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November 1997

Comprehensive RI/FS for the Idaho Chemical Processing Plant OU 3-13 at the INEEL—Part A, RI/BRA Report (Final)

Binder 2 of 3

Idaho National Engineering Laboratory

U.S. Department of Energy • Idaho Operations Office

Appendix A

Appendix A

OU 3-13 Track 1 Decision Documents

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DECISION DOCUMENTATION PACKAGE
COVER SHEET

prepared in accordance with

TRACK 1 SITES:
GUIDANCE FOR ASSESSING
LOW PROBABILITY HAZARD SITES
AT THE INEL

Site Description: Gas Canisters (Buried Gas Cylinder)

Site ID: CPP-84 Operable Unit: 3-13

Waste Area Group: 3

I. SUMMARY - Physical description of the site:

After initial construction of the ICPP complex in 1952, gas cylinder bottles which were either empty, leftover, or damaged during construction activities were buried in a trench measuring approximately 6 m x 9 m (20 ft x 30 ft) and was approximately 2 m (5 ft) deep. The trench, (CPP-84), is located outside the ICPP fence approximately 46 m (150 ft) north of last power pole before the bridge on Lincoln Blvd, and 15 to 18 m (50 to 60 ft) east of the Big Lost River[10] (Figure 1). In the winter of 1957-58 the ICPP flooded and the tanks were exposed. The tanks were recovered in the washout caused by the flood. Very little information is available on the exact location of the trench containing the cylinders. However, during the spring of 1992, and fall of 1994, metal detectors have been used to verify the location of the trench and the depth to the cylinders.

The cylinders buried at the site came from Igloo 638, near the maintenance building, and contained gases used for construction purposes. The exact number and content of the cylinders is not known, but it was believed that there were between 40 and 100 cylinders buried. A review of the chemical index sheet for the 660 Cylinder Dock at the ICPP indicates the construction gases which might have been buried at the site were limited to acetylene, compressed air, argon, carbon dioxide, helium, nitrogen, and oxygen. Other gases listed in the index were determined to be calibration gases, refrigerant gases, or were not stored at the site during the prescribed time period. The only contaminants of concern which might possibly be a source of environmental concern at this site are the acetone and asbestos, which are used as fillers in the acetylene tanks. Acetylene is not an environmental hazard, but is considered a simple asphyxiant and an explosive hazard. The average acetylene tank contains 40 lbs of acetone and 20 lbs of asbestos[4].

II. SUMMARY – Qualitative Assessment of Risk:

Because most of the types of gases which could possibly be buried in the trench would not pose a environmental risk at the site (see contaminant worksheet), a qualitative risk assessment was conducted for present day occupational workers and future residents at the site using acetone and asbestos as the contaminants of concern for the ingestion and groundwater exposure routes. These two contaminants are in acetylene tanks and used to stabilize the acetylene. Because of the uncertainty associated with the types of gas cylinders that were buried at the site, a conservative or worst case scenario was used for the risk assessment. This assessment estimated that all of the buried cylinders were acetylene, they all leaked acetone into the soil, and all of the acetone is still present in the soil. It is very unlikely that all of the cylinders buried in the trench were acetylene or that they have leaked into the soil. Even though the acetone would most likely have volatilized and it is unlikely that it is still present in the soil, the groundwater pathway was evaluated using GWSCREEN to estimate the risks associated with acetone reaching the groundwater. Asbestos (if present) would still be present within the acetylene cylinders, however, it is bound and non-fryable in a block inside the cylinder and would not migrate, even if the cylinder was ruptured.

Given this scenario, the calculated risked based soil concentration for ingestion of acetone was 2.7 E+04 mg/kg for future residential and 2.00 E+05 mg/kg for present day occupational (Appendix A). These risked based concentrations are greater than the soil concentration (2.8 E+03 mg/kg) in the trench, calculated using the worst case scenario mentioned above. Evaluation of acetone in the groundwater exposure pathway (Appendix B) indicates a limiting soil concentration of 3.025 E+5 mg/kg of acetone is required to produce a risk. The corresponding hazard quotient for acetone is 0.369, and the risks associated with the acetone at this site is considered low. Very little is known about the exact number and types of gases in the cylinders buried at this site, and therefore, the risk assessment reliability is considered low. However, metal detector scans have located the trench, which gives high reliability that the cylinders are buried at the site. The overall reliability of this data has been considered to be medium. Since some of the cylinders buried in the trench could still be under high pressure, which could lead to a risk of explosion or fire, if punctured, there is a possible safety risk associated with this site. In addition, the cylinders are buried in a former Big Lost River channel[11], which could in times of flood cause these cylinders to be exposed to the surface and possibly be moved by flood waters. If this occurred, current occupational or future residence could be exposed to possible risk associated with pressurized cylinders.

III. SUMMARY – Consequences of Error:

False negative error: If no further action is taken at this site, a receptor might be exposed to contaminants which could be present at this site. The probability of receptor being exposed to higher concentrations of acetone or asbestos than that determined in the risk assessment is low.

False positive error: Unwarranted remediation of this site would result in a low return in environmental benefit from a relatively large investment of time and money. The safety risked associated with removing pressurized cylinders could be greater than the risk from contaminants in the cylinders.

IV. SUMMARY – Other Decision Drivers:

There is very little human health risk from contaminants at this site. However, buried gas cylinders that are still pressurized are a safety hazard if ruptured from drilling or excavation activities, or are exposed to the surface and moved during extreme flooding of the Big Lost River.

DECISION RECOMMENDATION

Recommended Action:

Because of the low qualitative health risk associated with the contaminants identified at this site, CPP-84 is recommended to no further action. However, physical and administrative controls should be established to control access to this site for safety reasons (gas cylinders are suspected of still being pressurized).

Signatures	# PAGES:	DATE:
Prepared By:	DOE WAG Manager:	
Approved By:	Independent Review:	

DECISION STATEMENT (by DOE RPM)	
Date Recd:	
Disposition	
DATE:	# PAGES (decision statement):
NAME:	SIGNATURE:

DECISION STATEMENT (by EPA RPM)	
Date Recd:	
Disposition	
DATE:	# PAGES (decision statement):
NAME:	SIGNATURE:

DECISION STATEMENT
(by State RPM)

Date Recd:

Disposition

DATE:	# PAGES (decision statement):
NAME:	SIGNATURE:

PROCESS/WASTE WORKSHEET

SITE ID: CPP-84

Col 1 Processes Associated with this Site	Col 2 Waste Description & Handling Procedures	Col 3 Description & Location of any Artifacts/Structures/Disposal Areas Associated with this Waste or Process
Buried gas cylinders used during construction of CPP. Gas cylinders possibly containing acetylene, compressed air, argon, carbon dioxide, helium, nitrogen, and oxygen could have been buried at this site.	Possible wastes associated with this site are acetylene, and the acetone and asbestos fillers inside the acetylene tanks, argon, carbon dioxide, helium and oxygen.	Artifact: Buried gas cylinders are located at this site, and the possible disposal location has been marked with stakes. Location: The trench is located outside the CPP fence approximately 46 m (150 ft) north of last power pole before bridge on Lincoln Blvd, and 15 to 18 m (50 to 60 ft) east of the Big Lost River. Description: A staked area where the cylinders are thought to be buried was determined using a metal detector.
		Artifact: Location: Description:
		Artifact: Location: Description:
		Artifact: Location: Description:

CONTAMINANT WORKSHEET

SITE ID CPP-84

PROCESS (Col 1) Buried Gas Cylinders WASTE (Col 2) Contaminated soil

Col 4 What Known/Potential Hazardous Substance/ Constituents are Associated with this Waste or Process?	Col 5 Potential Sources Associated with this Hazardous Material	Col 6 Known/Estimated Concentration of Hazardous Substances/ Constituents[a]	Col 7 Risk-based Concentration (mg/kg)	Col 8 Qualitative Risk Assessment (hi/med/low)	Col 9 Overall Reliability (hi/med/low)
acetone	buried acetylene cylinders	2.8 E+3 mg/kg	2.7 E+04	low	low
asbestos	buried acetylene cylinders	Not determined[b]	Not determined[b]	low	low
acetylene[c]	buried gas cylinders	Not determined			
argon[d]	buried gas cylinders	Not determined			
carbon dioxide[e]	buried gas cylinders				
helium[f]	buried gas cylinders				
oxygen[g]	buried gas cylinders	Not determined			
nitrogen[h]	buried gas cylinders	Not determined			

a. ND = not detected
DL = detection limit.
b. Soil concentrations for asbestos was not determined because the asbestos is non-fryable and bound inside the acetylene cylinders.
c. Acetylene is considered a simple asphyxiant and in a free state can decompose violently when heated or shocked[11].
d. Argon is considered a simple asphyxiant (inert noble gas)[11].
e. Carbon dioxide is considered a simple asphyxiant[11].
f. Helium is an inert gas, a simple asphyxiant supplied as compressed gas (typically 2200 psig)[11].
g. Oxygen is non-flammable, but can support combustion and in an oxygen rich environment can be explosive. Supplied as a compressed gas (2100 psig)[11].
h. Nitrogen is a non-flammable, stable gas (simple asphyxiant)[11].

Qualitative Risk and Reliability Evaluation Table

Question 1. What are the waste generation process locations and dates of operation associated with this site?

Block 1 Answer:

After initial construction of the ICPP complex in 1952, gas cylinder bottles which were either empty, leftover, or damaged (e.g., bent and/or frozen valves, etc.), but not completely empty, were buried in a trench located outside CPP fence[6]. The cylinders buried at the site came from Igloo 638 near the ICPP maintenance building, and contained only gases used for welding or other construction purposes.

Block 2 How reliable are the information sources? ___High _x_Med ___Low (check one)

Explain the reasoning behind this evaluation.

There is no documentation of the gas cylinders being buried at this site. The information available was given by equipment operators who reported burying the cylinders[1,2], and surveys conducted with metal detectors.

Block 3 Has this INFORMATION been confirmed? __ Yes _x_No (check one)

If so, describe the confirmation.

Block 4 **Sources of Information** [check appropriate box(es) & source number from reference list]

No available	[ ]		Analytical data	[ ]	
Anecdotal	[x]	1,2	Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site	[ ]		D&D report	[ ]	
Unusual Occurrence	[ ]		Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[x]	6			

Question 2. What are the disposal process locations and dates of operation associated with this site?

Block 1 Answer:

Approximately 40 to 100 gas cylinders containing gases used constructing the ICPP were buried in a trench approximately 6 m x 9 m x 2 m (20 ft x 30 ft x 5 ft) after the initial construction of ICPP in 1952. The site is outside the CPP fence, nearly 46 m (150 ft) north of last power pole before the bridge on Lincoln Blvd, and 15 m to 18 m (50 ft to 60 ft) east of the Big Lost River[6,10] (Figure 1). In the winter of 1957-58, the ICPP flooded and the tanks were exposed. The tanks were recovered in the washout caused by the flood. Little information is available on the exact location of the trench, however, in the spring of 1992, and fall of 1994, use of metal detectors verified the approximate site location and depth [1 m (3 ft) bls[1,9]] to the cylinders. Cylinder contents are not known, but it is known that the cylinders were used for construction purposes (i.e., cutting and welding). The chemical index sheet for the 660 Cylinder Dock at the ICPP[5], identifies the cylinders buried at the site contain acetylene, compressed air, argon, carbon dioxide, helium, nitrogen, and oxygen. Other gases listed in the index were determined to be calibration or refrigerant gases, or were not stored at the site.

Block 2 How reliable are the information sources? ___High _x_Med ___Low (check one)

Explain the reasoning behind this evaluation.

There is no record of the cylinders being buried at the site. Anecdotal information indicates cylinders were buried at the site. Metal detectors confirm the site location[1,9]. Chemical index sheets for the ICPP, and knowledge of construction practices, indicate cylinder types buried.

Block 3 Has this INFORMATION been confirmed? ___ Yes _x_No (check one)

If so, describe the confirmation.

Block 4 **Sources of Information** [check appropriate box(es) & source number from reference list]

No available	[ ]		Analytical data	[ ]	
Anecdotal	[x]	3	Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[x]	10	Safety analysis report	[ ]	
Engineering/site	[ ]		D&D report	[ ]	
Unusual Occurrence	[ ]		Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[x]	1,5,6,9			

Question 3. Is there evidence that a source exists at this site? If so, list the sources and describe the evidence.

Block 1 Answer:

Surveys with metal detectors indicate that cylinders are buried at this site. The quantity of cylinders and their contents is not known, but is suspected to be cylinders containing oxygen, nitrogen, acetylene, carbon dioxide, helium, and nitrogen.

Block 2 How reliable are the information sources? ___High _x_Med ___Low (check one)

Explain the reasoning behind this evaluation.

The types of gas cylinders buried in the trench is an estimate based on types of gases used at construction sites[3]. The location of trench with the buried cylinders has been determined by a survey with metal detectors[1,9].

Block 3 Has this INFORMATION been confirmed? ___ Yes _x_No (check one)

If so, describe the confirmation.

Block 4 **Sources of Information** [check appropriate box(es) & source number from reference list]

No available	[ ]		Analytical data	[ ]	
Anecdotal	[x]	3,4	Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site	[ ]		D&D report	[ ]	
Unusual Occurrence	[ ]		Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[x]	1,9			

Question 4. Is there empirical, circumstantial, or other evidence of migration? If so, what is it?

Block 1 Answer:

There is no evidence of migration of contaminants from this site. However, due to the volatile nature of the acetone, any acetone which leaked into the surrounding soil would vaporize and would not be present in the soil. Asbestos located in the cylinders is a solid block of bound non-fryable asbestos, which would not migrate even if tanks were ruptured[4]. As noted in Reference 7, compounds with a vapor pressure greater than 10^{-6} mm HG, a molecular weight less than 200, and a Henry's constant greater than 0.0001 are likely to have little contaminant left in the soil to potentially migrate to the aquifer. Acetone, with a vapor pressure of 231 mm Hg, a molecular weight of 58, and a Henry's constant of 3.67E-05 atm-m^3/mole exceeds this criteria indicating that the groundwater ingestion pathway is unlikely. However the groundwater pathway using the maximum estimated concentration was evaluated.

Block 2 How reliable are the information sources? ___High ___Med _x_Low (check one)

Explain the reasoning behind this evaluation.

There is only circumstantial evidence that acetone and asbestos is present at the site. No sampling has been done.

Block 3 Has this INFORMATION been confirmed? ___ Yes _x_No (check one)

If so, describe the confirmation.

Block 4 **Sources of Information** [check appropriate box(es) & source number from reference list]

No available	[ ]		Analytical data	[ ]	
Anecdotal	[x]	4	Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site	[ ]		D&D report	[ ]	
Unusual Occurrence	[ ]		Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

Question 5. Does site operating or disposal historical information allow estimation of the pattern of potential contamination? If the pattern is expected to be a scattering of hot spots, what is the expected minimum size of a significant hot spot?

Block 1 Answer:

If all of the acetone leaked from the bottles at one time the area of contamination would be the area of the trench. However if the acetone leaked out from individual tanks as they failed over the years acetone would be limited to small hotspots near each ruptured tank. Because acetone has a high vapor pressure(231 mm Hg) it would volatilize rapidly after leakage so hotspots would disappear quickly. However if the acetone were to have leaked from all the cylinders simultaneously liquid acetone could fill the soil pore spaces below trench. Asbestos in its bound form inside cylinders would not migrate even if tank ruptured therefore it is not considered a problem[4].

Block 2 How reliable are the information sources? ___High _x_Med ___Low (check one)

Explain the reasoning behind this evaluation.

There is no record of the amount or types of cylinders or their contents buried at this site. However chemical index sheets from the loading dock and professional knowledge of the types of gases used during construction, their physical characteristic and the types of cylinders containing the gases give a reasonable reliability to the estimate.

Block 3 Has this INFORMATION been confirmed? ___ Yes _x_No (check one)

If so, describe the confirmation.

Block 4 **Sources of Information** [check appropriate box(es) & source number from reference list]

No available	[ ]		Analytical data	[ ]	
Anecdotal	[x]	4	Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site	[ ]		D&D report	[ ]	
Unusual Occurrence	[ ]		Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

Question 6. Estimate the length, width, and depth of the contaminated region. What is the known or estimated volume of the source? If this is an estimated volume, explain carefully how the estimate was derived.

Block 1 Answer:

The area within the trench is estimated to be approximately 6 m x 9 m x 2 m (20 ft x 30 ft x 5 ft)[1,2]. If all the potential acetone was released into to the soil at the same time it would fill the void spaces in the soil around and beneath the trench. Typical soil porosity is considered to be N_e= 0.25. This would give an estimated volume of 432 m^3 (12,7264 ft^3) (6 m x 9 m x 2 m/0.25). Due to the volatility of the acetone and the immobility of the asbestos, no downward leaching of contaminants is expected.

Block 2 How reliable are the information sources? ___High ___Med _x_Low (check one)

Explain the reasoning behind this evaluation.

The size of the trench is an estimate from interviews with operators who buried the cylinders, and a metal detector scan of the area. No engineering drawings are available.

Block 3 Has this INFORMATION been confirmed? ___ Yes _x_No (check one)

If so, describe the confirmation.

Block 4 **Sources of Information** [check appropriate box(es) & source number from reference list]

No available	[ ]		Analytical data	[ ]	
Anecdotal	[x]	1.2	Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site	[ ]		D&D report	[ ]	
Unusual Occurrence	[ ]		Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[x]	7, 8			

Question 7. What is the known or estimated quantity of hazardous substance/constituent at this source? If the quantity is an estimate, explain carefully how the estimate was derived.

Block 1 Answer:

Given the uncertainty of the contents of the cylinders buried at the site, it is difficult to estimate volumes of the nonhazardous contaminants. Calculations for an estimate of the amount of acetone and asbestos at this site are based on a worst case scenario, where all of the 100 cylinders potentially buried at this site contain acetylene. It is estimated that each acetylene cylinder contains 18 kg (40 lb) of acetone and 9 kg (20 lb) of asbestos[4]. The trench used to dispose of the acetylene cylinders measures 6 m x 9 m x 2 m (20 ft x 30 ft x 5 ft),or 108 m^3 (3,000 ft^3)[1,2]. It is conservatively assumed for these calculations that 100% of the acetone has leaked out of the acetylene cylinders, and is evenly distributed throughout the trench, that there is 1,818 kg (4,000 lb) of acetone and 909 kg (2,000 lb) of asbestos in the soil.

The total amount of asbestos in a worst case scenario has been calculated. However, because it is bound in a block inside the canisters, it will not be distributed throughout the soil, and therefore, would not be available for exposure to humans.

Block 2 How reliable are the information sources? _x_ High ___Med __Low (check one)

Explain the reasoning behind this evaluation.

The above estimations are based on a worst case scenario where all of the canisters contained acetone. Given the circumstance for this site this is conservative, and the reliability of this estimate is considered high.

Block 3 Has this INFORMATION been confirmed? ___ Yes _x_No (check one)

If so, describe the confirmation.

Block 4 **Sources of Information** [check appropriate box(es) & source number from reference list]

No available	[ ]		Analytical data	[ ]	
Anecdotal	[x]	1,2,3	Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site	[ ]		D&D report	[ ]	
Unusual Occurrence	[ ]		Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

Question 8. Is there evidence that this hazardous substance/constituent is present at the source as it exists today? If so, describe the evidence.

Block 1 Answer:

An unknown number of the cylinders buried at the site contained acetylene. If it is assumed these cylinders have not been breached, then acetone and asbestos are still present in the cylinders buried in the trench. If the acetylene cylinders have been breached over the years, the asbestos would still be present in the cylinders, and the acetone from the breached cylinders would have most likely leaked from the cylinders and volatilized. The manufacturer of the cylinders indicates that it is unlikely that they have been breached, as they are a high integrity container. They could remain intact indefinitely in an arid environment such as the INEL.

Block 2 How reliable are the information sources? ___High _x_Med ___Low (check one)

Explain the reasoning behind this evaluation.

Although there is substantial evidence that gas cylinders were buried at the site the quantity and contents of the cylinders is an estimation.

Block 3 Has this INFORMATION been confirmed? ___ Yes _x_No (check one)

If so, describe the confirmation.

Block 4 **Sources of Information** [check appropriate box(es) & source number from reference list]

No available	[ ]		Analytical data	[ ]	
Anecdotal	[x]	1,2,3	Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site	[ ]		D&D report	[ ]	
Unusual Occurrence	[ ]		Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

REFERENCES

1. Personal communication with Jim Southwick, WINCO, April 27 and May 1, 1992.

2. Personal communication with Wayne Toland, WINCO, April 27 and 29, 1992.

3. Notegram from K. L. Harris to D. E. Raunig, 6/13/94, Summary of types of gases believed to be buried Northwest of CPP.

4. Personal communication with Bill Richardson, 8/3/94.

5. Chemical Index Sheet for 660 Cylinder Dock.

6. New Site Identification Form, Dennis Raunig, 4/25/94.

7. Track 2 Sites: Guidance for Assessing Low Probability Hazard Sites at the INEL, Rev 6, 1994.

8. Handbook of Environmental Fate and Exposure Data for Organic Chemicals, Howard, P. H., Lewis Publishers, Vol, 2, pg 9, 1991.

9. Personal communication with Wayne McLerran, 11/4/94.

10. Aerial photograph of the ICPP and the site.

11. MSDS's for the types of gas bottles which could be buried in CPP-84.

DECISION DOCUMENTATION PACKAGE
COVER SHEET

prepared in accordance with

TRACK 1 SITES:
GUIDANCE FOR ASSESSING
LOW PROBABILITY HAZARD SITES
AT THE INEL

Site Description:	**Waste Calcining Facility (WCF) Hot Cell Blower Corridor**		
Site ID:	**CPP-85**	**Operable Unit:**	**3-13**
Waste Area Group:	**3**		

I. SUMMARY — Physical description of the site:

The WCF (building CPP-633) was used to calcine liquid from spent fuel dissolution process into a solid form for dry storage. Liquids were directly injected into the calciner vessel where it was heated, originally indirectly with liquid metal then later directly by kerosene combustion. As water in the liquid feed evaporated, dissolved metals in the feed formed solid oxides and salts.

The WCF Blower Corridor (CPP-85) is a 18 to 24 in. vitrified clay pipeline surrounded by a roughly 3 ft by 3.5 ft poured square concrete envelop. The blower corridor runs in a "U" shape on the east, north, and west sides of the building (approximately 110 ft in length along the east and west sides and 70 ft on the north side). Exact dimensions of the envelop depend on the pipe size and configuration. The blower corridor centerline is approximately 9 feet below land surface. The blower corridor was used for keeping a negative pressure of 0.75 in (water column) in the WCF hot cells. Vent gases from the WCF hot cells were blown through the blower corridor to building CPP-649 for HEPA filtering and discharge by a blower at the northwest corner of CPP-633. No release of contaminants from CPP-85 is known to have taken place. A videotape taken of the interior of the blower corridor did not show evidence of leaks or deterioration in the pipe.

MEMORANDUM

TO: WAG 3 Project File

FROM: S. Flynn

DATE: July 27, 1995

SUBJECT: Track 2 Preliminary Scoping Packages (PSPs) & Track 1 Decision Documentation Packages (DDPs)

Chemical Processing Plant (CPP)-39 and CPP-48 in Operable Unit (OU) 3-13 were designated in the INEL Federal Facility Agreement/Consent Order Table A.2, Revision 2, dated March 23, 1995 (FFA/CO Table), as sites to be evaluated during the Remedial Investigation/Feasibility Study (RI/FS) process. PSPs were prepared per the Track 2 guidance for these two sites .

Ten sites (CPP-84, -85, -86, -87, -88, -89, -90, -91, -92 & -93) in OU 3-13 were designated in the FFA/CO Table as Track 1 sites and sites to be evaluated during the RI/FS process. DDPs were prepared per the Track 1 guidance for these ten sites.

These 12 documents will not have signatures on the decision pages. The information contained in the documents will be used to evaluate each of the twelve sites for the OU 3-13 RI/ FS. The final disposition of each site will be included in the OU 3-13 Record of Decision.

DECISION RECOMMENDATION

II. SUMMARY – Qualitative Assessment of Risk:

A qualitative risk assessment was conducted for present day occupational workers and future residents at the site. The contaminants of concern which could be associated with this site are Cs-137 and Sr-90. No evidence exists indicating that a release has occurred from CPP-85. If a leak had developed in the corridor the negative pressure maintained in the duct would make any release minimal. A videotape of the duct interior taken in 1994 did not show any leaks or holes which would allow contamination to be released after use of the blower corridor stopped.

For the occupational scenario, the risked based soil concentration is 0.09 pCi/g for Cs-137 and 88.9 pCi/g for Sr-90. The risk is considered low as no source of contamination is known to exist at this site. Since no sampling of the soils surroundong the blower corridor has been conducted the reliability of this data is considered low.

III. SUMMARY – Consequences of Error:

False negative error:
If no further action is taken receptor might be exposed to contaminants which could be present at this site. The probability of a receptor being exposed to higher concentrations of contaminants at this site is low.

False positive error:
Unwarranted remediation of this site would result in a low return in environmental benefit from a relatively large investment of time and money.

IV. SUMMARY – Other Decision Drivers:

As the blower corridor concrete envelop bottom is approximately 10 ft below land surface, residential and occupational exposure pathways are unlikely to occur. CPP-633 is scheduled to be decontaminated and decommissioned at which time any unknown releases which had occurred would be discovered.

Recommended Action:

Because of the low risk associated with the contaminants at this site and the lack of evidence that a leak occurred, CPP-85 is recommended for no further action.

Signatures	# PAGES: 17	DATE: 05/01/95
Prepared By:	DOE WAG Manager:	
Approved By:	Independent Review:	

DECISION STATEMENT
(BY DOE RPM)

DATE RECD:

DISPOSITION

DATE:	# PAGES (DECISION STATEMENT):
NAME:	SIGNATURE:

DECISION STATEMENT
(BY EPA RPM)

DATE RECD:

DISPOSITION

DATE:	# PAGES (DECISION STATEMENT):
NAME:	SIGNATURE:

DECISION STATEMENT
(BY STATE RPM)

DATE RECD:

DISPOSITION

DATE:	# PAGES (DECISION STATEMENT):
NAME:	SIGNATURE:

PROCESS/WASTE WORKSHEET

SITE ID: CPP-85

Col 1 Processes Associated with this Site	Col 2 Waste Description & Handling Procedures	Col 3 Description & Location of any Artifacts/Structures/Disposal Areas Associated with this Waste or Process
Ventilation of WCF hot cells	A negative air pressure of 0.75" water was maintained in the WCF hot cells. Vent gases from the WCF hot cells were blown through the blower corridor to bldg. CPP-649 for HEPA filtering and discharge by a blower at the NW corner of CPP-633.	Artifact: The WCF blower corridor Location: The blower corridor is "U" shaped and located between 8 - 10 ft bls along the north, east, and west sides of building CPP-633. Description: The WCF Blower Corridor (CPP-85) is a 18 to 24 in vitrified clay pipeline surrounded by a roughly 3 ft by 3.5 ft poured square concrete sleeve. It runs for approximately 110 ft on the east and west sides of the building and 70 ft on the north side of the building.

CONTAMINANT WORKSHEET

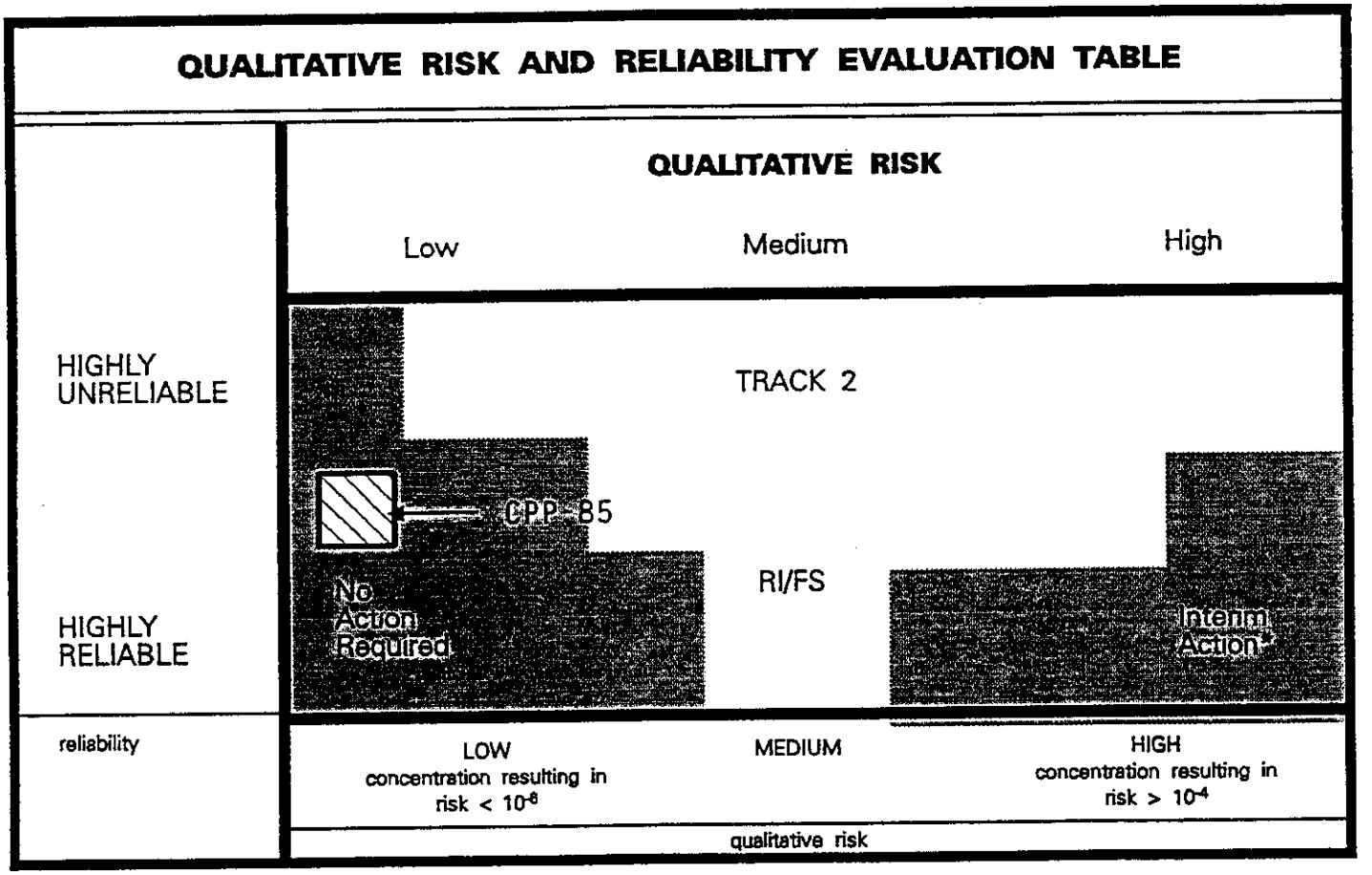
SITE ID CPP-85

PROCESS (Col 1) Ventilation of WCF hot cells **WASTE** (Col 2) Radiologically-Contaminated Gases

Col 4 What Known/Potential Hazardous Substance/ Constituents are Associated with this Waste or Process?	Col 5 Potential Sources Associated with this Hazardous Material	Col 6 Known/Estimated Concentration of Hazardous Substances/ Constituents[a]	Col 7 Risk-based Concentration (mg/kg)	Col 8 Qualitative Risk Assessment (hi/med/low)	Col 9 Overall Reliability (hi/med/low)
Cs-137	none	none	0.09 pCi/g[b]	low	low
Sr-90	none	none	88.9 pCi/g[b]	low	low

[a] ND = not detected
DL = detection limit

[b] See Appendix A.



* If sufficient data exist to identify an appropriate remedy.

Question 1. What are the waste generation process locations and dates of operation associated with this site?

Block 1 **Answer:**

The WCF (CPP-633) calcined highly radioactive liquid spent fuel dissolution process effluent from 1963 through 1981, at which time it was replaced by the New Waste Calcining Facility (NWCF).

Block 2 How reliable are the information sources? x High __ Med __ Low
Explain the reasoning behind this evaluation.

The operational dates if the WCF are also documented in monthly reports and operating logs.

Block 3 Has this INFORMATION been confirmed? _x_ Yes ___No (check one)
If so, describe the confirmation.

The operational dates of the WCF are documented in monthly reports and operating logs.

Block 4 **Sources of Information** [check appropriate box(es) & source number from reference list]

No available information	[ ]		Analytical data	[ ]	
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site drawings	[ ]		D&D report	[ ]	
Unusual Occurrence Report	[ ]		Initial assessment	[ ]	
Summary documents	[x]	1	Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

Question 2. What are the disposal process locations and dates of operation associated with this site?

Block 1 Answer:

From 1963 to the present a negative air pressure of 0.75" water has been maintained in the WCF hot cells by a blower at the northwest corner of CPP-633. The blower drew air through the CPP-85 blower corridor and forced it to building CPP-649 for HEPA filtering and discharge.

Block 2 How reliable are the information sources? _x_ High ___ Med __ Low (check one)

Explain the reasoning behind this evaluation.

Numerous engineering drawings and photos of the blower corridor under construction indicate that this information is correct.

Block 3 Has this INFORMATION been confirmed? _x_ Yes ___ No (check one)

If so, describe the confirmation.

Photos of the blower corridor under construction confirm the plan and specification drawings.

Block 4 **Sources of Information** [check appropriate box(es) & source number from reference list]

No available information	[ ]		Analytical data	[ ]	
Anecdotal	[x]	2	Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site drawings	[x]	3,4	D&D report	[ ]	
Unusual Occurrence Report	[ ]		Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[x]	5
OTHER	[ ]				

Question 3. Is there evidence that a source exists at this site? If so, list the sources and describe the evidence.

Block 1 Answer:

No evidence exists which indicates that a source exists at this site from a contamination leak from the blower corridor. The blower corridor is a 18 -24 in vitrified clay pipe surrounded by an approximately 3 ft by 3.5 ft block concrete sleeve which was poured in place after construction of the pipeline. While perched groundwater monitoring wells in the area (MW-2 and MW-5) have shown elevated levels of Sr-90 and the blower pump pit has shown elevated levels of Cs-137, video inspection of the interior of the blower corridor did not show evidence of deterioration. Because there is no indication of a leaks in the blower corridor, the contamination in the monitoring well is believed to have originated elsewhere.

Block 2 How reliable are the information sources? ___High _x_Med ___Low (check one)

Explain the reasoning behind this evaluation.

Construction photos show the clay pipeline under construction. Video inspection of the blower corridor showed no deteriorization, however, the entire length of the corridor could not be inspected.

Block 3 Has this INFORMATION been confirmed? _x_ Yes ___No (check one)

If so, describe the confirmation.

The soil screening summaries confirm that the risk-based concentrations for Cs-137 and Sr-90 are low (Appendix A).

Block 4 **Sources of Information** [check appropriate box(es) & source number from reference list]

No available information	[ ]		Analytical data	[x]	8,9
Anecdotal	[x]	10	Documentation about data	[x]	A
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site drawings	[x]	3,4,6	D&D report	[ ]	
Unusual Occurrence Report	[ ]		Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[x]	7
OTHER	[ ]				

Question 4. Is there empirical, circumstantial, or other evidence of migration? If so, what is it?

Block 1 Answer:

A video of the blower corridor interior did not show any evidence of deterioration of the pipeline, therefore there is no evidence of migration of contaminants from the CCP-85 blower corridor. Additionally, the corridor operated under a negative pressure indicating that if contamination were drawn into the corridor it would tend to be sucked through the blower to the HEPA filters in CPP-649 and would not then leak to the environment.

Block 2 How reliable are the information sources? ___High ___Med _x_Low (check one)

Explain the reasoning behind this evaluation.

No systemized sampling has been conducted on the soils surrounding the blower corridor.

Block 3 Has this INFORMATION been confirmed? ___ Yes _x_No (check one)

If so, describe the confirmation.

Block 4 **Sources of Information** [check appropriate box(es) & source number from reference list]

No available information	[ ]		Analytical data	[ ]	
Anecdotal	[x]	2,10	Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site drawings	[ ]		D&D report	[ ]	
Unusual Occurrence Report	[ ]		Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[x]	5
OTHER	[ ]				

Question 5. Does site operating or disposal historical information allow estimation of the pattern of potential contamination? If the pattern is expected to be a scattering of hot spots, what is the expected minimum size of a significant hot spot?

Block 1 Answer:

If a crack did occur in the pipe and its surrounding concrete sleeve contamination would be observed as a hotspot in the soils surrounding any crack.

Block 2 How reliable are the information sources? ___High ___Med _x_Low (check one)

Explain the reasoning behind this evaluation.

There is no evidence that a leak in the corridor has occurred.

Block 3 Has this INFORMATION been confirmed? ___ Yes _x_No (check one)

If so, describe the confirmation.

Block 4 **Sources of Information** [check appropriate box(es) & source number from reference list]

No available information	[X]		Analytical data	[ ]	
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site drawings	[ ]		D&D report	[ ]	
Unusual Occurrence Report	[ ]		Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[X]	7
OTHER	[ ]				

Question 6. Estimate the length, width, and depth of the contaminated region. What is the known or estimated volume of the source? If this is an estimated volume, explain carefully how the estimate was derived.

Block 1 Answer:

There is no contaminant source at this site to be estimated.

Block 2 How reliable are the information sources? ___High ___Med _x_Low (check one)

Explain the reasoning behind this evaluation.

No systemized sampling has been conducted on the soils surrounding the blower corridor.

Block 3 Has this INFORMATION been confirmed? ___ Yes _x_No (check one)

If so, describe the confirmation.

Block 4 **Sources of Information** [check appropriate box(es) & source number from reference list]

No available information	[X]		Analytical data	[ ]	
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site drawings	[X]	6	D&D report	[ ]	
Unusual Occurrence Report	[ ]		Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

Question 7. What is the known or estimated quantity of hazardous substance/constituent at this source? If the quantity is an estimate, explain carefully how the estimate was derived.

Block 1 Answer:

There is no known source at this site to quantify.

Block 2 How reliable are the information sources? ___High ___Med _x_Low (check one)

Explain the reasoning behind this evaluation.

No systemized sampling has been conducted on the soils surrounding the blower corridor.

Block 3 Has this INFORMATION been confirmed? ___ Yes _x_No (check one)

If so, describe the confirmation.

Block 4 **Sources of Information** [check appropriate box(es) & source number from reference list]

No available information	[x]		Analytical data	[ ]	
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site drawings	[ ]		D&D report	[ ]	
Unusual Occurrence Report	[ ]		Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

Question 8. Is there evidence that this hazardous substance/constituent is present at the source as it exists today? If so, describe the evidence.

Block 1 Answer:

There is no known source at the blower corridor, therefore, there are no hazardous constituents present in the soil from this site. However, perched groundwater monitoring wells in the area (MW-2 and MW-5) of CPP-633 show elevated levels of Sr-90.

Block 2 How reliable are the information sources? ___High ___Med _x_Low (check one)

Explain the reasoning behind this evaluation.

No systemized sampling has been conducted on the soils surrounding the blower corridor.

Block 3 Has this INFORMATION been confirmed? ___ Yes _x_No (check one)

If so, describe the confirmation.

Block 4 **Sources of Information** [check appropriate box(es) & source number from reference list]

No available information	[x]		Analytical data	[x]	8,9
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site drawings	[ ]		D&D report	[ ]	
Unusual Occurrence Report	[ ]		Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

REFERENCES

Appendix A: Risk-based Soil Screening Summaries for Hot Cell Blower Corridor (CPP-85).

1. Westinghouse Idaho Nuclear Company, Inc., RCRA Closure Plan for the Waste Calcining Facility at the Idaho National Engineering Laboratory, 1992, pages 1-1 through 1-14.

2. Memo of Conversation: Dennis Raunig with M. Ison and K. Neilson, September 11, 1994

3. Photograph of Blower Corridor Under Construction, July 21, 1959.

4. Plan Views of WCF Showing Blower Corridor, Fluor Co., Photo No. 5775-1-1, 7, & 9.

5. The Fluor Corporation, Ltd., Heating and Ventilating Equipment Specification No. 5775-CPP-HV1, Revision 3, 11-30-60, pages HV1-1 through HV1-3.

6. Ventilation Duct Plan, Section, & Details, Drawing No. 5775-CPP-633-5-53, 1-15-59.

7. The Fluor Corporation, Ltd., Concrete Specification No. 5775-CPP-S4, Revision 4, 10-20-60, pages S4-1 through S4-28.

8. Radiological Analysis Results from December 1993 Perched Water Monitoring (MW-2 & MW-5), pages 1 & 2.

9. Results of Analysis of Liquid/Sludge Samples collected from the Bottom r the Blower Pit for Metals & Radionuclides, Log No. 92-021811, 03/21/92.

10. Computer Enhanced Excerpts from Videotape of Blower Corridor Interior, 3-7-94, pictures 1, 9 & 10.

TRACK 2
PRELIMINARY SCOPING PACKAGE
COVER SHEET

DATE: 6/94

Prepared in accordance with

Track 2 Sites:
Guidance for Assessing
Low Probability Hazard Sites
at the INEL

Site Description: Hydrofluoric Acid Containment Vault and Dry Well

Site ID: CPP-39 **Operable Unit:** 3-13

Waste Area Group: 3

I. SUMMARY—Site Background:

CPP-39 is located in the northwest portion of the Idaho Chemical Processing Plant (ICPP) at the intersection of Birch Street and Pine Avenue. This site was originally designated as CPP-39. CPP-39 consisted of a hydrofluoric acid (HF) storage tank Yard Designation Area B-105 (YDB-105), a concrete containment vault, a 125-ft tile line connecting to the dry well[2]. YDB-105 sat over the concrete containment vault next to CPP-640 and was surrounded by gravel. This system was used from 1967 to 1984. The HF storage tank was taken out of service and removed in 1990[2]. The vitrified clay tile pipe was removed in 1993[2]. CPP-39 presently consists of the containment vault, dry well and soil in the area where the tile pipe was buried. The dry well is situated on the west side of Birch Street[4] and is surrounded by pavement.

Based on process knowledge, HF was transferred from tank YDB-105 to the CPP-601 makeup areas before the disolution process. HF was mixed with borated water in the makeup area, and if the solution was within specification it was introduced into the dissolution process if not it was readjusted and retested. Only the off-specification solutions which could not be adjusted to make useable in the disolution process were returned to the containment vault for neutralization. The rectangular containment vault is 11 x 24 x 5.5 ft, and was positioned under the YDB-105 tank to contain excess acids which may have escaped as a result of refilling, to trap overflow, and to receive off-specification HF from CPP-601. The vault was filled with limestone rock for neutralizing any acid entering the vault. The dry well, which also contained limestone rock, is a cemented circular structure 22.5-ft in circumference with a depth of 15 ft. The purpose of the dry well was to receive the discharges of off-specification HF from CPP-601 through the containment vault. The limestone in both locations was removed in July 1990[2]. No radioactive constituents were associated with this process.

I. SUMMARY—Site Background: (continued)

After removal of the limestone an inspection of the vault's concrete floor showed a crack near the southeast corner at the wall/floor interface. A 2-ft diameter hole was located in the cement floor at the southwest corner of the vault, which may have been the location of the drain to the transfer line to the dry well. The cement in this area was visibly stained and a cavity was present in the underlying soil to a depth of approximately 4 ft [10.5 ft below land surface (bls)]. No other cracks were observed in the containment vault floor.

Records indicate that the dry well received approximately 1,400 gallons of off-specification HF per year for a total of approximately 23,800 gallons[2]. Additionally, dilute concentrations of boric and nitric acid may have been discharged to the dry well. Boric acid (and possibly nitric acid) were usually mixed with the HF in the dissolution process. Soil sample pH (5.97 - 12.6) indicates that it is highly unlikely that HF is still present at this site.

Samples were collected under a RCRA closure plan from beneath the containment vault and the dry well in July of 1990 and November 1990 to determine the presence, nature and extent of eight RCRA hazardous constituents in the containment vault, dry well and subsurface soils. Boreholes were drilled and samples were collected at 1, 2, 4 ft below the concrete of the containment vault, and samples were taken in the southwest corner at 4.5 to 5.5 ft (10.5 to 11.5 ft bls) below the vault. In the dry well, samples were collected from the borehole at 5 ft intervals beginning with soils at the base of the dry well at 14.5 ft and extending to a depth of 50 ft. Basalt was encountered at a depth of 52.2 ft. Samples collected in July 1990 at the base of the dry well (14.5 to 18.5 ft bls) and above the basalt (48.8 to 50.8 ft) were prepared for analyses of 40 CFR Part 261 Appendix VIII analyses. Soil samples[6] were also collected during removal of tile pipe which indicated fluoride and mercury contamination to 10 ft bls. Contaminants were screened against background levels for metals found in Track 2 guidance or ICPP Background Report[7]. Of the 8 metals arsenic, cadmium, chromium, lead, and selenium were determined to have concentrations below background. The highest concentration of each of the contaminants which had concentrations above background at CPP-39 include:

Contaminant	Conc.(mg/kg)	Background (mg/kg)	Location (depth bls)
Silver	18.7	0.99*	Dry Well (15 ft)
Barium	1,100.0	335.0**	Below Vault (10.5 ft)
Mercury	0.25	0.07*	Tile pipe (<10 ft)
Fluoride	2650.0	NA	Tile pipe (<10 ft)
Phenanthrene	1.1	NA	Dry Well (15 ft)
Anthracene	0.18	NA	Dry Well (15 ft)
Fluoranthene	2.3	NA	Dry Well (15 ft)
Pyrene	1.3	NA	Dry Well (15 ft)
Benzo(a)Anthracene	0.86	NA	Dry Well (15 ft)
Chrysene	1.6	NA	Dry Well (15 ft)
bis(2-Ethylhexyl)Phthalate	14.0	NA	Dry Well (15 ft)
Benzo(b)Fluoranthene	1.1	NA	Dry Well (15 ft)
Benzo(k)Fluoranthene	0.97	NA	Dry Well (15 ft)
Benzo(a)Pyrene	0.5	NA	Dry Well (15 ft)
Indeno(1,2,3-cd)Pyrene	0.48	NA	Dry Well (15 ft)
Benzo(g,h,i)Perylene	0.27	NA	Dry Well (15 ft)

* Track 2 Guidance

** ICPP Background Report[7]

TRACK 2 PRELIMINARY SCOPING PACKAGE

II. SUMMARY—Qualitative Assessment of Risk and Reliability:

The qualitative risk at CPP-39 from the contaminants is low based on characterization sampling conducted in 1990[1] and soil samples taken during removal of tile pipe in 1993. Soil samples from beneath the containment vault detected low levels of barium, mercury and fluoride. Soil samples from beneath the dry well indicated surface contamination containing low levels of silver, fluoride, and twelve semi-volatile compounds which are probably associated with asphalt found in the dry well. Because of the small areas and the small number of samples collected at these two sites, risk were generated using the highest concentration detected for each contaminant. Soil samples taken during pipe removal indicated low levels of fluoride and mercury contamination down to 10 ft bls. Since 14 samples were collected along the 125 ft length contaminant concentrations were averaged per Track 2 guidance. This gives a average concentration of 0.06 mg/kg for mercury in the soil near the site of the tile pipe. This average soil concentration is less than the background level of 0.07 reported in the Track 2 Guidance but because two samples reported concentration of 0.25 and 0.23 for mercury its was evaluated in the risk assessement.

Because the contaminates at the containment vault and dry well are located at depths greater than 10 ft bls, the only viable exposure pathway is ingestion of groundwater from leaching of contaminants to the aquifer. Risk calculation indicates that all noncarcinogens contaminant have HQs less than 1 and all carcinogens have cancer risks less than 10^{-6}. Therefore the risk from contaminants at this site is considered low. Samples collected during the removal of the tile pipe indicated there was fluoride and mercury contamination in the soil at 8 and 10 ft bls. Exposure pathways for this contamination were inhalation of dust, soil ingestion and leaching of contaminants to the aquifer. Risk calculation indicated the HQ for fluoride and mercury for all pathways were below 1. Fluoride and mercury are not considered a carcinogen.

Since sampling has been conducted at this site, contaminant concentrations have been defined. However, no confirmation sampling has occurred so the reliability of this data is considered medium. Samples analyzed for fluoride during tile pipe removal indicated fluoride contamination but all samples were flagged with a J indicating that the contaminant was present but concentration is questionable. Although all samples for mercury were "U" flagged as not detected, concentrations reported were above background levels, therefore mercury concentrations were average at half the reported value. Therefore it is questionable whether mercury contamination is actually present in the vicinity of the area where the tile pipe was removed. This indicates low reliability in the mercury data. Therefore this site falls into the no further action area in Table 4.

TRACK 2 PRELIMINARY SCOPING PACKAGE

III. SUMMARY—Consequences of Error:

False negative error: If no further action is incorrectly taken, receptor could be exposed to higher levels of mercury, barium, silver, fluoride and semi-volatiles. However the only potential pathway is ingestion of groundwater for contaminants in the containment vault and dry well. GWSCREEN runs for each contaminant indicate that significantly higher level of contamination is required for these contaminants to pose a risk at this site. If the contamination in the soil where the tile pipe is greater than measured, occupational or future residential receptors could be exposed to high levels fluoride or mercury.

False positive error: Unwarranted remediation of this site would result in a low return in environmental benefit from a relatively large investment of time and money. To further investigate the potential for higher contaminant concentrations beneath the containment vault or the dry well would require additional sampling and man power. Present sampling is sufficient for characterization of this site and any cleanup would have a minimal reduction in risk.

IV. SUMMARY—Miscellaneous Information:

Characterization sampling in 1993[6], during removal of the drain line between the vault and dry well, indicated minor amount of fluoride was released to the soil. Although low levels of fluoride and mercury were found beneath the containment vault, dry well as well as in soil around the tile pipe, the risk assessment was conducted using the average of the soil concentration found in samples collected during the tile pipe removal.

V. SUMMARY—Conceptual Site Models:

The Track 2 preliminary Conceptual Site Model (CSM) (Figure 1) shows the generator and artifacts associated with the CPP-39 containment vault and dry well. In the preliminary CSM, all pathways were considered during initial investigation of the dry well and containment vault. It was determined that the contaminants were at depths greater than 10 ft below land surface for contaminants found beneath the containment vault and dry well. However fluoride found in samples collect in soil near where the tile pipe was buried indicated that the inhalation and ingestion pathways were viable pathways for fluoride. The CSM (Figure 2) was revised to indicate that then only viable exposure pathway was leaching of contaminants to the groundwater and subsequent ingestion of the groundwater by future residents for all contaminants except fluoride.

TRACK 2 PRELIMINARY SCOPING PACKAGE

VI. SUMMARY—Preliminary Scoping Recommendation:

As shown in Table 4 the Qualitative Risk assessment for all contaminants is low. This is because the only viable pathway determined for contaminants beneath the containment vault and dry well was the groundwater ingestion pathway because contaminants were found at depths greater than 10 ft below land surface, this eliminates occupational and residential intrusion scenarios and all other pathways for these contaminants. Risk from all contaminants were well below the HQ of one or the 10^{-6} carcinogenic risk levels set by the EPA. Sampling data collected in 1990[1,2] gives a fairly reliable estimate of contamination present at the site. The semi-volatiles detected in the dry well were probably not deposited through the waste stream (the waste stream for this site consisted of hydrofluoric acid, boric acid, and possibly nitric acid), but probably associated with the asphalt in and around the dry well. Samples collected during removal of the tile line connecting the containment vault and dry well indicated fluoride contamination in the soil down to 10 ft bls. No other contaminant were detected above backgound. Risk assessment conducted on the this site for occupational and residential ingestion of fluoride were below the HQ of 1 set by the EPA (there is no data or RFD for inhalation of fluoride and it is not considered a carcinogen). Therefore, because of the low risk and medium reliability of the data no further action is needed for the containment vault, the tile pipe area or dry well located at CPP-39.

OU: 3-13 Site: CPP-39 Date: 6/94

Table 1. Process/waste worksheet.

Column 1 Processes associated with this site	Column 2 Waste descriptions and handling procedures	Column 3 Description and location of any artifacts/structures/disposal areas associated with this waste or process
Process Hydrofluoric acid was transferred from tank YDB-105 to the CPP-601 makeup areas and was mixed with borated water for use in the dissolution of uranium enriched zirconium alloys. If the solution was within specification it was introduced into the dissolution process. If the solutions were off-specification they were returned to the containment vault for neutralization.	Off-specification hydrofluoric acid from CPP-601 was discharged to the containment vault which was connected to the dry well by a 125 ft tile pipe. The dry well received approximately 1,400 gallons of off-specification HF per year for a total of approximately 23,800 gallons[2]. Additionally, dilute concentrations of boric and nitric acid may have been discharged to the dry well. Boric acid (and possibly nitric acid) were usually mixed with the HF in the dissolution process.	Artifact Containment vault Location At the ICPP at the intersection of Birch Street and Pine Avenue Description A rectangular vault 11 x 24 x 5.5 ft.
		Artifact Dry Well Location 125 ft southwest of containment vault on the west side of Birch Street Description Cemented circular structure 22.5 ft in circumference and 15 ft deep.
		Artifact Vitrified tile line. Location Extending the 125 ft from containment vault to dry well. Description This line was removed in 1993.
Process		Artifact Location Description
		Artifact Location Description
		Artifact Location Description
Process		Artifact Location Description
		Artifact Location Description
		Artifact Location Description

OU: 3-13 Site: CPP-39 Date: 6/94

Table 2a. Summary of preliminary risk evaluation: forward calculation of risk.

Contaminants of concern	Volatile inhalation		Dust inhalation		Soil ingestion		External exposure	Groundwater ingestion	
	Hazard quotient	Cancer risk	Hazard quotient	Cancer risk	Hazard quotient	Cancer risk	Cancer risk	Hazard quotient	Cancer risk
Occupational scenario[1]									
Mercury (pipe area)	NA	NA	1.0E-05	NA	9.8E-05	NA	NA		
Fluoride (pipe area)	NA	NA	ND	NA	0.0013	NA	NA		
Residential scenario[2]									
Silver	NA	NA	NA	NA	NA	NA	NA	1.85E-05	NA
Barium	NA	NA	NA	NA	NA	NA	NA	2.8E-05	NA
Mercury (vault)	NA	NA	NA	NA	NA	NA	NA	4.2E-07	NA
Mercury (pipe area)	NA	NA	1.4E-05	NA	7.4E-04	NA	NA	3.1E-06	ND
Fluoride (vault)	NA	NA	NA	NA	NA	NA	NA	6.8E-04	ND
Fluoride (pipe area)	NA	NA	ND	NA	0.057	NA	NA	3.4E-02	ND
Fluoride (dry well)	NA	NA	NA	NA	NA	NA	NA	8.5E-04	ND
Phenanthene	NA	NA	NA	NA	NA	NA	NA	ND	ND
Anthracene	NA	NA	NA	NA	NA	NA	NA	6.6E-10	NA
Fluoranthene	NA	NA	NA	NA	NA	NA	NA	1.6E-07	NA
Pyrene	NA	NA	NA	NA	NA	NA	NA	1.2E-07	NA
Benzo(a)Anthracene	NA	NA	NA	NA	NA	NA	NA	NA	4.04E-11
Chrysene	NA	NA	NA	NA	NA	NA	NA	NA	3.03E-13
bis(2-	NA	NA	NA	NA	NA	NA	NA	1.2E-05	3.3E-09
ethylhexyl)Phthalate	NA	NA	NA	NA	NA	NA	NA	NA	6.6E-12
Benzo(b)Fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA	2.9E-13
Benzo(k)Fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA	1.3E-10
Benzo(a)Pyrene	NA	NA	NA	NA	NA	NA	NA	NA	4.5E-13
Indeno(1,2,3-cd)Pyrene	NA	NA	NA	NA	NA	NA	NA	ND	ND
Benzo(g,h,i)Perylene									

Notes:

1. The only contaminants of concern for the occupational scenario are mercury fluoride form soil near tile pipe. The rest of the contaminants are at depths greater than 10 ft below land surface.
2. The viable pathways for fluoride and mercury are inhalation, ingestion and groundwater ingestion for residential. All other contaminants are at depths greater than 10 ft bls there leaching to groundwater is the only pathway.

NA = Not applicable
ND = No Data for HQ or slope factors.

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Table 2b. Summary of preliminary risk evaluation: backward calculation of risk-based soil concentrations.

Contaminants of concern	Volatile inhalation		Dust inhalation		Soil ingestion		External exposure	Groundwater ingestion	
	SC at HQ=1	SC at 1E-06 risk	SC at HQ=1	SC at 1E-06 risk	SC at HQ=1	SC at 1E-06 risk	SC at 1E-06 risk	SC at HQ=1	SC at 1E-06 risk
Occupational scenario[1]									
Mercury	NA	NA	8.9E+07	NA	6E+02	NA	NA		
Fluoride	NA	NA	ND	ND	1.2E+05	NA	NA		
Residential scenario[2]									
Silver	NA	NA	NA	NA	NA	NA	NA	8.64E+05	NA
Barium	NA	NA	NA	NA	NA	NA	NA	PURE	NA
Mercury (vault)	NA	NA	NA	NA	NA	NA	NA	3.2E+05	NA
Mercury (pipe area)	NA	NA	6.4E+07	NA	8.1E+01	NA	NA	1.8E+04	NA
Fluoride (vault)	NA	NA	NA	NA	NA	NA	NA	PURE	NA
Fluoride (pipe area)	NA	NA	ND	NA	1.62E+04	NA	NA	PURE	NA
Fluoride (dry well)	NA	NA	NA	NA	NA	NA	NA	2.5E+04	NA
Phenanthene	NA	NA	NA	NA	NA	NA	NA	ND	ND
Anthracene	NA	NA	NA	NA	NA	NA	NA	PURE	NA
Fluoranthene	NA	NA	NA	NA	NA	NA	NA	PURE	NA
Pyrene	NA	NA	NA	NA	NA	NA	NA	PURE	NA
Benzo(a)Anthracene	NA	NA	NA	NA	NA	NA	NA	NA	1.65E+04
Chrysene	NA	NA	NA	NA	NA	NA	NA	NA	PURE
bis(2-ethylhexyl)Phthalate	NA	NA	NA	NA	NA	NA	NA	PURE	3.6E+03
Benzo(b)Fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA	1.0E+05
Benzo(k)Fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA	PURE
Benzo(a)Pyrene	NA	NA	NA	NA	NA	NA	NA	NA	3.9E+03
Indeno(1,2,3-cd)Pyrene	NA	NA	NA	NA	NA	NA	NA	NA	PURE
Benzo(g,h,i)Perylene	NA	NA	NA	NA	NA	NA	NA	ND	ND

Notes:
1. The only contaminants of concern for the occupational scenario are mercury and fluoride form soil near tile pipe. The rest of the contaminants are at depths greater than 10 ft below land surface.
2. The viable pathways for mercury and fluoride are inhalation, ingestion and groundwater ingestion for residential. All other contaminants are at depths greater than 10 ft bls there leaching to groundwater is the only pathway.

SC — soil concentration (mg/kg for nonradioactive; pCi/g for radioactive)
HQ — hazard quotient.
NA — Not applicable
ND — No Data for HQ or slope factors.
PURE — Contaminant limiting soil concentration greater than 10^6 mg/kg

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Table 3. Contaminant worksheet.
Process (Column 1) discharge of off-specification hydrofluoric acid

Column 4 Known or potential hazardous substances/constituents associated with this waste or process	Column 5 Potential sources associated with this hazardous material	Column 6 SOURCE TERM Known/estimated concentration of hazardous substances/constituents (mg/kg)	Column 7 FORWARD CALCULATION Calculated risk	Column 8 BACKWARD CALCULATION Lowest risk-based concentration for:		Column 9 Qualitative risk assessment (high/medium/low)	Column 10 Overall reliability (high/medium/low)
				8a. All pathways	8b. Only viable pathways		
Silver	Contaminated soil	18.7	1.85E-05 *IRH*	8.64E+05	8.64E+05	LOW	MEDIUM
Barium	Contaminated soil	1,100	2.8E-05 *IRH*	PURE	PURE	LOW	MEDIUM
Mercury (pipe area)	Contaminated soil	0.17	7.4E-04 *IRH*	8.1E+01[I]	8.1E+01[I]	LOW	MEDIUM
Fluoride (pipe area)	Contaminated soil	929.25	.057 *IRH*	1.6E+04[I]	1.6E+04[I]	LOW	MEDIUM
Phenanthene	Contaminated soil	1.1	ND	ND	ND	LOW	MEDIUM
Anthracene	Contaminated soil	0.18	6.6E-10 *IRH*	PURE	PURE	LOW	MEDIUM
Fluoranthene	Contaminated soil	2.3	1.6E-07 *IRH*	PURE	PURE	LOW	MEDIUM
Pyrene	Contaminated soil	1.3	1.2E-076 *IRH*	PURE	PURE	LOW	MEDIUM
Benzo(a)Anthracene	Contaminated soil	0.86	4.04E-11 *IRC*	1.65E+04	1.65E+04	LOW	MEDIUM
Chrysene	Contaminated soil	1.6	3.03E-13 *IRC*	PURE	PURE	LOW	MEDIUM
bis(2-ethylhexyl)Phthalate	Contaminated soil	14	3.3E-09 *IRC*	3.6E+03	3.6E+03	LOW	MEDIUM
Benzo(b)Fluoranthene	Contaminated soil	1.1	6.6E-12 *IRC*	1.0E+05	1.0E+05	LOW	MEDIUM
Benzo(k)Fluoranthene	Contaminated soil	0.97	2.9E-13 *IRC*	PURE	PURE	LOW	MEDIUM
Benzo(a)Pyrene	Contaminated soil	0.5	1.3E-10 *IRC*	3.9E+03	3.9E+03	LOW	MEDIUM
Indeno(1,2,3-cd)Pyrene	Contaminated soil	0.48	4.5E-13 *IRC*	PURE	PURE	LOW	MEDIUM
Benzo(g,h,i)Perylene	Contaminated soil	0.27	ND	ND	ND	LOW	MEDIUM

Notes:
PURE = Contaminant limiting soil concentration > 10^6 mg/kg

Release mechanisms:

v — volatilization → inhalation
s — suspension → inhalation
i — oral intake → ingestion
r — radiation → external exposure
l — leaching to groundwater → groundwater ingestion

Scenarios:

O — occupational
R — residential

Risk evaluation criteria:

C — cancer risk of 10^{-6}
H — hazard quotient of 1

Table 4. Qualitative risk and reliability evaluation table.

	QUALITATIVE RISK		
	Low	Medium	High
Highly unreliable	Screening data	TRACK 2	Screening data
Medium reliability	No Action Required		
		RI/FS	Interim Action[a]
Highly reliable			
RELIABILITY	LOW concentration resulting in risk < 10^{-6}	MEDIUM	HIGH concentration resulting in risk > 10^{-4}
	Qualitative risk		

a. If sufficient data exist to identify an appropriate remedy.

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Question 1. What are the waste generation processes, locations, and dates of operation associated with this site?

Block 1 **Answer:**

CPP-39 is located in the northwest portion of the Idaho Chemical Processing Plant (ICPP) at the intersection of Birch Street and Pine Avenue[4]. The area is a security exclusion zone which contains no buildings or process facilities. YDB-105 sat over the concrete containment vault next to CPP-640 and was surrounded by gravel. CPP-39 consisted of a hydrofluoric acid (HF) storage tank (YDB-105), a concrete containment vault, a 125-ft tile connecting line to the dry well[1,5]. This system was used from 1967 to 1984. The HF storage tank was taken out of service and removed in 1990[1] and the vitrified tile line was removed in 1993[2]. OU 3-13 (CPP-39) presently consists of a containment vault, the area near where the tile line was removed and the dry well.

The HF acid tank (YDB-105) was a 6,200 gallon carbon-steel storage tank used between 1967 and 1984 for storing 44 Molar (M) HF. The acid was stored in the tank and transferred to CPP-601 for use in the dissolution of uranium enriched zirconium alloys. The tank was removed, decontaminated and disposed of at the Central Facility Area landfill in August 1990[3].

The rectangular containment vault is 11 x 24 x 5.5 ft. It was positioned under the YDB-105 to contain excess acids which may have escaped as a result of refilling and to trap overflow. The vault was filled with limestone rock for neutralizing any acid entering the vault. The limestone was removed in July 1990[1]. After removal of the limestone an inspection of the vault's concrete floor showed a crack near the southeast corner at the wall/floor interface. A 2-ft diameter hole was located in the cement floor at the southwest corner of the vault, which may have been the location of the drain to the transfer line to the dry well. The cement in this area was visibly stained and a cavity was present in the underlying soil to a depth of approximately 4 ft (10.5 ft bls). No other cracks were observed in the containment vault floor[1].

The dry well is situated to the southwest of the containment vault on the west side of Birch Street and is surrounded by pavement. The dry well, which contained limestone rock, is a cemented circular structure 22.5 ft in circumference with a depth of 15 ft. The purpose of the dry well was to receive the discharges of off-specification HF from CPP-601 to the containment vault[1,2].

Block 2 **How reliable is/are the information source(s)? X High __Medium __Low** (check one)

Explain the reasoning behind this evaluation.

This site has been sampled and characterized for closure under RCRA, which gives the information given above a relatively high reliability.

Block 3 **Has this information been confirmed?** X Yes ___ No (check one)

If so, describe the confirmation.

Yes, several documents [1,2,3] all confirm the information provided above.

Block 4 **Sources of information**

[check appropriate box(es) and indicate source number from reference list]

No available information	[ ] ____	Analytical data	[ ] ____
Anecdotal	[ ] ____	Documentation about data	[ ] ____
Historical process data	[ ] ____	Disposal data	[ ] ____
Current process data	[ ] ____	Quality assurance data	[ ] ____
Photographs	[ ] ____	Safety analysis report	[ ] ____
Engineering/site drawings	[x] 4,5	D&D report	[ ] ____
Unusual occurrence report	[ ] ____	Initial assessment	[ ] ____
Summary documents	[ ] ____	Well data	[ ] ____
Facility SOPs	[ ] ____	Construction data	[ ] ____
OTHER	[x] 1, 2,3		

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Question 2. What are the disposal processes, locations, and dates of operation associated with this site?

Block 1 **Answer:**

The containment vault was positioned under the YDB-105 to contain excess acids which may have escaped as a result of refilling and to trap overflow. The vault was filled with limestone rock for neutralizing any acids which entered the vault.

Based on process knowledge, HF was transferred from tank YDB-105 to the CPP-601 makeup areasbefore the disolution process. HF was mixed with borated water in the makeup area. If the solution was within specification it was introduced into the dissolution process if not it was readjusted and retested. Only the off-specification solutions which could not be adjusted to make useable were returned to the containment vault for neutralization. Off-specification HF from CPP-601 was discharged to the containment vault which was connected to the dry well by a 125-ft tile pipe[5]. Based upon an extrapolation of data in available records, the dry well received approximately 1,400 gallons of off-specification HF per year for a total of approximately 23,800 gallons[2]. Additionally, dilute concentrations of boric and nitric acid may have been discharged to the dry well. Boric acid (and possibly nitric acid) were usually mixed with the HF in the dissolution process.

This system was used from 1967 to 1984. Since then, the HF tank was removed in 1990 and the tile pipe between the containment vault and dry well was removed in 1993.

Block 2 **How reliable is/are the information source(s)? __High _X_Medium __Low** (check one)

Explain the reasoning behind this evaluation.

Extrapolation of data in available records was used to estimate the amount of off-specification HF discharged through the containment vault to the dry well.

Block 3 **Has this information been confirmed?** __ **Yes** _X_ **No** (check one)

If so, describe the confirmation.

Block 4 **Sources of information**

[check appropriate box(es) and indicate source number from reference list]

No available information	[ ] ____	Analytical data	[ ] ____
Anecdotal	[ ] ____	Documentation about data	[ ] ____
Historical process data	[ ] ____	Disposal data	[ ] ____
Current process data	[ ] ____	Quality assurance data	[ ] ____
Photographs	[ ] ____	Safety analysis report	[ ] ____
Engineering/site drawings	[x] 5	D&D report	[ ] ____
Unusual occurrence report	[ ] ____	Initial assessment	[ ] ____
Summary documents	[ ] ____	Well data	[ ] ____
Facility SOPs	[ ] ____	Construction data	[ ] ____
OTHER	[x] 2		

Question 3. Is there empirical, circumstantial, or other evidence that sources exist at this site? If so, list the sources and describe the evidence.

Block 1 **Answer:**

Yes. Samples were collected from beneath the containment vault to the dry well in July of 1990 and November 1990[1] to determine the presence, nature and extent of hazardous constituents in the containment vault, dry well and subsurface soils in suppoet of RCRA closure. Boreholes were drilled and samples collected at 1, 2 and 4 ft below the concrete of the containment vault. Samples were also collected in the southwest corner below the vault at 4 to 4.7 ft and 5 to 5.7 ft. At the dry well location, samples were collected from the borehole at 5 ft intervals beginning with soils at the base of the dry well at 14.5 ft and extending to a depth of 50 ft. Basalt was encountered at a depth of 52.2 ft. Samples collected in July 1990 at the base of the dry well, 14.5 to 18.5 ft and above the basalt (48.8 to 50.8 ft), were prepared for analyses of 40 CFR Part 261 Appendix VIII analyses. Additional sampling in November 1990 were prepared for pH and fluoride analyses[2]. Sampling was also conducted during removal of tile pipe in 1993[6]. Fluoride and mercury were found in the samples from soil around the pipe to a depth of 10 ft.

Contaminants found in concentrations above background at CPP-39 include:

Contaminant	Conc.(mg/kg)	Location (depth)
Silver	18.7	Dry Well (15 ft)
Barium	1,100.0	Below Vault (10.5 ft)
Mercury	0.17	Below Vault (10.5 ft)
Mercury	0.06*	Tile Pipe (10 ft)
Fluoride	1440.0	Below Vault (10.5 ft)
Fluoride	929.25*	Tile Pipe (10 ft)
Fluoride	365.0	Dry Well (15 ft)
Anthracene	0.18	Dry Well (15 ft)
Fluoranthene	2.3	Dry Well (15 ft)
Pyrene	1.3	Dry Well (15 ft)
Benzo(a)Anthracene	0.86	Dry Well (15 ft)
Chrysene	1.6	Dry Well (15 ft)
bis(2-Ethylhexyl)Phthalate	14.0	Dry Well (15 ft)
Benzo(b)Fluoranthene	1.1	Dry Well (15 ft)
Benzo(k)Fluoranthene	0.97	Dry Well (15 ft)
Benzo(a)Pyrene	0.5	Dry Well (15 ft)
Indeno(1,2,3-cd)Pyrene	0.48	Dry Well (15 ft)
Benzo(g,h,i)Perylene	0.27	Dry Well (15 ft)

* Average of samples taken along area where tile pipe was buried

Soil sample pH (5.97 - 12.6) indicates that it is highly unlikely that HF would still be present at this site.

Block 2 **How reliable is/are the information source(s)?** _X_ High __Medium __Low (check one)

Explain the reasoning behind this evaluation.

July and December 1990 soil samples and samples collected during tile pipe removal are deemed reliable.

Block 3 **Has this information been confirmed?** _X_ Yes ___ No (check one)

If so, describe the confirmation.

Both the July and December 1990 and the 1993 sampling events confirm the presence of the contaminants of concern at this site.

Block 4 **Sources of information**

[check appropriate box(es) and indicate source number from reference list]

No available information	[ ] _____	Analytical data	[x] 6
Anecdotal	[ ] _____	Documentation about data	[ ] _____
Historical process data	[ ] _____	Disposal data	[ ] _____
Current process data	[ ] _____	Quality assurance data	[ ] _____
Photographs	[ ] _____	Safety analysis report	[ ] _____
Engineering/site drawings	[ ] _____	D&D report	[ ] _____
Unusual occurrence report	[ ] _____	Initial assessment	[ ] _____
Summary documents	[ ] _____	Well data	[ ] _____
Facility SOPs	[ ] _____	Construction data	[ ] _____
OTHER	[x] 1,2		

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Question 4. Does site operating or disposal historical information allow estimation of the pattern of potential contamination? Discuss the estimated patterns of potential contamination over time.

Block 1 **Answer:**

Yes. Sampling of and below containment vault indicates the highest contaminant concentrations are located in the soil approximately 5 ft below the southwest corner of the containment vault where the tile pipe was connected[2]. Concentrations above background were found there for mercury, barium and fluoride. Other samples beneath the vault did not indicate any contamination. Therefore the pattern of contamination at the vault is probably a relatively small hotspot located approximately 10.5 ft below land surface.

Sampling of the dry well indicates contamination of semi-volatile compounds probably associated with the asphalt pavement covering the area. Contamination in the dry well is limited to the surface area (15 ft below ground surface) and is contained laterally by cemented circular structure 22.5 ft in circumference. Sampling down to basalt has indicated that the contaminants are not highly mobile and moving vertically. Therefore the contamination in the dry well should be limited to the soils directly beneath the well.

Sampling of soil[6] when the tile pipe was removed indicated fluoride and mercury contamination to a depth of 10 ft beneath the tile pipe. Therefore fluoride contamination would be a long narrow hotspot.

Block 2 **How reliable is/are the information source(s)? __High _X_Medium __Low** (check one)

Explain the reasoning behind this evaluation.

Sampling has defined the depth of contamination in the dry well but lateral movement of contaminants beneath the concrete barrier has not been tested.

Contaminant concentrations have not been measured in depth past 6 ft under the containment vault or past 10 ft beneath the tile pipe.

Block 3 **Has this information been confirmed?** __ **Yes** _X_ **No** (check one)

If so, describe the confirmation.

Block 4 **Sources of information**

[check appropriate box(es) and indicate source number from reference list]

No available information	[ ] ____	Analytical data	[x] 6
Anecdotal	[ ] ____	Documentation about data	[ ] ____
Historical process data	[ ] ____	Disposal data	[ ] ____
Current process data	[ ] ____	Quality assurance data	[ ] ____
Photographs	[ ] ____	Safety analysis report	[ ] ____
Engineering/site drawings	[ ] ____	D&D report	[ ] ____
Unusual occurrence report	[ ] ____	Initial assessment	[ ] ____
Summary documents	[ ] ____	Well data	[ ] ____
Facility SOPs	[ ] ____	Construction data	[ ] ____
OTHER	[x] 2		

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Question 5. Estimate the length, width, and depth of the contaminated region as it is today. What is the known or estimated volume of each source as it is today? Discuss historical dimensions and volumes, and changes over time. If dimensions and volumes are estimates, explain carefully how the estimates were derived.

Block 1 **Answer:**

The contaminated area under the containment vaults is beneath a 2-ft diameter hole in the south west corner. Sampling indicates contamination to a depth of 6 ft[1,2]. Therefore the total area of contamination is approximately 4 ft^2 with a estimated volume of 24 $ft^3 \approx 1\ yd^3$ (4 ft^2 x 6 ft).

The area of contamination with the dry well is calculated at 40.3 ft^2 (area = $c^2/4\pi$) where the circumference of the well was determined to be 22.5 ft[1,2]. The majority of contamination was determined to be in top 3 ft of the surface soils at the bottom of the dry well. If all the surface soil was contaminated the total contaminated soil volume would be 40.3 ft^2 x 3 ft = 121 ft^3 (4.5 yd^3).

The area of contamination for the tile pipe is calculated at 125 ft length, by 3 ft wide, by 10 ft deep, which = 3,750 ft^3 (416 yd^3).

The estimated weight of each sources is calculated as follows
vault = 24 $ft^3 \times 0.0283\ m^3/ft^3 \times 10^6\ cm^3/m^3 \times 1.5\ g/cm^3 \times 1\ kg/1000g$ = 1019 kg of soil.
dry well = 121 $ft^3 \times 0.0283\ m^3/ft^3 \times 10^6\ cm^3/m^3 \times 1.5\ g/cm^3 \times 1\ kg/1000g$ = 5136 kg of soil.
pipe = 3,750 $ft^3 \times 0.0283\ m^3/ft^3 \times 10^6\ cm^3/m^3 \times 1.5\ g/cm^3 \times 1\ kg/1000g$ = 159,187 kg of soil

Block 2 **How reliable is/are the information source(s)? __High _X_Medium __Low** (check one)

Explain the reasoning behind this evaluation.
The area of contamination for the dry well is bounded by the cement casing and is well documented. The depth of contamination has also been determined by sampling[2,6].

The containment vault contamination has been determined by sampling the area and volume of contaminated soil has been estimated.

Block 3 **Has this information been confirmed?** __ **Yes** _X_ **No** (check one)

If so, describe the confirmation.

Block 4 **Sources of information**

[check appropriate box(es) and indicate source number from reference list]

No available information	[ ] ____	Analytical data	[x] 6
Anecdotal	[ ] ____	Documentation about data	[ ] ____
Historical process data	[ ] ____	Disposal data	[ ] ____
Current process data	[ ] ____	Quality assurance data	[ ] ____
Photographs	[ ] ____	Safety analysis report	[ ] ____
Engineering/site drawings	[ ] ____	D&D report	[ ] ____
Unusual occurrence report	[ ] ____	Initial assessment	[ ] ____
Summary documents	[ ] ____	Well data	[ ] ____
Facility SOPs	[ ] ____	Construction data	[ ] ____
OTHER	[x] 1,2		

Question 6. What is the known or estimated concentration or quantity of *each* hazardous substance/constituent at *each* source? If quantities are estimates, explain carefully how each estimate was derived.

Block 1 **Answer:**

Contaminants found in concentrations above background at CPP-39 include inorganic metals, fluoride and semi-volatile organics. Contaminant quantities found at each source are calculated as follows:

contaminated soil weight (kg) (question 5) × soil concentrations (mg/kg) = estimated quantity of each contaminant. Contaminants found only in the containment vault will use only the source estimate from that site. Contaminants found only in dry well will use only the dry well estimate. Contaminant concentrations and quantities are given below:

Contaminant	Conc.(mg/kg)	Estimated Quantity (kg)
Silver	18.7	0.0960
Barium	1,100.0	1.1209
Mercury (vault)	0.17	0.0002
Mercury (tile pipe)	0.06*	0.0095
Fluoride (tile pipe)	929.25*	148.00
Fluoride (vault)	365.0	0.1826
Fluoride (dry well)	1,440.0	1.47
Phenanthrene	1.1	0.0565
Anthracene	0.18	0.0009
Fluoranthene	2.3	0.0118
Pyrene	1.3	0.0067
Benzo(a)Anthracene	0.86	0.0044
Chrysene	1.6	0.0082
bis(2-Ethylhexyl)Phthalate	14.0	0.0719
Benzo(b)Fluoranthene	1.1	0.0057
Benzo(k)Fluoranthene	0.97	0.0050
Benzo(a)Pyrene	0.5	0.0026
Indeno(1,2,3-cd)Pyrene	0.48	0.0025
Benzo(g,h,i)Perylene	0.27	0.0014

* Average of samples collected during tile pipe removal

Soil sample pH (5.97 - 12.6) indicates that it is highly unlikely that HF would still be present at this site.

Block 2 **How reliable is/are the information source(s)? _High _Medium x Low** (check one)

Explain the reasoning behind this evaluation.

Sampling data has determined the contaminants and their concentrations[1,2,6]. Source quantities are calculated estimates.

Block 3 **Has this information been confirmed?** __ Yes _X_ No (check one)

If so, describe the confirmation.

Block 4 **Sources of information**

[check appropriate box(es) and indicate source number from reference list]

No available information	[ ] _____	Analytical data	[x] 6
Anecdotal	[ ] _____	Documentation about data	[ ] _____
Historical process data	[ ] _____	Disposal data	[ ] _____
Current process data	[ ] _____	Quality assurance data	[ ] _____
Photographs	[ ] _____	Safety analysis report	[ ] _____
Engineering/site drawings	[ ] _____	D&D report	[ ] _____
Unusual occurrence report	[ ] _____	Initial assessment	[ ] _____
Summary documents	[ ] _____	Well data	[ ] _____
Facility SOPs	[ ] _____	Construction data	[ ] _____
OTHER	[x] 1,2		

Question 7. Is there empirical, circumstantial, or other evidence of a release and/or contamination in a pathway? Discuss the evidence. Address each potential pathway.

Block 1 **Answer:**
The contamination beneath the vault and dry well and tile pipe could migrate by the following pathways:

Soil / leaching to the groundwater / groundwater ingestion. Contamination at the site could migrate to the water table as a result of the infiltration of precipitation.

In addition fluoride and mercury contamination in soil near the tile pipe could migrate by the following pathways

Air / suspension / inhalation. Wind at the site can mobilize dust and particulates from the area and potentially spread contamination from soils near where the tile pipe was buried. There is no expected inhalation exposure to airborne contamination from the potentially contaminated soil beneath the dry well because the bottom of the well is 15 ft bls and the containment vault soil contamination is greater than 10 ft bls.

Soil / direct contact / ingestion. Potentially contaminated soils with fluoride and mercury could be ingested by present day workers or future residences at this site. Potentially contaminated soils beneath the containment vault and dry well are below 10 ft and therefore are not available for ingestion or direct contact for the occupational or future residents.

Pathways that are considered incomplete are;

Air / volatilization / inhalation. There is no expected inhalation exposure to semi- volatile compounds which were only found in the soil beneath the dry well because the bottom of the well is 15 ft below land surface.

Soil / nuclear decay / external exposure. There is no evidence that radioactive contaminants were disposed of at the site.

Block 2 **How reliable is/are the information source(s)? X High __Medium __Low** (check one)
Explain the reasoning behind this evaluation.
Depth to contamination has been determined by sampling[1,2,6]. Sampling did not detect any radioactivity at this site.

Block 3 **Has this information been confirmed?** __ Yes _X_ No (check one)
If so, describe the confirmation.

Block 4 **Sources of information**
[check appropriate box(es) and indicate source number from reference list]

No available information	[ ] _____	Analytical data	[x] 6
Anecdotal	[ ] _____	Documentation about data	[ ] _____
Historical process data	[ ] _____	Disposal data	[ ] _____
Current process data	[ ] _____	Quality assurance data	[ ] _____
Photographs	[ ] _____	Safety analysis report	[ ] _____
Engineering/site drawings	[ ] _____	D&D report	[ ] _____
Unusual occurrence report	[ ] _____	Initial assessment	[ ] _____
Summary documents	[ ] _____	Well data	[ ] _____
Facility SOPs	[ ] _____	Construction data	[ ] _____
OTHER	[x] 1,2		

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Question 8. Is there evidence that hazardous substances or constituents are present at any of the potential sources today? If so, describe the evidence. For each pathway, discuss fate and transport.

Block 1 **Answer:**

Yes. Sampling in 1990 gives evidence that the soil beneath the containment vault is contaminated with low-levels of mercury, barium and fluoride. This sampling also indicates the soil beneath the dry well could be contaminated with low levels of silver, fluoride and twelve semi-volatile compounds including: Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benzo(a)Anthracene, Chrysene, bis(2-Ethylhexyl)Phthalate, Benzo(b)Fluoranthene, Benzo(k)Fluoranthene, Benzo(a)Pyrene, Indeno(1,2,3-cd)Pyrene, and Benzo(g,h,i)Perylene.

Sampling during removal of the tile pipe[6] gave evidence of fluoride and mercury contamination in the soil around where the pipe was buried.

Block 2 **How reliable is/are the information source(s)? X High __Medium __Low** (check one)

Explain the reasoning behind this evaluation.

Sampling data has determined the contaminants and their concentrations[1,2,6].

Block 3 **Has this information been confirmed?** __ Yes X No (check one)

If so, describe the confirmation.

Block 4 **Sources of information**

[check appropriate box(es) and indicate source number from reference list]

No available information	[ ] ____	Analytical data	[x] 6
Anecdotal	[ ] ____	Documentation about data	[ ] ____
Historical process data	[ ] ____	Disposal data	[ ] ____
Current process data	[ ] ____	Quality assurance data	[ ] ____
Photographs	[ ] ____	Safety analysis report	[ ] ____
Engineering/site drawings	[ ] ____	D&D report	[ ] ____
Unusual occurrence report	[ ] ____	Initial assessment	[ ] ____
Summary documents	[ ] ____	Well data	[ ] ____
Facility SOPs	[ ] ____	Construction data	[ ] ____
OTHER	[x] 1,2		

Figure 1. Track 2 preliminary conceptual site model.

OU: 3-13 Site: CPP-39 Date: 6/94

Table 5. Pathway and release mechanism assessment.

Receptor: Current occupational, future residential

Source discussion/justification	Source medium	Release mechanism → exposure route	Scenario/pathway discussion	Data needs (Y/N)
Air: Volatilization There were twelve SVOC's detected in soil beneath the dry well.	Air	Volatilization → inhalation	Pathway is incomplete because SVOC's beneath the dry well are at depths greater than 15 ft below land surface.	N
Air: Suspension The containment vault,dry well and tile pipe are usually dry so dust could be generated only if soils were exposed to the surface.	Air	Suspension → inhalation	Pathway is complete because fluoride and mercury contamination in the soil, near where the tile pipe was, is less than 10 ft.	N
Soil: Oral intake Contaminated soils are present at the site but would only be available if soils were exposed to the surface.	Soil	Direct contact → ingestion	Pathway is complete because fluoride and mercury contamination in the soil, near where the tile pipe was, is less than 10 ft.	N
Soil: Radiation There is no evidence that radioactive contaminants were disposed of at this site.	Soil: No source	None	Pathway is incomplete.	
Soil: Leaching to groundwater Contaminants could migrate to the groundwater due to infiltration of precipitation.	Groundwater	Leaching to groundwater → groundwater ingestion	Pathway is complete.	

Summary of Table 5:

Air suspension and soil ingestion pathways are complete due to the depth of the fluoride near tile pipe location. The radiation and volatilization pathway is incomplete due to lack of source. The only complete pathway for the other contaminants is leaching to the groundwater.

Notes:
SVOC's - semi-volatiles

OU: 3-13 Site: CPP-39 Date: 6/94

Table 6. Screening and risk evaluation of COCs.

Release mechanism → exposure route: soil ingestion

Contaminants of concern	Screening criteria	Source term	Forward risk calculations				Additional interpretation and justification/overall uncertainty	Data adequate to assess risk?
			Occupational		Residential			
			Hazard quotient	Cancer risk	Hazard quotient	Cancer risk		
Fluoride (pipe area) mercury (pipe area)	above background	929.25 0.06	.0013 9.8E-05	NA NA	.057 7.4E-04	NA NA		Yes Yes

Contaminants of concern	Screening criteria	Source term	Backward calculated risk-based concentrations				Additional interpretation and justification/overall uncertainty	Data adequate to assess risk?
			Occupational		Residential			
			SC at HQ=1	SC at 1E-06	SC at HQ=1	SC at 1E-06		
Fluoride (pipe area) mercury (pipe area)	above background	929.25 0.06	1.2E+05 6E+02	NA NA	1.6E+04 8.1E+01	NA NA		Yes Yes

Summary of Table 6:
Fluoride had HQs of .0013 and .057 for occupational and residential forward risk calculations respectively and risked based soil concentrations of 1.2E+05 and 1.6E+04 for occupational and residential respectively. Mercury had HQs of 9.8E-05 and 7.4E-04 for occupational and residential forward risk calculations respectively and risked based soil concentrations of 6E+02 and 8.1E+01 for occupational and residential respectively. No data gaps are apparent.

Notes:

HQ — hazard quotient
SC — soil concentration.

Units are pCi/g for radionuclides, mg/kg otherwise.

OU: 3-13 Site: CPP-39 Date: 6/94

Table 6a. Screening and risk evaluation of COCs.

Release mechanism → exposure route: inhalation

Contaminants of concern	Screening criteria	Source term	Forward risk calculations				Additional interpretation and justification/overall uncertainty	Data adequate to assess risk?
			Occupational		Residential			
			Hazard quotient	Cancer risk	Hazard quotient	Cancer risk		
Fluoride (pipe area)	above background	929.25	ND	NA	ND	NA		Yes
mercury (pipe area)		0.06	1E-05	NA	1.4E-05	NA		Yes

Contaminants of concern	Screening criteria	Source term	Backward calculated risk-based concentrations				Additional interpretation and justification/overall uncertainty	Data adequate to assess risk?
			Occupational		Residential			
			SC at HQ=1	SC at 1E-06	SC at HQ=1	SC at 1E-06		
Fluoride (pipe area)	above background	929.25	ND	NA	ND	NA		Yes
mercury (pipe area)		0.06	8.9E+07	NA	6.4E+07			Yes

Summary of Table 6:
There is no HQ or SF for inhalation of fluoride therefore risk calculation could not be made. Mercury had HQs of 1E-05 and 1.4E-05 for occupational and residential forward risk calculations respectively and risked based soil concentrations of 6E+02 and 8.1E+01 for occupational and residential respectively

Notes:

HQ — hazard quotient
SC — soil concentration.
ND — no data
NA — not applicable
Units are pCi/g for radionuclides, mg/kg otherwise.

OU: 3-13 Site: CPP-39 Date: 6/94

Table 6b. Screening and risk evaluation of COCs.

Release mechanism → exposure route: ingestion of groundwater

Contaminants of concern	Screening criteria	Source term	Forward risk calculations: Occupational: Hazard quotient	Occupational: Cancer risk	Residential: Hazard quotient	Residential: Cancer risk	Additional interpretation and justification/overall uncertainty	Data adequate to assess risk?
Silver	Soil concentration above background	18.7	NA	NA	1.85E-05	NA	These contaminants were found in soils at depths greater than 10 ft below land surface. Expect mercury and fluoride near the pipe area where they were found at depths less than 10 ft.	Yes
Barium		1100.0	NA	NA	2.8E-05	NA		
Mercury (vault)		0.17	NA	NA	4.2E-07	NA		
Mercury (pipe area)		0.06	NA	NA	3.1E-06	NA		
Fluoride (vault)		1440.0	NA	NA	6.8E-04	ND		
Fluoride (pipe area)		929.25	NA	NA	3.4E-02	ND		
Fluoride (dry well)		365.0	NA	NA	8.5E-04	ND		
Phenanthene		1.1	NA	NA	ND	ND		
Anthracene		0.18	NA	NA	6.6E-10	NA		
Fluoranthene		2.3	NA	NA	1.6E-07	NA		
Pyrene		1.3	NA	NA	1.2E-07	NA		
Benzo(a)Anthracene		0.86	NA	NA	NA	4.04E-11		
Chrysene		1.6	NA	NA	NA	3.03E-13		
bis(2-ethylhexyl)Phthalate		14.0	NA	NA	1.2E-05	3.3E-09		
Benzo(b)Fluoranthene		1.1	NA	NA	NA	6.6E-12		
Benzo(k)Fluoranthene		0.97	NA	NA	NA	2.9E-13		
Benzo(a)Pyrene		0.5	NA	NA	NA	1.3E-10		
Indeno(1,2,3-cd)Pyrene		0.48	NA	NA	NA	4.5E-13		
Benzo(g,h,i)Perylene		0.27	NA	NA	ND	ND		

Table 6b.
(con't)

Contaminants of concern	Screening criteria	Source term	Backward calculated risk-based concentrations				Additional interpretation and justification/overall uncertainty	Data adequate to assess risk?
			Occupational		Residential			
			SC at HQ=1	SC at 1E-06	SC at HQ=1	SC at 1E-06		
Silver	Soil Concentration above background	18.7	NA	NA	8.64E+05	NA	All contaminants were found in soils at depths greater than 10 ft below land surface. Therefore only the groundwater pathway was considered.	Yes
Barium		1100.0	NA	NA	PURE	NA		
Mercury (vault)		0.17	NA	NA	3.2E+05	NA		
Mercury (pipe area)		0.06	NA	NA	1.8E+04	NA		
Fluoride (vault)		1440.0	NA	NA	PURE	NA		
Fluoride (pipe area)		929.25	NA	NA	PURE	NA		
Fluoride (dry well)		365.0	NA	NA	2.5E+04	NA		
Phenanthene		1.1	NA	NA	ND	ND		
Anthracene		0.18	NA	NA	PURE	NA		
Fluoranthene		2.3	NA	NA	PURE	NA		
Pyrene		1.3	NA	NA	PURE	NA		
Benzo(a)Anthracene		0.86	NA	NA	NA	1.7E+04		
Chrysene		1.6	NA	NA	NA	PURE		
bis(2-ethylhexyl)Phthalate		14.0	NA	NA	PURE	3.6E+03		
Benzo(b)Fluoranthene		1.1	NA	NA	NA	1.0E+05		
Benzo(k)Fluoranthene		0.97	NA	NA	NA	PURE		
Benzo(a)Pyrene		0.5	NA	NA	NA	3.9E+03		
Indeno(1,2,3-cd)Pyrene		0.48	NA	NA	NA	PURE		
Benzo(g,h,i)Perylene		0.27	NA	NA	ND	ND		

Summary of Table 6:
The only viable pathway is groundwater ingestion by future residents because all contaminants were found at depths greater than 10 ft below land surface.
There is no risk due to ingestion of groundwater from any of the contaminants.

Notes:

HQ — hazard quotient
SC — soil concentration.
NA — Not applicable
ND — No Data or HQ or SF
PURE — Contaminant concentration above 10^6 mg/kg
Units are pCi/g for radionuclides, mg/kg otherwise.

OU: 3-13 Site: CPP-39 Date: 6/94

Table 7. Risk assessment summary for forward calculations.

Contaminants of concern	Source soil concentration	Volatile inhalation		Dust inhalation		Soil ingestion		External exposure	Groundwater ingestion	
		Hazard Quotient	Cancer Risk	Hazard Quotient	Cancer Risk	Hazard Quotient	Cancer Risk	Cancer Risk		
Occupational scenario										
Mercury	0.06	NA	NA	1E-05	ND	9.8E-05	NA	NA		
Fluoride	929.25	NA	NA	ND	ND	0.0013	NA	NA		
Residential scenario										
Silver	18.7	NA	NA	NA	NA	NA	NA	NA	1.85E-05	NA
Barium	1100.0	NA	NA	NA	NA	NA	NA	NA	2.8E-05	NA
Mercury (vault)	0.17	NA	NA	NA	NA	NA	NA	NA	4.2E-07	NA
Mercury (pipe area)	0.06	NA	NA	1.4E-05	NA	7.4E-04	NA	NA	3.1E-06	NA
Fluoride (vault)	1440.0	NA	NA	NA	NA	NA	NA	NA	6.8E-04	NA
Fluoride (pipe area)	929.25	NA	NA	ND	NA	0.057	NA	NA	3.4E-02	NA
Fluoride (dry well)	365.0	NA	NA	NA	NA	NA	NA	NA	8.5E-04	NA
Phenanthene	1.1	NA	NA	NA	NA	NA	NA	NA	ND	ND
Anthracene	0.18	NA	NA	NA	NA	NA	NA	NA	6.6E-10	NA
Fluoranthene	2.3	NA	NA	NA	NA	NA	NA	NA	1.6E-07	NA
Pyrene	1.3	NA	NA	NA	NA	NA	NA	NA	1.2E-07	NA
Benzo(a)Anthracene	0.86	NA	NA	NA	NA	NA	NA	NA	NA	4.04E-11
Chrysene	1.6	NA	NA	NA	NA	NA	NA	NA	NA	3.03E-13
bis(2-	14.0	NA	NA	NA	NA	NA	NA	NA	1.2E-05	3.3E-09
ethylhexyl)Phthalate	1.1	NA	NA	NA	NA	NA	NA	NA	NA	6.6E-12
Benzo(b)Fluoranthene	0.97	NA	NA	NA	NA	NA	NA	NA	NA	2.9E-13
Benzo(k)Fluoranthene	0.5	NA	NA	NA	NA	NA	NA	NA	NA	1.3E-10
Benzo(a)Pyrene	0.48	NA	NA	NA	NA	NA	NA	NA	NA	4.5E-13
Indeno(1,2,3-cd)Pyrene	0.27	NA	NA	NA	NA	NA	NA	NA	ND	ND
Benzo(g,h,i)Perylene										

Summary of Table 7:
There is no risk due to fluoride or mercury for the inhalation or ingestion pathways
There is no risk due to ingestion of groundwater from any of the contaminants.

Notes:

Soil concentration measurements are in mg/kg for nonradioactive; pCi/g for radioactive.
NA — Not applicable
ND — No Data or HQ or SF

OU: 3-13 Site: CPP-39 Date: 6/94

Table 8. Risk-based soil concentration summary for backward calculations.

Contaminants of concern	Source soil concentration	Volatile inhalation		Dust inhalation		Soil ingestion		External exposure	Groundwater ingestion	
		SC at HQ=1	SC at 1E-06 risk	SC at HQ=1	SC at 1E-06 risk	SC at HQ=1	SC at 1E-06 risk	SC at 1E-06 risk	SC at HQ=1	SC at 1E-06 risk
Occupational scenario										
Mercury (pipe area)	0.06	NA	NA	8.9E+07	NA	6E+02	NA	NA		
Fluoride (pipe area)	929.25	NA	NA	ND	ND	1.2E+05	NA	NA		
Residential scenario										
Silver	18.7	NA	NA	NA	NA	NA	NA	NA	8.64E+05	NA
Barium	1100.0	NA	NA	NA	NA	NA	NA	NA	PURE	NA
Mercury (vault)	0.17	NA	NA	NA	NA	NA	NA	NA	3.2E+05	NA
Mercury (pipe area)	0.06	NA	NA	6.4E+07	NA	8.1E+1	NA	NA	1.8E+04	NA
Fluoride (vault)	1440.0	NA	NA	NA	NA	NA	NA	NA	PURE	NA
Fluoride (pipe area)	929.25	NA	NA	ND	NA	1.62E+04	NA	NA	PURE	ND
Fluoride (dry well)	365.0	NA	NA	NA	NA	NA	NA	NA	2.5E+04	ND
Phenanthene	1.1	NA	NA	NA	NA	NA	NA	NA	ND	ND
Anthracene	0.18	NA	NA	NA	NA	NA	NA	NA	PURE	NA
Fluoranthene	2.3	NA	NA	NA	NA	NA	NA	NA	PURE	NA
Pyrene	1.3	NA	NA	NA	NA	NA	NA	NA	PURE	NA
Benzo(a)Anthracene	0.86	NA	NA	NA	NA	NA	NA	NA	NA	1.65E+04
Chrysene	1.6	NA	NA	NA	NA	NA	NA	NA	NA	PURE
bis(2-	14.0	NA	NA	NA	NA	NA	NA	NA	PURE	3.6E+03
ethylhexyl)Phthalate	1.1	NA	NA	NA	NA	NA	NA	NA	NA	1.0E+05
Benzo(b)Fluoranthene	0.97	NA	NA	NA	NA	NA	NA	NA	NA	PURE
Benzo(k)Fluoranthene	0.5	NA	NA	NA	NA	NA	NA	NA	NA	3.9E+03
Benzo(a)Pyrene	0.48	NA	NA	NA	NA	NA	NA	NA	NA	PURE
Indeno(1,2,3-cd)Pyrene	0.27	NA	NA	NA	NA	NA	NA	NA	ND	ND
Benzo(g,h,i)Perylene										

Summary of Table 8:
Mercury and fluoride were found at depths less than 10 ft bls near tile pipe area so inhalation, soil i ngestion, and groundwater pathways are viable, however there is no significant risk to these contaminants from these pathways. The only viable pathway for all other contaminants is groundwater ingestion by future residents because all contaminants were found at depths greater than 10 ft below land surface. There is no significant risk due to ingestion of groundwater from any of the contaminants.

Notes:

HQ — hazard quotient
SC — soil concentration (mg/kg for nonradioactive; pCi/g for radioactive).
NA — Not applicable
ND — No Data or HQ or SF
PURE — Contaminant concentration above 10^6 mg/kg

OU: 3-13 Site: CPP-39 Date: 6/94

Table 9. Data gaps and sampling needs assessment (sensitivity evaluation of non-COC parameters).

Receptor:_____ Release mechanism → Exposure route: _____

Parameter	Parameter use	Sensitivity (including change in o/p per unit change in i/p)	Known accuracy	Select parameter	Required level of accuracy	Sampling method	Analytical method	Capability of method (including incremental increase in capability per sample)	Sufficient accuracy?	Time per sample	Cost per sample	Select method?
No data needed for decision												

Justification of sampling method selection:

Summary of Table 9:

Notes: Intentionally left blank because no data gaps exists.

o/p — incremental change in the output
i/p — incremental change in parameter.

Figure 2. Track 2 revised conceptual site model.

REFERENCES

1. Report for the Idaho Chemical Processing Plant Drilling and Sampling Program at land Disposal Unit CPP-39, 893-1195.310, January 1991.

2. Final Closure Plan for LDU CPP-39 Hydrofluoric Acid Storage Tank and Dry Well, December 4, 1990.

3. Technical Work Plan for FY 1993 Removal and Characterization Activities (Sites: CPP-81, Bin Set #3, CPP-39, and CPP-48), Environmental Restoration Section, July, 1993.

4. ICPP Site Plan, 1140INEL.DWG, 1994 and CPP-39 Containment Vault and Dry Well, 1141INEL.DWG, MSE 1994.

5. CPP-39 CERCLA Characterization 6" Line HFN-710, Sketch 293065-1, July 1993.

6. Transmittal Letters, From Challender, J to Holder K., Transmittal of Operable Unit 3-12 Limitations and Validation Report for the Removal of the Tile Pipe, Sample Delivery Group #3BS00101DP and #3BS00101AN, JAC-109-93 and JAC-110-93, November 1993.

7. Background Concentrations of Selected Metals and Radionuclides in the Big Lost River Alluvium at the Idaho Chemical Processing Plant, Revision 1, February 28, 1994.

TRACK 2
PRELIMINARY SCOPING PACKAGE
COVER SHEET

DATE: 9/94

Prepared in accordance with

Track 2 Sites:
Guidance for Assessing
Low Probability Hazard Sites
at the INEL

Site Description: Dump Tank

Site ID: CPP-48 **Operable Unit: 3-13**

Waste Area Group: WAG 3 IDAHO CHEMICAL PROCESSING PLANT

I. SUMMARY—Site Background:

The old Waste Calcining Facility (CPP-633) at the Idaho Chemical Processing Plant (ICPP), was in use from 1963 to 1981 to calcine high level liquid waste (HLLW) into solid form, thereby reducing waste volume. The calcining process involved spraying liquid radioactive wastes into a hot air fluidized bed of heated granular solids. The liquid then evaporated, and the residual radioactive waste material solidified to form calcine. The calcine, which amounts to about 20 percent of the original liquid volume, contains nearly all of the inert and radioactive material that was present in the liquid waste[2].

CPP-48 is an excess chemical dump tank that was used as a french drain from 1975 to 1981 (Herein referred to as "dump tank"). The dump tank, was made of steel and measured approximately 5 ft in diameter and 12 ft long, with a lid and no bottom. The top of the dump tank stood approximately 2 ft above the ground surface, with the tank bottom at 10 ft bls (Reference 8 is a photograph of the dump tank). As part of the calcining process, nitric acid and other chemicals consisting primarily of aluminum nitrate and calcium nitrate used in the calcining process were disposed into CPP-48. The chemicals released to the dump tank were not treated or neutralized before percolating into the soil matrix through the bottom of the tank. An above ground disposal line was used to discharge effluent to the dump tank[9] The line was a portable flex hose that was stored in CPP-633 when not in use and rolled out to the dump tank when needed to dispose of calcining process effluent[9]. It is believed that potential chemical substances and radionuclides existing underneath the dump tank resulted from the disposal of calcining waste by-product fluids to CPP-48.

TRACK 2 PRELIMINARY SCOPING PACKAGE

I. SUMMARY—Site Background: (con't)

Records indicate that the chemical disposal to CPP-48 was in low quantities (several gallons at a time)[3]. Through the years of operation, however, site personnel indicate thousands of gallons of waste effluent may have been disposed[6]. No records were kept regarding the volume of effluent disposed or the constituents in the waste stream, but it is suspected the contaminants of concern (mercury, cesium-137, antimony-125, europium-155, and gross beta) may have been introduced to this site via waste chemicals from the calcining process.

In March 1991, a sampling program was conducted to characterize the contamination in the soils around the dump tank. Approximately 5 ft east of the dump tank, a borehole was drilled and continuously sampled to a depth of 46.5 ft, where basalt was encountered. Samples from the borehole were tested for RCRA metals, pH, nitrite, nitrate, VOCs, semiVOCs, pesticides, herbicides, and radionuclides. (Note: Characterization at this site was done subject to RCRA guidelines because CERCLA was not in effect until December of 1991. Also, these metals are present in normal soils at trace amounts and many are frequently present in the waste stream at the ICPP, and are commonly tested for). Testing Cesium-137 was observed just above the background limit, but was determined not to be a significant concern to surface pathways because of the depth below ground surface the contaminant was detected (15 ft), however it is a concern for groundwater ingestion. Based on the results of this characterization, it was concluded there was no need for any soils removal near CPP-48 under RCRA guidelines[3].

In July 1993, three boreholes were hand augured within one foot of the dump tank circumference to a depth of approximately 10 ft bls, and surveyed for radioactivity. Borehole 1 was north of the dump tank, Borehole 2 was west of the tank, and Borehole 3 was to the southeast of the tank. Borehole 1 was augured to 9.0 ft and had an average activity reading of 839 counts per minute (cpm), equivalent to an activity of 12.7 pCi/g (assuming the radionuclide was cesium-137). The highest reading of 4,000 cpm (equivalent to 61 pCi/g assuming cesium-137 as the radionuclide source material) was at 1.2 ft bls. Boreholes 2 and 3 had activity readings at background. During the dump tank removal (Sampling during tank removal is discussed in the next paragraph.), soils immediately adjacent to the dump tank were excavated to a depth of approximately 7 ft bls until the tank was "loose", and the was tank pulled from the cavity using a backhoe[10]. The total depth of the cavity after the tank was removed was approximately 12 ft bls. The excavated material was then used as fill in the cavity that remained after the tank was extracted from the ground, and soil samples were collected at 10 ft and 12 ft bls. The remainder of the dump tank cavity was infilled with clean soil. The 4,000 cpm point source of the high activity reading at 1.2 ft bls in Borehole 1 was excavated and redistributed at the bottom of the dump tank cavity when it was backfilled with the material that was excavated to remove the tank, so any risk associated is considered evaluating the groundwater pathway.

In August 1993, the CPP-48 dump tank was removed, cut into sections, packaged, and delivered to WERF for disposal. After the removal of the dump tank, four samples were collected in the uppermost soil beneath the tank bottom at approximately 10 ft bls (i.e., bottom of the dump tank) and at an interval approximately 2 ft below the dump tank bottom. Three samples were collected in soil and one was collected in a lense of "beige colored" material. All sample results were

TRACK 2 PRELIMINARY SCOPING PACKAGE

I. SUMMARY—Site Background: (con't)

consistent regarding contaminant and concentration. Samples collected at 10 ft and 12 ft bls, indicated the presence of mercury and several radionuclides, including cesium-137, antimony-125, europium-155, and gross beta occurring above background levels. The site was then backfilled with excavated site soil and topped with clean soil. Table 1 summarizes use of the CPP-48 site.

II. SUMMARY—Qualitative Assessment of Risk and Reliability:

The qualitative risk at CPP-48 from the contaminants is low based upon the results from the 1991 and 1993 characterization sampling. Above 10 ft bls the contaminant concentrations are low, or were excavated to the bottom of the dump tank cavity during the dump tank removal. Only the contaminants below 10 ft bls are occurring above background concentration.

Sample results from the 1991 adjacent borehole characterization effort concluded that no hazardous substances were detected above background in the soils in the vicinity of the dump tank, and that cesium-137 was the only radionuclide detected above background in a sample taken at 15 ft bls[3].

Because the cesium-137 is located greater than 10 ft bls, the only viable exposure pathway is ingestion of groundwater from leaching of contaminants to the aquifer. The reliability of this data is considered to be high.

Surface radioactivity sampling of the three hand augured boreholes performed in July 1993 detected a maximum radioactivity of 4,000 cpm at 1.2 ft bls. This activity corresponds to an approximate activity of 61 pCi/g, assuming the source is cesium-137. During the tank removal, contaminated soil was excavated from near surface and used as backfill placed at the bottom of the dump tank cavity (approximately 12 ft bls). Based on this data, the surface pathways are considered to be incomplete. The reliability of this data is considered to be medium since only field screening techniques were used to measure radioactivity.

Soil samples collected in August 1993 during the dump tank removal were above background levels for mercury, cesium-137, antimony-125, europium-155, and gross beta. However, these contaminants are located at depths greater than 10 ft bls, and therefore the only viable exposure pathway considered is the ingestion of groundwater from leaching of contaminants to the aquifer. These samples were reviewed for limitations and validation and the reliability of data is considered to be high.

The qualitative risk at this site is low based on the risk evaluations for the only complete pathway (groundwater ingestion). Table 3 summarizes the qualitative risk assessment as low and the overall reliability for the data for each contaminant of concern for CPP-48 as high.

Based upon the available sampling data, this site falls into the no further action area shown in Table 4.

TRACK 2 PRELIMINARY SCOPING PACKAGE

III. SUMMARY—Consequences of Error:

False Negative Error: If no further action is incorrectly taken at this site, the hazardous and radioactive substances that are present could present a higher than anticipated, unacceptable risk to human health through exposure to mercury, cesium-137, antimony-125, europium-155, and gross beta sources. Based upon the depth to contamination, however, the only potential pathway is ingestion of groundwater. GWSCREEN runs for each contaminant indicate that significantly higher levels of contamination would be required for these contaminants to pose an unacceptable risk at this site.

False Positive Error: Unwarranted remediation of this site would result in a low return in environmental benefit from a relatively large investment of time and money. Present sampling data appears to be sufficient for characterization of this site and any additional cleanup would result in a minimal reduction in risk.

IV. SUMMARY—Miscellaneous Information:

Prior to installation and use of the dump tank, the processing waste chemicals were disposed to a trench, approximately 10 ft x 5 ft x 1 ft in size, located at the site of the dump tank[3,9,13]. The trench soil, consisting of several cubic yards, was removed when the dump tank was installed. The removed soil was surface surveyed for radioactivity, none was detected. The soil was not tested for chemical contamination because it was believed chemical contamination would have neutralized in the soil matrix. The soil was used as fill for Bin Set 6 and/or Bin Set 7[9].

V. SUMMARY—Conceptual Site Models:

The Track 2 preliminary Conceptual Site Model (CSM) (Figure 1) shows the generator and artifacts associated with the CPP-48 dump tank. In the preliminary CSM, all pathways were considered during initial investigation. After it was determined that the contaminants above background were at depths greater than 10 ft bls, the CSM (Figure 2) was revised to indicate that the only viable exposure pathway was leaching of contaminants to the groundwater and subsequent ingestion of the groundwater by future residents.

VI. SUMMARY—Preliminary Scoping Recommendation:

The dump tank has not been used since 1981, was physically removed from the site in August, 1993, and the site backfilled with clean soil. As shown in Table 4 the Qualitative Risk assessment using the available characterization data determined a low risk for all contaminants. This is because the only complete exposure pathway for this site is through groundwater ingestion since the contaminants were detected at depths greater than 10 ft bls. Sampling data collected in 1991 and 1993[3,11,14] provide a reliable estimate of contamination present at the site. Given this information, no further action is recommended for the CPP-48 dump tank site.

OU: 3-13 Site: CPP-48, Dump Tank Date: September, 1994

Table 1. Process/waste worksheet.

Column 1 Processes associated with this site	Column 2 Waste descriptions and handling procedures	Column 3 Description and location of any artifacts/structures/disposal areas associated with this waste or process
Process The waste calcining process at CPP-633.	Nitric acid, aluminum nitrate, and calcium nitrate effluent from the waste calcining process at CPP-633 was discharged to the dump tank (CPP-48) and allowed to seep into the underlying soils without additional treatment. Low concentrations of chemical substances and radionuclides may have been disposed to the soils in the vicinity of the dump tank. Primary contaminants of concern for this site include mercury, cesium-137, antimony-125, europium-155, and gross beta.	Artifact: No artifact remains. The dump tank was physically removed in August 1993. Location: Approximately 30 ft south of the old Waste Calcining Facility Building (CPP-633). Description: The CPP-48 dump tank was cylindrical in shape having the dimensions of 5 ft in diameter and 12 ft tall. There was no bottom in the tank and effluent from CPP-633 was disposed to the dump tank via an above ground pipe and allowed to percolate into the ground untreated. The pipe was removed when CPP-48 was taken out of service in 1981. The dump tank was removed in August 1993.

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Table 2a. Summary of preliminary risk evaluation: forward calculation of risk.

Contaminants of concern	Volatile inhalation		Dust inhalation		Soil ingestion		External exposure	Groundwater ingestion	
	Hazard quotient	Cancer risk	Hazard quotient	Cancer risk	Hazard quotient	Cancer risk	Cancer risk	Hazard quotient	Cancer risk
Occupational scenario[1]	NA	NA	NA	NA	NA	NA	NA	NA	NA
Residential scenario[2]									
Mercury	NA	NA	NA	NA	NA	NA	NA	3.4E-05	NA
Cesium-137	NA	NA	NA	NA	NA	NA	NA	NA	1.2E-226
Antimony-125	NA	NA	NA	NA	NA	NA	NA	NA	7.8E-229
Europium-155	NA	NA	NA	NA	NA	NA	NA	NA	6.3E-231
Strontium-90*	NA	NA	NA	NA	NA	NA	NA	NA	1.8E-74

Notes:
* Strontium-90 properties were used to determine beta risk (Half the beta concentration from sample analysis and Sr-90 properties).

1. The contaminants are at depths greater than 10 ft bls, therefore occupational scenario pathways are incomplete.
2. The contaminants are at depths greater than 10 ft bls, therefore residential scenario pathways are incomplete except for leaching to groundwater.

NA - Not Applicable

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Table 2b. Summary of preliminary risk evaluation: backward calculation of risk-based soil concentrations.

Contaminants of concern	Volatile inhalation		Dust inhalation		Soil ingestion		External exposure	Groundwater ingestion	
	SC at HQ=1	SC at 1E-06 risk	SC at HQ=1	SC at 1E-06 risk	SC at HQ=1	SC at 1E-06 risk	SC at 1E-06 risk	SC at HQ=1	SC at 1E-06 risk
Occupational scenario[1]	NA	NA	NA	NA	NA	NA	NA	NA	NA
Residential scenario[2]									
Mercury	NA	NA	NA	NA	NA	NA	NA	2.1E+04	NA
Cesium-137	NA	NA	NA	NA	NA	NA	NA	NA	PURE
Antimony-125	NA	NA	NA	NA	NA	NA	NA	NA	PURE
Europium-155	NA	NA	NA	NA	NA	NA	NA	NA	PURE
Strontium-90*	NA	NA	NA	NA	NA	NA	NA	NA	PURE

Notes:
* Strontium-90 properties were used to determine beta risk (Half the beta concentration from sample analysis and Sr-90 properties).

1. The contaminants are at depths greater than 10 ft bls, therefore occupational scenario pathways are incomplete.
2. The contaminants are at depths greater than 10 ft bls, therefore residential scenario pathways are incomplete except for leaching to groundwater.

SC — soil concentration (mg/kg for nonradioactive; pCi/g for radioactive)
HQ — hazard quotient
PURE — contaminant limiting soil concentration greater than 10^6 mg/kg for hazardous substances or specific activity for nuclides
NA — not applicable

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Table 3. Contaminant worksheet.

Process (Column 1) Dump Tank

Column 4 Known or potential hazardous substances/constituents associated with this waste or process	Column 5 Potential sources associated with this hazardous material	Column 6 SOURCE TERM Known/estimated concentration of hazardous substances/constituents	Column 7 FORWARD CALCULATION Calculated risk	Column 8 BACKWARD CALCULATION Lowest risk-based concentration for:		Column 9 Qualitative risk assessment (high/medium/low)	Column 10 Overall reliability (high/medium/low)
				8a. All pathways	8b. Only viable pathways		
Mercury	Contaminated sediment/soil	0.95	3.4E-05[l,R,H]	2.1E+04[l,R,H]	2.1E+04[l,R,H]	Low	High
Cesium-137	Contaminated sediment/soil	65.0	1.2E-226[l,R,C]	PURE[l,R,C]	PURE[l,R,C]	Low	High
Antimony-125	Contaminated sediment/soil	5.30	7.8E-229[l,R,C]	PURE[l,R,C]	PURE[l,R,C]	Low	High
Europium-155	Contaminated sediment/soil	0.67	6.3-231[l,R,C]	PURE[l,R,C]	PURE[l,R,C]	Low	High
Strontium-90*	Contaminated sediment/soil	61.0(122.0/2)	1.8E-74[l,R,C]	PURE[l,R,C]	PURE[l,R,C]	Low	High

Notes:
Units are mg/kg for hazardous substances; pCi/g for radionuclides.
* Strontium-90 properties were used to determine beta risk (Half the beta concentration from sample analysis and Sr-90 properties).
PURE - contaminant limiting soil concentration greater than 10^6 mg/kg for hazardous substances or specific activity for nuclides

Release mechanisms:

v — volatilization → inhalation
s — suspension → inhalation
i — oral intake → ingestion
r — radiation → external exposure
l — leaching to groundwater → groundwater ingestion

Scenarios:

O — occupational
R — residential

Risk evaluation criteria:

C — cancer risk of 10^{-6}
H — hazard quotient of 1

Table 4. Qualitative risk and reliability evaluation table.

	QUALITATIVE RISK		
	Low	Medium	High
Highly unreliable	Screening data	TRACK 2	Screening data
Medium reliability	No Action Required		
		RI/FS	Interim Action[a]
Highly reliable			
RELIABILITY	LOW concentration resulting in risk < 10^{-6}	MEDIUM	HIGH concentration resulting in risk > 10^{-4}
	Qualitative risk		

a. If sufficient data exist to identify an appropriate remedy.

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Question 1. What are the waste generation processes, locations, and dates of operation associated with this site?

Block 1 **Answer:**
During the period between 1963 and 1981, the old Waste Calcining Facility (CPP-633) at the ICPP was operated to process radioactive liquid wastes for disposition[1,2,5,6]. The calcining process involves spraying liquid radioactive wastes into a hot air fluidized bed of heated granular solids. The liquid is then evaporated and the residual radioactive waste material solidified to form calcine. The calcine, which amounts to about 20 percent of the original liquid volume, contains nearly all of the inert and radioactive material that was present in the liquid waste[2]. This process produced a waste stream consisting of nitric acid and other chemicals consisting primarily of aluminum nitrate and calcium nitrate.

Prior to the installation of an excess chemical dump tank (CPP-48), in 1975, waste chemicals were disposed directly to the soil in a trench like depression located at the dump tank site[3,13]. The trench was approximately 10 ft x 5 ft x 1 ft in size. When the dump tank was installed, the surface soil making up the trench was surface tested for radioactivity, of which no radioactive source was discovered. The soil was not tested for chemical substance contamination because it was believed chemicals disposed of at this site would have neutralized. The removed soil, estimated to be several cubic yards, was used as fill material for the construction of Bin Set 6 and Bin Set 7[9]. From 1975 to 1981, chemicals from the calcining process were disposed directly to the CPP-48 dump tank. The above ground piping used to move calcining effluent from CPP-633 to CPP-48 was a flexible hose that, when not in use, was "rolled up" and stored in CPP-633[9]. In August 1993, the dump tank was dismantled, packaged, and removed to the WERF.

Block 2 **How reliable is/are the information source(s)?** ✓ **High** __**Medium** __**Low** (check one)
Explain the reasoning behind this evaluation.

There is little documentation available describing the specific disposal processes associated with this site. However, dates of operation of the dump tank are known and the sample data has verified the waste disposal operation. This site was characterized for closure under RCRA[3], which gives the information a relatively high reliability.

Block 3 **Has this information been confirmed?** ✓ **Yes** __ **No** (check one)
If so, describe the confirmation.

Yes, several documents all confirm the information provided above.

Block 4 **Sources of information**
[check appropriate box(es) and indicate source number from reference list]

No available information	[ ]		Analytical data	[ ]	
Anecdotal	[✓]	9	Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Quality assurance data	[ ]	
Photographs	[ ]		Safety analysis report	[ ]	
Engineering/site drawings	[ ]		D&D report	[ ]	
Unusual occurrence report	[ ]		Initial assessment	[✓]	5
Summary documents	[✓]	1,2,3,6,13	Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

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Question 2. What are the disposal processes, locations, and dates of operation associated with this site?

Block 1 **Answer:**

Potential contamination at this site originated from CPP-633, where calcination of HLLW was performed. From 1975 to 1981, the dump tank (located approximately 30 ft south of CPP-633) received waste effluent from CPP-633[3,6,7]. An above ground flexible tubing waste line from CPP-633 to the dump tank was used to discharge waste chemicals to the tank[9]. During calcining operations the waste chemicals, consisting of nitric acid, aluminum nitrate and calcium nitrate, were disposed of in the dump tank and were not treated in any way. They were allowed to percolate into the subsurface soil at the bottom of the tank.

Block 2 **How reliable is/are the information source(s)? __High ✓ Medium __Low** (check one)

Explain the reasoning behind this evaluation.

There is no documentation available describing the specific disposal processes or potential contaminants associated with this site, however, available information does confirm general disposal occurrences at this site.

Block 3 **Has this information been confirmed?** ✓ **Yes** __ **No** (check one)

If so, describe the confirmation.

Several sources corroborate the general disposal process, location, and dates of operation.

Block 4 **Sources of information**

[check appropriate box(es) and indicate source number from reference list]

No available information	[ ]		Analytical data	[ ]	
Anecdotal	[✓]	9	Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Quality assurance data	[ ]	
Photographs	[ ]		Safety analysis report	[ ]	
Engineering/site drawings	[✓]	7	D&D report	[ ]	
Unusual occurrence report	[ ]		Initial assessment	[ ]	
Summary documents	[✓]	3,6	Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER :	[ ]				

Question 3. Is there empirical, circumstantial, or other evidence that sources exist at this site? If so, list the sources and describe the evidence.

Block 1 **Answer:**

Yes. The Initial Assessment Form[5] indicates chemical effluent consisting primarily of aluminum nitrate and calcium nitrate from CPP-633 were disposed into this dump tank. There are no records of specific types or quantities of chemicals disposed at this site, however, interviews with site personnel indicate thousands of gallons of effluent were directed to the dump tank during its operation from 1975 to 1981[6].

In March 1991, a RCRA sampling program was conducted to characterize possible soil contaminants in the vicinity of the dump tank due to the disposal of nitric acid, aluminum nitrate, and calcium nitrate solutions to the underlying soils[3]. A borehole located as close to CPP-48 as possible (approximately 5 ft east) was drilled and continuously sampled to a depth of 46.5 ft (to basalt). Samples were collected and analyzed for RCRA metals, pH, nitrite, and nitrate. In the RCRA study, no metals were detected above background concentrations[12]. Nitrate concentrations of 3.84, 4.68, and 5.71 mg/kg were found at 10, 15, and 20 ft depths, respectively, which exceed the background Upper Tolerance Limit (UTL) of 1.42 mg/kg[3]. The pH of samples collected range between 6.8 and 8.1, indicating neutralization of the acid through the buffering capacity of the soils. Analysis indicated soil samples contained no detectable levels of the VOCs, semiVOCs, pesticides, dioxin/furan, or herbicides.

Eight soil samples were analyzed for radionuclide contamination. Cesium-137 was detected in one sample, collected at 15 ft bls, at a concentration of 3.3±0.1 pCi/g. Strontium-90 was detected in three samples at depths of 10 ft, 20 ft, and 45 ft bls at concentrations of 0.18±0.09 pCi/g, 0.12±0.09 pCi/g and 0.26±0.10 pCi/g, respectively. Uranium-234 and uranium-238 were detected in all samples collected, with the highest concentration for both radionuclides detected at the 45 ft bls depth, 0.30±0.03 pCi/g for U^{234} and 0.27±0.03 pCi/g for U^{238}. Background concentrations for U-234 and U-238 at the INEL are 0.94 to 1.69 pCi/g and 0.86 to 1.79 pCi/g, respectively. Of these results, only cesium-137 exceeded the background concentration of 1.1 pCi/g[12].

In July 1993, three boreholes were hand augured immediately adjacent to the dump tank to sample for field radioactivity measurements. Boreholes 1, 2, and 3 were augured to 9.0 ft, 10.0 ft, and 6.3 ft bls, respectively. Borehole 1 had the highest measured radioactivity of 4,000 cpm at 1.2 ft bls. This correlates to an activity of approximately 61 pCi/g, assuming the radioactive contaminant to be cesium-127 . Boreholes 2 and 3 had activity readings at background. When the dump tank was removed (sampling discussed on next page), soils adjacent to the dump tank were excavated to a depth of approximately 7 ft bls and the "loose" tank was removed from the cavity using a backhoe and cable. The cavity bottom was approximately 10 ft to 12 ft bls. The excavated soil was backfilled into the bottom of the dump tank cavity and the remaining cavity was infilled with clean soil. The point source of the high activity reading at Borehole 1 was excavated and then redistributed at the bottom of the dump tank cavity when it was backfilled with the excavated material after the tank was removed.

Question 3. (con't)

Based on this information, the activity detected from augured soil samples is not considered to be a risk. (The calculation for converting cpm from a probe to an equivalent pCi/g of Cs-137 is:
61 pCi/g = 4,000 cpm/probe x 1dpm/0.1cpm x 1 pCi/2.2 dpm x probe/200 cm^3 x 1 cm^3/1.5 g.)

In August 1993, the dump tank was removed and four soil samples were taken at the bottom of the dump tank (10 ft bls) and at 12 ft bls, to determine possible soils contamination in the underlying soil. At 12 ft bls, a material having a distinct beige color and texture was encountered, and specific samples of this material were collected and analyzed. Analysis of these samples indicated no difference regarding contaminant type and concentration than with those results of the other samples. Samples were analyzed for kerosene, VOCs, semiVOCs, RCRA metals, and radionuclides. Kerosene, VOC, and semiVOC constituents were not detected. Metals detected in the samples included arsenic, barium, chromium, and mercury. Only the mercury sample concentrations were in excess of background concentration with the highest concentration being 0.95 mg/kg at 10 ft bls. Analysis for radionuclide contamination showed a cesium-137 concentration highest at 12 ft bls with 65±1 pCi/g, an antimony-125 concentration of 5.3±0.2 pCi/g at 10 ft, and the highest europium-155 concentration of 0.67±0.10 pCi/g at 12 ft[11].

Block 2 **How reliable is/are the information source(s)?** ✓ **High** __**Medium** __**Low** (check one)
Explain the reasoning behind this evaluation.

The data evaluation and laboratory performance review for RCRA metals, VOCs and semiVOCs, and radionuclide sample analysis was comprehensive and deemed reliable.

Block 3 **Has this information been confirmed?** ✓ **Yes** __ **No** (check one)
If so, describe the confirmation.

Several sources corroborate the general disposal process, location, and dates of operation.

Block 4 **Sources of information**
[check appropriate box(es) and indicate source number from reference list]

No available information	[ ]	____	Analytical data	[ ]	____
Anecdotal	[ ]	____	Documentation about data	[ ]	____
Historical process data	[ ]	____	Disposal data	[ ]	____
Current process data	[ ]	____	Quality assurance data	[✓]	11
Photographs	[ ]	____	Safety analysis report	[ ]	____
Engineering/site drawings	[ ]	____	D&D report	[ ]	____
Unusual occurrence report	[ ]	____	Initial assessment	[✓]	5
Summary documents	[✓]	3,6	Well data	[ ]	____
Facility SOPs	[ ]	____	Construction data	[ ]	____
OTHER	[ ]	____			

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Question 4. Does site operating or disposal historical information allow estimation of the pattern of potential contamination? Discuss the estimated patterns of potential contamination over time.

Block 1 **Answer:**

Yes. It is anticipated the sediment and soils in the vicinity of the dump tank bottom are contaminated. Fluids deposited into the dump tank would not only migrate vertically downward from the dump tank bottom, but also would tend to migrate laterally outward from the boundary of the dump tank. However, metals and radionuclides have limited migration potential through the surface soils at INEL and therefore, any contamination due to migration should be limited. For the purposes of this evaluation, the area of potential contaminated soil at the dump tank bottom was estimated to be the 5 ft diameter of the dump tank plus an additional 5 ft from the external diameter of the tank (15 ft total diameter). The additional 5 ft from the external diameter of the tank is supported by the fact that contamination was observed in the adjacent 46.5 ft borehole drilled in 1991. It is reasonable to assume the contamination observed in the borehole is there because of CPP-48. It would not be logical to assume any additional area potentially contaminated by use of CPP-48 because there is no available data to support use of a larger area to estimate the amount of soil contamination. During the time period the dump tank was operated, thousands of gallons of calcining process effluent were disposed, and this information will be used to determine the extent of contamination into the soil matrix (see Question 5).

Block 2 **How reliable is/are the information source(s)? __High __Medium ✓ Low** (check one)

Explain the reasoning behind this evaluation.

Site personnel suggest perhaps several thousand gallons of effluent were disposed to this site. There is no evidence of specific volumes of effluent disposed.

Block 3 **Has this information been confirmed?** __ **Yes** ✓ **No** (check one)

If so, describe the confirmation.

Block 4 **Sources of information**

[check appropriate box(es) and indicate source number from reference list]

No available information	[✓]	____	Analytical data	[ ]	____
Anecdotal	[ ]	____	Documentation about data	[ ]	____
Historical process data	[ ]	____	Disposal data	[ ]	____
Current process data	[ ]	____	Quality assurance data	[ ]	____
Photographs	[ ]	____	Safety analysis report	[ ]	____
Engineering/site drawings	[ ]	____	D&D report	[ ]	____
Unusual occurrence report	[ ]	____	Initial assessment	[ ]	____
Summary documents	[ ]	____	Well data	[ ]	____
Facility SOPs	[ ]	____	Construction data	[ ]	____
OTHER	[ ]	____			

Question 5. Estimate the length, width, and depth of the contaminated region as it is today. What is the known or estimated volume of each source as it is today? Discuss historical dimensions and volumes, and changes over time. If dimensions and volumes are estimates, explain carefully how the estimates were derived.

Block 1 **Answer:**

Sampling results from the borehole adjacent to the dump tank indicated the presence of soil contamination, and it is reasonable to assume contamination found at depth at the borehole site was because of the infiltration of disposed fluid from the dump tank. To estimate the amount of contaminated soil, the radius of the dump tank (2.5 ft) plus the distance to the borehole (5 ft) adjacent to the dump tank was used to determine the areal contamination extent (See Question 4 for supporting rationale.). Contamination may be present past a radius of 7.5 ft, but there is no supporting data available. In the unsaturated zone soil porosity is estimated at 30% and for conservativeness, a residual fluid saturation of 10% was used for estimating the contaminated soil volume. The amount of calcining process effluent disposed into the dump tank was assumed to be 2,000 gallons. The contaminated soil volume was estimated using the equation:

$$\text{Volume}_{soil} = \text{Volume}_{liquid}/(\text{Residual Saturation})(\text{Porosity})$$

$$\text{Volume}_{soil} = (2{,}000\text{gal})/(202.2\text{gal/yd}^3)/((0.1)*(0.3)) = 329.7\text{yd}^3\ (252.3\ \text{m}^3)$$

Additionally, the volume of a cylinder is expressed by:

$$\text{Volume}_{cylinder} = \pi R^2 H$$

where R is the radius of the cylinder, and H is the height of the cylinder. Rearranging this equation and solving for H will result with an estimate of the depth of contamination, given the radius and the volume of contaminated soil calculated with the previous equation.

$$H = \text{Volume}_{cylinder}/\pi R^2 = (329.7\text{yd}^3*27\text{ft}^3/\text{yd}^3)/((\pi)*(7.5\text{ft})^2) = 50.4\text{ft}\ (15.4\ \text{m})$$

Block 2 **How reliable is/are the information source(s)? __High ✓Medium __Low** (check one)

Explain the reasoning behind this evaluation.

This estimate of volume is based on limited data and assumptions, but is considered reasonable based on results of sampling and the approximated amount of effluent disposed to the dump tank.

Block 3 **Has this information been confirmed?** __ **Yes** ✓ **No** (check one)

If so, describe the confirmation.

Block 4 Sources of information
[check appropriate box(es) and indicate source number from reference list]

No available information	[✓]	_____	Analytical data	[ ]	_____
Anecdotal	[ ]	_____	Documentation about data	[ ]	_____
Historical process data	[ ]	_____	Disposal data	[ ]	_____
Current process data	[ ]	_____	Quality assurance data	[ ]	_____
Photographs	[ ]	_____	Safety analysis report	[ ]	_____
Engineering/site drawings	[ ]	_____	D&D report	[ ]	_____
Unusual occurrence report	[ ]	_____	Initial assessment	[ ]	_____
Summary documents	[ ]	_____	Well data	[ ]	_____
Facility SOPs	[ ]	_____	Construction data	[ ]	_____
OTHER	[ ]	_____			

Question 6. What is the known or estimated concentration or quantity of *each* hazardous substance/constituent at *each* source? If quantities are estimates, explain carefully how each estimate was derived.

Block 1 **Answer:**

The estimates for contaminant quantities assume the contaminated soil volume determined in Question 5 (252.3 m^3), and are performed for those contaminants detected above background concentrations for the ICPP. Concentrations used are the maximum detected during the 1993 sampling event when the dump tank was removed[3,11]. The density of soil is assumed to be 1.5 g/cm^3. Strontium-90 and daughters are primarily beta emitters. Since strontium-90's presence is common at CPP, it's properties will be used with one half the concentration amount to determine the gross beta contaminant quantity.

Quantity of contaminant = Concentration x density x volume x conversion factor(s)

For Mercury: Q = (0.95 mg/kg)(1.5 g/cm^3)(252.3 m^3)(1E-06 kg/mg)(1E+06 cm^3/m^3) = 738 g
For Cesium-137: Q = (65 pCi/g)(1.5 g/cm^3)(252.3 m^3)(1E+06 cm^3/m^3) = 2.5E+10 pCi
For Antimony-125: Q = (5.3 pCi/g)(1.5 g/cm^3)(252.3 m^3)(1E+06 cm^3/m^3) = 2.0E+09 pCi
For Europium-155: Q = (0.67 pCi/g)(1.5 g/cm^3)(252.3 m^3)(1E+06 cm^3/m^3) = 2.5E+08 pCi
For Strontium-90: Q = (122 pCi/g)(1.5 g/cm^3)(252.3 m^3)(1E+06 cm^3/m^3)/2 = 2.3E+10 pCi (for gross beta)

Block 2 **How reliable is/are the information source(s)? __High ✓Medium __Low** (check one)
Explain the reasoning behind this evaluation.

These quantities are calculated using the volume of soil contamination determined in Question 5 and the maximum concentrations detected in the soil. By using the maximum concentration, a conservative estimate of the quantity should be provided.

Block 3 **Has this information been confirmed?** __ **Yes** ✓ **No** (check one)
If so, describe the confirmation.

Block 4 **Sources of information**
[check appropriate box(es) and indicate source number from reference list]

No available information	[ ]	____	Analytical data	[ ]	____
Anecdotal	[ ]	____	Documentation about data	[ ]	____
Historical process data	[ ]	____	Disposal data	[ ]	____
Current process data	[ ]	____	Quality assurance data	[✓]	11
Photographs	[ ]	____	Safety analysis report	[ ]	____
Engineering/site drawings	[ ]	____	D&D report	[ ]	____
Unusual occurrence report	[ ]	____	Initial assessment	[ ]	____
Summary documents	[✓]	3	Well data	[ ]	____
Facility SOPs	[ ]	____	Construction data	[ ]	____
OTHER	[ ]	____			

Question 7. Is there empirical, circumstantial, or other evidence of a release and/or contamination in a pathway? Discuss the evidence. Address each potential pathway.

Block 1 **Answer:**

Yes, there is empirical evidence that migration has occurred in the soil underneath and in the vicinity of the dump tank. Contamination migration away from the dump tank could occur by the following pathway[3]:

Ingestion Pathway (groundwater). Contamination at this site could migrate to the water table as a result of the infiltration of precipitation. However, migration of contaminants at this site would be very remote because RCRA metals and radionuclides tend to adhere to the soil matrix and are not considered very mobile. Nitrates are not included in the risk assessments to groundwater because there is no available provisional reference concentration (RfC) or provisional reference dose (RfD) toxicity information to estimate risk.

Pathways considered incomplete are:

Inhalation Pathway. At a site with surface contamination, wind could mobilize dust and particulates, potentially spreading contamination. Soil contamination above background concentration levels at this site were found between 10 ft and 15 ft bls[3,11,14]. Therefore, this pathway is not considered because residential receptor risk analysis does not require contaminants below a depth of 10 ft to be analyzed for risk. When the dump tank was removed in 1993 the bottom of the excavation was infilled with excavated site soil and then covered with clean fill making contaminants at this site inaccessible as an inhalation pathway.

Ingestion Pathway (soil). With surface contamination, wind could mobilize dust and particulates, potentially spreading contamination. Soil contamination above background concentration levels at this site were found between 10 ft and 15 ft bls[3,11,14]. Therefore, this pathway is not considered because residential receptor risk analysis does not require contaminants below a depth of 10 ft to be analyzed for risk. When the dump tank was removed in 1993 the excavation was infilled with excavated site soil and then covered with clean fill making contaminants at this site inaccessible as an inhalation pathway.

Direct Exposure Pathway. There is evidence of radionuclide contamination at this site. Soil samples between 0 and 10 ft in one borehole had radiation a reading from hand operated monitoring equipment of 4,000 cpm at 1.2 ft bls, which is equivalent to an activity of approximately 61 pCi/g. The soil adjacent to the dump tank was excavated for dump tank removal and then redistributed, at 10 ft to 12 ft bls, as backfill in the cavity created in the ground when the dump tank was removed. Because of the redistribution of soil between 0 ft and 10 ft bls, this pathway is considered incomplete. For contaminated soil samples collected between 10 and 15 ft bls[3,11,14], this pathway is considered incomplete because residential receptor risk analysis does not require contaminants below a depth of 10 ft bls to be analyzed for risk.

Inhalation Pathway (volatilization). Volatilization of VOCs was not considered at this site because there was no evidence of VOCs, semiVOCs, or kerosene above background limits.

Block 2 **How reliable is/are the information source(s)?** ✓ High __Medium __Low (check one)

Explain the reasoning behind this evaluation.

There is evidence of limited migration of contaminants beneath the dump tank bottom at this site.

Block 3 **Has this information been confirmed?** ✓ Yes __ No (check one)

If so, describe the confirmation.

Characterization work in 1991 and in 1993, during the dump tank removal, indicated the presence of mercury, cesium-137, antimony-125, europium-155, and gross beta above background levels.

Block 4 **Sources of information**

[check appropriate box(es) and indicate source number from reference list]

No available information	[ ]	____	Analytical data	[ ]	____
Anecdotal	[ ]	____	Documentation about data	[ ]	____
Historical process data	[ ]	____	Disposal data	[ ]	____
Current process data	[ ]	____	Quality assurance data	[✓]	11
Photographs	[ ]	____	Safety analysis report	[ ]	____
Engineering/site drawings	[ ]	____	D&D report	[ ]	____
Unusual occurrence report	[ ]	____	Initial assessment	[ ]	____
Summary documents	[✓]	3,13	Well data	[ ]	____
Facility SOPs	[ ]	____	Construction data	[ ]	____
OTHER	[ ]	____			

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Question 8. Is there evidence that hazardous substances or constituents are present at any of the potential sources today? If so, describe the evidence. For each pathway, discuss fate and transport.

Block 1 **Answer:**

Yes. Sampling indicates that low levels of metals including arsenic, barium, chromium, and mercury are present in the site soil. Only mercury was found to be above background concentrations. Also present above background concentrations are low levels of cesium-137, antimony-125, europium-155, and gross beta counts. Finally, nitrate is present at this site above background but there is no provisional reference concentration or dose information available to calculate risk. Ingestion, inhalation, and external exposure pathways are incomplete because the contaminants above background concentrations are occurring below 10 ft bls. The groundwater pathway is considered complete, however, risk analysis indicates this pathway does not present a risk to human health or the environment for this site.

Block 2 **How reliable is/are the information source(s)? __High ✓Medium __Low** (check one)
Explain the reasoning behind this evaluation.

Sampling data has determined the contaminants and their concentrations. Circumstances and data suggest, even though there is some contamination of this site, risk to human health or the environment is low.

Block 3 **Has this information been confirmed?** __ **Yes** ✓ **No** (check one)
If so, describe the confirmation.

Block 4 **Sources of information**
[check appropriate box(es) and indicate source number from reference list]

No available information	[ ]		Analytical data	[ ]	
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Quality assurance data	[✓]	11
Photographs	[ ]		Safety analysis report	[ ]	
Engineering/site drawings	[ ]		D&D report	[ ]	
Unusual occurrence report	[ ]		Initial assessment	[ ]	
Summary documents	[✓]	3	Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

Figure 1. Track 2 preliminary conceptual site model.

OU: 3-13 Site: CPP-48, Dump Tank Date: September, 1994

Table 5. Pathway and release mechanism assessment.

Receptor: Current occupational, future residential

Source discussion/justification	Source medium	Release mechanism → exposure route	Scenario/pathway discussion	Data needs (Y/N)
Air: Volatilization There is no evidence that volatile contaminants are a concern at this site.	Air: No Source	None	Pathway is incomplete.	No
Air: Suspension Possible contaminants at this site were disposed into the dump tank and introduced to the soil at 10 ft bls, the bottom of the tank.	Air	Suspension → inhalation	Pathway is incomplete. The residential intrusive scenario requires contamination found more than 10 ft bls be considered an incomplete pathway.	No
Soil: Oral intake Possible contaminants at this site were disposed into the dump tank and introduced to the soil at 10 ft bls.	Soil	Direct contact → ingestion	Pathway is incomplete. The residential intrusive scenario requires contamination found more than 10 ft bls be considered an incomplete pathway.	No
Soil: Radiation Possible contaminants at this site were disposed into the dump tank and introduced to the soil at 10 ft bls.	Soil	Nuclear decay → external exposure	Pathway is incomplete. The residential intrusive scenario requires contamination found more than 10 ft bls be considered an incomplete pathway.	No
Soil: Leaching to groundwater Contamination at this site could migrate to the water table as a result of precipitation and infiltration.	Groundwater	Leaching to groundwater → groundwater ingestion	Pathway is complete.	No

Summary of Table 5:

Samples collected and analyzed in 1991 (0 ft to 45.6 ft bls) and 1993 (10 ft to 12 ft bls) indicated contamination of soils above background at CPP-48 to be between 10 ft and 15 ft bls. Surface radioactivity sampling in 1993 indicated radioactivity contamination above background between 0 ft and 10 ft bls, however, when the dump tank was removed the site was filled in with excavated material and redistributed to the bottom of the dump tank cavity at 10 ft to 12 ft bls.. Occupational and nonintrusive residential pathways are not considered complete since there is no evidence to substantiate contamination between 0 and 4 ft at this site. There was no evidence of VOCs or semi VOCs at this site so the air volatilization pathway is incomplete. The groundwater pathway is considered to be complete because of possible water infiltration sufficient to migrate contaminants to the aquifer.

Notes:

None.

OU: 3-13 Site: CPP-48, Dump Tank Date: September, 1994

Table 6. Screening and risk evaluation of COCs.

Release mechanism → exposure route: Leaching to groundwater → groundwater ingestion

Contaminants of concern	Screening criteria	Source term	Forward risk calculations				Additional interpretation and justification/overall uncertainty	Data adequate to assess risk?
			Occupational		Residential			
			Hazard quotient	Cancer risk	Hazard quotient	Cancer risk		
Mercury	0.07	0.95			3.4E-05		There is no unacceptable risk, further evaluation of the pathway/receptor is not warranted	Yes
Cesium-137	1.1	65				1.2E-226	"	Yes
Antimony-125		5.3				7.8E-229	"	Yes
Europium-155		0.67				6.3E-231	"	Yes
Strontium-90*	33.0	122(61)				1.8E-74	"	Yes

Contaminants of concern	Screening criteria	Source term	Backward calculated risk-based concentrations				Additional interpretation and justification/overall uncertainty	Data adequate to assess risk?
			Occupational		Residential			
			SC at HQ=1	SC at 1E-06	SC at HQ=1	SC at 1E-06		
Mercury	0.07	0.95			2.1E+04		There is no unacceptable risk, further evaluation of the pathway/receptor is not warranted	Yes
Cesium-137	1.1	65				PURE	"	Yes
Antimony-125		5.3				PURE	"	Yes
Europium-155		0.67				PURE	"	Yes
Strontium-90*	33.0	122(61)				PURE	"	Yes

Summary of Table 6d:

There is no unacceptable risk for this pathway.

Notes: Units are pCi/g for radionuclides, mg/kg otherwise.
HQ — hazard quotient
SC — soil concentration
PURE — contaminant limiting soil concentration greater than 10^6 mg/kg for hazardous substances or specific activity for nuclides
* Strontium-90 was used to determine beta risk (Half the beta concentration from sample analysis and Sr-90 properties).

OU: 3-13 Site: CPP-48, Dump Tank Date: September, 1994

Table 7. Risk assessment summary for forward calculations.

Contaminants of concern	Source soil concentration	Volatile inhalation		Dust inhalation		Soil ingestion		External exposure	Groundwater ingestion	
Occupational scenario										
Mercury	0.95	NA	NA	NA	NA	NA	NA	NA		
Cesium-137	65	NA	NA	NA	NA	NA	NA	NA		
Antimony-125	5.3	NA	NA	NA	NA	NA	NA	NA		
Europium-155	0.67	NA	NA	NA	NA	NA	NA	NA		
Strontium-90	122(61)	NA	NA	NA	NA	NA	NA	NA		
Residential scenario										
Mercury	0.95	NA	NA	NA	NA	NA	NA	NA	3.4E-05	NA
Cesium-137	65	NA	NA	NA	NA	NA	NA	NA	NA	1.2E-226
Antimony-125	5.3	NA	NA	NA	NA	NA	NA	NA	NA	7.8E-229
Europium-155	0.67	NA	NA	NA	NA	NA	NA	NA	NA	6.3E-231
Strontium-90	122(61)	NA	NA	NA	NA	NA	NA	NA	NA	1.8E-74

Summary of Table 7:

The only viable pathway is groundwater ingestion because all contaminants were detected at depths greater than 10 ft bls.
No contaminants present an unacceptable risk.

Notes:

HQ — hazard quotient
SC — soil concentration (mg/kg for nonradioactive; pCi/g for radioactive)
NA — not applicable

OU: 3-13 Site: CPP-48, Dump Tank Date: September, 1994

Table 8. Risk-based soil concentration summary for backward calculations.

Contaminants of concern	Source soil concentration	Volatile inhalation		Dust inhalation		Soil ingestion		External exposure	Groundwater ingestion	
		SC at HQ=1	SC at 1E-06 risk	SC at HQ=1	SC at 1E-06 risk	SC at HQ=1	SC at 1E-06 risk	SC at 1E-06 risk	SC at HQ=1	SC at 1E-06 risk
Mercury	0.95	NA	NA	NA	NA	NA	NA	NA		
Cesium-137	65	NA	NA	NA	NA	NA	NA	NA		
Antimony-125	5.3	NA	NA	NA	NA	NA	NA	NA		
Europium-155	0.67	NA	NA	NA	NA	NA	NA	NA		
Strontium-90	122(61)	NA	NA	NA	NA	NA	NA	NA		
Mercury	0.95	NA	NA	NA	NA	NA	NA	NA	2.1E+04	NA
Cesium-137	65	NA	NA	NA	NA	NA	NA	NA	NA	PURE
Antimony-125	5.3	NA	NA	NA	NA	NA	NA	NA	NA	PURE
Europium-155	0.67	NA	NA	NA	NA	NA	NA	NA	NA	PURE
Strontium-90	122(61)	NA	NA	NA	NA	NA	NA	NA	NA	PURE

Summary of Table 8:

No contaminants present a health risk at this site.

Notes:

HQ — hazard quotient
SC — soil concentration (mg/kg for nonradioactive; pCi/g for radioactive)
NA — not applicable
PURE — contaminant limiting soil concentration greater than 10^6 mg/kg for hazardous substances or specific activity for nuclides

OU: 3-13 Site: CPP-48, Dump Tank Date: September, 1994

Table 9. Data gaps and sampling needs assessment (sensitivity evaluation of non-COC parameters).

Receptor:_____ Release mechanism → Exposure route: _____

Parameter	Parameter use	Sensitivity (including change in o/p per unit change in i/p)	Known accuracy	Select parameter	Required level of accuracy	Sampling method	Analytical method	Capability of method (including incremental increase in capability per sample)	Sufficient accuracy?	Time per sample	Cost per sample	Select method?

Justification of sampling method selection:

Summary of Table 9:

No data gaps need to be closed and no additional sampling is required. Table 9 is intentially left blank.

Notes:

o/p — incremental change in the output
i/p — incremental change in parameter.

Figure 2. Track 2 revised conceptual site model.

REFERENCES

1. Technical Work Plan for FY 1993 Removal and Characterization Activities, WINCO, 7/14/93.

2. Impact of Rain, Flood, and River Water on Potential Near-Surface Disposal of High-Level Radioactive Waste at the Idaho Chemical Processing Plant, WINCO, 9/86.

3. Report for the Idaho Chemical Processing Plant at Land Disposal Unit CPP-48, WINCO, 8/7/91, Ref: C86-131159, Task 6, Mod 9.

4. Operable Unit 3-08A, Draft Final Scope of Work for the WAG 3 Idaho Chemical Processing Plant, North Area, RI/FS, U.S. Department of Energy, 2/16/94, Revision 0.

5. Initial Assessment Form for French Drain South of CPP-633, 10/15/86.

6. Documentation Record for Hazard Ranking System for CPP-48, 10/20/86.

7. Schematic of CPP-48 Site.

8. Photograph of French Drain (Dump Tank) South of CPP-633.

9. Personal communication, Dennis Raunig, (WINCO).

10. Work log excerpts from FY 1993 Removal and Characterization Activities, WINCO, 8/18/93.

11. Limitation and Validation Report, Idaho Chemical Processing Plant, Summary Documentation for:
    a. Radiochemical Analyses, Sample Delivery Group #34800101AB - RPW-108-93
    b. Radiochemical Analyses, Sample Delivery Group #34800101AB - RPW-97-93 (water samples)
    c. Kerosene Data, Sample Delivery Group #34800101KE - JAC-108-93
    d. Metal Data, Sample Delivery Group #34800101RE - JAC-118-93
    e. Miscellaneous Inorganic Parameters and Metal Data, Sample Delivery Group #34800101AN and #34800101RE
    f. TCLP Volatile Data, Sample Delivery Group #34800401RE - JAC-106-93
    g. TCLP Semivolatile Data, Sample Delivery Group #34800401AN - JAC-107-93
    h. TCLP Metal Data, Sample Delivery Group #34800401RE - JAC-105-93.

12. Background Concentrations of Selected Metals and Radionuclides in the Big Lost River Alluvium at the Idaho Chemical Processing Plant, WINCO, 2/28/94.

13. Installation Assessment Report, Idaho Chemical Processing Plant, 5/86.

14. Correspondence W.M. Moe to W.M. Rainey, Field Radiation Screening of ECA CPP-48, 7/27/93.

DECISION DOCUMENTATION PACKAGE
COVER SHEET

PREPARED IN ACCORDANCE WITH

TRACK 1 SITES:
GUIDANCE FOR ASSESSING
LOW PROBABILITY HAZARD SITES
AT THE INEL

SITE DESCRIPTION: CPP-602 WASTE TRENCH PUMP SUMP (LC-207)

SITE ID: CPP-86 **OPERABLE UNIT:** 3-13

WASTE AREA GROUP: 3

I. SUMMARY — PHYSICAL DESCRIPTION OF THE SITE:

The CPP-602 building was originally constructed in 1953, with it's primary function being a laboratory and office building providing plant analytical support (radiochemistry development and research). Also housed in CPP-602 are a liquid product denitrator, and a product vault. Beneath the basement level of CPP-602 a waste trench runs the length of the North/South axis of the building. At the south end of the trench is a sump (LC-207) where waste material is collected for the Process Equipment Waste (PEW) evaporator system. Site CPP-86 is the Waste Trench Sump. The PEW system reduces the volume of material sent to the ICPP Tank Farm. The evaporator system vaporizes the process liquids, producing concentrated wastes (bottoms) and condensed vapor overheads (condensates). The bottoms are transferred to the Tank Farm Facility, while the process condensates are transferred to the Liquid Effluent Treatment and Disposal Facility for further processing. As part of the process, the PEW evaporator system tanks vent to the ICPP Vessel Off-Gas (VOG) System. The VOG system provides vacuum and filtration to processing vessels in nearby connected processing facilities. The VOG system flows to the Process Atmospheric Protection System (APS), located in CPP-649. From the APS, the off-gas is exhausted to the ICPP Main Stack, CPP-708.

In 1990, modifications were made to the PEW system in CPP-602, which included a new concrete floor and stainless steel sump liner. During sump modification, mercury was found in a sample of sludge/dirt from the base of the sump, below the concrete floor. Because of the discovery of mercury in the soil, non-protocol samples were taken to determine the extent of possible contamination. Sample analysis indicated barium, cadmium, chromium, and mercury were present in concentrations above detection limits. To insure the samples were free of concrete debris from broken up sump floor, samples at the CPP-86 site were taken six inches below the base of the concrete sump floor.

DECISION RECOMMENDATION

II. SUMMARY – QUALITATIVE ASSESSMENT OF RISK:

The level of reliability of the information collected for CPP-86 is medium, and the assessment of risk is low. Medium reliability was assigned because no radioactive sampling and analysis was performed, however since hazardous material concentrations were low, the assumption is made that radionuclide concentrations would also be low. The data collected for the hazardous material contaminants of concern at this site were either below detection limits, or were found in concentrations well below risk based concentration limits. Plotting these appraisals on the Qualitative Risk and Reliability Evaluation Table yields an intersection in the "no action required" portion of the chart.

III. SUMMARY – CONSEQUENCES OF ERROR:

False negative error: If no further action is taken at this site, a receptor might be exposed to contaminants which could be present. The probability of a receptor being exposed to higher concentrations of contaminants identified at this site than that determined in the risk assessments is low.

False positive error: Unwarranted remediation of this site would result in a low return in environmental benefit from a relatively large investment of time and money.

IV. SUMMARY – OTHER DECISION DRIVERS:

Remediation at CPP-86 would be difficult as it is currently in use and underlies the CPP-602 building. Additionally, contaminants under existing facilities are shielded from human contact and from precipitation.

DECISION RECOMMENDATION

RECOMMENDED ACTION:

This document recommends that no action be taken to remediate this site. Analytical results from the grab samples collected at this site during modification to the PEW collection system confirm that the site presents no hazard above acceptable levels of risk. Since the base of this sump is more than ten feet beneath land surface (bls), this Track 1 evaluation only addresses the groundwater pathway for these contaminants. Further action at this site would require expenditure of funds that could be dedicated to remediation elsewhere, and most significantly, would require extensive modifications to existing operating systems crucial to the ICPP mission.

SIGNATURES	# PAGES:	DATE:
Prepared By:	DOE WAG Manager:	
Approved By:	Independent Review:	

DECISION STATEMENT
(BY DOE RPM)

DATE RECD:

DISPOSITION

DATE:	# PAGES (DECISION STATEMENT):
NAME:	SIGNATURE:

DECISION STATEMENT
(BY EPA RPM)

DATE RECD:

DISPOSITION

DATE:	# PAGES (DECISION STATEMENT):
NAME:	SIGNATURE:

DECISION STATEMENT
(BY STATE RPM)

DATE RECD:

DISPOSITION

DATE:	# PAGES (DECISION STATEMENT):
NAME:	SIGNATURE:

PROCESS/WASTE WORKSHEET

SITE ID: CPP-86

Col 1 Processes Associated with this Site	Col 2 Waste Description & Handling Procedures	Col 3 Description & Location of any Artifacts/Structures/Disposal Areas Associated with this Waste or Process
PEW Evaporator System	Small amounts of barium, cadmium, chromium, and mercury were found in the soil beneath the concrete floor of the LC-207 sump. The sump is part of the PEW evaporator collection system.	Artifact: Soil Location: LC-207 Sump in CPP-602 basement area Description: The LC-207 Sump is part of the PEW evaporator collection system. Contamination was discovered in underlying soil during system modifications being done in 1990.
		Artifact: Location: Description:
		Artifact: Location: Description:
		Artifact: Location: Description:

CONTAMINANT WORKSHEET

SITE ID CPP-86

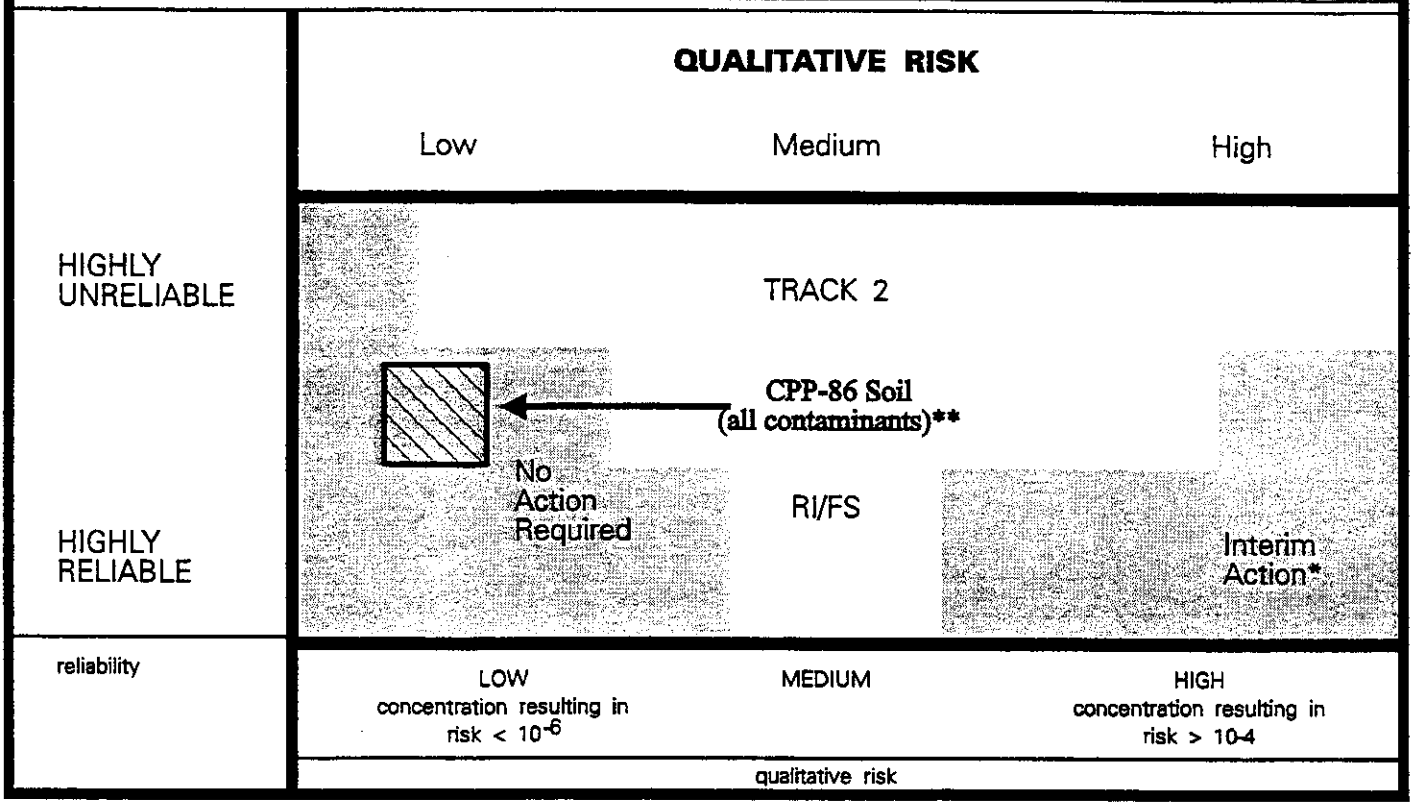
PROCESS (Col 1) CPP-602 Waste Trench Pump Sump (LC-207) **WASTE** (Col 2) Contaminated soil

Col 4 What Known/Potential Hazardous Substance/ Constituents are Associated with this Waste or Process?	Col 5 Potential Sources Associated with this Hazardous Material	Col 6 Known/Estimated Concentration of Hazardous Substances/ Constituents[a]	Col 7 Risk-based Concentration (mg/kg)	Col 8 Qualitative Risk Assessment (hi/med/low)	Col 9 Overall Reliability (hi/med/low)
Arsenic	Contaminated soil	ND, DL=0.065 mg/L	Not determined	Low	Medium
Barium	Contaminated soil	0.76 mg/L	5.684E+06[b]	Low	Medium
Cadmium	Contaminated soil	0.46 mg/L	8.722E+03[b]	Low	Medium
Chromium	Contaminated soil	0.0253 mg/L	1.508E+08[b] PURE	Low	Medium
Lead	Contaminated soil	ND, DL=0.080 mg/L	Not determined	Low	Medium
Mercury	Contaminated soil	0.054 mg/L	4.771E+04[b]	Low	Medium
Selenium	Contaminated soil	ND, DL=0.115 mg/L	Not determined	Low	Medium
Silver	Contaminated soil	ND, DL=0.007 mg/L	Not determined	Low	Medium
TCLP	104.48g/2089.6g leachate[1]				

a. ND = not detected 1. Sample 07036, 2089.6/104.48=20L/kg. Used to estimate mg/kg concentration for groundwater risk scenario. See Attachment 1.
DL = detection limit.

b. See Attachment 2 for groundwater risk assessments

QUALITATIVE RISK AND RELIABILITY EVALUATION TABLE



* If sufficient data exist to identify an appropriate remedy.
**Medium reliability because of no radiological analysis.

Question 1. What are the waste generation process locations and dates of operation associated with this site?

Block 1 Answer:

Waste generation in the area of CPP-86, the Waste Trench Sump in CPP-602, would be from the process facilities and/or laboratory and research work performed. Process waste generated in CPP-602 is collected using the waste trench, which drains into CPP-86, a part of the PEW system. The waste trench houses piping that drains into the PEW. The PEW system reduces the volume of wastes sent to the ICPP Tank Farm Facility. The system vaporizes the wastes, producing concentrated wastes (bottoms) and condensed vapor overheads (condensates). The bottoms are transferred to the Tank Farm Facility, while the process condensates are transferred to the Liquid Effluent Treatment and Disposal (LET&D) Facility for further processing. CPP-602 has been in operation since 1953.

Block 2 How reliable are the information sources? _x_ High ___ Med ___ Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

Soil sample collection documentation and sample analysis results for CPP-86 gathered in 1990 during modifications for the PEW evaporator system substantiate reliability.

Block 3 Has this INFORMATION been confirmed? _x_ Yes ___ No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

The documentation mentioned above are confirmation.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available	[ ]		Analytical data	[x]	2
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site	[ ]		D&D report	[ ]	
Unusual Occurrence	[ ]		Initial assessment	[ ]	
Summary documents	[x]	4	Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[x]	1			

Question 2. What are the disposal process locations and dates of operation associated with this site?

Block 1 Answer:

Waste disposal in the Waste Trench Sump, located in the basement of building CPP-602, would be from the PEW evaporator collection system. The PEW system reduces the volume of wastes sent to the ICPP Tank Farm Facility, and waste could be introduced to the soil beneath the sump through deteriorated concrete flooring in the sump. The systems housed in CPP-602 have been in operation since 1953.

Block 2 How reliable are the information sources? _x_ High ___ Med ___ Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

Soil sample collection documentation and sample analysis results for CPP-86 gathered in 1990 during modifications for the PEW evaporator system substantiate reliability.

Block 3 Has this INFORMATION been confirmed? _x_ Yes ___ No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

The documentation mentioned above are confirmation.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available	[ ]		Analytical data	[x]	2
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site	[ ]		D&D report	[ ]	
Unusual Occurrence	[ ]		Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[x]	3			

Question 3. Is there evidence that a source exists at this site? If so, list the sources and describe the evidence.

Block 1 Answer:

There is evidence that a source of contamination exists at this site. During modifications for the PEW evaporator system being made to the CPP-602 Waste Trench Sump in 1990, which included a new 2 ft thick concrete floor and a stainless steel liner which covered the new concrete and extended up the walls of the sump 2 ft. Non-protocol grab samples from soil under a deteriorated portion of sump floor concrete were collected and analyzed. The location of the sample in the cell was at a depth of six inches into the soil from the sump bottom to insure the sample was free from visible concrete particles that might have been in the soil from the sump floor. TCLP analysis results from the grab samples indicate there has been minimal deposition of contaminated material to the soil beneath the sump. Contaminant concentrations were reported in mg/L and were converted to mg/kg to perform risk analysis. The conversion is:

$$mg/kg = mg/L \times g(Leachate)/g(Sample) \times 1\ L/1000g \times 1000g/kg$$

Block 2 How reliable are the information sources? _x_ High ___ Med ___ Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

Soil sample collection documentation and sample analysis results for the CPP-602 Waste Trench Sump gathered in 1990 during modifications for the PEW evaporator system substantiate reliability.

Block 3 Has this INFORMATION been confirmed? _x_ Yes ___ No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

The documentation mentioned above are confirmation.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available	[ ]		Analytical data	[x]	2
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site	[ ]		D&D report	[ ]	
Unusual Occurrence	[ ]		Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

Question 4. Is there empirical, circumstantial, or other evidence of migration? If so, what is it?

Block 1 Answer:

There is no obvious evidence of migration of contaminant at or from this site. During 1990, when modifications were being made to the sump for the PEW system, only a small area of the sump floor was excavated and the underlying soil sampled for contamination. Since any evidence of migration would be under Building CPP-602, a determination or estimate of the extent of contamination was not practical. Additionally, the data collected for the hazardous material contaminants of concern were either below detection limits, or were found in concentrations well below risk based concentration levels. Even if migration of contaminants was a concern, the concentration levels of contaminant material are not a concern.

Block 2 How reliable are the information sources? _x_High ___Med ___Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

Soil sample collection documentation and sample analysis results for the CPP-602 Waste Trench Sump gathered in 1990 during modifications for the PEW evaporator system substantiate reliability.

Block 3 Has this INFORMATION been confirmed? _x_ Yes ___ No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

The documentation mentioned above are confirmation.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available	[ ]		Analytical data	[x]	2
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site	[ ]		D&D report	[ ]	
Unusual Occurrence	[ ]		Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

Question 5. Does site operating or disposal historical information allow estimation of the pattern of potential contamination? If the pattern is expected to be a scattering of hot spots, what is the expected minimum size of a significant hot spot?

Block 1 Answer:

No. Samples taken at this site were taken from soil underlying the concrete floor in LC-207, the Waste Trench Sump in CPP-602, where modifications were being for the PEW evaporator system. Modifications included a new 2 ft thick concrete floor and a stainless steel liner, which covered the new concrete and extended up the walls of the sump 2 ft. While the soil underlying the concrete floor at the sump was exposed, a dirt sample was taken and mercury was discovered. Two additional grab samples of the soil were taken for analysis. Because of the modifications made to the sump, and because the adjacent area in the vicinity of the sample point is underlying the CPP-602 building, there is presently no practical means available to estimate a pattern of potential contamination. If there was a hot spot,it would most likely be directly below the sump area (see Question 6 for an estimate of contaminated volume).

Block 2 How reliable are the information sources? ___High _x_Med ___Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

Soil sample collection documentation and sample analysis results for the CPP-602 Waste Trench Sump gathered in 1990 during modifications for the PEW evaporator system substantiate reliability.

Block 3 Has this INFORMATION been confirmed? _x_ Yes ___ No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

An inspection of the CPP-86, the Waste Trench Sump in CPP-602 indicates the soil underneath the floor in the sump is presently inaccessible.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available	[ ]		Analytical data	[x]	2
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site	[ ]		D&D report	[ ]	
Unusual Occurrence	[ ]		Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[x]	3			

Question 6. Estimate the length, width, and depth of the contaminated region. What is the known or estimated volume of the source? If this is an estimated volume, explain carefully how the estimate was derived.

Block 1 Answer:

The samples taken were gathered from beneath the bottom concrete floor of CPP-86, in preparation for modifications for the PEW evaporator system. Samples were taken from a 0.15m (0.5ft) level below the concrete sump floor to insure the samples were free from visible concrete particles. The area of CPP-86 is approximately 1.8m (6ft) x 1.2m (4ft). To be conservative, an area 3.0m (10ft) x 3.0m (10ft) and 0.15m (0.5ft) was used to estimate parameters for the contaminated soil region. And as an additional conservative measure, a residual saturation of a contaminant in the pore space of the soil matrix of 15% was assumed.

$V_S = (LxWxT)/RS = (3.05m \times 3.05m \times 0.15m)/0.15 = 9.44m^3$

The basement floor in CPP-602 is at -(14ft-6in), and the bottom of CPP-86 was at -(37ft-6in) prior to PEW modifications (Land surface is assumed to be approximately 0ft-0in.). CPP-86 is greater than 10 ft bls, therefore only groundwater risk assessment will be considered.

Block 2 How reliable are the information sources? ___High _x_Med ___Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

The values used for this calculation are either estimated from drawings, or are assumed.

Block 3 Has this INFORMATION been confirmed? ___ Yes _x_No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available	[ ]		Analytical data	[x]	2
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site	[ ]		D&D report	[ ]	
Unusual Occurrence	[ ]		Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[x]	3			

Question 7. What is the known or estimated quantity of hazardous substance/constituent at this source? If the quantity is an estimate, explain carefully how the estimate was derived.

Block 1 Answer:

The grab samples collected for CPP-86 were analyzed for arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver contamination. Barium, cadmium, chromium, and mercury had analysis results above detectable limits. Those estimated amounts are (See Attachment 1):

Source Mass = (1.5g/cc x 9.44m^3 x 1E06cc/m^3)/(1000g/kg) = 14158kg

Barium:(using Sample 07036 data)
mg/kg = 0.76mg/L x 2089.6g/104.48 g x 1 L/1000g x 1000g/kg = 15.20mg/kg

Cadmium:(using Sample 07036 data)
mg/kg = 0.46mg/L x 2089.6g/104.48g x 1L/1000g x 1000g/kg = 9.20mg/kg

Chromium:(using Sample 07036 data)
mg/kg = 0.0253mg/L x 2089.6g/104.48g x 1L/1000g x 1000g/kg = 0.51mg/kg

Mercury:(using Sample 07036 data)
mg/kg = 0.054mg/L x 2089.6g/104.48g x 1L/1000g x 1000g/kg = 1.08mg/kg

The initial contaminant mass (quantity) is estimated to be:

Barium: IA = 15.20mg/kg x 14158kg = 2.15E+05mg(215.0g)
Cadmium: IA = 9.20mg/kg x 14158kg = 1.30E+05mg(130.0g)
Chromium: IA = 0.51mg/kg x 14158kg = 7.16E+03mg(7.16g)
Mercury: IA = 1.08mg/kg x 14158kg = 1.53E+04mg(15.3g)

Block 2 How reliable are the information sources? _x_ High ___Med __Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

Samples were taken according to a sampling procedure outlined by the WINCO Environmental Compliance & Special Isotope Separation (SIS) Operations Department. Estimates are made using assumptions common to ICPP.

Block 3 Has this INFORMATION been confirmed? _x_ Yes ___No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

Because of analytical results.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available	[ ]		Analytical data	[x]	2
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site	[ ]		D&D report	[ ]	
Unusual Occurrence	[ ]		Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

Question 8. Is there evidence that this hazardous substance/constituent is present at the source as it exists today? If so, describe the evidence.

Block 1 Answer:

Yes,evidence exists that these hazardous substances/constituents are present at this source as it exists today. However,the data collected for the hazardous material contaminants of concern at this site were either below detection limits, or were found in concentrations well below risk based concentration levels. The Waste Trench Sump was modified in 1990 to accommodate modifications to the PEW evaporator system. The PEW evaporator system is in use today and as such renders extensive procurement and evaluation of additional evidence impractical. Additionally, contaminants under existing facilities are shielded from human contact and precipitation, and would be considered for remediation during decontamination and decommissioning of the facility.

Block 2 How reliable are the information sources? _x_High ___Med ___Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

Soil sample collection documentation and sample analysis results for CPP-86 gathered in 1990 during modifications for the PEW evaporator system substantiate reliability.

Block 3 Has this INFORMATION been confirmed? _x_ Yes ___No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

The documentation mentioned above are confirmation.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available	[ ]		Analytical data	[x]	2
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site	[ ]		D&D report	[ ]	
Unusual Occurrence	[ ]		Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

REFERENCES

1. RCRA Part B Permit Application for the Idaho National Engineering Laboratory, Volume 14, Process Equipment Waste Evaporator System, Section D, Process Description, July 1994.

2. D. L. Powell to J. E. Kaylor, "Grab Samples Taken From The CPP-602 Waste Trench Sump and CPP-604 Soil", DLP-06-90, December 14, 1990.

3. Schematic drawings showing layout of the Waste Trench Sump (LC-207)in CPP-602, "PEW Collection System Sump Modifications, Drawing No. 369320, Revision 2, United Engineers & Constructors, April, 1990.

4. Idaho Chemical Processing Plant Technical Site Information, Table 4-1. ICPP existing and planned building profile of FY-2013, F.G. Ferguson, J. Andrews, WINCO-1200, March, 1994.

DECISION DOCUMENTATION PACKAGE
COVER SHEET

PREPARED IN ACCORDANCE WITH

TRACK 1 SITES:
GUIDANCE FOR ASSESSING
LOW PROBABILITY HAZARD SITES
AT THE INEL

SITE DESCRIPTION:	1. VOG BLOWER CELL FLOOR DRAIN/SUMP, 2. PEW EVAPORATOR FEED PUMP CELL		
SITE ID:	CPP-87	OPERABLE UNIT:	3-13
WASTE AREA GROUP:	3		

I. SUMMARY – PHYSICAL DESCRIPTION OF THE SITE:

Site CPP-87 consists of two sites located in the CPP-604 building. Originally constructed during 1951-1953, with additions in the 1970's and 1980's, CPP-604 has been in operation since 1953. The Process Equipment Waste (PEW) Evaporator system, is located in CPP-604. The PEW system produces concentrated wastes (bottoms) and condensed vapor overheads (condensates). As part of the process, the PEW evaporator system tanks vent to the Vessel Off-Gas (VOG) System. The VOG system provides vacuum and filtration to processing vessels in nearby facilities. In 1990, the Process Waste Liquid (PWL) collection system was installed. This system collects hazardous waste from buildings CPP-604, CPP-605, CPP-649, and CPP-708, and transfers the waste to the PEW system. CPP-604 wastes are also collected from floor drains, including the floor drain in the VOG Blower Cell (Artifact 1). During construction of the PWL system, samples were taken of the soil under a deteriorated portion of concrete in the Blower Cell to determine if the soil was contaminated. The sampling location in the Blower Cell is where the old cell floor drain line was located, and the new sump for the PWL collection system was to be located. This site is located roughly 4.0 ft. below land surface (bls). This site is recommended for no action.

The second site is located in the PEW Evaporator Feed Pump Cell (Artifact 2). In January 1994, a small hole was identified in a weld in the stainless steel liner in the cell. Decon liquid squirted from the hole as a result of normal flexing when personnel walked across the liner. The liquid was between the liner and the concrete floor of the cell. Liquid was extracted from the hole and analyzed for hazardous constituents. Subsequently, the weld was repaired. Remedial action for the Artifact 2 site is recommended to be deferred to the Comprehensive RI/FS.

DECISION RECOMMENDATION

II. SUMMARY – QUALITATIVE ASSESSMENT OF RISK:

The level of reliability of the information collected for both the CPP-87 Artifact 1 and Artifact 2 sites is medium. Medium reliability was assigned to the Artifact 1 site because no radioactive sampling and analysis was performed, however since the hazardous material concentrations were low, the assumption is made that radionuclide concentrations would also be low. The Artifact 2 site was in a known radioactive area. The sample from Artifact 2 was analyzed for hazardous material contamination, and a health physics survey was performed. Gamma scan results indicate the presence of radionuclides. The Artifact 2 area was assigned medium reliability.

The assessment of qualitative risk for Artifact 1 is low because of the low concentration of hazardous contaminants. Sample analysis indicated contaminants of concern were either below detection limits, or were found in concentrations well below risk based concentration limits. Because the Artifact 2 site contains radionuclide concentrations above risk based concentrations (ingestion), the qualitative risk is assessed as medium. Plotting these appraisals on the Qualitative Risk and Reliability Evaluation Table yields an intersection in the "no action required" portion of the chart for the Artifact 1 site. The Artifact 2 site is recommended to further action in the Comprehensive RI/FS.

III. SUMMARY – CONSEQUENCES OF ERROR:

False negative error: If no further action is taken at these two locations at CPP-87, a receptor might be exposed to contaminants which could be present at this site. The probability of a receptor being exposed to higher concentrations of contaminants identified at this site than that determined in the risk assessments is low.

False positive error: Unwarranted remediation of either of these locations would result in a low return in environmental benefit from a relatively large investment of time and money.

IV. SUMMARY – OTHER DECISION DRIVERS:

Removal of contamination or contaminated material at these sites would be difficult as they are both underneath the structural and protective components of the CPP-604/605 buildings. Additionally, these contaminants are shielded from human contact and from meteorological factors.

MEMORANDUM

TO: WAG 3 Project File

FROM: S. Flynn

DATE: July 27, 1995

SUBJECT: Track 2 Preliminary Scoping Packages (PSPs) & Track 1 Decision Documentation Packages (DDPs)

Chemical Processing Plant (CPP)-39 and CPP-48 in Operable Unit (OU) 3-13 were designated in the INEL Federal Facility Agreement/Consent Order Table A.2, Revision 2, dated March 23, 1995 (FFA/CO Table), as sites to be evaluated during the Remedial Investigation/Feasibility Study (RI/FS) process. PSPs were prepared per the Track 2 guidance for these two sites .

Ten sites (CPP-84, -85, -86, -87, -88, -89, -90, -91, -92 & -93) in OU 3-13 were designated in the FFA/CO Table as Track 1 sites and sites to be evaluated during the RI/FS process. DDPs were prepared per the Track 1 guidance for these ten sites.

These 12 documents will not have signatures on the decision pages. The information contained in the documents will be used to evaluate each of the twelve sites for the OU 3-13 RI/ FS. The final disposition of each site will be included in the OU 3-13 Record of Decision.

DECISION RECOMMENDATION

RECOMMENDED ACTION:

This document recommends that no action be taken to remediate either of these sites. Analytical results from the two grab samples collected at the site of Artifact 1 during construction of the PWL collection system indicate that the concentrations of these contaminants are not an unacceptable risk. Hazardous material contamination identified from the liquid sample at the Artifact 2 site is not above unacceptable risk. However, the Co-60 and Cs-137 concentrations were above risk-based soil concentrations. The Feed Pump Cell in CPP-604 is a controlled radioactive area. Further action would require expenditure of funds that could be dedicated to remediation elsewhere, and most significantly, would require extensive modifications to existing operating systems crucial to the ICPP mission.

The VOG Blower Cell Floor Drain/Sump (Artifact 1) requires no further action. The PEW Evaporator Feed Pump Cell (Artifact 2) is recommended to the Comprehensive RI/FS because of concentrations of radionuclides (Co-60 and Cs-137) above risk-based concentrations.

SIGNATURES	# PAGES:	DATE:
Prepared By:	DOE WAG Manager:	
Approved By:	Independent Review:	

DECISION STATEMENT
(BY DOE RPM)

DATE RECD:

DISPOSITION

DATE:	# PAGES (DECISION STATEMENT):
NAME:	SIGNATURE:

DECISION STATEMENT
(BY EPA RPM)

DATE RECD:

DISPOSITION

DATE:	# PAGES (DECISION STATEMENT):
NAME:	SIGNATURE:

DECISION STATEMENT
(BY STATE RPM)

DATE RECD:

DISPOSITION

DATE:	# PAGES (DECISION STATEMENT):
NAME:	SIGNATURE:

PROCESS/WASTE WORKSHEET

SITE ID: CPP-87

Col 1 Processes Associated with this Site	Col 2 Waste Description & Handling Procedures	Col 3 Description & Location of any Artifacts/Structures/Disposal Areas Associated with this Waste or Process
PEW Evaporator System	Artifact 1: Small amounts of barium, cadmium, and chromium and other contaminants are collected, transported, and treated by the PEW Evaporator System during the waste processing cycle.	Artifact: Soil in vicinity of floor drain area Location: VOG Blower Cell, in CPP-604 Building Description: Floor drain in VOG Blower Cell modified during installation of PWL collection system. The site is now a sump.
	Artifact 2: Decon fluid contaminated with hazardous waste and radionuclides from the PEW Evaporator System Feed Pump Cell in CPP-604.	Artifact: Liquid between the stainless steel liner and concrete floor. Location: Evaporator Feed Pump Cell in Building CPP-604. Description: Suspected decon fluid seeped from a hole in a weld in the liner during decontamination activities in the cell. The liquid was extracted to the extent possible and the hole in the liner was repaired.
		Artifact: Location: Description:
		Artifact: Location: Description:

CONTAMINANT WORKSHEET

SITE ID CPP-87 (Artifact 1)

PROCESS (Col 1) VOG Blower Cell Floor Drain/Sump Area in CPP-604 **WASTE** (Col 2) Contaminated soil

Col 4 What Known/Potential Hazardous Substance/ Constituents are Associated with this Waste or Process?	Col 5 Potential Sources Associated with this Hazardous Material	Col 6 Known/Estimated Concentration of Hazardous Substances/ Constituents[a]	Col 7 Risk-based Concentration (mg/kg)	Col 8 Qualitative Risk Assessment (hi/med/low)	Col 9 Overall Reliability (hi/med/low)
Arsenic	Contaminated soil	ND, DL=0.065 mg/L	Not determined	Low	Medium
Barium	Contaminated soil	0.679 mg/L	1.89E+04[b]	Low	Medium
Cadmium	Contaminated soil	0.0053 mg/L	1.35E+02[b]	Low	Medium
Chromium	Contaminated soil	0.0137 mg/L	2.70E+05[b]	Low	Medium
Lead	Contaminated soil	ND, DL=0.065 mg/L	Not determined	Low	Medium
Mercury	Contaminated soil	ND, DL=0.0005 mg/L	Not determined	Low	Medium
Selenium	Contaminated soil	ND, DL=0.095 mg/L	Not determined	Low	Medium
Silver	Contaminated soil	ND, DL=0.0060 mg/L	Not determined	Low	Medium
TCLP	147.88g/2958g leachate[1] 172.16g/3443g leachate[2]				

a. ND = not detected
DL = detection limit.

1. Sample 1, 2958/147.88=20L/kg. Used to estimate mg/kg concentration for groundwater risk scenario. See Attachment 1.
2. Sample 2, 3443/172.16=20L/kg. Used to estimate mg/kg concentration for groundwater risk scenario. See Attachment 1.

b. Most conservative pathway used, see Attachments 2 & 3 for risk assessments.

CONTAMINANT WORKSHEET

SITE ID CPP-87 (Artifact 2)

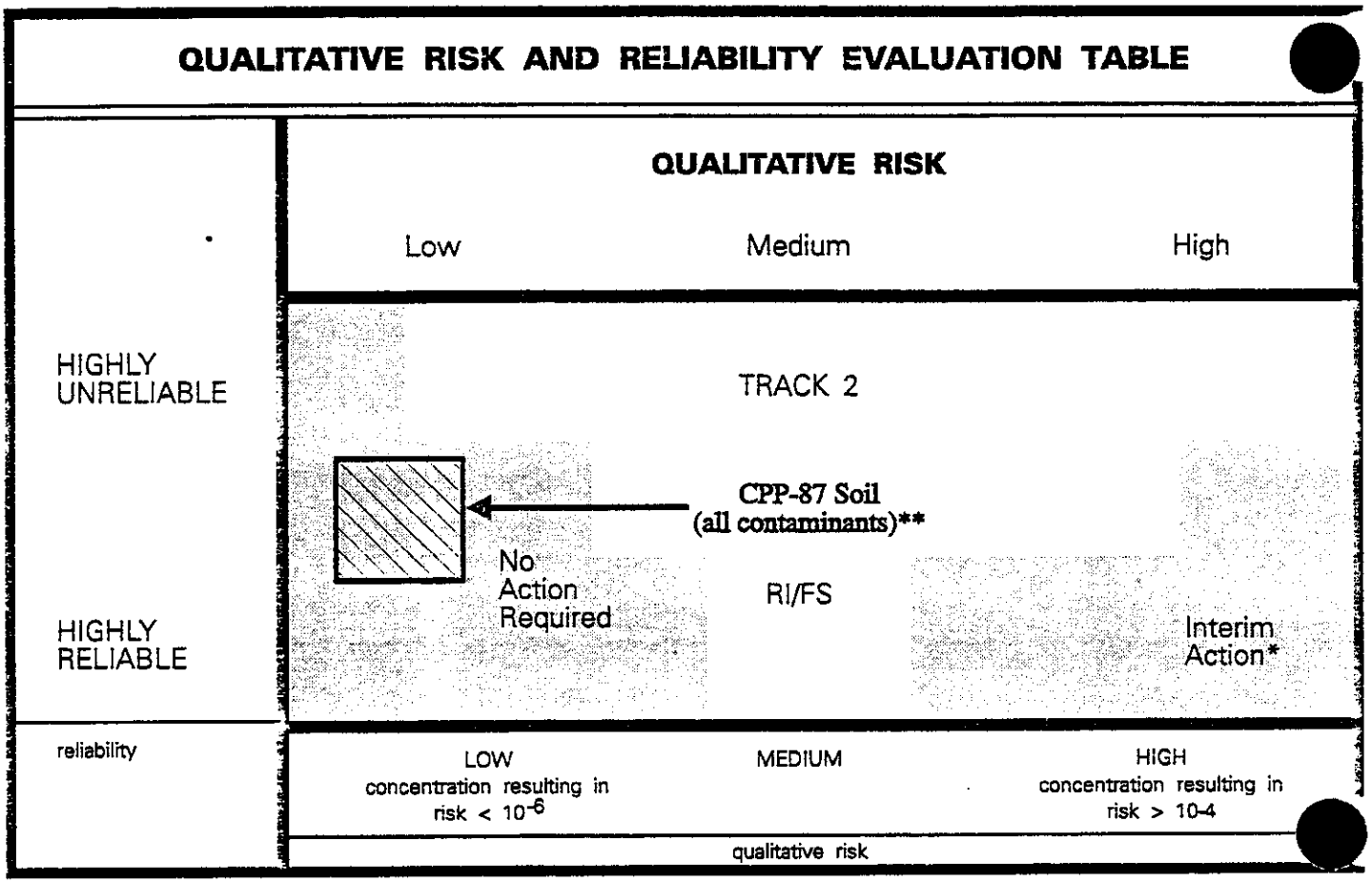
PROCESS (Col 1) Evaporator Feed Pump Cell in CPP-604

WASTE (Col 2) Liquid between liner and concrete floor

Col 4 What Known/Potential Hazardous Substance/ Constituents are Associated with this Waste or Process?	Col 5 Potential Sources Associated with this Hazardous Material	Col 6 Known/Estimated Concentration of Hazardous Substances/ Constituents[a,b]	Col 7 Risk-based Concentration (mg/kg)	Col 8 Qualitative Risk Assessment (hi/med/low)[d]	Col 9 Overall Reliability (hi/med/low)
Barium	Liquid	0.342 mg/L	1.89E+04[c]	Low	Medium
Cadmium	Liquid	0.877 mg/L	1.35E+02[c]	Low	Medium
Lead	Liquid	9.2 mg/L	Not determined	Low	Medium
Nickel	Liquid	0.67 mg/L	5.40E+03[c]	Low	Medium
Nitrate	Liquid	202 ug/ML	4.32E+5[c]	Low	Medium
Co-60	Liquid	70,740 pCi/g	2.72E+03 pCi/g	Medium	Medium
Cs-134	Liquid	4,018 pCi/g	4.65E+05 pCi/g	Medium	Medium
Cs-137	Liquid	330,480 pCi/g	5.62E+01 pCi/g	Medium	Medium

a. ND = not detected
DL = detection limit.
b. The fluid sample was collected from a known "hot area" (PEW Feed Pump Cell) and analyzed for hazardous materials.
c. Most conservative pathway used, see Attachments 2 & 3 for risk assessments.
d. Qualitative risk assessment was assigned a medium value because the PEW Feed Pump Cell due to presence of radionuclides.

QUALITATIVE RISK AND RELIABILITY EVALUATION TABLE



* If sufficient data exist to identify an appropriate remedy.
**Medium reliability because of no radiological analysis.

Question 1. What are the waste generation process locations and dates of operation associated with this site?

Block 1 Answer:

Waste generation in the area of the VOG Blower Cell floor drain (Artifact 1) and the PEW Evaporator Feed Pump Cell (Artifact 2), located in building CPP-604, would be from the PEW evaporator system. The PEW system reduces the volume of mixed wastes sent to the ICPP Tank Farm Facility. The system vaporizes the mixed wastes, producing concentrated wastes (bottoms) and condensed vapor overheads (condensates). The bottoms are transferred to the Tank Farm Facility, while the process condensates are transferred to the Liquid Effluent Treatment and Disposal (LET&D) Facility for further processing. The systems housed in CPP-604 have been in operation since 1953, with modifications being performed in the early 1970's, the early 1980's, and 1990.

Block 2 How reliable are the information sources? _x_ High ___ Med ___ Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

The waste generation processes and operational dates of the CPP-604 facility are well documented in RCRA Permitting Documentation. Soil sample documentation from the VOG Blower Cell floor drain area gathered in 1990 during construction for the PWL collection system, and sample analysis in 1994 of decon liquid discovered between the stainless steel liner and concrete floor in the Feed Pump Cell substantiate reliability.

Block 3 Has this INFORMATION been confirmed? _x_ Yes ___ No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

The RCRA Part B Permit application for the INEL documents the mission for CPP-604, and sample documents verify soil and liquid hazardous material contamination.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available	[ ]		Analytical data	[x]	2
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site	[ ]		D&D report	[ ]	
Unusual Occurrence	[x]	3	Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[x]	5,6
OTHER	[x]	1,4			

Question 2. What are the disposal process locations and dates of operation associated with this site?

Block 1 Answer:

Waste disposal in the area of the VOG Blower Cell floor drain (Artifact 1) and the PEW Evaporator Feed Pump Cell (Artifact 2), located in building CPP-604, would be from the PEW Evaporator System. The PEW system concentrates liquids from numerous processing vessels in nearby connected facilities. Waste could be introduced to the Artifact 1 site through deteriorated floor drains to surrounding soil. Wastes at the Artifact 2 site could be introduced through undetected breaches in the stainless steel liner and liner welds in the Feed Pump Cell of the PEW system. CPP-604 has been in operation since 1953, with modifications being performed in the early 1970's, the early 1980's, and 1990.

Block 2 How reliable are the information sources? _x_ High ___ Med ___ Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

The waste disposal processes and operational dates of the CPP-604 facility are well documented in RCRA Permitting Documentation, operator logs, and operational procedures.

Block 3 Has this INFORMATION been confirmed? _x_ Yes ___ No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

The RCRA Part B Permit application for the INEL confirms the mission for CPP-604. The other documentation supports modification activities, areas of contamination, and potential release reporting.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available	[ ]		Analytical data	[ ]	
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site	[ ]		D&D report	[ ]	
Unusual Occurrence	[x]	3	Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[x]	5,6
OTHER	[x]	1,4			

Question 3. Is there evidence that a source exists at this site? If so, list the sources and describe the evidence.

Block 1 Answer:

There is evidence that a source of contamination exists at both artifact sites. Two non-protocol grab samples of soil from beneath a deteriorated portion of concrete in the CPP-604 VOG Blower Cell (Artifact 1) were collected and analyzed in 1990. The samples were collected at the old floor drain. TCLP analysis results from the grab samples indicate there has been minimal deposition of contaminated material to the soil via the VOG Blower Cell floor drain. Decon liquid discovered between the stainless steel liner and concrete floor in the Feed Pump Cell (Artifact 2) in 1994 was sampled and analyzed. Integrity of the concrete floor beneath the liner is unknown. Hazardous contaminants tested for both Artifact 1 and Artifact 2 were either below detection limits, or were found to be in concentrations well below risk based concentration levels. A gamma scan conducted on the liquid sample from the Feed Pump Cell indicated Co-60, Cs-134, and Cs-137.

Block 2 How reliable are the information sources? _x_ High ___ Med ___ Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

Any contamination at CPP-87, the VOG Blower Cell Floor Drain/Sump originated at a source elsewhere within the ICPP complex. The function of CPP-604 is described in the RCRA permitting documentation. Sample collection documentation and analysis results for CPP-87 gathered in 1990 and liquid sample analysis gathered in 1994 substantiate reliability.

Block 3 Has this INFORMATION been confirmed? _x_ Yes ___ No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

RCRA permitting documentation and sample and analysis documentation describe the functions of the areas in which these samples were taken.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available	[ ]		Analytical data	[x]	2,8,9
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site	[ ]		D&D report	[ ]	
Unusual Occurrence	[x]	3,7	Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[x]	1,4			

Question 4. Is there empirical, circumstantial, or other evidence of migration? If so, what is it?

Block 1 Answer:

There is no obvious evidence of migration of contaminants from either of these artifact sites. CPP-87 (Artifact 1) was sampled during 1990, when modifications were being made to the drain/sump for the PEW system. CPP-87 (Artifact 2) was sampled in 1994 when decon liquid seeped through a hole in a weld in the liner of the PEW Evaporator Feed Pump Cell. Since evidence of migration for both Artifacts would be under CPP-604, determination of the extent of contamination is not practical. The integrity of the 14-in. thick concrete floor beneath the Feed Pump Cell liner is not known. Concentrations of hazardous contaminants were either below detection or had concentrations well below risk-based concentration levels. The concentration levels of hazardous contaminants are not a concern; however, Co-60 and Cs-137 had concentrations above risk-based levels. The physical location of Artifacts 1 and 2 under CPP-604 makes migration via ingestion or inhalation pathways remote, and the small quantities involved make chances of migration to the aquifer via a groundwater pathway unlikely.

Block 2 How reliable are the information sources? _x_ High ___ Med ___ Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

Sample collection documentation and sample analysis results for the VOG Blower Cell Floor Drain/Sump gathered in 1990 during modifications for the PEW evaporator system, and the liquid sample analysis performed in 1994 from the Feed Pump Cell substantiate reliability.

Block 3 Has this INFORMATION been confirmed? _x_ Yes ___ No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

The documentation mentioned provide confirmation.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available	[ ]		Analytical data	[x]	2,8
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aérial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site	[ ]		D&D report	[ ]	
Unusual Occurrence	[ ]		Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[x]	4			

Question 5. Does site operating or disposal historical information allow estimation of the pattern of potential contamination? If the pattern is expected to be a scattering of hot spots, what is the expected minimum size of a significant hot spot?

Block 1 Answer:

No. Grab samples were taken from under the concrete floor at the Artifact 1 site while the soil was exposed during installation of a sump (#SU-WL-138) for the PWL collection system. A sample of liquid that seeped from beneath the liner in the PEW Feed Pump Cell (Artifact 2) was collected prior to repairing the hole in the liner, and the integrity of the underlying concrete is unknown. Because of the changes made to the VOG Blower Cell and the physical structure of the PEW Feed Pump Cell, and because these Artifacts are beneath the CPP-604/605 buildings, there is no practical means to estimate a pattern. Sample analyses show hazardous contaminants at this site were below minimum risk-based concentration levels, or were not detected. There are no records indicating usage of the floor drain in the CPP-604 VOG Blower Cell (Artifact 1) for waste disposal. No hot spots are evident at the Artifact 1 site. The Artifact 2 site is contaminated with radionuclides in concentrations above risk based levels.

Block 2 How reliable are the information sources? _x_ High ___ Med ___ Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

Sampling documentation describes the specific circumstance of the CPP-87 sample sites and the relative inaccessibility of soil beneath those sites.

Block 3 Has this INFORMATION been confirmed? _x_ Yes ___ No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

Visual inspection of the VOG Blower Cell and the PEW evaporator feed cell indicates the soil beneath the floor at CPP-87 is presently inaccessible.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available	[ ]		Analytical data	[x]	2,8,9
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site	[ ]		D&D report	[ ]	
Unusual Occurrence	[x]	3,7	Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

Question 6. Estimate the length, width, and depth of the contaminated region. What is the known or estimated volume of the source? If this is an estimated volume, explain carefully how the estimate was derived.

Block 1 Answer:

The two soil samples from the CPP-87 VOG Blower Cell (Artifact 1) site were gathered through a hole that had been cut in the concrete floor during installation of a sump (#SU-WL-138) for the PWL Collection System modifications. To be conservative, the approximate area of the entire VOG Blower Cell was used to estimate parameters for the contaminated soil region. Samples were taken from a 0.15 m (0.5 ft) level below the floor to insure the samples were free from visible concrete particles. And as an additional conservative measure, a residual saturation of a contaminant in the pore space of the soil matrix of 15% was assumed. The estimated contaminated volume is 57.35 m^3 (See Attachment 1 for calculations). A liquid sample from the PEW Evaporator Feed Pump Cell (Artifact 2) was collected prior to the repair of the hole in the steel liner. The liquid removed from between the steel liner and the 14 in. thick concrete floor of the cell was approximately 125 milliliters. The Artifact 2 area, an assumed depth of three feet into the soil underneath the cell, and a liquid soil content of 30% were used to estimate a potential contaminated region volume of 62.07 m^3 (See Attachment 1 for calculations).

Block 2 How reliable are the information sources? ___High _x_Med ___Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

Calculations are made from drawings of the artifact sites and assumptions.

Block 3 Has this INFORMATION been confirmed? ___ Yes _x_No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available	[ ]		Analytical data	[x]	2.8
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site	[ ]		D&D report	[ ]	
Unusual Occurrence	[x]	3.7	Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[x]	5.6
OTHER	[ ]				

Question 7. What is the known or estimated quantity of hazardous substance/constituent at this source? If the quantity is an estimate, explain carefully how the estimate was derived.

Block 1 Answer:

The two grab samples collected from the CPP-87 VOG Blower Cell (Artifact 1) were analyzed for arsenic, barium, cadmium, chromium,lead, mercury, selenium, and silver contamination. Only barium, cadmium, and chromium had TCLP concentrations above detectable limits, but all were below risk-based concentration levels. Calculations are shown in Attachment 1. The liquid sample from the PEW Evaporator Feed Pump Cell (Artifact 2) was analyzed for arsenic, barium, cadmium, chromium, fluoride, lead, mercury, nickel, nitrate, selenium, and silver contamination. Only barium, cadmium, lead, nickel, and nitrate indicated concentrations above detectable levels. Lead was not evaluated because there is no risk-based RFD data. Barium, cadmium, nickel, and nitrate were all below risk-based concentration levels. Co-60, Cs-134, and Cs-137 were detected in the liquid sample collected from Artifact 2, and Co-60 and Cs-137 had concentrations above risk-based levels. See Attachment 1 for calculations.

Block 2 How reliable are the information sources? _x_ High ___Med __Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

The samples for Artifact 1 were taken in accordance to procedures outlined by the WINCO Environmental Compliance & Special Isotope Separation (SIS) Operations Department. The Artifact 2 sample was obtained according to Potential Release protocol from a known radioactive area.

Block 3 Has this INFORMATION been confirmed? _x_ Yes ___No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

Because of analytical results.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available	[ ]		Analytical data	[x]	2,8,9
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site	[ ]		D&D report	[ ]	
Unusual Occurrence	[x]	3,7	Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

Question 8. Is there evidence that this hazardous substance/constituent is present at the source as it exists today? If so, describe the evidence.

Block 1 Answer:

Yes, evidence exists that these hazardous substances/constituents are present at these artifact source as they exist today. However, sample analysis data for the hazardous contaminants of concern at these sites were either below detection limits or were present at concentrations below risk based concentration levels. Two radionuclide concentrations were above risk-based levels. The VOG Blower Cell (Artifact 1) was modified in 1990 to accommodate installation of the PWL collection system, and the stainless steel liner in the PEW Evaporator Feed Pump Cell (Artifact 2) was repaired subsequent to collection of the decon liquid sample. The PEW evaporator system is in use today and as such renders procurement and evaluation of such evidence from either the Artifact 1 or Artifact 2 site impractical. An additional point to emphasize is that these contaminants located beneath existing facilities are shielded from human contact and any meteorological events that might occur.

Block 2 How reliable are the information sources? _x_High ___Med ___Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

Sample collection documentation and sample analysis results for CPP-87 gathered in 1990 during modifications for the PEW evaporator system and in 1994 when liquid seeped from between the steel liner and the concrete floor in the PEW Evaporator Feed Pump Cell substantiate reliability.

Block 3 Has this INFORMATION been confirmed? _x_ Yes ___No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

Sample documentation provides confirmation.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available	[ ]		Analytical data	[x]	2,8
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site	[ ]		D&D report	[ ]	
Unusual Occurrence	[x]	3,7	Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

REFERENCES

Attachment 1
Q 1 Calculations for CPP-87 (pp. 1 - 2).

Attachment 2 (6 pp.)
GWSCREEN output for CPP-604 VOG Blower Cell Soil Sample - Barium.
GWSCREEN output for CPP-604 VOG Blower Cell Soil Sample - Cadmium.
GWSCREEN output for CPP-604 VOG Blower Cell Soil Sample - Chromium.

Attachment 3 (6 pp.)
Table 1a. Parameters used for risk-based soil screening for Barium at CPP-87.
Table 1b. Summary of risk-based soil screening for Barium at CPP-87.
Table 2a. Parameters used for risk-based soil screening for Cadmium at CPP-87.
Table 2b. Summary of risk-based soil screening for Cadmium at CPP-87.
Table 3a. Parameters used for risk-based soil screening for Chromium at CPP-87.
Table 3b. Summary of risk-based soil screening for Chromium at CPP-87.

1. RCRA Part B Permit Application for the Idaho National Engineering Laboratory, Volume 14, Process Equipment Waste Evaporator System, Section D, Process Description, pp. D-i, D-ii, D-1 through D-27, July 1994.

2. D. L. Penwell to J. E. Kaylor, "Grab Samples Taken From The CPP-602 Waste Trench Sump and CPP-604 Soil," DLP-06-90, (28 pp.), December 14, 1990.

3. S. M. Halupa to T. Perkins, "Potential Release Report," SMH-41-94, (4 pp.), February 17, 1994.

4. Background Concentrations of Selected Metals and Radionuclides in the Big Lost River Alluvium at the Idaho Chemical Processing Plant, Revision 1, Executive Summary, pp. ES-1 through ES-3, February 28, 1994.

5. Schematic drawing showing layout of floor drains in the CPP-604 VOG Blower Cell (Artifact 1) (1 p.).

6. Schematic drawing showing the PEW Evaporator Feed Pump Cell in CPP-604 (Artifact 2) (1 p.).

7. PC ORPS Occurrence Report, ID--WINC-WASTEMNGT-1994-0001, Final Report, pp. 1 through 6, March 7, 1995.

8. Final Report for 604 Pumppit (Lab copy), Log Number 94-01262, (1 p.) January 26, 1994.

9. Health Physics Survey Report, 604 Pump Pit, Sample liquid from floor area (& sketch), 94WP324, (2 pp.), January 26, 1994.

DECISION DOCUMENTATION PACKAGE
COVER SHEET

PREPARED IN ACCORDANCE WITH

TRACK 1 SITES:
GUIDANCE FOR ASSESSING
LOW PROBABILITY HAZARD SITES
AT THE INEL

SITE DESCRIPTION: RADIOLOGICALLY CONTAMINATED SOILS

SITE ID: CPP-88 **OPERABLE UNIT:** 3-13

WASTE AREA GROUP: 3

I. SUMMARY — PHYSICAL DESCRIPTION OF THE SITE:

This Track 1 package describes the available radiation measurements from the surface soils within the Idaho Chemical Processing Plant (ICPP) that comprise release site CPP-88 "Radiologically Contaminated Soils." This unit includes the radioactively-contaminated soils that have not been attributed to a release site identified in the FFA/CO.

During construction activities at the ICPP radiological contamination has been periodically discovered in the soils. This contamination is measured by Radiological Control Technicians (RCTs) using field instruments and reported in Health Physics Survey Reports. These measurements are not isotope specific (usually reported as total beta-gamma activity) and only provide a qualitative estimate of the radioactivity, reported as counts per minute (cpm) or millirem/hour (mrem/hr). CPP-88 includes only the measurements made on soil between December 1988 and March 1994 and excludes contamination associated with buildings, structures, and concrete or asphalt pads.

From the records search, measurements indicating soil radioactivity levels above background that could be located with confidence are plotted in Figure 1. Soil is generally considered radioactive if readings are more than 100 cpm above background. Whenever a range of radiation measurements were recorded in the Health Physics Survey Report, the highest reading was used. In a few instances, the radiation measurements were reported in mrem/hr. These values were converted in ICPP Health Physics Survey Reports from mrem/hr to cpm by multiplying by 3,000, since 1 mrem is approximately equal to 3,000 cpm cesium.

DECISION RECOMMENDATION

II. SUMMARY — QUALITATIVE ASSESSMENT OF RISK:

To better identify the areas of concern for this unit, the radiation measurements were screened using the following criteria:

1) All data points contained within an Environmentally Controled Area (ECA) or radiation materials area (RMA) were excluded.
2) For collocated data points [i.e., located within approximately 4.5 m (15 ft) of each other], the measurement from the most recent date was used and the other data was excluded.
3) For collocated data points that were sampled at the same date, the highest measurement was used and the lower measurements were excluded.

The radiation measurements remaining after these screening steps are plotted in Figure 2. This map contains the most recent data and presents the highest measured radiation levels recorded for a given sampling area.

Using the assumptions in these calculations, field surveys with approximately 36,000 cpm are considered to present a potential risk of 10^{-5}. This count rate was decreased to 30,000 cpm to add an additional conservatism to account for the uncertainty in the calculations. Therefore, a count rate of 30,000 cpm (i.e., approximately 10^{-5} risk or greater) was chosen to represent areas of potential concern at the ICPP. Figure 3 provides a plot of this data. Assuming the contamination is primarily Cs-137 (the most ubiquitous risk-driving radionuclide found at the ICPP which can easily be detected with hand-held field survey instruments), these contaminated areas are at a concentration much greater than the limiting soil concentration for Cs-137. An overall data reliability of medium is assigned for CPP-88 due to the large number of low quality field data points collected. The overall risk for this site is medium because contaminant concentrations are more likely to be greater than the limiting soil concentrations for Cs-137, but are not believed to be present over the large areas of the site as assumed in the calculation of the Track 1 limiting soil concentrations.

III. SUMMARY — CONSEQUENCES OF ERROR:

False negative error: If no further action is taken receptors might be exposed to contaminants which could be present at this site in concentrations greater than the limiting soil concentration. The probability of a receptor being exposed to high concentrations of contaminants at this site is low.

False positive error: Unwarranted remediation of this site would result in a low return in environmental benefit from a relatively large investment of time and money.

IV. SUMMARY — OTHER DECISION DRIVERS:

Field investigations for the WAG 3 Comprehensive Remedial Investigation/ Feasibility Study (RI/FS) are currently being scoped, therefore investigation of this site can be included. In addition, previous characterizations of ICPP surface soil not associated with a known specific release, have not included accurate location information, nor radioisotopic data.

DECISION RECOMMENDATION

RECOMMENDED ACTION:

Because of the lack of isotopic characterization data for the site and because the estimated Cs-137 concentration is estimated to be significantly greater than the limiting soil concentration calculated using Track 1 methodology, this site (CPP-88) is recommended to be further investigated in the WAG 3 Comprehensive RI/FS.

SIGNATURES	# PAGES: 18	DATE: 6/21/95
Prepared By:	DOE WAG Manager:	
Approved By:	Independent Review:	

DECISION STATEMENT
(BY DOE RPM)

DATE RECD:

DISPOSITION

DATE:	# PAGES (DECISION STATEMENT):
NAME:	SIGNATURE:

DECISION STATEMENT (BY EPA RPM)	
DATE RECD:	
DISPOSITION	
DATE:	# PAGES (DECISION STATEMENT):
NAME:	SIGNATURE:

DECISION STATEMENT
(BY STATE RPM)

DATE RECD:

DISPOSITION

DATE:	# PAGES (DECISION STATEMENT):
NAME:	SIGNATURE:

PROCESS/WASTE WORKSHEET

SITE ID: CPP-88

Col 1 Processes Associated with this Site	Col 2 Waste Description & Handling Procedures	Col 3 Description & Location of any Artifacts/Structures/Disposal Areas Associated with this Waste or Process
Miscellaneous unknown releases of radioactive contamination.	During construction activities at the ICPP, primarily digging and excavations, radiological contamination is occasionally discovered in the soils by radiological control technician surveys.	Artifact: Contaminated surface soils Location: At numerous locations throughout the ICPP. See Figure 1 of Reference2. Description: The sites are not associated with known releases addressed as individual sites in the FFA/CO. They are generally small areas but may be of any size or shape.

CONTAMINANT WORKSHEET

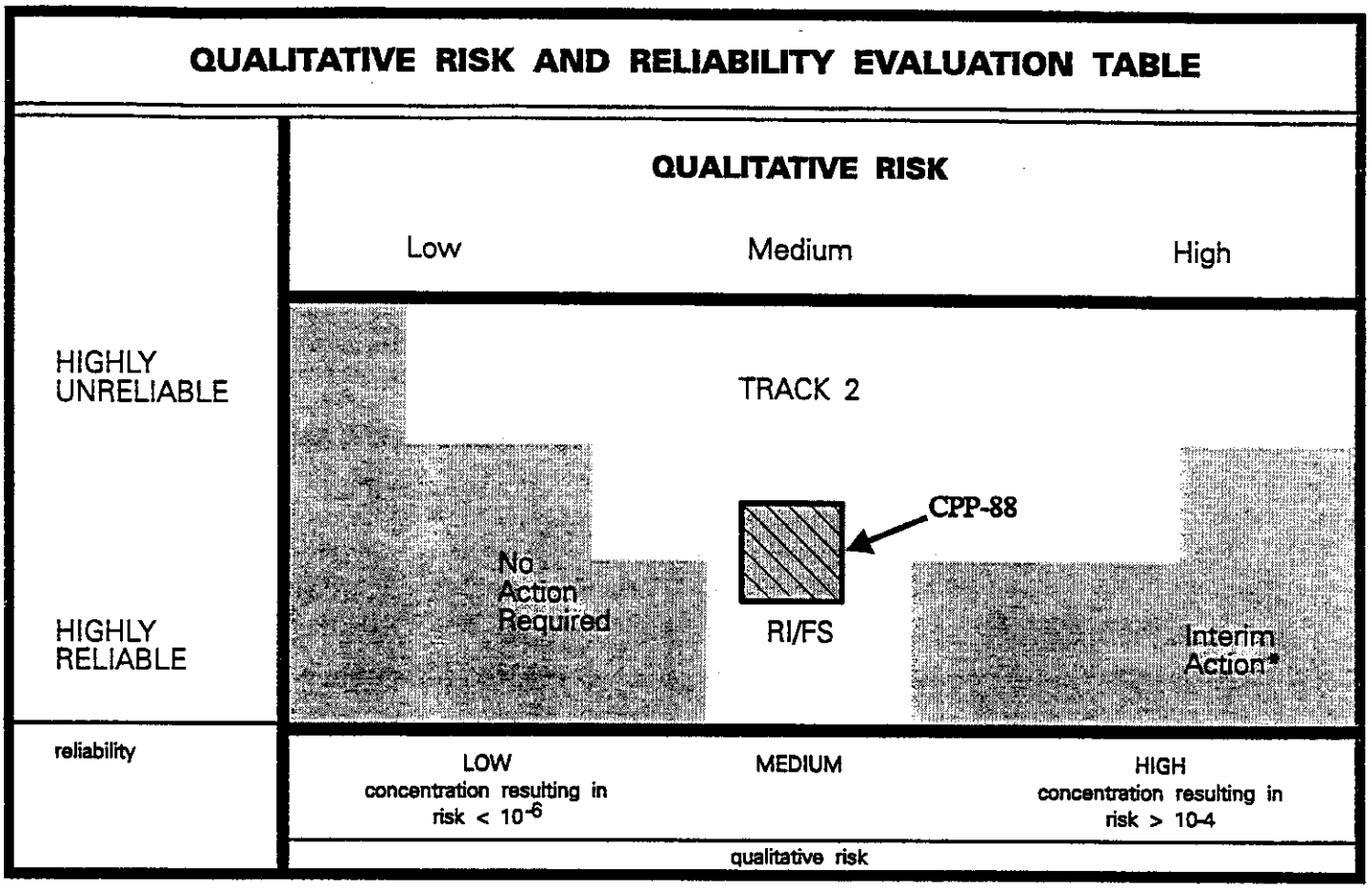
SITE ID CPP-88

PROCESS (Col 1) RADIOLOGICALLY CONTAMINATED SOILS

WASTE (Col 2) UNKNOWN

Col 4 What Known/Potential Hazardous Substance/ Constituents are Associated with this Waste or Process?	Col 5 Potential Sources Associated with this Hazardous Material	Col 6 Known/Estimated Concentration of Hazardous Substances/ Constituents	Col 7 Risk-based Concentration (mg/kg)	Col 8 Qualitative Risk Assessment (hi/med/low)	Col 9 Overall Reliability (hi/med/low)
Cs-137	contaminated soil	1500 pCi/g	0.035 pCi/g	medium*	medium*

* The lack of characterization data showing the location, contaminant identity, and concentration of contaminants associated with site CPP-88 indicate that the risk is medium, while the large volume of poor qulity information available for this site gives an overall reliability of medium.



* If sufficient data exist to identify an appropriate remedy.

Question 1. What are the waste generation process locations and dates of operation associated with this site?

Block 1 Answer:

The waste generation process locations for this site may include all radiological processes in the entire ICCP, which has been in operation since the 1950's. Major missions at the ICPP included storage and dissolution of spent nuclear fuel, and calcination of wastes generated by the dissolution of spent nuclear fuel. The exact origin of the numerous individual contaminated areas is not known.

Block 2 How reliable are the information sources? ___High ___Med _x_Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

Individual release events were not documented for this site. Releases were only discovered as an artifact when digging for construction activities, or during radiation surveys being conducted as part of other operations. ICCP missions have focused on storage and processing of spent nuclear fuel, and subsequent calcination and treatment of wastes generated by the spent fuel processing.

Block 3 Has this INFORMATION been confirmed? ___ Yes _x_No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available information	[ ]		Analytical data	[ ]	
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[x]	1	Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site drawings	[ ]		D&D report	[ ]	
Unusual Occurrence Report	[ ]		Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

Question 2. What are the disposal process locations and dates of operation associated with this site?

Block 1 Answer:

The waste disposal process locations are throughout the ICCP, where the radiologically contaminated soil is found. See Figures 1-3 in Reference 1.

Block 2 How reliable are the information sources? __High _x_Med __Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

The large number of detections indicate that contamination is fairly widespread. Radiologically contaminated soil locations are presented in Figure 1.

Block 3 Has this INFORMATION been confirmed? __ Yes _x_No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available information	[ ]		Analytical data	[ ]	
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[x]	1	Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site drawings	[ ]		D&D report	[ ]	
Unusual Occurrence Report	[ ]		Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

Question 3. Is there evidence that a source exists at this site? If so, lis the sources and describe the evidence.

Block 1 Answer:

The chronology of the data compilation for this site involved the following activities:

1) Acquisition of historical health physics (HP) records which mostly consisted of HP survey forms (Form #5601) and some excavation permits (Form #5612). These records covered the time period from December 1988 to March 1994.

2) Examination of approximately 20,000 pages of these records to identify soil-related radiation measurements. This examination also identified the headings or categories that are likely to indicate soil-related records. An additional 180,000 pages of records were then searched under the headings/categories likely to contain soil-related records.

3) Only the records that could be located by position (i.e., coordinates) were retained for the database. The precision in which the coordinates could be determined was designated by four indicators:

Excellent - coordinates located within 0.3 m (1 ft) of the measurement,
Good - coordinates located within 4.5 m (15 ft) of the measurement,
Fair - coordinates located within general area, and
Poor - coordinates location is a guess. The actual location may be hundre of meters (feet) from that shown on the map.

Block 2 How reliable are the information sources? ___High _x_Med ___Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

No sampling of soil has been conducted to determine exact locations and concentrations of contaminants. However, the large number of locations and instances in which elevated radiation readings were detected indicate that contamination is present.

Block 3 Has this INFORMATION been-confirmed? ___ Yes _x_No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available information	[ ]		Analytical data	[ ]	
Anecdotal	[ ]		Documentation about data	[x]	2
Historical process data	[x]	1	Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site drawings	[ ]		D&D report	[ ]	
Unusual Occurrence Report	[ ]		Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	

Question 4. Is there empirical, circumstantial, or other evidence of migration? If so, what is it?

Block 1 Answer:

Yes, there is circumstantial evidence of migration because areas of contamination were found at various times over almost the entire ICCP, as shown in Figures 1-3 (Reference 2).

Block 2 How reliable are the information sources? ___High ___Med _x_Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

Only radiological survey data exist. No confimation soil sampling has been conducted which gives radioactive contamination concentrations, or determines which radionuclides are present at each location.

Block 3 Has this INFORMATION been confirmed? ___ Yes _x_No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available information	[ ]		Analytical data	[ ]	
Anecdotal	[ ]		Documentation about data	[x]	2
Historical process data	[x]	1	Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site drawings	[ ]		D&D report	[ ]	
Unusual Occurrence Report	[ ]		Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

Question 5. Does site operating or disposal historical information allow estimation of the pattern of potential contamination? If the pattern is expected to be a scattering of hot spots, what is the expected minimum size of a significant hot spot?

Block 1 Answer:

Historical information between 1988 and 1994 consisting of HP log entries show contamination has been found as hot-spots at varying depths and are of various unknown sizes and shapes.

Block 2 How reliable are the information sources? ___High ___Med _x_Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

No confirmation soil sampling has been conducted to delineate the size and shape of the numerous areas of contamination included in CPP-88.

Block 3 Has this INFORMATION been confirmed? ___ Yes _x_No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available information	[ ]		Analytical data	[ ]	
Anecdotal	[ ]		Documentation about data	[x]	2
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site drawings	[ ]		D&D report	[ ]	
Unusual Occurrence Report	[ ]		Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

Question 6. Estimate the length, width, and depth of the contaminated region. What is the known or estimated volume of the source? If this is an estimated volume, explain carefully how the estimate was derived.

Block 1 Answer:

The individual contaminant sources included in CPP-88 are expected to be small. If the releases which resulted in the contaminated soil included in this site were large, it is assumed they would have been detected and evaluated as an individual site. For purposes of evaluating risk at this site, it was assumed a contaminated area measures 148 ft. by 148 ft. This corresponds to a 1/2 acre square residential lot size. None of the contaminated areas in CPP-88 are believed to be this large.

Block 2 How reliable are the information sources? ___High ___Med. _x_Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

No confirmation soil sampling has been conducted to delineate the size and shape of the numerous areas of contamination included in CPP-88.

Block 3 Has this INFORMATION been confirmed? ___ Yes _x_No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available information	[ ]		Analytical data	[ ]	
Anecdotal	[ ]		Documentation about data	[x]	2
Historical process data	[x]	1	Disposal data	[ ]	
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Unusual Occurrence Report	[ ]		Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

Question 7. What is the known or estimated quantity of hazardous substance/constituent at this source? If the quantity is an estimate, explain carefully how the estimate was derived.

Block 1 Answer:

The contaminated areas included in CPP-88 were defined or found with hand-held radiation survey instruments. Cs-137, the radionuclide most commonly found at the ICPP, can be readily detected with hand-held instruments. For this reason, and because Cs-137 is a risk driver at many ICPP sites, the contamination at the CPP-88 sites is assumed to be Cs-137 for evaluating risk. No specific metal or organic compound contamination is known (or suspected) to be associated with individual CPP-88 release sites.

The maximum Cs-137 concentration for CPP-88, of 1500 pCi/g, is calculated from the following assumptions:

- cpm survey data was > 50,000 cpm
- hand-held instrument efficiency is 10%
- minimum survey volume was 100 cm^3 (100 cm^2 area by 1 cm deep)
- 27 pCi/(d/s)
- soil density is 1.5 g/cm^3
- 60 s/m conversion factor

$((50{,}000 c/m)/100\ cm^3) \times m/60s \times cm^3/1.5g \times (10\ d/s)/(c/s) \times 27\ pCi/(d/s) = 1500\ pCi/g$

Block 2 How reliable are the information sources? ___High ___Med _x_Low (check

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

No confirmation soil sampling has been conducted to determine radioisotope contaminant concentrations or identity.

Block 3 Has this INFORMATION been confirmed? ___ Yes _x_No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available information	[ ]		Analytical data	[ ]	
Anecdotal	[ ]		Documentation about data	[x]	2
Historical process data	[x]	1	Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site drawings	[ ]		D&D report	[ ]	
Unusual Occurrence Report	[ ]		Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[3]	Limiting Soil Concentration Calculations (including GWSCREEN)			

Question 8. Is there evidence that this hazardous substance/constituent is present at the source as it exists today? If so, describe the evidence.

Block 1 Answer:

Yes, there is circumstantial evidence that a contaminant source exists at the site. The survey data obtained from HP survey logs generated during ICCP facility operations shows above background soil levels of radioactivity or radiation.

Block 2 How reliable are the information sources? ___High ___Med _x_Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

No confirmation soil sampling has been conducted to determine radioisotope contaminant concentrations or identity.

Block 3 Has this INFORMATION been confirmed? ___ Yes _x_No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available information	[ ]		Analytical data	[x]	1
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[x]	1	Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
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Unusual Occurrence Report	[ ]		Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

REFERENCES

1. Waste Area Group 3 Comprehensive Remedial Investigation/Feasibility Study Work Plan (Draft), Lockheed Idaho Technologies Company, INEL-95/0056, March 1995, section 2.3.1.1.

2. Technical Memorandum for the ICPP Radiologically Contaminated Soils, Lockheed Idaho Technologies Company, October, 1994, Appendix A.

3. Limiting Soil Concentration Calculations and GWSCREEN Results for Cs-137 at CPP-88.

DECISION DOCUMENTATION PACKAGE
COVER SHEET

PREPARED IN ACCORDANCE WITH

TRACK 1 SITES:
GUIDANCE FOR ASSESSING
LOW PROBABILITY HAZARD SITES
AT THE INEL

SITE DESCRIPTION:	CPP-709 RUTHENIUM DETECTION		
SITE ID:	CPP-90	OPERABLE UNIT:	3-13
WASTE AREA GROUP:	3		

I. SUMMARY — PHYSICAL DESCRIPTION OF THE SITE:

From 1952 to 1984 low-level and chemical service wastes from Idaho Chemical Processing Plant (ICPP) processes were discharged to the Snake River Plain Aquifer through the ICPP Disposal Well, CPP-03. Service waste from the Process Equipment Waste (PEW) Evaporator system, CPP-633, floor drains, steam condensate lines were routed through building CPP-709, the East Side Service Waste (ESSW) monitoring system building prior to discharge in CPP-03. A 24-in. (61 cm) concrete service waste transfer pipeline ran approximately 164.6 (540 ft) from CPP-709 to CPP-03. Due to suspected deterioration of the line, assumed to be correlated to ruthenium (Ru)-106 detections in upgradient CPP production wells, the concrete pipe was replaced in 1959-1960 with salt-glazed vitrified clay pipe and the joints were sealed with a synthetic rubber polymer. In 1969, due to suspected releases of tritium from leaks in the transfer line assumed to be correlated to increases of tritium in the production wells, the vitrified clay line was abandoned in place and replaced with a stainless steel line. In 1976, a leak in the stainless steel line released approximately 70,000 L of contaminated water containing approximately 60 μCi of radioactivity. At that time the line was repaired and in 1982, approximately two-thirds of the line was replaced. During construction of building CPP-684 and the 1982 upgrade of the service waste line, hot spots were detected along the pipeline. The service waste transfer line has not been used regularly since the majority of the service wastes were directed to the percolation ponds in 1984.

DECISION RECOMMENDATION

II. SUMMARY — QUALITATIVE ASSESSMENT OF RISK:

The overall data reliability of information collected for CPP-90 is medium as 3 separate transfer lines are believed to have leaked. The lack of contaminant concentration data from soil adjacent to the transfer line from CPP-709 to CPP-03 suggests the data reliability is less than high. Discharges into the injection well were monitored and known accidental discharges to the well also occurred. Because the amount of contaminants released from the transfer line to the adjacent soil is unknown, 20% of the volume released to the injection well was assumed to have leaked from the transfer line between 1953 and 1986. In addition, 20 percent of the 1/1/95 radionuclide activity in the injection well was used for risk assessment calculations. The overall reliability of risk analysis is based on concentrations of radionuclides (obtained from several years of monitoring studies) in the CPP-03 injection well which received waste from various ICPP processes through the CPP-709 monitoring station. Therefore, the qualitative risk is medium.

III. SUMMARY — CONSEQUENCES OF ERROR:

False negative error: If no further action is taken at this site, an occupational or residential receptor might be exposed to contaminants which could be present in concentrations greater than the limiting soil concentrations. The probability of a receptor being exposed to high concentrations of contaminants at this site is low.

False positive error: Unwarranted remediation of this site would result in a low return in environmental benefit from a relatively large investment of time and money.

IV. SUMMARY — OTHER DECISION DRIVERS:

Removal of contaminated soil along the entire length of the transfer line would be impractical because building CPP-684 is constructed over portions of both the abandoned and existing waste lines.

DECISION RECOMMENDATION

RECOMMENDED ACTION:

Further investigation of contamination at this site should be included in the WAG 3 Comprehensive Remedial Investigation/Feasibility Study (RI/FS). This recommendation is consistent with the scope of the current WAG 3 Remedial Investigation/Feasibility Study field investigations.

SIGNATURES	# PAGES: 18	DATE: 6/21/95
Prepared By:	DOE WAG Manager:	
Approved By:	Independent Review:	

DECISION STATEMENT (BY DOE RPM)	
DATE RECD:	
DISPOSITION	
DATE:	# PAGES (DECISION STATEMENT):
NAME:	SIGNATURE:

DECISION STATEMENT
(BY EPA RPM)

DATE RECD:

DISPOSITION

DATE:	# PAGES (DECISION STATEMENT):
NAME:	SIGNATURE:

DECISION STATEMENT
(BY STATE RPM)

DATE RECD:

DISPOSITION

DATE:	# PAGES (DECISION STATEMENT):
NAME:	SIGNATURE:

PROCESS/WASTE WORKSHEET

SITE ID: CPP-90

Col 1 Processes Associated with this Site	Col 2 Waste Description & Handling Procedures	Col 3 Description & Location of any Artifacts/Structures/Disposal Areas Associated with this Waste or Process
PEW Evaporator System, various floor drains, steam condensate lines and service waste from other ICPP facilities.	CPP-709 was a service waste monitoring station for various ICPP processes. If radiological contamination was detected in wastes, plant operators were instructed to discontinue operations and service waste was diverted. Ultimately, wastes were discharged to CPP-03 through the waste transfer pipeline.	Artifact: Radiologically contaminated soil Location: Beneath and adjacent to the service waste transfer line between building CPP-709 and disposal well CPP-03. Description: Liquid wastes from various CPP facilities were discharged through the CPP-709 service line to the CPP-03 injection well. The pipeline was replaced in 1960 and 1969 and partially replaced in 1982 after releases of service waste from deteriorated or damaged pipeline.

CONTAMINANT WORKSHEET

SITE ID CPP-90

PROCESS (Col 1) SERVICE WASTE LINE FROM BUILDING CPP-709 TO DISPOSAL WELL CPP-03

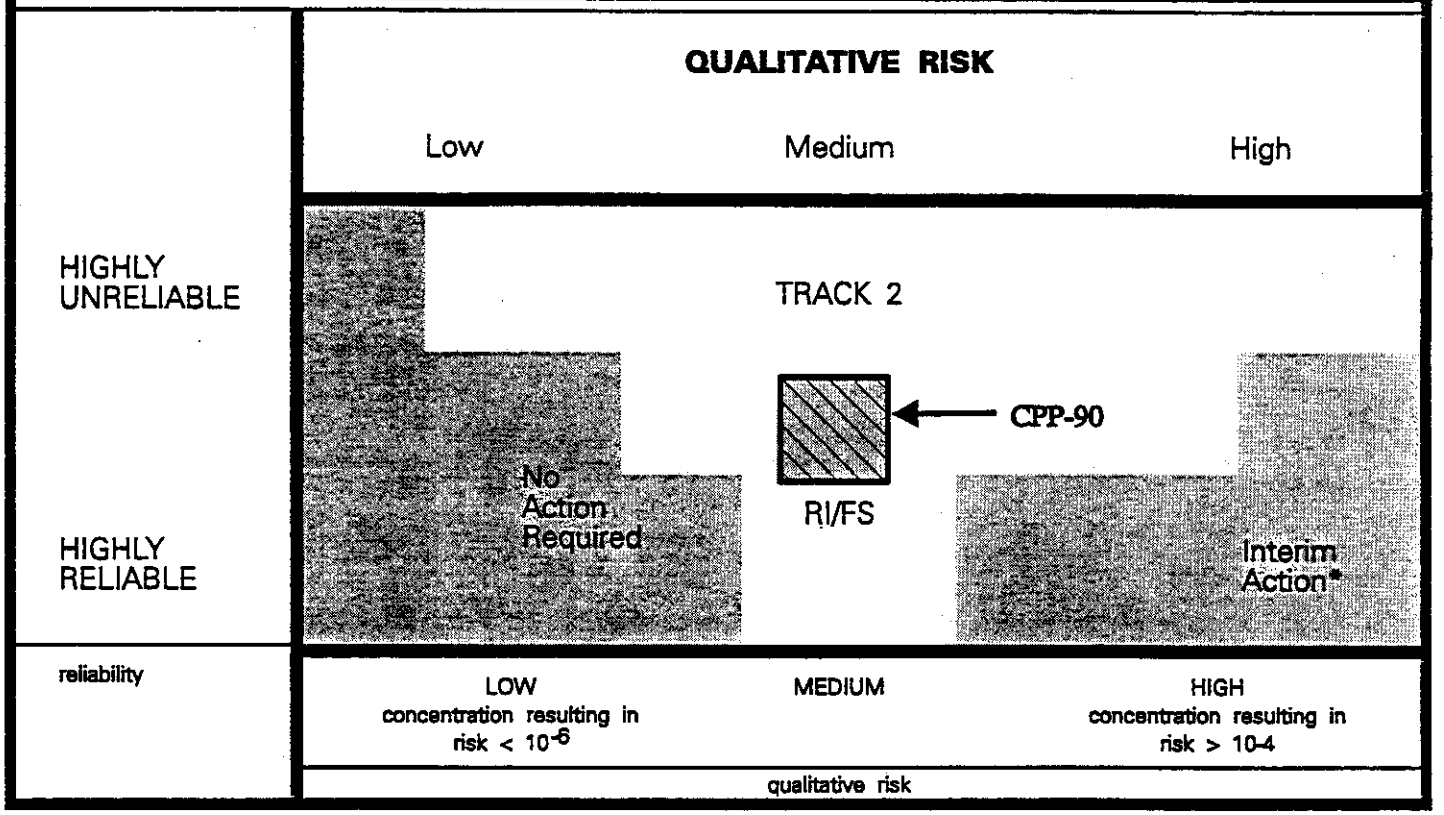
WASTE (Col 2) CONTAMINATED SOIL

Col 4 What Known/Potential Hazardous Substance/ Constituents are Associated with this Waste or Process?	Col 5 Potential Sources Associated with this Hazardous Material	Col 6 Known/Estimated Concentration of Hazardous Substances/ Constituents	Col 7 Risk-based Concentration (pCi/g)[a]	Col 8 Qualitative Risk Assessment (hi/med/low)	Col 9 Overall Reliability (hi/med/low)
Americium-241 (Am-241)	soil	2.22E-04 pCi/g	3.45E+00 pCi/g	Low	Medium
Cesium-137 (Cs-137)	soil	8.58E+00 pCi/g	3.48E-02 pCi/g	Medium	Medium
Europium-152 (Eu-152)	soil	3.1E-02 pCi/g	4.48E-02 pCi/g	Medium	Medium
Tritium (H-3)	soil	2.8E+03 pCi/g	5.93E+04 pCi/g	Low	Medium
Plutonium-238 (Pu-238)	soil	8.29E-02 pCi/g	4.55E+00 pCi/g	Low	Medium
Plutonium-239 (Pu-239)	soil	7.50E-03 pCi/g	3.44E+00 pCi/g	Low	Medium
Antimony-125 (Sb-125)	soil	8.79E-03 pCi/g	1.50E-01 pCi/g	Low	Medium
Strontium-90 (Sr-90)	soil	6.31E-00 pCi/g	4.54E+01 pCi/g	Low	Medium
Uranium-238 (U-238)	soil	4.91E-03 pCi/g	9.72E-01 pCi/g	Low	Medium
Uranium-235 (U-235)	soil	1.40E-03 pCi/g	1.46E-01 pCi/g	Low	Medium
Uranium-234 (U-234)	soil	1.64E-02 pCi/g	4.94E+01 pCi/g	Low	Medium

a. See Attachment 3 for groundwater risk assessment

8

QUALITATIVE RISK AND RELIABILITY EVALUATION TABLE



* If sufficient data exist to identify an appropriate remedy.

Question 1. What are the waste generation process locations and dates of operation associated with this site?

Block 1 Answer:

Waste generation process locations associated with CPP-709 include service wastes from the PEW evaporator system, CPP-633 (Waste Calcining Facility), CPP-601, including waste water from floor drains, steam condensate lines, and equipment cooling jackets. These wastes were routed to the CPP-709 monitoring station prior to discharge to the CPP-03 Injection Well. The greatest amount of radionuclide contaminants are suspected to result from PEW processes. These service wastes were routed to the percolation ponds in 1984.

Block 2 How reliable are the information sources? __High _x_Med ___Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

The processes and operational dates of the building CPP-709 and disposal well CPP-03 are documented in References 1 and 2. Process waste was monitored at CPP-709, however, limited documentation exists as to characterization of the service waste that passed through the monitoring station.

Block 3 Has this INFORMATION been confirmed? _x_ Yes ___ No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

Numerous sources (see block 4 below) containing the same information confirm that this is correct (Reference 3).

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available	[ ]		Analytical data	[ ]	
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[x]	3	Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site	[ ]		D&D report	[ ]	
Unusual Occurrence	[ ]		Initial assessment	[ ]	
Summary documents	[x]	1,2	Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

Question 2. What are the disposal process locations and dates of operation associated with this site?

Block 1 Answer:

Service wastes from the PEW evaporator system, CPP-633 (Waste Calcining Facility), CPP-601, including waste water from floor drains, steam condensate lines, and equipment cooling jackets were routed through the building CPP-709 monitoring station through the service line to the injection well, from 1953 until 1984 when service wastes were routed to the percolation ponds. The service line was replaced 2 times: 1959-60 & 1979, and partially replaced in 1982 due to suspected releases from pipeline leaks. The pipeline was also repaired a number of times due to releases. The monitoring equipment in CPP-709 detected radiological constituents in the wastewaters and an alarm signaled ICPP plant operators to terminate operations or divert the contaminated flows. The waste stream with the greatest potential for contamination was condensate from the PEW system, which was a source of Sr-90, Cs-137, Ru-106,and Co-60. Use of the injection well was discontinued in 1984 and was grouted in 1986. The transfer line was abandoned in place and has not been used since the injection well closure.

Block 2 How reliable are the information sources? _x_High ___Med ___Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

The operational dates of the service line from CPP-709 and the dates the service line was repaired and replaced are documented in the construction data (Reference 7).

Block 3 Has this INFORMATION been confirmed? _x_ Yes ___ No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

The information from the summary documents are consistent (Reference 1 & 2).

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available	[ ]		Analytical data	[ ]	
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[ ]	3	Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site	[ ]		D&D report	[ ]	
Unusual Occurrence	[ ]		Initial assessment	[ ]	
Summary documents	[ ]	1,2	Well data	[ ]	
Facility SOPs	[ ]		Construction data	[x]	7
OTHER	[ ]				

Question 3. Is there evidence that a source exists at this site? If so, list the sources and describe the evidence.

Block 1 Answer:

Yes, various radionuclides have been detected in the CPP service wells upgradient from the CPP-03 injection well and may have been related to deterioration of the service line from CPP-709 to CPP-03. In 1959, an increase in Ru-106 was thought to be directly related to the deterioration of the service line and the line was replace. Ruthenium has a very short half life and the radionuclide is no longer present. There was a change in the fission product inventory of the wastestream to CPP-706 and the maximum average monthly concentration of Ru-106 had occurred in December 1958. Another leak in the transfer line was suspected to be responsible for an increase in tritium levels in the CPP production wells in 1969. During replacement of the service line in 1982, areas of high radioactivity were detected in several locations in the soils adjacent to the transfer line.

Block 2 How reliable are the information sources? __High ___Med _x_Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

The historical process data and unusual occurrence references (Reference 2, 4, 6) were not adequately reliable to substantiate a correlation of radionuclide detections in the CPP production wells to leaks in the transfer line.

Block 3 Has this INFORMATION been confirmed? __ Yes _x_No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available	[ ]		Analytical data	[ ]	
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[x]	2	Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site	[ ]		D&D report	[ ]	
Unusual Occurrence	[x]	4,6	Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

Question 4. Is there empirical, circumstantial, or other evidence of migration? If so, what is it?

Block 1 Answer:

There is circumstantial evidence of migration. Though leaks in the transfer line were reported, a correlation between radiological contaminants from the transfer line to the CPP production wells was made based on circumstantial evidence of known releases from the transfer line. However, other contaminants found in the waste stream disposed of through CPP-03 were not found in production wells.

Block 2 How reliable are the information sources? __High _x_Med ___Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

No soil sampling adjacent to the transfer line has been conducted to determine the amount or types of contaminants released due to leaks in this pipeline (Reference 1). Information regarding radionuclide detections in the CPP production wells is reliable, but does not substantiate correlation of contaminants in production wells with the transfer line deterioration (Reference 4, 6).

Block 3 Has this INFORMATION been confirmed? __ Yes _x__ No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available	[ ]		Analytical data	[ ]	
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[x]	2	Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site	[ ]		D&D report	[ ]	
Unusual Occurrence	[x]	4,6	Initial assessment	[ ]	
Summary documents	[x]	1	Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

Question 5. Does site operating or disposal historical information allow estimation of the pattern of potential contamination? If the pattern is expected to be a scattering of hot spots, what is the expected minimum size of a significant hot spot?

Block 1 Answer:

No, historical information does not allow specific estimation of the pattern of potential contamination. It is not specifically known where leaks along the transfer line existed. Because the line was replaced 2 times and 2/3 of it was replaced in 1982, soil adjacent to the entire length of the line was considered potentially contaminated for this Track 1 investigation. The location of hot spots encountered during line replacement in 1982 is not known. The pattern of contamination is potentially hot spots at leaks or linear sources along the length of the existing and abandoned lines. The vertical extent of contamination beneath the line is assumed to be to the soil/basalt interface.

Block 2 How reliable are the information sources? ___High __Med _x_Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

Summary documents or historical process data references do not define the pattern of contamination. Soil sampling of areas where potential leaks from the line occurred has not been conducted.

Block 3 Has this INFORMATION been confirmed? ___ Yes _x_ No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available	[ ]		Analytical data	[ ]	
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[x]	2	Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site	[ ]		D&D report	[ ]	
Unusual Occurrence	[ ]		Initial assessment	[ ]	
Summary documents	[x]	1	Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

Question 6. Estimate the length, width, and depth of the contaminated region. What is the known or estimated volume of the source? If this is an estimated volume, explain carefully how the estimate was derived.

Block 1 Answer:

The entire area of the transfer line, conservatively estimated to be 213.36 m (700 ft) long, 10.67 m (35 ft) wide and assumed to be contaminated to the soil/basalt interface at a depth of 12.19 m (40 ft). The volume of service waste discharged to the soil was assumed to be 20 percent of the volume of service waste injected at disposal well CPP-03 (4.02E+10 L), i.e., 8.04E+09 L was leaked from the transfer line. Twenty percent is used as a conservative estimate since it is not known how much waste was disposed through the line while it was deteriorated or to the injection well while it was plugged with sediment.

Block 2 How reliable are the information sources? ___High _x_Med ___Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

Information regarding the length of the line is reliable (Reference 2); however the width and depth were estimated because no soil sampling adjacent to the line has been conducted.

Block 3 Has this INFORMATION been confirmed? ___ Yes _x_No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available	[ ]		Analytical data	[ ]	
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[x]	2	Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site	[ ]		D&D report	[ ]	
Unusual Occurrence	[ ]		Initial assessment	[ ]	
Summary documents	[x]	1	Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

Question 7. What is the known or estimated quantity of hazardous substance/constituent at this source? If the quantity is an estimate, explain carefully how the estimate was derived.

Block 1 Answer:

For purposes of this risk assessment, the contaminants of potential concern for this site are assumed to be those radionuclides disposed of in the injection well, including isotopes of americium, cesium, europium, antimony, hydrogen (tritium), plutonium, strontium, and uranium. Twenty percent of the radioactivity disposed of through the injection well (and decayed to 1/1/95) was used to determine concentrations in the contaminated volume of soil because 20 percent of the waste volume disposed of through the well was assumed to have leaked from the transfer line. These concentrations are listed in Attachment 1.

Block 2 How reliable are the information sources? ___ High _x_ Med __ Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

Amounts of contaminants released to the injection well have been substantiated by Reference 8. However, the amount of service waste that leaked from the service line cannot be substantiated through any of the references.

Block 3 Has this INFORMATION been confirmed? ___ Yes _x_ No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available	{ }				
Anecdotal	[ ]		Documentation about data	[x]	8
Historical process data	[x]	2	Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site	[ ]		D		
Unusual Occurrence	[ ]				[ ]
Summary documents	[x]	1	Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

Question 8. Is there evidence that this hazardous substance/constituent is present at the source as it exists today? If so, describe the evidence.

Block 1 Answer:

Yes, the evidence indicates that contaminants are in the soil adjacent to the pipelines. The lines were replaced three times due to suspected releases but no soil remediation has been conducted.

Block 2 How reliable are the information sources? ___High ___Med _x_Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

Estimates of radionuclide activity were derived from activity in the CPP injection well. No sampling of the area of concern has taken place.

Block 3 Has this INFORMATION been confirmed? __ Yes _x_No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available	[ ]		Analytical data	[ ]	
Anecdotal	[ ]		Documentation about data	[x]	8
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site	[ ]		D&D report	[ ]	
Unusual Occurrence	[ ]		Initial assessment	[ ]	
Summary documents	[x]	1	Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

REFERENCES

1. Waste Area Group 3 Comprehensive Remedial Investigation/Feasibility Study Work Plan (Draft), Lockheed Idaho Technologies Company, INEL-95/0056, March 1995. Section 1.

2. Document Title Unknown, Draft, Section 3, Inventory of ICPP Service Waste Streams and Section 3.2, Operating History, 1992.

3. Waste Management at the Idaho Chemical Processing Plant, A. L. Ayers, P. Burn, Phillips Petroleum Co., PTR-500,December 9, 1960.

4. Situation Report, Tritium in ICPP Production Wells, R. V. Batie, July 31, 1968.

5. New Site Identification Form, CPP-709 Ruthenium Detection Nu-7.94, October 10, 1994.

6. Low Activity Waste Disposal at the ICPP, InterOffice Correspondence, Phillips Petroleum Co., Rhod-5-6-A, May 24, 1960.

7. Specification for Service Waste Line and Fire Water Line Replacement - CPP, 842-CPP-201-U-1, September 16, 1959.

8. Waste Area Group 3 Comprehensive Remedial Investigation/Feasibility Study Work Plan (Draft), Lockheed Idaho Technologies Company, INEL-95/0056, March 1995. Section 2.

DECISION DOCUMENTATION PACKAGE
COVER SHEET

PREPARED IN ACCORDANCE WITH

TRACK 1 SITES:
GUIDANCE FOR ASSESSING
LOW PROBABILITY HAZARD SITES
AT THE INEL

SITE DESCRIPTION:	**WASTE CALCINING FACILITY (WCF) HOT CELL BLOWER PIT**		
SITE ID:	**CPP-91**	**OPERABLE UNIT:**	**3-13**
WASTE AREA GROUP:	**3**		

I. SUMMARY — PHYSICAL DESCRIPTION OF THE SITE:

The WCF (building CPP-633) was used to calcine liquid from spent fuel dissolution process into a solid form for dry storage. Liquids were directly injected into the calciner vessel where it was heated, originally indirectly with NaK, then later directly by kerosene combustion. As water in the liquid feed evaporated, dissolved metals in the feed formed solid oxides and salts.

The WCF Blower Pit (CPP-91) is a 13.67 by 8.92 ft. (inside dimensions) concrete vault located just below ground surface on the north side of building CPP-633. It contains the blowers used to provide a negative pressure of 0.75 in. water to hot cells in Building CPP-633. The WCF hot cells were ventilated by a blowers in the blower pit. The blowers drew air from the hot cells through a blower corridor on the north, east and west sides of the WCF and forced it to building CPP-649 for HEPA filtering and discharge. No release of contaminants from the vent duct is known to have occured. However, the blower pit contains a drain which is believed to discharge to the sediments approximately 10 ft. below the blower pit floor, which is approximately 10 ft. bls[1].

In 1992, a cleanup of the blower pit revealed elevated contamination levels on the blower pit walls and floor. During the cleanup, water from rain and snow melt had entered the blower pit and was observed to be flowing into the blower pit drain. A sample of the 4 in. of dirt on the blower pit floor showed elevated levels of cesium (Cs)-137, Cs-134, cobalt (Co)-60, europium (Eu)-154, and mercury. This indicates that a release of radioactive contamination may have occurred through the blower pit drain to the environment over the 25+ years since the WCF became operational. Upon discovery of the water and drain in 1992, the drain and blower pit were both sealed to prevent further infiltration of snow melt and subsequent draining of liquids to the environment.

DECISION RECOMMENDATION

II. SUMMARY – QUALITATIVE ASSESSMENT OF RISK:

A qualitative risk assessment was conducted for future residents at the site. The only viable exposure pathway due to the depth of contaminants (18 -22 ft. bls) at the CPP-91 site is the groundwater ingestion pathway for future residents. Based on TCLP results, the contaminants of concern associated with this site are Cs-137, Cs-134, Eu-154 and Co-60, and mercury which were found in approximate concentrations of 2481, 50.1, 218, 58 pCi/g, and 0.19 mg/kg respectively. These contaminants of concern are those compounds which have blower pit dirt concentrations (estimated from TCLP analysis results) greater than their corresponding 95% UTL background soil concentration. None of the compounds were found in excess of 40CFR 261 TCLP concentration limits.

Because the groundwater ingestion pathway is the only viable exposure pathway for this site the lowest risked based soil concentration is "pure" for all of the radioactive contaminants of concern. "Pure" means that due to the contaminants relatively short half-lives, GWSCREEN returned a limiting soil concentration for the contaminant much greater than its specific activity (specific activity is the activity per gram of the pure radionuclide). For example, Cs-137 has a specific activity of 87 Ci/g while the GWSCREEN limiting soil concentration is $3.0 \times 10^{+222}$ Ci/g. The limiting soil concentration for Hg was found to be 2.94×10^{5} mg/kg. This is almost pure Hg, as 10^{6} mg/kg (1 kg/kg) is pure. The risk is considered low as concentrations of contaminants found in the dirt at the bottom of the pit were not greater than the risk based limiting soil concentrations. The reliability of data for this site is considered low as no sampling has been conducted of soils at the blower pit drain outfall.

III. SUMMARY – CONSEQUENCES OF ERROR:

False negative error: If no further action is taken receptor might be exposed to contaminants present at this site. The probability of a receptor being exposed to high concentrations of contaminants at this site is believed to be low however.

False positive error: Unwarranted remediation of this site would result in a low return in environmental benefit from a relatively large investment of time and money.

IV. SUMMARY – OTHER DECISION DRIVERS:

The WAG 3 Comprehensive RI/FS is being scoped which allows field work for this site to be included in the RI/FS scope of work. Additionally, the sampling and analysis done for the blower pit dirt was not per standard CERCLA protocol and did not include complete radioanalysis.

DECISION RECOMMENDATION

RECOMMENDED ACTION:

Because of the lack of characterization data for soils near where the drain empties to the environment, this site (CPP-91) is recommended for further investigation in the WAG 3 (OU 3-13) Comprehensive RI/FS.

SIGNATURES	# PAGES:	DATE:
Prepared By:	DOE WAG Manager:	
Approved By:	Independent Review:	

DECISION STATEMENT
(BY DOE RPM)

DATE RECD:

DISPOSITION

DATE:	# PAGES (DECISION STATEMENT):
NAME:	SIGNATURE:

DECISION STATEMENT (BY EPA RPM)	
DATE RECD:	
DISPOSITION	
DATE:	# PAGES (DECISION STATEMENT):
NAME:	SIGNATURE:

DECISION STATEMENT
(BY STATE RPM)

DATE RECD:

DISPOSITION

DATE:	# PAGES (DECISION STATEMENT):
NAME:	SIGNATURE:

PROCESS/WASTE WORKSHEET

SITE ID: CPP-91

Col 1 Processes Associated with this Site	Col 2 Waste Description & Handling Procedures	Col 3 Description & Location of any Artifacts/Structures/Disposal Areas Associated with this Waste or Process
Ventilation of WCF hot cells	A negative air pressure of 0.75" water was maintained in the WCF hot cells. Vent gases from the WCF hot cells were drawn through the blower corridor and blown to building CPP-649 for HEPA filtering and discharge by a blower contained in the blower pit at the NW corner of CPP-633.	Artifact: The WCF blower pit Location: The blower pit is at the northwest corner of building CPP-633. Description: The WCF Blower Pit (CPP-91) is a 13.67 by 8.92 ft. (inside dimensions) concrete vault located just below ground surface on the north side of building CPP-633. It contains the blowers used to provide a negative pressure of 0.75 in. water to hot cells in Building CPP-633.
		Artifact: WCF blower pit drain Location: at the bottom of the WCF blower pit. Description: The drain is believed to terminate in the soils approximately 6 to 10 ft. below the bottom of the blower pit (18-22 ft. below ground surface).
		Artifact: Location: Description:
		Artifact: Location: Description:

CONTAMINANT WORKSHEET

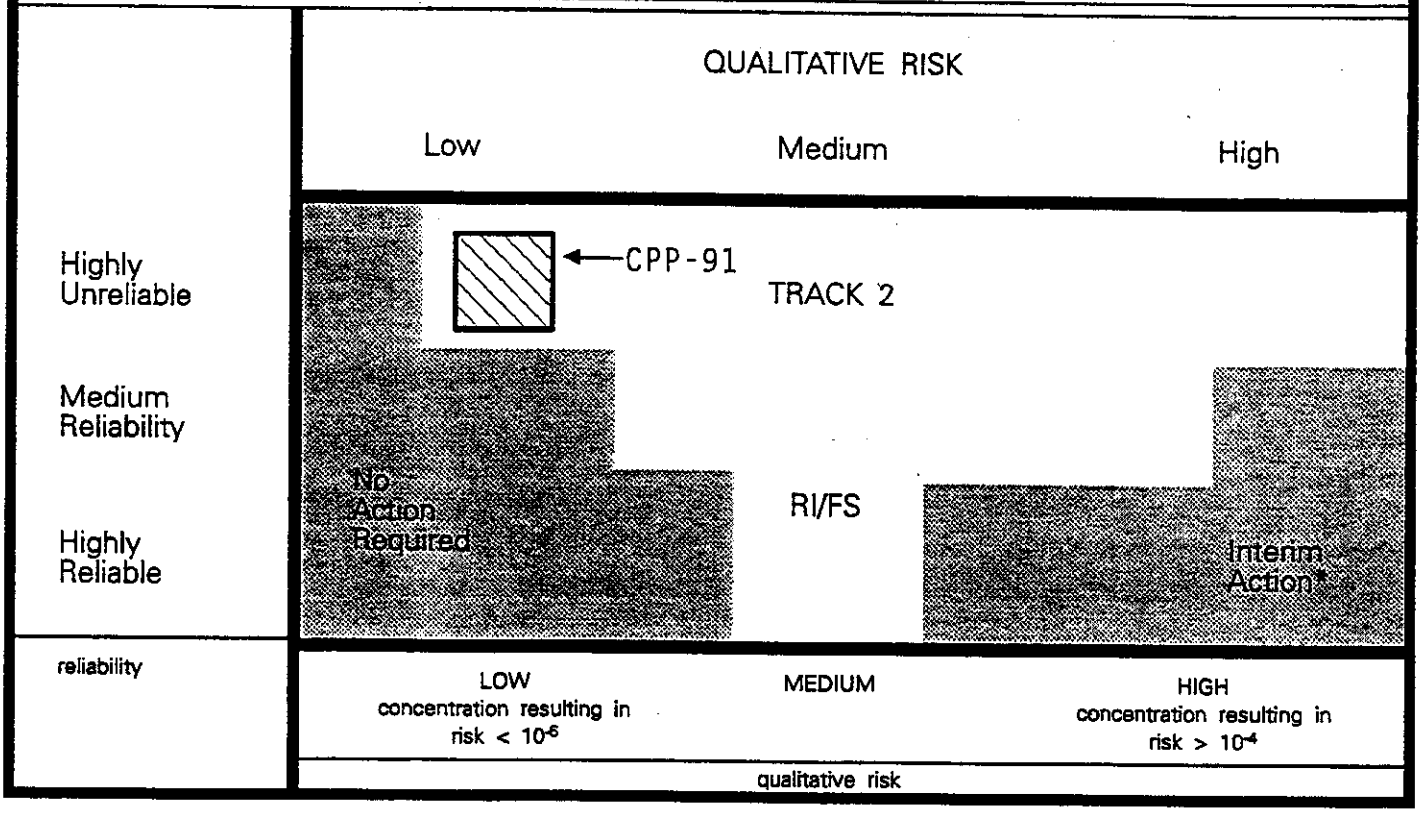
SITE ID CPP-91

PROCESS (Col 1) Blower pit drain **WASTE** (Col 2) Soil contaminated by drain water

Col 4 What Known/Potential Hazardous Substance/ Constituents are Associated with this Waste or Process?	Col 5 Potential Sources Associated with this Hazardous Material	Col 6 Known/Estimated Concentration of Hazardous Substances/ Constituents	Col 7 Risk-based Concentration (mg/kg)	Col 8 Qualitative Risk Assessment (hi/med/low)	Col 9 Overall Reliability (hi/med/low)
Cs-137	contaminated soil	2,481 pCi/g	pure[a]	low	low
Cs-134	contaminated soil	50.1 pCi/g	pure[a]	low	low
Co-60	contaminated soil	58 pCi/g	pure[a]	low	low
Eu-154	contaminated soil	218 pCi/g	pure[a]	low	low
mercury	contaminated soil	0.19 mg/kg	1.26E+05	low	low

[a] Pure - concentration greater than 10^6 mg/kg or a radionuclides specific activity.
Risk based concentrations are for groundwater ingestion pathway
ND = not detected
DL = detection limit.

Table 4. Qualitative Risk and Reliability Evaluation Table (CPP-91)



* If sufficient data exist to identify an appropriate remedy.

Question 1. What are the waste generation process locations and dates of operation associated with this site?

Block 1 Answer:

The WCF (CPP-633) calcined highly radioactive liquid spent fuel dissolution process effluent from 1963 through 1981, at which time it was replaced by the New Waste Calcining Facility (NWCF). The WCF hot cells were ventilated by a blowers in the blower pit. The blowers drew air from the hot cells through a blower corridor on the north, east and west sides of the WCF and forced it to building CPP-649 for HEPA filtering and discharge.

Block 2 How reliable are the information sources? _x_ High ___ Med ___ Low (check one)

Explain the reasoning behind this evaluation.

The operational dates of the WCF are documented.

Block 3 Has this INFORMATION been confirmed? _x_ Yes ___ No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

The operational dates of the WCF are documented in monthly reports and operating logs.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available information	[ ]		Analytical data	[ ]	
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site drawings	[ ]		D&D report	[ ]	
Unusual Occurrence Report	[ ]		Initial assessment	[ ]	
Summary documents	[x]	1	Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

Question 2. What are the disposal process locations and dates of operation associated with this site?

Block 1 Answer:

From 1963 to the present a negative air pressure of 0.75" water has been maintained in the WCF hot cells by a blower housed in the blower pit at the northwest corner of CPP-633. During cleanup of the blower pit in 1992 water which had infiltrated from rain and snowmelt was observed to be draining down a drain in the blower pit. The drain is believed to end in surrounding soils approximately 10 ft. below bottom of the blower pit. The bottom of the blower pit is approximately 10 ft. below land surface. The blower pit and drain were each consequently sealed to prevent further infiltration of water. A Permacon stainless steel coverwas built over the blower pit. The drain in the blower pit floor was sealed using an expandable rubber pipe plug. The plug was then sealed with a coating of silicon.

Block 2 How reliable are the information sources? __High _x_Med __Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

No accurate "as-built" drawings of the blower pit drain have been found to indicate where the drain ends.

Block 3 Has this INFORMATION been confirmed? _x_ Yes ___No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

Recent drawings show the plans and specifications for making the blower pit water tight, confirming the written reports that this was done.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available information	[ ]		Analytical data	[ ]	
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site drawings	[x]	2	D&D report	[ ]	
Unusual Occurrence Report	[ ]		Initial assessment	[ ]	
Summary documents	[x]	1	Well data	[ ]	
Facility SOPs	[ ]		Construction data	[x]	5
OTHER	[ ]				

Question 3. Is there evidence that a source exists at this site? If so, list the sources and describe the evidence.

Block 1 Answer:

Yes, as the dirt/sludge in the blower pit contained elevated levels of radionuclides and metals it is likely some contamination drained to the environment through the blower pit drain. To convert the TCLP extract dirt sample analysis results to total dirt analysis units, the metals values reported were multiplied by 20 (mg/l extract x 2 l extract/100 g dirt x 1000 g/kg), while the gamma scan extract results for radioactive contaminants were converted to total analysis results by multiplying the d/s/ml results by 2000 ml extract/100 g dirt and by 1 pCi/0.037 d/s to obtain units of pCi/g. These converted "total analysis" concentration values were then compared to background soil concentration values contained in the Track 1 guidance. Compounds whose total analysis concentration value exceeded its respective upper tolerance limits background concentration is considered a contaminant of concern as listed in the summary on page 1.

Block 2 How reliable are the information sources? ___High _x_Med ___Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

No accurate drawings of the blower pit drain have been found to indicate where the drain ends.

Block 3 Has this INFORMATION been confirmed? ___ Yes _x_No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

Sampling and analysis of the sirt in the blower pit was not conducted using standard techniques used for CERCLA investigations. The TCLP data that was obtained was not validated.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available information	[ ]		Analytical data	[ ]	
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site drawings	[ ]		D&D report	[ ]	
Unusual Occurrence Report	[ ]		Initial assessment	[ ]	
Summary documents	[x]	1	Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

Question 4. Is there empirical, circumstantial, or other evidence of migration? If so, what is it?

Block 1 Answer:

Yes, water was observed running out of the pit through the drain is circumstantial evidence. Samples of dirt in the bottom of the blower pit showed elevated levels of Cs-137, Cs-134, Eu-154, Co-60, and Hg.

Block 2 How reliable are the information sources? ___High ___Med _x_Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

No systemized sampling has been conducted on the soils surrounding the blower pit drain.

Block 3 Has this INFORMATION been confirmed? ___ Yes _x_No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available information	[x]		Analytical data	[ ]	
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site drawings	[ ]		D&D report	[ ]	
Unusual Occurrence Report	[ ]		Initial assessment	[ ]	
Summary documents	[x]	1	Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

Question 5. Does site operating or disposal historical information allow estimation of the pattern of potential contamination? If the pattern is expected to be a scattering of hot spots, what is the expected minimum size of a significant hot spot?

Block 1 Answer:

If contamination did flow down the drain it would be expected to exist as a hotspot at the point where the drain empties to the surrounding soils. The amount of contamination released is not believed to be large as direct radiation surveys of the blower pit walls and the trash removed from the pit were not significantly elevated. While anecdotal information indicated that the trash bags removed from the pit had levels up to 500 mR/hr on contact, the survey form from when 15 bags of trash were removed from the pit showed them all to be < 100 counts per minute (cpm) with hot spots on the blower pit wall of 200 and 300 cpm (one trash bag had a hot spot of 10 mR/hr). In addition to the low levels of radiation found during surveys of the trash, the low annual precipitation rates at the INEL indicate that the amount of water from rain/snowmelt (which is the only known water source) which could have infiltrated into the blower pit to empty through the blower pit drain is small.

Block 2 How reliable are the information sources? ___High ___Med _x_Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

No systemized sampling has been conducted on the soils surrounding the blower pit drain.

Block 3 Has this INFORMATION been confirmed? ___ Yes _x_No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available information	[ ]		Analytical data	[x]	3
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site drawings	[ ]		D&D report	[ ]	
Unusual Occurrence Report	[ ]		Initial assessment	[ ]	
Summary documents	[x]	1	Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

Question 6. Estimate the length, width, and depth of the contaminated region. What is the known or estimated volume of the source? If this is an estimated volume, explain carefully how the estimate was derived.

Block 1 Answer:

Based on the estimated pattern of contamination described in question 5, the contaminant source at this site is estimated to be small, approximately 1 cubic meter. This is based on the size of similar sites elsewhere at the INEL and the small amount of water believed to have emptied the blower pit through the drain. Alluvium thickness at the ICPP is approximately 40 ft. while the depth to groundwater is about 450 ft. Available drawings (not to scale) indicate the drain may end 18 - 22 ft. below ground surface. The contaminants of concern at this site are likely to be adsorbed to the alluvium near the drain outfall.

Block 2 How reliable are the information sources? ___High ___Med _x_Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

No systemized sampling has been conducted on the soils surrounding the blower corridor.

Block 3 Has this INFORMATION been confirmed? ___ Yes _x_No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available information	[x]		Analytical data	[ ]	
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site drawings	[ ]		D&D report	[ ]	
Unusual Occurrence Report	[ ]		Initial assessment	[ ]	
Summary documents	[x]	1	Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

Question 7. What is the known or estimated quantity of hazardous substance/constituent at this source? If the quantity is an estimate, explain carefully how the estimate was derived.

Block 1 Answer:

Based on the assumed volume of soil contamination (1 m^3) and the contaminant concentrations of the sludge in the blower pit, the estimated quantity of hazardous substances in the soil is 3.72 mCi Cs-137, 75.2 µCi Cs-134, 86.7 µCi Co-60, 0.33 mCi Eu-154, and 285 mg Hg (assuming a soil bulk density of 1500 kg/m^3). For example:

$$2481\ \frac{pCi}{g}\ Cs\text{-}137 \times 1500\ \frac{kg}{m^3} \times 1\ m^3 \times 1000\ \frac{g}{kg} \times \frac{10^{-9}\ mCi}{pCi} = 3.72\ mCi$$

Block 2 How reliable are the information sources? ___High ___Med _x_Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

No systemized sampling has been conducted on the soils surrounding the blower pit drain exit.

Block 3 Has this INFORMATION been confirmed? ___ Yes _x_No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

The available analytical data has not been validated and was not developed using standard CERCLA techniques.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available information	[ ]		Analytical data	[ ]	
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site drawings	[ ]		D&D report	[ ]	
Unusual Occurrence Report	[ ]		Initial assessment	[ ]	
Summary documents	[x]	1	Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

Question 8. Is there evidence that this hazardous substance/constituent is present at the source as it exists today? If so, describe the evidence.

Block 1 Answer:

Yes, circumstantial evidence of a contaminant source in the soil at the bottom of the blower pit drain consists of the observance of water trickling down the blower pit drain and the analytical results showing the dirt in the blower pit is contaminated with metals and radionuclides.

Block 2 How reliable are the information sources? ___High ___Med _x_Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

No systemized sampling has been conducted on the soils surrounding the blower pit drain exit.

Block 3 Has this INFORMATION been confirmed? ___ Yes _x_No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available information	[ ]		Analytical data	[x]	1
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site drawings	[ ]		D&D report	[ ]	
Unusual Occurrence Report	[ ]		Initial assessment	[ ]	
Summary documents	[x]	1	Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

REFERENCES

1. Documentation package consisting of memorandums of conversation, drawings, and analytical data from cleanout of the blower pit in 1992.

2. Engineering Drawings for CPP 633 Blower Pit Cover installation, drawing numbers 097372 - 097377

3. Radiation Control survey form from removal of trash from blower pit in 1992.

4. GWSCREEN results from CPP-91 runs for Hg, Ag, Cs-137, Co-60, and Eu-154.

DECISION DOCUMENTATION PACKAGE
COVER SHEET

PREPARED IN ACCORDANCE WITH

TRACK 1 SITES:
GUIDANCE FOR ASSESSING
LOW PROBABILITY HAZARD SITES
AT THE INEL

SITE DESCRIPTION: RADIOLOGICAL SOIL BOXES

SITE ID: CPP-92 **OPERABLE UNIT:** 3-13

WASTE AREA GROUP: 3

I. SUMMARY — PHYSICAL DESCRIPTION OF THE SITE:

This Track 1 package describes the Idaho Chemical Processing Plant (ICPP) release site CPP-92 "Radiological Soils Boxes." CPP-92 is a group of soil boxes located west of building CPP-1617, northwest of building CPP-603. The site consists of approximately 1,250 boxes containing soil with low levels of radioactive contamination. The 1- x 1- x 2-m (4- x 4- x 8-ft.) boxes are constructed of 1.8-cm (3/4-in.) plywood and are lined with a polyethylene membrane. The soil in the boxes was generated during a variety of ICPP activities, including the Tank Farm Upgrade, the building CPP-603 cleanup, construction of the emergency fire exit tunnel for building CPP-604/605, and the cleanup of soil at site CPP-17. Most of the boxes contain soil which cannot be accepted for disposal at the RWMC.

Approximately 250 of the boxes associated with Site CPP-92 contain soil excavated during a 1991-1992 installation of an emergency fire exit from the basement of CPP-604/605 (site CPP-89). The excavated soil was contaminated by various releases from pipeline leaks including nitric acid and condensates from the Process Equipment Waste (PEW) evaporator system. Soil in the boxes from this excavation was sampled in 1992 and the 1993. Analytical results indicate radiological contaminants include tritium (H-3), Strontium (Sr)-90, Ruthenium (Ru)-106, Cesium (Cs)-137, and Cerium (Ce)-144. Organic compounds and inorganic contaminants were not detected at concentrations above background.

I. SUMMARY — PHYSICAL DESCRIPTION OF THE SITE(CONTINUED):

Site CPP-92 also contains approximately 600 boxes of soil from site CPP-17, a storage area for soil, concrete, asphalt, and other debris. Radiation surveys of the soil and debris piles performed in 1991 had indicated radioactivity levels ranged from 100 to 22,000 counts per minute (cpm). Soil was monitored during the removal with a RO-2A meter; however, contamination was not detected. Results of gamma spectroscopy analyses indicated the presence of low levels of Cs-137. During containerization, grab samples were collected and analyzed for radiological constituents and by the toxicity characteristic leaching procedure (TCLP) for metals. The soil was not a characteristic hazardous waste. Site CPP-17 soil contained low levels of Cs-137 (19.4 pCi/g), Sr-90 (2.72 pCi/g), europium (Eu)-152 (2.07 pCi/g), and Eu-154 (1.88 pCi/g). Site CPP-92 also contains 102 boxes of soil from the excavation of valve box 39 at the ICPP Tank Farm and 300 boxes of soil from the building CPP-603 area cleanup. Soil from these two sites is contaminated with low levels of Cs-137.

The contaminant concentrations of CPP-92 boxed soil from the tank farm, from building CPP-603 cleanup, and from site CPP-17 are much lower than those concentrations found in Site CPP-89 boxed soil. Therefore the contaminant concentrations found in the CPP-89 boxed soil were used for comparison to risk-based calculated soil concentrations.

DECISION RECOMMENDATION

II. SUMMARY — QUALITATIVE ASSESSMENT OF RISK:

The qualitative risk at site CPP-92 is low. Some maximum contaminant concentrations are above their corresponding risk based limiting soil concentrations, however, the soil is currently containerized in polyethylene lined plywood boxes. The limiting soil concentrations are calculated assuming the soil is not in boxes but has been released to the environment. Although some of the boxes are beginning to deteriorate, the likelihood of a release of contaminated soil large enough to pose a significant risk to receptors is considered small for the near future. The data on which this assessment is based is considered to be of medium quality.

III. SUMMARY — CONSEQUENCES OF ERROR:

False negative error: If no further action is taken receptors might be exposed to contaminants which could be present at this site in concentrations greater than the limiting soil concentration. The probability of a receptor being exposed to high concentrations of contaminants at this site is low, since the soil is contained in boxes.

False positive error: Unwarranted remediation of this site would result in a low return in environmental benefit from a relatively large investment of time and money.

IV. SUMMARY — OTHER DECISION DRIVERS:

The WAG 3 Comprehensive Remedial Investigation/Feasibility Study (RI/FS) is currently being scoped. Therefore, further analysis of Site CPP-92 should occur during the WAG 3 RI/FS, rather than through a Track 2 Investigation.

DECISION RECOMMENDATION

RECOMMENDED ACTION:

CPP-92 is recommended for inclusion in the WAG 3 Comprehensive RI/FS for analysis of remedial alternatives. It is not believed that additional sampling and analysis is prudent because of the large number of boxes associated with CPP-92, the significant amount of existing data, and because the soil is confined in the boxes and is, therefore, not likely to migrate or allow exposure to receptors.

SIGNATURES	# PAGES: 19	DATE: 6/21/95
Prepared By:	DOE WAG Manager:	
Approved By:	Independent Review:	

DECISION STATEMENT
(BY DOE RPM)

DATE RECD:

DISPOSITION

DATE:	# PAGES (DECISION STATEMENT):
NAME:	SIGNATURE:

DECISION STATEMENT
(BY EPA RPM)

DATE RECD:

DISPOSITION

DATE:	# PAGES (DECISION STATEMENT):
NAME:	SIGNATURE:

DECISION STATEMENT
(BY STATE RPM)

DATE RECD:

DISPOSITION

DATE:	# PAGES (DECISION STATEMENT):
NAME:	SIGNATURE:

PROCESS/WASTE WORKSHEET

SITE ID: CPP-92

Col 1 Processes Associated with this Site	Col 2 Waste Description & Handling Procedures	Col 3 Description & Location of any Artifacts/Structures/Disposal Areas Associated with this Waste or Process	
Any of the spent nuclear fuel handling and processing operations may have contributed to the contamination in the boxed soils. Processes known to have contributed contamination to some portion of the boxed soil include the PEW system, the high-level radioactive waste storage tank farm (valve box 39 excavation), and fuel handling activities associated with the Building CPP-603 basins.	Leaks from deteriorated piping and other unintentional releases have been encountered during various construction activities at the ICPP, including soil found contaminated from leaking PEW pipes that was encountered during excavation for the emergency fire exit for building CPP-604/605.	Artifact:	250 boxes of contaminated soil from the CPP-604/605 emergency fire exit excavation
		Location:	Stored west of CPP-1617 / northwest of building CPP-603.
		Description:	Soil removed from underneath and outside of building CPP-604/605 (in SWMU-59)(Site CPP-89)(see contaminant worksheet for contaminant concentrations).
		Artifact:	100 boxes of soil from the excavation of valve box 39 at the ICPP tank farm.
		Location:	Stored west of CPP-1617/northwest of building CPP-603.
		Description:	Soil contaminated with Cs-137 up to 66 pCi/g.
		Artifact:	300 boxes of soil from outside building CPP-603.
		Location:	Stored west of CPP-1617/northwest of building CPP-603.
		Description:	Soil contaminated with Cs-137 up to 305 pCi/g and Co-60 of up to 57.5 pCi/g
		Artifact:	Approximately 600 boxes of contaminated soil and debris removed from Site CPP-17.
		Location:	Stored west of CPP-1617/northwest of building CPP-603.
		Description:	Soil, concrete and asphalt from various CPP excavations and construction projects were stored at site CPP-17. Contaminant concentrations in the boxed soil from CPP-17 are 19.4 pCi/g Cs-137, 0.54 pCi/g Co-57, 2.07 pCi/g Eu-152, 1.88 pCi/g Eu-154, and 2.72 pCi/g Sr-90.

CONTAMINANT WORKSHEET

SITE ID CPP-92

PROCESS (Col 1) CPP-604/605 SOILS **WASTE** (Col 2) BOXED CONTAMINATED SOIL

Col 4 What Known/Potential Hazardous Substance/ Constituents are Associated with this Waste or Process?[a]	Col 5 Potential Sources Associated with this Hazardous Material	Col 6 Known/Estimated Concentration of Hazardous Substances/ Constituents[b]	Col 7 Risk-based Concentration (mg/kg)[c]	Col 8 Qualitative Risk Assessment (hi/med/low)	Col 9 Overall Reliability (hi/med/low)
Arsenic	soil	5.90E-3 mg/Kg	8.1E+01	Low	Low
Barium	soil	1.26E-1 mg/Kg	1.8E+04	Low	Low
Cadmium	soil	1.00E-3 mg/Kg	1.3E+02	Low	Low
Chromium	soil	2.13E-2 mg/Kg	2.0E+06	Low	Low
Lead	soil	1.20E-2 mg/Kg	Not determined[d]	Low	Low
Mercury	soil	1.04E-2 mg/Kg	8.1E+01	Low	Low
Selenium	soil	4.00E-4 mg/Kg	1.3E+03	Low	Low
Silver	soil	2.00E-4 mg/Kg	1.3E+03	Low	Low
Sb-125	Soil	1.30E+01 pCi/g	1.5E-01 pCi/g	High	Medium
Sr-90	soil	1.08E+04 pCi/g	4.9E+01 pCi/g	High	Medium

a. Ru-106, Ce-144, Co-58, and Ru-103 were originally detected but were not evaluated as their halflives are short enough and they had decayed to stable isotopes.
b. The maximum concentrations for contaminants of concern were based on September 1993 sample results from site CPP-89.
c. The most conservative pathway was used, see Reference 6 for risk assessments.

d. No reference dose for lead exists so a limiting soil concentration could not be calculated.

CONTAMINANT WORKSHEET

SITE ID CPP-92

PROCESS (Col 1) CPP-604/605 SOILS **WASTE** (Col 2) BOXED CONTAMINATED SOIL

Col 4 What Known/Potential Hazardous Substance/ Constituents are Associated with this Waste or Process?[a]	Col 5 Potential Sources Associated with this Hazardous Material	Col 6 Known/Estimated Concentration of Hazardous Substances/ Constituents[b]	Col 7 Risk-based Concentration (pCi/g)[c]	Col 8 Qualitative Risk Assessment (hi/med/low)	Col 9 Overall Reliability (hi/med/low)
Am-241	soil	2.36E+01 pCi/g	3.5E+00	High	Low
Co-60	soil	3.90E+00 pCi/g	2.1E-02	High	Low
Cs-134	soil	2.30E+00 pCi/g	3.5E-02	High	Low
Cs-137	soil	773E+03 pCi/g	3.5E-02	High	Low
Eu-152	soil	2.0 E+00 pCi/g	5 E-02	Medium	Low
Eu-154	soil	1.9 E+00 pCi/g	5 E-02	Medium	Low
I-129	soil	3.10E+00 pCi/g	4.2E+00	High	Low
Np-237	soil	1.5E-01 pCi/g	8.1E-02	High	Low
Pu-238	soil	2.59E+02 pCi/g	4.6E+00	High	Low
Pu-239/240	soil	2.47E+01 pCi/g	3.4E+00	High	Low
U-234	soil	5.10E+00 pCi/g	4.9E+01	Low	Medium
U-235	soil	2.3E-01 pCi/g	1.5E-01	Medium	Medium
U-238	soil	1.20E+00 pCi/g	9.7E-01	Medium	Medium

a. Ru-106, Ce-144, Co-58, and Ru-103 were originally detected but were not evaluated as their halflives are short enough and they had decayed to stable isotopes.
b. The maximum concentration from September 1993 sampling of Site CPP-89 was used for determination of risk based concentration.
c. The most conservative pathway was used, see Reference 6 for risk assessments.

9

QUALITATIVE RISK AND RELIABILITY EVALUATION TABLE

	QUALITATIVE RISK		
	Low	Medium	High
HIGHLY UNRELIABLE	CPP-92 (CPP-89 Soil)	TRACK 2	
HIGHLY RELIABLE	No Action Required	RI/FS	Interim Action*
reliability	LOW concentration resulting in risk < 10^{-6}	MEDIUM	HIGH concentration resulting in risk > 10-4
	qualitative risk		

* If sufficient data exist to identify an appropriate remedy.

Question 1. What are the waste generation process locations and dates of operation associated with this site?

Block 1 Answer:

Waste generation processes associated with CPP-92 are those related to storage, and management of spent nuclear fuel, dissolution of fuel and calcination of the resulting high-level radioactive wastes. Soil removed during the CPP-604 fire exit construction (CPP-89) are boxed at CPP-92 and are contaminated due to leaks from deteriorated or broken lines associated with the PEW evaporator system. The PEW system reduces mixed wastes sent to the ICPP Tank Farm. The system vaporizes the mixed wastes producing concentrated wastes (bottoms) and condensates (as condensed vapor). The bottoms are transferred to the Tank Farm and the condensates are transferred to the Liquid Effluent Treatment and Disposal Facility. Service wastes and condensates from the PEW typically consisted of nitric acid, mercury, plutonium, cesium, cerium. and strontium. Soil from the excavation of valve box 39 at the ICPP Tank Farm was contaminated from leaking pipes and fittings used for transfer of liquid wastes to and from the tank farm. Site CPP-17 was used as a temporary storage area for miscellaneous soil, concrete, and asphalt from construction activities. Figure 1 shows the location and orientation of the boxed soil at CPP-92.

Block 2 How reliable are the information sources? ___High _x_Med ___Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

Contaminant concentrations and generation processes for soil in many of the boxes is unknown.

Block 3 Has this INFORMATION been confirmed? ___ Yes _x_No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available information	[ ]		Analytical data	[ ]	
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[x]	1,2	Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site drawings	[ ]		D&D report	[ ]	
Unusual Occurrence Report	[ ]		Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

Question 2. What are the disposal process locations and dates of operation associated with this site?

Block 1 Answer:

Contaminated soil, asphalt, and concrete with low contaminant concentrations which was generated in the late 1980s and early 1990s from many construction locations at the ICPP. The soil, which cannot be disposed of at the Radioactive Waste Management Complex, was boxed and is currently stored at CPP-92.

Block 2 How reliable are the information sources? __High ___Med _x_Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

The exact disposal process location and dates of operation are not listed in the references for the boxed soil from some of the sites, such as the soil from outside of building CPP-603. The disposal process location is known for the boxed soil from Site CPP-89, however, the dates of operation for piping leaks which caused CPP-89 are not known (Reference 2).

Block 3 Has this INFORMATION been confirmed? __ Yes _x_No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available information	[ ]		Analytical data	[ ]	
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[x]	2	Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site drawings	[ ]		D&D report	[ ]	
Unusual Occurrence Report	[ ]		Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

Question 3. Is there evidence that a source exists at this site? If so, list the sources and describe the evidence.

Block 1 Answer:

Yes, analytical data from samples of the boxed soil is evidence that a source exists in the boxed soil at this site. The boxes contain soil excavated in the installation of an emergency fire exit for buildings CPP-604/605. The waste generation processes in the vicinity of the emergency fire exit for the basement area of CPP-604/605, is from deteriorated, leaking underground pipes that are a part of the PEW evaporator system.

Site CPP-92 also contains 100 boxes from the soil excavation of valve box 39 at the ICPP Tank Farm and 300 boxes of soil from building CPP-603 area cleanup. Soil from these two sites is contaminated with low levels of Cs-137. Because the contaminant concentrations of soil from the tank farm, the building 603 cleanup, and site CPP-17 are much lower than those found in site CPP-89 soil boxed at site CPP-92, the CPP-89 soil concentrations will be used for comparison to risk based soil concentrations.

Block 2 How reliable are the information sources? ___High _x_Med ___Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

Elevated radioactivity levels were found in samples of the boxed soil, Reference 2, 3, 4, 7. However, sampling has not been conducted on all soil boxes staged at CPP-92.

Block 3 Has this INFORMATION been confirmed? ___ Yes _x_No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available information	[ ]		Analytical data	[x]	3,4,7
Anecdotal	[ ]		Documentation about data	[x]	2
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site drawings	[ ]		D&D report	[ ]	
Unusual Occurrence Report	[ ]		Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
Other					

Question 4. Is there empirical, circumstantial, or other evidence of migration? If so, what is it?

Block 1 Answer:

There is no evidence of migration from site CPP-92. The soil is currently containerized in polyethylene lined plywood boxes indicating that migration from the CPP-92 site is unlikely.

Block 2 How reliable are the information sources? ___High _x_Med __Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

It is known that approximately 1250 boxes are stored at CPP-92, but it is not believed that any of the boxes have deteriorated significantly (Reference 8).

Block 3 Has this INFORMATION been confirmed? ___ Yes _x_No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available information	[ ]		Analytical data	[ ]	
Anecdotal	[x]	8	Documentation about data	[ ]	
Historical process data	[x]	1	Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site drawings	[ ]		D&D report	[ ]	
Unusual Occurrence Report	[ ]		Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

Question 5. Does site operating or disposal historical information allow estimation of the pattern of potential contamination? If the pattern is expected to be a scattering of hot spots, what is the expected minimum size of a significant hot spot?

Block 1 Answer:

Yes. The boxes containing soil excavated from site CPP-89 are believed to contain the highest concentration, i.e., hot spots, of radioactivity at site CPP-92 (see Figure 1). The hot spots of contamination in the boxed soil is also expected to be inconsistently distributed. The expected size of a hot spot would be the size of the CPP-89 box, eithe 4 ft x 4 ft x 8 ft or 2 ft x 4 ft x 8 ft. Since the contaminated soil is staged in lined boxes that have not appreciably deteriorated, it can be reasonably presumed that hot spots of contamination are not currently present outside of the boxes at CPP-92 and that the pattern of contamination is within the physical boundary of the box staging area.

Block 2 How reliable are the information sources? ___High _x_Med ___Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

Figure 1 shows the approximate location of the staged boxes.

Block 3 Has this INFORMATION been confirmed? ___ Yes _x_No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available information	[x]		Analytical data	[ ]	
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site drawings	[ ]		D&D report	[ ]	
Unusual Occurrence Report	[ ]		Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

Question 6. Estimate the length, width, and depth of the contaminated region. What is the known or estimated volume of the source? If this is a estimated volume, explain carefully how the estimate was derived.

Block 1 Answer:

The contaminated soil is contained in approximately 1250, 4 ft x 4 ft x 8 ft boxes which yields a contaminated soil volume of 160,000 ft^3. If the boxes are assumed to be 80 percent full then there is a total of approximately 130,000 ft^3 of contaminated soil in the CPP-92 soil boxes.

Block 2 How reliable are the information sources? ___High ___Med _x_Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

Reference 8 lists the number of boxes containing soil from the individual sites.

Block 3 Has this INFORMATION been confirmed? ___ Yes _x_No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available information	[ ]		Analytical data	[ ]	
Anecdotal	[x]	8	Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site drawings	[ ]		D&D report	[ ]	
Unusual Occurrence Report	[ ]		Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

Question 7. What is the known or estimated quantity of hazardous substance/constituent at this source? If the quantity is an estimate, explain carefully how the estimate was derived.

Block 1 Answer:

Estimated concentrations of hazardous substances/constituents at this source are presented in the Contaminant Worksheet (pg. 8-9) of this Track 1 documentation package. Concentrations used for this Track 1 risk assessment were based on the maximum concentrations detected in the soil samples collected from the boxes which had been excavated for the building CPP-604/605 fire exit. Inorganic compounds were eliminated as potential contaminants of concern because the maximum concentrations were below background and risk-based levels. Organic compounds were not detected in soil samples. Contaminant concentrations in soil from other sites contained at CPP-92 are below those found in the site CPP-89 soil.

Block 2 How reliable are the information sources? ___High _x_Med ___Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

The analytical data indicate that radioactivity is present in the soil excavated for the building CPP-064/605 fire exit tunnel, but that no inorganic or organic compound contaminants are present (Reference 2, 3, 4).

Block 3 Has this INFORMATION been confirmed? ___ Yes _x_No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available information	[ ]		Analytical data	[x]	3,4
Anecdotal	[ ]		Documentation about data	[x]	2
Historical process data	[x]	1	Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site drawings	[ ]		D&D report	[ ]	
Unusual Occurrence Report	[ ]		Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[x]	6 Limiting Soil Concentration Calculations (including GWSCREEN)			

Question 8. Is there evidence that this hazardous substance/constituent is present at the source as it exists today? If so, describe the evidence.

Block 1 Answer:

Yes, circumstantial evidence of a contaminant source exists at CPP-92. The soil analytical data from sites CPP-17, the building CPP-603 area soil cleanup, the tank farm upgrade (valve box 39), and CPP-89 excavation all indicate the presence of radiological contamination.

Block 2 How reliable are the information sources? ___High ___Med _x_Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

The analytical data from CPP-89 indicates that radioactive contamination is present in meaningful amounts at CPP-92, References 3, 4, 5.

Block 3 Has this INFORMATION been confirmed? ___ Yes _x_No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available information	[ ]		Analytical data	[x]	3,4,5
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[x]	1	Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site drawings	[ ]		D&D report	[ ]	
Unusual Occurrence Report	[ ]		Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

REFERENCES

1. Waste Area Group 3 Comprehensive Remedial Investigation/Feasibility Study Work Plan (Draft), Lockheed Idaho Technologies Company, INEL-95/0056, March 1995, Section 2.

2. Correspondence from B.D. Nield, "LI-5 Task 1, Boxed Soil From CPP-604 Basement Exit Tunnel Excavation", BDN-06-93, April 13, 1993.

3. Data report for the analysis of organic and inorganic parameters for samples taken from the CPP-604/605 Fire Exit Excavated Soil, Huntingdon Engineering & Environmental, Inc., C92-170021 ER-TOS-197 Task Order #100, September 28, 1994.

4. Radionuclide sample analysis results from the CPP-604/605 Fire Exit Excavated Soil, Barringer Laboratories Inc., C92-170001/Task 53, October 3, 1994.

5. Sampling and Analysis Plan for Boxed Soils from Solid Waste Management Unit CPP-58, and Basement Exit Excavations at CPP-604/605 at the Idaho Chemical Processing Plant, Golder Associates Inc., July 1993, Revision 1.

6. Limiting Soil Concentration Calculations and GWSCREEN Results from CPP-92/89.

7. Sample analysis results from analysis of soil from the building 603 area soil cleanup and the valve box 39 excavation.

8. Personal communication between Dennis Raunig, LITCO, and ICPP operations personnel.

DECISION DOCUMENTATION PACKAGE
COVER SHEET

PREPARED IN ACCORDANCE WITH

TRACK 1 SITES:
GUIDANCE FOR ASSESSING
LOW PROBABILITY HAZARD SITES
AT THE INEL

SITE DESCRIPTION: NONRADIOACTIVE CALCINE DISPOSAL TRENCH

SITE ID: CPP-93 **OPERABLE UNIT:** 3-13

WASTE AREA GROUP: 3

I. SUMMARY – PHYSICAL DESCRIPTION OF THE SITE:

Historical operator log entries and photographs indicate that several tons of non-radioactive simulated calcine was disposed in a trench southeast of building CPP-633. The simulated calcine was generated in 1962 and 1963 during testing of CPP-633 waste calcining equipment and systems prior to operation with high level radioactive waste.

Test batch feed solutions contained varying amounts of aluminum nitrate, nitric acid, sodium nitrate, and boric acid. Test batch 10 was also spiked twice with an aluminum capsule containing a sodium (Na)-24 tracer. Mercuric nitrate was also added with the Na-24 tracer to aid in the dissolution of the aluminum capsule. The Na-24 was used in test run number 10 to determine the efficiency of the calcine vessel off-gas cleanup system. With a half life of 15 hr, any Na-24 that did not volatilize and was processed into the test batch calcine product would have decayed before eventual disposal in the trench.

Chemical reactions in the calcining process would have changed the feed material into solid aluminum oxide (Al_2O_3), mercuric oxide (HgO), boric anhydride (B_2O_3), sodium oxide (Na_2O), and sodium nitrate ($NaNO_3$). Gaseous products from the process include, nitrogen dioxide (NO_2), water vapor (H_2O), mercury (Hg), oxygen, and nitric oxide (NO).

The site CPP-93 burial trench is located at an approximate 45° angle from the southeast corner of building CPP-633. The trench was approximately 200 ft. long and 8 ft. in width at the bottom sloping to 16 ft. in width at the top. The trench contained 3.5 to 4 ft. of non-radioactive calcine before being backfilled to grade with approximately 4 ft. of topsoil. No sampling of the calcine to determine individual component concentrations was conducted prior to its disposal in the trench and no characterization of the trench itself has been conducted.

I. SUMMARY – PHYSICAL DESCRIPTION OF THE SITE: (CONT)

Calcine produced during the test runs were initially put in bin set #1 before being transferred to a temporary storage bin. At the time, the non-radioactive calcine was being saved for possible use as a starting material for radioactive waste calcining. As the non-radioactive calcine proved to be a poor starting material, the temporary storage bin was emptied, and the calcine was loaded into a truck, and disposed in the trench. Based on photos and operator logs, the trench was used for non-radioactive calcine disposal from 1964 through 1966.

DECISION RECOMMENDATION

II. SUMMARY – QUALITATIVE ASSESSMENT OF RISK:

A qualitative risk assessment was conducted for occupational workers and future residents at the site. For site CPP-93 the lowest risked based soil concentration is 81 mg/kg for mercury, 24,300 mg/kg for boron, and 4.32 E+5 mg/kg for nitrate in the residential soil ingestion pathway. The risk is considered medium as concentrations of mercury in the trench is calculated to be 8,500 mg/kg (the estimated concentrations of boron and nitrate are well below the lowest limiting soil concentration noted above). This calculated mercury concentration is over two orders of magnitude greater than the limiting soil concentration of 81 mg/kg. However, the qualitative risk for this site is only medium due to the small volume of mercury contaminated calcine in the trench, and because the trench was backfilled to level grade with the surrounding soils limiting potential exposure pathways. The reliability of data at this site is considered low, as no sampling has been conducted of soils at the trench or the calcine prior to disposal.

III. SUMMARY – CONSEQUENCES OF ERROR:

False negative error: If no further action is taken receptors might be exposed to contaminants which could be present at this site. The probability of a receptor being exposed to high concentrations of contaminants at this site is low as the amount of mercury contaminated calcine is small.

False positive error: Unwarranted remediation of this site would result in a low return in environmental benefit from a relatively large investment of time and money.

IV. SUMMARY – OTHER DECISION DRIVERS:

Field investigations for the WAG 3 Comprehensive RI/FS are currently being scoped indicating the WAG 3 RI/FS is the proper place for investigation of this site, rather than a Track 2 Investigation. No previous characterization of the trench or the calcine has been conducted.

DECISION RECOMMENDATION

RECOMMENDED ACTION:

Because of the lack of characterization data for the trench, and because the estimated Hg concentration is over 100 times the limiting soil concentration calculated using Track 1 methodology, this site (CPP-93) is recommended to be further investigated in the WAG 3 Comprehensive RI/FS.

SIGNATURES	# PAGES:	DATE:
Prepared By:	DOE WAG Manager:	
Approved By:	Independent Review:	

DECISION STATEMENT
(BY DOE RPM)

DATE RECD:

DISPOSITION

DATE:	**# PAGES (DECISION STATEMENT):**
NAME:	**SIGNATURE:**

DECISION STATEMENT
(BY EPA RPM)

DATE RECD:

DISPOSITION

DATE:	# PAGES (DECISION STATEMENT):
NAME:	SIGNATURE:

DECISION STATEMENT
(BY STATE RPM)

DATE RECD:	
DISPOSITION	
DATE:	# PAGES (DECISION STATEMENT):
NAME:	SIGNATURE:

PROCESS/WASTE WORKSHEET

SITE ID: CPP-93

Col 1 Processes Associated with this Site	Col 2 Waste Description & Handling Procedures	Col 3 Description & Location of any Artifacts/Structures/Disposal Areas Associated with this Waste or Process
Testing of Waste Calcining Facility (WCF) systems	Testing of CPP-633 calcining equipment prior to operation with radioactive wastes produced simulated calcine which was disposed into a trench southeast of CPP-633.	Artifact: Simulated calcine disposal trench. Location: At a 45° angle to the southeast corner of CPP-633. Description: The site CPP-93 burial trench is located at a 45° angle from the southeast corner of building CPP-633. The trench was approximately 200 ft. long and 8 ft. in width at the bottom sloping to 16 ft. in width at the top. The trench contained 3.5 to 4 ft. of non-radioactive calcine before being backfilled to grade with approximately 4 ft. of topsoil.
		Artifact: Location: Description:
		Artifact: Location: Description:
		Artifact: Location: Description:

CONTAMINANT WORKSHEET

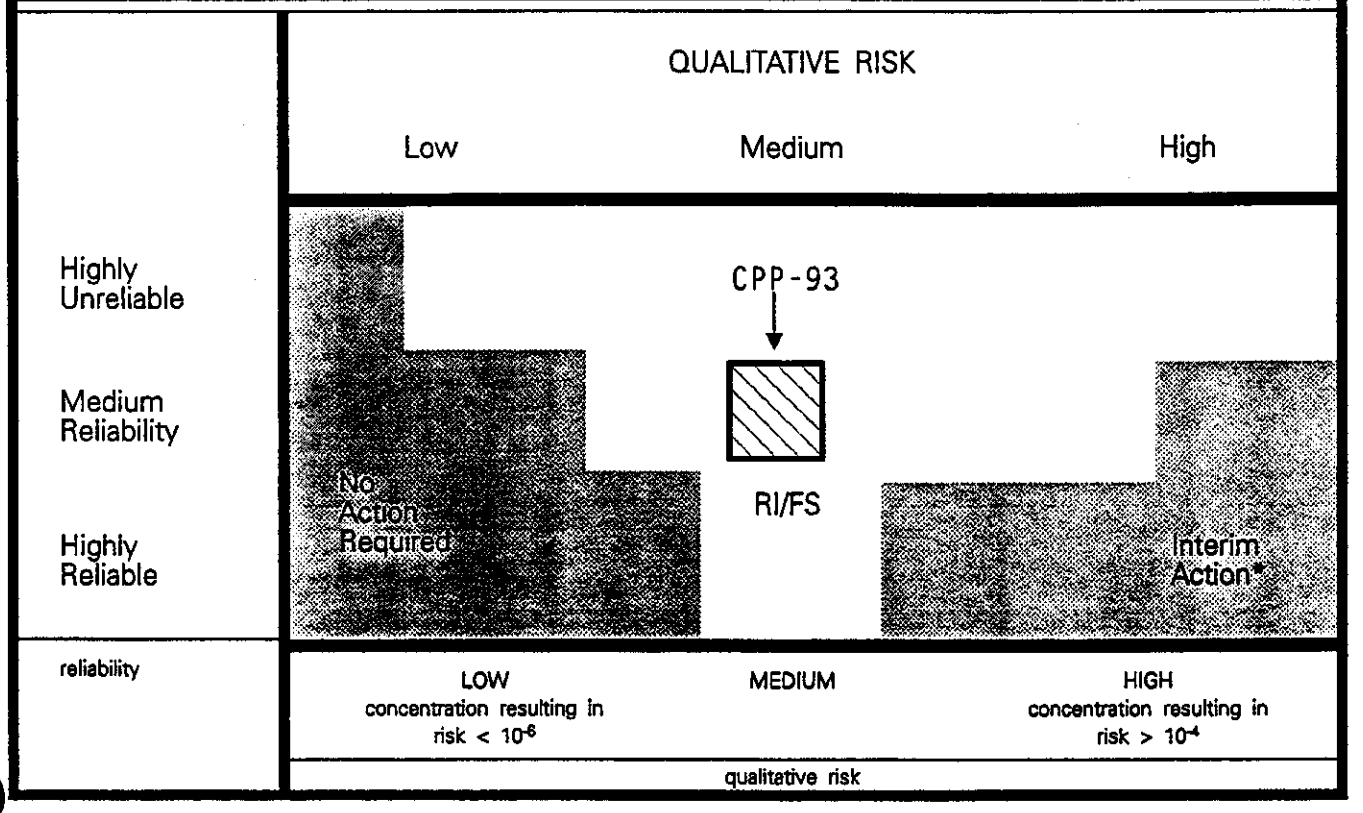
SITE ID CPP-93

PROCESS (Col 1) disposal trench **WASTE** (Col 2) simulated calcine containing mercury

Col 4 What Known/Potential Hazardous Substance/ Constituents are Associated with this Waste or Process?	Col 5 Potential Sources Associated with this Hazardous Material	Col 6 Known/Estimated Concentration of Hazardous Substances/ Constituents[a]	Col 7 Risk-based Concentration (mg/kg)	Col 8 Qualitative Risk Assessment (hi/med/low)	Col 9 Overall Reliability (hi/med/low)
mercury	contaminated soil	8,500 mg/kg	81 mg/kg	medium	low
boron	contaminated soil	1,441 mg/kg	24,300 mg/kg	low	low
nitrate	contaminated soil	50,000 mg/kg	432,000 mg/kg	low	low

ND = not detected
DL = detection limit.

Table 4. Qualitative Risk and Reliability Evaluation Table (CPP-91)



* If sufficient data exist to identify an appropriate remedy.

Question 1. What are the waste generation process locations and dates of operation associated with this site?

Block 1 Answer:

The WCF (CPP-633) calcined highly radioactive liquid spent fuel dissolution process effluent from 1963 to 1981, at which time it was replaced by the New Waste Calcining Facility (NWCF). Prior to going "hot" (processing radioactive waste), a series of 10 runs was conducted in 1961 and 1962 to test the system using simulated feed solutions. The solution for test run 1 was water and for test runs 2-10 included nitrates, runs 5, 6, 8, and 10 included boron (as boric acid) in the feed solution, and run 10 included 2 spikes of mercuric nitrate. Feed solutions for the test runs was made in 1,400 gallon batches and fed continuously at 60 to 80 gal/min (depending on the test run) for the duration of the test run.

In the calcination process, liquid radioactive wastes are evaporated and the dissolved metals are converted to salts and oxides. The key step in the calcination process is evaporation and solidification of the liquid wastes in a heated bed of fluidized particles. Feed is atomized by air and sprayed into a heated bed of spherical particles. Dissolved metals, including fission products oxidize to solids as they coat the surfaces of bed particles. Combustion and solid products build up in layers on the bed particles while the gaseous products are swept from the vessel with the fluidizing gases.

Block 2 How reliable are the information sources? _x_High ___Med ___Low (check one)
Explain the reasoning behind this evaluation.

The operational dates of the WCF are documented in operating logs.

Block 3 Has this INFORMATION been confirmed? _x_ Yes ___No (check one)
IF SO, DESCRIBE THE CONFIRMATION.

The operational dates of the WCF are also documented in quarterly reports.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available information	[ ]		Analytical data	[ ]	
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[x]	1	Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[x]	2
Engineering/site drawings	[ ]		D&D report	[ ]	
Unusual Occurrence Report	[ ]		Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

Question 2. What are the disposal process locations and dates of operation associated with this site?

Block 1 Answer:

Calcine produced during the test runs in 1961 and 1962 were initially put in bin set #1 before being transferred to a temporary storage bin. At the time, the non-radioactive calcine was being saved for possible use as a starting material for radioactive waste calcining. As the non-radioactive calcine proved to be a poor starting material, the temporary storage bin was emptied, and the calcine was loaded into a truck, and disposed into the trench.

Block 2 How reliable are the information sources? __High _x_Med __Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

Summaries of the test runs show the run date, but no information has been found to conclusively state the exact dates of disposal in the trench.

Block 3 Has this INFORMATION been confirmed? __ Yes _x_No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available information	[ ]		Analytical data	[ ]	
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[x]	1	Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[x]	4	Safety analysis report	[ ]	
Engineering/site drawings	[x]	5	D&D report	[ ]	
Unusual Occurrence Report	[ ]		Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[x]	(3) operator log entries			

Question 3. Is there evidence that a source exists at this site? If so, list the sources and describe the evidence.

Block 1 Answer:

Yes, calcine is known to have been disposed into the trench. Test batch feed solutions contained varying amounts of aluminum nitrate, nitric acid, sodium nitrate, and boric acid. Test batch 10 was also spiked twice with an aluminum capsule containing a sodium (Na)-24 tracer. Mercuric nitrate was also added with the Na-24 tracer to aid in the dissolution of the aluminum capsule. The Na-24 was used in test run number 10 to determine the efficiency of the calcine vessel off-gas cleanup system. With a half life of 15 hr, any Na-24 which did not volatilize and was processed into the test batch calcine would have decayed before its eventual disposal in the trench.

Chemical reactions in the calcining process would have changed the feed material into solid aluminum oxide (Al_2O_3), mercuric oxide (HgO), boric anhydride (B_2O_3), sodium oxide (Na_2O), and sodium nitrate ($NaNO_3$). Gaseous products from the process include, nitrogen dioxide (NO_2), water vapor (H_2O), mercury (Hg), oxygen (O), and nitric oxide (NO). Contaminants of concern in the simulated calcine would then be mercury, boron, and nitrate. Aluminum and sodium are not considered toxic and are left out of Track 1's by convention (Track 1 & 2 guidance).

Block 2 How reliable are the information sources? ___High _x_Med ___Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

No sampling of soils has been conducted at the location of the simulated calcine disposal trench to determine its exact location and concentration of contaminants. The calcining process information is considered to be good but little information exists of the calcine handling after completion of the test runs.

Block 3 Has this INFORMATION been confirmed? ___ Yes _x_No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available information	[ ]		Analytical data	[ ]	
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[x]	1	Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[x]	2
Engineering/site drawings	[ ]		D&D report	[ ]	
Unusual Occurrence Report	[ ]		Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

Question 4. Is there empirical, circumstantial, or other evidence of migration? If so, what is it?

Block 1 Answer:

No evidence of migration from the trench exists, nor does evidence exist that migration has not taken place. Mercuric Oxide (HgO), the mercuric compound formed in the calcination process, is practically insoluble in water, but decomposes to mercury and oxygen upon exposure to light. In the alkaline INEL soil and calcine conditions present in the disposal trench, mercury is generally found in an insoluble mercurous carbonate form which would not be expected to migrate from the source substantially.

Block 2 How reliable are the information sources? ___High ___Med _x_Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

No sampling has been conducted in or near the trench to indicate if contamination is present or has migrated.

Block 3 Has this INFORMATION been confirmed? ___ Yes _x_No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available information	[ ]		Analytical data	[ ]	
Anecdotal	[x]	11	Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site drawings	[ ]		D&D report	[ ]	
Unusual Occurrence Report	[ ]		Initial assessment	[ ]	
Summary documents	[x]	10	Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

Question 5. Does site operating or disposal historical information allow estimation of the pattern of potential contamination? If the pattern is expected to be a scattering of hot spots, what is the expected minimum size of a significant hot spot?

Block 1 Answer:

Mercury contaminated simulated calcine in the trench would be expected to exist as a hotspot at the point in the trench where it had been dumped. Calculations (see reference 7) suggest a source volume of 1 m depth by 2.4 m width (the estimated with of the bottom of the trench) by 1.3 m long (the dimension needed to generate the estimated volume of mercury contaminated calcine. Boron and nitrate source volumes are expected to be identical to the volume of the calcine in the trench.

Block 2 How reliable are the information sources? ___High ___Med _x_Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

No sampling has been conducted on the trench.

Block 3 Has this INFORMATION been confirmed? ___ Yes _x_No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available information	[ ]		Analytical data	[ ]	
Anecdotal	[x]	7	Documentation about data	[x]	6
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site drawings	[ ]		D&D report	[ ]	
Unusual Occurrence Report	[ ]		Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

Question 6. Estimate the length, width, and depth of the contaminated region. What is the known or estimated volume of the source? If this is an estimated volume, explain carefully how the estimate was derived.

Block 1 Answer:

The contaminant source at this site for mercury is expected to be small, approximately 3.2 m^3. This is based on the amount of mercury in test batch 10, the average test batch size, information on where mercury ends up in the calcining process, and on the physical properties of calcine. Boron and nitrate source volumes are expected to be identical to the volume of the calcine in the trench. The trench was approximately 200 ft. long and 8 ft. in width at the bottom sloping to 16 ft. in width at the top. The trench contained 3.5 to 4 ft. of non-radioactive calcine before being backfilled to grade with approximately 4 ft. of topsoil.

Block 2 How reliable are the information sources? ___High ___Med _x_Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

No sampling has been conducted on the trench.

Block 3 Has this INFORMATION been confirmed? ___ Yes _x_No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available information	[ ]		Analytical data	[ ]	
Anecdotal	[x]	7	Documentation about data	[x]	7
Historical process data	[x]	1	Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site drawings	[ ]		D&D report	[ ]	
Unusual Occurrence Report	[ ]		Initial assessment	[ ]	
Summary documents	[x]	8	Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

Question 7. What is the known or estimated quantity of hazardous substance/constituent at this source? If the quantity is an estimate, explain carefully how the estimate was derived.

Block 1 Answer:

Calculations using test batch 10 process information (see eference 7) illustrate that approximately 21.3 kg of mercury was contained in the test feed solution with 65% of the mercury in the feed solution contained in the disposed simulated calcine. The feed solutions used in the 10 trial runs contained a total of 263 kg of boron as boric acid. Documentation indicates that the nitrate content of the calcine is approximately 5% by weight; the calcine in the disposal trench contained approximately 9,126 kg of nitrate (NO_3). Limiting soil concentration calculations are contained in reference 9.

Block 2 How reliable are the information sources? ___High ___Med _x_Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

No sampling has been conducted on the trench.

Block 3 Has this INFORMATION been confirmed? ___ Yes _x_No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available information	[ ]		Analytical data	[ ]	
Anecdotal	[x]	7	Documentation about data	[ ]	
Historical process data	[x]	1	Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site drawings	[ ]		D&D report	[ ]	
Unusual Occurrence Report	[ ]		Initial assessment	[ ]	
Summary documents	[x]	8	Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[9]	Limiting Soil Concentration Calculations (including GWSCREEN)			

Question 8. Is there evidence that this hazardous substance/constituent is present at the source as it exists today? If so, describe the evidence.

Block 1 Answer:

Yes, circumstantial evidence of a contaminant source in the trench is the test run feed solutions makeup included large amounts of nitrates, boron, and a small amount of mercury (in run 10).

Block 2 How reliable are the information sources? ___High ___Med _x_Low (check one)

EXPLAIN THE REASONING BEHIND THIS EVALUATION.

No sampling has been conducted on the trench location.

Block 3 Has this INFORMATION been confirmed? ___ Yes _x_No (check one)

IF SO, DESCRIBE THE CONFIRMATION.

Block 4 **SOURCES OF INFORMATION** [check appropriate box(es) & source number from reference list]

No available information	[ ]		Analytical data	[x]	1
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[x]	1	Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Aerial photographs	[ ]		Safety analysis report	[ ]	
Engineering/site drawings	[ ]		D&D report	[ ]	
Unusual Occurrence Report	[ ]		Initial assessment	[ ]	
Summary documents	[x]	1	Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
OTHER	[ ]				

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9. IDAHO CHEMICAL PROCESSING PLANT WINDBLOWN AREA

This section of the RI report has been prepared for OU 10-06: Radionuclide-Contaminated Soils RI/FS for the Idaho Chemical Processing Plant (ICPP) Windblown Area. The windblown area under investigation in this section is defined to include all soils outside the ICPP perimeter fence and within the outermost EMI 1990 aerial survey isopleth (EMI 1992). The soil in this area is considered potentially contaminated as a result of atmospheric dispersion of radionuclides from ICPP operations. The windblown area at ICPP has been defined using the above-stated criteria and is the subject of this section. The elongated isopleths trending in the predominant southwest and northeast wind directions from ICPP are indicative of windblown contamination, possibly from a stack release.

This section of the RI report documents the results obtained from site characterization activities conducted at ICPP to define areas of windblown contamination resulting in radionuclide-contaminated soils. This section summarizes supporting site data, including pertinent historical data. These data are used to determine the nature and extent of contamination of the radionuclide-contaminated soils, to conduct fate and transport modeling of the radionuclide-contaminated soils, and to prepare the baseline risk assessment that presents the current and future potential risks to human health and the environment posed by these radionuclide-contaminated soils. The ultimate purpose of this section is to define the contamination in the ICPP Windblown Area and quantify the risk posed by the contamination to human health and the environment.

9.1 Idaho Chemical Processing Plant Windblown Area Site Description and History

The area surrounding the ICPP was identified as a potential windblown radionuclide-contaminated soil area by the EG&G EMI 1990 aerial survey (EMI 1992). Figure 9-1 shows the isopleths produced from the data collected during the 1990 survey over ICPP.

The ICPP was established in the early 1950s in the southwestern portion of the INEL, south of the Big Lost River, and approximately 76 km (47 mi) west of Idaho Falls, Idaho (see Figure 1-2). The ICPP Windblown Area is located outside the ICPP perimeter fence. The ICPP is located on approximately 81 ha (200 acres) and includes a variety of laboratory and processing facilities, process chemical storage facilities, process chemical and waste transfer pipelines, process waste storage and disposal facilities, office and maintenance facilities, and nonprocess waste disposal facilities. Plant activities require the use of numerous chemicals and radioactive materials, which result in the generation of a variety of hazardous, radioactive, and mixed wastes.

The ICPP began operations in 1953 as the principal INEL facility for receipt, interim storage, and reprocessing of nuclear materials from test, defense, and research reactors in the United States and other countries. Because the demand for reprocessing spent nuclear fuels has decreased, DOE announced in April 1992 that the reprocessing part of the ICPP mission would be phased out. However, the need to properly manage the fuels and wastes at the facility remains a high priority.

9.1.1 Previous Soil Investigations

Previous radiological soil investigations have been conducted within the ICPP Windblown Area, including aerial radiological surveys and routine soil sampling conducted by RESL. The WAGs 3

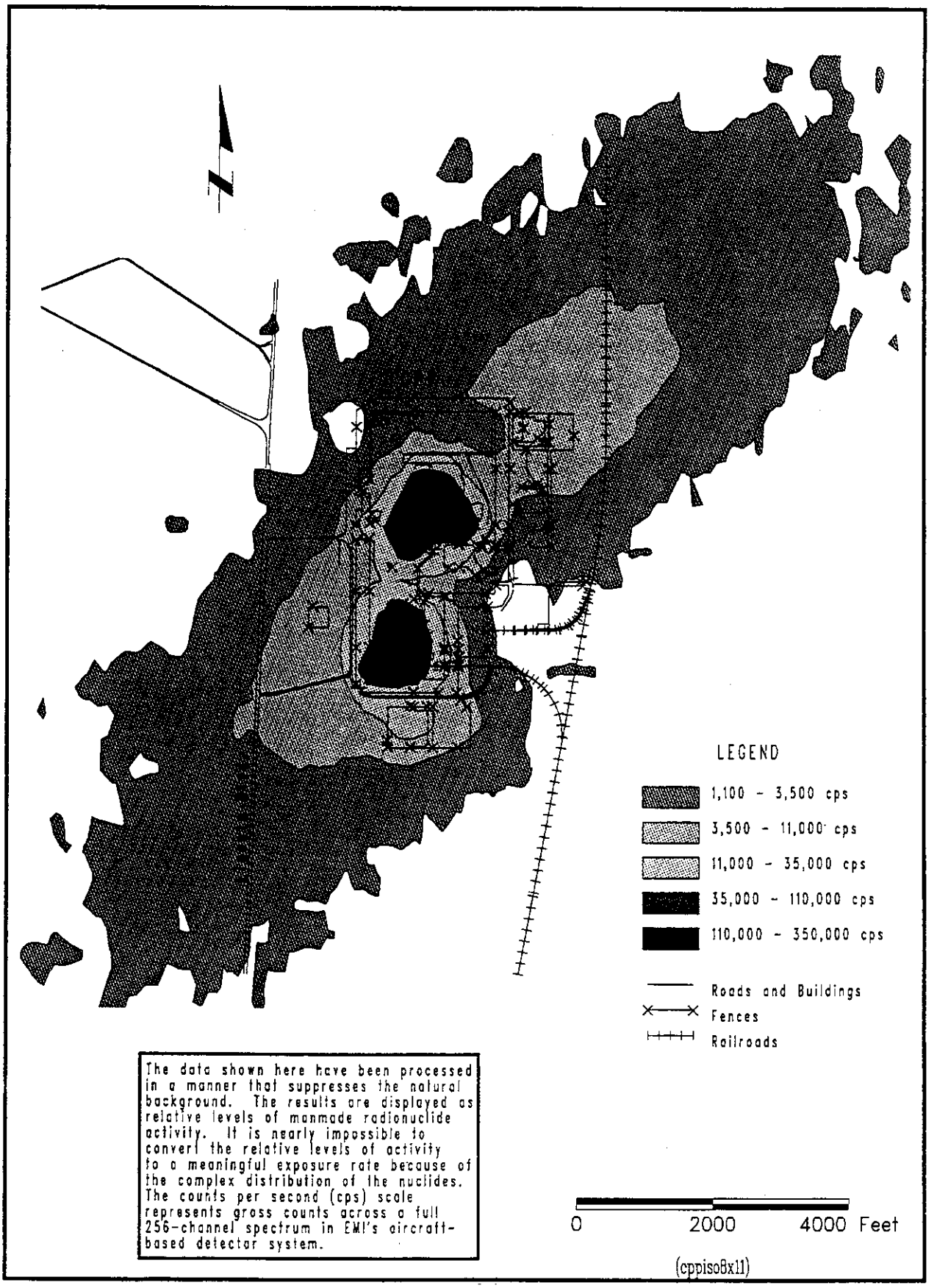

Figure 9-1. ICPP Windblown Area isopleth.

and 10 soils treatability study also encompassed portions of the ICPP Windblown Area. A discussion of these investigations follows.

9.1.1.1 1990 Aerial Radiological Survey. The ICPP was included in the 1990 EMI aerial radiological survey (EMI 1992) to determine potential areas of radioactivity deposited on the soil from ICPP operations (refer to Section 1.4.1 for a discussion of this survey). Figure 9-1 shows the ionizing radiation isopleth (in counts per second) produced from data collected during the 1990 aerial survey over ICPP. The isopleths generally indicate radioactive contamination and were used to identify areas that required more detailed nuclide-specific examination. The outer boundary for the Phase I investigation of radionuclide-contaminated soils at ICPP was established as the outer isopleth resulting from this aerial survey. This is consistent with outer boundaries established for other facilities at the INEL during the OU 10-06 Phase I investigation. It is recognized that smaller areas and isopleths were identified around ICPP during the aerial survey; however, these locations were isolated and assumed to contain the same type and level of activity as the radionuclides present within the main outer isopleth. For the purposes of the OU 10-06 Phase I investigation, this boundary indicated the maximum extent of soils to be considered potentially contaminated with radioactivity. It is recognized that the horizontal extent of contaminated soils indicated by the aerial survey may be overestimated. Incident gamma radiation on the detector is likely to be a result of direct radiation whose source is the facility being surveyed and not the surrounding soil. The outer isopleth produced by the EMI aerial survey served as the outer boundary of soil contamination for the OU 10-06 Phase I ICPP investigation but does not indicate that all or any of the soil within the isopleth is radioactively contaminated.

9.1.1.2 RESL Monitoring. The RESL monitoring program, discussed in Section 1.4.2, began collecting surface soil samples in the vicinity of ICPP during the early 1970s. Surface soil samples were collected by RESL in 1971, 1974, 1982, 1987, and 1990 in the same areas established as potential windblown contaminated areas during the OU 10-06 Phase I investigation. The RESL typically collected samples from a combination of 0–5 and 5–10-cm (0–2 and 2–4-in.) depths. Samples were analyzed by gamma spectroscopy, alpha spectrometry, or both. Select samples were also analyzed for Sr-90.

The RESL collected samples from points designated on a large and small grid. The small grid consisted of regularly spaced sample locations at 152-m (500-ft) intervals centered on the ICPP stack. The grid is divided into quadrants A to the northeast, B to the southwest, C to the northwest, and D to the southeast of the stack. Consequently, quadrants A and B are situated in the predominant wind directions at ICPP.

The large grid consisted of sample points along radial transects centered on the ICPP stack. Samples were collected at 6-km (3.7-mi) intervals along these transects to a distance of 39 km (24.2 mi). Radiological and Environmental Sciences Laboratory sample locations in the vicinity of ICPP are contained in Jessmore et al. (1994).

Emphasis has been placed on the RESL data set during collection of historical INEL radionuclide-contaminated soils data because there are over 6,000 data points available from this single source.

9.1.1.2.1 Sampling Locations on the ICPP Small Grid—Locations within the small grid were sampled in the early 1970s, 1982, and 1989. The majority of small grid sample locations have historically been located in the predominant wind directions. Typically, twice as many samples have been collected from quadrants A and B as from quadrants C and D. In the early 1970s,

additional samples were collected at locations 2.4 km (1.5 mi) or farther from ICPP. These locations were not within the small grid but were not as distant as locations within the large grid. Samples collected from the small grid in 1982 and 1989 are archived at the USGS Core Library.

As of January 1, 1994, the EG&G Idaho, Inc., Environmental Monitoring Unit assumed responsibility for on-Site sampling and monitoring activities. The responsibility for off-Site environmental sampling and monitoring was transferred to the Environmental Research Foundation on April 11, 1994. Resampling of the small grid is scheduled for 1996.

9.1.1.2.2 Sampling Locations on the ICPP Large Grid—All locations on the large grid were initially sampled in 1973 and were resampled in 1987. In 1973, the samples collected were evenly distributed between the quadrants to the northeast and southwest of the ICPP stack. Using a radius running due east from the ICPP stack as a reference, radial transects were located at 22.5, 45, 56, 67.5, 202.5, 214, 225, and 247.5 degrees. Additional samples were collected 9.7 km (6.02 mi) from the stack on the 0, 90, 112.5, and 270 degree lines. All sample locations to the north and east of the ICPP stack are located within the boundary of the INEL. One large grid sample location [19.4 km (12 mi) from the ICPP stack], and all locations at a distance of 29 km (18 mi) and 39 km (24 mi) to the south and west are outside the INEL boundary. In 1987, locations along these radii were resampled, and new sequential sample location numbers were assigned in instances where the original sample locations were not precisely identified. Samples collected in 1987 are archived at the USGS Core Library.

Sample analyses from points on the large grid (on and off the INEL) do not indicate radioactivity in excess of regional background levels of radionuclides normally detected in surface soil samples.

A summary of the ICPP RESL analytical data from surface soil samples is presented in Appendix A.

9.1.1.3 WAGs 3 and 10 Radionuclide-Contaminated Soils Treatability Study. Phase I of a treatability study for radionuclide-contaminated soils in WAG 3 and WAG 10 (Honeycutt 1994) was conducted to collect samples from radionuclide-contaminated soil sites, to provide basic data on relevant physical properties of the soil matrix and the distribution of radionuclides within the soil matrix, and to indicate where radionuclides could be mechanically separated from the soils of interest. Five samples were collected at ICPP under the auspices of this study, as described in Section 1.4.3. All samples [sample location identifier Chemical Processing Plant (CPP)-03, CPP-11, CPP-13, CPP-22, and CPP Outside], except CPP Outside, were collected inside the ICPP facility fence. The CPP Outside sample was collected with the ICPP Windblown Area. The analytical results from this sample are as follows: gross alpha 9.7 pCi/g, gross beta 26.8 pCi/g, and Cs-137 9.6 pCi/g.

9.2 ICPP Windblown Area Site Investigation

There were no site-specific investigations conducted at ICPP in support of this RI to further define surface features, geological properties, meteorology, source of contaminants, surface water and sediment, groundwater, human populations, or biota.

The OU 10-06 Phase I ICPP windblown investigation was conducted as part of this RI. Activities performed as part of this investigation are discussed below.

9.2.1 Soil Investigation

The OU 10-06 Phase I field investigation was conducted in the vicinity of ICPP to further characterize areas of windblown radionuclide-contaminated soils and to fill existing data gaps. The ICPP was included in the Phase I investigation because previous contamination had been detected in the area surrounding ICPP by the EMI 1990 aerial survey (EMI 1992) and during monitoring conducted by RESL. A brief discussion of these two surveys is provided in Section 9.1.1. Contaminant level data collection activities in the vicinity of ICPP in support of the OU 10-06 RI/FS were performed in the vicinity of ICPP on August 23 and 24, 1993, and included sample collection of surface soils from the 0–10-cm (0–4-in.) depth. In addition, dose equivalent rate measurements, as discussed in Section 1.4.4.5.2, were collected along the 1993 Phase I ICPP transects and at various RESL sampling locations. A summary of the analytical data resulting from the Phase I investigation is contained in Appendix A. A summary of the dose equivalent rate data is provided in Section 9.4.2.1. Appendix B contains the full set of dose equivalent rate data collected. A discussion of the Phase I soil investigation follows.

9.2.1.1 ICPP Phase I Radionuclide-Contaminated Soil Investigation. Twenty-five soil samples were collected at ICPP between August 23 and 24, 1993, as part of the Phase I radionuclide-contaminated soil investigation. Samples were collected from the northeast (NE), northwest (NW), and southwest (SW) transects according to the Phase I SAP (Berry et al. 1993). Twelve samples were collected on the NE transect, three on the NW transect, and ten on the SW transect. All samples were analyzed by gamma spectroscopy. Four samples were analyzed by total spectrometric alpha and for Sr-90.

Phase I sample transects were based on the 1990 aerial EMI aerial survey isopleths, predominant wind directions, RESL sample locations, and facility boundaries. Transects generally began at the facility boundary and terminated at a point approximately 15 m (50 ft) outside the outer isopleth. The sample collected outside the outer isopleth was used to support the assumption that no contamination occurs outside the isopleth. The outer isopleth is the point at which gamma radiation emitted from facilities or radionuclide-contaminated soils is indistinguishable from that emanating from background soils. Sample transects were placed in areas within the isopleths for which there was little or no existing soil sample data. When possible, transects were oriented through the isopleth of highest radiation identified in the 1990 EMI aerial radiological survey. Two legs of the transect are oriented in the predominant wind directions at the facility as determined by Clawson et al. (1989). The northwest transect at ICPP was specifically oriented in the wind direction at the time of a radioactive material release at ICPP, which occurred at 1305 hours on April 2, 1992 (WINCO 1992). The occurrence report indicates that a brown-colored particulate material was released from the ICPP main stack. This material was approximately 3 mrem/hr beta-gamma and contained the radionuclides Cs 137, Sb-125, and Ru-106. Wind speed and direction at the time of the release were 1.8 km/hr (1.1 mph) (6-min average) from 113 degrees at a 10-m (33-ft) height above the ground surface and 5 km/hr (3.1 mph) (6-min average) from 172 degrees at a 60-m (197-ft) height above the ground surface.

Sample locations were temporarily staked and flagged prior to sample collection, and samples were collected as close to these staked locations as possible. All samples collected in the vicinity of ICPP in support of this investigation were surface samples collected from the 0–10-cm (0–4-in.) depth. These samples included subsamples collected from the four corners and center of a 1 × 1-m (3.3 × 3.3-ft) sampling grid. Sample depths were limited to 10 cm (4 in.) for possible comparison to the RESL data set. In addition, previous data collected by RESL confirm the hypothesis that the

windblown deposited radionuclides are restricted to the top few inches of soil. Details of the Phase I sampling program and QA/QC samples and procedures are provided in Berry et al. (1993).

Smaller areas of potentially radionuclide-contaminated soils were identified as isopleths during the 1990 aerial radiological survey over ICPP. The numerous outlying single isopleths surrounding ICPP were not sampled individually because data collected during the transect sampling were assumed to be sufficient to determine whether radionuclides were present at levels of concern. In addition, these locations were isolated and assumed to contain the same type and level of activity as the radionuclides present within the larger, more encompassing outer isopleth.

9.2.1.1.1 Dose Equivalent Rate Measurements—In support of the OU 10-06 Phase I ICPP radionuclide-contaminated soil investigation, dose equivalent rate measurements were collected at all Phase I and various RESL sampling locations using a microrem meter. In addition, measurements were also collected at 15-m (50-ft) intervals between Phase I sampling locations. The dose equivalent rate measurements are used to determine the risk found from external exposure to gamma-emitting radionuclides. The measurements collected are summarized in Section 9.4.2.1.

9.3 Idaho Chemical Processing Plant Windblown Area Physical Characteristics

The following sections describe the physical characteristics of the ICPP Windblown Area including surface features, meteorology, hydrology, geology, soils, hydrogeology, demography and land use, and biota.

9.3.1 Surface Features

The study area for radionuclide-contaminated soils at ICPP is defined as those areas outside of the ICPP perimeter fence and within the outermost EMI 1990 aerial survey isopleths (see Figure 9-1). This area is located on the flood plain of the Big Lost River and is relatively flat. The channel of the Big Lost River crosses the northwestern corner of the ICPP area, trending roughly northeast. The flood plain slopes northeastward toward the Lost River Sinks at the rate of approximately 4.5 m (15 ft) per mile (Jones 1961).

Located outside the ICPP perimeter fence are parking areas, a helicopter landing pad, the waste water treatment lagoon, various pits and percolation ponds, and the tank farm project support facility. Also located around the perimeter of ICPP are unpaved roads and groundwater monitoring wells.

9.3.2 Meteorology

The longest and most complete record of meteorological observations exists for the CFA weather station. The ICPP and CFA are at approximately the same terrain elevation and have the same exposure to wind, snow, and cloud cover. The air temperature, atmospheric humidity, and precipitation data are recorded at CFA (Clawson et al. 1989) and summarized in Sections 1.3.2.1 through 1.3.2.3. Air mass characteristics, proximity to moisture sources, angle of solar incidence, and temperature effects caused by latitude differences would be expected to be similar for all locations at the INEL, making it possible to extrapolate meteorological data from CFA to ICPP (Bowman et al. 1984).

9.3.2.1 Wind. The predominate wind direction at ICPP is from the southwest to northeast. Section 1.3.2.3 contains general information regarding wind at the INEL.

9.3.3 Hydrology

The Big Lost River is the only major natural surface-water feature near ICPP. This river is the principal surface water drainage of the INEL and the closest major drainage to ICPP. The main channel of the Big Lost River passes within approximately 6.1 m (20 ft) of the northwest corner of the ICPP. The general slope of the surface at the ICPP is toward the river at approximately 0.07%.

Water flow in the Big Lost River is intermittent, with flows reaching the sinks only during years of high spring runoff and snowmelt from the surrounding mountains. Even during wet years, the river will normally flow only in winter and spring months because water is diverted to the spreading areas. The Big Lost River flowed onto the INEL for approximately one month, June 8 to July 7, 1993. A diversion system installed in 1958 several miles upstream of ICPP is designed to contain most of the flow, preventing major flood events.

Manmade surface water sites at ICPP include the ICPP Sewage Treatment Plant Lagoons and ICPP Percolation Ponds 1 and 2.

9.3.4 Geology

The ICPP is located on alluvial materials deposited by the Big Lost River and windblown sediments. Underlying the alluvial material are 610 to 914-m (2,000 to 3,000-ft) thick basalt flows and basalt-flow groups with interbedded sedimentary materials. One of the most significant of these sedimentary interbeds is a clay layer that occurs at a depth of approximately 33.5 m (110 ft) bls at ICPP and may be continuous over a large area of the INEL. Boreholes drilled in the vicinity of the tank farm encountered this interbed at depths ranging from 31 to 33 m (103 to 108.5 ft) bls, with thicknesses ranging from 0.15 to 3.4 m (0.5 to 11.2 ft). Stratigraphic relations between individual interbeds indicate a complex stratigraphy consisting of thin to thick, continuous to discontinuous units. Sedimentary interbeds in general are composed of sand, silt, and clay materials. There are also cinder layers within the basalts that are composed of sand and gravel-sized material (Sehlke and Bickford 1993).

The thickness and texture of individual basaltic lava flows are variable. The tops of the flows are typically highly vesicular and characterized by fractures and rubble zones. Drilling [maximum depth of investigation was 40 m (131 ft)] activities in the ICPP area encountered two highly fractured rubble zones (with greater than 10 fractures per foot). An upper rubble zone was encountered in all boreholes, except borehole CPP-33-2, at an elevation between 15 and 17.5 m (49.0 and 57.5 ft) bls. The total thickness of this upper rubble zone ranged between 0.12 to 0.91 m (0.4 to 3 ft). A lower rubble zone was encountered in all boreholes with the exception of borehole CPP-33-5. This lower rubble zone was encountered at depths ranging from 20.9 to 22.7 m (68.7 to 74.6 ft) bls with a range in thickness of 0.12 to 0.91 m (0.4 to 3 ft). In addition to the two major rubble zones described above, less laterally extensive zones at variable depths and extent are indicated in caliper logs of hole diameter, that reveal zones of blocky or loose basalt. Exposed fractures commonly have silt and clay infilling that reveal these zones. The middle portions of the flow typically have few vesicles and are dominated by vertical flow material. The basal portion of many flows are glassy in texture and are slightly vesicular.

The sequence of interbedded basalt and sediments continues to well below the water table, typically encountered at depths of approximately 137 m (450 ft) bls in the vicinity of the ICPP. There is some evidence of a sedimentary bed at a depth of 229 m (750 ft) bls, which may be the

effective bottom of the SRPA beneath the ICPP. A more detailed discussion of the geology at ICPP is provided in Sehlke and Bickford (1993)

9.3.5 Soils

The ICPP is located on alluvial materials deposited by the Big Lost River. Surficial sediments at ICPP can be divided into two distinct layers. The upper layer is a poorly sorted gravel to a gravelly coarse sand with abundant well-rounded small cobbles and traces of silt and clay. The larger fractions of the sediments are composed mostly of quartzite, limestone, dolomite, and fine-grained igneous rock. This layer extends down to the basalt, generally between 12 and 15 m (40 and 50 ft), or to a fine-grained layer that directly overlies the basalt.

9.3.6 Hydrogeology

The SRPA occurs beneath the ICPP area at approximately 137 m (450 ft) bls. The interpreted configuration of the water table and the SRPA's general direction of groundwater movement near ICPP in March/April 1990 and September/October 1990 is provided in Sehlke and Bickford (1993). The data presented in this document indicate that the gradient and flow directions are uncertain, but that the general direction of groundwater movement is to the south, although there is wide local variation in the flow direction and hydraulic gradient.

Tracer studies conducted at ICPP show flow rates within the aquifer vary from 1.5 m/d (5 ft/d) to 6 m/d (20 ft/d), with an average near 3 m/d (10 ft/d) (Cooper 1988). Assuming a transmissivity of 28,000 m^2/d (300,000 ft^2/d) and a thickness of 76 m (250 ft), a hydraulic conductivity equal to 366 m/d (1,200 ft/d) is calculated. Using these same parameter values, an average water table gradient of 0.001 and an effective porosity of 10% gives an average linear groundwater velocity of 3.4 m/d (11 ft/d), which is consistent with the results of the tracer test.

Several perched water bodies have been recognized underlying ICPP. The source of the perched water is thought to be infiltrating water from soil column disposal of ICPP wastewaters. An analysis of perching beneath ICPP (Hull 1987) showed that the maximum vertical flow velocity through the unsaturated zone was approximately 0.6 m/d (2 ft/d). This maximum velocity was based on field observations of the movement of radionuclides from the percolation ponds. At the observed flow rate, the travel time from the ground surface to the SRPA would be 225 days, or approximately 7 months. A comparison of Big Lost River flow with perched zone water levels near TRA indicates that the perched water dissipates 1 to 2 years after the source flow stops (Robertson 1974). Based on Robertson's observation of dissipation times and the lack of flow in the Big Lost River over the past 4 years, it is likely that the present perched water bodies beneath ICPP are derived from plant operations.

9.3.7 Demography and Land Use

Populations potentially affected by ICPP activities include Government contractor personnel employed at the INEL, hunters who have harvested game living on or near ICPP, and residential populations in neighboring communities. The ICPP land area is approximately 81 ha (200 acres). This land is used for existing fuel receipt, storage, and treatment for disposal.

There are no residents within an 17.7-km (11-mi) radius of the ICPP and a relatively low population density within a 51.5-km (32-mi) radius. The nearest community to ICPP is Atomic City, located south of the INEL border off U.S. Highway 26. Other population centers near ICPP include

Arco, 11 km (7 mi) west of the INEL on U.S. Highways 20 and 26; and Mud Lake and Terreton near the INEL's northeast border.

Approximately 7,030 people are employed at the INEL; approximately 1,800 at ICPP. During the day shift, the ICPP site population is approximately 1,200. Four rotating 12-hour shift crews are assigned to plant operations. Approximately 40% of the daytime population are involved in operations activities. The remaining 60% are engaged in support activities including environmental compliance, safety, engineering, projects, technical support and development, QA, finance, and human resources.

The BLM classified the acreage within the INEL as industrial and mixed use (DOE 1991). It is used as a nuclear research, materials, and development facility. The developed area within the INEL is surrounded by a 1,295 km^2 (500 mi^2) buffer zone of grazing land for cattle and sheep (DOE 1991). Grazing areas at the INEL are administered by the BLM. The nearest grazing boundary to ICPP is 6.4 km (4 mi) south. During selected years, depredation hunts of game animals, managed by the Idaho Department of Fish and Game, are permitted on-Site. Hunters are allowed in a hunting zone that extends 0.8 km (0.5 mi) inside the INEL boundary on portions of the northeast and west borders of the site.

In the counties surrounding ICPP, approximately 45% of the land is used for agriculture, 45% is open land, and 10% is urban (DOE 1991). Agricultural uses include production of sheep, cattle, hogs, poultry, and dairy cattle (Bowman et al. 1984). Crops grown include potatoes, sugar beets, wheat, barley, oats, forage, and seed crops. Most of the land surrounding the INEL is owned by private individuals or the U.S. Government; the Government land is administered by the BLM. U.S. Department of Energy (1994) indicates that ICPP will remain industrial.

9.3.8 Biota

The flora and fauna existing at ICPP are representative of those found across the INEL. The INEL is located in a cool desert ecosystem characterized by shrub-steppe vegetative communities. The flora and fauna are typical of the northern Great Basin and Columbia Plateau regions. The surface of the INEL is relatively flat, with several prominent volcanic buttes and numerous basalt flows that provide important habitat for small and large mammals, reptiles, and some raptors. The shrub-steppe communities are dominated by sagebrush and provide habitat for sagebrush community species, such as sage grouse, pronghorn, and sage sparrows. Rabbitbrush, grasses and forbs, salt desert shrubs, and exotic/weed species comprise other communities. Juniper woodlands occur near the buttes and in the northwest portion of the INEL; these woodlands provide important habitat for raptors and large mammals. Limited riparian communities exist along intermittently flowing waters. The screening-level ecological risk assessment prepared for WAG 3 contains an expanded discussion of the ecology in the ICPP area (EG&G Idaho 1994).

9.4 Idaho Chemical Processing Plant Windblown Area Nature and Extent of Contamination

The following sections present the results of site characterization activities conducted in support of this RI, as well as data collected previous to this RI, which are used to determine the nature and extent of radionuclide-contaminated soils at ICPP. The sources of COPCs pertinent to this site are described, and the results of the data collected are presented and evaluated to determine the horizontal extent of contamination.

For the purposes of this report, an analyte becomes a COPC if its maximum measured concentration is greater than the UTL as calculated in Rood et al. (1995). This approach is consistent with EPA guidance. Concentrations above the UTL indicate which contaminants were detected in greater than typical levels observed at the INEL but not necessarily which ones are present because of historical processes. For the ICPP Windblown Area, the COPCs are Am-241, Cs-137, Pu-238, and Sr-90. In addition, U-233, and U-235 are considered COPCs because no background values have been established for these radionuclides, and they were detected in the area.

9.4.1 Sources

The radionuclide-contaminated soils resulting from atmospheric dispersion in the vicinity of ICPP most likely result from a culmination of processes and activities that have been performed at ICPP since the 1950s. There have been a number of documented accidental releases containing radionuclides that have resulted in contaminated soils, as well as releases from the ICPP stack that may have contributed to the contamination found in this area. Other potential sources include the various pits, trenches, basins, storage areas, and ponds at ICPP where radioactive waste has been disposed and/or stored.

Section 6 and Appendix A of Sehlke and Bickford (1993) identify potential contamination sources at ICPP that may have an impact on groundwater quality. Many of the sources identified in this document may also be contributors to the radionuclide-contaminated soils addressed in this section of the RI report.

9.4.2 Soil Data

The soil investigation conducted at ICPP during OU 10-06 Phase I was performed to determine areas of radionuclide-contaminated soils at ICPP resulting from atmospheric dispersion. The resulting data from the Phase I investigation and the decayed RESL data are discussed below. The reported RESL data have been decayed to September 30, 1994. The data from both investigations were used for risk assessment purposes.

The COPCs, as previously discussed, are Am-241, Cs-137, Pu-238, Sr-90, U-233, and U-235. The following discussion summarizes the data for each COPC and compares the maximum concentration detected to the UTL where available. Discussion of the isopleth refers to the outer isopleth as depicted in Figure I-8 (map in Appendix I).

Am-241 and/or Pu-238—All Am-241 and/or Pu-238 results from the Phase I samples were reported as nondetectable. The maximum concentration of Am-241 reported in the RESL data set occurs at location 6-9 (0.037 ± 0.004 pCi/g). This sample was collected in 1987 from the 0–5-cm (0–2-in.) depth and is slightly above the Am-241 UTL reported in Rood et al. (1995) (0.011 pCi/g). The RESL data set reports a total of four Am-241 values above the UTL; two which occur inside the isopleth and two which occur outside the isopleth. The concentrations of Am-241 at locations outside the isopleth are 0.026 ± 0.003 at location D-114, and 0.037 ± 0.004 at location 6-9. The maximum concentration of Pu-238 reported in the RESL data set occurs at location B-96 (0.387 ± 0.017 pCi/g). This sample, collected in 1989 from 0–5 cm (0–2 in.) exceeds the UTL reported in Rood et al. (1995) (0.0049 pCi/g). Twenty-five additional RESL locations have Pu-238 concentrations that exceed UTL. Six of these locations occur outside the outer isopleth.

Cs-137—Cs-137 was detected above background in 26 Phase I samples. The maximum concentration of Cs-137 detected, occurred at location NE Transect-1 (16.2 ± 1.2 pCi/g). The next

highest concentration occurred at location NE Transect-4 (13.2 ± 1.0 pCi/g). The remainder of the Cs-137 concentrations range from 1.19 ± 0.9 to 10.8 ± 0.8 pCi/g.. The maximum concentration of Cs-137 reported in the RESL data set occurs at location B44a (651 ± 6 pCi/g). This sample was collected in 1974 within the ICPP facility fence, which is not considered part of the ICPP Windblown Area. The maximum concentration of Cs-137 detected in the ICPP Windblown Area occurs at location B66 (33.3 ± 0.5 pCi/g). This sample was collected in 1974. All of these values are above the UTL reported Rood et al. (1995) (0.82 pCi/g).

Sr-90—All Sr-90 results from the Phase I samples were reported as nondetectable. The maximum concentration of Sr-90 reported in the RESL data set occurs at location A46 (9.4 ± 0.3 pCi/g). This sample was collected in 1989 from the 0–5-cm (0–2-in.) depth and is above the UTL reported in Rood et al. (1995) (0.49 pCi/g).

U-233—Phase I samples were analyzed for U-233; however, none was detected. The maximum concentration of U-233/U-234 reported in the RESL data set occurs at location B27 (1.09 ± 0.03 pCi/g). This sample was collected in 1982 from 0–5-cm (0–2-in.) in depth. A UTL has not been determined for this radionuclide.

U-235—Phase I samples were analyzed for U-235; however, none was detected. The maximum concentration of U-235 reported in the RESL data set occurs at location 12-5 (0.11 ± 0.02 pCi/g). This sample was collected in 1987 from the 5–10-cm (0–2-in.) depth. A UTL has not been determined for this radionuclide.

The minimum, maximum, and mean concentrations for all of the isotopes analyzed for the Phase I samples and the locations at which the minimum and maximum concentrations exist are listed in Table 9-1). The decayed minimum, maximum, and mean concentrations of the isotopes analyzed for the RESL samples and the locations at which the minimum and maximum concentrations exist are listed in Table 9-2. Appendix A contains the analytical results for these soil samples.

Table 9-1. Radionuclide maximum, minimum, and mean concentrations of soil samples collected during Phase I at the ICPP Windblown Area.

	Concentration (pCi/g)			
Radionuclide	Minimum (sample number)	Maximum (sample number)	Mean	Count[a]
Am-241	NA[b]	NA	NA	0/4
Cs-137	1.1 ± 0.9 (3ISW01)	16.1 ± 1.2 (3INE01)	5.9	25/25
Pu-238	NA	NA	NA	0/4
Pu-239/240	NA	NA	NA	0/4
Sr-90	NA	NA	NA	0/4
U-238	1.12 ± 0.09 (3INE01)	1.16 ± 0.09 (3ISW09)	1.11	4/4
U-234	1.09 ± 0.09 (3INW01)	1.18 ± 0.09 (3ISW09)	1.15	4/4

a. Represents the number of true positives versus the number of samples for which the radionuclide was analyzed.

b. No true positives.

Table 9-2. Decayed radionuclide minimum, maximum, and mean concentrations for soil samples collected by RESL at the ICPP Windblown Area (decayed to September 30, 1994).

	Concentration (pCi/g)			
Radionuclide	Minimum (sample number, year)	Maximum (sample number, year)	Mean	Count[a]
Ac-228	0.63 ± 0.16 (A-44, 1982)	2.3 ± 0.2 (1.5 mi N, 0.5 mi E)	1.2	76/76
Am-241	0.0036 ± 0.0018 (1.5 m S, 0.5 mi E, 1974)	0.037 ± 0.004 (6-9, 1987)	0.01	68/83
Cs-137	0.06 ± 0.01 (12-3, 1987)	651 ± 6 (B44a, 1974)	13	258/262
K-40	2.03 ± 0.9 (12-5, 1987)	36 ± 3.8 (B96, 1989)	19	194/194
Pb-212	1.17 ± 0.09 (1.5 mi S, 1974)	2.1 ± 0.1 (1.5 mi N, 0.5 mi W, 1974)	1.6	39/40
Pb-214	0.94 ± 0.13 (D-36, 1982)	2.3 ± 0.2 (2.5 mi S, 1974)	1.4	75/75
Pu-238	0.0004 ± 0.00008 (D-114, 1982)	0.373 ± 0.015 (B96, 1989)	0.03	69/98
Pu-239/240	0.0018 ± 0.0009 (A-66, 1989)	0.073 ± 0.005 (B96, 1989)	0.02	84/99
Se-90	0.13 ± 0.04 (A63, 1989)	9.4 ± 0.3 (A-46, 1989)	1.1	43/48
Tl-208	0.879 ± 0.14 (A-90, 1982)	1.65 ± 0.22 (B69, 1982)	1.3	21/22
U-238	1.06 ± 0.03 (D-57, 1982)	1.17 ± 0.08 (A-17, 1982)	1.1	5/5
Pa-234m	2.5 ±0.9 (K-1, 1987)	10 ± 4.4 (D-57, 1987)	5	10/10
U-235	0.044 ± 0.004 (B-27, 1982)	0.11 ± 0.02 (12-5, 1987)	0.06	7/7
Bi-214	1 ± 0.2 (B-48, 1982)	1.57 ± 0.13 (B-69, 1982)	1.3	24/24
Bi-212	1.36 ± 0.52 (A-110, 1982)	3.6 ± 0.57 (D-57, 1982)	2.1	13/13
U-233/234	1.02 ± 0.03 (B-48, 1982)	1.09 ± 0.03 (B-27, 1982)	1.05	5/5
Co-60	BDL[b]	0.8 ± 0.1 (B37, 1974)	—	2/262
Sb-125	BDL	0.05 ± 0.004 (A14, 1974)	0.02	7/262
Eu-155	—	0.35 ± 0.04 (6-9, 1987)	—	1/262

a. Represents the number of true positives versus the number of samples for which the radionuclide was analyzed.

b. BDL = Concentration has decayed to below detection limit levels.

c. Only one true positive; reported as the maximum.

Figure I-8 (map in Appendix I) shows the Phase I and RESL sample locations and the corresponding concentrations of the major risk driver for the 100-year residential scenario (Sr-90). Only the Sr-90 concentrations above the UTL calculated in Rood et al. (1995) are represented in the figure. Sampling locations depicted in the figure with no corresponding Sr-90 contaminant data indicate that Sr-90 was either not detected or was below the UTL (0.49).

9.4.2.1 Results of the Dose Equivalent Rate Measurements—In support of the OU 10-06 Phase I ICPP investigation, dose equivalent rate measurements were collected in the vicinity of ICPP to determine the risk from external exposure from gamma-emitting radionuclides. Dose equivalent rate measurements were collected at all Phase I sampling locations and at 15-m (50-ft) intervals between sampling locations. Dose equivalent rate measurements were also collected at 97 RESL sampling locations. At the Phase I sampling locations, measurements on the 0.1 scale range from 4 to 7 μrem/hr, and measurements on the 1 scale range from 5 to 10 μrem/hr. At the RESL sampling locations, measurements on the 1 scale range from 8 to 18 μrem/hr. A summary of the measurements collected is presented in Table 9-3. Where indicated, the Phase I data represent an average of the dose equivalent rate measurements collected at the indicated sample location. A brief discussion on the collection of the dose equivalent rate measurements is contained in Section 1.4.4.5.2. A discussion of the screening of the dose rates is contained in Section 9.6.

9.4.3 Data Interpretation

The following section presents a brief discussion on the vertical extent of contamination at the ICPP Windblown Area. A discussion on the interpretation of the data contained in Section 9.4.2 is also presented and has been used to assess the horizontal extent of contamination in this area.

9.4.3.1 Vertical Extent of Contamination. Because the windblown radionuclide-contaminated surface soil areas characterized under OU 10-06 are thought to result from radionuclides deposited by atmospheric dispersion, it is believed that any radionuclide contamination will be restricted to the upper 10 cm (4 in.) of soil, with the majority in the upper 5 cm (2 in.). This is the basis upon which the OU 10-06 Phase I ICPP Windblown investigation was designed. Based on this premise and for possible comparison to the RESL data set, samples were collected from the 0–10-cm (0–4-in.) depth.

As discussed in Section 1.4.2, RESL conducted a special investigation in 1976 and 1977. The results of this investigation indicate that the majority of the activity in surface soils is confined to the top 10 cm (4 in.). Subsequent to this investigation, RESL limited sample analysis to those samples collected up to 10-cm (4-in.) in depth.

Based on the results of the RESL investigation, in addition to the suspected method of contaminant deposition, the vertical extent of the radionuclide COPCs detected in the ICPP Windblown Area is believed to be restricted to the upper 10 cm (4 in.) of soil.

9.4.3.2 Horizontal Extent of Contamination. An evaluation of the Phase I and decayed RESL data sets was performed to assess the horizontal extent of the radionuclide COPCs in the ICPP Windblown Area. The results of this evaluation are as follows:

- The distribution of Am-241 and Pu-238 concentrations above background are not homogeneous within the ICPP Windblown Area. The RESL data set indicates that concentrations of Pu-238 above background are not limited to a particular area. The majority of the observed concentrations generally occur in the primary and secondary wind

Table 9-3. Dose equivalent rate for the ICPP Windblown Area.

Sample identification			Readings in μrem/hr	
Sampling group	Sample number	Nearest facility	0.1 Scale[a]	1 Scale
Phase I	31NE01	ICPP	—	15
Phase I	31NE02	ICPP	—	15
Phase I	31NE03	ICPP	—	17.4
Phase I	31NE04	ICPP	—	15.4
Phase I	31NE05	ICPP	—	15
Phase I	31NE06	ICPP	—	14.7
Phase I	31NE07	ICPP	—	11.2
Phase I	31NE08	ICPP	—	11.4
Phase I	31NE09	ICPP	—	12.1
Phase I	31NE10	ICPP	—	10
Phase I	31NE11	ICPP	—	10
Phase I	31SW01	ICPP	—	10
Phase I	31SW02	ICPP	—	15
Phase I	31SW03	ICPP	—	14.6
Phase I	31SW04	ICPP	—	14.7
Phase I	31SW05	ICPP	—	10.6
Phase I	31SW06	ICPP	—	10
Phase I	31SW07	ICPP	—	10.1
Phase I	31SW08	ICPP	—	10.2
Phase I	31SW09	ICPP	—	10
Phase I	31NW01	ICPP	—	15
Phase I	31NW02	ICPP	—	10.3
Phase I	31NW03	ICPP	—	10.3
RESL	A10	ICPP	—	13
RESL	A109	ICPP	—	13.5
RESL	A110	ICPP	—	12[a]
RESL	A111	ICPP	—	12.2
RESL	A112	ICPP	—	12
RESL	A113	ICPP	—	13.2

Table 9-3. (continued).

Sample identification			Readings in μrem/hr	
Sampling group	Sample number	Nearest facility	0.1 Scale[a]	1 Scale
Phase I	31NE01	ICPP	—	15
RESL	A114	ICPP	—	11.5
RESL	A115	ICPP	—	11.7
RESL	A116	ICPP	—	11.5
RESL	A117	ICPP	—	11.3
RESL	A118	ICPP	—	11.3
RESL	A119	ICPP	—	11.7
RESL	A120	ICPP	—	11.8
RESL	A21	ICPP	—	12.4
RESL	A32	ICPP	—	12.8
RESL	A43	ICPP	—	12.5
RESL	A54	ICPP	—	12.2
RESL	A65	ICPP	—	12.8
RESL	A76	ICPP	—	11.3
RESL	A87	ICPP	—	11.5
RESL	A98	ICPP	—	12.2
RESL	B104	ICPP	—	10[a]
RESL	B112	ICPP	—	11[a]
RESL	B113	ICPP	—	11[a]
RESL	B114	ICPP	—	10[a]
RESL	B115	ICPP	—	10[a]
RESL	B93	ICPP	—	10
RESL	D109	ICPP	—	10[a]
RESL	D111	ICPP	—	10[a]
RESL	D112	ICPP	—	10[a]
RESL	D113	ICPP	—	10[a]
RESL	D114	ICPP	—	11[a]
RESL	D115	ICPP	—	10[a]

Table 9-3. (continued).

Sample identification			Readings in μrem/hr	
Sampling group	Sample number	Nearest facility	0.1 Scale[a]	1 Scale
Phase I	31NE01	ICPP	—	15
RESL	D116	ICPP	—	10[a]
RESL	D117	ICPP	—	10[a]
RESL	D118	ICPP	—	10[a]
RESL	D119	ICPP	—	10[a]
RESL	D120	ICPP	—	10[a]
RESL	D17	ICPP	8	10[a]
RESL	D18	ICPP	7	10[a]
RESL	D19	ICPP	9	10[a]
RESL	D21	ICPP	—	12.2
RESL	D27	ICPP	9	10[a]
RESL	D32	ICPP	—	11.4
RESL	D42	ICPP	6	10[a]
RESL	D43	ICPP	5	10.2
RESL	D54	ICPP	—	11.8
RESL	D64	ICPP	8	10[a]
RESL	D65	ICPP	—	10.5
RESL	D76	ICPP	—	10
RESL	D87	ICPP	—	11.3
RESL	D91	ICPP	10	10[a]
RESL	D98	ICPP	—	10[a]
RESL	D58	ICPP	7	5[a]
RESL	A6	ICPP	6	5[a]
RESL	A28	ICPP	9	10[a]
RESL	A72	ICPP	10	10[a]
RESL	A70	ICPP	7	10[a]
RESL	C46	ICPP	5	5[a]
RESL	A66	ICPP	5	5[a]

Table 9-3. (continued).

Sample identification			Readings in μrem/hr	
Sampling group	Sample number	Nearest facility	0.1 Scale[a]	1 Scale
Phase I	31NE01	ICPP	—	15
RESL	C112	ICPP	4	5[a]
RESL	C116	ICPP	4	5[a]
RESL	C49	ICPP	8	10[a]
RESL	B89	ICPP	9	10[a]
RESL	B116	ICPP	9	10[a]
RESL	B120	ICPP	7	10[a]
RESL	B76	ICPP	8	10[a]
RESL	B29	ICPP	8	10[a]
RESL	B7	ICPP	7	5[a]
RESL	C32	ICPP	6	5[a]
RESL	B32	ICPP	5	5[a]
RESL	C76	ICPP	7	10[a]
RESL	C120	ICPP	8	10[a]
RESL	D41	ICPP	6	10[a]
RESL	D29	ICPP	7	10[a]
RESL	D28	ICPP	8	10[a]
RESL	B73	ICPP	8	10[a]

a. Not an averaged value; only one reading collected.

directions from the facility. Americium-241 was detected at two locations outside the outer isopleth; Pu-238 was detected at six locations outside the outer isopleth. Concentrations of Am-241 and Pu-238 within the isopleth do not exceed 1 pCi/g. Concentrations above this limit were not observed outside the isopleth.

- The distribution of Cs-137 concentrations above background within the ICPP Windblown Area generally occur in the primary and secondary wind directions from the facility. Several RESL locations outside the isopleth show concentrations of Cs-137 that exceed background. The outer isopleth bounds the horizontal extent of Cs-137 to 5 pCi/g or greater within the isopleth. Concentrations above 5 pCi/g have not been detected outside the outer isopleth.

- The distribution of Sr-90 concentrations above background are not homogeneous within the ICPP Windblown Area. The RESL data set indicates that concentrations of Sr-90 generally occur close to the facility and in the primary and secondary wind directions from the facility. Concentrations of Sr-90 above background were not observed in areas outside the outer isopleth.

- Reported concentrations of U-233/U-234 and U-235 occur at the same locations, generally close to the facility. Five concentrations each of U-233/U-234 and U-235 are reported at locations north, south, east and west of ICPP. All reported concentrations of these isotopes occur within the outer isopleth.

An examination of the data indicates that the majority of the contaminants detected above background occur close to ICPP and in the primary wind directions. Contaminant concentrations generally decrease with increasing distance from the facility. Because each Phase I sample and the majority of the RESL samples were submitted for Cs-137 analysis, Cs-137 was used as an indicator for determining the horizontal extent of contamination in the ICPP Windblown Area. An examination of the most recent decayed RESL data collected at sample locations outside the outer isopleth, indicate that Cs-137 was detected above background at 11 locations northeast and southwest of the facility. The isopleth, however, bounds the horizontal extent of Cs-137 contamination to 5 pCi/g or greater within the isopleth.

9.5 Idaho Chemical Processing Plant Windblown Area Contaminant Fate and Transport

The following sections address the potential routes of migration for COPCs at the ICPP Windblown Area, their persistence in the environment, and the factors affecting contaminant migration.

9.5.1 Potential Routes of Migration

There are two potential migration routes for the COPCs at the ICPP Windblown Area to migrate in the environment: air and biota. Windblown deposited radionuclides occurring in soils are known to be restricted to the top few inches of soil. When exposed to wind, a potential migration route exists for these contaminants to migrate via atmospheric dispersion.

Biota that inhabit areas of the ICPP also have the ability to function as a potential route for contaminants to migrate. Studies performed on migrating animals and insects inhabiting the INEL

indicate that these animals and insects can potentially serve as a contaminant migration pathway (Section 1.4.4.4).

Surface water is not considered a potential route of migration for the COPCs at the ICPP Windblown Area. This is primarily because of a lack of surface water features at the ICPP. The Big Lost River is the only major natural surface water feature near the ICPP, but the river is dry for years at a time, never exits the INEL, and no surface waters are discharged from the ICPP to the Big Lost River. During years of high flow, the river infiltrates into the surface in the area of the Big Lost River Sinks, located in the north central portion of the INEL.

Groundwater does not serve as a potential route of migration for the COPCs at the ICPP Windblown Area because of the shallow depths at which they occur [0–10 cm (1–4 in.)] and the lack of a driving force to the subsurface. This is supported by a subsurface migration of radionuclides study conducted at the RWMC where samples were collected directly beneath pits containing buried waste. Analysis of these samples indicated limited radionuclide migration to the basalt-sediment interface below the pits (Humphrey 1980).

9.5.1.1 Conceptual Site Model. A preliminary conceptual site model was developed as part of the OU 10-06 Scope of Work (EG&G Idaho 1993). Figure A-1 of the scope of work provides the model for the windblown deposited radionuclide-contaminated soils, which includes soils at the ICPP Windblown Area. This preliminary model identifies contaminant release and transport mechanisms, affected media, and potential receptors. The model shows suspension, intrusion, and radioactive decay as the release mechanisms; air and soil as the transport mechanisms and affected media; and present-day workers, future residents, and future recreational users as the potential receptors. A risk characterization based on a modified preliminary conceptual site model was performed for the ICPP Windblown Area. Modifications consisted of adding dermal contact as an exposure pathway to both the occupational and residential scenarios and ingestion of food crops as an exposure pathway to the residential scenario. Figure 1-4 illustrates the modified conceptual site model.

9.5.2 Contaminant Persistence

The COPCs at the ICPP Windblown Area are Am-241, Cs-137, Pu-238, Se-90, U-233, and U-235. The primary process that affects the persistence of these contaminants in the environment is radioactive decay; the longer the decay half-life, the longer the radionuclide will persist in the environment. A discussion of radioactive decay is contained in Section 1.4.4.2.2. The decay half-lives for the COPCs are provided in the Table 9-4.

The persistence of these contaminants (as indicated by their decay half-lives) in order of most persistent to least persistent is as follows: U-235, U-233, Am-241, Pu-238, Cs-137, and Se-90.

9.5.3 Contaminant Migration

The primary contaminant migration pathway for the ICPP Windblown Area, where radioactive contaminants exist in the surface soil, is wind. Biota that inhabit areas of ICPP may also play a role in the migration of contaminants in surface soil. Section 1.4.4.1 is a detailed discussion of these migration pathways.

The ability of these contaminants to adsorb should also be considered when discussing contaminant migration because adsorption retards the rate of movement. A discussion of adsorption is contained in Section 1.4.4.2.1.

Table 9-4. Decay half-lives for the COPCs at the ICPP Windblown Area.

Contaminant of potential concern	Decay half-life (year)
Am-241	4.33E+02
Cs-137	3.02E+01
Pu-238	8.77E+01
Sr-90	2.9E+01
U-233	1.592E+05
U-235	7.04E+08

9.6 Idaho Chemical Processing Plant Windblown Area Baseline Risk Assessment

This section presents information and results specific to the baseline risk assessment performed for the ICPP Windblown Area. Standard information that applies to all baseline risk assessments conducted as part of this RI is contained in Section 1.4.5. This information includes the presentation of the standard default exposure scenarios and pathways; biotic uptake methodology; COPC intake equations; chronic radiation effects; and the methodology for evaluating carcinogenic and noncarcinogenic health effects.

9.6.1 Human Health Evaluation

This section presents a human health evaluation regarding the contamination at the ICPP Windblown Area.

9.6.1.1 Exposure Assessment. This section presents the information needed to quantify the type, magnitude, and duration of exposures to the COPCs at the site. Soil samples collected by RESL at ICPP in 1982, 1987, and 1989 were used because there were data at both the 0–5 and 5–10-cm (0–2 and 0–4-in.) depths.

Because the soil samples collected by RESL were collected before the 1992 release from the ICPP stack[a] and the OU 10-06 samples were collected in 1993, a t-test was used to determine if the Cs-137 soil concentrations were significantly different (i.e., from different populations) between the two sets of data. Cesium-137 concentrations in soil samples collected by RESL in 1989 in the northeast quadrant of the ICPP grid were compared to the OU 10-06 samples collected along the northeast transect. Results of this t-test indicated that the differences in Cs-137 concentrations before and after the release are not statistically significant and, therefore, can also be combined into one data set.

a. Personal communication R. S. Rotham, DOE-ID, to D. J. Pisarski, State of Idaho, April 28, 1992.

9.6.1.1.1 Screening Methodology—The radionuclides detected were screened to eliminate from further analysis those radionuclides that are below the 95-95 one-sided UTL of the background data and are indistinguishable from background. Background radionuclide concentrations (i.e., UTL) from Rood et al. (1995). These values were compared with the maximum concentrations of the COPCs detected in the Phase I and RESL soil samples collected at the ICPP Windblown Area to determine which radionuclides may be present as a result of past activities (EPA 1989). This section discusses the approach and results of this screening method.

9.6.1.1.1.1 Screening Radionuclides Detected—Table 9-5 compares the UTL reported in Rood et al. (1995) and the maximum radionuclide concentrations detected at the ICPP Windblown Area.

Potassium-40 was not included in the baseline risk assessment because there are no known instances of K-40 contamination from human activities. Although Eu-155 was detected in one of the soil samples, it will not be included in the baseline risk assessment because it was detected only in one sample, has a low concentration (0.96 pCi/g), and has a relatively short radioactive half-life (4.96 years).

9.6.1.1.1.2 Screening Dose Equivalent Rates—Dose equivalent rates at the sample locations in the ICPP Windblown Areas ranged from 5 to 20 μrem/hr. As stated in Rood

Table 9-5. Background UTL and maximum concentrations detected in soil samples at the ICPP Windblown Area.

Radionuclide	Upper tolerance limit (pCi/g)	Maximum concentration (pCi/g)	Number of detections above upper tolerance limit/number of samples analyzed
Am-241	0.011	0.0347	2/22
Cs-137	0.82	18.4	77/85[b]
Eu-155	—[a]	0.96	1/1[b]
K-40	24	27.8	1/59
Pu-238	0.0049	0.373	11/28
Pu-239/240	0.10	0.073	0/28
Sr-90	0.49	5.72	8/15
U-233	—[a]	1.09	5/5
U-234	1.44	1.18	0/9
U-235	—[a]	0.052	5/5
U-238	1.40	1.17	0/9

a. No background values were determined for these radionuclides.

b. The total number of samples analyzed for gamma-emitting radionuclides represents the number of true positive detections for the OU 10-06 Phase I data and all the RESL samples analyzed.

et al. (1995), the UTL for dose equivalent rates is 20 μrem/hr, and any dose equivalent rate above that value will be considered above background. Because none of the dose equivalent rates at the ICPP Windblown Areas exceed the UTL, the dose equivalent rates are considered to represent background and are not included in the baseline risk assessment.

9.6.1.1.1.3 COPCs—Based on the results of the screening analysis, the COPCs at the ICPP Windblown Area are Am-241, Cs-137, Pu-238, Sr-90, U-233, and U-235.

9.6.1.1.2 Extent of Contamination—The extent of contamination is determined to provide areal and vertical dimensions of the contamination. The areal extent of contamination is used in the risk assessment as the location of the receptor(s). The vertical extent of contamination is used to identify the exposure pathways to be evaluated.

To monitor the concentrations of radioactivity in soil, the RESL sampling program collected data from 1971, 1974, 1982, 1987, and 1989 at ICPP. In some instances, the same sample locations were sampled in more than one year. In these instances both radionuclide concentrations were used in the kriging analysis.

Cesium-137 was the COPC evaluated to determine the extent of contamination. This radionuclide was selected because of the relatively large number of sample locations with Cs-137 detected at 0–10 cm (0–4 in.). Kriging is described in Section 1.4.5.1.2.3.1.

A postplot of the Cs-137 data is presented in Figure 9-2, which indicates that a zone of contamination runs diagonally across the plot. This pattern supports the sampling design used in the OU 10-06 Phase I sampling program. In addition, the pattern also indicates that the correlation structure depends on direction.

Initially, an omnidirectional variogram was calculated for the ln(Cs-137) concentrations. However, because the results indicated strong spatial correlation with a range up to approximately 1,220 m (4,000 ft) in the southwest to northeast direction (the major axis), a directional variogram with a 45-degree angle (southwest to northeast) was calculated. This resulted in a slightly more stable variogram. A Gaussian model of the directional variogram was used. The form of the Gaussian model is presented in Equation (1-3).

For the major direction (45 degrees), the nugget was 0.15; the sill was 0.86 [which is the total variance in the ln(Cs-137) concentrations ($s = 0.93$ so $s^2 = 0.86$)]; and the range was 1,220 m (4,500 ft). The minor axis directional variogram (135 degrees, southeast to northwest) had a range of 760 m (2,500 ft), and all other model parameters (e.g., nugget) are the same as for the major axis. Because the kriging was done on the ln-transformed Cs-137 concentrations, the predicted values from the kriging were back-transformed to the original units (picocuries per gram). No data were collected from within the boundary of the ICPP administratively controlled area, so predicted Cs-137 concentrations from the area are uncertain.

To assess the quality of the results, the standard errors of prediction and the cross-validation of the predicted values with the observed values were calculated. The cross-validation showed the errors (predicted − observed values) were roughly normally distributed with a mean = 0 ln(pCi/g) and a standard deviation = 0.53. The errors ranged from -1.625 to 1.91. Therefore, the predicted Cs-137 concentrations are a reasonable fit to the observed data.

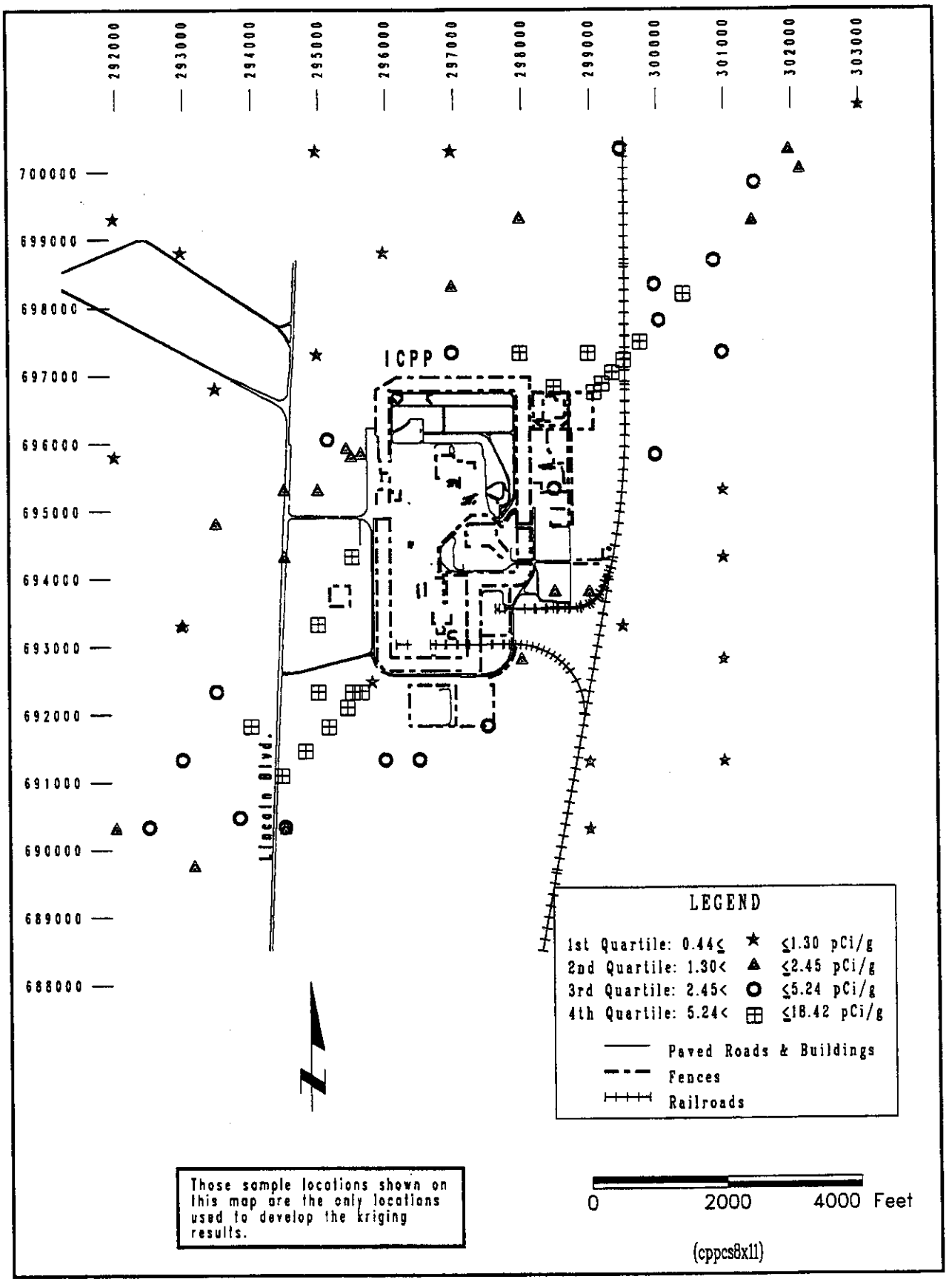

Figure 9-2. Postplot of Cs-137 concentrations at the ICPP Windblown Area.

The back-transformed kriging results were compared to a Cs-137 background concentration of approximately 0.8 pCi/g. Standard normal deviates, z, were generated using Equation (1-6). The z-values are plotted in Figure I-9 (map in Appendix I). When the value exceeds 2.0, it can generally be inferred that the predicted concentration is greater than background (at $\alpha = 0.05$).

As shown on Figure I-9 (map in Appendix I), there is an area in the northeast section of ICPP that has higher concentrations than the rest of the area around ICPP (i.e., concentrations greater than 9 pCi/g). This area was selected for the location of the hypothetical receptor. The areal extent is 139,520 m^2 (1,501,800 ft^2). The vertical extent of contamination is assumed to be the sample collection depth [i.e., 10 cm (4 in.)]. This is a reasonable assumption because the depositional mode of contamination from the source will not likely have contamination extending below this depth.

The extent of contamination presented in Figure I-9 (map in Appendix I) is smaller than the outermost isopleth from the 1990 EMI aerial survey. This is, in part, because of the limitations of the aerial flyover, discussed in Section 1.4.1, where some of the isopleth is likely a result of direct radiation whose source is the facility being surveyed (i.e., ICPP) and not the surrounding soil. In addition, spatial interpolation is a smoothing process where the range of the predicted values will not exceed the range of the observed data. For use in determining the extent of contamination in a baseline risk assessment, the focus is on determining an estimate of the average concentration within the contamination zone. Because block kriging results in a smaller standard error of prediction than point kriging, these will be less uncertainty in the boundaries of the contamination zone and in the estimated concentration within said zone.

9.6.1.1.3 Exposure Scenarios, Pathways, and Time Periods—Exposure scenarios, pathways, and time periods are presented in Section 1.4.5.1.3.

9.6.1.1.4 Concentration Term—Concentration terms for the COPCs are calculated using Equation (1-7) in Section 1.4.5.1.4 and are presented in Table 9-6. Because of the high variability in the Sr-90 results, the maximum Sr-90 soil concentration is used as the concentration term. Although the Cs-137 soil concentrations were distributed lognormally, to be conservative, the concentration term was defined as the maximum contour interval based on the kriging results (11 pCi/g).

9.6.1.1.5 Contaminant Transport—This section identifies factors that affect the concentration of the COPCs at a site and describes the processes that transport a COPC to a receptor. Site-specific data from Mitchell (1994) show that the mass loading of particulates in the air around the ICPP is approximately 1.4E-05 g/m^3. Using this information, COPC concentrations in air were calculated. These concentrations are listed in Table 9-7. See Section 1.4.5.1.5 for a more detailed discussion of the contaminant transport processes.

9.6.1.1.6 COPC Intake Equations—The COPC intake equations are presented in Section 1.4.5.1.6.

9.6.1.2 Toxicity Assessment. A toxicity assessment was conducted to identify potential adverse effects and toxicity values for COPCs at the ICPP Windblown Area. A toxicity value is a numerical expression of a substance dose-response relationship used in the risk assessment. Appendix C presents a detailed discussion of the effects of the COPCs on human health.

Table 9-6. Concentration terms for the COPCs at the ICPP Windblown Area.

Contaminant of potential concern	Concentration term (pCi/g)
Am-241	0.017[a]
Cs-137	11[c]
Pu-238	0.08[a]
Sr-90	5.3[b]
U-233	1.08[a]
U-235	0.05[a]
Uranium	3.47 mg/kg[d]

a. Ninety-five percent upper confidence limit.

b. Maximum concentration detected.

c. Based on the kriging results.

d. This soil concentration is derived from the maximum soil concentration of U-238.

Table 9-7. Calculated air concentrations of the COPCs at the ICPP Windblown Area.

Contaminant of potential concern	Air concentration[a]
Am-241	2.4E-07
Cs-137	1.5E-04
Pu-238	1.3E-06
Sr-90	7.4E-05
U-233	1.5E-05
U-235	7.0E-07
Uranium	4.9E-08

a. Calculated air concentrations reported as picocuries per cubic meter for radionuclides and milligrams per cubic meter for metals.

9.6.1.2.1 Radionuclides—The radionuclides evaluated in this human health evaluation are Am-241, Cs-137, Pu-238, Sr-90, U-233, and U-235. The EPA classifies all radionuclides as Group A carcinogens (known human carcinogens) based on emissions of ionizing radiation and the extensive weight-of-evidence provided by epidemiological studies of radiation-induced cancers in humans (EPA 1995). As with chemical carcinogens, it is assumed that any dose of radiation can produce adverse effects and a threshold does not exist for radiation carcinogenesis. Slope factors used to evaluate carcinogenic effects for the radionuclides are presented in Table 1-7.

9.6.1.2.2 Nonradionuclides—Because radioactive uranium has a chemical toxicity component associated with it, it will also be evaluated for nonradioactive effects. The toxicity value for uranium is present in Table 1-8.

9.6.1.3 Risk Characterization. Potential risks and hazards associated with the COPCs at the ICPP Windblown Area were assessed for hypothetical occupational and residential receptors. The following three potential exposure pathways were addressed based on their applicability to each receptor scenario and location:

1. Ingestion of soil

2. Inhalation of fugitive dust

3. Ingestion of food crops (residential scenario only).

The external exposure pathway was not evaluated because all the dose equivalent rate data were below background levels. The dermal contact exposure pathway was not evaluated because no toxicity information for the COPCs was available.

The quantitative evaluation of the COPCs for each pathway is dependent on the availability of toxicity values to perform the risk calculations for the exposure route. Risks are calculated only for those COPCs with established toxicity values. Qualitative evaluations are provided for COPCs when toxicity values are not available. Section 9.6.1.3.2 presents a qualitative characterization of the inhalation hazard from soluble salts of uranium.

9.6.1.3.1 Quantitative—Noncarcinogenic effects were quantitatively evaluated based on the hazard quotient relative to unity. Carcinogenic risks were quantitatively evaluated and compared to the NCP target risk range of 10^{-6} to 10^{-4}. The methods used in the human health risk assessment follow EPA guidance (EPA 1989). The risk values presented are incremental, individual lifetime cancer risks from exposure to the COPCs.

9.6.1.3.1.1 Carcinogenic Effects Methodology—The methodology for evaluating carcinogenic effects is presented in Section 1.4.5.3.1.1.

9.6.1.3.1.2 Noncarcinogenic Effects Methodology—The methodology for evaluating noncarcinogenic effects is presented in Section 1.4.5.3.1.2.

9.6.1.3.1.3 Results for the Current Occupational Scenario—The risks and hazard quotients for the exposure pathways evaluated for the current occupational scenario are presented in Table 9-8. The risk from all radionuclides for all exposure pathways is 3E-07. This is below the lower limit of the NCP target risk range. The hazard quotient for uranium is 6E-04. This is below the target hazard quotient of one.

Table 9-8. Summary of risks and hazard quotients for the ICPP Windblown Area current occupational exposure scenario.

	Soil ingestion		Fugitive dust inhalation		Total[a]	
Radionuclide	Risk	Hazard quotient	Risk	Hazard quotient	Risk	Hazard index
Am-241	2E-09	NA[b]	1E-09	NA	3E-09	NA
Cs-137	1E-07	NA	4E-10	NA	1E-07	NA
Pu-238	8E-09	NA	4E-09	NA	1E-08	NA
Sr-90	9E-08	NA	6E-10	NA	9E-08	NA
U-233	2E-08	NA	3E-08	NA	4E-08	NA
U-235	7E-10	NA	1E-09	NA	2E-09	NA
Uranium[c]	NA	6E-04	NA	NA	NA	6E-04
Total[a]	**2E-07**	**6E-04**	**3E-08**	**NA**	**3E-07**	**6E-04**

a. Total may not equal the sum of the values in the column because of rounding.

b. Not applicable.

c. Hazard quotients for uranium are based on the maximum soil concentration of U-238.

9.6.1.3.1.4 Results for the 30-Year Residential Scenario—The risks and hazard quotients for the exposure pathways evaluated for the hypothetical future 30-year residential scenario are presented in Table 9-9. Total risk from all exposure pathways is 4E-05. This is within the NCP target risk range. The total risk for the soil ingestion pathway is 3E-07, and the highest risk for the fugitive dust inhalation pathway is 5E-08. The total risks from ingestion of food crops is 5E-05 and from Sr-90 (4E-05) and Cs-137 (2E-06). The hazard quotient for uranium is 6E-03. This value is below the target hazard quotient of one.

9.6.1.3.1.5 Results for the 100-year Residential Scenario—The risks for the exposure to radionuclides in the ICPP Windblown Area for the 100-year residential scenario are presented below. This scenario is being evaluated because the maximum concentration of Sr-90 exceeds its PRG, which was determined in the FS and showed a risk in the 30-year residential exposure scenario. The total risk from exposure across all pathways is 8E-06, which is from food crop ingestion. This is within the NCP target risk range. The risk from soil ingestion (3E-08) and fugitive dust inhalation (1E-10) are below the NCP target risk range.

9.6.1.3.2 Qualitative—Because radioactive uranium has a chemical toxicity component to its health effects, and because no quantitative toxicity values are available for the inhalation pathway, it was evaluated qualitatively for the occupational scenario. The maximum calculated air concentration of soluble uranium compounds at the ICPP was compared to an OSHA time-weighted average of 5E-02 mg/m^3 (29 CFR 1900.1000). The calculated air concentration for uranium isotopes

Table 9-9. Summary of risks and hazard quotients for the ICPP Windblown Area 30-year residential exposure scenario.

	Soil ingestion		Fugitive dust inhalation		Food crop ingestion		Total[a]	
Radionuclide	Risk	Hazard quotient	Risk	Hazard quotient	Risk	Hazard quotient	Risk	Hazard index
Am-241	7E-09	NA[b]	2E-09	NA	4E-09	NA	1E-08	NA
Cs-137	2E-07	NA	3E-10	NA	2E-06	NA	2E-06	NA
Pu-238	2E-08	NA	5E-09	NA	2E-09	NA	3E-08	NA
Sr-90	2E-07	NA	5E-10	NA	4E-05	NA	4E-05	NA
U-233	6E-08	NA	4E-08	NA	5E-08	NA	2E-07	NA
U-235	3E-09	NA	2E-09	NA	3E-09	NA	8E-09	NA
Uranium[c]	NA	4E-03	NA	NA	NA	2E-03	NA	6E-03
Total[a]	**5E-07**	**5E-08**	**5E-08**	**NA**	**5E-05**	**2E-03**	**4E-05**	**6E-03**

a. Total may not equal the sum of the values in the column because of rounding.

b. Not applicable.

c. Hazard quotients for uranium are based on the maximum soil concentration of U-238.

in soil at the ICPP is 4.9E-08 mg/m^3. This value is well below the occupational limit of 5E-02 mg/m^3, indicating that there is no concern for inhalation hazards from the presence of uranium at the ICPP Windblown Area for the occupational scenario.

9.6.2 Ecological Risk Assessment

The ICPP Windblown Area was assessed for potential risk to ecological receptors using the methodology presented in VanHorn et al. (1994) and summarized in Section 1.4.5.4. The soil samples were collected at 10 cm (4 in.) or less; therefore, the pathway of concern is exposure through the surface soil.

The tables in Appendix H show that the 95% UCLs of all radionuclides of concern do not exceed their corresponding EBSLs for surface soils (SQLs range from 2E-03 to 9E-08). There is some evidence that radionuclides may have unusual bioconcentration mechanisms through consumption of meat or certain plants (IAEA 1992). An example is Cs-137 from the Chernobyl fallout studied in Sweden, which reached six times higher concentrations in certain animals (IAEA 1992). At the ICPP Windblown Area, using a conservative factor of 10 for the CF for any radionuclide indicates no risk. (This was verified by dividing the minimum EBSL by 10 and using this value to determine the SLQs). Therefore, it is highly unlikely that the radionuclides will cause adverse effects to populations of exposed ecological receptors.

As shown in the tables in Appendix H, the potential risk due to uranium was also examined. At concentrations in the soil, equal to the 95% UCL (3.47 mg/kg) at the ICPP Windblown Area, it appears that there is a possibility of adverse effects to ecological receptors (i.e., SLQs greater than 1). Shacklette and Boerngen (1984) reported a geometric mean of 2.5 mg/kg with a standard deviation of +/- 1.13 and a range of 0.68-7.9 mg/kg. Since the 95% UCL at the ICPP Windblown site is 1 standard deviation above the regional mean, it would be necessary to perform a baseline risk assessment to better understand the risk associated with this contaminant.

9.6.3 Uncertainty

A general discussion of uncertainty in the OU 10-06 risk assessment is presented in Section 1.4.5.5. As discussed previously, the magnitude levels used here reflect the potential magnitude of the effect of the uncertainty factor on the final calculated risk or hazard index, not the magnitude of the uncertainty itself. Uncertainty factors in the ICPP Windblown Area risk assessment are presented in Table 9-10.

9.7 Idaho Chemical Processing Plant Windblown Area Summary and Conclusions

The following sections summarize the nature and extent of contamination at the ICPP Windblown Area, the fate and transport of contaminants, and the risk assessment. Conclusions are made concerning data limitations, recommendations for future work, and recommended remedial action objectives.

9.7.1 Summary

9.7.1.1 Nature and Extent. The area of potential windblown radionuclide-contaminated soil at ICPP was originally based on the ionizing radiation isopleths produced by the EMI 1990 aerial

Table 9-10. Sources and effects of uncertainties in the ICPP Windblown Area risk assessment.

Uncertainty factor	Effect of uncertainty (level of magnitude)	Comment
	Environmental Sampling and Analysis	
Possible unidentified contaminants	May underestimate risk (moderate)	There is no way to determine magnitude of uncertainty. Underestimation of human health risk because of insufficient sample data is possible.
Handling of nondetects	May slightly overestimate risk (low)	Inclusion of estimates of the nondetects may slightly overestimate risk.
Screening method used when background data were unavailable	May overestimate risk (low)	Where data were not available to calculate a background value for a contaminant, the contaminant was assumed to be above background and was carried forward to the fate and transport model(s).
Use of soil sieving procedure on soil samples to separate soil into fine and coarse fractions	Will bias the measured soil radionuclide concentrations toward a higher value and, therefore, overestimate the calculated risk (moderate)	Soil samples collected for the ICPP Windblown Area were sieved (in order to be consistent with RESL procedures), which separates the soil into a fine fraction (<0.50 mm) and a coarse fraction (>0.50 mm). Analyses were then performed on the fine fraction, which has been found to have a higher activity per unit mass than the coarse fraction at the INEL. A conservative assumption was then made that activity concentration in the coarse fraction is the same as in the fine fraction, therefore, likely overestimating the calculated risk.
An analysis for alpha-emitting radionuclides was not performed on all of the soil samples collected for the ICPP Windblown Area	May underestimate the calculated risk (moderate)	Limited alpha analyses were performed on the ICPP Windblown Area soil samples because of historical information that indicates that these radionuclides are not common at INEL locations. Approximately 10% of the samples collected were analyzed for alpha-emitting radionuclides to verify that this was the case (i.e., that gamma-emitting radionuclides are the COPCs). This could result in a lower concentration term for the alpha-emitting radionuclides at the site.
Inclusion of one negative Sr-90 value reported for soil concentrations	May slightly underestimate risk (low)	Use of reported negative values reduces average concentration estimates. However, the estimated averages are unbiased and, therefore, more accurate. Use of negative values improves estimates of variance in concentration and better characterizes uncertainty.
Quality of data used in the kriging analysis	May underestimate or overestimate risk (low)	The precision of the kriging results is limited by the precision and representativeness of the observed data. Rigorous QA procedures maximize the quality of the data and, therefore, minimize the uncertainty in the kriging analysis. The calculated risk is not very dependent on the results of the kriging analysis.
Sufficiency of sampling design for kriging	May underestimate or overestimate risk (low)	The number of samples and their locations are sufficient for establishing the variogram model and for kriging. Additionally, the cross-validation of the results indicate that the kriging produced reasonable predicted values. Therefore, the areal extent of contamination is estimated fairly accurately and the uncertainty in the risk because of kriging is low.

Table 9-10. (continued).

Uncertainty factor	Effect of uncertainty (level of magnitude)	Comment
	Environmental Sampling and Analysis (continued)	
Nature of the underlying spatial continuity of the data used in the kriging analysis	May underestimate or overestimate risk (low)	Areas in which concentrations are relatively homogeneous are subject to less uncertainty than areas characterized by erratic concentrations. For example, data obtained from areas with randomly generated hotspots will be subject to a larger degree of uncertainty. The calculated risk is not very dependent on the results of the kriging analysis.
Quality of the spatial correlation model used in the kriging analysis	May underestimate or overestimate risk (low)	The kriging results are not grossly affected by the type of model chosen for the correlation structure; however, care must be taken in specifying parameters within the model. Also, selection of the variogram model is a subjective process. The calculated risk is not very dependent on the results of the kriging analysis.
Use of sample data collected in the 1970s	May overestimate risk (moderate)	Use of data collected in the 1970s may not be representative of what is currently at the site. Resuspension of dirt would have diluted the concentrations in the soil. The likelihood of the soil concentrations being greater than what was detected in the 1970s is low because the operations that resulted in releases to the atmosphere have either stopped or have been greatly reduced. In the absence of more recent data, these data are used in the risk assessment and are decayed to September 30, 1994, to be comparable with data collected as part of the OU 10-06 investigation.
	Fate and Transport Modeling	
Use of generic environmental modeling assumptions	May overestimate risk (moderate)	Site-specific data were not available for every parameter. Values chosen are conservative for conditions similar to those in the ICPP Windblown Area; therefore, risks will generally be overestimated.
	Exposure Estimates	
Calculation of the concentration term for the food crop ingestion exposure pathway using only the top 10 cm (4 in.) of soil	May overestimate risk (moderate)	The concentration term for the food crop ingestion exposure pathway was calculated using only the data available [i.e., to the top 10 cm (4 in.)]. Soil concentrations of the COPCs are not available for depths below 10 cm (4 in.). If background soil concentrations are assumed for the remainder of the 30-cm (1-ft) depth then the calculated concentration term would be overestimated. Because the majority of wind-deposited COPCs would be in the top 5 cm (2 in.) this is a conservative assumption.
	Toxicity Assessment	
Radiation slope factors	May overestimate or underestimate risk (moderate)	Slope factors are based on human data and assumption of linear nonthreshold dose-response. These slope factors are derived from extrapolation from high-dose studies to obtain low-dose risk estimates.
Lack of dermal absorption toxicity values	May slightly underestimate risk (low)	Dermal absorption of metals is expected to be insignificant when compared to ingestion.

Table 9-10. (continued).

Uncertainty factor	Effect of uncertainty (level of magnitude)	Comment
	Toxicity Assessment (continued)	
Toxicity value for uranium derived primarily from high doses and most exposures are at low doses	May overestimate or underestimate risk (moderate)	Toxicity metals assume linearity at low doses. Tend to have conservative assumptions, which tend to overestimate risk. If conservatism in toxicity models are incorrect, risks will be underestimated.
No inhalation RfD for uranium	Underestimate risk (moderate to high)	Several chemicals detected during the RI do not have inhalation RfDs and, therefore, do not contribute to the quantification of the total hazard index.
Uranium toxicity value based on animal studies	May overestimate or underestimate risk (moderate to high)	The cancer slope factors, in particular, are based on studies that may differ greatly from realistic situations. Experimental cancer bioassay typically exposes animals to high levels of chemicals for their entire lifetime. After the appropriate studies have been identified, the slope factor is calculated as the 95% UTL of the dose-response curve. This is thought to introduce conservatism into the risk assessment, therefore, overestimating the risk. However, if human toxicity response is significantly greater than experimental animals, the risk will be underestimated.
	Risk Characterization	
Risks/hazard quotients summed across pathways	May overestimate risk (moderate)	Not all of a COPC will be available for exposure through all applicable pathways.
Radioactive decay products neglected for parent radionuclides of >1,000 year half-lives	May slightly underestimate risk (low)	Ingrowth of decay products depends on the half-life of parent. For the time scales used in assessment scenarios, only small amounts of these products will be produced. This is a small addition to the total risk because risk is dominated by relatively short-lived radionuclides that do not produce decay products.

survey (Figure 9-1). The 1990 EMI isopleths in the vicinity of ICPP were identified by EMI to result from gamma-rays emitted by Cs-137 in the northeastern and southwestern portion of the ICPP Windblown Area. Cesium-137 was detected at elevated levels in OU 10-06 Phase I and RESL samples collected in these areas, indicating that the EMI isopleth is a result of gamma-rays emitted by Cs-137 contained in surface soils.

To determine the nature and extent of radionuclide-contaminated soils in the ICPP Windblown Area, samples were collected during Phase I of OU 10-06. The vertical extent of radionuclide-contaminated soils in the ICPP Windblown Area is believed to be restricted to the upper 10 cm (4 in.) of soil. An evaluation of the Phase I and RESL data sets was performed to determine the horizontal extent of radionuclide-contaminated soils. In the ICPP Windblown Area, the majority of the elevated Cs-137 concentrations observed occur in the vicinity of the facility and in the primary wind directions. Contaminant concentrations generally decrease with increasing distance from the facility. These observations are indicative of windblown contamination, possibly from a stack release. The kriging results generated using the Phase I and RESL data sets bounds the horizontal extent of Cs-137 contamination to 5 pCi/g or greater within the kriging contour as depicted in Figure 9-1.

9.7.1.2 Fate and Transport. Contaminants of concern for the ICPP Windblown Area are limited to radionuclides originating from activities associated with ICPP operations. Half-lives govern the persistence of radionuclides in the environment. The activity of any radionuclide is reduced to less that 1% after seven half-lives. The radionuclides of concern detected in the ICPP Windblown Area include Cs-137 and Sr-90, which have half-lives of 30.17 and 29 years, respectively.

The primary route of potential contaminant migration at the ICPP Windblown Area is atmospheric dispersion. Surface water was not considered a potential contaminant migration route because of the lack of surface water features at or near ICPP. Groundwater was not considered a potential contaminant migration route because of the shallow depths at which the contaminants occur and the lack of a driving force to the subsurface.

9.7.1.3 Baseline Risk Assessment. The baseline risk assessment performed for the ICPP Windblown Area evaluated the potential adverse health effects to current workers and hypothetical future residents. The COPCs evaluated in this baseline risk assessment are Am-241, Cs-137, Pu-238, Sr-90, U-233, and U-235. These radionuclides are considered COPCs because they either exceeded concentrations in surface soils detected above background or because no background values were available. All exposure pathways identified on the site CSM for windblown sites except dermal exposure were evaluated. The dermal exposure route was not evaluated because of a lack of toxicity information. In addition, because the maximum concentration detected for Sr-90 exceeded the PRG in the FS, the 100-year residential exposure scenario was also evaluated.

Results from the human health risk assessment indicate that risk from the current occupational scenario is less than the lower limit of the NCP target risk range and for the residential exposure scenario only, food crop ingestion from Sr-90 (4E-05) and external exposure to Cs-137 (2E-06) pose a risk within the NCP target risk range. The hazard quotient for uranium is below one. Results from the 100-year residential exposure scenario indicate that food crop ingestion of Sr-90 has a risk within the NCP target risk range of 8E-06 and all other exposure pathways are less than the lower limit of the NCP target risk range.

An ecological risk assessment was performed to assess the potential risk to ecological receptors in the ICPP Windblown Area. The results of this evaluation indicate that it is unlikely that the COPCs at the ICPP Windblown Area will cause adverse effects to populations of exposed ecological receptors.

In summary, there are no risk scenarios that exceed the NCP target risk range. The ICPP Windblown Area does not pose an unacceptable health threat to occupational personnel, future residents, or the ecological environment.

9.7.2 Conclusions

9.7.2.1 Data Limitations and Recommendations for Future Work. The analytical data generated during this RI were validated and found to be usable for defining nature and extent of contamination, conducting human health and ecological risk assessments, and conducting a FS. Precision, accuracy, representativeness, completeness, and comparability parameters were evaluated for the RI tasks, and the results of this evaluation are discussed below.

9.7.2.1.1 Precision—Precision is a quantitative measure of the variability of a group of measurements compared to their average and is used to measure the reproducibility of measurements under a given set of conditions (EPA 1987). Laboratory precision goals for radiological analyses are

specified in the SMO SOP 12.1.2, "Radiological Data Validation." Field precision is the measure of the variability not due to laboratory or analytical methods. Overall field precision will be calculated as the relative percent difference of field duplicates as defined in Section 8.1 of the QAPjP (Baumer and Flynn 1993).

A review of the associated limitation and validation report for the ICPP samples showed that all laboratory precision goals were met.

Field duplicate samples were collected at soil locations 3INE01 and 3ISW01 for the ICPP in accordance with sample duplicate guidelines in the QAPjP associated with Phase I sampling. The relative percent difference calculated for the various radionuclides found in the duplicate samples ranged from 0.9 to 14.0%. Radionuclide field precision is difficult to assess because of the heterogeneity of the radionuclides in the soil. As a result, no specific field precision goals have been set.

9.7.2.1.2 Accuracy—Accuracy is a measure of how close a reported value represents the true concentration of an analyte contained in a sample and is a function of both sampling technique and the analytical methods of the laboratory. As stated in the QAPjP, laboratory control samples are used to measure the accuracy of the radiological analysis per SMO SOP 12.1.2. A review of the Phase I limitation and validation reports indicates that all laboratory accuracy goals were met.

Results from field blanks and equipment rinsates are used to assess field accuracy. According to the QAPjP, field accuracy is a function of the sampling techniques used in the field. For the ICPP data, both rinsate and field blank samples collected and analyzed by gamma spectroscopy were found to be nondetects. These sample results verify that it is unlikely that cross contamination occurred during sample collection, handling, or shipping.

9.7.2.1.3 Representativeness—Representativeness is a qualitative parameter and expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is addressed by describing sampling techniques and the rationale used to select sampling locations (EPA 1987).

For Phase I sampling, sample location selection was biased. Soil sample locations were based on results of the 1990 aerial radiological survey showing areas potentially contaminated with radionuclides. Additionally, samples were collected at prespecified intervals along transects that spanned the areal extent of the isopleths.

Details of the sampling rationale for the ICPP samples are provided in the SAP prepared for Phase I (Haney 1994). These biased locations are effective in establishing the extent of the windblown contamination and are considered representative given the objective of detecting the presence and approximate concentration in radioactively contaminated soils in the ICPP area.

9.7.2.1.4 Completeness—Completeness is defined as the percentage of measurements made that are judged to be valid measurements (EPA 1987). Nonvalid or unusable measurements are defined as those sample results qualified with a "R" flag for rejected. For Phase I, no samples were flagged as unusable either by the laboratory or the validator.

A completeness goal of 90% was established for noncritical samples for Phase I sampling in the QAPjP. There were no critical samples identified for ICPP.

Based on a review of the ICPP data, 33 of the 36 planned samples (including blanks and rinsates) were collected and analyzed, resulting in an overall completeness of 92%. Three samples (3IBS0101R4, 3IBS0102R4, and 3IBS0201R4) could not be collected as the sample locations fell within an ordnance area and permission for entry could not be obtained. These deviations from the field sampling plan had little impact because the overall noncritical completeness goal for ICPP Phase I data was met.

9.7.2.1.5 Comparability—Comparability is a qualitative parameter and is evaluated to ensure that the analytical data generated during the various sampling events are comparable between the sampling rounds and to data from previous studies. As specified in the QAPjP, comparability will be achieved using standard field and analytical methods and/or written procedures, and that all data will be reported in units consistent with the conventions used for the given analyte and methods employed.

Standard methods were used for collecting and analyzing all ICPP Phase I samples, and the analytical results were reported in standard units. A field audit conducted during Phase I sampling confirmed that reviewed and approved SOPs were followed and that applicable methods were used. The use of standard methods meets the objective of the qualitative comparability parameter as defined in the QAPjP. However, for Phase I radiological data to be comparable to existing RESL data, the existing RESL radiological data will need to be decayed to account for the time difference in sampling.

The data quality objectives for this RI have been met, and it is recommended that no future work be conducted at this site to determine the nature and extent of radionuclide-contaminated soils.

9.7.2.2 Recommended Remedial Action Objectives. Remedial action objectives for the ICPP Windblown Area were developed in accordance with the NCP and CERCLA RI/FS guidance (EPA 1988a). The remedial action objectives provide the basis for developing general response actions that will satisfy the objectives of protecting human health and the environment. The remedial action objectives specified for protecting human health are expressed as both a contaminant level and an exposure pathway because protection can be achieved by reducing exposure and reducing contaminant levels.

Development of remedial action objectives are based on the results of the human health baseline risk assessment in Section 9.6 and are specific to the contaminant of concern and exposure pathways identified for the site. Remedial action objectives for protecting the environment are not presented because the ICPP Windblown Area was found to be protective of the environment. The recommended remedial action objectives appear in Table 9-11.

Table 9-11. Recommended remedial action objectives.

Environmental media	Human health
Soil	Prevent direct exposure to radiation posing excess cancer risk levels of 10^{-4} to 10^{-6}
Food crops	Prevent ingestion of food crops posing excess cancer risk levels of 10^{-4} to 10^{-6}

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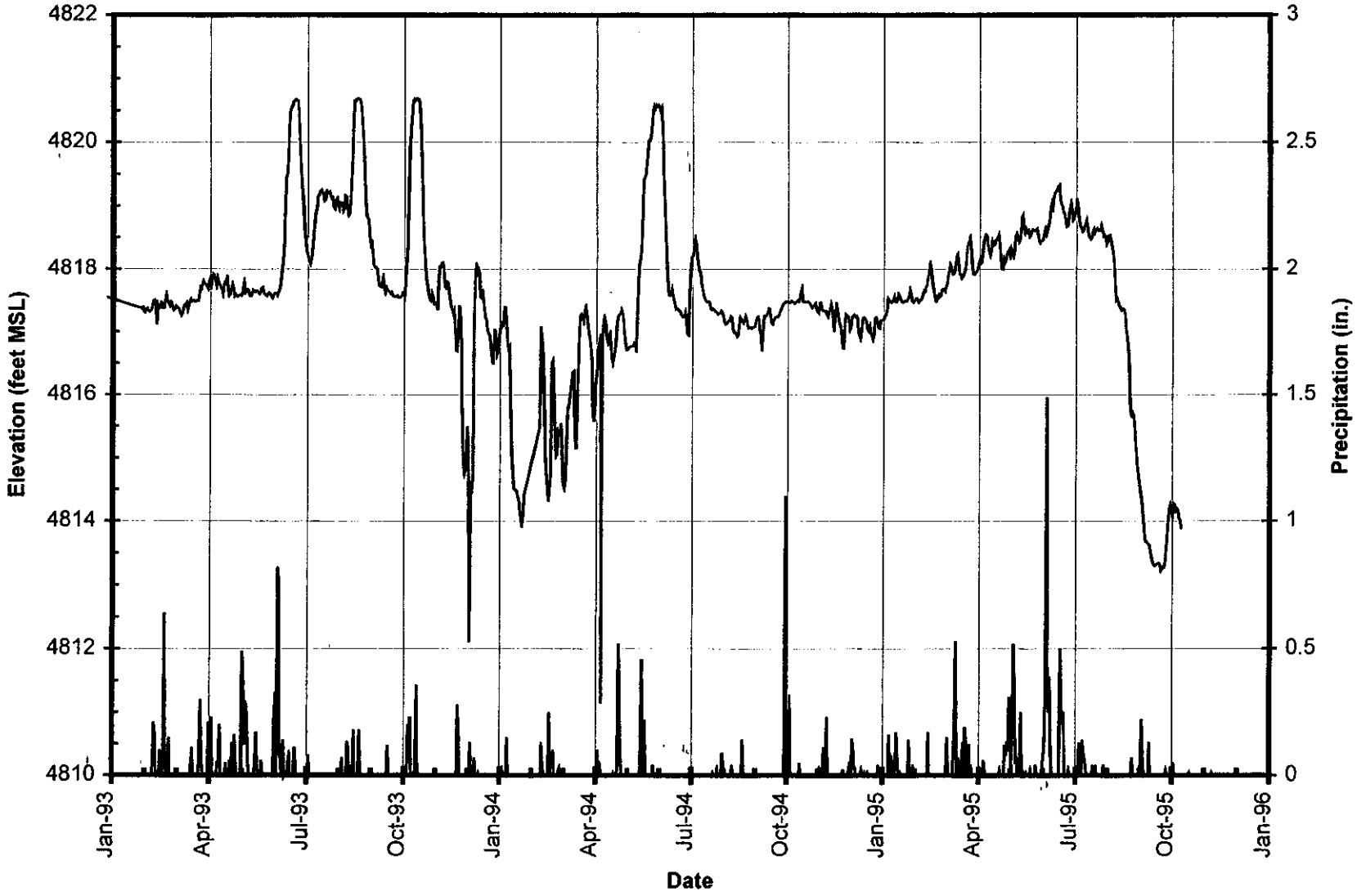
Appendix B

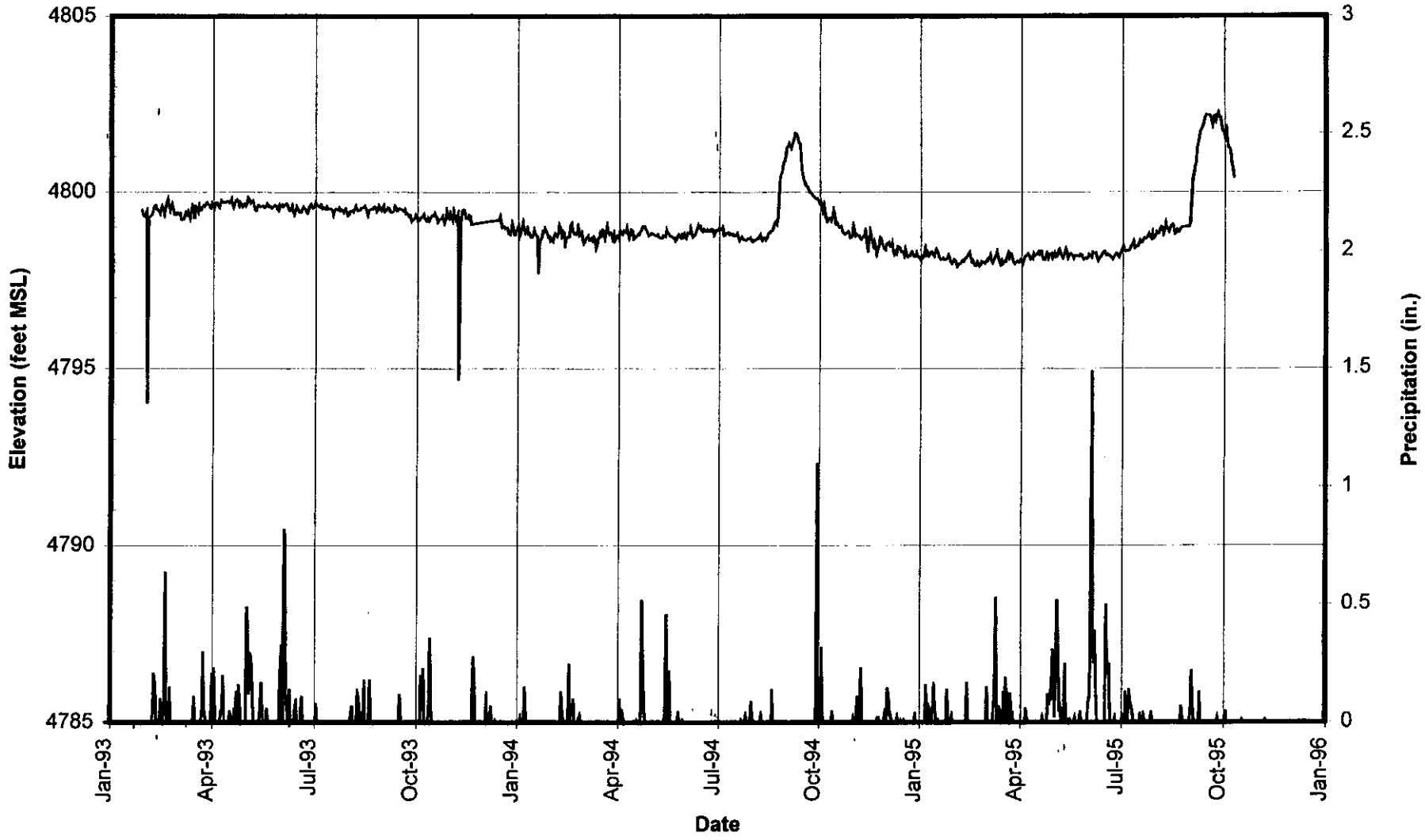
Appendix B

Well Hydrographs

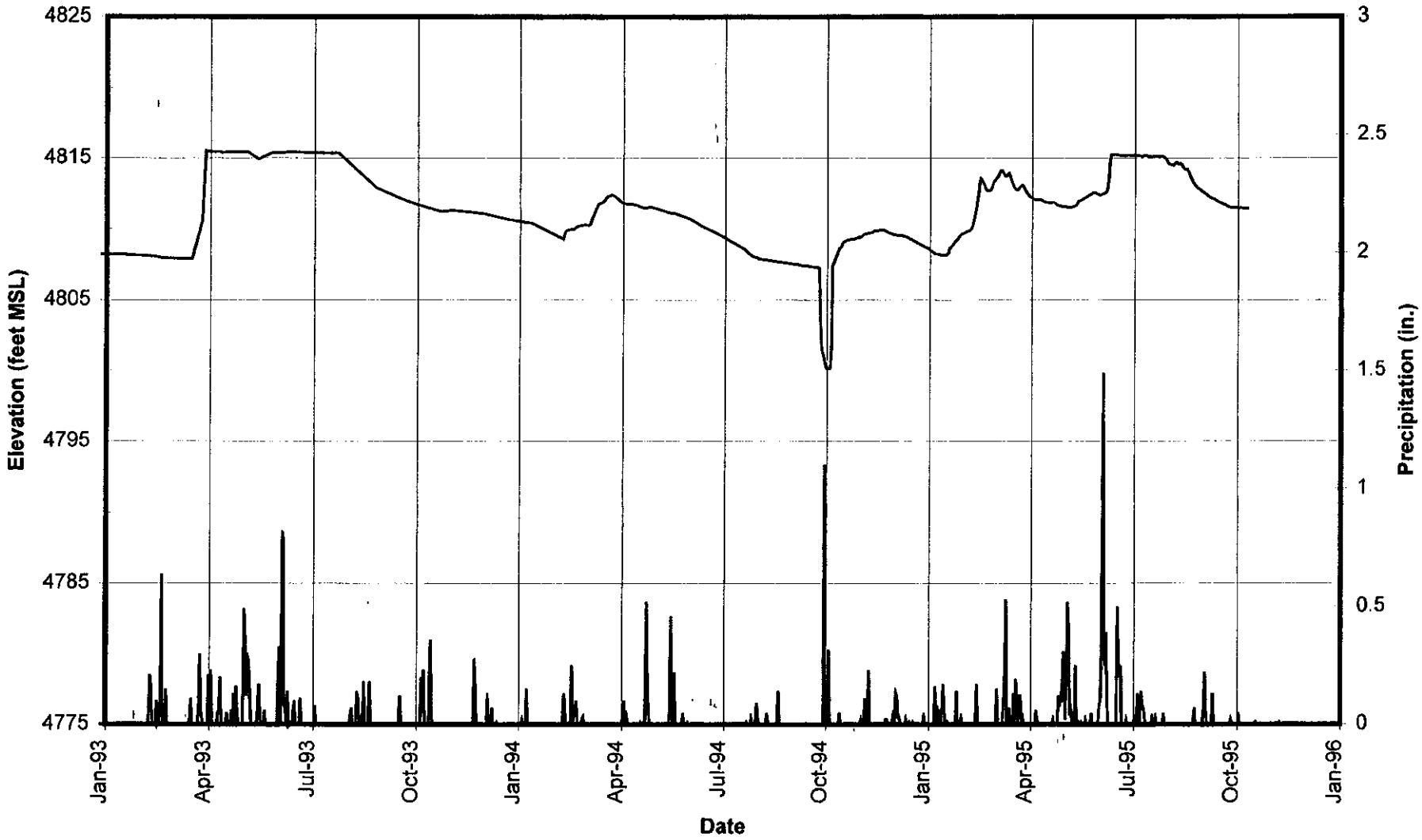
CPP 33-2 Water Level & Precipitation



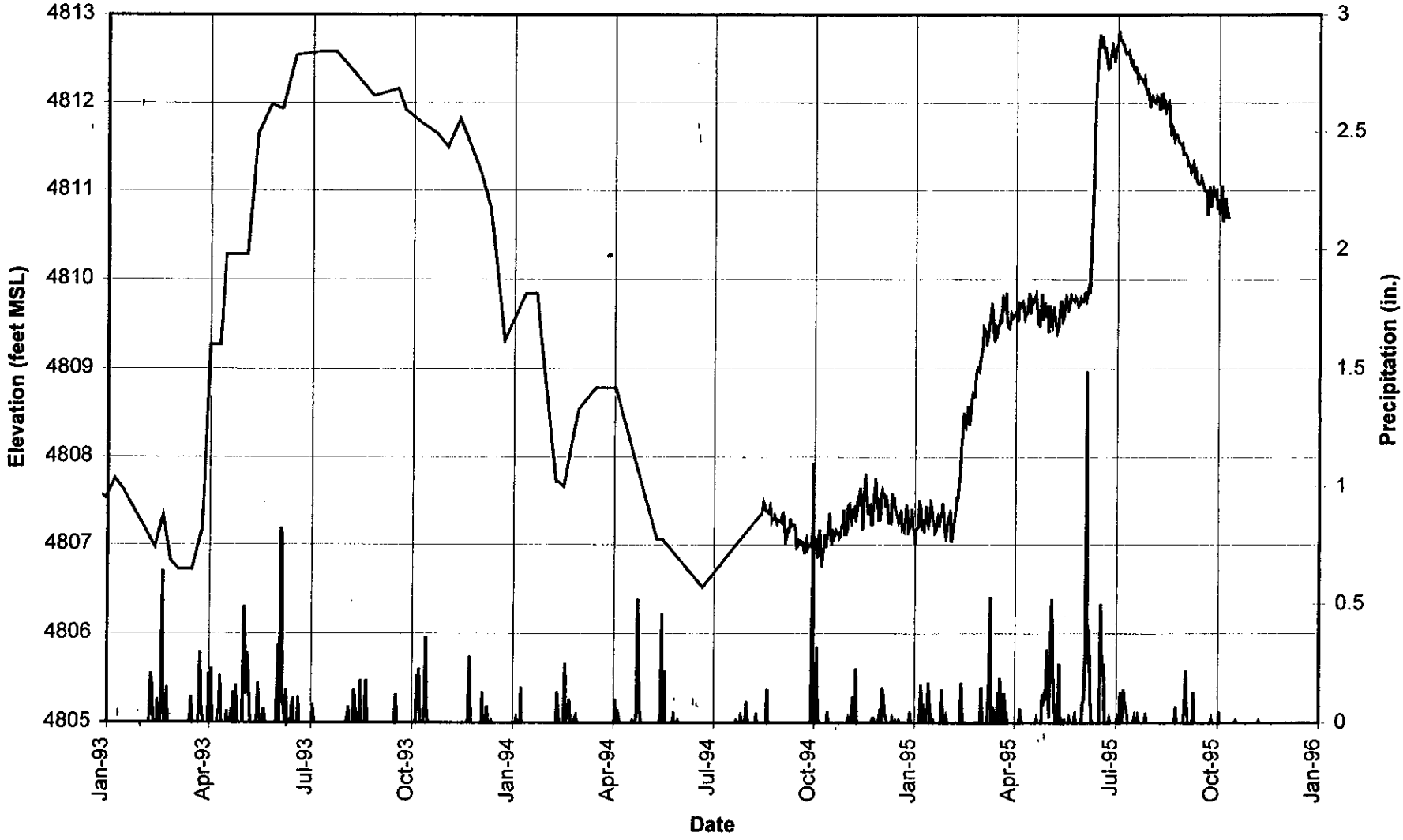
CPP 33-3 Water Level & Precipitation



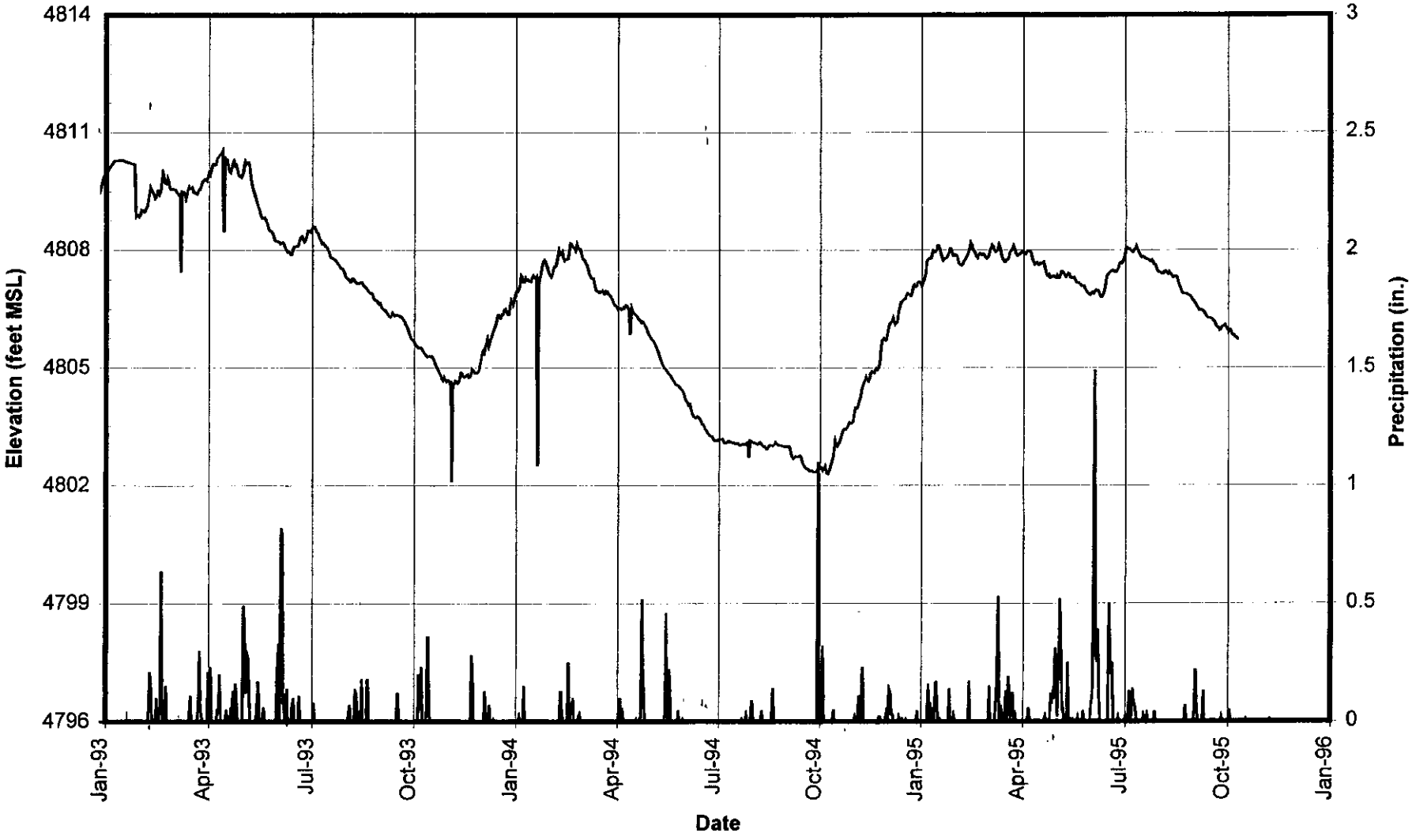
CPP 33-4 Water Level & Precipitation



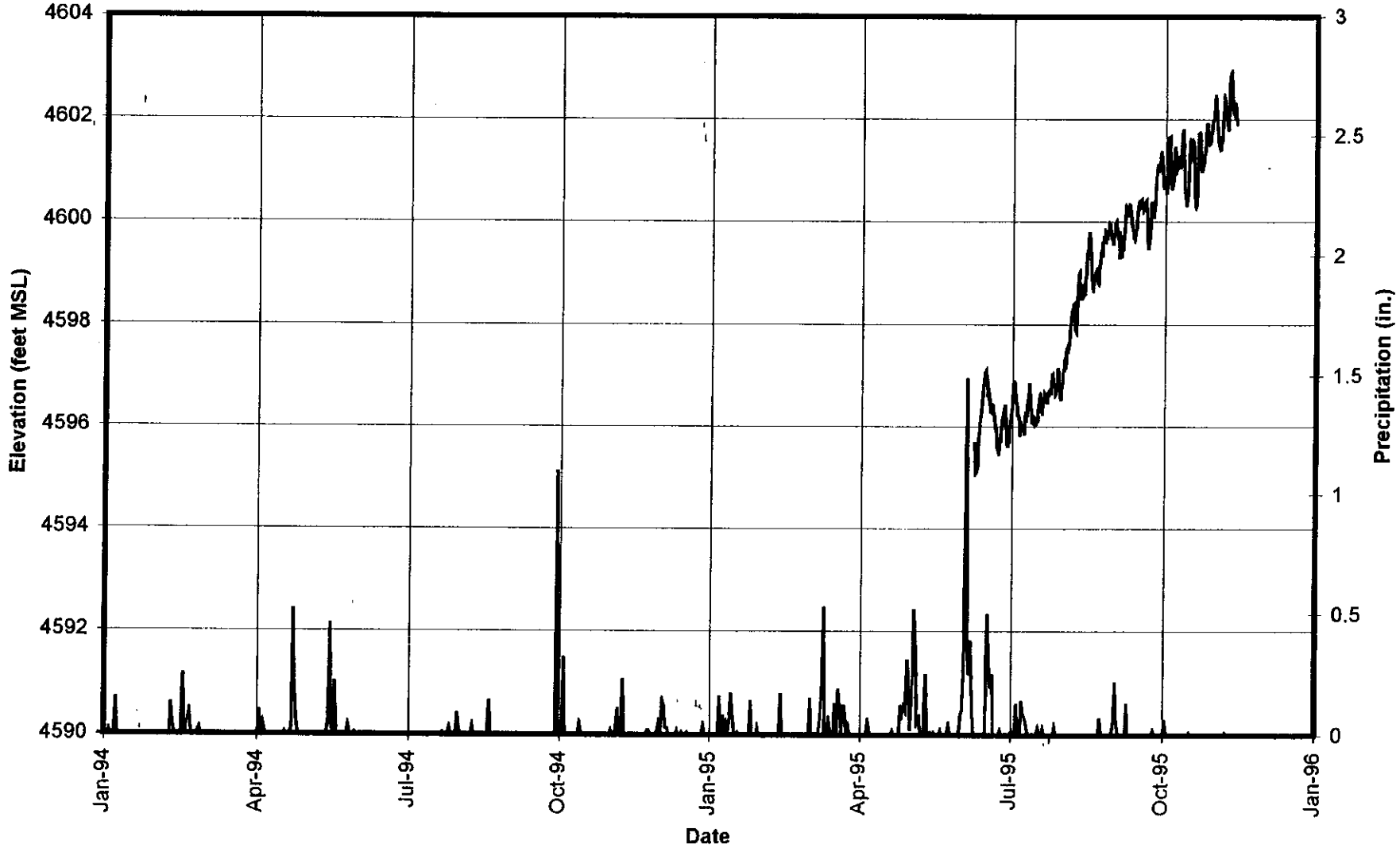
CPP 37-4 Water Level & Precipitation



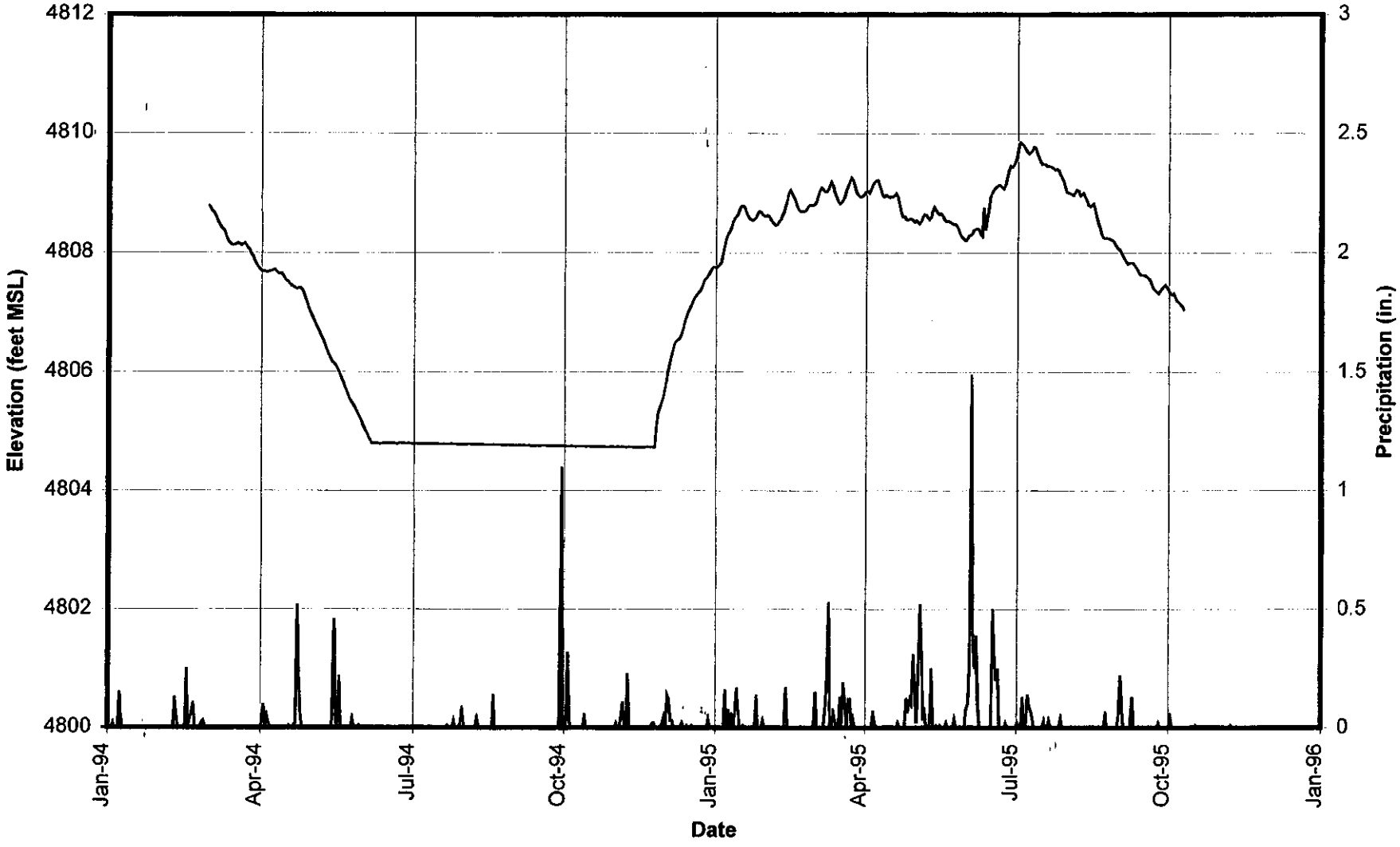
CPP 55-06 Water Level & Precipitation



MW-1 Water Level & Precipitation



MW-2 Water Level & Precipitation



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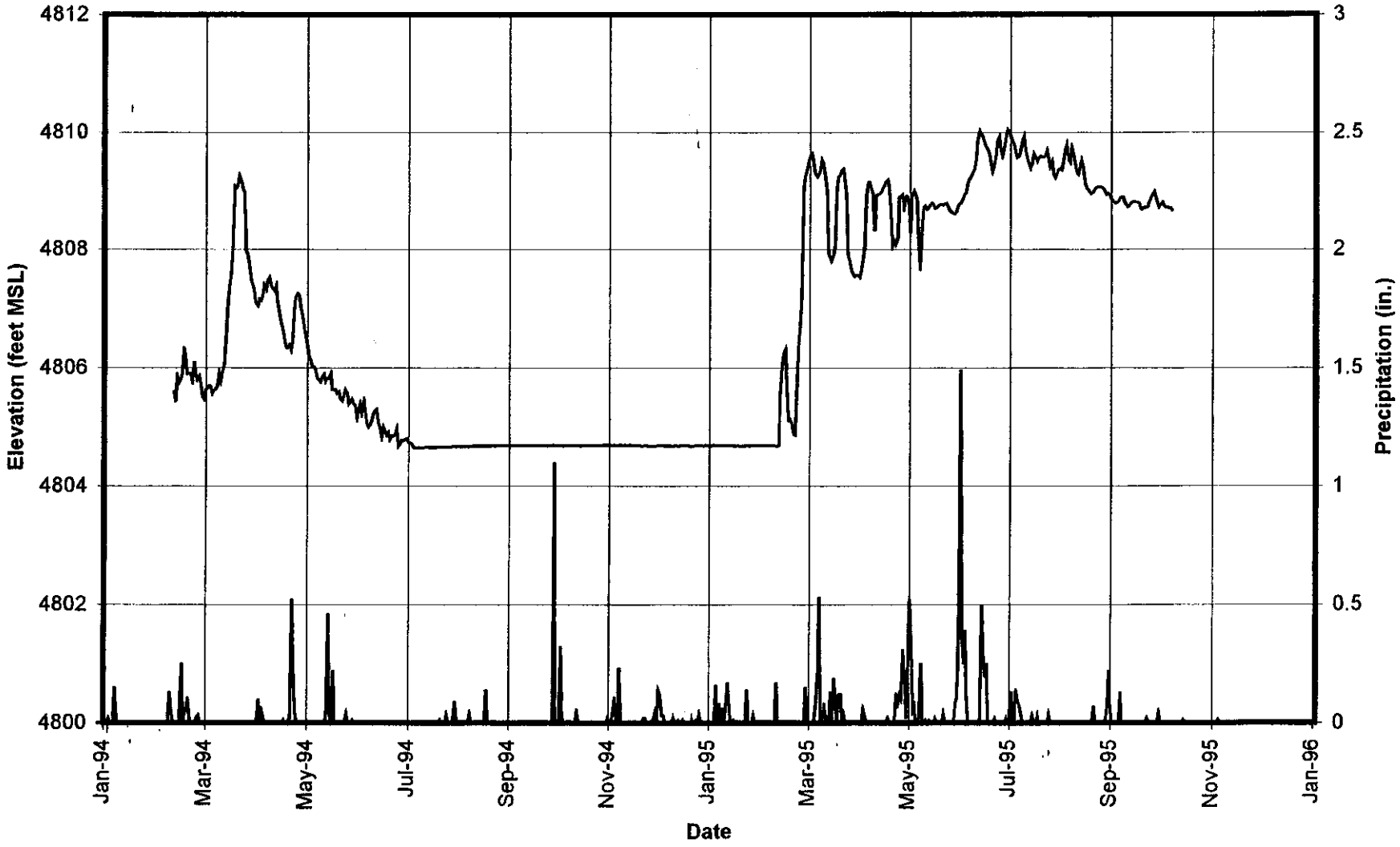
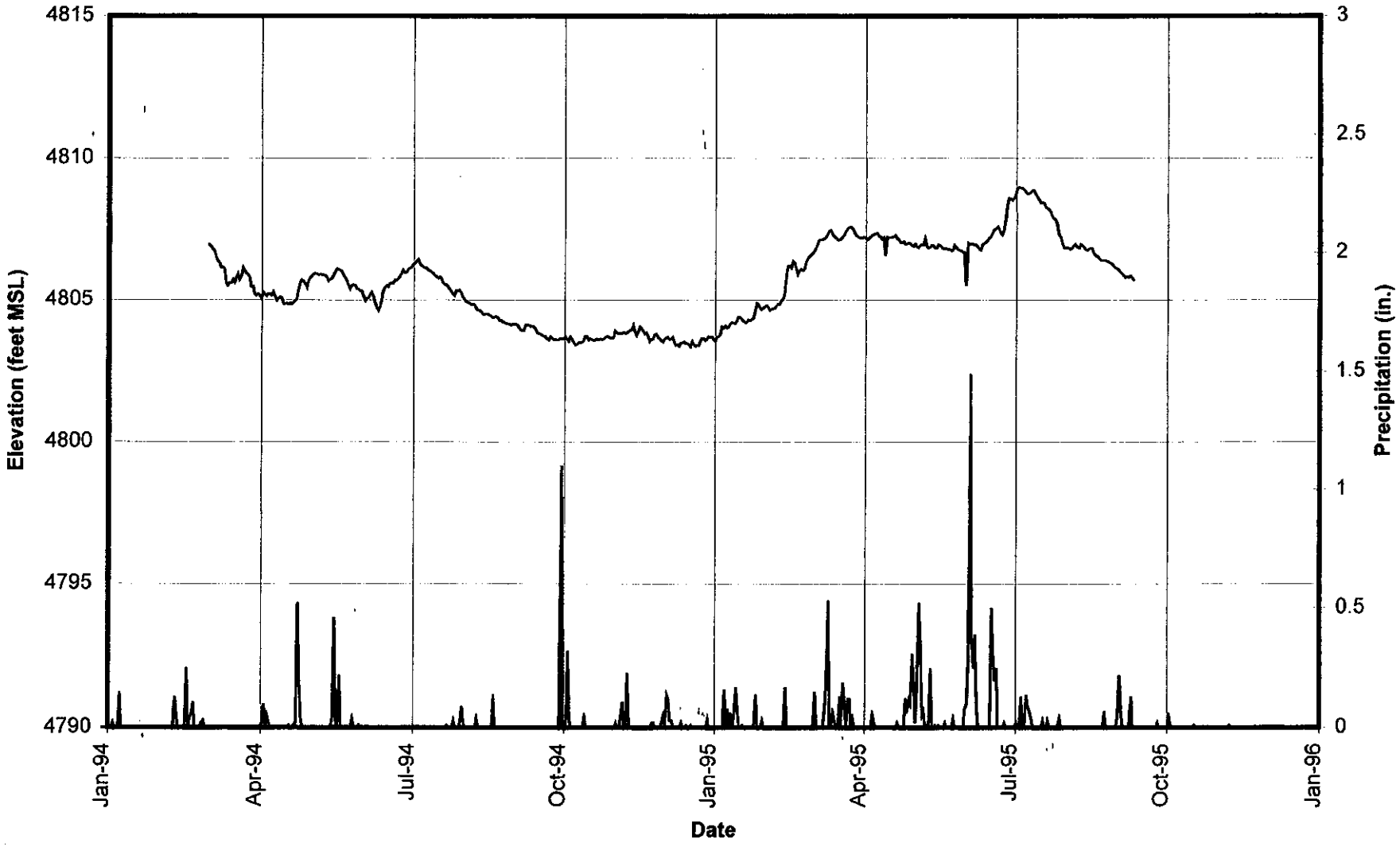
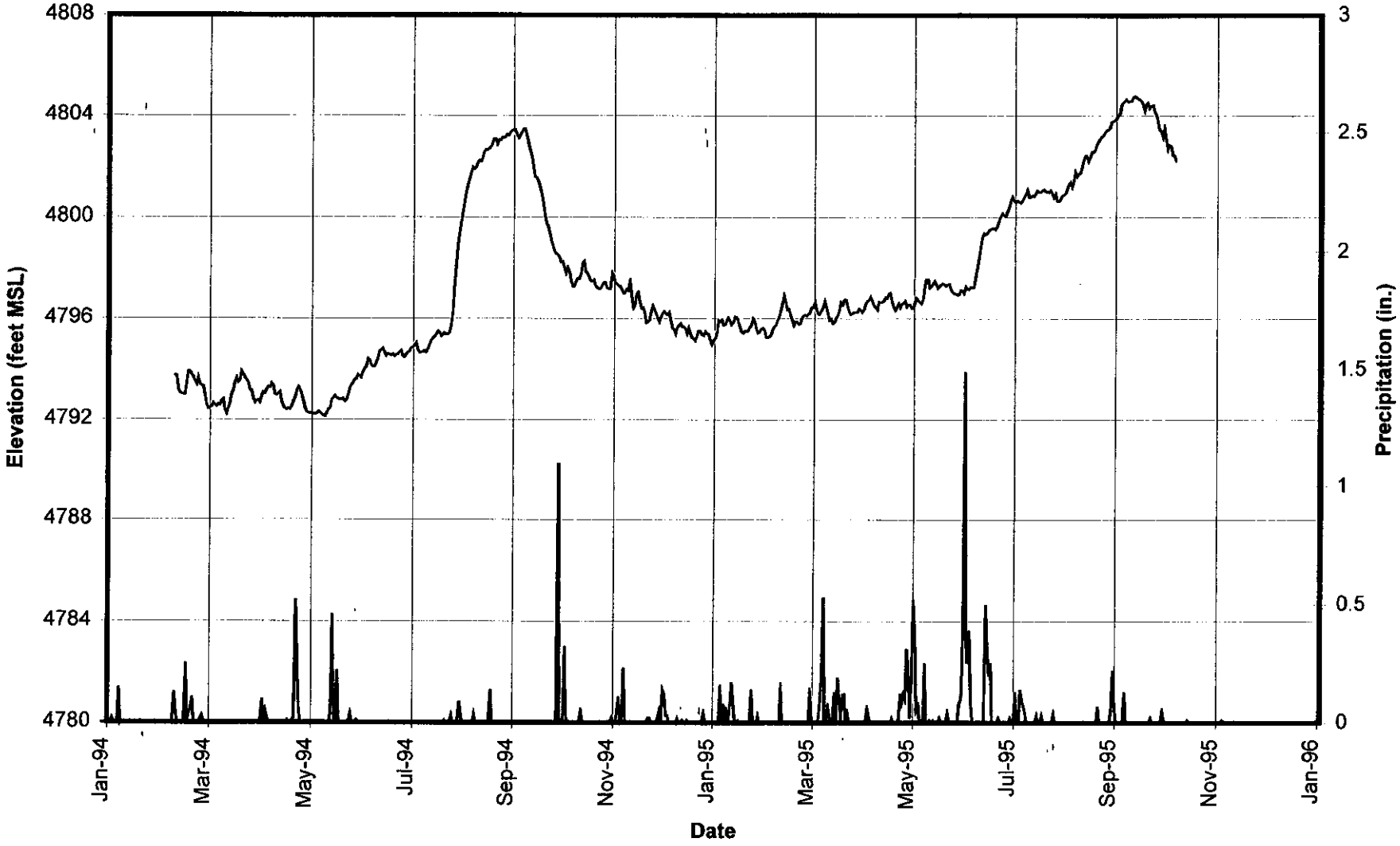


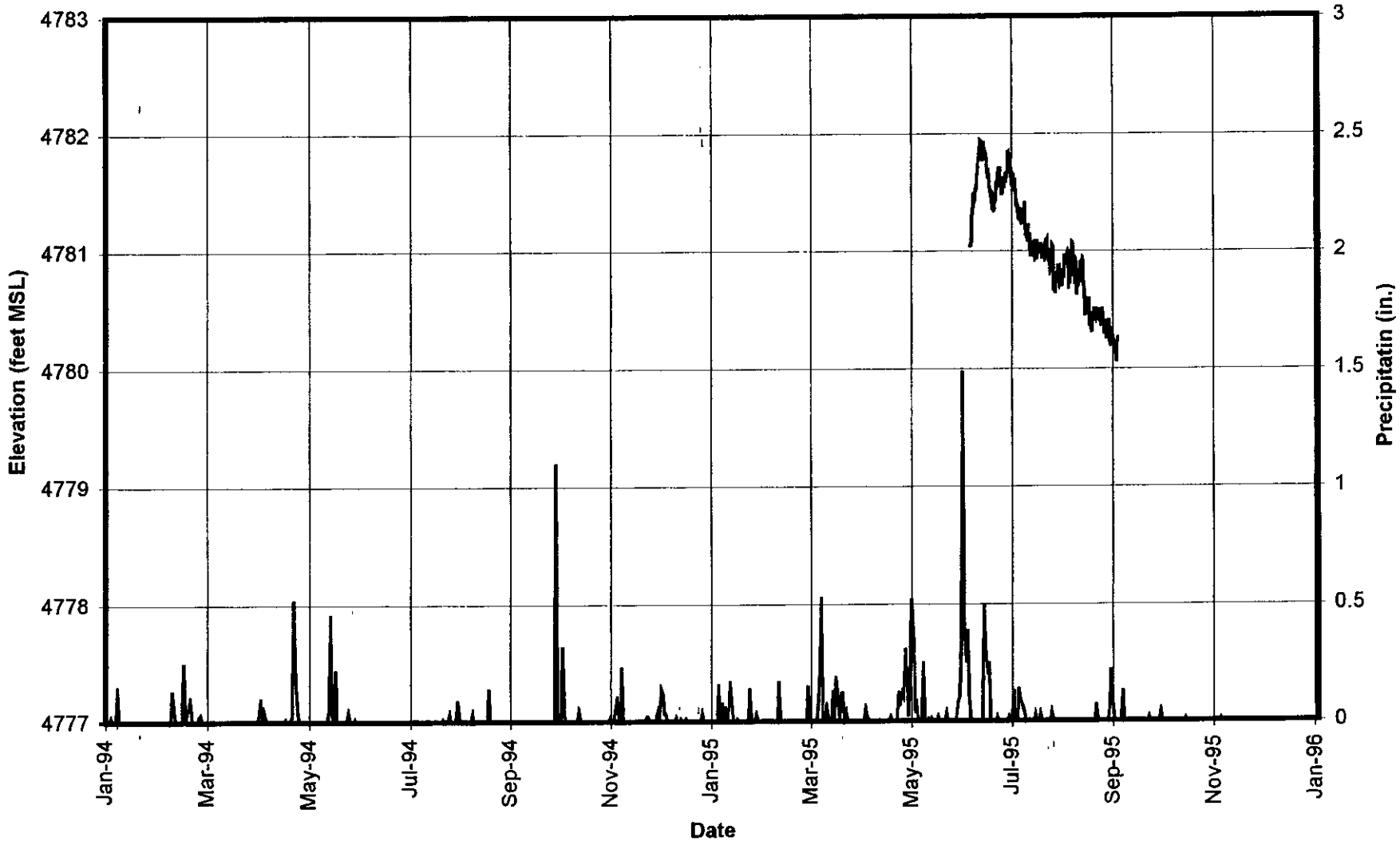
MW-5 Water Level & Precipitation



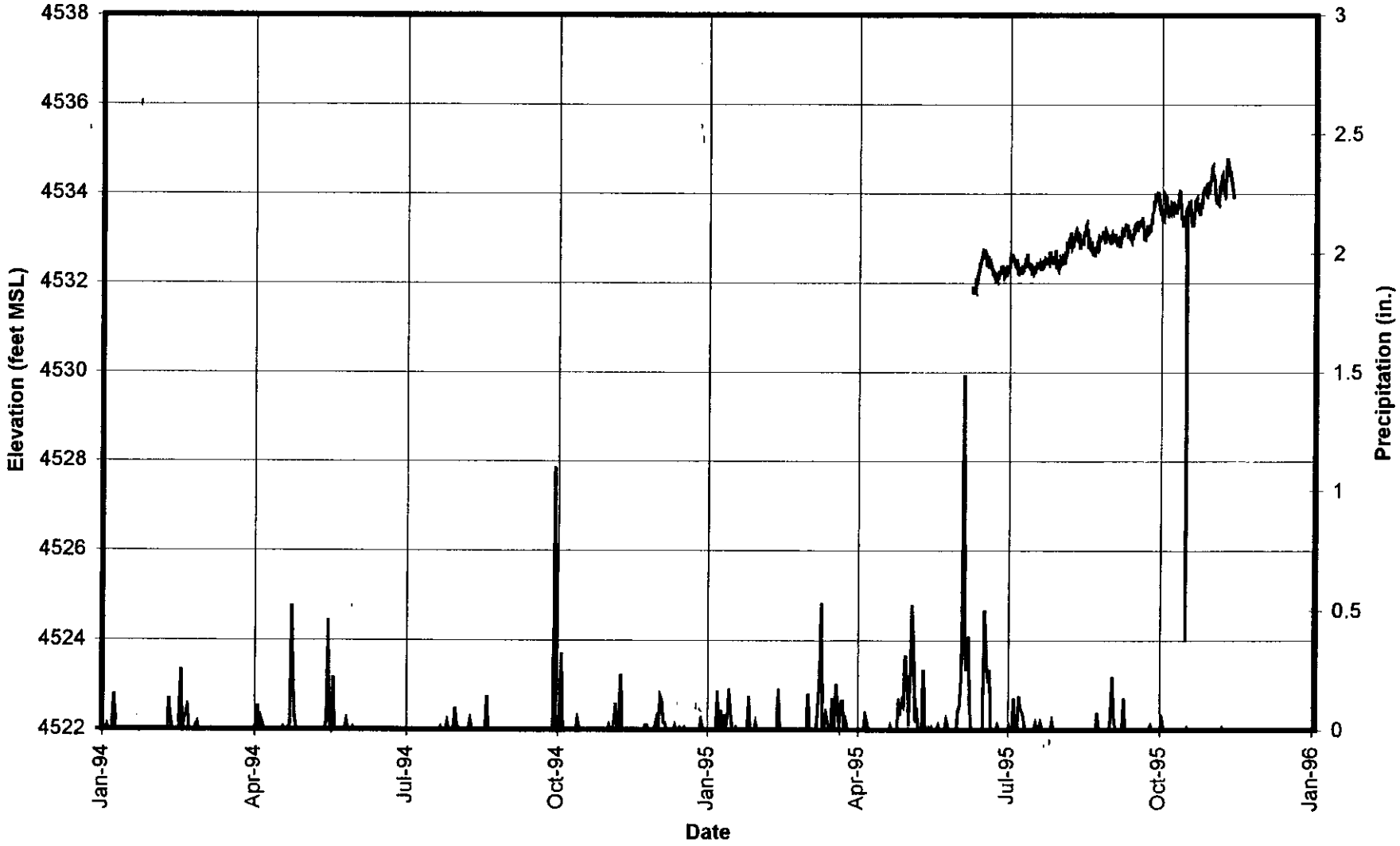
MW-6 Level & Precipitation



MW-20 Water Level & Precipitation



USGS-50 Water Level & Precipitation



Appendix C

Appendix C

TDEM Investigations and Results

9123-102

REPORT

PHASE I GEOPHYSICAL INVESTIGATION AT THE IDAHO NATIONAL ENGINEERING LABORATORY (INEL) IDAHO CHEMICAL PROCESSING PLANT (ICPP)

Purchase Order No. C95-175737

Prepared For:

LOCKHEED IDAHO TECHNOLOGIES COMPANY (LITCO)
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Prepared By:

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Golden, Colorado 80401

October 3, 1995

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Appendix B: . Technical Note

EXECUTIVE SUMMARY

During the operation of the Idaho Chemical Processing Plant (ICPP), waste waters from the plant were discharged through percolation ponds and other discharges. This discharge has caused contaminated water to occur in perched zones, one at the depth interval between 100 and 150 ft, and one between 320 and 420 ft. A surface geophysical test survey was performed to determine if perched zones can be delineated. The geophysical technology tested was surface measurements of the lateral and vertical electrical resistivity variation (geoelectric section). The geophysical method selected was time domain electromagnetic (TDEM) soundings.

The test survey (Phase I) consisted of making TDEM soundings near drill holes. Correlation of the geoelectric section derived from TDEM measurements with core descriptions and geophysical logs in drill holes, showed that the geoelectric section correlates with cumulative clay content observed in drill holes. Cumulative clay content, in turn, appears to correlate with the presence of perched zones, because cumulative clay content likely influences the lateral variations in vertical permeability.

Because of the correlations established between the geoelectric section and the perched zones, it is recommended to proceed with Phase II, so that a contour map of the cumulative clay distribution, and the likely extent of perched zones, can be made. The high cost of drilling makes it imperative that lower cost methods for delineation are exploited to the maximum extent possible.

1.0 INTRODUCTION

This report describes the procedures and results of the Phase I geophysical investigation of a two-phase project (Purchase Order No. C95-175737) conducted for Lockheed Idaho Technologies Company (LITCO) at the Idaho National Engineering Laboratory (INEL), Idaho Chemical Processing Plant (ICPP).

During the operation of the ICPP, waste waters from the plant were discharged through percolation ponds and other discharges. Some of the waste waters were contaminated with radionuclides and chemical contaminants. The distribution of waste water and contaminants in the subsurface depends upon the geology, and in particular on the presence of impermeable strata such as clay layers and welded basalts.

This hydrostratigraphy has resulted in perched (likely contaminated) water tables where impermeable strata are present, and probably less perched water where a higher vertical hydraulic conductivity exists. The perched water has been observed in several drill holes at depths of 100 to 150 ft for the "upper perched water zone" and 320 to 420 ft for the "deep perched water zone."

The depth of occurrence of the perched zones and the likely contamination with radionuclides makes drilling and completion of monitoring wells expensive. For this reason surface geophysical measurements were tested in this program to:

- allow extrapolation of borehole data laterally; and,
- determine critical locations for additional monitoring wells.

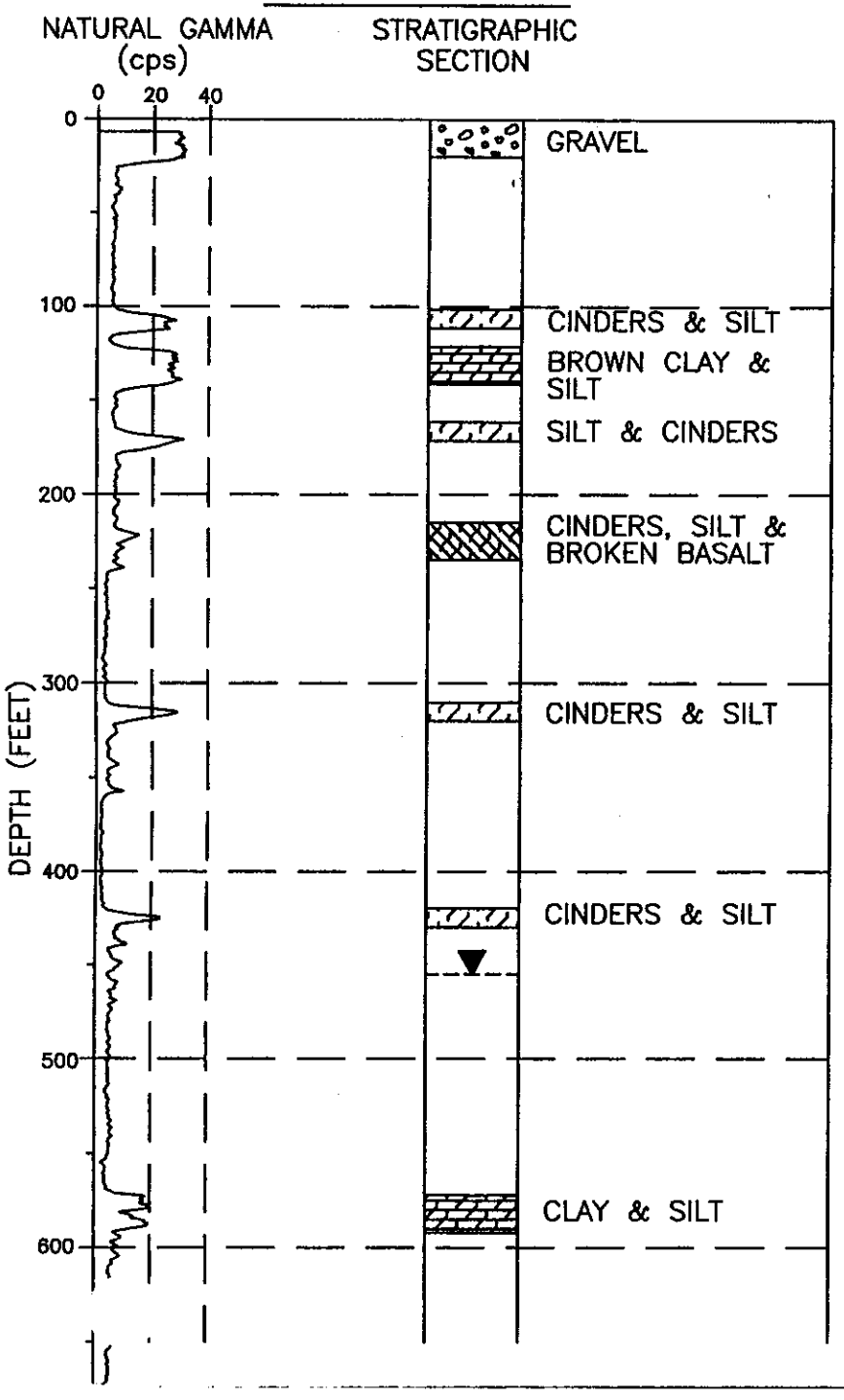
From surface geophysical measurements, one can not infer the same detail of information as can be derived from drilling, but the cost of a surface geophysical is a small fraction (typically 1/100) of the cost of drilling. Therefore, in a well planned approach, surface geophysical measurements are used to define areas of similar subsurface conditions to optimally located drill holes so that expensive drill hole data can be extrapolated laterally over well defined regions of similarity.

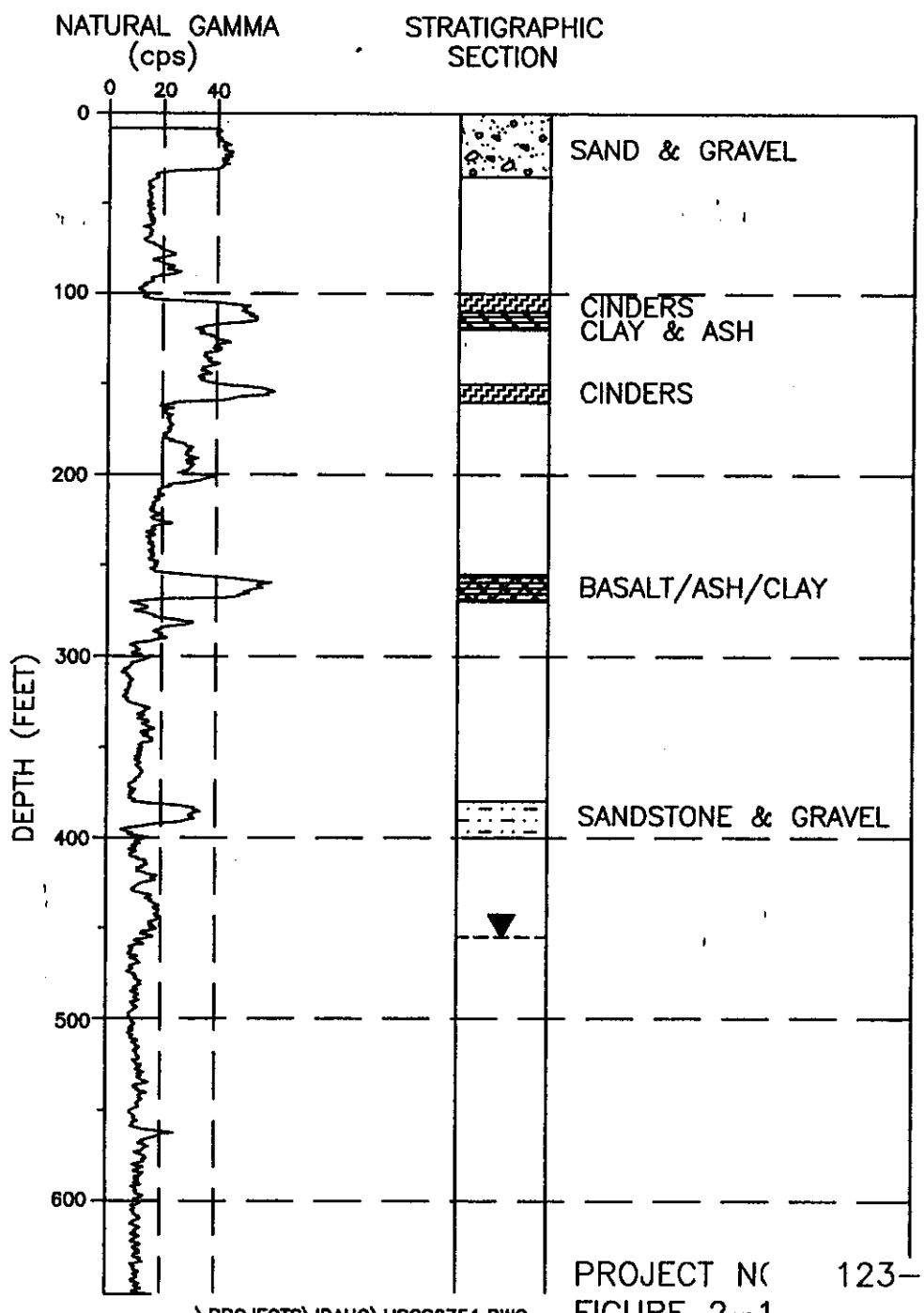
There are a number of surface geophysical technologies in use, each measure a physical property of the Earth, such as seismic velocity or electrical resistivity. The selection of the optimum geophysical method depends on the objective and the physical property that best differentiates the mapping objective. The goal of this project is to define the lateral extent of perched or saturated zones of water in and around the ICPP, and if possible, to resolve the thickness of the perched zone.

For this specific objective, it was decided to test if the perched zones can be delineated from measurements of the lateral and vertical resistivity specification (the geoelectric section). Moreover, it was decided that the surface geophysical technique best suited for determining the geoelectric section over the depth of range of interest (400 ft), was time domain electromagnetic (TDEM) soundings.

The contract called for conducting work in two phases. In Phase I, the available information (mainly from drill holes) are to be collected, a limited number of

TDEM soundings are to be made near drill holes, and the geoelectric sections derived from the TDEM measurements are to be correlated to drill hole information to determine if perched zones can be delineated from the geoelectric sections. Subsequently, based on the results of Phase I, recommendations about more extensive surveys in Phase II are to be made.





PROJECT N(123–102
FIGURE 2–1

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From many other investigations, it is known that the detectability of clay layers by electromagnetic methods depends on a number of factors such as:

- electrical conductivity and conductivity contrast between clay layers and surrounding lithologies;
- conductance of clay layer, (e.g. product of thickness and conductivity);
- depth of occurrence of clay layer;
- complexity of geoelectric section (e.g. the number of clay layers); and,
- data quality.

Area of Investigation

Figure 2-2 shows the study area at the ICPP, the location of the TDEM soundings taken in Phase 1, and the approximate location of the Upper and Deep perched water bodies. Across the site, the Upper perched water body has been encountered between 100 and 150 ft below land surface (bls), and the Deep perched water body has been identified between 320 and 420 ft bls.

3.0 LOGISTICS AND DATA ACQUISITION

In Phase I, a brief site review was conducted to determine the best locations to obtain data with the TDEM system. Several areas were selected as possible locations for the survey. These include:

- the area adjacent to the sewage treatment ponds, northeast of the ICPP;
- the area adjacent to the percolation ponds south of the ICPP; and,
- the area inside of the ICPP on the northeast portion of the site where minimal interference from cultural features (e.g. power lines, fences pipelines etc.) was expected.

During the first day of field work, personnel from MSE and LITCO joined Blackhawk personnel to perform a site overview. The LITCO, Blackhawk, and MSE personnel identified areas within the ICPP where potential TDEM data could be obtained. It was realized at this time, that information about the perched water zones inside of the ICPP was very important to the project. It was conveyed to MSE and LITCO personnel by Blackhawk at this time that it would be difficult to obtain good quality TDEM data inside the ICPP due to potential interference from cultural features (i.e., power lines, fences, pipelines, etc.).

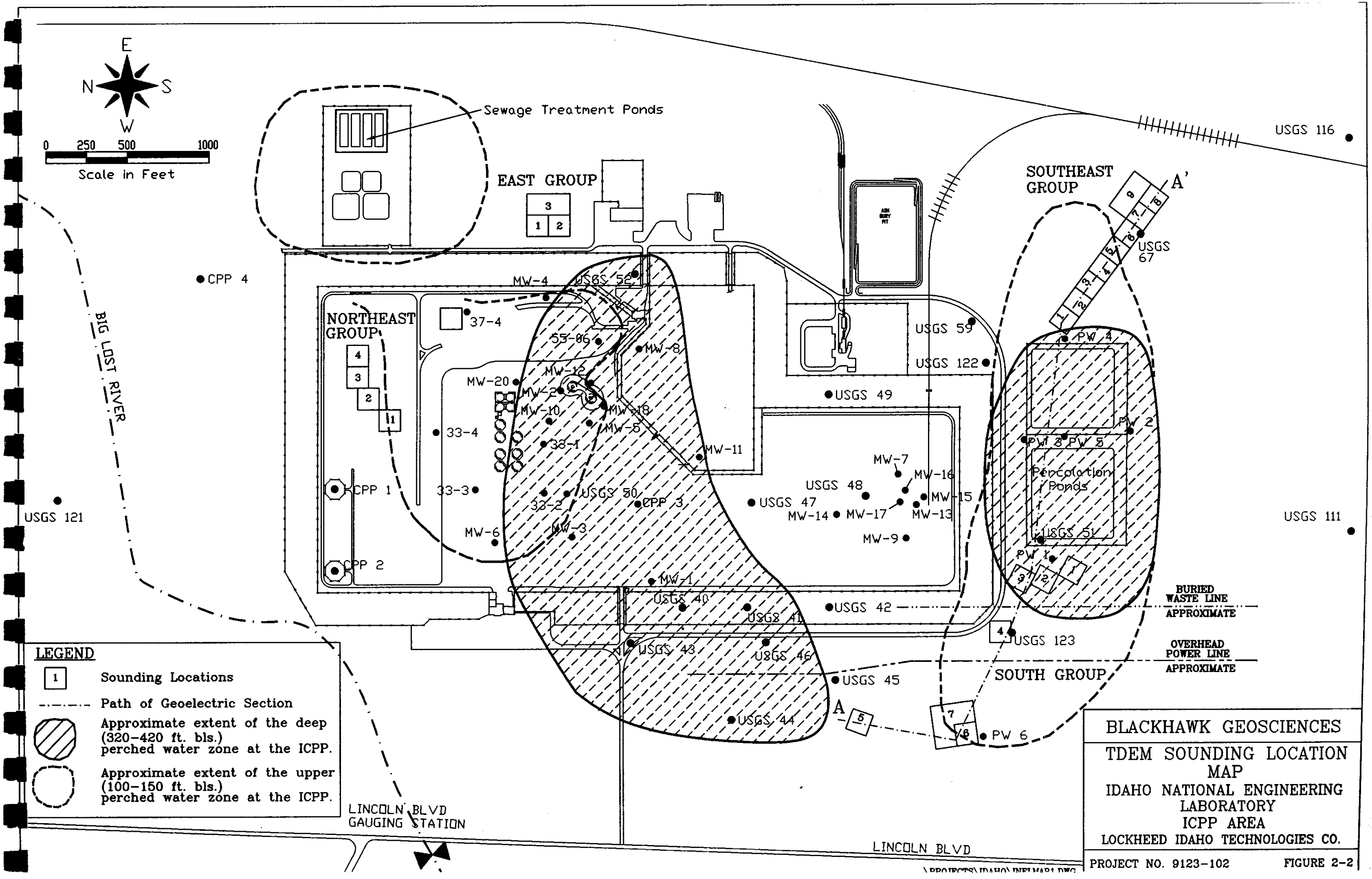
Figure 2-2 shows the locations of the TDEM soundings obtained during Phase I. At each TDEM sounding, a stake was placed at the center of each measurement along with red and blue flagging. The survey was labeled using the following designation for the soundings.

S (south) area, includes 6 transmitter loops 40 x 40 meters on each side and 1 transmitter loop 80 x 80 meters on each side. These soundings are along the south west side of the ICPP, west of the percolation ponds and generally between PW-1, and USGS 45. Soundings were performed as a group near PW-1 (Soundings S1, S2, and S3), near USGS 123 (Sounding S4), near USGS 45 (Sounding S5), and near PW-6 (Soundings S6 and S7).The field survey was started at locations near the percolation ponds adjacent to PW-1. It was discovered at this time that a high voltage power line and buried waste line were in the vicinity (see Figure 2-1).

SE (Southeast) area, includes 8 transmitter loops 40 x 40 meters and 1 transmitter loop 80 x 80 meters. This area was selected after determining that the S area soundings may have been affected by cultural features. These soundings were placed between PW-4 and USGS 67 and continued toward the southeast.

A sounding near Well 37-4 was also selected because of the well information available. This sounding is in the northeast area of the ICPP. Limited area was available, and therefore only one sounding was obtained.

NE (Northeast) area, includes 4 transmitter loops 40 x 40 meters. This area was selected to obtain information inside the ICPP, but in an area that was expected to contain little culture. An electric line running northeast to southwest was


E
N
S
W
0 250 500 1000
Scale in Feet
Sewage Treatment Ponds
EAST GROUP
3
1 2
NORTHEAST GROUP
4
3
2
1
SOUTHEAST GROUP
SOUTH GROUP
CPP 4
CPP 1
CPP 2
CPP 3
BIG LOST RIVER
USGS 121
USGS 116
USGS 111
USGS 67
USGS 59
USGS 122
USGS 49
USGS 48
USGS 47
USGS 52
USGS 50
USGS 40
USGS 41
USGS 42
USGS 43
USGS 46
USGS 45
USGS 44
USGS 123
USGS 51
MW-4
MW-8
MW-12
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MW-17
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MW-6
MW-3
MW-1
37-4
55-06
33-4
33-1
33-3
33-2
PW 4
PW 2
PW 3
PW 5
PW 1
PW 6
Percolation Ponds
A
A'
BURIED WASTE LINE APPROXIMATE
OVERHEAD POWER LINE APPROXIMATE
LEGEND
Sounding Locations
Path of Geoelectric Section
Approximate extent of the deep (320–420 ft. bls.) perched water zone at the ICPP.
Approximate extent of the upper (100–150 ft. bls.) perched water zone at the ICPP.
LINCOLN BLVD GAUGING STATION
LINCOLN BLVD
BLACKHAWK GEOSCIENCES
TDEM SOUNDING LOCATION MAP
IDAHO NATIONAL ENGINEERING LABORATORY
ICPP AREA
LOCKHEED IDAHO TECHNOLOGIES CO.
PROJECT NO. 9123-102
FIGURE 2-2

located about 30 meters west of Sounding NE1, and the area was also surrounded by a fire water line (at least 40 meters from any sounding). An unknown well is also located northeast of NE4.

E (East) area, this area was selected to obtain data as close as possible to the sewage treatment ponds. A radiologically controlled area is located adjacent to the sewage ponds, and data could not be obtained in the controlled area during the Phase I survey. A total of three soundings, 2 40 x 40 meter transmitter loops and 1 80 x 80 meter transmitter loop was used for measurements.

All data were collected with the Geonics EM47 TDEM system. Specifications of this system are given in Appendix A. For the most part, data were collected using 40 x 40 meter non-grounded transmitter loops. Three soundings were measured using 80 x 80 transmitter loops. The 40 x 40 meter loops used a current of 3 amperes and a turn off time of 2.5 microseconds. The 80 x 80 meter transmitter loops used a current of 2.5 amperes with a turn off time of 4.5 microseconds.

The non-grounded transmitter loops were positioned as much as possible away from cultural features such as fences, power lines, and other utilities in the area which degrade TDEM data quality. Measurements of the z (vertical) component field were usually measured at the center of the loop and at locations 20 meters outside of the transmitter loop on 2 opposite sides. In some areas, the horizontal (x) field data was collected at the external measurement location. Table 3-1 gives the daily log of field activities.

Table 3-1
Daily Field Activities

Date (1995)	Activities
September 11	Mobilize to Idaho Falls. Meet with MSE and LITCO personnel.
September 12	ICPP site check and data collection along the S area.
September 13	Site emergency drill, no data collection AM. In PM collect data along SE area.
September 14	Complete SE area. Obtain data from inside ICPP in NE area and WELL 37-4.
September 15	Obtain data in E area near sewage ponds and collect data near PW-6, S area loops s6 and S7. Demobilize to Golden, Colorado.

4.0 INTERPRETATION PROCEDURES

4.1 General

Fine grained sediments (clays, silts, ash, etc.) can often be differentiated from basalts by electrical resistivity (the inverse of conductivity). Figure 4-1 shows typical resistivity ranges for various soil and rock types. This figure shows that clayey (and fine grained) sediments typically have low resistivities (1 to 100 ohm-m) compared to basalts which have higher resistivities (200 to 1,000 ohm-m). Thus, from measurements of the geoelectric section the presence of fine grained sediments can often be inferred. Recognizing fine grained sediments is particularly effective when the geoelectric section is derived from borehole electromagnetic logs, because such logs can resolve the geoelectric section in great detail. Measuring the geoelectric section remotely from the surface cannot provide the same detail as sections obtained from geophysical borehole logging. There are a number of electrical and electromagnetic methods in common use in geoelectric prospecting for determining, from the surface, the geoelectric section of the subsurface. These methods differ in lateral and vertical resolution, sensitivity to ambient and geologic noise, and in practical aspects of surveying. In the exploration, depth range from about 15 to 7,500 ft, time domain electromagnetic (TDEM) has advantages over other methods because of its high sensitivity to the geoelectric section, low sensitivity to geologic noise, and good lateral resolution. A brief technical note describing the fundamentals of TDEM is given in Appendix B.

The TDEM data taken at the ICPP were interpreted by inversion with one dimensional (1-D) algorithms (program TEMIXH by Interpex Ltd.). At each receiver station, a 1-D geoelectric profile (using discrete layers and thicknesses) is derived, and typically a 2-D geoelectric cross-section is constructed from a series of 1-D profiles. For 1-D inversions, the minimum number of layers necessary to adequately fit the data is usually used (i.e., a significant improvement in error between model and data is not achieved by adding more layers). Typically, all of the parameters of the geoelectric section (resistivities and thicknesses) are allowed to vary freely in the inversions, unless information from borehole resistivity logs is available. At the ICPP, no borehole resistivity logs were available in the depth range of interest. An interpretation of the geoelectric parameters into geologic\lithologic units can be accomplished by assigning characteristic resistivity ranges to lithologic units. In this survey, information from nearby boreholes was used to help guide this correlation.

The TDEM data were also processed using a 1-D imaging method. With this method, a "smooth" model at each sounding location is estimated by Occam's Inversion (Constable et al., 1987). Occam's Inversion seeks the smoothest geoelectric model which fits the data to within an expected tolerance. The advantage of this method is that the inversion is not biased by initial starting parameters and the results may be more appropriate for lithologies which vary gradually in space (e.g. facies changes).

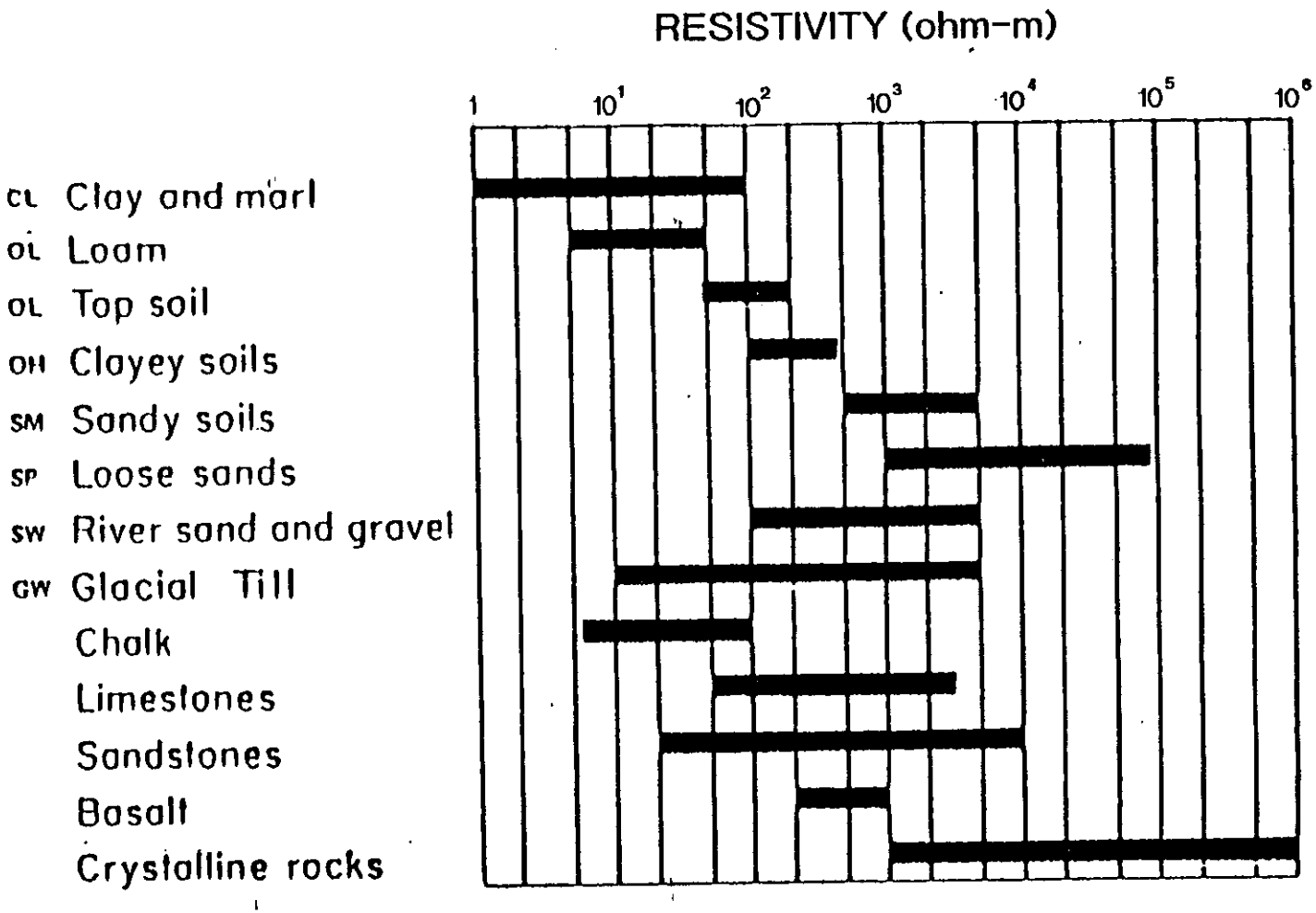
4.2 Data Quality Assurance\Quality Control

In the INEL ICPP area, interference from cultural features (which degrades TDEM data quality) was expected to be a primary concern. In this Phase 1 survey, a number of survey parameters were tested to determine optimum operating procedures and to try and mitigate the influence of cultural features. Some of the survey parameters tested were:

- influence of transmitter loop size. Transmitter loop sizes of 40m by 40m, and 80m by 80m were tested;
- receiver station location (inside and outside transmitter loop); and,
- dependence of data quality on component of electromagnetic field measured (horizontal and vertical).
- influence of distance between measurement and buried utilities and power lines.

These tests show that a moderate improvement in signal to noise ratio is sometimes achieved with the larger (80m by 80m) transmitter loop. Measurements of the vertical electromagnetic field taken at positions outside of the transmitter loops were the highest quality. In this survey, approximately 96 measurement positions were occupied from a total of 24 transmitter loops. Approximately 40 percent of the data were affected by cultural interference and could not be used for interpretation. In general, soundings taken within about 100 to 200 ft of buried utilities, and inside of the ICPP appear to be most affected. Soundings which were not affected by cultural interference and were used in the interpretation were:

South Group	Soundings 3, 5, 6, and 7
Southeast Group	Soundings 1, 2, 3, 4, 5, 6, 7, 8, and 9
Northeast Group	Soundings 3 and 4
East Group	Soundings 1, 2, and 3



BLACKHAWK GEOSCIENCES

RESISTIVITY RANGES FOR VARIOUS TERRAIN MATERIALS (after Culley et al.)

PROJECT NO. 9123-102

URE 4-1

5.0 RESULTS

5.1 Comparison and Correlation of 1-D Geoelectric Sections Derived from TDEM Measurements and Drill Holes

TDEM soundings were taken in the vicinity of several wells for comparison with well data. Well information used for comparison purposes consisted of lithologic logs which were derived from core and cuttings, and natural gamma borehole geophysical logs. A comparison of well data and TDEM results was made at the following locations (reference Figure 2-2 for well and sounding locations):

Borehole USGS 67	Sounding SE6 (Figure 5-1)
Borehole USGS 51	Sounding S3 (Figure 5-2)
Borehole USGS 45	Sounding S5 (Figure 5-3)

In these figures, the natural gamma log and stratigraphic section for the borehole is compared to the geoelectric profile derived from a nearby sounding. In the stratigraphic sections, only the significant fine grained zones (clays, ashes, silts, etc.) are indicated, the remainder of the stratigraphy is composed of basalts.

In borehole USGS 67 (Figure 5-1), the stratigraphic log shows several fine grained zones between 100 and 175 ft bls.. A thick layer of brown clay and silt is mapped between 122 and 144 ft bls. Other fine grained zones mapped in the borehole are thinner than this clay and mainly composed of silts and cinders. The natural gamma log correlates precisely with the stratigraphic log, with higher natural gamma responses indicating fine grained zones. Water table is at a depth of 455 ft bls. The geoelectric profile derived from the inversion of TDEM Sounding SE6 shows generally high resistivities (greater than 80 ohm-m) over most of the section, with a thin (9 ft), conductive (5.2 ohm-m) layer at a depth of about 123 ft. This conductive layer correlates accurately with the brown clay and silt shown in the stratigraphic log.

In borehole USGS 51 (Figure 5-2), the stratigraphic log again shows several fine grained zones between 100 and 175 ft bls.. Clays were noted in the thin zone between 110 and 119 ft bls and as a smaller component of the layer at 254 to 270 ft bls. Water table is at a depth of 454.71 ft bls. The geoelectric profile derived from the inversion of TDEM Sounding S3 shows two relatively low resistivity layers: one occurring at a depth of about 140 ft bls (resistivity of 68 ohm-m), and another at a depth of 432 ft bls (resistivity of 58 ohm-m). The deeper less resistive layer correlates with the water table. The shallow less resistive layer is expected to correlate with the clays and fine grained zones noted between 100 and 175 ft bls. The distance from the sounding to the borehole is approximately 200 ft.

In borehole USGS 45 (Figure 5-3), the stratigraphic log again shows several fine grained zones between 100 and 175 ft bls. Clays are described as a smaller component of the fine grained lithologies in this interval. A clay layer is noted on

the stratigraphic section between 260 and 275 ft bls, and basalt and clay are mapped between 400 and 445 ft bls. Water table is at 453.43 ft bls. The geoelectric profile derived from the inversion of TDEM Sounding S5 (approximately 200 ft to the west), shows two relatively low resistivity layers, occurring at about 129 ft and 430 ft bls. The deeper less resistive layer (5.7 ohm-m) appears to correlate with the basalt and clay and water table region in the stratigraphic log. The shallow less resistive layer (79 ohm-m) correlates with the fine grained zones between 100 and 175 ft bls noted in the stratigraphic log.

In summary, these three comparisons show that the TDEM data can detect fine grained zones noted in the stratigraphic logs between 100 and 175 ft bls. In one case (near USGS 67), the TDEM data detects an individual, thick,clay layer. In the other comparisons, the TDEM data detect a broader, low resistivity zone which appears to correlate to a combination of several fine grained zones with varying amounts of clay. Also, in some of the soundings the water table is detected. In these comparisons, there is no indication of the deep perched water zone or fine grained zones which may create it.

Multiple fine grained zones in the 100 to 175 ft bls range are mapped at the ICPP. The TDEM data cannot separately detect the layers, however, the conductance (ratio of thickness and resistivity) of TDEM measurements can be used to help indicate the aggregate conductance of clay layers within certain intervals.

5.2 Construction of a 2-D Geoelectric Section from Individual Soundings

Figure 5-4 shows a geoelectric cross section created from TDEM soundings taken in the southern part of the ICPP. Figure 2-2 shows the path of this section in plan view. The geoelectric section was derived from 1-D inversions using discrete layers. Also shown on this figure is the geoelectric section derived using Occam's inversion in which smoothly varying resistivity layering is used, and the total conductance of the geoelectric section to a depth of 200 ft. Also shown on this figure is stratigraphic information from several well in the area (location of fine grained zones), the approximate lateral extent of the upper and deep perched water zones (from Figure 2-2), and the location of the percolation ponds.

On the geoelectric section created from the 1-D inversions, a relatively low resistivity layer (4.5 to 118 ohm-m) is interpreted at a depth of 100 to 180 ft bls. This layer is interpreted as a zone of fine grained sediments and may consist of several separate sedimentary layers. The resistivity of this layer increases rapidly from the east side of the percolation ponds toward the west portion of the section and the total conductance (to a depth of 200 ft) shows a rapid decrease in this same direction. This data infers a thinning, or lithologic change (e.g. increase in silts or cinders) in the sediments toward the west.

Portions of the geoelectric section with a low resistivity sediment layer (higher total conductance) infer clayey sediments and thus a higher potential for perched water bodies (e.g. from Sounding SE1 toward the east). Conversely, portions of the geoelectric section with a higher resistivity sediment layer (lower total

conductance) infer less clay in the sediments and a reduced potential for perched water (e.g. from Sounding S3 toward the west).

Thickness of the upper perched water zone (from Reference 2, Section 1.0) at several wells is plotted along with the 1-D geoelectric section. Thick upper perched water zones occur beneath the percolation ponds (Wells PW1 and PW4), and a rapid thinning of the upper perched water zone is shown toward the west (Well PW6). This rapid decrease in the thickness of the upper perched water zone correlates with a rapid increase in resistivity of the sediment layer (decrease in total conductance) over the same region.

The Occam's inversion along this section shows similar results as the 1-D geoelectric section i.e., more conductive sediments from Sounding 1SE toward the east, and more resistive sediments from Sounding S3 toward the west. Both the 1-D inversions and Occam's inversion show a deeper (430 to 520 ft bls) conductive layer on the west side of the section. This layer is expected to be caused by a combination of the water table and clayey sediments in the vicinity of the water table. This deep layer likely extend across the entire section, but was not detected with the TDEM soundings on the east side of the section due to the high conductance of the upper sediments.

USGS 67 – SOUNDING SE6 COMPARISON

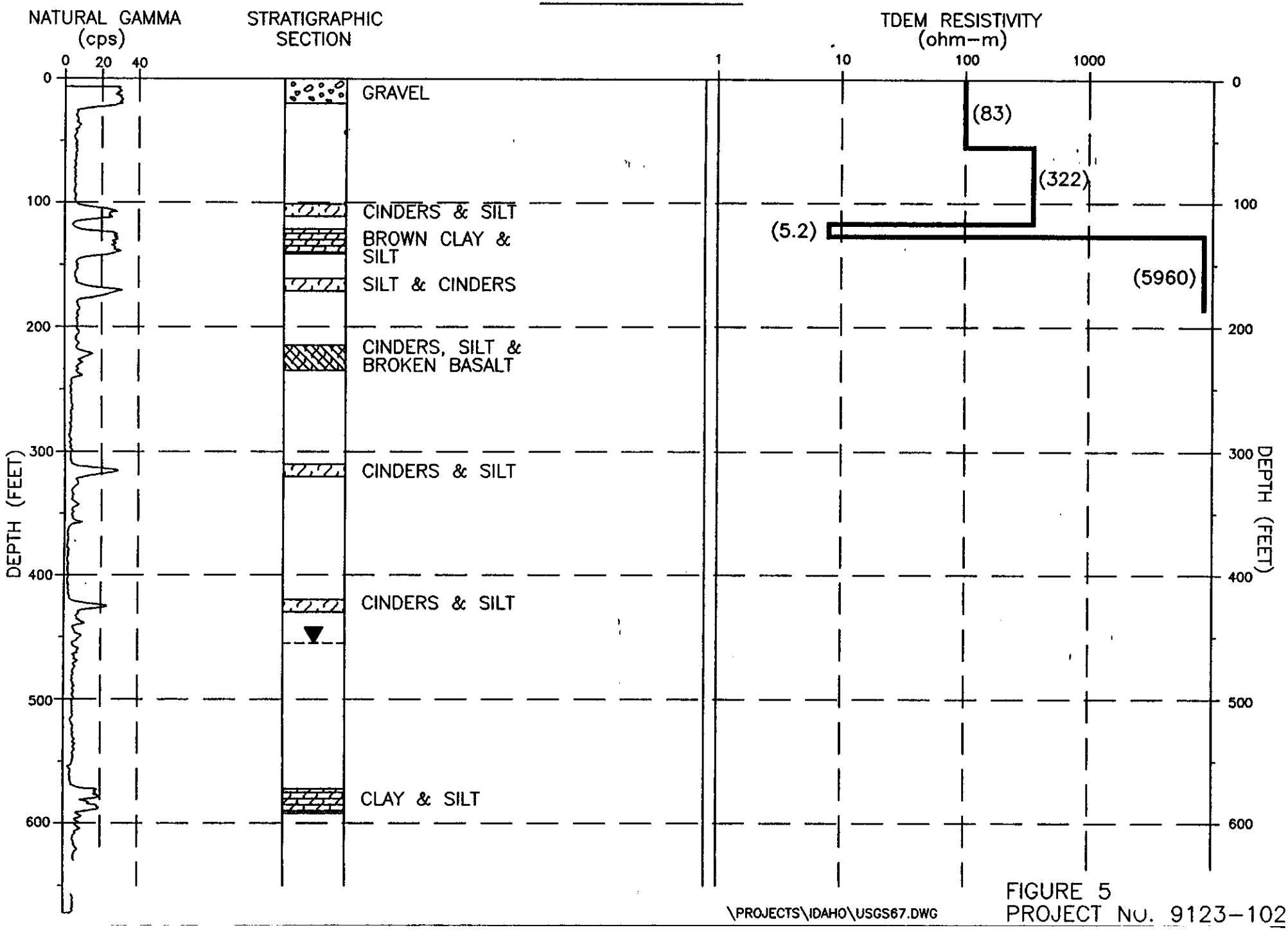


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FIGURE 5
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USGS 51 - OUNDING S3 COMPARISON

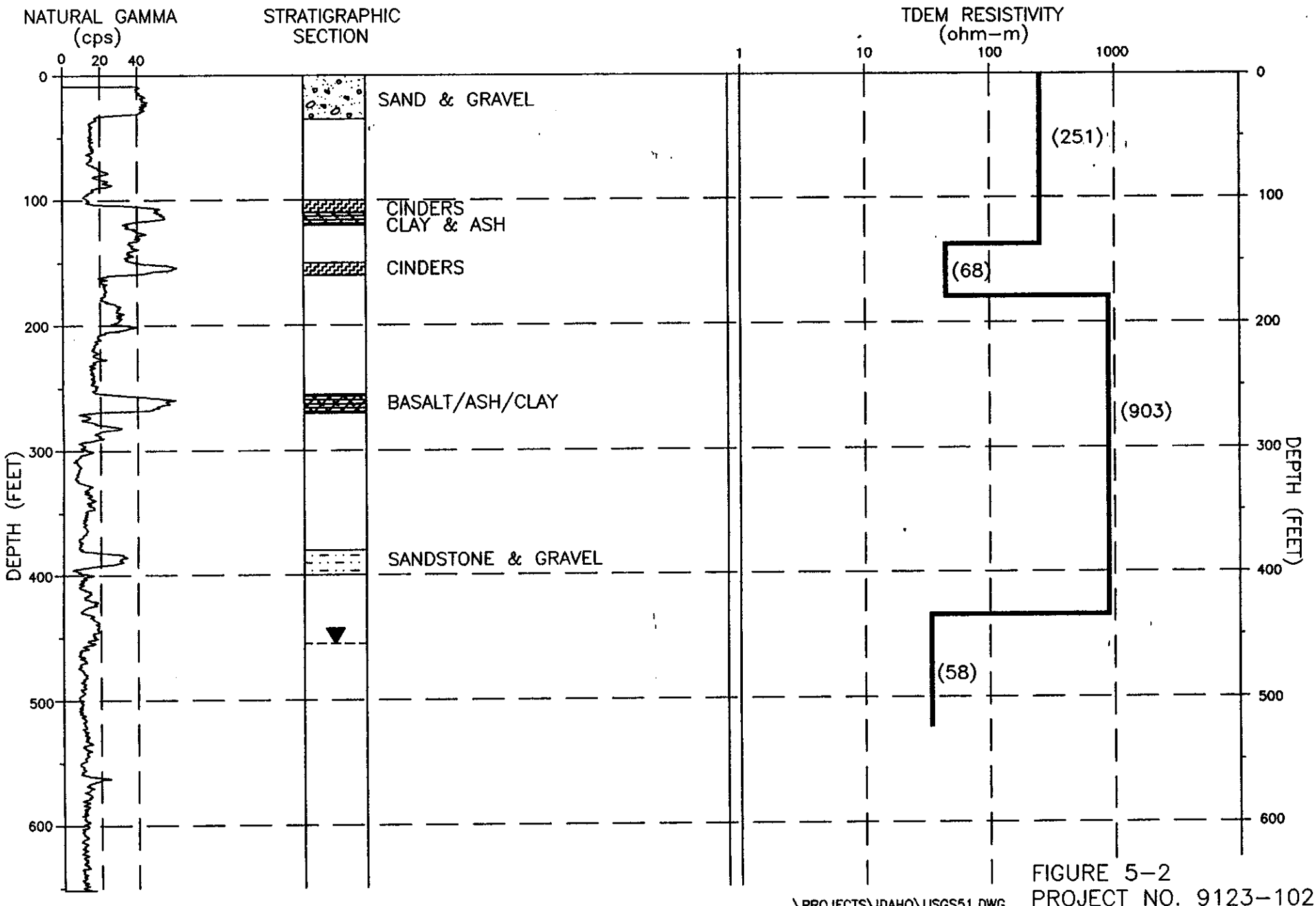

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FIGURE 5-2
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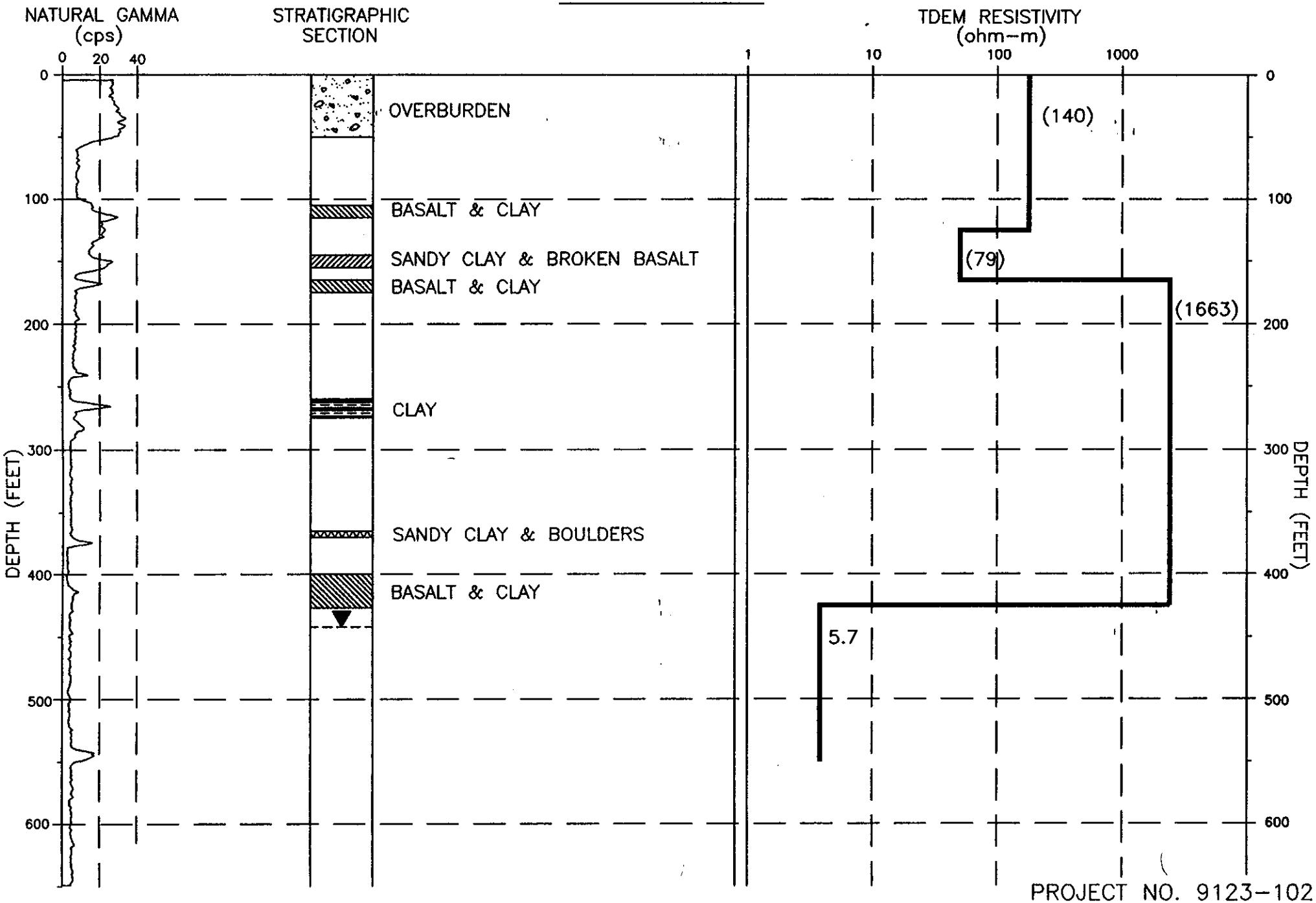
USGS 45 – SOUNDING S5 COMPARISON



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6.0 CONCLUSIONS AND RECOMMENDATIONS

The Phase I TDEM geophysical survey at the INEL ICPP area detected an electrically conductive layer at a depth ranging from 80 to 170 ft bls. This layer correlates with fine grained sediments in boreholes which are believed to cause perched water bodies in the upper perched water zone beneath the ICPP. Variations in the TDEM total conductance (to a depth of 200 ft) correlates with variations in total clay content in the fine grained sediments, which in turn, correlates with the occurrence of the upper perched water zone.

Based on the results of the test survey (Phase I), we recommend proceeding with the Phase II survey. The rationales for this recommendation are:

- Phase I data showed that from TDEM measurements, a geoelectric section is derived that correlates to cumulative clay content, and this clay content, in turn, correlates to the presence or absence of perched zones. TDEM measurements can only be performed away from infrastructure, i.e., around the ICPP and in very limited areas inside.
- The cost of drilling is high due to the depth of required investigation and the likely presence of radionuclides in the perched water. Any additional geophysical data that allows extrapolation of drill hole information likely will significantly reduce costs.

Phase II work in addition to surface TDEM measurements, should also include borehole induction logging for the reasons that i) no resistivity logs were previously run, and ii) inductions logs will directly relate to clay content and the geoelectric section derived from TDEM data. Induction logs can be run in holes with non-metallic casings or open holes, and in dry or wet holes.

7.0 REFERENCES

Constable, S.C., Parker, R.L., and Constable, C.G., 1987, Occam's Inversion: A practical algorithm for generating smooth models from electromagnetic sounding data: Geophysics, v.52, N.3, p.289-300.

Appendix D

Appendix D

L&V Summary and RI/FS Quality Control Sample Results

WAG 3 RI/FS Field Investigation - Soil

Sampling Location	Date Sampled	Sample Designation	Planned Sampling Interval (feet)	Collected Sampling Interval (feet)	Comments
1	9-11-95	ECA-15-1	NA	0-3	Sample collected from soil stockpiled in dumptruck during initial excavation of the site.
2	9-11-95	ECA-15-2	2	2	Sample collected approximately 18 inches away from the column.
3	9-11-95	ECA-15-3	2	2	Sample collected near the concrete column.
4	9-11-95	ECA-15-4	10	4	Sample collected below subsurface at approximately 4 feet and refusal.
5	9-11-95	ECA-15-5	2	2	Sample collected near the concrete column (duplicate field sample of ECA-15-3).

The samples collected had rad range (field instrumentation) of 20 to 50 mR/hr. (> 50,000 cpm).
Information on analytical method error limits has not been included for the site CPP 15 data set.

WAG 3 RI/FS Field Investigation - Soil

Sampling Location	Sample Designation	Gross Alpha			Gross Beta			Sr-90			Cs-137		
		Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q
1	ECA-15-1	0.00		U	84.7			16.4			44.5	7.7	
2	ECA-15-2	84.0			3500			727			2810	140	
3	ECA-15-3	75.9			2970			617 597			2350	120	
4	ECA-15-4	462			27700			7990			15400	850	
5	ECA-15-5	1090			48100			4250			43400	1800	

Sample Location	Sample Designation	Pu-238			Pu-239			Am-241			Np-237			U-233		
		Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q
1	ECA-15-1	0.57	0.16		0.08	0.12	U	0.10	0.14	U	0.03	0.04	U	23.5		
2	ECA-15-2	22.7	1.6		4.30	0.50		3.42	0.42		0.04	0.06	U	47.9		
3	ECA-15-3	19.6 20.2	1.3 1.3		3.44 3.95	0.38 0.42		2.42 2.82	0.32 0.35		0.10 0.00	0.13 0.01	U U	243 93.3		
4	ECA-15-4	112	5.4		19.8	1.3		19.6	1.9		0.47	0.12		23.7		
5	ECA-15-5	93.3	4.6		16.9	1.2		15.8	1.6		0.15	0.18	U	18.2		

Sample Location	Sample Designation	U-234			U-235			U-236			U-238			Tc-99		
		Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q
1	ECA-15-1	2		U	0.02			0.02		U	0.26			7.41		
2	ECA-15-2	2		U	0.03			0.02		U	0.36			7.24		
3	ECA-15-3	3 3		U U	0.06 0.03			0.3 0.03		U U	0.28 0.28			4.15 5.46		
4	ECA-15-4	3		U	0.02			0.03		U	0.31			6.17		
5	ECA-15-5	3		U	0.01			0.03		U	0.29			5.89		

WAG 3 RI/FS Field Investigation - Soil

Sample Location	Sample Designation	Aluminum		Antimony		Arsenic		Barium		Beryllium		Cadminum		Calcium		Chromium	
		(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q
1	ECA-15-1	3830		2	U	2	U	62.9		0.02		0.21		13900		11.7	
2	ECA-15-2	4400		2	U	3	U	81.5		0.003	U	0.35		55600		19.0	
3	ECA-15-3	2590		2	U	2	U	44.5		0.03		0.42		130000		8.63	
4	ECA-15-4	3560		2	U	3.46		63.8		0.097		0.1	U	13400		14.5	
5	ECA-15-5	4020		2	U	3.26		75.6		0.098		0.25		23300		12.2	

Sample Location	Sample Designation	Cobalt		Copper		Iron		Lead		Magnesium		Manganese		Mercury		Nickel	
		(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q
1	ECA-15-1	3.12		8.63		7900		5.44		2610		121				13.1	
2	ECA-15-2	3.89		10.5		9740		7.66		4390		162				16.9	
3	ECA-15-3	1.86		7.38		5590		5.43		2490		91.5				10.4	
4	ECA-15-4	3.15		10.6		7990		7.38		3220		119				18.0	
5	ECA-15-5	3.09		12.6		8080		9.17		3400		118				17.0	

Sample Location	Sample Designation	Potassium		Selenium		Silver		Sodium		Thallium		Vanadium		Zinc		Zirconium	
		(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q
1	ECA-15-1	643		2	U	0.2	U	99.0		2	U	16		36.9		8.88	
2	ECA-15-2	745		3	U	0.2	U	132		2	U	17.4		51.1		10.3	
3	ECA-15-3	498		2	U	0.2	U	82.5		2	U	12.5		40.4		5.13	
4	ECA-15-4	628		3	U	0.2	U	134		2	U	15.3		44.5		7.39	
5	ECA-15-5	722		2	U	0.2	U	125		4.85		17.4		47.8		6.31	

WAG 3 RI/FS Field Investigation - Soil

Sample Location	Sample Designation	N-nitroso-dimethylamine		Phenol		2-Chlorophenol		bis (2-Chloroethyl) ether		1,3-Dichlorobenzene		1,4-Dichlorobenzene		1,2-Dichlorobenzene	
		(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q
1	ECA-15-1	107 101	U U	57 59	U U	56 53	U U	69 65	U U	61 57	U U	18 17	U U	73 69	U U
2	ECA-15-2	92	U	49	U	48	U	59	U	52	U	15	U	63	U
3	ECA-15-3	109	U	58	U	57	U	70	U	62	U	18	U	74	U
4	ECA-15-4	101	U	54	U	53	U	65	U	57	U	17	U	69	U
5	ECA-15-5	111	U	59	U	58	U	72	U	63	U	19	U	76	U

Sample Location	Sample Designation	2-Methylphenol		2,2'-oxybis (1-Chrolopropane)		Hexochloroethane		N-Nitroso-Di-n-propylamine		4-Methylphenol		Nitrobenzene		Isophorone	
		(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q
1	ECA-15-1	50 47	U U	61 57	U U	85 80	U U	131 123	U U	54 57	U U	87 82	U U	72 68	U U
2	ECA-15-2	43	UJ	52	U	73	U	113	U	46	U	75	U	62	U
3	ECA-15-3	51	U	62	U	87	U	134	U	55	U	89	U	74	U
4	ECA-15-4	47	U	57	U	80	U	123	U	51	U	82	U	68	U
5	ECA-15-5	52	UJ	63	U	88	U	136	U	56	U	90	U	75	U

Sample Location	Sample Designation	2-Nitrophenol		2,4-Dimethylphenol		bis (2-Chloroethoxy) methane		2,4-Dichlorophenol		1,2,4-Trichlorobenzene		Naphthalene		4-Choroaniline	
		(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q
1	ECA-15-1	73 69	U UJ	166 156	U U	77 72	U U	76 71	U U	69 65	U UJ	77 72	UJ UJ	269 253	U UJ
2	ECA-15-2	63	U	143	U	66	U	65	U	59	U	66	UJ	231	U
3	ECA-15-3	74	U	169	U	79	U	78	U	70	U	79	U	274	U
4	ECA-15-4	69	U	156	U	72	U	71	U	65	U	72	U	253	U
5	ECA-15-5	76	U	173	U	80	U	79	U	72	U	80	UJ	280	U

WAG 3 RI/FS Field Investigation - Soil

Sample Location	Sample Designation	Hexachloro-butadiene		4-Chloro-3-methylphenol		2-Methylnaphthalene		Hexachloro-cyclopentadiene		2,4,5-Trichlorophenol		2,4,6-Trichlorophenol		2-Chloronaphthalene	
		(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q
1	ECA-15-1	98 92	U U	76 71	U U	70 66	UJ UJ	130 122	U U	174 164	U U	101 95	U U	104 98	U UJ
2	ECA-15-2	84	U	65	U	60	UJ	112	U	150	U	87	U	89	UJ
3	ECA-15-3	100	U	78	U	71	U	133	U	177	U	103	U	106	UJ
4	ECA-15-4	92	U	71	U	66	U	122	U	164	U	95	U	98	U
5	ECA-15-5	102	U	79	U	73	U	135	U	181	U	105	U	108	U

Sample Location	Sample Designation	2-Nitroaniline		Acenaphthylene		Dimethylphthalate		2,6-Dinitrotoluene		3-Nitroaniline		Acenaphthene		2,4-Dinitrophenol	
		(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q
1	ECA-15-1	63 59	U U	69 65	U UJ	69 65	UJ UJ	79 74	UJ UJ	166 156	UJ U	56 53	UJ UJ	166 250	U U
2	ECA-15-2	54	U	59	U	59	UJ	68	UJ	143	U	48	U	229	U
3	ECA-15-3	64	U	70	UJ	70	UJ	81	U	169	U	57	U	271	U
4	ECA-15-4	59	U	65	U	65	UJ	74	U	156	U	53	UJ	250	U
5	ECA-15-5	66	U	72	U	72	UJ	82	UJ	173	U	58	UJ	277	U

Sample Location	Sample Designation	Dibenzofuran		4-Nitrophenol		2,4-Dinitrotoluene		Fluorene		Diethylphthalate		4-Chlorophenyl-phenylether		4-Nitroaniline	
		(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q
1	ECA-15-1	41 39	UJ UJ	186 175	U U	98 92	U UJ	46 43	U UJ	85 80	UJ UJ	73 69	U UJ	42 39	U U
2	ECA-15-2	35	UJ	160	U	84	U	40	U	73	UJ	63	U	36	U
3	ECA-15-3	42	U	190	UJ	100	UJ	47	U	87	UJ	74	U	43	U
4	ECA-15-4	39	UJ	175	U	92	UJ	43	U	80	UJ	69	U	39	U
5	ECA-15-5	43	U	193	U	102	UJ	48	U	88	UJ	76	U	44	U

WAG 3 RI/FS Field Investigation - Soil

Sample Location	Sample Designation	4,6-Dinitro-2-methylphenol		N-Nitrosodi-phenylamine		Azobenzene (diphenyl amine)		Tri-n-Butylphosphate		4-Bromphenyl-phenylether		Hexachoro-benzene		Pentachlorophenol	
		(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q
1	ECA-15-1	50 47	U U	100 99	UJ UJ	100 94	UJ UJ	100 94	UJ UJ	67 63	U UJ	70 66	U U	133 125	U U
2	ECA-15-2	43	U	86	UJ	86	UJ	86	UJ	58	U	60	U	114	U
3	ECA-15-3	51	U	102	UJ	102	UJ	102	UJ	68	U	71	U	136	U
4	ECA-15-4	47	U	94	UJ	94	UJ	94	UJ	63	U	66	U	125	U
5	ECA-15-5	52	U	104	UJ	104	UJ	104	UJ	70	U	73	U	138	U

Sample Location	Sample Designation	Phenanthrene		Anthracene		Carazole		Di-n-Butylphthalate		Fluoranthene		Pyrene		Butylbenzyl-phthalate	
		(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q
1	ECA-15-1	65 61	UJ UJ	52 49	UJ UJ	100 94	U UJ	458 366		82 77	UJ UJ	117 110	UJ UJ	82 77	UJ UJ
2	ECA-15-2	56	UJ	45	UJ	86	U	586		71	U	101	UJ	71	UJ
3	ECA-15-3	66	UJ	53	U	102	U	27	UJ	84	U	119	U	84	UJ
4	ECA-15-4	61	UJ	49	UJ	94	U	71		77	U	110	U	77	UJ
5	ECA-15-5	68	UJ	54	U	104	UJ	36		85	U	122	UJ	85	UJ

Sample Location	Sample Designation	Chrysene		Benzo (a) anthracene		3,3'-Dichlorobenzidine		bis (2-Ethylhexyl) phthalate		Di-n-Octyl phthalate		Benzo (k) fluoranthene		Benzo (b) fluoranthene	
		(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q
1	ECA-15-1	83 78	U U	78 73	U U	663 623	U U	1520 921	E E	29 27	UJ UJ	57 54	U U	73 69	U U
2	ECA-15-2	71	U	67	U	570	U	344		25	UJ	49	U	63	U
3	ECA-15-3	85	U	80	U	676	U	1560	E	30	UJ	58	U	74	U
4	ECA-15-4	78	U	73	U	623	U	143		38		54	U	69	U
5	ECA-15-5	86	U	81	U	690	U	430		84		59	U	76	U

WAG 3 RI/FS Field Investigation - Soil

Sample Location	Sample Designation	Benzo (a) pyrene		Indeo (1,2,3-cd) pyrene		Dibenzo (a,h) anthracene		Benzo (g,h,i) perylene		*105-30-6 2-methyl-1-pentanol		*32357-83-8 hexyl-penyl-ether		*556-67-2 octamethyl-cyclotetra-siloxane	
		(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q
1	ECA-15-1	13	U	355	U	48	U	32	U	126	J	111	J	602	J
		12	U	334	U	45	U	30	U	200	J				

WAG 3 RI/FS Investigation - Snake River Plain Aquifer

Well	Well Type	Date Sampled	Sample Designation	Water Depth (Feet TOC)	Comments
MW-18	4" PVC Well	6/05/95	31330101	464.19	
USGS-34	Aquifer Well	5/10/95	31330201	477.33	
USGS-35	Aquifer Well	5/05/95	31330301	477.76	
USGS-36	Aquifer Well	5/12/95	31330401	477.48	
USGS-36 (duplicate)	Aquifer Well	5/12/95	31334801	477.48	
USGS-37	Aquifer Well	5/12/95	31330501	477.61	
USGS-38	Aquifer Well	5/16/95	31330601	478.03	
USGS-39	Aquifer Well	5/04/95	31330701	479.16	
USGS-40	Aquifer Well	5/10/95	31330801	463.58	
USGS-41	Aquifer Well	5/11/95	31330901	464.53	
USGS-42	Aquifer Well	5/15/95	31334301	464.83	
USGS-43	Aquifer Well	Not sampled	31331001	462.48	This well was not sampled due to a failure with the dedicated sampling pump.
USGS-44	Aquifer Well	5/09/95	31331101	465.58	
USGS-45	Aquifer Well	5/19/95	31331201	467.41	
USGS-46	Aquifer Well	5/31/95	31331301	468.1	
USGS-47	Aquifer Well	6/26/95	31334401	461.34	
USGS-48	Aquifer Well	5/09/95	31331401	464.16	
USGS-51	Aquifer Well	5/16/95	31331601	467.77	
USGS-52	Aquifer Well	5/12/95	31331701	457.75	
USGS-57	Aquifer Well	5/17/95	31331801	471.80	
USGS-59	Aquifer Well	5/18/95	31331901	461.44	
USGS-67	Aquifer Well	5/18/95	31332001	462.34	
USGS-67 (duplicate)	Aquifer Well	5/18/95	31335001	462.34	

WAG 3 RI/FS Investigation - Snake River Plain Aquifer

Well	Well Type	Date Sampled	Sample Designation	Water Depth (Feet TOC)	Comments
USGS-77	Aquifer Well	5/16/95	31332101	471.26	
USGS-82	Aquifer Well	5/09/95	31332201	454.94	
USGS-84	Aquifer Well	5/12/95	31334201	486.56	
USGS-85	Aquifer Well	5/22/95	31332301	489.07	
USGS-111	Aquifer Well	5/08/95	31332401	475.98	
USGS-112	Aquifer Well	5/19/95	31332501	479.67	
USGS-113	Aquifer Well	5/17/95	31332601	480.31	
USGS-114	Aquifer Well	5/17/95	31332701	474.02	
USGS-115	Aquifer Well	5/15/95	31332801	470.27	
USGS-116	Aquifer Well	5/10/95	31332901	464.71	
USGS-121	Aquifer Well	5/22/95	31333001	459.12	
USGS-121 (duplicate)	Aquifer Well	5/22/95	31334901	459.12	
USGS-122	Aquifer Well	5/31/95	31333101	462.62	
USGS-123	Aquifer Well	5/23/95	31333201	468.39	
LF2-08	Aquifer Well	5/25/95	31333301	485.79	
LF2-10	Aquifer Well	5/11/95	31333501	484.74	
LF2-11	Aquifer Well	8/03/95	31333601	477.60	
LF2-12	Aquifer Well	6/05/95	31333701	481.85	
LF3-08	Aquifer Well	5/25/95	31333801	494.16	
LF3-09	Aquifer Well	5/25/95	31333901	490.59	
LF3-10	Aquifer Well	8/02/95	31334001	492.14	
CPP-1	Aquifer Well	6/05/95	31334501		
CPP-2	Aquifer Well	6/05/95	31334601		

WAG 3 RI/FS Investigation - Snake River Plain Aquifer

Well Designation	Sample Designation	Gross Alpha			Gross Beta			Tritium			Sr-90			Pu-238		
		Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q
MW-18	31330101	10	2		469	6		26400	400		84	1		0.00	0.07	U
USGS-34	31330201	2.0	1.2	U	13	1		4530	217		2.4	0.3		NA		
USGS-35	31330301	2.4	1.2		14	1		6680	250		2.6	0.3		NA		
USGS-36	31330401	4.4	1.4		32	2		6580	240		9.0 8.1	0.5 0.5		NA		
USGS-36 (duplicate)	31334801	2.9	1.3		31	2		6110	230		8.6 10.5	0.5 0.6		NA		
USGS-37	31330501	1.7	1.6	U	38	2		17700	400		7.6 8.2	0.5 0.5		NA		
USGS-38	31330601	4.9	2.0		63	3		17300	400		18.1 19.0	0.6 0.7		NA		
USGS-39	31330701	1.6	1.0	U	3.2	1.2		7620	260		0.0	0.3	U	NA		
USGS-40	31330801	3.0	1.3		81	2		9850	280		17.4 20.2	0.6 0.6	J J	NA		
USGS-41	31330901	4.1	1.4		52.4	2.2		7770	250		14.1 15.8	0.6 0.6		NA		
USGS-42	31334301	2.6	1.2		33	2		3880	200		9.7 9.8	0.6 0.5		0.03	0.04	U
USGS-43	31331001	NS			NS			NS			NS			NS		
USGS-44	31331101	3.6	1.3		14	1		581	138		3.6	0.3		NA		
USGS-45	31331201	2.3	1.2	U	14	1		2540	180		4.8 3.8	0.4 0.4		NA		
USGS-46	31331301	2.8	1.3	J	140	3	J	10200	300		23.4	0.8		NA		
USGS-47	31334401	3.8	1.5	U	233	3		15800	400		67	1	J	NA		
USGS-48	31331401	2.3	1.2	U	81	2		6820	252		18.4	0.5		0.00	0.03	U
USGS-51	31331601	0.2	1.2	U	5.7	1.4		23900	400		0.4 0.1	0.3 0.3	U U	NA		
USGS-52	31331701	2.8	1.3	U	183	3		10700	300		12.1 12.1	0.6 0.6		NA		
USGS-57	31331801	2.0	1.8	U	83	3		18400	400		23.2 22.7	0.7 0.7		0.00	0.07	U

WAG 3 RI/FS Investigation - Snake River Plain Aquifer

Well Designation	Sample Designation	Gross Alpha			Gross Beta			Tritium			Sr-90			Pu-238		
		Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q
USGS-59	31331901	1.0	1.7	U	43	3		17900	400		10.8 12.0	0.5 0.5		NA		
USGS-67	31332001	1.6	1.6	U	45	3		21200	400		12.6 10.3	0.5 0.5		NA		
USGS-67 (duplicate)	31335001	0.0	1.5	U	47	3		21000	400		13.3 12.8	0.5 0.5		NA		
USGS-77	31332101	4.6	1.7		13	2		30700	500		1.8 1.3	0.3 0.3		NA		
USGS-82	31332201	2.9	1.1		4.1	1.3		67	122	U	0.1	0.3	U	NA		
USGS-84	31334201	1.0	1.2	U	2.4	1.2		4790	210		0.2 0.0	0.3 0.3	U U	NA		
USGS-85	31332301	3.0	1.4		16	2		11800	300		4.7 4.0	0.4 0.4		NA		
USGS-111	31332401	0.2	1.2	U	3.5	1.3		10900	300		0.2	0.3	U	NA		
USGS-112	31332501	2.3	1.7	U	78	3		17900	400		20.3 21.5	0.6 0.7		0.00	0.02	U
USGS-113	31332601	0.0	1.8	U	38	3		15500	300		12.5 12.0	0.6 0.5		NA		
USGS-114	31332701	0.4	1.1	U	11	1		27000	400		0.3 0.1	0.3 0.4	U U	NA		
USGS-115	31332801	2.3	1.0		8.4	1.3		5340	220		0.6 0.3	0.3 0.3	U U	NA		
USGS-116	31332901	3.5	1.6		5.8	1.6		8020	260		0.9 0.8	0.3 0.3		NA		
USGS-121	31333001	2.6	1.1		2.7	1.1		168	123	U	1.0 0.3	0.3 0.3	 U	NA		
USGS-121 (duplicate)	31334901	4.7	1.2		3.8	1.2		240	123	U	0.7 0.0	0.3 0.4	 U	NA		
USGS-122	31333101	1.6	1.1	U	13	1		19300	300		2.2	0.3		NA		
USGS-123	31333201	1.7	1.5	U	123	3		25900	400		30	1		0.08	0.06	U
LF2-08	31333301	2.0	1.6	U	38	2		21000	400		0.6	0.3	U	NA		

WAG 3 RI/FS Investigation - Snake River Plain Aquifer

Well Designation	Sample Designation	Gross Alpha			Gross Beta			Tritium			Sr-90			Pu-238		
		Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q
LF2-10	31333501	2.5	1.3	U	3.4	1.3		7700	300		0.7	0.3		NA		
LF2-11	31333601	0.0	1.7	U	18	2		24000	400		0.4	0.3	U	NA		
LF2-12	31333701	2.6	1.6	U	12	2		25200	400		0.3	0.3	U	NA		
LF3-08	31333801	4.0	1.8		17	2		25200	400		0.2	0.3	U	NA		
LF3-09	31333901	1.8	1.4	U	31	2		26900	400		0.2	0.3	U	NA		
LF3-10	31334001	2.3	1.6	U	13	2		17600	400		0.7	0.3		NA		
CPP-1	31334501	1.9	1.1	U	25	2		754	173		0.9	0.3	U	NA		
CPP-2	31334601	1.6	1.0	U	3.8	1.2		136	156	U	0.7	0.3	U	NA		

WAG 3 RI/FS Investigation - Snake River Plain Aquifer

Well Designation	Sample Designation	Pu-239/240			Am-241			Np-237			I-129			Tc-99		
		Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q
MW-18	31330101	0.03	0.05	U	0.05	0.07	U	3.1	0.3		0.0	0.3	U	448	4	J
USGS-34	31330201	NA			NA			NA			0.0	0.3	U	0.9	0.6	U
USGS-35	31330301	NA			NA			NA			0.0	0.3	U	0.9	0.8	U
USGS-36	31330401	NA			NA			NA			0.0	0.3	U	4.1 5.3	0.5 0.6	
USGS-36 (duplicate)	31334801	NA			NA			NA			0.0	0.3	U	4.8 5.8	0.8 0.8	
USGS-37	31330501	NA			NA			NA			0.0	0.3	U	7.3 9.6	0.5 0.6	
USGS-38	31330601	NA			NA			NA			0.0	0.3	U	16 14	1 1	
USGS-39	31330701	NA			NA			NA			0.0	0.4	U	39	1	
USGS-40	31330801	NA			NA			NA			0.0	0.4	U	3.9 3.1	0.5 0.5	
USGS-41	31330901	NA			NA			NA			0.0	0.3	U	6.7 8.2	0.6 0.6	
USGS-42	31334301	0.00	0.03	U	0.54	0.14		0.00	0.11	U	0.0	0.3	U	8.0 6.3	0.8 0.7	
USGS-43	31331001	NS			NS			NS			NS			NS		
USGS-44	31331101	NA			NA			NA			0.0	0.3	U	0.4	0.6	U
USGS-45	31331201	NA			NA			NA			0.0	0.3	U	0.6 0.4	0.5 0.5	U U
USGS-46	31331301	NA			NA			NA			0.0	0.4	U	9.7	0.7	
USGS-47	31334401	NA			NA			NA			0.1	0.3	U	174	2	
USGS-48	31331401	0.00	0.04	U	0.00	0.05	U	0.00	0.11	U	0.0	0.3	U	2.0	0.7	
USGS-51	31331601	NA			NA			NA			0.0	0.4	U	0.8 1.1	0.5 0.4	U
USGS-52	31331701	NA			NA			NA			0.0	0.3	U	235 226	3 2	
USGS-57	31331801	0.00	0.02	U	0.09	0.07	U	0.00	0.14	U	0.1	0.3	U	26 28	1 1	

WAG 3 RI/FS Investigation - Snake River Plain Aquifer

Well Designation	Sample Designation	Pu-239/240			Am-241			Np-237			I-129			Tc-99		
		Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q
USGS-59	31331901	NA			NA			NA			0.0	0.3	U	19 20	1 1	
USGS-67	31332001	NA			NA			NA			1.0	0.3		14 13	1 1	
USGS-67 (duplicate)	31335001	NA			NA			NA			0.0	0.3	U	12 12	1 1	
USGS-77	31332101	NA			NA			NA			0.0	0.3	U	7.3 7.5	0.7 0.7	
USGS-82	31332201	NA			NA			NA			0.0	0.3	U	0.1	0.6	U
USGS-84	31334201	NA			NA			NA			0.0	0.3	U	1.0 0.8	0.6 0.6	U U
USGS-85	31332301	NA			NA			NA			0.0	0.3	U	6.5 6.4	0.6 0.6	
USGS-111	31332401	NA			NA			NA			0.0	0.3	U	1.5	0.8	U
USGS-112	31332501	0.00	0.04	U	0.09	0.07	U	0.02	0.14	U	0.1	0.4	U	17 18	1 1	
USGS-113	31332601	NA			NA			NA			0.1	0.3	U	10.3 9.6	0.7 0.7	
USGS-114	31332701	NA			NA			NA			0.0	0.3	U	10.7 12.6	0.8 0.9	
USGS-115	31332801	NA			NA			NA			0.0	0.4	U	3.7 4.0	0.7 0.7	
USGS-116	31332901	NA			NA			NA			0.0	0.3	U	4.3 3.4	0.6 0.6	
USGS-121	31333001	NA			NA			NA			0.0	0.4	U	0.3 0.1	0.5 0.5	U U
USGS-121 (duplicate)	31334901	NA			NA			NA			0.0	0.3	U	0.5 0.1	0.5 0.5	U U
USGS-122	31333101	NA			NA			NA			0.0	0.2	U	2.0	0.5	J
USGS-123	31333201	0.00	0.03	U	0.03	0.06	U	0.00	0.12	U	0.0	0.2	U	48	1	
LF2-08	31333301	NA			NA			NA			0.4	0.4	U	4.7	0.4	

WAG 3 RI/FS Investigation - Snake River Plain Aquifer

Well Designation	Sample Designation	Pu-239/240			Am-241			Np-237			I-129			Tc-99		
		Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q
LF2-10	31333501	NA			NA			NA			0.0	0.3	U	0.6	0.5	U
LF2-11	31333601	NA			NA			NA			0.3	0.3	U	3.1	0.5	
LF2-12	31333701	NA			NA			NA			1.2	0.3		8.5	0.6	
LF3-08	31333801	NA			NA			NA			0.3	0.3	U	9.4	0.6	
LF3-09	31333901	NA			NA			NA			0.9	0.3		9.4	0.6	
LF3-10	31334001	NA			NA			NA			0.2	0.3	U	1.8	0.5	
CPP-1	31334501	NA			NA			NA			0.0	0.3	U	31	1	J
CPP-2	31334601	NA			NA			NA			0.0	0.3	U	1.1	0.5	

WAG 3 RI/FS Investigation - Snake River Plain Aquifer

Well Designation	Sample Designation	U-234			U-235			U-238			Ce-144			Nb-95		
		Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q
MW-18	31330101	0.7	0.3		0.0	0.2	U	0.9	0.3		ND	NA	U	ND	NA	U
USGS-34	31330201	NA			NA			NA			ND	NA	U	ND	NA	U
USGS-35	31330301	NA			NA			NA			ND	NA	U	ND	NA	U
USGS-36	31330401	NA			NA			NA			ND	NA	U	ND	NA	U
USGS-36 (duplicate)	31334801	NA			NA			NA			ND	NA	U	ND	NA	U
USGS-37	31330501	NA			NA			NA			ND	NA	U	ND	NA	U
USGS-38	31330601	NA			NA			NA			ND	NA	U	ND	NA	U
USGS-39	31330701	NA			NA			NA			ND	NA	U	ND	NA	U
USGS-40	31330801	NA			NA			NA			ND	NA	U	ND	NA	U
USGS-41	31330901	NA			NA			NA			ND	NA	U	ND	NA	U
USGS-42	31334301	1.8	0.4		0.0	0.2	U	0.9	0.3		ND	NA	U	ND	NA	U
USGS-43	31331001	NS			NS			NS			NS			NS		
USGS-44	31331101	NA			NA			NA			ND	NA	U	ND	NA	U
USGS-45	31331201	NA			NA			NA			ND	NA	U	ND	NA	U
USGS-46	31331301	NA			NA			NA			ND	NA	U	ND	NA	U
USGS-47	31334401	2.6	0.8		0.0	0.3	U	0.4	0.5	U	ND	NA	U	ND	NA	U
USGS-48	31331401	1.9	0.4		0.0	0.2	U	0.8	0.3		ND	NA	U	ND	NA	U
USGS-51	31331601	NA			NA			NA			ND	NA	U	ND	NA	U
USGS-52	31331701	NA			NA			NA			ND	NA	U	ND	NA	U
USGS-57	31331801	2.0	0.4		0.0	0.2	U	0.9	0.3		ND	NA	U	ND	NA	U
USGS-59	31331901	NA			NA			NA			ND	NA	U	ND	NA	U
USGS-67	31332001	NA			NA			NA			ND	NA	U	ND	NA	U
USGS-67 (duplicate)	31335001	NA			NA			NA								
USGS-77	31332101	NA			NA			NA			ND	NA	U	ND	NA	U
USGS-82	31332201	NA			NA			NA			ND	NA	U	ND	NA	U
USGS-84	31334201	NA			NA			NA			ND	NA	U	ND	NA	U

WAG 3 RI/FS Investigation - Snake River Plain Aquifer

Well Designation	Sample Designation	U-234			U-235			U-238			Ce-144			Nb-95		
		Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q
USGS-85	31332301	NA			NA			NA			ND	NA	U	ND	NA	U
USGS-111	31332401	NA			NA			NA			ND	NA	U	ND	NA	U
USGS-112	31332501	1.3	0.4		0.0	0.2	U	0.6	0.3	U	ND	NA	U	ND	NA	U
USGS-113	31332601	NA			NA			NA			ND	NA	U	ND	NA	U
USGS-114	31332701	NA			NA			NA			ND	NA	U	ND	NA	U
USGS-115	31332801	NA			NA			NA			ND	NA	U	ND	NA	U
USGS-116	31332901	NA			NA			NA			ND	NA	U	ND	NA	U
USGS-121	31333001	NA			NA			NA			ND	NA	U	ND	NA	U
USGS-121 (duplicate)	31334901	NA			NA			NA			ND	NA	U	ND	NA	U
USGS-122	31333101	NA			NA			NA			ND	NA	U	ND	NA	U
USGS-123	31333201	1.3	0.4		0.0	0.2	U	1.1	0.4		ND	NA	U	ND	NA	U
LF2-08	31333301	NA			NA			NA			ND	NA	U	ND	NA	U
LF2-10	31333501	NA			NA			NA			ND	NA	U	ND	NA	U
LF2-11	31333601	NA			NA			NA			ND	NA	U	ND	NA	U
LF2-12	31333701	NA			NA			NA			ND	NA	U	ND	NA	U
LF3-08	31333801	NA			NA			NA			ND	NA	U	ND	NA	U
LF3-09	31333901	NA			NA			NA			ND	NA	U	ND	NA	U
LF3-10	31334001	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-1	31334501	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-2	31334601	NA			NA			NA			ND	NA	U	ND	NA	U

WAG 3 RI/FS Investigation - Snake River Plain Aquifer

Well Designation	Sample Designation	Co-60			Cs-134			Cs-137			Eu-154			Eu-155		
		Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q
MW-18	31330101	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-34	31330201	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-35	31330301	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-36	31330401	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-36 (duplicate)	31334801	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-37	31330501	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-38	31330601	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-39	31330701	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-40	31330801	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-41	31330901	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-42	31334301	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-43	31331001	NS			NS			NS			NS			NS		
USGS-44	31331101	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-45	31331201	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-46	31331301	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-47	31334401	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-48	31331401	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-51	31331601	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-52	31331701	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-57	31331801	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-59	31331901	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-67	31332001	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-67 (duplicate)	31335001															
USGS-77	31332101	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-82	31332201	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-84	31334201	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U

WAG 3 RI/FS Investigation - Snake River Plain Aquifer

Well Designation	Sample Designation	Co-60			Cs-134			Cs-137			Eu-154			Eu-155		
		Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q
USGS-85	31332301	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-111	31332401	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-112	31332501	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-113	31332601	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-114	31332701	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-115	31332801	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-116	31332901	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-121	31333001	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-121 (duplicate)	31334901	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-122	31333101	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-123	31333201	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
LF2-08	31333301	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
LF2-10	31333501	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
LF2-11	31333601	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
LF2-12	31333701	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
LF3-08	31333801	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
LF3-09	31333901	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
LF3-10	31334001	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-1	31334501	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-2	31334601	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U

WAG 3 RI/FS Investigation - Snake River Plain Aquifer

Well Designation	Sample Designation	Ru-103			Ru-106			Sb-125			Co-58		
		Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q
MW-18	31330101	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-34	31330201	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-35	31330301	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-36	31330401	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-36 (duplicate)	31334801	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-37	31330501	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-38	31330601	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-39	31330701	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-40	31330801	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-41	31330901	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-42	31334301	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-43	31331001	NS			NS			NS			NS		
USGS-44	31331101	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-45	31331201	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-46	31331301	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-47	31334401	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-48	31331401	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-51	31331601	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-52	31331701	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-57	31331801	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-59	31331901	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-67	31332001	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-67 (duplicate)	31335001												
USGS-77	31332101	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-82	31332201	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-84	31334201	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U

WAG 3 RI/FS Investigation - Snake River Plain Aquifer

Well Designation	Sample Designation	Ru-103			Ru-106			Sb-125			Co-58		
		Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q
USGS-85	31332301	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-111	31332401	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-112	31332501	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-113	31332601	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-114	31332701	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-115	31332801	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-116	31332901	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-121	31333001	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-121 (duplicate)	31334901	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-122	31333101	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-123	31333201	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
LF2-08	31333301	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
LF2-10	31333501	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
LF2-11	31333601	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
LF2-12	31333701	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
LF3-08	31333801	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
LF3-09	31333901	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
LF3-10	31334001	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-1	31334501	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-2	31334601	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U

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Well Designation	Sample Designation	Aluminum		Antimony		Arsenic		Barium		Beryllium		Cadminum		Calcium		Chromium	
		(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q
MW-18	31330101	26.8	U	1.9	U	4.0	U	122		0.10	U	0.40	U	62300		4.1	U
USGS-34	31330201	49.9	U	42.2	U	1.8	U	95.1		0.10	U	2.9	U	57000		21.6	
USGS-35	31330301	53.4	U	42.2	U	1.8	U	98.1		0.10	U	2.9	U	57400		29.2	
USGS-36	31330401	26.8	U	1.9	U	4.0	U	109		0.10	U	0.40	U	57200		13.5	
USGS-36 (duplicate)	31334801	26.8	U	1.9	U	4.0	U	108		0.10	U	0.40	U	56000		12.9	
USGS-37	31330501	26.8	U	1.9	U	4.0	U	170		0.10	U	0.40	U	71200		7.1	
USGS-38	31330601	26.8	U	1.9	U	4.0	U	197		0.10	U	0.40	U	66900		5.6	
USGS-39	31330701	42.9	U	42.2	U	1.8	U	104		0.10	U	3.0		58000		38.8	
USGS-40	31330801	26.8	U	1.9	U	4.0	U	98.3		0.10	U	0.40	U	62100		5.3	
USGS-41	31330901	26.8	U	1.9	U	4.0	U	94.2		0.10	U	0.40	U	60800		5.3	
USGS-42	31334301	26.8	U	1.9	U	4.0	U	91.8		0.10	U	0.40	U	58800		5.4	
USGS-43	31331001	NS		NS		NS		NS		NS		NS		NS		NS	
USGS-44	31331101	42.9	U	42.2	U	1.8	U	89.9		0.10	U	2.9	U	56300		5.5	U
USGS-45	31331201	27.2	U	1.9	U	4.0	U	82.0		0.10	U	0.40	U	54400		5.1	
USGS-46	31331301	120	U	1.9	U	4.0	U	107		0.10	U	0.40	U	64500		4.7	
USGS-47	31334401	25.2	U	2.7	U	2.4	U	98.3		0.10	U	0.30	U	64800		6.7	
USGS-48	31331401	47.5	U	42.2	U	1.8	U	85		0.10	U	2.9	U	57400		5.5	U
USGS-51	31331601	26.8	U	1.9	U	4.0	U	101		0.10	U	0.40	U	59400		8.9	
USGS-52	31331701	26.8	U	1.9	U	4.0	U	99.5		0.10	U	0.40	U	48700		6.2	
USGS-57	31331801	26.8	U	1.9	U	4.0	U	90.9		0.10	U	0.40	U	30000		4.1	U
USGS-59	31331901	36.4	U	3.1		10.8		188		0.10	U	0.40	U	62500		5.8	
USGS-67	31332001	56.7	U	1.9	U	4.0	U	185		0.10	U	0.40	U	77200		5.6	
USGS-67 (duplicate)	31335001																
USGS-77	31332101	26.8	U	1.9	U	4.0	U	147		0.10	U	0.40	U	68000		11.4	
USGS-82	31332201	43.4	U	42.2	U	3.1		50		0.10	U	2.9	U	35300		5.5	U
USGS-84	31334201	26.8	U	1.9	U	4.0	U	92.6		0.10	U	0.40	U	55500		19.9	

WAG 3 RI/FS Investigation - Snake River Plain Aquifer

Well Designation	Sample Designation	Aluminum		Antimony		Arsenic		Barium		Beryllium		Cadminum		Calcium		Chromium	
		(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q
USGS-85	31332301	38.4	U	1.9	U	4.0	U	127		0.10	U	0.40	U	63400		16.2	
USGS-111	31332401	57.6	U	42.2	U	1.8	U	105		0.10	U	2.9	U	58100		29.6	
USGS-112	31332501	44.1	U	1.9	U	4.0	U	205		0.10	U	0.40	U	71500		6.0	
USGS-113	31332601	26.8	U	1.9	U	4.0	U	107		0.10	U	0.40	U	32000		4.1	U
USGS-114	31332701	26.8	U	1.9	U	4.0	U	102		0.10	U	0.40	U	55600		9.3	
USGS-115	31332801	26.8	U	1.9	U	4.0	U	57.6		0.10	U	0.40	U	40100		7.7	
USGS-116	31332901	26.8	U	1.9	U	4.0	U	137		0.10	U	0.40	U	59000		7.8	
USGS-121	31333001	36.6	U	1.9	U	7.5		88.6		0.10	U	0.40	U	52800		4.2	
USGS-121 (duplicate)	31334901	38.7	U	1.9	U	4.0	U	90.7		0.10	U	0.40	U	53900		5.1	
USGS-122	31333101	26.8	U	1.9	U	4.0	U	114		0.10	U	0.40	U	46000		4.1	U
USGS-123	31333201	69.1	U	1.9	U	4.0	U	173		0.10	U	0.40	U	70400		8.6	
LF2-08	31333301	26.8	U	1.9	U	4.0	U	159		0.10	U	2.1		74900		9.1	
LF2-10	31333501	26.8	U	1.9	U	4.0	U	92.1		0.10	U	0.40	U	64800		8.9	
LF2-11	31333601	76.3	U	4.6		2.4	U	127		0.10	U	1.0	U	66200		1.8	
LF2-12	31333701	26.8	U	1.9	U	4.0	U	177		0.10	U	2.7		77000		4.1	U
LF3-08	31333801	26.8	U	1.9	U	4.0	U	139		0.10	U	0.40	U	69900		4.1	U
LF3-09	31333901	26.8	U	1.9	U	4.0	U	132		0.10	U	0.48		68500		4.1	U
LF3-10	31334001	96.4	U	2.7	U	2.4	U	152		0.10	U	0.94	U	65700		5.1	
CPP-1	31334501	26.8	U	1.9	U	4.0	U	96.2		0.10	U	0.40	U	58100		4.1	U
CPP-2	31334601	43.9 26.8	U U	1.9 1.9	U U	4.0 4.0	U U	186 96.6		0.10 0.10	U U	0.40 0.40	U U	77500 55100		5.9 4.1	 U

WAG 3 RI/FS Investigation - Snake River Plain Aquifer

Well Designation	Sample Designation	Cobalt		Copper		Iron		Lead		Magnesium		Manganese		Mercury		Nickel	
		(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q
MW-18	31330101	0.50	U	2.8		21.5	U	2.0	U	18700		2.0		0.10	U	3.4	U
USGS-34	31330201	4.9	U	7.1	U	7.1	U	2.3	J	14300		1.2	U	0.10	U	12.4	U
USGS-35	31330301	4.9	U	7.1	U	20.3		1.5	U	14900		1.2	U	0.10	U	12.4	U
USGS-36	31330401	0.50	U	2.0	U	21.5	U	2.0	U	14700		0.80	U	0.10	U	3.4	U
USGS-36 (duplicate)	31334801	0.50	U	1.8	U	21.5	U	2.0	U	14500		0.80	U	0.10	U	3.4	U
USGS-37	31330501	0.50	U	1.3	U	21.5	U	3.9		18900		0.80	U	0.10	U	3.4	U
USGS-38	31330601	0.50	U	1.3	U	21.5	U	2.0	U	18300		0.84		0.10	U	3.4	U
USGS-39	31330701	4.9	U	7.1	U	9.4		1.5	U	15700		1.4	U	0.10	U	12.4	U
USGS-40	31330801	0.50	U	1.3	U	21.5	U	2.0	U	17000		0.80	U	0.10	U	3.4	U
USGS-41	31330901	0.50	U	1.3	U	21.5	U	2.0	U	16700		0.80	U	0.10	U	3.4	U
USGS-42	31334301	0.50	U	1.8	U	21.5	U	2.0	U	16200		0.80	U	0.10	U	3.4	U
USGS-43	31331001	NS		NS		NS		NS		NS		NS		NS		NS	
USGS-44	31331101	4.9	U	7.1	U	7.1	U	1.5	U	14600		1.2	U	0.10	U	12.4	U
USGS-45	31331201	0.50	U	1.3	UJ	21.5	U	2.0	U	14700		0.80	U	0.10	U	3.4	U
USGS-46	31331301	0.93		1.3	U	119		2.0	U	17100		1.3		0.10	U	3.4	U
USGS-47	31334401	0.60	U	2.2	U	3.0	U	2.0	U	17200		0.80	U	0.32		3.4	U
USGS-48	31331401	4.9	U	7.1	U	7.1	U	1.5	U	15700		1.7	U	0.11		12.4	U
USGS-51	31331601	0.50	U	1.6	U	21.5	U	2.9		20000		0.80	U	0.10	U	3.4	U
USGS-52	31331701	0.50	U	1.7	U	21.5	U	2.0	U	14100		0.80	U	0.10	U	3.4	U
USGS-57	31331801	0.50	U	1.3	U	21.5	U	2.0	U	8250		0.80	U	0.18		3.4	U
USGS-59	31331901	0.50	U	1.6	J	21.5	U	2.0	U	16800		0.80	U	0.10	U	3.4	U
USGS-67	31332001	0.50	U	1.3	UJ	21.5	U	5.0	U	21700		0.80	U	0.10	U	3.4	U
USGS-67 (duplicate)	31335001																
USGS-77	31332101	0.50	U	2.3	U	21.5	U	2.0	U	20000		0.80	U	0.10	U	3.4	U
USGS-82	31332201	4.9	U	7.1	U	8.8		1.5	U	13000		1.4	U	0.10	U	12.4	U
USGS-84	31334201	0.50	U	5.7	U	29.1		17.5		17700		0.80	U	0.10	U	3.4	U

WAG 3 RI/FS Investigation - Snake River Plain Aquifer

Well Designation	Sample Designation	Cobalt		Copper		Iron		Lead		Magnesium		Manganese		Mercury		Nickel	
		(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q
USGS-85	31332301	0.55		1.3	UJ	21.5	U	2.0	U	16200		1.9		0.10	U	3.4	U
USGS-111	31332401	4.9	U	7.1	U	86.8		1.5	U	16900		1.2	U	0.10	U	12.4	U
USGS-112	31332501	0.50	U	1.3	UJ	21.5	U	2.0	U	19000		0.80	U	0.10	U	3.4	U
USGS-113	31332601	0.50	U	1.7	U	21.5	U	2.0	U	9060		0.80	U	0.10	U	3.4	U
USGS-114	31332701	0.50	U	3.9	U	21.5	U	2.0	U	17700		0.80	U	0.10	U	3.4	U
USGS-115	31332801	0.50	U	1.7	U	21.5	U	3.0		12600		0.80	U	0.10	U	3.4	U
USGS-116	31332901	0.50	U	2.0	U	21.5	U	2.9		17000		0.80	U	0.10	U	3.4	U
USGS-121	31333001	0.50	U	1.3	UJ	21.5	U	2.0	U	14100		0.80	U	0.10	U	3.4	U
USGS-121 (duplicate)	31334901	0.50	U	1.3	UJ	21.5	U	2.0	U	14300		0.80	U	0.10	U	3.4	U
USGS-122	31333101	0.50	U	1.3	U	21.5	U	2.0	U	11900		44.0		0.10	U	4.3	
USGS-123	31333201	0.79		1.8		129		2.0	U	18900		3.0		0.14		4.7	
LF2-08	31333301	0.50	U	2.1		21.5	U	37.7		20400		0.80	U	0.10	U	3.4	U
LF2-10	31333501	0.50	U	1.8		21.5	U	2.0	U	18100		0.80	U	0.10	UJ	3.4	U
LF2-11	31333601	1.4		18.5	U	6.3	U	2.0	U	19600		62.8		0.10	U	206	
LF2-12	31333701	0.74		1.3	U	21.5	U	12.2		20300		6.7		0.44		23.3	
LF3-08	31333801	1.00		3.2		21.5	U	2.0	U	20100		0.80	U	0.10	U	3.4	U
LF3-09	31333901	0.52		1.8		36.6		13.9		20300		1.8		0.10	U	24.7	
LF3-10	31334001	0.69		16.2	U	6.3	U	2.6		18700		10.4		0.10	U	7.0	
CPP-1	31334501	0.50	U	1.3	U	21.5	U	2.0	U	17000		0.80	U	0.10	U	3.4	U
CPP-2	31334601	0.50 0.50	U U	1.3 13.5	UJ	21.5 21.5	U U	2.1 2.0	U U	21600 16300		0.80 0.80	U U	0.10 0.10	U U	3.4 3.4	U U

WAG 3 RI/FS Investigation - Snake River Plain Aquifer

Well Designation	Sample Designation	Potassium		Selenium		Silver		Sodium		Thallium		Vanadium		Zinc		Zirconium	
		(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q
MW-18	31330101	4650		2.7	U	0.60	U	30800		4.6	U	3.2		14.2	U	31.2	U
USGS-34	31330201	2640		1.2	U	5.2	R	10100		2.3	U	6.9		2.6		31.3	U
USGS-35	31330301	3110		1.2	U	6.5	R	9950		2.3	U	4.0	U	3.5		31.3	U
USGS-36	31330401	2770	J	2.7	U	0.60	U	16600		4.6	U	3.7	U	2.0	UJ	31.3	U
USGS-36 (duplicate)	31334801	2810	J	2.7	U	0.60	U	16200		4.6	U	3.3	U	6.2	UJ	31.3	U
USGS-37	31330501	4220	J	2.7	U	0.60	U	41900		4.6	U	3.8	U	179	J	31.3	U
USGS-38	31330601	4500	J	2.7	U	0.60	U	52000		4.6	U	3.8	U	18.6	U	31.3	U
USGS-39	31330701	2250		1.2	U	5.1	U	8460		2.3	U	6.3		3.9		31.3	U
USGS-40	31330801	2510	J	2.7	U	0.60	U	16100		4.6	U	3.8	U	216	J	31.3	U
USGS-41	31330901	2410	J	2.7	U	0.60	U	13200		4.6	U	4.1	U	10.8	UJ	31.3	U
USGS-42	31334301	2350	J	2.7	U	0.60	U	10500		4.6	U	4.1	U	11.1	UJ	31.3	U
USGS-43	31331001	NS		NS		NS		NS		NS		NS		NS		NS	
USGS-44	31331101	2550		1.2	U	5.1	U	8360		2.3	U	4.2		3.2		31.3	U
USGS-45	31331201	2510	J	2.7	U	0.60	UJ	10300		4.6	U	3.5	J	4.5	U	NA	
USGS-46	31331301	2740		2.7	U	0.60	U	16000		4.6	U	4.0		7.6	U	31.2	U
USGS-47	31334401	2290		2.8		0.80	U	20000		3.2	U	3.8		380		11.6	U
USGS-48	31331401	2550		1.5		5.50	R	14500		2.3	U	4.1		5.5		31.3	U
USGS-51	31331601	5000	J	2.7	U	0.60	U	23700		4.6	U	5.7	U	166	J	31.3	U
USGS-52	31331701	3280	J	2.7	U	0.60	U	22400		4.6	U	4.9	U	5.9	UJ	31.3	U
USGS-57	31331801	1960	J	2.7	U	0.60	U	24400		4.6	U	1.8	U	4.4	UJ	31.3	U
USGS-59	31331901	5140	J	4.5	U	0.60	UJ	76700		4.6	U	3.1	J	296		NA	
USGS-67	31332001	5430	J	5.0	U	0.60	UJ	44700		4.6	U	3.1	J	329		NA	
USGS-67 (duplicate)	31335001																
USGS-77	31332101	4430	J	2.7	U	0.73	J	30800		4.6	U	3.7	U	5.3	UJ	31.3	U
USGS-82	31332201	3460		1.2	U	5.8	R	10400		2.3	U	9.9		106		31.3	U
USGS-84	31334201	2030	J	2.7	U	0.60	U	8980		4.6	U	3.2	U	428	J	31.3	U

WAG 3 RI/FS Investigation - Snake River Plain Aquifer

Well Designation	Sample Designation	Potassium		Selenium		Silver		Sodium		Thallium		Vanadium		Zinc		Zirconium	
		(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q
USGS-85	31332301	3530	J	2.7	U	0.63	J	25600		4.6	U	3.2	J	8.6		NA	
USGS-111	31332401	3600		1.4		5.1	R	23700		2.3	UJ	6.1		200		31.3	U
USGS-112	31332501	4920	J	2.7	U	0.60	UJ	57000		4.6	U	3.6	J	169		NA	
USGS-113	31332601	2520	J	2.7	U	0.88	J	33500		4.6	U	1.9	U	90.7	J	31.3	U
USGS-114	31332701	3850	J	2.7	U	0.60	U	19800		4.6	U	3.6	U	261	J	31.3	U
USGS-115	31332801	3300	J	2.7	U	0.60	U	13100		4.6	U	4.1	U	454	J	31.3	U
USGS-116	31332901	4950	J	2.7	U	0.60	U	32200		4.6	U	4.4	U	197	J	31.3	U
USGS-121	31333001	2350	J	3.0	U	0.60	UJ	7340		4.6	U	3.4	J	6.8	U	NA	
USGS-121 (duplicate)	31334901	2380	J	5.5	U	0.60	UJ	7480		4.6	U	3.8	J	9.5		NA	
USGS-122	31333101	6800		2.7	U	0.60	U	30600		4.6	U	3.2		46.8		31.2	U
USGS-123	31333201	4570		2.7	U	0.60	U	46100		4.6	U	3.9		7.3	U	31.2	U
LF2-08	31333301	6100		2.7	U	0.60	U	40600		4.6	U	3.1		5.7	U	31.2	U
LF2-10	31333501	2840		2.7	U	0.60	U	11700		4.6	U	4.0		18.3	U	31.2	U
LF2-11	31333601	14900	J	3.7		0.80	U	54500		3.4	U	0.70	U	11.2	UJ	11.6	U
LF2-12	31333701	5340		2.7		0.60	U	46700		4.6	U	2.3		30.8		31.2	U
LF3-08	31333801	5950		2.8		0.60	U	42700		4.6	U	3.7		46.0		31.2	U
LF3-09	31333901	5030		2.7	U	0.60	U	36500		4.6	U	3.0		168		31.2	U
LF3-10	31334001	4810	J	3.2		0.80	U	40800		7.6	U	2.5	U	109	J	11.6	U
CPP-1	31334501	2980		2.7	U	0.60	U	9110		4.6	U	4.9		1.3	U	31.2	U
CPP-2	31334601	5330 2890	J	2.7 2.7	U U	0.60 0.60	UJ U	44500 8180		4.6 4.6	U U	3.4 4.9	J	339 3.6	U	NA 31.2	U

WAG 3 RI/FS Investigation - Vertical Contaminant Profile (SRPA Well USGS-47)

Sample Location	Sampling Depth (feet)	Date Sampled	Sample Designation	Comments
Interval 1	462.0' - 470.8'	6/22/95	31340601	
Interval 2	483.0' - 491.8'	6/22/95	31340701	
Interval 2 (duplicate)	483.0' - 491.8'	6/22/95	31341101	
Interval 3	511.5' - 520.8'	6/23/95	31340801	
Interval 4	558.0' - 566.8'	6/23/95	31340901	
Interval 5	576.0' -584.8'	6/23/95	31341001	
Interval 6	596.0' -604.8'	6/23/95	31341401	

Well Designation	Sample Designation	Gross Alpha			Gross Beta			Tritium			Sr-90			Tc-99			I-129		
		Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q
Interval 1	31340601	1.4	0.8	U	105	2		10300	300		31	1		119	2		0.0	0.3	U
Interval 2	31340701	4.3	1.6		267	4		15600	400		44	1		17	1		0.2	0.3	U
Interval 2 (duplicate)	31341101	1.4	1.3	U	268	4		15800	400		44	1		18	1		0.8	0.3	
Interval 3	31340801	2.3	1.2	J	148	3		5310	260		40	1		62	1		0.0	0.3	U
Interval 4	31340901	2.5	1.2		158	3		6130	270		41	1		23	1		0.0	0.3	U
Interval 5	31341001	4.6	1.4		151	3		7570	280		42	1		63	1		0.0	0.3	U
Interval 6	31341401	4.0	1.3		80	2		3280	220		29	1		34	1		0.0	0.3	U

WAG 3 RI/FS Investigation - Soil

Sampling Location	Date Sampled	Sample Designation	Planned Sampling Interval (feet)	Collected Sampling Interval (feet)	Comments
CPP-11-1	6/05/95	31100101	0.0 - 0.5	0 - 0.5	Survey instrument radiation level 200 cpm
CPP-11-1	6/05/95	31100201	0.5 -4	0.5 - 2.5	Survey instrument radiation level 200 cpm
CPP-11-1	6/05/95	31100301	4 -6	7.5 - 10	Survey instrument radiation level 1000 cpm
CPP-11-1	6/05/95	31100302		10 - 12.5	Survey instrument radiation level 400 cpm; borehole terminated at 15' as the radiation level for soil cuttings at 15' were at the background radiation level
CPP-11-2	6/06/95	31100401	0.0 - 0.5	0 - 0.5	Survey instrument radiation level 2000 cpm
CPP-11-2	6/06/95	31100501	0.5 -4	0.5 - 2.5	Survey instrument radiation level 2000 cpm
CPP-11-2	6/06/95	31100601	4 -6	7.5 - 10	Survey instrument radiation level ~150 cpm
CPP-11-3	6/05/95	31100701	0.0 - 0.5	0 - 0.5	Survey instrument radiation level ~270 cpm
CPP-11-3	6/05/95	31100801	0.5 -4	2.5 - 5	Survey instrument radiation level ~275 cpm
CPP-11-3	6/05/95	31100901	4 -10	5 - 7.5	Survey instrument radiation level ≤200 cpm
CPP-11-3	6/05/95	31101001	10 - 25	22.5 - 25	Survey instrument radiation level ≤150 cpm; borehole terminated at 25' as the radiation level for soil cuttings at 25' were at the background radiation level
CPP-11-3	No sample	31101101	25 - basalt	NA	Field screen did not detect rad. Per SAP no sample required
CPP-11-3	No sample	31101201	soil/basalt	NA	Field screen did not detect rad. Per SAP no sample required
CPP-13-1	5/31/95	31350101	0.5 - 1	0.5 - 1	Survey instrument radiation level ≤150 cpm
CPP-13-1	5/31/95	31350201	1 - 4	1 - 2.5	Survey instrument radiation level ≤150 cpm
CPP-13-1	5/31/95	31350301	4 - 10	7.5 -10	Survey instrument radiation level ≤150 cpm; borehole terminated at 10' as the radiation level for soil cuttings at 10' were at the background radiation level
CPP-13-1	5/31/95	31350302	4 - 10	7.5 - 10	Survey instrument radiation level ≤150 cpm; borehole terminated at 10' as the radiation level for soil cuttings at 10' were at the background radiation level
CPP-13-1	No sample	31350401	10 - basalt	NA	Field screen did not detect rad. Per SAP no sample required
CPP-13-1	No sample	31350501	soil/basalt	NA	Field screen did not detect rad above background. Per SAP no sample required
CPP-13-2	5/15/95	31350601	0.5 - 1	0.5 - 1	Survey instrument radiation level 500 cpm

WAG 3 RI/FS Investigation - Soil

Sampling Location	Date Sampled	Sample Designation	Planned Sampling Interval (feet)	Collected Sampling Interval (feet)	Comments
CPP-13-2	5/15/95	31350701	1 -4	2.5 - 4	Survey instrument radiation level 400 cpm
CPP-13-3	5/15/95	31350801	0.5 - 1	0.5 - 1	Survey instrument radiation level 0.8 mR/hr
CPP-13-3	5/15/95	31350901	1 - 4	2.5 - 4	Survey instrument radiation level 25,000 cpm
CPP-19-3	6/13/95	31900101	0.0 - 0.5	0 - 0.5	Survey instrument radiation level 75 cpm
CPP-19-3	6/13/95	31900201	0.5 - 4	2.5 - 5	Survey instrument radiation level 75 cpm
CPP-19-3	6/13/95	31300301	4 - 10	5 - 7.5	Survey instrument radiation level 75 cpm
CPP-19-3	6/13/95	31900401	10 - basalt	27.5 - 30	Survey instrument radiation level 75 cpm
CPP-19-3	6/13/95	31900501	soil/basalt	31.5 - 31.5	Survey instrument radiation level 75 cpm
CPP-19-4	6/15/95	31900601	0.0 - 0.5	0.5 - 2.5	Survey instrument radiation level 100 cpm
CPP-19-4	6/15/95	31900701	0.5 - 4	2.5 - 5	Survey instrument radiation level 100 cpm
CPP-19-4	6/15/95	31900702	0.5 - 4	2.5 - 5	Survey instrument radiation level 100 cpm
CPP-19-4	6/15/95	31900801	4 - 10	7.5 - 10	Survey instrument radiation level 125 cpm
CPP-19-4	6/15/95	31900901	10 - basalt	22.5 - 25	Survey instrument radiation level 175 cpm
CPP-19-4	6/15/95	31901001	soil/basalt	31.4 - 31.4	Survey instrument radiation level 150 cpm
CPP-22-1	7/06/95	32200101	0.0 - 0.5	0 - 0.5	Survey instrument radiation level < 100 cpm
CPP-22-1	7/06/95	32200102	0.0 - 0.5	3 - 7	Survey instrument radiation level 180 cpm
CPP-22-1	7/06/95	32200201	0.5 - 4	0.5 - 3	Survey instrument radiation level < 100 cpm
CPP-22-1	7/06/95	32200301	4 - 10	3 - 7	Survey instrument radiation level 180 cpm; borehole terminated at 10'
CPP-22-2	7/06/95	32200401	0.0 - 0.5	0 - 0.5	Survey instrument radiation level 100 cpm
CPP-22-2	7/06/95	32200501	0.5 - 4	0.5 - 2.5	Survey instrument radiation level 100 cpm
CPP-22-2	7/06/95	32200601	4 - 10	7 - 10	Survey instrument radiation level < 100 cpm; borehole terminated at 10'
CPP-22-3	7/06/95	32200701	0.0 - 0.5	0 - 0.5	Survey instrument radiation level < 100 cpm
CPP-22-3	7/06/95	32200801	0.5 - 4	0.5 - 3	Survey instrument radiation level < 100 cpm
CPP-22-3	7/06/95	32200901	4 - 10	8 - 10	Survey instrument radiation level < 100 cpm; borehole terminated at 10'
CPP-40-1	6/01/95	34000101	0.0 - 0.5	0 - 0.5	Survey instrument radiation level ≤100 cpm
CPP-40-1	6/01/95	34000201	0.5 - 4	2.5 - 5	Survey instrument radiation level ≤100 cpm

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Sampling Location	Date Sampled	Sample Designation	Planned Sampling Interval (feet)	Collected Sampling Interval (feet)	Comments
CPP-40-1	6/01/95	34000301	4 - 10	7.5 - 10	Survey instrument radiation level ≤100 cpm; borehole terminated at 10' as the radiation level for soil cuttings at 10' were at the background radiation level
CPP-40-1	6/01/95	34000302	4 - 10	7.5 - 10	Survey instrument radiation level ≤100 cpm; borehole terminated at 10' as the radiation level for soil cuttings at 10' were at the background radiation level
CPP-40-1	No sample	34000401	10 - basalt	NA	Field screen did not detect rad. Per SAP no sample required
CPP-40-1	No sample	34000501	soil/basalt	NA	Field screen did not detect rad. Per SAP no sample required
CPP-46-1	5/09/95	34600101	0.0 - 0.5	0 - 0.5	Survey instrument radiation level ≤100 cpm
CPP-46-1	5/09/95	34600201	0.5 - 4	2 - 4	Survey instrument radiation level ≤100 cpm
CPP-46-1	5/09/95	34600301	4 - 10	8 - 10	Survey instrument radiation level ≤100 cpm; borehole terminated at 10' as the radiation level for soil cuttings at 10' were at the background radiation level
CPP-46-1	No sample	34600401	10 - basalt	NA	Field screen did not detect rad. Per SAP no sample required
CPP-46-1	No sample	34600501	soil/basalt	NA	Field screen did not detect rad. Per SAP no sample required
CPP-61-1	5/10/95	36100101	0.0 - 0.5	0 - 0.5	Survey instrument radiation level ≤100 cpm
CPP-61-1	5/10/95	36100201	0.5 - 4	2 - 4	Survey instrument radiation level ≤100 cpm
CPP-61-1	5/10/95	36100301	4 - 10	8 - 10	Survey instrument radiation level ≤100 cpm; borehole terminated at 10' as the radiation level for soil cuttings at 10' were at the background radiation level
CPP-61-1	No sample	36100401	10 - basalt	NA	
CPP-61-1	No sample	36100501	soil/basalt	NA	
CPP-61-2	6/29/95	36100601	0.0 - 0.5	0 - 0.5	Survey instrument radiation level ≤ 150 cpm
CPP-61-2	6/29/95	36100701	0.5 - 6	4 - 4.5	Survey instrument radiation level ≤ 150 cpm; borehole terminated at 6'
CPP-61-3	6/29/95	36100801	0.0 - 0.5	0 - 0.5	Survey instrument radiation level 300 cpm
CPP-61-3	6/29/95	36100901	0.5 - 6	0.5 - 1	Survey instrument radiation level 300 cpm; borehole terminated at 5.9'; hit refusal at 5.9'
CPP-61-4	6/30/95	36101001	0.0 - 0.5	0 - 0.5	Survey instrument radiation level ≤ 100 cpm
					Survey instrument radiation level ~20 cpm over 100 cpm background;

WAG 3 RI/FS Investigation - Soil

Sampling Location	Date Sampled	Sample Designation	Planned Sampling Interval (feet)	Collected Sampling Interval (feet)	Comments
CPP-61-4	6/30/95	36101101	0.5 - 6	1 - 1.5	borehole terminated at 5.75'; hit refusal at both 4' and 5.75'
CPP-603-1	5/31/95	36300101	0.0 - 0.5	0 - 0.5	Survey instrument radiation level ≤200 cpm
CPP-603-1	5/31/95	36300201	0.5 - 4	2.5 - 5	Survey instrument radiation level ≤200 cpm
CPP-603-1	5/31/95	36300301	4 - 10	5 - 7.5	Survey instrument radiation level ≤200 cpm
CPP-603-1	5/31/95	36300401	10 - basalt	22.5 - 24.5	Survey instrument radiation level ≤200 cpm
CPP-603-1	5/31/95	36300501	soil/basalt	31.5 - 32	Survey instrument radiation level ≤200 cpm
CPP-603-2	5/25/95	36300601	0.0 - 0.5	0 - 0.5	Survey instrument radiation level ≤175-200 cpm
CPP-603-2	5/25/95	36300701	0.5 - 4	2.5 - 5	Survey instrument radiation level ≤175-200 cpm
CPP-603-2	5/25/95	36300801	4 - 10	7.5 - 10	Survey instrument radiation level ≤175-200 cpm
CPP-603-2	5/25/95	36300901	10 - basalt	22.5 - 25	Survey instrument radiation level ≤175-200 cpm
CPP-603-2	5/25/95	36301001	soil/basalt	31.5 - 32	Survey instrument radiation level ≤175-200 cpm
CPP-78-1	5/26/95	37800101	0.0 - 0.5	0 - 0.5	Survey instrument radiation level ≤150 cpm
CPP-78-1	5/26/95	37800102	0.0 - 0.5	0 - 0.5	Survey instrument radiation level ≤150 cpm
CPP-78-1	5/26/95	37800201	0.5 - 4	2.5 - 5	Survey instrument radiation level ≤150 cpm
CPP-78-1	5/26/95	37800301	4 - 10	7.5 - 10	Survey instrument radiation level ≤150 cpm; borehole terminated at 10' as the radiation level for soil cuttings at 10' were at the background radiation level
CPP-78-1	No sample	37800401	10 - basalt	NA	Field screen did not detect rad. Per SAP no sample required
CPP-78-1	No sample	37800501	soil/basalt	NA	Field screen did not detect rad. Per SAP no sample required
CPP-78-2	5/26/95	37800601	0.0 - 0.5	0 - 0.5	Survey instrument radiation level ≤150 cpm
CPP-78-2	5/26/95	37800701	0.5 - 4	2.5 - 5	Survey instrument radiation level ≤150 cpm
CPP-78-2	5/26/95	37800801	4 - 10	7.5 - 10	Survey instrument radiation level ≤150 cpm; borehole terminated at 10' as the radiation level for soil cuttings at 10' were at the background radiation level
CPP-78-2	No sample	37800901	10 - basalt	NA	Field screen did not detect rad. Per SAP no sample required
CPP-78-2	No sample	37801001	soil/basalt	NA	Field screen did not detect rad. Per SAP no sample required
CPP-88-1-1	6/01/95	38800101	0.0 - 0.5	0 - 0.5	Survey instrument radiation level ≤100-120 cpm

WAG 3 RI/FS Investigation - Soil

Sampling Location	Date Sampled	Sample Designation	Planned Sampling Interval (feet)	Collected Sampling Interval (feet)	Comments
CPP-88-1-1	6/01/95	38800201	0.5 - 4	2.5 - 5	Survey instrument radiation level ≤100-120 cpm
CPP-88-1-1	6/01/95	38800301	4 - 10	7.5 - 10	Survey instrument radiation level ≤100-120 cpm; borehole terminated at 10' as the radiation level for soil cuttings at 10' were at the background radiation level
CPP-88-1-1	No sample	38800401	10 - basalt	NA	Field screen did not detect rad. Per SAP no sample required
CPP-88-1-1	No sample	38800501	soil/basalt	NA	Field screen did not detect rad. Per SAP no sample required
CPP-88-1-1	6/01/95	38800601	TBD	2.5 - 5	Survey instrument radiation level ≤100-120 cpm
CPP-88-2-1	5/22/95	38800701	0.0 - 0.5	0 - 0.5	Survey instrument radiation level ≤125 cpm
CPP-88-2-1	5/22/95	38800801	0.5 - 4	2.5 - 5	Survey instrument radiation level ≤125 cpm
CPP-88-2-1	5/22/95	38800901	4 - 10	5 - 7.5	Survey instrument radiation level ≤125 cpm; borehole terminated at 10' as the radiation level for soil cuttings at 10' were at the background radiation level
CPP-88-2-1	5/22/95	38800902	4 - 10	5 - 7.5	Survey instrument radiation level ≤125 cpm; borehole terminated at 10' as the radiation level for soil cuttings at 10' were at the background radiation level
CPP-88-2-1	No sample	38801001	10 - basalt	NA	Field screen did not detect rad. Per SAP no sample required
CPP-88-2-1	No sample	38801101	soil/basalt	NA	Field screen did not detect rad. Per SAP no sample required
CPP-88-2-1	5/22/95	38801201	TBD	2.5 - 5	Survey instrument radiation level ≤125 cpm
CPP-88-3-1	5/19/95	38801301	0.0 - 0.5	0 - 0.5	Survey instrument radiation level ≤125 cpm
CPP-88-3-1	5/19/95	38801401	0.5 - 4	2.5 - 5	Survey instrument radiation level ≤125 cpm
CPP-88-3-1	5/19/95	38801501	4 - 10	7.5 - 10	Survey instrument radiation level ≤125 cpm; borehole terminated at 10' as the radiation level for soil cuttings at 10' were at the background radiation level
CPP-88-3-1	No sample	38801601	10 - basalt	NA	Field screen did not detect rad. Per SAP no sample required
CPP-88-3-1	No sample	38801701	soil/basalt	NA	Field screen did not detect rad. Per SAP no sample required
CPP-88-3-1	5/19/95	38801801	TBD	2.5 - 5	Survey instrument radiation level ≤125 cpm
CPP-88-4-1	5/19/95	38801901	0.0 - 0.5	0 - 0.5	Survey instrument radiation level ≤200 cpm
CPP-88-4-1	5/19/95	38802001	0.5 - 4	2.5 - 5	Survey instrument radiation level ≤200 cpm

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Sampling Location	Date Sampled	Sample Designation	Planned Sampling Interval (feet)	Collected Sampling Interval (feet)	Comments
CPP-88-4-1	5/19/95	38802101	4 - 10	7.5 - 10	Survey instrument radiation level ≤200 cpm; borehole terminated at 10' as the radiation level for soil cuttings at 10' were at the background radiation level
CPP-88-4-1	No sample	38802201	10 - basalt	NA	Field screen did not detect rad. Per SAP no sample required
CPP-88-4-1	No sample	38802301	soil/basalt	NA	Field screen did not detect rad. Per SAP no sample required
CPP-88-4-1	5/19/95	38802401	TBD	2.5 - 5	Survey instrument radiation level ≤200 cpm
CPP-88-5-1	5/19/95	38802501	0.0 - 0.5	0 - 0.5	Survey instrument radiation level ≤100 cpm
CPP-88-5-1	5/22/95	38802601	0.5 - 4	2.5 - 5	Survey instrument radiation level ≤100 cpm
CPP-88-5-1	5/22/95	38802701	4 - 10	7.5 - 10	Survey instrument radiation level ≤100 cpm; borehole terminated at 10' as the radiation level for soil cuttings at 10' were at the background radiation level
CPP-88-5-1	No sample	38802801	10 - basalt	NA	Field screen did not detect rad. Per SAP no sample required
CPP-88-5-1	No sample	38802901	soil/basalt	NA	Field screen did not detect rad. Per SAP no sample required
CPP-88-5-1	5/22/95	38803001	TBD	5 - 7.5	Survey instrument radiation level ≤100 cpm
CPP-88-6-1	5/10/95	38803101	0.0 - 0.5	0 - 0.5	Survey instrument radiation level ≤100 cpm
CPP-88-6-1	5/10/95	38803201	0.5 - 4	0.5 - 2	Survey instrument radiation level ≤100 cpm
CPP-88-6-1	5/10/95	38803301	4 - 10	4 - 6	Survey instrument radiation level ≤100 cpm; borehole terminated at 10' as the radiation level for soil cuttings at 10' were at the background radiation level
CPP-88-6-1	No sample	38803401	10 - basalt	NA	Field screen did not detect rad. Per SAP no sample required
CPP-88-6-1	No sample	38803501	soil/basalt	NA	Field screen did not detect rad. Per SAP no sample required
CPP-88-6-1	No sample	38803601	TBD	NA	No sample collected as no radiation levels exceeding background detected in borehole cuttings
CPP-88-7-1	5/22/95	38803701	0.0 - 0.5	0 - 0.5	Survey instrument radiation level < 100 cpm
CPP-88-7-1	5/22/95	38803702	0.0 - 0.5	0 - 0.5	Survey instrument radiation level < 100 cpm
CPP-88-7-1	5/22/95	38803801	0.5 - 4	0.5 - 2.5	Survey instrument radiation level < 100 cpm
CPP-88-7-1	5/22/95	38803901	4 - 10	7.5 - 10	Survey instrument radiation level < 100 cpm; borehole terminated at 10' as the radiation level for soil cuttings at 10' were at the background radiation level

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Sampling Location	Date Sampled	Sample Designation	Planned Sampling Interval (feet)	Collected Sampling Interval (feet)	Comments
CPP-88-7-1	No sample	38804001	10 - basalt	NA	Field screen did not detect rad. Per SAP no sample required
CPP-88-7-1	No sample	38804101	soil/basalt	NA	Field screen did not detect rad. Per SAP no sample required
CPP-88-7-1	5/22/95	38804201	TBD	0.5 - 2.5	Survey instrument radiation level < 100 cpm
CPP-88-8-1	5/18/95	38804301	0.0 - 0.5	0 - 0.5	Survey instrument radiation level ≤ 100 cpm
CPP-88-8-1	5/18/95	38804401	0.5 - 4	2.5 - 4	Survey instrument radiation level ≤ 100 cpm
CPP-88-8-1	5/19/95	38804501	4 - 10	7.5 - 10	Survey instrument radiation level ≤ 100 cpm; borehole terminated at 10' as the radiation level for soil cuttings at 10' were at the background radiation level
CPP-88-8-1	No sample	38804601	10 - basalt	NA	Field screen did not detect rad. Per SAP no sample required
CPP-88-8-1	No sample	38804701	soil/basalt	NA	Field screen did not detect rad. Per SAP no sample required
CPP-88-8-1	5/19/95	38804801	TBD	7.5 - 10	Survey instrument radiation level ≤ 100 cpm
CPP-88-9-1	5/22/95	38804901	0.0 - 0.5	0 - 0.5	Survey instrument radiation level ≤ 150 cpm
CPP-88-9-1	5/22/95	38805001	0.5 - 4	2.5 - 5	Survey instrument radiation level < 150 cpm
CPP-88-9-1	5/22/95	38805101	4 - 10	7.5 - 10	Survey instrument radiation level < 150; borehole terminated at 10' as the radiation level for soil cuttings at 10' were at the background radiation level
CPP-88-9-1	No sample	38805201	10 - basalt	NA	Field screen did not detect rad. Per SAP no sample required
CPP-88-9-1	No sample	38805301	soil/basalt	NA	Field screen did not detect rad. Per SAP no sample required
CPP-88-9-1	5/22/95	38805401	TBD	2.5 - 5	Survey instrument radiation level < 150 cpm
CPP-88-9-2	5/26/95	38805501	0.0 - 0.5	0 - 0.5	Survey instrument radiation level ≤ 150 cpm
CPP-88-9-2	5/26/95	38805601	0.5 - 4	0.5 - 2.5	Survey instrument radiation level ≤ 150 cpm
CPP-88-9-2	5/26/95	38805701	4 - 10	7.5 - 10	Survey instrument radiation level ≤ 150 cpm; borehole terminated at 10' as the radiation level for soil cuttings at 10' were at the background radiation level
CPP-88-9-2	5/26/95	38805702	4 - 10	7.5 - 10	Survey instrument radiation level ≤ 150 cpm; borehole terminated at 10' as the radiation level for soil cuttings at 10' were at the background radiation level
CPP-88-9-2	No sample	38805801	10 - basalt	NA	Field screen did not detect rad. Per SAP no sample required

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Sampling Location	Date Sampled	Sample Designation	Planned Sampling Interval (feet)	Collected Sampling Interval (feet)	Comments
CPP-88-9-2	No sample	38805901	soil/basalt	NA	Field screen did not detect rad. Per SAP no sample required
CPP-88-9-2	5/26/95	38806001	TBD	0.5 - 2.5	Survey instrument radiation level ≤ 150 cpm
CPP-88-9-2	5/26/95	38806002	TBD	0.5 - 2.5	Survey instrument radiation level ≤ 150 cpm
CPP-88-10-1	5/17/95	38806101	0.0 - 0.5	0 - 0.5	Survey instrument radiation level ≤ 150 cpm
CPP-88-10-1	5/18/95	38806201	0.5 - 4	2.5 - 4	Survey instrument radiation level ≤ 150 cpm
CPP-88-10-1	5/18/95	38806301	4 - 10	7.5 - 10	Survey instrument radiation level ≤ 150 cpm; borehole terminated at 10' as the radiation level for soil cuttings at 10' were at the background radiation level
CPP-88-10-1	No sample	38806401	10 - basalt	NA	Field screen did not detect rad. Per SAP no sample required
CPP-88-10-1	No sample	38806501	soil/basalt	NA	Field screen did not detect rad. Per SAP no sample required
CPP-88-10-1	No sample	38806601	TBD	NA	No sample collected as no radiation levels exceeding background detected in borehole cuttings
CPP-88-11-1	5/18/95	38806701	0.0 - 0.5	0 - 0.5	Survey instrument radiation level ≤ 125 cpm
CPP-88-11-1	5/18/95	38806801	0.5 - 4	2.5 - 4	Survey instrument radiation level ≤ 125 cpm
CPP-88-11-1	5/18/95	38806901	4 - 10	7.5 - 10	Survey instrument radiation level ≤ 125 cpm; borehole terminated at 10' as the radiation level for soil cuttings at 10' were at the background radiation level
CPP-88-11-1	No sample	38807001	10 - basalt	NA	Field screen did not detect rad. Per SAP no sample required
CPP-88-11-1	No sample	38807101	soil/basalt	NA	Field screen did not detect rad. Per SAP no sample required
CPP-88-11-1	No sample	38807201	TBD	NA	No sample collected as no radiation levels exceeding background detected in borehole cuttings
CPP-88-12-1	5/18/95	38807301	0.0 - 0.5	0 - 0.5	Survey instrument radiation level ≤ 150 cpm
CPP-88-12-1	5/18/95	38807401	0.5 - 4	0.5 - 2.5	Survey instrument radiation level ≤ 150 cpm
CPP-88-12-1	5/18/95	38807501	4 - 10	7.5 - 10	Survey instrument radiation level ≤ 150 cpm; borehole terminated at 10' as the radiation level for soil cuttings at 10' were at the background radiation level
CPP-88-12-1	No sample	38807601	10 - basalt	NA	Field screen did not detect rad. Per SAP no sample required
CPP-88-12-1	No sample	38807701	soil/basalt	NA	Field screen did not detect rad. Per SAP no sample required

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Sampling Location	Date Sampled	Sample Designation	Planned Sampling Interval (feet)	Collected Sampling Interval (feet)	Comments
CPP-88-12-1	No sample	38807801	TBD	NA	No sample collected as no radiation levels exceeding background detected in borehole cuttings
CPP-88-13-1	5/17/95	38807901	0.0 - 0.5	0 - 0.5	Survey instrument radiation level ≤ 125 cpm
CPP-88-13-1	5/17/95	38808001	0.5 - 4	0.5 - 2.5	Survey instrument radiation level ≤ 125 cpm
CPP-88-13-1	5/17/95	38808002	0.5 - 4	0.5 - 2.5	Survey instrument radiation level ≤ 125 cpm
CPP-88-13-1	5/17/95	38808101	4 - 10	7.5 - 10	Survey instrument radiation level ≤ 125 cpm; borehole terminated at 10' as the radiation level for soil cuttings at 10' were at the background radiation level
CPP-88-13-1	No sample	38808201	10 - basalt	NA	Field screen did not detect rad. Per SAP no sample required
CPP-88-13-1	No sample	38808301	soil/basalt	NA	Field screen did not detect rad. Per SAP no sample required
CPP-88-13-1	No sample	38808401	TBD	NA	No sample collected as no radiation levels exceeding background detected in borehole cuttings
CPP-88-14-1	5/17/95	38808501	0.0 - 0.5	0 - 0.5	Survey instrument radiation level ≤ 100 cpm
CPP-88-14-1	5/17/95	38808601	0.5 - 4	0.5 - 2	Survey instrument radiation level ≤ 100 cpm
CPP-88-14-1	5/17/95	38808701	4 - 10	7.5 - 10	Survey instrument radiation level ≤ 100 cpm; borehole terminated at 10' as the radiation level for soil cuttings at 10' were at the background radiation level
CPP-88-14-1	No sample	38808801	10 - basalt	NA	Field screen did not detect rad. Per SAP no sample required
CPP-88-14-1	No sample	38808901	soil/basalt	NA	Field screen did not detect rad. Per SAP no sample required
CPP-88-14-1	No sample	38809001	TBD	NA	No sample collected as no radiation levels exceeding background detected in borehole cuttings
CPP-88-15-1	7/07/95	38809101	0.0 - 0.5	0 - 0.5	Survey instrument radiation level 150 cpm
CPP-88-15-1	7/07/95	38809102	0.0 - 0.5	0.5 - 4	Survey instrument radiation level 150 cpm
CPP-88-15-1	7/07/95	38809201	0.5 - 4	0.5 - 4	Survey instrument radiation level 150 cpm
CPP-88-15-1	7/07/95	38809301	4 - 10	7 - 11	Survey instrument radiation level 180 cpm (30 cpm over background); borehole terminated at 11'
CPP-88-15-1	No sample	38809401	10 - basalt	NA	Field screen did not detect rad. Per SAP no sample required
CPP-88-15-1	No sample	38809501	soil/basalt	NA	Field screen did not detect rad. Per SAP no sample required

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Sampling Location	Date Sampled	Sample Designation	Planned Sampling Interval (feet)	Collected Sampling Interval (feet)	Comments
CPP-88-15-1	7/07/95	38809601	TBD	7 - 11	Survey instrument radiation level 180 cpm (30 cpm over background)
CPP-88-15-1	7/07/95	38809602	TBD	7 - 11	Survey instrument radiation level 180 cpm (30 cpm over background)
CPP-90-1	6/14/95	39000101	0.0 - 0.5	0 - 2.5	Survey instrument radiation level 200 cpm
CPP-90-1	6/14/95	39000201	0.5 - 4	2.5 - 5	Survey instrument radiation level 200 cpm
CPP-90-1	6/14/95	39000301	4 - 10	7.5 - 10	Survey instrument radiation level 200 cpm
CPP-90-1	6/14/95	39000401	10 - basalt	27.5 - 30	Survey instrument radiation level 200 cpm
CPP-90-1	6/14/95	39000501	soil/basalt	40 - 42	Survey instrument radiation level 200 cpm
CPP-90-2	6/14/95	39000601	0.0 - 0.5	0 - 0.5	Survey instrument radiation level 150 cpm
CPP-90-2	6/14/95	39000701	0.5 - 4	2.5 - 5	Survey instrument radiation level 150 cpm
CPP-90-2	6/14/95	39000801	4 - 10	7.5 - 10	Survey instrument radiation level 150 cpm
CPP-90-2	6/14/95	39000901	10 - basalt	32.5 - 35	Survey instrument radiation level 150 cpm
CPP-90-2	6/14/95	39000902	10 - basalt	32.5 - 35	Survey instrument radiation level 150 cpm
CPP-90-2	6/14/95	39001001	soil/basalt	48.1 - 48.1	Survey instrument radiation level 150 cpm
CPP-90-3	6/20/95	39001101	0.0 - 0.5	0 - 2.5	Survey instrument radiation level ≤ 200 cpm
CPP-90-3	6/20/95	39001201	0.5 - 4	2.5 - 5	Survey instrument radiation level ≤ 200 cpm
CPP-90-3	6/20/95	39001301	4 - 10	7.5 - 10	Survey instrument radiation level ≤ 200 cpm
CPP-90-3	6/20/95	39001401	10 - basalt	22.5 - 25	Survey instrument radiation level ≤ 200 cpm
CPP-90-3	6/20/95	39001501	soil/basalt	40 - 41.8	Survey instrument radiation level ≤ 200 cpm
CPP-91-1	6/08/95	39100101	0.0 - 0.5	0 - 0.5	Survey instrument radiation level 200 cpm
CPP-91-1	6/08/95	39100201	0.5 - 4	2.5 - 5	Survey instrument radiation level 250 cpm
CPP-91-1	6/08/95	39100301	4 - 10	7.5 - 10	Survey instrument radiation level 300 cpm
CPP-91-1	6/08/95	39100401	10 - basalt	17.5 - 20	Survey instrument radiation level 8000 cpm
CPP-91-1	6/08/95	39100501	soil/basalt	46 - 46.5	Survey instrument radiation level ≤ 200 cpm
CPP-91-2	6/12/95	39100601	0.0 - 0.5	0 - 0.5	Survey instrument radiation level ~ 250 cpm
CPP-91-2	6/12/95	39100701	0.5 - 4	0.5 - 2.5	Survey instrument radiation level ~ 250 cpm
CPP-91-2	6/12/95	39100801	4 - 10	5 - 7.5	Survey instrument radiation level ~275 cpm

WAG 3 RI/FS Investigation - Soil

Sampling Location	Date Sampled	Sample Designation	Planned Sampling Interval (feet)	Collected Sampling Interval (feet)	Comments
CPP-91-2	6/12/95	39100901	10 - basalt	37.5 - 40	Survey instrument radiation level ~10,000 cpm
CPP-91-2	6/12/95	39101001	soil/basalt	42 - 42.5	Survey instrument radiation level ~15 mR/hr
CPP-91-2	6/12/95	39101002		32.5 - 35	Survey instrument radiation level 3000 cpm: sample collected at this interval due to the presence of an organic smell encountered during the drilling of the borehole
CPP-93-1	7/13/95	39300101	4 - 7.5	2.5 - 4	Survey instrument radiation level < 100 cpm
CPP-93-1	7/13/95	39300201	14	12 - 12	Survey instrument radiation level < 100 cpm; borehole terminated at 12'
CPP-93-1	7/13/95	39300202	14	12 - 12	Survey instrument radiation level < 100 cpm; borehole terminated at 12'
CPP-93-2	7/13/95	39300301	4 - 7.5	2.5 - 3	Survey instrument radiation level < 100 cpm
CPP-93-2	7/13/95	39300401	14	12 - 12	Survey instrument radiation level < 100 cpm; borehole terminated at 12'
CPP-93-3	7/14/95	39300501	4 - 7.5	2.5 - 3	Survey instrument radiation level < 100 cpm
CPP-93-3	7/14/95	39300601	14	11.5 - 12	Survey instrument radiation level < 100 cpm; borehole terminated at 12'
CPP-93-4	7/17/95	39300701	4 - 7.5	6.5 - 7	Survey instrument radiation level < 100 cpm
CPP-93-4	7/17/95	39300801	14	11.5 - 12	Survey instrument radiation level < 100 cpm; borehole terminated at 12'
CPP-93-7	7/18/95	39301301		6.5 - 7	Survey instrument radiation level < 200 cpm (background); borehole terminated at 7'
CPP-93-8	7/18/95	39301401		6.5 - 7	Survey instrument radiation level < 200 cpm (background); borehole terminated at 7.5'
CPP-93-9	7/18/95	39301501		6.5 - 7	Survey instrument radiation level < 200 cpm (background); borehole terminated at 7.5'
CPP-93-10	7/18/95	39301601		6.5 - 7	Survey instrument radiation level < 200 cpm (background); borehole terminated at 7.5'
CPP-93-11	7/18/95	39301701		6.5 - 7	Survey instrument radiation level < 200 cpm (background); borehole terminated at 7.5'
CPP-93-12	7/18/95	39301801		6.5 - 7	Survey instrument radiation level < 200 cpm (background); borehole terminated at 7.5'
location #1	6/28/95	3CS00101	1	1 - 1.5	Survey instrument radiation level ≤ 100 cpm. Tank Farm stockpile
location #2	6/28/95	3CS00201	1	1 - 1.5	Survey instrument radiation level ~ 1500 cpm. Tank Farm stockpile
location #3	6/28/95	3CS00301	1	1 - 1.5	Survey instrument radiation level 200 cpm. Tank Farm stockpile

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Sampling Location	Date Sampled	Sample Designation	Planned Sampling Interval (feet)	Collected Sampling Interval (feet)	Comments
location #4	6/28/95	3CS00401	1	1 - 1.5	Survey instrument radiation level ≤ 100 cpm. Tank Farm stockpile
location #5	6/28/95	3CS00501	1	1 - 1.5	Survey instrument radiation level 500 cpm. Tank Farm stockpile
location #6	6/28/95	3CS00601	1	1 - 1.5	Survey instrument radiation level 300 cpm. Tank Farm stockpile
location #7	6/28/95	3CS00701	1	1 - 1.5	Survey instrument radiation level 200 cpm. Tank Farm stockpile
location #8	6/28/95	3CS00801	1	1 - 1.5	Survey instrument radiation level 350 cpm. Tank Farm stockpile
location #9	6/28/95	3CS00901	1	1 - 1.5	Survey instrument radiation level 200 cpm. Tank Farm stockpile
location #10	6/28/95	3CS01001	1	1 - 1.5	Survey instrument radiation level 900 cpm. Tank Farm stockpile
location #11	6/28/95	3CS01101	1	1 - 1.5	Survey instrument radiation level 100 cpm. Tank Farm stockpile

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Sampling Location	Sample Designation	Gross Alpha			Gross Beta			Sr-90			Pu-238		
		Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q
CPP-11-1	31100101	13	3		118	4	J	20.0	0.3	R ?	NA		
CPP-11-1	31100201	9.7	2.4		103	4	J	20.5	0.3	R ?	NA		
CPP-11-1	31100301	7.4	2.2		154	5	J	13.1	0.3	R ?	NA		
CPP-11-1	31100302	9.3	2.4		123	4	J	26.3	0.3	R ?	NA		
CPP-11-2	31100401	14	3		93	4	J	13.1	0.3	J	NA		
CPP-11-2	31100501	23	3		2980	20	J	823	9	R ?	0.00	0.01	U
CPP-11-2	31100601	6.8	2.2		26	3	J	NA			NA		
CPP-11-3	31100701	4.6	1.7		104	4					NA		
CPP-11-3	31100801	12	2		106	4					NA		
CPP-11-3	31100901	8.2	2.0		24	3		NA			NA		
CPP-11-3	31101001	12	2		35	3					NA		
CPP-11-3	31101101	NS			NS			NS			NS		
CPP-11-3	31101201	NS			NS			NS			NS		
CPP-13-1	31350101	4.0	1.4		32	3		4.7	0.2		NA		
CPP-13-1	31350201	7.2	1.6		27	3		NA			NA		
CPP-13-1	31350301	6.4	1.6		27	3		NA			NA		
CPP-13-1	31350302	5.8	1.6		20	3		NA			NA		
CPP-13-1	31350401	NS			NS			NS			NS		
CPP-13-1	31350501	NS			NS			NS			NS		
CPP-13-2	31350601	6.2	1.6		133	4		29.4	0.5		NA		
CPP-13-2	31350701	6.4	1.6		123	4		25.9	0.6		NA		
CPP-13-3	31350801	11	7		5650	60		4180	30		NA		
CPP-13-3	31350901	15	3		7950	30		2600	30		NA		
CPP-19-3	31900101	11	2		126	5		20.0	0.3	R ?	NA		
CPP-19-3	31900201	9.6	2.1		27	3		NA			NA		
CPP-19-3	31300301	8.5	2.0		31	3		0.4	0.1	R ?	NA		
CPP-19-3	31900401	14	2		31	3		0.1	0.2	U	NA		
CPP-19-3	31900501	4.9	1.9		17	3		NA			NA		

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Sampling Location	Sample Designation	Gross Alpha			Gross Beta			Sr-90			Pu-238		
		Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q
CPP-19-4	31900601	9.6	2.2		33	3		5.9	0.2	R ?	NA		
CPP-19-4	31900701	9.4	2.2		29	3		16.3	0.3	R ?	NA		
CPP-19-4	31900702	11	2		22	3		NA			NA		
CPP-19-4	31900801	7.5	2.1		21	3		18.4	0.3	R ?	NA		
CPP-19-4	31900901	13	2		34	3		0.0	0.2	U	NA		
CPP-19-4	31901001	17	3		26	3		1.3	0.2	R ?	NA		
CPP-22-1	32200101	6.7	1.8		23	3		NA			NA		
CPP-22-1	32200102	12	2		20	3		NA			NA		
CPP-22-1	32200201	6.5	1.8		21	3		NA			NA		
CPP-22-1	32200301	9.0	2.0		23	3		NA			NA		
CPP-22-2	32200401	14	2		74	4		5.4	0.2		NA		
CPP-22-2	32200501	13	2		22	3		NA			NA		
CPP-22-2	32200601	9.7	2.0		20	3		NA			NA		
CPP-22-3	32200701	12	2		31	3		2.7	0.2		NA		
CPP-22-3	32200801	8.1	1.8		30	3		0.1	0.2	U	NA		
CPP-22-3	32200901	5.7	1.7		22	3		NA			NA		
CPP-40-1	34000101	6.7	1.8		19	3		NA			NA		
CPP-40-1	34000201	7.2	1.8		18	3		NA			NA		
CPP-40-1	34000301	4.9	1.6		16	3		NA			NA		
CPP-40-1	34000302	4.8	1.5		25	3		NA			NA		
CPP-40-1	34000401	NS			NS			NS			NS		
CPP-40-1	34000501	NS			NS			NS			NS		
CPP-46-1	34600101	16	3		27	3		0.9	0.2		NA		
CPP-46-1	34600201	11	3		29	3		0.5	0.2		NA		
CPP-46-1	34600301	8.5	2.8		20	3		0.2	0.2	U	NA		
CPP-46-1	34600401	NS			NS			NS			NS		
CPP-46-1	34600501	NS			NS			NS			NS		
CPP-61-1	36100101	14	3		36	3		0.9	0.2		NA		

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Sampling Location	Sample Designation	Gross Alpha			Gross Beta			Sr-90			Pu-238		
		Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q
CPP-61-1	36100201	16	3		27	3		0.3	0.2	U	NA		
CPP-61-1	36100301	13	3		25	3		0.3	0.2	U	NA		
CPP-61-1	36100401	NS			NS			NS			NS		
CPP-61-1	36100501	NS			NS			NS			NS		
CPP-61-2	36100601	14	2		32	3		2.0	0.2		NA		
CPP-61-2	36100701	7.4	1.9		22	3		NA			NA		
CPP-61-3	36100801	9.7	2.0		31	3		1.2	0.2		NA		
CPP-61-3	36100901	7.4	1.9		25	3		NA			NA		
CPP-61-4	36101001	14	2		32	3		3.0	0.2		NA		
CPP-61-4	36101101	7.0	1.9		26	3		NA			NA		
CPP-603-1	36300101	5.1	1.6		36	3		3.0	0.2	R ?	NA		
CPP-603-1	36300201	3.8	1.4		24	3		NA			NA		
CPP-603-1	36300301	6.2	1.6		14	3		NA			NA		
CPP-603-1	36300401	6.5	1.6		22	3		NA			NA		
CPP-603-1	36300501	4.8	1.5		18	3		NA			NA		
CPP-603-2	36300601	7.3	1.8		71	4		8.7	0.3		NA		
CPP-603-2	36300701	11	2		21	3		NA			NA		
CPP-603-2	36300801	6.1	1.8		24	3		NA			NA		
CPP-603-2	36300901	7.9	1.7		25	3		NA			NA		
CPP-603-2	36301001	6.7	1.6		68	3		4.7	0.2		NA		
CPP-78-1	37800101	15	2		29	3		NA			NA		
CPP-78-1	37800102	6.8	1.6		20	3		NA			NA		
CPP-78-1	37800201	8.2	1.9		30	3		0.7	0.2		NA		
CPP-78-1	37800301	6.5	1.7		25	3		NA			NA		
CPP-78-1	37800401	NS			NS			NS			NS		
CPP-78-1	37800501	NS			NS			NS			NS		
CPP-78-2	37800601	7.7	1.8		24	3		NA			NA		
CPP-78-2	37800701	5.8	1.8		24	3		NA			NA		

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Sampling Location	Sample Designation	Gross Alpha			Gross Beta			Sr-90			Pu-238		
		Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q
CPP-78-2	37800801	7.3	1.7		17	3		NA			NA		
CPP-78-2	37800901	NS			NS			NS			NS		
CPP-78-2	37801001	NS			NS			NS			NS		
CPP-88-1-1	38800101	NA			NA			0.7	0.2	U ?	NA		
CPP-88-1-1	38800201	NA			NA			5.5	0.3		NA		
CPP-88-1-1	38800301	NA			NA			4.1	0.3		NA		
CPP-88-1-1	38800401	NS			NS			NS			NS		
CPP-88-1-1	38800501	NS			NS			NS			NS		
CPP-88-2-1	38800701	NA			NA			3.6	0.3		NA		
CPP-88-2-1	38800801	NA			NA			0.5	0.2		NA		
CPP-88-2-1	38800901	NA			NA			0.1	0.2	U	NA		
CPP-88-2-1	38800902	NA			NA			0.3	0.2	U	NA		
CPP-88-2-1	38801001	NS			NS			NS			NS		
CPP-88-2-1	38801101	NS			NS			NS			NS		
CPP-88-3-1	38801301	NA			NA			0.9	0.2		NA		
CPP-88-3-1	38801401	NA			NA			0.2	0.2	U	NA		
CPP-88-3-1	38801501	NA			NA			0.3	0.2	U	NA		
CPP-88-3-1	38801601	NS			NS			NS			NS		
CPP-88-3-1	38801701	NS			NS			NS			NS		
CPP-88-4-1	38801901	NA			NA			0.9	0.2		NA		
CPP-88-4-1	38802001	NA			NA			9.2	0.4		NA		
CPP-88-4-1	38802101	NA			NA			0.6	0.2		NA		
CPP-88-4-1	38802201	NS			NS			NS			NS		
CPP-88-4-1	38802301	NS			NS			NS			NS		
CPP-88-5-1	38802501	NA			NA			1.4	0.2		NA		
CPP-88-5-1	38802601	NA			NA			1.6	0.3		NA		
CPP-88-5-1	38802701	NA			NA			2.0	0.3		NA		
CPP-88-5-1	38802801	NS			NS			NS			NS		

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Sampling Location	Sample Designation	Gross Alpha			Gross Beta			Sr-90			Pu-238		
		Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q
CPP-88-5-1	38802901	NS			NS			NS			NS		
CPP-88-6-1	38803101	NA			NA			1.0	0.2		NA		
CPP-88-6-1	38803201	NA			NA			0.7	0.1		NA		
CPP-88-6-1	38803301	NA			NA			0.6	0.1		NA		
CPP-88-6-1	38803401	NS			NS			NS			NS		
CPP-88-6-1	38803501	NS			NS			NS			NS		
CPP-88-7-1	38803701	NA			NA			4.2	0.3		NA		
CPP-88-7-1	38803702	NA			NA			1.6	0.2		NA		
CPP-88-7-1	38803801	NA			NA			0.1	0.2	U	NA		
CPP-88-7-1	38803901	NA			NA			0.1	0.2	U	NA		
CPP-88-7-1	38804001	NS			NS			NS			NS		
CPP-88-7-1	38804101	NS			NS			NS			NS		
CPP-88-8-1	38804301	NA			NA			1.4	0.2		NA		
CPP-88-8-1	38804401	NA			NA			0.1	0.2	U	NA		
CPP-88-8-1	38804501	NA			NA			0.0	0.2	U	NA		
CPP-88-8-1	38804601	NS			NS			NS			NS		
CPP-88-8-1	38804701	NS			NS			NS			NS		
CPP-88-9-1	38804901	NA			NA			0.6	0.2		NA		
CPP-88-9-1	38805001	NA			NA			0.4	0.2	U	NA		
CPP-88-9-1	38805101	NA			NA			0.2	0.2	U	NA		
CPP-88-9-1	38805201	NS			NS			NS			NS		
CPP-88-9-1	38805301	NS			NS			NS			NS		
CPP-88-9-2	38805501	NA			NA			1.2	0.3		NA		
CPP-88-9-2	38805601	NA			NA			1.5	0.3		NA		
CPP-88-9-2	38805701	NA			NA			0.0	0.2	U	NA		
CPP-88-9-2	38805702	NA			NA			0.4	0.2	U	NA		
CPP-88-9-2	38805801	NS			NS			NS			NS		
CPP-88-9-2	38805901	NS			NS			NS			NS		

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Sampling Location	Sample Designation	Gross Alpha			Gross Beta			Sr-90			Pu-238		
		Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q
CPP-88-10-1	38806101	NA			NA			6.4	0.3		NA		
CPP-88-10-1	38806201	NA			NA			0.1	0.1	U	NA		
CPP-88-10-1	38806301	NA			NA			0.1	0.2	U	NA		
CPP-88-10-1	38806401	NS			NS			NS			NS		
CPP-88-10-1	38806501	NS			NS			NS			NS		
CPP-88-11-1	38806701	NA			NA			1.1	0.2		NA		
CPP-88-11-1	38806801	NA			NA			0.2	0.2	U	NA		
CPP-88-11-1	38806901	NA			NA			0.4	0.2		NA		
CPP-88-11-1	38807001	NS			NS			NS			NS		
CPP-88-11-1	38807101	NS			NS			NS			NS		
CPP-88-12-1	38807301	NA			NA			1.0	0.2		NA		
CPP-88-12-1	38807401	NA			NA			7.4	0.3		NA		
CPP-88-12-1	38807501	NA			NA			0.9	0.2		NA		
CPP-88-12-1	38807601	NS			NS			NS			NS		
CPP-88-12-1	38807701	NS			NS			NS			NS		
CPP-88-13-1	38807901	NA			NA			1.5	0.2		NA		
CPP-88-13-1	38808001	NA			NA			0.6	0.2		NA		
CPP-88-13-1	38808002	NA			NA			0.5	0.2		NA		
CPP-88-13-1	38808101	NA			NA			0.4	0.2	U	NA		
CPP-88-13-1	38808201	NS			NS			NS			NS		
CPP-88-13-1	38808301	NS			NS			NS			NS		
CPP-88-14-1	38808501	NA			NA			1.2	0.2		NA		
CPP-88-14-1	38808601	NA			NA			0.1	0.2	U	NA		
CPP-88-14-1	38808701	NA			NA			0.0	0.2	U	NA		
CPP-88-14-1	38808801	NS			NS			NS			NS		
CPP-88-14-1	38808901	NS			NS			NS			NS		
CPP-88-15-1	38809101	NA			NA			6.1	0.3		NA		
CPP-88-15-1	38809102	NA			NA			0.0	0.1	U	NA		

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Sampling Location	Sample Designation	Gross Alpha			Gross Beta			Sr-90			Pu-238		
		Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q
CPP-88-15-1	38809201	NA			NA			0.1	0.1	U	NA		
CPP-88-15-1	38809301	NA			NA			0.3	0.2	U	NA		
CPP-88-15-1	38809401	NS			NS			NS			NS		
CPP-88-15-1	38809501	NS			NS			NS			NS		
CPP-90-1	39000101	12	2		27	3		NA			NA		
CPP-90-1	39000201	12	2		27	3		NA			NA		
CPP-90-1	39000301	9.6	2.2		30	3		0.6	0.1	R ?	NA		
CPP-90-1	39000401	17	3		44	3		6.3	0.3		NA		
CPP-90-1	39000501	7.3	2.0		31	3		1.4	0.2		NA		
CPP-90-2	39000601	10	2		48	3		0.9	0.1	R ?	NA		
CPP-90-2	39000701	13	2		42	3		1.2	0.1	R ?	NA		
CPP-90-2	39000801	9.8	2.1		25	3		NA			NA		
CPP-90-2	39000901	13	2		28	3		NA			NA		
CPP-90-2	39000902	9.4	2.1		28	3		NA			NA		
CPP-90-2	39001001	14	2		29	3		NA			NA		
CPP-90-3	39001101	6.0	1.7		25	3		NA			NA		
CPP-90-3	39001201	8.6	1.9		34	3		5.0	0.2	R ?	NA		
CPP-90-3	39001301	8.1	1.9		20	3		NA			NA		
CPP-90-3	39001401	14	2		42	3		1.6	0.2		NA		
CPP-90-3	39001501	9.2	1.8		25	3		NA			NA		
CPP-91-1	39100101	13	2		49	3	J	2.6	0.1	R ?	NA		
CPP-91-1	39100201	15	3		186	5	J	27.8	0.4	R ?	NA		
CPP-91-1	39100301	5.3	2.1		142	5	J	11.0	0.2	R ?	NA		
CPP-91-1	39100401	16	3		3760	20	J	1510	10		NA		
CPP-91-1	39100501	11	2		81	4	J	20.0	0.4		NA		
CPP-91-2	39100601	2.3	1.4		27	3		NA			NA		
CPP-91-2	39100701	7.0	1.7		156	5		37.7	0.5	J	NA		
CPP-91-2	39100801	9.1	1.9		298	6		30.6	0.4	R ?	NA		

WAG 3 RI/FS Investigation - Soil

Sampling Location	Sample Designation	Gross Alpha			Gross Beta			Sr-90			Pu-238		
		Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q
CPP-91-2	39100901	19	2		20930	50		7580	7		NA		
CPP-91-2	39101001	NA			NA			79500 82300	682 680		0.319 0.395	0.0686 0.0628	
CPP-91-2	39101002	11	2		25	3		NA			NA		
location #1	3CS00101	7.1	1.8		36	3		6.6	0.3		0.00	0.02	UJ
location #2	3CS00201	12	2		689	3		330	3	J	0.35	0.04	J
location #3	3CS00301	5.2	1.7		49	3		11.3	0.4	J	0.18	0.03	J
location #4	3CS00401	7.3	1.9		47	3		8.1	0.4		0.11	0.03	J
location #5	3CS00501	5.3	1.7		240	6		95	1	J	0.18	0.04	J
location #6	3CS00601	10	2		112	4		32.6	0.5		0.29	0.04	J
location #7	3CS00701	5.9	1.7		95	4		16.4	0.4		0.19	0.03	J
location #8	3CS00801	9.3	1.9		124	4		33.2	0.5		0.11	0.03	J
location #9	3CS00901	5.5	1.6		55	3		11.6	0.3		0.03	0.03	UJ
location #10	3CS01001	6.8	1.8		189	5		62.1	0.6		0.14	0.03	J
location #11	3CS01101	6.4	1.7		142	5		40.6	0.5		0.43	0.05	J

For CPP-91-2: 39101001 - the results for Sr-90 are total Sr and the error values shown are the MDAs

WAG 3 RI/FS Investigation - Soil

Sample Location	Sample Designation	Pu-239/240			Am-241			Np-237			Tc-99		
		Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q
CPP-11-1	31100101	NA			NA			NA			4.3	4.1	R ?
CPP-11-1	31100201	NA			NA			NA			11	4	R ?
CPP-11-1	31100301	NA			NA			NA			14	4	R ?
CPP-11-1	31100302	NA			NA			NA			12	5	R ?
CPP-11-2	31100401	NA			NA			NA			7.3	5.0	R ?
CPP-11-2	31100501	0.02	0.02	U	0.05	0.03	U	0.15	0.05		23	5	R ?
CPP-11-2	31100601	NA			NA			NA			NA		
CPP-11-3	31100701	NA			NA			NA					
CPP-11-3	31100801	NA			NA			NA					
CPP-11-3	31100901	NA			NA			NA			NA		
CPP-11-3	31101001	NA			NA			NA					
CPP-11-3	31101101	NS			NS			NS			NS		
CPP-11-3	31101201	NS			NS			NS			NS		
CPP-13-1	31350101	NA			NA			NA			17	4	R ?
CPP-13-1	31350201	NA			NA			NA			NA		
CPP-13-1	31350301	NA			NA			NA			NA		
CPP-13-1	31350302	NA			NA			NA			NA		
CPP-13-1	31350401	NS			NS			NS			NS		
CPP-13-1	31350501	NS			NS			NS			NS		
CPP-13-2	31350601	NA			NA			NA			0.9	0.4	
CPP-13-2	31350701	NA			NA			NA			0.4	0.3	U
CPP-13-3	31350801	NA			NA			NA			2.7	0.4	
CPP-13-3	31350901	NA			NA			NA			1.4	0.4	
CPP-19-3	31900101	NA			NA			NA			7.5	3.3	R ?
CPP-19-3	31900201	NA			NA			NA			NA		
CPP-19-3	31300301	NA			NA			NA			9.6	3.6	R ?
CPP-19-3	31900401	NA			NA			NA			23	5	R ?
CPP-19-3	31900501	NA			NA			NA			NA		

WAG 3 RI/FS Investigation - Soil

Sample Location	Sample Designation	Pu-239/240			Am-241			Np-237			Tc-99		
		Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q
CPP-19-4	31900601	NA			NA			NA			6.8	3.5	R ?
CPP-19-4	31900701	NA			NA			NA			12	5	R ?
CPP-19-4	31900702	NA			NA			NA			NA		
CPP-19-4	31900801	NA			NA			NA			21	5	R ?
CPP-19-4	31900901	NA			NA			NA			8.0	3.5	R ?
CPP-19-4	31901001	NA			NA			NA			19	5	R ?
CPP-22-1	32200101	NA			NA			NA			NA		
CPP-22-1	32200102	NA			NA			NA			NA		
CPP-22-1	32200201	NA			NA			NA			NA		
CPP-22-1	32200301	NA			NA			NA			NA		
CPP-22-2	32200401	NA			NA			NA			0.9	0.4	
CPP-22-2	32200501	NA			NA			NA			NA		
CPP-22-2	32200601	NA			NA			NA			NA		
CPP-22-3	32200701	NA			NA			NA			2.3	0.5	
CPP-22-3	32200801	NA			NA			NA			3.5	0.5	
CPP-22-3	32200901	NA			NA			NA			NA		
CPP-40-1	34000101	NA			NA			NA			NA		
CPP-40-1	34000201	NA			NA			NA			NA		
CPP-40-1	34000301	NA			NA			NA			NA		
CPP-40-1	34000302	NA			NA			NA			NA		
CPP-40-1	34000401	NS			NS			NS			NS		
CPP-40-1	34000501	NS			NS			NS			NS		
CPP-46-1	34600101	NA			NA			NA			1.5	0.5	
CPP-46-1	34600201	NA			NA			NA			1.3	0.5	
CPP-46-1	34600301	NA			NA			NA			0.0	0.4	U
CPP-46-1	34600401	NS			NS			NS			NS		
CPP-46-1	34600501	NS			NS			NS			NS		
CPP-61-1	36100101	NA			NA			NA			1.4	0.4	

WAG 3 RI/FS Investigation - Soil

Sample Location	Sample Designation	Pu-239/240			Am-241			Np-237			Tc-99		
		Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q
CPP-61-1	36100201	NA			NA			NA			1.9	0.4	
CPP-61-1	36100301	NA			NA			NA			1.5	0.4	
CPP-61-1	36100401	NS			NS			NS			NS		
CPP-61-1	36100501	NS			NS			NS			NS		
CPP-61-2	36100601	NA			NA			NA			1.3	0.4	
CPP-61-2	36100701	NA			NA			NA			NA		
CPP-61-3	36100801	NA			NA			NA			1.5	0.5	
CPP-61-3	36100901	NA			NA			NA			NA		
CPP-61-4	36101001	NA			NA			NA			1.6	0.5	
CPP-61-4	36101101	NA			NA			NA			NA		
CPP-603-1	36300101	NA			NA			NA			14	4	R ?
CPP-603-1	36300201	NA			NA			NA			NA		
CPP-603-1	36300301	NA			NA			NA			NA		
CPP-603-1	36300401	NA			NA			NA			NA		
CPP-603-1	36300501	NA			NA			NA			NA		
CPP-603-2	36300601	NA			NA			NA			0.2	0.5	U
CPP-603-2	36300701	NA			NA			NA			NA		
CPP-603-2	36300801	NA			NA			NA			NA		
CPP-603-2	36300901	NA			NA			NA			NA		
CPP-603-2	36301001	NA			NA			NA			17	4	R ?
CPP-78-1	37800101	NA			NA			NA			NA		
CPP-78-1	37800102	NA			NA			NA			NA		
CPP-78-1	37800201	NA			NA			NA			0.8	0.4	U
CPP-78-1	37800301	NA			NA			NA			NA		
CPP-78-1	37800401	NS			NS			NS			NS		
CPP-78-1	37800501	NS			NS			NS			NS		
CPP-78-2	37800601	NA			NA			NA			NA		
CPP-78-2	37800701	NA			NA			NA			NA		

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Sample Location	Sample Designation	Pu-239/240			Am-241			Np-237			Tc-99		
		Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q
CPP-78-2	37800801	NA			NA			NA			NA		
CPP-78-2	37800901	NS			NS			NS			NS		
CPP-78-2	37801001	NS			NS			NS			NS		
CPP-88-1-1	38800101	NA			NA			NA			NA		
CPP-88-1-1	38800201	NA			NA			NA			NA		
CPP-88-1-1	38800301	NA			NA			NA			NA		
CPP-88-1-1	38800401	NS			NS			NS			NS		
CPP-88-1-1	38800501	NS			NS			NS			NS		
CPP-88-2-1	38800701	NA			NA			NA			NA		
CPP-88-2-1	38800801	NA			NA			NA			NA		
CPP-88-2-1	38800901	NA			NA			NA			NA		
CPP-88-2-1	38800902	NA			NA			NA			NA		
CPP-88-2-1	38801001	NS			NS			NS			NS		
CPP-88-2-1	38801101	NS			NS			NS			NS		
CPP-88-3-1	38801301	NA			NA			NA			NA		
CPP-88-3-1	38801401	NA			NA			NA			NA		
CPP-88-3-1	38801501	NA			NA			NA			NA		
CPP-88-3-1	38801601	NS			NS			NS			NS		
CPP-88-3-1	38801701	NS			NS			NS			NS		
CPP-88-4-1	38801901	NA			NA			NA			NA		
CPP-88-4-1	38802001	NA			NA			NA			NA		
CPP-88-4-1	38802101	NA			NA			NA			NA		
CPP-88-4-1	38802201	NS			NS			NS			NS		
CPP-88-4-1	38802301	NS			NS			NS			NS		
CPP-88-5-1	38802501	NA			NA			NA			NA		
CPP-88-5-1	38802601	NA			NA			NA			NA		
CPP-88-5-1	38802701	NA			NA			NA			NA		
CPP-88-5-1	38802801	NS			NS			NS			NS		

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Sample Location	Sample Designation	Pu-239/240			Am-241			Np-237			Tc-99		
		Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q
CPP-88-5-1	38802901	NS			NS			NS			NS		
CPP-88-6-1	38803101	NA			NA			NA			NA		
CPP-88-6-1	38803201	NA			NA			NA			NA		
CPP-88-6-1	38803301	NA			NA			NA			NA		
CPP-88-6-1	38803401	NS			NS			NS			NS		
CPP-88-6-1	38803501	NS			NS			NS			NS		
CPP-88-7-1	38803701	NA			NA			NA			NA		
CPP-88-7-1	38803702	NA			NA			NA			NA		
CPP-88-7-1	38803801	NA			NA			NA			NA		
CPP-88-7-1	38803901	NA			NA			NA			NA		
CPP-88-7-1	38804001	NS			NS			NS			NS		
CPP-88-7-1	38804101	NS			NS			NS			NS		
CPP-88-8-1	38804301	NA			NA			NA			NA		
CPP-88-8-1	38804401	NA			NA			NA			NA		
CPP-88-8-1	38804501	NA			NA			NA			NA		
CPP-88-8-1	38804601	NS			NS			NS			NS		
CPP-88-8-1	38804701	NS			NS			NS			NS		
CPP-88-9-1	38804901	NA			NA			NA			NA		
CPP-88-9-1	38805001	NA			NA			NA			NA		
CPP-88-9-1	38805101	NA			NA			NA			NA		
CPP-88-9-1	38805201	NS			NS			NS			NS		
CPP-88-9-1	38805301	NS			NS			NS			NS		
CPP-88-9-2	38805501	NA			NA			NA			NA		
CPP-88-9-2	38805601	NA			NA			NA			NA		
CPP-88-9-2	38805701	NA			NA			NA			NA		
CPP-88-9-2	38805702	NA			NA			NA			NA		
CPP-88-9-2	38805801	NS			NS			NS			NS		
CPP-88-9-2	38805901	NS			NS			NS			NS		

WAG 3 RI/FS Investigation - Soil

Sample Location	Sample Designation	Pu-239/240			Am-241			Np-237			Tc-99		
		Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q
CPP-88-10-1	38806101	NA			NA			NA			NA		
CPP-88-10-1	38806201	NA			NA			NA			NA		
CPP-88-10-1	38806301	NA			NA			NA			NA		
CPP-88-10-1	38806401	NS			NS			NS			NS		
CPP-88-10-1	38806501	NS			NS			NS			NS		
CPP-88-11-1	38806701	NA			NA			NA			NA		
CPP-88-11-1	38806801	NA			NA			NA			NA		
CPP-88-11-1	38806901	NA			NA			NA			NA		
CPP-88-11-1	38807001	NS			NS			NS			NS		
CPP-88-11-1	38807101	NS			NS			NS			NS		
CPP-88-12-1	38807301	NA			NA			NA			NA		
CPP-88-12-1	38807401	NA			NA			NA			NA		
CPP-88-12-1	38807501	NA			NA			NA			NA		
CPP-88-12-1	38807601	NS			NS			NS			NS		
CPP-88-12-1	38807701	NS			NS			NS			NS		
CPP-88-13-1	38807901	NA			NA			NA			NA		
CPP-88-13-1	38808001	NA			NA			NA			NA		
CPP-88-13-1	38808002	NA			NA			NA			NA		
CPP-88-13-1	38808101	NA			NA			NA			NA		
CPP-88-13-1	38808201	NS			NS			NS			NS		
CPP-88-13-1	38808301	NS			NS			NS			NS		
CPP-88-14-1	38808501	NA			NA			NA			NA		
CPP-88-14-1	38808601	NA			NA			NA			NA		
CPP-88-14-1	38808701	NA			NA			NA			NA		
CPP-88-14-1	38808801	NS			NS			NS			NS		
CPP-88-14-1	38808901	NS			NS			NS			NS		
CPP-88-15-1	38809101	NA			NA			NA			NA		
CPP-88-15-1	38809102	NA			NA			NA			NA		

WAG 3 RI/FS Investigation - Soil

Sample Location	Sample Designation	Pu-239/240			Am-241			Np-237			Tc-99		
		Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q
CPP-88-15-1	38809201	NA			NA			NA			NA		
CPP-88-15-1	38809301	NA			NA			NA			NA		
CPP-88-15-1	38809401	NS			NS			NS			NS		
CPP-88-15-1	38809501	NS			NS			NS			NS		
CPP-90-1	39000101	NA			NA			NA			NA		
CPP-90-1	39000201	NA			NA			NA			NA		
CPP-90-1	39000301	NA			NA			NA			5.2	2.6	R ?
CPP-90-1	39000401	NA			NA			NA			4.2	2.9	R ?
CPP-90-1	39000501	NA			NA			NA			8.2	2.9	R ?
CPP-90-2	39000601	NA			NA			NA			16	3	R ?
CPP-90-2	39000701	NA			NA			NA			13	4	R ?
CPP-90-2	39000801	NA			NA			NA			NA		
CPP-90-2	39000901	NA			NA			NA			NA		
CPP-90-2	39000902	NA			NA			NA			NA		
CPP-90-2	39001001	NA			NA			NA			NA		
CPP-90-3	39001101	NA			NA			NA			NA		
CPP-90-3	39001201	NA			NA			NA			8.4	3.4	R ?
CPP-90-3	39001301	NA			NA			NA			NA		
CPP-90-3	39001401	NA			NA			NA			15	4	R ?
CPP-90-3	39001501	NA			NA			NA					
CPP-91-1	39100101	NA			NA			NA			13	4	R ?
CPP-91-1	39100201	NA			NA			NA			19	5	R ?
CPP-91-1	39100301	NA			NA			NA			17	5	R ?
CPP-91-1	39100401	NA			NA			NA			21	5	R ?
CPP-91-1	39100501	NA			NA			NA			19	4	R ?
CPP-91-2	39100601	NA			NA			NA			NA		
CPP-91-2	39100701	NA			NA			NA			7.4	3.0	R ?
CPP-91-2	39100801	NA			NA			NA			8.0	2.9	R ?

WAG 3 RI/FS Investigation - Soil

Sample Location	Sample Designation	Pu-239/240			Am-241			Np-237			Tc-99		
		Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q
CPP-91-2	39100901	NA			NA			NA			54	4	R ?
CPP-91-2	39101001	0.0610 0.146	0.0247 0.0826		0.0702 0.263	0.223 0.160	UJ UJ	0.00984 0.0366	0.0583 0.0667	UJ UJ	2.32	0.526	J
CPP-91-2	39101002	NA			NA			NA			NA		
location #1	3CS00101	0.00	0.01	U	0.01	0.02	U	0.16	0.04	J	1.2	0.5	
location #2	3CS00201	0.09	0.03		0.06	0.03		0.07	0.03	UJ	2.1	0.5	
location #3	3CS00301	0.05	0.02		0.03	0.03	U	0.14	0.04	J	2.2	0.5	
location #4	3CS00401	0.00	0.01	U	0.02	0.02	U	0.09	0.04	UJ	1.3	0.4	
location #5	3CS00501	0.02	0.01	U	0.04	0.03	U	0.08	0.04	UJ	1.1	0.4	
location #6	3CS00601	0.02	0.02	U	0.01	0.02	U	0.09	0.04	UJ	0.9	0.4	
location #7	3CS00701	0.01	0.01	U	0.00	0.02	U	0.11	0.04	J	1.4	0.5	
location #8	3CS00801	0.00	0.01	U	0.01	0.02	U	0.17	0.04	J	1.6	0.5	
location #9	3CS00901	0.01	0.01	U	0.03	0.03	U	0.10	0.04	J	1.6	0.5	
location #10	3CS01001	0.02	0.02	U	0.17	0.04		0.10	0.04	J	1.7	0.5	
location #11	3CS01101	0.01	0.01	U	0.02	0.02	U	0.11	0.04	J	1.0	0.4	

For CPP-91-2: 39101001 - the error values shown are the MDAs

WAG 3 RI/FS Investigation - Soil

Sample Location	Sample Designation	U-234			U-235			U-238			Ce-144			Nb-95		
		Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q
CPP-11-1	31100101	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-11-1	31100201	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-11-1	31100301	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-11-1	31100302	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-11-2	31100401	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-11-2	31100501	1.2	0.1		0.00	0.09	U	1.0	0.1		ND	NA	U	ND	NA	U
CPP-11-2	31100601	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-11-3	31100701	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-11-3	31100801	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-11-3	31100901	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-11-3	31101001	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-11-3	31101101	NS			NS			NS			NS			NS		
CPP-11-3	31101201	NS			NS			NS			NS			NS		
CPP-13-1	31350101	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-13-1	31350201	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-13-1	31350301	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-13-1	31350302	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-13-1	31350401	NS			NS			NS			NS			NS		
CPP-13-1	31350501	NS			NS			NS			NS			NS		
CPP-13-2	31350601	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-13-2	31350701	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-13-3	31350801	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-13-3	31350901	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-19-3	31900101	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-19-3	31900201	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-19-3	31300301	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-19-3	31900401	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-19-3	31900501	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-19-4	31900601	NA			NA			NA			ND	NDA	U	009	0.02	
CPP-19-4	31900701	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-19-4	31900702	NA			NA			NA			ND	NA	U	0.08	0.02	

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Sample Location	Sample Designation	U-234			U-235			U-238			Ce-144			Nb-95		
		Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q
CPP-19-4	31900801	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-19-4	31900901	NA			NA			NA			ND	NA	U	0.06	0.01	
CPP-19-4	31901001	NA			NA			NA			ND	NA	U	0.07	0.02	
CPP-22-1	32200101	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-22-1	32200102	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-22-1	32200201	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-22-1	32200301	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-22-2	32200401	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-22-2	32200501	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-22-2	32200601	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-22-3	32200701	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-22-3	32200801	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-22-3	32200901	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-40-1	34000101	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-40-1	34000201	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-40-1	34000301	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-40-1	34000302	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-40-1	34000401	NS			NS			NS			NS			NS		
CPP-40-1	34000501	NS			NS			NS			NS			NS		
CPP-46-1	34600101	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-46-1	34600201	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-46-1	34600301	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-46-1	34600401	NS			NS			NS			NS			NS		
CPP-46-1	34600501	NS			NS			NS			NS			NS		
CPP-61-1	36100101	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-61-1	36100201	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-61-1	36100301	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-61-1	36100401	NS			NS			NS			NS			NS		
CPP-61-1	36100501	NS			NS			NS			NS			NS		
CPP-61-2	36100601	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-61-2	36100701	NA			NA			NA			ND	NA	U	ND	NA	U

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Sample Location	Sample Designation	U-234			U-235			U-238			Ce-144			Nb-95		
		Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q
CPP-61-3	36100801	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-61-3	36100901	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-61-4	36101001	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-61-4	36101101	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-603-1	36300101	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-603-1	36300201	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-603-1	36300301	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-603-1	36300401	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-603-1	36300501	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-603-2	36300601	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-603-2	36300701	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-603-2	36300801	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-603-2	36300901	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-603-2	36301001	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-78-1	37800101	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-78-1	37800102	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-78-1	37800201	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-78-1	37800301	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-78-1	37800401	NS			NS			NS			NS			NS		
CPP-78-1	37800501	NS			NS			NS			NS			NS		
CPP-78-2	37800601	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-78-2	37800701	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-78-2	37800801	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-78-2	37800901	NS			NS			NS			NS			NS		
CPP-78-2	37801001	NS			NS			NS			NS			NS		
CPP-88-1-1	38800101	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-1-1	38800201	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-1-1	38800301	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-1-1	38800401	NS			NS			NS			NS			NS		
CPP-88-1-1	38800501	NS			NS			NS			NS			NS		
CPP-88-2-1	38800701	NA			NA			NA			ND	NA	U	ND	NA	U

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Sample Location	Sample Designation	U-234			U-235			U-238			Ce-144			Nb-95		
		Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q
CPP-88-2-1	38800801	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-2-1	38800901	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-2-1	38800902	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-2-1	38801001	NS			NS			NS			NS			NS		
CPP-88-2-1	38801101	NS			NS			NS			NS			NS		
CPP-88-3-1	38801301	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-3-1	38801401	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-3-1	38801501	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-3-1	38801601	NS			NS			NS			NS			NS		
CPP-88-3-1	38801701	NS			NS			NS			NS			NS		
CPP-88-4-1	38801901	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-4-1	38802001	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-4-1	38802101	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-4-1	38802201	NS			NS			NS			NS			NS		
CPP-88-4-1	38802301	NS			NS			NS			NS			NS		
CPP-88-5-1	38802501	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-5-1	38802601	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-5-1	38802701	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-5-1	38802801	NS			NS			NS			NS			NS		
CPP-88-5-1	38802901	NS			NS			NS			NS			NS		
CPP-88-6-1	38803101	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-6-1	38803201	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-6-1	38803301	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-6-1	38803401	NS			NS			NS			NS			NS		
CPP-88-6-1	38803501	NS			NS			NS			NS			NS		
CPP-88-7-1	38803701	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-7-1	38803702	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-7-1	38803801	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-7-1	38803901	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-7-1	38804001	NS			NS			NS			NS			NS		
CPP-88-7-1	38804101	NS			NS			NS			NS			NS		

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Sample Location	Sample Designation	U-234			U-235			U-238			Ce-144			Nb-95		
		Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q
CPP-88-8-1	38804301	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-8-1	38804401	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-8-1	38804501	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-8-1	38804601	NS			NS			NS			NS			NS		
CPP-88-8-1	38804701	NS			NS			NS			NS			NS		
CPP-88-9-1	38804901	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-9-1	38805001	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-9-1	38805101	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-9-1	38805201	NS			NS			NS			NS			NS		
CPP-88-9-1	38805301	NS			NS			NS			NS			NS		
CPP-88-9-2	38805501	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-9-2	38805601	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-9-2	38805701	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-9-2	38805702	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-9-2	38805801	NS			NS			NS			NS			NS		
CPP-88-9-2	38805901	NS			NS			NS			NS			NS		
CPP-88-10-1	38806101	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-10-1	38806201	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-10-1	38806301	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-10-1	38806401	NS			NS			NS			NS			NS		
CPP-88-10-1	38806501	NS			NS			NS			NS			NS		
CPP-88-11-1	38806701	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-11-1	38806801	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-11-1	38806901	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-11-1	38807001	NS			NS			NS			NS			NS		
CPP-88-11-1	38807101	NS			NS			NS			NS			NS		
CPP-88-12-1	38807301	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-12-1	38807401	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-12-1	38807501	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-12-1	38807601	NS			NS			NS			NS			NS		
CPP-88-12-1	38807701	NS			NS			NS			NS			NS		

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Sample Location	Sample Designation	U-234			U-235			U-238			Ce-144			Nb-95		
		Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q
CPP-88-13-1	38807901	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-13-1	38808001	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-13-1	38808002	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-13-1	38808101	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-13-1	38808201	NS			NS			NS			NS			NS		
CPP-88-13-1	38808301	NS			NS			NS			NS			NS		
CPP-88-14-1	38808501	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-14-1	38808601	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-14-1	38808701	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-14-1	38808801	NS			NS			NS			NS			NS		
CPP-88-14-1	38808901	NS			NS			NS			NS			NS		
CPP-88-15-1	38809101	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-15-1	38809102	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-15-1	38809201	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-15-1	38809301	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-88-15-1	38809401	NS			NS			NS			NS			NS		
CPP-88-15-1	38809501	NS			NS			NS			NS			NS		
CPP-90-1	39000101	NA			NA			NA			ND	NA	U	0.08	0.02	
CPP-90-1	39000201	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-90-1	39000301	NA			NA			NA			ND	NA	U	0.13	0.02	
CPP-90-1	39000401	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-90-1	39000501	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-90-2	39000601	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-90-2	39000701	NA			NA			NA			ND	NA	U	0.07	0.02	
CPP-90-2	39000801	NA			NA			NA			ND	NA	U	0.09	0.01	
CPP-90-2	39000901	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-90-2	39000902	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-90-2	39001001	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-90-3	39001101	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-90-3	39001201	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-90-3	39001301	NA			NA			NA			ND	NA	U	ND	NA	U

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Sample Location	Sample Designation	U-234			U-235			U-238			Ce-144			Nb-95		
		Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q
CPP-90-3	39001401	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-90-3	39001501	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-91-1	39100101	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-91-1	39100201	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-91-1	39100301	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-91-1	39100401	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-91-1	39100501	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-91-2	39100601	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-91-2	39100701	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-91-2	39100801	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-91-2	39100901	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-91-2	39101001	6.37 12.6	0.983 1.64	J J	0.0238 0.0236	0.00341 0.000570		0.643 0.656	5.29e-05 8.86e-05		ND	NA	U	ND	NA	U
CPP-91-2	39101002	NA			NA			NA			ND	NA	U	ND	NA	U
location #1	3CS00101	0.8	0.1		0.0	0.1	U	0.8	0.1		ND	NA	U	ND	NA	U
location #2	3CS00201	0.7	0.1		0.09	0.08	U	0.8	0.1		ND	NA	U	ND	NA	U
location #3	3CS00301	0.8	0.1		0.01	0.08	U	0.9	0.1		ND	NA	U	ND	NA	U
location #4	3CS00401	0.8	0.1		0.0	0.08	U	0.7	0.1		ND	NA	U	ND	NA	U
location #5	3CS00501	0.7	0.1		0.0	0.1	U	0.6	0.1		ND	NA	U	ND	NA	U
location #6	3CS00601	0.9	0.1		0.0	0.1	U	1.0	0.1		ND	NA	U	ND	NA	U
location #7	3CS00701	0.5	0.1		0.0	0.1	U	0.7	0.1		ND	NA	U	ND	NA	U
location #8	3CS00801	0.8	0.1		0.0	0.1	U	1.0	0.1		ND	NA	U	ND	NA	U
location #9	3CS00901	0.8	0.1		0.0	0.1	U	0.8	0.1		ND	NA	U	ND	NA	U
location #10	3CS01001	1.0	0.1		0.0	0.1	U	0.9	0.1		ND	NA	U	ND	NA	U
location #11	3CS01101	0.8	0.1		0.0	0.1	U	0.9	0.1		ND	NA	U	ND	NA	U

for CPP-91-2: 39101001 - error values shown for U-234, U-235, and U-238 are the MDAs also U-233 (results: -3.96 UJ and -14.4 UJ; error: 1.51 and 2.52) and U-236 (results: 0.0133 J and 0.0187 J; error: 0.0101 and 0.0169)

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Location Designation	Sample Designation	Co-60			Cs-134			Cs-137			Eu-154			Eu-155		
		Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q
CPP-11-1	31100101	0.16	0.03		ND	NA	U	26.8	0.3		1.0	0.1		ND	NA	U
CPP-11-1	31100201	ND	NA	U	ND	NA	U	16.8	0.2		0.36	0.08		ND	NA	U
CPP-11-1	31100301	0.61	0.04		ND	NA	U	71.1	0.7		1.8	0.2		ND	NA	U
CPP-11-1	31100302	ND	NA	U	ND	NA	U	12.1	0.2		0.41	0.08		ND	NA	U
CPP-11-2	31100401	0.11	0.03		ND	NA	U	28.5	0.3		0.39	0.07		ND	NA	U
CPP-11-2	31100501	ND	NA	U	ND	NA	U	72.7	0.7		0.53	0.10		ND	NA	U
CPP-11-2	31100601	ND	NA	U	ND	NA	U	2.20	0.06		ND	NA	U	ND	NA	U
CPP-11-3	31100701	ND	NA	U	ND	NA	U	23.7	0.3		0.44	0.07		ND	NA	U
CPP-11-3	31100801	ND	NA	U	ND	NA	U	10.4	0.1		ND	NA	U	ND	NA	U
CPP-11-3	31100901	ND	NA	U	ND	NA	U	3.51	0.08		ND	NA	U	ND	NA	U
CPP-11-3	31101001	ND	NA	U	ND	NA	U	0.29	0.03		ND	NA	U	ND	NA	U
CPP-11-3	31101101	NS			NS			NS			NS			NS		
CPP-11-3	31101201	NS			NS			NS			NS			NS		
CPP-13-1	31350101	ND	NA	U	ND	NA	U	2.83	0.07		ND	NA	U	ND	NA	U
CPP-13-1	31350201	ND	NA	U	ND	NA	U	1.21	0.05		ND	NA	U	ND	NA	U
CPP-13-1	31350301	ND	NA	U	ND	NA	U	0.08	0.02		ND	NA	U	ND	NA	U
CPP-13-1	31350302	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-13-1	31350401	NS			NS			NS			NS			NS		
CPP-13-1	31350501	NS			NS			NS			NS			NS		
CPP-13-2	31350601	ND	NA	U	ND	NA	U	47.0	0.5		ND	NA	U	ND	NA	U
CPP-13-2	31350701	ND	NA	U	ND	NA	U	45.7	0.5		ND	NA	U	ND	NA	U
CPP-13-3	31350801	0.49	0.08		0.6	0.1		3710	40		22	1		ND	NA	U
CPP-13-3	31350901	0.9	0.2		ND	NA	U	4630	50		31	2		ND	NA	U
CPP-19-3	31900101	0.19	0.03		ND	NA	U	11.5	0.2		0.76	0.08		ND	NA	U
CPP-19-3	31900201	ND	NA	U	ND	NA	U	0.19	0.02		ND	NA	U	ND	NA	U
CPP-19-3	31300301	ND	NA	U	ND	NA	U	0.06	0.01		ND	NA	U	ND	NA	U
CPP-19-3	31900401	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-19-3	31900501	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-19-4	31900601	ND	NA	U	ND	NA	U	1.80	0.05		0.17	0.04		ND	NA	U
CPP-19-4	31900701	ND	NA	U	ND	NA	U	4.4	0.1		ND	NA	U	ND	NA	U
CPP-19-4	31900702	ND	NA	U	ND	NA	U	0.86	0.03		ND	NA	U	0.24	0.05	

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Location Designation	Sample Designation	Co-60			Cs-134			Cs-137			Eu-154			Eu-155		
		Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q
CPP-19-4	31900801	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	0.16	0.05	
CPP-19-4	31900901	ND	NA	U	0.05	0.01		ND	NA	U	ND	NA	U	0.20	0.03	
CPP-19-4	31901001	ND	NA	U	0.06	0.02		ND	NA	U	ND	NA	U	ND	NA	U
CPP-22-1	32200101	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-22-1	32200102	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-22-1	32200201	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-22-1	32200301	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-22-2	32200401	ND	NA	U	ND	NA	U	14.3	0.3		ND	NA	U	ND	NA	U
CPP-22-2	32200501	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-22-2	32200601	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-22-3	32200701	ND	NA	U	ND	NA	U	3.7	0.1		ND	NA	U	ND	NA	U
CPP-22-3	32200801	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-22-3	32200901	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-40-1	34000101	ND	NA	U	ND	NA	U	1.34	0.04		ND	NA	U	ND	NA	U
CPP-40-1	34000201	ND	NA	U	ND	NA	U	0.23	0.02		ND	NA	U	ND	NA	U
CPP-40-1	34000301	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-40-1	34000302	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-40-1	34000401	NS			NS			NS			NS			NS		
CPP-40-1	34000501	NS			NS			NS			NS			NS		
CPP-46-1	34600101	ND	NA	U	0.07	0.02		0.64	0.03		ND	NA	U	ND	NA	U
CPP-46-1	34600201	ND	NA	U	ND	NA	U	1.76	0.06	U ?	ND	NA	U	ND	NA	U
CPP-46-1	34600301	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-46-1	34600401	NS			NS			NS			NS			NS		
CPP-46-1	34600501	NS			NS			NS			NS			NS		
CPP-61-1	36100101	ND	NA	U	ND	NA	U	1.69	0.06		ND	NA	U	ND	NA	U
CPP-61-1	36100201	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-61-1	36100301	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-61-1	36100401	NS			NS			NS			NS			NS		
CPP-61-1	36100501	NS			NS			NS			NS			NS		
CPP-61-2	36100601	ND	NA	U	ND	NA	U	1.93	0.06		ND	NA	U	ND	NA	U
CPP-61-2	36100701	ND	NA	U	ND	NA	U	0.12	0.02		ND	NA	U	ND	NA	U

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Location Designation	Sample Designation	Co-60			Cs-134			Cs-137			Eu-154			Eu-155		
		Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q
CPP-61-3	36100801	ND	NA	U	ND	NA	U	2.03	0.06		ND	NA	U	ND	NA	U
CPP-61-3	36100901	ND	NA	U	ND	NA	U	1.10	0.05		ND	NA	U	ND	NA	U
CPP-61-4	36101001	ND	NA	U	ND	NA	U	2.51	0.07		ND	NA	U	ND	NA	U
CPP-61-4	36101101	ND	NA	U	ND	NA	U	0.44	0.06		ND	NA	U	ND	NA	U
CPP-603-1	36300101	ND	NA	U	ND	NA	U	7.3	0.1		0.56	0.07		ND	NA	U
CPP-603-1	36300201	ND	NA	U	ND	NA	U	1.44	0.05		ND	NA	U	ND	NA	U
CPP-603-1	36300301	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-603-1	36300401	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-603-1	36300501	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-603-2	36300601	ND	NA	U	ND	NA	U	23.9	0.3		ND	NA	U	ND	NA	U
CPP-603-2	36300701	ND	NA	U	ND	NA	U	0.11	0.02		ND	NA	U	ND	NA	U
CPP-603-2	36300801	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-603-2	36300901	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-603-2	36301001	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-78-1	37800101	ND	NA	U	ND	NA	U	0.22	0.02		ND	NA	U	ND	NA	U
CPP-78-1	37800102	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-78-1	37800201	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-78-1	37800301	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-78-1	37800401	NS			NS			NS			NS			NS		
CPP-78-1	37800501	NS			NS			NS			NS			NS		
CPP-78-2	37800601	ND	NA	U	ND	NA	U	0.38	0.03		ND	NA	U	ND	NA	U
CPP-78-2	37800701	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-78-2	37800801	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-78-2	37800901	NS			NS			NS			NS			NS		
CPP-78-2	37801001	NS			NS			NS			NS			NS		
CPP-88-1-1	38800101	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-1-1	38800201	ND	NA	U	ND	NA	U	13.3	0.2		ND	NA	U	ND	NA	U
CPP-88-1-1	38800301	ND	NA	U	ND	NA	U	5.7	0.1		ND	NA	U	ND	NA	U
CPP-88-1-1	38800401	NS			NS			NS			NS			NS		
CPP-88-1-1	38800501	NS			NS			NS			NS			NS		
CPP-88-2-1	38800701	ND	NA	U	ND	NA	U	5.9	0.1		ND	NA	U	ND	NA	U

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Location Designation	Sample Designation	Co-60			Cs-134			Cs-137			Eu-154			Eu-155		
		Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q
CPP-88-2-1	38800801	ND	NA	U	ND	NA	U	0.08	0.02		ND	NA	U	ND	NA	U
CPP-88-2-1	38800901	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-2-1	38800902	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-2-1	38801001	NS			NS			NS			NS			NS		
CPP-88-2-1	38801101	NS			NS			NS			NS			NS		
CPP-88-3-1	38801301	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-3-1	38801401	ND	NA	U	ND	NA	U	0.21	0.02		ND	NA	U	ND	NA	U
CPP-88-3-1	38801501	ND	NA	U	ND	NA	U	36.6	0.4		ND	NA	U	ND	NA	U
CPP-88-3-1	38801601	NS			NS			NS			NS			NS		
CPP-88-3-1	38801701	NS			NS			NS			NS			NS		
CPP-88-4-1	38801901	ND	NA	U	ND	NA	U	1.38	0.05		ND	NA	U	ND	NA	U
CPP-88-4-1	38802001	ND	NA	U	ND	NA	U	6.9	0.1		ND	NA	U	ND	NA	U
CPP-88-4-1	38802101	ND	NA	U	ND	NA	U	0.53	0.03		ND	NA	U	ND	NA	U
CPP-88-4-1	38802201	NS			NS			NS			NS			NS		
CPP-88-4-1	38802301	NS			NS			NS			NS			NS		
CPP-88-5-1	38802501	ND	NA	U	ND	NA	U	2.77	0.06		ND	NA	U	ND	NA	U
CPP-88-5-1	38802601	ND	NA	U	ND	NA	U	3.09	0.07		ND	NA	U	ND	NA	U
CPP-88-5-1	38802701	ND	NA	U	ND	NA	U	4.43	0.09		ND	NA	U	ND	NA	U
CPP-88-5-1	38802801	NS			NS			NS			NS			NS		
CPP-88-5-1	38802901	NS			NS			NS			NS			NS		
CPP-88-6-1	38803101	ND	NA	U	ND	NA	U	1.51	0.05	U ?	ND	NA	U	ND	NA	U
CPP-88-6-1	38803201	ND	NA	U	ND	NA	U	0.62	0.03		ND	NA	U	ND	NA	U
CPP-88-6-1	38803301	ND	NA	U	ND	NA	U	0.53	0.03		ND	NA	U	ND	NA	U
CPP-88-6-1	38803401	NS			NS			NS			NS			NS		
CPP-88-6-1	38803501	NS			NS			NS			NS			NS		
CPP-88-7-1	38803701	ND	NA	U	ND	NA	U	6.7	0.1		ND	NA	U	ND	NA	U
CPP-88-7-1	38803702	ND	NA	U	ND	NA	U	3.03	0.08		ND	NA	U	ND	NA	U
CPP-88-7-1	38803801	ND	NA	U	ND	NA	U	0.11	0.02		ND	NA	U	ND	NA	U
CPP-88-7-1	38803901	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-7-1	38804001	NS			NS			NS			NS			NS		
CPP-88-7-1	38804101	NS			NS			NS			NS			NS		

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Location Designation	Sample Designation	Co-60			Cs-134			Cs-137			Eu-154			Eu-155		
		Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q
CPP-88-8-1	38804301	ND	NA	U	ND	NA	U	0.76	0.04		ND	NA	U	ND	NA	U
CPP-88-8-1	38804401	ND	NA	U	ND	NA	U	2.24	0.06		ND	NA	U	ND	NA	U
CPP-88-8-1	38804501	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-8-1	38804601	NS			NS			NS			NS			NS		
CPP-88-8-1	38804701	NS			NS			NS			NS			NS		
CPP-88-9-1	38804901	ND	NA	U	ND	NA	U	0.25	0.03		ND	NA	U	ND	NA	U
CPP-88-9-1	38805001	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-9-1	38805101	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-9-1	38805201	NS			NS			NS			NS			NS		
CPP-88-9-1	38805301	NS			NS			NS			NS			NS		
CPP-88-9-2	38805501	ND	NA	U	ND	NA	U	3.50	0.09		ND	NA	U	ND	NA	U
CPP-88-9-2	38805601	ND	NA	U	ND	NA	U	2.05	0.08		ND	NA	U	ND	NA	U
CPP-88-9-2	38805701	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-9-2	38805702	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-9-2	38805801	NS			NS			NS			NS			NS		
CPP-88-9-2	38805901	NS			NS			NS			NS			NS		
CPP-88-10-1	38806101	ND	NA	U	ND	NA	U	6.6	0.1		ND	NA	U	ND	NA	U
CPP-88-10-1	38806201	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-10-1	38806301	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-10-1	38806401	NS			NS			NS			NS			NS		
CPP-88-10-1	38806501	NS			NS			NS			NS			NS		
CPP-88-11-1	38806701	ND	NA	U	ND	NA	U	0.76	0.05		ND	NA	U	ND	NA	U
CPP-88-11-1	38806801	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-11-1	38806901	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-11-1	38807001	NS			NS			NS			NS			NS		
CPP-88-11-1	38807101	NS			NS			NS			NS			NS		
CPP-88-12-1	38807301	ND	NA	U	ND	NA	U	2.14	0.06		ND	NA	U	ND	NA	U
CPP-88-12-1	38807401	ND	NA	U	ND	NA	U	7.6	0.1		ND	NA	U	ND	NA	U
CPP-88-12-1	38807501	ND	NA	U	ND	NA	U	0.43	0.03		ND	NA	U	ND	NA	U
CPP-88-12-1	38807601	NS			NS			NS			NS			NS		
CPP-88-12-1	38807701	NS			NS			NS			NS			NS		

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Location Designation	Sample Designation	Co-60			Cs-134			Cs-137			Eu-154			Eu-155		
		Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q
CPP-88-13-1	38807901	ND	NA	U	ND	NA	U	12.8	0.2		ND	NA	U	ND	NA	U
CPP-88-13-1	38808001	ND	NA	U	ND	NA	U	2.08	0.06		ND	NA	U	ND	NA	U
CPP-88-13-1	38808002	ND	NA	U	ND	NA	U	1.57	0.05		ND	NA	U	ND	NA	U
CPP-88-13-1	38808101	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-13-1	38808201	NS			NS			NS			NS			NS		
CPP-88-13-1	38808301	NS			NS			NS			NS			NS		
CPP-88-14-1	38808501	ND	NA	U	ND	NA	U	0.32	0.03		ND	NA	U	ND	NA	U
CPP-88-14-1	38808601	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-14-1	38808701	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-14-1	38808801	NS			NS			NS			NS			NS		
CPP-88-14-1	38808901	NS			NS			NS			NS			NS		
CPP-88-15-1	38809101	ND	NA	U	ND	NA	U	15.2	0.3		ND	NA	U	ND	NA	U
CPP-88-15-1	38809102	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-15-1	38809201	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-15-1	38809301	ND	NA	U	ND	NA	U	0.92	0.07		ND	NA	U	ND	NA	U
CPP-88-15-1	38809401	NS			NS			NS			NS			NS		
CPP-88-15-1	38809501	NS			NS			NS			NS			NS		
CPP-90-1	39000101	ND	NA	U	ND	NA	U	0.34	0.03		ND	NA	U	0.26	0.04	
CPP-90-1	39000201	ND	NA	U	ND	NA	U	1.29	0.05		ND	NA	U	ND	NA	U
CPP-90-1	39000301	ND	NA	U	ND	NA	U	1.06	0.05		ND	NA	U	ND	NA	U
CPP-90-1	39000401	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-90-1	39000501	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-90-2	39000601	ND	NA	U	ND	NA	U	1.02	0.04		ND	NA	U	0.19	0.05	
CPP-90-2	39000701	ND	NA	U	0.09	0.02		1.28	0.05		ND	NA	U	ND	NA	U
CPP-90-2	39000801	ND	NA	U	0.06	0.01		0.10	0.01		ND	NA	U	ND	NA	U
CPP-90-2	39000901	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	0.17	0.04	
CPP-90-2	39000902	ND	NA	U	0.07	0.1		ND	NA	U	ND	NA	U	ND	NA	U
CPP-90-2	39001001	ND	NA	U	0.13	0.02		ND	NA	U	ND	NA	U	ND	NA	U
CPP-90-3	39001101	ND	NA	U	ND	NA	U	3.13	0.09		ND	NA	U	ND	NA	U
CPP-90-3	39001201	ND	NA	U	ND	NA	U	7.5	0.1		ND	NA	U	ND	NA	U
CPP-90-3	39001301	ND	NA	U	ND	NA	U	2.9	0.1		ND	NA	U	ND	NA	U

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Location Designation	Sample Designation	Co-60			Cs-134			Cs-137			Eu-154			Eu-155		
		Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q
CPP-90-3	39001401	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-90-3	39001501	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-91-1	39100101	ND	NA	U	ND	NA	U	16.6	0.2		ND	NA	U	ND	NA	U
CPP-91-1	39100201	ND	NA	U	ND	NA	U	62.9	0.7		ND	NA	U	ND	NA	U
CPP-91-1	39100301	ND	NA	U	ND	NA	U	36.2	0.4		ND	NA	U	ND	NA	U
CPP-91-1	39100401	ND	NA	U	ND	NA	U	0.26	0.04		ND	NA	U	ND	NA	U
CPP-91-1	39100501	ND	NA	U	ND	NA	U	0.10	0.03		ND	NA	U	ND	NA	U
CPP-91-2	39100601	ND	NA	U	ND	NA	U	5.6	0.1		ND	NA	U	ND	NA	U
CPP-91-2	39100701	ND	NA	U	ND	NA	U	15.6	0.2		ND	NA	U	ND	NA	U
CPP-91-2	39100801	ND	NA	U	ND	NA	U	140	1		ND	NA	U	ND	NA	U
CPP-91-2	39100901	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-91-2	39101001	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-91-2	39101002	ND	NA	U	ND	NA	U	0.06	0.01		ND	NA	U	ND	NA	U
location #1	3CS00101	ND	NA	U	ND	NA	U	3.81	0.08		ND	NA	U	ND	NA	U
location #2	3CS00201	0.09	0.02		0.13	0.03		114	1		0.48	0.10		ND	NA	U
location #3	3CS00301	ND	NA	U	ND	NA	U	15.2	0.2		ND	NA	U	ND	NA	U
location #4	3CS00401	ND	NA	U	ND	NA	U	9.6	0.1		ND	NA	U	ND	NA	U
location #5	3CS00501	ND	NA	U	ND	NA	U	73.4	0.8		ND	NA	U	ND	NA	U
location #6	3CS00601	ND	NA	U	ND	NA	U	22.0	0.3		ND	NA	U	ND	NA	U
location #7	3CS00701	ND	NA	U	ND	NA	U	36.4	0.4		ND	NA	U	ND	NA	U
location #8	3CS00801	ND	NA	U	ND	NA	U	25.9	0.3		ND	NA	U	ND	NA	U
location #9	3CS00901	ND	NA	U	ND	NA	U	11.4	0.2		ND	NA	U	ND	NA	U
location #10	3CS01001	ND	NA	U	ND	NA	U	32.8	0.4		ND	NA	U	ND	NA	U
location #11	3CS01101	ND	NA	U	0.19	0.03		29.3	0.3		ND	NA	U	ND	NA	U

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Location Designation	Sample Designation	Ru-103			Ru-106			Sb-125			Co-58		
		Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q
CPP-11-1	31100101	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-11-1	31100201	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-11-1	31100301	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-11-1	31100302	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-11-2	31100401	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-11-2	31100501	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-11-2	31100601	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-11-3	31100701	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-11-3	31100801	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-11-3	31100901	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-11-3	31101001	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-11-3	31101101	NS			NS			NS			NS		
CPP-11-3	31101201	NS			NS			NS			NS		
CPP-13-1	31350101	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-13-1	31350201	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-13-1	31350301	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-13-1	31350302	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-13-1	31350401	NS			NS			NS			NS		
CPP-13-1	31350501	NS			NS			NS			NS		
CPP-13-2	31350601	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-13-2	31350701	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-13-3	31350801	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-13-3	31350901	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-19-3	31900101	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-19-3	31900201	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-19-3	31300301	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-19-3	31900401	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-19-3	31900501	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-19-4	31900601	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-19-4	31900701	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-19-4	31900702	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U

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Location Designation	Sample Designation	Ru-103			Ru-106			Sb-125			Co-58		
		Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q
CPP-19-4	31900801	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-19-4	31900901	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-19-4	31901001	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-22-1	32200101	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-22-1	32200102	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-22-1	32200201	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-22-1	32200301	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-22-2	32200401	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-22-2	32200501	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-22-2	32200601	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-22-3	32200701	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-22-3	32200801	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-22-3	32200901	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-40-1	34000101	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-40-1	34000201	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-40-1	34000301	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-40-1	34000302	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-40-1	34000401	NS			NS			NS			NS		
CPP-40-1	34000501	NS			NS			NS			NS		
CPP-46-1	34600101	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-46-1	34600201	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-46-1	34600301	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-46-1	34600401	NS			NS			NS			NS		
CPP-46-1	34600501	NS			NS			NS			NS		
CPP-61-1	36100101	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-61-1	36100201	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-61-1	36100301	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-61-1	36100401	NS			NS			NS			NS		
CPP-61-1	36100501	NS			NS			NS			NS		
CPP-61-2	36100601	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-61-2	36100701	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U

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Location Designation	Sample Designation	Ru-103			Ru-106			Sb-125			Co-58		
		Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q
CPP-61-3	36100801	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-61-3	36100901	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-61-4	36101001	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-61-4	36101101	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-603-1	36300101	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-603-1	36300201	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-603-1	36300301	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-603-1	36300401	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-603-1	36300501	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-603-2	36300601	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-603-2	36300701	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-603-2	36300801	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-603-2	36300901	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-603-2	36301001	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-78-1	37800101	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-78-1	37800102	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-78-1	37800201	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-78-1	37800301	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-78-1	37800401	NS			NS			NS			NS		
CPP-78-1	37800501	NS			NS			NS			NS		
CPP-78-2	37800601	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-78-2	37800701	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-78-2	37800801	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-78-2	37800901	NS			NS			NS			NS		
CPP-78-2	37801001	NS			NS			NS			NS		
CPP-88-1-1	38800101	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-1-1	38800201	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-1-1	38800301	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-1-1	38800401	NS			NS			NS			NS		
CPP-88-1-1	38800501	NS			NS			NS			NS		
CPP-88-2-1	38800701	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U

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Location Designation	Sample Designation	Ru-103			Ru-106			Sb-125			Co-58		
		Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q
CPP-88-2-1	38800801	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-2-1	38800901	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-2-1	38800902	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-2-1	38801001	NS			NS			NS			NS		
CPP-88-2-1	38801101	NS			NS			NS			NS		
CPP-88-3-1	38801301	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-3-1	38801401	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-3-1	38801501	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-3-1	38801601	NS			NS			NS			NS		
CPP-88-3-1	38801701	NS			NS			NS			NS		
CPP-88-4-1	38801901	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-4-1	38802001	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-4-1	38802101	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-4-1	38802201	NS			NS			NS			NS		
CPP-88-4-1	38802301	NS			NS			NS			NS		
CPP-88-5-1	38802501	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-5-1	38802601	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-5-1	38802701	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-5-1	38802801	NS			NS			NS			NS		
CPP-88-5-1	38802901	NS			NS			NS			NS		
CPP-88-6-1	38803101	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-6-1	38803201	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-6-1	38803301	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-6-1	38803401	NS			NS			NS			NS		
CPP-88-6-1	38803501	NS			NS			NS			NS		
CPP-88-7-1	38803701	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-7-1	38803702	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-7-1	38803801	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-7-1	38803901	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-7-1	38804001	NS			NS			NS			NS		
CPP-88-7-1	38804101	NS			NS			NS			NS		

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Location Designation	Sample Designation	Ru-103			Ru-106			Sb-125			Co-58		
		Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q
CPP-88-8-1	38804301	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-8-1	38804401	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-8-1	38804501	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-8-1	38804601	NS			NS			NS			NS		
CPP-88-8-1	38804701	NS			NS			NS			NS		
CPP-88-9-1	38804901	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-9-1	38805001	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-9-1	38805101	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-9-1	38805201	NS			NS			NS			NS		
CPP-88-9-1	38805301	NS			NS			NS			NS		
CPP-88-9-2	38805501	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-9-2	38805601	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-9-2	38805701	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-9-2	38805702	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-9-2	38805801	NS			NS			NS			NS		
CPP-88-9-2	38805901	NS			NS			NS			NS		
CPP-88-10-1	38806101	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-10-1	38806201	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-10-1	38806301	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-10-1	38806401	NS			NS			NS			NS		
CPP-88-10-1	38806501	NS			NS			NS			NS		
CPP-88-11-1	38806701	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-11-1	38806801	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-11-1	38806901	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-11-1	38807001	NS			NS			NS			NS		
CPP-88-11-1	38807101	NS			NS			NS			NS		
CPP-88-12-1	38807301	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-12-1	38807401	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-12-1	38807501	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-12-1	38807601	NS			NS			NS			NS		
CPP-88-12-1	38807701	NS			NS			NS			NS		

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Location Designation	Sample Designation	Ru-103			Ru-106			Sb-125			Co-58		
		Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q
CPP-88-13-1	38807901	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-13-1	38808001	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-13-1	38808002	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-13-1	38808101	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-13-1	38808201	NS			NS			NS			NS		
CPP-88-13-1	38808301	NS			NS			NS			NS		
CPP-88-14-1	38808501	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-14-1	38808601	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-14-1	38808701	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-14-1	38808801	NS			NS			NS			NS		
CPP-88-14-1	38808901	NS			NS			NS			NS		
CPP-88-15-1	38809101	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-15-1	38809102	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-15-1	38809201	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-15-1	38809301	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-88-15-1	38809401	NS			NS			NS			NS		
CPP-88-15-1	38809501	NS			NS			NS			NS		
CPP-90-1	39000101	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-90-1	39000201	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-90-1	39000301	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-90-1	39000401	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-90-1	39000501	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-90-2	39000601	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-90-2	39000701	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-90-2	39000801	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-90-2	39000901	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-90-2	39000902	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-90-2	39001001	ND	NA	U	ND	NA	U	ND	NA	U	0.07	0.02	
CPP-90-3	39001101	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-90-3	39001201	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-90-3	39001301	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U

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Location Designation	Sample Designation	Ru-103			Ru-106			Sb-125			Co-58		
		Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q	Result (pCi/g)	Error (pCi/g)	Q
CPP-90-3	39001401	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-90-3	39001501	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-91-1	39100101	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-91-1	39100201	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-91-1	39100301	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-91-1	39100401	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-91-1	39100501	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-91-2	39100601	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-91-2	39100701	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-91-2	39100801	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-91-2	39100901	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-91-2	39101001	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-91-2	39101002	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
location #1	3CS00101	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
location #2	3CS00201	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
location #3	3CS00301	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
location #4	3CS00401	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
location #5	3CS00501	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
location #6	3CS00601	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
location #7	3CS00701	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
location #8	3CS00801	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
location #9	3CS00901	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
location #10	3CS01001	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
location #11	3CS01101	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U

WAG 3 RI/FS Investigation - Soil

Sample Location	Sample Designation	Aluminum		Antimony		Arsenic		Barium		Beryllium		Cadminum		Calcium		Chromium	
		(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q
CPP-11-1	31100101	6550		0.44		6.4		104		0.45		1.7		15600	J	19.7	J
CPP-11-1	31100201	6450		0.59		5.7		106		0.43		1.6		30700	J	18.6	J
CPP-11-1	31100301	4140		0.45		2.8		63.4		0.25		1.1		22800	J	13.2	J
CPP-11-1	31100302	4490		0.42		5.5		75.4		0.34		1.2		12400	J	12.4	J
CPP-11-2	31100401	5140		0.62		5.3		81.6		0.39		1.5		28000	J	18.6	J
CPP-11-2	31100501	4490		0.47		4.8		72.7		0.36		1.4		11000	J	14.4	J
CPP-11-2	31100601	6080		0.40	U	6.2		91.5		0.45		1.6		13300	J	20.6	J
CPP-11-3	31100701	6630		0.49		4.3		107		0.47		0.61		20300		17.8	
CPP-11-3	31100801	6990		0.83		2.9		122		0.47		0.71		12300		17.2	
CPP-11-3	31100901	7420		0.78		3.9		118		0.50		0.55		11800		20.7	
CPP-11-3	31101001	6030		0.78		5.4		110		0.46		0.43		2930		23.7	
CPP-11-3	31101101	NS		NS		NS		NS		NS		NS		NS		NS	
CPP-11-3	31101201	NS		NS		NS		NS		NS		NS		NS		NS	
CPP-13-1	31350101	6190		1.1	U	6.1		113		0.46		0.27	U	13700		16.4	
CPP-13-1	31350201	4800		0.40	U	7.0		83.6		0.38		0.09	U	7000		11.6	
CPP-13-1	31350301	5530		0.41	U	5.3		95.1		0.43		0.13	U	13900		14.1	
CPP-13-1	31350302	6210		0.46	U	5.2		107		0.44		0.15	U	16400		15.2	
CPP-13-1	31350401	NS		NS		NS		NS		NS		NS		NS		NS	
CPP-13-1	31350501	NS		NS		NS		NS		NS		NS		NS		NS	
CPP-13-2	31350601	5450		0.40	UJ	5.8		81.0		0.43		0.08	U	4090	J	12.1	
CPP-13-2	31350701	5120		0.39	UJ	5.9		76.4		0.44		0.08	U	5230	J	12.1	
CPP-13-3	31350801	6440		0.40	UJ	8.3		100		0.53		0.08	U	6830	J	17.1	
CPP-13-3	31350901	4710		0.39	UJ	5.7		75.8		0.38		0.08	U	7940	J	12.3	
CPP-19-3	31900101	5030		0.39	UJ	3.3		87.8		0.42		0.47		19100		17.4	
CPP-19-3	31900201	8750		0.76		3.9		154		0.63		0.75		18000		21.9	
CPP-19-3	31300301	9390		0.53		5.8		160		0.66		0.74		28100		26.3	
CPP-19-3	31900401	6070		0.83		4.2		100		0.50		0.44		2770		24.3	
CPP-19-3	31900501	8470		0.70		5.3		184		0.42		0.96		232000		17.4	
CPP-19-4	31900601	3130		0.81		4.0	J	76.0		0.33		0.26		16300		8.3	J
CPP-19-4	31900701	2410		0.57	U	4.3	J	66.7		0.26		0.19		9350		6.9	J
CPP-19-4	31900702	2470		0.58	U	8.3	J	72.0		0.29		0.23		11300		6.8	J

WAG 3 RI/FS Investigation - Soil

Sample Location	Sample Designation	Aluminum		Antimony		Arsenic		Barium		Beryllium		Cadminum		Calcium		Chromium	
		(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q
CPP-19-4	31900801	1300		0.57	U	3.1	UJ	44.5		0.16		0.13		23200		5.1	J
CPP-19-4	31900901	2890		0.57	U	5.6	J	71.8		0.33		0.17		2330		10.7	J
CPP-19-4	31901001	3780		0.64		7.0	J	86.6		0.37		0.22		2180		15.5	J
CPP-603-1	36300101	8220		0.78	U	5.9		140		0.57		0.23	U	17400		17.6	
CPP-603-1	36300201	8150		0.41	U	4.4		140		0.55		0.32	U	13500		16.8	
CPP-603-1	36300301	6280		0.72	U	5.3		171		0.44		0.21	U	55500		19.9	
CPP-603-1	36300401	7010		0.59	U	7.1		125		0.53		0.13	U	3130		17.2	
CPP-603-1	36300501	5680		0.41	U	5.1		110		0.38		0.15	U	2650		14.1	
CPP-603-2	36300601	8580		0.40	R	3.9		123		0.48		0.08	U	13800	J	11.1	
CPP-603-2	36300701	3120		0.39	R	5.4		80.0		0.29		0.08	U	17400	J	10.6	
CPP-603-2	36300801	7030		0.43	R	6.9		170		0.56		0.09	U	27800	J	17.6	
CPP-603-2	36300901	4820		0.80	U	5.3		97.1		0.40		0.16	U	2310		15.7	
CPP-603-2	36301001	5910		0.76	U	6.1		87.4		0.45		0.13	U	2150		19.0	
CPP-88-1-1	38800601	4500		1.2	U	7.1		137		0.35		0.38	U	18700		14.6	
CPP-88-2-1	38801201	3620		0.40	R	4.8		78.3		0.33		0.08	U	17700	J	10.7	
CPP-88-3-1	38801801	6340		0.46	J	5.2		108		0.45		0.08	U	24700		21.5	J
CPP-88-4-1	38802401	5790		0.41	UJ	5.9		98.4		0.41		1.1		16400		14.0	J
CPP-88-5-1	38803001	5350		0.40	R	4.3		104		0.40		0.08	U	26600	J	14.3	
CPP-88-6-1	38803601	NS		NS		NS		NS		NS		NS		NS		NS	
CPP-88-7-1	38804201	3130		0.40	R	5.3		102		0.26		0.08	U	26000	J	8.2	
CPP-88-8-1	38804801	2210		0.39	UJ	3.5		36.1		0.20		0.08	U	21500		11.6	J
CPP-88-9-1	38805401	12400		0.43	R	5.1		197		0.82		0.09	U	25300	J	21.7	
CPP-88-9-2	38806001	6890		0.40	R	7.3		138		0.51		0.08	U	20600	J	15.9	
CPP-88-9-2	38806002	8510		0.41	R	4.6		142		0.59		0.09	U	6870	J	13.0	
CPP-88-10-1	38806601	NS		NS		NS		NS		NS		NS		NS		NS	
CPP-88-11-1	38807201	NS		NS		NS		NS		NS		NS		NS		NS	
CPP-88-12-1	38807801	NS		NS		NS		NS		NS		NS		NS		NS	
CPP-88-13-1	38808401	NS		NS		NS		NS		NS		NS		NS		NS	
CPP-88-14-1	38809001	NS		NS		NS		NS		NS		NS		NS		NS	
CPP-88-15-1	38809601	3530		0.55	UJ	5.4		79.0		0.38		0.25		17600	J	16.1	
CPP-88-15-1	38809602	2890		0.55	UJ	4.7		70.3		0.32		0.23		23200	J	12.4	

WAG 3 RI/FS Investigation - Soil

Sample Location	Sample Designation	Aluminum		Antimony		Arsenic		Barium		Beryllium		Cadminum		Calcium		Chromium	
		(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q
CPP-90-1	39000101	2500		9.5		29.5	J	60.5		0.36		0.25		14500		8.6	J
CPP-90-1	39000201	3150		0.56	U	5.4	J	79.2		0.32		0.25		19400		10.4	J
CPP-90-1	39000301	3100		0.91		6.1	J	77.8		0.32		0.27		12700		8.1	J
CPP-90-1	39000401	2880		0.58	U	5.6	J	70.2		0.30		0.24		2070		9.7	J
CPP-90-1	39000501	1670		0.60	U	4.3	J	45.3		0.22		0.15		3020		6.3	J
CPP-90-2	39000601	2840		0.56	U	5.4	J	73.5		0.31		0.23		16200		16.2	J
CPP-90-2	39000701	2910		1.3		5.4	J	72.3		0.32		0.26		15100		9.3	J
CPP-90-2	39000801	2580		0.58	U	4.5	J	61.0		0.27		0.30		43100		12.8	J
CPP-90-2	39000901	2790		0.59	U	5.0	J	52.1		0.30		0.18		1790		7.4	J
CPP-90-2	39000902	3030		0.60	U	5.1	J	55.5		0.29		0.16		1730		7.9	J
CPP-90-2	39001001	6860		1.1		11.1	J	140		0.69		0.19		8190		17.0	J
CPP-90-3	39001101	3850	J	0.58	U	4.7		91.4		0.39		0.06	U	15300	J	12.4	J
CPP-90-3	39001201	3100	J	0.58	U	4.4		97.6		0.31		0.06	U	12000	J	9.8	J
CPP-90-3	39001301	3080	J	0.58	U	4.7		67.5		0.32		0.17		21700	J	9.3	J
CPP-90-3	39001401	2880	J	0.61		5.0		73.3		0.31		0.06	U	5850	J	8.8	J
CPP-90-3	39001501	2690	J	0.67		4.6		61.2		0.29		0.06	U	2500	J	9.9	J
CPP-91-1	39100101	4680		0.65		5.4		78.1		0.37		1.5		26300	J	15.2	J
CPP-91-1	39100201	7390		0.77		5.9		107		0.51		1.8		16600	J	22.2	J
CPP-91-1	39100301	5870		0.64		6.3		97.4		0.43		1.6		17500	J	17.8	J
CPP-91-1	39100401	6740		0.43	U	6.9		96.8		0.50		1.6		3900	J	22.5	J
CPP-91-1	39100501	23500		1.2		10.3		186		1.2		3.3		5750	J	37.3	J
CPP-91-2	39100601	5380		1.0		4.1		103		0.41		0.47		22300	J	20.9	
CPP-91-2	39100701	5140		0.58		6.3		90.3		0.37		0.43		25400	J	20.0	
CPP-91-2	39100801	5420		0.71		3.6		92.2		0.50		0.58		21300	J	19.6	
CPP-91-2	39100901	8780		1.1		3.8		124		0.65		0.66		9250	J	28.2	
CPP-91-2	39101001	14700		1.0		9.1		136		0.95		0.79		26000	J	36.0	
CPP-91-2	39101002	5290		0.83		3.2		83.1		0.42		0.32		2280	J	16.8	
location #1	3CS00101	3070		0.55	UJ	3.9		66.8		0.32		0.25		31500	J	9.9	
location #2	3CS00201	2760		0.56	UJ	3.1		55.4		0.28		0.26		11100	J	7.5	
location #3	3CS00301	3200		0.55	UJ	4.4		58.3		0.37		0.32		14400	J	9.9	
location #4	3CS00401	4440		0.54	UJ	4.2		72.8		0.44		0.34		21400	J	14.0	

WAG 3 RI/FS Investigation - Soil

Sample Location	Sample Designation	Aluminum		Antimony		Arsenic		Barium		Beryllium		Cadminum		Calcium		Chromium	
		(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q
location #5	3CS00501	4230		0.57	UJ	5.4		79.3		0.45		0.38		27800	J	12.5	
location #6	3CS00601	3140		0.55	UJ	4.9		55.6		0.35		0.27		11600	J	9.9	
location #7	3CS00701	2380		0.56	UJ	3.6		48.2		0.28		0.32		26600	J	8.2	
location #8	3CS00801	3030		0.55	UJ	3.2		57.0		0.32		0.26		16400	J	8.9	
location #9	3CS00901	3360		0.55	UJ	3.6		63.3		0.36		0.22		12100	J	9.9	
location #10	3CS01001	3990		0.57	UJ	4.4		70.3		0.39		0.26		13100	J	11.4	
location #11	3CS01101	4600		0.54	UJ	5.9		83.3		0.45		0.37		19100	J	13.5	

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Sample Location	Sample Designation	Cobalt		Copper		Iron		Lead		Magnesium		Manganese		Mercury		Nickel	
		(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q
CPP-11-1	31100101	5.4		15.0		12900		7.6		4120	J	197		0.05	U	18.2	
CPP-11-1	31100201	5.3		13.0		11700		8.0		4050	J	191		0.05	U	18.1	
CPP-11-1	31100301	3.5		7.8		8020		5.3		3250	J	132		0.04	U	11.6	
CPP-11-1	31100302	4.0		10.4		9040		6.3		3240	J	148		0.05	U	13.0	
CPP-11-2	31100401	5.0		13.1		11100		8.8		4090	J	160		0.05	U	18.5	
CPP-11-2	31100501	4.3		11.3		10300		6.1		2840	J	136		0.05	U	13.9	
CPP-11-2	31100601	5.2		15.0		12100		7.6		3940	J	189		0.05	U	16.5	
CPP-11-3	31100701	5.4		13.6		12400		5.9		4240		232	J	0.05	U	18.4	
CPP-11-3	31100801	5.9		12.8		12800		6.0		4150		230	J	0.05	U	16.4	
CPP-11-3	31100901	6.3		14.4		14300		7.5		4720		245	J	0.06	U	20.3	
CPP-11-3	31101001	5.0		15.4		11800		6.8		3360		258	J	0.05		20.6	
CPP-11-3	31101101	NS		NS		NS		NS		NS		NS		NS		NS	
CPP-11-3	31101201	NS		NS		NS		NS		NS		NS		NS		NS	
CPP-13-1	31350101	5.6		17.4	J	11900		13.9		3930		257	J	0.28		19.7	
CPP-13-1	31350201	4.2		12.0	J	9590		7.6		2810		170	J	0.13		14.1	
CPP-13-1	31350301	4.8		15.0	J	11400		6.3		3430		187	J	0.91		14.9	
CPP-13-1	31350302	5.4		14.6	J	11800		6.9		3820		201	J	0.28		17.2	
CPP-13-1	31350401	NS		NS		NS		NS		NS		NS		NS		NS	
CPP-13-1	31350501	NS		NS		NS		NS		NS		NS		NS		NS	
CPP-13-2	31350601	4.3		13.0		9250		7.1		3180		155	J	0.05	U	14.1	
CPP-13-2	31350701	4.2		13.4		9090		8.2		3090		155	J	0.05	U	14.9	
CPP-13-3	31350801	5.1		16.2		11500		8.5		3820		211	J	0.05	U	17.9	
CPP-13-3	31350901	4.1		12.6		8570		7.6		3040		139	J	0.05	U	14.1	
CPP-19-3	31900101	5.1		13.5		11700		5.7		3910		212	J	0.05	U	18.5	
CPP-19-3	31900201	7.6		15.2		16300		10.1		5940		294	J	0.06	U	23.3	
CPP-19-3	31300301	8.2		16.3		18200		9.2		7440		270	J	0.05	U	26.4	
CPP-19-3	31900401	5.8		16.7		12700		6.1		3940		213	J	0.15		20.9	
CPP-19-3	31900501	5.1		14.9		9950		6.1		9700		114	J	0.07	U	14.9	
CPP-19-4	31900601	3.6		9.0		6840		6.3	J	2630		142		0.05	U	12.6	
CPP-19-4	31900701	3.0		7.6		5570		6.6	J	2060		117		0.05	U	10.1	
CPP-19-4	31900702	3.0		8.2		5790		6.7	J	2030		133		0.05	U	10.4	

WAG 3 RI/FS Investigation - Soil

Sample Location	Sample Designation	Cobalt		Copper		Iron		Lead		Magnesium		Manganese		Mercury		Nickel	
		(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q
CPP-19-4	31900801	1.9		6.0		3520		3.8	J	1800		91.1		0.05	U	8.4	
CPP-19-4	31900901	3.6		11.0		6500		6.9	J	2040		163		0.05	U	14.1	
CPP-19-4	31901001	3.8		15.0		8280		7.8	J	2260		188		0.05	U	15.4	
CPP-603-1	36300101	6.4		14.4	J	14300		8.3		4710		260	J	0.05	U	19.7	
CPP-603-1	36300201	6.0		14.1	J	13800		7.9		4440		252	J	0.05	U	18.4	
CPP-603-1	36300301	6.0		11.8	J	12800		8.1		7710		176	J	0.06	U	20.8	
CPP-603-1	36300401	5.6		16.5	J	12900		8.6		3570		220	J	0.05	U	19.8	
CPP-603-1	36300501	5.0		13.8	J	10200		6.2		2960		208	J	0.05	U	13.5	
CPP-603-2	36300601	4.7		11.5		10100		7.6	J	3940		213		1.2		12.6	
CPP-603-2	36300701	3.3		9.3		7130		5.1	J	2500		125		0.05	U	12.6	
CPP-603-2	36300801	6.9		13.3		13100		8.3	J	7730		245		0.06	U	23.3	
CPP-603-2	36300901	4.6		17.5	J	9860		6.1		3590		189	J	0.05	U	15.8	
CPP-603-2	36301001	4.9		18.5	J	11600		5.9		3540		205	J	0.05	U	18.5	
CPP-88-1-1	38800601	4.1		12.5	J	9560		6.7		3610		147	J	0.16		15.3	
CPP-88-2-1	38801201	3.3		10.5		6910		5.3	J	2790		130		1.0		12.1	
CPP-88-3-1	38801801	5.7	J	13.7		10600		8.8	U	5100		216	J	0.05	U	18.5	
CPP-88-4-1	38802401	4.6	J	14.0		9540		24.8		3920		162	J	0.05	U	15.6	
CPP-88-5-1	38803001	4.4		11.3		9030		6.5	J	3960		178		0.14		16.1	
CPP-88-6-1	38803601	NS		NS		NS		NS		NS		NS		NS		NS	
CPP-88-7-1	38804201	2.6		6.6		5840		3.3	J	5040		108		0.05	U	10.4	
CPP-88-8-1	38804801	2.4	J	7.2		4550		3.6	U	1950		109	J	0.05	U	10.7	
CPP-88-9-1	38805401	8.4		17.1		17600		10.9	J	7180		285		0.06	U	27.4	
CPP-88-9-2	38806001	5.8		14.6		11600		8.2	J	4820		250		0.05	U	19.1	
CPP-88-9-2	38806002	5.9		12.7		12400		7.5	J	4360		252		0.05	U	16.2	
CPP-88-10-1	38806601	NS		NS		NS		NS		NS		NS		NS		NS	
CPP-88-11-1	38807201	NS		NS		NS		NS		NS		NS		NS		NS	
CPP-88-12-1	38807801	NS		NS		NS		NS		NS		NS		NS		NS	
CPP-88-13-1	38808401	NS		NS		NS		NS		NS		NS		NS		NS	
CPP-88-14-1	38809001	NS		NS		NS		NS		NS		NS		NS		NS	
CPP-88-15-1	38809601	4.6		10.1		7650		6.0		3130		159	J	0.05	U	280	
CPP-88-15-1	38809602	3.3		8.9		6540		4.8		3210		119	J	0.05	U	46.4	

WAG 3 RI/FS Investigation - Soil

Sample Location	Sample Designation	Cobalt		Copper		Iron		Lead		Magnesium		Manganese		Mercury		Nickel	
		(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q
CPP-90-1	39000101	3.7		16.1		6350		17.3	J	2650		130		0.09		11.2	
CPP-90-1	39000201	3.6		10.6		7070		8.2	J	3010		148		0.09		13.6	
CPP-90-1	39000301	3.7		10.6		6620		9.1	J	2910		144		0.07		13.8	
CPP-90-1	39000401	3.6		11.1		6170		7.1	J	1870		242		0.65		17.4	
CPP-90-1	39000501	2.4		7.5		4220		6.1	J	1180		116		0.49		7.8	
CPP-90-2	39000601	3.5		10.8		6380		7.4	J	2730		141		0.05	U	16.3	
CPP-90-2	39000701	3.6		11.1		6740		7.5	J	2910		143		0.14		13.3	
CPP-90-2	39000801	2.9		8.7		6040		6.2	J	2460		122		0.05		12.4	
CPP-90-2	39000901	2.8		10.2		5340		6.0	J	1610		112		1.1		9.9	
CPP-90-2	39000902	2.8		10.0		5890		5.1	J	1660		117		0.82		11.4	
CPP-90-2	39001001	7.8		21.0		12900		14.5	J	4590		313		0.06	U	24.1	
CPP-90-3	39001101	4.5		12.1		8040	J	11.3	J	3430	J	176	J	1.0		15.9	
CPP-90-3	39001201	3.4		9.6		6560	J	7.6	J	2690	J	139	J	0.25		12.2	
CPP-90-3	39001301	3.5		10		6670	J	6.8	J	3240	J	138	J	0.26		13.0	
CPP-90-3	39001401	3.2		10.7		6450	J	5.9	J	1980	J	137	J	0.34		11.6	
CPP-90-3	39001501	2.8		11.4		6190	J	5.8	J	1690	J	120	J	0.06		9.6	
CPP-91-1	39100101	4.8		13.6		10600		8.6		3580	J	167		0.28		23.0	
CPP-91-1	39100201	6.3		14.7		13700		10.0		5010	J	208		0.54		22.2	
CPP-91-1	39100301	5.4		13.9		11800		9.1		4040	J	184		0.16		19.0	
CPP-91-1	39100401	5.7		15.4		12500		8.2		3940	J	200		0.06	U	21.1	
CPP-91-1	39100501	12.2		32.8		26500		17.2		8810	J	534		0.06	U	38.0	
CPP-91-2	39100601	5.6		13.7		12400		6.6		1770		213	J	0.20		20.2	
CPP-91-2	39100701	4.9		12.5		11800		5.6		4560		184	J	0.43		18.1	
CPP-91-2	39100801	5.8		15.0		13000		8.7		4540		245	J	0.23		22.6	
CPP-91-2	39100901	8.3		18.0		17100		7.6		5570		215	J	0.07		27.6	
CPP-91-2	39101001	11.5		27.2		23900		15.8		8120		466	J	0.23		35.4	
CPP-91-2	39101002	4.8		16.5		11900		6.4		3300		177	J	0.05	U	23.1	
location #1	3CS00101	2.9		8.3		6130		5.1		2410		101	J	0.05	U	11.0	
location #2	3CS00201	2.8		7.4		5400		4.9		2260		112	J	0.05	U	9.5	
location #3	3CS00301	3.4		12.8		7060		7.6		2740		113	J	0.05	U	13.1	
location #4	3CS00401	4.3		11.2		8780		6.7		3630		153	J	0.10		16.1	

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Sample Location	Sample Designation	Cobalt		Copper		Iron		Lead		Magnesium		Manganese		Mercury		Nickel	
		(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q
location #5	3CS00501	4.0		12.1		8690		8.4		3440		146	J	0.07		15.0	
location #6	3CS00601	3.4		9.7		6830		6.3		2770		118	J	0.05	U	13.6	
location #7	3CS00701	2.7		9.9		5410		4.8		2080		104	J	0.05	U	10.7	
location #8	3CS00801	3.2		8.6		6540		5.2		2490		151	J	0.05	U	12.1	
location #9	3CS00901	3.2		7.8		6710		5.1		2560		111	J	0.06		11.9	
location #10	3CS01001	3.8		9.5		7890		6.6		2920		134	J	0.05	U	13.1	
location #11	3CS01101	4.4		11.6		9230		7.1		3340		175	J	0.07		17.1	

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Sample Location	Sample Designation	Potassium		Selenium		Silver		Sodium		Thallium		Vanadium		Zinc		Zirconium	
		(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q
CPP-11-1	31100101	1320	J	0.57	U	0.13	U	136		0.97	U	28.1		53.3		NA	
CPP-11-1	31100201	1410	J	0.57	U	0.13	U	151		0.97	U	26.4		53.8		NA	
CPP-11-1	31100301	719	J	0.58	U	0.13	U	95.1		1.3		18.3		32.9		NA	
CPP-11-1	31100302	924	J	0.58	U	0.13	U	118		0.99	U	19.5		39.0		NA	
CPP-11-2	31100401	983	J	0.85		0.13	U	168		0.99	U	26.9		47.9		NA	
CPP-11-2	31100501	860	J	0.58	U	0.13	U	118		0.99	U	20.7		43.1		NA	
CPP-11-2	31100601	1110	J	0.57	U	0.13	U	124		0.97	U	25.8		48.4		NA	
CPP-11-3	31100701	1280	J	0.58	U	0.13	U	123	J	0.99	U	25.9		56.5		NA	
CPP-11-3	31100801	1310	J	0.58	U	0.13	U	120	J	0.99	U	25.2		55.1		NA	
CPP-11-3	31100901	1370	J	0.60	U	0.13	U	129	J	1.0	U	27.9		64.2		NA	
CPP-11-3	31101001	958	J	0.57	U	0.13	U	160	J	0.98	U	25.2		48.9		NA	
CPP-11-3	31101101	NS		NS		NS		NS		NS		NS		NS		NS	
CPP-11-3	31101201	NS		NS		NS		NS		NS		NS		NS		NS	
CPP-13-1	31350101	1190		0.68		0.13	U	139	J	0.97	U	22.9		85.9		11.5	
CPP-13-1	31350201	879		0.57	U	0.13	U	91.3	J	0.97	U	19.1		38.4		7.5	
CPP-13-1	31350301	896		0.91		0.13	U	113	J	1.0	U	23.5		46.0		12.3	
CPP-13-1	31350302	1080		0.88		0.13	U	113	J	1.0	U	22.7		57.3		14.3	
CPP-13-1	31350401	NS		NS		NS		NS		NS		NS		NS		NS	
CPP-13-1	31350501	NS		NS		NS		NS		NS		NS		NS		NS	
CPP-13-2	31350601	866		0.96		0.13	U	95.1		0.96	U	19.0		40.6		11.1	
CPP-13-2	31350701	796		0.56		0.12	U	102		0.95	U	19.5		45.5		10.2	
CPP-13-3	31350801	1070		0.81		0.13	U	105		0.96	U	26.5		51.1		11.6	
CPP-13-3	31350901	760		0.56	U	0.12	U	101		0.95	U	16.9		41.9		10.3	
CPP-19-3	31900101	906	J	0.56	U	0.12	U	112	J	0.95	U	25.4		49.8		NA	
CPP-19-3	31900201	1690	J	0.60	U	0.13	U	166	J	1.0	U	30.5		78.8		NA	
CPP-19-3	31300301	1500	J	0.59	U	0.13	U	215	J	1.0	U	36.4		86.0		NA	
CPP-19-3	31900401	873	J	0.57	U	0.13	U	217	J	0.98	U	27.9		48.8		NA	
CPP-19-3	31900501	1280	J	0.73	U	0.16	U	507	J	1.2	U	21.8		35.0		NA	
CPP-19-4	31900601	610	J	0.59	U	0.17	U	78.9		0.67	U	11.3		41.4	J	NA	
CPP-19-4	31900701	416	J	0.59	U	0.17	U	69.6		0.67	U	9.2		36.5	J	NA	
CPP-19-4	31900702	463	J	0.60	U	0.17	U	68.9		0.68	U	9.3		38.3	J	NA	

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Sample Location	Sample Designation	Potassium		Selenium		Silver		Sodium		Thallium		Vanadium		Zinc		Zirconium	
		(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q
CPP-19-4	31900801	225	J	0.59	U	0.17	U	64.7		0.67	U	6.5		22.1	J	NA	
CPP-19-4	31900901	429	J	0.59	U	0.17	U	103		0.67	U	10.7		37.2	J	NA	
CPP-19-4	31901001	527	J	0.60	U	0.17	U	142		0.69	U	14.0		39.2	J	NA	
CPP-603-1	36300101	1600		0.56	U	0.12	U	120	J	0.95	U	26.7		67.0		NA	
CPP-603-1	36300201	1580		0.58	U	0.13	U	157	J	0.99	U	26.2		61.9		NA	
CPP-603-1	36300301	1100		0.63	U	0.14	U	193	J	1.1	U	24.0		62.0		NA	
CPP-603-1	36300401	1040		1.1		0.13	U	145	J	0.99	U	29.4		47.7		NA	
CPP-603-1	36300501	963		0.58	U	0.13	U	153	J	0.99	U	21.3		37.8		NA	
CPP-603-2	36300601	2160		0.71		0.25		120		1.1		16.3		59.3		NA	
CPP-603-2	36300701	452		0.71		0.12	U	93.1		0.95		16.4		34.2		NA	
CPP-603-2	36300801	1260		0.74		0.14	U	174		1.1	U	25.7		69.4		NA	
CPP-603-2	36300901	735		0.61		0.13	U	132	J	0.97	U	22.7		40.4		NA	
CPP-603-2	36301001	844		0.60		0.13	U	189	J	1.00	U	25.4		42.3		NA	
CPP-88-1-1	38800601	886		0.85		0.13	U	144	J	0.97	U	20.3		47.7		NA	
CPP-88-2-1	38801201	601		0.68		0.13	U	77.9		0.97	U	21.3		35.6		NA	
CPP-88-3-1	38801801	1050		1.1	U	0.13	UJ	201		1.5		19.1		57.4		NA	
CPP-88-4-1	38802401	1130		1.0	U	0.13	UJ	136		1.0		21.3		50.4		NA	
CPP-88-5-1	38803001	999		0.57	U	0.13	U	188		0.96	U	19.6		51.1		NA	
CPP-88-6-1	38803601	NS		NS		NS		NS		NS		NS		NS		NS	
CPP-88-7-1	38804201	496		0.56	U	0.12	U	129		0.96	U	10.6		32.3		NA	
CPP-88-8-1	38804801	490		0.56	U	0.12	UJ	86.2		0.95	U	13.7		25.8		NA	
CPP-88-9-1	38805401	2070		0.95		0.21		195		1.5		27.7		105		NA	
CPP-88-9-2	38806001	1430		0.75		0.13	U	140		1.3		22.9		61.2		NA	
CPP-88-9-2	38806002	1620		0.58	U	0.13	U	145		0.98	U	19.2		65.8		NA	
CPP-88-10-1	38806601	NS		NS		NS		NS		NS		NS		NS		NS	
CPP-88-11-1	38807201	NS		NS		NS		NS		NS		NS		NS		NS	
CPP-88-12-1	38807801	NS		NS		NS		NS		NS		NS		NS		NS	
CPP-88-13-1	38808401	NS		NS		NS		NS		NS		NS		NS		NS	
CPP-88-14-1	38809001	NS		NS		NS		NS		NS		NS		NS		NS	
CPP-88-15-1	38809601	649	J	0.57	U	0.16	U	269		0.65	U	17.2		43.3		NA	
CPP-88-15-1	38809602	528	J	0.57	U	0.17		277		0.65	U	13.9		35.5		NA	

WAG 3 RI/FS Investigation - Soil

Sample Location	Sample Designation	Potassium		Selenium		Silver		Sodium		Thallium		Vanadium		Zinc		Zirconium	
		(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q
CPP-90-1	39000101	481	J	0.60	U	0.17	U	111		1.1	U	10.8		113	J	NA	
CPP-90-1	39000201	618	J	0.58	U	0.17	U	111		0.67	U	11.9		41.7	J	NA	
CPP-90-1	39000301	562	J	0.60	U	0.17	U	115		0.88	U	10.8		49.1	J	NA	
CPP-90-1	39000401	448	J	0.60	U	0.17	U	105		0.69	U	11.9		31.5	J	NA	
CPP-90-1	39000501	259	J	0.62	U	0.18	U	64.4		0.71	U	7.6		19.7	J	NA	
CPP-90-2	39000601	543	J	0.58	U	0.17	U	75.7		0.67	U	10.8		41.4	J	NA	
CPP-90-2	39000701	547	J	0.59	U	0.17	U	113		0.77		11.8		41.5	J	NA	
CPP-90-2	39000801	501	J	0.60	U	0.17	U	105		1.2		10.3		35.3	J	NA	
CPP-90-2	39000901	401	J	0.62	U	0.18	U	95.9		0.70	U	9.6		29.8	J	NA	
CPP-90-2	39000902	394	J	0.62	U	0.18	U	93.7		0.71	U	10.4		31.9	J	NA	
CPP-90-2	39001001	1080	J	0.68	U	0.19	U	219		1.6	U	23.7		76.5	J	NA	
CPP-90-3	39001101	695	J	0.74		0.17	U	82.1		1.4		13.5		52.2	J	NA	
CPP-90-3	39001201	549	J	0.60	U	0.17	U	78.5		0.69	U	12.0		37.7	J	NA	
CPP-90-3	39001301	536	J	0.60	U	0.17	U	89.4		0.69	U	11.8		46.4	J	NA	
CPP-90-3	39001401	421	J	0.60	U	0.18		56.8	U	0.68	U	11.6		29.8	J	NA	
CPP-90-3	39001501	348	J	0.59	U	0.17	U	57.7		0.67	U	11.4		26.3	J	NA	
CPP-91-1	39100101	906	J	0.58	U	0.13	U	151		0.98	U	23.4		55.1		NA	
CPP-91-1	39100201	1380	J	0.58	U	0.13	U	167		0.99	U	30.0		69.7		NA	
CPP-91-1	39100301	1090	J	0.58	U	0.13	U	157		0.98	U	24.3		52.6		NA	
CPP-91-1	39100401	1190	J	0.62	U	0.14	U	145		1.1	U	28.0		51.1		NA	
CPP-91-1	39100501	3770	J	2.0		0.14	U	231		1.8		43.4		107		NA	
CPP-91-2	39100601	978	J	0.57	U	0.13	U	217	J	0.96	U	25.9		57.3		NA	
CPP-91-2	39100701	833	J	0.55	U	0.12	U	176	J	0.94	U	25.7		47.3		NA	
CPP-91-2	39100801	1010	J	0.56	U	0.12	U	195	J	0.95	U	26.5		58.7		NA	
CPP-91-2	39100901	1210	J	0.61	U	0.13	U	153	J	1.0	U	38.3		76.4		NA	
CPP-91-2	39101001	1640	J	0.66	U	0.15	U	156	J	1.1	U	42.8		96.2		NA	
CPP-91-2	39101002	682	J	0.59	U	0.13	U	88.4	J	1.0	U	25.6		47.9		NA	
location #1	3CS00101	572	J	0.58	U	0.16	U	85.3		0.66	U	13.3		35.3		NA	
location #2	3CS00201	514	J	0.58	U	0.17	U	93.3		0.66	U	9.1		32.5		NA	
location #3	3CS00301	496	J	0.80		0.16	U	211		0.66	U	13.0		39.7		NA	
location #4	3CS00401	746	J	0.57	U	0.16	U	99.1		0.65	U	18.0		45.9		NA	

WAG 3 RI/FS Investigation - Soil

Sample Location	Sample Designation	Potassium		Selenium		Silver		Sodium		Thallium		Vanadium		Zinc		Zirconium	
		(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q
location #5	3CS00501	744	J	0.60	U	0.17	U	101		0.68	U	18.5		51.8		NA	
location #6	3CS00601	521	J	0.57	U	0.16	U	77.2		0.65	U	14.1		38.3		NA	
location #7	3CS00701	420	J	0.59	U	0.28		69.5		0.67	U	10.3		32.0		NA	
location #8	3CS00801	543	J	0.57	U	0.16	U	77.5		0.65	U	12.8		41.4		NA	
location #9	3CS00901	616	J	0.57	U	0.16	U	84.6		0.65	U	13.6		36.9		NA	
location #10	3CS01001	649	J	0.59	U	0.17	U	87.1		0.68	U	14.9		38.6		NA	
location #11	3CS01101	788	J	0.56	U	0.16	U	94.5		0.64	U	18.3		55.5		NA	

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Sample Location	Sample Designation	Aluminum		Mercury		Sodium		NO_3/NO_2 as N	
		(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q	(mg/kg)	Q
CPP-93-1	39300101	12000Q		67.8		429		74.9	
CPP-93-1	39300201	8580		17.5		147	U	5.1	
CPP-93-1	39300202	6890		8.5		108	U	1.0	
CPP-93-2	39300301	12800		6.2		155	U	1.4	
CPP-93-2	39300401	6980		4.2		152	U	1.0	
CPP-93-3	39300501	79500		98.4		263	U	3.8	
CPP-93-3	39300601	9260		17.3		117	U	43.6	
CPP-93-4	39300701	74000		140		216	U	1.9	
CPP-93-4	39300801	6110		2.8		126	U	1.1	
CPP-93-7	39301301	3630		0.05	U	151	U	1.3	
CPP-93-8	39301401	3090		0.05	U	105	U	1.2	
CPP-93-9	39301501	3190		0.05	U	89.3	U	1.4	
CPP-93-10	39301601	3450		0.05	U	115	U	1.5	
CPP-93-11	39301701	3220		0.05	U	103	U	0.53	
CPP-93-12	39301801	6880		0.74		193	U	0.98	

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Sample Location	Sample Designation	Phenol		bis (2-Chloroethyl) ether		2-Chlorophenol		1,3-Dichlorobenzene		1,4-Dichlorobenzene		Benzyl alcohol		1,2-Dichlorobenzene	
		(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q
CPP-90-1	39000101	360	U	360	U	360	U	360	U	360	U	360	U	360	U
CPP-90-1	39000201	350	U	350	U	350	U	350	U	350	U	350	U	350	U
CPP-90-1	39000301	370	U	370	U	370	U	370	U	370	U	370	U	370	U
CPP-90-1	39000401	360	U	360	U	360	U	360	U	360	U	360	U	360	U
CPP-90-1	39000501	360	U	360	U	360	U	360	U	360	U	360	U	360	U
CPP-90-2	39000601	360	U	360	U	360	U	360	U	360	U	360	U	360	U
CPP-90-2	39000701	360	U	360	U	360	U	360	U	360	U	360	U	360	U
CPP-90-2	39000801	360	U	360	U	360	U	360	U	360	U	360	U	360	U
CPP-90-2	39000901	360	U	360	U	360	U	360	U	360	U	360	U	360	U
CPP-90-2	39000902	360	U	360	U	360	U	360	U	360	U	360	U	360	U
CPP-90-2	39001001	400	U	400	U	400	U	400	U	400	U	400	U	400	U
CPP-90-3	39001101	360	U	360	U	360	U	360	U	360	U	360	U	360	U
CPP-90-3	39001201	360	U	360	U	360	U	360	U	360	U	360	U	360	U
CPP-90-3	39001301	350	U	350	U	350	U	350	U	350	U	350	U	350	U
CPP-90-3	39001401	350	U	350	U	350	U	350	U	350	U	350	U	350	U
CPP-90-3	39001501	360	U	360	U	360	U	360	U	360	U	360	U	360	U
CPP-91-2	39101002	360	U	360	U	360	U	360	U	360	U	360	U	360	U

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Sample Location	Sample Designation	2-Methylphenol		bis (2-Chloroisopropyl) ether		4-Methylphenol		N-Nitroso-Di-n-propylamine		Hexochloroethane		Nitrobenzene		Isophorone	
		(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q
CPP-90-1	39000101	360	U	360	U	360	U	360	U	360	U	360	U	360	U
CPP-90-1	39000201	350	U	350	U	350	U	350	U	350	U	350	U	350	U
CPP-90-1	39000301	370	U	370	U	370	U	370	U	370	U	370	U	370	U
CPP-90-1	39000401	360	U	360	U	360	U	360	U	360	U	360	U	360	U
CPP-90-1	39000501	360	U	360	U	360	U	360	U	360	U	360	U	360	U
CPP-90-2	39000601	360	U	360	U	360	U	360	U	360	U	360	U	360	U
CPP-90-2	39000701	360	U	360	U	360	U	360	U	360	U	360	U	360	U
CPP-90-2	39000801	360	U	360	U	360	U	360	U	360	U	360	U	360	U
CPP-90-2	39000901	360	U	360	U	360	U	360	U	360	U	360	U	360	U
CPP-90-2	39000902	360	U	360	U	360	U	360	U	360	U	360	U	360	U
CPP-90-2	39001001	400	U	400	U	400	U	400	U	400	U	400	U	400	U
CPP-90-3	39001101	360	U	360	U	360	U	360	U	360	U	360	U	360	U
CPP-90-3	39001201	360	U	360	U	360	U	360	U	360	U	360	U	360	U
CPP-90-3	39001301	350	U	350	U	350	U	350	U	350	U	350	U	350	U
CPP-90-3	39001401	350	U	350	U	350	U	350	U	350	U	350	U	350	U
CPP-90-3	39001501	360	U	360	U	360	U	360	U	360	U	360	U	360	U
CPP-91-2	39101002	360	U	360	U	360	U	360	U	360	U	360	U	360	U

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Sample Location	Sample Designation	2-Nitrophenol		2,4-Dimethylphenol		Benzoic acid		bis (2-Chloroethoxy) methane		2,4-Dichlorophenol		1,2,4-Trichlorobenzene		Naphthalene	
		(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q
CPP-90-1	39000101	360	U	360	U	1800	U	360	U	360	U	360	U	360	U
CPP-90-1	39000201	350	U	350	U	1800	U	350	U	350	U	350	U	350	U
CPP-90-1	39000301	370	U	370	U	1800	U	370	U	370	U	370	U	370	U
CPP-90-1	39000401	360	U	360	U	1800	U	360	U	360	U	360	U	360	U
CPP-90-1	39000501	360	U	360	U	1800	U	360	U	360	U	360	U	360	U
CPP-90-2	39000601	360	U	360	U	1800	U	360	U	360	U	360	U	360	U
CPP-90-2	39000701	360	U	360	U	1800	U	360	U	360	U	360	U	360	U
CPP-90-2	39000801	360	U	360	U	1800	U	360	U	360	U	360	U	360	U
CPP-90-2	39000901	360	U	360	U	1800	U	360	U	360	U	360	U	360	U
CPP-90-2	39000902	360	U	360	U	1800	U	360	U	360	U	360	U	360	U
CPP-90-2	39001001	400	U	400	U	2000	U	400	U	400	U	400	U	400	U
CPP-90-3	39001101	360	U	360	U	1800	U	360	U	360	U	360	U	360	U
CPP-90-3	39001201	360	U	360	U	1800	U	360	U	360	U	360	U	360	U
CPP-90-3	39001301	350	U	350	U	1800	U	350	U	350	U	350	U	350	U
CPP-90-3	39001401	350	U	350	U	1800	U	350	U	350	U	350	U	350	U
CPP-90-3	39001501	360	U	360	U	1800	U	360	U	360	U	360	U	360	U
CPP-91-2	39101002	360	U	360	U	1800	U	360	U	360	U	360	U	360	U

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Sample Location	Sample Designation	4-Choroaniline		Hexachloro-butadiene		4-Chloro-3-methylphenol		2-Methylnaphthalene		Hexachloro-cyclopentadiene		2,4,6-Trichlorophenol		2,4,5-Trichlorophenol	
		(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q
CPP-90-1	39000101	360	U	360	U	360	U	360	U	360	U	360	U	1800	U
CPP-90-1	39000201	350	U	350	U	350	U	350	U	350	U	350	U	1800	U
CPP-90-1	39000301	370	U	370	U	370	U	370	U	370	U	370	U	1800	U
CPP-90-1	39000401	360	U	360	U	360	U	360	U	360	U	360	U	1800	U
CPP-90-1	39000501	360	U	360	U	360	U	360	U	360	U	360	U	1800	U
CPP-90-2	39000601	360	U	360	U	360	U	360	U	360	U	360	U	1800	U
CPP-90-2	39000701	360	U	360	U	360	U	360	U	360	U	360	U	1800	U
CPP-90-2	39000801	360	U	360	U	360	U	360	U	360	U	360	U	1800	U
CPP-90-2	39000901	360	U	360	U	360	U	360	U	360	U	360	U	1800	U
CPP-90-2	39000902	360	U	360	U	360	U	360	U	360	U	360	U	1800	U
CPP-90-2	39001001	400	U	400	U	400	U	400	U	400	U	400	U	2000	U
CPP-90-3	39001101	360	U	360	U	360	U	360	U	360	U	360	U	1800	U
CPP-90-3	39001201	360	U	360	U	360	U	360	U	360	U	360	U	1800	U
CPP-90-3	39001301	350	U	350	U	350	U	350	U	350	U	350	U	1800	U
CPP-90-3	39001401	350	U	350	U	350	U	350	U	350	U	350	U	1800	U
CPP-90-3	39001501	360	U	360	U	360	U	360	U	360	U	360	U	1800	U
CPP-91-2	39101002	360	U	360	U	360	U	360	U	360	U	360	U	1800	U

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Sample Location	Sample Designation	2-Chloronaphthalene		2-Nitroaniline		Dimethylphthalate		Acenaphthylene		2,6-Dinitrotoluene		3-Nitroaniline		Acenaphthene	
		(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q
CPP-90-1	39000101	360	U	1800	U	360	U	360	U	360	U	1800	U	360	U
CPP-90-1	39000201	350	U	1800	U	350	U	350	U	350	U	1800	U	350	U
CPP-90-1	39000301	370	U	1800	U	370	U	370	U	370	U	1800	U	370	U
CPP-90-1	39000401	360	U	1800	U	360	U	360	U	360	U	1800	U	360	U
CPP-90-1	39000501	360	U	1800	U	360	U	360	U	360	U	1800	U	360	U
CPP-90-2	39000601	360	U	1800	U	360	U	360	U	360	U	1800	U	360	U
CPP-90-2	39000701	360	U	1800	U	360	U	360	U	360	U	1800	U	360	U
CPP-90-2	39000801	360	U	1800	U	360	U	360	U	360	U	1800	U	360	U
CPP-90-2	39000901	360	U	1800	U	360	U	360	U	360	U	1800	U	360	U
CPP-90-2	39000902	360	U	1800	U	360	U	360	U	360	U	1800	U	360	U
CPP-90-2	39001001	400	U	2000	U	400	U	400	U	400	U	2000	U	400	U
CPP-90-3	39001101	360	U	1800	U	360	U	360	U	360	U	1800	U	55	J
CPP-90-3	39001201	360	U	1800	U	360	U	360	U	360	U	1800	U	360	U
CPP-90-3	39001301	350	U	1800	U	350	U	350	U	350	U	1800	U	350	U
CPP-90-3	39001401	350	U	1800	U	350	U	350	U	350	U	1800	U	350	U
CPP-90-3	39001501	360	U	1800	U	360	U	360	U	360	U	1800	U	360	U
CPP-91-2	39101002	360	U	1800	U	360	U	360	U	360	U	1800	U	360	U

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Sample Location	Sample Designation	2,4-Dinitrophenol		4-Nitrophenol		Dibenzofuran		2,4-Dinitrotoluene		Diethylphthalate		4-Chlorophenyl-phenylether		Fluorene	
		(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q
CPP-90-1	39000101	1800	U	1800	U	360	U	360	U	360	U	360	U	360	U
CPP-90-1	39000201	1800	U	1800	U	350	U	350	U	350	U	350	U	350	U
CPP-90-1	39000301	1800	U	1800	U	370	U	370	U	370	U	370	U	370	U
CPP-90-1	39000401	1800	U	1800	U	360	U	360	U	360	U	360	U	360	U
CPP-90-1	39000501	1800	U	1800	U	360	U	360	U	360	U	360	U	360	U
CPP-90-2	39000601	1800	U	1800	U	360	U	360	U	360	U	360	U	360	U
CPP-90-2	39000701	1800	U	1800	U	360	U	360	U	360	U	360	U	360	U
CPP-90-2	39000801	1800	U	1800	U	360	U	360	U	360	U	360	U	360	U
CPP-90-2	39000901	1800	U	1800	U	360	U	360	U	360	U	360	U	360	U
CPP-90-2	39000902	1800	U	1800	U	360	U	360	U	360	U	360	U	360	U
CPP-90-2	39001001	2000	U	2000	U	400	U	400	U	400	U	400	U	400	U
CPP-90-3	39001101	1800	U	1800	U	360	U	360	U	360	U	360	U	360	U
CPP-90-3	39001201	1800	U	1800	U	360	U	360	U	360	U	360	U	360	U
CPP-90-3	39001301	1800	U	1800	U	350	U	350	U	350	U	350	U	350	U
CPP-90-3	39001401	1800	U	1800	U	350	U	350	U	350	U	350	U	350	U
CPP-90-3	39001501	1800	U	1800	U	360	U	360	U	360	U	360	U	360	U
CPP-91-2	39101002	1800	U	1800	U	360	U	360	U	360	U	360	U	360	U

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Sample Location	Sample Designation	4-Nitroaniline		4,6-Dinitro-2-methylphenol		N-Nitrosodi-phenylamine (1)		4-Bromophenyl-phenylether		Hexachoro-benzene		Pentachlorophenol		Phenanthrene	
		(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q
CPP-90-1	39000101	1800	U	1800	U	360	U	360	U	360	U	1800	U	360	U
CPP-90-1	39000201	1800	U	1800	U	350	U	350	U	350	U	1800	U	350	U
CPP-90-1	39000301	1800	U	1800	U	370	U	370	U	370	U	1800	U	370	U
CPP-90-1	39000401	1800	U	1800	U	360	U	360	U	360	U	1800	U	360	U
CPP-90-1	39000501	1800	U	1800	U	360	U	360	U	360	U	1800	U	360	U
CPP-90-2	39000601	1800	U	1800	U	360	U	360	U	360	U	1800	U	360	U
CPP-90-2	39000701	1800	U	1800	U	360	U	360	U	360	U	1800	U	360	U
CPP-90-2	39000801	1800	U	1800	U	360	U	360	U	360	U	1800	U	360	U
CPP-90-2	39000901	1800	U	1800	U	360	U	360	U	360	U	1800	U	360	U
CPP-90-2	39000902	1800	U	1800	U	360	U	360	U	360	U	1800	U	360	U
CPP-90-2	39001001	2000	U	2000	U	400	U	400	U	400	U	2000	U	400	U
CPP-90-3	39001101	1800	U	1800	U	360	U	360	U	360	U	1800	U	290	J
CPP-90-3	39001201	1800	U	1800	U	360	U	360	U	360	U	1800	U	360	U
CPP-90-3	39001301	1800	U	1800	U	350	U	350	U	350	U	1800	U	53	J
CPP-90-3	39001401	1800	U	1800	U	350	U	350	U	350	U	1800	U	350	U
CPP-90-3	39001501	1800	U	1800	U	360	U	360	U	360	U	1800	U	360	U
CPP-91-2	39101002	1800	U	1800	U	360	U	360	U	360	U	1800	U	360	U

(1) Cannot be separated from Diphenylamine

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Sample Location	Sample Designation	Anthracene		Di-n-Butylphthalate		Fluoranthene		Pyrene		Butylbenzyl-phthalate		3,3'-Dichlorobenzidine		Benzo (a) anthracene	
		(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q
CPP-90-1	39000101	360	U	360	U	360	U	360	U	360	U	710	U	360	U
CPP-90-1	39000201	350	U	350	U	350	U	350	U	350	U	710	U	350	U
CPP-90-1	39000301	370	U	370	U	370	U	370	U	370	U	730	U	370	U
CPP-90-1	39000401	360	U	360	U	360	U	360	U	360	U	710	U	360	U
CPP-90-1	39000501	360	U	360	U	360	U	360	U	360	U	720	U	360	U
CPP-90-2	39000601	360	U	360	U	360	U	360	U	360	U	710	U	360	U
CPP-90-2	39000701	360	U	360	U	360	U	360	U	360	U	730	U	360	U
CPP-90-2	39000801	360	U	360	U	360	U	360	U	360	U	720	U	360	U
CPP-90-2	39000901	360	U	360	U	360	U	360	U	360	U	720	U	360	U
CPP-90-2	39000902	360	U	360	U	360	U	360	U	360	U	720	U	360	U
CPP-90-2	39001001	400	U	400	U	400	U	400	U	400	U	800	U	400	U
CPP-90-3	39001101	49	J	360	U	390		400		360	U	720	U	360	U
CPP-90-3	39001201	360	U	360	U	45	J	48	J	360	U	720	U	360	U
CPP-90-3	39001301	350	U	350	U	77	J	76	J	350	U	700	U	350	U
CPP-90-3	39001401	350	U	350	U	350	U	350	U	350	U	710	U	350	U
CPP-90-3	39001501	360	U	360	U	360	U	360	U	360	U	710	U	360	U
CPP-91-2	39101002	360	U	360	U	360	U	360	U	360	U	720	U	360	U

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Sample Location	Sample Designation	Chrysene		bis (2-Ethylhexyl) phthalate		Di-n-Octyl phthalate		Benzo (b) fluoranthene		Benzo (k) fluoranthene		Benzo (a) pyrene		Indeo (1,2,3-cd) pyrene	
		(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q
CPP-90-1	39000101	360	U	360	U	360	U	360	U	360	U	360	U	360	U
CPP-90-1	39000201	350	U	350	U	350	U	350	U	350	U	350	U	350	U
CPP-90-1	39000301	370	U	370	U	370	U	370	U	370	U	370	U	370	U
CPP-90-1	39000401	360	U	360	U	360	U	360	U	360	U	360	U	360	U
CPP-90-1	39000501	360	U	360	U	360	U	360	U	360	U	360	U	360	U
CPP-90-2	39000601	360	U	360	U	360	U	360	U	360	U	360	U	360	U
CPP-90-2	39000701	360	U	360	U	360	U	360	U	360	U	360	U	360	U
CPP-90-2	39000801	360	U	57	J	360	U	360	U	360	U	360	U	360	U
CPP-90-2	39000901	360	U	360	U	360	U	360	U	360	U	360	U	360	U
CPP-90-2	39000902	360	U	360	U	360	U	360	U	360	U	360	U	360	U
CPP-90-2	39001001	400	U	400	U	400	U	400	U	400	U	400	U	400	U
CPP-90-3	39001101	220	J	360	U	360	U	120	J	150	J	150	J	81	J
CPP-90-3	39001201	360	U	360	U	360	U	360	U	360	U	360	U	360	U
CPP-90-3	39001301	46	J	350	U	350	U	350	U	350	U	350	U	350	U
CPP-90-3	39001401	350	U	350	U	350	U	350	U	350	U	350	U	350	U
CPP-90-3	39001501	360	U	360	U	360	U	360	U	360	U	360	U	360	U
CPP-91-2	39101002	360	U	360	U	360	U	360	U	360	U	360	U	360	U

WAG 3 RI/FS Investigation - Soil

Sample Location	Sample Designation	Dibenzo (a,h) anthracene		Benzo (g,h,i) perylene		Aldol Condensate		Bromacil		Unknown		Alkane			
		(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q
CPP-90-1	39000101	360	U	360	U	1000 (1) 300 (2) 600 (3) 100 (4)	R R R R	100 (9)	JN	200 (10) 300 (11)	J J				
CPP-90-1	39000201	350	U	350	U	1000 (1) 400 (2) 700 (3)	R R R			200 (10) 400 (11) 200 (12)	J J J				
CPP-90-1	39000301	370	U	370	U	1000 (1) 300 (5) 800 (3)	R R R			300 (13) 800 (11) 100 (12)	J J J				
CPP-90-1	39000401	360	U	360	U	1000 (6) 200 (7) 200 (8)	R R R			200 (14) 400 (15)	J J	2000 (16) 400 (17)	J J		
CPP-90-1	39000501	360	U	360	U	1000 (18) 200 (19) 300 (8)	R R R			300 (15)	J	1000 (20) 300 (21)	J J		
CPP-90-2	39000601	360	U	360	U	1000 (18) 100 (22) 200 (19) 500 (80	R R R R			300 (24) 300 (15)	J J	1000 (20) 300 (17) 100 (23)	J J J		
CPP-90-2	39000701	360	U	360	U	1000 (18) 300 (19) 500 (8)	R R R			100 (24) 200 (14) 200 (15) 200 (25)	J J J J	900 (20) 200 (17)	J J		
CPP-90-2	39000801	360	U	360	U	1000 (18) 300 (7) 300 (8)	R R R			300 (14) 300 (15)	J J	2000 (20) 400 (17)	J J		
CPP-90-2	39000901	360	U	360	U	1000 (18) 300 (19) 300 (8)	R R R			400 (15)	J	1000 (20) 300 (21)	J J		
CPP-90-2	39000902	360	U	360	U	1000 (18) 300 (19) 200 (8)	R R R			300 (15)	J	1000 (20) 300 (21)	J J		
CPP-90-2	39001001	400	U	400	U	1000 (18) 200 (7) 200 (8)	R R R					2000 (16) 300 (17)	J J		

WAG 3 RI/FS Investigation - Soil

Sample Location	Sample Designation	Dibenzo (a,h) anthracene		Benzo (g,h,i) perylene		Aldol Condensate		Bromacil		Unknown		Alkane			
		(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q
CPP-90-3	39001101	360	U	89	J	1000 (26) 200 (27) 400 (28) 400 (29) 200 (30)	R R R R R					100 (31) 200 (32)	J J		
CPP-90-3	39001201	360	U	360	U	1000 (26) 100 (33) 300 (28) 400 (29)	R R R R			200 (34) 900 (35)	J J	400 (31)	J		
CPP-90-3	39001301	350	U	350	U	1000 (26) 200 (2) 800 (29)	R R R			600 (35)	J				
CPP-90-3	39001401	350	U	350	U	1000 (26) 200 (28) 300 (3)	R R R			900 (35)	J				
CPP-90-3	39001501	360	U	360	U	1000 (36) 200 (28) 200 (29)	R R R			400 (37)	J				
CPP-91-2	39101002	360	U	360	U	1000 (36) 200 (38) 200 (29)	R R R			300 (34) 800 (37)	J J				

(1) Aldol condensate: RT=8.01 minutes
(2) Aldol condensate: RT=8.56 minutes
(3) Aldol condensate: RT=9.35 minutes
(4) Aldol condensate: RT=9.77 minutes
(5) Aldol condensate: RT=8.57 minutes
(6) Aldol condensate: RT=7.78 minutes
(7) Aldol condensate: RT=8.34 minutes
(8) Aldol condensate: RT=9.12 minutes
(9) Bromacil: RT=21.56 minutes
(10) Unknown: RT=23.78 minutes
(11) Unknown: RT=27.55 minutes
(12) Unknown: RT=35.90 minutes
(13) Unknown: RT=23.79 minutes
(14) Unknown: RT=23.56 minutes
(15) Unknown: RT=27.14 minutes
(16) Alkane: RT=16.72 minutes
(17) Alkane: RT=17.95 minutes
(18) Aldol condensate: RT=7.77 minutes
(19) Aldol condensate: RT=8.33 minutes
(20) Alkane: RT=16.71 minutes
(21) Alkane: RT=17.94 minutes
(22) Aldol condensate: RT=8.04 minutes
(23) Alkane: RT=28.18 minutes
(24) Unknown: RT=8.04 minutes
(25) Unknown: RT=35.23 minutes
(26) Aldol condensate: RT=8.00 minutes
(27) Aldol condensate: RT=8.27 minutes
(28) Aldol condensate: RT=8.55 minutes
(29) Aldol condensate: RT=9.34 minutes
(30) Aldol condensate:RT=10.49 minutes
(31) Alkane: RT=14.26 minutes
(32) Alkane: RT=28.65 minutes
(33) Aldol condensate: RT=8.26 minutes
(34) Unknown: RT=23.77 minutes
(35) Unknown: RT=27.54 minutes
(36) Aldol condensate: RT=7.99 minutes
(37) Unknown: RT=27.53 minutes
(38) Aldol condensate: RT=8.54 minutes

WAG 3 RI/FS Investigation - Soil

Sample Location	Sample Designation	Chloromethane		Bromomethane		Vinyl Chloride		Chloroethane		Methyl Chloride		Acetone		Carbon Disulfide	
		(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q
CPP-90-1	39000101	11	U	11	U	11	U	11	U	14	U	11	U	6	U
CPP-90-1	39000201	11	U	11	U	11	U	11	U	14	U	11	U	6	U
CPP-90-1	39000301	11	U	11	U	11	U	11	U	14	U	11	U	6	U
CPP-90-1	39000401	11	U	11	U	11	U	11	U	11	U	11	U	6	U
CPP-90-1	39000501	11	U	11	U	11	U	11	U	11	U	11	U	6	U
CPP-90-2	39000601	11	U	11	U	11	U	11	U	15	U	11	U	6	U
CPP-90-2	39000701	11	U	11	U	11	U	11	U	17	U	11	U	6	U
CPP-90-2	39000801	11	U	11	U	11	U	11	U	15	U	11	U	6	U
CPP-90-2	39000901	11	U	11	U	11	U	11	U	16	U	11	U	6	U
CPP-90-2	39000902	11	U	11	U	11	U	11	U	18	U	11	U	6	U
CPP-90-2	39001001	12	U	12	U	12	U	12	U	20	U	12	U	6	U
CPP-90-3	39001101	11	U	11	U	11	U	11	U	11	BJ	11	U	6	U
CPP-90-3	39001201	11	U	11	U	11	U	11	U	6	BJ	9	BJ	6	U
CPP-90-3	39001301	10	U	10	U	10	U	10	U	4	BJ	14	BJ	5	U
CPP-90-3	39001401	11	U	11	U	11	U	11	U	9	BJ	11	U	6	U
CPP-90-3	39001501	10	U	10	U	10	U	10	U	12	BJ	10	U	5	U
CPP-91-2	39101002	11	U	11	U	11	U	11	U	10	U	11	U	6	U

WAG 3 RI/FS Investigation - Soil

Sample Location	Sample Designation	1,1-Dichloroethene		1,1-Dichloroethane		1,2-Dichloroethene (total)		Chloroform		1,2-Dichloroethane		2-Butanone		1,1,1-Tirchloroethane	
		(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q
CPP-90-1	39000101	6	U	6	U	6	U	6	U	6	U	11	U	6	U
CPP-90-1	39000201	6	U	6	U	6	U	6	U	6	U	11	U	6	U
CPP-90-1	39000301	6	U	6	U	6	U	6	U	6	U	11	U	6	U
CPP-90-1	39000401	6	U	6	U	6	U	6	U	6	U	11	U	6	U
CPP-90-1	39000501	6	U	6	U	6	U	6	U	6	U	11	U	6	U
CPP-90-2	39000601	6	U	6	U	6	U	6	U	6	U	11	U	6	U
CPP-90-2	39000701	6	U	6	U	6	U	6	U	6	U	11	U	6	U
CPP-90-2	39000801	6	U	6	U	6	U	6	U	6	U	11	U	6	U
CPP-90-2	39000901	6	U	6	U	6	U	6	U	6	U	11	U	6	U
CPP-90-2	39000902	6	U	6	U	6	U	6	U	6	U	11	U	6	U
CPP-90-2	39001001	6	U	6	U	6	U	6	U	6	U	12	U	6	U
CPP-90-3	39001101	6	U	6	U	6	U	6	U	6	U	11	U	6	U
CPP-90-3	39001201	6	U	6	U	6	U	6	U	6	U	11	U	6	U
CPP-90-3	39001301	5	U	5	U	5	U	5	U	5	U	10	U	5	U
CPP-90-3	39001401	6	U	6	U	6	U	6	U	6	U	11	U	6	U
CPP-90-3	39001501	5	U	5	U	5	U	5	U	5	U	10	U	5	U
CPP-91-2	39101002	6	U	6	U	6	U	6	U	6	U	11	U	6	U

WAG 3 RI/FS Investigation - Soil

Sample Location	Sample Designation	Carbon Tetrachloride		Vinyl Acetate		Bromodichloro-methane		1,2-Dichloropropane		cis - 1,3-Dichloropropene		Trichloroethene		Dibromochloro-methane	
		(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q
CPP-90-1	39000101	6	U	11	U	6	U	6	U	6	U	6	U	6	U
CPP-90-1	39000201	6	U	11	U	6	U	6	U	6	U	6	U	6	U
CPP-90-1	39000301	6	U	11	U	6	U	6	U	6	U	6	U	6	U
CPP-90-1	39000401	6	U	11	U	6	U	6	U	6	U	6	U	6	U
CPP-90-1	39000501	6	U	11	U	6	U	6	U	6	U	6	U	6	U
CPP-90-2	39000601	6	U	11	U	6	U	6	U	6	U	6	U	6	U
CPP-90-2	39000701	6	U	11	U	6	U	6	U	6	U	6	U	6	U
CPP-90-2	39000801	6	U	11	U	6	U	6	U	6	U	6	U	6	U
CPP-90-2	39000901	6	U	11	U	6	U	6	U	6	U	6	U	6	U
CPP-90-2	39000902	6	U	11	U	6	U	6	U	6	U	6	U	6	U
CPP-90-2	39001001	6	U	12	U	6	U	6	U	6	U	6	U	6	U
CPP-90-3	39001101	6	U	11	U	6	U	6	U	6	U	6	U	6	U
CPP-90-3	39001201	6	U	11	U	6	U	6	U	6	U	6	U	6	U
CPP-90-3	39001301	5	U	10	U	5	U	5	U	5	U	5	U	5	U
CPP-90-3	39001401	6	U	11	U	6	U	6	U	6	U	6	U	6	U
CPP-90-3	39001501	5	U	10	U	5	U	5	U	5	U	5	U	5	U
CPP-91-2	39101002	6	U	11	U	6	U	6	U	6	U	6	U	6	U

WAG 3 RI/FS Investigation - Soil

Sample Location	Sample Designation	1,1,2-Trichloroethane		Benzene		Trans-1,3-Dichloropropene		Bromoform		4-Methyl-2-pentanone		2-Hexanone		Tetrachloroethene	
		(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q
CPP-90-1	39000101	6	U	6	U	6	U	6	U	11	U	11	U	6	U
CPP-90-1	39000201	6	U	6	U	6	U	6	U	11	U	11	U	6	U
CPP-90-1	39000301	6	U	6	U	6	U	6	U	11	U	11	U	6	U
CPP-90-1	39000401	6	U	6	U	6	U	6	U	11	U	11	U	6	U
CPP-90-1	39000501	6	U	6	U	6	U	6	U	11	U	11	U	6	U
CPP-90-2	39000601	6	U	6	U	6	U	6	U	11	U	11	U	6	U
CPP-90-2	39000701	6	U	6	U	6	U	6	U	11	U	11	U	6	U
CPP-90-2	39000801	6	U	6	U	6	U	6	U	11	U	11	U	6	U
CPP-90-2	39000901	6	U	6	U	6	U	6	U	11	U	11	U	6	U
CPP-90-2	39000902	6	U	6	U	6	U	6	U	11	U	11	U	6	U
CPP-90-2	39001001	6	U	6	U	6	U	6	U	12	U	12	U	6	U
CPP-90-3	39001101	6	U	6	U	6	U	6	U	11	U	11	U	6	U
CPP-90-3	39001201	6	U	6	U	6	U	6	U	11	U	11	U	6	U
CPP-90-3	39001301	5	U	5	U	5	U	5	U	10	U	10	U	5	U
CPP-90-3	39001401	6	U	6	U	6	U	6	U	11	U	11	U	6	U
CPP-90-3	39001501	5	U	5	U	5	U	5	U	10	U	10	U	5	U
CPP-91-2	39101002	6	U	6	U	6	U	6	U	11	U	11	U	6	U

WAG 3 RI/FS Investigation - Soil

Sample Location	Sample Designation	1,1,2,2-Tetrachloroethane		Toluene		Chlorobenzene		Ethylbenzene		Styrene		Xylene (total)	
		(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q	(ug/kg)	Q
CPP-90-1	39000101	6	U	6	U	6	U	6	U	6	U	6	U
CPP-90-1	39000201	6	U	6	U	6	U	6	U	6	U	6	U
CPP-90-1	39000301	6	U	6	U	6	U	6	U	6	U	6	U
CPP-90-1	39000401	6	U	6	U	6	U	6	U	6	U	6	U
CPP-90-1	39000501	6	U	6	U	6	U	6	U	6	U	6	U
CPP-90-2	39000601	6	U	6	U	6	U	6	U	6	U	6	U
CPP-90-2	39000701	6	U	6	U	6	U	6	U	6	U	6	U
CPP-90-2	39000801	6	U	6	U	6	U	6	U	6	U	6	U
CPP-90-2	39000901	6	U	6	U	6	U	6	U	6	U	6	U
CPP-90-2	39000902	6	U	6	U	6	U	6	U	6	U	6	U
CPP-90-2	39001001	6	U	6	U	6	U	6	U	6	U	6	U
CPP-90-3	39001101	6	U	6	U	6	U	6	U	6	U	6	U
CPP-90-3	39001201	6	U	6	U	6	U	6	U	6	U	6	U
CPP-90-3	39001301	5	U	5	U	5	U	5	U	5	U	5	U
CPP-90-3	39001401	6	U	6	U	6	U	6	U	6	U	6	U
CPP-90-3	39001501	5	U	5	U	5	U	5	U	5	U	5	U
CPP-91-2	39101002	6	U	6	U	6	U	6	U	6	U	6	U

Sample Location	Sample Designation	Isopropyl alcohol		Unknown	
		(ug/kg)	Q	(ug/kg)	Q
CPP-91-2	39101002	70 (1)	JN	9 (2)	J

(1) Isopropyl alcohol: RT=4.008 minutes (2) Unknown: RT=24.331 minutes

WAG 3 RI/FS Investigation - Perched Ground Water

Well	Well Type	Date Sampled	Sample Designation	Water Depth (Feet TOC)	Comments
CPP-33-1	2" SS Well	Not sampled	31320101	99.91	There was insufficient water available in this well to collect a sample.
CPP-33-2	2" SS Well	5/17/95	31320201	97.5	
CPP-33-3	2" SS Well	Not sampled	31320301	118.33	There was insufficient water available in this well to collect a sample.
CPP-33-4	2" SS Well	5/17/95	31320401	102.85	This is well CPP-33-4E and well CPP-33-4W was dry and not sampled.
CPP-33-4 (duplicate)	2" SS Well	5/17/95	31324401	102.85	This is well CPP-33-4E and well CPP-33-4W was dry and not sampled.
CPP-37-4	2" SS Well	5/25/95	31320501	103.8	
CPP-55-06	2" SS Well	6/07/95	31320601	106.25	
MW-1	4" PVC Well	5/31/95	31320701	322.28	
MW-1	1" piezo	Not sampled	31320801		There was no water available in this well to collect a sample (dry well).
MW-2	2" PVC Well	6/05/95	31320901	107.49	
MW-3	2" PVC Well	Not sampled	31321001		There was no water available in this well to collect a sample (dry well).
MW-3	1" piezo	Not sampled	31321101		There was no water available in this well to collect a sample (dry well).
MW-4	2" PVC Well	6/08/95	31321201	105.85	
MW-4	1" piezo	Not sampled	31321301	131.1	There was insufficient water available in this well to collect a sample.
MW-5	2" PVC Well	6/02/95	31321401	112.3	
MW-6	2" PVC Well	5/18/95	31321501	122.7	
MW-7	2" PVC Well	Not sampled	31321601		There was no water available in this well to collect a sample (dry well).

WAG 3 RI/FS Investigation - Perched Ground Water

Well	Well Type	Date Sampled	Sample Designation	Water Depth (Feet TOC)	Comments
MW-7	1" piezo	Not sampled	31321701		There was no water available in this well to collect a sample (dry well).
MW-8	2" PVC Well	Not sampled	31321801		There was no water available in this well to collect a sample (dry well).
MW-9	2" PVC Well	Not sampled	31321901		There was no water available in this well to collect a sample (dry well).
MW-9	1" piezo	Not sampled	31322001		There was no water available in this well to collect a sample (dry well).
MW-10	2" PVC Well	6/14/95	31322101	148.12	
MW-10	1" piezo	Not sampled	31322201	79.12	There was insufficient water available in this well to collect a sample.
MW-11	2" PVC Well	Not sampled	31322301		There was no water available in this well to collect a sample (dry well).
MW-11	1" piezo	Not sampled	31322401		There was no water available in this well to collect a sample (dry well).
MW-12	2" PVC Well	Not sampled	31322501		There was no water available in this well to collect a sample (dry well).
MW-12	1" piezo	Not sampled	31322601		There was insufficient water available in this well to collect a sample.
MW-13	2" PVC Well	Not sampled	31322701		There was no water available in this well to collect a sample (dry well).
MW-14	2" PVC Well	Not sampled	31322801		There was no water available in this well to collect a sample (dry well).
MW-15	2" PVC Well	6/09/95	31322901	122.85	
MW-16	2" PVC Well	Not sampled	31323001		There was no water available in this well to collect a sample (dry well).
MW-17	2" PVC Well	5/22/95	31323101	190.37	
MW-17	1" piezo	Not sampled	31323201		There was no water available in this well to collect a sample (dry well).
MW-17	4" steel well	5/31/95	31323301	364.8	
MW-18	2" PVC Well	Not sampled	31323401	124.35	There was no water available in this well to collect a sample (dry well).

WAG 3 RI/FS Investigation - Perched Ground Water

Well	Well Type	Date Sampled	Sample Designation	Water Depth (Feet TOC)	Comments
MW-18	1" PVC Well	6/14/95	31323501	407.63	
MW-20	2" PVC Well	6/01/95	31323601	137.33	
MW-20	1" piezo	Not sampled	31323701	109.34	There was insufficient water available in this well to collect a sample.
USGS-50	4" steel well	5/30/95	31323801	384	
MW-5	2" PVC	10-11-95	313239	START	Start of MW-5 pump test sample.
MW-5	2" PVC	10-11-95	313240	MIDDLE	Middlet of MW-5 pump test sample.
MW-5	2" PVC	10-11-95	313241	END	End of MW-5 pump test sample.
MW-5	2" PVC	10-11-95	313242	MIDDLE	2nd middle sample was collected during test.
USGS-50 QC (duplicate)	4"SS	5-30-95	313243	384	Quality control sample.
CPP 33-4 QC	2"SS	5-30-95	313244	102.85	Quality control sample.
QC	RINSATE	6-2-95	313245	RINSATE	Quality control sample.
QC	FIELD BLANK	6-2-95	313246	FIELD BLANK	Quality control sample.

WAG 3 RI/FS Investigation - Perched Ground Water

well Designation	Sample Designation	Gross Alpha			Gross Beta			Tritium			Sr-90			Pu-238		
		Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q
CPP-33-1	31320101	NS			NS			NS			NS			NS		
CPP-33-2	31320201	3.0	1.4		317	4		2540	170		120 102	1 1		NA		
CPP-33-3	31320301	NS			NS			NS			NS			NS		
CPP-33-4	31320401	2.1	1.8	U	505	6		839	134		178 191	2 2		NA		
CPP-33-4 (duplicate)	31324401	8.4	2.6		491	7		971	143		173 178	1 2		0.06	0.07	U
CPP-37-4	31320501	3.8	1.6		57	2		1680	190		5.0	0.5		NA		
CPP-55-06	31320601	92	9		138800	200		621	113		66300	600		0.17	0.11	U
MW-1	31320701	3.0	2.1	U	26	3		24700	400		4.5	0.4		NA		
MW-1	31320801	NS			NS			NS			NS			NS		
MW-2	31320901	1140	220		589100	2600		6380	260		320000	3000		0.00	0.04	U
MW-3	31321001	NS			NS			NS			NS			NS		
MW-3	31321101	NS			NS			NS			NS			NS		
MW-4	31321201	23	4		23410	40		382	106	U	11900	200		0.07	0.08	U
MW-4	31321301	NS			NS			NS			NS			NS		
MW-5	31321401	265	108		206600	1600		15300	400		104000	1000		0.00	0.01	U
MW-6	31321501	0.3	1.4	U	5.2	1.7		197	123	U	0.7 1.3	0.3 0.3		NA		
MW-7	31321601	NS			NS			NS			NS			NS		
MW-7	31321701	NS			NS			NS			NS			NS		
MW-8	31321801	NS			NS			NS			NS			NS		
MW-9	31321901	NS			NS			NS			NS			NS		
MW-9	31322001	NS			NS			NS			NS			NS		

WAG 3 RI/FS Investigation - Perched Ground Water

well Designation	Sample Designation	Gross Alpha			Gross Beta			Tritium			Sr-90			Pu-238		
		Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q
MW-10	31322101	137	9	J	48800	100		38000	500		17200	200		0.05	0.06	U
MW-10	31322201	NS			NS			NS			NS			NS		
MW-11	31322301	NS			NS			NS			NS			NS		
MW-11	31322401	NS			NS			NS			NS			NS		
MW-12	31322501	NS			NS			NS			NS			NS		
MW-12	31322601	NS			NS			NS			NS			NS		
MW-13	31322701	NS			NS			NS			NS			NS		
MW-14	31322801	NS			NS			NS			NS			NS		
MW-15	31322901	25	4		44700	100		3630	176		22100	200		0.03	0.07	U
MW-16	31323001	NS			NS			NS			NS			NS		
MW-17	31323101	2.3	1.0		11	1		25700	400		2.2 1.6	0.4 1.4	U	NA		
MW-17	31323201	NS			NS			NS			NS			NS		
MW-17	31323301	0.0	1.1	U	45	2		25100	400		0.7	0.4	U	NA		
MW-18	31323401	NS			NS			NS			NS			NS		
MW-18	31323501	3.2	1.7	U	756	7		73000	700		207	2		NA		
MW-20	31323601	16	19	U	65300	600		1150			25770	30		0.00	0.12	U
MW-20	31323701	NS			NS			NS			NS			NS		
USGS-50	31323801	0.3	1.7	U	456	6		61900	700		151	2		NA		
USGS-50 (duplicate)	31324301	2.6	1.8	U	479	6		62800	700		159	2		NA		
CPP33-4 QC	31324401	8.4			491			971			173			.06		U
QC	31324501	3.2			8.9			711		U	.2		U	NA		
QC	31324502	1.2		U	1.5		U	281		U	.5			U		
QC	31324601	.6		U	2.7			56			1.1			NA		
QC	31324602	1.1			4			140		U	.3		U	NA		
MW-5	313239										76700					
MW-5	313240										98400					
MW-5	313241										104000					
MW-5	313241										101000					

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Well Designation	Sample Designation	Pu-239/240			Am-241			Np-237			I-129			Tc-99		
		Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q
CPP-33-1	31320101	NS			NS			NS			NS			NS		
CPP-33-2	31320201	NA			NA			NA			0.0	0.5	U	3.3 3.1	0.6 0.7	
CPP-33-3	31320301	NS			NS			NS			NS			NS		
CPP-33-4	31320401	NA			NA			NA			0.0	0.3	U	0.9 0.4	0.7 0.6	U U
CPP-33-4 (duplicate)	31324401	0.00	0.07	U	0.00	0.04	U	0.00	0.11	U	0.0	0.3	U	0.5 1.3	0.5 0.5	U
CPP-37-4	31320501	NA			NA			NA			0.0	0.2	U	3.3	0.6	
CPP-55-06	31320601	0.02	0.06	U	0.00	0.06	U	0.00	0.14	U	0.0	1.2	U	73	1	J
MW-1	31320701	NA			NA			NA			0.0	0.3	U	0.3	0.3	UJ
MW-1	31320801	NS			NS			NS			NS			NS		
MW-2	31320901	0.00	0.05	U	0.16	0.10	U	0.00	0.09	U	0.5	0.3	U	77	2	J
MW-3	31321001	NS			NS			NS			NS			NS		
MW-3	31321101	NS			NS			NS			NS			NS		
MW-4	31321201	0.00	0.04	U	0.00	0.06	U	0.00	0.09	U	0.0	1.3	U	12.9	0.7	
MW-4	31321301	NS			NS			NS			NS			NS		
MW-5	31321401	0.00	0.05	U	0.03	0.08	U	0.00	0.14	U	0.5	0.3	U	105	2	J
MW-6	31321501	NA			NA			NA			0.0	0.3	U	0.0 0.6	0.5 0.5	U U
MW-7	31321601	NS			NS			NS			NS			NS		
MW-7	31321701	NS			NS			NS			NS			NS		
MW-8	31321801	NS			NS			NS			NS			NS		
MW-9	31321901	NS			NS			NS			NS			NS		
MW-9	31322001	NS			NS			NS			NS			NS		
MW-10	31322101	0.00	0.04	U	0.00	0.05	U	0.00	0.14	U	0.0 0.0	0.5 0.7	U U	127	2	
MW-10	31322201	NS			NS			NS			NS			NS		
MW-11	31322301	NS			NS			NS			NS			NS		

WAG 3 RI/FS Investigation - Perched Ground Water

Well Designation	Sample Designation	Pu-239/240			Am-241			Np-237			I-129			Tc-99		
		Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q
MW-11	31322401	NS			NS			NS			NS			NS		
MW-12	31322501	NS			NS			NS			NS			NS		
MW-12	31322601	NS			NS			NS			NS			NS		
MW-13	31322701	NS			NS			NS			NS			NS		
MW-14	31322801	NS			NS			NS			NS			NS		
MW-15	31322901	0.01	0.08	U	0.11	0.10	U	0.00	0.13	U	0.0	1.4	U	23.7	0.6	J
MW-16	31323001	NS			NS			NS			NS			NS		
MW-17	31323101	NA			NA			NA			0.0	0.4	U	5.2 6.4	0.6 0.6	
MW-17	31323201	NS			NS			NS			NS			NS		
MW-17	31323301	NA			NA			NA			0.0	0.3	U	5.9	0.6	
MW-18	31323401	NS			NS			NS			NS			NS		
MW-18	31323501	NA			NA			NA			0.0	0.3	U	736	6	J
MW-20	31323601	0.07	0.08	U	0.00	0.06	U	0.02	0.14	U	0.0	0.3	U	18.3	0.5	
MW-20	31323701	NS			NS			NS			NS			NS		
USGS-50	31323801	NA			NA			NA			0.0	0.3	U	63	1	J
USGS-50 (duplicate)	31324301	NA			NA			NA			0.0	0.2	U	75	1	
CPP33-4 QC	31324401	0		U	0		U	0		U	0		U	1.3		
QC	31324501	NA			NA			NA			0		U	.5		U
QC	31324502	NA			NA			NA			0		U	1.5		U
QC	31324601	NA			NA			NA			0		U	1.1		J
QC	31324602	NA			NA			NA			0		U	.1		U

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Well Designation	Sample Designation	U-234			U-235			U-238			Ce-144			Nb-95		
		Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q
CPP-33-1	31320101	NS			NS			NS			NS			NS		
CPP-33-2	31320201	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-33-3	31320301	NA			NA			NA			NS			NS		
CPP-33-4	31320401	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-33-4 (duplicate)	31324401	3.2	0.6		0.0	0.2	U	2.8	0.5		ND	NA	U	ND	NA	U
CPP-37-4	31320501	NA			NA			NA			ND	NA	U	ND	NA	U
CPP-55-06	31320601	3.5	0.6	J	0.0	0.2	U	2.1	0.5	J	ND	NA	U	ND	NA	U
MW-1	31320701	NA			NA			NA			ND	NA	U	ND	NA	U
MW-1	31320801	NS			NS			NS			NS			NS		
MW-2	31320901	3.7	0.6	J	0.0	0.2	U	1.6	0.4	J	ND	NA	U	ND	NA	U
MW-3	31321001	NS			NS			NS			NS			NS		
MW-3	31321101	NS			NS			NS			NS			NS		
MW-4	31321201	4.1	0.6	J	0.1	0.2	U	1.9	0.4	J	ND	NA	U	ND	NA	U
MW-4	31321301	NS			NS			NS			NS			NS		
MW-5	31321401	1.9	0.4	J	0.0	0.2	U	0.8	0.3	J	ND	NA	U	ND	NA	U
MW-6	31321501	NA			NA			NA			ND	NA	U	ND	NA	U
MW-7	31321601	NS			NS			NS			NS			NS		
MW-7	31321701	NS			NS			NS			NS			NS		
MW-8	31321801	NS			NS			NS			NS			NS		
MW-9	31321901	NS			NS			NS			NS			NS		
MW-9	31322001	NS			NS			NS			NS			NS		
MW-10	31322101	4.6	0.7		0.0	0.2	U	2.2	0.5		ND	NA	U	ND	NA	U
MW-10	31322201	NS			NS			NS			NS			NS		
MW-11	31322301	NS			NS			NS			NS			NS		
MW-11	31322401	NS			NS			NS			NS			NS		
MW-12	31322501	NS			NS			NS			NS			NS		

WAG 3 RI/FS Investigation - Perched Ground Water

Well Designation	Sample Designation	U-234			U-235			U-238			Ce-144			Nb-95		
		Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q
MW-12	31322601	NS			NS			NS			NS			NS		
MW-13	31322701	NS			NS			NS			NS			NS		
MW-14	31322801	NS			NS			NS			NS			NS		
MW-15	31322901	11.8	1.0		0.2	0.3	U	2.3	0.5	J	ND	NA	U	ND	NA	U
MW-16	31323001	NS			NS			NS			NS			NS		
MW-17	31323101	NA			NA			NA			ND	NA	U	ND	NA	U
MW-17	31323201	NS			NS			NS			NS			NS		
MW-17	31323301	NA			NA			NA			ND	NA	U	ND	NA	U
MW-18	31323401	NS			NS			NS			NS			NS		
MW-18	31323501	NA			NA			NA			ND	NA	U	ND	NA	U
MW-20	31323601	3.8	0.5	J	0.0	0.2	U	2.7	0.5	J	ND	NA	U	ND	NA	U
MW-20	31323701	NS			NS			NS			NS			NS		
USGS-50	31323801	NA			NA			NA			ND	NA	U	ND	NA	U
USGS-50 (duplicate)	31324301	NA			NA			NA			ND	NA	U	ND	NA	U
CPP33-4 QC	31324401	3.2			0		U	2.8					U			U
QC	31324501												U			U
QC	31324502	.5		U	0		U	0		U			U			U
QC	31324601												U			U
QC	31324602												U			U

WAG 3 RI/FS Investigation - Perched Ground Water

Well Designation	Sample Designation	Co-60			Cs-134			Cs-137			Eu-154			Eu-155		
		Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q
CPP-33-1	31320101	NS			NS			NS			NS			NS		
CPP-33-2	31320201	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-33-3	31320301	NS			NS			NS			NS			NS		
CPP-33-4	31320401	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-33-4 (duplicate)	31324401	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-37-4	31320501	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-55-06	31320601	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
MW-1	31320701	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
MW-1	31320801	NS			NS			NS			NS			NS		
MW-2	31320901	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
MW-3	31321001	NS			NS			NS			NS			NS		
MW-3	31321101	NS			NS			NS			NS			NS		
MW-4	31321201	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
MW-4	31321301	NS			NS			NS			NS			NS		
MW-5	31321401	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
MW-6	31321501	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
MW-7	31321601	NS			NS			NS			NS			NS		
MW-7	31321701	NS			NS			NS			NS			NS		
MW-8	31321801	NS			NS			NS			NS			NS		
MW-9	31321901	NS			NS			NS			NS			NS		
MW-9	31322001	NS			NS			NS			NS			NS		
MW-10	31322101	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
MW-10	31322201	NS			NS			NS			NS			NS		
MW-11	31322301	NS			NS			NS			NS			NS		
MW-11	31322401	NS			NS			NS			NS			NS		
MW-12	31322501	NS			NS			NS			NS			NS		

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Well Designation	Sample Designation	Co-60			Cs-134			Cs-137			Eu-154			Eu-155		
		Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q
MW-12	31322601	NS			NS			NS			NS			NS		
MW-13	31322701	NS			NS			NS			NS			NS		
MW-14	31322801	NS			NS			NS			NS			NS		
MW-15	31322901	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
MW-16	31323001	NS			NS			NS			NS			NS		
MW-17	31323101	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
MW-17	31323201	NS			NS			NS			NS			NS		
MW-17	31323301	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
MW-18	31323401	NS			NS			NS			NS			NS		
MW-18	31323501	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
MW-20	31323601	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
MW-20	31323701	NS			NS			NS			NS			NS		
USGS-50	31323801	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-50 (duplicate)	31324301	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP33-4 QC	31324401			U			U			U			U			U
QC	31324501			U			U			U			U			U
QC	31324502			U			U			U			U			U
QC	31324601			U			U			U			U			U
QC	31324602			U			U			U			U			U

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Well Designation	Sample Designation	Ru-103			Ru-106			Sb-125			Co-58		
		Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q
CPP-33-1	31320101	NS			NS			NS			NS		
CPP-33-2	31320201	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-33-3	31320301	NS			NS			NS			NS		
CPP-33-4	31320401	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-33-4 (duplicate)	31324401	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-37-4	31320501	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP-55-06	31320601	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
MW-1	31320701	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
MW-1	31320801	NS			NS			NS			NS		
MW-2	31320901	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
MW-3	31321001	NS			NS			NS			NS		
MW-3	31321101	NS			NS			NS			NS		
MW-4	31321201	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
MW-4	31321301	NS			NS			NS			NS		
MW-5	31321401	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
MW-6	31321501	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
MW-7	31321601	NS			NS			NS			NS		
MW-7	31321701	NS			NS			NS			NS		
MW-8	31321801	NS			NS			NS			NS		
MW-9	31321901	NS			NS			NS			NS		
MW-9	31322001	NS			NS			NS			NS		
MW-10	31322101	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
MW-10	31322201	NS			NS			NS			NS		
MW-11	31322301	NS			NS			NS			NS		
MW-11	31322401	NS			NS			NS			NS		
MW-12	31322501	NS			NS			NS			NS		

WAG 3 RI/FS Investigation - Perched Ground Water

Well Designation	Sample Designation	Ru-103			Ru-106			Sb-125			Co-58		
		Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q	Result (pCi/L)	Error (pCi/L)	Q
MW-12	31322601	NS			NS			NS			NS		
MW-13	31322701	NS			NS			NS			NS		
MW-14	31322801	NS			NS			NS			NS		
MW-15	31322901	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
MW-16	31323001	NS			NS			NS			NS		
MW-17	31323101	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
MW-17	31323201	NS			NS			NS			NS		
MW-17	31323301	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
MW-18	31323401	NS			NS			NS			NS		
MW-18	31323501	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
MW-20	31323601	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
MW-20	31323701	NS			NS			NS			NS		
USGS-50	31323801	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
USGS-50 (duplicate)	31324301	ND	NA	U	ND	NA	U	ND	NA	U	ND	NA	U
CPP33-4 QC	31324401			U			U			U			U
QC	31324501			U			U			U			U
QC	31324502			U			U			U			U
QC	31324601			U			U			U			U
QC	31324602			U			U			U			U

WAG 3 RI/FS Investigation - Perched Ground Water

Well Designation	Sample Designation	Aluminum		Antimony		Arsenic		Barium		Beryllium		Cadminum		Calcium		Chromium	
		(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q
CPP-33-1	31320101	NS		NS		NS		NS		NS		NS		NS		NS	
CPP-33-2	31320201	26.8	U	1.9	U	4.0	U	139		0.10	U	0.40	U	56200		5.7	
CPP-33-3	31320301	NS		NS		NS		NS		NS		NS		NS		NS	
CPP-33-4	31320401	26.8	U	1.9	U	4.0	U	138		0.10	U	0.40	U	51000		4.1	U
CPP-33-4 (duplicate)	31324401	26.8	U	1.9	U	4.0	U	284		0.10	U	0.40	U	103000		4.1	U
CPP-37-4	31320501	45.7	U	2.8		4.0	U	220		0.10	U	0.40	U	72200		4.1	U
CPP-55-06	31320601	50.5	U	2.0		4.9		289		0.10	U	0.40	U	94100		5.0	
MW-1	31320701	26.8	U	3.4		4.0	U	253		0.10	U	0.40	U	114000		4.1	U
MW-1	31320801	NS		NS		NS		NS		NS		NS		NS		NS	
MW-2	31320901	47.0	U	1.9	U	4.0	U	328		0.10	U	0.40	U	84400		4.8	
MW-3	31321001	NS		NS		NS		NS		NS		NS		NS		NS	
MW-3	31321101	NS		NS		NS		NS		NS		NS		NS		NS	
MW-4	31321201	58.2	U	1.9	U	4.2		227		0.10	U	0.40	U	85700		5.4	
MW-4	31321301	NS		NS		NS		NS		NS		NS		NS		NS	
MW-5	31321401	65.9	U	3.4		4.0	U	394		0.10	U	0.40	U	94900		4.1	U
MW-6	31321501	79.5	U	1.9	U	4.0	U	230		0.10	U	0.40	U	75800		4.1	U
MW-7	31321601	NS		NS		NS		NS		NS		NS		NS		NS	
MW-7	31321701	NS		NS		NS		NS		NS		NS		NS		NS	
MW-8	31321801	NS		NS		NS		NS		NS		NS		NS		NS	
MW-9	31321901	NS		NS		NS		NS		NS		NS		NS		NS	
MW-9	31322001	NS		NS		NS		NS		NS		NS		NS		NS	
MW-10	31322101	44.8	U	2.7	U	2.4	U	165		0.12		0.30	U	97100		1.6	U
MW-10	31322201	NS		NS		NS		NS		NS		NS		NS		NS	
MW-11	31322301	NS		NS		NS		NS		NS		NS		NS		NS	
MW-11	31322401	NS		NS		NS		NS		NS		NS		NS		NS	
MW-12	31322501	NS		NS		NS		NS		NS		NS		NS		NS	
MW-12	31322601	NS		NS		NS		NS		NS		NS		NS		NS	

WAG 3 RI/FS Investigation - Perched Ground Water

Well Designation	Sample Designation	Aluminum		Antimony		Arsenic		Barium		Beryllium		Cadminum		Calcium		Chromium	
		(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q
MW-13	31322701	NS		NS		NS		NS		NS		NS		NS		NS	
MW-14	31322801	NS		NS		NS		NS		NS		NS		NS		NS	
MW-15	31322901	45.8	U	1.9	U	5.1		71.4		0.10	U	0.40	U	62700		4.1	U
MW-16	31323001	NS		NS		NS		NS		NS		NS		NS		NS	
MW-17	31323101	68.9	U	1.9	U	4.0	U	72.1		0.10	U	0.40	U	40600		4.1	U
MW-17	31323201	NS		NS		NS		NS		NS		NS		NS		NS	
MW-17	31323301	26.8	U	6.4		4.0	U	136		0.10	U	0.40	U	22100		4.1	U
MW-18	31323401	NS		NS		NS		NS		NS		NS		NS		NS	
MW-18	31323501	69.7	U	2.7	U	3.4		86.8		0.10	U	0.30	U	49100		11.1	
MW-20	31323601	26.8	U	1.9	U	4.0	U	194		0.10	U	0.40	U	87700		4.1	U
MW-20	31323701	NS		NS		NS		NS		NS		NS		NS		NS	
USGS-50	31323801	26.8	U	1.9	U	4.0	U	183		0.10	U	0.40	U	73300		4.3	
USGS-50 (duplicate)	31324301	33.1	BU	1.9	U	4.0	U	165	B	0.10	U	0.40	U	67100		5.2	B
CPP33-4 QC	31324401	26.8	U	1.9	U	4	U	284		.1	U	.4	U	103000		4.1	U
QC	31324501	48.6	BU	1.9	U	4	U	1.8	B	.1	U	.4	U	538	BU	4.1	U
QC	31324502	28.7	BU	2.7.	U	2.4	U	.56	B	.2	*	.3	U	129	BU	1.6	U
QC	31324601	44.2	BU	1.9	U	4	U	.78	B	.1	U	.4	U	93	B	4.1	U
QC	31324602	44.3	BU	1.9	U	4	U	1	B	.1	U	.4	U	170	B	4.1	U

WAG 3 RI/FS Investigation - Perched Ground Water

Well Designation	Sample Designation	Cobalt		Copper		Iron		Lead		Magnesium		Manganese		Mercury		Nickel	
		(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q
CPP-33-1	31320101	NS		NS		NS		NS		NS		NS		NS		NS	
CPP-33-2	31320201	0.50	U														
CPP-33-3	31320301	NS		NS		NS		NS		NS		NS		NS		NS	
CPP-33-4	31320401	0.50	U	1.3	U	21.5	U	2.0	U	13700		0.85		0.10	U	3.4	U
CPP-33-4 (duplicate)	31324401	0.52		1.3	UJ	21.5	U	2.0	U	27000		0.80	U	0.10	U	3.4	U
CPP-37-4	31320501	1.3		1.3		21.5	U	2.0	U	23800		2.2		0.10	U	3.9	
CPP-55-06	31320601	0.90		1.3	U	21.5	U	2.0	UJ	27700		2.2		0.10	U	7.5	
MW-1	31320701	0.60		2.0		21.5	U	2.0	U	34000		18.9		0.10	U	3.4	U
MW-1	31320801	NS		NS		NS		NS		NS		NS		NS		NS	
MW-2	31320901	0.63		1.3	U	21.5	U	2.0	UJ	22900		0.80	U	0.10	U	3.4	U
MW-3	31321001	NS		NS		NS		NS		NS		NS		NS		NS	
MW-3	31321101	NS		NS		NS		NS		NS		NS		NS		NS	
MW-4	31321201	0.66		2.7		33.8		2.0	UJ	24300		1.4		0.10	U	3.4	U
MW-4	31321301	NS		NS		NS		NS		NS		NS		NS		NS	
MW-5	31321401	0.64		1.7		62.7		2.0	UJ	29200		186		0.10	U	3.4	U
MW-6	31321501	0.57		1.3	UJ	21.5	U	2.0	U	17900		1.2		0.10	U	3.4	U
MW-7	31321601	NS		NS		NS		NS		NS		NS		NS		NS	
MW-7	31321701	NS		NS		NS		NS		NS		NS		NS		NS	
MW-8	31321801	NS		NS		NS		NS		NS		NS		NS		NS	
MW-9	31321901	NS		NS		NS		NS		NS		NS		NS		NS	
MW-9	31322001	NS		NS		NS		NS		NS		NS		NS		NS	
MW-10	31322101	0.60	U	2.2	U	5.3	U	2.0	U	27900		1.1		0.10	U	3.0	U
MW-10	31322201	NS		NS		NS		NS		NS		NS		NS		NS	
MW-11	31322301	NS		NS		NS		NS		NS		NS		NS		NS	
MW-11	31322401	NS		NS		NS		NS		NS		NS		NS		NS	
MW-12	31322501	NS		NS		NS		NS		NS		NS		NS		NS	
MW-12	31322601	NS		NS		NS		NS		NS		NS		NS		NS	

WAG 3 RI/FS Investigation - Perched Ground Water

Well Designation	Sample Designation	Cobalt		Copper		Iron		Lead		Magnesium		Manganese		Mercury		Nickel	
		(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q
MW-13	31322701	NS		NS		NS		NS		NS		NS		NS		NS	
MW-14	31322801	NS		NS		NS		NS		NS		NS		NS		NS	
MW-15	31322901	0.50	U	1.3	U	21.5	U	2.0	J	15200		1.7		0.10	U	3.4	U
MW-16	31323001	NS		NS		NS		NS		NS		NS		NS		NS	
MW-17	31323101	0.50	U	2.7	J	173		2.0	U	10400		51.7		0.10	U	3.4	U
MW-17	31323201	NS		NS		NS		NS		NS		NS		NS		NS	
MW-17	31323301	0.50	U	14.9		21.5	U	2.0	U	9250		3.7		0.10	U	3.4	U
MW-18	31323401	NS		NS		NS		NS		NS		NS		NS		NS	
MW-18	31323501	0.94		2.2	U	30.0		2.0	U	18900		1.3	U	0.10	U	2.5	
MW-20	31323601	0.50	U	2.1		21.5	U	2.0	U	23400		0.80	U	0.10	U	3.4	U
MW-20	31323701	NS		NS		NS		NS		NS		NS		NS		NS	
USGS-50	31323801	0.50	U	2.6		21.5	U	2.0	U	20000		1.8		0.10	U	3.4	U
USGS-50 (duplicate)	31324301	1.2	B	7.4	B	21.5	U	2.0	U	18400		2.2	B	0.28		3.8	B
CPP33-4 QC	31324401	.52	B	1.3	UJ	21.5	U	2	U	27000		.8	U	.1	U	3.4	U
QC	31324501	.5	U	19	B	39.3	B	2	U	281	BU	3.3	B	.1	U	3.4	U
QC	31324502	.6	U	2.2	U	10.9	B	2	U	59.9	BU	.8	U	.1	U	1.8	U
QC	31324601	.5	U	10.8	B	28.2	B	2	UJ	47.6	B	.8	U	.1	U	3.4	U
QC	31324602	.5	U	9.6	B	25	B	2	UJ	88.4	B	1.6	B	.1	U	3.4	U

WAG 3 RI/FS Investigation - Perched Ground Water

Well Designation	Sample Designation	Potassium		Selenium		Silver		Sodium		Thallium		Vanadium		Zinc		Zirconium	
		(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q
CPP-33-1	31320101	NS		NS		NS		NS		NS		NS		NS		NS	
CPP-33-2	31320201	2910	J	2.7	U	0.60	U	21900		5.0		3.0	U	69.3	J	31.3	U
CPP-33-3	31320301	NS		NS		NS		NS		NS		NS		NS		NS	
CPP-33-4	31320401	1910	J	2.7	U	0.77	J	14300		4.6	U	1.4	U	7.6	UJ	31.3	U
CPP-33-4 (duplicate)	31324401	3930	J	5.4	U	0.60	UJ	30300		4.6	U	1.1	J	13.7		NA	
CPP-37-4	31320501	3960		4.0		0.60	U	40200		4.6	U	4.1		7.9	U	31.2	U
CPP-55-06	31320601	5240		2.7	U	0.60	U	48000		4.6	U	2.6		2.6		31.2	U
MW-1	31320701	6220		2.7	U	0.60	U	35400		4.6	U	2.2	U	29.5		31.2	U
MW-1	31320801	NS		NS		NS		NS		NS		NS		NS		NS	
MW-2	31320901	5340		2.7	U	0.60	U	59000		4.6	U	2.8		3.0		31.2	U
MW-3	31321001	NS		NS		NS		NS		NS		NS		NS		NS	
MW-3	31321101	NS		NS		NS		NS		NS		NS		NS		NS	
MW-4	31321201	4490		2.7	U	0.60	U	38500		4.6	U	2.7		30.2		31.2	U
MW-4	31321301	NS		NS		NS		NS		NS		NS		NS		NS	
MW-5	31321401	5300		2.7	U	0.60	U	41700		4.6	U	2.8		4.1		31.2	U
MW-6	31321501	3380	J	2.7	U	0.60	UJ	19600		4.6	U	2.4	J	16.7		NA	
MW-7	31321601	NS		NS		NS		NS		NS		NS		NS		NS	
MW-7	31321701	NS		NS		NS		NS		NS		NS		NS		NS	
MW-8	31321801	NS		NS		NS		NS		NS		NS		NS		NS	
MW-9	31321901	NS		NS		NS		NS		NS		NS		NS		NS	
MW-9	31322001	NS		NS		NS		NS		NS		NS		NS		NS	
MW-10	31322101	6510	J	3.0		0.80	U	44400	J	3.3		1.9		28.1	J	11.6	U
MW-10	31322201	NS		NS		NS		NS		NS		NS		NS		NS	
MW-11	31322301	NS		NS		NS		NS		NS		NS		NS		NS	
MW-11	31322401	NS		NS		NS		NS		NS		NS		NS		NS	
MW-12	31322501	NS		NS		NS		NS		NS		NS		NS		NS	
MW-12	31322601	NS		NS		NS		NS		NS		NS		NS		NS	

WAG 3 RI/FS Investigation - Perched Ground Water

Well Designation	Sample Designation	Potassium		Selenium		Silver		Sodium		Thallium		Vanadium		Zinc		Zirconium	
		(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q	(ug/L)	Q
MW-13	31322701	NS		NS		NS		NS		NS		NS		NS		NS	
MW-14	31322801	NS		NS		NS		NS		NS		NS		NS		NS	
MW-15	31322901	3980		3.0		0.60	U	37900		4.6	U	5.2		4.3		31.2	U
MW-16	31323001	NS		NS		NS		NS		NS		NS		NS		NS	
MW-17	31323101	5160	J	3.2	U	0.60	U	33300		4.6	U	1.5	J	3.4	U	NA	
MW-17	31323201	NS		NS		NS		NS		NS		NS		NS		NS	
MW-17	31323301	24500		2.7	U	0.60	U	75600		4.6	U	6.7		4.2		31.2	U
MW-18	31323401	NS		NS		NS		NS		NS		NS		NS		NS	
MW-18	31323501	8060	J	2.8	U	1.4		75200	J	3.2	U	3.4	U	27.1	J	11.6	U
MW-20	31323601	5310		2.7	U	0.60	U	47200		4.6	U	3.3	U	12.6	U	31.2	U
MW-20	31323701	NS		NS		NS		NS		NS		NS		NS		NS	
USGS-50	31323801	6350		2.7	U	0.60	U	66200		4.6	U	6.5		10.8	U	31.2	U
USGS-50 (duplicate)	31324301	5750		3.4	B	0.60	U	59400		4.6	U	6.0	B	10.8	UB	31.2	U
CPP33-4 QC	31324401	3930	BEJ	5.4	BU	.6	NU J	30300		4.6	U	1.1	BJ	13.7	B		
QC	31324501	81.5	BU	2.7	U	.6	U	266	BU	4.6	U	.4	U	18.6	BU	31.2	U
QC	31324502	40.6	U	2.8	U	.8	UN	138	U	3.2	U	.7	U	5.4	B	11.6	U
QC	31324601	19.2	B	2.7	U	.6	U	120	B	4.6	U	.4	U	11.7	B	31.2	U
QC	31324602	29.3	B	2.7	U	.6	U	183	B	4.6	U	.4	U	6.5	B	31.2	U

WAG 3 RI/FS Investigation - Perched Ground Water

Well Designation	Sample Designation	Alkalinity		Bicarbonate		Carbonate		Chloride		Fluoride		Sulfate		TKN		NO_3/NO_2 as N		Ammonia as N	
		(mg/L)	Q	(mg/L)	Q	(mg/L)	Q	(mg/L)	Q	(mg/L)	Q	(mg/L)	Q	(mg/L)	Q	(mg/L)	Q	(mg/L)	Q
CPP-33-1	31320101	NS		NS		NS		NS		NS		NS		NS		NS		NS	
CPP-33-2	31320201	168		168		2.0	U	27.4		0.29		27.7		0.10	U	3.3		0.10	U
CPP-33-3	31320301	NS		NS		NS		NS		NS		NS		NS		NS		NS	
CPP-33-4	31320401	217		217		2.0	U	81.2		0.16		61.8		0.10	U	13.0		0.10	U
CPP-33-4 (duplicate)	31324401	216		216		2.0	U	81.3		0.15		60.1		0.10	U	12.7		0.10	U
CPP-37-4	31320501	214		214		2.0	U	32.6		0.27		48.9		0.10	U	17.7		0.10	U
CPP-55-06	31320601	229		229		2.0	U	52.5		0.21		39.8		0.10	U	35.4		0.10	U
MW-1	31320701	165		165		2.0	U	63.4		0.22		26.4		0.10	UJ	69.6		0.10	U
MW-1	31320801	NS		NS		NS		NS		NS		NS		NS		NS		NS	
MW-2	31320901	223		223		2.0	U	83.7		0.24		35.5		0.10	U	15.7		0.10	U
MW-3	31321001	NS		NS		NS		NS		NS		NS		NS		NS		NS	
MW-3	31321101	NS		NS		NS		NS		NS		NS		NS		NS		NS	
MW-4	31321201	246		246		2.0	U	45.8		0.25		42.6		0.10	U	10.9		0.10	U
MW-4	31321301	NS		NS		NS		NS		NS		NS		NS		NS		NS	
MW-5	31321401	293		293		2.0	U	37.6		0.28		27.9		0.10	U	19.0		0.10	U
MW-6	31321501	180		180		2.0	U	55.7		0.21		26.2		0.10	U	4.6		0.10	U
MW-7	31321601	NS		NS		NS		NS		NS		NS		NS		NS		NS	
MW-7	31321701	NS		NS		NS		NS		NS		NS		NS		NS		NS	
MW-8	31321801	NS		NS		NS		NS		NS		NS		NS		NS		NS	
MW-9	31321901	NS		NS		NS		NS		NS		NS		NS		NS		NS	
MW-9	31322001	NS		NS		NS		NS		NS		NS		NS		NS		NS	
MW-10	31322101	217		217		2.0	U	54.4		0.24		61.4		0.10	U	26.8		0.10	U
MW-10	31322201	NS		NS		NS		NS		NS		NS		NS		NS		NS	
MW-11	31322301	NS		NS		NS		NS		NS		NS		NS		NS		NS	
MW-11	31322401	NS		NS		NS		NS		NS		NS		NS		NS		NS	
MW-12	31322501	NS		NS		NS		NS		NS		NS		NS		NS		NS	
MW-12	31322601	NS		NS		NS		NS		NS		NS		NS		NS		NS	

WAG 3 RI/FS Investigation - Perched Ground Water

Well Designation	Sample Designation	Alkalinity		Bicarbonate		Carbonate		Chloride		Fluoride		Sulfate		TKN		NO_3/NO_2 as N		Ammonia as N	
		(mg/L)	Q	(mg/L)	Q	(mg/L)	Q	(mg/L)	Q	(mg/L)	Q	(mg/L)	Q	(mg/L)	Q	(mg/L)	Q	(mg/L)	Q
MW-13	31322701	NS		NS		NS		NS		NS		NS		NS		NS		NS	
MW-14	31322801	NS		NS		NS		NS		NS		NS		NS		NS		NS	
MW-15	31322901	178		178		2.0	U	24.1		0.26		31.9		0.10	U	14.7		0.10	U
MW-16	31323001	NS		NS		NS		NS		NS		NS		NS		NS		NS	
MW-17	31323101	152		152		2.0	U	21.5		0.30		28.1		0.10	U	4.9		0.10	U
MW-17	31323201	NS		NS		NS		NS		NS		NS		NS		NS		NS	
MW-17	31323301	61.2		55.9		5.4		125		0.28		33.5		0.22	J	4.6		0.10	U
MW-18	31323401	NS		NS		NS		NS		NS		NS		NS		NS		NS	
MW-18	31323501	143		143		2.0	U	78.6		0.21		58.6		1.5	J	34.4		0.10	U
MW-20	31323601	284		284		2.0	U	28.3		0.23		49.3		0.10	UJ	12.1		0.10	U
MW-20	31323701	NS		NS		NS		NS		NS		NS		NS		NS		NS	
USGS-50	31323801	129		129		2.0	U	66.0		0.36		44.8		0.11		31.3		0.10	U
USGS-50 (duplicate)	31324301	130		130		2.0	U	69.6		0.35		44.5		0.10	U	33.2		0.10	U
CPP33-4 QC	31324401	216		216		2	U	81.3		.15		60.1		.1	U	12.7		.1	U

Appendix E

Appendix E

RI/FS QC Results and Summary of Qualified and Rejected Data

Field QC Sample Results

Organic, inorganic and miscellaneous parameters QC summary.

	Accuracy			Precision	
SDG #	Blanks	Spike recoveries	Lab calibration	Serial dilution %	Duplicates
JJE-172-95	X	-	X	-	-
JJE-174-95	-	-	-	-	X
JJE-175-95	X	-	-	X	X
JJE-176-95	X	-	-	X	-
JJE-177-95		X	-	-	-
JJE-178-95	X	-	-	-	-
JJE-183-95	X	X	X	-	-
JJE-184-95	X	X	-	X	X
JJE-185-95	X	X	-	-	X
JJE-207-95	X	-	-	-	-

X – Indicates qualified and/or rejected data as a result of QC out-of-tolerance.

Organic, inorganic and miscellaneous parameters QC summary.

SDG #	Accuracy			Precision	
	Blanks	Spike recoveries	Lab calibration	Serial dilution %	Duplicates
JJE-120-95	X	X	-	X	
JJE-121-95	X	X	-	X	-
JJE-123-95	X	X	-	-	X
JJE-133-95	X	X	-	X	X
JJE-142-95	X	X	-	X	-
JJE-143-95	X	-	-	-	X
JJE-144-95	X	X	-	-	X
JJE-159-95	X	-	-	-	-
JJE-161-95	X	-	-	-	-
JJE-164-95	-	X	-	X	-
JJE-167-95	-	X	-	-	-
JJE-169-95	-	-	-	X	X
JJE-170-95	-	X	-	X	X
JJE-171-95	X	-	-	X	-

Summary of Quality Control Parameters

Qualified radionuclide parameters due to out-of-tolerance precision.

SDG #	Sample ID #	GRA	GRB	GMS	Am-241	Co-60	Cs-134	Cs-137	Eu-154	H-3	I-129
RPW-258-95	3CS00401EH	-	-	-	-	NA	NA	NA	NA	NA	NA
RPW-258-95	3CS00501EH	-	-	-	-	NA	NA	NA	NA	NA	NA
RPW-258-95	3CS00601EH	-	-	-	-	NA	NA	NA	NA	NA	NA
DMF-14-95	39101001EH	NA	NA	NA	UJ	NA	NA	NA	NA	NA	NA

SDG #	Sample ID #	Np-237	Pu-238	Pu-239/240	Sr-90	Tc-99	U-233	U-234	U-235	U-236	U-238
RPW-258-95	3CS00401EH	-	-	J	-	-	NA	-	-	NA	-
RPW-258-95	3CS00501EH	-	-	J	-	-	NA	-	-	NA	-
RPW-258-95	3CS00601EH	-	-	J	-	-	NA	-	-	NA	-
DMF-14-95	39101001EH	UJ	-	-	-	J	UJ	-	-	J	-

J – The result is a statistically positive value at the 95% confidence level and is considered to be an estimated quantity.

UJ – The result is a statistical nondetect at the 95% confidence level and is considered to be an estimated quantity because of an unacceptable quality control parameter.

R – The result is rejected because of an unacceptable quality control parameter.

NA – The analyte was not analyzed for.

Qualified miscellaneous parameters due to out-of-tolerance precision and/or accuracy.

SDG #	Sample ID #	Analysis	Parameter	Qualification	QC
JJE-183-95	3XR00101VGDL	CLP volatile organic	MEK	J	Accuracy
JJE-183-95	3XV00101VGDL	CLP volatile organic	Acetone	J	Accuracy
JJE-183-95	3XV00101VGDL	CLP volatile organic	MEK	J	Accuracy

U – The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

UJ – The material was analyzed for, but was not detected. The associated value is an estimate and may not accurately reflect the IDL in the sample matrix.

J – The analyte was analyzed for and was positively identified, but the associated numerical value may not be consistent with the amount actually present in the envrionmental sample.

B – Teh analyte is found in the associated blank as well as the sample and indicates possible/probable blank contamination.

NA – The analyte was not analyzed for.

Qualified miscellaneous parameters due to out-of-tolerance precision and/or accuracy.

SDG #	Sample ID #	Analysis	Parameter	Qualification	QC
JJE-183-95	3XR00101VG	CLP volatile organic	Methylene chloride	U	Accuracy
JJE-183-95	3XV00101VG	CLP volatile organic	Methylene chloride	U	Accuracy
JJE-183-95	39000101VG	CLP volatile organic	Methylene chloride	U	Accuracy
JJE-183-95	39000201VG	CLP volatile organic	Methylene chloride	U	Accuracy
JJE-183-95	39000301VG	CLP volatile organic	Methylene chloride	U	Accuracy
JJE-183-95	39000401VG	CLP volatile organic	Methylene chloride	U	Accuracy
JJE-183-95	39000401VG	CLP volatile organic	Acetone	U	Accuracy
JJE-183-95	39000501VG	CLP volatile organic	Methylene chloride	U	Accuracy
JJE-183-95	39000501VG	CLP volatile organic	Acetone	U	Accuracy
JJE-183-95	39000601VG	CLP volatile organic	Methylene chloride	U	Accuracy
JJE-183-95	39000701VG	CLP volatile organic	Methylene chloride	U	Accuracy
JJE-183-95	39000801VG	CLP volatile organic	Methylene chloride	U	Accuracy
JJE-183-95	39000901VG	CLP volatile organic	Methylene chloride	U	Accuracy
JJE-183-95	39000902VG	CLP volatile organic	Methylene chloride	U	Accuracy
JJE-183-95	39001001VG	CLP volatile organic	Methylene chloride	U	Accuracy
JJE-183-95	3XR00101VGDL	CLP volatile organic	Acetone	J	Accuracy

Qualified miscellaneous parameters due to out-of-tolerance precision and/or accuracy.

SDG #	Sample ID #	Analysis	Parameter	Qualification	QC
JJE-161-95	39000401SV	Semivolatile organic	Di-n-butyl	U	Accuracy
JJE-161-95	39000601SV	Semivolatile organic	Di-n-butyl	U	Accuracy
JJE-167-95	31320701NK	Miscellaneous inorganic	Total kjeldahl nitrogen	UJ	Accuracy
JJE-167-95	313233301NK	Miscellaneous inorganic	Total kjeldahl nitrogen	J	Accuracy
JJE-167-95	31323601NK	Miscellaneous inorganic	Total kjeldahl nitrogen	UJ	Accuracy
JJE-172-95	39001101VG	CLP volatile organic	Methylene chloride	BJ	Accuracy
JJE-172-95	39001201VG	CLP volatile organic	Methylene chloride	BJ	Accuracy
JJE-172-95	39001201VG	CLP volatile organic	Acetone	BJ	Accuracy
JJE-172-95	39001301VG	CLP volatile organic	Methylene chloride	BJ	Accuracy
JJE-172-95	39001301VG	CLP volatile organic	Acetone	BJ	Accuracy
JJE-172-95	39001401VG	CLP volatile organic	Methylene chloride	BJ	Accuracy
JJE-172-95	39001501VG	CLP volatile organic	Methylene chloride	BJ	Accuracy
JJE-174-95	31323501NK	Miscellaneous inorganic	Total kjeldahl nitrogen	J	Precision
JJE-177-95	31322101NK	Miscellaneous inorganic	Total kjeldahl nitrogen	UJ	Accuracy
JJE-183-95	3XF00101VG	CLP volatile organic	Methylene chloride	U	Accuracy
JJE-183-95	3XF00101VG	CLP volatile organic	Acetone	J	Accuracy

Qualified radionuclide parameters due to out-of-tolerance precision.

SDG #	Sample ID #	Np-237	Pu-238	Pu-239/240	Sr-90	Tc-99	U-233	U-234	U-235	U-236	U-238
RPW-227-95	39100201EH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
RPW-227-95	39100301EH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
RPW-227-95	39100401EH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
RPW-227-95	39100501EH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
RPW-236-95	31320601EA	NA	-	-	-	J	NA	-	-	NA	-
RPW-236-95	31322901EA	NA	-	-	-	J	NA	-	-	NA	-
RPW-238-95	31323501EA	NA	NA	NA	-	J	NA	NA	NA	NA	NA
RPW-246-95	31322101AB	NA	-	-	-	-	NA	-	-	NA	-
RPW-258-95	3CS00101EH	-	-	J	-	-	NA	-	-	NA	-
RPW-258-95	3CS00301EH	-	-	J	-	-	NA	-	-	NA	-
RPW-258-95	3CS00701EH	-	-	J	-	-	NA	-	-	NA	-
RPW-258-95	3CS00801EH	-	-	J	-	-	NA	-	-	NA	-
RPW-258-95	3CS00901EH	-	-	J	-	-	NA	-	-	NA	-
RPW-258-95	3CS01001EH	-	-	J	-	-	NA	-	-	NA	-
RPW-258-95	3CS01101EH	-	-	J	-	-	NA	-	-	NA	-
RPW-258-95	3CS00201EH	-	-	J	-	-	NA	-	-	NA	-

Qualified radionuclide parameters due to out-of-tolerance precision.

SDG #	Sample ID #	GRA	GRB	GMS	Am-241	Co-60	Cs-134	Cs-137	Eu-154	H-3	I-129
RPW-227-95	39100201EH	-	J	-	NA	-	NA	-	-	NA	NA
RPW-227-95	39100301EH	-	J	-	NA	-	NA	-	-	NA	NA
RPW-227-95	39100401EH	-	J	-	NA	-	NA	-	-	NA	NA
RPW-227-95	39100501EH	-	J	-	NA	-	NA	-	-	NA	NA
RPW-236-95	31320601EA	-	-	-	-	NA	NA	NA	NA	-	-
RPW-236-95	31322901EA	-	-	-	-	NA	NA	NA	NA	-	-
RPW-238-95	31323501EA	-	-	NA	NA	NA	NA	NA	NA	-	-
RPW-246-95	31322101AB	J	-	-	-	NA	NA	NA	NA	-	-
RPW-258-95	3CS00101EH	-	-	-	-	NA	NA	NA	NA	NA	NA
RPW-258-95	3CS00301EH	-	-	-	-	NA	NA	NA	NA	NA	NA
RPW-258-95	3CS00701EH	-	-	-	-	NA	NA	NA	NA	NA	NA
RPW-258-95	3CS00801EH	-	-	-	-	NA	NA	NA	NA	NA	NA
RPW-258-95	3CS00901EH	-	-	-	-	NA	NA	NA	NA	NA	NA
RPW-258-95	3CS01001EH	-	-	-	-	NA	NA	NA	NA	NA	NA
RPW-258-95	3CS01101EH	-	-	-	-	NA	NA	NA	NA	NA	NA
RPW-258-95	3CS00201EH	-	-	-	-	NA	NA	NA	NA	NA	NA

Qualified radionuclide parameters due to out-of-tolerance precision.

SDG #	Sample ID #	Np-237	Pu-238	Pu-239/240	Sr-90	Tc-99	U-233	U-234	U-235	U-236	U-238
RPW-203-95	31323801EA	NA	NA	NA	-	J	NA	NA	NA	NA	NA
RPW-203-95	31334501EA	NA	NA	NA	-	J	NA	NA	NA	NA	NA
RPW-209-95	31320701EA	-	-	-	-	UJ	NA	-	-	NA	-
RPW-209-95	31330101EA	-	-	-	-	J	NA	-	-	NA	-
RPW-212-95	31324601EA	NA	NA	NA	-	J	NA	NA	NA	NA	NA
RPW-212-95	31333101EA	NA	NA	NA	-	J	NA	NA	NA	NA	NA
RPW-225-95	31321401EA	NA	-	-	-	J	NA	-	-	NA	-
RPW-225-95	31320901EA	NA	-	-	-	J	NA	-	-	NA	-
RPW-227-95	31100101EH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
RPW-227-95	31100201EH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
RPW-227-95	31100301EH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
RPW-227-95	31100302EH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
RPW-227-95	31100401EH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
RPW-227-95	31100501EH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
RPW-227-95	31100601EH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
RPW-227-95	39100101EH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Qualified radionuclide parameters due to out-of-tolerance precision.

SDG #	Sample ID #	GRA	GRB	GMS	Am-241	Co-60	Cs-134	Cs-137	Eu-154	H-3	I-129
RPW-203-95	31323801EA	-	-	NA	NA	NA	NA	NA	NA	-	-
RPW-203-95	31334501EA	-	-	NA	NA	NA	NA	NA	NA	-	-
RPW-209-95	31320701EA	-	-	NA	-	NA	NA	NA	NA	-	-
RPW-209-95	31330101EA	-	-	NA	-	NA	NA	NA	NA	-	-
RPW-212-95	31324601EA	-	-	NA	NA	NA	NA	NA	NA	-	-
RPW-212-95	31333101EA	-	-	NA	NA	NA	NA	NA	NA	-	-
RPW-225-95	31321401EA	-	-	-	-	NA	NA	NA	NA	-	-
RPW-225-95	31320901EA	-	-	-	-	NA	NA	NA	NA	-	-
RPW-227-95	31100101EH	-	J	-	NA	-	NA	-	-	NA	NA
RPW-227-95	31100201EH	-	J	-	NA	-	NA	-	-	NA	NA
RPW-227-95	31100301EH	-	J	-	NA	-	NA	-	-	NA	NA
RPW-227-95	31100302EH	-	J	-	NA	-	NA	-	-	NA	NA
RPW-227-95	31100401EH	-	J	-	NA	-	NA	-	-	NA	NA
RPW-227-95	31100501EH	-	J	-	NA	-	NA	-	-	NA	NA
RPW-227-95	31100601EH	-	J	-	NA	-	NA	-	-	NA	NA
RPW-227-95	39100101EH	-	J	-	NA	-	NA	-	-	NA	NA

Qualified TAL (CLP) metals parameters due to out-of-tolerance precision.

SDG #	Sample ID #	Al	Sb	As	Ba	Be	Cd	Ca	Cr	Co	Cu	Fe	Pb	Mg	Mn	Hg	Ni	K	Se	Ag	Na	Tl	V	Zn	Zr
JJE-184-95	39001001C1	-	-	J	-	-	-	-	-	-	-	-	J	-	-	-	-	J	-	-	-	-	-	-	-
JJE-184-95	31900601C1	-	-	J	-	-	-	-	-	-	-	-	J	-	-	-	-	J	-	-	-	-	-	-	-
JJE-184-95	31900701C1	-	-	J	-	-	-	-	-	-	-	-	J	-	-	-	-	J	-	-	-	-	-	-	-
JJE-184-95	31900702C1	-	-	J	-	-	-	-	-	-	-	-	J	-	-	-	-	J	-	-	-	-	-	-	-
JJE-184-95	31900801C1	-	-	UJ	-	-	-	-	-	-	-	-	J	-	-	-	-	J	-	-	-	-	-	-	-
JJE-184-95	31900901C1	-	-	J	-	-	-	-	-	-	-	-	J	-	-	-	-	J	-	-	-	-	-	-	-
JJE-184-95	31901001C1	-	-	J	-	-	-	-	-	-	-	-	J	-	-	-	-	J	-	-	-	-	-	-	-
JJE-185-95	38809601C1	-	-	-	-	-	-	J	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NA
JJE-185-95	38809602C1	-	-	-	-	-	-	J	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NA
JJE-185-95	3XF00104C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NA
JJE-185-95	3XR00104C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NA

U – The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

UJ – The material was analyzed for, but was not detected. The associated value is an estimate and may not accurately reflect the IDL in the sample matrix.

J – The analyte was analyzed for and was positively identified, but the associated numerical value may not be consistent with the amount actually present in the envrionmental sample.

NA – The analyte was not analyzed for.

Qualified TAL (CLP) metals parameters due to out-of-tolerance precision.

SDG #	Sample ID #	Al	Sb	As	Ba	Be	Cd	Ca	Cr	Co	Cu	Fe	Pb	Mg	Mn	Hg	Ni	K	Se	Ag	Na	Tl	V	Zn	Zr
JJE-170-95	39101002C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JJE-175-95	39001101C1	J	-	-	-	-	-	J	J	-	-	J	J	J	J	-	-	-	-	-	-	-	-	J	NA
JJE-175-95	39001201C1	J	-	-	-	-	-	J	J	-	-	J	J	J	J	-	-	-	-	-	-	-	-	J	NA
JJE-175-95	39001301C1	J	-	-	-	-	-	J	J	-	-	J	J	J	J	-	-	-	-	-	-	-	-	J	NA
JJE-175-95	39001401C1	J	-	-	-	-	-	J	J	-	-	J	J	J	J	-	-	-	-	-	-	-	-	J	NA
JJE-175-95	39001501C1	J	-	-	-	-	-	J	J	-	-	J	J	J	J	-	-	-	-	-	-	-	-	J	NA
JJE-184-95	39000101C1	-	-	J	-	-	-	-	-	-	-	-	J	-	-	-	-	J	-	-	-	-	-	-	-
JJE-184-95	39000201C1	-	-	J	-	-	-	-	-	-	-	-	J	-	-	-	-	J	-	-	-	-	-	-	-
JJE-184-95	39000301C1	-	-	J	-	-	-	-	-	-	-	-	J	-	-	-	-	J	-	-	-	-	-	-	-
JJE-184-95	39000401C1	-	-	J	-	-	-	-	-	-	-	-	J	-	-	-	-	J	-	-	-	-	-	-	-
JJE-184-95	39000501C1	-	-	J	-	-	-	-	-	-	-	-	J	-	-	-	-	J	-	-	-	-	-	-	-
JJE-184-95	39000601C1	-	-	J	-	-	-	-	-	-	-	-	J	-	-	-	-	J	-	-	-	-	-	-	-
JJE-184-95	39000701C1	-	-	J	-	-	-	-	-	-	-	-	J	-	-	-	-	J	-	-	-	-	-	-	-
JJE-184-95	39000801C1	-	-	J	-	-	-	-	-	-	-	-	J	-	-	-	-	J	-	-	-	-	-	-	-
JJE-184-95	39000901C1	-	-	J	-	-	-	-	-	-	-	-	J	-	-	-	-	J	-	-	-	-	-	-	-
JJE-184-95	39000902C1	-	-	J	-	-	-	-	-	-	-	-	J	-	-	-	-	J	-	-	-	-	-	-	-

Qualified TAL (CLP) metals parameters due to out-of-tolerance precision.

SDG #	Sample ID #	Al	Sb	As	Ba	Be	Cd	Ca	Cr	Co	Cu	Fe	Pb	Mg	Mn	Hg	Ni	K	Se	Ag	Na	Tl	V	Zn	Zr
JJE-169-95	31100201C1	-	-	-	-	-	-	J	J	-	-	-	-	J	-	-	-	-	-	-	-	-	-	-	-
JJE-169-95	31100301C1	-	-	-	-	-	-	-	J	-	-	-	-	J	-	-	-	-	-	-	-	-	-	-	-
JJE-169-95	31100302C1	-	-	-	-	-	-	-	J	-	-	-	-	J	-	-	-	-	-	-	-	-	-	-	-
JJE-169-95	31100401C1	-	-	-	-	-	-	-	J	-	-	-	-	J	-	-	-	-	-	-	-	-	-	-	-
JJE-169-95	31100501C1	-	-	-	-	-	-	-	J	-	-	-	-	J	-	-	-	-	-	-	-	-	-	-	-
JJE-169-95	31100601C1	-	-	-	-	-	-	-	J	-	-	-	-	J	-	-	-	-	-	-	-	-	-	-	-
JJE-169-95	31900101C1	-	-	-	-	-	-	-	J	-	-	-	-	J	-	-	-	-	-	-	-	-	-	-	-
JJE-169-95	31900201C1	-	-	-	-	-	-	-	J	-	-	-	-	J	-	-	-	-	-	-	-	-	-	-	-
JJE-169-95	31900301C1	-	-	-	-	-	-	-	J	-	-	-	-	J	-	-	-	-	-	-	-	-	-	-	-
JJE-169-95	31900401C1	-	-	-	-	-	-	-	J	-	-	-	-	J	-	-	-	-	-	-	-	-	-	-	-
JJE-169-95	31900501C1	-	-	-	-	-	-	-	J	-	-	-	-	J	-	-	-	-	-	-	-	-	-	-	-
JJE-170-95	39100601C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JJE-170-95	39100701C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JJE-170-95	39100801C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JJE-170-95	39100901C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JJE-170-95	39101001C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Qualified TAL (CLP) metals parameters due to out-of-tolerance precision.

SDG #	Sample ID #	Al	Sb	As	Ba	Be	Cd	Ca	Cr	Co	Cu	Fe	Pb	Mg	Mn	Hg	Ni	K	Se	Ag	Na	Tl	V	Zn	Zr
JJE-143-95	31321402JN	-	-	-	-	-	-	-	-	-	-	-	UJ	-	-	-	-	-	-	-	-	-	-	-	-
JJE-143-95	31322901JN	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	-	-	-	-	-	-	-	-	-
JJE-143-95	31324601JN	-	-	-	-	-	-	-	-	-	-	-	UJ	-	-	-	-	-	-	-	-	-	-	-	-
JJE-143-95	31324602JN	-	-	-	-	-	-	-	-	-	-	-	UJ	-	-	-	-	-	-	-	-	-	-	-	-
JJE-144-95	36300601C1	-	-	-	-	-	-	J	-	-	-	-	J	-	-	-	-	-	-	-	-	-	-	-	-
JJE-144-95	36300701C1	-	-	-	-	-	-	J	-	-	-	-	J	-	-	-	-	-	-	-	-	-	-	-	-
JJE-144-95	36300801C1	-	-	-	-	-	-	J	-	-	-	-	J	-	-	-	-	-	-	-	-	-	-	-	-
JJE-144-95	38801201C1	-	-	-	-	-	-	J	-	-	-	-	J	-	-	-	-	-	-	-	-	-	-	-	-
JJE-144-95	38803001C1	-	-	-	-	-	-	J	-	-	-	-	J	-	-	-	-	-	-	-	-	-	-	-	-
JJE-144-95	38804201C1	-	-	-	-	-	-	J	-	-	-	-	J	-	-	-	-	-	-	-	-	-	-	-	-
JJE-144-95	38805401C1	-	-	-	-	-	-	J	-	-	-	-	J	-	-	-	-	-	-	-	-	-	-	-	-
JJE-144-95	38806001C1	-	-	-	-	-	-	J	-	-	-	-	J	-	-	-	-	-	-	-	-	-	-	-	-
JJE-144-95	38806002C1	-	-	-	-	-	-	J	-	-	-	-	J	-	-	-	-	-	-	-	-	-	-	-	-
JJE-144-95	3XF00103C1	-	-	-	-	-	-	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JJE-144-95	3XR00103C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JJE-169-95	31100101C1	-	-	-	-	-	-	J	J	-	-	-	-	J	-	-	-	-	-	-	-	-	-	-	-

Qualified TAL (CLP) metals parameters due to out-of-tolerance precision.

SDG #	Sample ID #	Al	Sb	As	Ba	Be	Cd	Ca	Cr	Co	Cu	Fe	Pb	Mg	Mn	Hg	Ni	K	Se	Ag	Na	Tl	V	Zn	Zr
JJE-123-95	31350601JN	-	-	-	-	-	-	J	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JJE-123-95	31350701JN	-	-	-	-	-	-	J	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JJE-123-95	31350801JN	-	-	-	-	-	-	J	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JJE-123-95	31350901JN	-	-	-	-	-	-	J	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JJE-123-95	3XF00101JN	-	-	-	-	-	-	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JJE-123-95	3XR00101JN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JJE-133-95	38801801C1	-	-	-	-	-	-	-	J	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NA
JJE-133-95	38802401C1	-	-	-	-	-	-	-	J	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NA
JJE-133-95	38804801C1	-	-	-	-	-	-	-	J	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NA
JJE-133-95	3XF00101C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NA
JJE-133-95	3XR00101C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NA
JJE-133-95	3XF00102C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NA
JJE-133-95	3XR00102C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NA
JJE-143-95	31320601JN	-	-	-	-	-	-	-	-	-	-	-	UJ	-	-	-	-	-	-	-	-	-	-	-	-
JJE-143-95	31320902JN	-	-	-	-	-	-	-	-	-	-	-	UJ	-	-	-	-	-	-	-	-	-	-	-	-
JJE-143-95	31321201JN	-	-	-	-	-	-	-	-	-	-	-	UJ	-	-	-	-	-	-	-	-	-	-	-	-

Precision

Qualified miscellaneous parameters due to out-of-tolerance precision and/or accuracy.

SDG #	Sample ID #	Analysis	Parameter	Qualification	QC
JJE-183-95	3XR00101VGDL	CLP volatile organic	MEK	J	Accuracy
JJE-183-95	3XV00101VGDL	CLP volatile organic	Acetone	J	Accuracy
JJE-183-95	3XV00101VGDL	CLP volatile organic	MEK	J	Accuracy

U - The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

UJ - The material was analyzed for, but was not detected. The associated value is an estimate and may not accurately reflect the IDL in the sample matrix.

J - The analyte was analyzed for and was positively identified, but the associated numerical value may not be consistent with the amount actually present in the envrionmental sample.

B - Teh analyte is found in the associated blank as well as the sample and indicates possible/probable blank contamination.

NA - The analyte was not analyzed for.

Qualified miscellaneous parameters due to out-of-tolerance precision and/or accuracy.

SDG #	Sample ID #	Analysis	Parameter	Qualification	QC
JJE-183-95	3XR00101VG	CLP volatile organic	Methylene chloride	U	Accuracy
JJE-183-95	3XV00101VG	CLP volatile organic	Methylene chloride	U	Accuracy
JJE-183-95	39000101VG	CLP volatile organic	Methylene chloride	U	Accuracy
JJE-183-95	39000201VG	CLP volatile organic	Methylene chloride	U	Accuracy
JJE-183-95	39000301VG	CLP volatile organic	Methylene chloride	U	Accuracy
JJE-183-95	39000401VG	CLP volatile organic	Methylene chloride	U	Accuracy
JJE-183-95	39000401VG	CLP volatile organic	Acetone	U	Accuracy
JJE-183-95	39000501VG	CLP volatile organic	Methylene chloride	U	Accuracy
JJE-183-95	39000501VG	CLP volatile organic	Acetone	U	Accuracy
JJE-183-95	39000601VG	CLP volatile organic	Methylene chloride	U	Accuracy
JJE-183-95	39000701VG	CLP volatile organic	Methylene chloride	U	Accuracy
JJE-183-95	39000801VG	CLP volatile organic	Methylene chloride	U	Accuracy
JJE-183-95	39000901VG	CLP volatile organic	Methylene chloride	U	Accuracy
JJE-183-95	39000902VG	CLP volatile organic	Methylene chloride	U	Accuracy
JJE-183-95	39001001VG	CLP volatile organic	Methylene chloride	U	Accuracy
JJE-183-95	3XR00101VGDL	CLP volatile organic	Acetone	J	Accuracy

Qualified miscellaneous parameters due to out-of-tolerance precision and/or accuracy.

SDG #	Sample ID #	Analysis	Parameter	Qualification	QC
JJE-161-95	39000401SV	Semivolatile organic	Di-n-butyl	U	Accuracy
JJE-161-95	39000601SV	Semivolatile organic	Di-n-butyl	U	Accuracy
JJE-167-95	31320701NK	Miscellaneous inorganic	Total kjeldahl nitrogen	UJ	Accuracy
JJE-167-95	313233301NK	Miscellaneous inorganic	Total kjeldahl nitrogen	J	Accuracy
JJE-167-95	31323601NK	Miscellaneous inorganic	Total kjeldahl nitrogen	UJ	Accuracy
JJE-172-95	39001101VG	CLP volatile organic	Methylene chloride	BJ	Accuracy
JJE-172-95	39001201VG	CLP volatile organic	Methylene chloride	BJ	Accuracy
JJE-172-95	39001201VG	CLP volatile organic	Acetone	BJ	Accuracy
JJE-172-95	39001301VG	CLP volatile organic	Methylene chloride	BJ	Accuracy
JJE-172-95	39001301VG	CLP volatile organic	Acetone	BJ	Accuracy
JJE-172-95	39001401VG	CLP volatile organic	Methylene chloride	BJ	Accuracy
JJE-172-95	39001501VG	CLP volatile organic	Methylene chloride	BJ	Accuracy
JJE-174-95	31323501NK	Miscellaneous inorganic	Total kjeldahl nitrogen	J	Precision
JJE-177-95	31322101NK	Miscellaneous inorganic	Total kjeldahl nitrogen	UJ	Accuracy
JJE-183-95	3XF00101VG	CLP volatile organic	Methylene chloride	U	Accuracy
JJE-183-95	3XF00101VG	CLP volatile organic	Acetone	J	Accuracy

Qualified radionuclide parameters due to out-of-tolerance accuracy.

SDG #	Sample ID #	GRA	GRB	GMS	Am-241	Cs-134	Cs-137	Co-60	Eu-154	H-3	I-129
RPW-271-95	31100401EH	NA	NA	NA	-	NA	NA	NA	NA	NA	NA
RPW-271-95	31100501EH	NA	NA	NA	-	NA	NA	NA	NA	NA	NA
DMF-14-95	3910100EH	NA	NA	NA	UJ	NA	NA	NA	NA	NA	NA

SDG #	Sample ID #	Np-237	Pu-238	Pu-239/240	Sr-90	Tc-99	U-233	U-234	U-235	U-236	U-238
RPW-271-95	31100401EH	-	-	-	J	R	NA	-	-	NA	-
RPW-271-95	31100501EH	-	-	-	R	R	NA	-	-	NA	-
DMF-14-95	3910100EH	UJ	-	-	-	J	UJ	-	-	J	-

J – The result is a statistically positive value at the 95% confidence level and is considered to be an estimated quantity.

UJ – The result is a statistical nondetect at the 95% confidence level and is considered to be an estimated quantity because of an unacceptable quality control parameter.

R – The result is rejected because of an unacceptable quality control parameter.

NA – The analyte was not analyzed for.

Qualified radionuclide parameters due to out-of-tolerance accuracy.

SDG #	Sample ID #	Np-237	Pu-238	Pu-239/240	Sr-90	Tc-99	U-233	U-234	U-235	U-236	U-238
RPW-271-95	39000701EH	-	-	-	R	-	NA	-	-	NA	-
RPW-271-95	39001201EH	-	-	-	R	R	NA	-	-	NA	-
RPW-271-95	39001401EH	-	-	-	-	R	NA	-	-	NA	-
RPW-271-95	31900101EH	-	-	-	R	R	NA	-	-	NA	-
RPW-271-95	31900301EH	-	-	-	R	R	NA	-	-	NA	-
RPW-271-95	31900401EH	-	-	-	-	R	NA	-	-	NA	-
RPW-271-95	31900601EH	-	-	-	R	R	NA	-	-	NA	-
RPW-271-95	31900701EH	-	-	-	R	R	NA	-	-	NA	-
RPW-271-95	31900801EH	-	-	-	R	R	NA	-	-	NA	-
RPW-271-95	31900901EH	-	-	-	-	R	NA	-	-	NA	-
RPW-271-95	31901001EH	-	-	-	R	R	NA	-	-	NA	-
RPW-271-95	31100101EH	-	-	-	R	R	NA	-	-	NA	-
RPW-271-95	31100201EH	-	-	-	R	R	NA	-	-	NA	-
RPW-271-95	31100301EH	-	-	-	R	R	NA	-	-	NA	-
RPW-271-95	31100302EH	-	-	-	R	R	NA	-	-	NA	-

Qualified radionuclide parameters due to out-of-tolerance accuracy.

SDG #	Sample ID #	GRA	GRB	GMS	Am-241	Cs-134	Cs-137	Co-60	Eu-154	H-3	I-129
RPW-271-95	39000701EH	NA	NA	NA	-	NA	NA	NA	NA	NA	NA
RPW-271-95	39001201EH	NA	NA	NA	-	NA	NA	NA	NA	NA	NA
RPW-271-95	39001401EH	NA	NA	NA	-	NA	NA	NA	NA	NA	NA
RPW-271-95	31900101EH	NA	NA	NA	-	NA	NA	NA	NA	NA	NA
RPW-271-95	31900301EH	NA	NA	NA	-	NA	NA	NA	NA	NA	NA
RPW-271-95	31900401EH	NA	NA	NA	-	NA	NA	NA	NA	NA	NA
RPW-271-95	31900601EH	NA	NA	NA	-	NA	NA	NA	NA	NA	NA
RPW-271-95	31900701EH	NA	NA	NA	-	NA	NA	NA	NA	NA	NA
RPW-271-95	31900801EH	NA	NA	NA	-	NA	NA	NA	NA	NA	NA
RPW-271-95	31900901EH	NA	NA	NA	-	NA	NA	NA	NA	NA	NA
RPW-271-95	31901001EH	NA	NA	NA	-	NA	NA	NA	NA	NA	NA
RPW-271-95	31100101EH	NA	NA	NA	-	NA	NA	NA	NA	NA	NA
RPW-271-95	31100201EH	NA	NA	NA	-	NA	NA	NA	NA	NA	NA
RPW-271-95	31100301EH	NA	NA	NA	-	NA	NA	NA	NA	NA	NA
RPW-271-95	31100302EH	NA	NA	NA	-	NA	NA	NA	NA	NA	NA
RPW-271-95	31100401EH	NA	NA	NA	-	NA	NA	NA	NA	NA	NA

Qualified radionuclide parameters due to out-of-tolerance accuracy.

SDG #	Sample ID #	Np-237	Pu-238	Pu-239/240	Sr-90	Tc-99	U-233	U-234	U-235	U-236	U-238
RPW-258-95	3CS00201EH	UJ	J	-	J	-	NA	-	-	NA	-
RPW-258-95	3CS00401EH	UJ	J	-	-	-	NA	-	-	NA	-
RPW-258-95	3CS00501EH	UJ	J	-	J	-	NA	-	-	NA	-
RPW-258-95	3CS00601EH	UJ	J	-	-	-	NA	-	-	NA	-
RPW-271-95	39100101EH	-	-	-	R	R	NA	-	-	NA	-
RPW-271-95	39100201EH	-	-	-	R	R	NA	-	-	NA	-
RPW-271-95	39100301EH	-	-	-	R	R	NA	-	-	NA	-
RPW-271-95	39100401EH	-	-	-	-	R	NA	-	-	NA	-
RPW-271-95	39100501EH	-	-	-	-	R	NA	-	-	NA	-
RPW-271-95	39100701EH	-	-	-	J	R	NA	-	-	NA	-
RPW-271-95	39100801EH	-	-	-	R	R	NA	-	-	NA	-
RPW-271-95	39100901EH	-	-	-	-	R	NA	-	-	NA	-
RPW-271-95	39000301EH	-	-	-	R	-	NA	-	-	NA	-
RPW-271-95	39000401EH	-	-	-	-	-	NA	-	-	NA	-
RPW-271-95	39000501EH	-	-	-	-	-	NA	-	-	NA	-
RPW-271-95	39000601EH	-	-	-	R	-	NA	-	-	NA	-

Qualified radionuclide parameters due to out-of-tolerance accuracy.

SDG #	Sample ID #	GRA	GRB	GMS	Am-241	Cs-134	Cs-137	Co-60	Eu-154	H-3	I-129
RPW-258-95	3CS00201EH	-	-	-	-	NA	NA	NA	NA	NA	NA
RPW-258-95	3CS00401EH	-	-	-	-	NA	NA	NA	NA	NA	NA
RPW-258-95	3CS00501EH	-	-	-	-	NA	NA	NA	NA	NA	NA
RPW-258-95	3CS00601EH	-	-	-	-	NA	NA	NA	NA	NA	NA
RPW-271-95	39100101EH	NA	NA	NA	-	NA	NA	NA	NA	NA	NA
RPW-271-95	39100201EH	NA	NA	NA	-	NA	NA	NA	NA	NA	NA
RPW-271-95	39100301EH	NA	NA	NA	-	NA	NA	NA	NA	NA	NA
RPW-271-95	39100401EH	NA	NA	NA	-	NA	NA	NA	NA	NA	NA
RPW-271-95	39100501EH	NA	NA	NA	-	NA	NA	NA	NA	NA	NA
RPW-271-95	39100701EH	NA	NA	NA	-	NA	NA	NA	NA	NA	NA
RPW-271-95	39100801EH	NA	NA	NA	-	NA	NA	NA	NA	NA	NA
RPW-271-95	39100901EH	NA	NA	NA	-	NA	NA	NA	NA	NA	NA
RPW-271-95	39000301EH	NA	NA	NA	-	NA	NA	NA	NA	NA	NA
RPW-271-95	39000401EH	NA	NA	NA	-	NA	NA	NA	NA	NA	NA
RPW-271-95	39000501EH	NA	NA	NA	-	NA	NA	NA	NA	NA	NA
RPW-271-95	39000601EH	NA	NA	NA	-	NA	NA	NA	NA	NA	NA

Qualified radionuclide parameters due to out-of-tolerance accuracy.

SDG #	Sample ID #	Np-237	Pu-238	Pu-239/240	Sr-90	Tc-99	U-233	U-234	U-235	U-236	U-238
RPW-230-95	31323601R9	NA	-	-	-	-	NA	J	-	NA	J
RPW-235-95	31321201R9	NA	-	-	-	-	NA	J	-	NA	J
RPW-236-95	31320601R9	NA	-	-	-	J	NA	J	-	NA	J
RPW-236-95	31322901R9	NA	-	-	-	J	NA	-	-	NA	J
RPW-236-95	31320601EA	NA	-	-	-	J	NA	-	-	NA	-
RPW-236-95	31322901EA	NA	-	-	-	J	NA	-	-	NA	-
RPW-241-95	31340801GA	NA	NA	NA	-	-	NA	NA	NA	NA	NA
RPW-244-95	31334401RB	NA	NA	NA	J	-	NA	-	-	NA	-
RPW-246-95	31322101AB	NA	-	-	-	-	NA	-	-	NA	-
RPW-258-95	3CS00101EH	J	J	-	-	-	NA	-	-	NA	-
RPW-258-95	3CS00301EH	J	J	-	J	-	NA	-	-	NA	-
RPW-258-95	3CS00701EH	J	J	-	-	-	NA	-	-	NA	-
RPW-258-95	3CS00801EH	J	J	-	-	-	NA	-	-	NA	-
RPW-258-95	3CS00901EH	J	J	-	-	-	NA	-	-	NA	-
RPW-258-95	3CS01001EH	J	J	-	-	-	NA	-	-	NA	-
RPW-258-95	3CS01101EH	J	J	-	-	-	NA	-	-	NA	-

Qualified radionuclide parameters due to out-of-tolerance accuracy.

SDG #	Sample ID #	GRA	GRB	GMS	Am-241	Cs-134	Cs-137	Co-60	Eu-154	H-3	I-129
RPW-230-95	31323601R9	-	-	NA	NA	NA	NA	NA	NA	-	-
RPW-235-95	31321201R9	-	-	NA	-	NA	NA	NA	NA	-	-
RPW-236-95	31320601R9	-	-	-	-	NA	NA	NA	NA	-	-
RPW-236-95	31322901R9	-	-	-	-	NA	NA	NA	NA	-	-
RPW-236-95	31320601EA	-	-	-	-	NA	NA	NA	NA	-	-
RPW-236-95	31322901EA	-	-	-	-	NA	NA	NA	NA	-	-
RPW-241-95	31340801GA	J	-	NA	NA	NA	NA	NA	NA	-	-
RPW-244-95	31334401RB	-	-	-	NA	NA	NA	NA	NA	-	-
RPW-246-95	31322101AB	J	-	-	-	NA	NA	NA	NA	-	-
RPW-258-95	3CS00101EH	-	-	-	-	NA	NA	NA	NA	NA	NA
RPW-258-95	3CS00301EH	-	-	-	-	NA	NA	NA	NA	NA	NA
RPW-258-95	3CS00701EH	-	-	-	-	NA	NA	NA	NA	NA	NA
RPW-258-95	3CS00801EH	-	-	-	-	NA	NA	NA	NA	NA	NA
RPW-258-95	3CS00901EH	-	-	-	-	NA	NA	NA	NA	NA	NA
RPW-258-95	3CS01001EH	-	-	-	-	NA	NA	NA	NA	NA	NA
RPW-258-95	3CS01101EH	-	-	-	-	NA	NA	NA	NA	NA	NA

Qualified radionuclide parameters due to out-of-tolerance accuracy.

SDG #	Sample ID #	Np-237	Pu-238	Pu-239/240	Sr-90	Tc-99	U-233	U-234	U-235	U-236	U-238
RPW-181-95	31330801RB	NA	NA	NA	J	-	NA	NA	NA	NA	NA
RPW-181-95	31330801EA	NA	NA	NA	J	-	NA	NA	NA	NA	NA
RPW-207-95	31331301R8	NA	NA	NA	-	-	NA	NA	NA	NA	NA
RPW-208-95	36300101EH	NA	NA	NA	R	NA	NA	NA	NA	NA	NA
RPW-227-95	31100101EH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
RPW-227-95	31100201EH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
RPW-227-95	31100301EH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
RPW-227-95	31100302EH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
RPW-227-95	31100401EH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
RPW-227-95	31100501EH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
RPW-227-95	31100601EH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
RPW-227-95	39100101EH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
RPW-227-95	39100201EH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
RPW-227-95	39100301EH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
RPW-227-95	39100401EH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
RPW-227-95	39100501EH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Qualified radionuclide parameters due to out-of-tolerance accuracy.

SDG #	Sample ID #	GRA	GRB	GMS	Am-241	Cs-134	Cs-137	Co-60	Eu-154	H-3	I-129
RPW-181-95	31330801RB	-	-	NA	NA	NA	NA	NA	NA	-	-
RPW-181-95	31330801EA	-	-	NA	NA	NA	NA	NA	NA	-	-
RPW-207-95	31331301R8	J	J	NA	NA	NA	NA	NA	NA	-	-
RPW-208-95	36300101EH	-	-	NA	NA	NA	-	NA	NA	NA	NA
RPW-227-95	31100101EH	-	J	-	NA	NA	-	-	-	-	NA
RPW-227-95	31100201EH	-	J	-	NA	NA	-	-	-	-	NA
RPW-227-95	31100301EH	-	J	-	NA	NA	-	-	-	-	NA
RPW-227-95	31100302EH	-	J	-	NA	NA	-	-	-	-	NA
RPW-227-95	31100401EH	-	J	-	NA	NA	-	-	-	-	NA
RPW-227-95	31100501EH	-	J	-	NA	NA	-	-	-	-	NA
RPW-227-95	31100601EH	-	J	-	NA	NA	-	-	-	-	NA
RPW-227-95	39100101EH	-	J	-	NA	NA	-	-	-	-	NA
RPW-227-95	39100201EH	-	J	-	NA	NA	-	-	-	-	NA
RPW-227-95	39100301EH	-	J	-	NA	NA	-	-	-	-	NA
RPW-227-95	39100401EH	-	J	-	NA	NA	-	-	-	-	NA
RPW-227-95	39100501EH	-	J	-	NA	NA	-	-	-	-	NA

Qualified TAL (CLP) metals parameters due to out-of-tolerance accuracy.

SDG #	Sample ID #	Al	Sb	As	Ba	Be	Cd	Ca	Cr	Co	Cu	Fe	Pb	Mg	Mn	Hg	Ni	K	Se	Ag	Na	Tl	V	Zn	Zr
JJE-207-95	39300801LM	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	NA	NA	NA	NA	U	NA	NA	NA	NA
JJE-207-95	39301301LM	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	NA	NA	NA	NA	U	NA	NA	NA	NA
JJE-207-95	39301401LM	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	NA	NA	NA	NA	U	NA	NA	NA	NA
JJE-207-95	39301501LM	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	NA	NA	NA	NA	U	NA	NA	NA	NA
JJE-207-95	39301601LM	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	NA	NA	NA	NA	U	NA	NA	NA	NA

U – The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

UJ – The material was analyzed for, but was not detected. The associated value is an estimate and may not accurately reflect the IDL in the sample matrix.

J – The analyte was analyzed for and was positively identified, but the associated numerical value may not be consistent with the amount actually present in the envrionmental sample.

NA – The analyte was not analyzed for.

Qualified TAL (CLP) metals parameters due to out-of-tolerance accuracy.

SDG #	Sample ID #	Al	Sb	As	Ba	Be	Cd	Ca	Cr	Co	Cu	Fe	Pb	Mg	Mn	Hg	Ni	K	Se	Ag	Na	Tl	V	Zn	Zr
JJE-184-95	31900702C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	-	-	J	-
JJE-184-95	31900801C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	-	-	J	-
JJE-184-95	31900901C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	-	-	J	-
JJE-184-95	31901001C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	-	-	J	-
JJE-185-95	38809601C1	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	J	-	-	-	-	-	-	NA
JJE-185-95	38809602C1	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	J	-	-	-	-	-	-	NA
JJE-185-95	3XF00104C1	U	-	U	-	-	U	R	U	-	-	R	-	R	-	-	-	U	-	U	R	U	U	-	NA
JJE-185-95	3XR00104C1	U	-	-	-	-	U	R	U	-	-	R	-	R	-	-	-	-	-	U	R	U	U	-	NA
JJE-207-95	39300101LM	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	NA	NA	NA	NA	-	NA	NA	NA	NA
JJE-207-95	39300201LM	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	NA	NA	NA	NA	U	NA	NA	NA	NA
JJE-207-95	39300202LM	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	NA	NA	NA	NA	U	NA	NA	NA	NA
JJE-207-95	39300301LM	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	NA	NA	NA	NA	U	NA	NA	NA	NA
JJE-207-95	39300401LM	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	NA	NA	NA	NA	U	NA	NA	NA	NA
JJE-207-95	39300501LM	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	NA	NA	NA	NA	U	NA	NA	NA	NA
JJE-207-95	39300601LM	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	NA	NA	NA	NA	U	NA	NA	NA	NA
JJE-207-95	39300701LM	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	NA	NA	NA	NA	U	NA	NA	NA	NA

Qualified TAL (CLP) metals parameters due to out-of-tolerance accuracy.

SDG #	Sample ID #	Al	Sb	As	Ba	Be	Cd	Ca	Cr	Co	Cu	Fe	Pb	Mg	Mn	Hg	Ni	K	Se	Ag	Na	Tl	V	Zn	Zr
JJE-176-95	31322101JN	U	-	-	-	-	-	-	-	-	-	U	-	-	-	-	U	J	-	-	J	-	-	J	-
JJE-178-95	31324502JN	U	-	-	-	-	-	U	-	-	-	-	-	U	-	-	-	-	-	-	-	-	-	-	-
JJE-178-95	31334401JN	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JJE-184-95	39000101C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	U	-	J	-
JJE-184-95	39000201C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-		-	J	-
JJE-184-95	39000301C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	U	-	J	-
JJE-184-95	39000401C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	-	-	J	-
JJE-184-95	39000501C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	-	-	J	-
JJE-184-95	39000601C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	-	-	J	-
JJE-184-95	39000701C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	-	-	J	-
JJE-184-95	39000801C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	U	-	J	-
JJE-184-95	39000901C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	-	-	J	-
JJE-184-95	39000902C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	-	-	J	-
JJE-184-95	39001001C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	U	-	J	-
JJE-184-95	31900601C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	-	-	J	-
JJE-184-95	31900701C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	-	-	J	-

Qualified TAL (CLP) metals parameters due to out-of-tolerance accuracy.

SDG #	Sample ID #	Al	Sb	As	Ba	Be	Cd	Ca	Cr	Co	Cu	Fe	Pb	Mg	Mn	Hg	Ni	K	Se	Ag	Na	Tl	V	Zn	Zr
JJE-169-95	31900201C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	-	-	-	-
JJE-169-95	31900301C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	-	-	-	-
JJE-169-95	31900401C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	-	-	-	-
JJE-169-95	31900501C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	-	-	-	-
JJE-170-95	39100601C1	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	J	-	-	J	-	-	-	-
JJE-170-95	39100701C1	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	J	-	-	J	-	-	-	-
JJE-170-95	39100801C1	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	J	-	-	J	-	-	-	-
JJE-170-95	39100901C1	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	J	-	-	J	-	-	-	-
JJE-170-95	39101001C1	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	J	-	-	J	-	-	-	-
JJE-170-95	39101002C1	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	J	-	-	J	-	-	-	-
JJE-171-95	31323501JN	-	-	-	-	-	-	-	-	-	-	-	-	-	U	-	-	J	-	-	J	-	U	J	-
JJE-175-95	39001101C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	-	-	-	NA
JJE-175-95	39001201C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	-	-	-	NA
JJE-175-95	39001301C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	-	-	-	NA
JJE-175-95	39001401C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	U	-	-	-	NA
JJE-175-95	39001501C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	U	-	-	-	NA

Qualified TAL (CLP) metals parameters due to out-of-tolerance accuracy.

SDG #	Sample ID #	Al	Sb	As	Ba	Be	Cd	Ca	Cr	Co	Cu	Fe	Pb	Mg	Mn	Hg	Ni	K	Se	Ag	Na	Tl	V	Zn	Zr
JJE-164-95	31100801C1	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	J	-	-	J	-	-	-	-
JJE-164-95	31100901C1	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	J	-	-	J	-	-	-	-
JJE-164-95	31101001C1	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	J	-	-	J	-	-	-	-
JJE-164-95	31900101C1	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	J	-	-	J	-	-	-	-
JJE-164-95	31900201C1	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	J	-	-	J	-	-	-	-
JJE-164-95	31900301C1	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	J	-	-	J	-	-	-	-
JJE-164-95	31900401C1	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	J	-	-	J	-	-	-	-
JJE-164-95	31900501C1	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	J	-	-	J	-	-	-	-
JJE-169-95	31100101C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	-	-	-	-
JJE-169-95	31100201C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	-	-	-	-
JJE-169-95	31100301C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	-	-	-	-
JJE-169-95	31100302C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	-	-	-	-
JJE-169-95	31100401C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	-	-	-	-
JJE-169-95	31100501C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	-	-	-	-
JJE-169-95	31100601C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	-	-	-	-
JJE-169-95	31900101C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	-	-	-	-

Qualified TAL (CLP) metals parameters due to out-of-tolerance accuracy.

SDG #	Sample ID #	Al	Sb	As	Ba	Be	Cd	Ca	Cr	Co	Cu	Fe	Pb	Mg	Mn	Hg	Ni	K	Se	Ag	Na	Tl	V	Zn	Zr
JJE-159-95	31324501JN	U	-	-	-	-	-	U	-	-	-	-	-	U	-	-	-	U	-	-	U	-		U	-
JJE-159-95	31330101JN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	U	-
JJE-159-95	31331301JN	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	U	-
JJE-159-95	31333101JN		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JJE-159-95	31333201JN	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	U	-
JJE-159-95	31333301JN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	U	-
JJE-159-95	31333501JN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	U	-
JJE-159-95	31333701JN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JJE-159-95	31333801JN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JJE-159-95	31333901JN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JJE-159-95	31334501JN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	U	-
JJE-159-95	31334601JN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	U	-
JJE-159-95	31335101JN	-	-	-	U	-	-	U	-	-	-	-	-	U	-	-	-	U	-	-	U	-	-	-	-
JJE-159-95	31335102JN	-	-	-	U	-	-	U	-	-	-	-	-	U	-	-	-	U	-	-	U	-	-	U	-
JJE-159-95	31335203JN	-	-	-	U	-	-	U	-	-	-	-	-	U	-	-	-	U	-	-	U	-	-	-	-
JJE-164-95	31100701C1	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	J	-	-	J	-	-	-	-

Qualified TAL (CLP) metals parameters due to out-of-tolerance accuracy.

SDG #	Sample ID #	Al	Sb	As	Ba	Be	Cd	Ca	Cr	Co	Cu	Fe	Pb	Mg	Mn	Hg	Ni	K	Se	Ag	Na	Tl	V	Zn	Zr
JJE-144-95	36300701C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JJE-144-95	36300801C1	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JJE-144-95	38801201C1	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JJE-144-95	38803001C1	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JJE-144-95	38804201C1	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JJE-144-95	38805401C1	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JJE-144-95	38806001C1	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JJE-144-95	38806002C1	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JJE-144-95	3XF00103C1	-	-	-	-	-	-	-	-	-	-	-	-	U	-	-	-	U	-	-	U	-	U	U	-
JJE-144-95	3XR00103C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	U	-	UJ	U	-	U	-	-
JJE-159-95	31320501JN	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	U	-
JJE-159-95	31320701JN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	U	U	-
JJE-159-95	31323301JN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		U	-
JJE-159-95	31323601JN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	U	U	-
JJE-159-95	31323801JN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	U	-
JJE-159-95	31324301JN	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	U	-

Qualified TAL (CLP) metals parameters due to out-of-tolerance accuracy.

SDG #	Sample ID #	Al	Sb	As	Ba	Be	Cd	Ca	Cr	Co	Cu	Fe	Pb	Mg	Mn	Hg	Ni	K	Se	Ag	Na	Tl	V	Zn	Zr
JJE-142-95	36300101C1	-	U	-	-	-	U	-	-	-	U	-	-	-	U	-	-	-	-	-	U	-	-	-	NA
JJE-142-95	36300201C1	-	-	-	-	-	U	-	-	-	U	-	-	-	U	-	-	-	-	-	U	-	-	-	NA
JJE-142-95	36300301C1	-	U	-	-	-	U	-	-	-	U	-	-	-	U	-	-	-	-	-	U	-	-	-	NA
JJE-142-95	36300401C1	-	U	-	-	-	U	-	-	-	U	-	-	-	U	-	-	-	-	-	U	-	-	-	NA
JJE-142-95	36300501C1	-	U	-	-	-	U	-	-	-	U	-	-	-	U	-	-	-	-	-	U	-	-	-	NA
JJE-142-95	36300901C1	-	U	-	-	-	U	-	-	-	U	-	-	-	U	-	-	-	-	-	U	-	-	-	NA
JJE-142-95	36300001C1	-	U	-	-	-	U	-	-	-	U	-	-	-	U	-	-	-	-	-	U	-	-	-	NA
JJE-142-95	38800601C1	-	U	-	-	-	U	-	-	-	U	-	-	-	U	-	-	-	-	-	U	-	-	-	NA
JJE-143-95	31320601JN	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JJE-143-95	31320902JN	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JJE-143-95	31321201JN	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JJE-143-95	31321402JN	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JJE-143-95	31322901JN	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JJE-143-95	31324601JN	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JJE-143-95	31324602JN	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JJE-144-95	36300601C1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Qualified TAL (CLP) metals parameters due to out-of-tolerance accuracy.

SDG #	Sample ID #	Al	Sb	As	Ba	Be	Cd	Ca	Cr	Co	Cu	Fe	Pb	Mg	Mn	Hg	Ni	K	Se	Ag	Na	Tl	V	Zn	Zr
JJE-123-95	31350701JN	-	UJ	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	-	-	-	-	-	-	-
JJE-123-95	31350801JN	-	UJ	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	-	-	-	-	-	-	-
JJE-123-95	31350901JN	-	UJ	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	-	-	-	-	-	-	-
JJE-123-95	3XF00101JN	-	-	-	U	-	-	-	-	UJ	-	-	-	U	-	-	-	-	-	-	U	-	-	U	-
JJE-123-95	3XR00101JN	-	-	-	U	-	-	-	-	UJ	-	-	-	-	-	-	-	U	-	-	U	-	U	U	-
JJE-133-95	38801801C1	-	J	-	-	-	-	-	-	J	-	-	U	-	J	-	-	-	U	UJ	-	-	-	-	NA
JJE-133-95	38802401C1	-	UJ	-	-	-	-	-	-	J	-	-		-	J	-	-	-	U	UJ	-	-	-	-	NA
JJE-133-95	38804801C1	-	UJ	-	-	-	-	-	-	J	-	-	U	-	J	-	-	-	-	UJ	-	-	-	-	NA
JJE-133-95	3XF00101C1	U	-	-	U	-	-	U	-	-	UJ	-	-	U	-	-	-	-	U	J	U	-	-	U	NA
JJE-133-95	3XR00101C1	U	-	-	-	-	-	-	-	-	J	-	-	U	-	-	-	-	-	UJ	U	-	-	-	NA
JJE-133-95	3XF00102C1	U	-	-	U	-	-	U	-	-	UJ	-	-	U	-	-	-	-	-	UJ	U	-	-	U	NA
JJE-133-95	3XR00102C1	U	-	-	U	-	-	U	-	-	UJ	-	-	U	-	-	-	-	-	UJ	U	-	-	U	NA
JJE-142-95	31350101JN	-	U	-	-	-	U	-	-	-	U	-	-	-	U	-	-	-	-	-	U	-	-	-	-
JJE-142-95	31350201JN	-	-	-	-	-	U	-	-	-	U	-	-	-	U	-	-	-	-	-	U	-	-	-	-
JJE-142-95	31350301JN	-	-	-	-	-	U	-	-	-	U	-	-	-	U	-	-	-	-	-	U	-	-	-	-
JJE-142-95	31350302JN	-	U	-	-	-	U	-	-	-	U	-	-	-	U	-	-	-	-	-	U	-	-	-	-

Qualified TAL (CLP) metals parameters due to out-of-tolerance accuracy.

SDG #	Sample ID #	Al	Sb	As	Ba	Be	Cd	Ca	Cr	Co	Cu	Fe	Pb	Mg	Mn	Hg	Ni	K	Se	Ag	Na	Tl	V	Zn	Zr
JJE-121-95	31330801JN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	-	U	UJ	-
JJE-121-95	31330901JN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	-	U	UJ	-
JJE-121-95	31331601JN	-	-	-	-	-	-	-	-	-	U	-	-	-	-	-	-	J	-	-	-	-	U	UJ	-
JJE-121-95	31331701JN	-	-	-	-	-	-	-	-	-	U	-	-	-	-	-	-	J	-	-	-	-	U	UJ	-
JJE-121-95	31331801JN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	-	U	UJ	-
JJE-121-95	31332101JN	-	-	-	-	-	-	-	-	-	U	-	-	-	-	-	-	J	-	J	-	-	U	UJ	-
JJE-121-95	31332601JN	-	-	-	-	-	-	-	-	-	U	-	-	-	-	-	-	J	-	J	-	-	U	UJ	-
JJE-121-95	31332701JN	-	-	-	-	-	-	-	-	-	U	-	-	-	-	-	-	J	-	-	-	-	U	UJ	-
JJE-121-95	31332801JN	-	-	-	-	-	-	-	-	-	U	-	-	-	-	-	-	J	-	-	-	-	U	UJ	-
JJE-121-95	31332901JN	-	-	-	-	-	-	-	-	-	U	-	-	-	-	-	-	J	-	-	-	-	U	UJ	-
JJE-121-95	31334201JN	-	-	-	-	-	-	-	-	-	U	-	-	-	-	-	-	J	-	-	-	-	U	UJ	-
JJE-121-95	31334301JN	-	-	-	-	-	-	-	-	-	U	-	-	-	-	-	-	J	-	-	-	-	U	UJ	-
JJE-121-95	31334801JN	-	-	-	-	-	-	-	-	-	U	-	-	-	-	-	-	J	-	-	-	-	U	UJ	-
JJE-121-95	31335201JN	-	-	-	-	-	-	U	-	-	U	-	-	U	-	-	-	UJ	-	J	-	-	U	UJ	-
JJE-121-95	31335202JN	-	-	-	-	-	-	U	-	-	U	-	-	U	-	-	-	UJ	-	-	-	-	-	UJ	-
JJE-123-95	31350601JN	-	UJ	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	-	-	-	-	-	-	-

Qualified TAL (CLP) metals parameters due to out-of-tolerance accuracy.

SDG #	Sample ID #	Al	Sb	As	Ba	Be	Cd	Ca	Cr	Co	Cu	Fe	Pb	Mg	Mn	Hg	Ni	K	Se	Ag	Na	Tl	V	Zn	Zr
JJE120-95	31321501JN	U	-	-	-	-	-	-	-	-	UJ	-	-	-	-	-	-	J	-	UJ	-	-	J	-	-
JJE120-95	31323101JN	U	-	-	-	-	-	-	-	-	J	-	-	-	-	-	-	J	U	UJ	-	-	J	U	-
JJE120-95	31324401JN	-	-	-	-	-	-	-	-	-	UJ	-	-	-	-	-	-	J	U	UJ	-	-	J	-	-
JJE120-95	31331201JN	U	-	-	-	-	-	-	-	-	UJ	-	-	-	-	-	-	J	-	UJ	-	-	J	U	-
JJE120-95	31331901JN	U	-	-	-	-	-	-	-	-	J	-	-	-	-	-	-	J	U	UJ	-	-	J	-	-
JJE120-95	31332001JN	U	-	-	-	-	-	-	-	-	UJ	-	U	-	-	-	-	J	U	UJ	-	-	J	-	-
JJE120-95	31332301JN	U	-	-	-	-	-	-	-	-	UJ	-	-	-	-	-	-	J	-	J	-	-	J	-	-
JJE120-95	31332501JN	U	-	-	-	-	-	-	-	-	UJ	-	-	-	-	-	-	J	-	UJ	-	-	J	-	-
JJE120-95	31333001JN	U	-	-	-	-	-	-	-	-	UJ	-	-	-	-	-	-	J	U	UJ	-	-	J	U	-
JJE120-95	31334601JN	U	-	-	-	-	-	-	-	-	UJ	-	U	-	-	-	-	J		UJ	-	-	J	-	-
JJE120-95	31334901JN	U	-	-	-	-	-	-	-	-	UJ	-	-	-	-	-	-	J	U	UJ	-	-	J	-	-
JJE-121-95	31320201JN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	-	U	UJ	-
JJE-121-95	31320401JN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	J	-	-	U	UJ	-
JJE-121-95	31330401JN	-	-	-	-	-	-	-	-	-	U	-	-	-	-	-	-	J	-	-	-	-	U	UJ	-
JJE-121-95	31330501JN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	-	U	UJ	-
JJE-121-95	31330601JN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	J	-	-	-	-	U	UJ	-

Accuracy

Summary of Qualified and Rejected Data

SAMPLE LOCATION	SAMPLE NUMBER	TYPE LOCATION	DEPTH (ft)	ANALYSIS	COMPOUND	CONC	RAD UNCERT	UNITS	Q FLAG	MATRIX	SAMPLE DATE	VAL LEVEL	NOTE
CPP-78-1	37800102EH	BOREHOLE	0-0.5	RAD	ALPHA	6.8	1.6	pCi/g		OTHER	26-May-95	A	
CPP-78-1	37800101EH	BOREHOLE	0-0.5	RAD	ALPHA	15	2	pCi/g		OTHER	26-May-95	A	
CPP-78-1	37800102EH	BOREHOLE	0-0.5	RAD	BETA	20	3	pCi/g		OTHER	26-May-95	A	
CPP-78-1	37800101EH	BOREHOLE	0-0.5	RAD	BETA	29	3	pCi/g		OTHER	26-May-95	A	
CPP-78-1	37800101EH	BOREHOLE	0-0.5	RAD	Ce-144			pCi/g	U	OTHER	26-May-95	A	
CPP-78-1	37800102EH	BOREHOLE	0-0.5	RAD	Ce-144			pCi/g	U	OTHER	26-May-95	A	
CPP-78-1	37800101EH	BOREHOLE	0-0.5	RAD	Co-58			pCi/g	U	OTHER	26-May-95	A	
CPP-78-1	37800102EH	BOREHOLE	0-0.5	RAD	Co-58			pCi/g	U	OTHER	26-May-95	A	
CPP-78-1	37800101EH	BOREHOLE	0-0.5	RAD	Co-60			pCi/g	U	OTHER	26-May-95	A	
CPP-78-1	37800102EH	BOREHOLE	0-0.5	RAD	Co-60			pCi/g	U	OTHER	26-May-95	A	
CPP-78-1	37800102EH	BOREHOLE	0-0.5	RAD	Cs-134			pCi/g	U	OTHER	26-May-95	A	
CPP-78-1	37800101EH	BOREHOLE	0-0.5	RAD	Cs-134			pCi/g	U	OTHER	26-May-95	A	
CPP-78-1	37800102EH	BOREHOLE	0-0.5	RAD	Cs-137			pCi/g	U	OTHER	26-May-95	A	
CPP-78-1	37800101EH	BOREHOLE	0-0.5	RAD	Cs-137	0.22	0.02	pCi/g		OTHER	26-May-95	A	
CPP-78-1	37800102EH	BOREHOLE	0-0.5	RAD	Eu-154			pCi/g	U	OTHER	26-May-95	A	
CPP-78-1	37800101EH	BOREHOLE	0-0.5	RAD	Eu-154			pCi/g	U	OTHER	26-May-95	A	
CPP-78-1	37800102EH	BOREHOLE	0-0.5	RAD	Eu-155			pCi/g	U	OTHER	26-May-95	A	
CPP-78-1	37800101EH	BOREHOLE	0-0.5	RAD	Eu-155			pCi/g	U	OTHER	26-May-95	A	
CPP-78-1	37800102EH	BOREHOLE	0-0.5	RAD	Nb-95			pCi/g	U	OTHER	26-May-95	A	
CPP-78-1	37800101EH	BOREHOLE	0-0.5	RAD	Nb-95			pCi/g	U	OTHER	26-May-95	A	
CPP-78-1	37800101EH	BOREHOLE	0-0.5	RAD	Ru-103			pCi/g	U	OTHER	26-May-95	A	
CPP-78-1	37800102EH	BOREHOLE	0-0.5	RAD	Ru-103			pCi/g	U	OTHER	26-May-95	A	
CPP-78-1	37800101EH	BOREHOLE	0-0.5	RAD	Ru-106			pCi/g	U	OTHER	26-May-95	A	
CPP-78-1	37800102EH	BOREHOLE	0-0.5	RAD	Ru-106			pCi/g	U	OTHER	26-May-95	A	
CPP-78-1	37800102EH	BOREHOLE	0-0.5	RAD	Sb-125			pCi/g	U	OTHER	26-May-95	A	
CPP-78-1	37800101EH	BOREHOLE	0-0.5	RAD	Sb-125			pCi/g	U	OTHER	26-May-95	A	

SAMPLE LOCATION	SAMPLE NUMBER	TYPE LOCATION	DEPTH (M)	ANALYSIS	COMPOUND	CONC	RAD UNCERT	UNITS	Q FLAG	MATRIX	SAMPLE DATE	VAL LEVEL	NOTE
CPP-40-1	34000302EH	BOREHOLE	7.5-10	RAD	ALPHA	4.8	1.5	pCi/g		OTHER	01-Jun-95	A	
CPP-40-1	34000301EH	BOREHOLE	7.5-10	RAD	ALPHA	4.9	1.6	pCi/g		OTHER	01-Jun-95	A	
CPP-40-1	34000302EH	BOREHOLE	7.5-10	RAD	BETA	25	3	pCi/g		OTHER	01-Jun-95	A	
CPP-40-1	34000301EH	BOREHOLE	7.5-10	RAD	BETA	16	3	pCi/g		OTHER	01-Jun-95	A	
CPP-40-1	34000301EH	BOREHOLE	7.5-10	RAD	Ce-144			pCi/g	U	OTHER	01-Jun-95	A	
CPP-40-1	34000302EH	BOREHOLE	7.5-10	RAD	Ce-144			pCi/g	U	OTHER	01-Jun-95	A	
CPP-40-1	34000301EH	BOREHOLE	7.5-10	RAD	Co-58			pCi/g	U	OTHER	01-Jun-95	A	
CPP-40-1	34000302EH	BOREHOLE	7.5-10	RAD	Co-58			pCi/g	U	OTHER	01-Jun-95	A	
CPP-40-1	34000301EH	BOREHOLE	7.5-10	RAD	Co-60			pCi/g	U	OTHER	01-Jun-95	A	
CPP-40-1	34000302EH	BOREHOLE	7.5-10	RAD	Co-60			pCi/g	U	OTHER	01-Jun-95	A	
CPP-40-1	34000302EH	BOREHOLE	7.5-10	RAD	Cs-134			pCi/g	U	OTHER	01-Jun-95	A	
CPP-40-1	34000301EH	BOREHOLE	7.5-10	RAD	Cs-134			pCi/g	U	OTHER	01-Jun-95	A	
CPP-40-1	34000302EH	BOREHOLE	7.5-10	RAD	Cs-137			pCi/g	U	OTHER	01-Jun-95	A	
CPP-40-1	34000301EH	BOREHOLE	7.5-10	RAD	Cs-137			pCi/g	U	OTHER	01-Jun-95	A	
CPP-40-1	34000302EH	BOREHOLE	7.5-10	RAD	Eu-154			pCi/g	U	OTHER	01-Jun-95	A	
CPP-40-1	34000301EH	BOREHOLE	7.5-10	RAD	Eu-154			pCi/g	U	OTHER	01-Jun-95	A	
CPP-40-1	34000302EH	BOREHOLE	7.5-10	RAD	Eu-155			pCi/g	U	OTHER	01-Jun-95	A	
CPP-40-1	34000301EH	BOREHOLE	7.5-10	RAD	Eu-155			pCi/g	U	OTHER	01-Jun-95	A	
CPP-40-1	34000302EH	BOREHOLE	7.5-10	RAD	Nb-95			pCi/g	U	OTHER	01-Jun-95	A	
CPP-40-1	34000301EH	BOREHOLE	7.5-10	RAD	Nb-95			pCi/g	U	OTHER	01-Jun-95	A	
CPP-40-1	34000301EH	BOREHOLE	7.5-10	RAD	Ru-103			pCi/g	U	OTHER	01-Jun-95	A	
CPP-40-1	34000302EH	BOREHOLE	7.5-10	RAD	Ru-103			pCi/g	U	OTHER	01-Jun-95	A	
CPP-40-1	34000301EH	BOREHOLE	7.5-10	RAD	Ru-106			pCi/g	U	OTHER	01-Jun-95	A	
CPP-40-1	34000302EH	BOREHOLE	7.5-10	RAD	Ru-106			pCi/g	U	OTHER	01-Jun-95	A	
CPP-40-1	34000302EH	BOREHOLE	7.5-10	RAD	Sb-125			pCi/g	U	OTHER	01-Jun-95	A	
CPP-40-1	34000301EH	BOREHOLE	7.5-10	RAD	Sb-125			pCi/g	U	OTHER	01-Jun-95	A	

SAMPLE LOCATION	SAMPLE NUMBER	TYPE LOCATION	DEPTH (ft)	ANALYSIS	COMPOUND	CONC	RAD UNCERT	UNITS	Q FLAG	MATRIX	SAMPLE DATE	VAL LEVEL	NOTE
CPP-22-1	32200102EH	BOREHOLE	3-7	RAD	ALPHA	12	2	pCi/g		OTHER	06-Jul-95	A	
CPP-22-1	32200101EH	BOREHOLE	0-0.5	RAD	ALPHA	6.7	1.8	pCi/g		OTHER	06-Jul-95	A	
CPP-22-1	32200102EH	BOREHOLE	3-7	RAD	BETA	20	3	pCi/g		OTHER	06-Jul-95	A	
CPP-22-1	32200101EH	BOREHOLE	0-0.5	RAD	BETA	23	3	pCi/g		OTHER	06-Jul-95	A	
CPP-22-1	32200101EH	BOREHOLE	0-0.5	RAD	Ce-144			pCi/g	U	OTHER	06-Jul-95	A	
CPP-22-1	32200102EH	BOREHOLE	3-7	RAD	Ce-144			pCi/g	U	OTHER	06-Jul-95	A	
CPP-22-1	32200101EH	BOREHOLE	0-0.5	RAD	Co-58			pCi/g	U	OTHER	06-Jul-95	A	
CPP-22-1	32200102EH	BOREHOLE	3-7	RAD	Co-58			pCi/g	U	OTHER	06-Jul-95	A	
CPP-22-1	32200101EH	BOREHOLE	0-0.5	RAD	Co-60			pCi/g	U	OTHER	06-Jul-95	A	
CPP-22-1	32200102EH	BOREHOLE	3-7	RAD	Co-60			pCi/g	U	OTHER	06-Jul-95	A	
CPP-22-1	32200102EH	BOREHOLE	3-7	RAD	Cs-134			pCi/g	U	OTHER	06-Jul-95	A	
CPP-22-1	32200101EH	BOREHOLE	0-0.5	RAD	Cs-134			pCi/g	U	OTHER	06-Jul-95	A	
CPP-22-1	32200102EH	BOREHOLE	3-7	RAD	Cs-137			pCi/g	U	OTHER	06-Jul-95	A	
CPP-22-1	32200101EH	BOREHOLE	0-0.5	RAD	Cs-137			pCi/g	U	OTHER	06-Jul-95	A	
CPP-22-1	32200102EH	BOREHOLE	3-7	RAD	Eu-154			pCi/g	U	OTHER	06-Jul-95	A	
CPP-22-1	32200101EH	BOREHOLE	0-0.5	RAD	Eu-154			pCi/g	U	OTHER	06-Jul-95	A	
CPP-22-1	32200102EH	BOREHOLE	3-7	RAD	Eu-155			pCi/g	U	OTHER	06-Jul-95	A	
CPP-22-1	32200101EH	BOREHOLE	0-0.5	RAD	Eu-155			pCi/g	U	OTHER	06-Jul-95	A	
CPP-22-1	32200102EH	BOREHOLE	3-7	RAD	Nb-95			pCi/g	U	OTHER	06-Jul-95	A	
CPP-22-1	32200101EH	BOREHOLE	0-0.5	RAD	Nb-95			pCi/g	U	OTHER	06-Jul-95	A	
CPP-22-1	32200101EH	BOREHOLE	0-0.5	RAD	Ru-103			pCi/g	U	OTHER	06-Jul-95	A	
CPP-22-1	32200102EH	BOREHOLE	3-7	RAD	Ru-103			pCi/g	U	OTHER	06-Jul-95	A	
CPP-22-1	32200101EH	BOREHOLE	0-0.5	RAD	Ru-106			pCi/g	U	OTHER	06-Jul-95	A	
CPP-22-1	32200102EH	BOREHOLE	3-7	RAD	Ru-106			pCi/g	U	OTHER	06-Jul-95	A	
CPP-22-1	32200102EH	BOREHOLE	3-7	RAD	Sb-125			pCi/g	U	OTHER	06-Jul-95	A	
CPP-22-1	32200101EH	BOREHOLE	0-0.5	RAD	Sb-125			pCi/g	U	OTHER	06-Jul-95	A	

SAMPLE LOCATION	SAMPLE NUMBER	TYPE LOCATION	DEPTH (ft)	ANALYSIS	COMPOUND	CONC	RAD UNCERT	UNITS	Q FLAG	MATRIX	SAMPLE DATE	VAL LEVEL	NOTE
USGS 36	31334801JN	AQUIFER WELL	477.48-567.1	INORG	Aluminum	26.8		ug/L	U P	WATER	12-May-95	A	
USGS 36	31330401JN	AQUIFER WELL	477.48-567.1	INORG	Aluminum	26.8		ug/L	U P	WATER	12-May-95	A	
USGS 36	31334801JN	AQUIFER WELL	477.48-567.1	INORG	Antimony	1.9		ug/L	U P	WATER	12-May-95	A	
USGS 36	31330401JN	AQUIFER WELL	477.48-567.1	INORG	Antimony	1.9		ug/L	U P	WATER	12-May-95	A	
USGS 36	31334801JN	AQUIFER WELL	477.48-567.1	INORG	Arsenic	4		ug/L	U P	WATER	12-May-95	A	
USGS 36	31330401JN	AQUIFER WELL	477.48-567.1	INORG	Arsenic	4		ug/L	U P	WATER	12-May-95	A	
USGS 36	31334801JN	AQUIFER WELL	477.48-567.1	INORG	Barium	108		ug/L	B P	WATER	12-May-95	A	
USGS 36	31330401JN	AQUIFER WELL	477.48-567.1	INORG	Barium	109		ug/L	B P	WATER	12-May-95	A	
USGS 36	31330401JN	AQUIFER WELL	477.48-567.1	INORG	Beryllium	0.1		ug/L	U P	WATER	12-May-95	A	
USGS 36	31334801JN	AQUIFER WELL	477.48-567.1	INORG	Beryllium	0.1		ug/L	U P	WATER	12-May-95	A	
USGS 36	31330401JN	AQUIFER WELL	477.48-567.1	INORG	Cadmium	0.4		ug/L	U P	WATER	12-May-95	A	
USGS 36	31334801JN	AQUIFER WELL	477.48-567.1	INORG	Cadmium	0.4		ug/L	U P	WATER	12-May-95	A	
USGS 36	31330401JN	AQUIFER WELL	477.48-567.1	INORG	Calcium	57200		ug/L	P	WATER	12-May-95	A	
USGS 36	31334801JN	AQUIFER WELL	477.48-567.1	INORG	Calcium	56000		ug/L	P	WATER	12-May-95	A	
USGS 36	31330401JN	AQUIFER WELL	477.48-567.1	INORG	Chromium	13.5		ug/L	P	WATER	12-May-95	A	
USGS 36	31334801JN	AQUIFER WELL	477.48-567.1	INORG	Chromium	12.9		ug/L	P	WATER	12-May-95	A	
USGS 36	31330401JN	AQUIFER WELL	477.48-567.1	INORG	Cobalt	0.5		ug/L	U P	WATER	12-May-95	A	
USGS 36	31334801JN	AQUIFER WELL	477.48-567.1	INORG	Cobalt	0.5		ug/L	U P	WATER	12-May-95	A	
USGS 36	31330401JN	AQUIFER WELL	477.48-567.1	INORG	Copper	2		ug/L	BU P	WATER	12-May-95	A	
USGS 36	31334801JN	AQUIFER WELL	477.48-567.1	INORG	Copper	1.8		ug/L	BU P	WATER	12-May-95	A	
USGS 36	31330401JN	AQUIFER WELL	477.48-567.1	INORG	Iron	21.5		ug/L	U P	WATER	12-May-95	A	
USGS 36	31334801JN	AQUIFER WELL	477.48-567.1	INORG	Iron	21.5		ug/L	U P	WATER	12-May-95	A	
USGS 36	31334801JN	AQUIFER WELL	477.48-567.1	INORG	Lead	2		ug/L	U P	WATER	12-May-95	A	
USGS 36	31330401JN	AQUIFER WELL	477.48-567.1	INORG	Lead	2		ug/L	U P	WATER	12-May-95	A	
USGS 36	31334801JN	AQUIFER WELL	477.48-567.1	INORG	Magnesium	14500		ug/L	P	WATER	12-May-95	A	
USGS 36	31330401JN	AQUIFER WELL	477.48-567.1	INORG	Magnesium	14700		ug/L	P	WATER	12-May-95	A	
USGS 36	31330401JN	AQUIFER WELL	477.48-567.1	INORG	Manganese	0.8		ug/L	U P	WATER	12-May-95	A	
USGS 36	31334801JN	AQUIFER WELL	477.48-567.1	INORG	Manganese	0.8		ug/L	U P	WATER	12-May-95	A	
USGS 36	31334801JN	AQUIFER WELL	477.48-567.1	INORG	Mercury	0.1		ug/L	U AV	WATER	12-May-95	A	
USGS 36	31330401JN	AQUIFER WELL	477.48-567.1	INORG	Mercury	0.1		ug/L	U AV	WATER	12-May-95	A	
USGS 36	31334801JN	AQUIFER WELL	477.48-567.1	INORG	Nickel	3.4		ug/L	U P	WATER	12-May-95	A	
USGS 36	31330401JN	AQUIFER WELL	477.48-567.1	INORG	Nickel	3.4		ug/L	U P	WATER	12-May-95	A	
USGS 36	31330401JN	AQUIFER WELL	477.48-567.1	INORG	Potassium	2770		ug/L	BEJ P	WATER	12-May-95	A	
USGS 36	31334801JN	AQUIFER WELL	477.48-567.1	INORG	Potassium	2810		ug/L	BEJ P	WATER	12-May-95	A	
USGS 36	31334801JN	AQUIFER WELL	477.48-567.1	INORG	Selenium	2.7		ug/L	U P	WATER	12-May-95	A	
USGS 36	31330401JN	AQUIFER WELL	477.48-567.1	INORG	Selenium	2.7		ug/L	U P	WATER	12-May-95	A	
USGS 36	31330401JN	AQUIFER WELL	477.48-567.1	INORG	Silver	0.6		ug/L	UN P	WATER	12-May-95	A	
USGS 36	31334801JN	AQUIFER WELL	477.48-567.1	INORG	Silver	0.6		ug/L	UN P	WATER	12-May-95	A	
USGS 36	31334801JN	AQUIFER WELL	477.48-567.1	INORG	Sodium	16200		ug/L	P	WATER	12-May-95	A	
USGS 36	31330401JN	AQUIFER WELL	477.48-567.1	INORG	Sodium	16600		ug/L	P	WATER	12-May-95	A	
USGS 36	31330401JN	AQUIFER WELL	477.48-567.1	INORG	Thallium	4.6		ug/L	U P	WATER	12-May-95	A	
USGS 36	31334801JN	AQUIFER WELL	477.48-567.1	INORG	Thallium	4.6		ug/L	U P	WATER	12-May-95	A	
USGS 36	31334801JN	AQUIFER WELL	477.48-567.1	INORG	Vanadium	3.3		ug/L	BU P	WATER	12-May-95	A	
USGS 36	31330401JN	AQUIFER WELL	477.48-567.1	INORG	Vanadium	3.7		ug/L	BU P	WATER	12-May-95	A	
USGS 36	31334801JN	AQUIFER WELL	477.48-567.1	INORG	Zinc	6.2		ug/L	BEUJ P	WATER	12-May-95	A	
USGS 36	31330401JN	AQUIFER WELL	477.48-567.1	INORG	Zinc	2		ug/L	BEUJ P	WATER	12-May-95	A	
USGS 36	31334801JN	AQUIFER WELL	477.48-567.1	INORG	Zirconium	31.3		ug/L	U P	WATER	12-May-95	A	
USGS 36	31330401JN	AQUIFER WELL	477.48-567.1	INORG	Zirconium	31.3		ug/L	U P	WATER	12-May-95	A	

SAMPLE LOCATION	SAMPLE NUMBER	TYPE LOCATION	DEPTH (ft)	ANALYSIS	COMPOUND	CONC	RAD UNCERT	UNITS	Q FLAG	MATRIX	SAMPLE DATE	VAL LEVEL	NOTE
USGS 36	31334801AB	AQUIFER WELL	477.48-567.1	RAD	ALPHA	2.9	1.3	pCi/L		NWATER	12-May-95	A	
USGS 36	31330401AB	AQUIFER WELL	477.48-567.1	RAD	ALPHA	4.4	1.4	pCi/L		NWATER	12-May-95	A	
USGS 36	31330401AB	AQUIFER WELL	477.48-567.1	RAD	ALPHA	4.4	1.4	pCi/L		NWATER	12-May-95	A	
USGS 36	31330401AB	AQUIFER WELL	477.48-567.1	RAD	BETA	32	2	pCi/L		NWATER	12-May-95	A	
USGS 36	31330401AB	AQUIFER WELL	477.48-567.1	RAD	BETA	32	2	pCi/L		NWATER	12-May-95	A	
USGS 36	31334801AB	AQUIFER WELL	477.48-567.1	RAD	BETA	31	2	pCi/L		NWATER	12-May-95	A	
USGS 36	31334801R4	AQUIFER WELL	477.48-567.1	RAD	Ce-144			pCi/L	U	NWATER	12-May-95	A	
USGS 36	31330401R4	AQUIFER WELL	477.48-567.1	RAD	Ce-144			pCi/L	U	NWATER	12-May-95	A	
USGS 36	31334801R4	AQUIFER WELL	477.48-567.1	RAD	Co-58			pCi/L	U	NWATER	12-May-95	A	
USGS 36	31330401R4	AQUIFER WELL	477.48-567.1	RAD	Co-58			pCi/L	U	NWATER	12-May-95	A	
USGS 36	31334801R4	AQUIFER WELL	477.48-567.1	RAD	Co-60			pCi/L	U	NWATER	12-May-95	A	
USGS 36	31330401R4	AQUIFER WELL	477.48-567.1	RAD	Co-60			pCi/L	U	NWATER	12-May-95	A	
USGS 36	31334801R4	AQUIFER WELL	477.48-567.1	RAD	Cs-134			pCi/L	U	NWATER	12-May-95	A	
USGS 36	31330401R4	AQUIFER WELL	477.48-567.1	RAD	Cs-134			pCi/L	U	NWATER	12-May-95	A	
USGS 36	31334801R4	AQUIFER WELL	477.48-567.1	RAD	Cs-137			pCi/L	U	NWATER	12-May-95	A	
USGS 36	31330401R4	AQUIFER WELL	477.48-567.1	RAD	Cs-137			pCi/L	U	NWATER	12-May-95	A	
USGS 36	31334801R4	AQUIFER WELL	477.48-567.1	RAD	Eu-154			pCi/L	U	NWATER	12-May-95	A	
USGS 36	31330401R4	AQUIFER WELL	477.48-567.1	RAD	Eu-154			pCi/L	U	NWATER	12-May-95	A	
USGS 36	31334801R4	AQUIFER WELL	477.48-567.1	RAD	Eu-155			pCi/L	U	NWATER	12-May-95	A	
USGS 36	31330401R4	AQUIFER WELL	477.48-567.1	RAD	Eu-155			pCi/L	U	NWATER	12-May-95	A	
USGS 36	31330401RI	AQUIFER WELL	477.48-567.1	RAD	I-129	0	0.3	pCi/L	U	NWATER	12-May-95	A	
USGS 36	31334801RI	AQUIFER WELL	477.48-567.1	RAD	I-129	0	0.3	pCi/L	U	NWATER	12-May-95	A	
USGS 36	31334801R4	AQUIFER WELL	477.48-567.1	RAD	Nb-95			pCi/L	U	NWATER	12-May-95	A	
USGS 36	31330401R4	AQUIFER WELL	477.48-567.1	RAD	Nb-95			pCi/L	U	NWATER	12-May-95	A	
USGS 36	31334801R4	AQUIFER WELL	477.48-567.1	RAD	Ru-103			pCi/L	U	NWATER	12-May-95	A	
USGS 36	31330401R4	AQUIFER WELL	477.48-567.1	RAD	Ru-103			pCi/L	U	NWATER	12-May-95	A	
USGS 36	31330401R4	AQUIFER WELL	477.48-567.1	RAD	Ru-106			pCi/L	U	NWATER	12-May-95	A	
USGS 36	31334801R4	AQUIFER WELL	477.48-567.1	RAD	Ru-106			pCi/L	U	NWATER	12-May-95	A	
USGS 36	31330401R4	AQUIFER WELL	477.48-567.1	RAD	Sb-125			pCi/L	U	NWATER	12-May-95	A	
USGS 36	31334801R4	AQUIFER WELL	477.48-567.1	RAD	Sb-125			pCi/L	U	NWATER	12-May-95	A	
USGS 36	31330401EA	AQUIFER WELL	477.48-567.1	RAD	Sr-90	8.1	0.5	pCi/L		NWATER	12-May-95	A	
USGS 36	31330401RB	AQUIFER WELL	477.48-567.1	RAD	Sr-90	9	0.5	pCi/L		NWATER	12-May-95	A	
USGS 36	31330401EA	AQUIFER WELL	477.48-567.1	RAD	Sr-90	8.1	0.5	pCi/L		NWATER	12-May-95	A	
USGS 36	31330401RB	AQUIFER WELL	477.48-567.1	RAD	Sr-90	9	0.5	pCi/L		NWATER	12-May-95	A	
USGS 36	31334801EA	AQUIFER WELL	477.48-567.1	RAD	Sr-90	8.6	0.5	pCi/L		NWATER	12-May-95	A	
USGS 36	31334801RB	AQUIFER WELL	477.48-567.1	RAD	Sr-90	10.5	0.6	pCi/L		NWATER	12-May-95	A	
USGS 36	31330401RB	AQUIFER WELL	477.48-567.1	RAD	Tc-99	4.1	0.5	pCi/L		NWATER	12-May-95	A	
USGS 36	31330401RB	AQUIFER WELL	477.48-567.1	RAD	Tc-99	4.1	0.5	pCi/L		NWATER	12-May-95	A	
USGS 36	31330401EA	AQUIFER WELL	477.48-567.1	RAD	Tc-99	5.3	0.6	pCi/L		NWATER	12-May-95	A	
USGS 36	31330401EA	AQUIFER WELL	477.48-567.1	RAD	Tc-99	5.3	0.6	pCi/L		NWATER	12-May-95	A	
USGS 36	31334801EA	AQUIFER WELL	477.48-567.1	RAD	Tc-99	4.8	0.8	pCi/L		NWATER	12-May-95	A	
USGS 36	31334801RB	AQUIFER WELL	477.48-567.1	RAD	Tc-99	5.8	0.8	pCi/L		NWATER	12-May-95	A	
USGS 36	31330401R8	AQUIFER WELL	477.48-567.1	RAD	Tritium	6560	240	pCi/L		NWATER	12-May-95	A	
USGS 36	31334801R8	AQUIFER WELL	477.48-567.1	RAD	Tritium	6110	230	pCi/L		NWATER	12-May-95	A	
USGS 36	31330401R8	AQUIFER WELL	477.48-567.1	RAD	Tritium	6560	240	pCi/L		NWATER	12-May-95	A	

313350(dup & 313320

SAMPLE LOCATION	SAMPLE NUMBER	TYPE LOCATION	DEPTH (ft)	ANALYSIS	COMPOUND	CONC	RAD UNCERT	UNITS	Q FLAG	MATRIX	SAMPLE DATE	VAL LEVEL	NOTE
USGS 67	31332001JN	AQUIFER WELL	462-699	INORG	Aluminum	0.0567		mg/L	BU P	WATER	18-May-95	A	
USGS 67	31332001JN	AQUIFER WELL	462-699	INORG	Antimony	0.0019		mg/L	U P	WATER	18-May-95	A	
USGS 67	31332001JN	AQUIFER WELL	462-699	INORG	Arsenic	0.004		mg/L	U P	WATER	18-May-95	A	
USGS 67	31332001JN	AQUIFER WELL	462-699	INORG	Barium	0.185		mg/L	B P	WATER	18-May-95	A	
USGS 67	31332001JN	AQUIFER WELL	462-699	INORG	Beryllium	0.0001		mg/L	U P	WATER	18-May-95	A	
USGS 67	31332001JN	AQUIFER WELL	462-699	INORG	Cadmium	0.0004		mg/L	U P	WATER	18-May-95	A	
USGS 67	31332001JN	AQUIFER WELL	462-699	INORG	Calcium	77.2		mg/L	P	WATER	18-May-95	A	
USGS 67	31332001JN	AQUIFER WELL	462-699	INORG	Chromium	0.0056		mg/L	B P	WATER	18-May-95	A	
USGS 67	31332001JN	AQUIFER WELL	462-699	INORG	Cobalt	0.0005		mg/L	U P	WATER	18-May-95	A	
USGS 67	31332001JN	AQUIFER WELL	462-699	INORG	Copper	0.0013		mg/L	UJ P	WATER	18-May-95	A	
USGS 67	31332001JN	AQUIFER WELL	462-699	INORG	Iron	0.0215		mg/L	U P	WATER	18-May-95	A	
USGS 67	31332001JN	AQUIFER WELL	462-699	INORG	Lead	0.005		mg/L	BU P	WATER	18-May-95	A	
USGS 67	31332001JN	AQUIFER WELL	462-699	INORG	Magnesium	21.7		mg/L	P	WATER	18-May-95	A	
USGS 67	31332001JN	AQUIFER WELL	462-699	INORG	Manganese	0.0008		mg/L	U P	WATER	18-May-95	A	
USGS 67	31332001JN	AQUIFER WELL	462-699	INORG	Mercury	0.0001		mg/L	U AV	WATER	18-May-95	A	
USGS 67	31332001JN	AQUIFER WELL	462-699	INORG	Nickel	0.0034		mg/L	U P	WATER	18-May-95	A	
USGS 67	31332001JN	AQUIFER WELL	462-699	INORG	Potassium	5.34		mg/L	EJ P	WATER	18-May-95	A	
USGS 67	31332001JN	AQUIFER WELL	462-699	INORG	Selenium	0.005		mg/L	BU P	WATER	18-May-95	A	
USGS 67	31332001JN	AQUIFER WELL	462-699	INORG	Silver	0.0006		mg/L	NUJ P	WATER	18-May-95	A	
USGS 67	31332001JN	AQUIFER WELL	462-699	INORG	Sodium	44.7		mg/L	P	WATER	18-May-95	A	
USGS 67	31332001JN	AQUIFER WELL	462-699	INORG	Thallium	0.0046		mg/L	U P	WATER	18-May-95	A	
USGS 67	31332001JN	AQUIFER WELL	462-699	INORG	Vanadium	0.0031		mg/L	BJ P	WATER	18-May-95	A	
USGS 67	31332001JN	AQUIFER WELL	462-699	INORG	Zinc	0.329		mg/L	P	WATER	18-May-95	A	
USGS 67	31332001AB	AQUIFER WELL	462-699	RAD	ALPHA	1.6	1.6	pCi/L	U	NWATER	18-May-95	A	
USGS-67	31335001AB	AQUIFER WELL	462.34-698	RAD	ALPHA	0	1.5	pCi/L	U	NWATER	18-May-95	A	
USGS 67	31332001AB	AQUIFER WELL	462-699	RAD	BETA	45	3	pCi/L		NWATER	18-May-95	A	
USGS-67	31335001AB	AQUIFER WELL	462.34-698	RAD	BETA	47	3	pCi/L		NWATER	18-May-95	A	
USGS 67	31332001R4	AQUIFER WELL	462-699	RAD	Ce-144			pCi/L	U	NWATER	18-May-95	A	
USGS 67	31332001R4	AQUIFER WELL	462-699	RAD	Co-58			pCi/L	U	NWATER	18-May-95	A	
USGS 67	31332001R4	AQUIFER WELL	462-699	RAD	Co-60			pCi/L	U	NWATER	18-May-95	A	
USGS 67	31332001R4	AQUIFER WELL	462-699	RAD	Cs-134			pCi/L	U	NWATER	18-May-95	A	
USGS 67	31332001R4	AQUIFER WELL	462-699	RAD	Cs-137			pCi/L	U	NWATER	18-May-95	A	
USGS 67	31332001R4	AQUIFER WELL	462-699	RAD	Eu-154			pCi/L	U	NWATER	18-May-95	A	
USGS 67	31332001R4	AQUIFER WELL	462-699	RAD	Eu-155			pCi/L	U	NWATER	18-May-95	A	
USGS 67	31332001RI	AQUIFER WELL	462-699	RAD	I-129	1	0.3	pCi/L		NWATER	18-May-95	A	
USGS-67	31335001RI	AQUIFER WELL	462.34-698	RAD	I-129	0	0.3	pCi/L	U	NWATER	18-May-95	A	
USGS 67	31332001R4	AQUIFER WELL	462-699	RAD	Nb-95			pCi/L	U	NWATER	18-May-95	A	
USGS 67	31332001R4	AQUIFER WELL	462-699	RAD	Ru-103			pCi/L	U	NWATER	18-May-95	A	
USGS 67	31332001R4	AQUIFER WELL	462-699	RAD	Ru-106			pCi/L	U	NWATER	18-May-95	A	
USGS 67	31332001R4	AQUIFER WELL	462-699	RAD	Sb-125			pCi/L	U	NWATER	18-May-95	A	
USGS-67	31335001RB	AQUIFER WELL	462.34-698	RAD	Sr-90	13.3	0.5	pCi/L		NWATER	18-May-95	A	
USGS 67	31332001RB	AQUIFER WELL	462-699	RAD	Sr-90	12.6	0.5	pCi/L		NWATER	18-May-95	A	
USGS-67	31335001EA	AQUIFER WELL	462.34-698	RAD	Sr-90	12.8	0.5	pCi/L		NWATER	18-May-95	A	
USGS 67	31332001EA	AQUIFER WELL	462-699	RAD	Sr-90	10.3	0.5	pCi/L		NWATER	18-May-95	A	
USGS 67	31332001EA	AQUIFER WELL	462-699	RAD	Tc-99	13	1	pCi/L		NWATER	18-May-95	A	
USGS-67	31335001RB	AQUIFER WELL	462.34-698	RAD	Tc-99	12	1	pCi/L		NWATER	18-May-95	A	
USGS-67	31335001EA	AQUIFER WELL	462.34-698	RAD	Tc-99	12	1	pCi/L		NWATER	18-May-95	A	
USGS 67	31332001RB	AQUIFER WELL	462-699	RAD	Tc-99	14	1	pCi/L		NWATER	18-May-95	A	

SAMPLE LOCATION	SAMPLE NUMBER	TYPE LOCATION	DEPTH (m)	ANALYSIS	COMPOUND	CONC	RAD UNCERT	UNITS	Q FLAG	MATRIX	SAMPLE DATE	VAL LEVEL	NOTE
USGS-67	31335001R8	AQUIFER WELL	462.34-698	RAD	Tritium	21000	400	pCi/L		NWATER	18-May-95	A	
USGS 67	31332001R8	AQUIFER WELL	462-699	RAD	Tritium	21200	400	pCi/L		NWATER	18-May-95	A	

SAMPLE LOCATION	SAMPLE NUMBER	TYPE LOCATION	DEPTH (ft)	ANALYSIS	COMPOUND	CONC	RAD UNCERT	UNITS	Q FLAG	MATRIX	SAMPLE DATE	VAL LEVEL	NOTE
QC	31335101JN	RINSATE	N/A	INORG	Aluminum	26.8		ug/L	U P	WATER	24-May-95	A	
QC	31335102JN	RINSATE	N/A	INORG	Aluminum	26.8		ug/L	U P	WATER	05-Jun-95	A	
QC	31335101JN	RINSATE	N/A	INORG	Antimony	1.9		ug/L	U P	WATER	24-May-95	A	
QC	31335102JN	RINSATE	N/A	INORG	Antimony	5		ug/L	B P	WATER	05-Jun-95	A	
QC	31335101JN	RINSATE	N/A	INORG	Arsenic	4		ug/L	U P	WATER	24-May-95	A	
QC	31335102JN	RINSATE	N/A	INORG	Arsenic	4		ug/L	U P	WATER	05-Jun-95	A	
QC	31335102JN	RINSATE	N/A	INORG	Barium	1.7		ug/L	BU P	WATER	05-Jun-95	A	
QC	31335101JN	RINSATE	N/A	INORG	Barium	0.81		ug/L	BU P	WATER	24-May-95	A	
QC	31335101JN	RINSATE	N/A	INORG	Beryllium	0.1		ug/L	U P	WATER	24-May-95	A	
QC	31335102JN	RINSATE	N/A	INORG	Beryllium	0.1		ug/L	U P	WATER	05-Jun-95	A	
QC	31335102JN	RINSATE	N/A	INORG	Cadmium	2.5		ug/L	B P	WATER	05-Jun-95	A	
QC	31335101JN	RINSATE	N/A	INORG	Cadmium	0.4		ug/L	U P	WATER	24-May-95	A	
QC	31335102JN	RINSATE	N/A	INORG	Calcium	2590		ug/L	BU P	WATER	05-Jun-95	A	
QC	31335101JN	RINSATE	N/A	INORG	Calcium	451		ug/L	BU P	WATER	24-May-95	A	
QC	31335102JN	RINSATE	N/A	INORG	Chromium	4.1		ug/L	U P	WATER	05-Jun-95	A	
QC	31335101JN	RINSATE	N/A	INORG	Chromium	4.1		ug/L	U P	WATER	24-May-95	A	
QC	31335102JN	RINSATE	N/A	INORG	Cobalt	0.5		ug/L	U P	WATER	05-Jun-95	A	
QC	31335101JN	RINSATE	N/A	INORG	Cobalt	0.5		ug/L	U P	WATER	24-May-95	A	
QC	31335102JN	RINSATE	N/A	INORG	Copper	4.6		ug/L	B P	WATER	05-Jun-95	A	
QC	31335101JN	RINSATE	N/A	INORG	Copper	8.6		ug/L	B P	WATER	24-May-95	A	
QC	31335102JN	RINSATE	N/A	INORG	Iron	21.5		ug/L	U P	WATER	05-Jun-95	A	
QC	31335101JN	RINSATE	N/A	INORG	Iron	21.5		ug/L	U P	WATER	24-May-95	A	
QC	31335102JN	RINSATE	N/A	INORG	Lead	2.9		ug/L	B P	WATER	05-Jun-95	A	
QC	31335101JN	RINSATE	N/A	INORG	Lead	14		ug/L	P	WATER	24-May-95	A	
QC	31335101JN	RINSATE	N/A	INORG	Magnesium	265		ug/L	BU P	WATER	24-May-95	A	
QC	31335102JN	RINSATE	N/A	INORG	Magnesium	286		ug/L	BU P	WATER	05-Jun-95	A	
QC	31335101JN	RINSATE	N/A	INORG	Manganese	0.8		ug/L	U P	WATER	24-May-95	A	
QC	31335102JN	RINSATE	N/A	INORG	Manganese	6.2		ug/L	B P	WATER	05-Jun-95	A	
QC	31335102JN	RINSATE	N/A	INORG	Mercury	0.1		ug/L	U AV	WATER	05-Jun-95	A	
QC	31335101JN	RINSATE	N/A	INORG	Mercury	0.1		ug/L	U AV	WATER	24-May-95	A	
QC	31335102JN	RINSATE	N/A	INORG	Nickel	3.4		ug/L	U P	WATER	05-Jun-95	A	
QC	31335101JN	RINSATE	N/A	INORG	Nickel	3.4		ug/L	U P	WATER	24-May-95	A	
QC	31335102JN	RINSATE	N/A	INORG	Potassium	157		ug/L	BU P	WATER	05-Jun-95	A	
QC	31335101JN	RINSATE	N/A	INORG	Potassium	67.4		ug/L	BU P	WATER	24-May-95	A	
QC	31335102JN	RINSATE	N/A	INORG	Selenium	2.7		ug/L	U P	WATER	05-Jun-95	A	
QC	31335101JN	RINSATE	N/A	INORG	Selenium	2.7		ug/L	U P	WATER	24-May-95	A	
QC	31335101JN	RINSATE	N/A	INORG	Silver	0.6		ug/L	U P	WATER	24-May-95	A	
QC	31335102JN	RINSATE	N/A	INORG	Silver	0.6		ug/L	U P	WATER	05-Jun-95	A	
QC	31335101JN	RINSATE	N/A	INORG	Sodium	180		ug/L	BU P	WATER	24-May-95	A	
QC	31335102JN	RINSATE	N/A	INORG	Sodium	263		ug/L	BU P	WATER	05-Jun-95	A	
QC	31335102JN	RINSATE	N/A	INORG	Thallium	4.6		ug/L	U P	WATER	05-Jun-95	A	
QC	31335101JN	RINSATE	N/A	INORG	Thallium	4.6		ug/L	U P	WATER	24-May-95	A	
QC	31335102JN	RINSATE	N/A	INORG	Vanadium	0.4		ug/L	U P	WATER	05-Jun-95	A	
QC	31335101JN	RINSATE	N/A	INORG	Vanadium	0.4		ug/L	U P	WATER	24-May-95	A	
QC	31335102JN	RINSATE	N/A	INORG	Zinc	165		ug/L	P	WATER	05-Jun-95	A	
QC	31335101JN	RINSATE	N/A	INORG	Zinc	72.4		ug/L	P	WATER	24-May-95	A	
QC	31335101JN	RINSATE	N/A	INORG	Zirconium	31.2		ug/L	U P	WATER	24-May-95	A	
QC	31335102JN	RINSATE	N/A	INORG	Zirconium	31.2		ug/L	U P	WATER	05-Jun-95	A	

SAMPLE LOCATION	SAMPLE NUMBER	TYPE LOCATION	DEPTH (ft)	ANALYSIS	COMPOUND	CONC	RAD UNCERT	UNITS	Q FLAG	MATRIX	SAMPLE DATE	VAL LEVEL	NOTE
QC	31335101AB	AQUIFER WELL	N/A	RAD	ALPHA	0.1	0.4	pCi/L	U	NWATER	24-May-95	A	
QC	31335102AB	RINSATE	N/A	RAD	ALPHA	0.3	0.5	pCi/L	U	NWATER	05-Jun-95	A	
QC	31335103AB	RINSATE	N/A	RAD	ALPHA	0.5	0.4	pCi/L	U	NWATER	03-Aug-95	A	
QC	31335102AB	RINSATE	N/A	RAD	BETA	1.4	1.2	pCi/L	U	NWATER	05-Jun-95	A	
QC	31335103AB	RINSATE	N/A	RAD	BETA	1.1	1	pCi/L	U	NWATER	03-Aug-95	A	
QC	31335101AB	AQUIFER WELL	N/A	RAD	BETA	8.9	1.4	pCi/L		NWATER	24-May-95	A	
QC	31335102R4	RINSATE	N/A	RAD	Ce-144			pCi/L	U	NWATER	05-Jun-95	A	
QC	31335103R4	RINSATE	N/A	RAD	Ce-144			pCi/L	U	NWATER	03-Aug-95	A	
QC	31335101R4	RINSATE	N/A	RAD	Ce-144			pCi/L	U	NWATER	24-May-95	A	
QC	31335103R4	RINSATE	N/A	RAD	Co-58			pCi/L	U	NWATER	03-Aug-95	A	
QC	31335101R4	RINSATE	N/A	RAD	Co-58			pCi/L	U	NWATER	24-May-95	A	
QC	31335102R4	RINSATE	N/A	RAD	Co-58			pCi/L	U	NWATER	05-Jun-95	A	
QC	31335103R4	RINSATE	N/A	RAD	Co-60			pCi/L	U	NWATER	03-Aug-95	A	
QC	31335101R4	RINSATE	N/A	RAD	Co-60			pCi/L	U	NWATER	24-May-95	A	
QC	31335102R4	RINSATE	N/A	RAD	Co-60			pCi/L	U	NWATER	05-Jun-95	A	
QC	31335103R4	RINSATE	N/A	RAD	Cs-134			pCi/L	U	NWATER	03-Aug-95	A	
QC	31335102R4	RINSATE	N/A	RAD	Cs-134			pCi/L	U	NWATER	05-Jun-95	A	
QC	31335101R4	RINSATE	N/A	RAD	Cs-134			pCi/L	U	NWATER	24-May-95	A	
QC	31335101R4	RINSATE	N/A	RAD	Cs-137			pCi/L	U	NWATER	24-May-95	A	
QC	31335103R4	RINSATE	N/A	RAD	Cs-137			pCi/L	U	NWATER	03-Aug-95	A	
QC	31335102R4	RINSATE	N/A	RAD	Cs-137			pCi/L	U	NWATER	05-Jun-95	A	
QC	31335101R4	RINSATE	N/A	RAD	Eu-154			pCi/L	U	NWATER	24-May-95	A	
QC	31335103R4	RINSATE	N/A	RAD	Eu-154			pCi/L	U	NWATER	03-Aug-95	A	
QC	31335102R4	RINSATE	N/A	RAD	Eu-154			pCi/L	U	NWATER	05-Jun-95	A	
QC	31335101R4	RINSATE	N/A	RAD	Eu-155			pCi/L	U	NWATER	24-May-95	A	
QC	31335103R4	RINSATE	N/A	RAD	Eu-155			pCi/L	U	NWATER	03-Aug-95	A	
QC	31335102R4	RINSATE	N/A	RAD	Eu-155			pCi/L	U	NWATER	05-Jun-95	A	
QC	31335101RI	AQUIFER WELL	N/A	RAD	I-129	0	0.3	pCi/L	U	NWATER	24-May-95	A	
QC	31335102RI	RINSATE	N/A	RAD	I-129	0	0.3	pCi/L	U	NWATER	05-Jun-95	A	
QC	31335103RI	RINSATE	N/A	RAD	I-129	0	0.3	pCi/L	U	NWATER	03-Aug-95	A	
QC	31335103R4	RINSATE	N/A	RAD	Nb-95			pCi/L	U	NWATER	03-Aug-95	A	
QC	31335102R4	RINSATE	N/A	RAD	Nb-95			pCi/L	U	NWATER	05-Jun-95	A	
QC	31335101R4	RINSATE	N/A	RAD	Nb-95			pCi/L	U	NWATER	24-May-95	A	
QC	31335101R4	RINSATE	N/A	RAD	Ru-103			pCi/L	U	NWATER	24-May-95	A	
QC	31335102R4	RINSATE	N/A	RAD	Ru-103			pCi/L	U	NWATER	05-Jun-95	A	
QC	31335103R4	RINSATE	N/A	RAD	Ru-103			pCi/L	U	NWATER	03-Aug-95	A	
QC	31335101R4	RINSATE	N/A	RAD	Ru-106			pCi/L	U	NWATER	24-May-95	A	
QC	31335102R4	RINSATE	N/A	RAD	Ru-106			pCi/L	U	NWATER	05-Jun-95	A	
QC	31335103R4	RINSATE	N/A	RAD	Ru-106			pCi/L	U	NWATER	03-Aug-95	A	
QC	31335102R4	RINSATE	N/A	RAD	Sb-125			pCi/L	U	NWATER	05-Jun-95	A	
QC	31335101R4	RINSATE	N/A	RAD	Sb-125			pCi/L	U	NWATER	24-May-95	A	
QC	31335103R4	RINSATE	N/A	RAD	Sb-125			pCi/L	U	NWATER	03-Aug-95	A	
QC	31335103RB	RINSATE	N/A	RAD	Sr-90	0.1	0.3	pCi/L	U	NWATER	03-Aug-95	A	
QC	31335102RB	RINSATE	N/A	RAD	Sr-90	0.6	0.4	pCi/L	U	NWATER	05-Jun-95	A	
QC	31335101RB	AQUIFER WELL	N/A	RAD	Sr-90	0	0.4	pCi/L	U	NWATER	24-May-95	A	
QC	31335102EA	RINSATE	N/A	RAD	Tc-99	0.2	0.5	pCi/L	U	NWATER	05-Jun-95	A	
QC	31335101EA	AQUIFER WELL	N/A	RAD	Tc-99	0.1	0.6	pCi/L	U	NWATER	24-May-95	A	
QC	31335103EA	RINSATE	N/A	RAD	Tc-99	0	0.5	pCi/L	U	NWATER	03-Aug-95	A	

313351 Rinsate

SAMPLE LOCATION	SAMPLE NUMBER	TYPE LOCATION	DEPTH (ft)	ANALYSIS	COMPOUND	CONC	RAD UNCERT	UNITS	Q FLAG	MATRIX	SAMPLE DATE	VAL LEVEL	NOTE
QC	31335103R8	RINSATE	N/A	RAD	Tritium	118	149	pCi/L	U	NWATER	03-Aug-95	A	
QC	31335101R8	AQUIFER WELL	N/A	RAD	Tritium	339	160	pCi/L		NWATER	24-May-95	A	
QC	31335102R8	RINSATE	N/A	RAD	Tritium	0	151	pCi/L	U	NWATER	05-Jun-95	A	

313352 Field Blank

SAMPLE LOCATION	SAMPLE NUMBER	TYPE LOCATION	DEPTH (ft)	ANALYSIS	COMPOUND	CONC	RAD UNCERT	UNITS	Q FLAG	MATRIX	SAMPLE DATE	VAL LEVEL	NOTE
QC	31335202JN	FIELD BLANK	N/A	INORG	Aluminum	26.8		ug/L	U P	WATER	16-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Aluminum	26.8		ug/L	U P	WATER	15-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Aluminum	26.8		ug/L	U P	WATER	15-May-95	A	
QC	31335202JN	FIELD BLANK	N/A	INORG	Antimony	1.9		ug/L	U P	WATER	16-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Antimony	1.9		ug/L	U P	WATER	15-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Antimony	1.9		ug/L	U P	WATER	15-May-95	A	
QC	31335202JN	FIELD BLANK	N/A	INORG	Arsenic	4		ug/L	U P	WATER	16-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Arsenic	4		ug/L	U P	WATER	15-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Arsenic	4		ug/L	U P	WATER	15-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Barium	0.92		ug/L	BU P	WATER	15-May-95	A	
QC	31335202JN	FIELD BLANK	N/A	INORG	Barium	0.42		ug/L	B P	WATER	16-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Barium	0.3		ug/L	B P	WATER	15-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Beryllium	0.1		ug/L	U P	WATER	15-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Beryllium	0.1		ug/L	U P	WATER	15-May-95	A	
QC	31335202JN	FIELD BLANK	N/A	INORG	Beryllium	0.1		ug/L	U P	WATER	16-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Cadmium	0.4		ug/L	U P	WATER	15-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Cadmium	0.4		ug/L	U P	WATER	15-May-95	A	
QC	31335202JN	FIELD BLANK	N/A	INORG	Cadmium	0.4		ug/L	U P	WATER	16-May-95	A	
QC	31335202JN	FIELD BLANK	N/A	INORG	Calcium	134		ug/L	BU P	WATER	16-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Calcium	381		ug/L	BU P	WATER	15-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Calcium	188		ug/L	BU P	WATER	15-May-95	A	
QC	31335202JN	FIELD BLANK	N/A	INORG	Chromium	4.1		ug/L	U P	WATER	16-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Chromium	4.1		ug/L	U P	WATER	15-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Chromium	4.1		ug/L	U P	WATER	15-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Cobalt	0.51		ug/L	B P	WATER	15-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Cobalt	0.5		ug/L	U P	WATER	15-May-95	A	
QC	31335202JN	FIELD BLANK	N/A	INORG	Cobalt	0.5		ug/L	U P	WATER	16-May-95	A	
QC	31335202JN	FIELD BLANK	N/A	INORG	Copper	3.9		ug/L	BU P	WATER	16-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Copper	3.5		ug/L	BU P	WATER	15-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Copper	4.4		ug/L	B P	WATER	15-May-95	A	
QC	31335202JN	FIELD BLANK	N/A	INORG	Iron	21.5		ug/L	U P	WATER	16-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Iron	27.3		ug/L	B P	WATER	15-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Iron	21.5		ug/L	U P	WATER	15-May-95	A	
QC	31335202JN	FIELD BLANK	N/A	INORG	Lead	2.3		ug/L	B P	WATER	16-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Lead	2		ug/L	U P	WATER	15-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Lead	2.5		ug/L	B P	WATER	15-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Magnesium	246		ug/L	BU P	WATER	15-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Magnesium	95.4		ug/L	BU P	WATER	15-May-95	A	
QC	31335202JN	FIELD BLANK	N/A	INORG	Magnesium	67.6		ug/L	BU P	WATER	16-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Manganese	0.8		ug/L	U P	WATER	15-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Manganese	0.8		ug/L	U P	WATER	15-May-95	A	
QC	31335202JN	FIELD BLANK	N/A	INORG	Manganese	0.8		ug/L	U P	WATER	16-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Mercury	0.1		ug/L	U AV	WATER	15-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Mercury	0.1		ug/L	U AV	WATER	15-May-95	A	
QC	31335202JN	FIELD BLANK	N/A	INORG	Mercury	0.1		ug/L	U AV	WATER	16-May-95	A	
QC	31335202JN	FIELD BLANK	N/A	INORG	Nickel	3.4		ug/L	U P	WATER	16-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Nickel	4.9		ug/L	B P	WATER	15-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Nickel	3.4		ug/L	U P	WATER	15-May-95	A	

SAMPLE LOCATION	SAMPLE NUMBER	TYPE LOCATION	DEPTH (ft)	ANALYSIS	COMPOUND	CONC	RAD UNCERT	UNITS	Q FLAG	MATRIX	SAMPLE DATE	VAL LEVEL	NOTE
QC	31335202JN	FIELD BLANK	N/A	INORG	Potassium	44.2		ug/L	BEUJ P	WATER	16-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Potassium	56.7		ug/L	BU P	WATER	15-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Potassium	47.1		ug/L	BEUJ P	WATER	15-May-95	A	
QC	31335202JN	FIELD BLANK	N/A	INORG	Selenium	2.7		ug/L	U P	WATER	16-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Selenium	2.7		ug/L	U P	WATER	15-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Selenium	2.7		ug/L	U P	WATER	15-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Silver	1.5		ug/L	BNJ P	WATER	15-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Silver	0.6		ug/L	U P	WATER	15-May-95	A	
QC	31335202JN	FIELD BLANK	N/A	INORG	Silver	0.6		ug/L	UN P	WATER	16-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Sodium	124		ug/L	BU P	WATER	15-May-95	A	
QC	31335202JN	FIELD BLANK	N/A	INORG	Sodium	78.3		ug/L	BU P	WATER	16-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Sodium	178		ug/L	BU P	WATER	15-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Thallium	4.6		ug/L	U P	WATER	15-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Thallium	4.6		ug/L	U P	WATER	15-May-95	A	
QC	31335202JN	FIELD BLANK	N/A	INORG	Thallium	4.6		ug/L	U P	WATER	16-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Vanadium	0.74		ug/L	BU P	WATER	15-May-95	A	
QC	31335202JN	FIELD BLANK	N/A	INORG	Vanadium	0.4		ug/L	U P	WATER	16-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Vanadium	0.4		ug/L	U P	WATER	15-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Zinc	3.8		ug/L	BEUJ P	WATER	15-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Zinc	4.4		ug/L	BU P	WATER	15-May-95	A	
QC	31335202JN	FIELD BLANK	N/A	INORG	Zinc	4.4		ug/L	BEUJ P	WATER	16-May-95	A	
QC	31335202JN	FIELD BLANK	N/A	INORG	Zirconium	31.3		ug/L	U P	WATER	16-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Zirconium	31.3		ug/L	U P	WATER	15-May-95	A	
QC	31335201JN	FIELD BLANK	N/A	INORG	Zirconium	31.2		ug/L	U P	WATER	15-May-95	A	
QC	31335202AB	FIELD BLANK	N/A	RAD	ALPHA	0	0.4	pCi/L	U	NWATER	16-May-95	A	
QC	31335201AB	FIELD BLANK	N/A	RAD	ALPHA	0	0.3	pCi/L	U	NWATER	15-May-95	A	
QC	31335203AB	FIELD BLANK	N/A	RAD	ALPHA	0.2	0.4	pCi/L	U	NWATER	23-May-95	A	
QC	31335203AB	FIELD BLANK	N/A	RAD	BETA	1.8	1.2	pCi/L	U	NWATER	23-May-95	A	
QC	31335202AB	FIELD BLANK	N/A	RAD	BETA	0	1	pCi/L	U	NWATER	16-May-95	A	
QC	31335201AB	FIELD BLANK	N/A	RAD	BETA	2.2	1.1	pCi/L	U	NWATER	15-May-95	A	
QC	31335203R4	FIELD BLANK	N/A	RAD	Ce-144			pCi/L	U	NWATER	23-May-95	A	
QC	31335202R4	FIELD BLANK	N/A	RAD	Ce-144			pCi/L	U	NWATER	16-May-95	A	
QC	31335201R4	FIELD BLANK	N/A	RAD	Ce-144			pCi/L	U	NWATER	15-May-95	A	
QC	31335203R4	FIELD BLANK	N/A	RAD	Co-58			pCi/L	U	NWATER	23-May-95	A	
QC	31335201R4	FIELD BLANK	N/A	RAD	Co-58			pCi/L	U	NWATER	15-May-95	A	
QC	31335202R4	FIELD BLANK	N/A	RAD	Co-58			pCi/L	U	NWATER	16-May-95	A	
QC	31335201R4	FIELD BLANK	N/A	RAD	Co-60			pCi/L	U	NWATER	15-May-95	A	
QC	31335202R4	FIELD BLANK	N/A	RAD	Co-60			pCi/L	U	NWATER	16-May-95	A	
QC	31335203R4	FIELD BLANK	N/A	RAD	Co-60			pCi/L	U	NWATER	23-May-95	A	
QC	31335201R4	FIELD BLANK	N/A	RAD	Cs-134			pCi/L	U	NWATER	15-May-95	A	
QC	31335202R4	FIELD BLANK	N/A	RAD	Cs-134			pCi/L	U	NWATER	16-May-95	A	
QC	31335203R4	FIELD BLANK	N/A	RAD	Cs-134			pCi/L	U	NWATER	23-May-95	A	
QC	31335201R4	FIELD BLANK	N/A	RAD	Cs-137			pCi/L	U	NWATER	15-May-95	A	
QC	31335202R4	FIELD BLANK	N/A	RAD	Cs-137			pCi/L	U	NWATER	16-May-95	A	
QC	31335203R4	FIELD BLANK	N/A	RAD	Cs-137			pCi/L	U	NWATER	23-May-95	A	
QC	31335202R4	FIELD BLANK	N/A	RAD	Eu-154			pCi/L	U	NWATER	16-May-95	A	
QC	31335203R4	FIELD BLANK	N/A	RAD	Eu-154			pCi/L	U	NWATER	23-May-95	A	
QC	31335201R4	FIELD BLANK	N/A	RAD	Eu-154			pCi/L	U	NWATER	15-May-95	A	

SAMPLE LOCATION	SAMPLE NUMBER	TYPE LOCATION	DEPTH (m)	ANALYSIS	COMPOUND	CONC	RAD UNCERT	UNITS	Q FLAG	MATRIX	SAMPLE DATE	VAL LEVEL	NOTE
QC	31335203R4	FIELD BLANK	N/A	RAD	Eu-155			pCi/L	U	NWATER	23-May-95	A	
QC	31335202R4	FIELD BLANK	N/A	RAD	Eu-155			pCi/L	U	NWATER	16-May-95	A	
QC	31335201R4	FIELD BLANK	N/A	RAD	Eu-155			pCi/L	U	NWATER	15-May-95	A	
QC	31335202RI	FIELD BLANK	N/A	RAD	I-129	0	0.4	pCi/L	U	NWATER	16-May-95	A	
QC	31335203RI	FIELD BLANK	N/A	RAD	I-129	0	0.3	pCi/L	U	NWATER	23-May-95	A	
QC	31335201RI	FIELD BLANK	N/A	RAD	I-129	0	0.3	pCi/L	U	NWATER	15-May-95	A	
QC	31335202R4	FIELD BLANK	N/A	RAD	Nb-95			pCi/L	U	NWATER	16-May-95	A	
QC	31335203R4	FIELD BLANK	N/A	RAD	Nb-95			pCi/L	U	NWATER	23-May-95	A	
QC	31335201R4	FIELD BLANK	N/A	RAD	Nb-95			pCi/L	U	NWATER	15-May-95	A	
QC	31335201R4	FIELD BLANK	N/A	RAD	Ru-103			pCi/L	U	NWATER	15-May-95	A	
QC	31335202R4	FIELD BLANK	N/A	RAD	Ru-103			pCi/L	U	NWATER	16-May-95	A	
QC	31335203R4	FIELD BLANK	N/A	RAD	Ru-103			pCi/L	U	NWATER	23-May-95	A	
QC	31335202R4	FIELD BLANK	N/A	RAD	Ru-106			pCi/L	U	NWATER	16-May-95	A	
QC	31335203R4	FIELD BLANK	N/A	RAD	Ru-106			pCi/L	U	NWATER	23-May-95	A	
QC	31335201R4	FIELD BLANK	N/A	RAD	Ru-106			pCi/L	U	NWATER	15-May-95	A	
QC	31335203R4	FIELD BLANK	N/A	RAD	Sb-125			pCi/L	U	NWATER	23-May-95	A	
QC	31335202R4	FIELD BLANK	N/A	RAD	Sb-125			pCi/L	U	NWATER	16-May-95	A	
QC	31335201R4	FIELD BLANK	N/A	RAD	Sb-125			pCi/L	U	NWATER	15-May-95	A	
QC	31335201RB	FIELD BLANK	N/A	RAD	Sr-90	0.7	0.3	pCi/L		NWATER	15-May-95	A	
QC	31335203RB	FIELD BLANK	N/A	RAD	Sr-90	0.7	0.4	pCi/L	U	NWATER	23-May-95	A	
QC	31335202EA	FIELD BLANK	N/A	RAD	Sr-90	0.3	0.4	pCi/L	U	NWATER	16-May-95	A	
QC	31335201EA	FIELD BLANK	N/A	RAD	Sr-90	0.1	0.3	pCi/L	U	NWATER	15-May-95	A	
QC	31335202RB	FIELD BLANK	N/A	RAD	Sr-90	0	0.4	pCi/L	U	NWATER	16-May-95	A	
QC	31335201EA	FIELD BLANK	N/A	RAD	Tc-99	0.1	0.5	pCi/L	U	NWATER	15-May-95	A	
QC	31335202RB	FIELD BLANK	N/A	RAD	Tc-99	0.6	0.6	pCi/L	U	NWATER	16-May-95	A	
QC	31335202EA	FIELD BLANK	N/A	RAD	Tc-99	0.04	0.61	pCi/L	U	NWATER	16-May-95	A	
QC	31335201RB	FIELD BLANK	N/A	RAD	Tc-99	0	0.5	pCi/L	U	NWATER	15-May-95	A	
QC	31335203EA	FIELD BLANK	N/A	RAD	Tc-99	0.02	0.5	pCi/L	U	NWATER	23-May-95	A	
QC	31335201R8	FIELD BLANK	N/A	RAD	Tritium	194	117	pCi/L	U	NWATER	15-May-95	A	
QC	31335203R8	FIELD BLANK	N/A	RAD	Tritium	56	158	pCi/L	U	NWATER	23-May-95	A	
QC	31335202R8	FIELD BLANK	N/A	RAD	Tritium	38	122	pCi/L	U	NWATER	16-May-95	A	

SAMPLE LOCATION	SAMPLE NUMBER	TYPE LOCATION	DEPTH (m)	ANALYSIS	COMPOUND	CONC	RAD UNCERT	UNITS	Q FLAG	MATRIX	SAMPLE DATE	VAL LEVEL	NOTE
USGS 47	31340601GA	AQUIFER WELL	462-470.8	RAD	ALPHA	1.4	0.8	pCi/L	U	NWATER	22-Jun-95	A	
USGS 47	31340601GA	AQUIFER WELL	462-470.8	RAD	BETA	105	2	pCi/L		NWATER	22-Jun-95	A	
USGS 47	31340601RI	AQUIFER WELL	462-470.8	RAD	I-129	0	0.3	pCi/L	U	NWATER	22-Jun-95	A	
USGS 47	31340601RB	AQUIFER WELL	462-470.8	RAD	Sr-90	31	1	pCi/L		NWATER	22-Jun-95	A	
USGS 47	31340601EA	AQUIFER WELL	462-470.8	RAD	Tc-99	119	2	pCi/L		NWATER	22-Jun-95	A	
USGS 47	31340601R8	AQUIFER WELL	462-470.8	RAD	Tritium	10300	300	pCi/L		NWATER	22-Jun-95	A	
USGS 47	31340701GA	AQUIFER WELL	483-491.8	RAD	ALPHA	4.3	1.6	pCi/L		NWATER	22-Jun-95	A	
USGS 47	31341101GA	AQUIFER WELL	483-491.8	RAD	ALPHA	1.4	1.3	pCi/L	U	NWATER	22-Jun-95	A	
USGS 47	31340701GA	AQUIFER WELL	483-491.8	RAD	BETA	267	4	pCi/L		NWATER	22-Jun-95	A	
USGS 47	31341101GA	AQUIFER WELL	483-491.8	RAD	BETA	268	4	pCi/L		NWATER	22-Jun-95	A	
USGS 47	31340701RI	AQUIFER WELL	483-491.8	RAD	I-129	0.2	0.3	pCi/L	U	NWATER	22-Jun-95	A	
USGS 47	31341101RI	AQUIFER WELL	483-491.8	RAD	I-129	0.8	0.3	pCi/L		NWATER	22-Jun-95	A	
USGS 47	31341101RB	AQUIFER WELL	483-491.8	RAD	Sr-90	44	1	pCi/L	U	NWATER	22-Jun-95	A	
USGS 47	31340701RB	AQUIFER WELL	483-491.8	RAD	Sr-90	44	1	pCi/L	U	NWATER	22-Jun-95	A	
USGS 47	31341101EA	AQUIFER WELL	483-491.8	RAD	Tc-99	18	1	pCi/L		NWATER	22-Jun-95	A	
USGS 47	31340701EA	AQUIFER WELL	483-491.8	RAD	Tc-99	17	1	pCi/L		NWATER	22-Jun-95	A	
USGS 47	31341101R8	AQUIFER WELL	483-491.8	RAD	Tritium	15800	400	pCi/L		NWATER	22-Jun-95	A	
USGS 47	31340701R8	AQUIFER WELL	483-491.8	RAD	Tritium	15600	400	pCi/L		NWATER	22-Jun-95	A	
USGS 47	31340801GA	AQUIFER WELL	511.5-520.8	RAD	ALPHA	2.3	1.2	pCi/L	J	NWATER	23-Jun-95	A	
USGS 47	31340801GA	AQUIFER WELL	511.5-520.8	RAD	BETA	148	3	pCi/L		NWATER	23-Jun-95	A	
USGS 47	31340801RI	AQUIFER WELL	511.5-520.8	RAD	I-129	0	0.3	pCi/L	U	NWATER	23-Jun-95	A	
USGS 47	31340801RB	AQUIFER WELL	511.5-520.8	RAD	Sr-90	40	1	pCi/L		NWATER	23-Jun-95	A	
USGS 47	31340801EA	AQUIFER WELL	511.5-520.8	RAD	Tc-99	62	1	pCi/L		NWATER	23-Jun-95	A	
USGS 47	31340801R8	AQUIFER WELL	511.5-520.8	RAD	Tritium	5310	260	pCi/L		NWATER	23-Jun-95	A	
USGS 47	31340901GA	AQUIFER WELL	558-566.8	RAD	ALPHA	2.5	1.2	pCi/L		NWATER	23-Jun-95	A	
USGS 47	31340901GA	AQUIFER WELL	558-566.8	RAD	BETA	158	3	pCi/L		NWATER	23-Jun-95	A	
USGS 47	31340901RI	AQUIFER WELL	558-566.8	RAD	I-129	0	0.3	pCi/L	U	NWATER	23-Jun-95	A	
USGS 47	31340901RB	AQUIFER WELL	558-566.8	RAD	Sr-90	41	1	pCi/L		NWATER	23-Jun-95	A	
USGS 47	31340901EA	AQUIFER WELL	558-566.8	RAD	Tc-99	23	1	pCi/L		NWATER	23-Jun-95	A	
USGS 47	31340901R8	AQUIFER WELL	558-566.8	RAD	Tritium	6130	270	pCi/L		NWATER	23-Jun-95	A	
USGS 47	31341001GA	AQUIFER WELL	576-584.8	RAD	ALPHA	4.6	1.4	pCi/L		NWATER	23-Jun-95	A	
USGS 47	31341001GA	AQUIFER WELL	576-584.8	RAD	BETA	151	3	pCi/L		NWATER	23-Jun-95	A	
USGS 47	31341001RI	AQUIFER WELL	576-584.8	RAD	I-129	0	0.3	pCi/L	U	NWATER	23-Jun-95	A	
USGS 47	31341001RB	AQUIFER WELL	576-584.8	RAD	Sr-90	42	1	pCi/L		NWATER	23-Jun-95	A	
USGS 47	31341001EA	AQUIFER WELL	576-584.8	RAD	Tc-99	63	1	pCi/L		NWATER	23-Jun-95	A	
USGS 47	31341001R8	AQUIFER WELL	576-584.8	RAD	Tritium	7570	280	pCi/L		NWATER	23-Jun-95	A	
USGS 47	31341401GA	AQUIFER WELL	596-604.8	RAD	ALPHA	4	1.3	pCi/L	U	NWATER	23-Jun-95	A	
USGS 47	31341401GA	AQUIFER WELL	596-604.8	RAD	BETA	80	2	pCi/L		NWATER	23-Jun-95	A	
USGS 47	31341401RI	AQUIFER WELL	596-604.8	RAD	I-129	0	0.3	pCi/L	U	NWATER	23-Jun-95	A	
USGS 47	31341401RB	AQUIFER WELL	596-604.8	RAD	Sr-90	29	1	pCi/L		NWATER	23-Jun-95	A	
USGS 47	31341401EA	AQUIFER WELL	596-604.8	RAD	Tc-99	34	1	pCi/L		NWATER	23-Jun-95	A	
USGS 47	31341401R8	AQUIFER WELL	596-604.8	RAD	Tritium	3280	220	pCi/L		NWATER	23-Jun-95	A	

313412 Rinsate

SAMPLE LOCATION	SAMPLE NUMBER	TYPE LOCATION	DEPTH (ft)	ANALYSIS	COMPOUND	CONC	RAD UNCERT	UNITS	Q FLAG	MATRIX	SAMPLE DATE	VAL LEVEL	NOTE
QC	31341201GA	RINSATE	N/A	RAD	ALPHA	0	0.4	pCi/L	U	NWATER	23-Jun-95	A	
QC	31341201GA	RINSATE	N/A	RAD	BETA	0.3	1.1	pCi/L	U	NWATER	23-Jun-95	A	
QC	31341201RI	RINSATE	N/A	RAD	I-129	0	0.3	pCi/L	U	NWATER	23-Jun-95	A	
QC	31341201RB	RINSATE	N/A	RAD	Sr-90	0.3	0.3	pCi/L	U	NWATER	23-Jun-95	A	
QC	31341201EA	RINSATE	N/A	RAD	Tc-99	0.5	0.4	pCi/L	U	NWATER	23-Jun-95	A	
QC	31341201R8	RINSATE	N/A	RAD	Tritium	0	165	pCi/L	U	NWATER	23-Jun-95	A	

313413 Field Blank

SAMPLE LOCATION	SAMPLE NUMBER	TYPE LOCATION	DEPTH (ft)	ANALYSIS	COMPOUND	CONC	RAD UNCERT	UNITS	Q FLAG	MATRIX	SAMPLE DATE	VAL LEVEL	NOTE
QC	31341301GA	FIELD BLANK	N/A	RAD	ALPHA	0.1	0.4	pCi/L	U	NWATER	22-Jun-95	A	
QC	31341301GA	FIELD BLANK	N/A	RAD	BETA	0	0.8	pCi/L		NWATER	22-Jun-95	A	
QC	31341301RI	FIELD BLANK	N/A	RAD	I-129	0	0.3	pCi/L	U	NWATER	22-Jun-95	A	
QC	31341301RB	FIELD BLANK	N/A	RAD	Sr-90	0.2	0.3	pCi/L	U	NWATER	22-Jun-95	A	
QC	31341301EA	FIELD BLANK	N/A	RAD	Tc-99	0.1	0.4	pCi/L	U	NWATER	22-Jun-95	A	
QC	31341301R8	FIELD BLANK	N/A	RAD	Tritium	0	162	pCi/L	U	NWATER	22-Jun-95	A	

SAMPLE LOCATION	SAMPLE NUMBER	TYPE LOCATION	DEPTH OD	ANALYSIS	COMPOUND	CONC	RAD UNCERT	UNITS	Q FLAG	MATRIX	SAMPLE DATE	VAL LEVEL	NOTE
USGS 121	31334901JN	AQUIFER WELL	459.12-475	INORG	Aluminum	38.7		ug/L	BU P	WATER	22-May-95	A	
USGS 121	31333001JN	AQUIFER WELL	459.12-475	INORG	Aluminum	36.6		ug/L	BU P	WATER	22-May-95	A	
USGS 121	31333001JN	AQUIFER WELL	459.12-475	INORG	Antimony	1.9		ug/L	B P	WATER	22-May-95	A	
USGS 121	31334901JN	AQUIFER WELL	459.12-475	INORG	Antimony	1.9		ug/L	U P	WATER	22-May-95	A	
USGS 121	31334901JN	AQUIFER WELL	459.12-475	INORG	Arsenic	4		ug/L	U P	WATER	22-May-95	A	
USGS 121	31333001JN	AQUIFER WELL	459.12-475	INORG	Arsenic	7.5		ug/L	B P	WATER	22-May-95	A	
USGS 121	31334901JN	AQUIFER WELL	459.12-475	INORG	Barium	90.7		ug/L	B P	WATER	22-May-95	A	
USGS 121	31333001JN	AQUIFER WELL	459.12-475	INORG	Barium	88.6		ug/L	B P	WATER	22-May-95	A	
USGS 121	31333001JN	AQUIFER WELL	459.12-475	INORG	Beryllium	0.1		ug/L	U P	WATER	22-May-95	A	
USGS 121	31334901JN	AQUIFER WELL	459.12-475	INORG	Beryllium	0.1		ug/L	U P	WATER	22-May-95	A	
USGS 121	31333001JN	AQUIFER WELL	459.12-475	INORG	Cadmium	0.4		ug/L	U P	WATER	22-May-95	A	
USGS 121	31334901JN	AQUIFER WELL	459.12-475	INORG	Cadmium	0.4		ug/L	U P	WATER	22-May-95	A	
USGS 121	31334901JN	AQUIFER WELL	459.12-475	INORG	Calcium	53900		ug/L	P	WATER	22-May-95	A	
USGS 121	31333001JN	AQUIFER WELL	459.12-475	INORG	Calcium	52800		ug/L	P	WATER	22-May-95	A	
USGS 121	31333001JN	AQUIFER WELL	459.12-475	INORG	Chromium	4.2		ug/L	B P	WATER	22-May-95	A	
USGS 121	31334901JN	AQUIFER WELL	459.12-475	INORG	Chromium	5.1		ug/L	B P	WATER	22-May-95	A	
USGS 121	31333001JN	AQUIFER WELL	459.12-475	INORG	Cobalt	0.5		ug/L	U P	WATER	22-May-95	A	
USGS 121	31334901JN	AQUIFER WELL	459.12-475	INORG	Cobalt	0.5		ug/L	U P	WATER	22-May-95	A	
USGS 121	31333001JN	AQUIFER WELL	459.12-475	INORG	Copper	1.3		ug/L	UJ P	WATER	22-May-95	A	
USGS 121	31334901JN	AQUIFER WELL	459.12-475	INORG	Copper	1.3		ug/L	UJ P	WATER	22-May-95	A	
USGS 121	31333001JN	AQUIFER WELL	459.12-475	INORG	Iron	21.5		ug/L	U P	WATER	22-May-95	A	
USGS 121	31334901JN	AQUIFER WELL	459.12-475	INORG	Iron	21.5		ug/L	U P	WATER	22-May-95	A	
USGS 121	31334901JN	AQUIFER WELL	459.12-475	INORG	Lead	2		ug/L	U P	WATER	22-May-95	A	
USGS 121	31333001JN	AQUIFER WELL	459.12-475	INORG	Lead	2		ug/L	U P	WATER	22-May-95	A	
USGS 121	31333001JN	AQUIFER WELL	459.12-475	INORG	Magnesium	14100		ug/L	P	WATER	22-May-95	A	
USGS 121	31334901JN	AQUIFER WELL	459.12-475	INORG	Magnesium	14300		ug/L	P	WATER	22-May-95	A	
USGS 121	31333001JN	AQUIFER WELL	459.12-475	INORG	Manganese	0.8		ug/L	U P	WATER	22-May-95	A	
USGS 121	31334901JN	AQUIFER WELL	459.12-475	INORG	Manganese	0.8		ug/L	U P	WATER	22-May-95	A	
USGS 121	31333001JN	AQUIFER WELL	459.12-475	INORG	Mercury	0.1		ug/L	U AV	WATER	22-May-95	A	
USGS 121	31334901JN	AQUIFER WELL	459.12-475	INORG	Mercury	0.1		ug/L	U AV	WATER	22-May-95	A	
USGS 121	31334901JN	AQUIFER WELL	459.12-475	INORG	Nickel	3.4		ug/L	U P	WATER	22-May-95	A	
USGS 121	31333001JN	AQUIFER WELL	459.12-475	INORG	Nickel	3.4		ug/L	U P	WATER	22-May-95	A	
USGS 121	31334901JN	AQUIFER WELL	459.12-475	INORG	Potassium	2380		ug/L	BEJ P	WATER	22-May-95	A	
USGS 121	31333001JN	AQUIFER WELL	459.12-475	INORG	Potassium	2350		ug/L	BEJ P	WATER	22-May-95	A	
USGS 121	31334901JN	AQUIFER WELL	459.12-475	INORG	Selenium	5.5		ug/L	BU P	WATER	22-May-95	A	
USGS 121	31333001JN	AQUIFER WELL	459.12-475	INORG	Selenium	3		ug/L	BU P	WATER	22-May-95	A	
USGS 121	31333001JN	AQUIFER WELL	459.12-475	INORG	Silver	0.6		ug/L	NUJ P	WATER	22-May-95	A	
USGS 121	31334901JN	AQUIFER WELL	459.12-475	INORG	Silver	0.6		ug/L	NUJ P	WATER	22-May-95	A	
USGS 121	31333001JN	AQUIFER WELL	459.12-475	INORG	Sodium	7340		ug/L	P	WATER	22-May-95	A	
USGS 121	31334901JN	AQUIFER WELL	459.12-475	INORG	Sodium	7480		ug/L	P	WATER	22-May-95	A	
USGS 121	31334901JN	AQUIFER WELL	459.12-475	INORG	Thallium	4.6		ug/L	U P	WATER	22-May-95	A	
USGS 121	31333001JN	AQUIFER WELL	459.12-475	INORG	Thallium	4.6		ug/L	U P	WATER	22-May-95	A	
USGS 121	31333001JN	AQUIFER WELL	459.12-475	INORG	Vanadium	3.4		ug/L	BJ P	WATER	22-May-95	A	
USGS 121	31334901JN	AQUIFER WELL	459.12-475	INORG	Vanadium	3.8		ug/L	BJ P	WATER	22-May-95	A	
USGS 121	31334901JN	AQUIFER WELL	459.12-475	INORG	Zinc	9.5		ug/L	B P	WATER	22-May-95	A	
USGS 121	31333001JN	AQUIFER WELL	459.12-475	INORG	Zinc	6.8		ug/L	BU P	WATER	22-May-95	A	
USGS 121	31333001AB	AQUIFER WELL	459.12-475	RAD	ALPHA	2.6	1.1	pCi/L		NWATER	22-May-95	A	
USGS 121	31334901AB	AQUIFER WELL	459.12-475	RAD	ALPHA	4.7	1.2	pCi/L		NWATER	22-May-95	A	

SAMPLE LOCATION	SAMPLE NUMBER	TYPE LOCATION	DEPTH (ft)	ANALYSIS	COMPOUND	CONC	RAD UNCERT	UNITS	Q FLAG	MATRIX	SAMPLE DATE	VAL LEVEL	NOTE
USGS 121	31334901AB	AQUIFER WELL	459.12-475	RAD	BETA	3.8	1.2	pCi/L		NWATER	22-May-95	A	
USGS 121	31333001AB	AQUIFER WELL	459.12-475	RAD	BETA	2.7	1.1	pCi/L		NWATER	22-May-95	A	
USGS 121	31334901R4	AQUIFER WELL	459.12-475	RAD	Ce-144			pCi/L	U	NWATER	22-May-95	A	
USGS 121	31333001R4	AQUIFER WELL	459.12-475	RAD	Ce-144			pCi/L	U	NWATER	22-May-95	A	
USGS 121	31334901R4	AQUIFER WELL	459.12-475	RAD	Co-58			pCi/L	U	NWATER	22-May-95	A	
USGS 121	31333001R4	AQUIFER WELL	459.12-475	RAD	Co-58			pCi/L	U	NWATER	22-May-95	A	
USGS 121	31333001R4	AQUIFER WELL	459.12-475	RAD	Co-60			pCi/L	U	NWATER	22-May-95	A	
USGS 121	31334901R4	AQUIFER WELL	459.12-475	RAD	Co-60			pCi/L	U	NWATER	22-May-95	A	
USGS 121	31333001R4	AQUIFER WELL	459.12-475	RAD	Cs-134			pCi/L	U	NWATER	22-May-95	A	
USGS 121	31334901R4	AQUIFER WELL	459.12-475	RAD	Cs-134			pCi/L	U	NWATER	22-May-95	A	
USGS 121	31333001R4	AQUIFER WELL	459.12-475	RAD	Cs-137			pCi/L	U	NWATER	22-May-95	A	
USGS 121	31334901R4	AQUIFER WELL	459.12-475	RAD	Cs-137			pCi/L	U	NWATER	22-May-95	A	
USGS 121	31333001R4	AQUIFER WELL	459.12-475	RAD	Eu-154			pCi/L	U	NWATER	22-May-95	A	
USGS 121	31334901R4	AQUIFER WELL	459.12-475	RAD	Eu-154			pCi/L	U	NWATER	22-May-95	A	
USGS 121	31333001R4	AQUIFER WELL	459.12-475	RAD	Eu-155			pCi/L	U	NWATER	22-May-95	A	
USGS 121	31334901R4	AQUIFER WELL	459.12-475	RAD	Eu-155			pCi/L	U	NWATER	22-May-95	A	
USGS 121	31333001RI	AQUIFER WELL	459.12-475	RAD	I-129	0	0.4	pCi/L	U	NWATER	22-May-95	A	
USGS 121	31334901RI	AQUIFER WELL	459.12-475	RAD	I-129	0	0.3	pCi/L	U	NWATER	22-May-95	A	
USGS 121	31333001R4	AQUIFER WELL	459.12-475	RAD	Nb-95			pCi/L	U	NWATER	22-May-95	A	
USGS 121	31334901R4	AQUIFER WELL	459.12-475	RAD	Nb-95			pCi/L	U	NWATER	22-May-95	A	
USGS 121	31333001R4	AQUIFER WELL	459.12-475	RAD	Ru-103			pCi/L	U	NWATER	22-May-95	A	
USGS 121	31334901R4	AQUIFER WELL	459.12-475	RAD	Ru-103			pCi/L	U	NWATER	22-May-95	A	
USGS 121	31333001R4	AQUIFER WELL	459.12-475	RAD	Ru-106			pCi/L	U	NWATER	22-May-95	A	
USGS 121	31334901R4	AQUIFER WELL	459.12-475	RAD	Ru-106			pCi/L	U	NWATER	22-May-95	A	
USGS 121	31333001R4	AQUIFER WELL	459.12-475	RAD	Sb-125			pCi/L	U	NWATER	22-May-95	A	
USGS 121	31334901R4	AQUIFER WELL	459.12-475	RAD	Sb-125			pCi/L	U	NWATER	22-May-95	A	
USGS 121	31333001EA	AQUIFER WELL	459.12-475	RAD	Sr-90	0.3	0.3	pCi/L	U	NWATER	22-May-95	A	
USGS 121	31333001RB	AQUIFER WELL	459.12-475	RAD	Sr-90	1	0.3	pCi/L		NWATER	22-May-95	A	
USGS 121	31334901EA	AQUIFER WELL	459.12-475	RAD	Sr-90	0	0.4	pCi/L	U	NWATER	22-May-95	A	
USGS 121	31334901RB	AQUIFER WELL	459.12-475	RAD	Sr-90	0.7	0.3	pCi/L		NWATER	22-May-95	A	
USGS 121	31334901EA	AQUIFER WELL	459.12-475	RAD	Tc-99	0.1	0.5	pCi/L	U	NWATER	22-May-95	A	
USGS 121	31333001EA	AQUIFER WELL	459.12-475	RAD	Tc-99	0.1	0.5	pCi/L	U	NWATER	22-May-95	A	
USGS 121	31334901RB	AQUIFER WELL	459.12-475	RAD	Tc-99	0.5	0.5	pCi/L	U	NWATER	22-May-95	A	
USGS 121	31333001RB	AQUIFER WELL	459.12-475	RAD	Tc-99	0.3	0.5	pCi/L	U	NWATER	22-May-95	A	
USGS 121	31333001R8	AQUIFER WELL	459.12-475	RAD	Tritium	168	123	pCi/L	U	NWATER	22-May-95	A	
USGS 121	31334901R8	AQUIFER WELL	459.12-475	RAD	Tritium	240	123	pCi/L	U	NWATER	22-May-95	A	

SAMPLE LOCATION	SAMPLE NUMBER	TYPE LOCATION	DEPTH (ft)	ANALYSIS	COMPOUND	CONC	RAD UNCERT	UNITS	Q	FLAG	MATRIX	SAMPLE DATE	VAL LEVEL	NOTE
QC	3XF00101JN	FIELD BLANK	N/A	INORG	Aluminum	0.0268		mg/L	U	P	WATER	15-May-95	A	
QC	3XF00102C1	FIELD BLANK	N/A	INORG	Aluminum	0.0604		mg/L	BU	P	WATER	19-May-95	A	
QC	3XF00101C1	FIELD BLANK	N/A	INORG	Aluminum	0.0515		mg/L	BU	P	WATER	19-May-95	A	
QC	3XF00104C1	FIELD BLANK	N/A	INORG	Aluminum	0.09		mg/L	BU	P	WATER	07-Jul-95	A	
QC	3XF00103C1	FIELD BLANK	N/A	INORG	Aluminum	0.0268		mg/L	U	P	WATER	25-May-95	A	
QC	3XF00101C1	FIELD BLANK	N/A	INORG	Antimony	0.0019		mg/L	U	P	WATER	19-May-95	A	
QC	3XF00101JN	FIELD BLANK	N/A	INORG	Antimony	0.0019		mg/L	U	P	WATER	15-May-95	A	
QC	3XF00102C1	FIELD BLANK	N/A	INORG	Antimony	0.0019		mg/L	U	P	WATER	19-May-95	A	
QC	3XF00103C1	FIELD BLANK	N/A	INORG	Antimony	0.0019		mg/L	U	P	WATER	25-May-95	A	
QC	3XF00104C1	FIELD BLANK	N/A	INORG	Antimony	0.0027		mg/L	U	P	WATER	07-Jul-95	A	
QC	3XF00102C1	FIELD BLANK	N/A	INORG	Arsenic	0.004		mg/L	U	P	WATER	19-May-95	A	
QC	3XF00101C1	FIELD BLANK	N/A	INORG	Arsenic	0.004		mg/L	U	P	WATER	19-May-95	A	
QC	3XF00103C1	FIELD BLANK	N/A	INORG	Arsenic	0.004		mg/L	U	P	WATER	25-May-95	A	
QC	3XF00104C1	FIELD BLANK	N/A	INORG	Arsenic	0.003		mg/L	BU	P	WATER	07-Jul-95	A	
QC	3XF00101JN	FIELD BLANK	N/A	INORG	Arsenic	0.004		mg/L	U	P	WATER	15-May-95	A	
QC	3XF00102C1	FIELD BLANK	N/A	INORG	Barium	0.00071		mg/L	BU	P	WATER	19-May-95	A	
QC	3XF00104C1	FIELD BLANK	N/A	INORG	Barium	0.0045		mg/L	B	P	WATER	07-Jul-95	A	
QC	3XF00101C1	FIELD BLANK	N/A	INORG	Barium	0.0015		mg/L	BU	P	WATER	19-May-95	A	
QC	3XF00101JN	FIELD BLANK	N/A	INORG	Barium	0.0013		mg/L	BU	P	WATER	15-May-95	A	
QC	3XF00103C1	FIELD BLANK	N/A	INORG	Barium	0.00055		mg/L	B	P	WATER	25-May-95	A	
QC	3XF00103C1	FIELD BLANK	N/A	INORG	Beryllium	0.0001		mg/L	U	P	WATER	25-May-95	A	
QC	3XF00101C1	FIELD BLANK	N/A	INORG	Beryllium	0.0001		mg/L	U	P	WATER	19-May-95	A	
QC	3XF00104C1	FIELD BLANK	N/A	INORG	Beryllium	0.0001		mg/L	U	P	WATER	07-Jul-95	A	
QC	3XF00101JN	FIELD BLANK	N/A	INORG	Beryllium	0.0001		mg/L	U	P	WATER	15-May-95	A	
QC	3XF00102C1	FIELD BLANK	N/A	INORG	Beryllium	0.0001		mg/L	U	P	WATER	19-May-95	A	
QC	3XF00102C1	FIELD BLANK	N/A	INORG	Cadmium	0.0004		mg/L	U	P	WATER	19-May-95	A	
QC	3XF00104C1	FIELD BLANK	N/A	INORG	Cadmium	0.00064		mg/L	BU	P	WATER	07-Jul-95	A	
QC	3XF00101JN	FIELD BLANK	N/A	INORG	Cadmium	0.0004		mg/L	U	P	WATER	15-May-95	A	
QC	3XF00101C1	FIELD BLANK	N/A	INORG	Cadmium	0.0004		mg/L	U	P	WATER	19-May-95	A	
QC	3XF00103C1	FIELD BLANK	N/A	INORG	Cadmium	0.0004		mg/L	U	P	WATER	25-May-95	A	
QC	3XF00101C1	FIELD BLANK	N/A	INORG	Calcium	0.036		mg/L	BU	P	WATER	19-May-95	A	
QC	3XF00102C1	FIELD BLANK	N/A	INORG	Calcium	0.0799		mg/L	BU	P	WATER	19-May-95	A	
QC	3XF00101JN	FIELD BLANK	N/A	INORG	Calcium	0.1		mg/L	BU	P	WATER	15-May-95	A	
QC	3XF00103C1	FIELD BLANK	N/A	INORG	Calcium	0.0755		mg/L	BU	P	WATER	25-May-95	A	
QC	3XF00104C1	FIELD BLANK	N/A	INORG	Chromium	0.0014		mg/L	BU	P	WATER	07-Jul-95	A	
QC	3XF00101JN	FIELD BLANK	N/A	INORG	Chromium	0.0041		mg/L	U	P	WATER	15-May-95	A	
QC	3XF00101C1	FIELD BLANK	N/A	INORG	Chromium	0.0041		mg/L	U	P	WATER	19-May-95	A	
QC	3XF00103C1	FIELD BLANK	N/A	INORG	Chromium	0.0041		mg/L	U	P	WATER	25-May-95	A	
QC	3XF00102C1	FIELD BLANK	N/A	INORG	Chromium	0.0041		mg/L	U	P	WATER	19-May-95	A	
QC	3XF00103C1	FIELD BLANK	N/A	INORG	Cobalt	0.0005		mg/L	U	P	WATER	25-May-95	A	
QC	3XF00101C1	FIELD BLANK	N/A	INORG	Cobalt	0.00095		mg/L	B	P	WATER	19-May-95	A	
QC	3XF00101JN	FIELD BLANK	N/A	INORG	Cobalt	0.0005		mg/L	UJ	P	WATER	15-May-95	A	
QC	3XF00102C1	FIELD BLANK	N/A	INORG	Cobalt	0.0005		mg/L	U	P	WATER	19-May-95	A	
QC	3XF00104C1	FIELD BLANK	N/A	INORG	Cobalt	0.0006		mg/L	U	P	WATER	07-Jul-95	A	
QC	3XF00104C1	FIELD BLANK	N/A	INORG	Copper	0.0069		mg/L	B	P	WATER	07-Jul-95	A	
QC	3XF00101JN	FIELD BLANK	N/A	INORG	Copper	0.0016		mg/L	B	P	WATER	15-May-95	A	
QC	3XF00101C1	FIELD BLANK	N/A	INORG	Copper	0.0013		mg/L	UJ	P	WATER	19-May-95	A	
QC	3XF00103C1	FIELD BLANK	N/A	INORG	Copper	0.0013		mg/L	U	P	WATER	25-May-95	A	

SAMPLE LOCATION	SAMPLE NUMBER	TYPE LOCATION	DEPTH (ft)	ANALYSIS	COMPOUND	CONC	RAD UNCERT	UNITS	Q FLAG	MATRIX	SAMPLE DATE	VAL LEVEL	NOTE
QC	3XF00102C1	FIELD BLANK	N/A	INORG	Copper	0.0013		mg/L	UJ P	WATER	19-May-95	A	
QC	3XF00101C1	FIELD BLANK	N/A	INORG	Iron	0.0215		mg/L	U P	WATER	19-May-95	A	
QC	3XF00103C1	FIELD BLANK	N/A	INORG	Iron	0.0215		mg/L	U P	WATER	25-May-95	A	
QC	3XF00101JN	FIELD BLANK	N/A	INORG	Iron	0.0215		mg/L	U P	WATER	15-May-95	A	
QC	3XF00102C1	FIELD BLANK	N/A	INORG	Iron	0.0215		mg/L	U P	WATER	19-May-95	A	
QC	3XF00102C1	FIELD BLANK	N/A	INORG	Lead	0.002		mg/L	U P	WATER	19-May-95	A	
QC	3XF00101C1	FIELD BLANK	N/A	INORG	Lead	0.002		mg/L	U P	WATER	19-May-95	A	
QC	3XF00103C1	FIELD BLANK	N/A	INORG	Lead	0.002		mg/L	U P	WATER	25-May-95	A	
QC	3XF00104C1	FIELD BLANK	N/A	INORG	Lead	0.0044		mg/L	P	WATER	07-Jul-95	A	
QC	3XF00101JN	FIELD BLANK	N/A	INORG	Lead	0.002		mg/L	U P	WATER	15-May-95	A	
QC	3XF00102C1	FIELD BLANK	N/A	INORG	Magnesium	0.0334		mg/L	BU P	WATER	19-May-95	A	
QC	3XF00101C1	FIELD BLANK	N/A	INORG	Magnesium	0.0179		mg/L	BU P	WATER	19-May-95	A	
QC	3XF00101JN	FIELD BLANK	N/A	INORG	Magnesium	0.0585		mg/L	BU P	WATER	15-May-95	A	
QC	3XF00103C1	FIELD BLANK	N/A	INORG	Magnesium	0.0276		mg/L	BU P	WATER	25-May-95	A	
QC	3XF00103C1	FIELD BLANK	N/A	INORG	Manganese	0.0008		mg/L	U P	WATER	25-May-95	A	
QC	3XF00101C1	FIELD BLANK	N/A	INORG	Manganese	0.0008		mg/L	U P	WATER	19-May-95	A	
QC	3XF00102C1	FIELD BLANK	N/A	INORG	Manganese	0.0008		mg/L	U P	WATER	19-May-95	A	
QC	3XF00104C1	FIELD BLANK	N/A	INORG	Manganese	0.0022		mg/L	B P	WATER	07-Jul-95	A	
QC	3XF00101JN	FIELD BLANK	N/A	INORG	Manganese	0.0008		mg/L	U P	WATER	15-May-95	A	
QC	3XF00104C1	FIELD BLANK	N/A	INORG	Mercury	0.0001		mg/L	U AV	WATER	07-Jul-95	A	
QC	3XF00103C1	FIELD BLANK	N/A	INORG	Mercury	0.0001		mg/L	U AV	WATER	25-May-95	A	
QC	3XF00101C1	FIELD BLANK	N/A	INORG	Mercury	0.0001		mg/L	U AV	WATER	19-May-95	A	
QC	3XF00102C1	FIELD BLANK	N/A	INORG	Mercury	0.0001		mg/L	U AV	WATER	19-May-95	A	
QC	3XF00101JN	FIELD BLANK	N/A	INORG	Mercury	0.0001		mg/L	U AV	WATER	15-May-95	A	
QC	3XF00101JN	FIELD BLANK	N/A	INORG	Nickel	0.0034		mg/L	U P	WATER	15-May-95	A	
QC	3XF00102C1	FIELD BLANK	N/A	INORG	Nickel	0.0034		mg/L	U P	WATER	19-May-95	A	
QC	3XF00101C1	FIELD BLANK	N/A	INORG	Nickel	0.0034		mg/L	U P	WATER	19-May-95	A	
QC	3XF00103C1	FIELD BLANK	N/A	INORG	Nickel	0.0034		mg/L	U P	WATER	25-May-95	A	
QC	3XF00104C1	FIELD BLANK	N/A	INORG	Nickel	0.0019		mg/L	B P	WATER	07-Jul-95	A	
QC	3XF00104C1	FIELD BLANK	N/A	INORG	Potassium	0.131		mg/L	BU P	WATER	07-Jul-95	A	
QC	3XF00103C1	FIELD BLANK	N/A	INORG	Potassium	0.0926		mg/L	BU P	WATER	25-May-95	A	
QC	3XF00102C1	FIELD BLANK	N/A	INORG	Potassium	0.0185		mg/L	U P	WATER	19-May-95	A	
QC	3XF00101C1	FIELD BLANK	N/A	INORG	Potassium	0.0459		mg/L	B P	WATER	19-May-95	A	
QC	3XF00101JN	FIELD BLANK	N/A	INORG	Potassium	0.0185		mg/L	U P	WATER	15-May-95	A	
QC	3XF00104C1	FIELD BLANK	N/A	INORG	Selenium	0.0028		mg/L	U P	WATER	07-Jul-95	A	
QC	3XF00101JN	FIELD BLANK	N/A	INORG	Selenium	0.0027		mg/L	U P	WATER	15-May-95	A	
QC	3XF00102C1	FIELD BLANK	N/A	INORG	Selenium	0.0027		mg/L	U P	WATER	19-May-95	A	
QC	3XF00103C1	FIELD BLANK	N/A	INORG	Selenium	0.0027		mg/L	U P	WATER	25-May-95	A	
QC	3XF00101C1	FIELD BLANK	N/A	INORG	Selenium	0.0039		mg/L	BU P	WATER	19-May-95	A	
QC	3XF00103C1	FIELD BLANK	N/A	INORG	Silver	0.0006		mg/L	UN P	WATER	25-May-95	A	
QC	3XF00101JN	FIELD BLANK	N/A	INORG	Silver	0.0006		mg/L	UN P	WATER	15-May-95	A	
QC	3XF00101C1	FIELD BLANK	N/A	INORG	Silver	0.0015		mg/L	BNJ P	WATER	19-May-95	A	
QC	3XF00102C1	FIELD BLANK	N/A	INORG	Silver	0.0006		mg/L	NUJ P	WATER	19-May-95	A	
QC	3XF00104C1	FIELD BLANK	N/A	INORG	Silver	0.0019		mg/L	BU P	WATER	07-Jul-95	A	
QC	3XF00101JN	FIELD BLANK	N/A	INORG	Sodium	0.0779		mg/L	BU P	WATER	15-May-95	A	
QC	3XF00101C1	FIELD BLANK	N/A	INORG	Sodium	0.0796		mg/L	BU P	WATER	19-May-95	A	
QC	3XF00102C1	FIELD BLANK	N/A	INORG	Sodium	0.106		mg/L	BU P	WATER	19-May-95	A	
QC	3XF00103C1	FIELD BLANK	N/A	INORG	Sodium	0.0645		mg/L	BU P	WATER	25-May-95	A	

SAMPLE LOCATION	SAMPLE NUMBER	TYPE LOCATION	DEPTH (ft)	ANALYSIS	COMPOUND	CONC	RAD UNCERT	UNITS	Q FLAG	MATRIX	SAMPLE DATE	VAL LEVEL	NOTE
QC	3XF00101C1	FIELD BLANK	N/A	INORG	Thallium	0.0046		mg/L	U P	WATER	19-May-95	A	
QC	3XF00101JN	FIELD BLANK	N/A	INORG	Thallium	0.0046		mg/L	U P	WATER	15-May-95	A	
QC	3XF00104C1	FIELD BLANK	N/A	INORG	Thallium	0.0063		mg/L	BU P	WATER	07-Jul-95	A	
QC	3XF00103C1	FIELD BLANK	N/A	INORG	Thallium	0.0046		mg/L	U P	WATER	25-May-95	A	
QC	3XF00102C1	FIELD BLANK	N/A	INORG	Thallium	0.0046		mg/L	U P	WATER	19-May-95	A	
QC	3XF00104C1	FIELD BLANK	N/A	INORG	Vanadium	0.0018		mg/L	BU P	WATER	07-Jul-95	A	
QC	3XF00102C1	FIELD BLANK	N/A	INORG	Vanadium	0.0004		mg/L	UJ P	WATER	19-May-95	A	
QC	3XF00101C1	FIELD BLANK	N/A	INORG	Vanadium	0.00099		mg/L	BUJ P	WATER	19-May-95	A	
QC	3XF00103C1	FIELD BLANK	N/A	INORG	Vanadium	0.00049		mg/L	BU P	WATER	25-May-95	A	
QC	3XF00101JN	FIELD BLANK	N/A	INORG	Vanadium	0.0004		mg/L	U P	WATER	15-May-95	A	
QC	3XF00104C1	FIELD BLANK	N/A	INORG	Zinc	0.0232		mg/L	P	WATER	07-Jul-95	A	
QC	3XF00102C1	FIELD BLANK	N/A	INORG	Zinc	0.0046		mg/L	BU P	WATER	19-May-95	A	
QC	3XF00101C1	FIELD BLANK	N/A	INORG	Zinc	0.0039		mg/L	BU P	WATER	19-May-95	A	
QC	3XF00101JN	FIELD BLANK	N/A	INORG	Zinc	0.0028		mg/L	BU P	WATER	15-May-95	A	
QC	3XF00103C1	FIELD BLANK	N/A	INORG	Zinc	0.0016		mg/L	BU P	WATER	25-May-95	A	
QC	3XF00101JN	FIELD BLANK	N/A	INORG	Zirconium	0.0313		mg/L	U P	WATER	15-May-95	A	
QC	3XF00101VG	FIELD BLANK	N/A	ORG	1,1,1-Trichloroethane	0.05		mg/L	U	WATER	14-Jun-95	A	
QC	3XF00101VG	FIELD BLANK	N/A	ORG	1,1,2,2-	0.05		mg/L	U	WATER	14-Jun-95	A	
QC	3XF00101VG	FIELD BLANK	N/A	ORG	1,1,2-Trichlorethane	0.05		mg/L	U	WATER	14-Jun-95	A	
QC	3XF00101VG	FIELD BLANK	N/A	ORG	1,1,2-Trichloroethane	0.05		mg/L	U	WATER	14-Jun-95	A	
QC	3XF00101VG	FIELD BLANK	N/A	ORG	1,1-Dichloroethane	0.05		mg/L	U	WATER	14-Jun-95	A	
QC	3XF00101VG	FIELD BLANK	N/A	ORG	1,1-Dichloroethene	0.05		mg/L	U	WATER	14-Jun-95	A	
QC	3XF00101VG	FIELD BLANK	N/A	ORG	1,2-Dichloroethane	0.05		mg/L	U	WATER	14-Jun-95	A	
QC	3XF00101VG	FIELD BLANK	N/A	ORG	1,2-Dichloroethene	0.05		mg/L	U	WATER	14-Jun-95	A	
QC	3XF00101VG	FIELD BLANK	N/A	ORG	1,2-Dichloropropane	0.05		mg/L	U	WATER	14-Jun-95	A	
QC	3XF00101VG	FIELD BLANK	N/A	ORG	2-Butanone	0.24		mg/L		WATER	14-Jun-95	A	
QC	3XF00101VG	FIELD BLANK	N/A	ORG	2-Hexanone	0.1		mg/L	U	WATER	14-Jun-95	A	
QC	3XF00101VG	FIELD BLANK	N/A	ORG	4-Methyl-2-Pentanone	0.1		mg/L	U	WATER	14-Jun-95	A	
QC	3XF00101VG	FIELD BLANK	N/A	ORG	Acetone	1.7		mg/L	BJ	WATER	14-Jun-95	A	
QC	3XF00101VG	FIELD BLANK	N/A	ORG	Benzene	0.05		mg/L	U	WATER	14-Jun-95	A	
QC	3XF00101VG	FIELD BLANK	N/A	ORG	Bromodichloromethane	0.05		mg/L	U	WATER	14-Jun-95	A	
QC	3XF00101VG	FIELD BLANK	N/A	ORG	Bromoform	0.05		mg/L	U	WATER	14-Jun-95	A	
QC	3XF00101VG	FIELD BLANK	N/A	ORG	Bromomethane	0.1		mg/L	U	WATER	14-Jun-95	A	
QC	3XF00101VG	FIELD BLANK	N/A	ORG	Carbon Disulfide	0.05		mg/L	U	WATER	14-Jun-95	A	
QC	3XF00101VG	FIELD BLANK	N/A	ORG	Carbon Tetrachloride	0.05		mg/L	U	WATER	14-Jun-95	A	
QC	3XF00101VG	FIELD BLANK	N/A	ORG	Chlorobenzene	0.05		mg/L	U	WATER	14-Jun-95	A	
QC	3XF00101VG	FIELD BLANK	N/A	ORG	Chloroethane	0.1		mg/L	U	WATER	14-Jun-95	A	
QC	3XF00101VG	FIELD BLANK	N/A	ORG	Chloroform	0.05		mg/L	U	WATER	14-Jun-95	A	
QC	3XF00101VG	FIELD BLANK	N/A	ORG	Chloromethane	0.1		mg/L	U	WATER	14-Jun-95	A	
QC	3XF00101VG	FIELD BLANK	N/A	ORG	cis-1,3-Dichloropropene	0.05		mg/L	U	WATER	14-Jun-95	A	
QC	3XF00101VG	FIELD BLANK	N/A	ORG	Dibromochloromethan	0.05		mg/L	U	WATER	14-Jun-95	A	
QC	3XF00101VG	FIELD BLANK	N/A	ORG	Ethylbenzene	0.05		mg/L	U	WATER	14-Jun-95	A	
QC	3XF00101VG	FIELD BLANK	N/A	ORG	Methylene Chloride	0.1		mg/L	U	WATER	14-Jun-95	A	
QC	3XF00101VG	FIELD BLANK	N/A	ORG	Styrene	0.05		mg/L	U	WATER	14-Jun-95	A	
QC	3XF00101VG	FIELD BLANK	N/A	ORG	Tetrachloroethene	0.05		mg/L	U	WATER	14-Jun-95	A	
QC	3XF00101VG	FIELD BLANK	N/A	ORG	Toluene	0.05		mg/L	U	WATER	14-Jun-95	A	
QC	3XF00101VG	FIELD BLANK	N/A	ORG	trans-1,3-	0.05		mg/L	U	WATER	14-Jun-95	A	
QC	3XF00101VG	FIELD BLANK	N/A	ORG	Trichloroethene	0.05		mg/L	U	WATER	14-Jun-95	A	

SAMPLE LOCATION	SAMPLE NUMBER	TYPE LOCATION	DEPTH (ft)	ANALYSIS	COMPOUND	CONC	RAD UNCERT	UNITS	Q FLAG	MATRIX	SAMPLE DATE	VAL LEVEL	NOTE
QC	3XF00101VG	FIELD BLANK	N/A	ORG	Vinyl Acetate	0.1		mg/L	U	WATER	14-Jun-95	A	
QC	3XF00101VG	FIELD BLANK	N/A	ORG	Vinyl Chloride	0.1		mg/L	U	WATER	14-Jun-95	A	
QC	3XF00101VG	FIELD BLANK	N/A	ORG	Xylene (total)	0.05		mg/L	U	WATER	14-Jun-95	A	
QC	3XF00102EH	FIELD BLANK	N/A	RAD	ALPHA	0.2	0.4	pCi/L	U	NWATER	15-May-95	A	
QC	3XF00104EH	FIELD BLANK	N/A	RAD	ALPHA	0	0.4	pCi/L	U	NWATER	26-May-95	A	
QC	3XF00101EH	FIELD BLANK	N/A	RAD	ALPHA	0.6	0.4	pCi/L	U	NWATER	10-May-95	A	
QC	3XF00105EH	FIELD BLANK	N/A	RAD	ALPHA	0.7	0.4	pCi/L	U	NWATER	01-Jun-95	A	
QC	3XF00103EH	FIELD BLANK	N/A	RAD	ALPHA	0	0.4	pCi/L	U	NWATER	25-May-95	A	
QC	3XF00106EH	FIELD BLANK	N/A	RAD	ALPHA	0	0.4	pCi/L	U	NWATER	08-Jun-95	A	
QC	3XF00104EH	FIELD BLANK	N/A	RAD	BETA	0	1	pCi/L	U	NWATER	26-May-95	A	
QC	3XF00101EH	FIELD BLANK	N/A	RAD	BETA	0	1	pCi/L	U	NWATER	10-May-95	A	
QC	3XF00103EH	FIELD BLANK	N/A	RAD	BETA	1.3	1.1	pCi/L	U	NWATER	25-May-95	A	
QC	3XF00102EH	FIELD BLANK	N/A	RAD	BETA	1.7	1	pCi/L	U	NWATER	15-May-95	A	
QC	3XF00105EH	FIELD BLANK	N/A	RAD	BETA	17	1	pCi/L		NWATER	01-Jun-95	A	
QC	3XF00106EH	FIELD BLANK	N/A	RAD	BETA	0	0.8	pCi/L	U	NWATER	08-Jun-95	A	
QC	3XF00103EH	FIELD BLANK	N/A	RAD	Ce-144			pCi/L	U	NWATER	25-May-95	A	
QC	3XF00102F7	FIELD BLANK	N/A	RAD	Ce-144			pCi/L	U	NWATER	19-May-95	A	
QC	3XF00101F7	FIELD BLANK	N/A	RAD	Ce-144			pCi/L	U	NWATER	17-May-95	A	
QC	3XF00105F7	FIELD BLANK	N/A	RAD	Ce-144			pCi/L	U	NWATER	07-Jul-95	A	
QC	3XF00104F7	FIELD BLANK	N/A	RAD	Ce-144			pCi/L	U	NWATER	01-Jun-95	A	
QC	3XF00101EH	FIELD BLANK	N/A	RAD	Ce-144			pCi/L	U	NWATER	10-May-95	A	
QC	3XF00103F7	FIELD BLANK	N/A	RAD	Ce-144			pCi/L	U	NWATER	19-May-95	A	
QC	3XF00104EH	FIELD BLANK	N/A	RAD	Ce-144			pCi/L	U	NWATER	26-May-95	A	
QC	3XF00105EH	FIELD BLANK	N/A	RAD	Ce-144			pCi/L	U	NWATER	01-Jun-95	A	
QC	3XF00106EH	FIELD BLANK	N/A	RAD	Ce-144			pCi/L	U	NWATER	08-Jun-95	A	
QC	3XF00102EH	FIELD BLANK	N/A	RAD	Ce-144			pCi/L	U	NWATER	15-May-95	A	
QC	3XF00105F7	FIELD BLANK	N/A	RAD	Co-58			pCi/L	U	NWATER	07-Jul-95	A	
QC	3XF00106EH	FIELD BLANK	N/A	RAD	Co-58			pCi/L	U	NWATER	08-Jun-95	A	
QC	3XF00103F7	FIELD BLANK	N/A	RAD	Co-58			pCi/L	U	NWATER	19-May-95	A	
QC	3XF00103EH	FIELD BLANK	N/A	RAD	Co-58			pCi/L	U	NWATER	25-May-95	A	
QC	3XF00104F7	FIELD BLANK	N/A	RAD	Co-58			pCi/L	U	NWATER	01-Jun-95	A	
QC	3XF00101F7	FIELD BLANK	N/A	RAD	Co-58			pCi/L	U	NWATER	17-May-95	A	
QC	3XF00104EH	FIELD BLANK	N/A	RAD	Co-58			pCi/L	U	NWATER	26-May-95	A	
QC	3XF00102F7	FIELD BLANK	N/A	RAD	Co-58			pCi/L	U	NWATER	19-May-95	A	
QC	3XF00105EH	FIELD BLANK	N/A	RAD	Co-58			pCi/L	U	NWATER	01-Jun-95	A	
QC	3XF00102EH	FIELD BLANK	N/A	RAD	Co-58			pCi/L	U	NWATER	15-May-95	A	
QC	3XF00101EH	FIELD BLANK	N/A	RAD	Co-58			pCi/L	U	NWATER	10-May-95	A	
QC	3XF00101F7	FIELD BLANK	N/A	RAD	Co-60			pCi/L	U	NWATER	17-May-95	A	
QC	3XF00101EH	FIELD BLANK	N/A	RAD	Co-60			pCi/L	U	NWATER	10-May-95	A	
QC	3XF00105EH	FIELD BLANK	N/A	RAD	Co-60			pCi/L	U	NWATER	01-Jun-95	A	
QC	3XF00106EH	FIELD BLANK	N/A	RAD	Co-60			pCi/L	U	NWATER	08-Jun-95	A	
QC	3XF00104EH	FIELD BLANK	N/A	RAD	Co-60			pCi/L	U	NWATER	26-May-95	A	
QC	3XF00102F7	FIELD BLANK	N/A	RAD	Co-60			pCi/L	U	NWATER	19-May-95	A	
QC	3XF00103F7	FIELD BLANK	N/A	RAD	Co-60			pCi/L	U	NWATER	19-May-95	A	
QC	3XF00103EH	FIELD BLANK	N/A	RAD	Co-60			pCi/L	U	NWATER	25-May-95	A	
QC	3XF00102EH	FIELD BLANK	N/A	RAD	Co-60			pCi/L	U	NWATER	15-May-95	A	
QC	3XF00105F7	FIELD BLANK	N/A	RAD	Co-60			pCi/L	U	NWATER	07-Jul-95	A	
QC	3XF00104F7	FIELD BLANK	N/A	RAD	Co-60			pCi/L	U	NWATER	01-Jun-95	A	

SAMPLE LOCATION	SAMPLE NUMBER	TYPE LOCATION	DEPTH (ft)	ANALYSIS	COMPOUND	CONC	RAD UNCERT	UNITS	Q FLAG	MATRIX	SAMPLE DATE	VAL LEVEL	NOTE
QC	3XF00106EH	FIELD BLANK	N/A	RAD	Cs-134			pCi/L	U	NWATER	08-Jun-95	A	
QC	3XF00104F7	FIELD BLANK	N/A	RAD	Cs-134			pCi/L	U	NWATER	01-Jun-95	A	
QC	3XF00103EH	FIELD BLANK	N/A	RAD	Cs-134			pCi/L	U	NWATER	25-May-95	A	
QC	3XF00101EH	FIELD BLANK	N/A	RAD	Cs-134			pCi/L	U	NWATER	10-May-95	A	
QC	3XF00102EH	FIELD BLANK	N/A	RAD	Cs-134			pCi/L	U	NWATER	15-May-95	A	
QC	3XF00104EH	FIELD BLANK	N/A	RAD	Cs-134			pCi/L	U	NWATER	26-May-95	A	
QC	3XF00105EH	FIELD BLANK	N/A	RAD	Cs-134			pCi/L	U	NWATER	01-Jun-95	A	
QC	3XF00102F7	FIELD BLANK	N/A	RAD	Cs-134			pCi/L	U	NWATER	19-May-95	A	
QC	3XF00103F7	FIELD BLANK	N/A	RAD	Cs-134			pCi/L	U	NWATER	19-May-95	A	
QC	3XF00105F7	FIELD BLANK	N/A	RAD	Cs-134			pCi/L	U	NWATER	07-Jul-95	A	
QC	3XF00101F7	FIELD BLANK	N/A	RAD	Cs-134			pCi/L	U	NWATER	17-May-95	A	
QC	3XF00101F7	FIELD BLANK	N/A	RAD	Cs-137			pCi/L	U	NWATER	17-May-95	A	
QC	3XF00103F7	FIELD BLANK	N/A	RAD	Cs-137			pCi/L	U	NWATER	19-May-95	A	
QC	3XF00101EH	FIELD BLANK	N/A	RAD	Cs-137			pCi/L	U	NWATER	10-May-95	A	
QC	3XF00103EH	FIELD BLANK	N/A	RAD	Cs-137			pCi/L	U	NWATER	25-May-95	A	
QC	3XF00104EH	FIELD BLANK	N/A	RAD	Cs-137			pCi/L	U	NWATER	26-May-95	A	
QC	3XF00104F7	FIELD BLANK	N/A	RAD	Cs-137			pCi/L	U	NWATER	01-Jun-95	A	
QC	3XF00102F7	FIELD BLANK	N/A	RAD	Cs-137			pCi/L	U	NWATER	19-May-95	A	
QC	3XF00102EH	FIELD BLANK	N/A	RAD	Cs-137			pCi/L	U	NWATER	15-May-95	A	
QC	3XF00105F7	FIELD BLANK	N/A	RAD	Cs-137			pCi/L	U	NWATER	07-Jul-95	A	
QC	3XF00105EH	FIELD BLANK	N/A	RAD	Cs-137			pCi/L	U	NWATER	01-Jun-95	A	
QC	3XF00106EH	FIELD BLANK	N/A	RAD	Cs-137			pCi/L	U	NWATER	08-Jun-95	A	
QC	3XF00103F7	FIELD BLANK	N/A	RAD	Eu-154			pCi/L	U	NWATER	19-May-95	A	
QC	3XF00101EH	FIELD BLANK	N/A	RAD	Eu-154			pCi/L	U	NWATER	10-May-95	A	
QC	3XF00104F7	FIELD BLANK	N/A	RAD	Eu-154			pCi/L	U	NWATER	01-Jun-95	A	
QC	3XF00105EH	FIELD BLANK	N/A	RAD	Eu-154			pCi/L	U	NWATER	01-Jun-95	A	
QC	3XF00104EH	FIELD BLANK	N/A	RAD	Eu-154			pCi/L	U	NWATER	26-May-95	A	
QC	3XF00102EH	FIELD BLANK	N/A	RAD	Eu-154			pCi/L	U	NWATER	15-May-95	A	
QC	3XF00105F7	FIELD BLANK	N/A	RAD	Eu-154			pCi/L	U	NWATER	07-Jul-95	A	
QC	3XF00101F7	FIELD BLANK	N/A	RAD	Eu-154			pCi/L	U	NWATER	17-May-95	A	
QC	3XF00102F7	FIELD BLANK	N/A	RAD	Eu-154			pCi/L	U	NWATER	19-May-95	A	
QC	3XF00106EH	FIELD BLANK	N/A	RAD	Eu-154			pCi/L	U	NWATER	08-Jun-95	A	
QC	3XF00103EH	FIELD BLANK	N/A	RAD	Eu-154			pCi/L	U	NWATER	25-May-95	A	
QC	3XF00106EH	FIELD BLANK	N/A	RAD	Eu-155			pCi/L	U	NWATER	08-Jun-95	A	
QC	3XF00101EH	FIELD BLANK	N/A	RAD	Eu-155			pCi/L	U	NWATER	10-May-95	A	
QC	3XF00101F7	FIELD BLANK	N/A	RAD	Eu-155			pCi/L	U	NWATER	17-May-95	A	
QC	3XF00105F7	FIELD BLANK	N/A	RAD	Eu-155			pCi/L	U	NWATER	07-Jul-95	A	
QC	3XF00103EH	FIELD BLANK	N/A	RAD	Eu-155			pCi/L	U	NWATER	25-May-95	A	
QC	3XF00104EH	FIELD BLANK	N/A	RAD	Eu-155			pCi/L	U	NWATER	26-May-95	A	
QC	3XF00104F7	FIELD BLANK	N/A	RAD	Eu-155			pCi/L	U	NWATER	01-Jun-95	A	
QC	3XF00105EH	FIELD BLANK	N/A	RAD	Eu-155			pCi/L	U	NWATER	01-Jun-95	A	
QC	3XF00102EH	FIELD BLANK	N/A	RAD	Eu-155			pCi/L	U	NWATER	15-May-95	A	
QC	3XF00102F7	FIELD BLANK	N/A	RAD	Eu-155			pCi/L	U	NWATER	19-May-95	A	
QC	3XF00103F7	FIELD BLANK	N/A	RAD	Eu-155			pCi/L	U	NWATER	19-May-95	A	
QC	3XF00104EH	FIELD BLANK	N/A	RAD	Nb-95			pCi/L	U	NWATER	26-May-95	A	
QC	3XF00104F7	FIELD BLANK	N/A	RAD	Nb-95			pCi/L	U	NWATER	01-Jun-95	A	
QC	3XF00101EH	FIELD BLANK	N/A	RAD	Nb-95			pCi/L	U	NWATER	10-May-95	A	
QC	3XF00103EH	FIELD BLANK	N/A	RAD	Nb-95			pCi/L	U	NWATER	25-May-95	A	

SAMPLE LOCATION	SAMPLE NUMBER	TYPE LOCATION	DEPTH (ft)	ANALYSIS	COMPOUND	CONC	RAD UNCERT	UNITS	Q FLAG	MATRIX	SAMPLE DATE	VAL LEVEL	NOTE
QC	3XF00102F7	FIELD BLANK	N/A	RAD	Nb-95			pCi/L	U	NWATER	19-May-95	A	
QC	3XF00105EH	FIELD BLANK	N/A	RAD	Nb-95			pCi/L	U	NWATER	01-Jun-95	A	
QC	3XF00106EH	FIELD BLANK	N/A	RAD	Nb-95			pCi/L	U	NWATER	08-Jun-95	A	
QC	3XF00101F7	FIELD BLANK	N/A	RAD	Nb-95			pCi/L	U	NWATER	17-May-95	A	
QC	3XF00102EH	FIELD BLANK	N/A	RAD	Nb-95			pCi/L	U	NWATER	15-May-95	A	
QC	3XF00103F7	FIELD BLANK	N/A	RAD	Nb-95			pCi/L	U	NWATER	19-May-95	A	
QC	3XF00105F7	FIELD BLANK	N/A	RAD	Nb-95			pCi/L	U	NWATER	07-Jul-95	A	
QC	3XF00101EH	FIELD BLANK	N/A	RAD	Ru-103			pCi/L	U	NWATER	10-May-95	A	
QC	3XF00104EH	FIELD BLANK	N/A	RAD	Ru-103			pCi/L	U	NWATER	26-May-95	A	
QC	3XF00103EH	FIELD BLANK	N/A	RAD	Ru-103			pCi/L	U	NWATER	25-May-95	A	
QC	3XF00105F7	FIELD BLANK	N/A	RAD	Ru-103			pCi/L	U	NWATER	07-Jul-95	A	
QC	3XF00102F7	FIELD BLANK	N/A	RAD	Ru-103			pCi/L	U	NWATER	19-May-95	A	
QC	3XF00101F7	FIELD BLANK	N/A	RAD	Ru-103			pCi/L	U	NWATER	17-May-95	A	
QC	3XF00104F7	FIELD BLANK	N/A	RAD	Ru-103			pCi/L	U	NWATER	01-Jun-95	A	
QC	3XF00106EH	FIELD BLANK	N/A	RAD	Ru-103			pCi/L	U	NWATER	08-Jun-95	A	
QC	3XF00102EH	FIELD BLANK	N/A	RAD	Ru-103			pCi/L	U	NWATER	15-May-95	A	
QC	3XF00105EH	FIELD BLANK	N/A	RAD	Ru-103			pCi/L	U	NWATER	01-Jun-95	A	
QC	3XF00103F7	FIELD BLANK	N/A	RAD	Ru-103			pCi/L	U	NWATER	19-May-95	A	
QC	3XF00103F7	FIELD BLANK	N/A	RAD	Ru-106			pCi/L	U	NWATER	19-May-95	A	
QC	3XF00103EH	FIELD BLANK	N/A	RAD	Ru-106			pCi/L	U	NWATER	25-May-95	A	
QC	3XF00101EH	FIELD BLANK	N/A	RAD	Ru-106			pCi/L	U	NWATER	10-May-95	A	
QC	3XF00104EH	FIELD BLANK	N/A	RAD	Ru-106			pCi/L	U	NWATER	26-May-95	A	
QC	3XF00102EH	FIELD BLANK	N/A	RAD	Ru-106			pCi/L	U	NWATER	15-May-95	A	
QC	3XF00101F7	FIELD BLANK	N/A	RAD	Ru-106			pCi/L	U	NWATER	17-May-95	A	
QC	3XF00106EH	FIELD BLANK	N/A	RAD	Ru-106			pCi/L	U	NWATER	08-Jun-95	A	
QC	3XF00102F7	FIELD BLANK	N/A	RAD	Ru-106			pCi/L	U	NWATER	19-May-95	A	
QC	3XF00105EH	FIELD BLANK	N/A	RAD	Ru-106			pCi/L	U	NWATER	01-Jun-95	A	
QC	3XF00105F7	FIELD BLANK	N/A	RAD	Ru-106			pCi/L	U	NWATER	07-Jul-95	A	
QC	3XF00104F7	FIELD BLANK	N/A	RAD	Ru-106			pCi/L	U	NWATER	01-Jun-95	A	
QC	3XF00103F7	FIELD BLANK	N/A	RAD	Sb-125			pCi/L	U	NWATER	19-May-95	A	
QC	3XF00105F7	FIELD BLANK	N/A	RAD	Sb-125			pCi/L	U	NWATER	07-Jul-95	A	
QC	3XF00101F7	FIELD BLANK	N/A	RAD	Sb-125			pCi/L	U	NWATER	17-May-95	A	
QC	3XF00105EH	FIELD BLANK	N/A	RAD	Sb-125			pCi/L	U	NWATER	01-Jun-95	A	
QC	3XF00102EH	FIELD BLANK	N/A	RAD	Sb-125			pCi/L	U	NWATER	15-May-95	A	
QC	3XF00106EH	FIELD BLANK	N/A	RAD	Sb-125			pCi/L	U	NWATER	08-Jun-95	A	
QC	3XF00102F7	FIELD BLANK	N/A	RAD	Sb-125			pCi/L	U	NWATER	19-May-95	A	
QC	3XF00103EH	FIELD BLANK	N/A	RAD	Sb-125			pCi/L	U	NWATER	25-May-95	A	
QC	3XF00104F7	FIELD BLANK	N/A	RAD	Sb-125			pCi/L	U	NWATER	01-Jun-95	A	
QC	3XF00101EH	FIELD BLANK	N/A	RAD	Sb-125			pCi/L	U	NWATER	10-May-95	A	
QC	3XF00104EH	FIELD BLANK	N/A	RAD	Sb-125			pCi/L	U	NWATER	26-May-95	A	
QC	3XF00105F7	FIELD BLANK	N/A	RAD	Sr-90	1	0.6	pCi/L	U	NWATER	07-Jul-95	A	
QC	3XF00104F7	FIELD BLANK	N/A	RAD	Sr-90	4.6	0.7	pCi/L		NWATER	01-Jun-95	A	
QC	3XF00104EH	FIELD BLANK	N/A	RAD	Sr-90	0.6	0.4	pCi/L	U	NWATER	26-May-95	A	
QC	3XF00102EH	FIELD BLANK	N/A	RAD	Sr-90	0.3	0.3	pCi/L	U	NWATER	15-May-95	A	
QC	3XF00103F7	FIELD BLANK	N/A	RAD	Sr-90	0.6	0.9	pCi/L	U	NWATER	19-May-95	A	
QC	3XF00103EH	FIELD BLANK	N/A	RAD	Sr-90	0.8	0.4	pCi/L		NWATER	25-May-95	A	
QC	3XF00102F7	FIELD BLANK	N/A	RAD	Sr-90	1.6	0.8	pCi/L		NWATER	19-May-95	A	
QC	3XF00101F7	FIELD BLANK	N/A	RAD	Sr-90	1.9	1	pCi/L	U	NWATER	17-May-95	A	

SAMPLE LOCATION	SAMPLE NUMBER	TYPE LOCATION	DEPTH (ft)	ANALYSIS	COMPOUND	CONC	RAD UNCERT	UNITS	Q FLAG	MATRIX	SAMPLE DATE	VALLEVEL	NOTE
QC	3XF00101EH	FIELD BLANK	N/A	RAD	Sr-90	0.5	0.4	pCi/L	U	NWATER	10-May-95	A	
QC	3XF00104EH	FIELD BLANK	N/A	RAD	Tc-99	0.1	0.5	pCi/L	U	NWATER	26-May-95	A	
QC	3XF00101EH	FIELD BLANK	N/A	RAD	Tc-99	0	0.7	pCi/L	U	NWATER	10-May-95	A	
QC	3XF00103EH	FIELD BLANK	N/A	RAD	Tc-99	0.1	0.6	pCi/L	U	NWATER	25-May-95	A	

SAMPLE LOCATION	SAMPLE NUMBER	TYPE LOCATION	DEPTH (ft)	ANALYSIS	COMPOUND	CONC	RAD UNCERT	UNITS	Q FLAG	MATRIX	SAMPLE DATE	VAL LEVEL	NOTE
CPP-88-13-1	38808002F7	GRID 64	0.5-2.5	RAD	Ce-144			pCi/g	U	OTHER	17-May-95	A	
CPP-88-13-1	38808001F7	GRID 64	0.5-2.5	RAD	Ce-144			pCi/g	U	OTHER	17-May-95	A	
CPP-88-13-1	38808002F7	GRID 64	0.5-2.5	RAD	Co-58			pCi/g	U	OTHER	17-May-95	A	
CPP-88-13-1	38808001F7	GRID 64	0.5-2.5	RAD	Co-58			pCi/g	U	OTHER	17-May-95	A	
CPP-88-13-1	38808001F7	GRID 64	0.5-2.5	RAD	Co-60			pCi/g	U	OTHER	17-May-95	A	
CPP-88-13-1	38808002F7	GRID 64	0.5-2.5	RAD	Co-60			pCi/g	U	OTHER	17-May-95	A	
CPP-88-13-1	38808001F7	GRID 64	0.5-2.5	RAD	Cs-134			pCi/g	U	OTHER	17-May-95	A	
CPP-88-13-1	38808002F7	GRID 64	0.5-2.5	RAD	Cs-134			pCi/g	U	OTHER	17-May-95	A	
CPP-88-13-1	38808001F7	GRID 64	0.5-2.5	RAD	Cs-137	2.08	0.06	pCi/g		OTHER	17-May-95	A	
CPP-88-13-1	38808002F7	GRID 64	0.5-2.5	RAD	Cs-137	1.57	0.05	pCi/g		OTHER	17-May-95	A	
CPP-88-13-1	38808002F7	GRID 64	0.5-2.5	RAD	Eu-154			pCi/g	U	OTHER	17-May-95	A	
CPP-88-13-1	38808001F7	GRID 64	0.5-2.5	RAD	Eu-154			pCi/g	U	OTHER	17-May-95	A	
CPP-88-13-1	38808002F7	GRID 64	0.5-2.5	RAD	Eu-155			pCi/g	U	OTHER	17-May-95	A	
CPP-88-13-1	38808001F7	GRID 64	0.5-2.5	RAD	Eu-155			pCi/g	U	OTHER	17-May-95	A	
CPP-88-13-1	38808002F7	GRID 64	0.5-2.5	RAD	Nb-95			pCi/g	U	OTHER	17-May-95	A	
CPP-88-13-1	38808001F7	GRID 64	0.5-2.5	RAD	Nb-95			pCi/g	U	OTHER	17-May-95	A	
CPP-88-13-1	38808002F7	GRID 64	0.5-2.5	RAD	Ru-103			pCi/g	U	OTHER	17-May-95	A	
CPP-88-13-1	38808001F7	GRID 64	0.5-2.5	RAD	Ru-103			pCi/g	U	OTHER	17-May-95	A	
CPP-88-13-1	38808001F7	GRID 64	0.5-2.5	RAD	Ru-106			pCi/g	U	OTHER	17-May-95	A	
CPP-88-13-1	38808002F7	GRID 64	0.5-2.5	RAD	Ru-106			pCi/g	U	OTHER	17-May-95	A	
CPP-88-13-1	38808001F7	GRID 64	0.5-2.5	RAD	Sb-125			pCi/g	U	OTHER	17-May-95	A	
CPP-88-13-1	38808002F7	GRID 64	0.5-2.5	RAD	Sb-125			pCi/g	U	OTHER	17-May-95	A	
CPP-88-13-1	38808002F7	GRID 64	0.5-2.5	RAD	Sr-90	0.5	0.2	pCi/g		OTHER	17-May-95	A	
CPP-88-13-1	38808001F7	GRID 64	0.5-2.5	RAD	Sr-90	0.6	0.2	pCi/g		OTHER	17-May-95	A	

SAMPLE LOCATION	SAMPLE NUMBER	TYPE LOCATION	DEPTH (ft)	ANALYSIS	COMPOUND	CONC	RAD UNCERT	UNITS	Q	FLAG	MATRIX	SAMPLE DATE	VAL LEVEL	NOTE
QC	31324602JN	FIELD BLANK	N/A	INORG	Aluminum	44.3		ug/L	BU	P	WATER	08-Jun-95	A	
QC	31324601JN	FIELD BLANK	N/A	INORG	Aluminum	44.2		ug/L	BU	P	WATER	02-Jun-95	A	
QC	31324601JN	FIELD BLANK	N/A	INORG	Antimony	1.9		ug/L	U	P	WATER	02-Jun-95	A	
QC	31324602JN	FIELD BLANK	N/A	INORG	Antimony	1.9		ug/L	U	P	WATER	08-Jun-95	A	
QC	31324602JN	FIELD BLANK	N/A	INORG	Arsenic	4		ug/L	U	P	WATER	08-Jun-95	A	
QC	31324601JN	FIELD BLANK	N/A	INORG	Arsenic	4		ug/L	U	P	WATER	02-Jun-95	A	
QC	31324602JN	FIELD BLANK	N/A	INORG	Barium	1		ug/L	B	P	WATER	08-Jun-95	A	
QC	31324601JN	FIELD BLANK	N/A	INORG	Barium	0.78		ug/L	B	P	WATER	02-Jun-95	A	
QC	31324601JN	FIELD BLANK	N/A	INORG	Beryllium	0.1		ug/L	U	P	WATER	02-Jun-95	A	
QC	31324602JN	FIELD BLANK	N/A	INORG	Beryllium	0.1		ug/L	U	P	WATER	08-Jun-95	A	
QC	31324602JN	FIELD BLANK	N/A	INORG	Cadmium	0.4		ug/L	U	P	WATER	08-Jun-95	A	
QC	31324601JN	FIELD BLANK	N/A	INORG	Cadmium	0.4		ug/L	U	P	WATER	02-Jun-95	A	
QC	31324602JN	FIELD BLANK	N/A	INORG	Calcium	170		ug/L	B	P	WATER	08-Jun-95	A	
QC	31324601JN	FIELD BLANK	N/A	INORG	Calcium	93		ug/L	B	P	WATER	02-Jun-95	A	
QC	31324601JN	FIELD BLANK	N/A	INORG	Chromium	4.1		ug/L	U	P	WATER	02-Jun-95	A	
QC	31324602JN	FIELD BLANK	N/A	INORG	Chromium	4.1		ug/L	U	P	WATER	08-Jun-95	A	
QC	31324601JN	FIELD BLANK	N/A	INORG	Cobalt	0.5		ug/L	U	P	WATER	02-Jun-95	A	
QC	31324602JN	FIELD BLANK	N/A	INORG	Cobalt	0.5		ug/L	U	P	WATER	08-Jun-95	A	
QC	31324601JN	FIELD BLANK	N/A	INORG	Copper	10.8		ug/L	B	P	WATER	02-Jun-95	A	
QC	31324602JN	FIELD BLANK	N/A	INORG	Copper	9.6		ug/L	B	P	WATER	08-Jun-95	A	
QC	31324601JN	FIELD BLANK	N/A	INORG	Iron	28.2		ug/L	B	P	WATER	02-Jun-95	A	
QC	31324602JN	FIELD BLANK	N/A	INORG	Iron	25		ug/L	B	P	WATER	08-Jun-95	A	
QC	31324602JN	FIELD BLANK	N/A	INORG	Lead	2		ug/L	*UJ	P	WATER	08-Jun-95	A	
QC	31324601JN	FIELD BLANK	N/A	INORG	Lead	2		ug/L	*UJ	P	WATER	02-Jun-95	A	
QC	31324602JN	FIELD BLANK	N/A	INORG	Magnesium	88.4		ug/L	B	P	WATER	08-Jun-95	A	
QC	31324601JN	FIELD BLANK	N/A	INORG	Magnesium	47.6		ug/L	B	P	WATER	02-Jun-95	A	
QC	31324601JN	FIELD BLANK	N/A	INORG	Manganese	0.8		ug/L	U	P	WATER	02-Jun-95	A	
QC	31324602JN	FIELD BLANK	N/A	INORG	Manganese	1.6		ug/L	B	P	WATER	08-Jun-95	A	
QC	31324601JN	FIELD BLANK	N/A	INORG	Mercury	0.1		ug/L	U	AV	WATER	02-Jun-95	A	
QC	31324602JN	FIELD BLANK	N/A	INORG	Mercury	0.1		ug/L	U	AV	WATER	08-Jun-95	A	
QC	31324601JN	FIELD BLANK	N/A	INORG	Nickel	3.4		ug/L	U	P	WATER	02-Jun-95	A	
QC	31324602JN	FIELD BLANK	N/A	INORG	Nickel	3.4		ug/L	U	P	WATER	08-Jun-95	A	
QC	31324601JN	FIELD BLANK	N/A	INORG	Potassium	19.2		ug/L	B	P	WATER	02-Jun-95	A	
QC	31324602JN	FIELD BLANK	N/A	INORG	Potassium	29.3		ug/L	B	P	WATER	08-Jun-95	A	
QC	31324601JN	FIELD BLANK	N/A	INORG	Selenium	2.7		ug/L	U	P	WATER	02-Jun-95	A	
QC	31324602JN	FIELD BLANK	N/A	INORG	Selenium	2.7		ug/L	U	P	WATER	08-Jun-95	A	
QC	31324602JN	FIELD BLANK	N/A	INORG	Silver	0.6		ug/L	U	P	WATER	08-Jun-95	A	
QC	31324601JN	FIELD BLANK	N/A	INORG	Silver	0.6		ug/L	U	P	WATER	02-Jun-95	A	
QC	31324602JN	FIELD BLANK	N/A	INORG	Sodium	183		ug/L	B	P	WATER	08-Jun-95	A	
QC	31324601JN	FIELD BLANK	N/A	INORG	Sodium	120		ug/L	B	P	WATER	02-Jun-95	A	
QC	31324602JN	FIELD BLANK	N/A	INORG	Thallium	4.6		ug/L	U	P	WATER	08-Jun-95	A	
QC	31324601JN	FIELD BLANK	N/A	INORG	Thallium	4.6		ug/L	U	P	WATER	02-Jun-95	A	
QC	31324602JN	FIELD BLANK	N/A	INORG	Vanadium	0.4		ug/L	U	P	WATER	08-Jun-95	A	
QC	31324601JN	FIELD BLANK	N/A	INORG	Vanadium	0.4		ug/L	U	P	WATER	02-Jun-95	A	
QC	31324602JN	FIELD BLANK	N/A	INORG	Zinc	6.5		ug/L	B	P	WATER	08-Jun-95	A	
QC	31324601JN	FIELD BLANK	N/A	INORG	Zinc	11.7		ug/L	B	P	WATER	02-Jun-95	A	
QC	31324602JN	FIELD BLANK	N/A	INORG	Zirconium	31.2		ug/L	U	P	WATER	08-Jun-95	A	
QC	31324601JN	FIELD BLANK	N/A	INORG	Zirconium	31.2		ug/L	U	P	WATER	02-Jun-95	A	

SAMPLE LOCATION	SAMPLE NUMBER	TYPE LOCATION	DEPTH (ft)	ANALYSIS	COMPOUND	CONC	RAD UNCERT	UNITS	Q FLAG	MATRIX	SAMPLE DATE	VAL LEVEL	NOTE
QC	31324602AB	FIELD BLANK	N/A	RAD	ALPHA	1.1	0.5	pCi/L		NWATER	08-Jun-95	A	
QC	31324601AB	RINSATE	N/A	RAD	ALPHA	0.6	0.4	pCi/L	U	NWATER	02-Jun-95	A	
QC	31324601AB	RINSATE	N/A	RAD	BETA	2.7	1.1	pCi/L		NWATER	02-Jun-95	A	
QC	31324602AB	FIELD BLANK	N/A	RAD	BETA	4	1	pCi/L		NWATER	08-Jun-95	A	
QC	31324602R4	FIELD BLANK	N/A	RAD	Ce-144			pCi/L	U	NWATER	08-Jun-95	A	
QC	31324601R4	FIELD BLANK	N/A	RAD	Ce-144			pCi/L	U	NWATER	02-Jun-95	A	
QC	31324602R4	FIELD BLANK	N/A	RAD	Co-58			pCi/L	U	NWATER	08-Jun-95	A	
QC	31324601R4	FIELD BLANK	N/A	RAD	Co-58			pCi/L	U	NWATER	02-Jun-95	A	
QC	31324602R4	FIELD BLANK	N/A	RAD	Co-60			pCi/L	U	NWATER	08-Jun-95	A	
QC	31324601R4	FIELD BLANK	N/A	RAD	Co-60			pCi/L	U	NWATER	02-Jun-95	A	
QC	31324602R4	FIELD BLANK	N/A	RAD	Cs-134			pCi/L	U	NWATER	08-Jun-95	A	
QC	31324601R4	FIELD BLANK	N/A	RAD	Cs-134			pCi/L	U	NWATER	02-Jun-95	A	
QC	31324602R4	FIELD BLANK	N/A	RAD	Cs-137			pCi/L	U	NWATER	08-Jun-95	A	
QC	31324601R4	FIELD BLANK	N/A	RAD	Cs-137			pCi/L	U	NWATER	02-Jun-95	A	
QC	31324602R4	FIELD BLANK	N/A	RAD	Eu-154			pCi/L	U	NWATER	08-Jun-95	A	
QC	31324601R4	FIELD BLANK	N/A	RAD	Eu-154			pCi/L	U	NWATER	02-Jun-95	A	
QC	31324602R4	FIELD BLANK	N/A	RAD	Eu-155			pCi/L	U	NWATER	08-Jun-95	A	
QC	31324601R4	FIELD BLANK	N/A	RAD	Eu-155			pCi/L	U	NWATER	02-Jun-95	A	
QC	31324601RI	RINSATE	N/A	RAD	I-129	0	0.4	pCi/L	U	NWATER	02-Jun-95	A	
QC	31324602RI	FIELD BLANK	N/A	RAD	I-129	0	1.4	pCi/L	U	NWATER	08-Jun-95	A	
QC	31324601R4	FIELD BLANK	N/A	RAD	Nb-95			pCi/L	U	NWATER	02-Jun-95	A	
QC	31324602R4	FIELD BLANK	N/A	RAD	Nb-95			pCi/L	U	NWATER	08-Jun-95	A	
QC	31324601R4	FIELD BLANK	N/A	RAD	Ru-103			pCi/L	U	NWATER	02-Jun-95	A	
QC	31324602R4	FIELD BLANK	N/A	RAD	Ru-103			pCi/L	U	NWATER	08-Jun-95	A	
QC	31324601R4	FIELD BLANK	N/A	RAD	Ru-106			pCi/L	U	NWATER	02-Jun-95	A	
QC	31324602R4	FIELD BLANK	N/A	RAD	Ru-106			pCi/L	U	NWATER	08-Jun-95	A	
QC	31324602R4	FIELD BLANK	N/A	RAD	Sb-125			pCi/L	U	NWATER	08-Jun-95	A	
QC	31324601R4	FIELD BLANK	N/A	RAD	Sb-125			pCi/L	U	NWATER	02-Jun-95	A	
QC	31324601RB	RINSATE	N/A	RAD	Sr-90	1.1	0.4	pCi/L		NWATER	02-Jun-95	A	
QC	31324602RB	FIELD BLANK	N/A	RAD	Sr-90	0.3	0.4	pCi/L	U	NWATER	08-Jun-95	A	
QC	31324602EA	FIELD BLANK	N/A	RAD	Tc-99	0.1	0.5	pCi/L	U	NWATER	08-Jun-95	A	
QC	31324601EA	RINSATE	N/A	RAD	Tc-99	1.1	0.5	pCi/L	J	NWATER	02-Jun-95	A	
QC	31324602R8	FIELD BLANK	N/A	RAD	Tritium	140	99	pCi/L	U	NWATER	08-Jun-95	A	
QC	31324601R8	RINSATE	N/A	RAD	Tritium	56	156	pCi/L	U	NWATER	02-Jun-95	A	

SAMPLE LOCATION	SAMPLE NUMBER	TYPE LOCATION	DEPTH (ft)	ANALYSIS	COMPOUND	CONC	RAD UNCERT	UNITS	Q FLAG	MATRIX	SAMPLE DATE	VAL LEVEL	NOTE
QC	31324502JN	RINSATE	N/A	INORG	Aluminum	28.7		ug/L	BU P	WATER	22-Jun-95	A	
QC	31324501JN	RINSATE	N/A	INORG	Aluminum	48.6		ug/L	BU P	WATER	02-Jun-95	A	
QC	31324502JN	RINSATE	N/A	INORG	Antimony	2.7		ug/L	U P	WATER	22-Jun-95	A	
QC	31324501JN	RINSATE	N/A	INORG	Antimony	1.9		ug/L	U P	WATER	02-Jun-95	A	
QC	31324501JN	RINSATE	N/A	INORG	Arsenic	4		ug/L	U P	WATER	02-Jun-95	A	
QC	31324502JN	RINSATE	N/A	INORG	Arsenic	2.4		ug/L	U P	WATER	22-Jun-95	A	
QC	31324501JN	RINSATE	N/A	INORG	Barium	1.8		ug/L	B P	WATER	02-Jun-95	A	
QC	31324502JN	RINSATE	N/A	INORG	Barium	0.56		ug/L	B P	WATER	22-Jun-95	A	
QC	31324501JN	RINSATE	N/A	INORG	Beryllium	0.1		ug/L	U P	WATER	02-Jun-95	A	
QC	31324502JN	RINSATE	N/A	INORG	Beryllium	0.2		ug/L	* P	WATER	22-Jun-95	A	
QC	31324501JN	RINSATE	N/A	INORG	Cadmium	0.4		ug/L	U P	WATER	02-Jun-95	A	
QC	31324502JN	RINSATE	N/A	INORG	Cadmium	0.3		ug/L	U P	WATER	22-Jun-95	A	
QC	31324501JN	RINSATE	N/A	INORG	Calcium	538		ug/L	BU P	WATER	02-Jun-95	A	
QC	31324502JN	RINSATE	N/A	INORG	Calcium	129		ug/L	BU P	WATER	22-Jun-95	A	
QC	31324502JN	RINSATE	N/A	INORG	Chromium	1.6		ug/L	U P	WATER	22-Jun-95	A	
QC	31324501JN	RINSATE	N/A	INORG	Chromium	4.1		ug/L	U P	WATER	02-Jun-95	A	
QC	31324502JN	RINSATE	N/A	INORG	Cobalt	0.6		ug/L	U P	WATER	22-Jun-95	A	
QC	31324501JN	RINSATE	N/A	INORG	Cobalt	0.5		ug/L	U P	WATER	02-Jun-95	A	
QC	31324502JN	RINSATE	N/A	INORG	Copper	2.2		ug/L	U P	WATER	22-Jun-95	A	
QC	31324501JN	RINSATE	N/A	INORG	Copper	19		ug/L	B P	WATER	02-Jun-95	A	
QC	31324502JN	RINSATE	N/A	INORG	Iron	10.9		ug/L	B P	WATER	22-Jun-95	A	
QC	31324501JN	RINSATE	N/A	INORG	Iron	39.3		ug/L	B P	WATER	02-Jun-95	A	
QC	31324501JN	RINSATE	N/A	INORG	Lead	2		ug/L	U P	WATER	02-Jun-95	A	
QC	31324502JN	RINSATE	N/A	INORG	Lead	2		ug/L	U P	WATER	22-Jun-95	A	
QC	31324502JN	RINSATE	N/A	INORG	Magnesium	59.9		ug/L	BU P	WATER	22-Jun-95	A	
QC	31324501JN	RINSATE	N/A	INORG	Magnesium	281		ug/L	BU P	WATER	02-Jun-95	A	
QC	31324502JN	RINSATE	N/A	INORG	Manganese	0.8		ug/L	U P	WATER	22-Jun-95	A	
QC	31324501JN	RINSATE	N/A	INORG	Manganese	3.3		ug/L	B P	WATER	02-Jun-95	A	
QC	31324501JN	RINSATE	N/A	INORG	Mercury	0.1		ug/L	U AV	WATER	02-Jun-95	A	
QC	31324502JN	RINSATE	N/A	INORG	Mercury	0.1		ug/L	U AV	WATER	22-Jun-95	A	
QC	31324502JN	RINSATE	N/A	INORG	Nickel	1.8		ug/L	U P	WATER	22-Jun-95	A	
QC	31324501JN	RINSATE	N/A	INORG	Nickel	3.4		ug/L	U P	WATER	02-Jun-95	A	
QC	31324501JN	RINSATE	N/A	INORG	Potassium	81.5		ug/L	BU P	WATER	02-Jun-95	A	
QC	31324502JN	RINSATE	N/A	INORG	Potassium	40.6		ug/L	U P	WATER	22-Jun-95	A	
QC	31324501JN	RINSATE	N/A	INORG	Selenium	2.7		ug/L	U P	WATER	02-Jun-95	A	
QC	31324502JN	RINSATE	N/A	INORG	Selenium	2.8		ug/L	U P	WATER	22-Jun-95	A	
QC	31324502JN	RINSATE	N/A	INORG	Silver	0.8		ug/L	UN P	WATER	22-Jun-95	A	
QC	31324501JN	RINSATE	N/A	INORG	Silver	0.6		ug/L	U P	WATER	02-Jun-95	A	
QC	31324502JN	RINSATE	N/A	INORG	Sodium	138		ug/L	U P	WATER	22-Jun-95	A	
QC	31324501JN	RINSATE	N/A	INORG	Sodium	266		ug/L	BU P	WATER	02-Jun-95	A	
QC	31324502JN	RINSATE	N/A	INORG	Thallium	3.2		ug/L	U P	WATER	22-Jun-95	A	
QC	31324501JN	RINSATE	N/A	INORG	Thallium	4.6		ug/L	U P	WATER	02-Jun-95	A	
QC	31324502JN	RINSATE	N/A	INORG	Vanadium	0.7		ug/L	U P	WATER	22-Jun-95	A	
QC	31324501JN	RINSATE	N/A	INORG	Vanadium	0.4		ug/L	U P	WATER	02-Jun-95	A	
QC	31324502JN	RINSATE	N/A	INORG	Zinc	5.4		ug/L	B P	WATER	22-Jun-95	A	
QC	31324501JN	RINSATE	N/A	INORG	Zinc	18.6		ug/L	BU P	WATER	02-Jun-95	A	
QC	31324502JN	RINSATE	N/A	INORG	Zirconium	11.6		ug/L	U P	WATER	22-Jun-95	A	
QC	31324501JN	RINSATE	N/A	INORG	Zirconium	31.2		ug/L	U P	WATER	02-Jun-95	A	

SAMPLE LOCATION	SAMPLE NUMBER	TYPE LOCATION	DEPTH (ft)	ANALYSIS	COMPOUND	CONC	RAD UNCERT	UNITS	Q FLAG	MATRIX	SAMPLE DATE	VAL LEVEL	NOTE
QC	31324501AB	RINSATE	N/A	RAD	ALPHA	3.2	0.8	pCi/L		NWATER	02-Jun-95	A	
QC	31324502AB	RINSATE	N/A	RAD	ALPHA	1.2	0.5	pCi/L	U	NWATER	22-Jun-95	A	
QC	31324501AB	RINSATE	N/A	RAD	BETA	8.9	1.3	pCi/L		NWATER	02-Jun-95	A	
QC	31324502AB	RINSATE	N/A	RAD	BETA	1.5	0.9	pCi/L	U	NWATER	22-Jun-95	A	
QC	31324502R4	RINSATE	N/A	RAD	Ce-144			pCi/L	U	NWATER	22-Jun-95	A	
QC	31324501R4	RINSATE	N/A	RAD	Ce-144			pCi/L	U	NWATER	02-Jun-95	A	
QC	31324502R4	RINSATE	N/A	RAD	Co-58			pCi/L	U	NWATER	22-Jun-95	A	
QC	31324501R4	RINSATE	N/A	RAD	Co-58			pCi/L	U	NWATER	02-Jun-95	A	
QC	31324502R4	RINSATE	N/A	RAD	Co-60			pCi/L	U	NWATER	22-Jun-95	A	
QC	31324501R4	RINSATE	N/A	RAD	Co-60			pCi/L	U	NWATER	02-Jun-95	A	
QC	31324502R4	RINSATE	N/A	RAD	Cs-134			pCi/L	U	NWATER	22-Jun-95	A	
QC	31324501R4	RINSATE	N/A	RAD	Cs-134			pCi/L	U	NWATER	02-Jun-95	A	
QC	31324502R4	RINSATE	N/A	RAD	Cs-137			pCi/L	U	NWATER	22-Jun-95	A	
QC	31324501R4	RINSATE	N/A	RAD	Cs-137			pCi/L	U	NWATER	02-Jun-95	A	
QC	31324502R4	RINSATE	N/A	RAD	Eu-154			pCi/L	U	NWATER	22-Jun-95	A	
QC	31324501R4	RINSATE	N/A	RAD	Eu-154			pCi/L	U	NWATER	02-Jun-95	A	
QC	31324502R4	RINSATE	N/A	RAD	Eu-155			pCi/L	U	NWATER	22-Jun-95	A	
QC	31324501R4	RINSATE	N/A	RAD	Eu-155			pCi/L	U	NWATER	02-Jun-95	A	
QC	31324502RI	RINSATE	N/A	RAD	I-129	0	0.3	pCi/L	U	NWATER	22-Jun-95	A	
QC	31324501RI	RINSATE	N/A	RAD	I-129	0	0.4	pCi/L	U	NWATER	02-Jun-95	A	
QC	31324502R4	RINSATE	N/A	RAD	Nb-95			pCi/L	U	NWATER	22-Jun-95	A	
QC	31324501R4	RINSATE	N/A	RAD	Nb-95			pCi/L	U	NWATER	02-Jun-95	A	
QC	31324502R4	RINSATE	N/A	RAD	Ru-103			pCi/L	U	NWATER	22-Jun-95	A	
QC	31324501R4	RINSATE	N/A	RAD	Ru-103			pCi/L	U	NWATER	02-Jun-95	A	
QC	31324501R4	RINSATE	N/A	RAD	Ru-106			pCi/L	U	NWATER	02-Jun-95	A	
QC	31324502R4	RINSATE	N/A	RAD	Ru-106			pCi/L	U	NWATER	22-Jun-95	A	
QC	31324501R4	RINSATE	N/A	RAD	Sb-125			pCi/L	U	NWATER	02-Jun-95	A	
QC	31324502R4	RINSATE	N/A	RAD	Sb-125			pCi/L	U	NWATER	22-Jun-95	A	
QC	31324501RB	RINSATE	N/A	RAD	Sr-90	0.2	0.4	pCi/L	U	NWATER	02-Jun-95	A	
QC	31324502RB	RINSATE	N/A	RAD	Sr-90	0.5	0.4	pCi/L	U	NWATER	22-Jun-95	A	
QC	31324502EA	RINSATE	N/A	RAD	Tc-99	0.1	0.4	pCi/L	U	NWATER	22-Jun-95	A	
QC	31324501EA	RINSATE	N/A	RAD	Tc-99	0.5	0.5	pCi/L	U	NWATER	02-Jun-95	A	
QC	31324501R8	RINSATE	N/A	RAD	Tritium	281	160	pCi/L	U	NWATER	02-Jun-95	A	
QC	31324502R8	RINSATE	N/A	RAD	Tritium	711	180	pCi/L	U	NWATER	22-Jun-95	A	
QC	31324502R9	RINSATE	N/A	RAD	U-234	0.5	0.5	pCi/L	U	NWATER	22-Jun-95	A	
QC	31324502R9	RINSATE	N/A	RAD	U-235	0	0.4	pCi/L	U	NWATER	22-Jun-95	A	
QC	31324502R9	RINSATE	N/A	RAD	U-238	0	0.4	pCi/L	U	NWATER	22-Jun-95	A	

SAMPLE LOCATION	SAMPLE NUMBER	TYPE LOCATION	DEPTH (m)	ANALYSIS	COMPOUND	CONC	RAD UNCERT	UNITS	Q FLAG	MATRIX	SAMPLE DATE	VAL LEVEL	NOTE
USGS-50	31323801BA	4" STEEL WELL	384-405	INORG	Alkalinity	129		mg/L		WATER	30-May-95	A	
USGS-50	31324301BA	4" STEEL WELL	384-405	INORG	Alkalinity	130		mg/L		WATER	30-May-95	A	
USGS-50	31324301JN	4" STEEL WELL	384-405	INORG	Aluminum	0.0331		mg/L	BU P	WATER	30-May-95	A	
USGS-50	31323801JN	4" STEEL WELL	384-405	INORG	Aluminum	0.0268		mg/L	U P	WATER	30-May-95	A	
USGS-50	31324301NK	4" STEEL WELL	384-405	INORG	Ammonia-N	0.1		mg/L	U	WATER	30-May-95	A	
USGS-50	31323801NK	4" STEEL WELL	384-405	INORG	Ammonia-N	0.1		mg/L	U	WATER	30-May-95	A	
USGS-50	31324301JN	4" STEEL WELL	384-405	INORG	Antimony	0.0019		mg/L	U P	WATER	30-May-95	A	
USGS-50	31323801JN	4" STEEL WELL	384-405	INORG	Antimony	0.0019		mg/L	U P	WATER	30-May-95	A	
USGS-50	31323801JN	4" STEEL WELL	384-405	INORG	Arsenic	0.004		mg/L	U P	WATER	30-May-95	A	
USGS-50	31324301JN	4" STEEL WELL	384-405	INORG	Arsenic	0.004		mg/L	U P	WATER	30-May-95	A	
USGS-50	31323801JN	4" STEEL WELL	384-405	INORG	Barium	0.183		mg/L	B P	WATER	30-May-95	A	
USGS-50	31324301JN	4" STEEL WELL	384-405	INORG	Barium	0.165		mg/L	B P	WATER	30-May-95	A	
USGS-50	31323801JN	4" STEEL WELL	384-405	INORG	Beryllium	0.0001		mg/L	U P	WATER	30-May-95	A	
USGS-50	31324301JN	4" STEEL WELL	384-405	INORG	Beryllium	0.0001		mg/L	U P	WATER	30-May-95	A	
USGS-50	31323801BA	4" STEEL WELL	384-405	INORG	Bic Alkaline	129		mg/L		WATER	30-May-95	A	
USGS-50	31324301BA	4" STEEL WELL	384-405	INORG	Bic Alkaline	130		mg/L		WATER	30-May-95	A	
USGS-50	31324301JN	4" STEEL WELL	384-405	INORG	Cadmium	0.0004		mg/L	U P	WATER	30-May-95	A	
USGS-50	31323801JN	4" STEEL WELL	384-405	INORG	Cadmium	0.0004		mg/L	U P	WATER	30-May-95	A	
USGS-50	31324301JN	4" STEEL WELL	384-405	INORG	Calcium	67.1		mg/L	P	WATER	30-May-95	A	
USGS-50	31323801JN	4" STEEL WELL	384-405	INORG	Calcium	73.3		mg/L	P	WATER	30-May-95	A	
USGS-50	31323801BA	4" STEEL WELL	384-405	INORG	Carbonate	2		mg/L	U	WATER	30-May-95	A	
USGS-50	31324301BA	4" STEEL WELL	384-405	INORG	Carbonate	2		mg/L	U	WATER	30-May-95	A	
USGS-50	31324301F3	4" STEEL WELL	384-405	INORG	Chloride	69.6		mg/L		WATER	30-May-95	A	
USGS-50	31323801F3	4" STEEL WELL	384-405	INORG	Chloride	66		mg/L		WATER	30-May-95	A	
USGS-50	31324301JN	4" STEEL WELL	384-405	INORG	Chromium	0.0052		mg/L	B P	WATER	30-May-95	A	
USGS-50	31323801JN	4" STEEL WELL	384-405	INORG	Chromium	0.0043		mg/L	B P	WATER	30-May-95	A	
USGS-50	31323801JN	4" STEEL WELL	384-405	INORG	Cobalt	0.0005		mg/L	U P	WATER	30-May-95	A	
USGS-50	31324301JN	4" STEEL WELL	384-405	INORG	Cobalt	0.0012		mg/L	B P	WATER	30-May-95	A	
USGS-50	31323801JN	4" STEEL WELL	384-405	INORG	Copper	0.0026		mg/L	B P	WATER	30-May-95	A	
USGS-50	31324301JN	4" STEEL WELL	384-405	INORG	Copper	0.0074		mg/L	B P	WATER	30-May-95	A	
USGS-50	31323801F3	4" STEEL WELL	384-405	INORG	Fluoride	0.36		mg/L		WATER	30-May-95	A	
USGS-50	31324301F3	4" STEEL WELL	384-405	INORG	Fluoride	0.35		mg/L		WATER	30-May-95	A	
USGS-50	31324301JN	4" STEEL WELL	384-405	INORG	Iron	0.0215		mg/L	U P	WATER	30-May-95	A	
USGS-50	31323801JN	4" STEEL WELL	384-405	INORG	Iron	0.0215		mg/L	U P	WATER	30-May-95	A	
USGS-50	31324301JN	4" STEEL WELL	384-405	INORG	Lead	0.002		mg/L	U P	WATER	30-May-95	A	
USGS-50	31323801JN	4" STEEL WELL	384-405	INORG	Lead	0.002		mg/L	U P	WATER	30-May-95	A	
USGS-50	31323801JN	4" STEEL WELL	384-405	INORG	Magnesium	20		mg/L	P	WATER	30-May-95	A	
USGS-50	31324301JN	4" STEEL WELL	384-405	INORG	Magnesium	18.4		mg/L	P	WATER	30-May-95	A	
USGS-50	31323801JN	4" STEEL WELL	384-405	INORG	Manganese	0.0018		mg/L	B P	WATER	30-May-95	A	
USGS-50	31324301JN	4" STEEL WELL	384-405	INORG	Manganese	0.0022		mg/L	B P	WATER	30-May-95	A	
USGS-50	31324301JN	4" STEEL WELL	384-405	INORG	Mercury	0.00028		mg/L	AV	WATER	30-May-95	A	
USGS-50	31323801JN	4" STEEL WELL	384-405	INORG	Mercury	0.0001		mg/L	U AV	WATER	30-May-95	A	
USGS-50	31323801JN	4" STEEL WELL	384-405	INORG	Nickel	0.0034		mg/L	U P	WATER	30-May-95	A	
USGS-50	31324301JN	4" STEEL WELL	384-405	INORG	Nickel	0.0038		mg/L	B P	WATER	30-May-95	A	
USGS-50	31324301N2	4" STEEL WELL	384-405	INORG	Nitrate/Nitrite	33.2		mg-N/	L	WATER	30-May-95	A	
USGS-50	31323801N2	4" STEEL WELL	384-405	INORG	Nitrate/Nitrite	31.3		mg-N/	L	WATER	30-May-95	A	
USGS-50	31324301JN	4" STEEL WELL	384-405	INORG	Potassium	5.75		mg/L	P	WATER	30-May-95	A	
USGS-50	31323801JN	4" STEEL WELL	384-405	INORG	Potassium	6.35		mg/L	P	WATER	30-May-95	A	

SAMPLE LOCATION	SAMPLE NUMBER	TYPE LOCATION	DEPTH (ft)	ANALYSIS	COMPOUND	CONC	RAD UNCERT	UNITS	Q	FLAG	MATRIX	SAMPLE DATE	VAL LEVEL	NOTE
USGS-50	31323801JN	4" STEEL WELL	384-405	INORG	Selenium	0.0027		mg/L	U	P	WATER	30-May-95	A	
USGS-50	31324301JN	4" STEEL WELL	384-405	INORG	Selenium	0.0034		mg/L	B	P	WATER	30-May-95	A	
USGS-50	31323801JN	4" STEEL WELL	384-405	INORG	Silver	0.0006		mg/L	U	P	WATER	30-May-95	A	
USGS-50	31324301JN	4" STEEL WELL	384-405	INORG	Silver	0.0006		mg/L	U	P	WATER	30-May-95	A	
USGS-50	31324301JN	4" STEEL WELL	384-405	INORG	Sodium	59.4		mg/L	P		WATER	30-May-95	A	
USGS-50	31323801JN	4" STEEL WELL	384-405	INORG	Sodium	66.2		mg/L	P		WATER	30-May-95	A	
USGS-50	31323801F3	4" STEEL WELL	384-405	INORG	Sulfate	44.8		mg/L			WATER	30-May-95	A	
USGS-50	31324301F3	4" STEEL WELL	384-405	INORG	Sulfate	44.5		mg/L			WATER	30-May-95	A	
USGS-50	31323801JN	4" STEEL WELL	384-405	INORG	Thallium	0.0046		mg/L	U	P	WATER	30-May-95	A	
USGS-50	31324301JN	4" STEEL WELL	384-405	INORG	Thallium	0.0046		mg/L	U	P	WATER	30-May-95	A	
USGS-50	31324301NK	4" STEEL WELL	384-405	INORG	TKN	0.1		mg/L	U		WATER	30-May-95	A	
USGS-50	31323801NK	4" STEEL WELL	384-405	INORG	TKN	0.11		mg/L			WATER	30-May-95	A	
USGS-50	31324301NK	4" STEEL WELL	384-405	INORG	Total Kjeldahl-	0.1		mg/L	U		WATER	30-May-95	A	
USGS-50	31323801NK	4" STEEL WELL	384-405	INORG	Total Kjeldahl-	0.11		mg/L			WATER	30-May-95	A	
USGS-50	31323801JN	4" STEEL WELL	384-405	INORG	Vanadium	0.0066		mg/L	B	P	WATER	30-May-95	A	
USGS-50	31324301JN	4" STEEL WELL	384-405	INORG	Vanadium	0.006		mg/L	B	P	WATER	30-May-95	A	
USGS-50	31324301JN	4" STEEL WELL	384-405	INORG	Zinc	0.0108		mg/L	BU	P	WATER	30-May-95	A	
USGS-50	31323801JN	4" STEEL WELL	384-405	INORG	Zinc	0.0108		mg/L	BU	P	WATER	30-May-95	A	
USGS-50	31323801JN	4" STEEL WELL	384-405	INORG	Zirconium	0.0312		mg/L	U	P	WATER	30-May-95	A	
USGS-50	31324301JN	4" STEEL WELL	384-405	INORG	Zirconium	0.0312		mg/L	U	P	WATER	30-May-95	A	
USGS-50	31324301AB	4" STEEL WELL	384-405	RAD	ALPHA	2.6	1.8	pCi/L	U		NWATER	30-May-95	A	
USGS-50	31323801AB	4" STEEL WELL	384-405	RAD	ALPHA	0.3	1.7	pCi/L	U		NWATER	30-May-95	A	
USGS-50	31323801AB	4" STEEL WELL	384-405	RAD	BETA	456	6	pCi/L			NWATER	30-May-95	A	
USGS-50	31324301AB	4" STEEL WELL	384-405	RAD	BETA	479	6	pCi/L			NWATER	30-May-95	A	
USGS-50	31324301R4	4" STEEL WELL	384-405	RAD	Ce-144			pCi/L	U		NWATER	30-May-95	A	
USGS-50	31323801R4	4" STEEL WELL	384-405	RAD	Ce-144			pCi/L	U		NWATER	30-May-95	A	
USGS-50	31324301R4	4" STEEL WELL	384-405	RAD	Co-58			pCi/L	U		NWATER	30-May-95	A	
USGS-50	31323801R4	4" STEEL WELL	384-405	RAD	Co-58			pCi/L	U		NWATER	30-May-95	A	
USGS-50	31324301R4	4" STEEL WELL	384-405	RAD	Co-60			pCi/L	U		NWATER	30-May-95	A	
USGS-50	31323801R4	4" STEEL WELL	384-405	RAD	Co-60			pCi/L	U		NWATER	30-May-95	A	
USGS-50	31324301R4	4" STEEL WELL	384-405	RAD	Cs-134			pCi/L	U		NWATER	30-May-95	A	
USGS-50	31323801R4	4" STEEL WELL	384-405	RAD	Cs-134			pCi/L	U		NWATER	30-May-95	A	
USGS-50	31323801R4	4" STEEL WELL	384-405	RAD	Cs-137			pCi/L	U		NWATER	30-May-95	A	
USGS-50	31324301R4	4" STEEL WELL	384-405	RAD	Cs-137			pCi/L	U		NWATER	30-May-95	A	
USGS-50	31324301R4	4" STEEL WELL	384-405	RAD	Eu-154			pCi/L	U		NWATER	30-May-95	A	
USGS-50	31323801R4	4" STEEL WELL	384-405	RAD	Eu-154			pCi/L	U		NWATER	30-May-95	A	
USGS-50	31324301R4	4" STEEL WELL	384-405	RAD	Eu-155			pCi/L	U		NWATER	30-May-95	A	
USGS-50	31323801R4	4" STEEL WELL	384-405	RAD	Eu-155			pCi/L	U		NWATER	30-May-95	A	
USGS-50	31323801RI	4" STEEL WELL	384-405	RAD	I-129	0	0.3	pCi/L	U		NWATER	30-May-95	A	
USGS-50	31324301RI	4" STEEL WELL	384-405	RAD	I-129	0	0.2	pCi/L	U		NWATER	30-May-95	A	
USGS-50	31323801R4	4" STEEL WELL	384-405	RAD	Nb-95			pCi/L	U		NWATER	30-May-95	A	
USGS-50	31324301R4	4" STEEL WELL	384-405	RAD	Nb-95			pCi/L	U		NWATER	30-May-95	A	
USGS-50	31324301R4	4" STEEL WELL	384-405	RAD	Ru-103			pCi/L	U		NWATER	30-May-95	A	
USGS-50	31323801R4	4" STEEL WELL	384-405	RAD	Ru-103			pCi/L	U		NWATER	30-May-95	A	
USGS-50	31323801R4	4" STEEL WELL	384-405	RAD	Ru-106			pCi/L	U		NWATER	30-May-95	A	
USGS-50	31324301R4	4" STEEL WELL	384-405	RAD	Ru-106			pCi/L	U		NWATER	30-May-95	A	
USGS-50	31323801R4	4" STEEL WELL	384-405	RAD	Sb-125			pCi/L	U		NWATER	30-May-95	A	
USGS-50	31324301R4	4" STEEL WELL	384-405	RAD	Sb-125			pCi/L	U		NWATER	30-May-95	A	

SAMPLE LOCATION	SAMPLE NUMBER	TYPE LOCATION	DEPTH (m)	ANALYSIS	COMPOUND	CONC	RAD UNCERT	UNITS	Q FLAG	MATRIX	SAMPLE DATE	VAL LEVEL	NOTE
USGS-50	31323801RB	4" STEEL WELL	384-405	RAD	Sr-90	151	2	pCi/L		NWATER	30-May-95	A	
USGS-50	31324301RB	4" STEEL WELL	384-405	RAD	Sr-90	159	2	pCi/L		NWATER	30-May-95	A	
USGS-50	31323801EA	4" STEEL WELL	384-405	RAD	Tc-99	63	1	pCi/L	J	NWATER	30-May-95	A	
USGS-50	31324301EA	4" STEEL WELL	384-405	RAD	Tc-99	75	1	pCi/L		NWATER	30-May-95	A	
USGS-50	31324301R8	4" STEEL WELL	384-405	RAD	Tritium	62800	700	pCi/L		NWATER	30-May-95	A	
USGS-50	31323801R8	4" STEEL WELL	384-405	RAD	Tritium	61900	700	pCi/L		NWATER	30-May-95	A	

SAMPLE LOCATION	SAMPLE NUMBER	TYPE LOCATION	DEPTH (ft)	ANALYSIS	COMPOUND	CONC	RAD UNCERT	UNITS	Q FLAG	MATRIX	SAMPLE DATE	VAL LEVEL	NOTE
CPP 33-4	31324401BA	2" SS WELL	102.85-118.2	INORG	Alkalinity	216		mg/L		WATER	17-May-95	A	
CPP 33-4	31320401BA	2" SS WELL	102.85-118.2	INORG	Alkalinity	217		mg/L		WATER	17-May-95	A	
CPP 33-4	31320401JN	2" SS WELL	102.85-118.2	INORG	Aluminum	0.0268		mg/L	U P	WATER	17-May-95	A	
CPP 33-4	31324401JN	2" SS WELL	102.85-118.2	INORG	Aluminum	0.0268		mg/L	U P	WATER	17-May-95	A	
CPP 33-4	31320401NK	2" SS WELL	102.85-118.2	INORG	Ammonia-N	0.1		mg/L	U	WATER	17-May-95	A	
CPP 33-4	31324401NK	2" SS WELL	102.85-118.2	INORG	Ammonia-N	0.1		mg/L	U	WATER	17-May-95	A	
CPP 33-4	31324401JN	2" SS WELL	102.85-118.2	INORG	Antimony	0.0019		mg/L	U P	WATER	17-May-95	A	
CPP 33-4	31320401JN	2" SS WELL	102.85-118.2	INORG	Antimony	0.0019		mg/L	U P	WATER	17-May-95	A	
CPP 33-4	31324401JN	2" SS WELL	102.85-118.2	INORG	Arsenic	0.004		mg/L	U P	WATER	17-May-95	A	
CPP 33-4	31320401JN	2" SS WELL	102.85-118.2	INORG	Arsenic	0.004		mg/L	U P	WATER	17-May-95	A	
CPP 33-4	31324401JN	2" SS WELL	102.85-118.2	INORG	Barium	0.284		mg/L	P	WATER	17-May-95	A	
CPP 33-4	31320401JN	2" SS WELL	102.85-118.2	INORG	Barium	0.138		mg/L	B P	WATER	17-May-95	A	
CPP 33-4	31324401JN	2" SS WELL	102.85-118.2	INORG	Beryllium	0.0001		mg/L	U P	WATER	17-May-95	A	
CPP 33-4	31320401JN	2" SS WELL	102.85-118.2	INORG	Beryllium	0.0001		mg/L	U P	WATER	17-May-95	A	
CPP 33-4	31324401BA	2" SS WELL	102.85-118.2	INORG	Bic Alkaline	216		mg/L		WATER	17-May-95	A	
CPP 33-4	31320401BA	2" SS WELL	102.85-118.2	INORG	Bic Alkaline	217		mg/L		WATER	17-May-95	A	
CPP 33-4	31324401JN	2" SS WELL	102.85-118.2	INORG	Cadmium	0.0004		mg/L	U P	WATER	17-May-95	A	
CPP 33-4	31320401JN	2" SS WELL	102.85-118.2	INORG	Cadmium	0.0004		mg/L	U P	WATER	17-May-95	A	
CPP 33-4	31324401JN	2" SS WELL	102.85-118.2	INORG	Calcium	103		mg/L	P	WATER	17-May-95	A	
CPP 33-4	31320401JN	2" SS WELL	102.85-118.2	INORG	Calcium	51		mg/L	P	WATER	17-May-95	A	
CPP 33-4	31320401BA	2" SS WELL	102.85-118.2	INORG	Carbonate	2		mg/L	U	WATER	17-May-95	A	
CPP 33-4	31324401BA	2" SS WELL	102.85-118.2	INORG	Carbonate	2		mg/L	U	WATER	17-May-95	A	
CPP 33-4	31320401F3	2" SS WELL	102.85-118.2	INORG	Chloride	81.2		mg/L		WATER	17-May-95	A	
CPP 33-4	31324401F3	2" SS WELL	102.85-118.2	INORG	Chloride	81.3		mg/L		WATER	17-May-95	A	
CPP 33-4	31320401JN	2" SS WELL	102.85-118.2	INORG	Chromium	0.0041		mg/L	U P	WATER	17-May-95	A	
CPP 33-4	31324401JN	2" SS WELL	102.85-118.2	INORG	Chromium	0.0041		mg/L	U P	WATER	17-May-95	A	
CPP 33-4	31320401JN	2" SS WELL	102.85-118.2	INORG	Cobalt	0.0005		mg/L	U P	WATER	17-May-95	A	
CPP 33-4	31324401JN	2" SS WELL	102.85-118.2	INORG	Cobalt	0.00052		mg/L	B P	WATER	17-May-95	A	
CPP 33-4	31320401JN	2" SS WELL	102.85-118.2	INORG	Copper	0.0013		mg/L	U P	WATER	17-May-95	A	
CPP 33-4	31324401JN	2" SS WELL	102.85-118.2	INORG	Copper	0.0013		mg/L	UJ P	WATER	17-May-95	A	
CPP 33-4	31324401F3	2" SS WELL	102.85-118.2	INORG	Fluoride	0.15		mg/L		WATER	17-May-95	A	
CPP 33-4	31320401F3	2" SS WELL	102.85-118.2	INORG	Fluoride	0.16		mg/L		WATER	17-May-95	A	
CPP 33-4	31320401JN	2" SS WELL	102.85-118.2	INORG	Iron	0.0215		mg/L	U P	WATER	17-May-95	A	
CPP 33-4	31324401JN	2" SS WELL	102.85-118.2	INORG	Iron	0.0215		mg/L	U P	WATER	17-May-95	A	
CPP 33-4	31324401JN	2" SS WELL	102.85-118.2	INORG	Lead	0.002		mg/L	U P	WATER	17-May-95	A	
CPP 33-4	31320401JN	2" SS WELL	102.85-118.2	INORG	Lead	0.002		mg/L	U P	WATER	17-May-95	A	
CPP 33-4	31324401JN	2" SS WELL	102.85-118.2	INORG	Magnesium	27		mg/L	P	WATER	17-May-95	A	
CPP 33-4	31320401JN	2" SS WELL	102.85-118.2	INORG	Magnesium	13.7		mg/L	P	WATER	17-May-95	A	
CPP 33-4	31324401JN	2" SS WELL	102.85-118.2	INORG	Manganese	0.0008		mg/L	U P	WATER	17-May-95	A	
CPP 33-4	31320401JN	2" SS WELL	102.85-118.2	INORG	Manganese	0.00085		mg/L	B P	WATER	17-May-95	A	
CPP 33-4	31324401JN	2" SS WELL	102.85-118.2	INORG	Mercury	0.0001		mg/L	U AV	WATER	17-May-95	A	
CPP 33-4	31320401JN	2" SS WELL	102.85-118.2	INORG	Mercury	0.0001		mg/L	U AV	WATER	17-May-95	A	
CPP 33-4	31320401JN	2" SS WELL	102.85-118.2	INORG	Nickel	0.0034		mg/L	U P	WATER	17-May-95	A	
CPP 33-4	31324401JN	2" SS WELL	102.85-118.2	INORG	Nickel	0.0034		mg/L	U P	WATER	17-May-95	A	
CPP 33-4	31320401N2	2" SS WELL	102.85-118.2	INORG	Nitrate/Nitrite	13		mg-N/	L	WATER	17-May-95	A	
CPP 33-4	31324401N2	2" SS WELL	102.85-118.2	INORG	Nitrate/Nitrite	12.7		mg-N/	L	WATER	17-May-95	A	
CPP 33-4	31320401JN	2" SS WELL	102.85-118.2	INORG	Potassium	1.91		mg/L	BEJ P	WATER	17-May-95	A	
CPP 33-4	31324401JN	2" SS WELL	102.85-118.2	INORG	Potassium	3.93		mg/L	BEJ P	WATER	17-May-95	A	

SAMPLE LOCATION	SAMPLE NUMBER	TYPE LOCATION	DEPTH (ft)	ANALYSIS	COMPOUND	CONC	RAD UNCERT	UNITS	Q FLAG	MATRIX	SAMPLE DATE	VAL LEVEL	NOTE
CPP 33-4	31320401JN	2" SS WELL	102.85-118.2	INORG	Selenium	0.0027		mg/L	U P	WATER	17-May-95	A	
CPP 33-4	31324401JN	2" SS WELL	102.85-118.2	INORG	Selenium	0.0054		mg/L	BU P	WATER	17-May-95	A	
CPP 33-4	31320401JN	2" SS WELL	102.85-118.2	INORG	Silver	0.00077		mg/L	BNJ P	WATER	17-May-95	A	
CPP 33-4	31324401JN	2" SS WELL	102.85-118.2	INORG	Silver	0.0006		mg/L	NUJ P	WATER	17-May-95	A	
CPP 33-4	31320401JN	2" SS WELL	102.85-118.2	INORG	Sodium	14.3		mg/L	P	WATER	17-May-95	A	
CPP 33-4	31324401JN	2" SS WELL	102.85-118.2	INORG	Sodium	30.3		mg/L	P	WATER	17-May-95	A	
CPP 33-4	31324401F3	2" SS WELL	102.85-118.2	INORG	Sulfate	60.1		mg/L		WATER	17-May-95	A	
CPP 33-4	31320401F3	2" SS WELL	102.85-118.2	INORG	Sulfate	61.8		mg/L		WATER	17-May-95	A	
CPP 33-4	31324401JN	2" SS WELL	102.85-118.2	INORG	Thallium	0.0046		mg/L	U P	WATER	17-May-95	A	
CPP 33-4	31320401JN	2" SS WELL	102.85-118.2	INORG	Thallium	0.0046		mg/L	U P	WATER	17-May-95	A	
CPP 33-4	31324401NK	2" SS WELL	102.85-118.2	INORG	TKN	0.1		mg/L	U	WATER	17-May-95	A	
CPP 33-4	31320401NK	2" SS WELL	102.85-118.2	INORG	TKN	0.1		mg/L	U	WATER	17-May-95	A	
CPP 33-4	31324401NK	2" SS WELL	102.85-118.2	INORG	Total Kjeldahl-	0.1		mg/L	U	WATER	17-May-95	A	
CPP 33-4	31320401NK	2" SS WELL	102.85-118.2	INORG	Total Kjeldahl-	0.1		mg/L	U	WATER	17-May-95	A	
CPP 33-4	31324401JN	2" SS WELL	102.85-118.2	INORG	Vanadium	0.0011		mg/L	BJ P	WATER	17-May-95	A	
CPP 33-4	31320401JN	2" SS WELL	102.85-118.2	INORG	Vanadium	0.0014		mg/L	BU P	WATER	17-May-95	A	
CPP 33-4	31324401JN	2" SS WELL	102.85-118.2	INORG	Zinc	0.0137		mg/L	B P	WATER	17-May-95	A	
CPP 33-4	31320401JN	2" SS WELL	102.85-118.2	INORG	Zinc	0.0076		mg/L	BEUJ P	WATER	17-May-95	A	
CPP 33-4	31320401JN	2" SS WELL	102.85-118.2	INORG	Zirconium	0.0313		mg/L	U P	WATER	17-May-95	A	
CPP 33-4	31324401AB	2" SS WELL	102.85-118.2	RAD	ALPHA	8.4	2.6	pCi/L		NWATER	17-May-95	A	
CPP 33-4	31320401AB	2" SS WELL	102.85-118.2	RAD	ALPHA	2.1	1.8	pCi/L	U	NWATER	17-May-95	A	
CPP 33-4	31324401A4	2" SS WELL	102.85-118.2	RAD	Am-241	0	0.04	pCi/L	U	NWATER	17-May-95	A	
CPP 33-4	31320401AB	2" SS WELL	102.85-118.2	RAD	BETA	505	6	pCi/L		NWATER	17-May-95	A	
CPP 33-4	31324401AB	2" SS WELL	102.85-118.2	RAD	BETA	491	7	pCi/L		NWATER	17-May-95	A	
CPP 33-4	31320401R4	2" SS WELL	102.85-118.2	RAD	Ce-144			pCi/L	U	NWATER	17-May-95	A	
CPP 33-4	31324401R4	2" SS WELL	102.85-118.2	RAD	Ce-144			pCi/L	U	NWATER	17-May-95	A	
CPP 33-4	31324401R4	2" SS WELL	102.85-118.2	RAD	Co-58			pCi/L	U	NWATER	17-May-95	A	
CPP 33-4	31320401R4	2" SS WELL	102.85-118.2	RAD	Co-58			pCi/L	U	NWATER	17-May-95	A	
CPP 33-4	31324401R4	2" SS WELL	102.85-118.2	RAD	Co-60			pCi/L	U	NWATER	17-May-95	A	
CPP 33-4	31320401R4	2" SS WELL	102.85-118.2	RAD	Co-60			pCi/L	U	NWATER	17-May-95	A	
CPP 33-4	31320401R4	2" SS WELL	102.85-118.2	RAD	Cs-134			pCi/L	U	NWATER	17-May-95	A	
CPP 33-4	31324401R4	2" SS WELL	102.85-118.2	RAD	Cs-134			pCi/L	U	NWATER	17-May-95	A	
CPP 33-4	31324401R4	2" SS WELL	102.85-118.2	RAD	Cs-137			pCi/L	U	NWATER	17-May-95	A	
CPP 33-4	31320401R4	2" SS WELL	102.85-118.2	RAD	Cs-137			pCi/L	U	NWATER	17-May-95	A	
CPP 33-4	31324401R4	2" SS WELL	102.85-118.2	RAD	Eu-154			pCi/L	U	NWATER	17-May-95	A	
CPP 33-4	31320401R4	2" SS WELL	102.85-118.2	RAD	Eu-154			pCi/L	U	NWATER	17-May-95	A	
CPP 33-4	31324401R4	2" SS WELL	102.85-118.2	RAD	Eu-155			pCi/L	U	NWATER	17-May-95	A	
CPP 33-4	31320401R4	2" SS WELL	102.85-118.2	RAD	Eu-155			pCi/L	U	NWATER	17-May-95	A	
CPP 33-4	31320401RI	2" SS WELL	102.85-118.2	RAD	I-129	0	0.3	pCi/L	U	NWATER	17-May-95	A	
CPP 33-4	31324401RI	2" SS WELL	102.85-118.2	RAD	I-129	0	0.3	pCi/L	U	NWATER	17-May-95	A	
CPP 33-4	31324401R4	2" SS WELL	102.85-118.2	RAD	Nb-95			pCi/L	U	NWATER	17-May-95	A	
CPP 33-4	31320401R4	2" SS WELL	102.85-118.2	RAD	Nb-95			pCi/L	U	NWATER	17-May-95	A	
CPP 33-4	31324401A4	2" SS WELL	102.85-118.2	RAD	Np-237	3.9	0.3	pCi/L		NWATER	17-May-95	A	
CPP 33-4	31324401R7	2" SS WELL	102.85-118.2	RAD	Pu-238	0.06	0.07	pCi/L	U	NWATER	17-May-95	A	
CPP 33-4	31324401R7	2" SS WELL	102.85-118.2	RAD	Pu-239/240	0	0.07	pCi/L	U	NWATER	17-May-95	A	
CPP 33-4	31320401R4	2" SS WELL	102.85-118.2	RAD	Ru-103			pCi/L	U	NWATER	17-May-95	A	
CPP 33-4	31324401R4	2" SS WELL	102.85-118.2	RAD	Ru-103			pCi/L	U	NWATER	17-May-95	A	
CPP 33-4	31320401R4	2" SS WELL	102.85-118.2	RAD	Ru-106			pCi/L	U	NWATER	17-May-95	A	

SAMPLE LOCATION	SAMPLE NUMBER	TYPE LOCATION	DEPTH (ft)	ANALYSIS	COMPOUND	CONC	RAD UNCERT	UNITS	Q FLAG	MATRIX	SAMPLE DATE	VAL LEVEL	NOTE
CPP 33-4	31324401R4	2" SS WELL	102.85-118.2	RAD	Ru-106			pCi/L	U	NWATER	17-May-95	A	
CPP 33-4	31320401R4	2" SS WELL	102.85-118.2	RAD	Sb-125			pCi/L	U	NWATER	17-May-95	A	
CPP 33-4	31324401R4	2" SS WELL	102.85-118.2	RAD	Sb-125			pCi/L	U	NWATER	17-May-95	A	
CPP 33-4	31324401RB	2" SS WELL	102.85-118.2	RAD	Sr-90	173	1	pCi/L		NWATER	17-May-95	A	
CPP 33-4	31320401EA	2" SS WELL	102.85-118.2	RAD	Sr-90	178	2	pCi/L		NWATER	17-May-95	A	
CPP 33-4	31324401EA	2" SS WELL	102.85-118.2	RAD	Sr-90	178	2	pCi/L		NWATER	17-May-95	A	
CPP 33-4	31320401RB	2" SS WELL	102.85-118.2	RAD	Sr-90	191	2	pCi/L		NWATER	17-May-95	A	
CPP 33-4	31324401RB	2" SS WELL	102.85-118.2	RAD	Tc-99	0.5	0.5	pCi/L	U	NWATER	17-May-95	A	
CPP 33-4	31324401EA	2" SS WELL	102.85-118.2	RAD	Tc-99	1.3	0.5	pCi/L		NWATER	17-May-95	A	
CPP 33-4	31320401EA	2" SS WELL	102.85-118.2	RAD	Tc-99	0.9	0.7	pCi/L	U	NWATER	17-May-95	A	
CPP 33-4	31320401RB	2" SS WELL	102.85-118.2	RAD	Tc-99	0.4	0.6	pCi/L	U	NWATER	17-May-95	A	
CPP 33-4	31324401R8	2" SS WELL	102.85-118.2	RAD	Tritium	971	143	pCi/L		NWATER	17-May-95	A	
CPP 33-4	31320401R8	2" SS WELL	102.85-118.2	RAD	Tritium	839	134	pCi/L		NWATER	17-May-95	A	
CPP 33-4	31324401R7	2" SS WELL	102.85-118.2	RAD	U-234	3.2	0.6	pCi/L		NWATER	17-May-95	A	
CPP 33-4	31324401R7	2" SS WELL	102.85-118.2	RAD	U-235	0	0.2	pCi/L	U	NWATER	17-May-95	A	
CPP 33-4	31324401R7	2" SS WELL	102.85-118.2	RAD	U-238	2.8	0.5	pCi/L		NWATER	17-May-95	A	

Appendix F

APPENDIX F:

WAG-3 VADOSE ZONE AND AQUIFER RI/FS CONTAMINANT SOURCE IDENTIFICATION AND FATE AND TRANSPORT MODELING RESULTS

ANNETTE L. SCHAFER
PETER MARTIAN
JAMES M. McCARTHY
THOMAS HONEYCUTT

OCTOBER 13, 1997

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1 VADOSE ZONE AND AQUIFER DATA SUMMARY

1.1 Section Overview and Purpose

There are two major WAG-3 subsurface modeling objectives. The first is to estimate contaminant fate and transport in support of the WAG-3 OU-3-13 (ICPP) Baseline Risk Assessment, and the second is to develop a simulation tool to help evaluate the effectiveness of remedial action alternatives with respect to the groundwater pathway. In order to satisfy the first objective, two subsurface flow and transport conceptual models have been devised and implemented. The first model presented is for the vadose zone, and the second model is for the aquifer. Numerical simulation results based on these conceptual models were obtained using TETRAD together with analytical/semi-analytical results and observed groundwater quality data to evaluate the risk from the predicted contaminant concentrations in the aquifer. TETRAD was chosen to be consistent with its use for the WAG-7 OU-7-13/14 RI/FS simulation effort (Becker et al, 1996). The theory and use of this code has been documented by Shook, 1995, Shook et al., 1991, Vinsome et al, 1993, and Schafer et al, 1997, and will not be reviewed here.

This section presents the data forming the basis of the conceptual models for both the vadose zone and aquifer models. For modeling purposes, the data are often analyzed in a very specific fashion. Thus, steps performed in the analysis of field data for both the aquifer and vadose zone models are presented here. Following presentation of the data, simplifications for the purpose of model prediction and the resulting conceptualization are discussed in Section 2. The following outlines the information presented in this Section:

- 1.1 Section Overview and Purpose
- 1.2 Components of the ICCP Surface and Subsurface
- 1.3 Stratigraphic Data
  - 1.3.1 Well Locations (Areal Information)
  - 1.3.2 Vadose Zone Interbed, Sediment, and Clay Lens Locations by Well (Vertical Profiles)
  - 1.3.3 Aquifer Interbeds and Primary Basalt Units
- 1.4 Measured Hydrologic Properties
  - 1.4.1 Unsaturated Hydraulic Conductivities
  - 1.4.2 Saturated Hydraulic Conductivities and Permeabilities
- 1.5 Locations of Perched Water and Water Sources
  - 1.5.1 Vadose Zone Wells (Either Dry or Showing Perched Water)
  - 1.5.2 Summary of Water Sources

1.2 Components of the ICCP Surface and Subsurface

The physical and hydrogeologic setting of the ICPP is highly complex, consisting of layered basalt and sediment units. In the vadose zone, the sedimentary units are often associated with relatively high water saturation, known as perched water zones. At the surface of the ICPP, there are large water sources that contribute to the formation of the perched water zones. In order to account for the subsurface sediments and basalts and for the surface water and contaminant sources, the conceptualization of the ICPP has been maintained as fully three-dimensional.

Figure 1-1 is a schematic representation of the vadose zone above the aquifer at the ICPP. Key points to note are that 1) the vadose zone consists of layered sedimentary interbeds and basalt units; 2) surface water sources are areally distributed as well as existing as point water sources (steam vents); 3) the Big Lost River bounds the ICPP to the north; 4) there are perched water bodies underlying several of the facilities at the ICPP; 5) there are distributed and point contaminant sources at the surface, in the perched water, and in the aquifer. What is not illustrated is that the TRA area exists to the north-west of the ICPP primary facilities as an additional potential contributor to the groundwater risk at the ICPP.

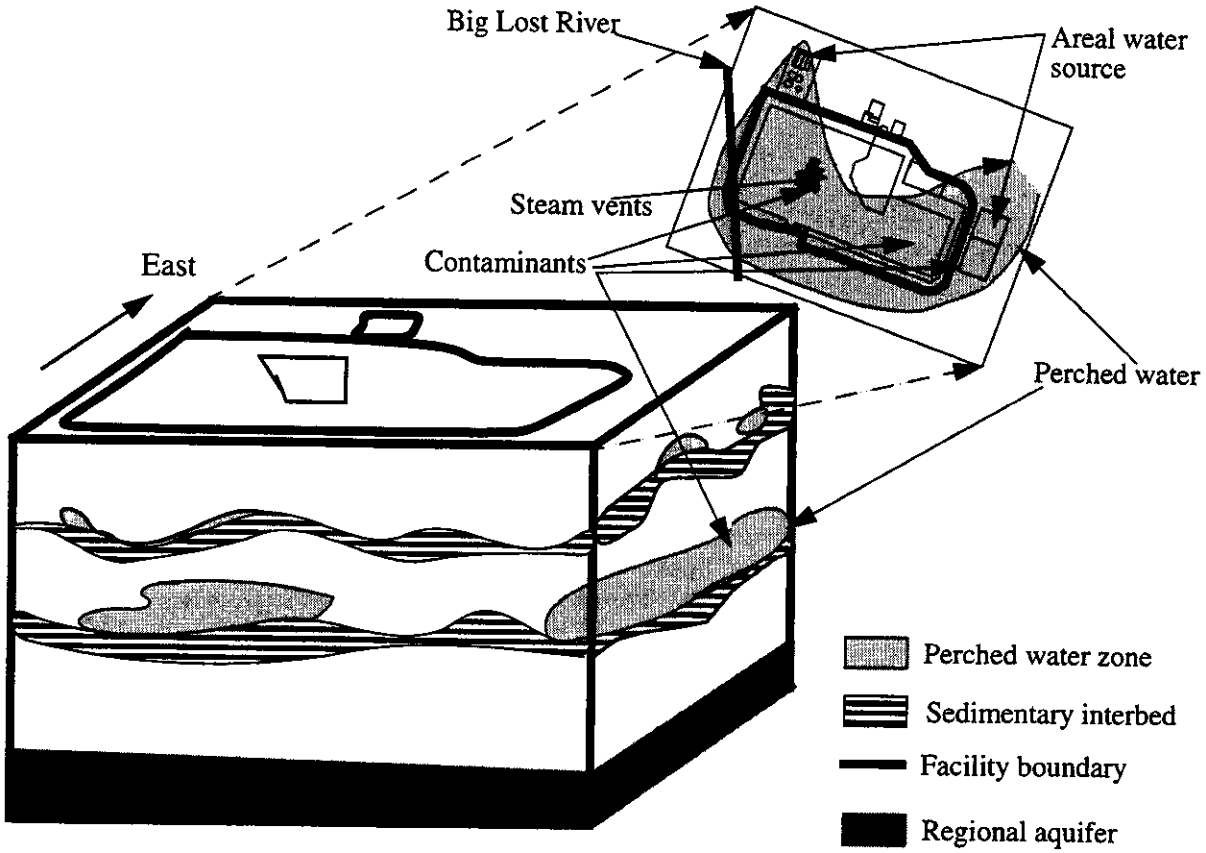


Figure 1-1 Schematic of ICPP with primary interbeds, perched water, and the aquifer.

Thus, the key components of the subsurface at the ICPP are 1) stratigraphy, 2) water sources, 3) perched water bodies, and 4) contaminant sources. These components exist in two distinct regions consisting of the vadose (unsaturated) and saturated (aquifer) zones. The following presents an analysis of these key components by region.

1.3 Stratigraphic Data

The geology of the vadose zone is fairly uniform areally, with the primary variability being exhibited in vertical profile. This can be seen by examining the stratigraphic logs for the wells that have been drilled in/through the vadose zone and aquifer regions. In addition, the variability can be seen by comparing the range of sediment permeability (two orders of magnitude) to the difference between sediment permeability and basalt permeability (five orders of magnitude). The permeability contrast necessitates the delineation of stratigraphy so that material properties can be assigned within a stratigraphic unit as opposed to trying to interpolate properties across stratigraphic boundaries. The following sections present a detailed analysis of the stratigraphic information from well logs and field measured hydraulic properties of stratigraphic units.

1.3.1 Well Locations (Areal Information)

Stratigraphy has been characterized at the ICPP through the use of wells. The locations of the 53 wells used to define the stratigraphy are shown in Figure 1-2. The wells range from shallow perched water wells to aquifer wells. The elevations of the interbeds in each well were obtained from the ICPP database created by

MSE, Inc. and currently maintained by LITCO. Logs for these wells have been analyzed for stratigraphic continuity as presented in the following section.

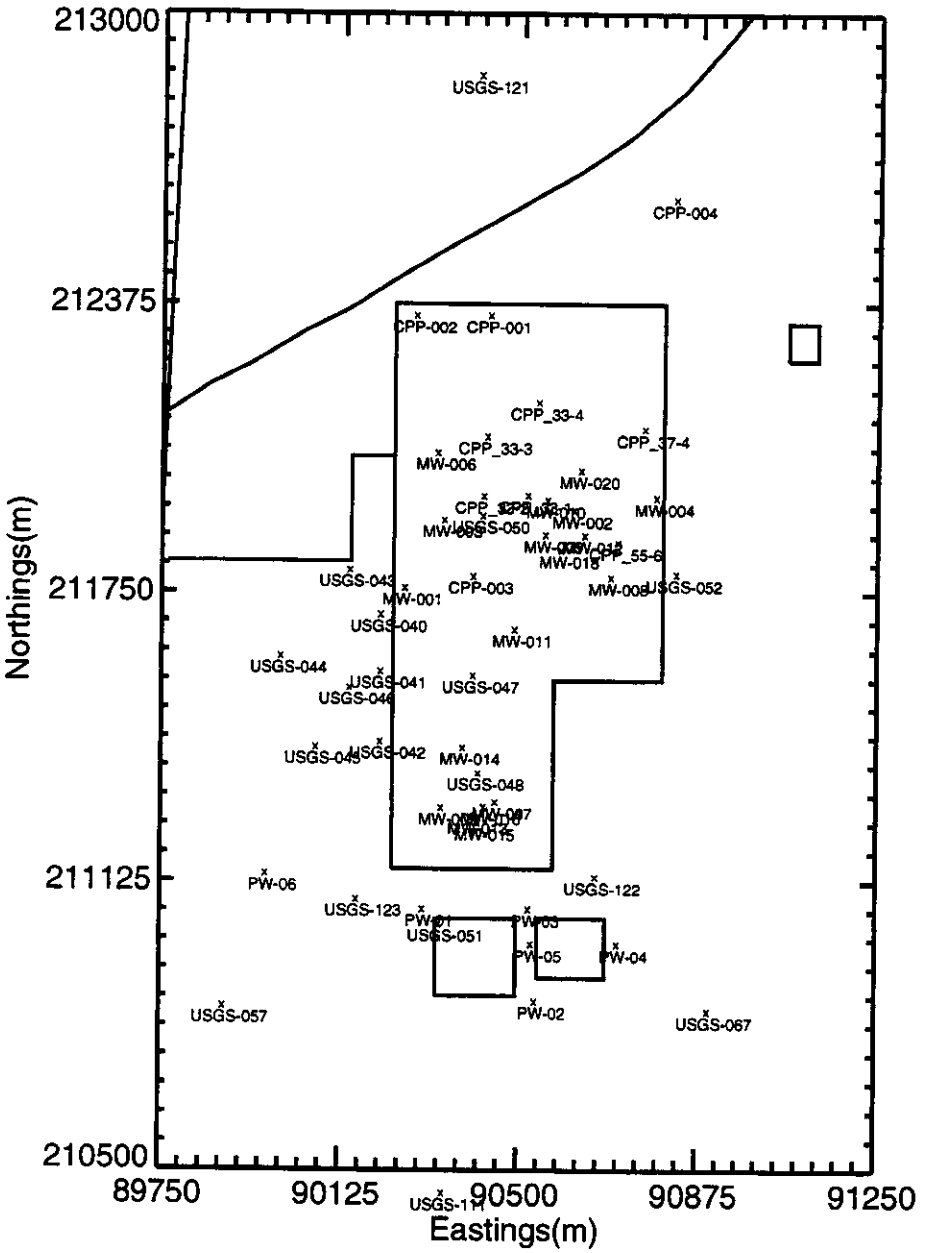


Figure 1-2 Wells used to define the vadose zone stratigraphy.

1.3.2 Vadose Zone Interbed, Sediment, and Clay Lens Locations by Well (Vertical Profiles)

There are 15 different interbed units to note below the ICPP as described in Anderson (1991). The first is the alluvium, followed by 13 interbeds, and the I basalt unit as listed in Column 1 of Table 1-1. Column 2 gives a numerical flag that is used in Figures 1-3 through 1-13 as an indicator of the stratigraphic unit. Column 3 contains the average depth to the top of the stratigraphic unit in feet below land surface. The B-D interbeds are relatively thin, closely grouped in depth, with the primary feature being the C-CD interbed. This primary

grouping is given in Column 4. Column 5 gives a grouping flag that is used in the numerical model and will be discussed in Section 2.2 in the context of model parameterization.

Table 1-1 Definition of stratigraphic units appearing in the ICPP vadose zone.

Stratigraphic Units in the ICPP Vadose Zone	Numerical Flag by Stratigraphic Unit	Average Depth to the top of Stratigraphic Unit	Primary Stratigraphic Unit	Model Layer
Alluvium	10	10	Ground surface	Alluvium
B BC	12	35	C CD	Upper 1 (U1)
BC C	15	95		
C CD	20	110		
CD D	25	130		
D DE2	30	140	D DE2	Upper2 (U2)
DE2 DE3	40	160		
DE3 DE3-4E	45	195	DE3-4E DE4	Middle (M)
DE3-4E DE4	50	225		
DE4 DE5	55	300		
DE5 DE6	60	365	DE5 DE6	Lower (L)
DE6 DE7	70	390		
DE7 DE8	80	410		
DE8 E	90	460		
I	95	>500	I Basalt Flow	I Basalt Flow (I)

Figures 1-3 through 1-13 contain a representation of the stratigraphy by well as a function of depth. The order in which these wells are presented is indicative of their relative position from the northern edge of the ICPP facilities (i.e., the wells were sorted by northing coordinate). In Figures 1-3 through 1-13, the vertical axis of each plot is thickness, and the horizontal axis is elevation. Presenting the stratigraphic depth in this way allows the figures to be viewed as a histogram of the thickness of each of the stratigraphic units. Each well has been plotted to a total elevation of 4300 ft. regardless of the penetration depth of the well. This has been done for ease in comparing the stratigraphic logs across the wells. The total penetration depth of the well is indicated by the continuous light-shaded region beginning at a total depth of 4300 ft., and extending upward to the bottom of the well (i.e., the well is in the unshaded region). Only the sediment units are represented, the basalt units existing between the sediment has not been explicitly presented.

In the plots for each well, the numbers down the center represent the numerical flag as listed in Column 2 of Table 1-1, indicating which stratigraphic unit exists at a particular depth. For example, between the elevations of 4482 and 4494 ft. in the USGS-111 well (Figure 1-3), the DE7-DE8 stratigraphic unit occurs, is 12 ft. thick, and is indicated by the "80" flag. Looking at these logs, it is apparent that there are several cases where a sediment unit of 90 appears at multiple depths within a given well. This occurs because the names are based on the basalt flow. These basalt flows were actual events that happened during several different time periods but are still considered to be the same event. The intermittent nature of the flow allowed the sediment associated with that flow to be deposited at different depths.

These logs also indicate those wells in which water has been found in the vadose zone. In many of these wells, there is not actually standing or flowing water, but water that appeared while drilling in the form of moist soil. In the wells showing moisture rather than standing water, the most probable depths of the water are indicated by question marks. Wells in which water was definitely found are represented by the "upside down" shaded areas denoted with a "w".

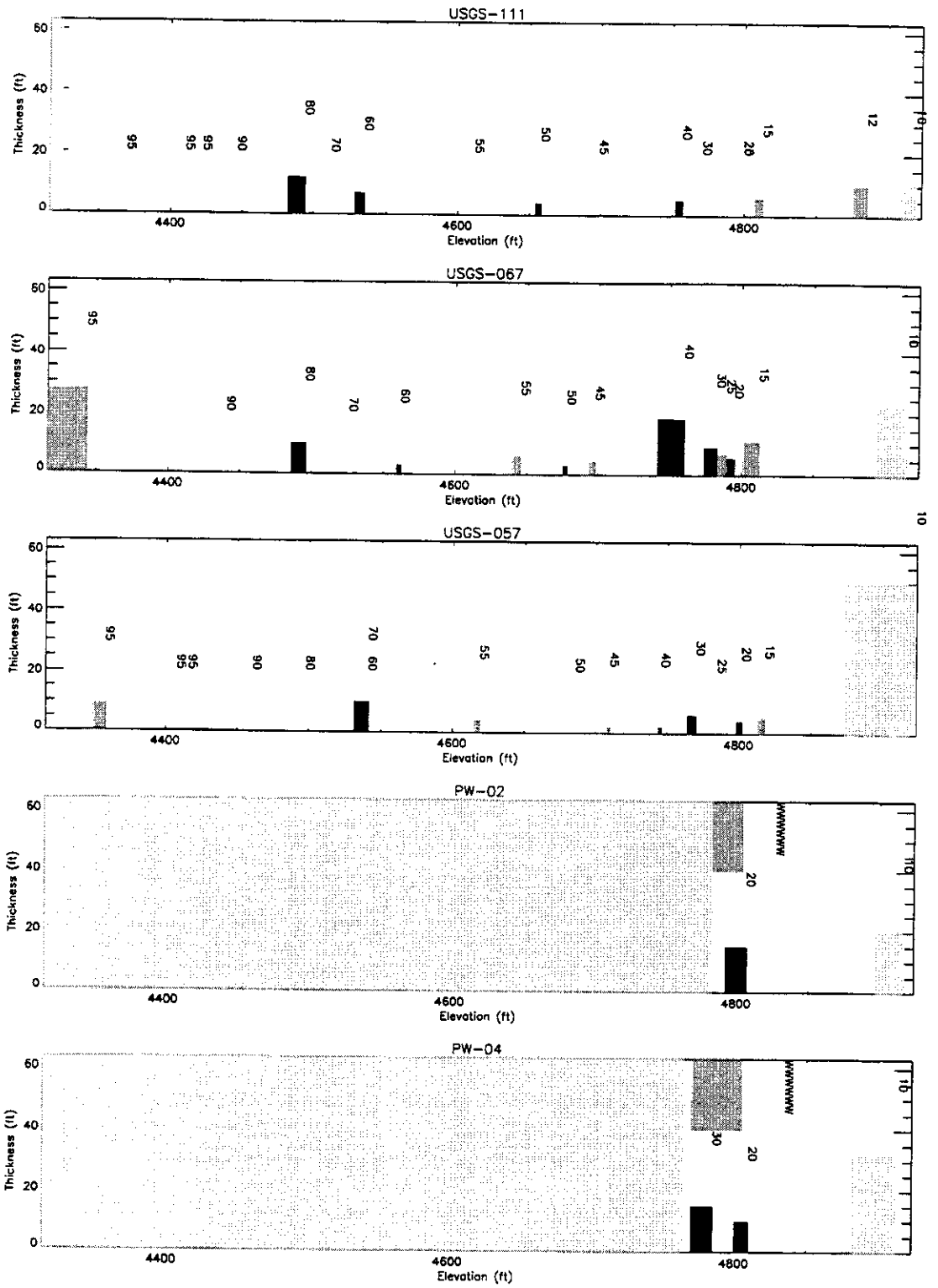


Figure 1-3 Stratigraphic log representation for wells USGS-111, USGS-067, USGS-057, PW-02, and PW-04. Locations for these wells can be found in Figure 1-2.

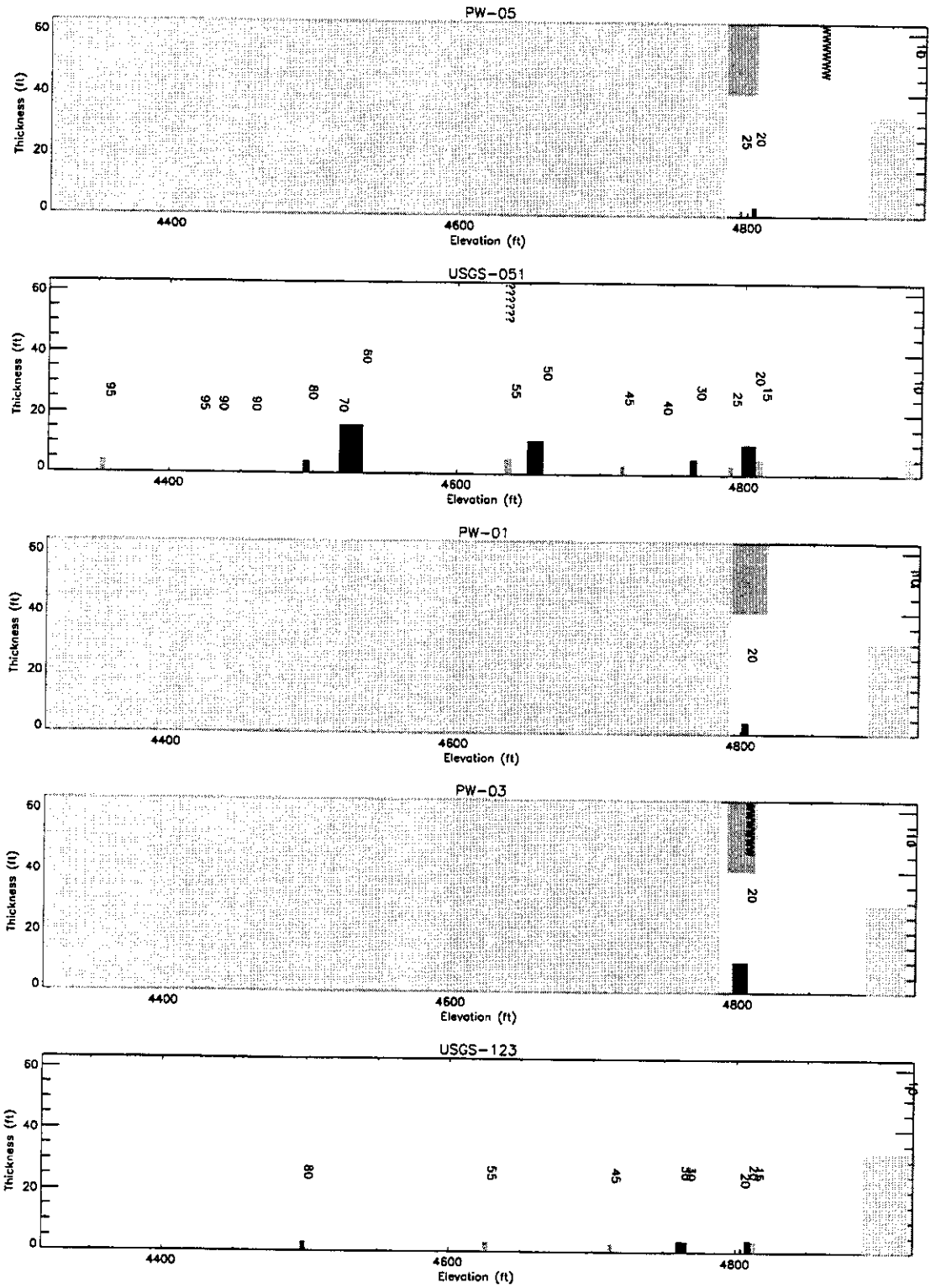


Figure 1-4 Stratigraphic log representation for wells PW-05, USGS-051, PW-01, PW-03, and USGS-123. Locations for these wells can be found in Figure 1-2.

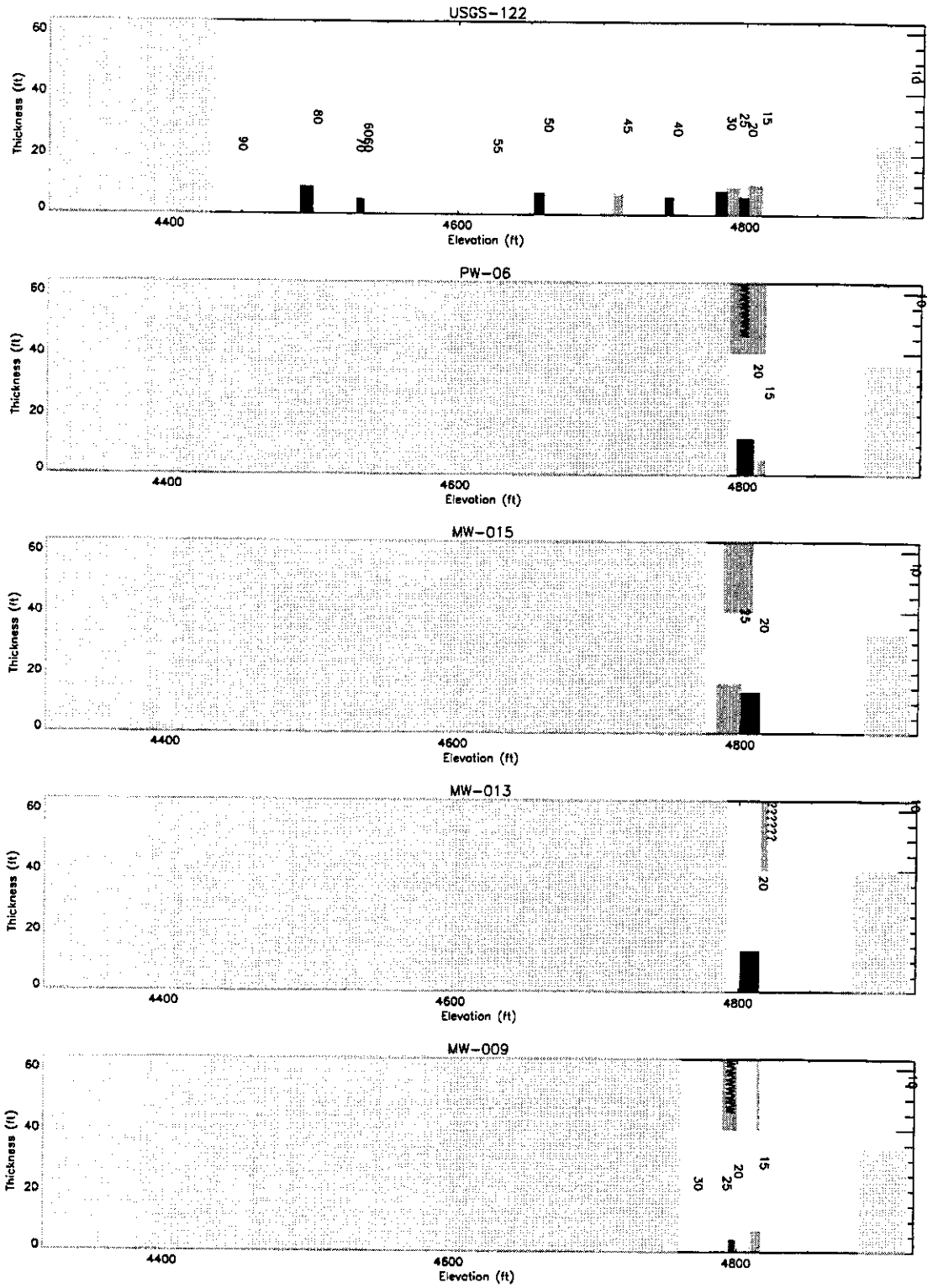


Figure 1-5 Stratigraphic log representation for wells USGS-122, PW-06, MW-015, MW-013, and MW-009. Locations for these wells can be found in Figure 1-2.

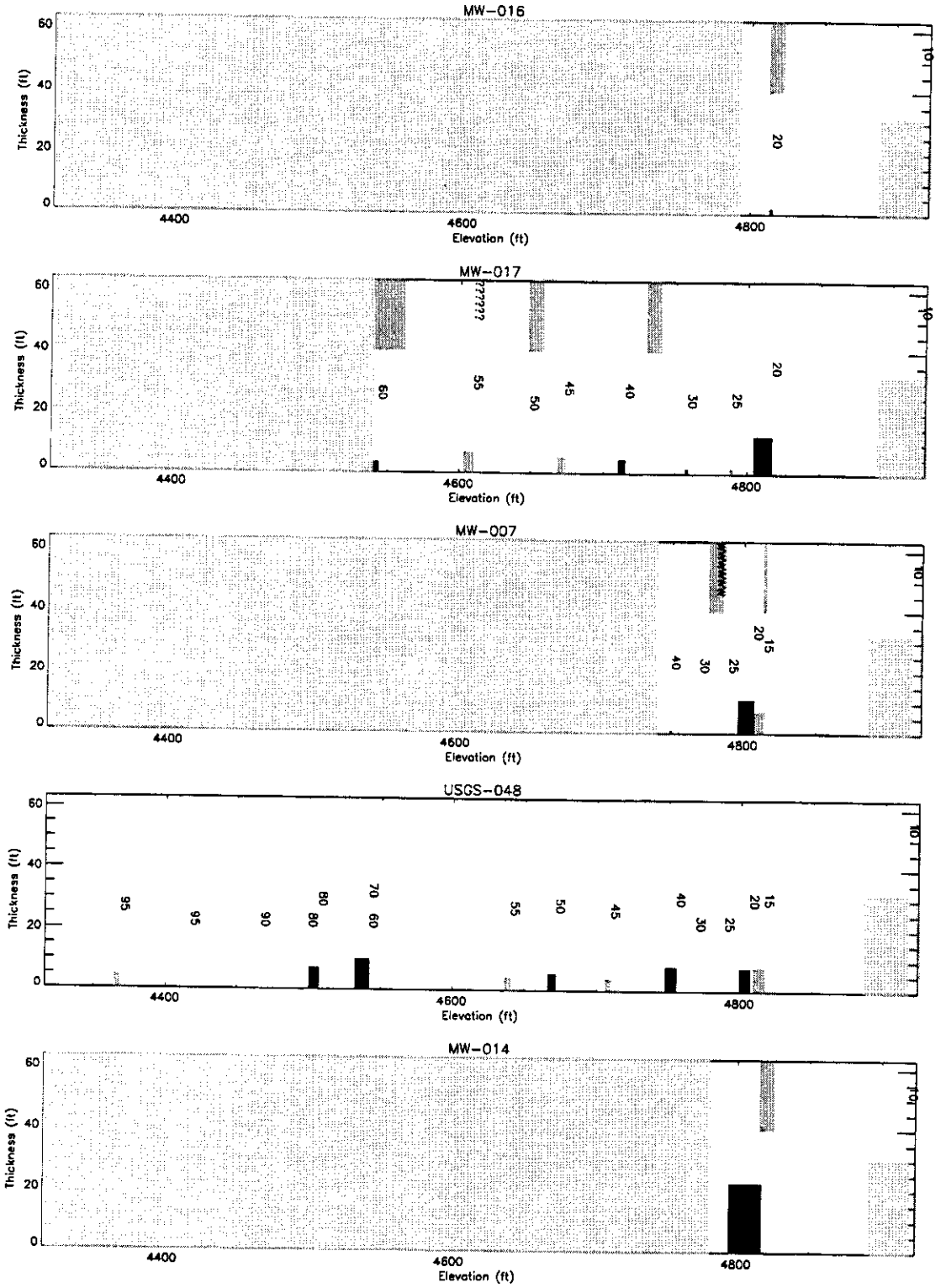


Figure 1-6 Stratigraphic log representation for wells MW-016, MW-017, MW-007, USGS-048, and MW-014. Locations for these wells can be found in Figure 1-2.

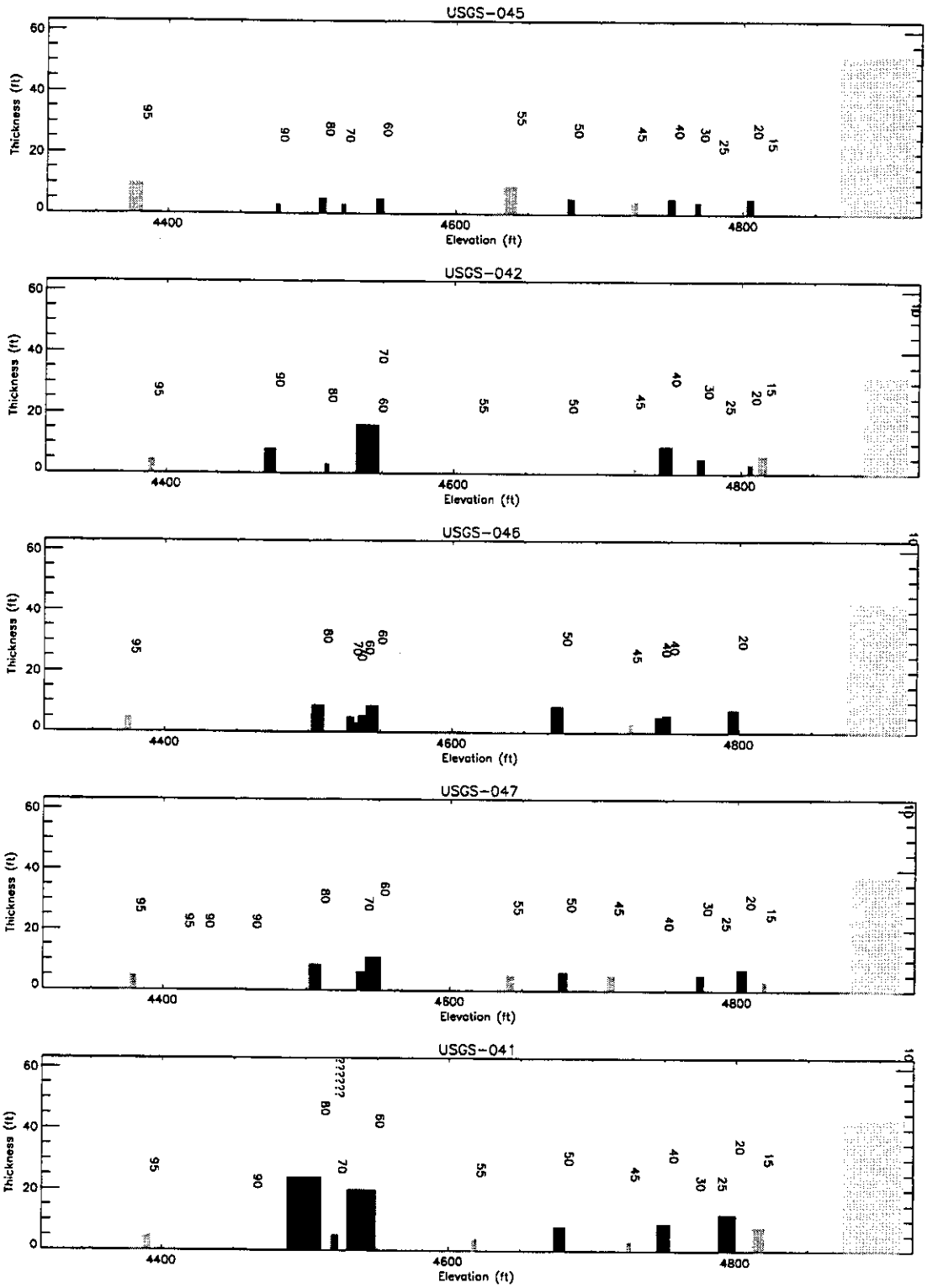


Figure 1-7 Stratigraphic log representation for wells USGS-045, USGS-042, USGS-046, USGS-047, and USGS-041. Locations for these wells can be found in Figure 1-2.

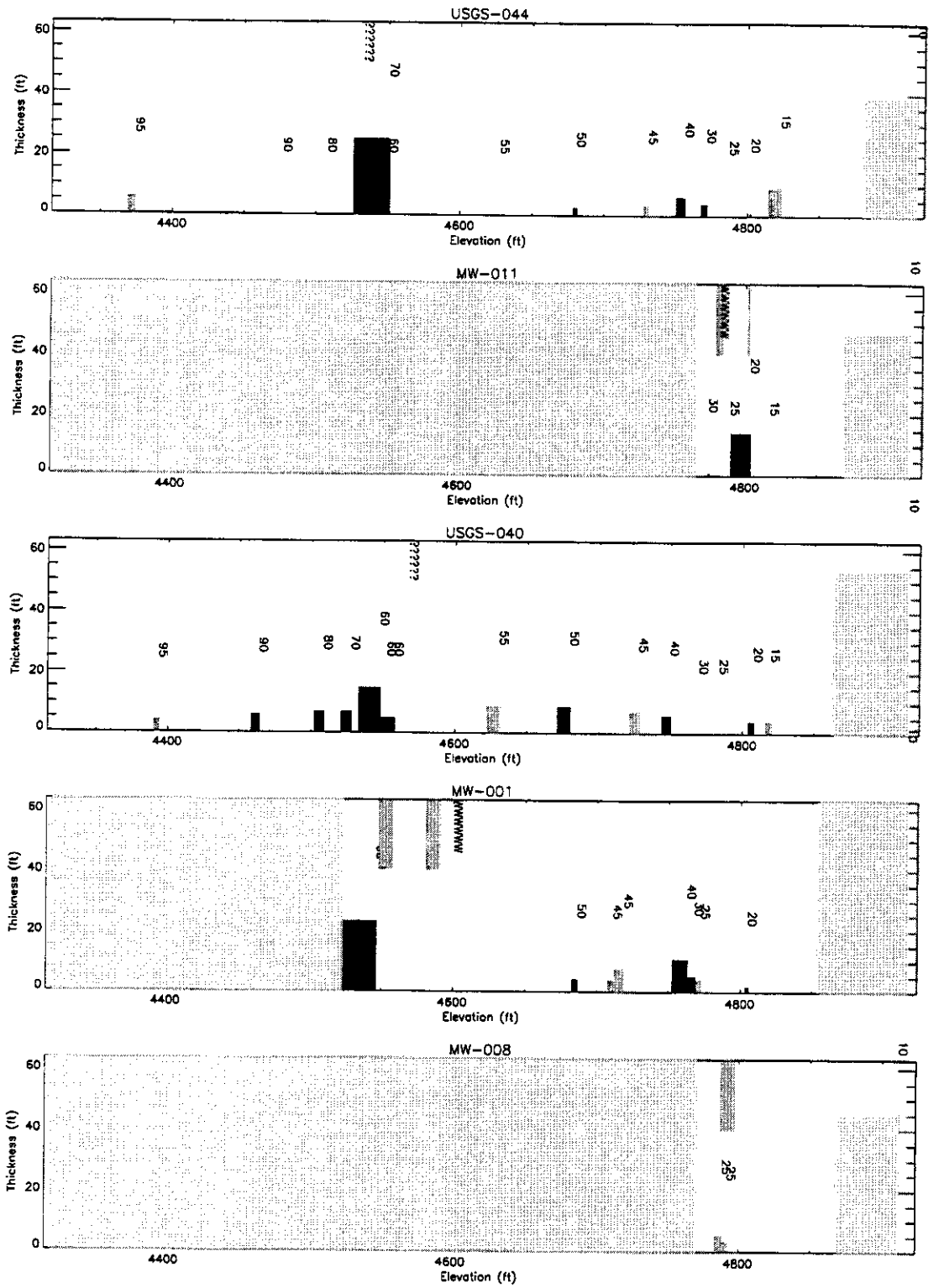


Figure 1-8 Stratigraphic log representation for wells USGS-044, MW-011, USGS-040, MW-001, and MW-008. Locations for these wells can be found in Figure 1-2.

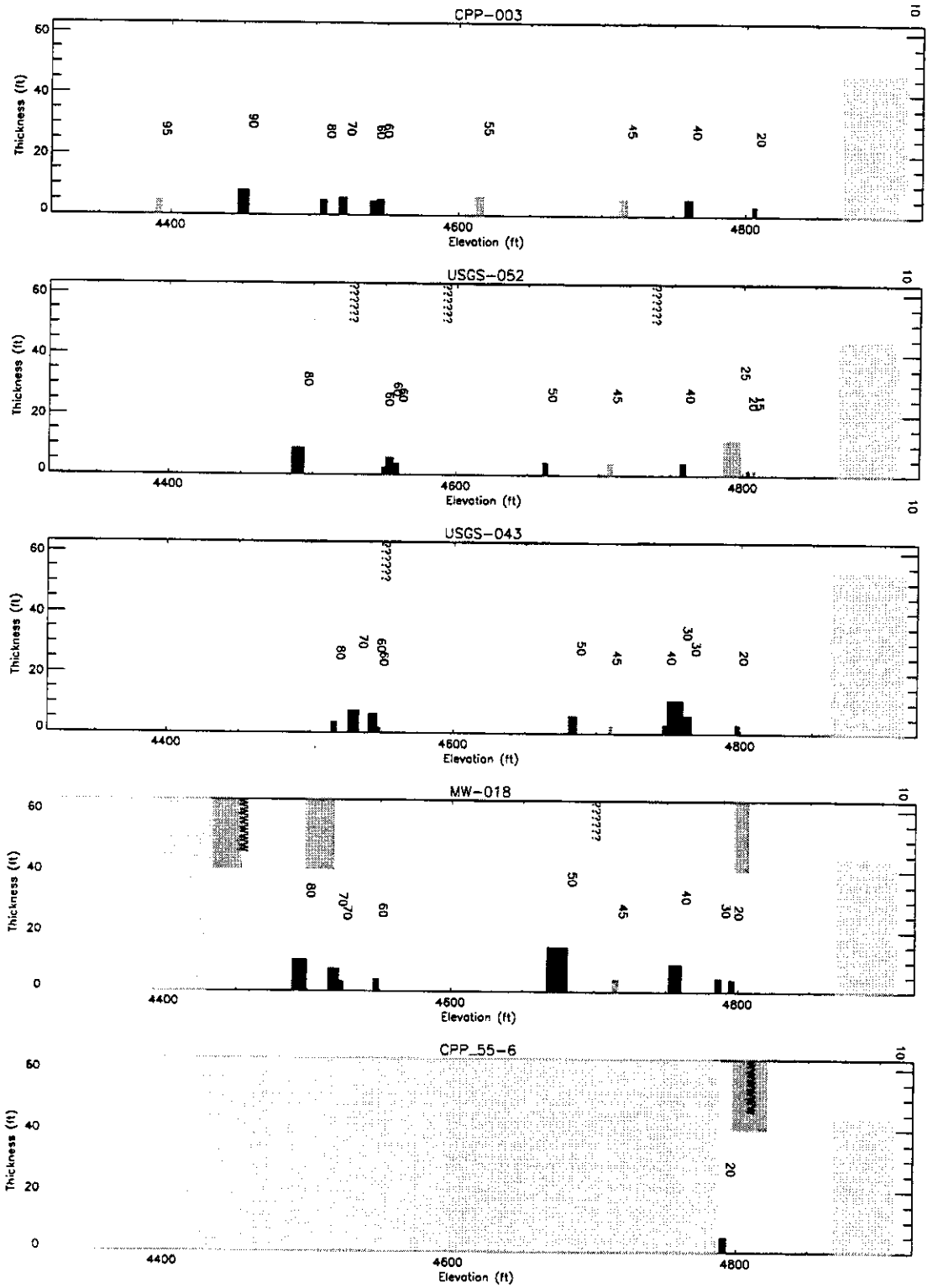


Figure 1-9 Stratigraphic log representation for wells CPP-003, USGS-052, USGS-043, MW-018, and CPP_55-6. Locations for these wells can be found in Figure 1-2.

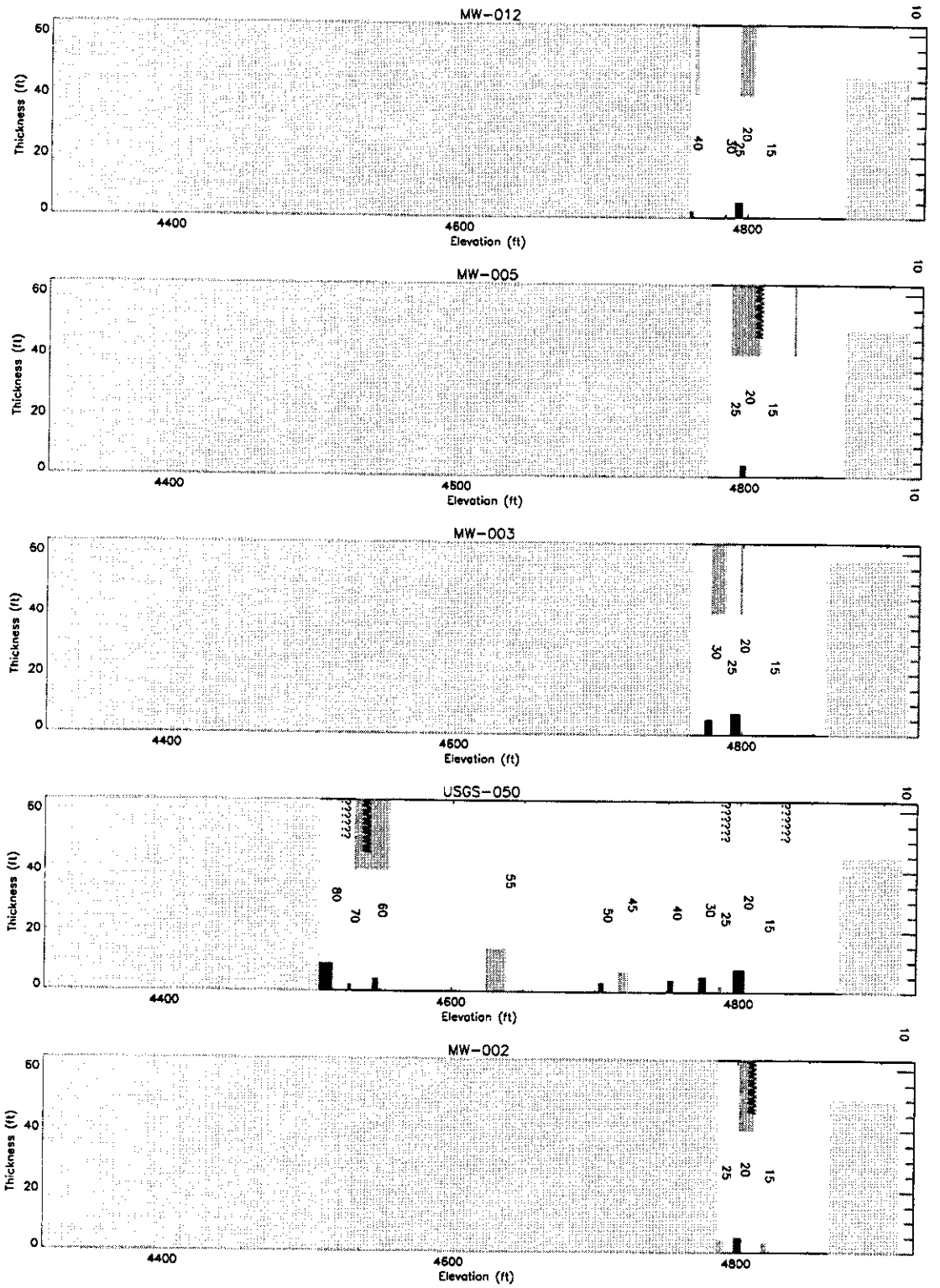


Figure 1-10 Stratigraphic log representation for wells MW-012, MW-005, MW-003, USGS-050 and MW-002. Locations for these wells can be found in Figure 1-2.

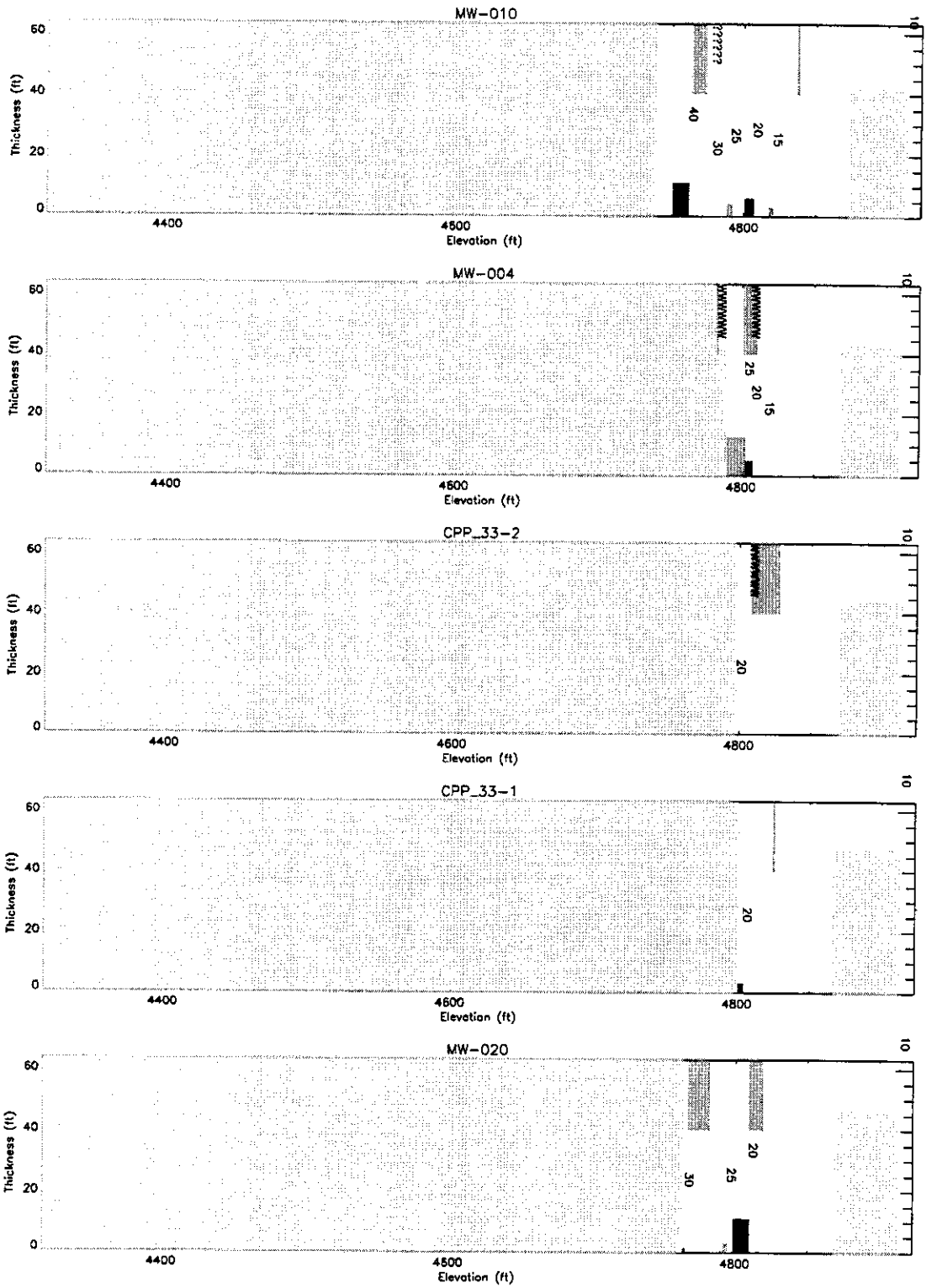


Figure 1-11 Stratigraphic log representation for wells MW-010, MW-004, CPP_33-2, CPP_33-1, and MW-020. Locations for these wells can be found in Figure 1-2.

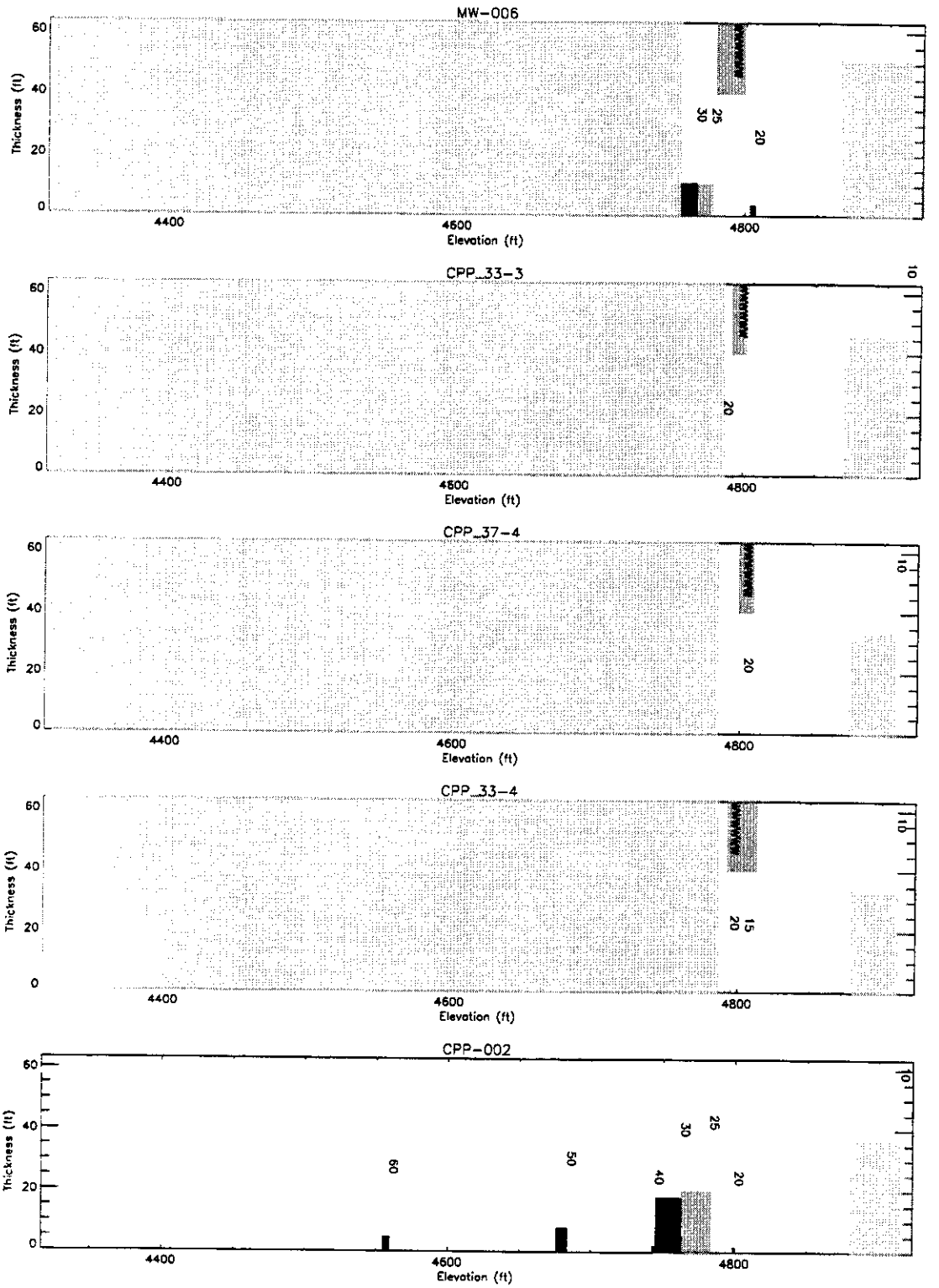


Figure 1-12 Stratigraphic log representation for wells MW-006, CPP_33-3, CPP_37-4, CPP_33-4, and CPP-002. Locations for these wells can be found in Figure 1-2.

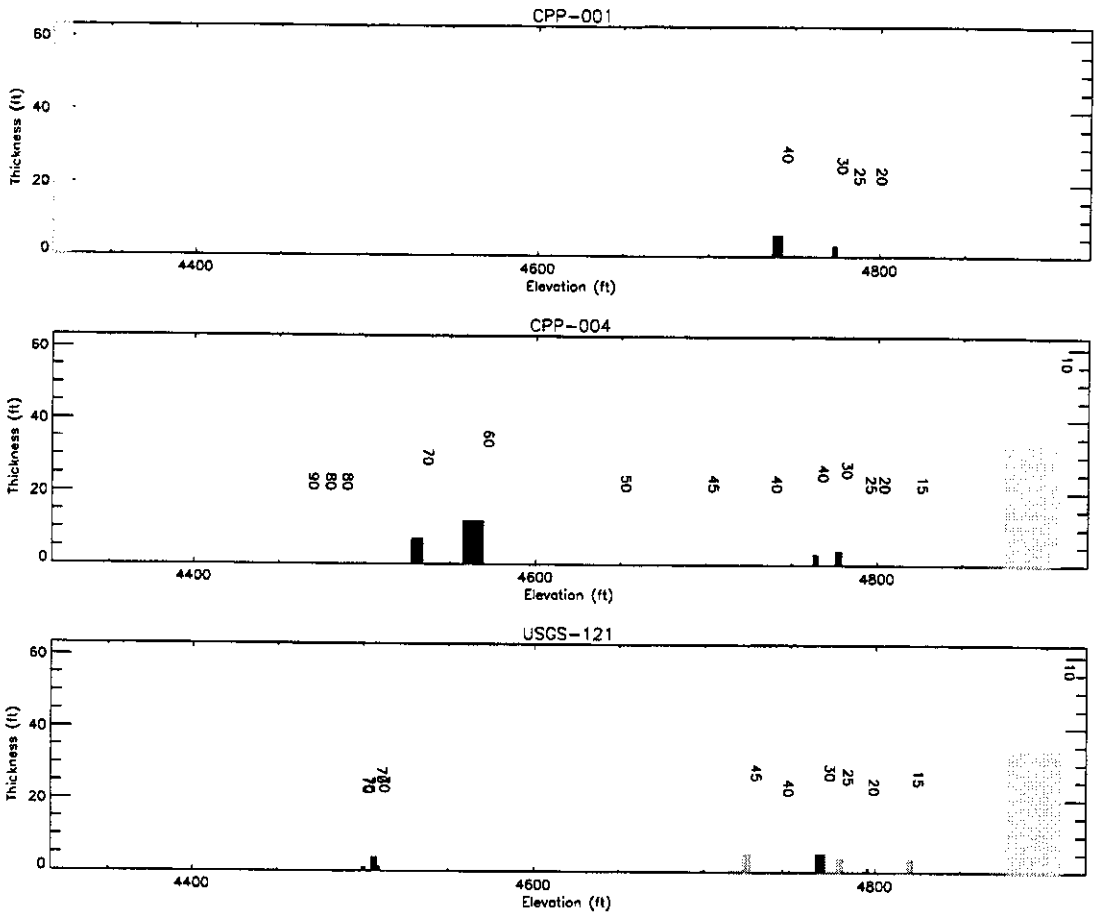


Figure 1-13 Stratigraphic log representation for wells CPP-001, CPP-004, and USGS-121. Locations for these wells can be found in Figure 1-2.

1.3.3 Aquifer Interbeds and Primary Basalt Units

USGS studies (Anderson, 1991) indicate that aquifer in the region north of the ICPP and extending south of the RWMC is comprised primarily of the H basalt flow, the HI interbed, and the lower I basalt flow. Based on the USGS report, the I basalt flow is significantly thicker and has a lower hydraulic conductivity than the H basalt flow. The HI interbed separates the two basalt flows. The tops of the H and I basalt flows are fairly well known, however, there is little information on the HI interbed top and thickness. The bottom of the I basalt flow extends below the region of interest in this report.

The top of the I basalt flow is contoured in Figure 1-14. Note that the I basalt flow extends to the ground surface near the TRA facilities, and then drops below the ICPP and RWMC facilities.

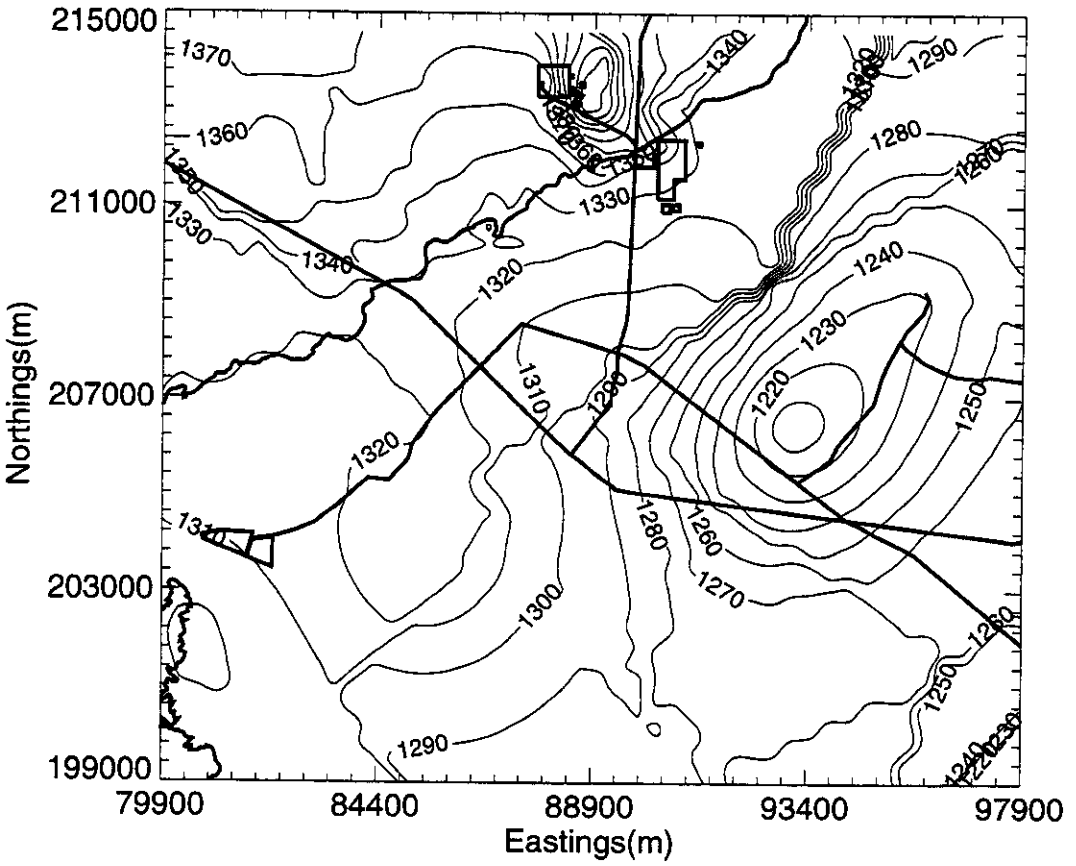


Figure 1-14 Top elevation in meters of the I basalt flow.

1.4 Measured Hydrologic Properties

Hydrologic properties for both the vadose zone and aquifer are presented in the work plan. A summary of these values is presented below without a discussion of the pumping rates, durations, or test analysis

1.4.1 Unsaturated Hydraulic Conductivities

Tables 1-2, 1-3, and 1-4 are simply reproductions of Tables 2-11, 2-12 and 2-13 (pages 2-91, 2-92, and 2-94) from the work plan (Lockheed, 1995).

Table 1-2 Results of perched water aquifer tests at the ICPP (work plan Table 2-11).

Well	Test Zone (ft bls)	Test Type	Material	Hydraulic Conductivity cm/sec	Hydraulic Conductivity ft/day	Permeability mDarcy
CPP33-2	97.8-105.8	Pumping/Recovery	Basalt	$1.8x10^{-3}$	$5.0x10^{0}$	1.9e+03
CPP33-3	111.2-121.8	Pumping/Recovery	Basalt	$9.5x10^{-4}$	$2.7x10^{0}$	9.9e+02
CPP33-4	103.7-118.2	Pumping/Recovery	Basalt	$2.4x10^{-3}$	$6.9x10^{0}$	2.5e+03
CPP33-4	103.7-118.2	Pumping/Recovery	Basalt	$3.4x10^{-3}$	$9.6x10^{0}$	3.5e+03
CPP55-6	105.2-113.1	Pumping/Recovery	Basalt	$4.2x10^{-4}$	$1.2x10^{0}$	4.4e+02
MW-1	326-336	Slug	Basalt	$2x10^{-4}$	$5.67x10^{-1}$	2.1e+02
MW-2	107.9-112	Slug	Sandy clay interbed	$3.7x10^{-3}$ (average)	$5.1x10^{0}$	3.8e+03
MW-4	104.6-110.6	Slug	Silty sand and gravel interbed	$3.86x10^{-5}$	$1.09x10^{-1}$	4.0e+01
MW-5	115-129.5	Slug	Basalt with small sandy clay interbeds	$1.08x10^{-3}$	$3.06x10^{0}$	1.1e+03
MW-6	140-151	Slug	Silty sand, fine grained interbed	$1.3x10^{-3}$ (average)	$3.72x10^{0}$	1.4e+03

Table 1-3 Results of laboratory analysis on core samples collected during drilling of perched water wells at the ICPP (work plan Table 2-12).

Sample Number	Well	Interbed	Soil Type	Depth	Initial Moisture Content		Dry Bulk Density	Calculated Porosity	K_{sat}	k_{sat}
			Log books	(feet)	(%, g/g)	(%, cc/cc)	(g/cc)	(%)	(cm/sec)	(mDarcy)
3PG10701PR	MW-3	C CD	silty clay	117-119.3	32.8	42.5	1.29	52.5	8.9E-05	9.3e+01
3PG11001PR	MW-4	C CD	silty sand and gravel	108-109.3	35.9	49.2	1.37	50.2	1.6E-05	1.7e+01
3PG11901PR	MW-7	C CD	silt with fine gravel	113.5-114.5	22.7	32.5	1.44	47.0	1.3E-03	1.4e+03
3PG12201PR	MW-8	C CD	clay with silt	122.3-123.7	28.0	42.2	1.51	45.0	1.1E-05	1.1e+01
3PG12801PR	MW-10	C CD	sandy silt	110.3-111	39.5	50.2	1.27	54.0	1.0E-05	1.0e+01
3PG13101PR	MW-11	C CD	silty sand	113.7-115.3	29.5	43.7	1.48	45.9	1.2E-05	1.2e+01
MW-4 (105.1-105.6)	MW-4	C CD	silt	105.1-105.6	43.8	51.4	1.18	57.6	3.2E-05	3.3e+01
MW-4 (105.6-106.8)	MW-4	C CD	silt	105.6-106.8	50.8	56.8	1.12	60.9	6.7E-05	7.0e+01
3PG11601PR	MW-6	C CD	clay	110-111	33.4	48.3	1.45	47.8	3.0E-07	3.1e-01

Table 1-3 Results of laboratory analysis on core samples collected during drilling of perched water wells at the ICPP (work plan Table 2-12).

Sample Number	Well	Interbed	Soil Type	Depth	Initial Moisture Content		Dry Bulk Density	Calculated Porosity	K_{sat}	k_{sat}
			Log books	(feet)	(%, g/g)	(%, cc/cc)	(g/cc)	(%)	(cm/sec)	(mDarcy)
3PGI2501PR	MW-9	C CD	clay with silt	111.6-112.5	28.8	30.1	1.05	61.4	2.1E-03	2.2e+03
3PG13201PR	MW-11	D-DE2	clay	135.4-136	18.1	33.2	1.83	33.6	5.2E-08	5.4e-02
3PG10801PR	MW-3	D-DE2	silty clay	138-139	21.6	30.9	1.43	47.2	8.3E-04	8.6e+02
3PG11701PR	MW-6	DE2-D E3	silty sand	142-143	22.4	30.6	1.36	49.5	2.2E-03	2.3e+03
3PG12601PR	MW-9	DE2-D E3	silt with clay	148.7-149.4	9.5	12.7	1.34	50.3	3.4E-03	3.5e+03
3PG10101PR	MW-1	DE3-4E DE4	sand with silt	231.7-232.3	15.7	24.8	1.59	41.3	3.3E-04	3.4e+02

Table 1-4 Comparison of means for physical properties data from ICPP, TRA, and RWMC (work plan Table 2-13)

Interbed or INEL Facility	Approx. Depth	Ksat	Dry Bulk Density	Porosity	Van Genuchten Parameters				r^2
					Sat. Water Content	Res. Water Content	Alpha	n	
	(ft)	(cm/sec)	(g/cc)						
C Interbed (ROV)	110	3.7E-05 (3.0E-07-2.1E-03) (3.8e+01 mDarcy)	1.33 (1.05-1.51)	50.9 (45.0 -61.4)	0.50 (0.43-0.64)	0 --	0.0025 (0.00012-.25)	1.43 (1.12-2.70)	0.96 (0.88-1.00)
D Interbed (ROV)	140	1.3E-04 (5.2E-08-3.4E-03) (1.4e+02 mDarcy)	1.48 (1.34-1.83)	44.6 (33.6-50.3)	0.46 (0.36 -0.55)	0.0036 (0.00-0.82)	0.24 (0.0021-0.078)	1.63 (1.20 -2.71)	0.97 (0.95-0.99)
Deep Interbed (ROV)	230	3.3E-04 - (3.4e+02 mDarcy)	1.59 -	41.3 -	0.43 -	0.041 -	0.052 -	1.29 -	0.99
TRA (ROV)	-	1.4E-06 (1.7E-08 -1.4E-03) (1.5e+00 mDarcy)	1.66 (1.24-2.13)	38.4 (20.4-54.8)	0.42 (0.31-0.57)	- -	- -	- -	- -
RWMC (ROV)	- -	7.6E-05 - (7.9e+01 mDarcy)	- -	- -	0.48 -	0.10 -	0.012 -	1.36 -	- -

ROV = Range Of Values

- = no value

1.4.2 Saturated Hydraulic Conductivities and Permeabilities

Aquifer tests in the vicinity of the ICPP have been summarized in Ackerman, (1991). Table 1-5 below is a reproduction of Table 2 15 from the work plan, included to summarizes the results of those tests. Column 6 has been added in Table 1-5 to indicate the type of stratigraphic unit sampled in the test. The Ackerman report did not calculate either the hydraulic conductivity or permeabilty, but simply reported the transmissivity. The

permeability and hydraulic conductivity were estimated in the Workplan from current saturated thicknesses that may not be equal to those present during the pumping tests.

Table 1-5 Transmissivities determined from aquifer tests performed in the vicinity of the ICPP (Ackerman 1991) and estimates of hydraulic conductivity (2-15).

Well Identifier	Transmissivity	Saturated Thickness	Hydraulic Conductivity	Permeability	Stratigraphic Unit
	(ft./day)	(ft.)[a]	(ft./day)	(mDarcy)	
CPP-1	$7.3x10^4$	150	$4.9x10^2$	1.8e+05	I basalt flow
CPP-2	$1.6x10^5$	75	$2.1x10^3$	7.7e+05	I basalt flow
CPP-3	$7.6x10^5$	74	$1.0x10^4$	3.7e+06	I basalt flow
CPP-4	$2.5x10^2$	255	$9.8x10^{-1}$	3.6e+02	HI interbed and I basalt flow
USGS-37	$1.6x10^4$	65	$2.5x10^2$	9.2e+04	H basalt flow
USGS-40	$8.7x10^4$	27	$3.2x10^3$	1.2e+06	HI interbed and I basalt flow
USGS-43	$8.0x10^4$	225	$3.6x10^2$	1.3e+05	HI interbed and I basalt flow
USGS-51	$2.9x10^3$	184	$1.6x10^1$	5.9e+03	HI interbed and I basalt flow
USGS-57	$2.8x10^4$	255	$1.1x10^2$	4.0e+04	HI interbed and I basalt flow
USGS-82	$5.6x10^4$	100	$5.6x10^2$	2.1e+05	I lower HI upper
USGS-111	$2.2x10^1$	137	$1.6x10^{-1}$	5.9e+01	?
USGS-112	$6.4x10^4$	96	$6.7x10^2$	2.5e+05	?
USGS-113	$1.9x10^5$	97	$2.0x10^3$	7.3e+05	?
USGS-114	$1.0x10^1$	100	$1.0x10^{-1}$	3.7e+01	?
USGS-115	$3.2x10^1$	123	$2.6x10^{-1}$	9.5e+01	?
USGS-116	$1.5x10^2$	127	$1.2x10^0$	4.4e+02	?
Maximum	**$7.6x\ 10^5$**		**$1.0x10^4$**	**3.7e+06**	
Minimum	**$1.0x10^1$**		**$1.0x10^{-1}$**	**3.7e+01**	
Average S.D.	**$9.5x10^4$**		**$1.3x10^3$**	**4.8e+05**	
	$1.9x10^5$		**$2.6x10^3$**	**9.5e+05**	

a. Saturated thickness values are the total saturated portion of the open well intervals.

Spatial variability of the data presented in Table 1-5 is graphically represented as the kriged contours appearing in Figure 1-15.

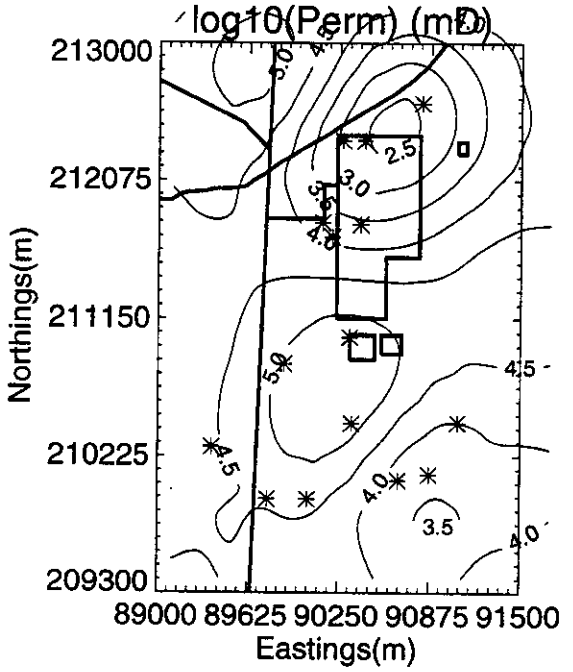


Figure 1-15 ICPP permeability computed from transmissibilities for the aquifer region.

The permeability estimates from these primarily local-scale aquifer tests range over five orders of magnitude. The minimum hydraulic conductivity is 0.03 m/day (0.1 ft/day), and the maximum is 3,000 m/d (10,000 ft/day). The average hydraulic conductivity value is about 400 m/day (1,300 ft/day). Note that the extreme range in values is due primarily to sampling above, across and below the HI interbed. Values above the HI interbed are probably much higher, and in the range of 15 m/day (4.9 ft/day). Similar plots have not been presented for the hydraulic properties of the vadose zone sediments because of limited data.

1.5 Locations of Perched Water and Water Sources

At the ICPP, there are regions of high water saturation in the interbeds throughout the vadose zone. These regions are referred to as perched water. Formation of perched water regions at the ICPP is caused by a constant influx of large volumes of water from the surface. Wells in which perched water have been measured, vadose zone wells in which no perched water has been measured, and surface sources of the water are presented below.

1.5.1 Vadose Zone Wells (Either Dry or Showing Perched Water)

Thirty-two perched water wells were used to define the extent of the perched water bodies. Many of these wells have multiple completions, resulting in 46 measurement points for the ICPP vadose zone. Of the 46 measurement points, 27 have measured perched water and 19 have been dry. Figure 1-16 shows the locations of all the perched water wells that have at least one wet interval, and Figure 1-17 gives the locations for the dry wells. In those figures, the letters at the end of the well name indicate the effective interbed in which the well is completed. Tables 1-6 and 1-7 list the perched water wells that are wet and dry along with the initial steady state calibration elevations (Columns 6 and 7 in Table 1-6) for the perched water.

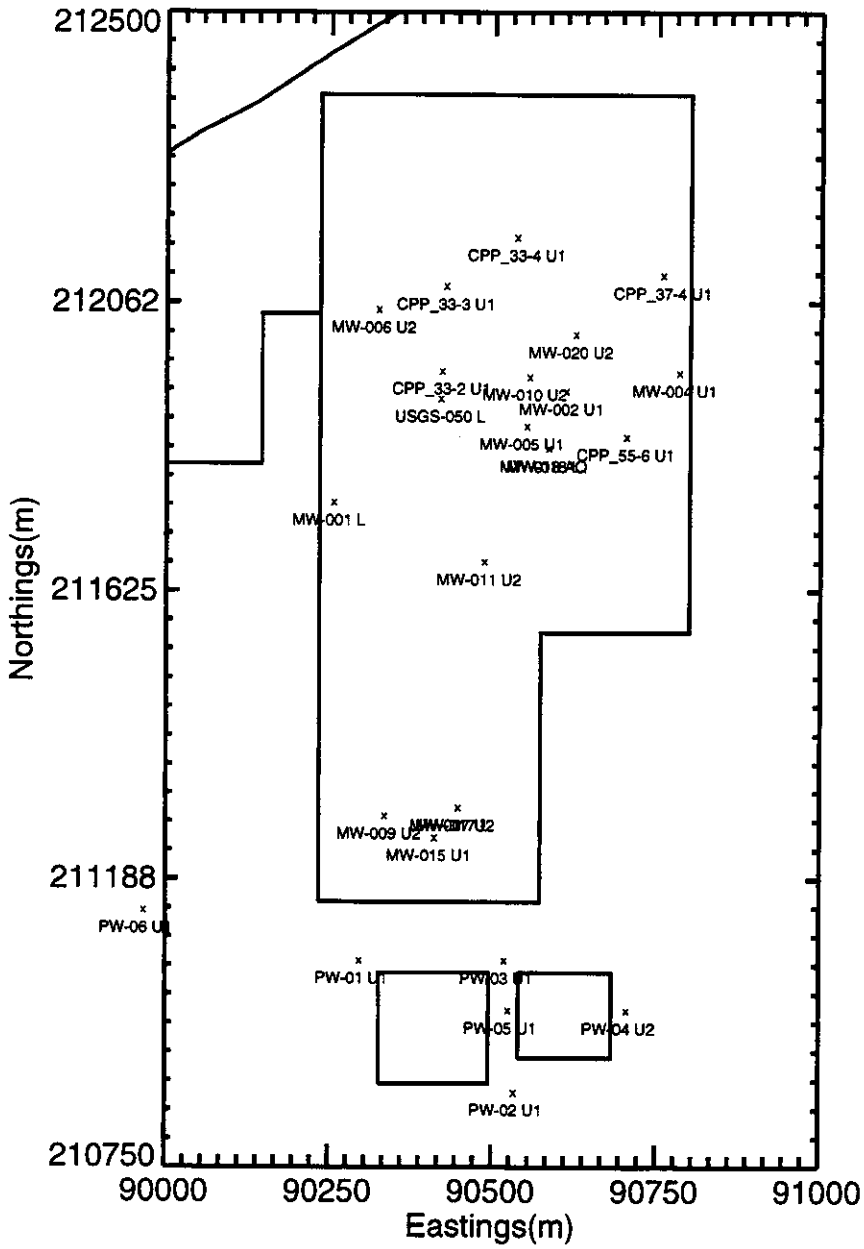


Figure 1-16 ICPP well map for the wells where perched water has been measured at least one elevation.

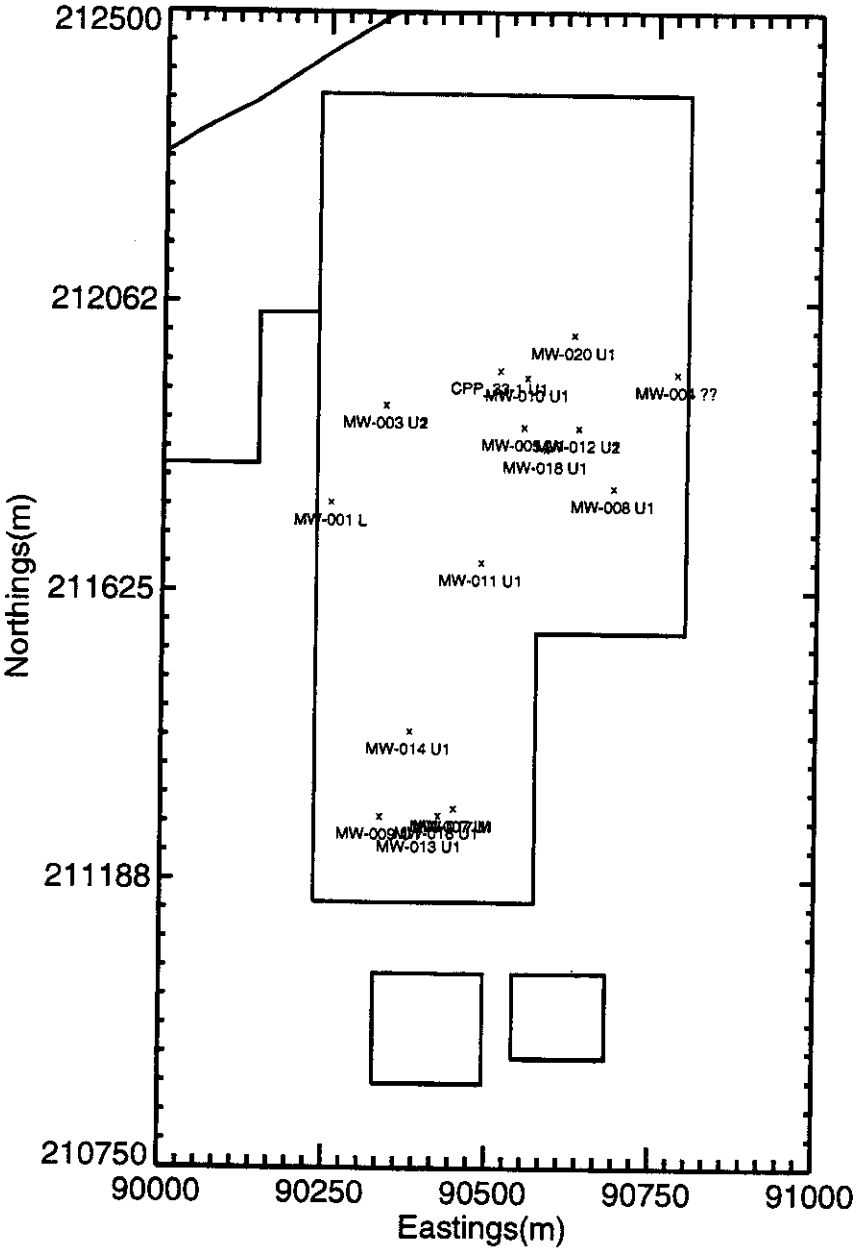


Figure 1-17 ICPP well map for the wells with dry interbeds.

Table 1-6 Wet perched water wells.

Official Name	Easting (m)	Northing (m)	Screen Bottom Elevation (m)	Interbed Flag	Average Water Level (m)	Average Water Level (ft)	Comments
MW-001	90251.2	211754.3	1396.1	L	1402.1	4600.0	hydrograph available
MW-002	90605.8	211923.4	1463.4	U1	1464.9	4806	hydrograph available
MW-004	90778.3	211951.1	1463.3	U1	1464.9	4806.00	intermittent
MW-005	90545.6	211870.0	1460.0	U1	1464.9	4806.00	hydrograph available
MW-006	90318.9	212047.0	1456.8	U2	1461.8	4796.00	hydrograph available
MW-007	90442.6	211290.6	1455.5	U2	1456.6	4779.00	spot measurements
MW-009	90330.1	211278.3	1459.9	U2	1460.3	4791.0	spot measurements
MW-010	90549.7	211945.0	1452.0	U2	1453.9	4770.00	spot measurements
MW-011	90481.5	211664.3	1458.1	U2	1457.9	4783.00	spot measurements -some-times dry
MW-015	90406.5	211245.2	1459.3	U1	1461.9	4796.40	only one measurement
MW-017	90442.6	211290.6	1440.7	U2	1441.0	4727.80	only one measurement
MW-017	90442.6	211290.6	1383.0	L	1388.1	4554.00	only one measurement
MW-018	90579.1	211836.4	1371.6	L	1373.7	4507.00	only one measurement
MW-018	90579.1	211836.4	1351.8	aquifer	1356.7	4451.00	only one measurement
MW-020	90620.0	212009.4	1452.9	U2	1457.3	4781.00	hydrograph available
USGS-050	90413.9	211911.7	1381.3	L	1381.7	4533.00	hydrograph available
CPP_33-2	90415.6	211953.7	1465.6	U1	1468.2	4817.00	hydrograph available
CPP_33-3	90421.9	212082.0	1460.6	U1	1462.7	4799.00	hydrograph available
CPP_33-4	90529.6	212155.5	1461.1	U1	1466.7	4812.00	hydrograph available
CPP_37-4	90752.6	212098.6	1463.4	U1	1465.8	4809.00	hydrograph available
CPP_55-6	90697.4	211853.7	1462.6	U1	1464.9	4806.00	hydrograph available
PW-01	90292.5	211058.6	1462.3	U1	1474.9	4839.00	hydrograph available
PW-02	90529.1	210858.5	1458.8	U1	1461.8	4796.00	hydrograph available
PW-03	90514.0	211058.6	1461.1	U1	1462.4	4798.00	hydrograph available
PW-04	90700.4	210982.3	1452.3	U2	1475.2	4840.00	hydrograph available
PW-05	90520.1	210982.8	1459.2	U1	1477.7	4848.00	hydrograph available
PW-06	89962.2	211134.5	1461.7	U1	1462.4	4798.00	hydrograph available

Table 1-7 Dry vadose zone wells.

Official Name	Easting (m)	Northing (m)	Screen Bottom Elevation (m)	Interbed Flag	Comments
MW-001	90251.2	211754.3	1386.1	L	spot measurements - screened near lower and looks dry. This well is also screened higher where water is observed.
MW-003	90333.8	211902.2	1456.3	U2	spot measurements
MW-003	90333.8	211902.2	1462.4	U1	spot measurements

Table 1-7 Dry vadose zone wells.

Official Name	Easting (m)	Northing (m)	Screen Bottom Elevation (m)	Interbed Flag	Comments
MW-004	90778.3	211951.1	1457.5	?	spot measurements - unclear what it is measuring
MW-005	90545.6	211870.0	1473.3	above U1	Generally not recorded for some reason - screened above U1
MW-007	90442.6	211290.6	1467.1	U1	spot measurements
MW-008	90682.7	211777.5	1459.0	U1	spot measurements
MW-009	90330.1	211278.3	1467.3	U1	spot measurements
MW-010	90549.7	211945.0	1474.2	U1	spot measurements - screened too high
MW-011	90481.5	211664.3	1465.0	U1	spot measurements
MW-012	90628.4	211869.0	1461.2	U1	spot measurements
MW-012	90628.4	211869.0	1451.7	U2	spot measurements
MW-013	90392.3	211259.2	1467.6	U1	only one measurement
MW-014	90374.5	211408.1	1467.7	U1	only one measurement
MW-016	90419.0	211279.6	1466.7	U1	only one measurement, little interbed, screened high
MW-017	90442.6	211290.6	1415.6	M	only one measurement
MW-018	90579.1	211836.4	1462.7	U1	only one measurement
MW-020	90620.0	212009.4	1465.8	U1	only one measurement
CPP_33-1	90507.6	211955.2	1468.0	U1	spot measurements - screened high

1.5.2 Summary of Water Sources

This section summarizes the primary sources of information available for assigning water infiltration rates to the computational domain. These sources include the WAG-3 Work Plan and Book 1. Unfortunately, the volumetric discharges in these two documents do not always agree. Section 2.2.6 shows how these estimates of water infiltration rates are actually assigned to the computational domain and, as indicated, the values accepted for modeling generally fall between the two different information sources.

Table 1-8 below is a reproduction of Table 2-7 from Book 1 summarizing the annual volume of water recharging the perched water bodies at the ICPP. Water sources include precipitation, fire-water system leaks, irrigation, steam injection condensate, infiltration from the basins at CPP-603, infiltration from the sewage treatment ponds, and the water disposed of at the percolation ponds (listed in Column 1). Columns 2 and 3 list the annual volumetric rate of water infiltrating into the northern portion of the ICPP in gal/yr., and million kg/day, respectively. Source rates for the entire facility are given in Columns 4 and 5. The total of Columns 4 and 5, excluding the precipitation infiltration, indicates that the total influx rate is 712 Mgal/yr. or 7.7

Mkg/day. Precipitation was excluded from the subtotal because of the arbitrary area (180 acres) over which it was computed, and because of the uniformly low rate of 4.1 cm/yr.

Table 1-8 Estimated volume of water recharging the perched water bodies at ICPP taken from Book 1 (Chapter 2).

Source	Northern ICPP Volume (gal/yr)	Northern ICPP Volume (Million kg/day)	Facility Total Volume (gal/yr)	Facility Total Volume (kg/day)
Precipitation infiltration (180 acres, 4.1cm/yr)	3,800,000 (northern most 87 of 180 acres)	0.0394	8,000,000	82,967.9
Water system leaks	3,980,000	0.0413	3,980,000	41,276.5
Landscape irrigation	1,568,000	0.0163	1,568,000	16,261.7
Steam Condensate	1,300,000	0.0135	1,700,000	17,630.7
CPP-603 Basins	None	None	49,275	511.0
Sewage treatment ponds	15,000,000	0.1556	15,000,000	155,564.9
Service waste water (perc ponds)	None	None	690,000,000	7,470,197.0
Subtotal (excludes precipitation)	25,648,000	0.2660	712,297,275	7,701,441.8
Estimate based on past leaks and irrigation practices. Actual loss from piping leaks is unknown.				

Table 1-9 lists the estimated volumetric rate of discharge as given in Book 1 and the WAG-3 work plan. In addition, it lists the values used to form the basis for the WAG-3 RI/BRA modeling which will be discussed in Section 2.2.6.

Table 1-9 Estimated volumetric rate of water recharging the perched water bodies at ICPP taken from the Workplan, Book 1, and estimated elsewhere.

Source	RI/BRA (kg/day)	Work plan (kg/day)	Model Values (kg/day)
Precipitation infiltration	82,968 (180 acres@ 4cm/yr)	no estimate	558,960 (1482 acres @1-10 cm/yr.)
Water system leaks (Fire water leaks)	41,277	41,277	41,277
Landscape irrigation	16,262	16,262	13,500 (smaller than 16,262 to reflect reduction in irrigation that was not reflected in the workplan or water balance inventory.)
Steam Condensate	17,630.7	17,630.7	17,332 smaller from workplan because the workplan values do not sum to 17630.7, they sum to 17,332.
CPP-603 Basins	511.0	no estimate	511.0
Sewage treatment ponds	155,564.9	155,565	155,565

Table 1-9 Estimated volumetric rate of water recharging the perched water bodies at ICPP taken from the Workplan, Book 1, and estimated elsewhere.

Source	RI/BRA	Work plan	Model Values
	(kg/day)		
Service waste water (Perc Ponds)	7,470,197.0	5,838,868	5,838,868
Big Lost River	no estimate	no estimate	2,100,000

Note that the individual sources of water given in Table 1-9 are lumped by broad category. In actuality this water is distributed in part areally (Figure 1-18) and at single locations or points (Figure 1-19). Figure 1-18 is used to indicate the 14 discrete areal water source locations shown as the black areas in each of the small subplots. The subplots for the 14 source locations (Figure 1-18) are numbered from the lower left corner to the upper right corner. Zones 5 and 6, for example, correspond to the west and east percolation ponds, respectively. Note that the lower left figure corresponding to Zone 1 has lighter shaded regions within it that correspond to Zones 8, 9, 11, 12, 13, and 14. Superposition of these water sources on top of one another indicates that several of these water source types exist at a given spatial location. As a result, spatial water volumes at a given location will be contributed to from a combination of different source categories as indicated in Table 1-10.

Table 1-10 Volumetric rates observed in the regions shown in Figure 1-18.

Distributed Sources			Point Sources	
Zone #	Source Area	Volume kg/day	Source Area	Volume kg/day
1	Fire Line Leak 1	2.8E+04	S-3	3359
2	Fire Line Leak 2	5.29E+03	S-19	2091
3	Fire Line Leak 3	7.94E+03	S-76	448
4	Sewage Treatment Plant	1.21E+05	S-78	233
5	West Perc. Pond	2.917E+06	S-180	783
6	East Perc. Pond	2.917E+06	21	417
7	ICPP-603	5.11E+02	24	1619
8	Steam Vent Area 1	1.821E+03	27	224
9	Steam Vent Area 2	2.288E+03	30	672
10	Steam Vent Area 3	1.528E+03	UT-46	201
11	Steam Vent Area 4	1.002E+03	UT-47	231
12	Irrigation Zone 1	2.245E+03	UT-48	394
13	Irrigation Zone 2	2.25E+03		
14	Irrigation Zone 3	8.981E+03		

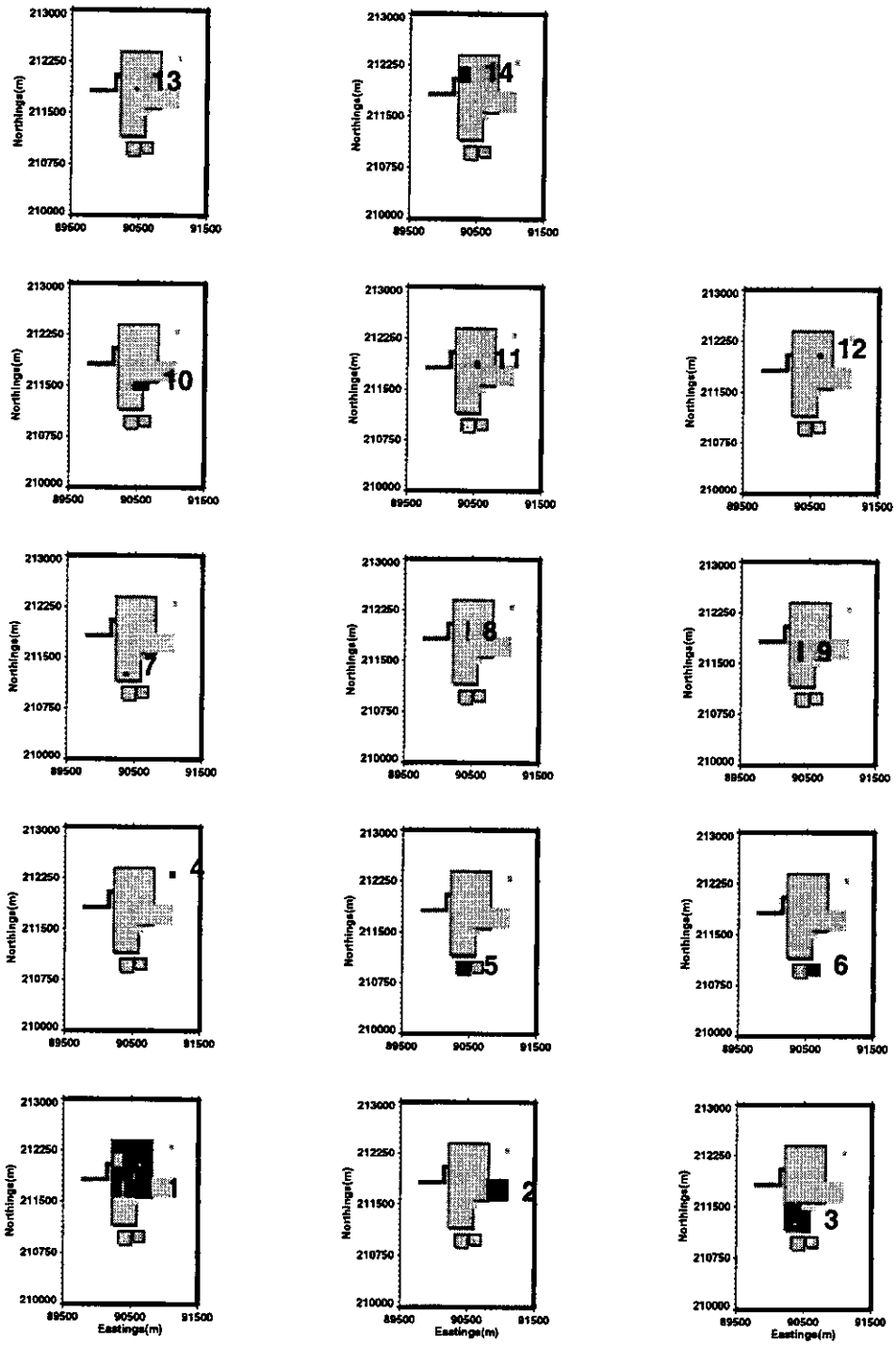


Figure 1-18 Areally distributed source locations for water at the ICPP (shaded areas in each figure), source numbers increase bottom left to upper right and are numbered from 1 to 14.

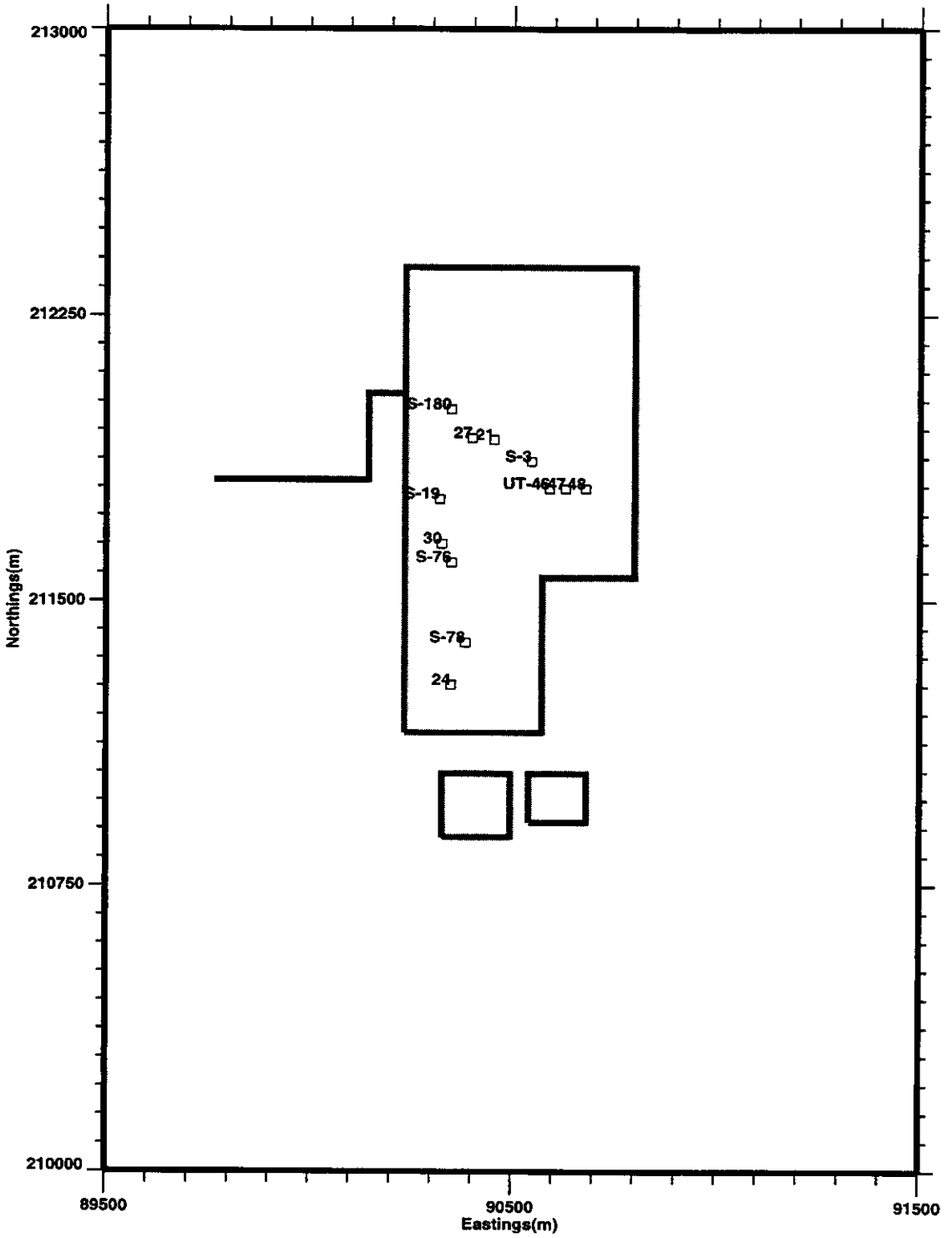


Figure 1-19 Source locations for point sources of water at the ICPP (steam vents).

2 VADOSE ZONE AND AQUIFER MODEL PARAMETERIZATION

2.1 Section Overview and Purpose

In order to incorporate the geologic, stratigraphic, hydrologic, and water information into the numerical simulations, the conceptual model was simplified. First, the vadose zone and aquifer domains were discretized horizontally and vertically. Based on the discretization, stratigraphic units were assigned to each grid block. Hydrologic properties were then assigned to grid blocks based on the stratigraphy existing at each location. Surface water sources were then placed into the modeling domain, and other exterior boundary conditions were applied. The parameterization of the vadose zone and aquifer simulation domains are presented in the following order:

- 2.1 Section Overview and Purpose
- 2.2 Vadose Zone Simulation Domain
  - 2.2.1 Domain Extent
  - 2.2.2 Discretization
  - 2.2.3 Stratigraphic Data Incorporation
  - 2.2.4 3-D Representation of Vadose Zone Stratigraphy
  - 2.2.5 Model Hydrologic Properties
  - 2.2.6 Primary Water Sources
  - 2.2.7 Remaining Vadose Zone Water Boundary Conditions
- 2.3 Aquifer Simulation Domain
  - 2.3.1 Model Extent
  - 2.3.2 Domain Discretization
  - 2.3.3 Assignment of Hydrologic Properties
  - 2.3.4 3D Representation of Aquifer Domain Stratigraphy
  - 2.3.5 Aquifer Domain Water Sources
  - 2.3.6 Flow and Lateral Boundary Conditions
  - 2.3.7 Remaining Aquifer Water Boundary Conditions

2.2 Vadose Zone Simulation Domain

2.2.1 Domain Extent

The vadose zone model extends 2000 m in the east-west direction and 3000 m in the north-south direction. This domain extends approximately 800 m beyond the facility boundaries in the north-south direction and 600 m in the east-west direction as illustrated by the inset box in Figure 2-1 and by the discretized model domain shown in Figure 2-2.

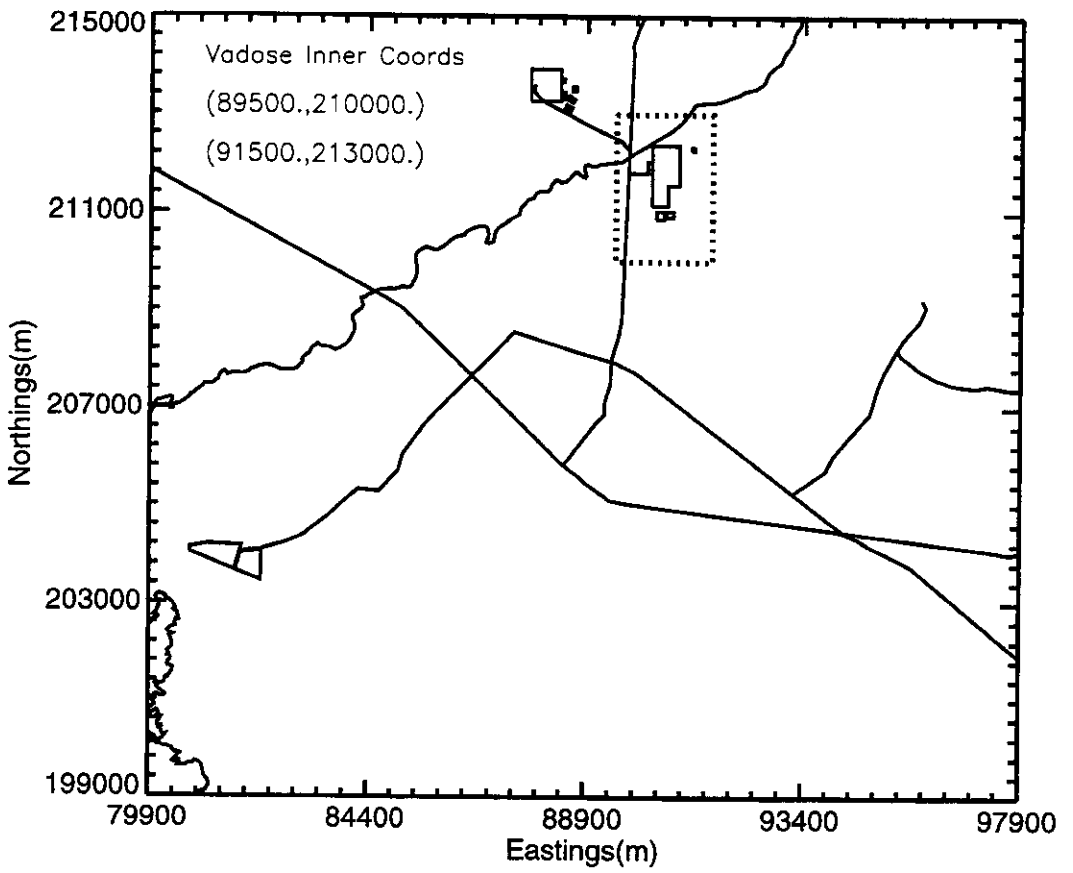


Figure 2-1 Areal view of the vadose zone model simulation domain shown as the dashed (inset) area.

2.2.2 Discretization

Areal discretization of the ICPP vadose zone model uses a 10x15grid. Grid block sizes are 200m x 200m ($\Delta x=\Delta y=200$m). However, at the ground surface, and extending downward to the midpoint of the middle basalt unit (halfway between the upper-2 and middle interbeds), a refined grid was used. This refined discretization ($\Delta x=\Delta y=100$m) corresponds approximately to the footprint of the ICPP. The refined grid was used in order to adequately resolve the water and contaminant sources as they are introduced to the subsurface. The land surface- upper-2 basalt discretization is shown in Figure 2-2.

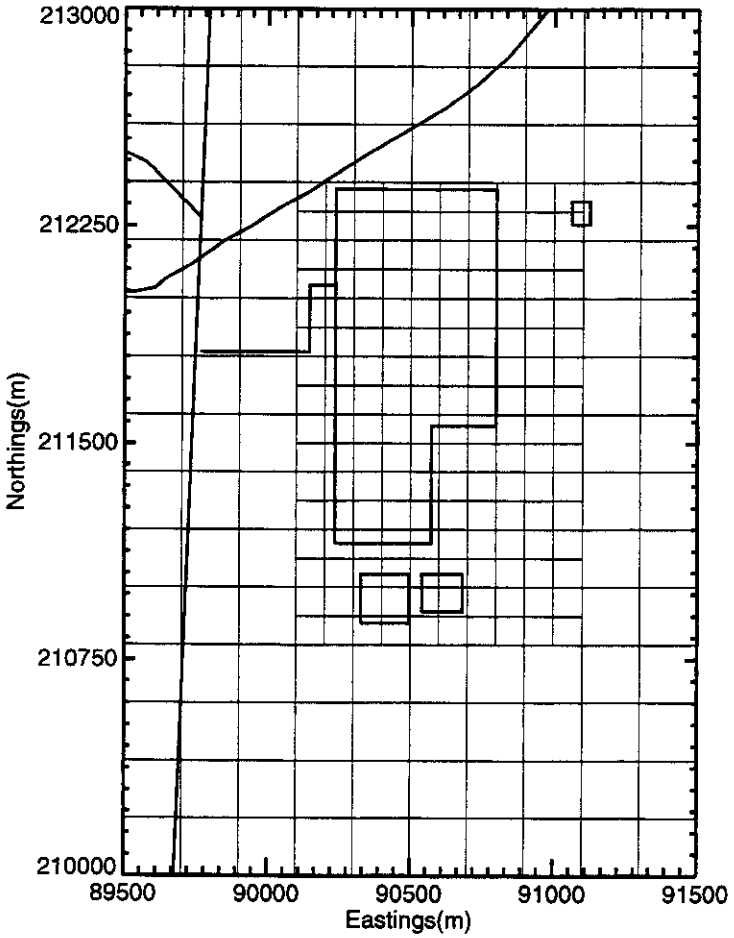


Figure 2-2 Horizontal discretization of vadose zone model from the land surface down to the center basalt region between the upper-2 and middle interbeds.

The vertical discretization of the vadose zone model was determined by the need to incorporate a rigorous treatment of the basalt-interbed permeability contrast as discussed in the following section. After illustrating how the stratigraphic data were incorporated, the vertically discretized model is presented.

2.2.3 Stratigraphic Data Incorporation

Delineation of the stratigraphy at the ICPP is necessary because the average basalt permeability is on the order of 10^6 mDarcy, while the average permeability in a sediment unit is on the order of 10 mDarcy as discussed in Sections 1.4.1 and 1.4.2. In order to adequately resolve the permeability contrasts, permeability needed to be assigned by stratigraphic unit rather than interpolating the permeability across the stratigraphic units.

The 13 sedimentary interbeds, the alluvium, and the inter-layering basalt units existing in the vadose zone (Section 1.3.2) have been grouped together in the conceptual model of the vadose zone. These groups were based on the stratigraphy identifiable in well logs, and resulted in five effective sedimentary layers. Thus, in this model, the vadose zone consists of the alluvium, upper-1 basalt, upper-1 interbed, upper-2 basalt, upper-2 interbed, middle basalt, middle interbed, lower basalt, lower interbed, and the deep basalt forming the top of the aquifer model.

This simplification results in a total of 10 different stratigraphic units instead of trying to incorporate the actual alluvium, 13 sedimentary interbeds, and the 14 inter-layering basalt units. These 10 stratigraphy units can be defined by delineating the tops and thicknesses of the alluvium and sedimentary units. The mechanics of this simplification are outlined below.

2.2.3.1 Interpretation of the vadose zone stratigraphy using effective interbeds

The 13 sedimentary interbeds, the alluvium, and the inter-layering basalt units existing in the vadose zone (Section 1.3.2) have been grouped together in the conceptual model of the vadose zone. These groups were based on the stratigraphy identifiable in well logs, and resulted in five effective sedimentary layers. The model layers were given in Column 5 of Table 1-1. Upper bounding surfaces of the model layers by associated stratigraphic unit were given in Column 4 of Table 1-1.

A log has been generated for each of the wells illustrating the effective model interbeds and are presented in Figures 2-3 through 2-13. Those figures also reproduce the data taken from the well logs that appeared in Figures 1-3 through 1-13 for ease in interpretation. The letter associated with each effective interbed indicates the effective stratigraphic unit to which the actual sediment layers have been assigned.

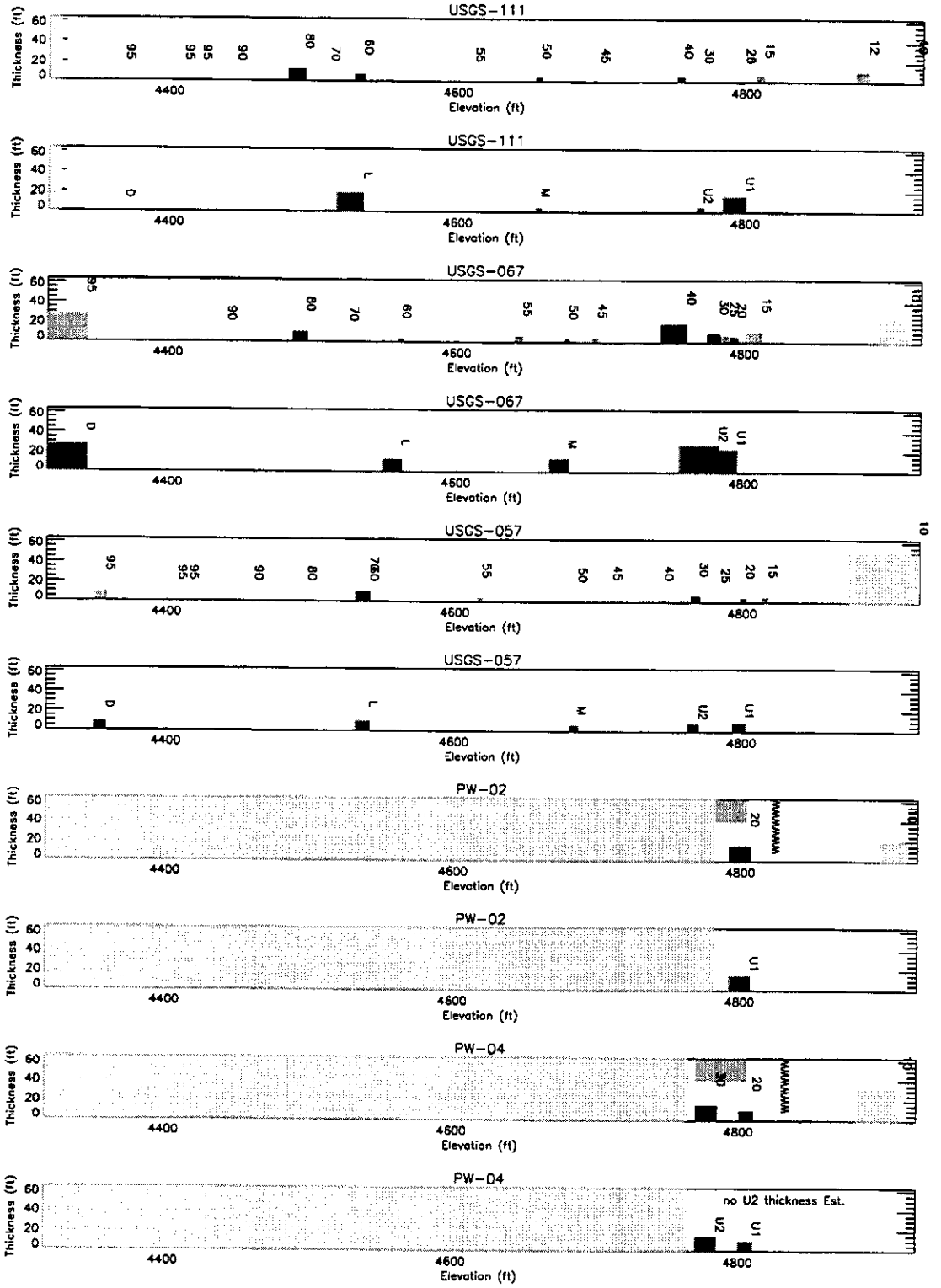


Figure 2-3 Stratigraphic log representation for wells USGS-111, USGS-067, USGS-057, PW-02, and PW-04. Locations for these wells can be found in Figure 1-2.

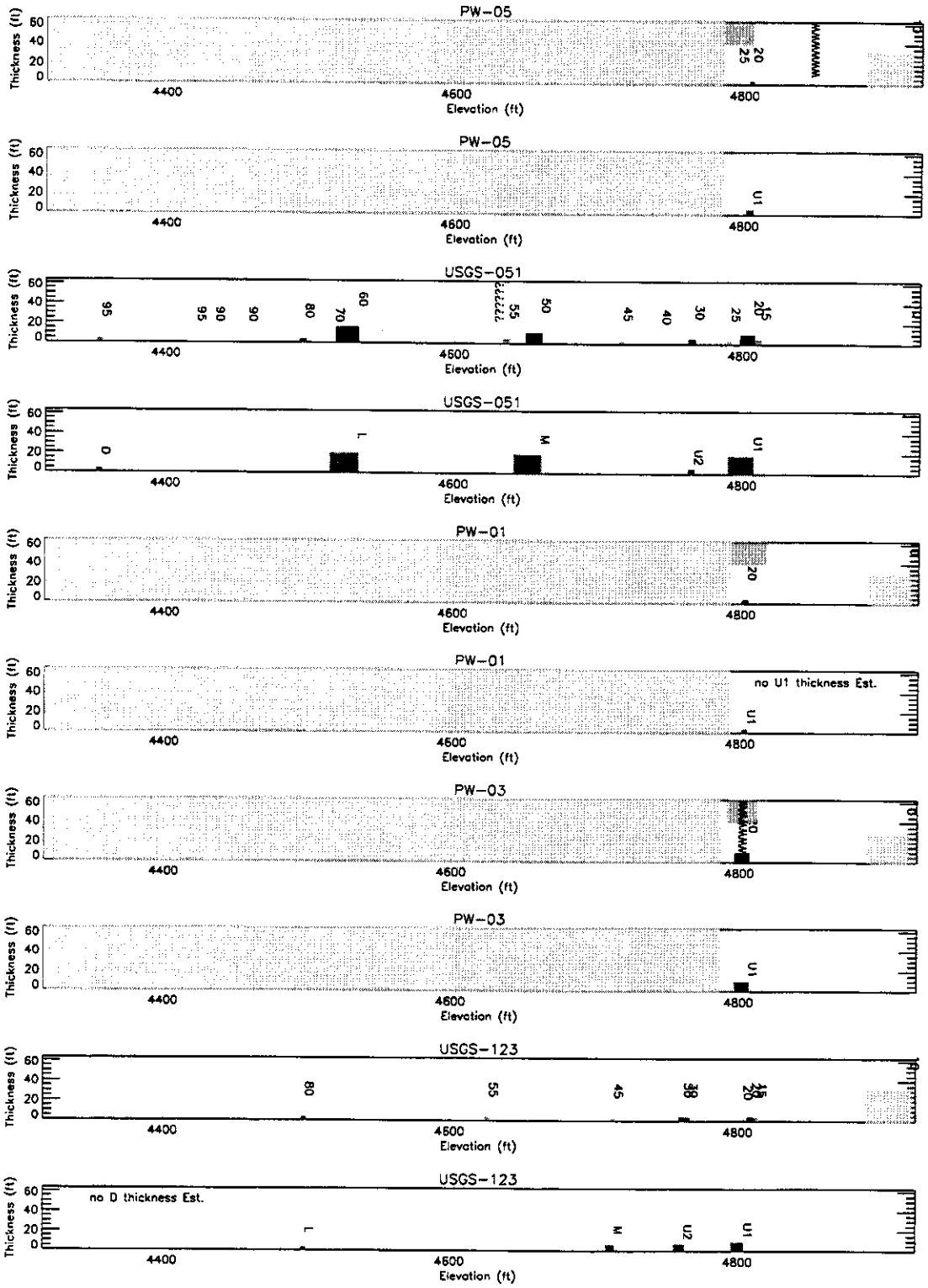


Figure 2-4 Stratigraphic log representation for wells PW-05, USGS-051, PW-01, PW-03, and USGS-123. Locations for these wells can be found in Figure 1-2.

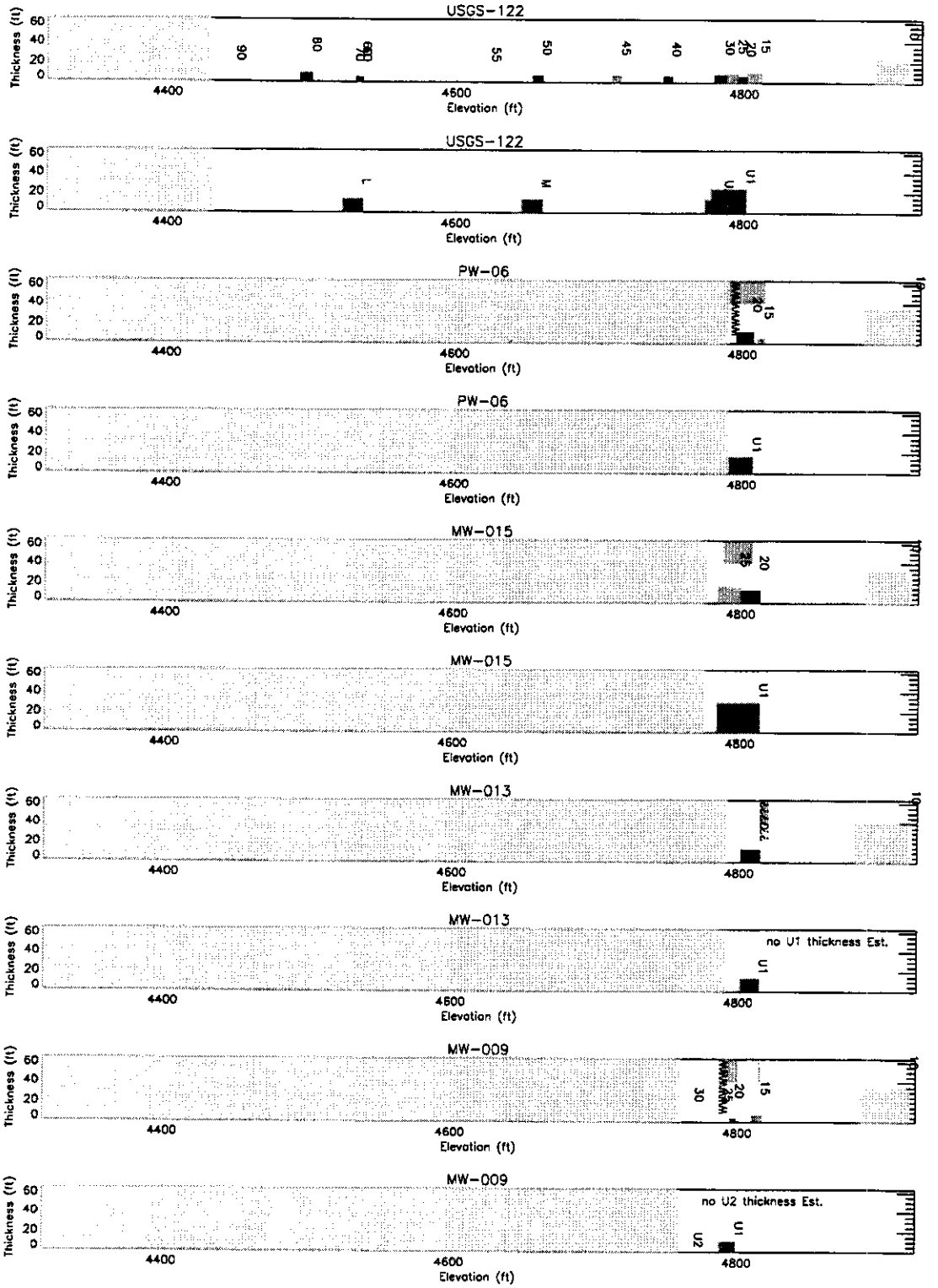


Figure 2-5 Stratigraphic log representation for wells USGS-122, PW-06, MW-015, MW-013, and MW-009. Locations for these wells can be found in Figure 1-2.

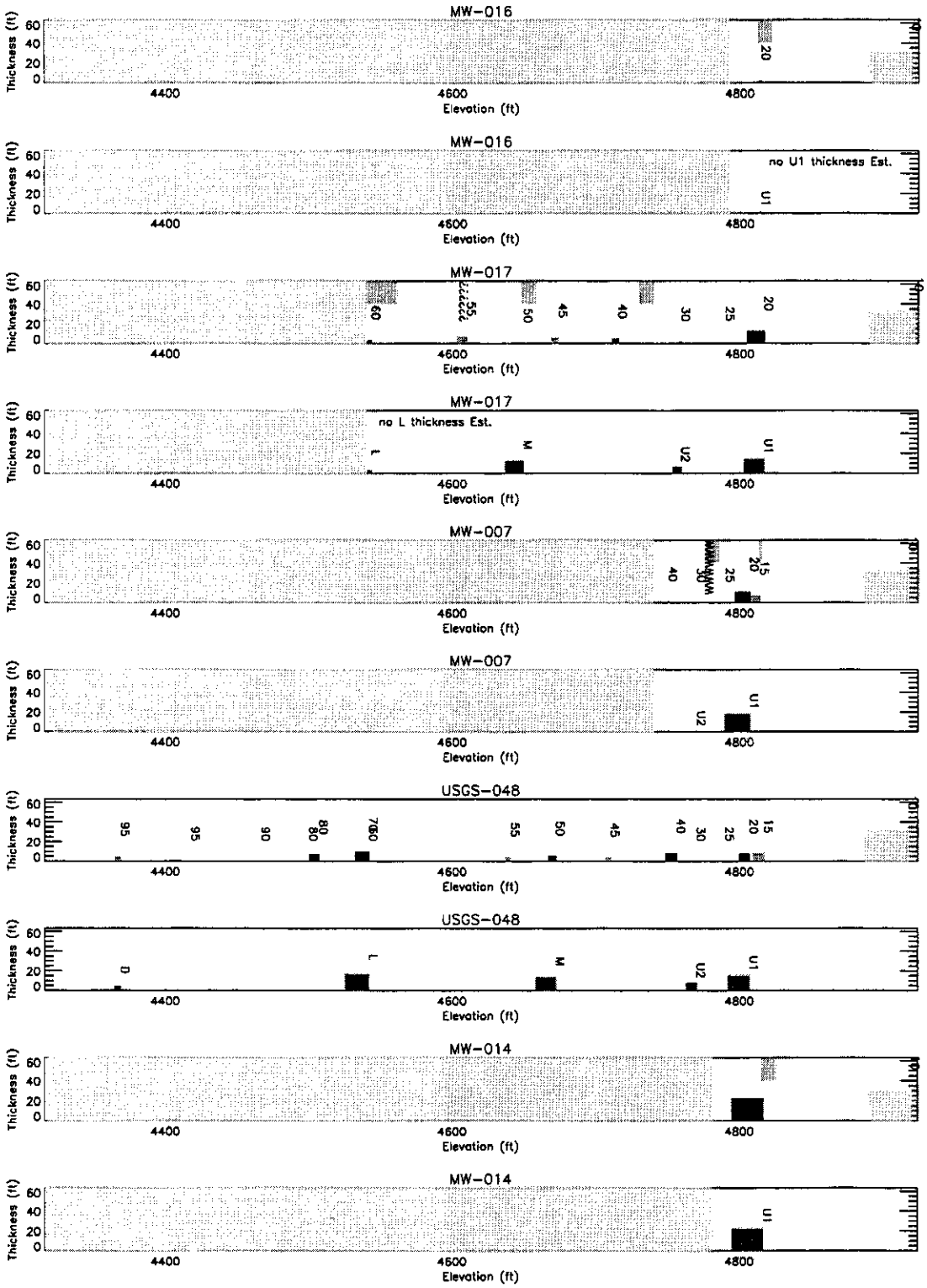


Figure 2-6 Stratigraphic log representation for wells MW-016, MW-017, MW-007, USGS-048, and MW-014. Locations for these wells can be found in Figure 1-2.

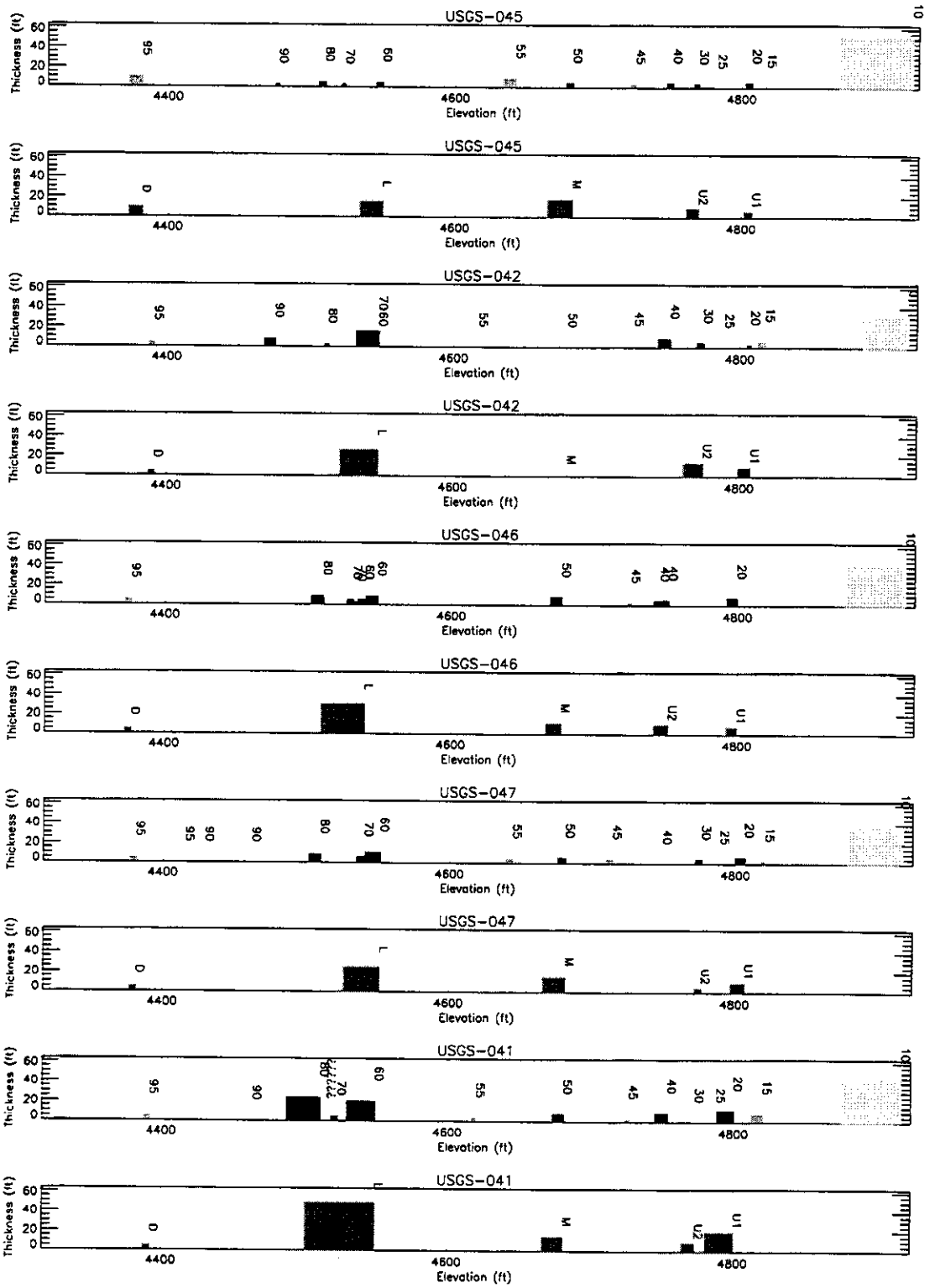


Figure 2-7 Stratigraphic log representation for wells USGS-045, USGS-042, USGS-046, USGS-047, and USGS-041. Locations for these wells can be found in Figure 1-2.

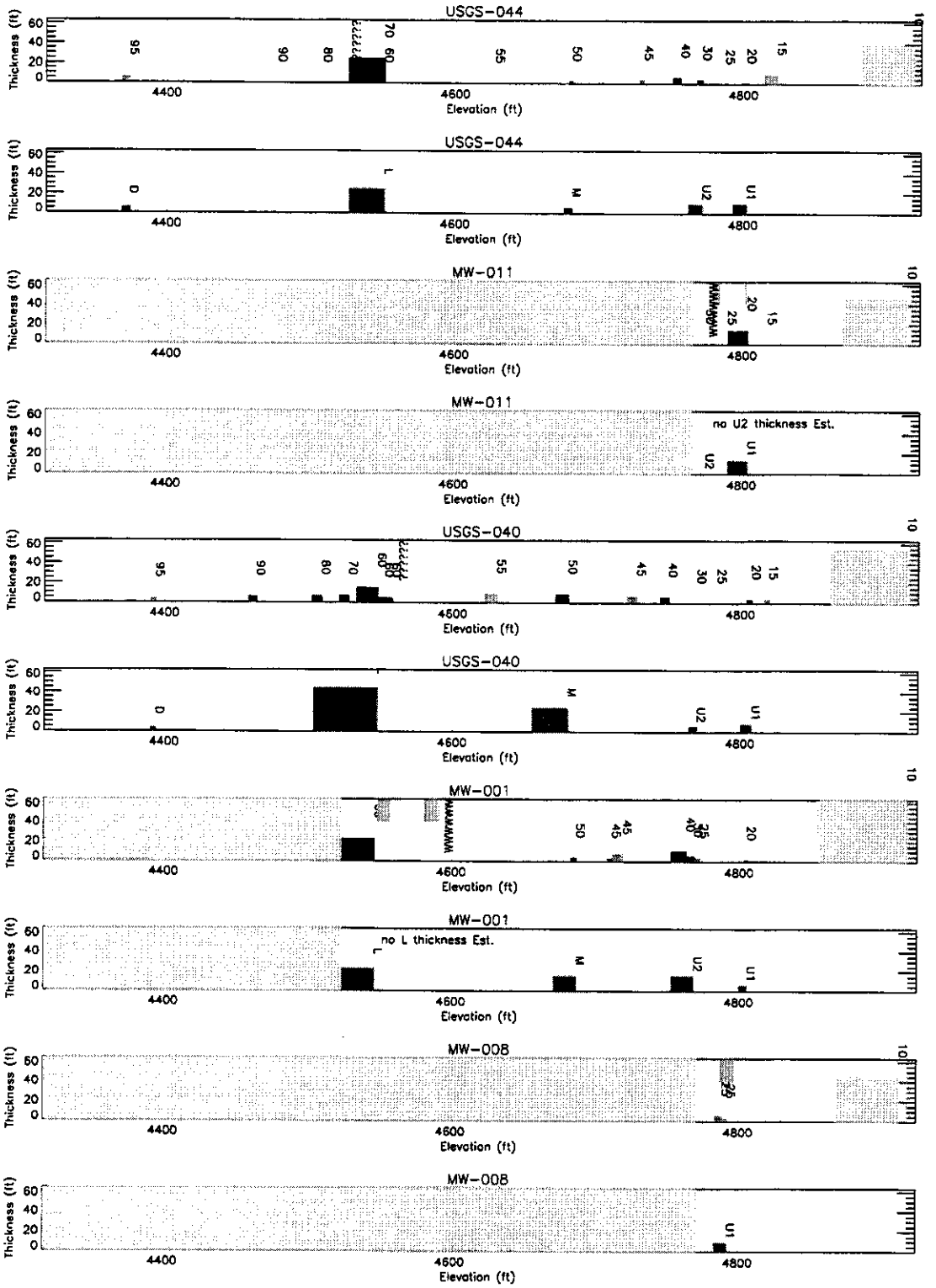


Figure 2-8 Stratigraphic log representation for wells USGS-044, MW-011, USGS-040, MW-001, and MW-008. Locations for these wells can be found in Figure 1-2.

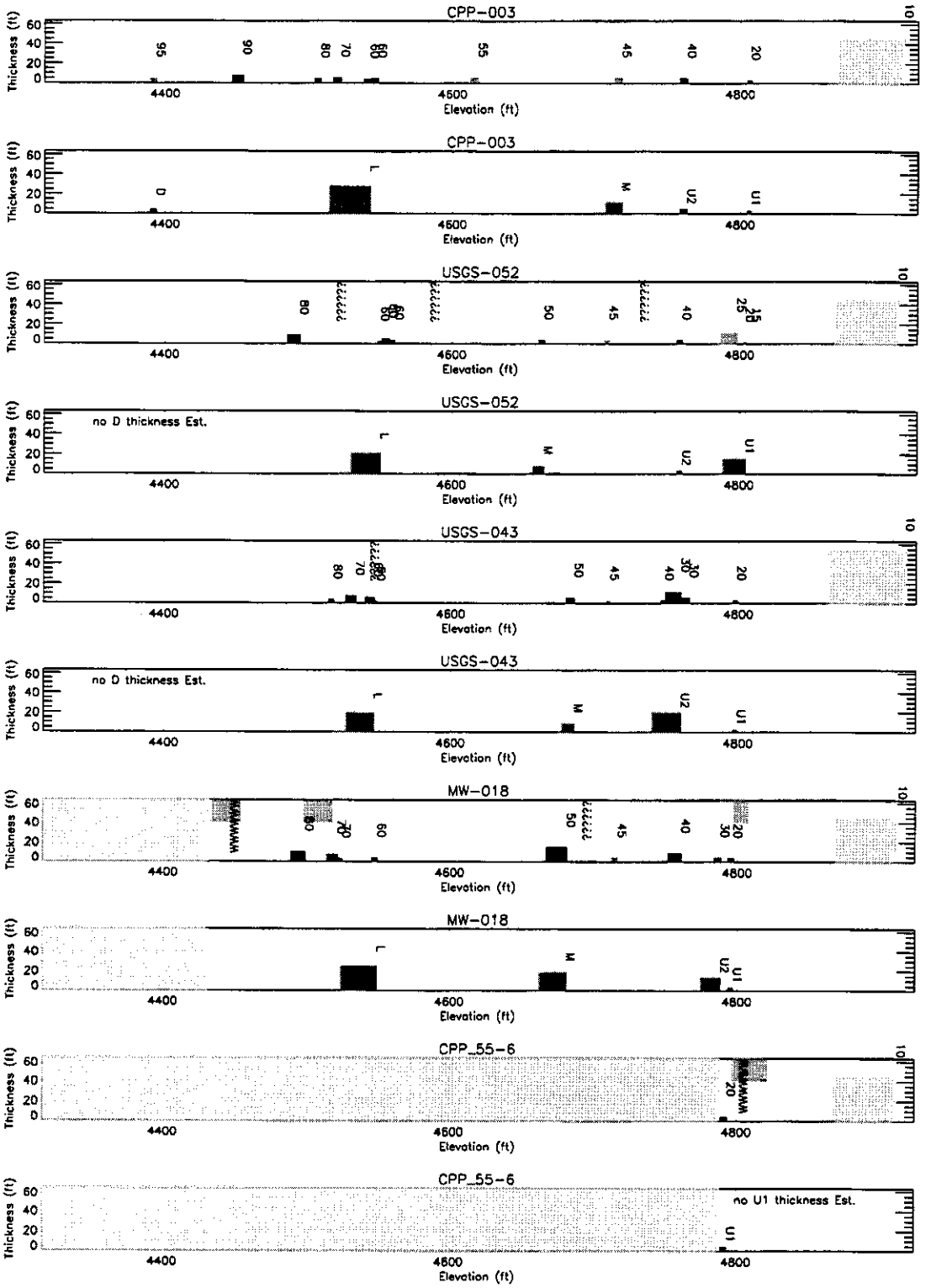


Figure 2-9 Stratigraphic log representation for wells CPP-003, USGS-052, USGS-043, MW-018, and CPP_55-6. Locations for these wells can be found in Figure 1-2.

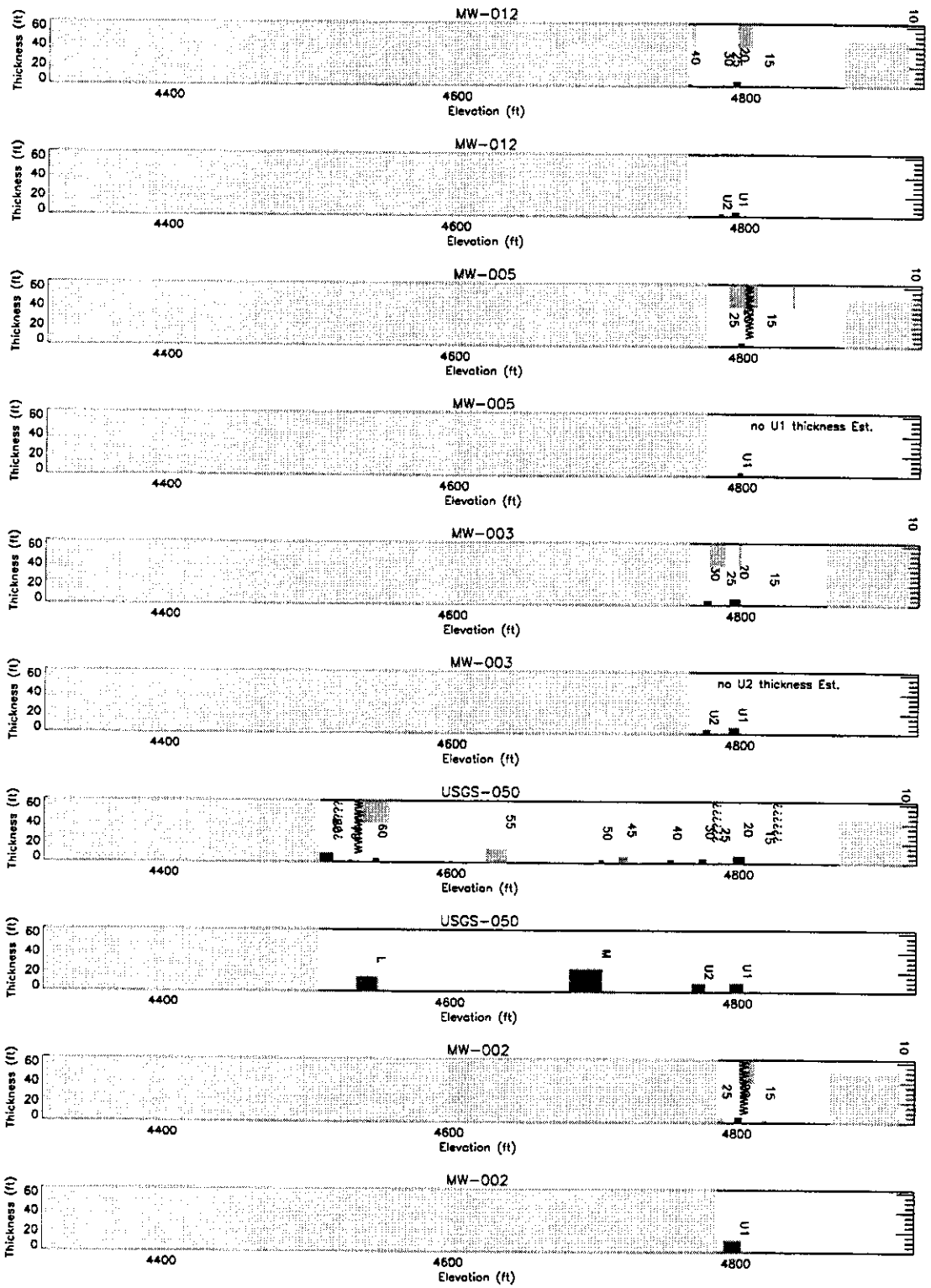


Figure 2-10 Stratigraphic log representation for wells MW-012, MW-005, MW-003, USGS-050 and MW-002. Locations for these wells can be found in Figure 1-2.

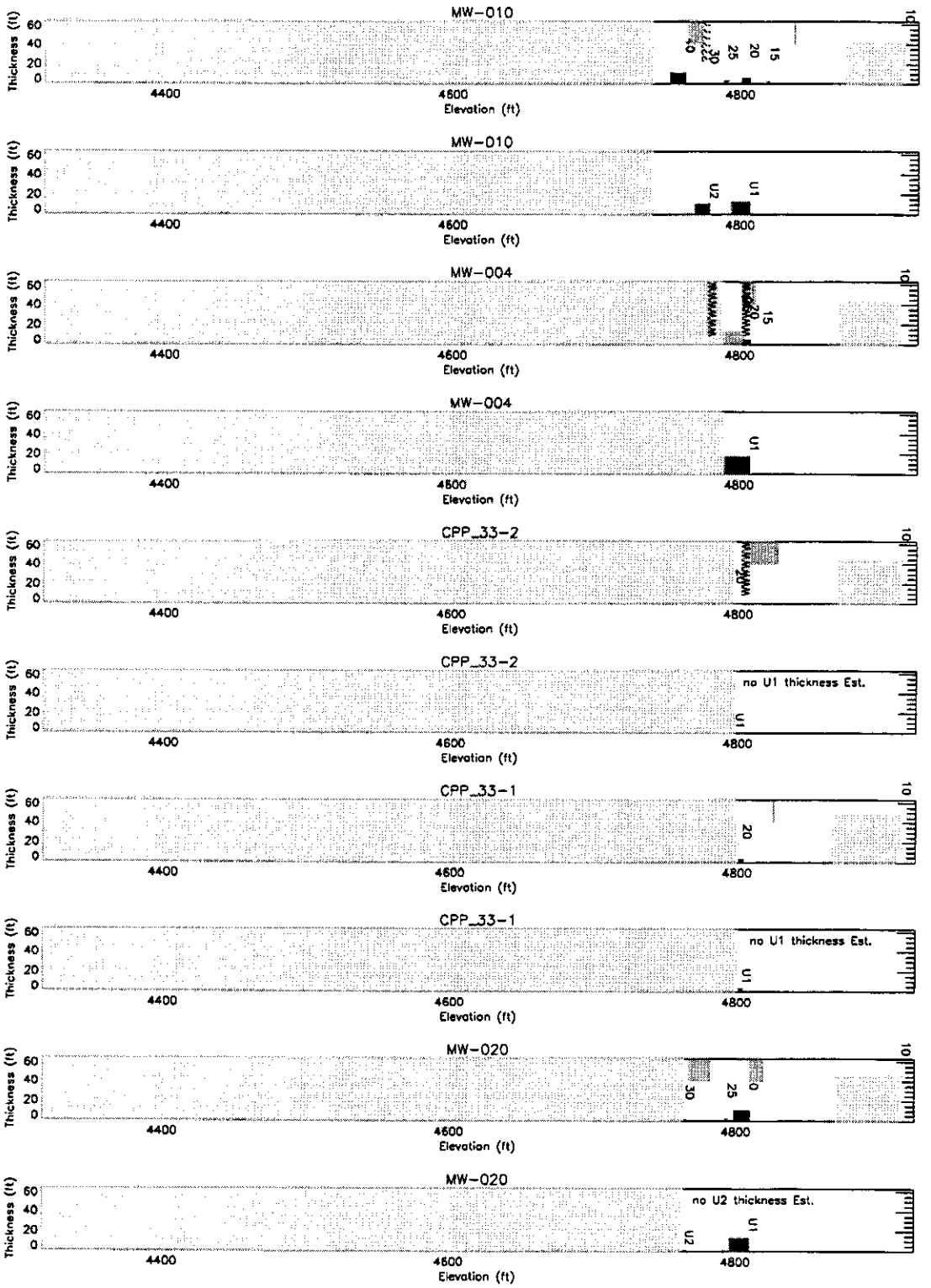


Figure 2-11 Stratigraphic log representation for wells MW-010, MW-004, CPP_33-2, CPP_33-1, and MW-020. Locations for these wells can be found in Figure 1-2.

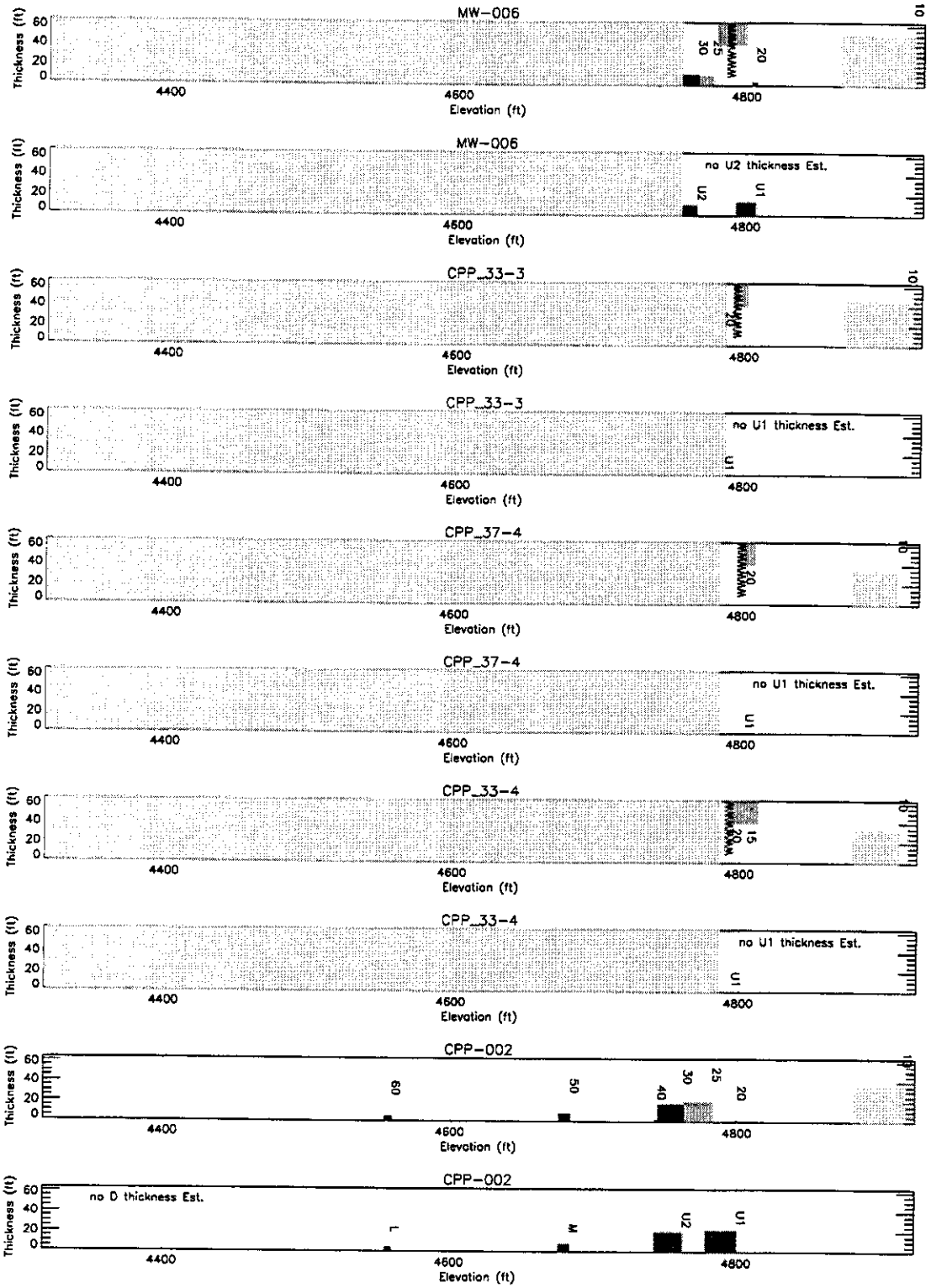


Figure 2-12 Stratigraphic log representation for wells MW-006, CPP_33-3, CPP_37-4, CPP_33-4, and CPP-002. Locations for these wells can be found in Figure 1-2.

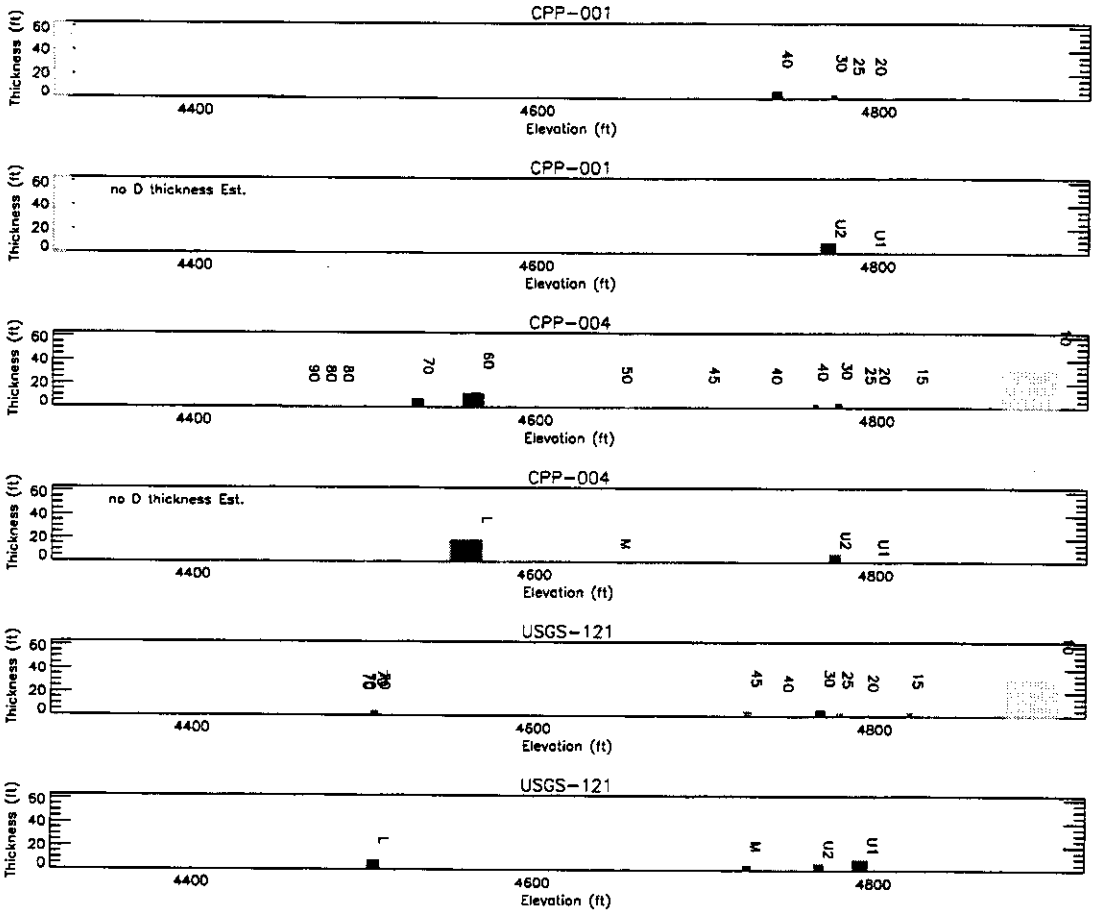


Figure 2-13 Stratigraphic log representation for wells CPP-001, CPP-004, and USGS-121. Locations for these wells can be found in Figure 1-2.

2.2.3.2 Fine grid kriged/contoured "effective" interbeds

A geostatistical analysis of the effective interbeds was performed resulting in the kriged interbed tops and thicknesses shown in Figures 2-14 through 2-18. In Figures 2-14 through 2-18, the left plot presents the elevation of the stratigraphic top. This top represents the elevation generated following a trend removal, variogram analysis, kriging, trend addition process as outlined by Schafer-Perini (1994). The plot on the right is the kriged thickness generated following the same procedure. Lateral continuity is shown by the general smoothness of the top elevation and thickness for each of the "effective" stratigraphic units. The discretization level and lateral boundaries in the figures are consistent with that used for the vadose zone domain. Note that an elevation of 1503 m represents a model depth of zero ft., which from the alluvium top figure indicates that the maximum elevation, or minimum depth is to the southwest, and that the maximum alluvium thickness is to the northwest with the minimum alluvium thickness to the southeast.

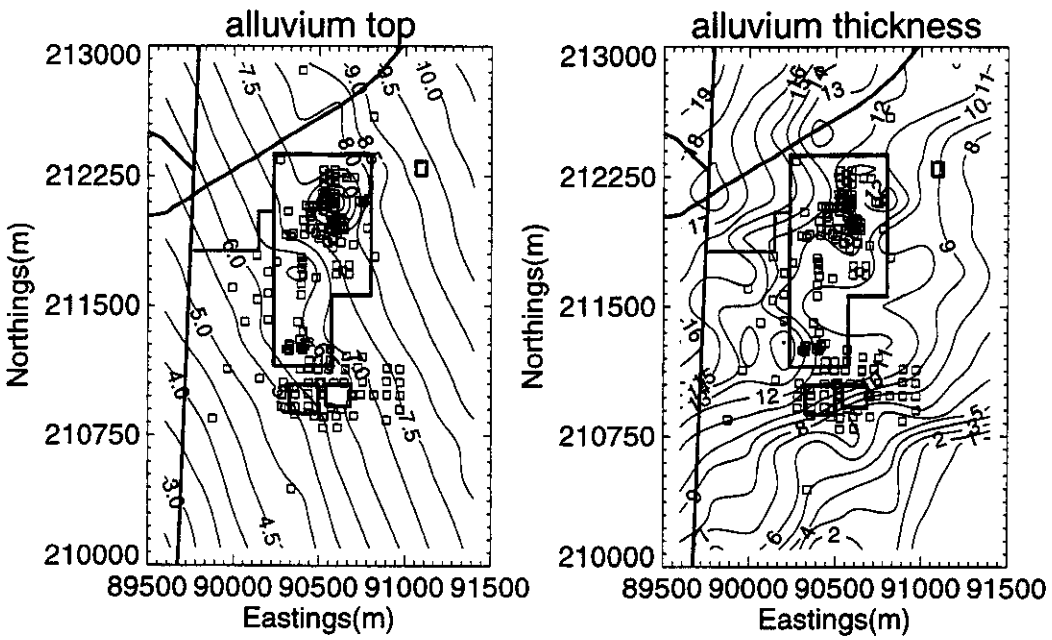


Figure 2-14 Alluvium top (m below an elevation of 1503m) and thickness (m) (kriged results).

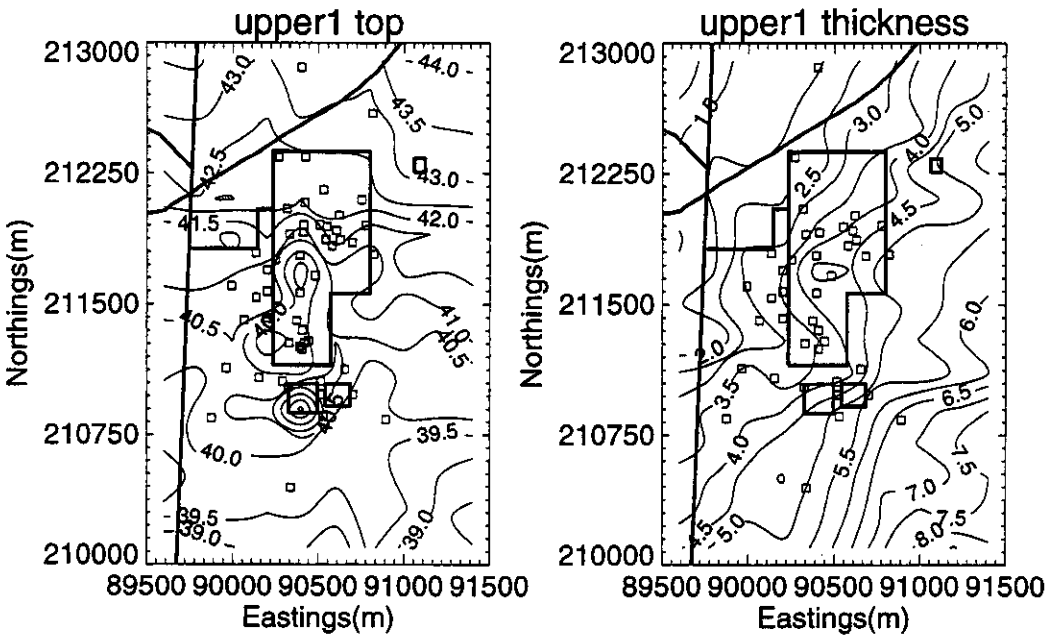


Figure 2-15 First upper interbed top (m below an elevation of 1503m) and thickness (m) (kriged results). Well locations are shown as squares.

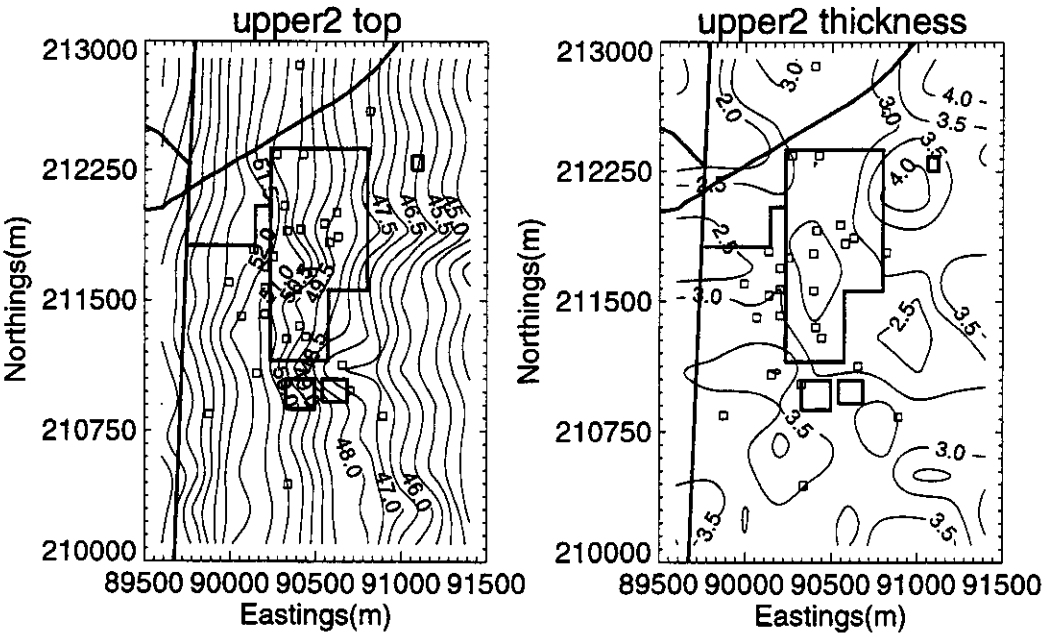


Figure 2-16 Second upper interbed top (m below an elevation of 1503m) and thickness (m) (kriged results). Well locations are shown as squares.

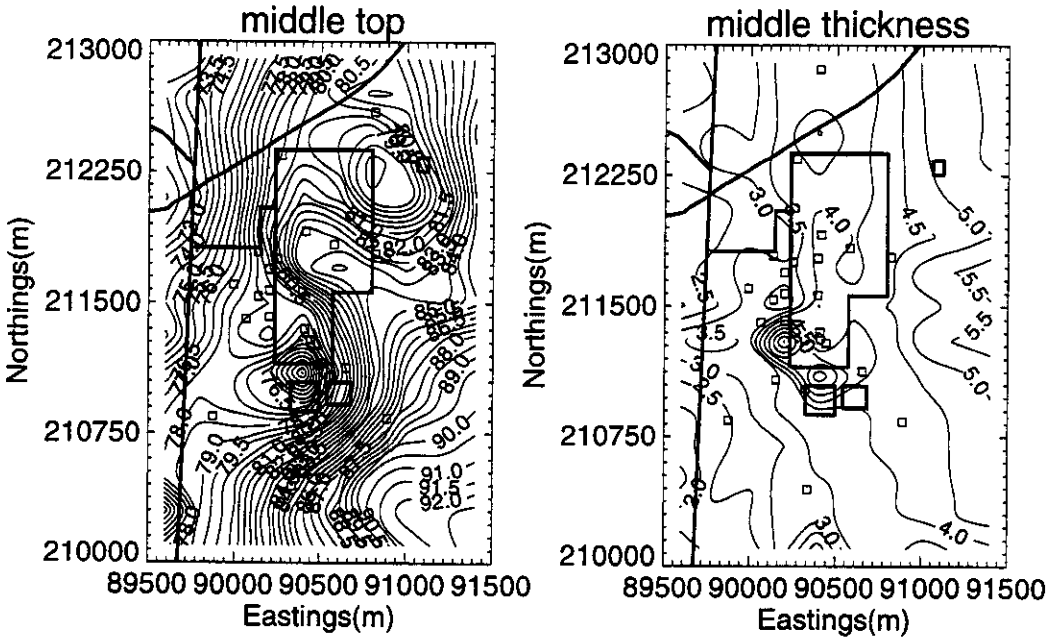


Figure 2-17 Middle interbed top (m below an elevation of 1503m) and thickness (m) (kriged results). Well locations are shown as squares.

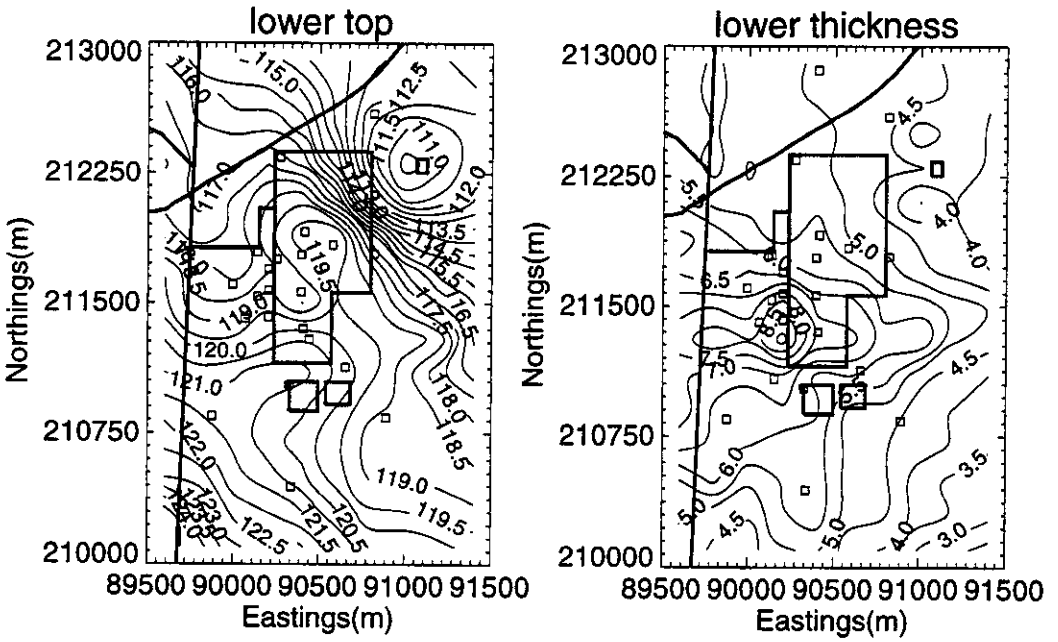


Figure 2-18 Lower interbed top (m below an elevation of 1503m) and thickness (m) (kriged results). Well locations are shown as squares.

2.2.4 3-D Representation of Vadose Zone Stratigraphy

These interbeds were combined into the following three-dimensional domain by preserving the interbed top and thickness as a function of horizontal location (Figure 2-19). As indicated in Figures 2-19 and 2-20, the "effective interbeds" are neither horizontal nor of uniform thickness.

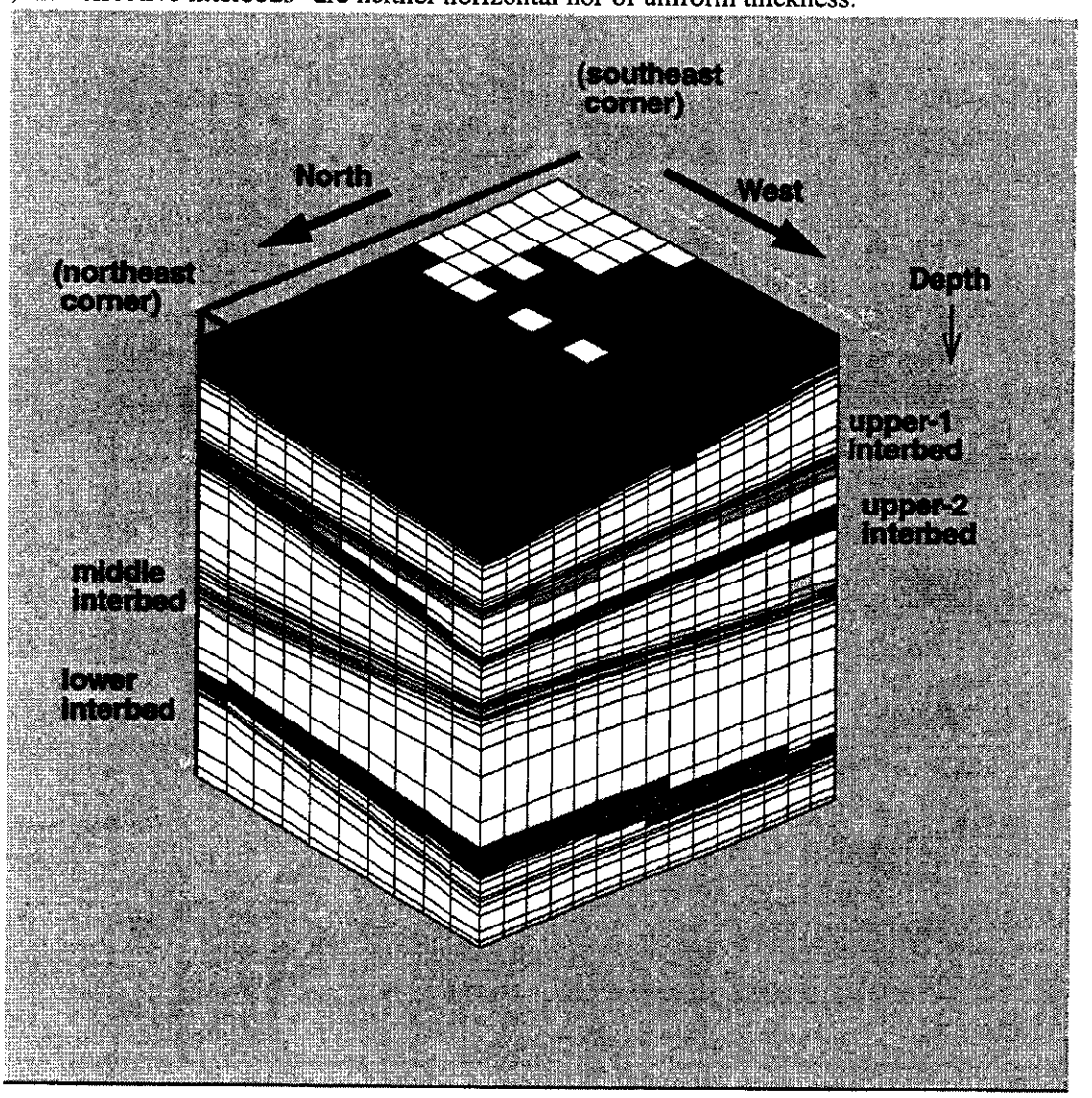


Figure 2-19 3-D representation of effective interbeds in the vadose zone looking down from the northwest corner. From the thickness maps, the alluvium thins to the south-east, and is thickest in the northwest corner.

The vertical discretization uses exponentially decreasing and increasing spacing moving towards and away from the alluvium-basalt and interbed-basalt interfaces. The exponential spacing at basalt and sediment interfaces places more nodes in areas where they are needed (i.e., at high gradient areas). Furthermore, the planes which define the interfaces were orientated to follow the general tilt of each interface. The end result of using this discretization was to significantly reduce the number of computational nodes needed to represent the very heterogeneous ICPP subsurface and make three-dimensional simulation feasible. The total number of nodes used vertically was 61.

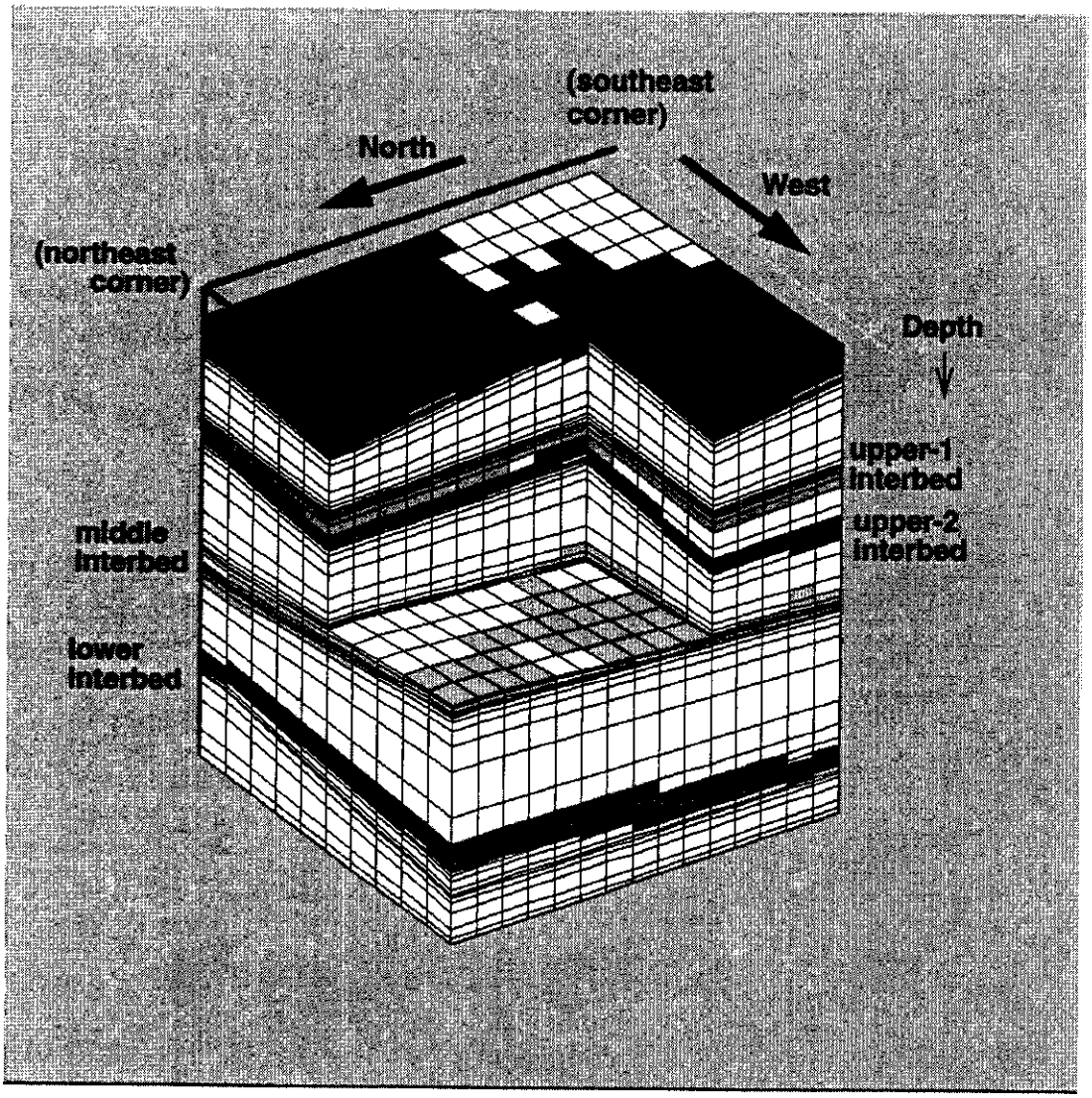


Figure 2-20 3D vadose zone model discretization and material type interfaces looking into the domain.

2.2.5 Model Hydrologic Properties.

It is recognized that the stratigraphy beneath the INEL consists of fractured basalt and sedimentary interbeds; these interbeds have been incorporated into the model as discussed above. However, this model also recognizes that the basalts are composed of fractures and matrix. Parameterization for the basalt and fractures in this work is based on the modeling results for the Large Scale Infiltration Test (Magnuson, 1995). A modeling study entitled "Inverse Modeling for Field-Scale Hydrologic and Transport Parameters of Fractured Basalt" (S.O. Magnuson, INEL-95/0637, Dec 1995) used both dual porosity and single porosity models to illustrate that the bulk infiltration of the LSIT could be adequately represented using a model that accounted for flow occurring only in the fractures. The LSIT experiment examined the infiltration of water from a large surface pond (field-scale study) through the fractured basalts near the RWMC. Magnuson's work was a numerical experiment that performed a sensitivity analysis not only in model parameterization but in model conceptualization. Results illustrated that including flow through the basalt matrix (high porosity, low permeability) was essentially optional when organics are not partitioning between fracture and basalt matrix, and that the bulk of infiltration behavior could be captured by considering anisotropic transport through

fractures characterized by low porosity and high permeability. These simulation results and resultant parameterization form the basis for basalt-fracture representation used in this study.

The presence of preferred flow channels is highly probable as is the idea that they form the dominant transport paths in the basalts at the ICCP. This was one of the primary hypotheses going into the field for the LSIT experiment, with the secondary question as to whether the fracture flow paths were laterally extensive or primarily vertical. Perched water hydrographs (available for roughly 20 wells) and the geophysical information collected during that test showed that some preferred flow existed in the horizontal directions, and that horizontal migration paths could be monitored from the surface. However, the geophysical data also indicated that the bulk of flow occurred vertically.

If primary vertical flow channels exist at the ICCP, and if water-bearing contaminants were discharged above those flow channels, they could impact the "area of arrival" of contaminants in the first perched water zone. However, the simulations that will be presented in Section 3 of this work suggest that the overall impact of vertical flow channels will be mitigated by the presence of the perched water, which enhances mixing/dilution of contaminants, resulting in a more distributed source term to the next lower perched zone and ultimately to the aquifer. As a result, complete delineation of these vertical flow channels becomes, in some sense, less important when defining the ultimate contribution to the aquifer. If, at some future date, field data are collected that identifies preferred flow paths, the information could be incorporated in this modeling approach as a nonuniform dual porosity media without a great deal of effort.

For this modeling, it has been assumed that the basalt characteristics determined from the LSIT modeling (Magnuson, 1995) are also appropriate for the ICPP basalts. Based on Magnuson's results, it has been assumed in all of the simulations to be presented here that the basalts can be treated as an anisotropic "single porosity" media (i.e. neglect the matrix and only simulate the fracture network). This is done for reasons of computational tractability and is based again on the results of Magnuson (1995) who showed that in a dual porosity formulation, the contribution of the matrix to bulk flow at the LSIT was negligible. In the absence of additional information, we assume that the material under the ICPP will behave as did the material under the LSIT. Again, to be consistent with Magnuson (1995), we apply a horizontal and vertical fracture permeability of 90,000 mDarcy and 300 mDarcy, respectively, and an effective porosity of 5%. Unsaturated moisture characteristic curves for the fractured material will be discussed in Section 2.2.5.

To solve the unsaturated flow problem beneath the ICPP, the TETRAD code requires parameterization of the saturation verses capillary pressure relationship and saturation verses hydraulic conductivity relationship. The relationships for the saturation versus capillary pressure and hydraulic conductivity are known as the constitutive relationships and they are discussed below for the sediments and basalt fracture.

2.2.5.1 Constitutive relationships

Relationships are required to describe the interaction between capillary pressure, saturation, and relative permeability for each material type used in the simulation domain. For the sediments, van Genuchten (1980) equations from the soil physics literature formed the basis for the constitutive relationships. The two-phase van Genuchten constitutive equations as adapted by Parker et.al. (1987) with slight modifications to the normalized saturations terms were used. The resulting constitutive relation equations used for the alluvium and interbed soil types in this simulation study are:

$$\bar{S}_w = \frac{S_w - S_{wr}}{1 - S_{wr}} \; ; \quad \bar{S}_a = \frac{S_a - S_{ar}}{1 - S_{ar}} \tag{1}$$

$$P_{c\,aw} = \frac{\rho_{fw}\, g}{\alpha} \left[(1 - \bar{S}_a)^{1/\gamma} - 1 \right]^{1/\beta} \Leftrightarrow \bar{S}_a = 1 - \left[1 + \left(\frac{\alpha\, P_{c\,aw}}{\rho_{fw}\, g} \right)^{\beta} \right]^{-\gamma} \tag{2}$$

$$k_{rw} = (\bar{S}_w)^{1/2} [1 - [1 - (\bar{S}_w)^{1/\gamma}]^{\gamma}]^2 \quad (3)$$

$$k_{ra} = (\bar{S}_a)^{1/2} [1 - (1 - \bar{S}_a)^{1/\gamma}]^{2\gamma} \quad (4)$$

where

S_w and S_a = water and air saturations,

S_{wr} and S_{ar} = residual water and air saturations,

$P_{c\,aw}$ = capillary pressure between air and water (kPa),

α = curve fitting parameter (m^{-1} of water) inversely related to the air entry potential,

β = curve fitting parameter, affects nonlinearity of characteristic curve (dimensionless),

$\gamma = 1 - 1/\beta$,

ρ_{fw} = fresh water density (kg/m^3),

g = gravitational acceleration (m/s^2), and

k_{rw} and k_{ra} = water and air relative permeability.

These constitutive relations are implemented in the simulation study through the use of tabular input functions. An external numerical code was written to generate the tabular values and required as input the porosity, the residual saturation, and the van Genuchten parameters (α and β). These constitutive relationships have also been extended to three-phase simulations by Parker et al. (1987) through use of scaling relationships based on interfacial tensions.

Determining constitutive relationships for fractures continues to be an active research area. A Brooks-Corey (1966) analytical formulation was used to describe the constitutive relationships for the fractures. The general Brooks-Corey formulas implemented in TETRAD are

$$P_{c\,aw} = A_{aw}(1 - S_w)^{B_{aw}} \quad (5)$$

$$k_{ri} = A_i((S_i - S_{ir})/(1 - S_{ir}))^{B_i} \quad (6)$$

where

$P_{c\,aw}$ = capillary pressure between air and water (kPa),

k_{ri} = relative permeability of any phase i,

S_i and S_{ir} = saturation and residual saturation of any phase i, and

A_{aw}, B_{aw}, A_i, B_i, are fitting parameters for the various curves.

Initial estimates for the parameters discussed above are presented in Table 2-1, and the final model calibrated values are presented in Table 4-1, after the presentation of the model calibration results.

Table 2-1 Hydrologic parameters (same as Magnuson, 1995).

Parameter	Value	Source
Surficial and Interbed Sediments		
k_s	78 milliDarcy (mD), isotropic	GWSCREEN sediment default (Baca et al., 1992)

Table 2-1 Hydrologic parameters (same as Magnuson, 1995).

Parameter	Value	Source
θ	0.487 cm^3/cm^3	GWSCREEN sediment default
S_{wr}	0.292	GWSCREEN sediment default
S_{ar}	0.0	assumed
α	1.066 m^{-1}	GWSCREEN sediment default
β	1.523	GWSCREEN sediment default
Basalt		
A_{aw}	32 kPa	assumed
B_{aw}	1.5	assumed
A_w	1.0	assumed
B_w	1.0	assumed to be a linear function
S_{wr}	0.0	assumed, allows complete drying
A_o	0.0	assumed, no oil present
B_o	1.1	assumed, no oil present
S_{or}	0.0	assumed, no oil present
A_a	1.0	assumed
B_a	1.2	assumed to be slightly nonlinear
S_{ar}	0.0	assumed, allows complete wetting
θ_b	0.01 to 0.05	Porro and Bishop, 1995
$k_{v,b}$ (vertical)	300 mDarcy	assumed
$k_{h,b}$ (horizontal)	90000 mDarcy	assumed
Other		
ρ_{fw}	1000 kg/m^3	literature value
characteristic matrix block length	2 m	Knutson et al. (1992)

A graphical representation of the relative permeability-saturation relationships for the basalt fracture hydrologic description is presented in Figure 2-21, and the corresponding figure for the sediments is presented in Figure

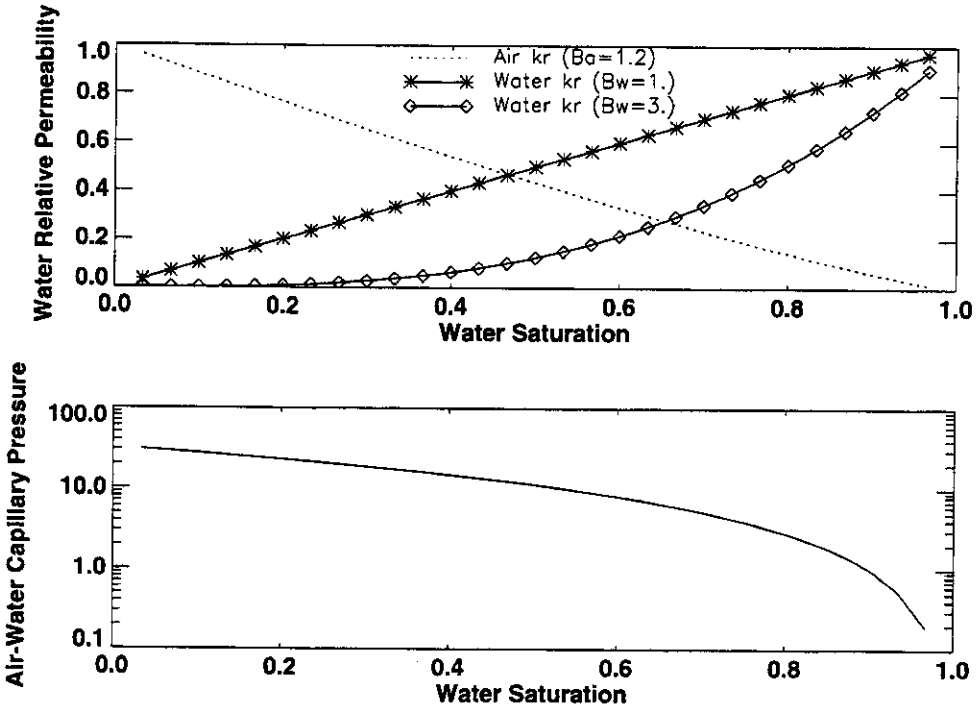


Figure 2-21 Basalt fracture characteristic curves. Relative permeability-water saturation curves for B_w=1.0 and 3.0 (top figure) and air-water capillary pressure-water saturation curve (bottom figure).

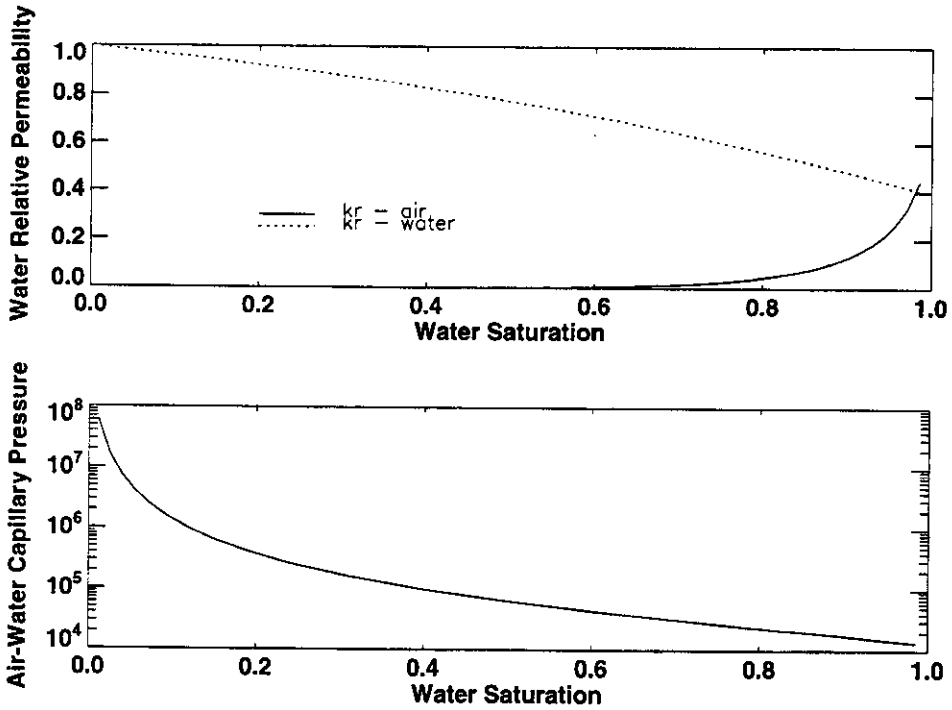


Figure 2-22 Sedimentary interbed characteristic curves. Relative permeability-water saturation curves (top figure) and air-water capillary pressure curve (bottom figure).

2.2.6 Primary Water Sources

In order to add the water sources to the numerical model, we have split all water sources into 19 zones. Each of these zones include all sources of water for those given grid blocks. The 19 zones are necessary because the model requires a single areal (plus as many as necessary point) source value to be assigned to each grid block. When examining the 14 source categories discussed in Section 1.5, it is apparent that the 14 source categories overlap. As a result, the overlapping zones were superposed on top of one another resulting in 19 zones. These 19 zones are consistent with the discretized domain areas as shown in Figure 2-23. Zone 1 consists of the refined area forming the footprint of the ICPP facilities. Zone 2 consists of the area under the Northern portion of the ICPP, etc. Zone 1 only includes the area not covered by Zones 2 through 17 which are accounted for explicitly.

Table 2-2 gives the volume of water per unit horizontal area being applied throughout the modeling domain for each of the numbered regions depicted in Figure 2-23. Column 1 lists the model zone, Column 2 gives the total area covered by the region in m^2/10,000. (i.e. 78 corresponds to 780,000 m^2), Columns 3 through 10 list the daily mass infiltration rate per square meter (kg/day/m^2) for the region, and Column 11 is a cumulative sum over Columns 3 through 10 resulting in the total daily areal mass flux rate (kg/day/m^2). Note that precipitation, fire water losses, lawn irrigation, ICPP-603, the sewage treatment plant and the percolation ponds are accounted for. In addition, Table 2-2 indicates that we are lumping several of the smaller steam vents into areal sources, thus not all of the steam vents contribute to the areal volume balance.

As indicated in Table 2-2 a steady-state contribution to infiltration has been assumed for the Big Lost River and has been applied to the coarse grids forming Zone 18. In actuality, the Big Lost River acts as a transient source of water to the vadose zone, with the historical records showing that it was either dry or wet for several years at a time (i.e., relatively long time periods). For purposes of the RI/BRA, infiltration from the Big Lost River was treated as steady-state flow, and sensitivity analysis will be presented evaluating the effects of changes in flow rates. The difference in flow between the stream gauging stations at Lincoln Blvd. and at the Playa area was used to compute an average linear stream loss. The total loss of 42580 Acre-ft./yr. (Bennett, 1990) between the two gauging stations (separated by roughly 30 miles) resulted in a net infiltration rate of 2.445 kg/m^2/day over the distance spanned through the vadose zone model. This infiltration rate was applied in top layer of each horizontal grid block containing the Big Lost River downstream of the Lincoln Blvd. gauging station.

Although it appears in Table 2-2, Zone 0 is not shown in Figure 2-23 explicitly, but corresponds to the entire model region not included refined area. This region has a background infiltration rate of 1cm/yr which is lower than the precipitation infiltration rate of 10 cm/yr. (0.274 kg/day/m^2) that is assumed within the ICPP fence boundaries. Lower infiltration rates outside the facility boundaries are assumed because of undisturbed soils and intact vegetation. Martian (1995) showed that these conditions lead to reduced infiltration. Opposite logic inside the facility boundaries is also applicable because the ICPP ground surface is either covered with gravel or is paved. The gravel surface will encourage infiltration and discourage evaporation by providing a capillary break at the surface. The paved surfaces will route precipitation into culverts and ditches where it will quickly infiltrate.

Note that with the exception of the percolation pond areas, the precipitation contribution to infiltration is the largest areal mass flux. The next largest contribution is shown by the grey shaded boxes. Note also that

the largest sources of water are from the Big Lost River (Northern ICPP) and from the Percolation Ponds (Southern ICPP) with large contributions from lawn irrigation and the sewage treatment plant.

Table 2-2 Areal water flux rates applied to the model zones shown in Figure 2-23.

Zone	Area /10^4 m^2 (# grids)	Precipitation	Fire Water	Lawn Irrigation	Areal Steam Vents	ICPP-603	Sewage Treatment Plant	Perc. Ponds	Big Lost River	Total
		(kg/day/m^2)								
0	412	2.7400e-02								2.7400e-02
1	77	2.7400e-01								2.7400e-01
2	37	2.7400e-01	5.8000e-02							3.3200e-01
3	9	2.7400e-01	5.9000e-02							3.3300e-01
4	12	2.7400e-01	4.9000e-02							3.2300e-01
5	1	2.7400e-01	5.8000e-02	2.2500e-01						5.5700e-01
6	1	2.7400e-01	5.8000e-02	2.2500e-01	6.0000e-02					6.1700e-01
7	4	2.7400e-01	5.8000e-02	2.2500e-01						5.5700e-01
8	2	2.7400e-01	5.8000e-02		6.1000e-02					3.9300e-01
9	2	2.7400e-01	5.8000e-02		7.6500e-02					4.0850e-01
10	2	2.7400e-01	4.9000e-02		5.3000e-02					3.7600e-01
11	1	2.7400e-01			5.1000e-02					3.2500e-01
12	1	2.7400e-01	5.8000e-02		9.7000e-02					4.2900e-01
13	1	2.7400e-01	4.9000e-02			4.5000e-02				3.6800e-01
14	1	2.7400e-01					1.2100e+01			1.2374e+01
15	4	2.7400e-01						7.2900e+01		7.3174e+01
16	4	2.7400e-01						7.2900e+01		7.3174e+01
17	1	2.7400e-01	4.9000e-02		7.7000e-02					4.0000e-01
18	28	2.7400e-02							2.445	2.4724e-00

The area given in Column 2 of Table 2-2 was multiplied by the mass flux rates per unit area (Columns 3 through 9), resulting in the daily mass flux rate by region shown in Table 2-3.Thus, the total over Columns 3 through 10 of Table 2-3 gives the net mass flux of water by source contribution, which can be compared to the values given in Table 1-8. As indicated above, the total mass application rate includes the contribution of areal steam vents as well as the application at point source vents. These vents appear in Table 4, and are shown in Figure 2-24. Note that Figure 2-24 is the same as Figure 1-19 with the exception that vents S-76 and I-30 have been combined into a single injection point as have vents UT-46 and UT-47.

Table 2-3 Flux rates applied to each of the model zones shown in Figure 2-23.

Zone	Precipitation	Fire Water	Lawn Irrigation	Point Source Steam Vents	ICPP-603	Sewage Treatment Plant	Percolation Ponds	Big Lost River
	(kg/day)							
0	1.1289e+05							
1	2.1098e+05							
2	1.0138e+05	2.1460e+04						
3	2.4660e+04	5.3100e+03						
4	3.2880e+04	5.8800e+03						
5	2.7400e+03	5.8000e+02	2.2500e+03					

Table 2-3 Flux rates applied to each of the model zones shown in Figure 2-23.

Zone	Precipitation	Fire Water	Lawn Irrigation	Point Source Steam Vents	ICPP-603	Sewage Treatment Plant	Percolation Ponds	Big Lost River
	(kg/day)							
6	2.7400e+03	5.8000e+02	2.2500e+03	6.0000e+02				
7	1.0960e+04	2.3200e+03	9.0000e+03					
8	5.4800e+03	1.1600e+03		1.2200e+03				
9	5.4800e+03	1.1600e+03		1.5300e+03				
10	5.4800e+03	9.8000e+02		1.0600e+03				
11	2.7400e+03			5.1000e+02				
12	2.7400e+03	5.8000e+02		9.7000e+02				
13	2.7400e+03	4.9000e+02			4.5000e+02			
14	2.7400e+03					1.2100e+05		
15	1.0960e+04						2.9160e+06	
16	1.0960e+04						2.9160e+06	
17	2.7400e+03	4.9000e+02		7.7000e+02				
18	7.6720e+03							2.0538e+06
AREAL SOURCE TOTALS (not including precipitation)	**5.5896e+05**	**4.0990e+04**	**1.3500e+04**	**6.6600e+03**	**4.5000e+02**	**1.2100e+05**	**5.8320e+06**	**2.0538e+06**
STEAM INJECTION # (NAME)				**Point Source Vents**				
1 (S-3)				3359				
2 (S-19)				2091				
3 (S-76 + I-30)				1120				
4 (S-78)				233				
5 (S-180)				783				
6 (I-21)				417				
7 (I-24)				1619				
8 (I-27)				224				
9 (UT-46+47)				432				
10 (UT-48)				394				
POINT SOURCE TOTALS				**1.0672e+04**				
TOTALS	**5.5896e+05**	**4.0990e+04**	**1.3500e+04**	**1.7332e+04**	**4.5000e+02**	**1.2100e+05**	**5.8320e+06**	**2.0538e+06**

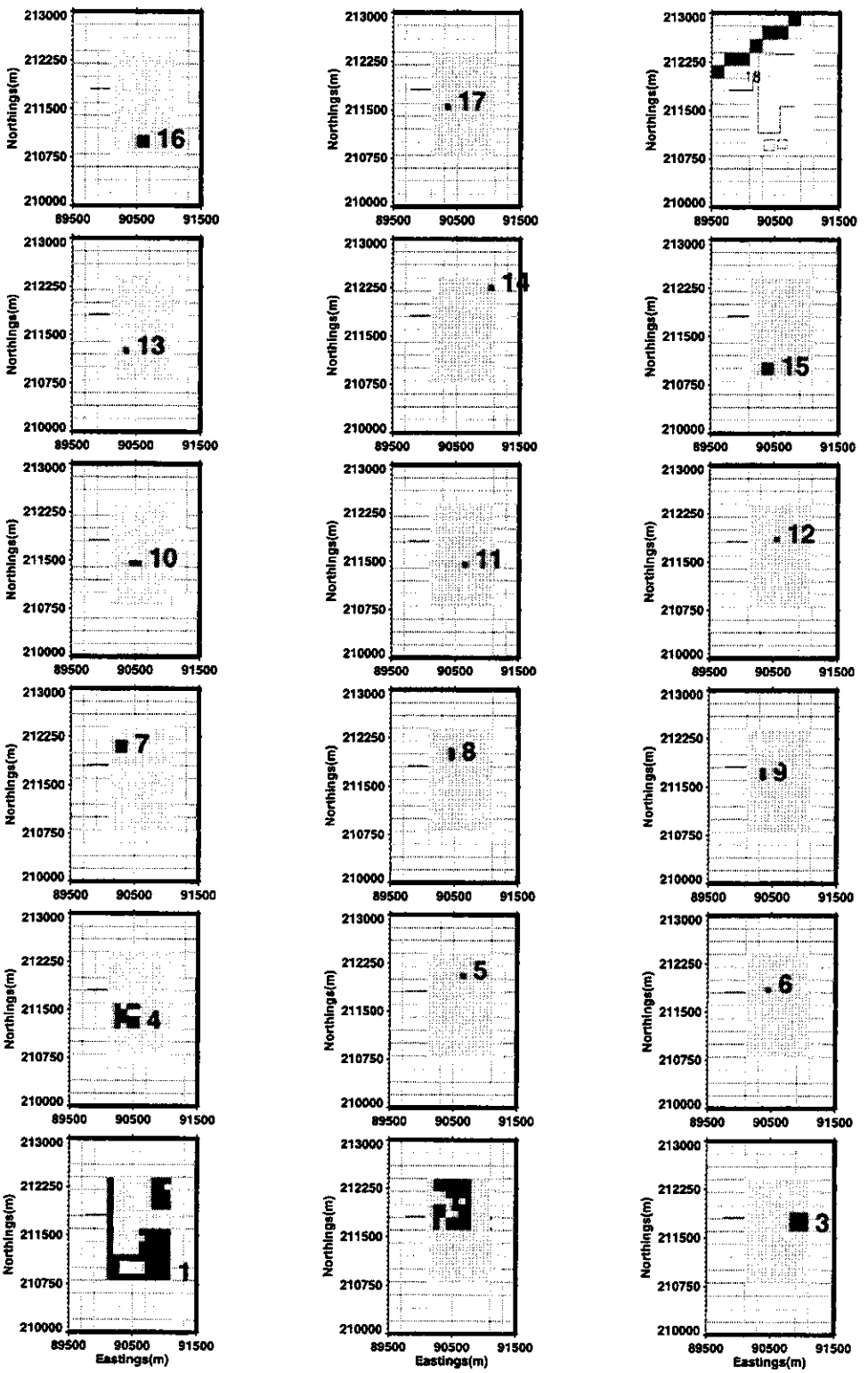


Figure 2-23 Distributed water source locations at the ICPP. Zones are numbered from 1 through 18 beginning in the lower left corner and increase up through the upper right figure. Zone 0 corresponds to the region not covered by Zones 1 through 18.

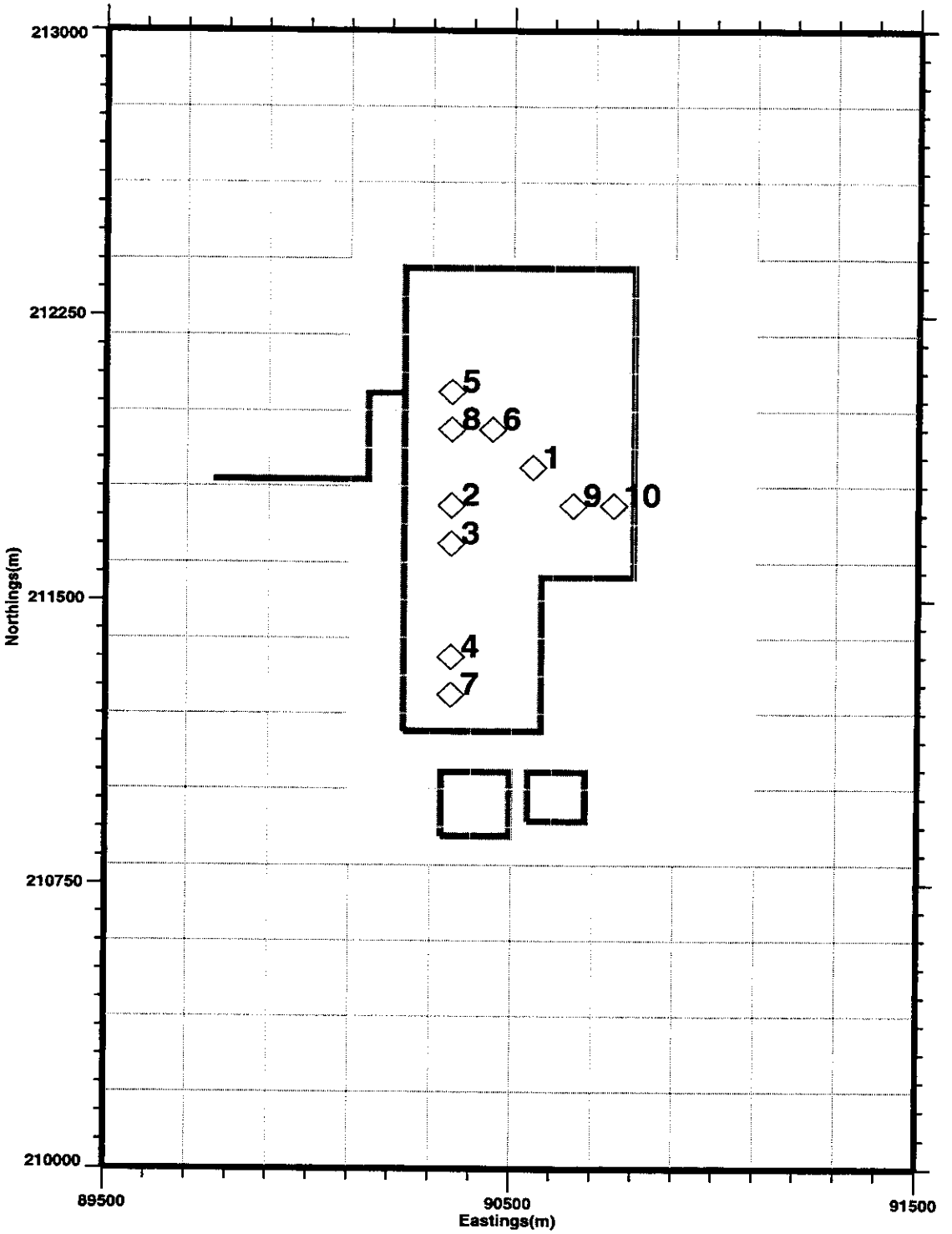


Figure 2-24 Source locations for point sources of water at the ICPP (steam vents).

2.2.7 Remaining Vadose Zone Water Boundary Conditions

Lateral boundary conditions for the remainder of the vadose zone model represent no-flow conditions. The bottom or outflow aquifer boundary was simulated as a unit gradient boundary representative of a no lateral-flow infinite-contaminant sink condition allowing contaminant fluxes to disperse into the aquifer. These contaminant and water fluxes were then input into the upper layer of the aquifer model as the upper boundary condition.

2.3 Aquifer Simulation Domain

2.3.1 Model Extent

The aquifer model domain extends from approximately 2.5 km north of the ICPP facility to approximately 11.6 km south of the southern INEL boundary in the north-south direction and approximately 6.5 km east of the ICPP facility to approximately 25.2 km west of the RWMC facility in the east-west direction as shown in Figure 2-25.This domain includes a region north of the TRA facilities to allow incorporating the primary TRA contaminants of concern into the WAG-3 aquifer model. This was required because the TRA plumes may combine with the ICPP plumes and contribute to the cumulative ICPP groundwater risk, within the time frame of interest to WAG-3.

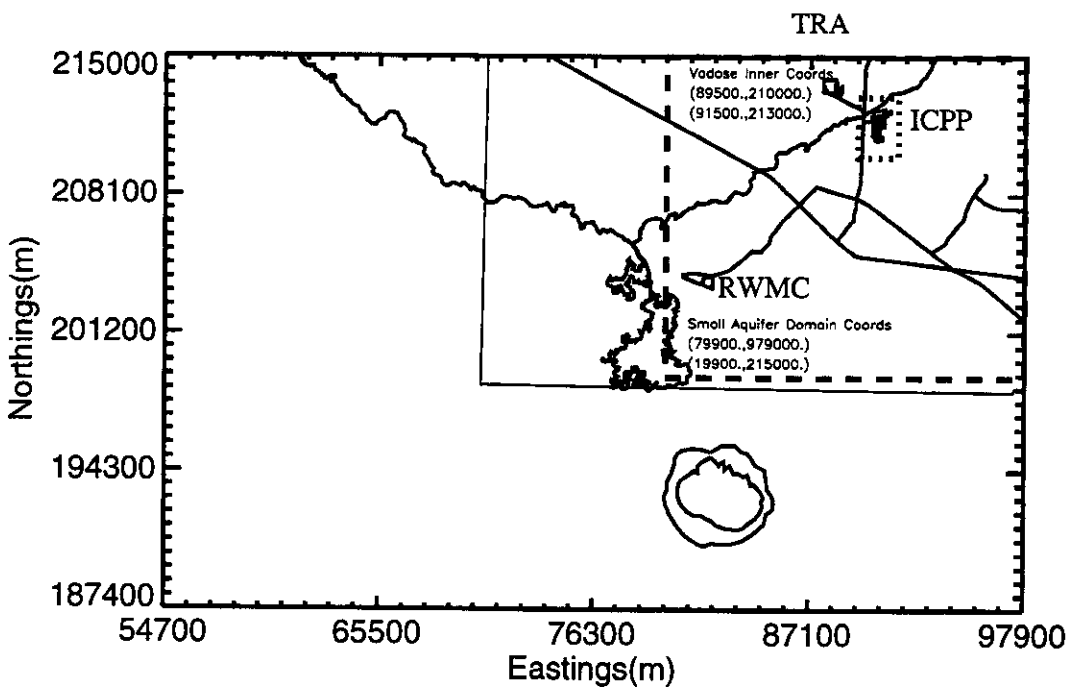


Figure 2-25 Aquifer and vadose model domains. Primary TRA facilities are shown north-west of the ICPP facilities, the RWMC is in the southwest of the model domain.

This modeling domain is three dimensional, and covers a large areal extent in order to allow simulated contaminant transport to remain within the modeling domain. However, most of the contaminants examined should not require the domain to be as large as shown in Figure 2-25. To reduce computational time, a smaller domain will be used for most of the contaminant transport simulations. This smaller aquifer domain is shown in Figure 2-25 by the thick dotted line, and is reproduced in Figure 2-26 below.

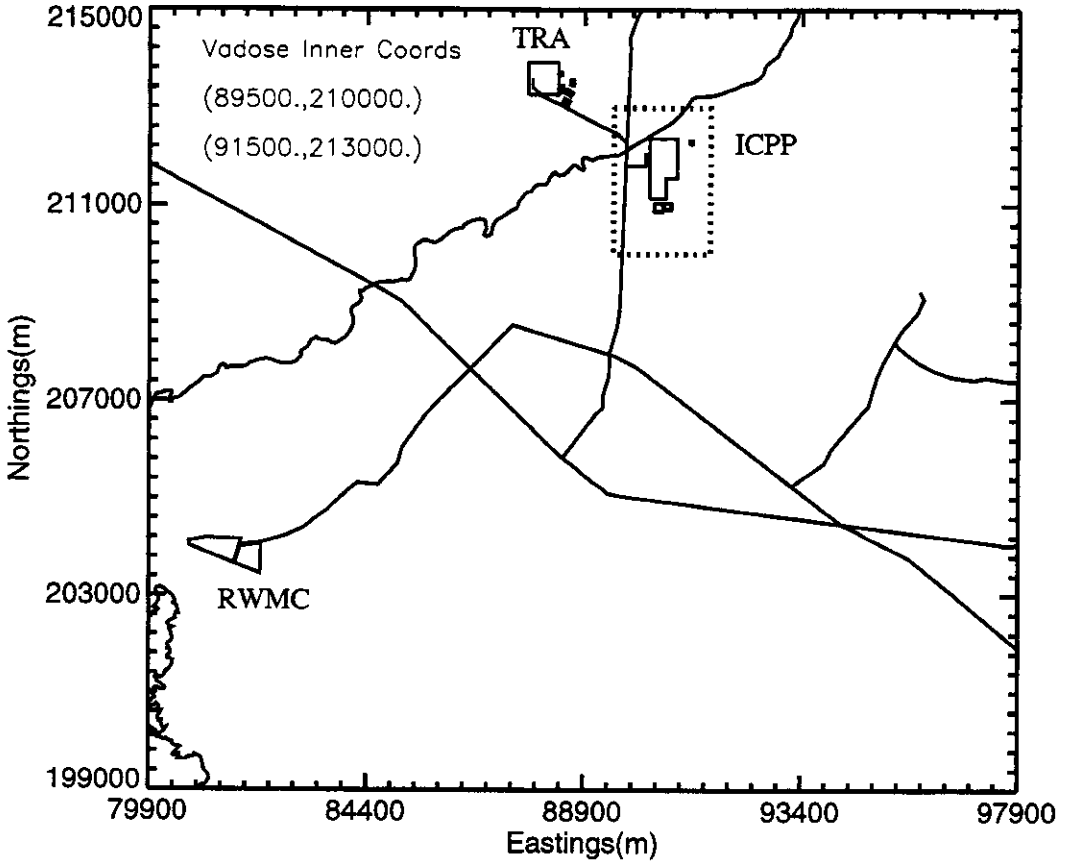


Figure 2-26 Smaller aquifer domain used for selected contaminants. Primary TRA facilities are shown north-west of the ICPP facilities, the RWMC is in the southwest of the model domain.

2.3.2 Domain Discretization

The areal extent shown in Figure 2-25 has been discretized into 1200m x 1200m grid blocks as shown in Figure 2-27 with three areas of local refinement. The first level of refinement is applied to the small-scale aquifer model depicted in Figure 2-26. This area is shown in Figure 2-28. In both aquifer models, local refinement corresponding to the discretization level applied in the vadose zone model is used for the footprint of the ICPP (200m x 200m) and also in the vicinity of the TRA with 400m x 400m grid blocks used for the area outside of those locally refined regions as shown in Figure 2-28.

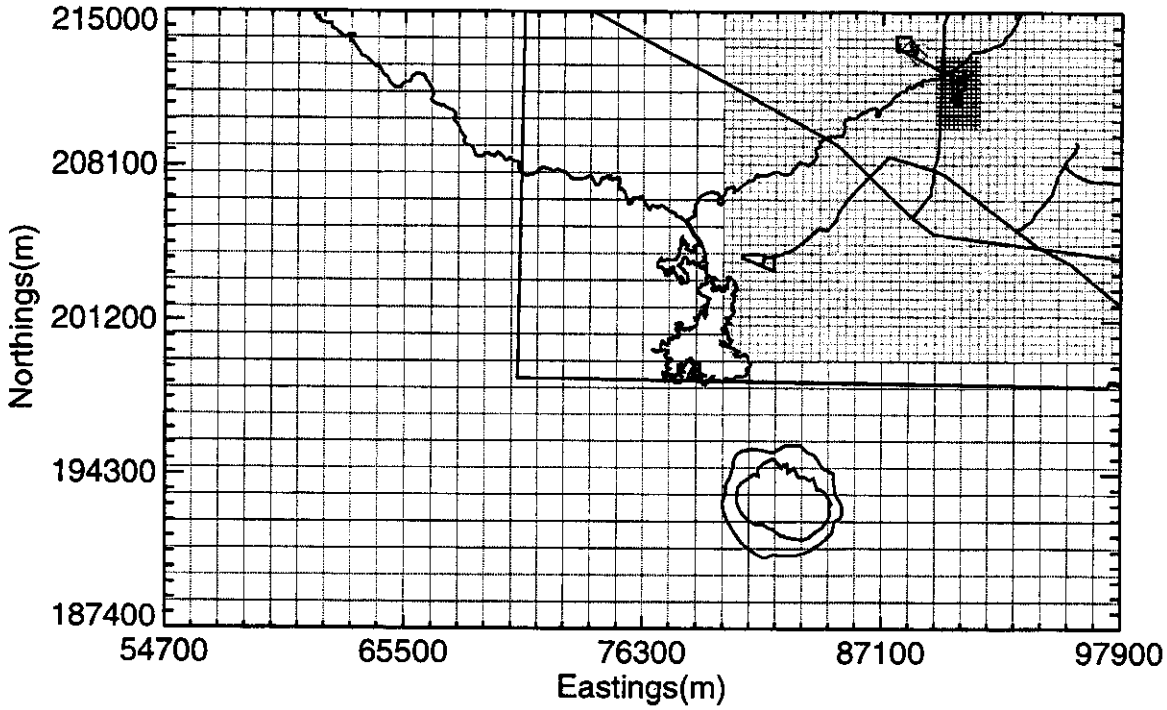


Figure 2-27 Discretized aquifer model domains. The base grid is 400mx400m, with the refined areas

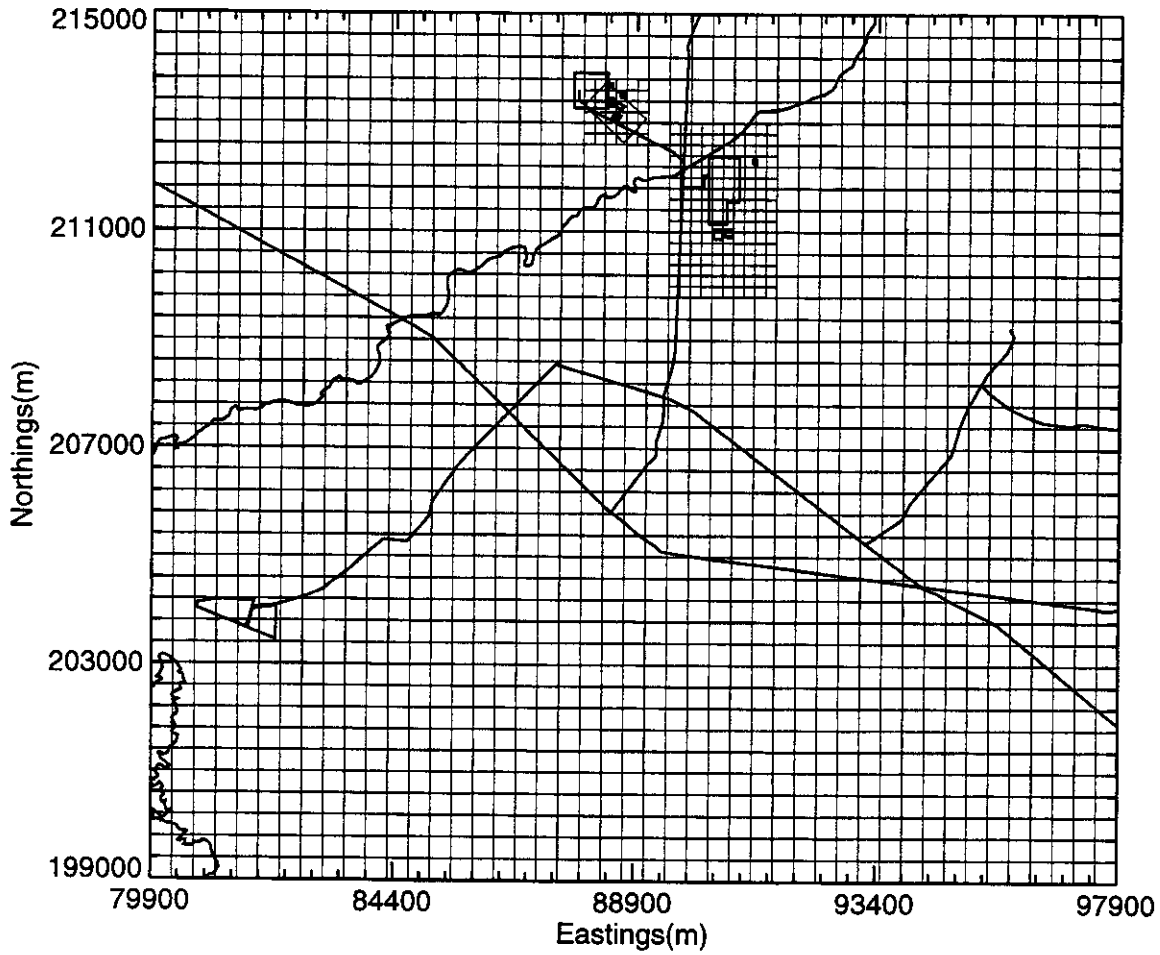


Figure 2-28 Discretized aquifer model domains. The base grid is 400mx400m, with the refined areas over the TRA and ICPP facilities gridded at 200mx200m.

The vertical aquifer domain extends downward from an elevation of 1360m to an elevation of 1284m. This total depth was chosen based on the completion intervals of the primary ICPP pumping and injection wells (CPP-01, CPP-02, CPP-03, and CPP-04) as shown in Figure 2-29. Placing the bottom aquifer model boundary at that depth dictates an effective aquifer thickness. This thickness was selected to be below the bottom of the primary injection well to allow vertical mixing of contaminants to be modeled. Selecting a larger vertical depth would allow contaminants to mix throughout a larger vertical region, possibly resulting in excessive dilution. Although this effective thickness marginally encompasses the CPP-04 pumping well, that well is upgradient of the injection well, and thus should not have an overly large effect on the down gradient contaminants.

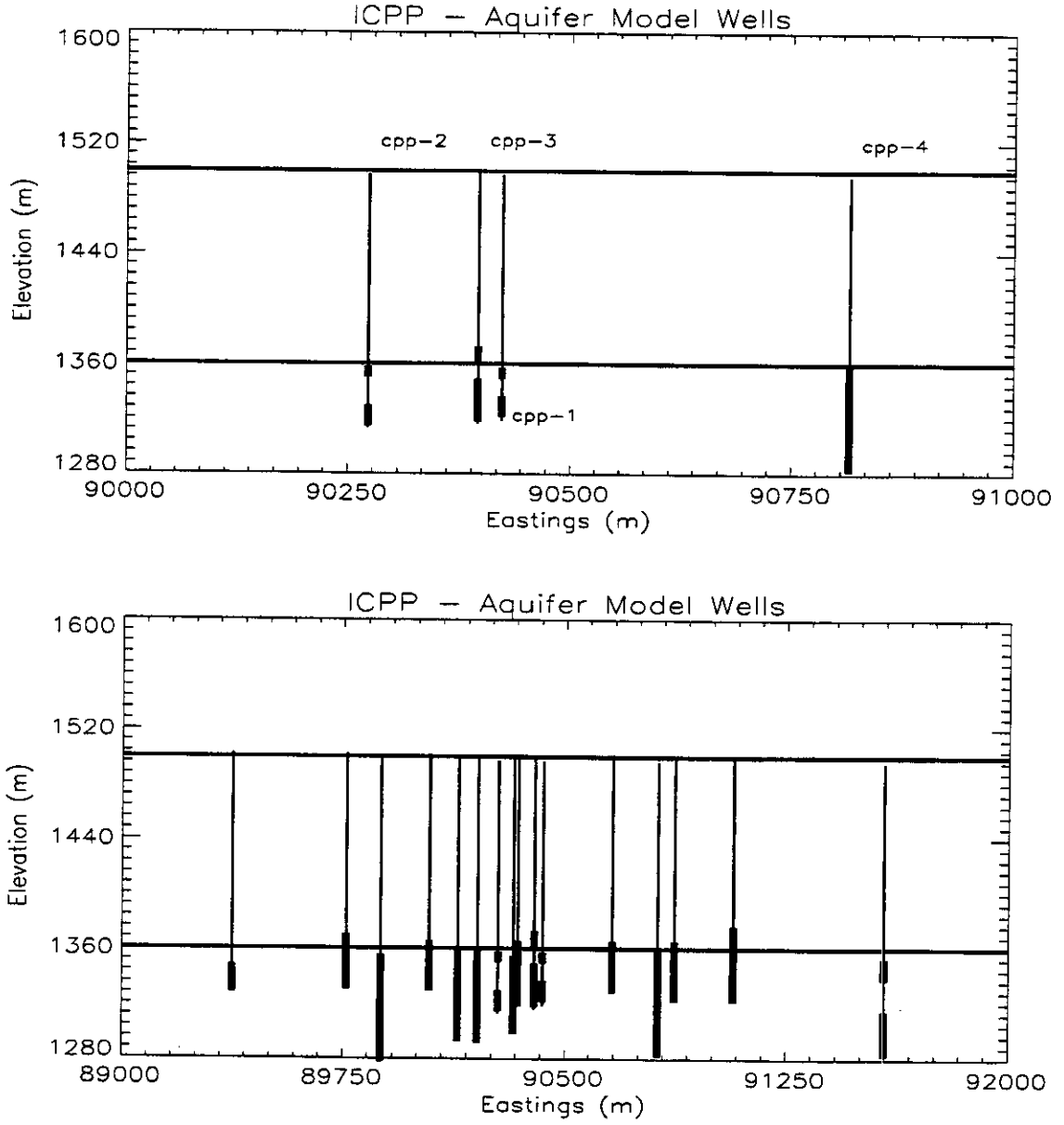


Figure 2-29 Wells with vertical well screens completed in the aquifer at the ICPP. The upper figure shows the pumping wells (CPP-01, CPP-02, and CPP-04) and the injection well (CPP-03). The lower figure shows all of the USGS monitoring wells in the area.

2.3.2.1 3-D Representation of Aquifer Stratigraphy

The I basalt flow, HI interbed and upper basalt unit were combined into the following 3-dimensional domain in area covered by the small aquifer model by preserving the I basalt flow top and assumed thickness to

the bottom of our modeling domain as a function of horizontal location (Figure 2-30). The I basalt flow and HI interbed were not included outside of the small aquifer domain. As indicated in Figures 1-14 and 2-30, the I basalt flow outcrops along the north - to north-west boundary. Note also that the slope of the I basalt flow near the north-west of the region shown is steeply angled downward. High dip angles are usually associated with more fractures which means that the top of the I basalt flow will exhibit higher permeability, with the permeability decreasing in the flatter regions to the south. This distinction between an upper and lower I basalt region is indicated by the two darker shades in Figure 2-30. The lightest shaded (not white) region represents the HI sedimentary interbed. The vertical discretization is uniform at a spacing of 7.6m.

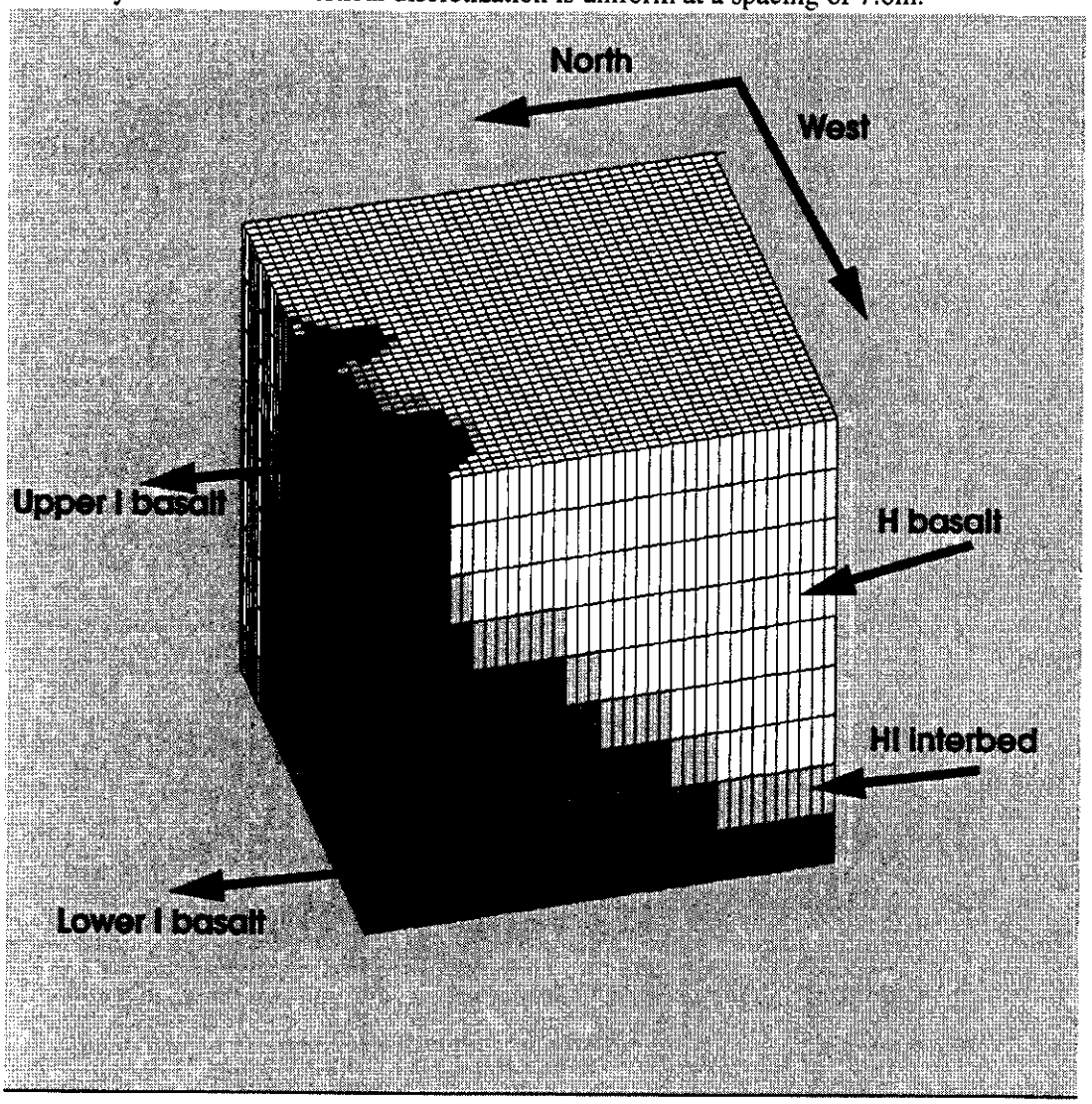


Figure 2-30 3-D representation of effective interbeds.

2.3.3 Assignment of Hydrologic Properties

As stated in Section 1.3.3, there are 4 distinct Stratigraphic types in the aquifer region. These include an upper I basalt unit; a lower I basalt unit; the HI interbed, and the H basalt. Estimates of permeability for the I basalt region, wells local to the ICPP facility, and regional estimates of hydraulic conductivity form the data base for aquifer hydraulic values. The I basalt unit was assigned permeabilities representative of those obtained in the ICPP pumping and injection wells, larger scale regional permeabilities were taken from the WAG-10 modeling effort, and local ICPP permeabilities were shown in Figure 1-15. As discussed below, these hydraulic parameters were assigned to the model grid based on the area in which they appeared.

2.3.3.1 WAG-10 hydraulic conductivity for the region external to the ICPP boundary

The hydraulic conductivities used in the aquifer model were first interpolated onto the large-scale WAG-3 aquifer model grid from the WAG 10 regional groundwater flow model. This model used an Eastern Snake River Plain regional water balance to define the boundaries in order to assure a water mass balance through the Eastern Snake River Plain aquifer. The hydraulic conductivities used in the WAG 10 model are shown in Figure 2-31 and given for the ICPP region in Table 2-4.

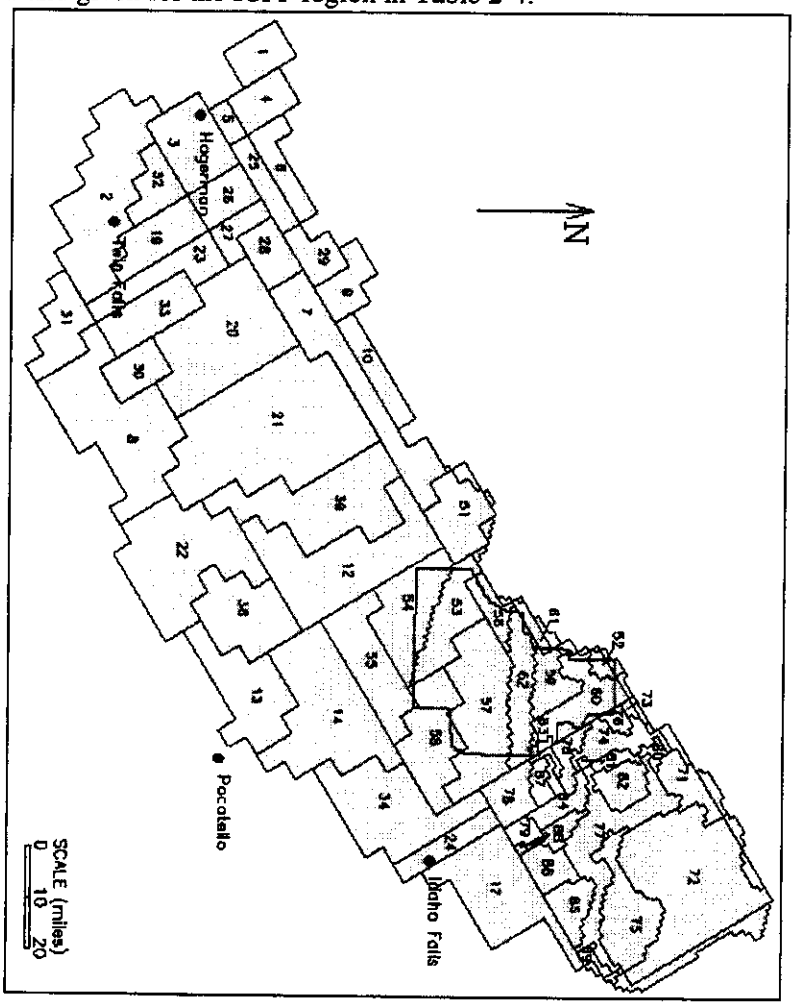


Figure 2-31 Wag 10 hydraulic conductivities and model domain.

These conductivities are similar in magnitude to the local ICPP values that were given in Table 1-5. Because of this similarity, the WAG 10 conductivities were felt to provide reasonable larger scale values for long term transport predictions for this model.Therefore, these hydraulic conductivities were converted to water permeability and assigned to every grid block in the domain.

Table 2-4 Wag 10 hydraulic conductivities in the vicinity of ICPP.

WAG 10 K Zone	Hydraulic Conductivity		Comment
	(ft/sec)	(ft/day)	
7	0.0021	181.4	This zone is south west of the INEL boundary.
12	0.0062	535.5	This zone is south west of the INEL boundary.
39	0.0012	103.7	This zone is south west of the INEL boundary.

Table 2-4 Wag 10 hydraulic conductivities in the vicinity of ICPP.

WAG 10 K Zone	Hydraulic Conductivity (ft/sec)	Hydraulic Conductivity (ft/day)	Comment
51	0.0017	146.9	This zone is west of the INEL boundary.
53	0.0053	457.9	ICPP is in this zone
54	0.0570	4925	This zone is south of the ICPP.
55	0.0529	4570	This zone is south east of the INEL boundary.
56	0.0036	311	This zone is west of the ICPP.
57	0.0116	1002	This zone is east of the ICPP.

2.3.3.2 I basalt flow and HI sedimentary interbed permeabilities

As stated in Section 1.3.3, the upper I basalt unit, lower I basalt unit, and the HI interbed are the dominant stratigraphic features in the saturated zone. The upper I basalt flow and lower I basalt flow differ hydraulically because the I basalt flow dips steeply near the north- to north-west boundary of our model domain. This dip means that the top of that basalt flow is probably more highly fractured and thus exhibits higher permeability, with the permeability decreasing in the flatter regions to the south. Distinguishing an upper and lower I basalt region was done by assigning a value representative of the CPP-01, CPP-02, and CPP-3 wells (1.3e6 mDarcy from Table 1-5) to the upper I basalt region, and assigning one half of the lowest WAG-10 ICPP permeability (8.5e4 mDarcy) to the lower I basalt region. These values replaced the WAG-10 permeabilities in grid blocks containing the I basalt flow. However, because of lack of information and the large scale over which contaminant transport is to be predicted, the HI interbed and I basalt units were neglected outside of the inner small scale aquifer modeling domain.

To be consistent with the sediment properties used in the vadose zone, permeability of 4mD was assigned to the first layer of grid blocks overlying the I basalt flow. Assigning sediment properties uniformly over the I flow assumes that the HI interbed is 7.6 m thick and exists everywhere the I basalt flow exists.

2.3.3.3 Local ICPP permeability/hydraulic conductivity

The final level of refinement for hydraulic conductivities in the ICPP aquifer model incorporated ICPP local scale field data. These local scale hydraulic conductivities were shown in Figure 1-15 and were initially applied throughout the vertical profile defined by the footprint of the vadose zone model. Final values were assigned on the basis of model calibration, and as will be shown in Section 4.2.7 were adjusted upward from the values given in Table 1-5

2.3.4 3D Representation of Aquifer Domain Stratigraphy

Figure 2-32 illustrates the model discretization and the placement of the Wag-10 permeability zones in the large scale aquifer modeling domain. The vertical discretization is uniformly 7.6 m. Figures 2-33 and 2-34 illustrate the model discretization in the small scale model region and shows the placement of the Wag-10, I basalt, HI interbed, and local ICPP permeability zones. These figures were simply taken as a subset of the domain shown in Figure 2-32.

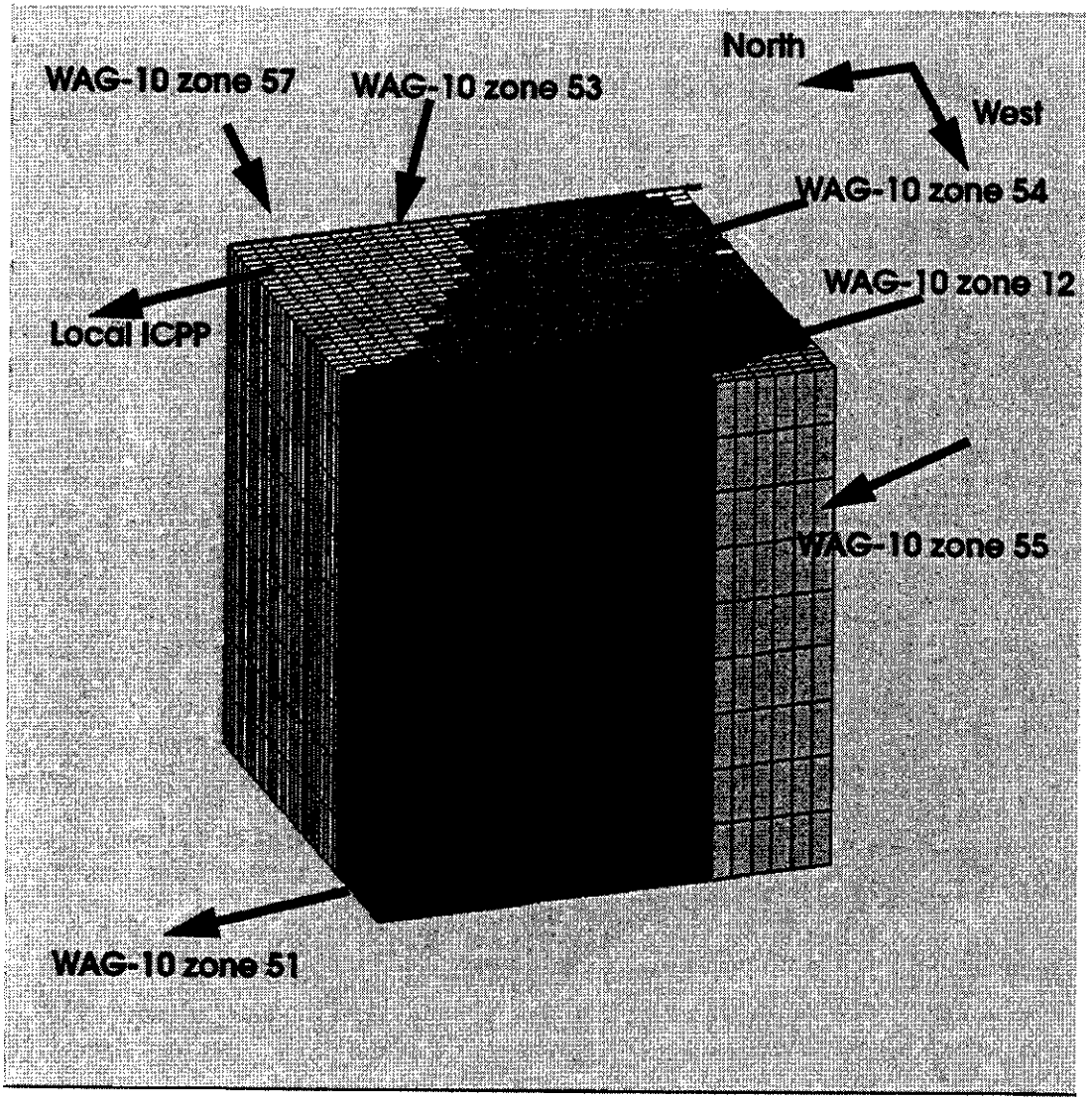


Figure 2-32 3D Large scale aquifer model discretization. Horizontal gridding is uniform prior to local grid refinement which takes place in TETRAD.

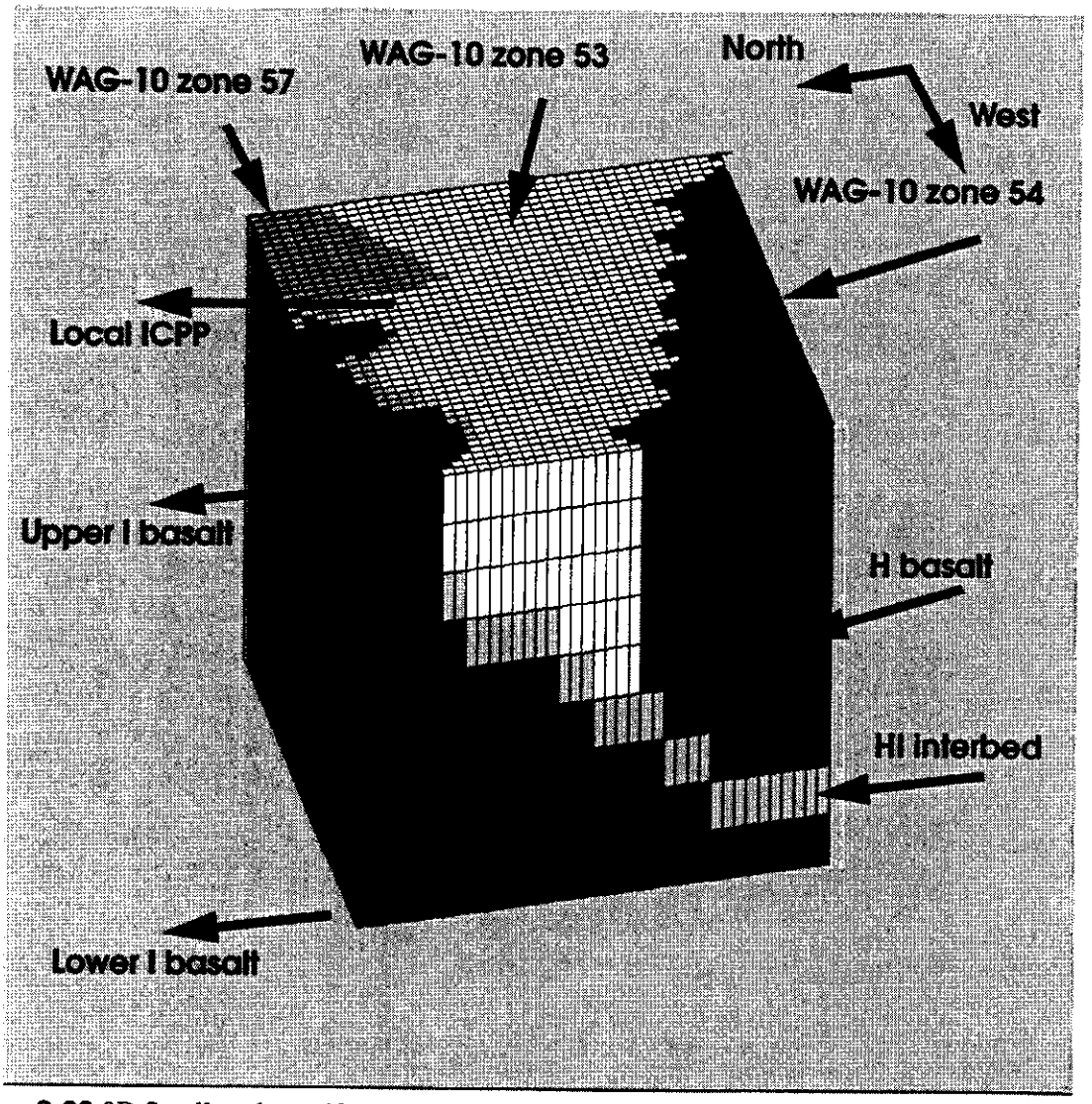


Figure 2-33 3D Small scale aquifer model discretization (subsetted from the large scale aquifer domain). Horizontal gridding is uniform prior to local grid refinement which takes place in TETRAD.

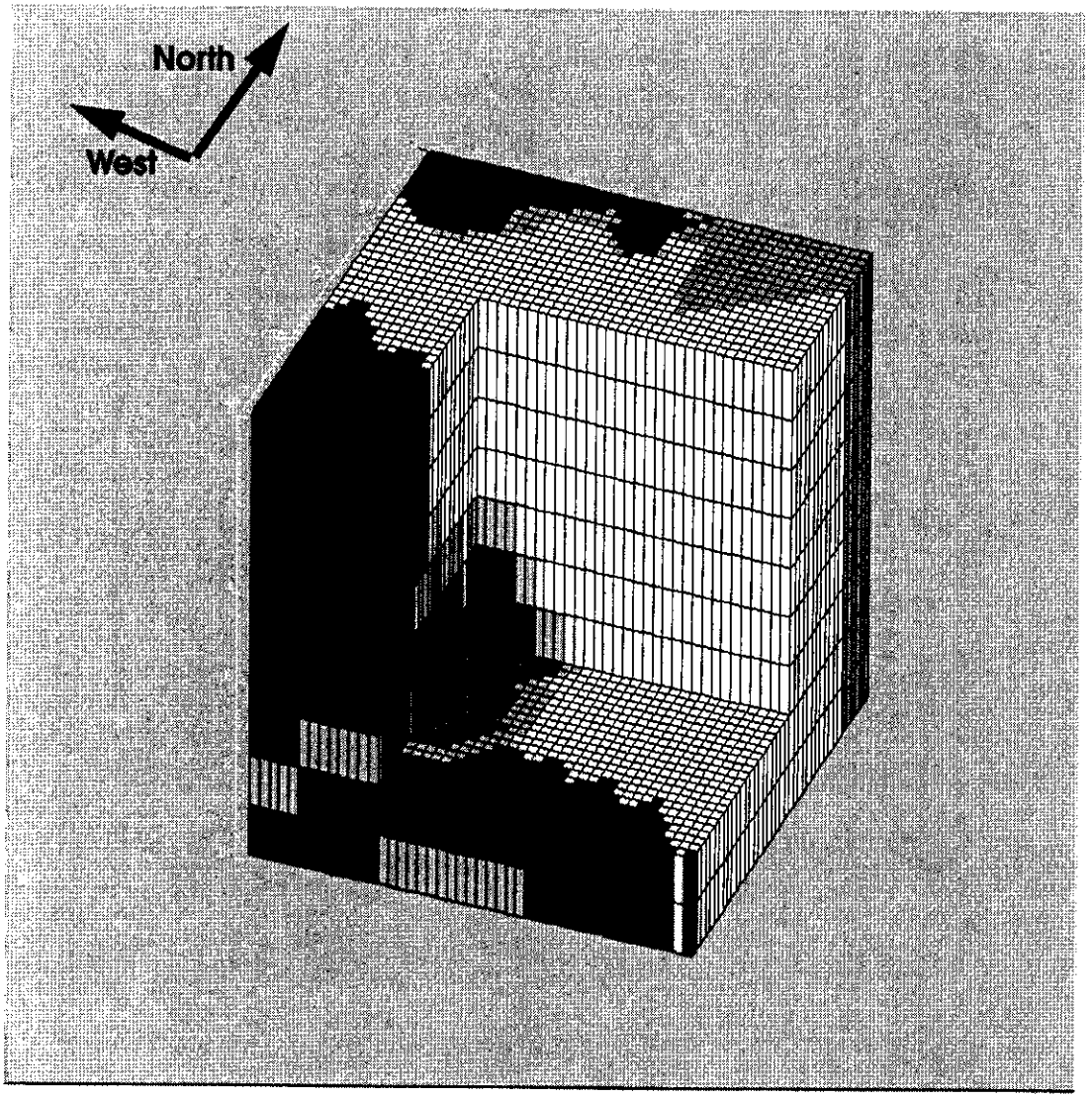


Figure 2-34 3D Aquifer model discretization showing material type interfaces in the small scale aquifer domain.

2.3.5 Aquifer Domain Water Sources

As with the vadose zone model, the Big Lost River flows across the WAG-3 aquifer model domain. The difference in flow between the stream gauging stations at Lincoln Blvd. and the diversion dam at the spreading areas was used to compute an average linear stream loss. The total loss of 9820 Acre-ft./yr. (Bennett, 1990) between the two gauging stations resulted in a net infiltration rate of 7.53 kg/m^2/day. This infiltration rate was applied in top layer of each horizontal grid block containing the Big Lost River upstream of the Lincoln Blvd. gauging station. Down stream of the Lincoln Blvd. gauging station, the Big Lost River flows intermittently and at a lower rate which has been estimated using the Lincoln Blvd. to the Playa area losses of 42,580 Acre-ft./yr (Bennett, 1990). Of the total amount it has been estimated that roughly 1418 Acre-ft/yr is lost within the northern portion of the aquifer model. This is roughly 1/30 th of the total losses in that span. Of the 1418 Acre-ft/yr, 608 Acre-ft/yr has already been applied in the vadose zone model (2.445 kg/day/m^2) east of the Lincoln Blvd. gauging station, and are subsequently fed into the aquifer model at the contact between the two models. The remaining 810 Acre-ft/yr is applied directly to the upper aquifer

model boundary in the area spanned by the aquifer model North-East of the northern edge of the vadose-zone model boundary.

In addition to the Big Lost River, there are two other primary water sources influencing the aquifer heads. These include pumping from CPP-02 and CPP-04, and reinjection into CPP-03. Historical pumping has alternated between the two pumping wells, averaging about 4500m^3/day. The time history of combined pumping rates is given in Figure 2-35. In this figure, it is apparent that 1) yearly rates are available prior to 1972, 2) from 1970-1990 the rate is variable, but that the volume could be captured with an average number, and 3) although high in the early 1990's, the pumping rates are declining back to the 1970-1980 average value.

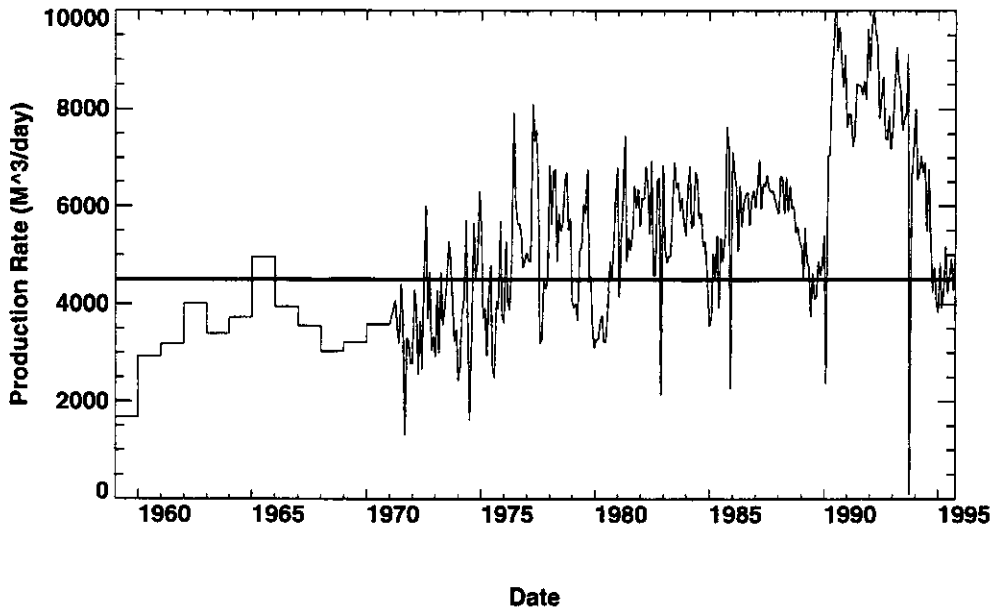


Figure 2-35 Combined pumping rates from CPP-01, CPP-02 and CPP-04. The average value applied in the model is 4.5e3 m^3/day.

Because the pumping wells are located close to each other and are upgradient of the injection well, a steady state pumping rate equal to the average pumping rate is used in this model. This pumping rate will be applied to CPP-04 and is equal to 4.5e3 m^3/day.

The reinjection rate at CPP-03 is time variant and was taken from the tritium disposal record. This reinjection rate is depicted in Figure 2-36. Because the contaminants prior to 1982 were disposed of with the injection water, this time variant injection history will be maintained.

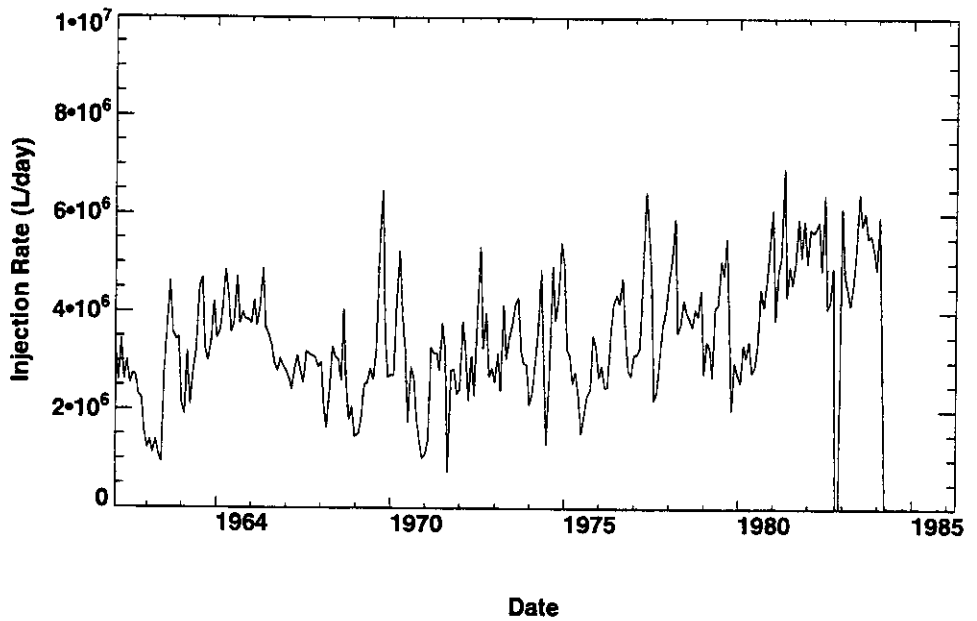


Figure 2-36 Injection rate at CPP-03.

2.3.6 Flow and Lateral Boundary Conditions

2.3.6.1 Summary of WAG-10 hydraulic heads

The boundary conditions used in the large scale aquifer model and small scale aquifer model were each taken from the WAG 10 regional groundwater flow model. This model used an Eastern Snake River Plain regional water balance to define the boundaries in order to ensure a water mass balance through the Eastern Snake River Plain aquifer. The hydraulic heads (computed by the WAG-10 model) used in the current aquifer model are shown in Figure 2-37. The heads along the perimeter of the WAG-3 model domain were interpolated from the WAG-10 top layer heads.

The WAG-3 initial parameter values and boundary conditions were based on the results of the WAG-10 model. The WAG-10 model was based on a combination of the Garabedian (1992) regional SRPA model and the Spinazola (1994) upper SRPA model. Both of these models were developed by the USGS. The WAG-3 aquifer thickness is 76 m and the WAG-10 aquifer was composed of 4 layers of which the top two layers were 60.8 m and 91.2 m, respectfully. Therefore, the WAG-3 aquifer thickness is a combination of the top two layers of the WAG-10 model and parameter values from the top two layers needed to be used to define the WAG-3 parameter values. Fortunately, the parameter values in the top two layers of the WAG-10 model are equal in the area simulated by the WAG-3 model, simplifying the definition of representative parameters in the WAG-3 model.

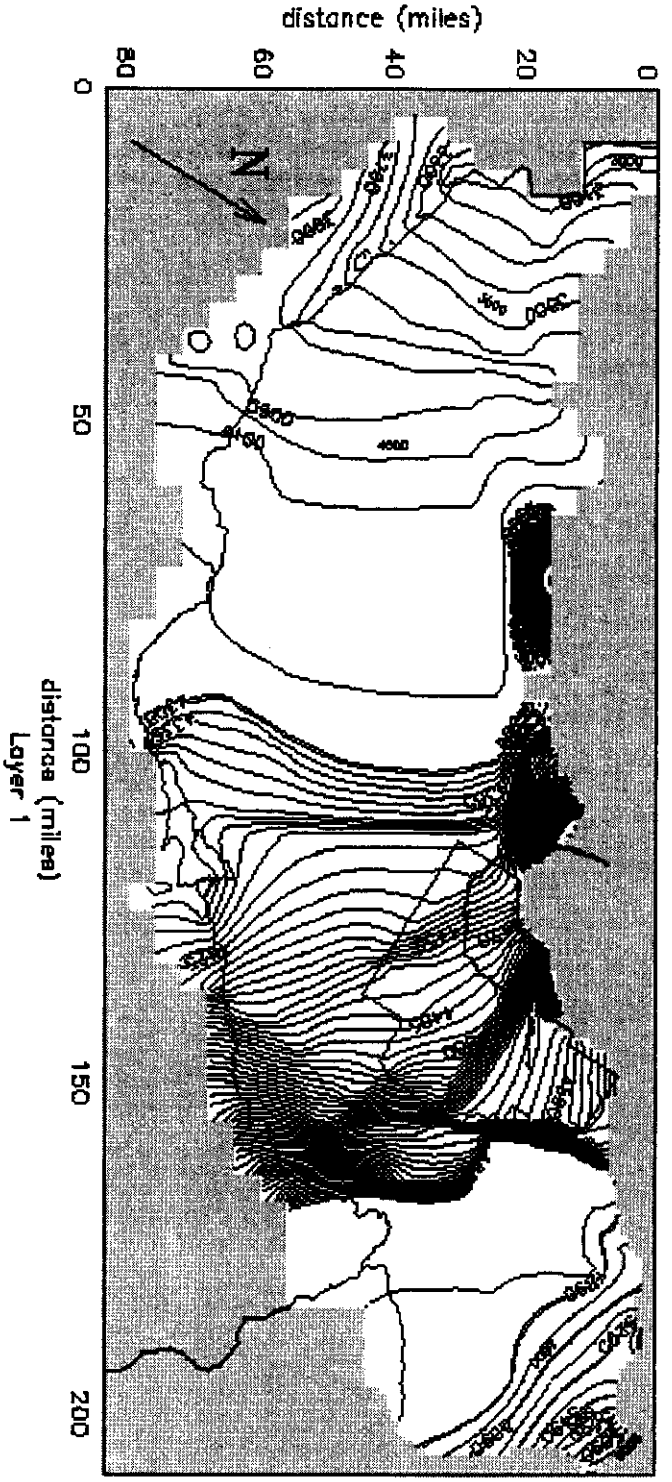


Figure 2-37 Wag 10 hydraulic heads. Contour interval is 100 ft. outside the INEL boundary and 5ft inside the INEL boundary.

2.3.7 Remaining Aquifer Water Boundary Conditions

The top and bottom of the aquifer were be modeled with no flow boundaries and the water flux through the vadose zone to the aquifer was input into the top numerical grid of the aquifer. This allowed a total system (vadose zone and aquifer) water balance to be maintained. Implicit in the no flow aquifer bottom assumption is that there is no vertical flux deeper than the assumed WAG-3 aquifer thickness of 76 m. Because the aquifer water balance is based on the WAG-10 results, the vertical component of flow in the WAG-10 model was examined to evaluate the error introduced by this no flow boundary condition.

The WAG 10 vertical fluxes between layers 1 and 2 were compared with the horizontal fluxes in layer 1. Within the region of the WAG 3 model, the average vertical flow component ranges from 4% to 4.5% of the horizontal flow component, depending on the location within the domain. There are larger vertical flow components near the margins of the SRPA, but not in the area of the WAG 3 model. Given the magnitude and uncertainty associated with the vertical flow component, a zero flux lower boundary appears to be a reasonable assumption.

3 VADOSE ZONE AND AQUIFER WATER CALIBRATION

3.1 Section Overview and Purpose

The purpose of this chapter is to present a representative collection of figures and data tables describing the vadose zone and aquifer water calibration results. As such, this chapter will include the following:

3.1 Section Overview and Purpose

3.2 Vadose Zone Model Water Calibration Results

- 3.2.1 Base Case Simulation Without the Big Lost River
- 3.2.2 Big Lost River Added to the Base Case Simulation
- 3.2.3 Reducing Sediment Saturated Permeability to 10 mD From the Base Case
- 3.2.4 Additional Refinement in the ICPP Footprint Area for k_{sat}=10 mD, With Big Lost River
- 3.2.5 Non Linear Basalt Characteristic Curves (Sediment k_{sat}=9 mD, Alluvium k_{sat}=10 mD)
- 3.2.6 Reduced Basalt Permeability (Basalt k_{sat}=9000 mD, Sediment=78 mD,&Alluvium=78 mD)
- 3.2.7 Increased Fluxes From Fire Water in the North (k_{sat}=10 mD)
- 3.2.8 Increased Big Lost River Fluxes (k_{sat} = 10 mD)
- 3.2.9 Decreased Sediment Permeability (k_{sat}=5 mD) With 10 mD Alluvium Permeability
- 3.2.10 Decreased Sediment Porosity (Sediment k_{sat}=5 mD, Alluvium k_{sat}=10 mD)
- 3.2.11 Anisotropic Sediment Permeability (k_{hsat}=8 mD, k_{vsat}=5 mD) and Alluvium k_{sat}=10 mD
- 3.2.12 Increased Background Infiltration (sediment k_{sat}=5 mD, Alluvium k_{sat}=10 mD)
- 3.2.13 Increased Facility Infiltration (Sediment k_{sat}=5 mD, Alluvium k_{sat}=10 mD)
- 3.2.14 Transient Big Lost River Fluxes (Sediment k_{sat} = 10 mD)
- 3.2.15 Reduced Sediment Permeability (k_{sat}=4 mD) With 78 mD Alluvium Permeability

3.3 Aquifer Model Head Calibration Results

The vadose zone simulation parameters are given in Table 3-1 and represent the parametric study with respect to key features controlling the formation of perched water in the vadose zone as well as including a sensitivity to most of the primary water source volumetric rates applied at the ICPP. Specifically, this table illustrates that the sensitivity to sediment permeability, basalt characteristics, the application of fire line leaks, the influence of the Big Lost River, and local grid refinement are examined. Results of these simulations will be presented in the form of saturation contour plots for various time periods as well as a forty year saturation condition in each of the wells compared to measured field data. The forty year saturation plots are given for wells in which perched water is known to exist as well as in wells in which perched water is not typically found.

Unlike the calibration process for the vadose zone, where an extensive sensitivity study was performed during the perched water calibration, the bulk of the aquifer sensitivity study was done as a part of transport calibration. As a result, only the heads resulting from the final transport calibration run will be given here. The primary reason for this is that transport is governed by the insitu velocity and not just the head distribution. Thus, matching the heads does not imply that transport velocity is appropriate. For the purposes of aquifer flow and transport calibration, it was decided to concentrate on matching the breakthrough curves of tritium to field data rather than matching heads at wells. This was done in part because a steady state head model was used to try to capture long term effects of the transient head on transport. This is different than the calibration of the vadose zone model because there were sufficient field data to calibrate the transient infiltration (pressure and saturation), but not enough to extensively calibrate to chemical transport.

3.2 Vadose Zone Model Water Calibration Results

Using the water sources presented in Section 1.5.2 and the hydraulic parameters given in Section 2.2.5, the infiltration of water at the ICPP was simulated. As a starting point, the background precipitation of 1 cm/yr (corresponding to Zone 0) was applied uniformly at land surface, and the modeling domain was allowed to equilibrate. At this point, a steady-state moisture distribution was achieved that should correspond to ambient conditions existing before the land inside the fenced area was disturbed and before process water application began (roughly 1954). There is no means by which this condition can be quantitatively verified. However, qualitatively, one would expect moisture distributions representative of those observed throughout the INEL. After this initial steady-state condition was achieved numerically, the precipitation/infiltration rate was increased inside the facility boundaries, and the remaining process water was simulated. The increased infiltration rates throughout this transient period allows perched water to form on the interbeds. The amount of perching is a function of applied water rates and the permeability characteristics of the basalt and interbed zones.

Calibration of the water model progressed through key stages in which the sensitive calibration parameters were adjusted. These parameters are summarized in Table 3-1 and are discussed in detail below. As indicated in Table 3-1, model sensitivity to 1) the saturated permeability in the alluvium, 2) saturated permeability in the sediment layers, 3) location and amount of water due to line leakage, and 4) contribution of the Big Lost River were examined. Performance measures for the water calibration consist of comparing perched water levels at model "well points" to the average perched water elevations observed in wells.

Not all of the simulation results obtained thus far are presented here because not all parameter combinations examined have significant influence on the formation of perched water. Additional calibration simulations to fine tune parameters by examining chloride releases from the percolation ponds at perched water well locations in order to simulate measured releases will be presented in Section 4.1. Table 4-1 contains the final calibrated set of hydraulic parameters that will be used for the prediction of transport through the vadose zone.

Table 3-1 Parameter groups used in the key stages of vadose zone water model calibration.

Simulation Stage	Key Feature	Alluvium & Interbed Saturated Permeability (ksat)	Line Leak Area of Application	Big Lost River Flux	Grid Discretization
		md		kg/day	(m x m)
3.2.1 (3 dmi)	Base case with no Big Lost River contribution.	78	uniform over fine grid domain	0	200 x 200 base
3.2.2 (mibl1)	1 with a steady-state Big Lost River	78	uniform over fine grid domain	2.74×10^6	200 x 200 base
3.2.3 (mibl3)	2 with lower interbed permeability	10	uniform over fine grid domain	2.74×10^6	200 x 200 base
3.2.4 (mirbl3)	3 with refinement under the ICPP footprint as shown in Figures 1-18- 2-24	10	uniform over fine grid domain	2.74×10^6	200 x 200 base with 100 x 100 local refinement
3.2.5 (mibl11)	4 with nonlinear basalt characteristic curves (beta=3., Figure 2-21)	10	uniform over fine grid domain	2.74×10^6	200 x 200 base with 100 x 100 local refinement
3.2.6 (3dmibl)	1 with saturated basalt permeability reduced to 9000 md from 90000 md and sediment and alluvium permeability equal to 78 md	78	uniform over fine grid domain	2.74×10^6	200 x 200 base with 100 x 100 local refinement

Table 3-1 Parameter groups used in the key stages of vadose zone water model calibration.

Simulation Stage	Key Feature	Alluvium & Interbed Saturated Permeability (ksat)	Line Leak Area of Application	Big Lost River Flux	Grid Discretization
		md		kg/day	(m x m)
3.2.7 (33rbl5)	4 with 10 times more fire water applied in the North	10	North Fire water leakage increased by one order of magnitude	2.74×10^6	200 x 200 base with 100 x 100 local refinement
3.2.8 (mibl5)	4 with 2 times as much flux from the Big Lost River	10	uniform over fine grid domain	2.74×10^6	200 x 200 base with 100 x 100 local refinement
3.2.9 (mibl14)	4 with the interbed permeability reduced to 5 mD	10 alluvium 5 interbed	uniform over fine grid domain	2.74×10^6	200 x 200 base with 100 x 100 local refinement
3.2.10 (mibl17)	4 with the sedimentary porosity reduced to 0.4 from 0.487	10 alluvium 5 interbed	uniform over fine grid domain	2.74×10^6	200 x 200 base with 100 x 100 local refinement
3.2.11 (mibl20)	4 with 10 mD alluvium, 5 md Vertical interbed permeability 8 md Horizontal. interbed permeability	10 alluvium 8 md k_h for interbeds 5 md k_v for interbeds	uniform over fine grid domain	2.74×10^6	200 x 200 base with 100 x 100 local refinement
3.2.12 (mibl19)	4 with increased background infiltration of 4 cm/yr everywhere prior to application of process water, and thereafter outside of the facility boundaries.	10 alluvium 5 interbed	uniform over fine grid domain	2.74×10^6	200 x 200 base with 100 x 100 local refinement
3.2.13 (r4bl14)	4 with increased infiltration rates inside the facility boundaries from 10 cm/yr to 12 cm/yr	10 alluvium 5 interbed	uniform over fine grid domain	2.74×10^6	200 x 200 base with 100 x 100 local refinement
3.2.14 (r3bl14)	Transient Big Lost River, letting the Big Lost River fluxes occur for 1 month each year.	10 alluvium 5 interbed	uniform over fine grid domain	3.29×10^7 (30 days/year)	200 x 200 base with 100 x 100 local refinement
3.2.15 (mibl21)	4 with decreased interbed permeability of 4 mD, with the alluvium permeability equal to 78 mD	78 alluvium 4 interbed	uniform over fine grid domain	2.74×10^6	200 x 200 base with 100 x 100 local refinement

3.2.1 Base Case Simulation Without the Big Lost River

The first simulation presented here assumed that the contribution to the Big Lost River, which flows across the northern portion of the ICPP from the southwest to the northeast, was negligible. Computations were performed on a 200 m x 200 m grid assuming that the permeability in the alluvium and interbeds was 78 mD. The initial water saturation profile prior to application of process water for the base case without the Big Lost River is given in Figure 3-1. These saturation contours represent long-term or ambient conditions that result when background precipitation is applied at 1 cm/yr throughout the modeling domain. This figure shows a north-south cross-section through a state planar easting coordinate of 9.05e+04 m passing through the center of the east percolation pond. A graph distance of 0 m corresponds to a state planar northing coordinate of 2.130e+05 m, while a distance of 3000 m corresponds to a state planar northing of 2.1e+05 m (i.e., distance increases to the south). Land surface corresponds to a depth of 0 m, corresponding to an elevation of 1503 m.

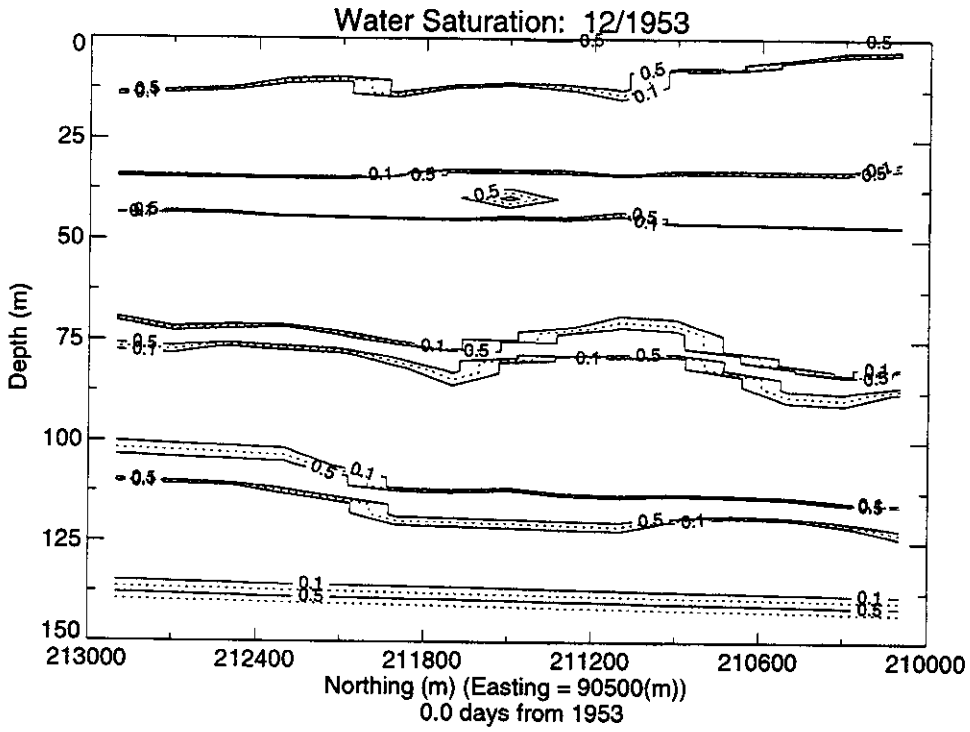


Figure 3-1 Initial water saturation condition prior to application of process water for the base case simulations without the Big Lost River.

Note that saturations are higher in the alluvium (0-12 m), upper interbeds (34-47 m), middle interbeds (68-82 m), lower interbeds (103-114 m) and approaching the unit gradient interval forming the top of the aquifer region. However, there are no perched water regions (saturations of 1.0). The bottom of the alluvium and upper interbed appear to dip to the north, while the middle and lower interbeds dip slightly to the south. Although the angles of dip are slight, their influence will become apparent as process water is supplied.

Process water was then applied to the steady-state initial condition shown in Figure 3-1. Rates of application are consistent with the totals given in Table 2-2 with the exception that the fire water was uniformly distributed over the 1,600,000 m^2 fine-grid region at a rate of 2.55e-02 kg/day/m^2. This uniform source was assumed before better information was obtained, indicating that, in fact, the fire-line leakage is primarily associated with the northern portion of the ICPP as indicated in Table 5.

Figure 3-2 illustrates the water saturation at 100 days after the initial application of process water to the base case simulation shown in Figure 3-1. Water under the percolation ponds has reached the first interbed Note that there is a region of slightly lower saturation appearing at land surface that corresponds to the area (distance=1650 m) of decreased alluvium thickness. In this cross-section, the influence of the sewage treatment plant (larger north water source) is not evident; however, it exists as indicated in Figures 3-5 through 3-9.

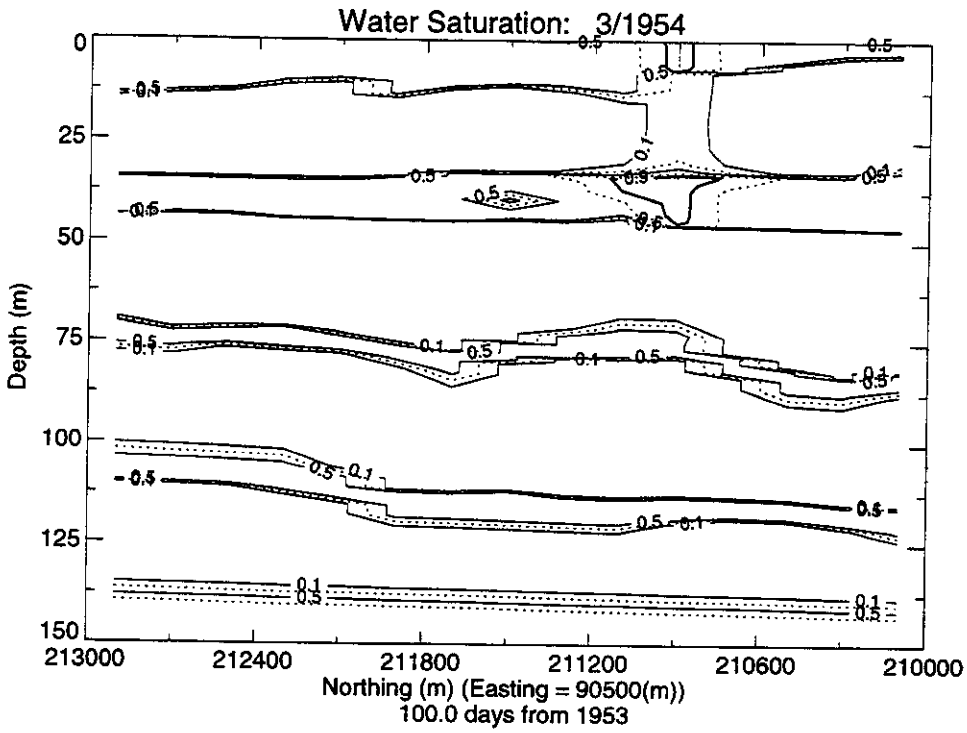


Figure 3-2 Water saturation at 100 days after the initial application of process water to the base case simulation shown in Figure 3-1. The two slightly elevated saturations appearing at land surface correspond to the percolation ponds in the south (distance = 2045 m) and to the area containing steam vent S-3 in the north (distance = 1650 m).

As simulation time progresses through the first 10,000 days (27.4 years), the water coming from the percolation ponds has reached the first three interbeds as shown in Figure 3-3. The influence of the north dipping upper interbed is manifested in higher saturations to the north, indicating that the percolation ponds have a far reaching influence in the upper interbeds. On the other hand, the south dipping middle interbed has not noticeably allowed saturations to increase to the south, indicating that the highly localized percolation pond flux is widely distributed by the first interbed. The zone of perching (saturations of 1.0) is relatively small and is located directly beneath the percolation pond area. Water originating in the north part of the ICPP is beginning to reach the first interbed, but has not yet done so. In addition, the saturations resulting from the north water bodies are not enough to cause perched water regions to form.

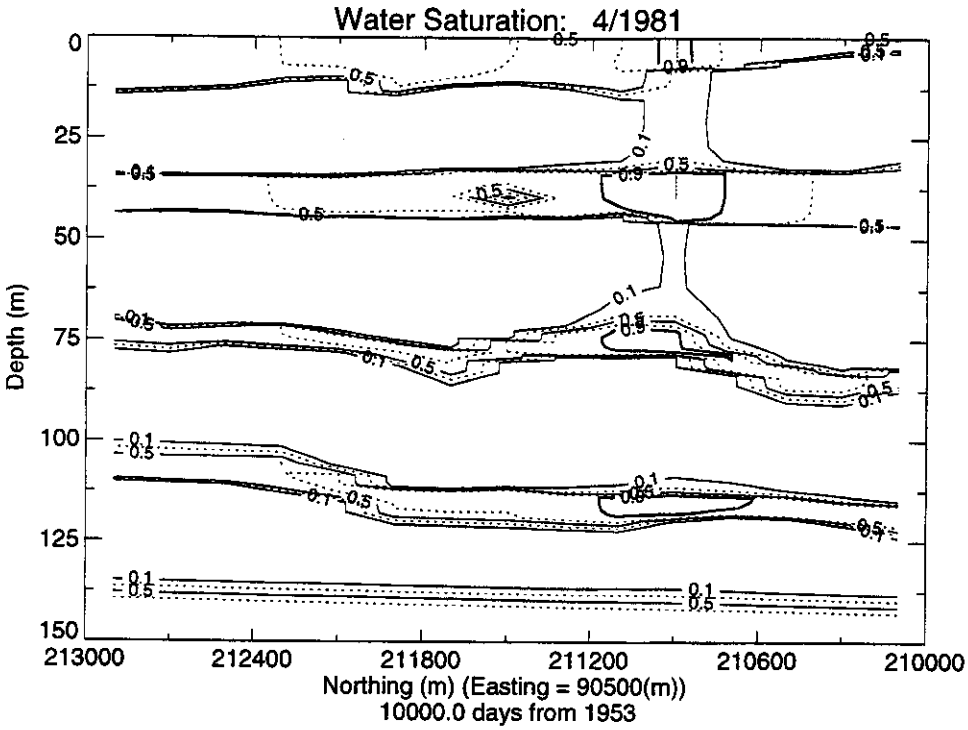


Figure 3-3 Water saturation 10,000 days (27.4 years, 1981) after the initial application of process water to the base case simulation shown in Figure 3-1. Influence of the percolation pond to the south and the combined distributed water sources to the north. Note the influence of dipping interbeds as saturations increase more to the north than to the south on the first interbed, and increase more to the south in the second interbed.

At 36500 days, (Figure 3-4) there is not an appreciable difference in saturation profile throughout the cross-section. This indicates that a steady-state situation is near and that given the input parameters for sediment permeability and water volumes, perched water regions will not form in the north. Note, however, that there is a very small amount of perching in upper, middle, and lower interbed directly below the percolation ponds.

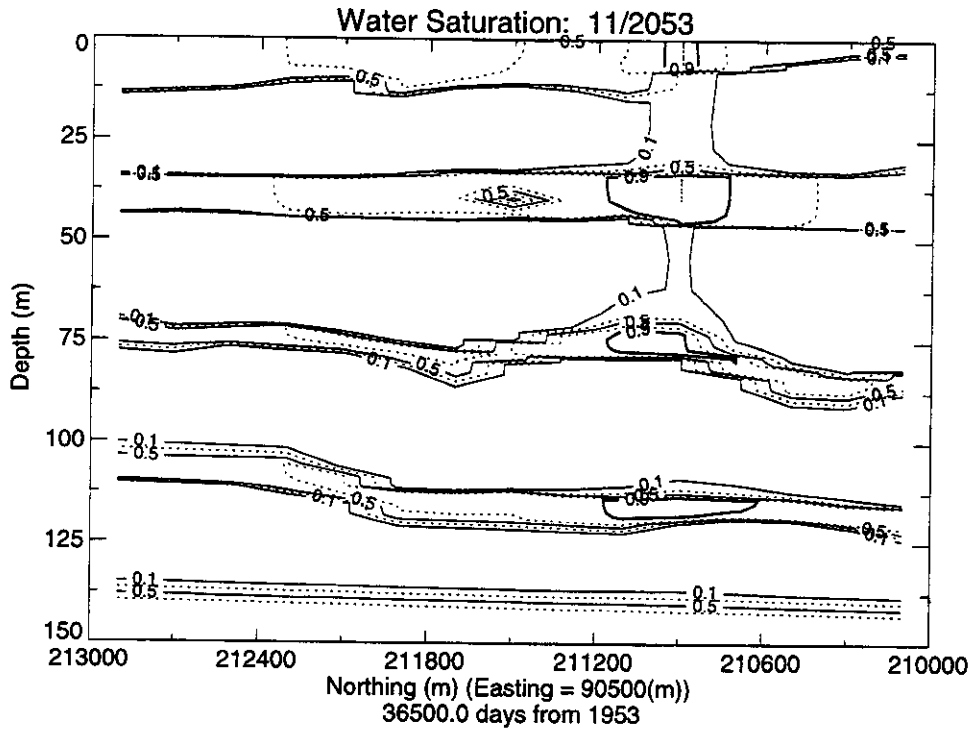


Figure 3-4 Water saturation 36,500 days after the initial application of process water to the base case simulation shown in Figure 3-1. No really noticeable change in saturations profile throughout the depth interval from 10,000 days. Note that there is no perching on the lower interbed and none at all to the north.

At a simulation time of 40 years (corresponding to 1994), the water saturation versus depth was plotted at points corresponding to wells in which perched water was observed (Figures 3-5 through 3-7). The vertical axis is elevation in meters, the horizontal axis is saturation. For each well, the dotted line represents the center of the completion interval and the thick dark line represents the top of the perched zone. Computed water saturation in each well is given as the thinner line, and perched water is achieved when the saturation reaches 1.0. Wells PW-02U1, PW-03U1, and PW-5U1 indicate very good agreement between predicted and observed perched water levels. Water levels in the northern wells are all underpredicted (wells plotted in Figures 1-16 and 1-17). Figures 3-8 and 3-9 give the same information for the wells in which perched water does not occur. For these locations, the model only has to predict saturations less than 1. to be correct. And it does predict correctly as can be seen in the figures.

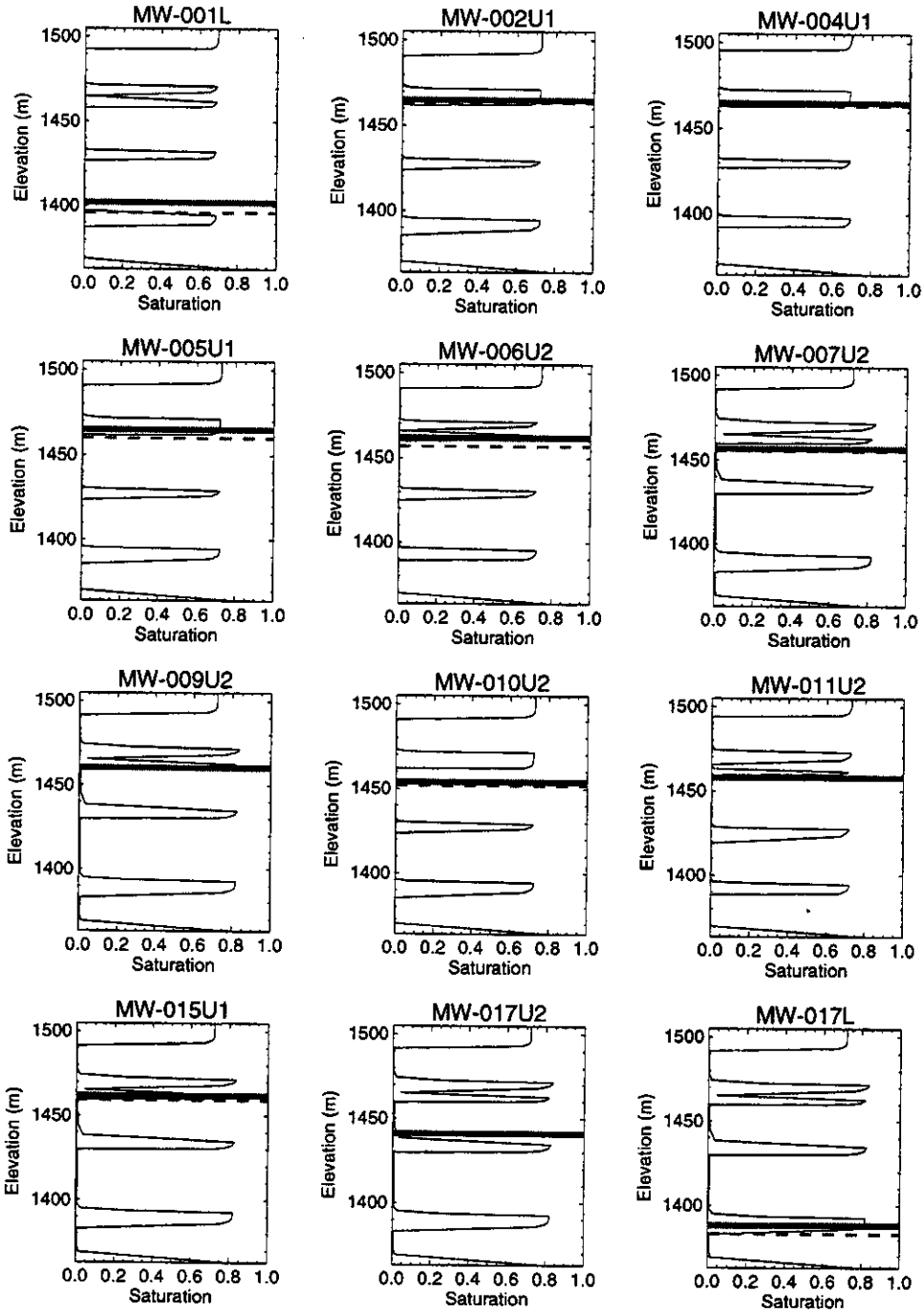


Figure 3-5 Water saturation as a function of elevation in wells that should show perched water. The dotted line is center of the screened interval, the thick dark line is the top of the perched water zone, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-1.

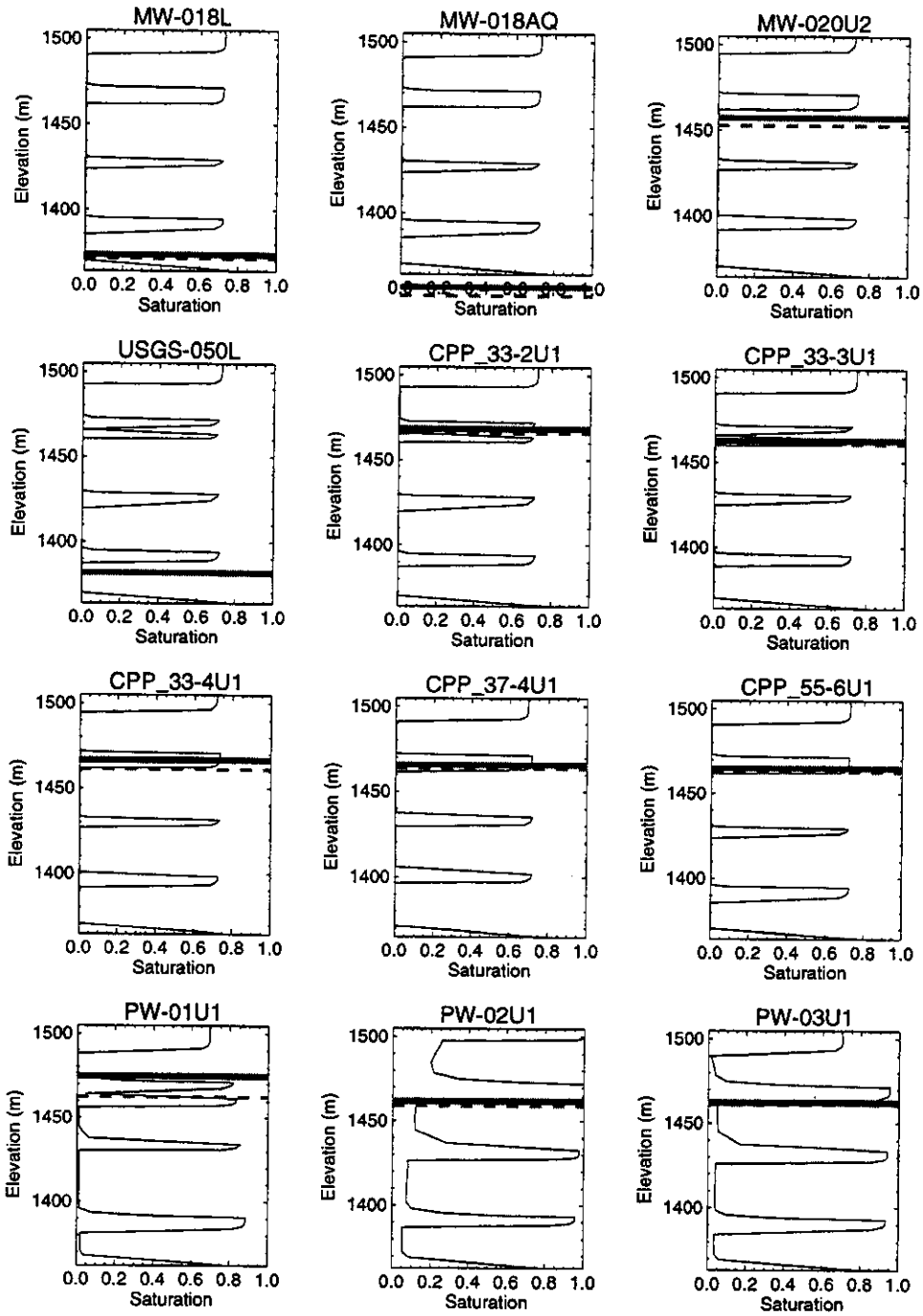


Figure 3-6 Water saturation as a function of elevation in wells that should show perched water. The dotted line is center of the screened interval, the thick dark line is the top of the perched water zone, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-1.

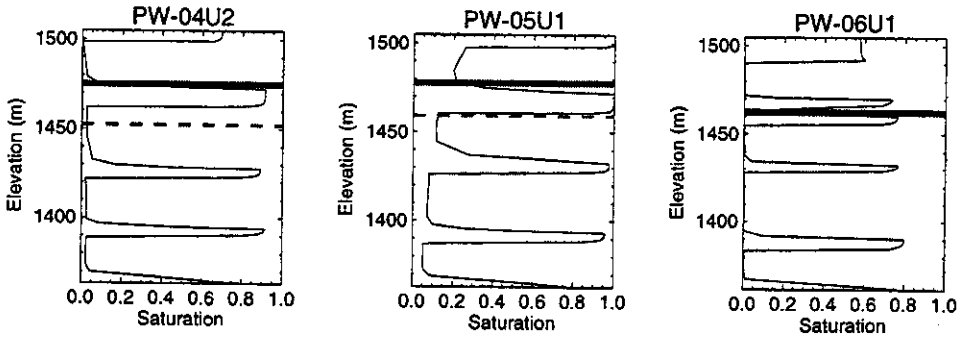


Figure 3-7 Water saturation as a function of elevation in wells that should show perched water. The dotted line is center of the screened interval, the thick dark line is the top of the perched water zone, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-1.

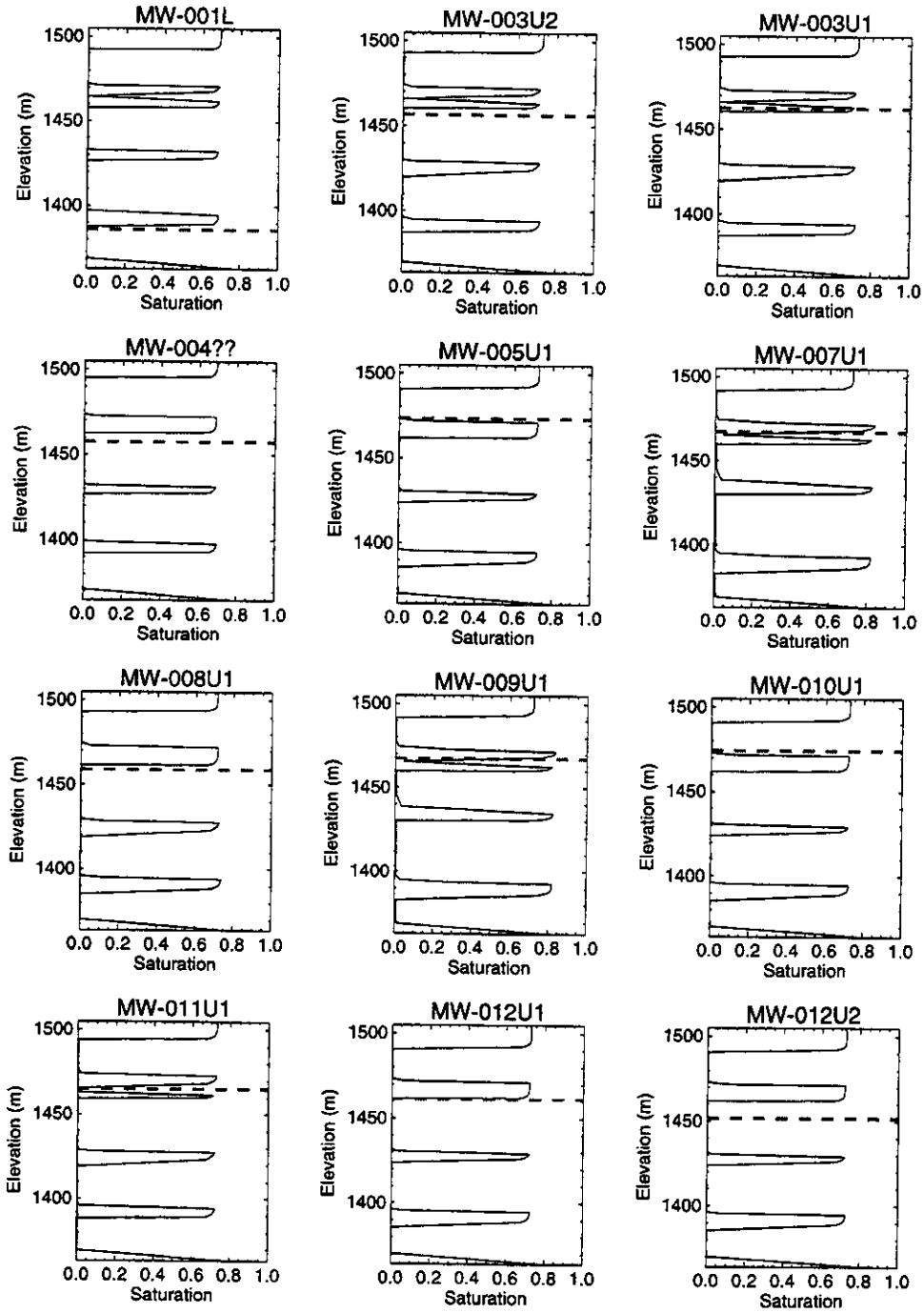


Figure 3-8 Water saturation as a function of elevation in wells that should not show perched water. The dotted line is center of the screened interval, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-1.

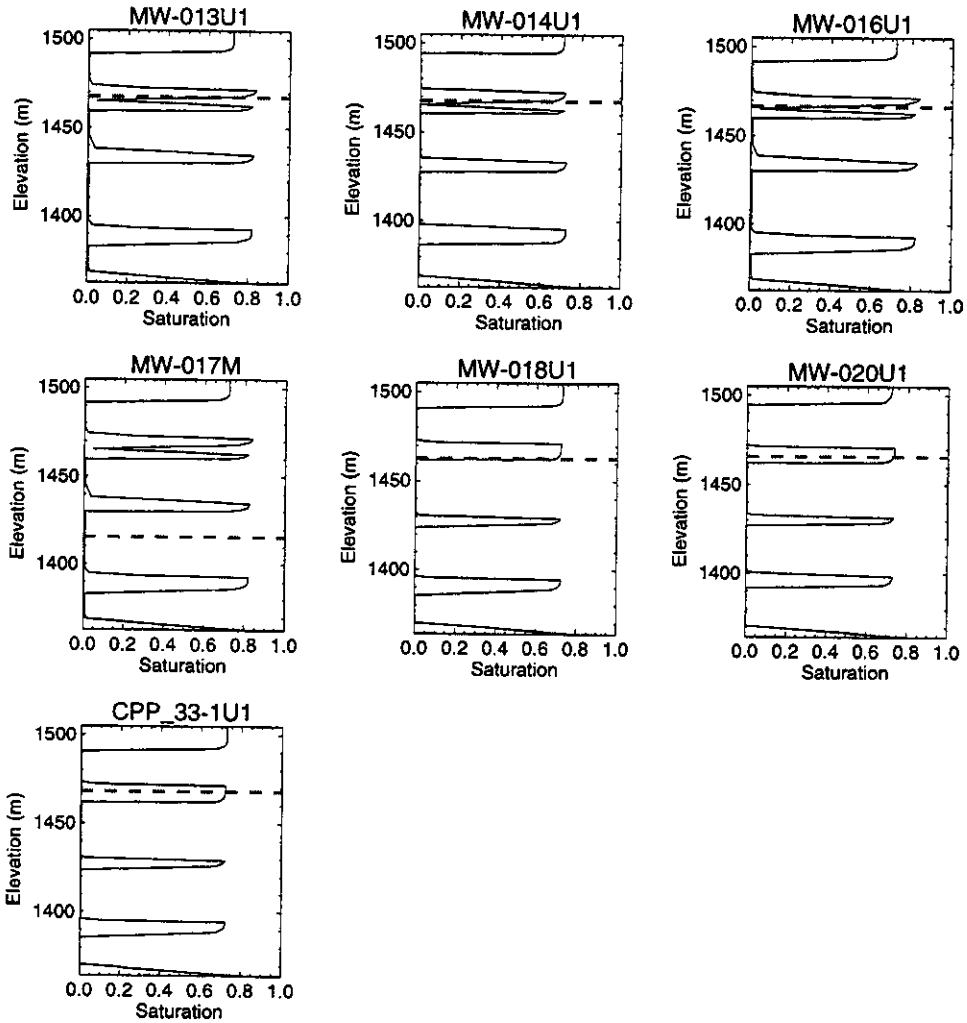


Figure 3-9 Water saturation as a function of elevation in wells that should not show perched water. The dotted line is center of the screened interval, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-1.

3.2.2 Big Lost River Added to the Base Case Simulation

Insufficient water to cause perching in the northern portion of the ICPP could be due to several factors, one of which is the influence of the Big Lost River that runs across the ICPP facilities as indicated in Figure 2-23. The volumetric contribution of the Big Lost River has been estimated to be 0.978e+01 kg/day/m^2), and is one of the larger water sources in the northern ICPP area. The Big Lost River is not considered to be process water, but like the ambient infiltration rate of 1 cm/yr, it is a long-term steady-state water source. As such, it contributes to the initial conditions or model time 0 as shown in Figure 3-10. These saturation contours represent long-term or ambient conditions that result when background precipitation is applied at 1 cm/yr throughout the modeling domain, and the Big Lost River fluxes are applied in Zone 18.

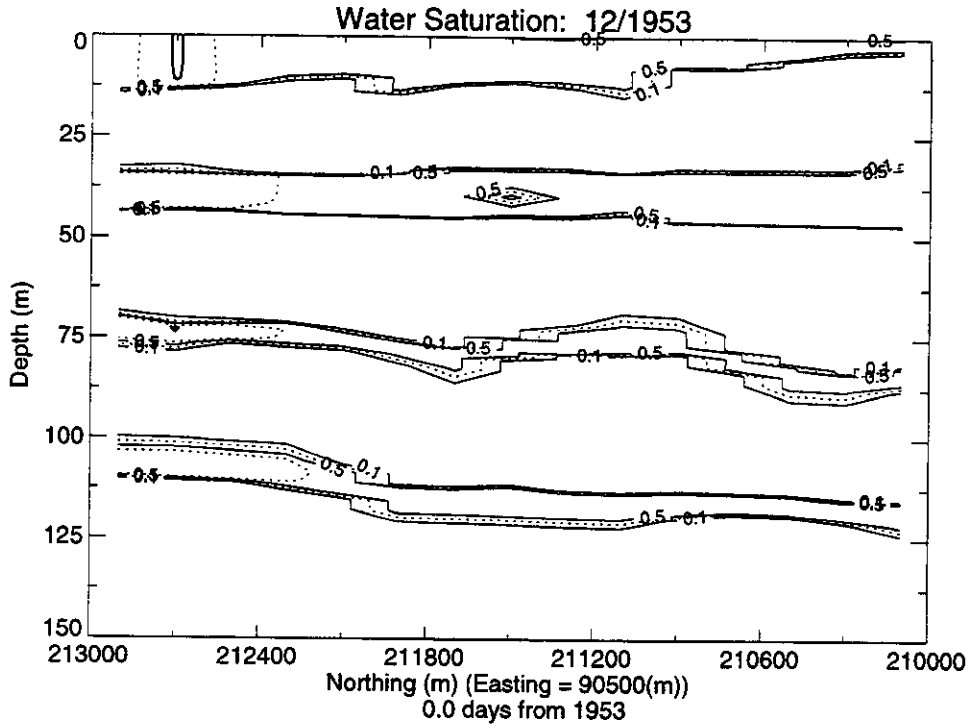


Figure 3-10 Initial water saturation condition prior to application of process water for the base case simulations including the Big Lost River.

Compared to the initial condition of Figure 3-1, saturations are much higher in the alluvium (0-12 m), upper interbeds (34-47 m), middle interbeds (68-82 m), and lower interbeds (103-114 m). The saturation at the top of the aquifer region is very close to that of the bottom of the lower interbed. However, at this point, there are still no perched water regions (saturations of 1.0). The lateral extent of the influence of the Big Lost River ranges from 270 m in the alluvium to as much as 800 m in the lower interbed.

Process water was then applied to the steady-state condition shown in Figure 3-10. Rates of application are consistent with the totals given in Table 2-2 with the exception that the fire water was uniformly distributed over the 1,600,000 m^2 fine-grid region at a rate of 2.55e-02 kg/day/m^2 (same as the previous simulation suite). Figure 3-11 illustrates the water saturation at 100 days after the initial application of process water. Even though saturations have increased to the south as a result of the Big Lost River discharge, they haven't increased enough to create perching from the northern water sources.

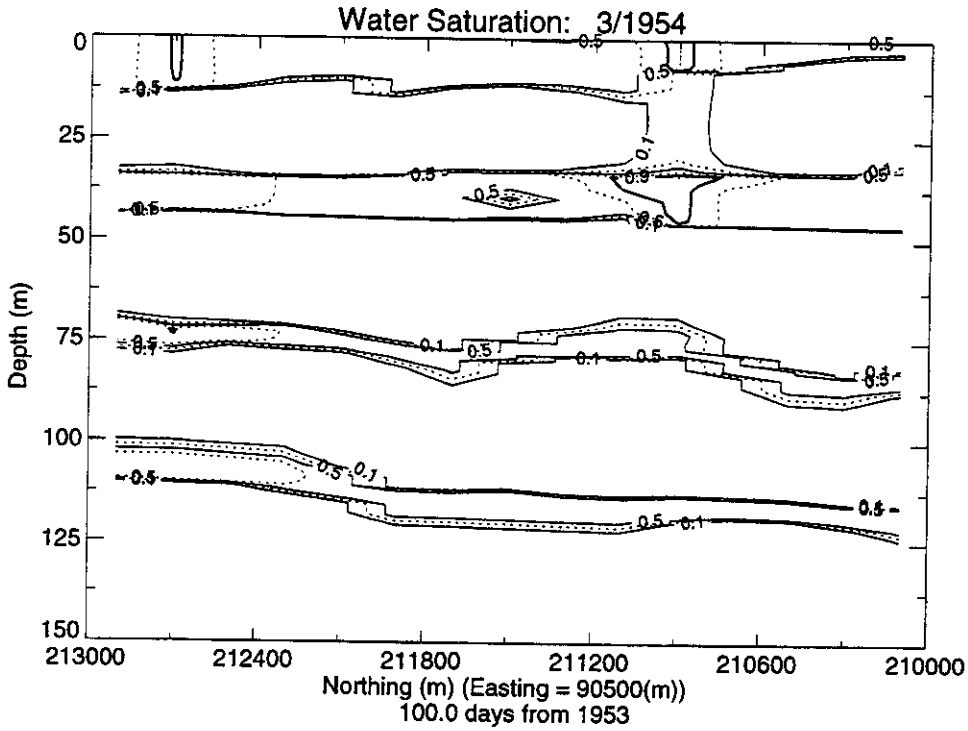


Figure 3-11 Water saturation at 100 days after the initial application of process water to the base case simulation shown in Figure 3-10.

Because of the higher saturations caused by the Big Lost River, steady-state is reached by 10000 days (Figure 3-12). The water coming from the percolation ponds has reached the first two interbeds and has increased the saturation in the first interbed from 0.5 to 0.7. Saturations under the north water sources are not noticeably higher than before. This is probably due to the increase in alluvium-basalt contact elevation that occurs south of the Big Lost River, that acts to restrict spreading to the south, forcing the water to redistribute to the north.

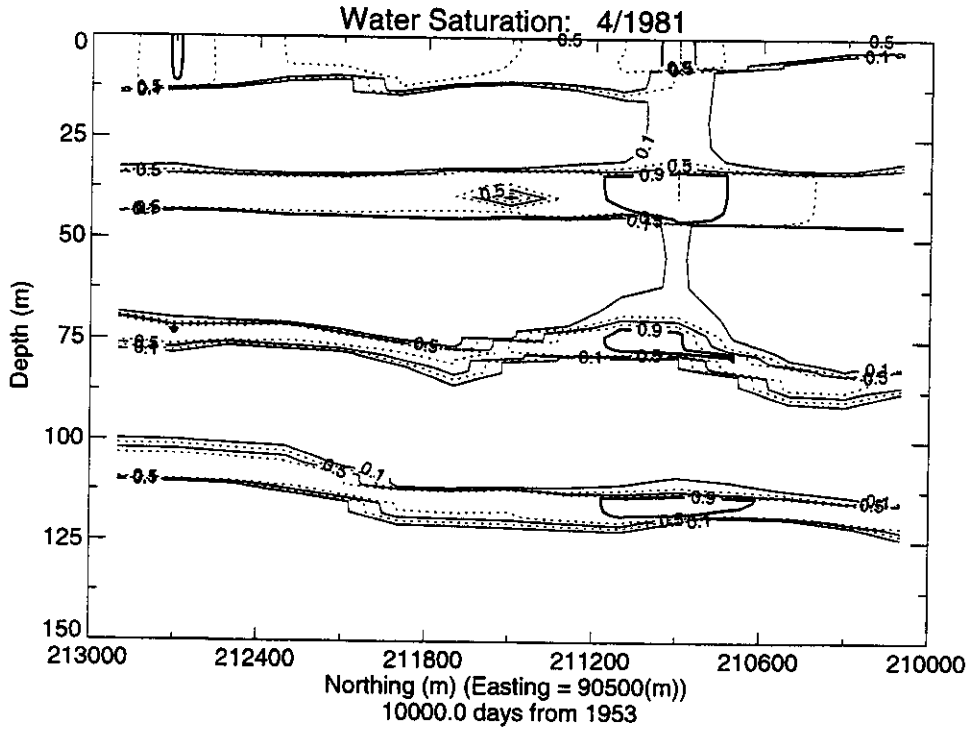


Figure 3-12 Water saturation 10,000 days (27.4 years, 1981) after the initial application of process water to the base case simulation shown in Figure 3-10.

At 36,500 days (Figure 3-13) there is not an appreciable difference in saturation profile throughout the cross-section. This indicates a steady-state situation and suggests that given the input parameters for sediment permeability and water volumes, perched water regions will not form in the north. As with the previous simulation, there is only perching occurring under the percolation ponds.

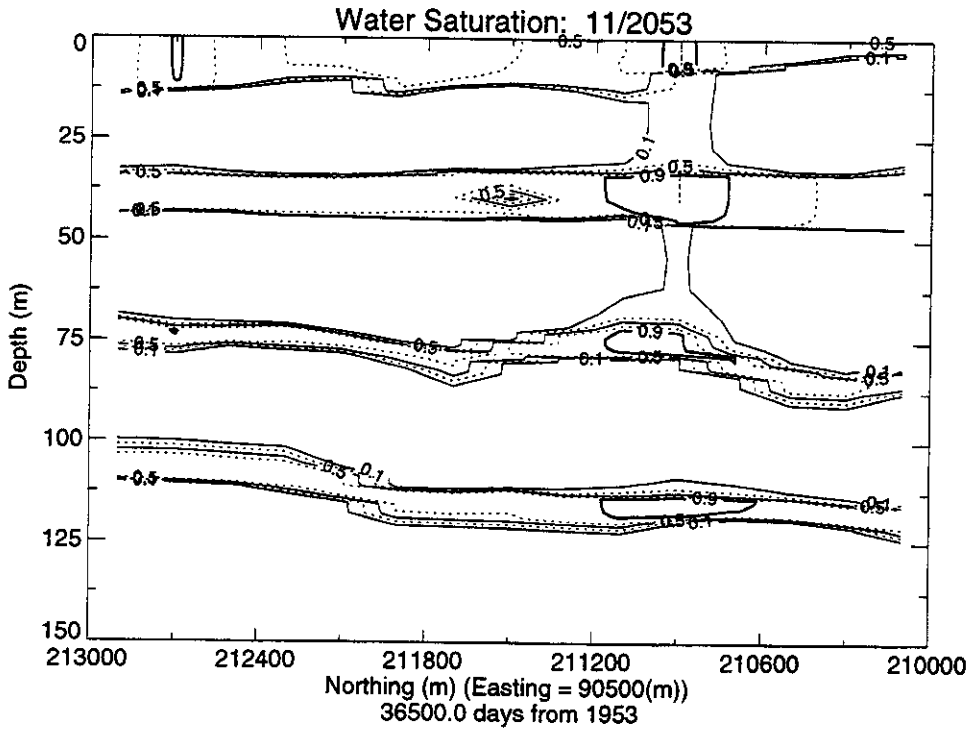


Figure 3-13 Water saturation 36,500 days after the initial application of process water to the base case shown in Figure 3-10.

At a simulation time of 40 years (corresponding to 1994), the water saturation versus depth was plotted at points corresponding to wells in which perched water was observed at some depth (Figures 3-14 through 3-18). Wells under the percolation ponds still show very good agreement between predicted and observed perched water levels. Increased saturations for the wells in the north can be seen by comparison to Figures 3-5 through 3-9. However, water levels in the northern wells are still all underpredicted.

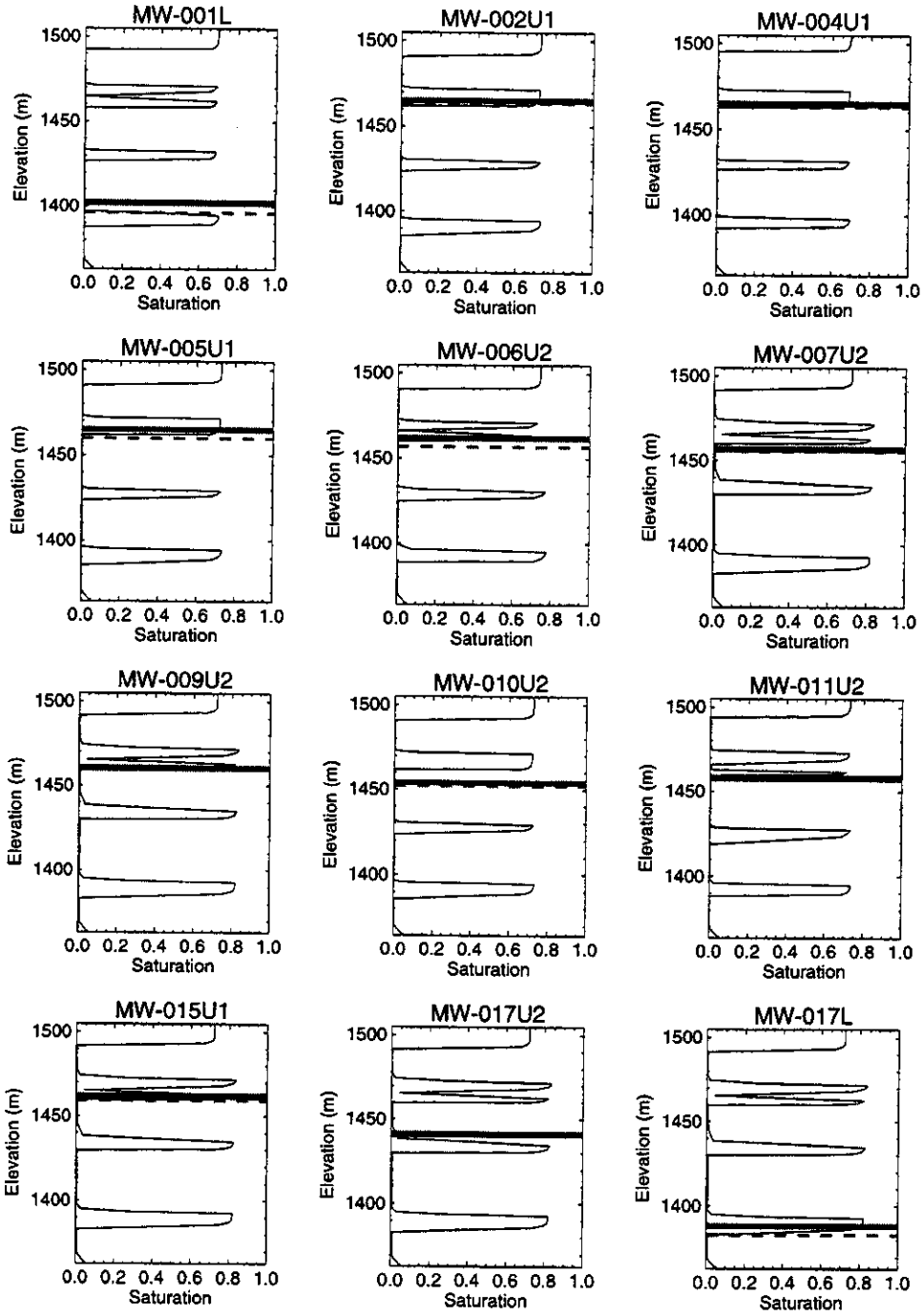


Figure 3-14 Water saturation as a function of elevation in wells that should show perched water. The dotted line is center of the screened interval, the thick dark line is the top of the perched water zone, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-10.

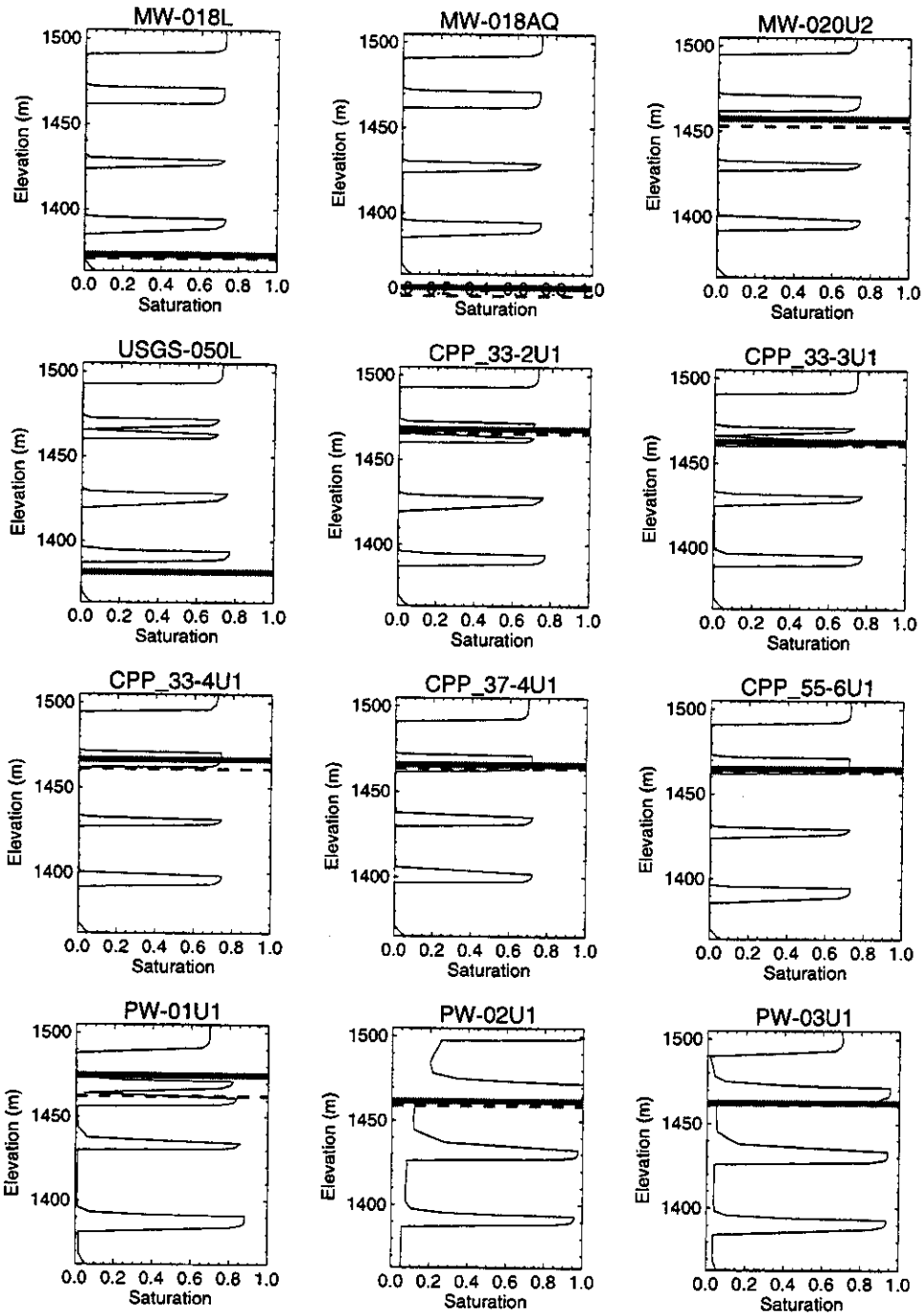


Figure 3-15 Water saturation as a function of elevation in wells that should show perched water. The dotted line is center of the screened interval, the thick dark line is the top of the perched water zone, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-10.

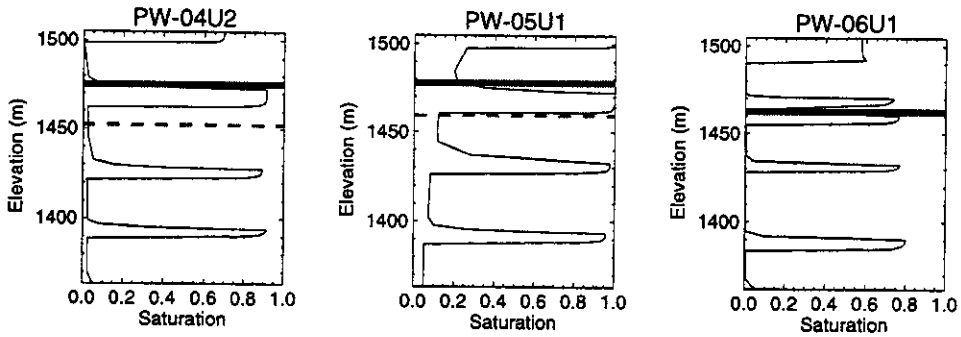


Figure 3-16 Water saturation as a function of elevation in wells that should show perched water. The dotted line is center of the screened interval, the thick dark line is the top of the perched water zone, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-10.

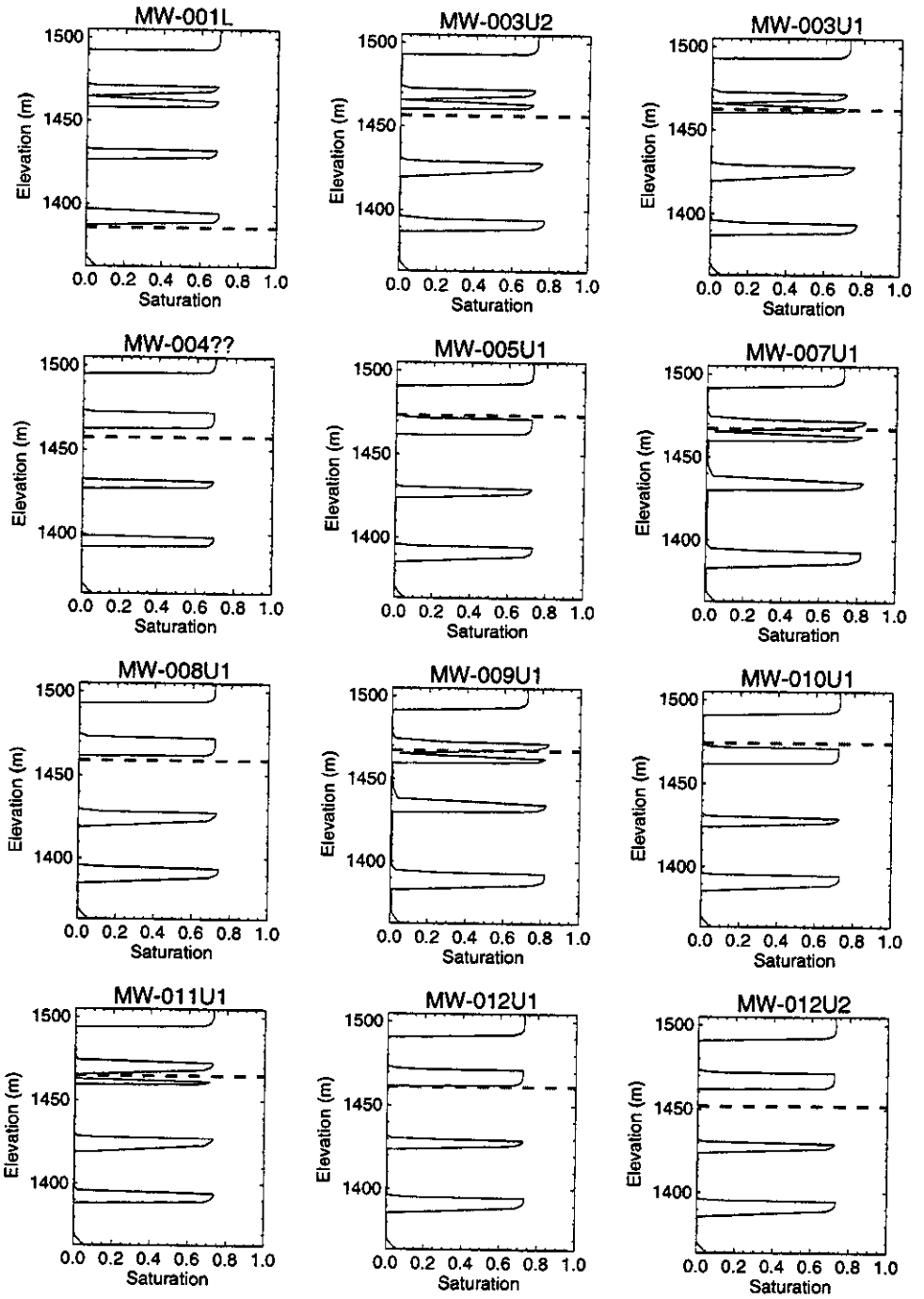


Figure 3-17 Water saturation as a function of elevation in wells that should not show perched water. The dotted line is center of the screened interval, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-10.

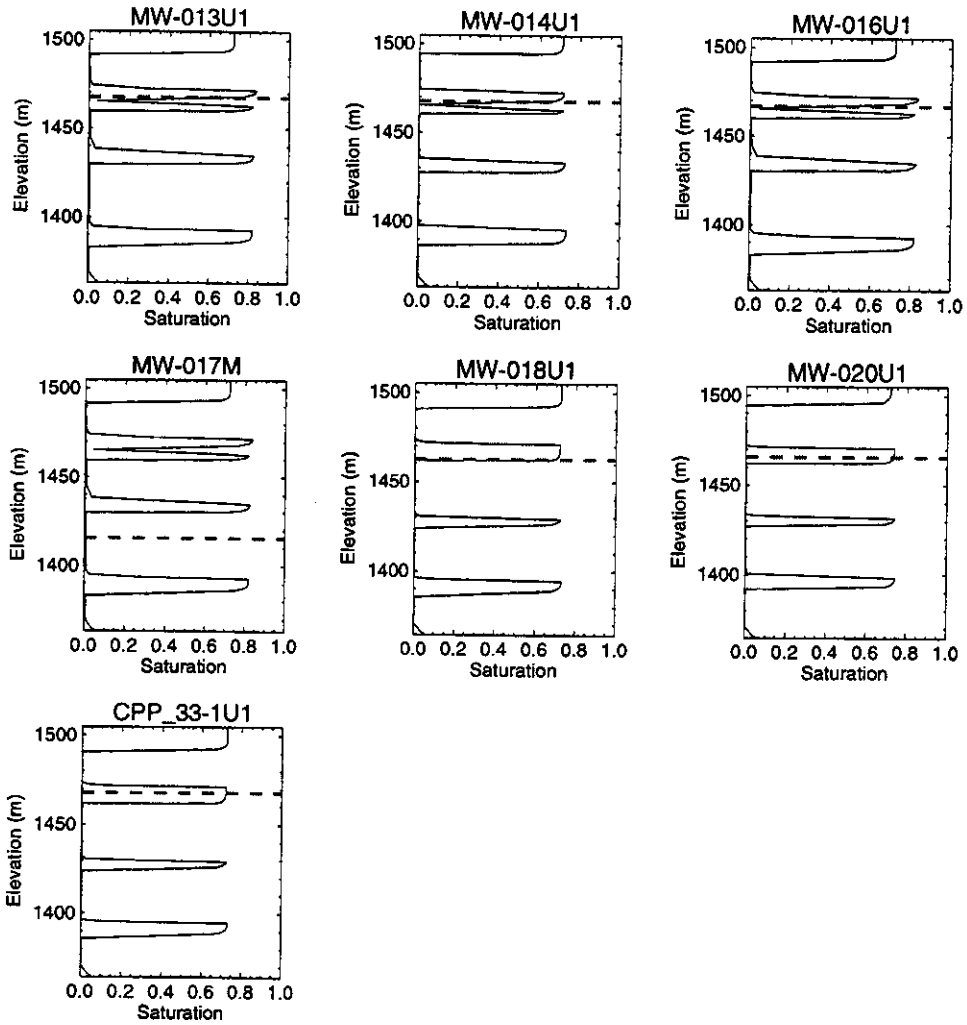


Figure 3-18 Water saturation as a function of elevation in wells that should not show perched water. The dotted line is center of the screened interval, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-10.

3.2.3 Reducing Sediment Saturated Permeability to 10 mD from the Base Case

Insufficient perching still persists throughout the ICPP and is probably due to assuming an excessively high saturated permeability in the sedimentary interbeds. The first two simulations assumed a value of 78 mD, which is representative of RWMC alluvium permeability measured in field samples. Reviewing the stratigraphic logs, it is apparent that there is some clay beneath the ICPP, which would result in a decrease in permeability for the lumped sediment layers. In addition, compared to alluvium material, reduction due to compaction of interbed material would be expected.

The following figures illustrate the case when a 10 mD permeability is assumed for each of the sediment units (including the alluvium). This simulation includes the influence of the Big Lost River as a long-term contributor to the initial conditions (shown in Figure 3-19). This saturation distribution represents ambient conditions resulting from background precipitation and is applied at 1 cm/yr throughout the modeling domain.

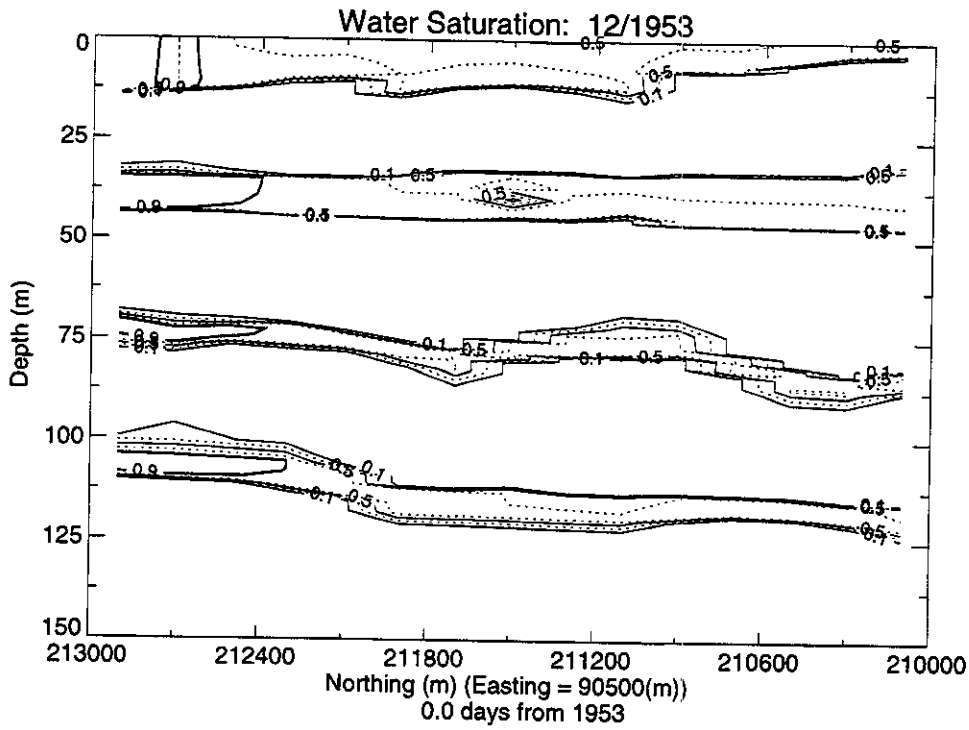


Figure 3-19 Initial water saturation condition prior to application of process water for the base case simulations including the Big Lost River. Sediment permeability is set at 10 mD.

Compared to the initial condition of Figure 3-10, saturations are much higher in the alluvium (0-12 m), upper interbeds (34-47 m), middle interbeds (68-82 m), and lower interbeds (103-114 m). In addition, the lateral influence of the Big Lost River is extensive in the alluvium and first interbed.

Process water was then applied to the steady-state condition at rates consistent with the totals given in Table 2-2 with the exception that the fire water was uniformly distributed over the 1,600,000 m^2 fine-grid region at a rate of 2.55e-02 kg/day/m^2 (same as the previous simulation suite). Figure 3-20 illustrates the water saturation at 100 days after the initial application of process water. Saturations resulting from the Big Lost

River have not reached a point where there is a visible influence of the sewage treatment plant (larger north water source).

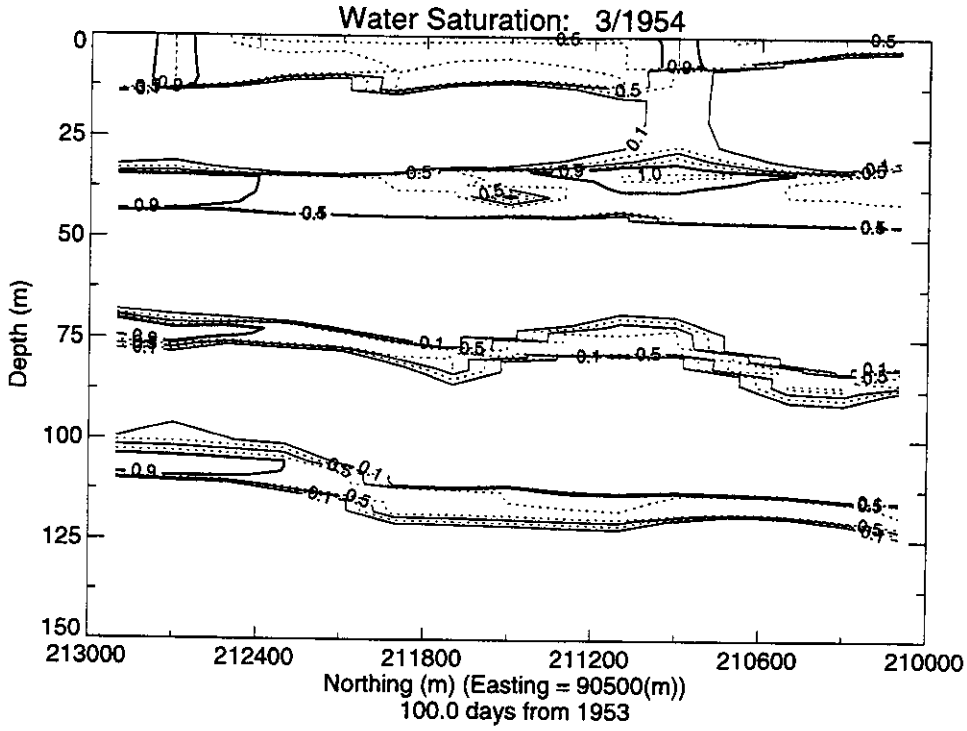


Figure 3-20 Water saturation at 100 days after the initial application of process water to the base case simulation shown in Figure 3-19.

Because of the lower permeability, higher water saturations are extensive in the alluvium and first interbeds. At 10000 days (Figure 3-21), saturations have increased to as high as 0.9 in the second interbed under the percolation ponds. Saturations under the north water sources are not noticeably higher than at 100 days.

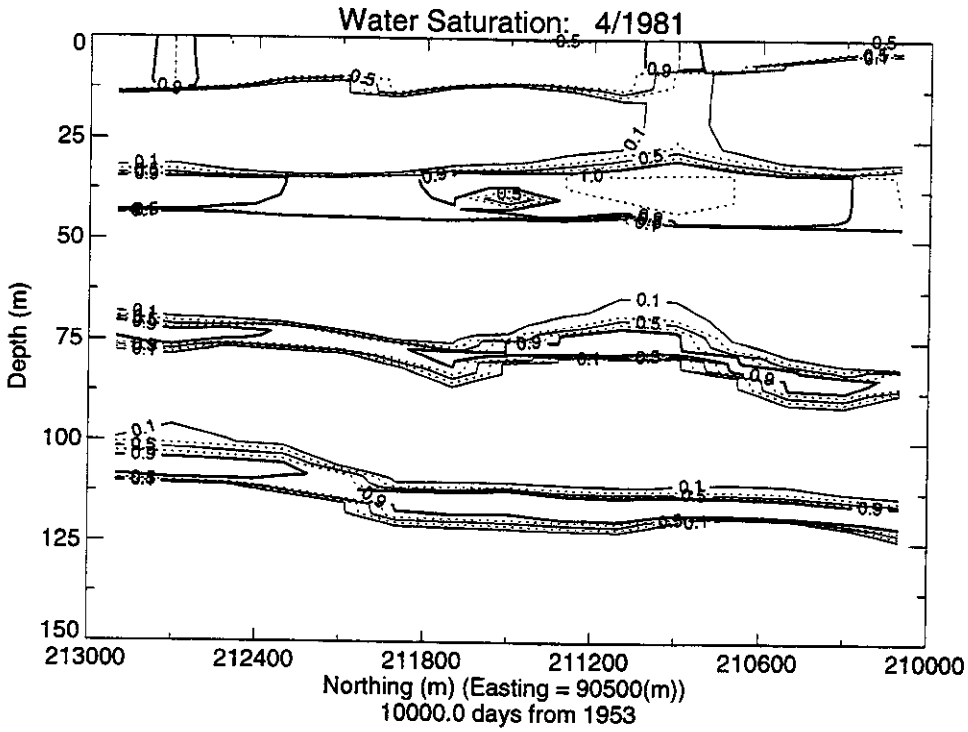


Figure 3-21 Water saturation 10,000 days (27.4 years, 1981) after the initial application of process water to the base case simulation shown in Figure 3-19.

At 36,500 days (Figure 3-22), there is not an appreciable difference in saturation profile (from 10000 days) throughout the cross-section. This confirms the steady-state situation and shows that there is still insufficient perched water forming in the north.

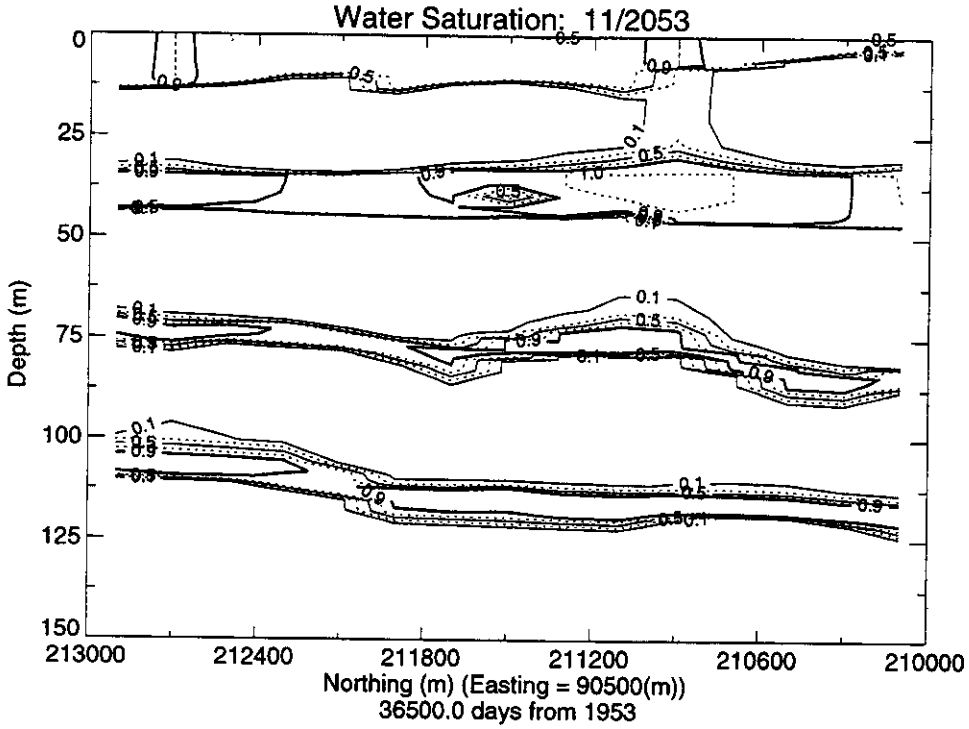


Figure 3-22 Water saturation 36,500 days after the initial application of process water to the initial condition simulation shown in Figure 3-19.

At a simulation time of 40 years (corresponding to 1994), the water saturation versus depth was plotted at points corresponding to wells in which perched water was observed at some depth (Figures 3-23 through 3-27). Wells under the percolation ponds still show very good agreement between predicted and observed perched water levels. Increased saturations for the wells in the north can be seen by comparison to Figures 3-14 through 3-18. However, water levels in the northern wells are still all underpredicted.

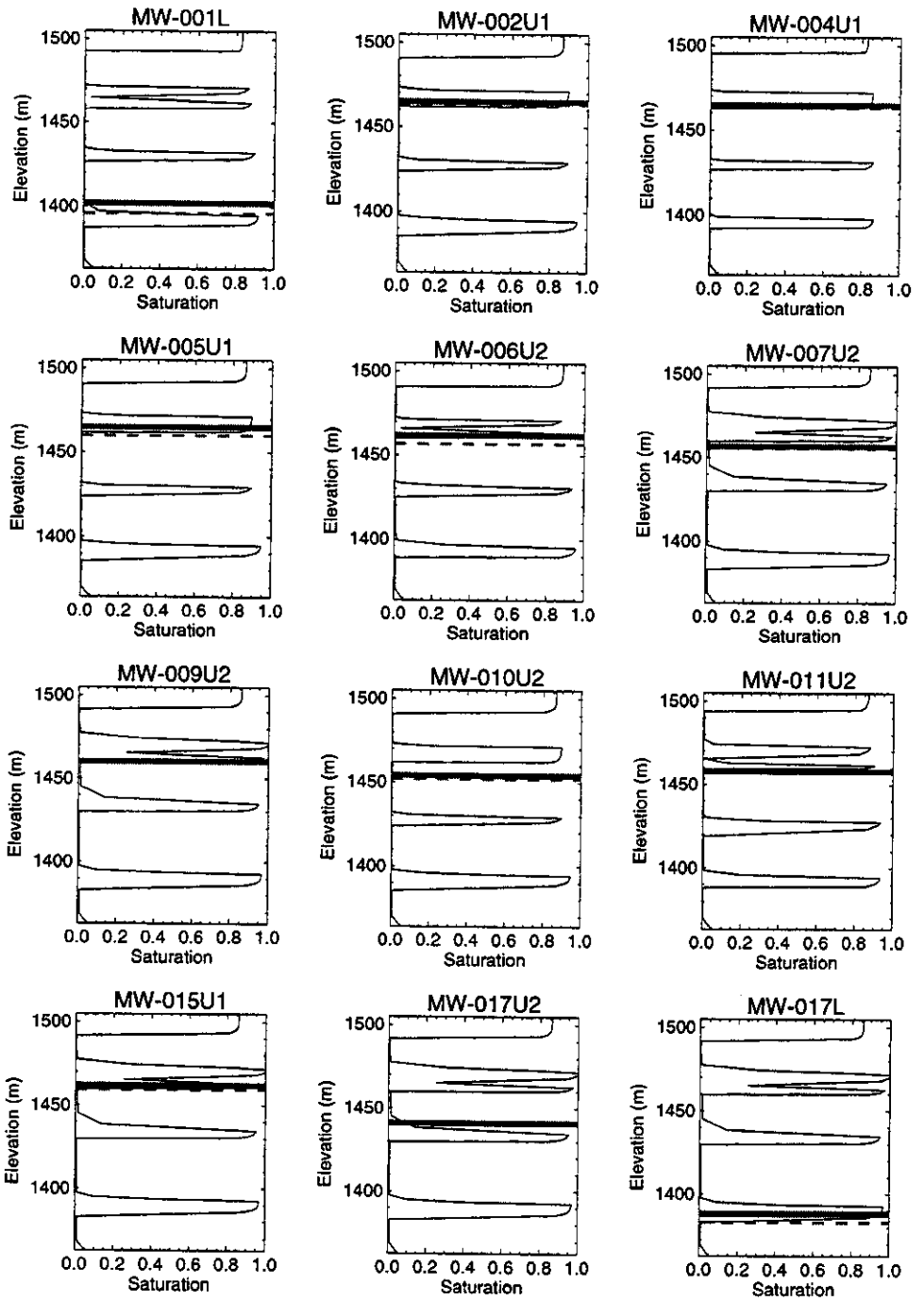


Figure 3-23 Water saturation as a function of elevation in wells in wells that should show perched water. The dotted line is center of the screened interval, the thick dark line is the top of the perched water zone, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-19.

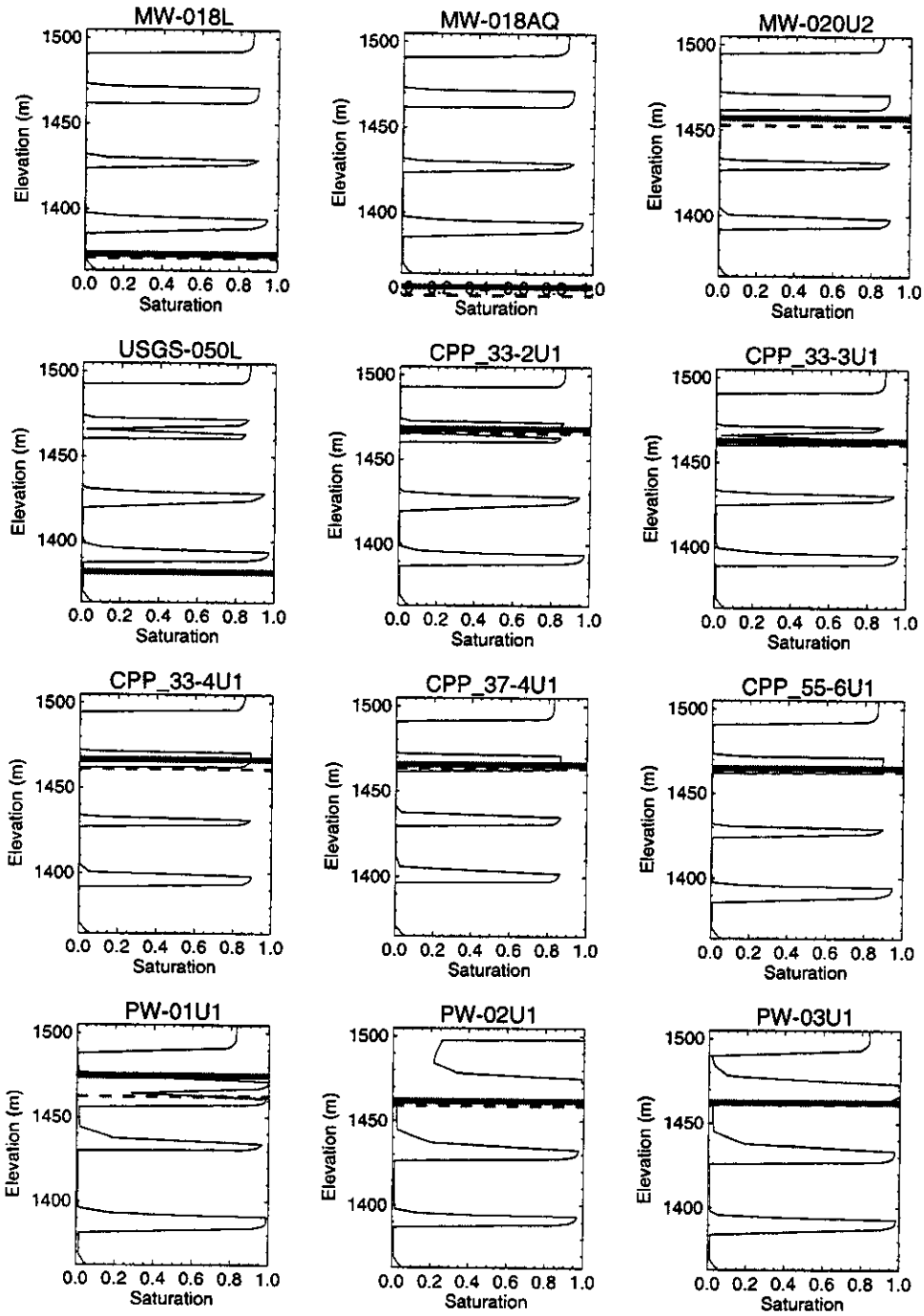


Figure 3-24 Water saturation as a function of elevation in wells that should show perched water. The dotted line is center of the screened interval, the thick dark line is the top of the perched water zone, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-19.

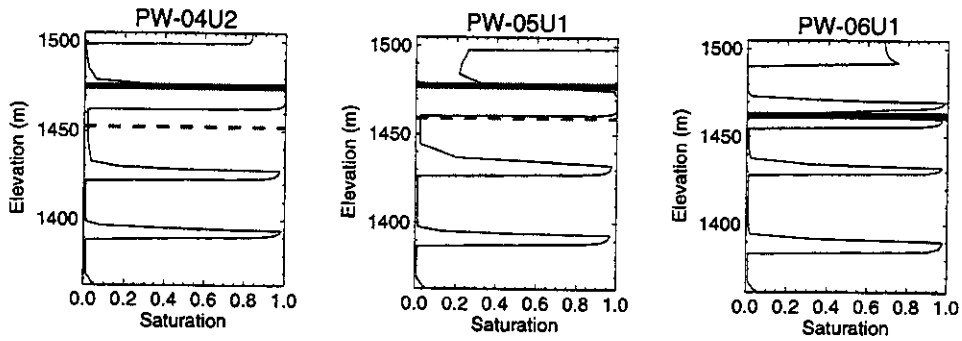


Figure 3-25 Water saturation as a function of elevation in wells that should show perched water. The dotted line is center of the screened interval, the thick dark line is the top of the perched water zone, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-19.

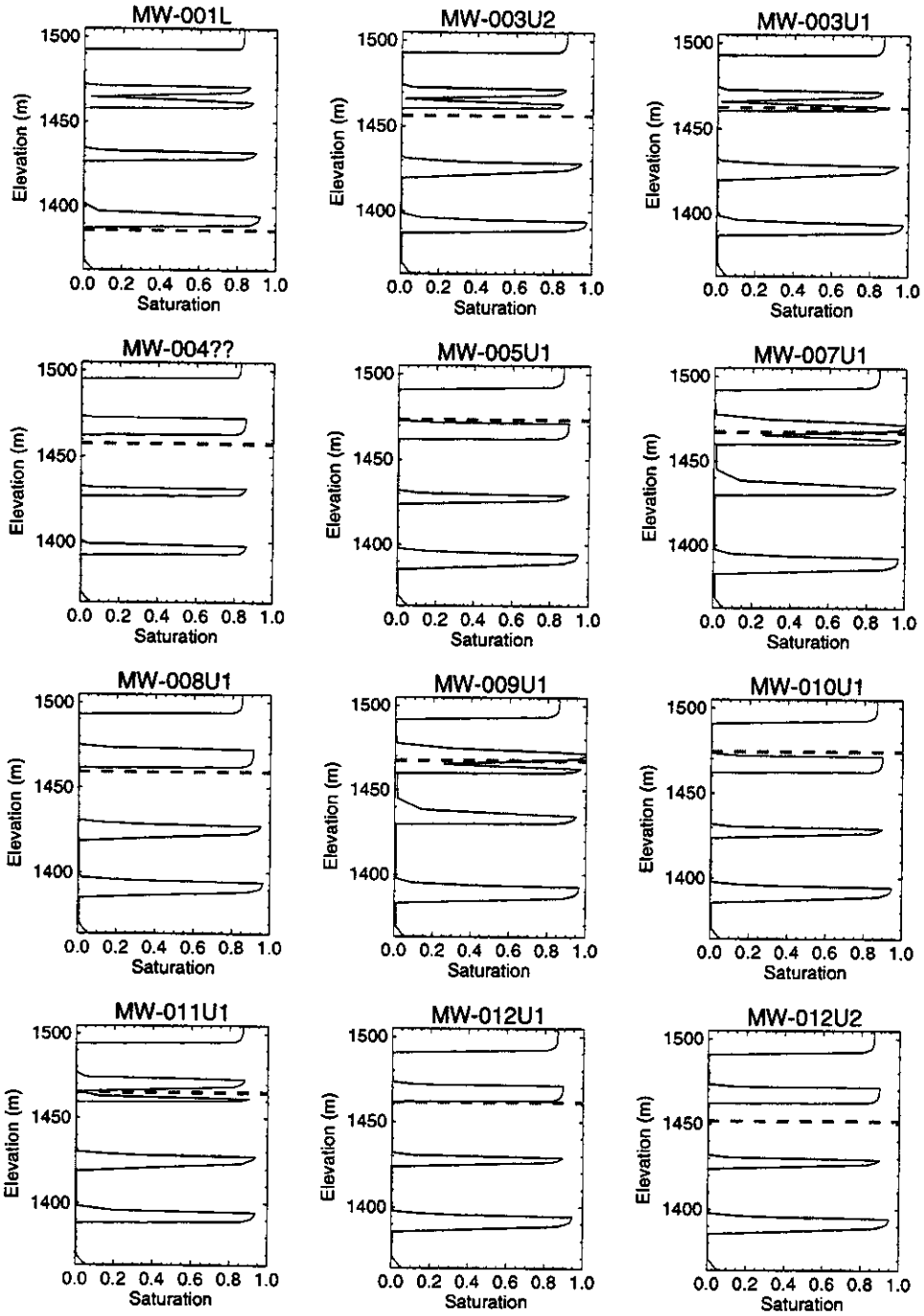


Figure 3-26 Water saturation as a function of elevation in wells that should not show perched water. The dotted line is center of the screened interval, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-19.

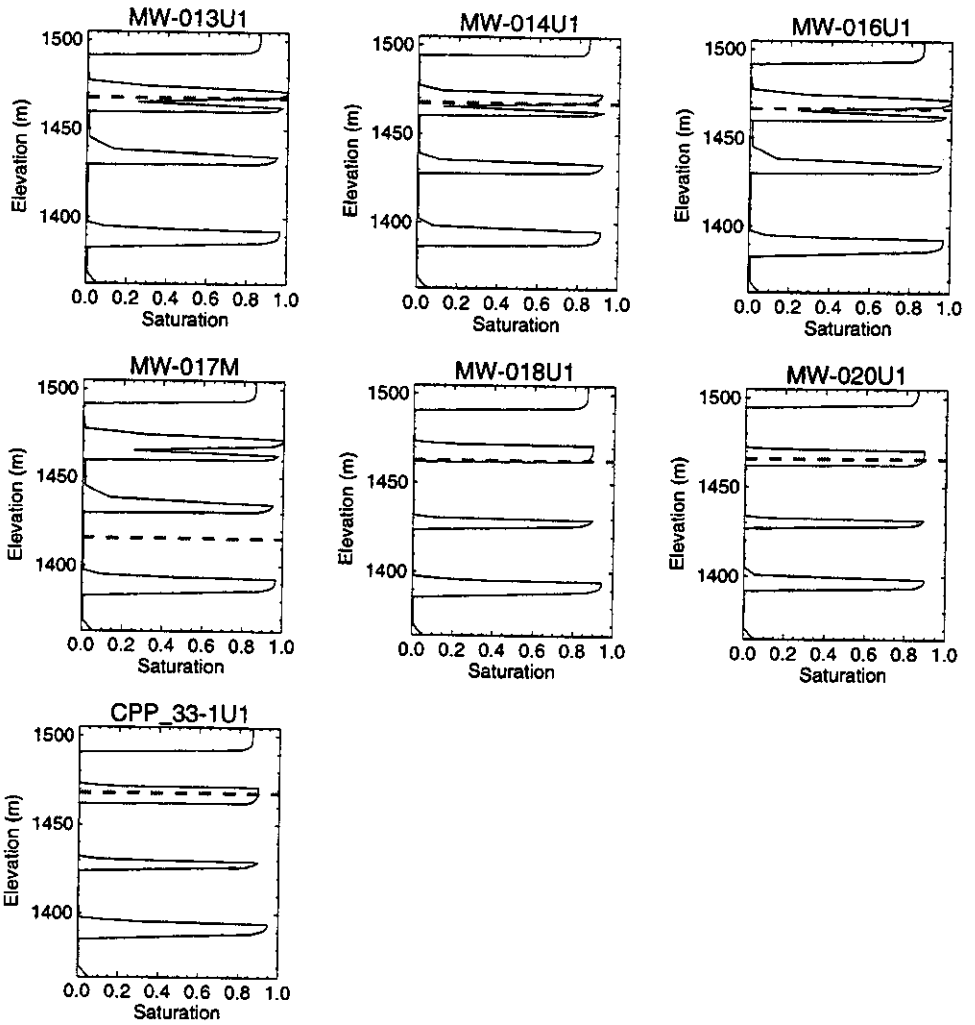


Figure 3-27 Water saturation as a function of elevation in wells that should not show perched water. The dotted line is center of the screened interval, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-19.

3.2.4 Additional Refinement in the ICPP Footprint Area for k_{sat}=10 mD, With Big Lost River

In the simulations presented thus far, the horizontal grid refinement has been uniform at 200 x 200 m. Because of the local changes in infiltration rate, sediment topography, and ultimately, the need to incorporate contaminant source regions, the area comprising the footprint of the ICPP was further refined to 100 x 100 m. In addition, there should be some refinement of the saturation distribution that results from grid refinement. The following figures illustrate the case when a 10 mD permeability is assumed for each of the sediment units (including the alluvium), the influence of the Big Lost River as a long-term contributor to the initial conditions is included, and the local grid refinement is incorporated. Note that the initial condition is the same as that shown in Figure 3-19 because refinement is not utilized in determining the initial conditions, but occurs after that point as an internal option in TETRAD. Saturations 100 days after the initial application of process water are shown in Figure 3-28 and can be compared to the 100-day coarse grid simulation illustrated in Figure 3-20. Note that the 0.9 contour line just below the percolation ponds is not evident in Figure 3-20.

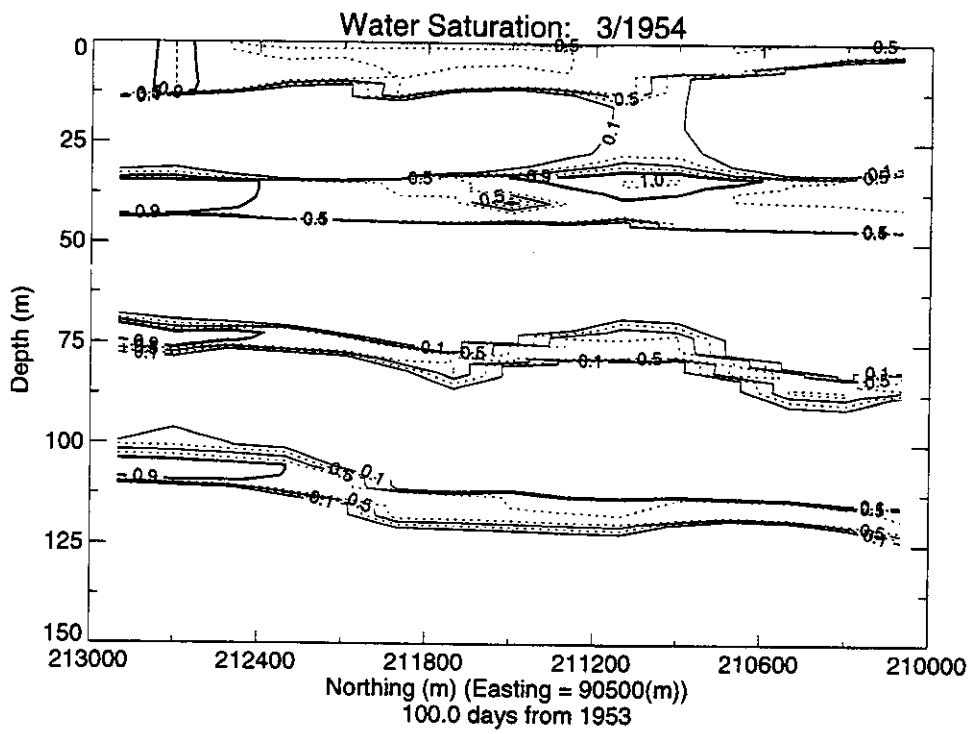


Figure 3-28 Water saturation at 100 days after the initial application of process water to the base case simulation shown in Figure 3-19. The grid spacing under the ICPP footprint has been refined to 100 x 100 m.

Figure 3-29 represents the steady-state saturation distribution that can be compared to that shown for the coarser grid simulation given in Figure 3-22. Note that appreciable differences in saturation profiles do not exist, suggesting that this grid refinement is sufficient for the purposes of distinguishing perched water elevations. Note that there is still insufficient perched water forming in the north.

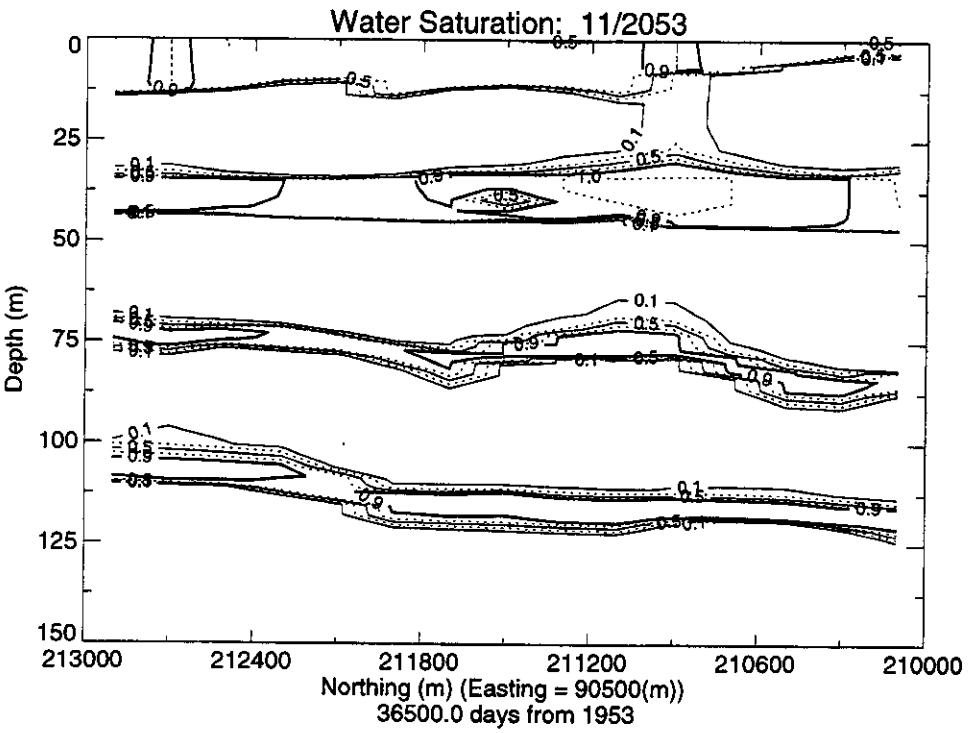


Figure 3-29 Water saturation 36,500 days after the initial application of process water to the base case simulation shown in Figure 3-19. The grid spacing under the ICPP footprint has been refined to 100 x 100 m.

Water saturations versus depth are given for the 40 yr simulation time in Figures 3-30 through 3-34. Wells under the percolation ponds still show very good agreement between predicted and observed perched water levels. These saturation profiles can be compared to Figures 3-23 through 3-27. Water levels in the northern wells are still all underpredicted.

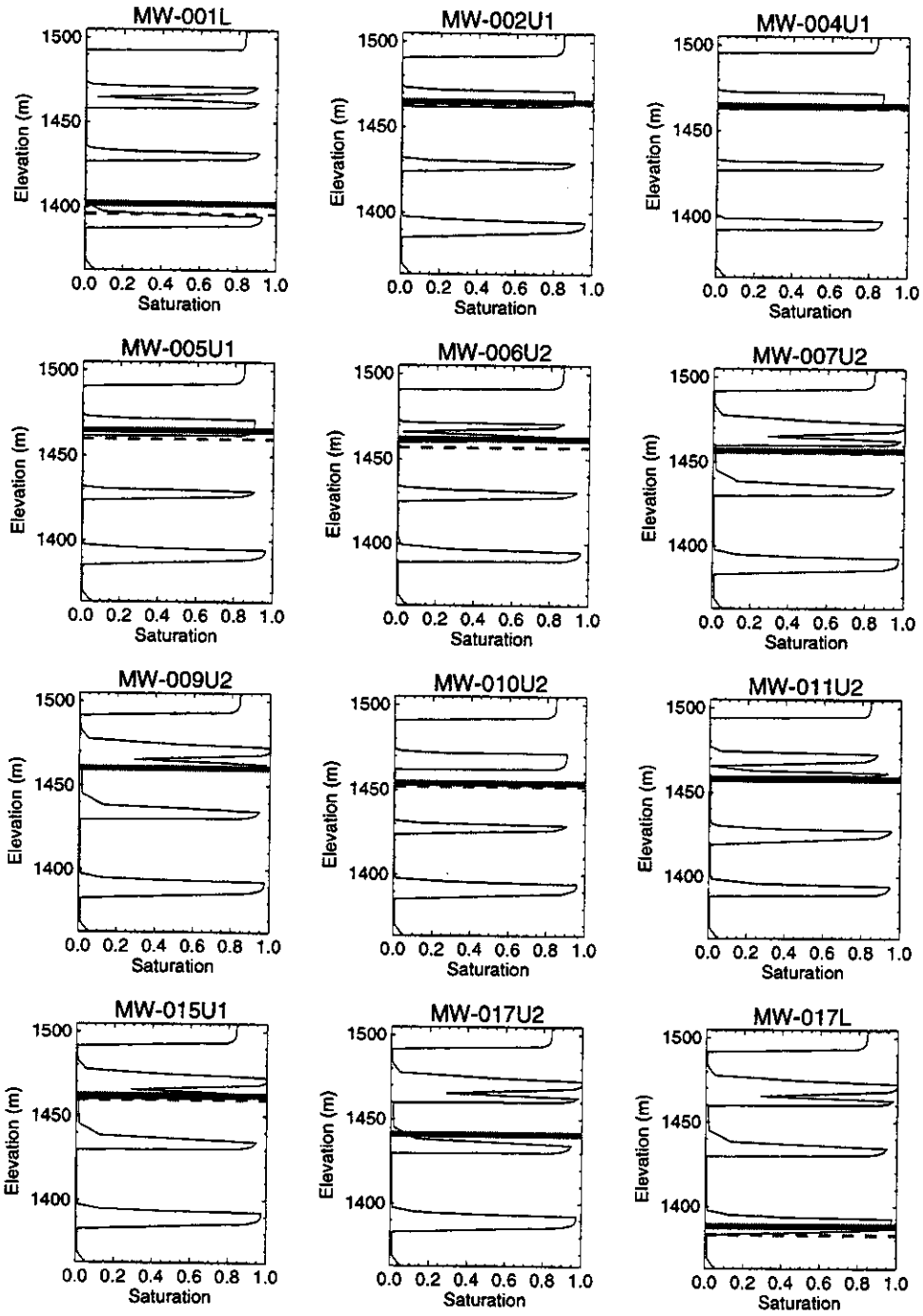


Figure 3-30 Water saturation as a function of elevation in wells that should show perched water. The dotted line is center of the screened interval, the thick dark line is the top of the perched water zone, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-28.

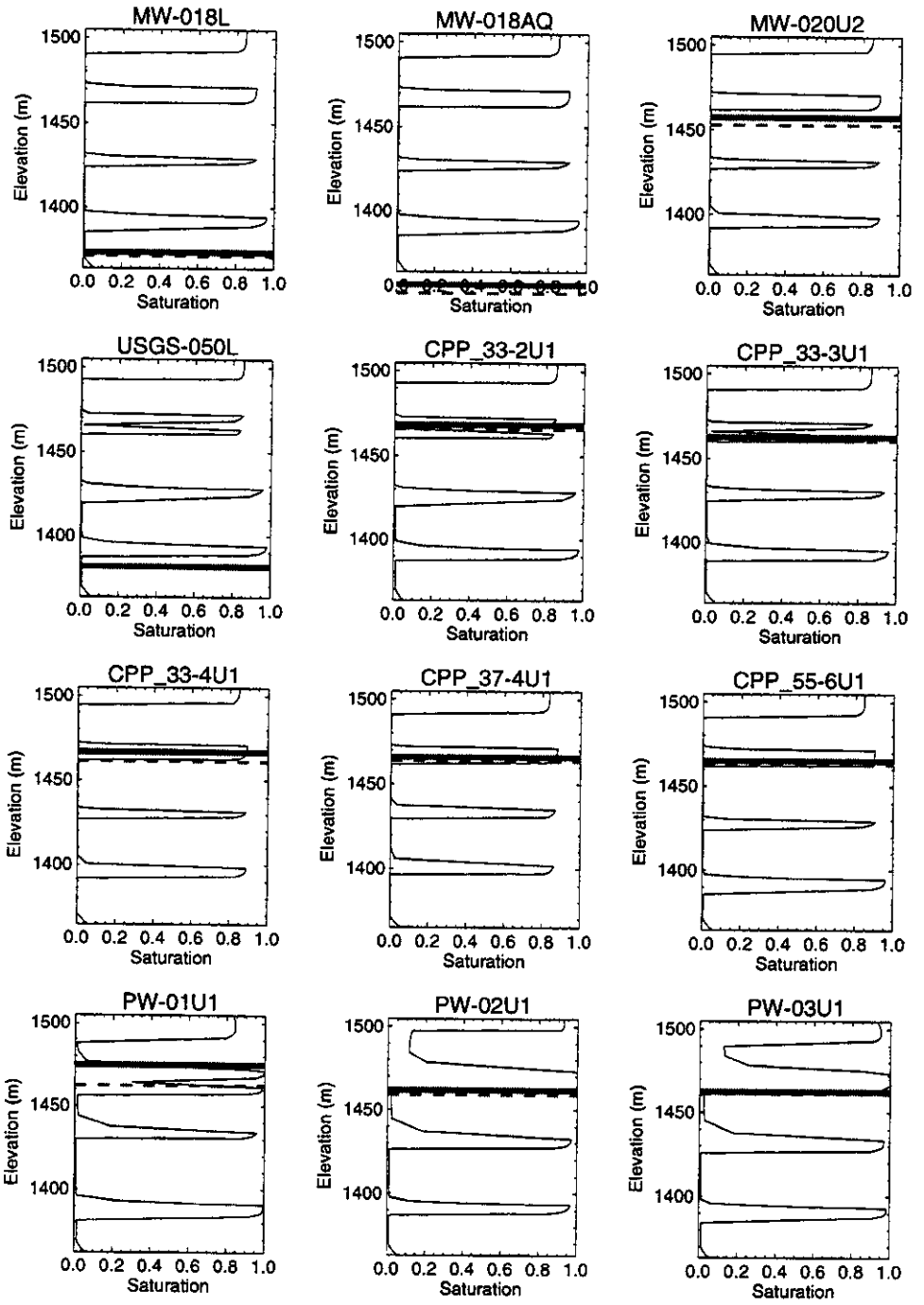


Figure 3-31 Water saturation as a function of elevation in wells that should show perched water. The dotted line is center of the screened interval, the thick dark line is the top of the perched water zone, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-28.

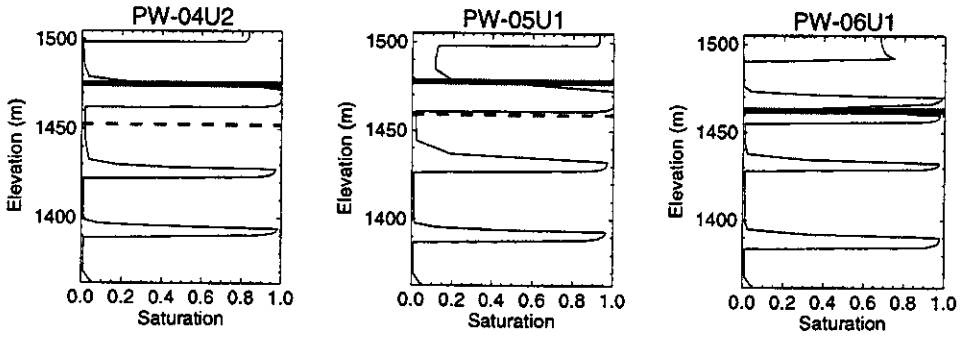


Figure 3-32 Water saturation as a function of elevation in wells that should show perched water. The dotted line is center of the screened interval, the thick dark line is the top of the perched water zone, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-28.

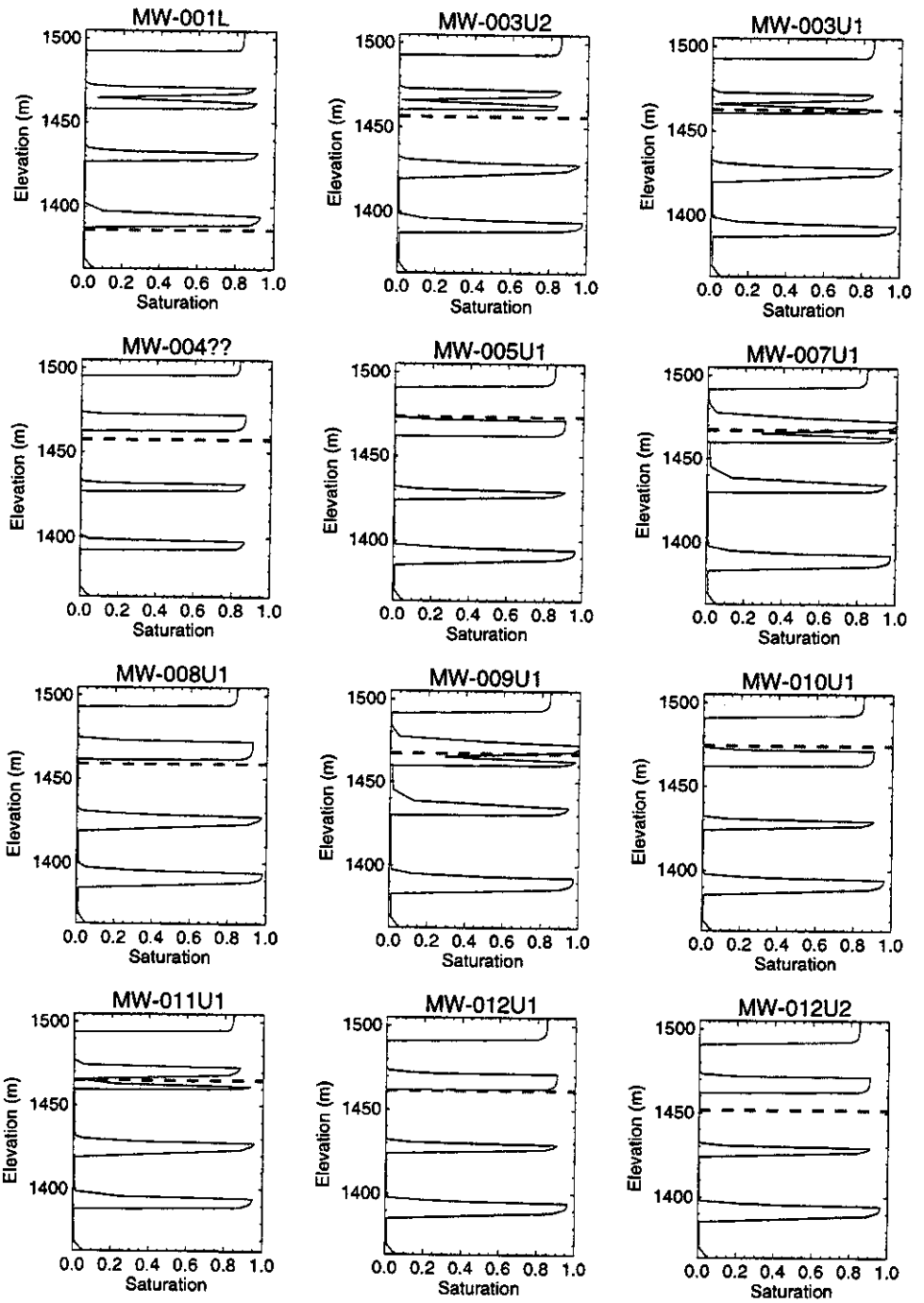


Figure 3-33 Water saturation as a function of elevation in wells that should not show perched water. The dotted line is center of the screened interval, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-28.

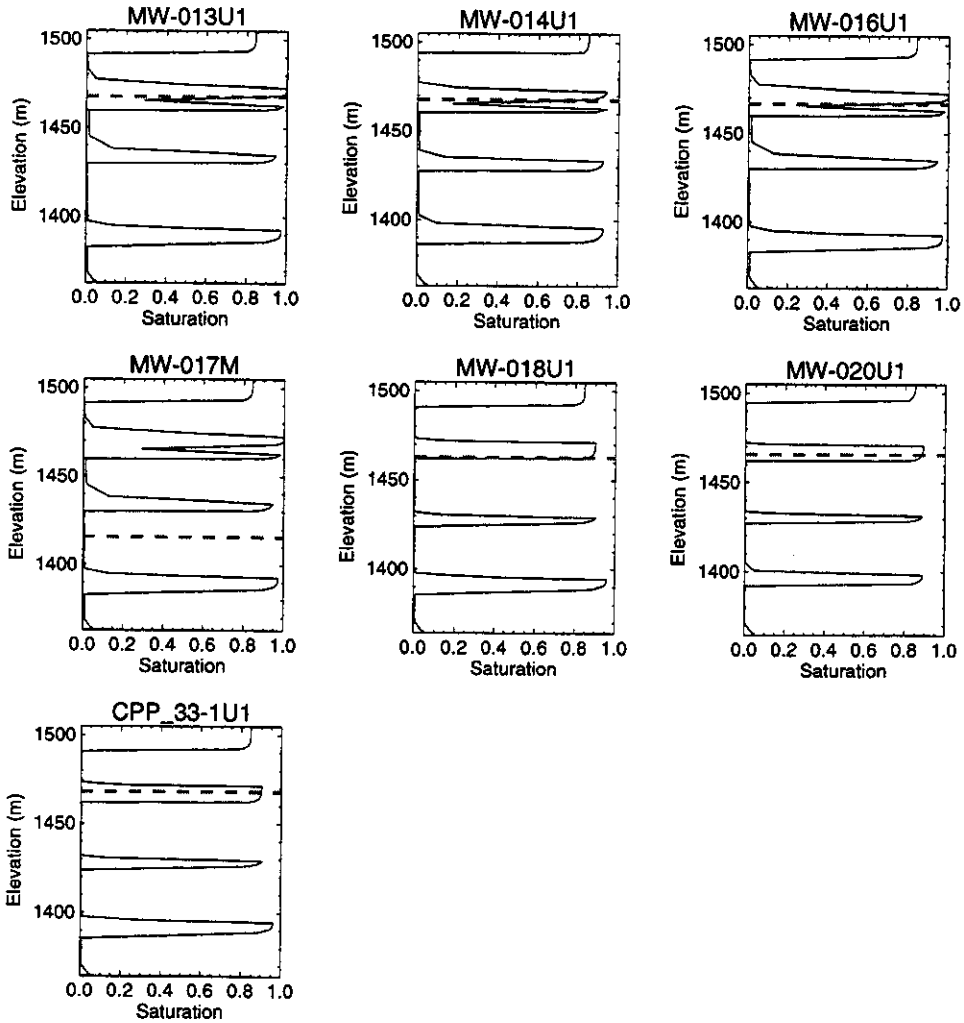


Figure 3-34 Water saturation as a function of elevation in wells that should not show perched water. The dotted line is center of the screened interval, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-28.

3.2.5 Non Linear Basalt Characteristic Curves (Sediment k_{sat}=9 mD, Alluvium k_{sat}=10 mD)

In all of the simulations presented thus far, the basalt characteristic curves assumed a Brooks-Corey (1966) parameter β_w =1, corresponding to a linear increase in relative permeability with saturation. Because the relative permeability-saturation curves for field-scale fractured basalt are unknown, the effect of the shape of the characteristic curve is examined in this simulation. One would expect the saturation in the basalt fractures to increase with increasing β_w, as shown in the initial condition given in Figure 3-35.

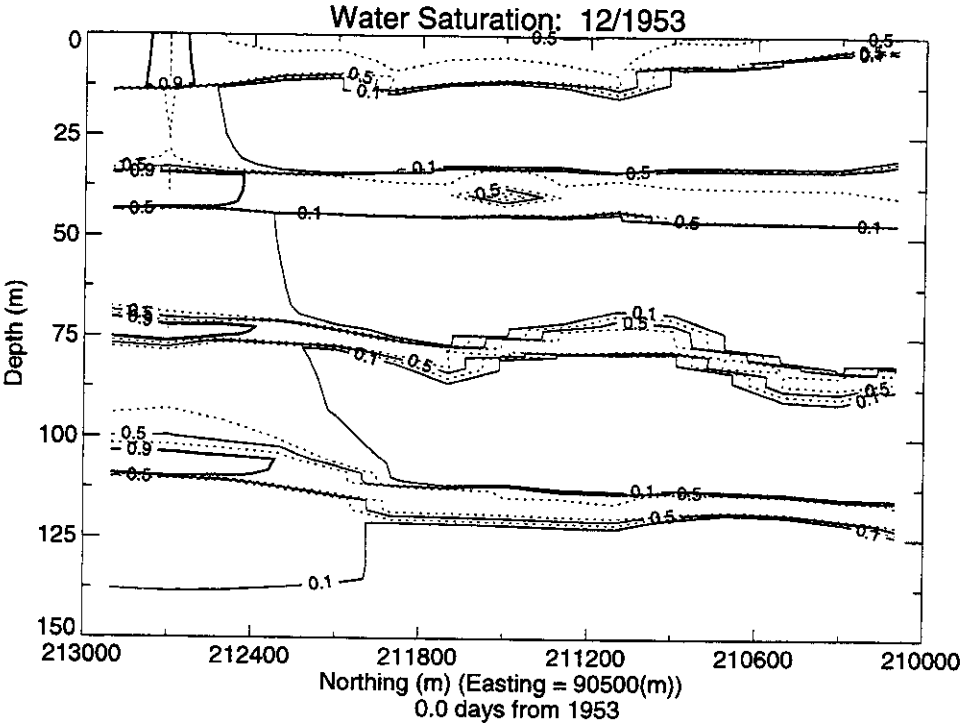


Figure 3-35 Water saturation prior to the application of process water. The system is characterized by a nonlinear basalt characteristic curve shown in Figure 2-21.

The steady-state water saturation at 100 years is given in Figure 3-36 and can be compared to that given in Figure 3-29. Note that the water saturation in the basalt regions is uniformly higher, but that the water

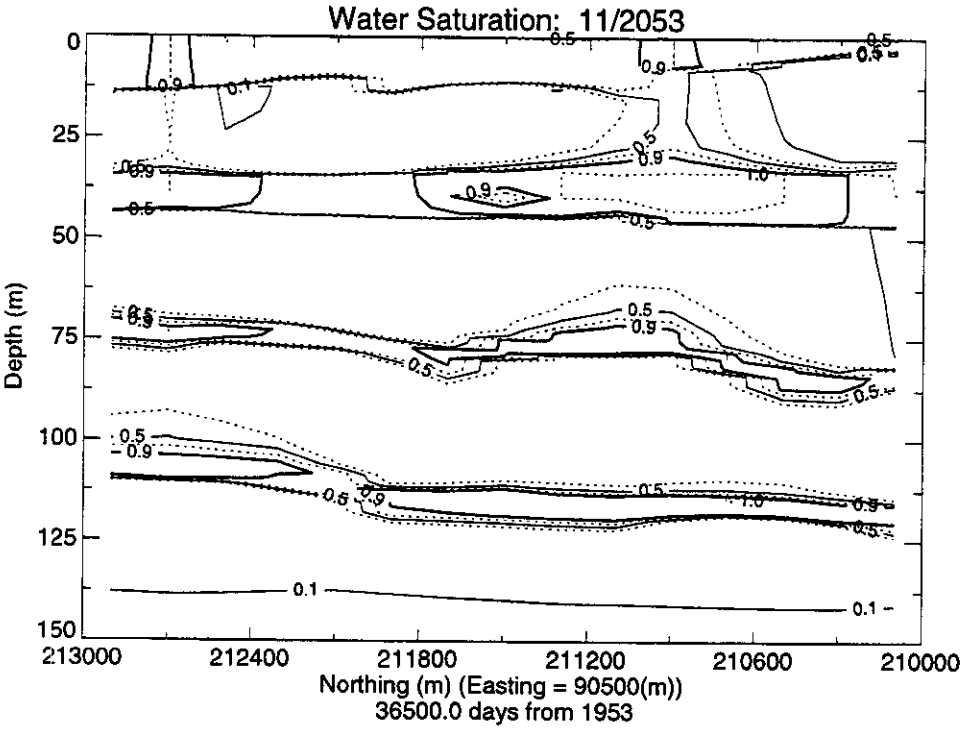


Figure 3-36 Water saturation 100 years after the application of process water to a system characterized by a nonlinear basalt characteristic curve (Figure 2-21). The initial condition is given in Figure 3-35.

saturations in the interbed regions do not increase significantly. Therefore, a nonlinear basalt characteristic curve does not contribute to perched water formation as much as it contributes to increased saturations in the basalts. Saturation versus depth for the calibration wells are given in Figures 3-37 through 3-41. Note that the average water saturation in the basalt regions is about 20%. It is felt that these higher fracture saturations may not be representative of the ICPP.

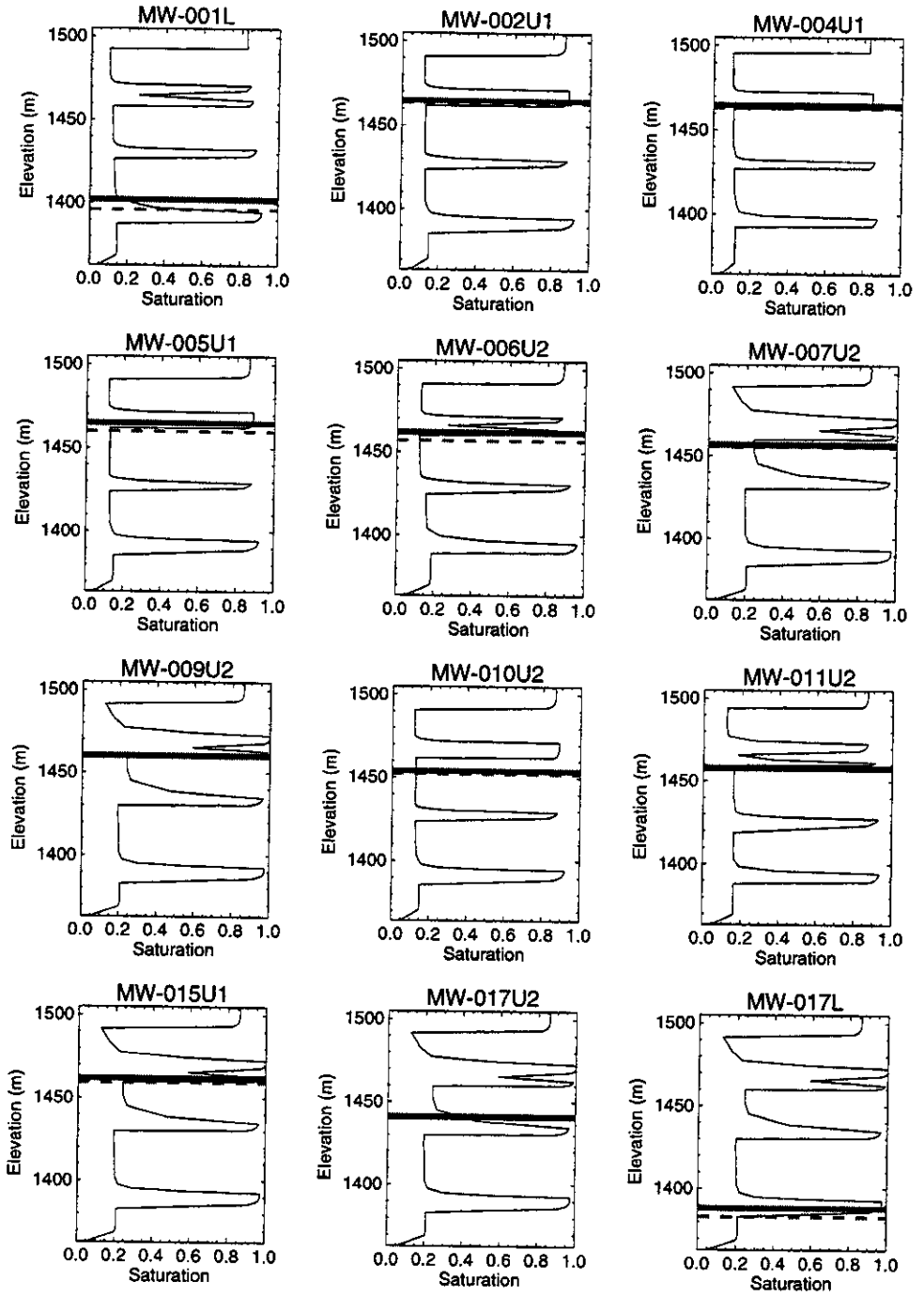


Figure 3-37 Water saturation as a function of elevation in wells that should show perched water. The dotted line is center of the screened interval, the thick dark line is the top of the perched water zone, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-35.

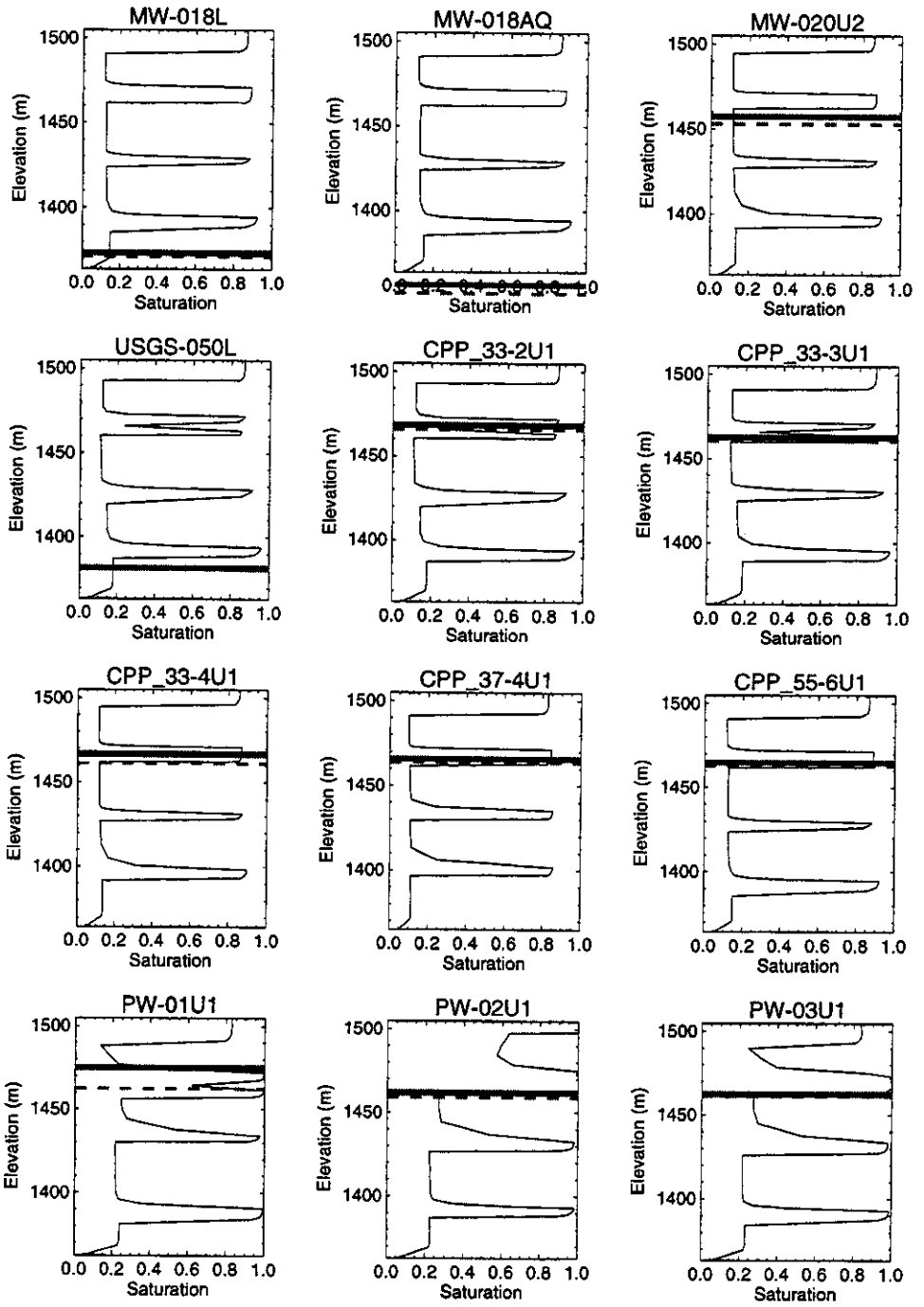


Figure 3-38 Water saturation as a function of elevation in wells that should show perched water. The dotted line is center of the screened interval, the thick dark line is the top of the perched water zone, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-35.

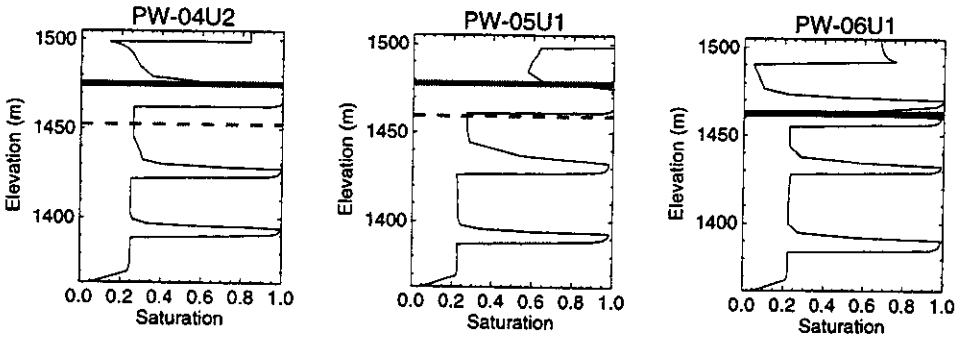


Figure 3-39 Water saturation as a function of elevation in wells that should show perched water. The dotted line is center of the screened interval, the thick dark line is the top of the perched water zone, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-35.

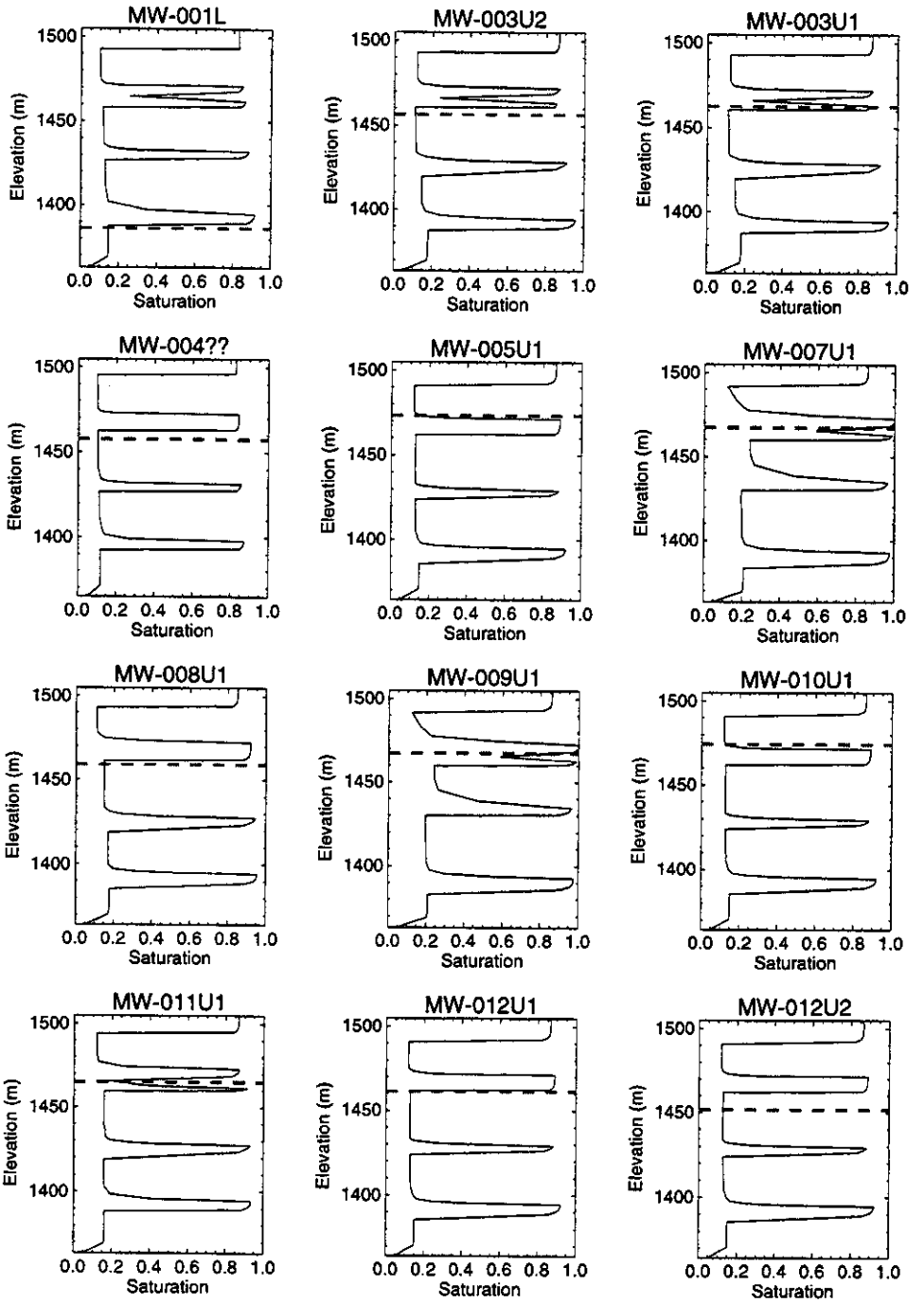


Figure 3-40 Water saturation as a function of elevation in wells that should not show perched water. The dotted line is center of the screened interval, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-35.

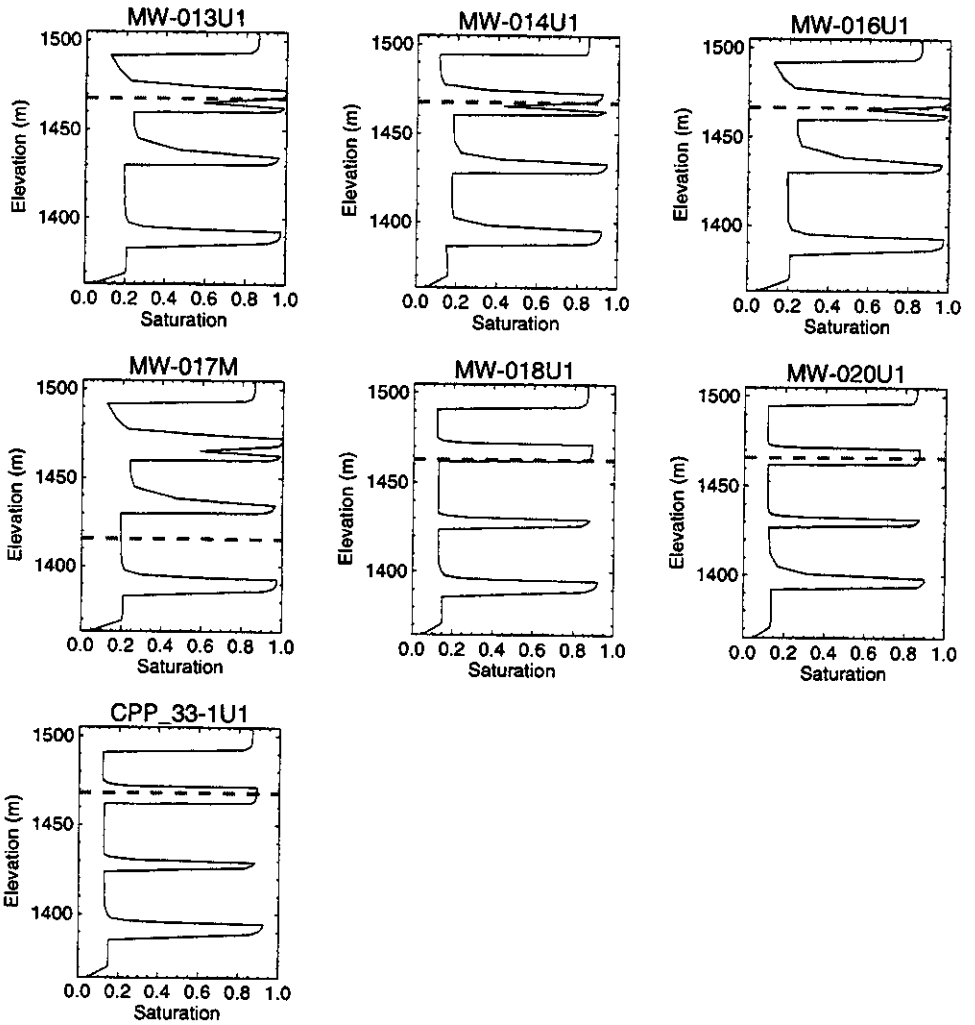


Figure 3-41 Water saturation as a function of elevation in wells that should not show perched water. The dotted line is center of the screened interval, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-35.

3.2.6 Reduced Basalt Horizontal Permeability (Basalt k_{sat}=9000 mD, Sediment=78 mD, & Alluvium=78 mD)

In addition to the characteristic curve shape of the basalt, the other primary parameter describing the basalt is the saturated permeability. The following simulation examines the effect of reducing the horizontal saturated basalt permeability by an order of magnitude. As compared to the initial condition presented in Section 3.2.2., saturations are slightly higher throughout the vadose zone because the lower horizontal basalt permeability acts to inhibit downward migration of the surface water sources. The inhibitory aspect occurs indirectly by reducing the lateral area over which the water is distributed for downward movement.

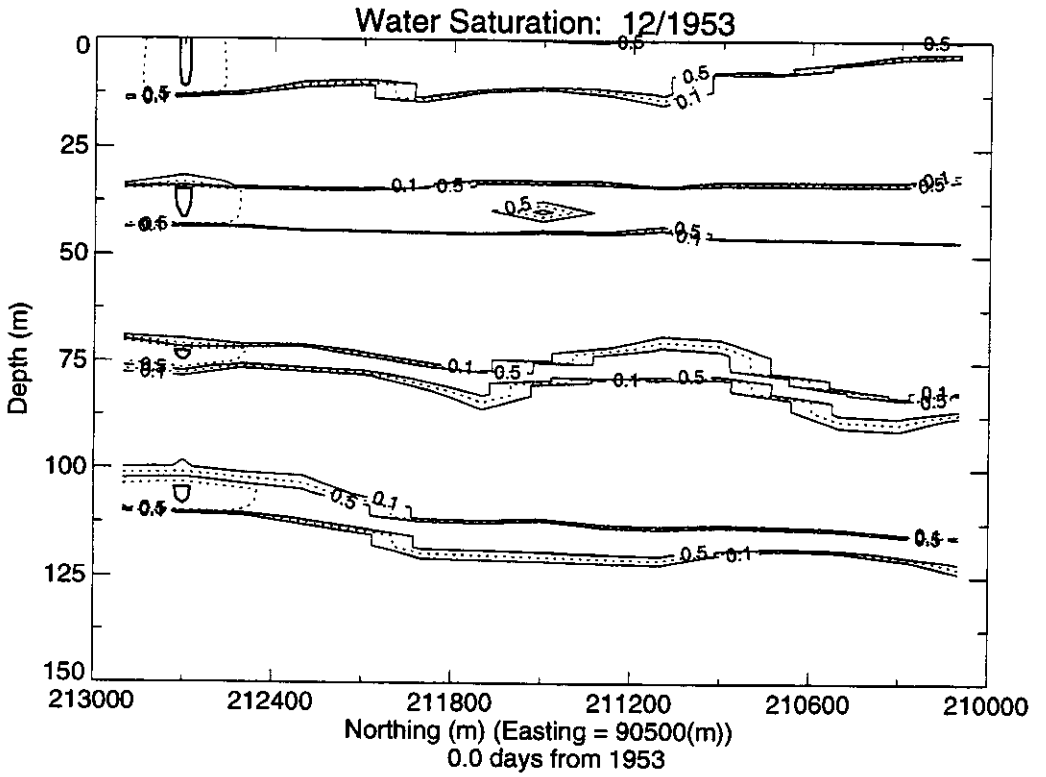


Figure 3-42 Water saturation prior to the application of process water to a system characterized by an order of magnitude smaller saturated basalt permeability.

The steady-state water saturation at 100 years is given in Figure 3-43 and can be compared to that given in Figure 3-13. Throughout the basalt regions, saturations are about 0.05 higher than before, a very small increase given the order of magnitude decrease in basalt permeability. This occurs because only the horizontal permeability was reduced with the vertical permeability remaining at 300 mD in both simulations. The most noticeable increase is beneath the percolation ponds and the Big Lost River. This very small increase in saturation will not increase travel times because of the lower base permeability, but will have an equally small dilution effect. In essence, decreasing the basalt permeability will have no real net effect on transport. In addition, Figures 3-44 through 3-48 show that reducing the basalt permeability does not result in the required perched water formation under the tank farm area of the ICPP.

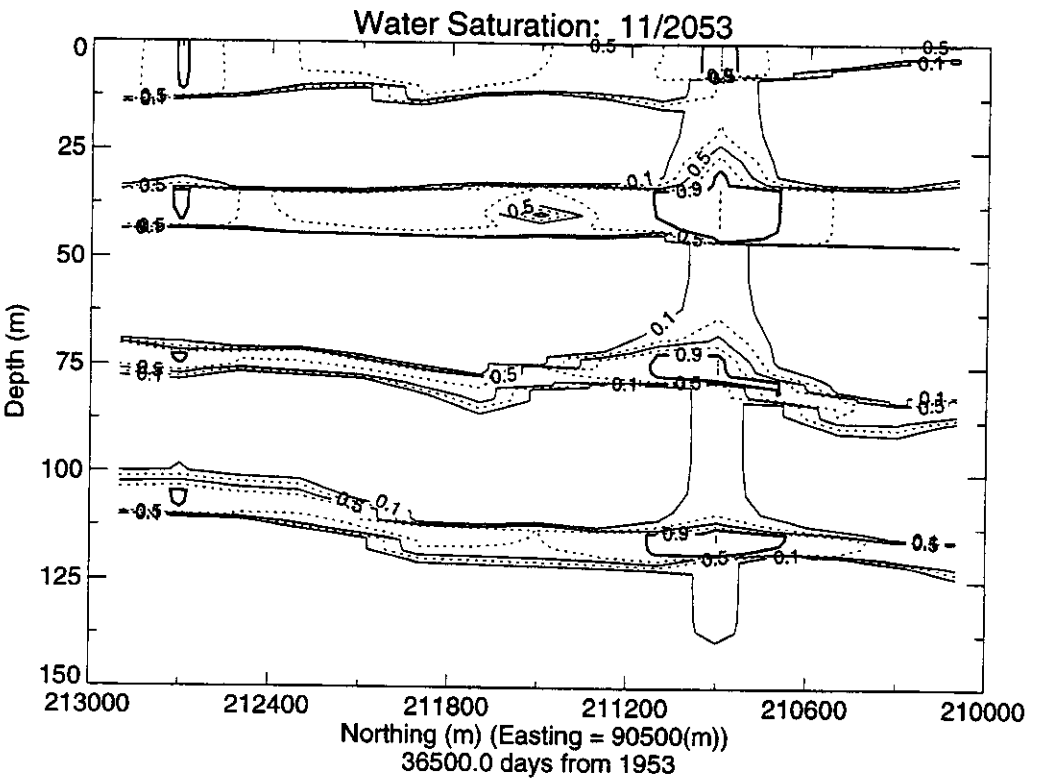


Figure 3-43 Water saturation 100 years after the initial application of process water (Figure 3-42) in a system where the saturated basalt permeability is one order of magnitude lower than the comparable base case (Figure 3-13).

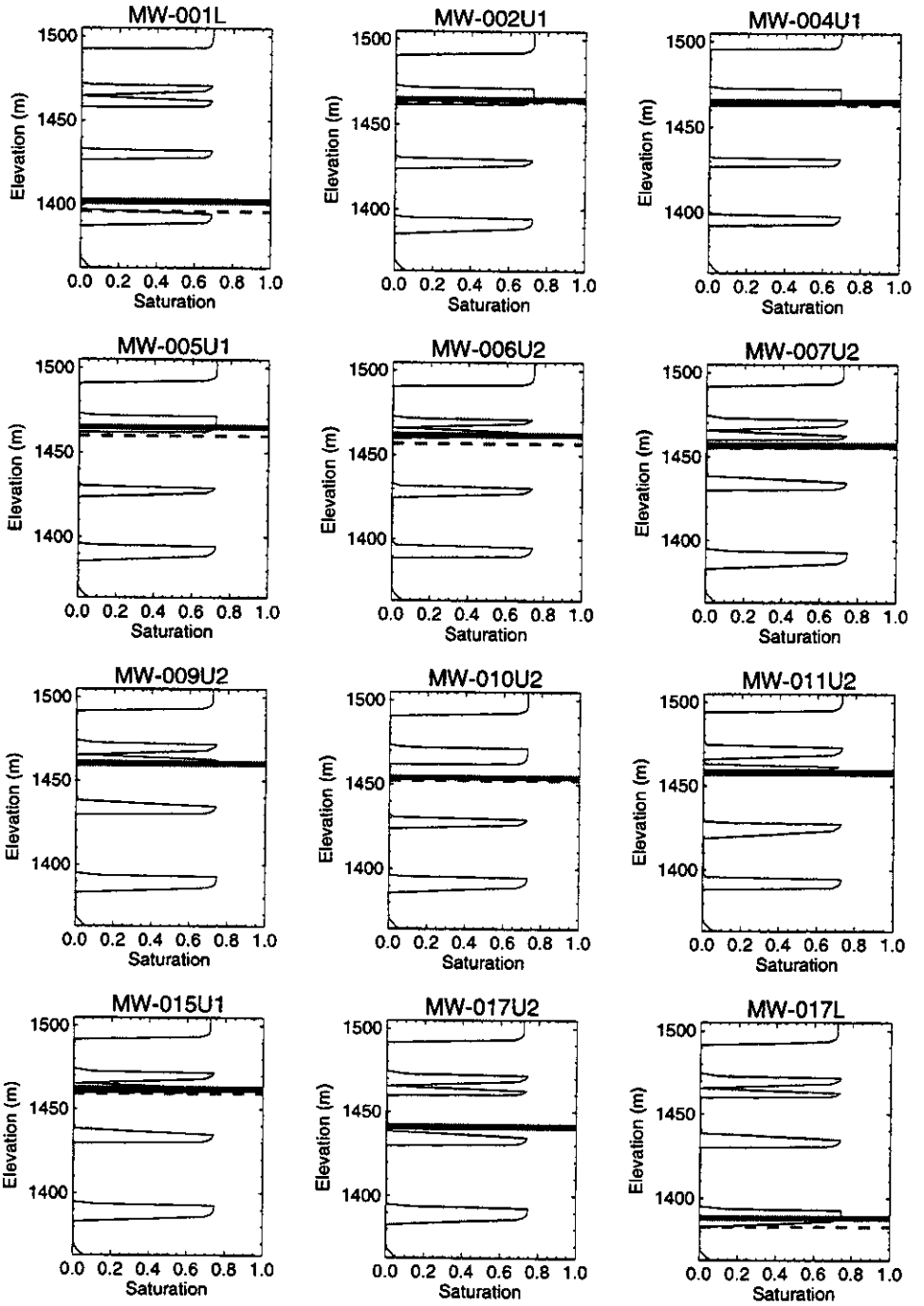


Figure 3-44 Water saturation as a function of elevation in wells that should show perched water. The dotted line is center of the screened interval, the thick dark line is the top of the perched water zone, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-42.

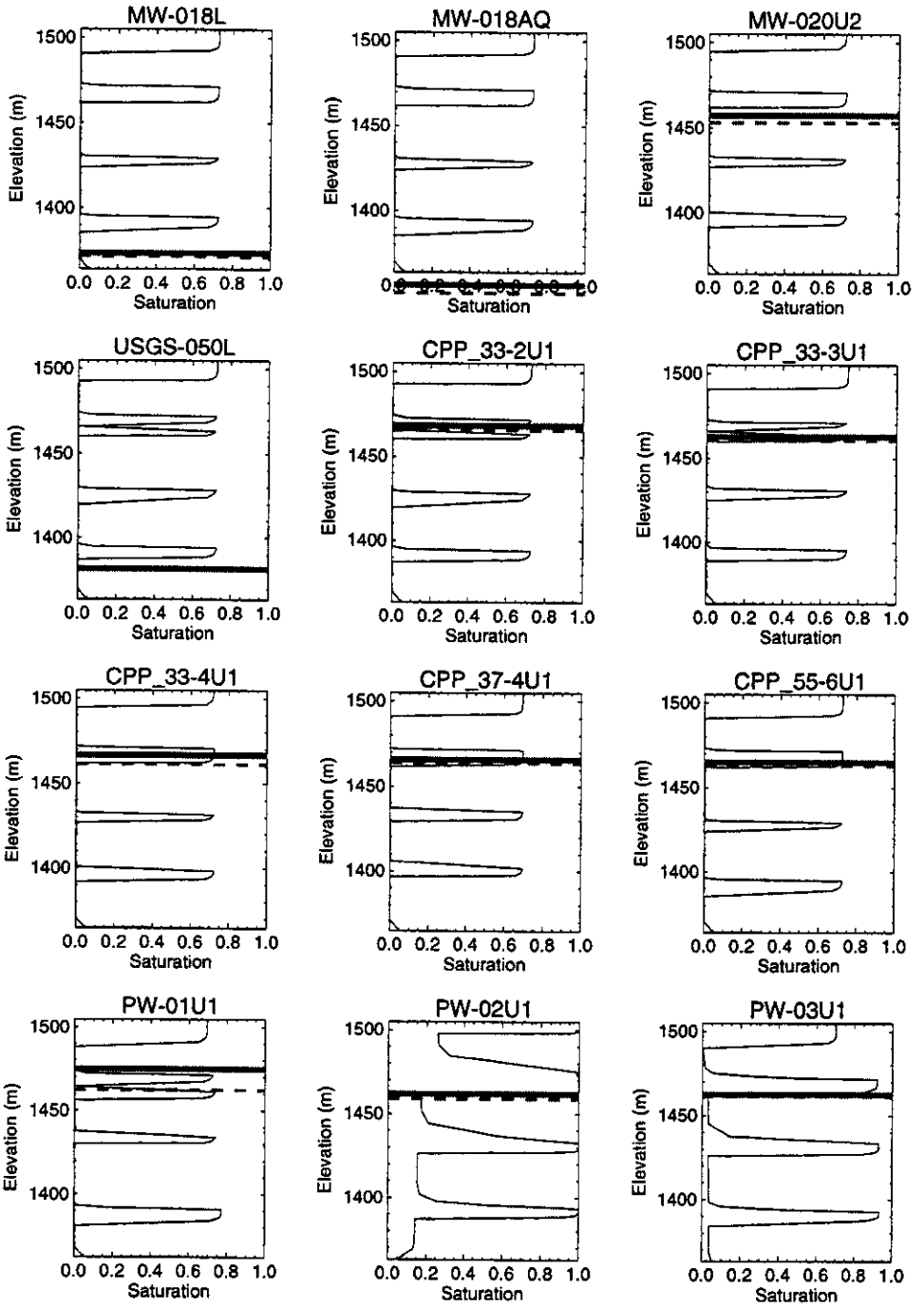


Figure 3-45 Water saturation as a function of elevation in wells that should show perched water. The dotted line is center of the screened interval, the thick dark line is the top of the perched water zone, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-42.

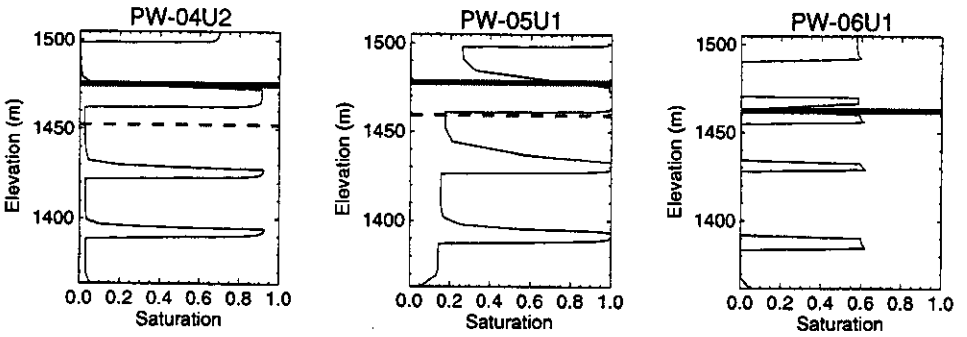


Figure 3-46 Water saturation as a function of elevation in wells that should show perched water. The dotted line is center of the screened interval, the thick dark line is the top of the perched water zone, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-42.

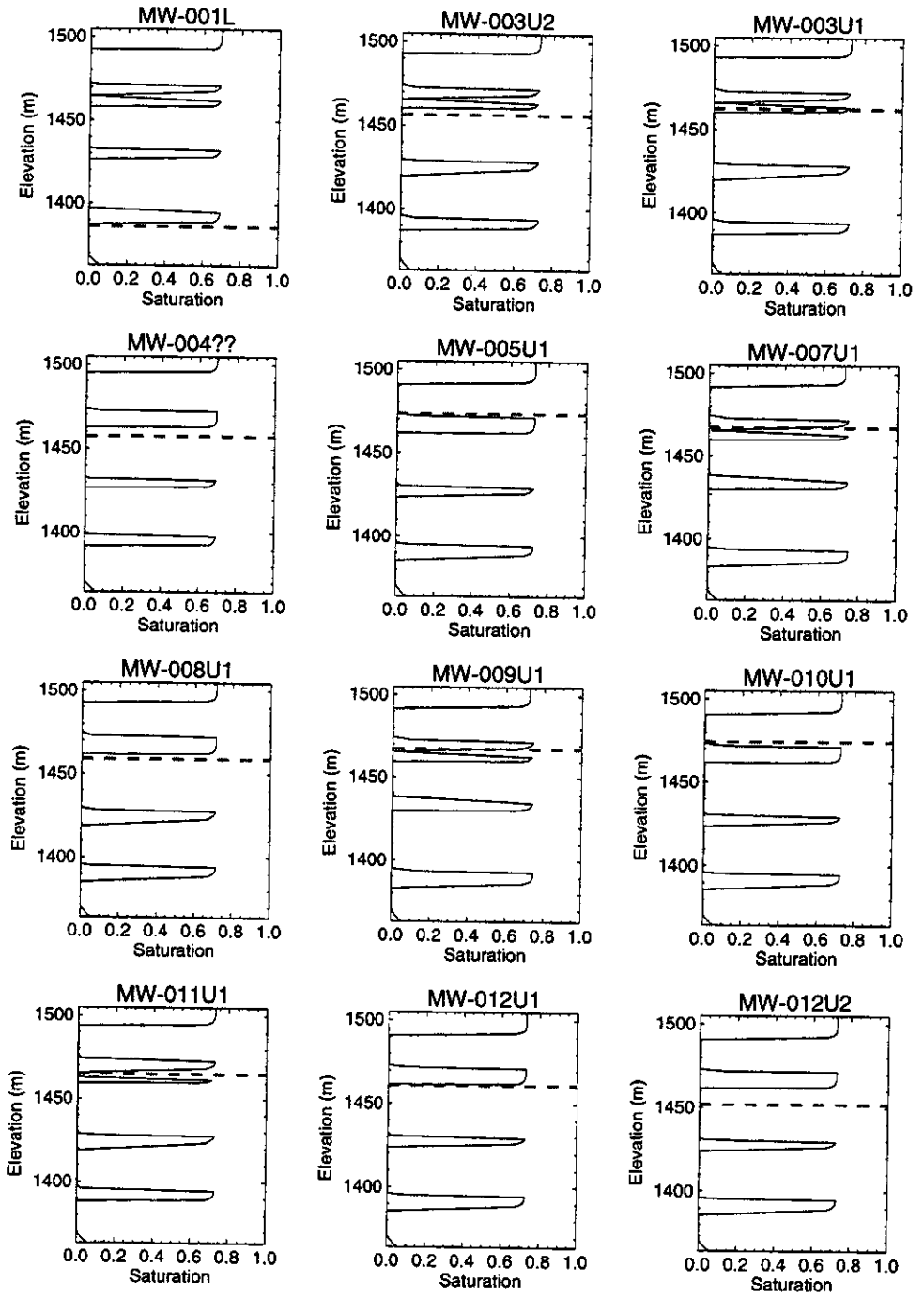


Figure 3-47 Water saturation as a function of elevation in wells that should not show perched water. The dotted line is center of the screened interval, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-42.

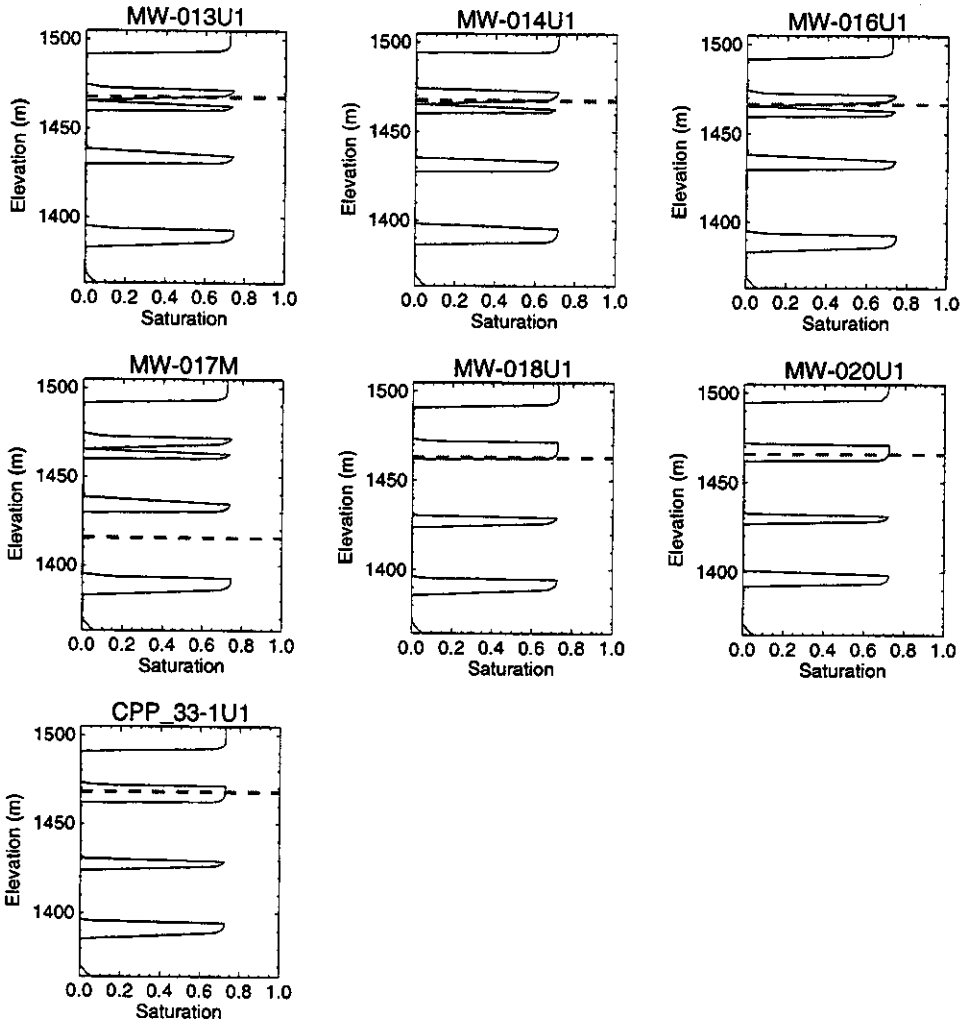


Figure 3-48 Water saturation as a function of elevation in wells that should not show perched water. The dotted line is center of the screened interval, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-42.

3.2.7 Increased Fluxes from Fire Water in the North (k_{sat}=10 mD)

The previous simulations have assumed that the fire water was uniformly distributed throughout the entire footprint area. Research into the source of the leakages has indicated that the fire water leaks were primarily confined to the northern portion of the ICPP as indicated in Tables 2-2 and 2-3. As a result, the fluxes from Zones 1, 2, and 3 were combined and applied to Zone 1. Results of this simulation did not produce the observed perched water bodies, indicating that there is still not enough water being applied in the north.

Table 1-9 shows that there is a significant range in estimated recharge volumes due to the transient nature of recharge introducing variability due to averaging times, and insufficient monitoring that introduces uncertainty through measurement error. It is difficult to assign water to the 17 model source areas sequentially in an effort to pinpoint the flux values or flux-permeability combinations that should be used in the ICPP model. However, it is not a computationally intensive effort to bracket the water volumes that would be required to create observed perched water elevations by arbitrarily increasing large-area source terms.

The following simulations illustrate the effect of increasing the fire-water leakage rates by one order of magnitude (fire = fire*10). This does not imply that there is that much uncertainty in fire water line leakage, but simply asks the question, "how much water is needed to form correct perched water levels in the north?" The base horizontal grid spacing is a uniform 200 x 200 m with local refinement of 100 x 100 m under the footprint of the ICPP. Sediment permeability is 10 mD, and the influence of the Big Lost River as a long-term contributor to the initial conditions is included. Note that the initial condition is the same as that shown in Figure 3-19.

Saturations 100 days after the initial application of process water are shown in Figure 3-49 and can be compared to the 100-day saturation of Figure 3-28.

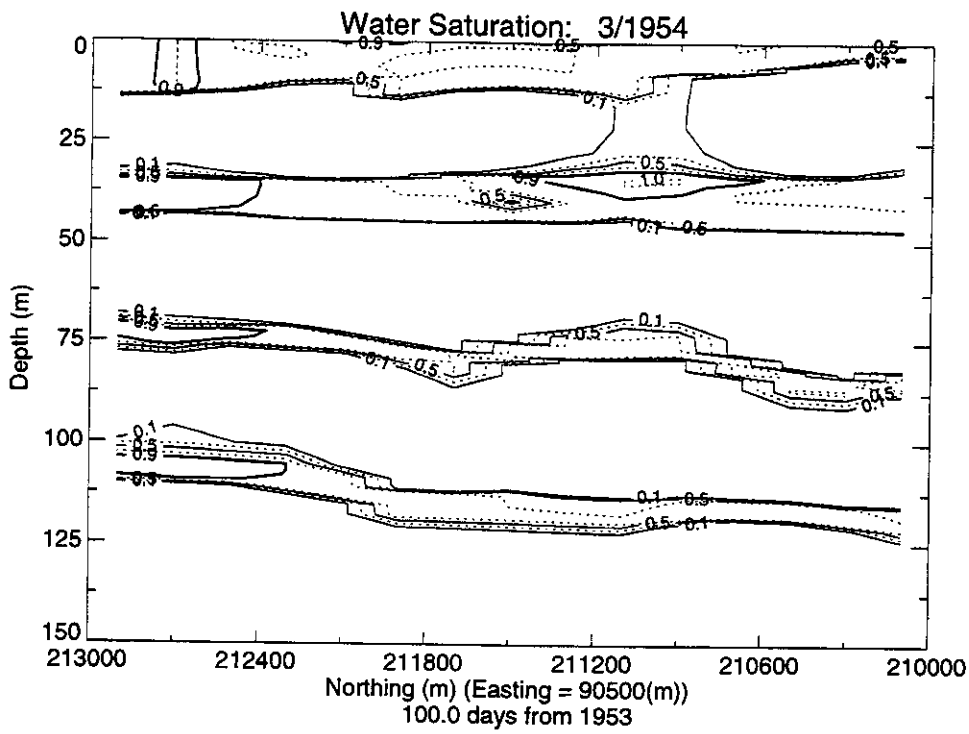


Figure 3-49 Water saturation at 100 days after the initial application of process water to the base case simulation shown in Figure 3-19. The grid spacing under the ICPP footprint has been refined to 100 x 100 m. Fire-line leakage has been increased by a factor of 10 relative to the values given in Table 2-2.

Figure 3-50 represents the steady-state saturation distribution, which can be compared to base case simulation given in Figure 3-29. Note that appreciable differences in saturation profiles exist as indicated by the merging of the Big Lost River and percolation pond water sources. This merging in water sources occurs throughout the depth profile including all three interbed regions. Resultant perched water elevations in the area beneath the percolation ponds are still very near observed values, while perched water elevations in the north are still underpredicted.

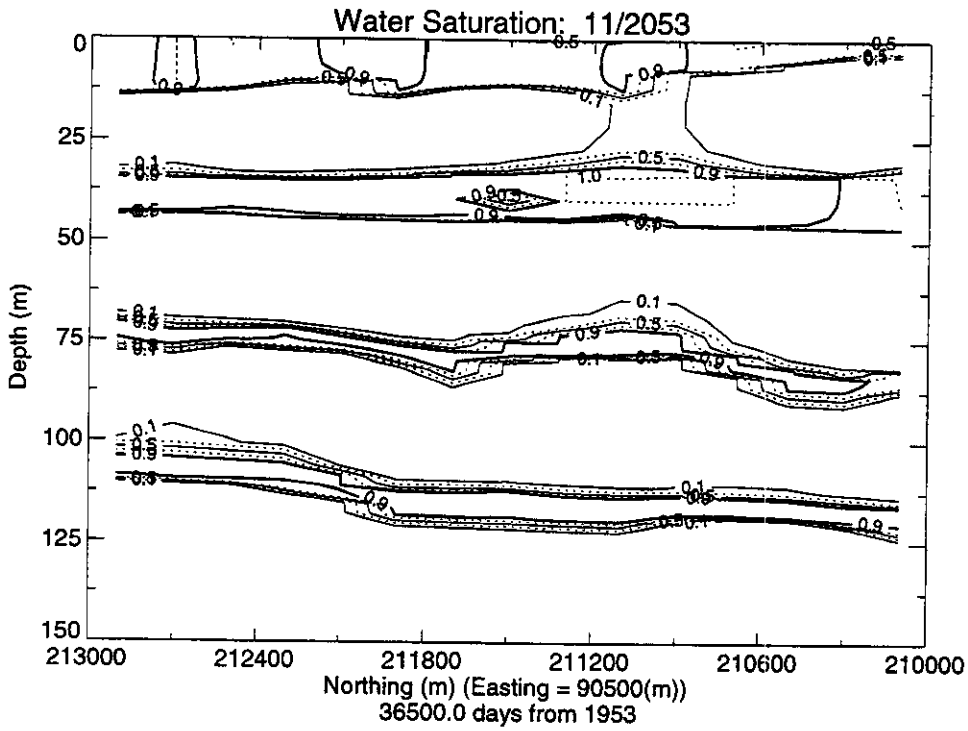


Figure 3-50 Water saturation 36,500 days after the initial application of process water to the initial condition shown in Figure 3-19. The grid spacing under the ICPP footprint has been refined to 100 x 100 m. Fire-line leakage has been increased by a factor of 10 relative to the values given in Table 2-2.

The resultant water saturations versus depth are given for the 40-year simulation time in Figures 3-51 through 3-55.

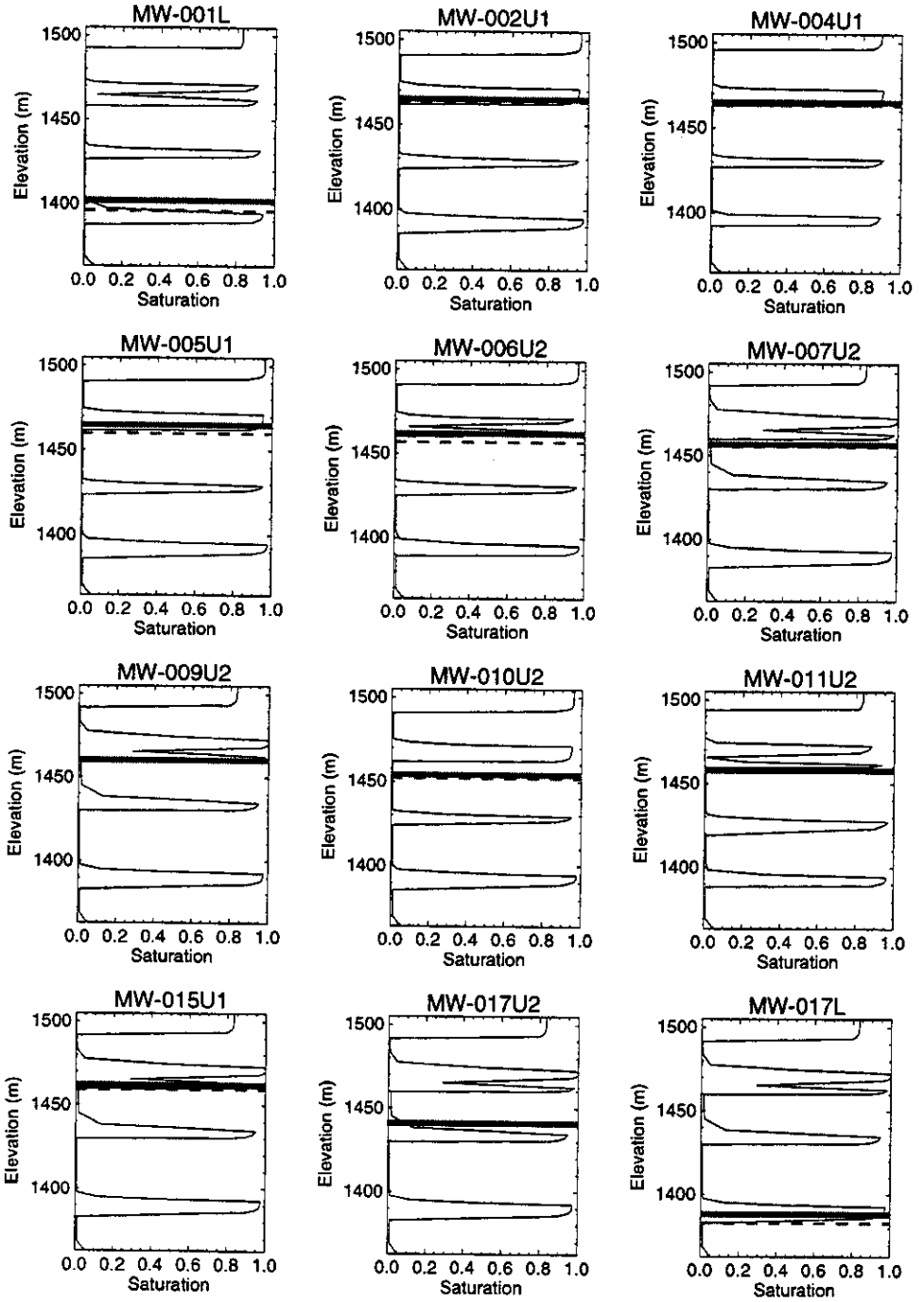


Figure 3-51 Water saturation as a function of elevation in wells that should show perched water. The dotted line is center of the screened interval, the thick dark line is the top of the perched water zone, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-49.

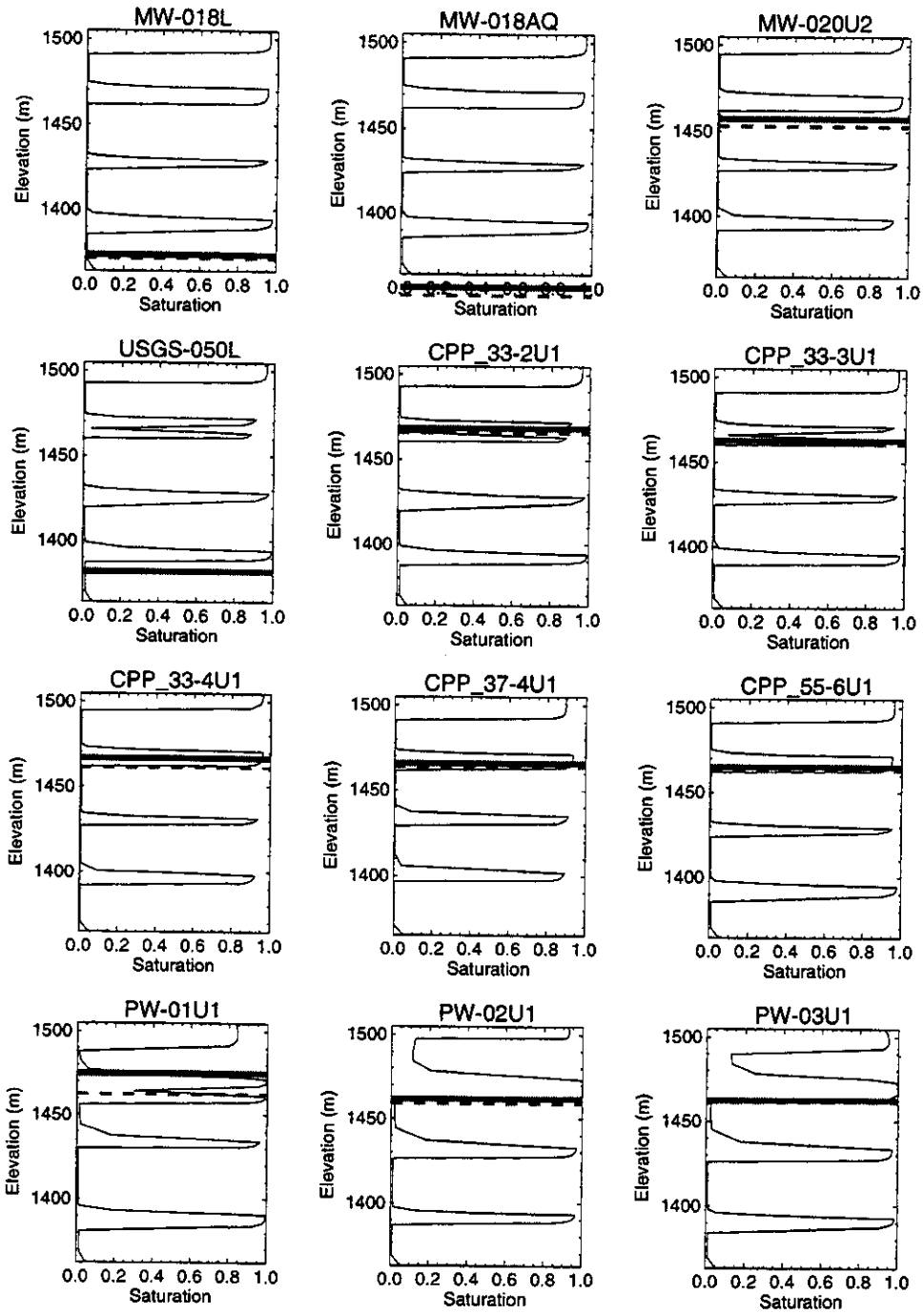


Figure 3-52 Water saturation as a function of elevation in wells that should show perched water. The dotted line is center of the screened interval, the thick dark line is the top of the perched water zone, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-49

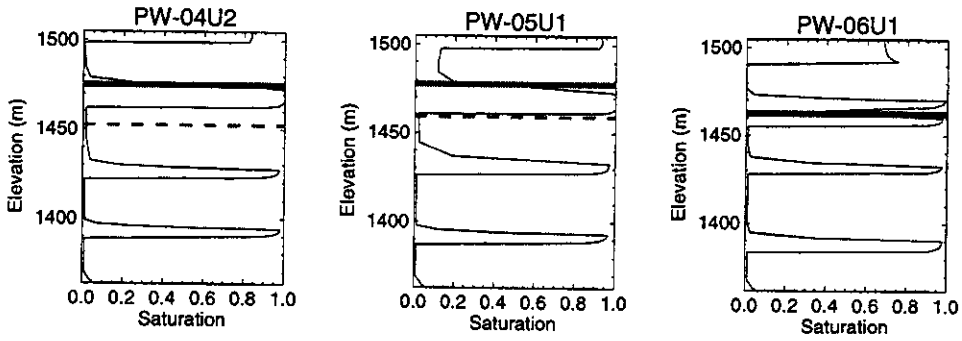


Figure 3-53 Water saturation as a function of elevation in wells that should show perched water. The dotted line is center of the screened interval, the thick dark line is the top of the perched water zone, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-49

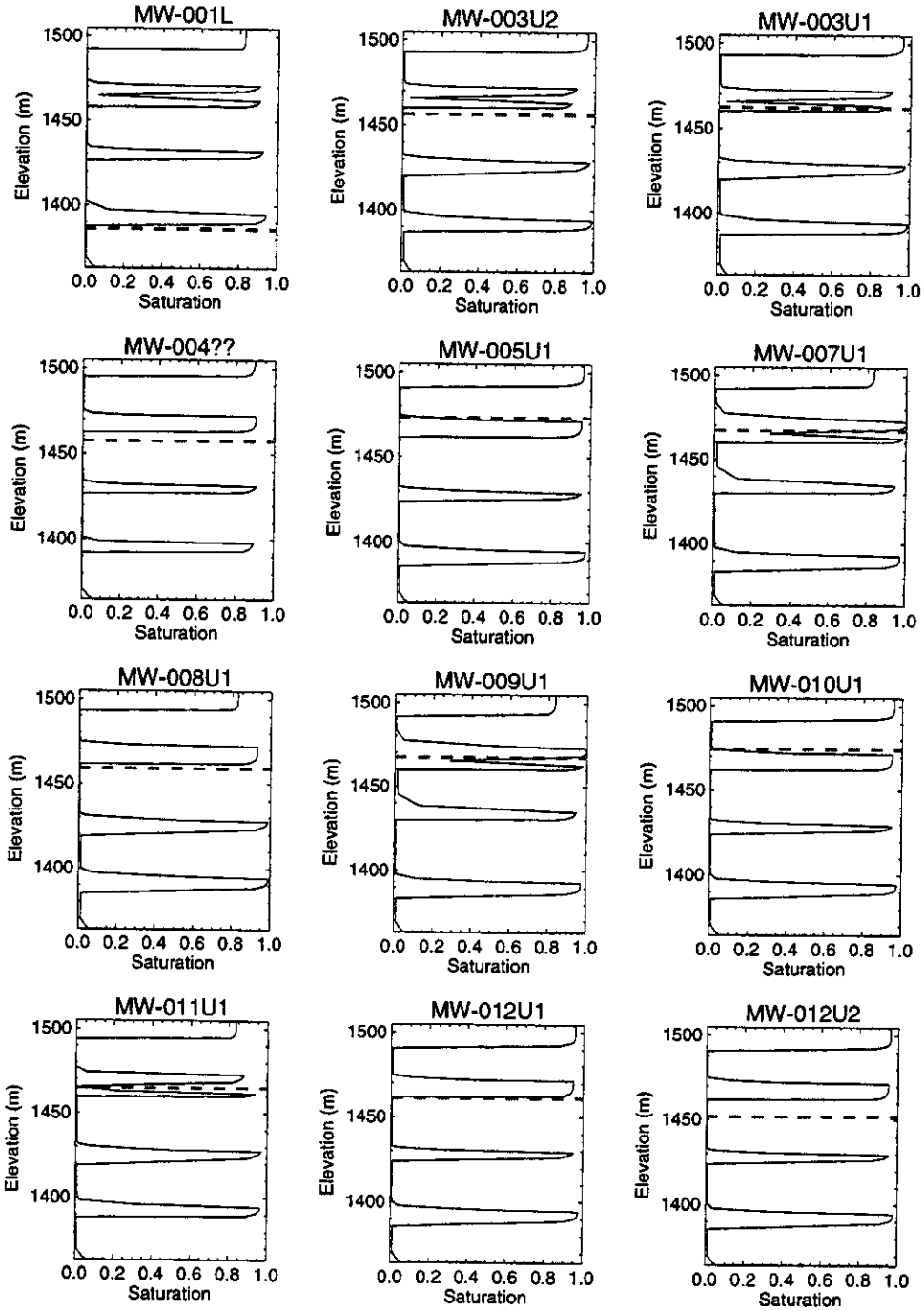


Figure 3-54 Water saturation as a function of elevation in wells that should not show perched water. The dotted line is center of the screened interval, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-49

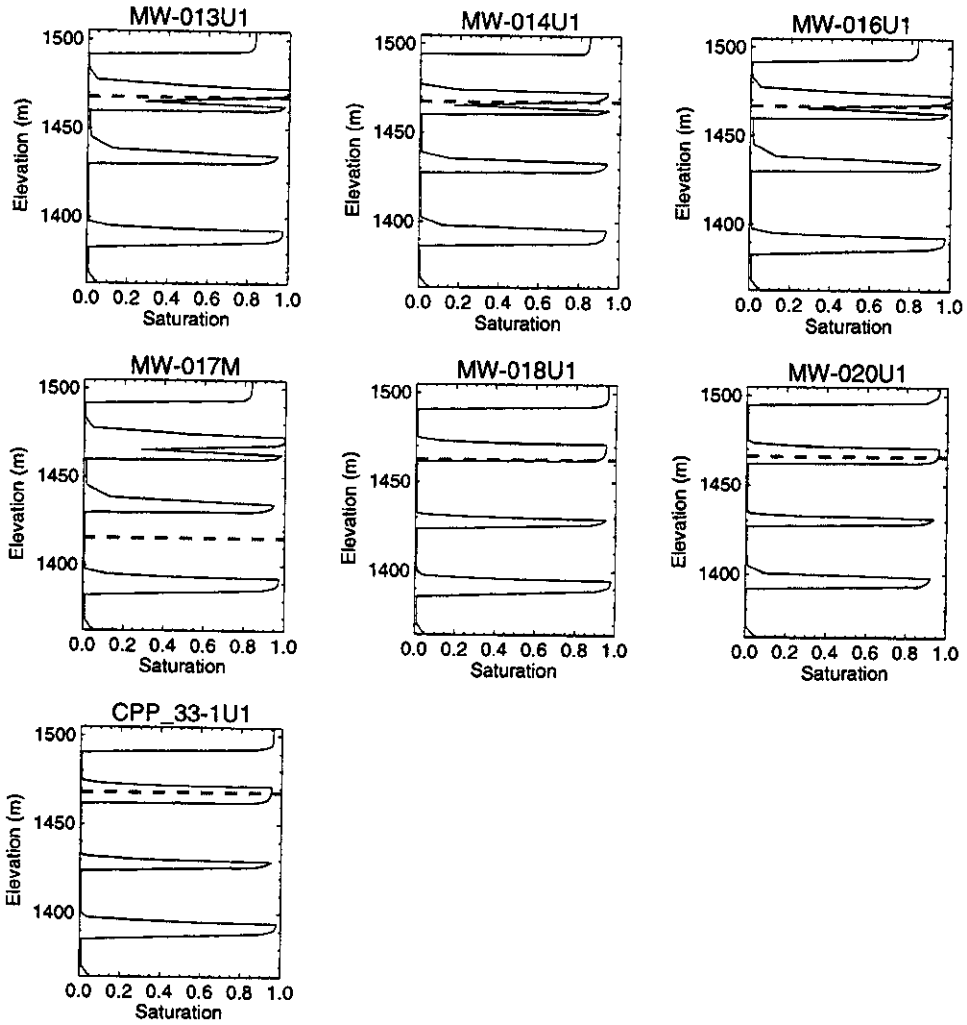


Figure 3-55 Water saturation as a function of elevation in wells that should not show perched water. The dotted line is center of the screened interval, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-49

3.2.8 Increased Big Lost River Fluxes (k_{sat} = 10 mD)

The previous simulation indicates that an increase in northern water influx will result in the required perched water elevations. One possible source of additional water is the Big Lost River. Estimates of the Big Lost River recharge have a significant range in addition to being orders of magnitude larger than any other water source in the northern portion of the ICPP. The following simulations illustrate the effect of increasing the Big Lost River recharge by a factor of 2 (rate = rate*2). The base horizontal grid spacing is a uniform 200 x 200 m with local refinement of 100 x 100 m under the footprint of the ICPP. Sediment permeability is 10 mD, and the influence of the Big Lost River as a long-term contributor to the initial conditions is included.

Saturations 100 days after the initial application of process water are shown in Figure 3-56 and can be compared to the 100-day saturation of Figure 3-28.

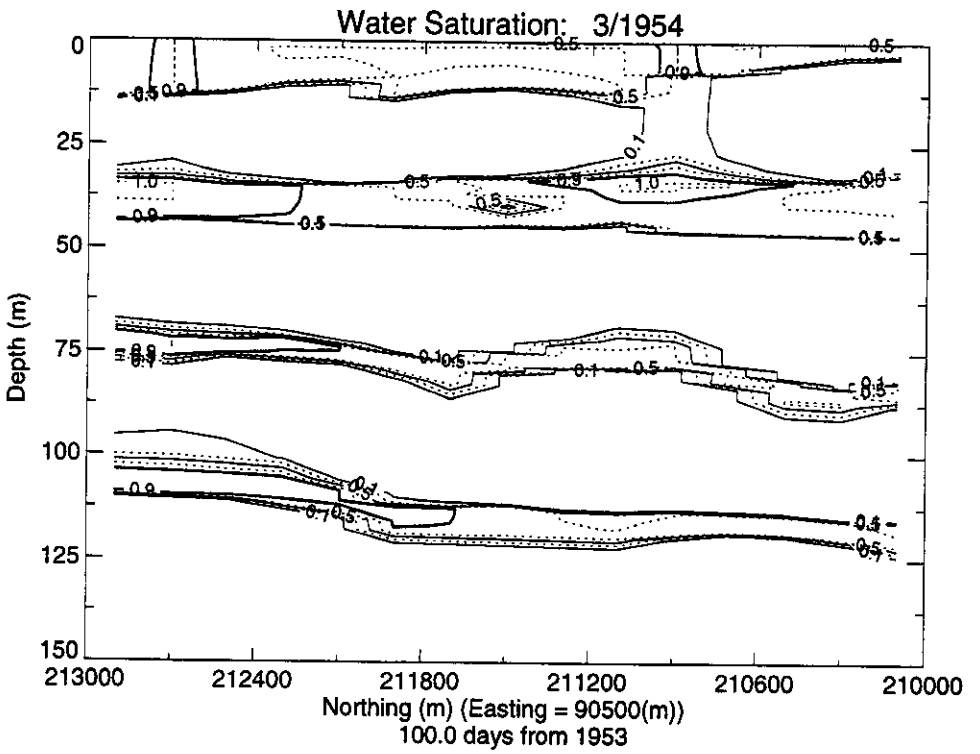


Figure 3-56 Water saturation at 100 days after the initial application of process water to the base case simulation shown in Figure 3-19. The grid spacing under the ICPP footprint has been refined to 100 x 100 m. Big Lost River leakage has been increased by a factor of 2 relative to the values given in Table 2-2.

Figure 3-57 represents the steady-state saturation distribution, which can be compared to base case simulation given in Figure 3-29 and water saturations versus depth are given for the 40-year simulation time in Figures 3-58 through 3-62.

Like the previous simulation, saturations from the Big Lost River and Percolation Ponds are beginning to merge. However, they aren't quite equal to 1.0, which means that there is still insufficient perched water forming in the north. This implies that either the Big Lost River contribution should be further increased or that sediment permeability should be further reduced. To analyze the first case, the following simulation imposes a large transient influx over a short period of time to see if an average annual transient effect would be sufficient to cause long-term residual saturations that would, in turn, cause the desired perched water elevations. This

simulation will be based on data indicating that the Big Lost River flooding does cause dramatic increases in perched water elevations (spring/summer 1995).

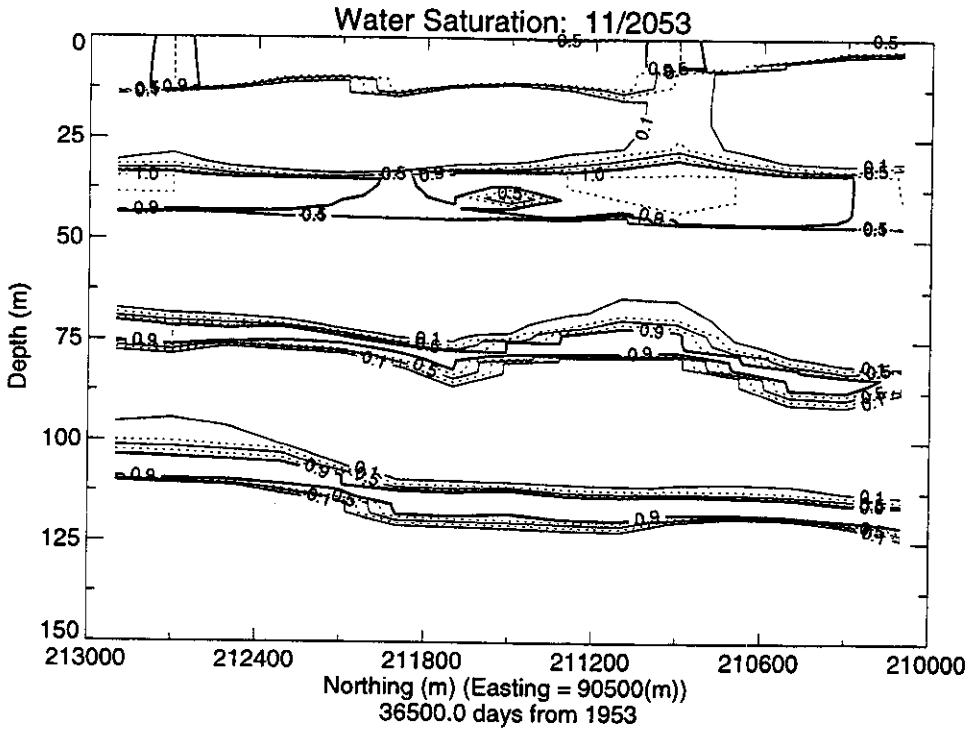


Figure 3-57 Water saturation 36,500 days after the initial application of process water for the initial condition shown in Figure 3-56. The grid spacing under the ICPP footprint has been refined to 100 x 100 m. Big Lost River leakage has been increased by a factor of 2 relative to the values given in Table 2-2.

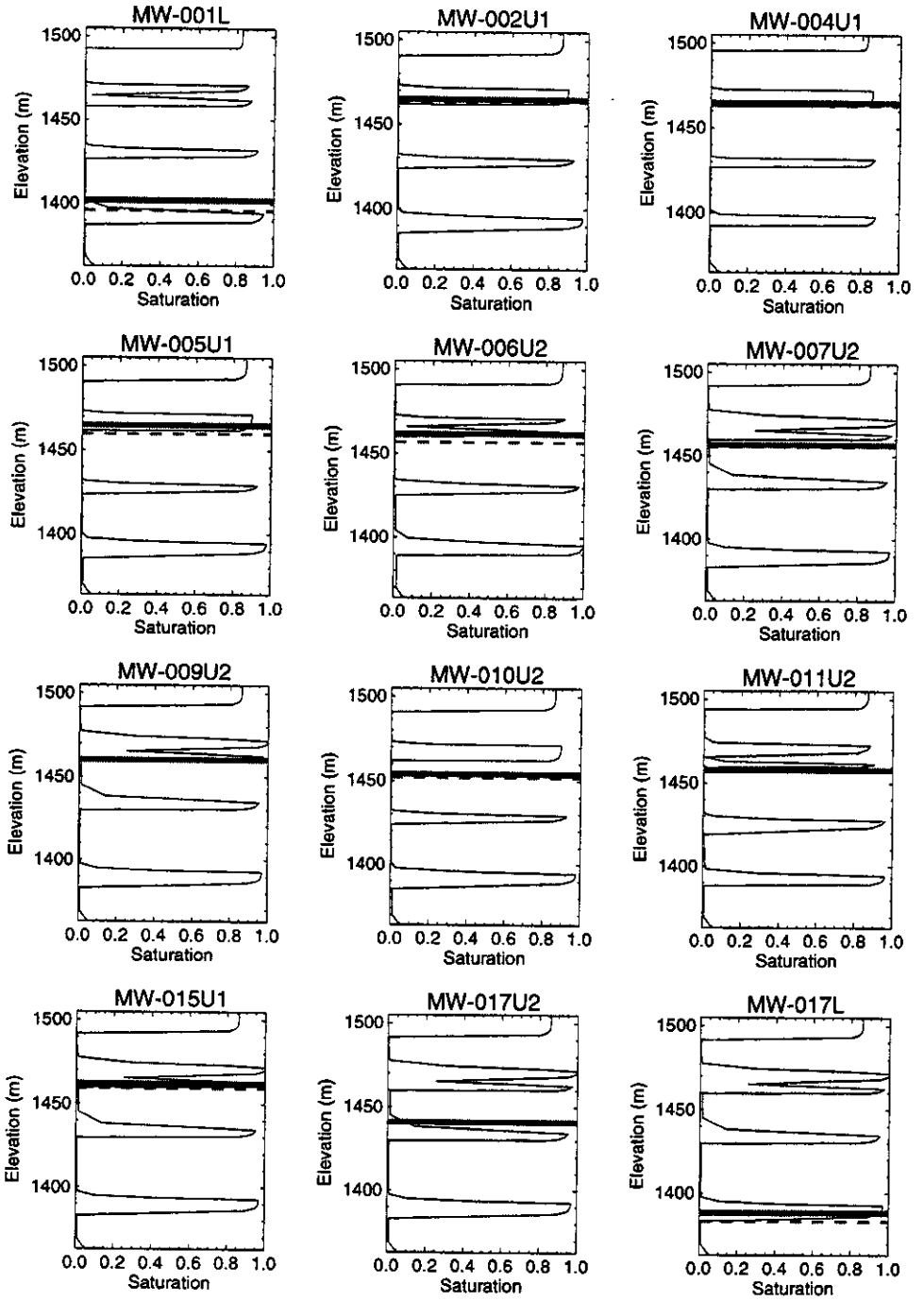


Figure 3-58 Water saturation as a function of elevation in wells that should show perched water. The dotted line is center of the screened interval, the thick dark line is the top of the perched water zone, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-56.

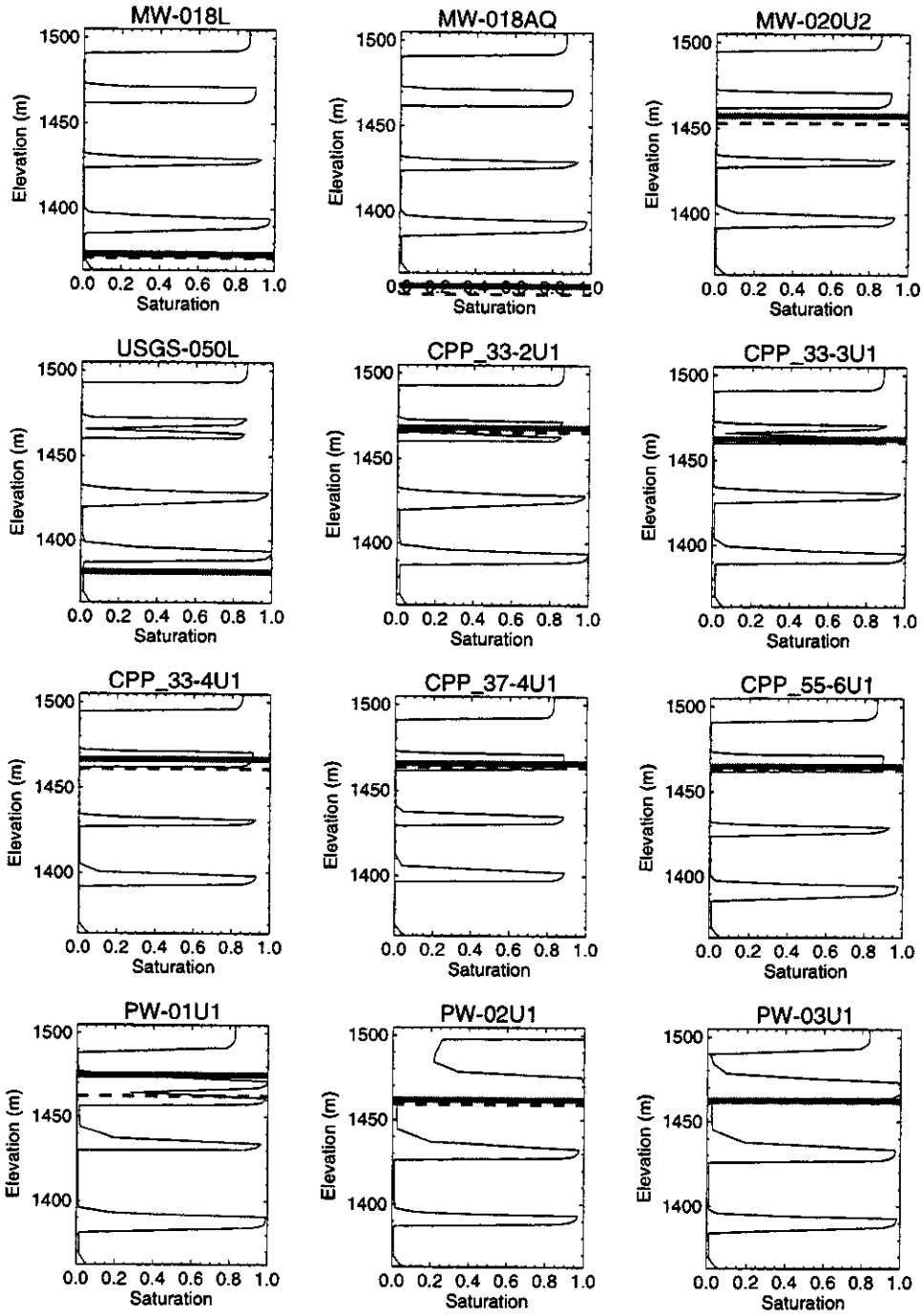


Figure 3-59 Water saturation as a function of elevation in wells that should show perched water. The dotted line is center of the screened interval, the thick dark line is the top of the perched water zone, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-56.

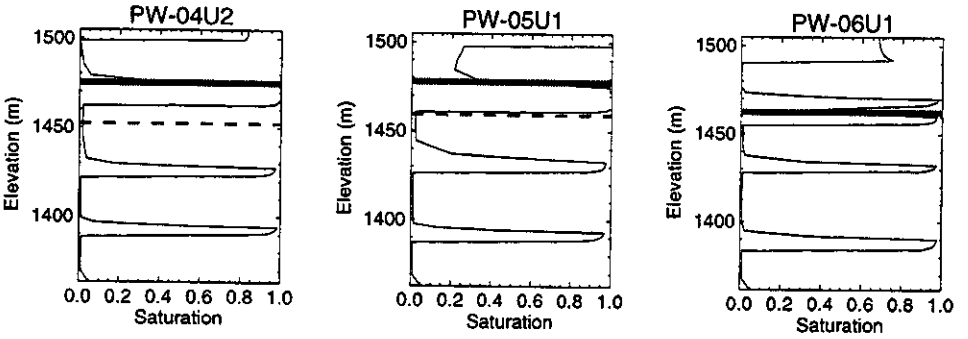


Figure 3-60 Water saturation as a function of elevation in wells that should show perched water. The dotted line is center of the screened interval, the thick dark line is the top of the perched water zone, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-56.

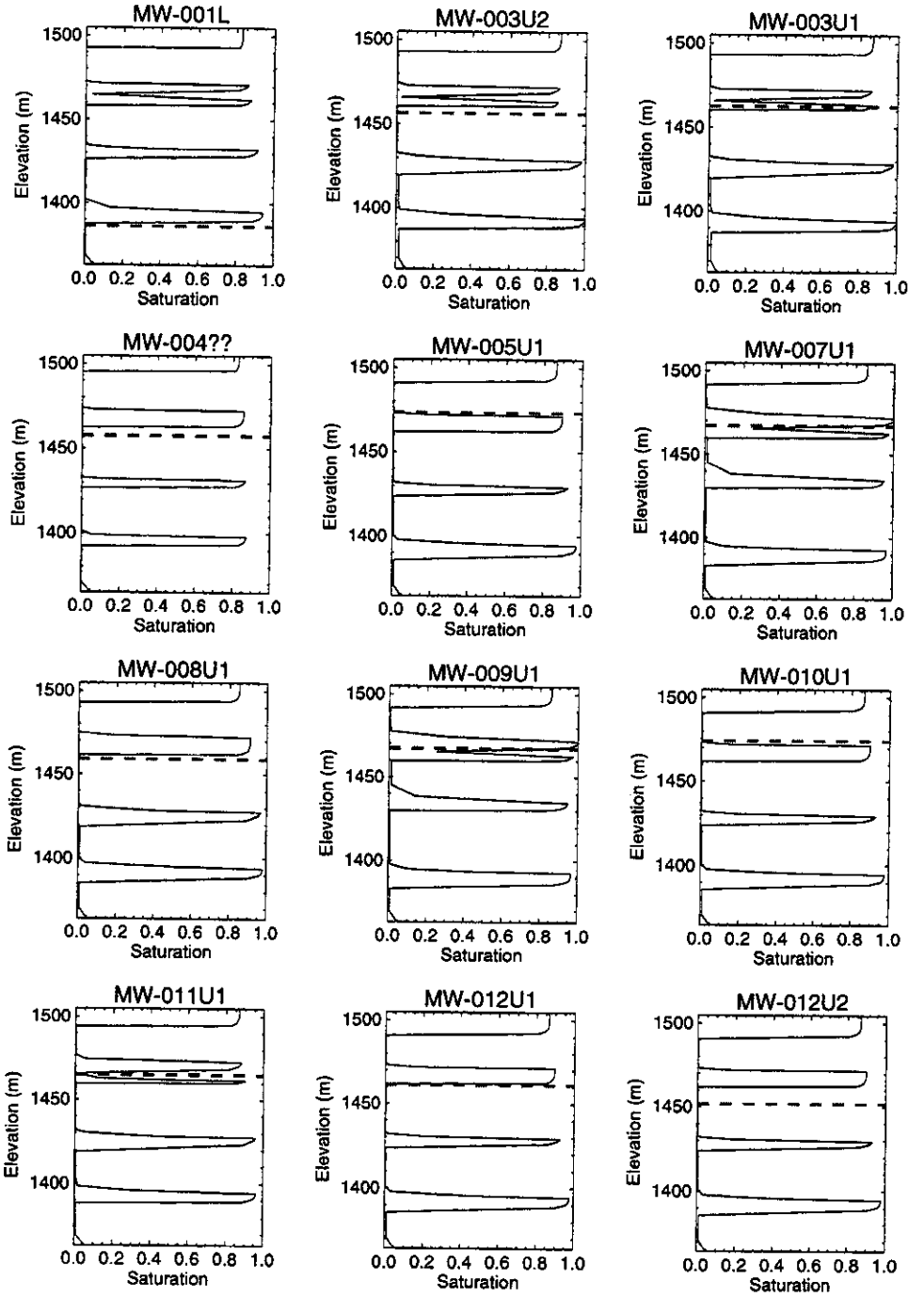


Figure 3-61 Water saturation as a function of elevation in wells that should not show perched water. The dotted line is center of the screened interval, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-56.

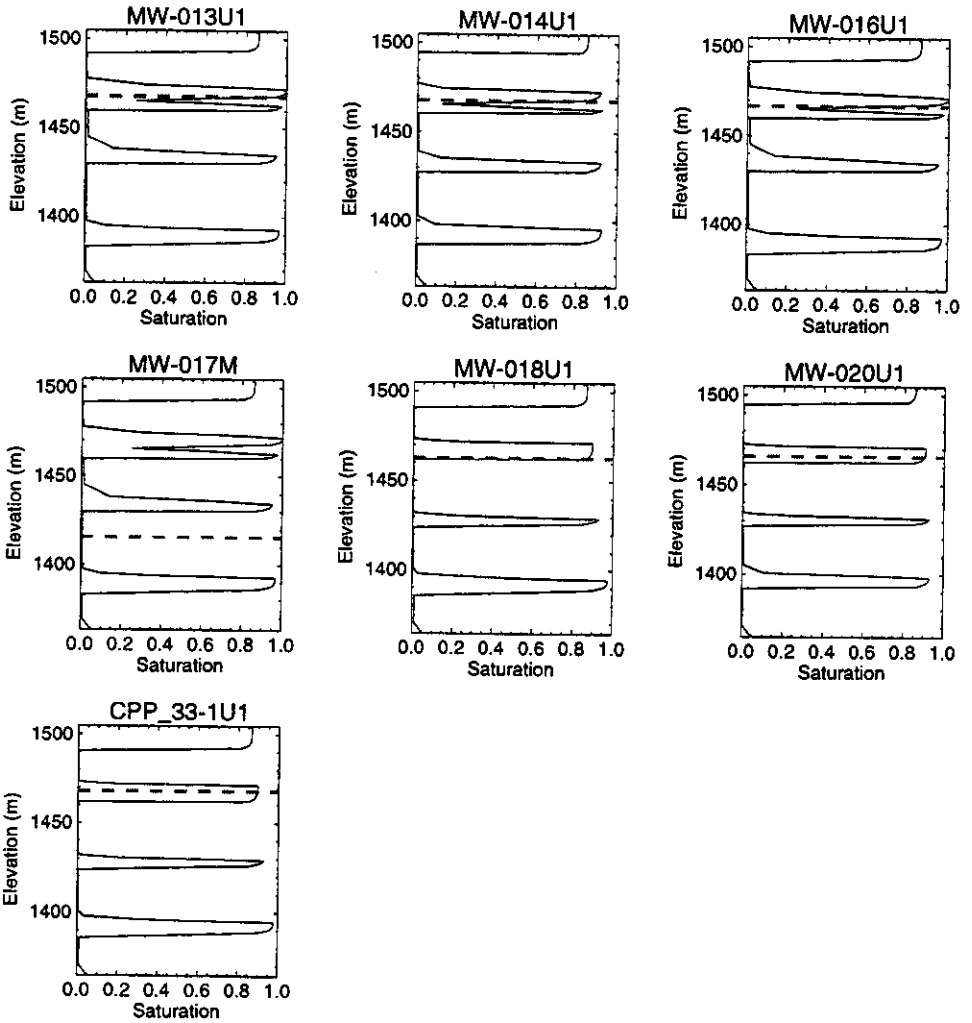


Figure 3-62 Water saturation as a function of elevation in wells that should not show perched water. The dotted line is center of the screened interval, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-56.

3.2.9 Decreased Sediment Permeability (k_{sat}=5 mD) With 10 mD Alluvium Permeability

Based on the previous simulations and the relative effects of reducing permeability as opposed to increasing fluxes, the sediment permeability was further reduced to 5 mD (from 10 mD). The following sequence of figures show that without further increasing fluxes above the base case simulation, sufficient perched water forms where necessary throughout the ICPP. Although this set of parameters forms adequate perching throughout the ICPP, it is perhaps not ideal in that the alluvium permeability is 10 mD. Based on the RWMC alluvium measurements, the permeability should be higher at about 80 mD. However, we present it here as a basis for comparison to the results following. The base horizontal grid spacing is a uniform 200 x 200 m with local refinement of 100 x 100 m under the footprint of the ICPP. Fire water leakage is uniform throughout the ICPP, and the influence of the Big Lost River as a long-term contributor to the initial conditions is included.

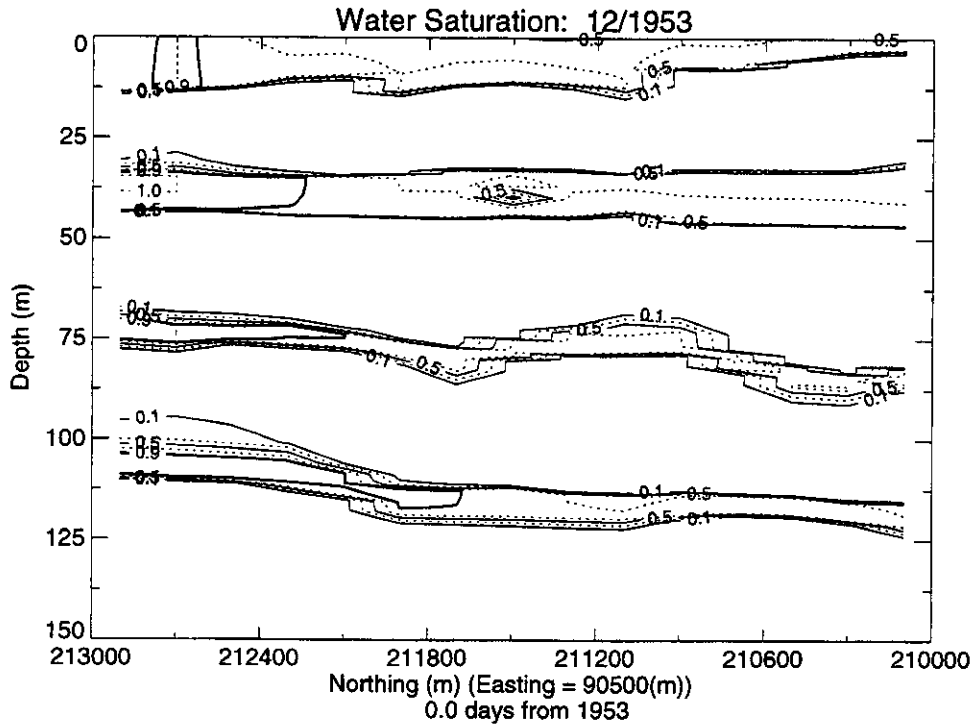


Figure 3-63 Initial water saturation condition prior to application of process water forming the base case simulation with interbed permeability equal to 5 mD and alluvium permeability of 10 mD.

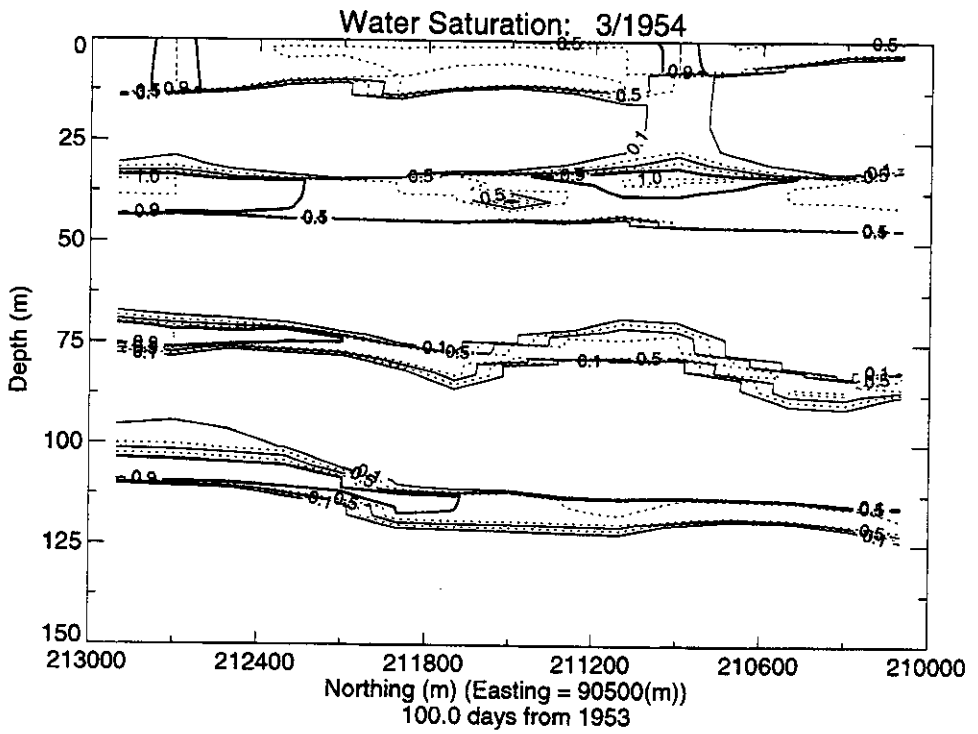


Figure 3-64 Water saturation at 100 days after the initial application of process water to the base case simulation shown in Figure 3-63. This simulation uses an interbed permeability equal to 5 mD and alluvium permeability of 10 mD.

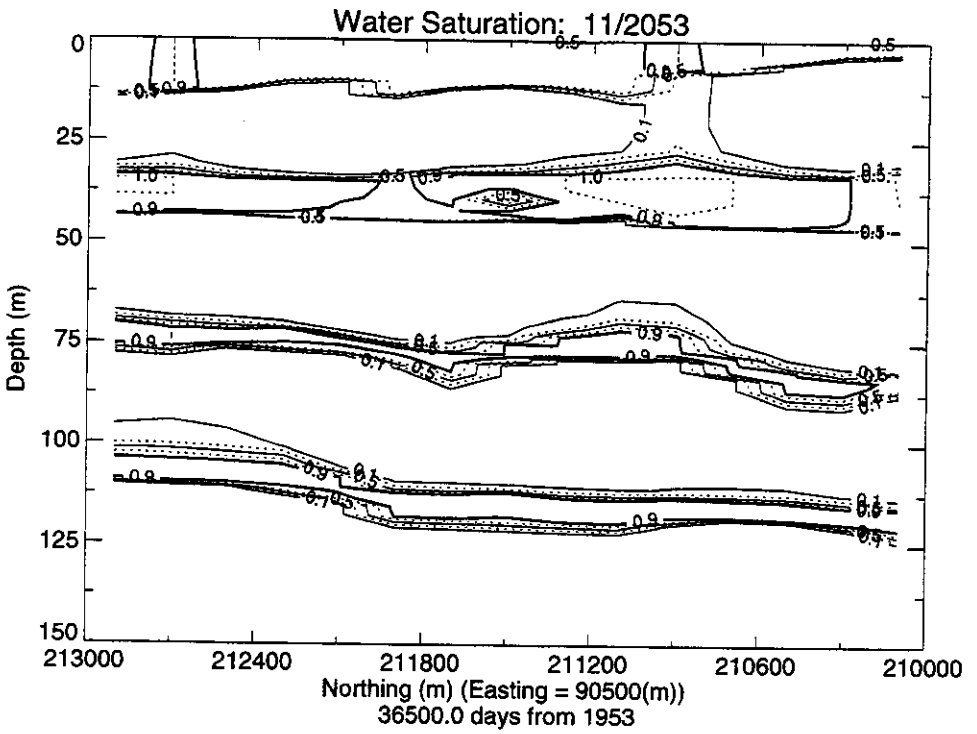


Figure 3-65 Water saturation 100 years after the initial application of process water to the base case simulation shown in Figure 3-63. This simulation uses an interbed permeability equal to 5 mD and alluvium permeability of 10 mD.

At 36,500 days (Figure 3-65), there is not an appreciable difference in saturation profile throughout the cross-section compared to a simulation time of 10,000 days. There is clearly a region of complete saturation under the Big Lost River, with saturations well above 0.9 extending in the upper interbed region beneath the northern facilities. The saturation by well is given in Figures 3-66 through 3-70, and shows that these parameters result in saturations of about 98 to 100% in upper interbed below the tank farm.

Although this simulation shows that sediment permeability is probably the controlling factor in the formation of perched water, the sensitivity/parametric analysis was completed as shown in the following simulations.

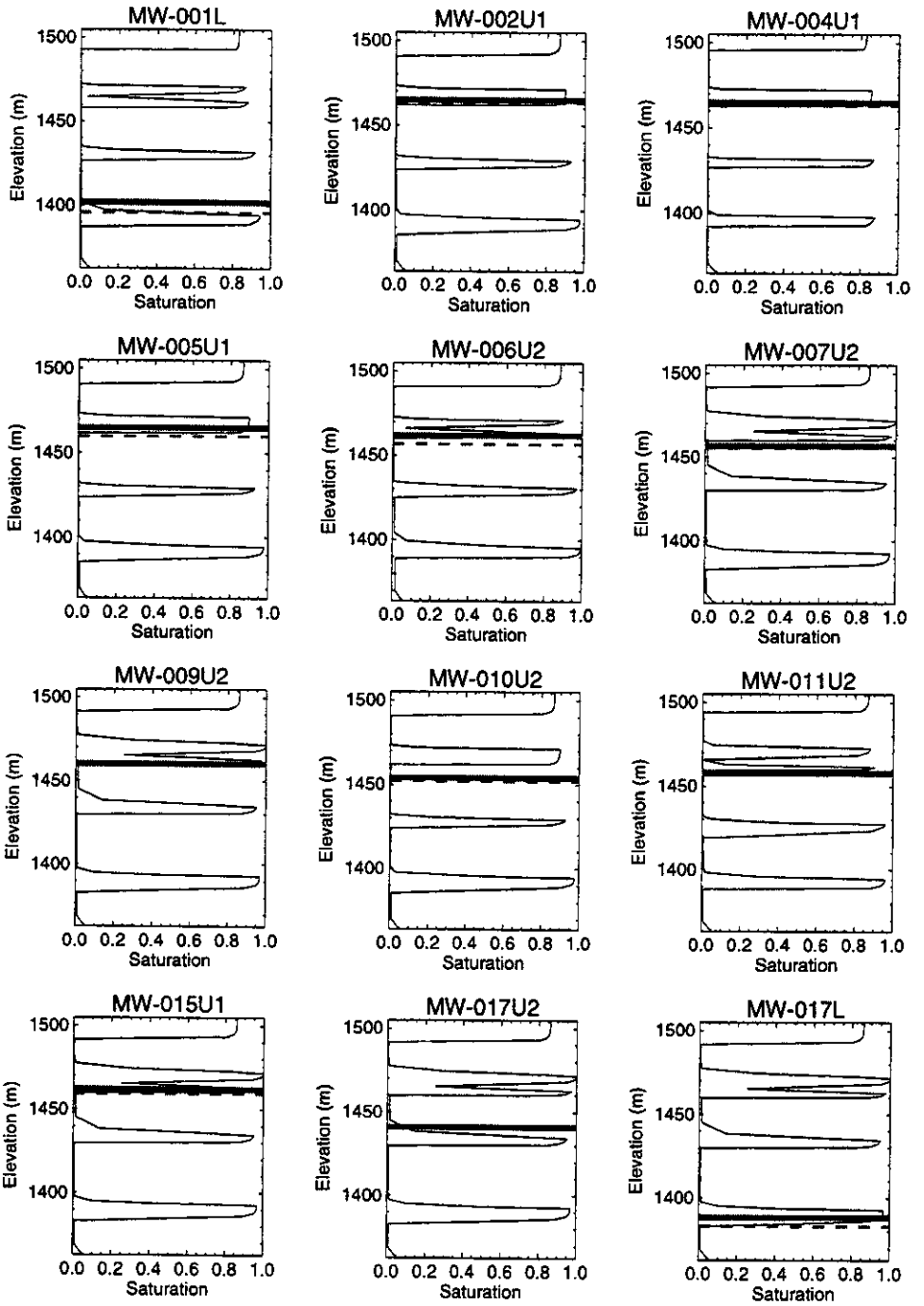


Figure 3-66 Water saturation as a function of elevation in wells that should show perched water. The dotted line is center of the screened interval, the thick dark line is the top of the perched water zone, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-63.

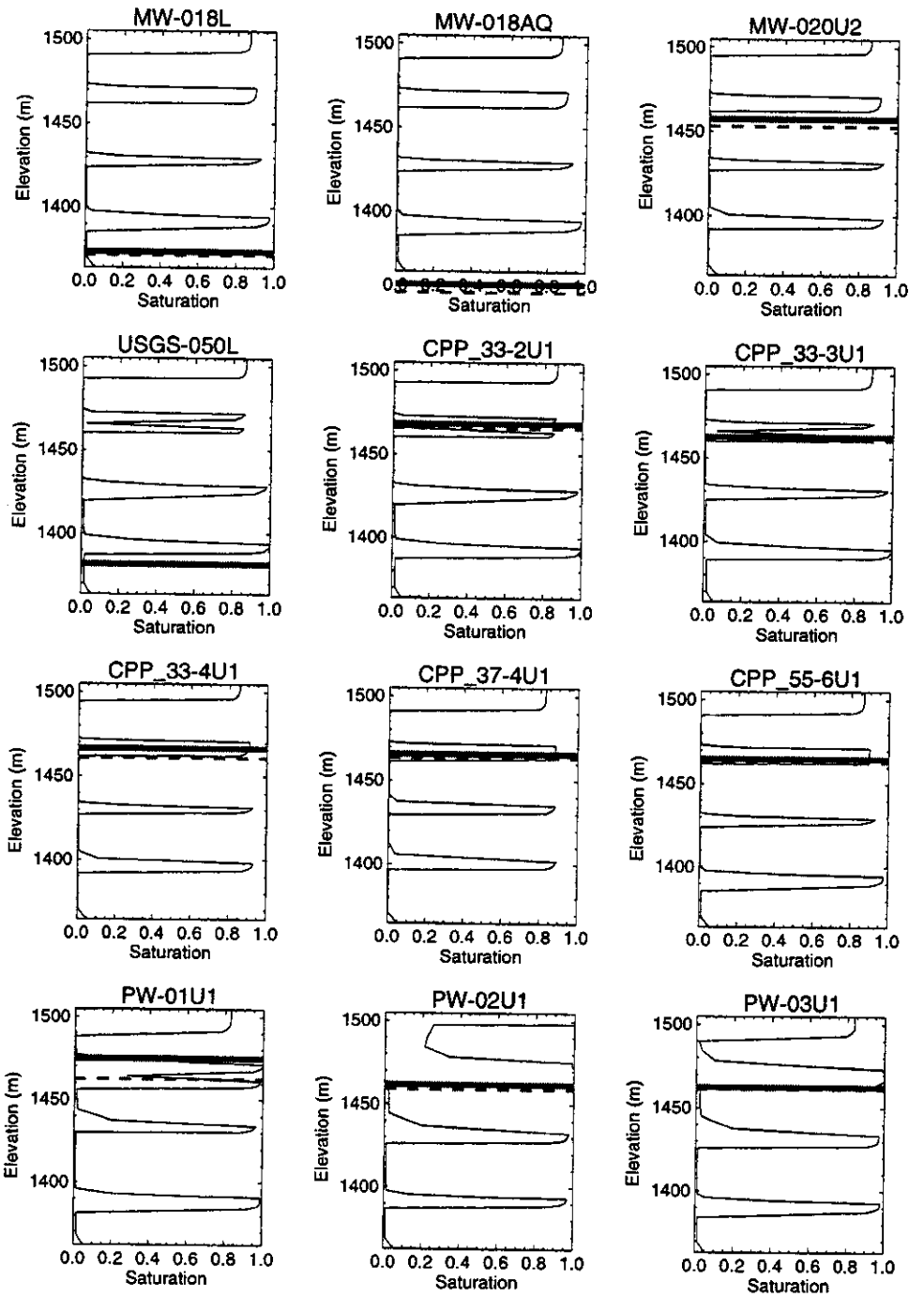


Figure 3-67 Water saturation as a function of elevation in wells that should show perched water. The dotted line is center of the screened interval, the thick dark line is the top of the perched water zone, and the thin line is the water saturation predicted from the model. These sub-figures correspond to the initial condition shown in Figure 3-63.

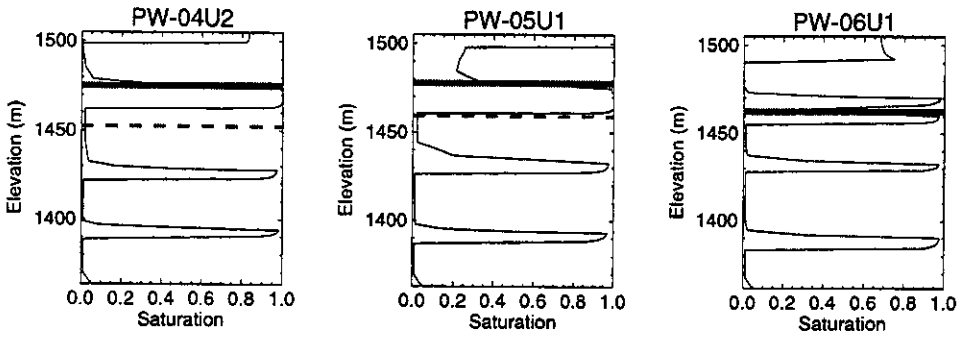


Figure 3-68 Water saturation as a function of elevation in wells that should show perched water. The dotted line is center of the screened interval, the thick dark line is the top of the perched water zone, and the thin line is the water saturation predicted from the model These sub-figures correspond to the initial condition shown in Figure 3-63.

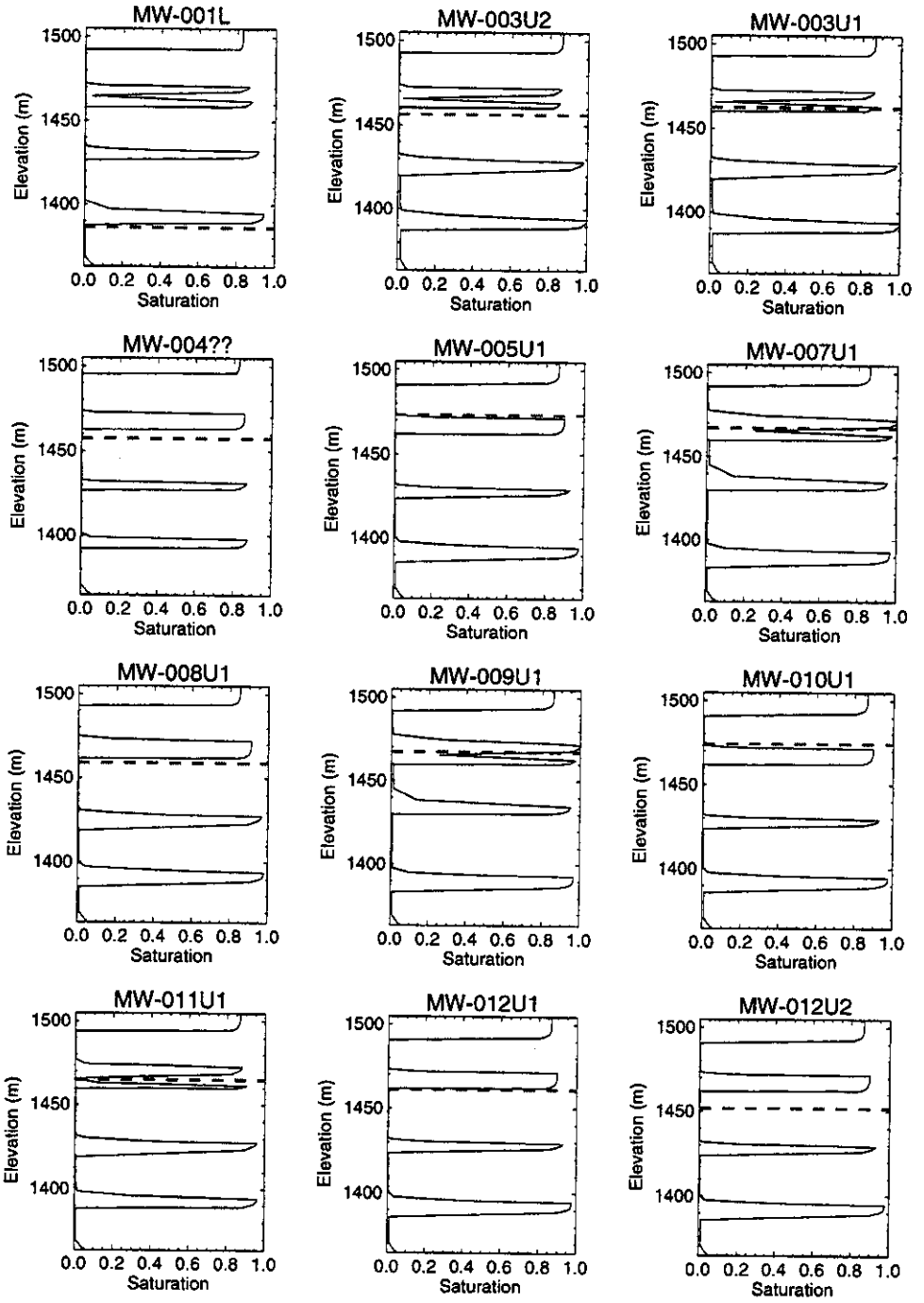


Figure 3-69 Water saturation as a function of elevation in wells that should not show perched water. The dotted line is center of the screened interval, and the thin line is the water saturation predicted from the model These sub-figures correspond to the initial condition shown in Figure 3-63.

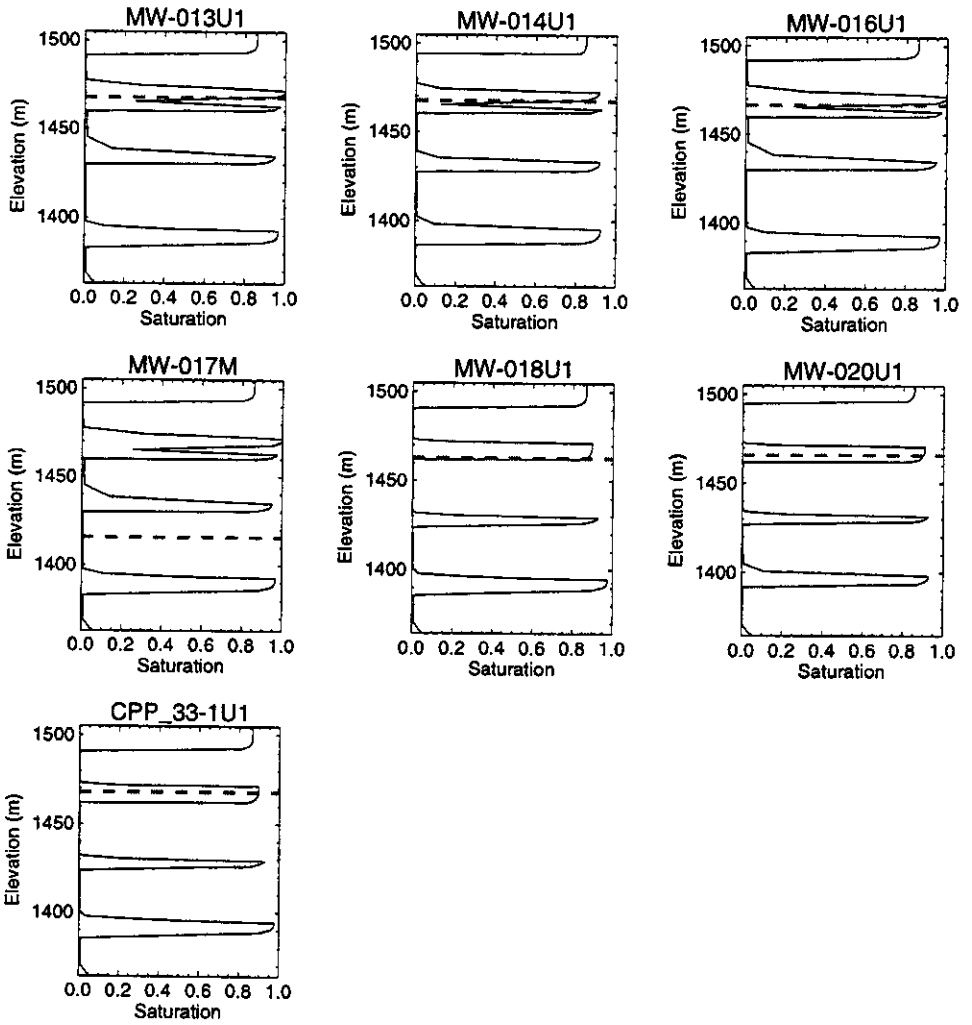


Figure 3-70 Water saturation as a function of elevation in wells that should not show perched water. The dotted line is center of the screened interval, and the thin line is the water saturation predicted from the model These sub-figures correspond to the initial condition shown in Figure 3-63.

3.2.10 Decreased Sediment Porosity (Sediment k_{sat}=5 mD, Alluvium k_{sat}=10 mD)

Travel time will be sensitive to permeability and porosity. The previous simulations have examined the effect of permeability, and this set of simulations looks at the effect of porosity on the perched water. The base case parameters of Section 3.2.9 were used with a porosity decrease from 0.487 to 0.4. The base horizontal grid spacing is a uniform 200 x 200 m with local refinement of 100 x 100 m under the footprint of the ICPP. Fire water leakage is uniform throughout the ICPP, and the influence of the Big Lost River as a long-term contributor to the initial conditions is included.

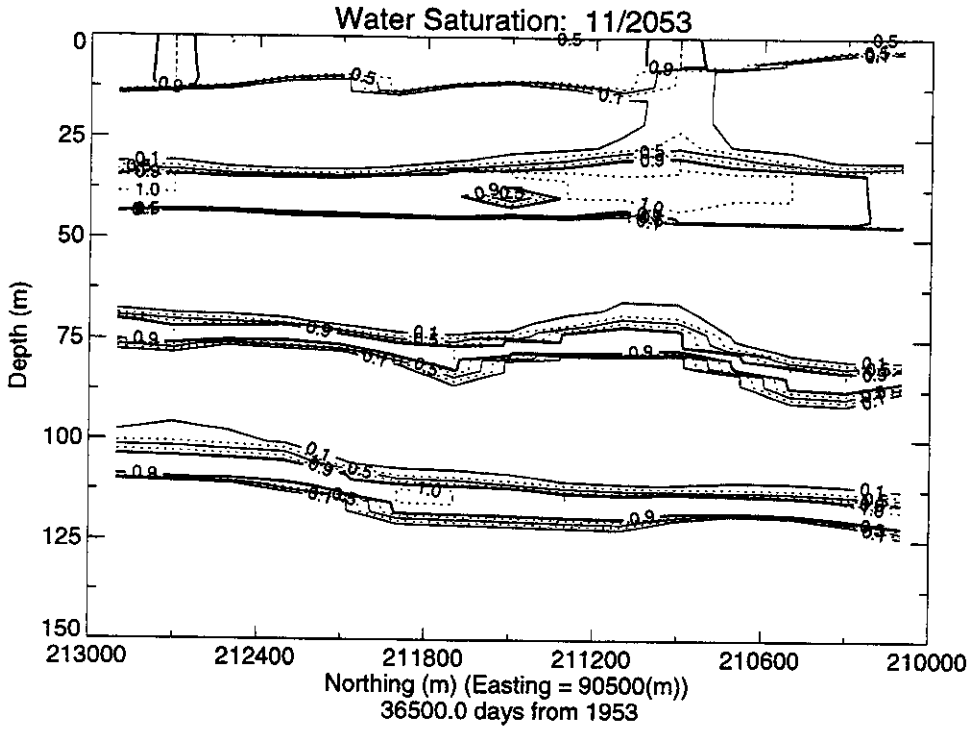


Figure 3-71 Water saturation 100 years after the initial application of process water to the base case simulation shown in Figure 3-63. This simulation uses an interbed permeability equal to 5 mD and alluvium permeability of 10 mD and reduces the porosity to 0.4 from 0.487.

At 36,500 days (Figure 3-71), there is not an appreciable difference in saturation profile throughout the cross-section compared to a simulation time of 10,000 days. There is a very slight increase in saturated thickness that can be seen in Figures 3-72 through 3-76 compared to the base case simulation (Figures 3-66 through 3-70).

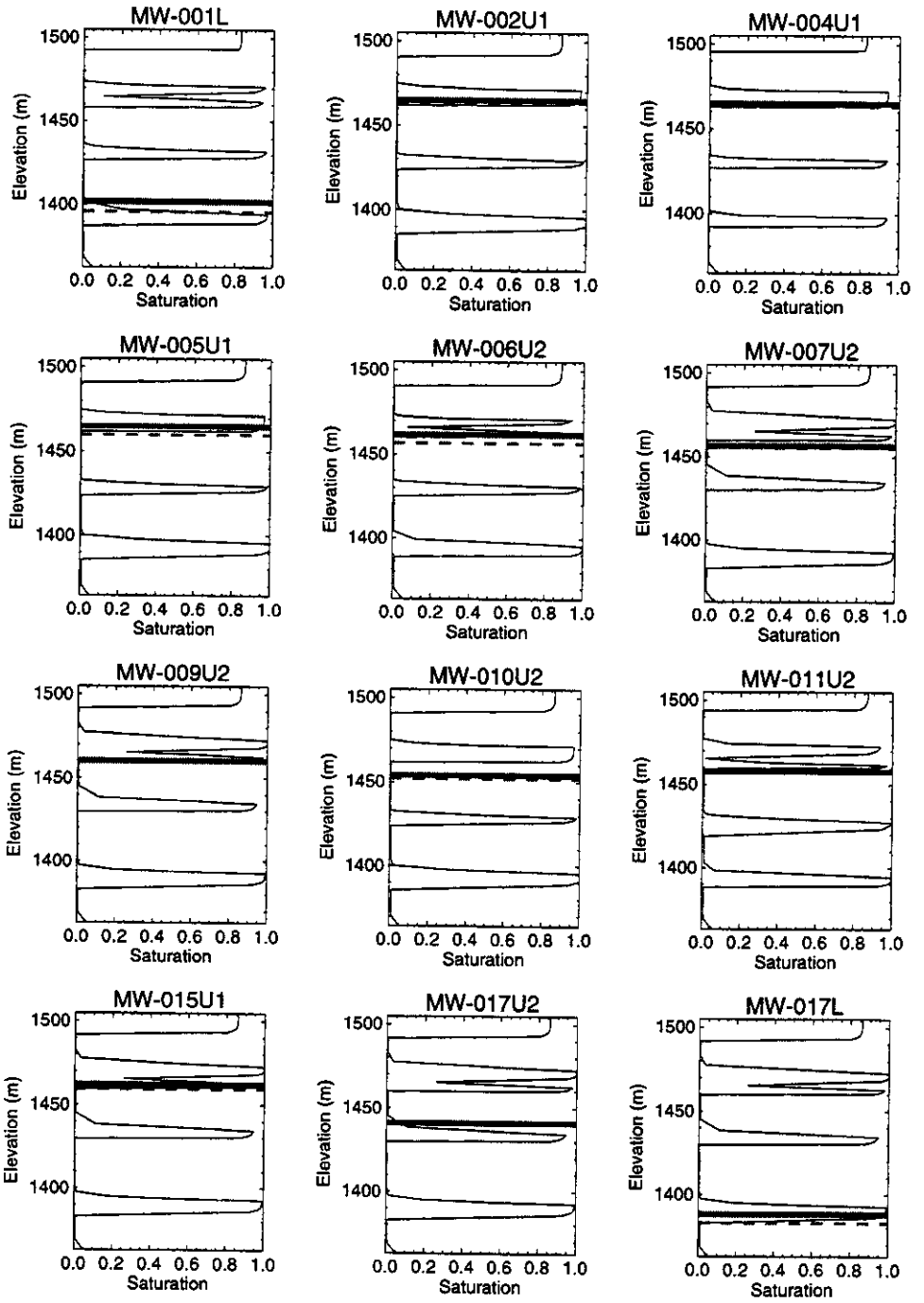


Figure 3-72 Water saturation as a function of elevation in wells that should show perched water. The dotted line is center of the screened interval, the thick dark line is the top of the perched water zone, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-71.

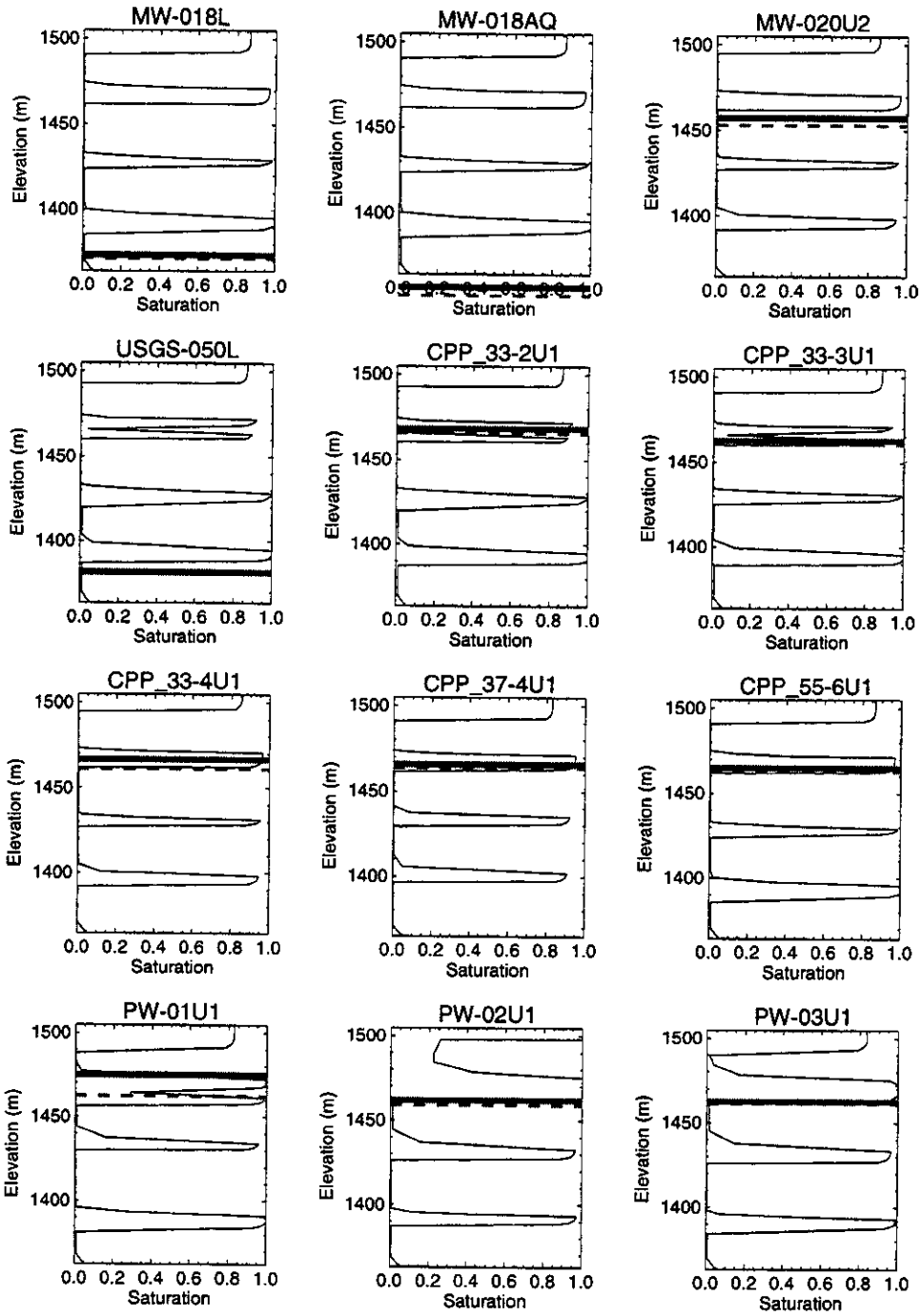


Figure 3-73 Water saturation as a function of elevation in wells that should show perched water. The dotted line is center of the screened interval, the thick dark line is the top of the perched water zone, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-71.

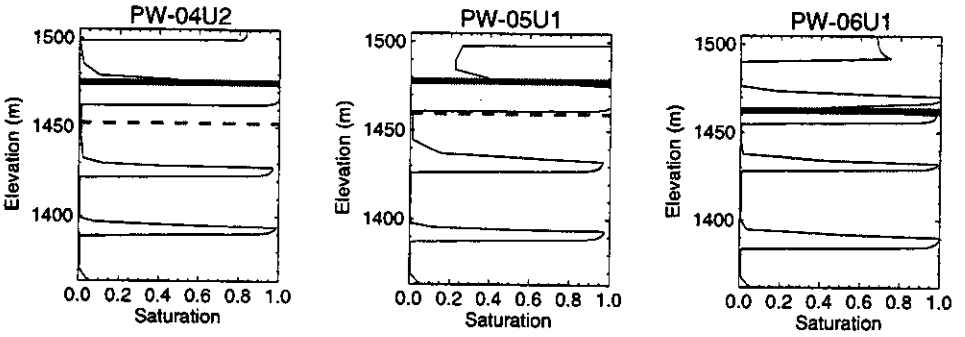


Figure 3-74 Water saturation as a function of elevation in wells that should show perched water. The dotted line is center of the screened interval, the thick dark line is the top of the perched water zone, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-71.

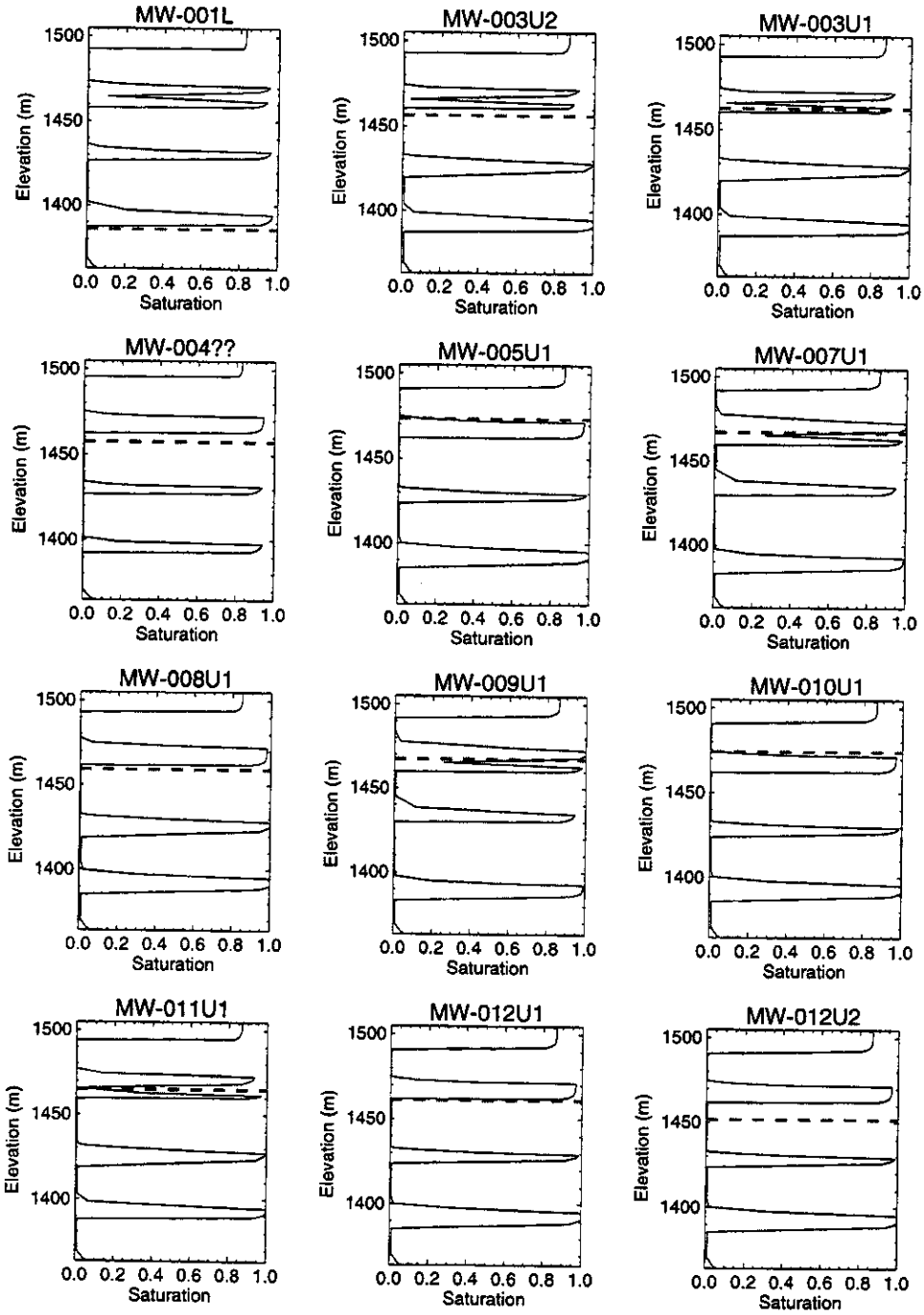


Figure 3-75 Water saturation as a function of elevation in wells that should not show perched water. The dotted line is center of the screened interval, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-71.

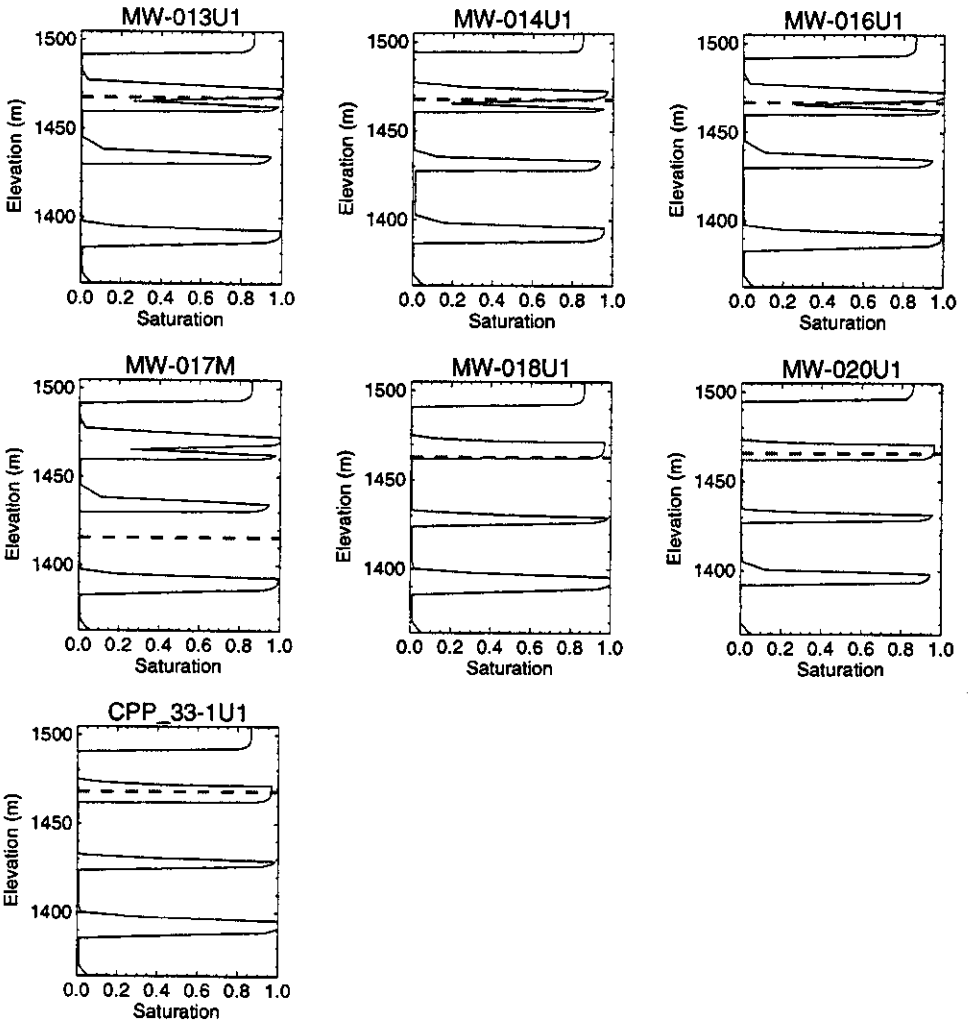


Figure 3-76 Water saturation as a function of elevation in wells that should not show perched water. The dotted line is center of the screened interval, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-71.

3.2.11 Anisotropic Sediment (k_{hsat}=8 mD, k_{vsat}=5 mD) with 10 mD Alluvium k_{sat}

Examination of the previous simulations shows that water saturations approaching 1.0 in the northern region of the ICPP are allowed to occur primarily as a function the lateral spreading of the high volumes of water originating at the percolation ponds in the south and from the Big Lost River in the north. This spreading effect would be enhanced if the permeability in the sediments was preferentially higher in the horizontal direction. Anisotropic permeability in sediments is a common phenomenon caused in part by the horizontal layering in clays, by vertical compaction, and by the processes depositing the sediments among a multitude of other reasons.

To our knowledge, measurements distinguishing the horizontal from vertical components of permeability in the ICPP sediments have not been made. On the other hand, typically one would expect the k_h/k_v ratio to range from 1 to 100. Given that water saturations under the percolation pond area are close to observed values and that the saturations in the north-upper interbed need to increase by only a few percent, the following simulation was performed assuming a horizontal permeability of k_h=8 mD and k_v=5 mD. This preserves the vertical permeability of the thus far best base case (Section 3.2.9) which should in turn preserve the bulk behavior near the percolation ponds while allowing a small incremental change in lateral spreading. The base horizontal grid spacing is a uniform 200 x 200 m with local refinement of 100 x 100 m under the footprint of the ICPP; fire water leakage is uniform throughout the ICPP; porosity is 0.487; and the influence of the Big Lost River as a long-term contributor to the initial conditions is included.

Steady-state water saturation conditions at 100 years following the application of process water is shown in Figure 3-77. Compared to the similar state under isotropic conditions (Figure 3-65), the saturations in the upper interbed are not significantly higher. The large impact of the anisotropy ratio chosen appears in the middle and lower interbeds where is now one region of complete saturation under the percolation pond and another under the north tank farm area.

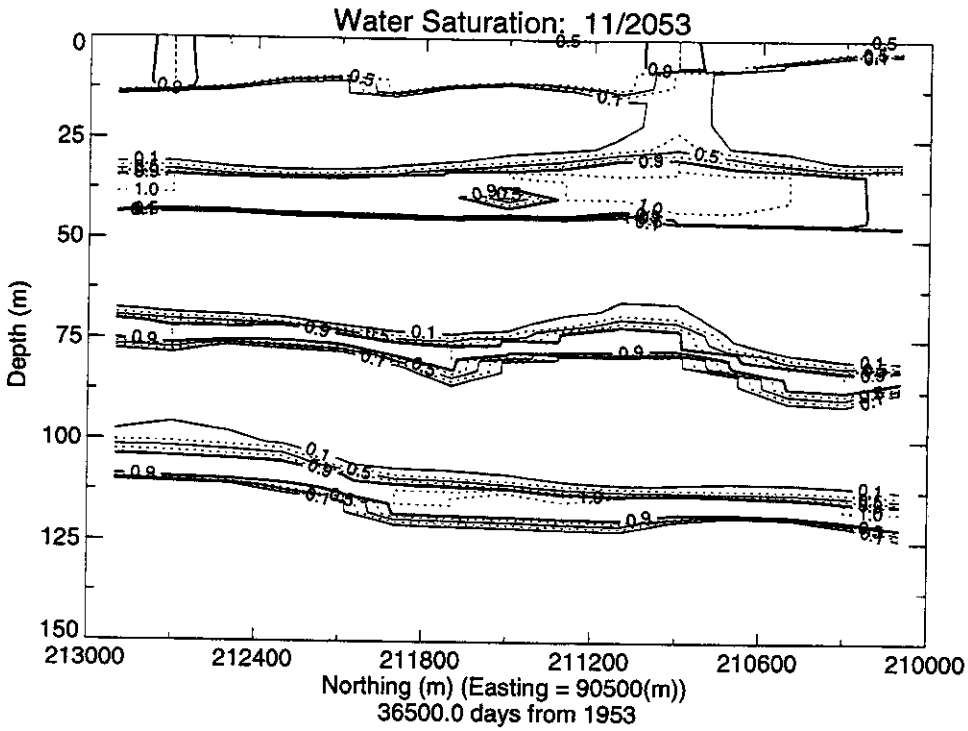


Figure 3-77 Water saturation 36,500 days after the initial application of process water to the base case simulation (parameters used in Section 3.2.9) with the exception of an anisotropic sediment permeability of k_h/k_v=8/5 mD. Differences from the isotropic simulation occur primarily in the middle and lower interbeds.

Well-by-well conditions at 40 years after the application of process water are given in Figures 3-78 through 3-82. From these figures, it is apparent that increasing the anisotropy ratio further will cause too much perching in the middle and lower interbeds before the desired saturations are reached in the upper interbed.

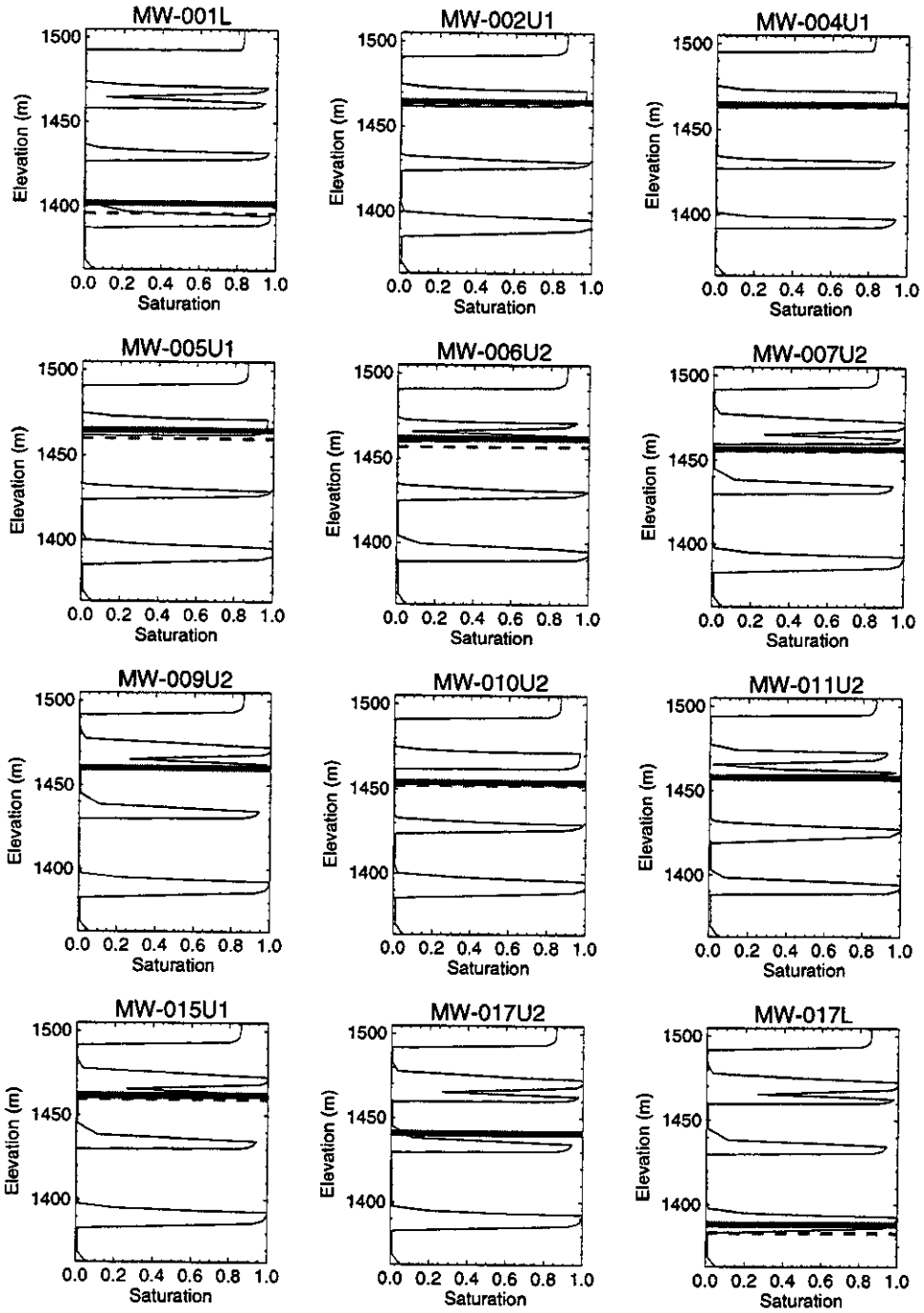


Figure 3-78 Water saturation as a function of elevation in wells that should show perched water. The dotted line is center of the screened interval, the thick dark line is the top of the perched water zone, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-77.

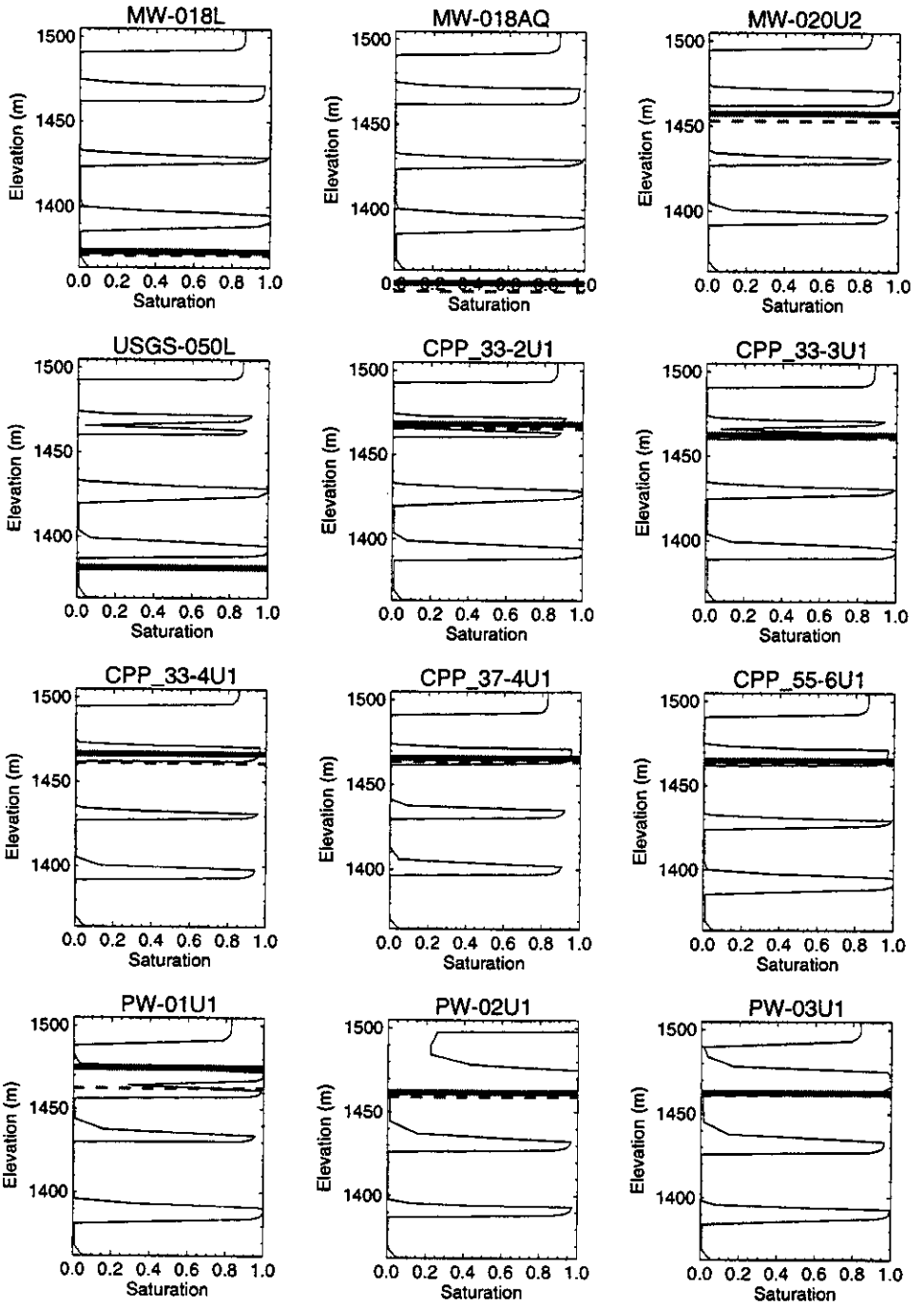


Figure 3-79 Water saturation as a function of elevation in wells that should show perched water. The dotted line is center of the screened interval, the thick dark line is the top of the perched water zone, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-77.

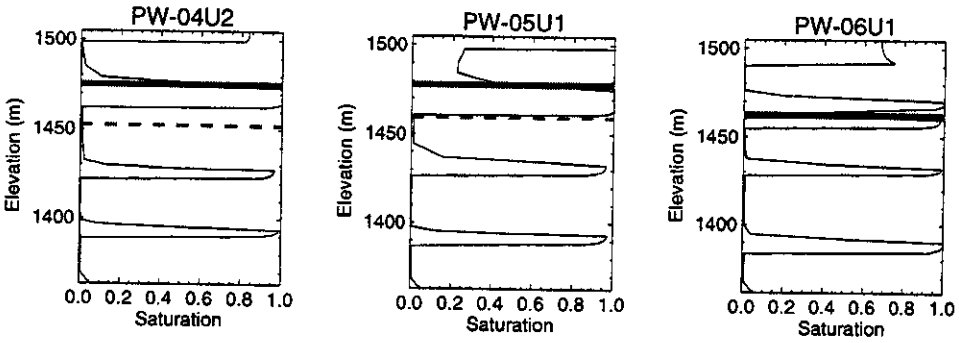


Figure 3-80 Water saturation as a function of elevation in wells that should show perched water. The dotted line is center of the screened interval, the thick dark line is the top of the perched water zone, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-77.

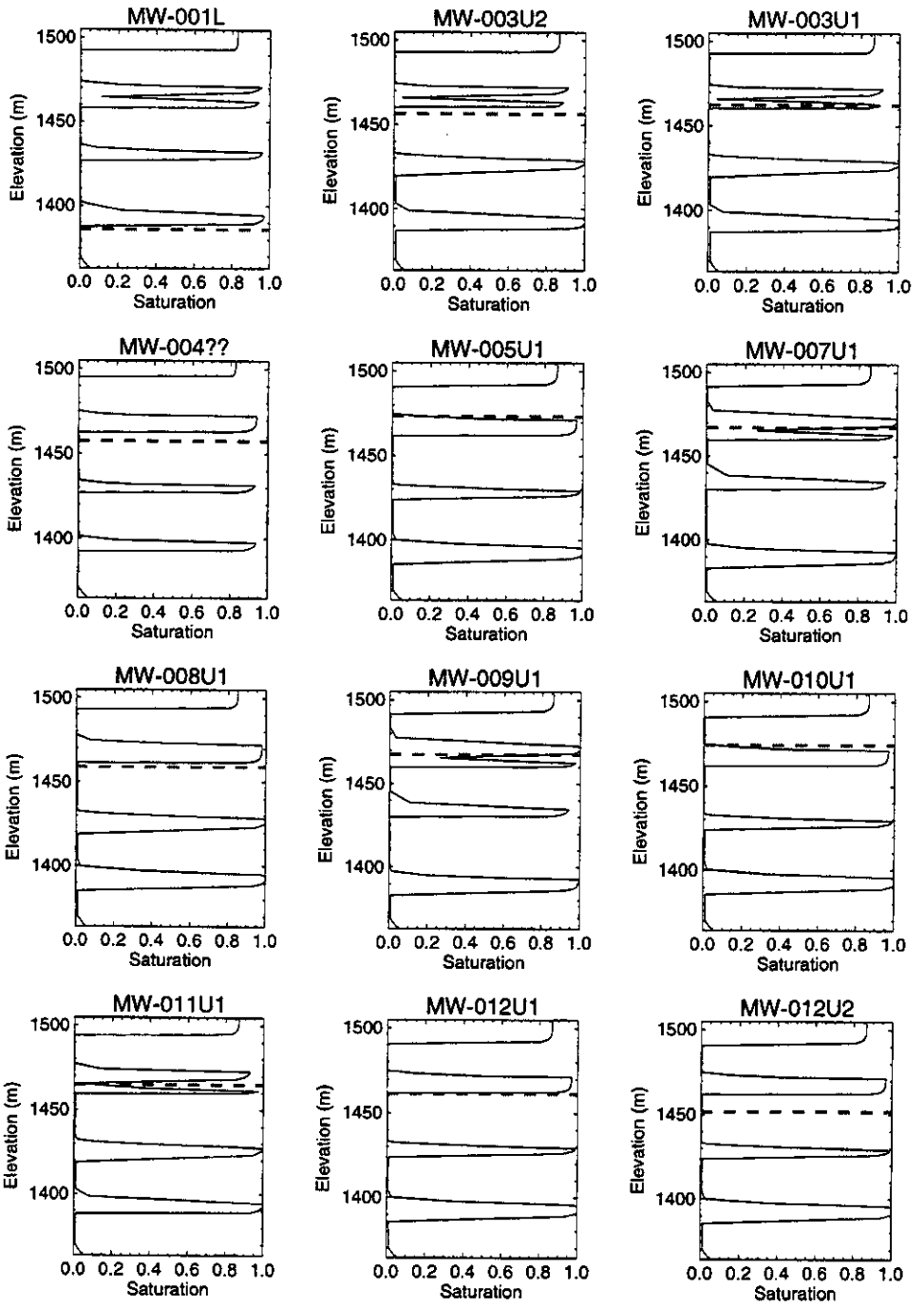


Figure 3-81 Water saturation as a function of elevation in wells that should not show perched water. The dotted line is center of the screened interval, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-77.

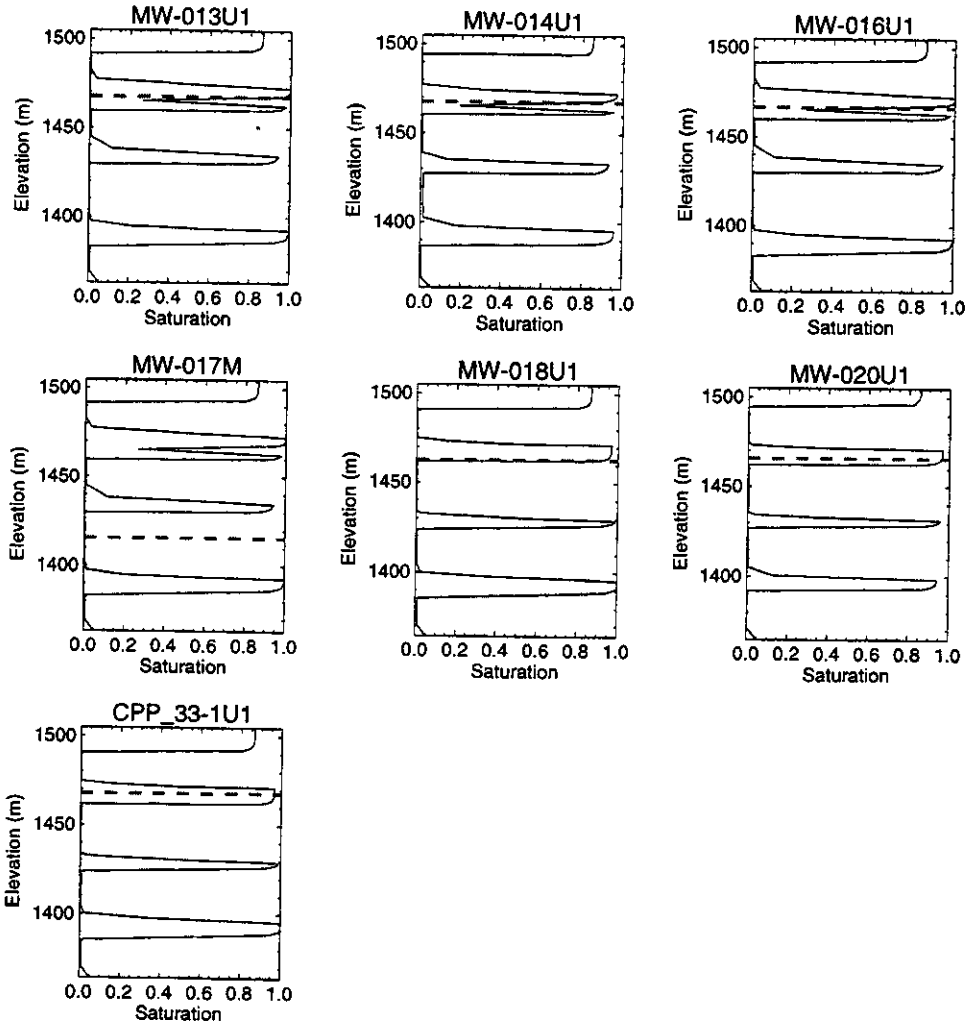


Figure 3-82 Water saturation as a function of elevation in wells that should not show perched water. The dotted line is center of the screened interval, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-77.

3.2.12 Increased Background Infiltration (sediment k_{sat}=5 mD, Alluvium k_{sat}=10 mD)

As this model was being parameterized, there was some discussion about the uncertainty associated with the infiltration rates both inside and outside the facility boundary. Outside the facility boundary, the infiltration rate could range as high as 10 cm/yr and be as low as 1 cm/yr. In the previous simulations, a background infiltration rate of 1 cm/yr outside the facility boundary and 10 cm/yr inside the facility boundary were assumed. The next two simulations examine the sensitivity to perched water formation to increased infiltration.

Simulation 3.2.12 increases the outer infiltration rate to 4 cm/yr everywhere prior to the application of process water, then applies the infiltration rate of 10 cm/yr inside the facility boundary for the duration of the simulated time. For these simulations, a base horizontal grid spacing of 200 x 200 m with local refinement of 100 x 100 m under the footprint of the ICPP was used; fire water leakage was uniform throughout the ICPP; porosity was 0.487; and the influence of the Big Lost River as a long-term contributor was included.

The initial condition shows that the saturations in the alluvium have increased from an average of 0.7 to 0.8, and the region of >0.9 has increased laterally in the middle interbed beneath the Big Lost River.

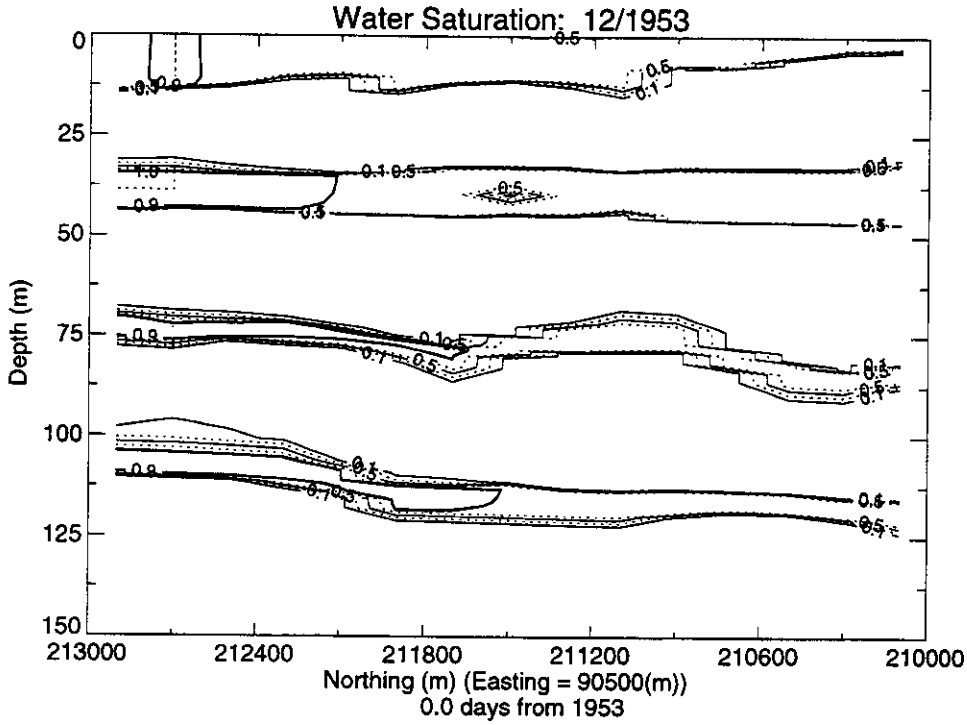


Figure 3-83 Initial water saturation condition prior to application of process water with a background infiltration rate of 4 cm/year in Zone 0 for the base case simulation of Section 3.2.9. Saturations are higher in the alluvium and in the middle interbed.

The steady-state condition of 100 years is given in Figure 3-84. This figure shows that 4 cm/yr is not high enough to increase saturations throughout the ICPP at steady-state. Basically, this implies that the saturated permeability of the interbeds are still controlling the flow system or that the process water and the increased precipitation infiltration have a much larger effect than the pre-process water infiltration. As a result, the increased infiltration simply flows through the system as opposed to creating higher saturations.

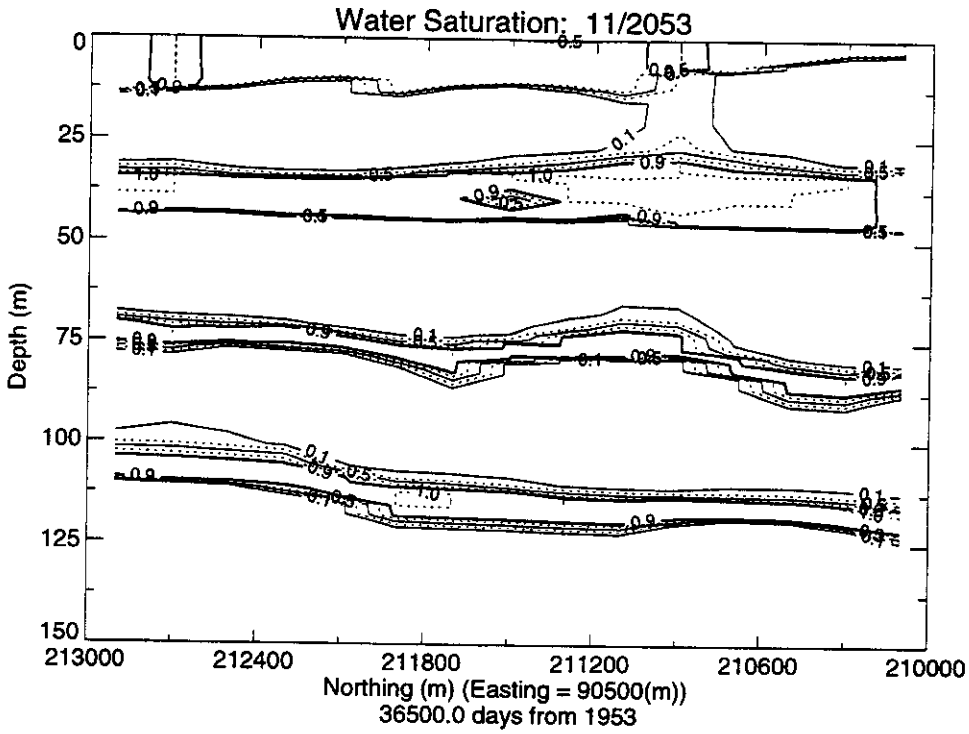


Figure 3-84 Water saturation 36,500 days after the initial application of process water to the base case simulation shown in Figure 3-83.

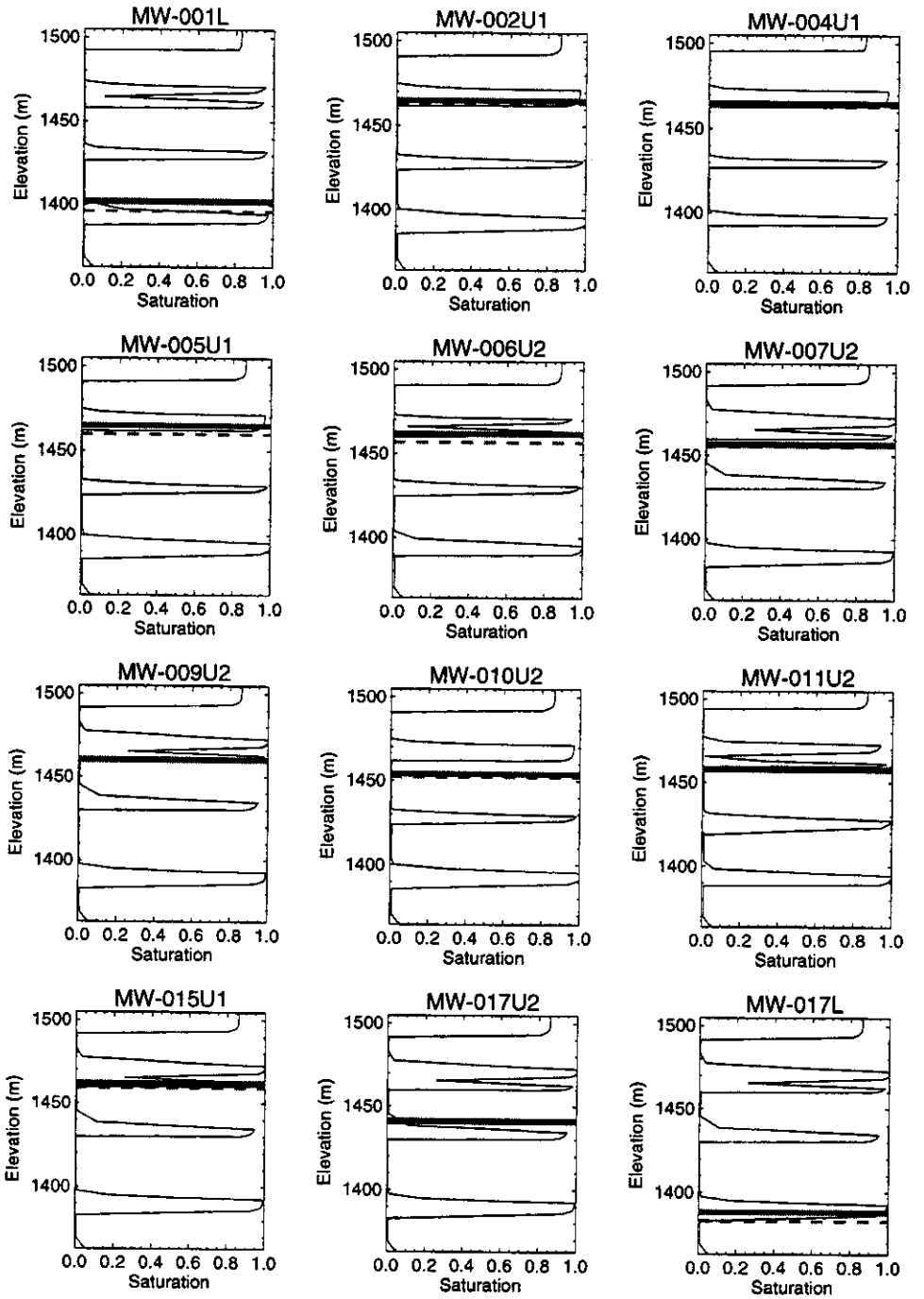


Figure 3-85 Water saturation as a function of elevation in wells that should show perched water. The dotted line is center of the screened interval, the thick dark line is the top of the perched water zone, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-83.

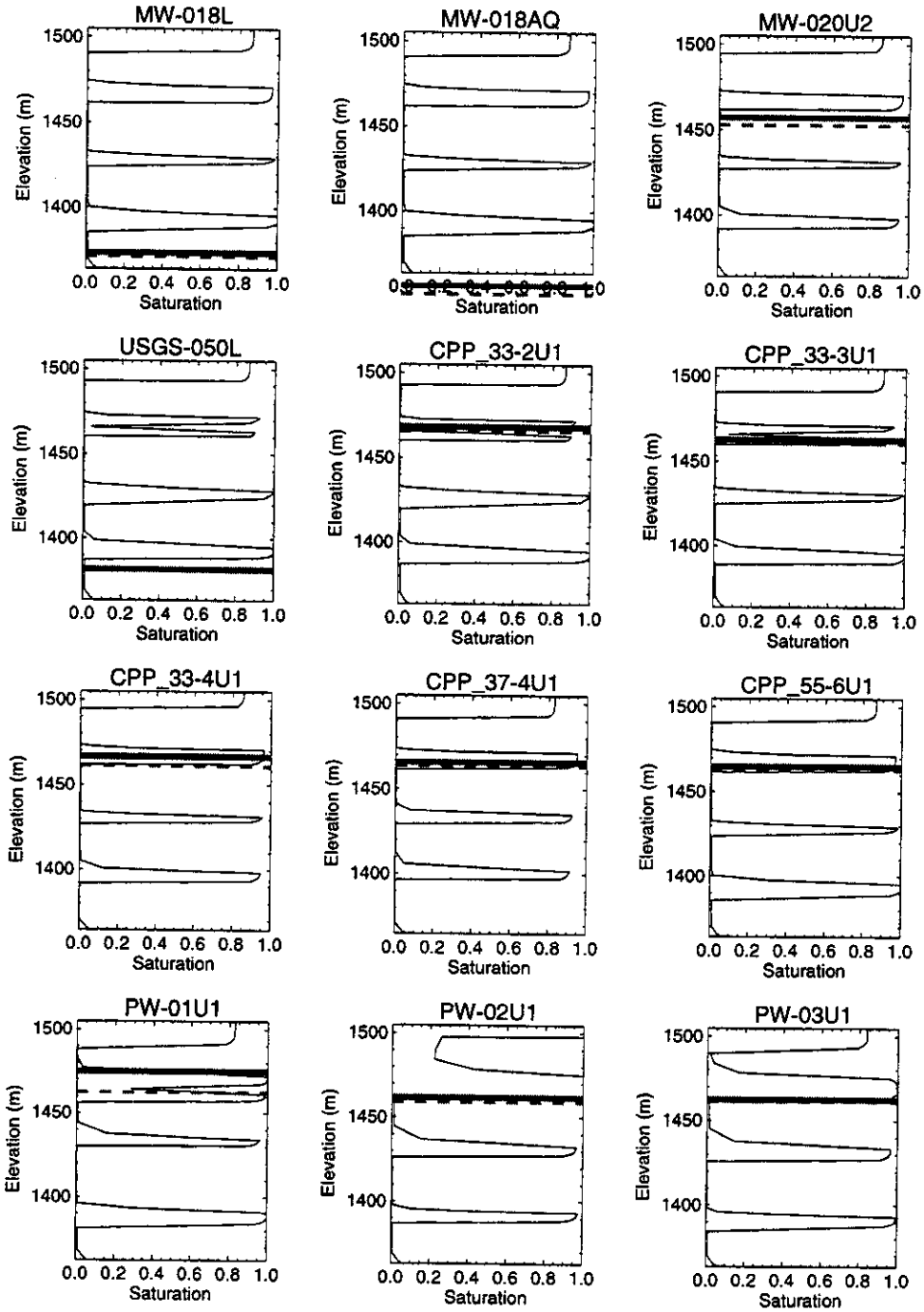


Figure 3-86 Water saturation as a function of elevation in wells that should show perched water. The dotted line is center of the screened interval, the thick dark line is the top of the perched water zone, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-83.

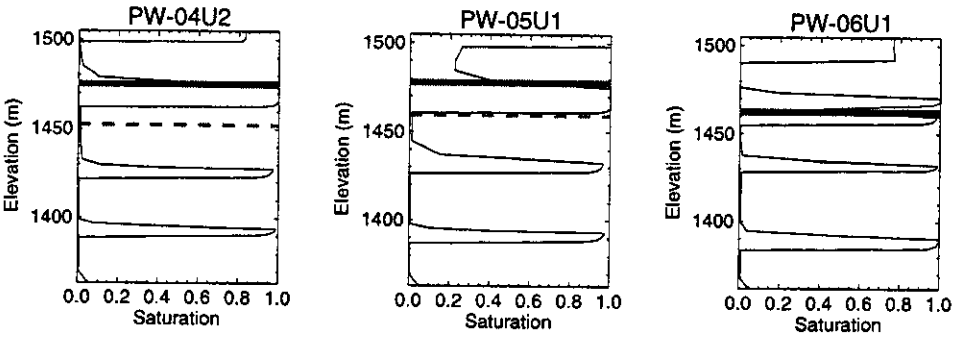


Figure 3-87 Water saturation as a function of elevation in wells that should show perched water. The dotted line is center of the screened interval, the thick dark line is the top of the perched water zone, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-83.

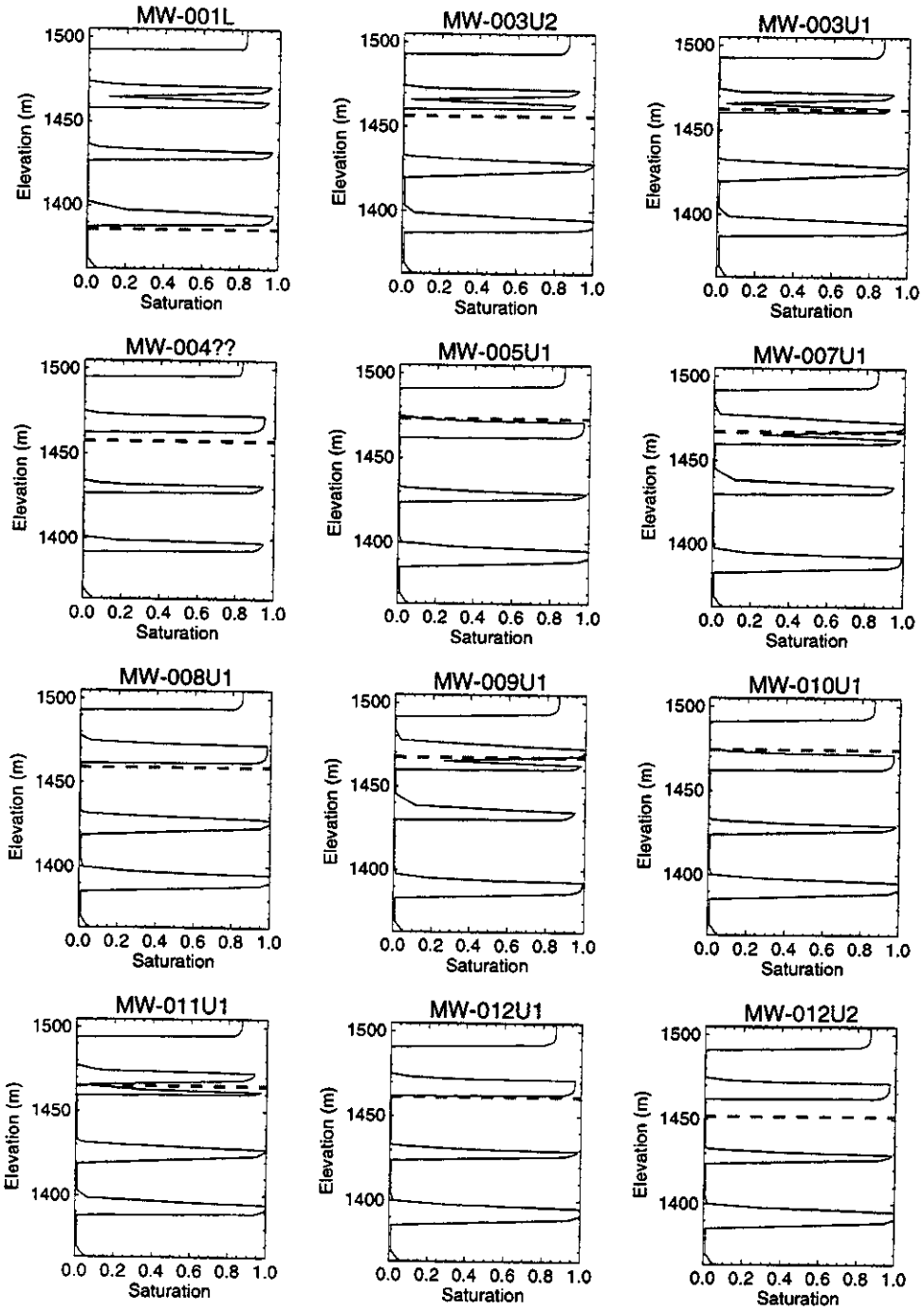


Figure 3-88 Water saturation as a function of elevation in wells that should not show perched water. The dotted line is center of the screened interval, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-83.

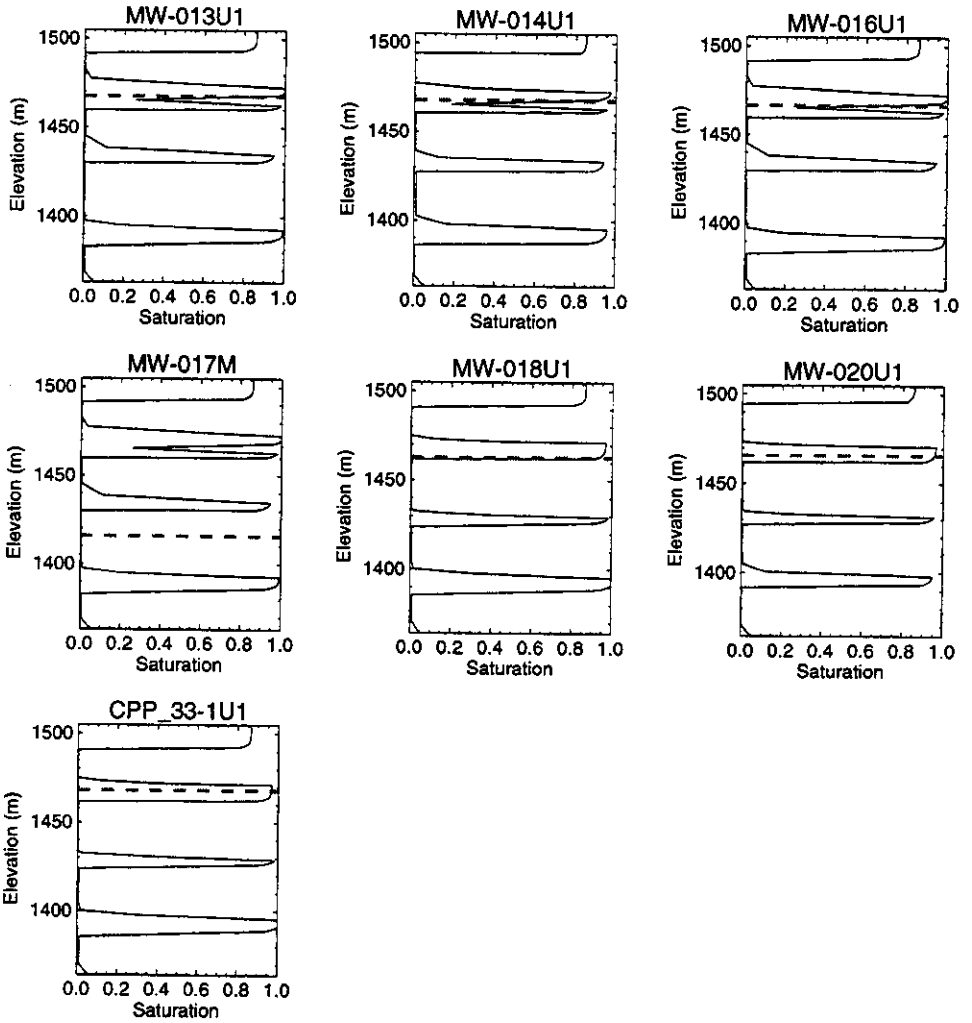


Figure 3-89 Water saturation as a function of elevation in wells that should not show perched water. The dotted line is center of the screened interval, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-83.

3.2.13 Increased Facility Infiltration (Sediment k_{sat}=5 mD, Alluvium k_{sat}=10 mD)

In this simulation, effect of increasing the infiltration rate inside the facility boundary from 10 cm/yr (Section 3.2.9) to 12 cm/yr is examined. Outside the facility boundary, the infiltration rate is kept at 1 cm/yr; simulations were performed on a base horizontal grid spacing of 200 x 200 m with local refinement of 100 x 100 m under the footprint of the ICPP; fire water leakage was uniform throughout the ICPP; porosity was 0.487; and the influence of the Big Lost River as a long-term contributor was included.

The initial condition is the same as that shown in Figure 3-63, and the steady-state condition of Figure 3-90 shows that the region of >0.9 saturations in the alluvium under the percolation ponds have increased significantly laterally and vertically. The next largest change is observed in the lower interbed where the region of complete saturation has expanded somewhat laterally but not vertically. In the upper and middle interbeds, the saturations have not undergone significant change. This indicates that again, this increase in infiltration is not high enough to induce the formation of perched water, and that in all probability, the perched water at the ICPP is primarily controlled by the sediment interbed properties. Well-by-well comparisons of saturation are given in Figures 3-91 through 3-95.

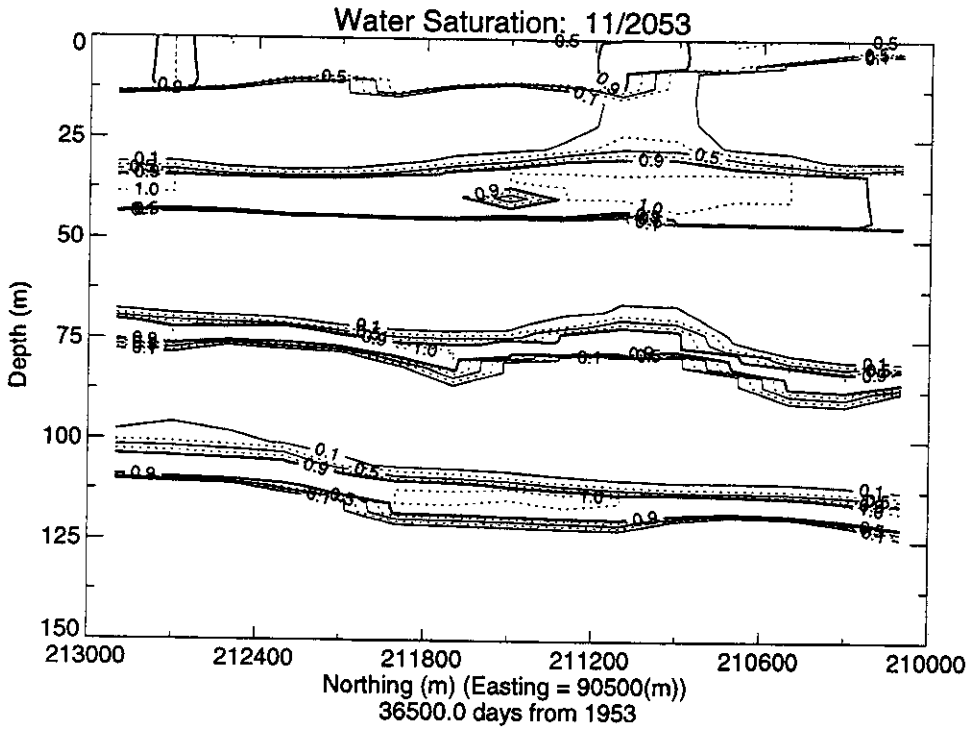


Figure 3-90 Water saturation 36,500 days after the initial application of process water to the base case simulation shown in Figure 3-63 using a background infiltration rate in the facility boundary (Zone 1) of 12 cm/yr.

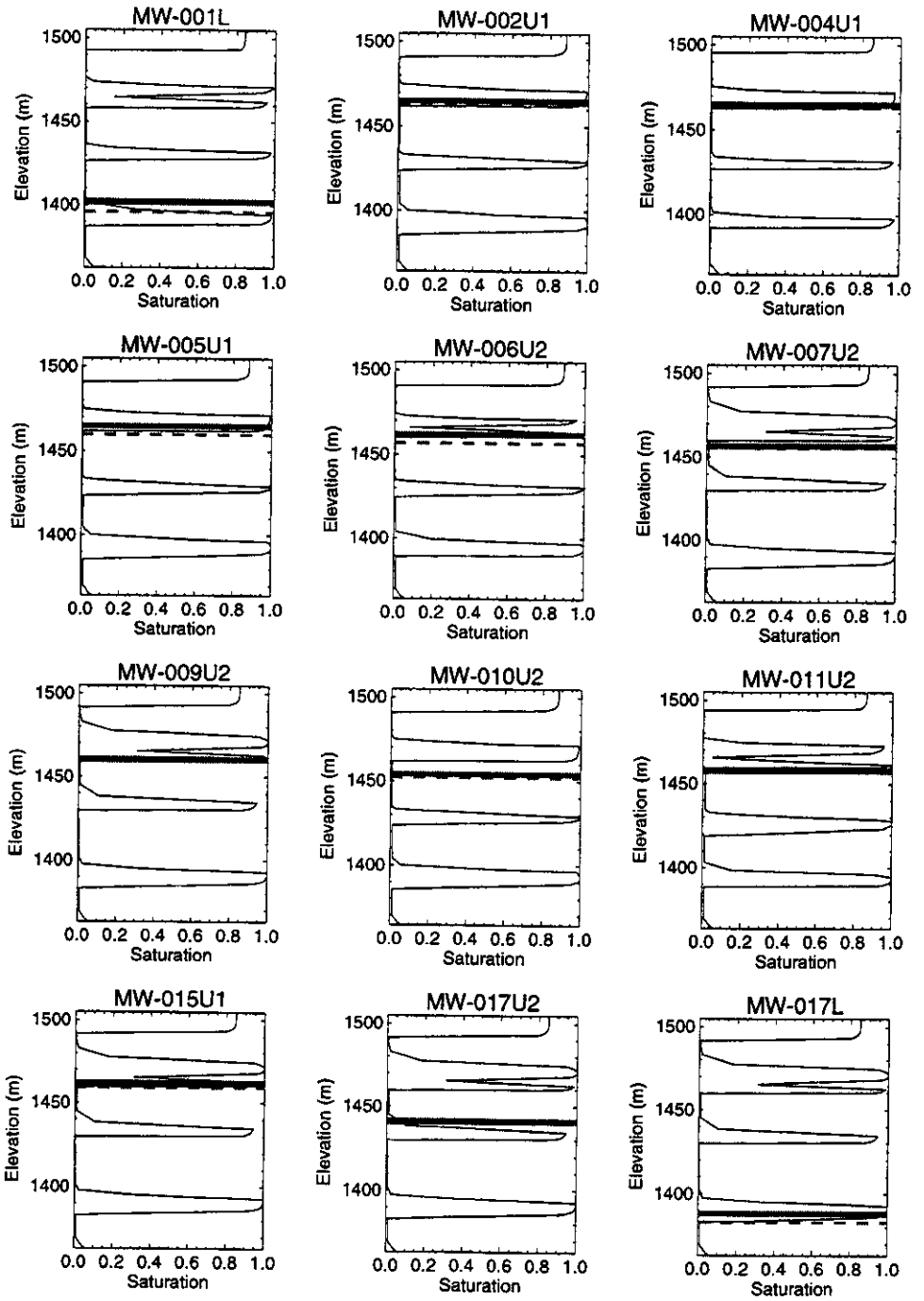


Figure 3-91 Water saturation as a function of elevation in wells that should show perched water. The dotted line is center of the screened interval, the thick dark line is the top of the perched water zone, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-90.

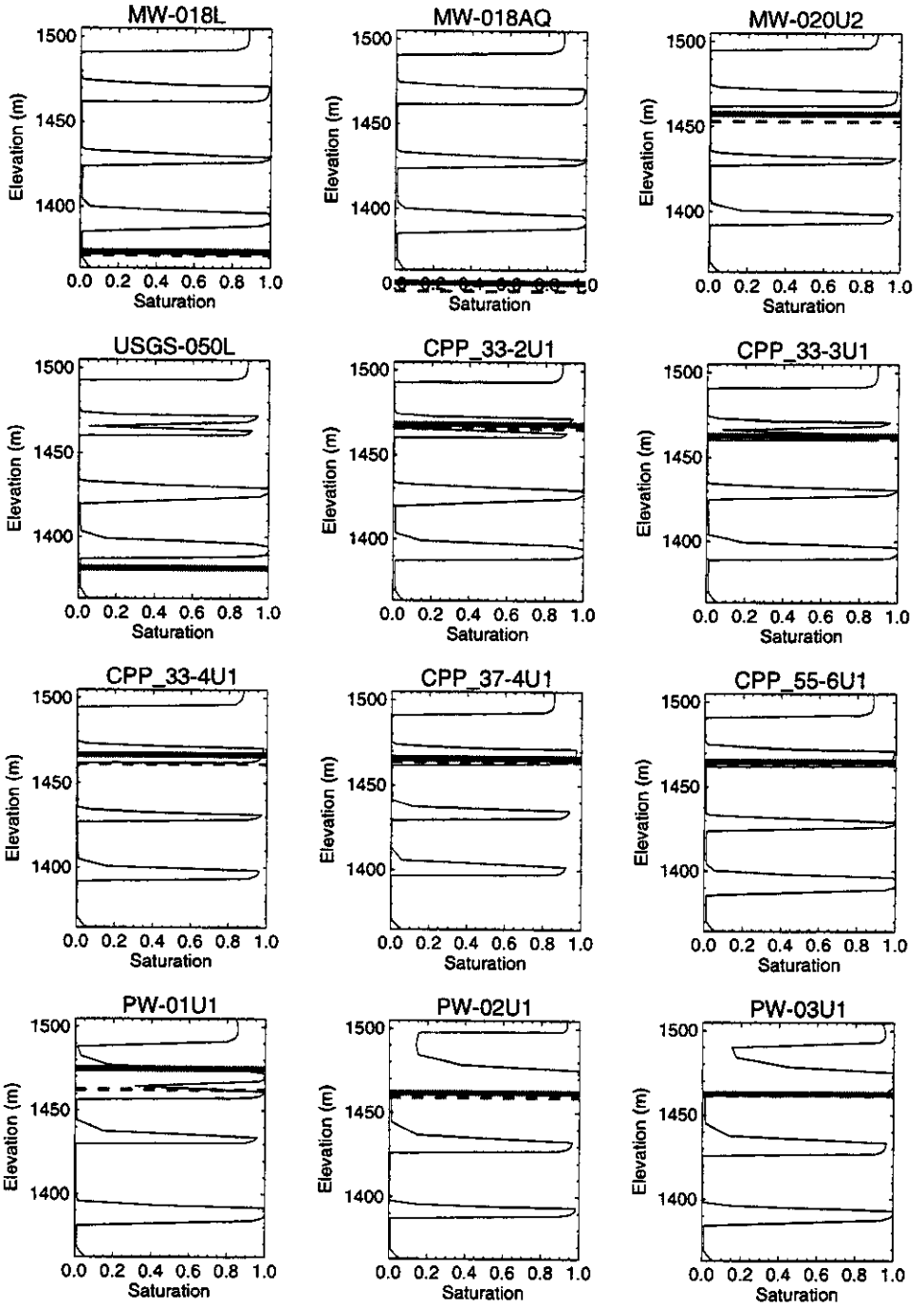


Figure 3-92 Water saturation as a function of elevation in wells that should show perched water. The dotted line is center of the screened interval, the thick dark line is the top of the perched water zone, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-90.

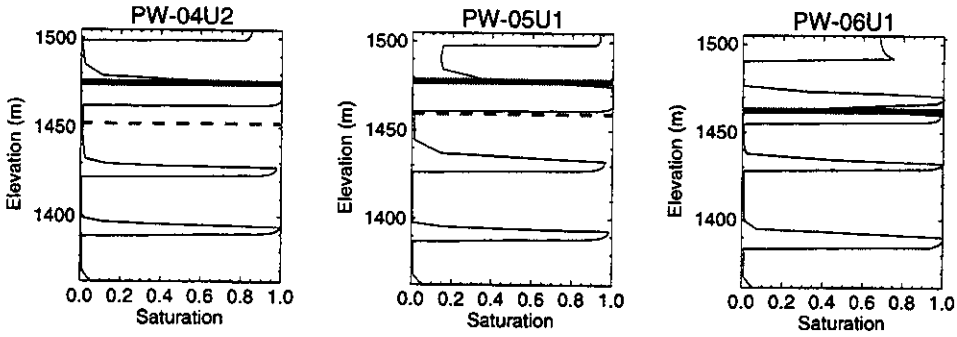


Figure 3-93 Water saturation as a function of elevation in wells that should show perched water. The dotted line is center of the screened interval, the thick dark line is the top of the perched water zone, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-90.

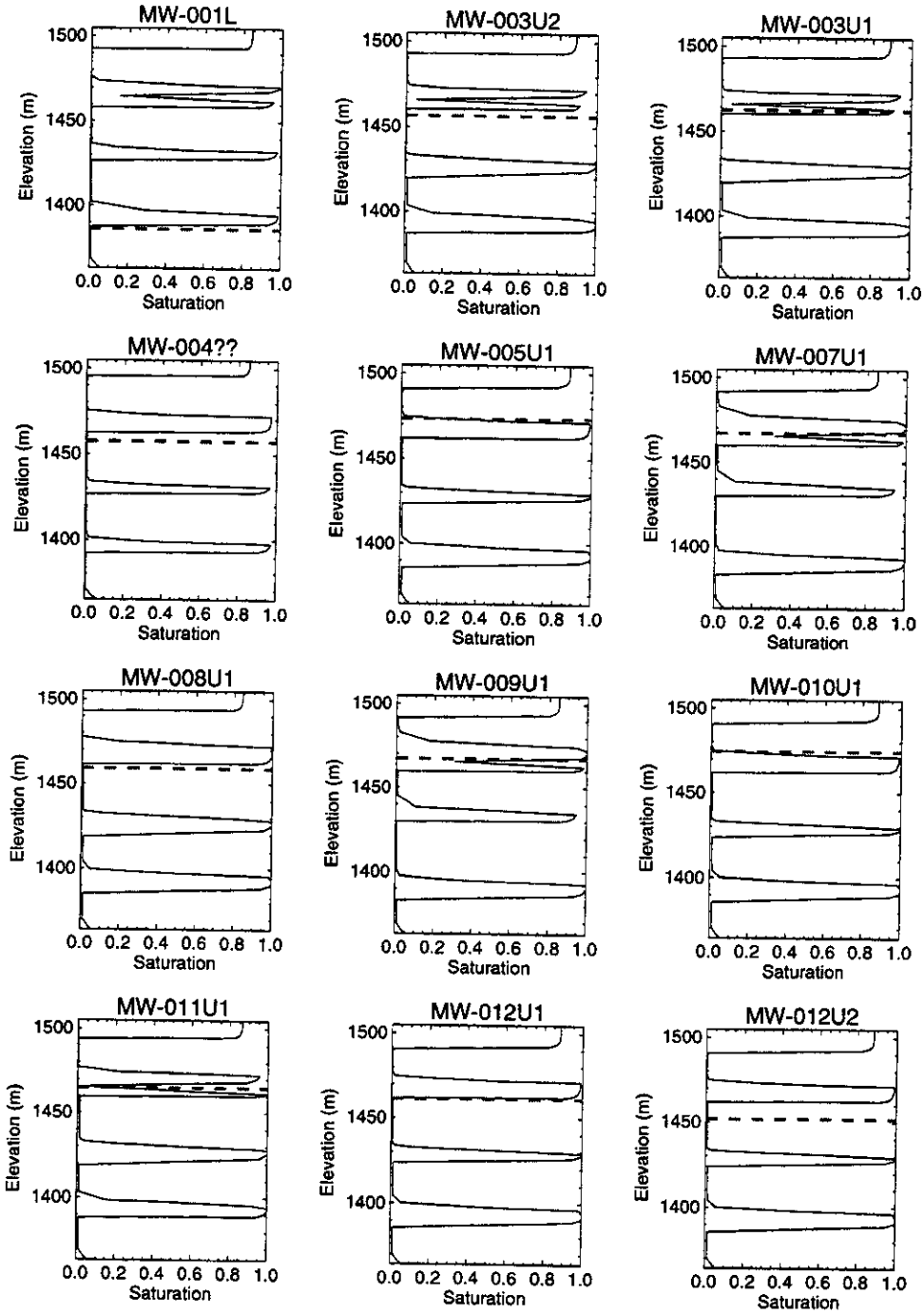


Figure 3-94 Water saturation as a function of elevation in wells that should not show perched water. The dotted line is center of the screened interval, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-90.

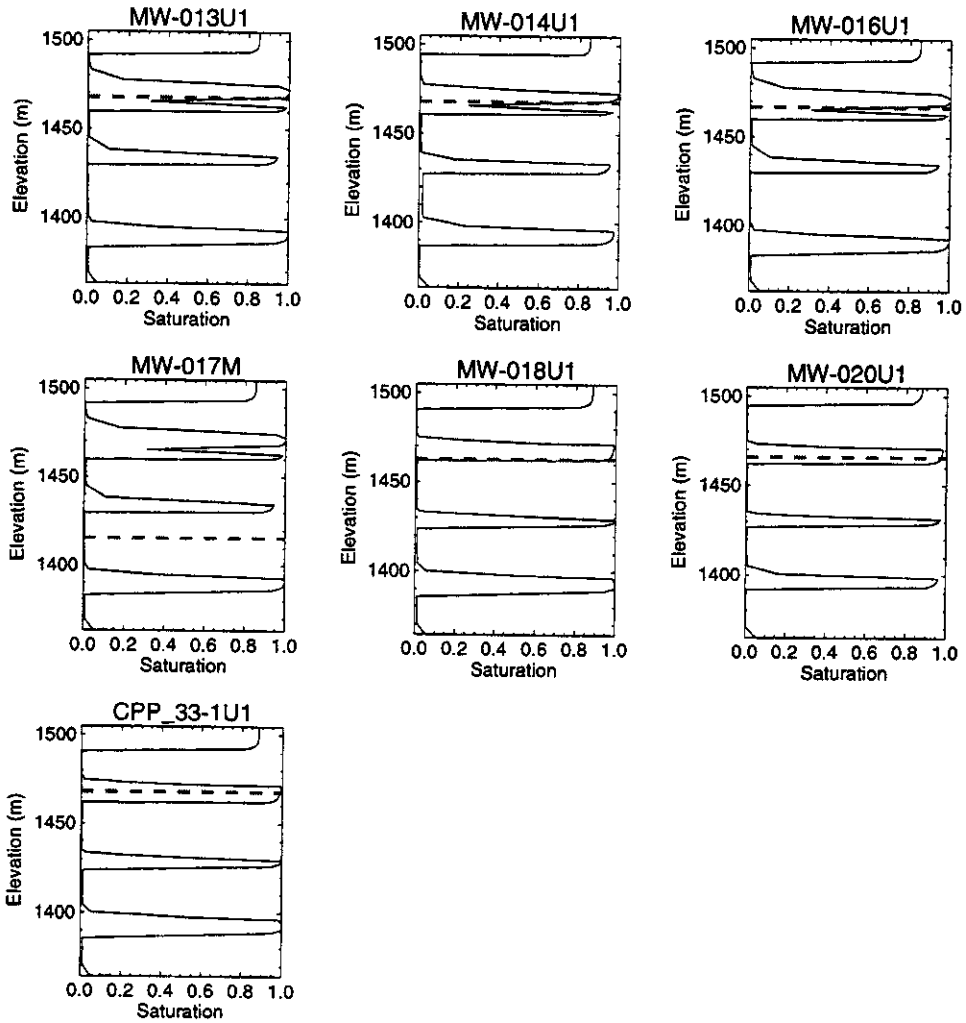


Figure 3-95 Water saturation as a function of elevation in wells that should not show perched water. The dotted line is center of the screened interval, and the thin line is the water saturation predicted from the model. These figures correspond to a time of 50 years for the simulation shown in Figure 3-90.

3.2.14 Transient Big Lost River Fluxes (Sediment k_{sat} = 10 mD)

The formation of perched water in the interbeds below the ICPP occurs essentially because water is added to the strategraphically layered system faster than it can drain through the sediments into the underlying basalts. The rate of drainout through the sediments is controlled by the underlying basalt characteristic curves, the characteristic curves of the sedimentary interbeds, and the residual water remaining in the system prior to the application of process water. Increased residual water saturations would occur if the periodic flooding of the Big Lost River resulted in areally extensive high saturations accompanied by slow drainout. Estimates of the Big Lost River recharge have a significant range in addition to being orders of magnitude larger than any other water source in the northern portion of the ICPP. In addition, the Big Lost River typically flows during the spring months as opposed to flowing in winter (frozen) or summer (dry) months. The following simulations illustrate the effect of applying the Big Lost River recharge during one month in the spring of every year as opposed to averaging the infiltration over a period of 12 months. The base horizontal grid spacing is a uniform 200 x 200 m with local refinement of 100 x 100 m under the footprint of the ICPP. Sediment permeability is 5 mD, and alluvium permeability is 10 mD (compare this simulation to that of Section 3.2.9).

The simulations begin with the steady-state situation established in Figure 3-63. Saturations 91 days after the initial application of process water are shown in Figure 3-96 and can be compared to the 100-day saturation of Figure 3-64.

Ninety-two days after the initial application of process water, the Big Lost River was allowed to flow for 30 days. The saturations prior to the flooding are shown in Figure 3-96. At the end of the 30 day flooding cycle, the saturations were significantly higher throughout the vadose zone as shown in Figure 3-97.

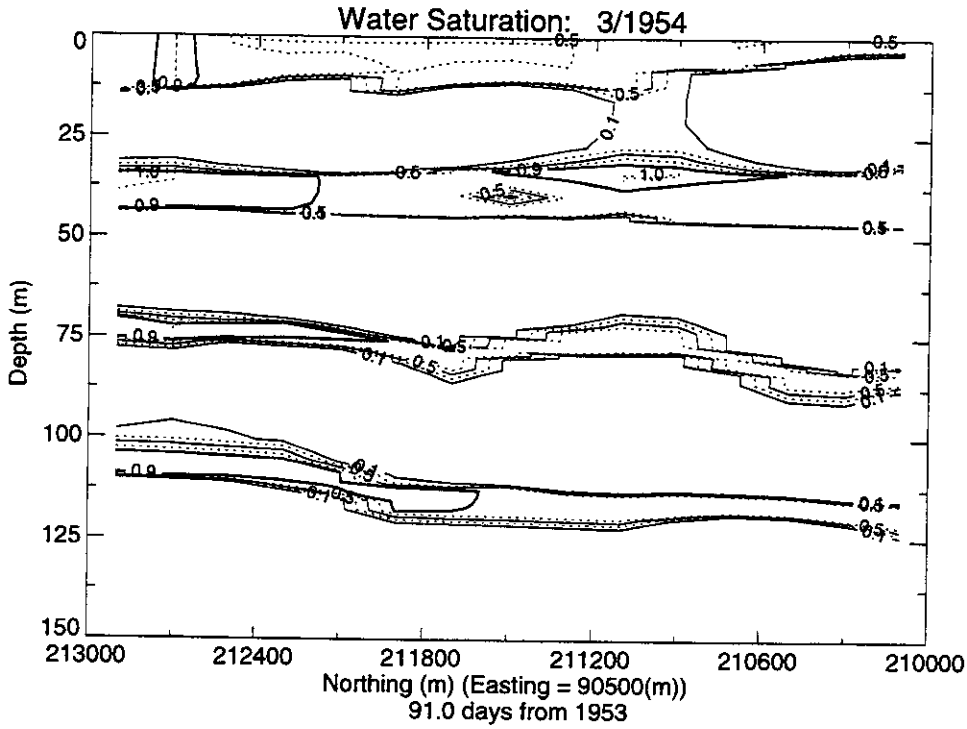


Figure 3-96 Water saturation at 91 days after the initial application of process water to the base case simulation shown in Figure 3-63. Sediment permeability is 5 mD, alluvium permeability is 10 mD. This is the situation existing just prior to flooding the Big Lost River for 30 days.

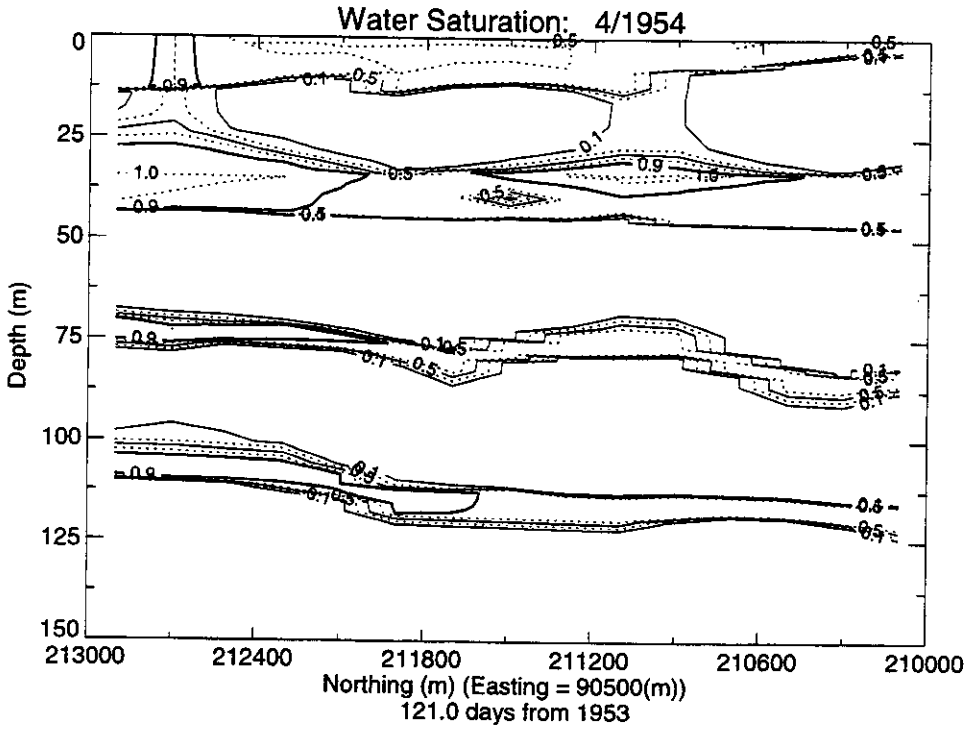


Figure 3-97 Water saturation at 121 days after flooding the Big Lost River for 30 days. Sediment permeability is 5 mD; alluvium permeability is 10 mD.

A saturation of greater than 90% is fairly laterally extensive beneath the Big Lost River. However, the lateral extent is not much larger than that seen in Figure 3-65 for the steady-state Big Lost River case. The primary difference is in the thickness of the basalt exhibiting saturations of between 0.1-0.5. These slightly higher saturations in the basalts will not greatly impact transport times through the basalt relative to the transport times in lower saturations because of the extremely high permeability in the basalt. These higher saturations extend to the region beneath the Tank Farm area in the upper interbed. However, note that the saturations are not significantly higher in the middle and lower interbeds when compared to the base case steady-state simulation.

At this point in time, flow in the Big Lost River is shut off, simulating a period of no infiltration, and the vadose zone dries out as shown in Figure 3-98. The saturations shown in this figure can be compared to the steady-state situation of Figure 3-65. With the exception of the laterally small region at about northing coordinate of 211800, the saturation profile has reached the average condition of the steady-state simulation. This implies that the water from the Big Lost River essentially spreads out and re-equilibrates within 1 year resulting in just slightly higher than average steady-state saturations.

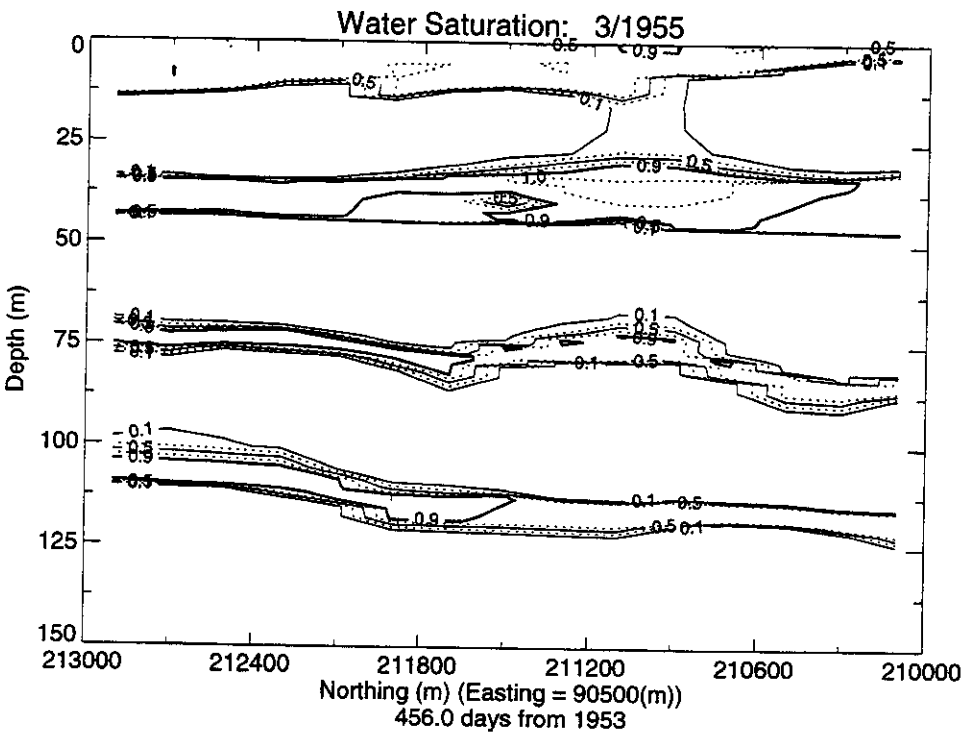


Figure 3-98 Water saturation at 456 days after the initial application of process water, and 335 days after flooding the Big Lost River for 30 days. Sediment permeability is 5 mD; alluvium permeability is 10 mD. Note the residual saturation is slightly higher than prior to the first flooding cycle. (Figure 3-96).

The second flooding cycle began 457 days after the initial application of process water beginning with the saturations shown in Figure 3-98, post flooding saturations for the second cycle are shown in Figure 3-99. Because the volume of flooding in the two flooding cycles was the same, and because the residual saturations from the first cycle are similar to those of the steady-state initial condition, saturations after the second flood are very similar to those after the first flood (Figure 3-97). The same is true of the third flooding and draining cycles as shown in Figures 3-99 and 3-100. This similarity implies that using a steady-state Big Lost River contribution should allow adequate representation of its contribution over the 100+ year simulations planned for transport.

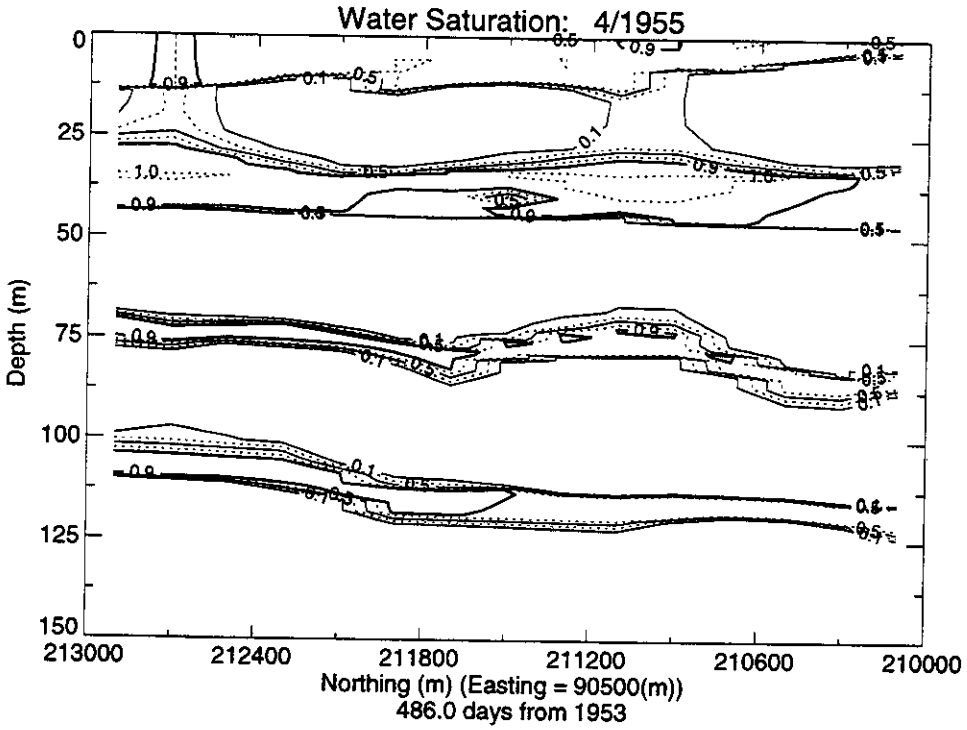


Figure 3-99 Water saturation at 486 days, 30 days after the second flooding cycle (Figure 3-98). These saturations can be compared to those after the first flooding cycle shown in Figure 3-97. Overall residual saturation is somewhat higher, and saturations of 0.1 to 0.98 exist below the tank farm region.

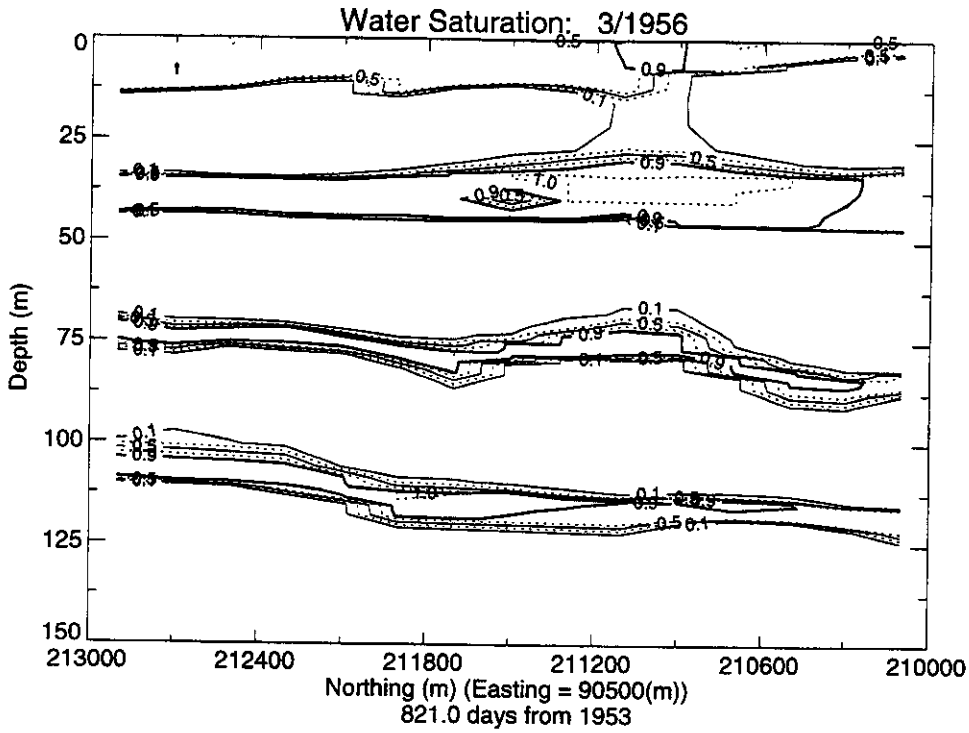


Figure 3-100 Water saturation at 821 days, 335 days after the second flooding cycle (Figure 3-99). These saturations can be compared to those after the first flooding cycle shown in Figure 3-98. Note that the overall saturation is similar to that observed after the first cycle, indicating that in a period of 1 year, the effects of flooding have dissipated.

3.2.15 Reduced Sediment Permeability (k_{sat}=4 mD) With 78 mD Alluvium Permeability

All of the previous simulations have shown that the primary controlling factor in the formation of perched water in the northern portion of the ICPP is the sediment interbed saturated permeability. It was felt that the simulation parameters shown in Section 3.2.9 closely enough approximated the saturations observed at the ICPP with the exception of the saturation in the alluvium. This last steady-state parameter set increases the alluvium permeability which results in decreased water saturation in the alluvium, and will form the basis for the transport simulations to be presented in Section 4.1.

In this simulation, the sediment permeability was isotropic and equal to 4 mD. The alluvium permeability was isotropic and equal to 78 mD, representative of the alluvium permeability measured at the RWMC. Porosity in the interbeds was 0.487, the background infiltration rate was 1 cm/yr, facility infiltration rate was 10 cm/yr, and simulations were performed on a base horizontal grid spacing of 200 x 200 m with local refinement of 100 x 100 m under the footprint of the ICPP; fire water leakage was uniform throughout the ICPP; and the influence of the Big Lost River as a long-term contributor was included.

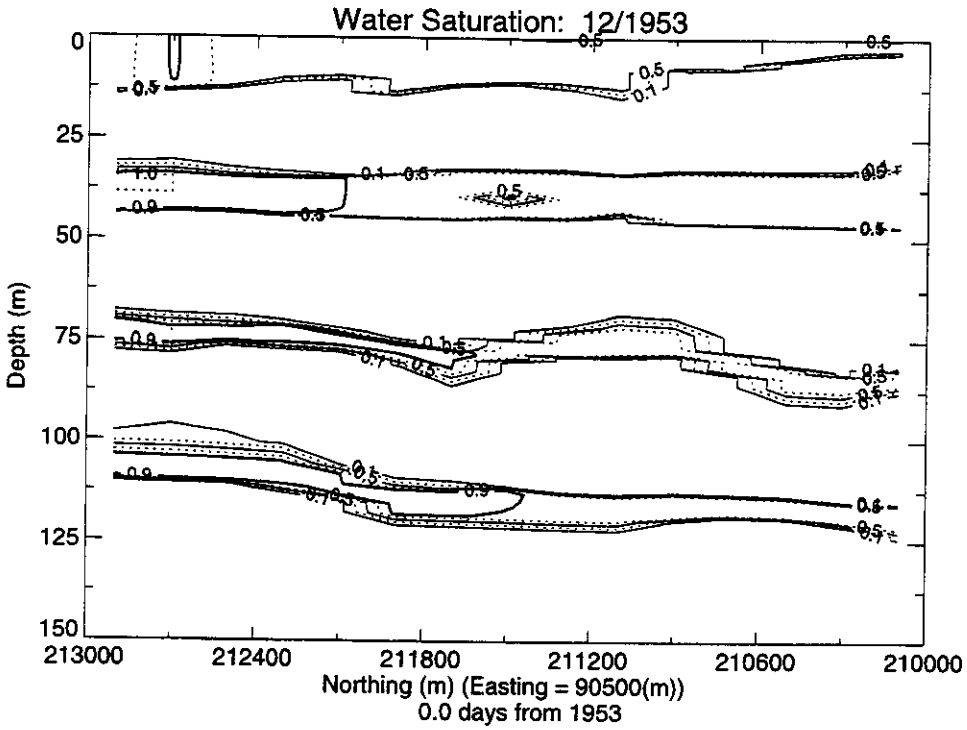


Figure 3-101 Initial water saturation condition prior to application of process water for the simulations with alluvium permeability of 78 mD, and sediment permeability of 4 mD. This simulation includes the Big Lost River, background infiltration of 1 cm/yr in Zone 0, background infiltration of 10 cm/yr in Zone 1, porosity of 0.487, and base basalt characteristics.

The corresponding water saturation at 100, 10000, and 36,500 days are given in Figures 3-102, 3-103, and 3-104, respectively, with depth profiles for calibration wells given in Figures 3-105 through 3-109.

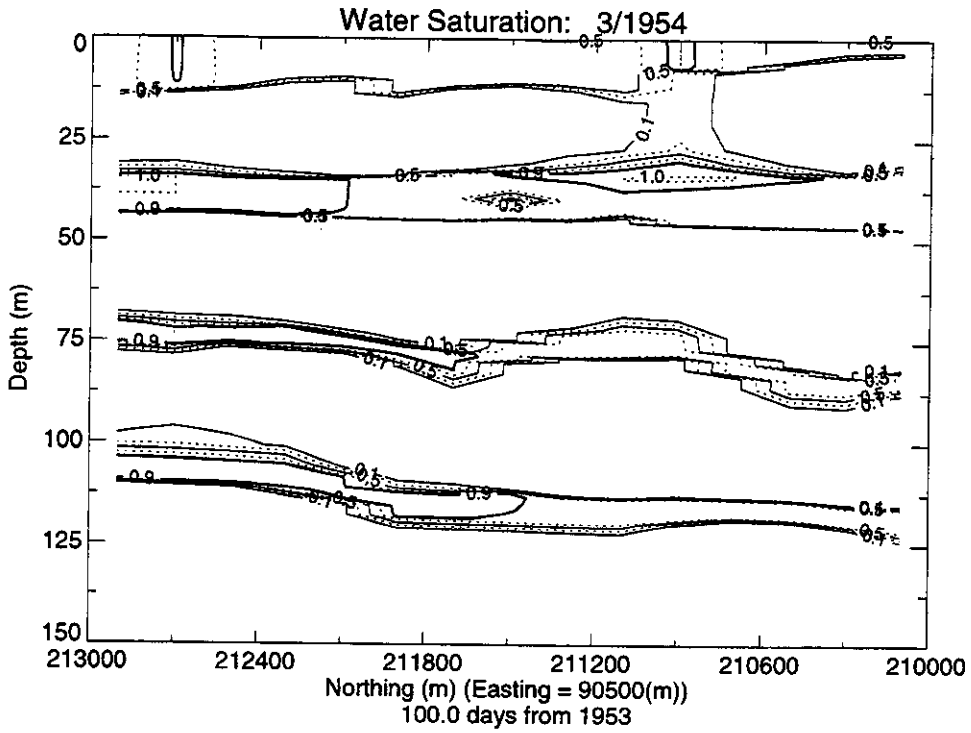


Figure 3-102 Water saturation at 100 days after the initial application of process water to the base case simulation shown in Figure 3-101.

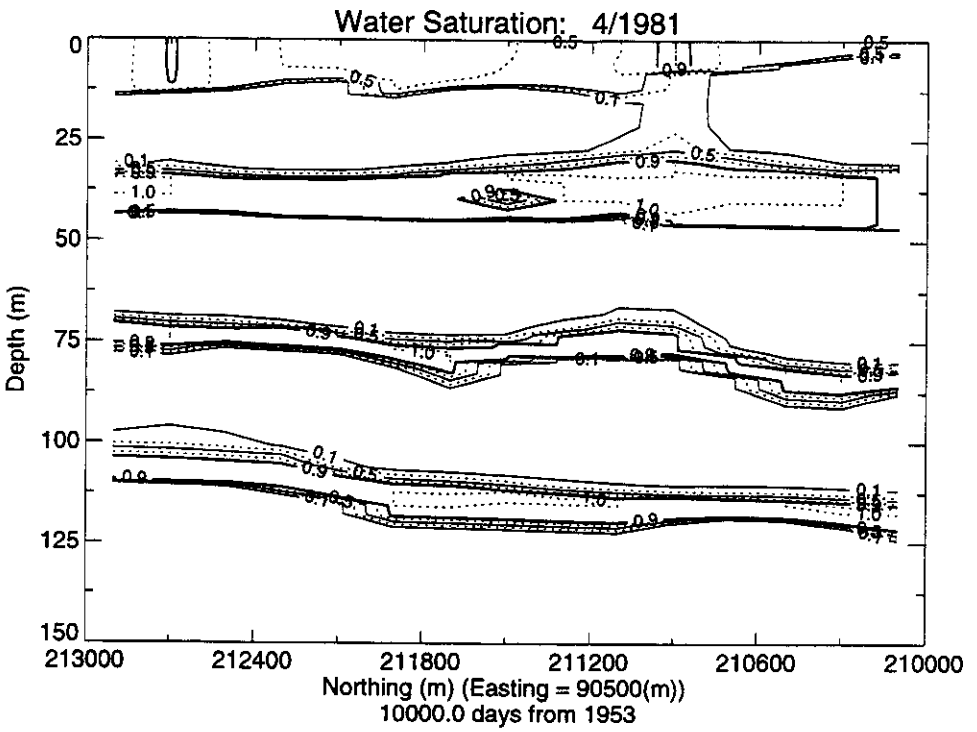


Figure 3-103 Water saturation 10,000 days (27.4 years, 1981) after the initial application of process water to the base case simulation shown in Figure 3-101.

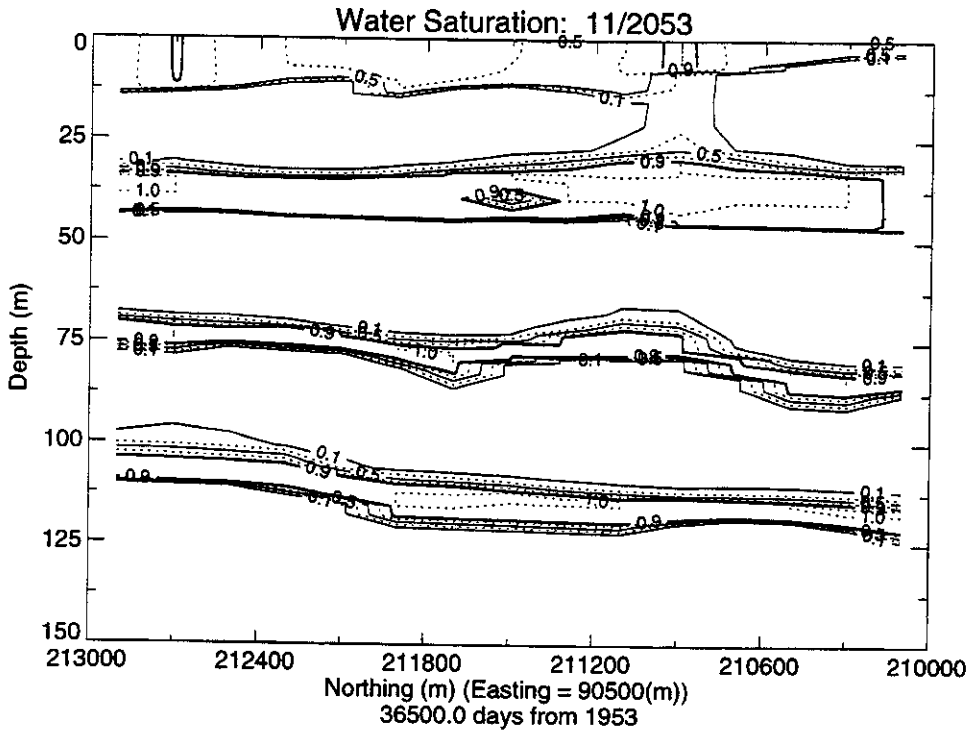


Figure 3-104 Water saturation 36,500 days after the initial application of process water to the base case simulation shown in Figure 3-101.

Note in Figures 3-105 through 3-109, the reduced alluvium water saturations at steady-state (compare to Figures 3-66 through 3-70). It was felt that an average alluvium saturation of 0.75 more closely represents the ambient conditions at the ICPP than the previously computed values of 0.85. Saturations throughout the rest of the vadose zone closely resemble those of Section 3.2.9. Thus, additional parametric sensitivity is not required, and this set of simulation parameters will form the basis of the transport runs.

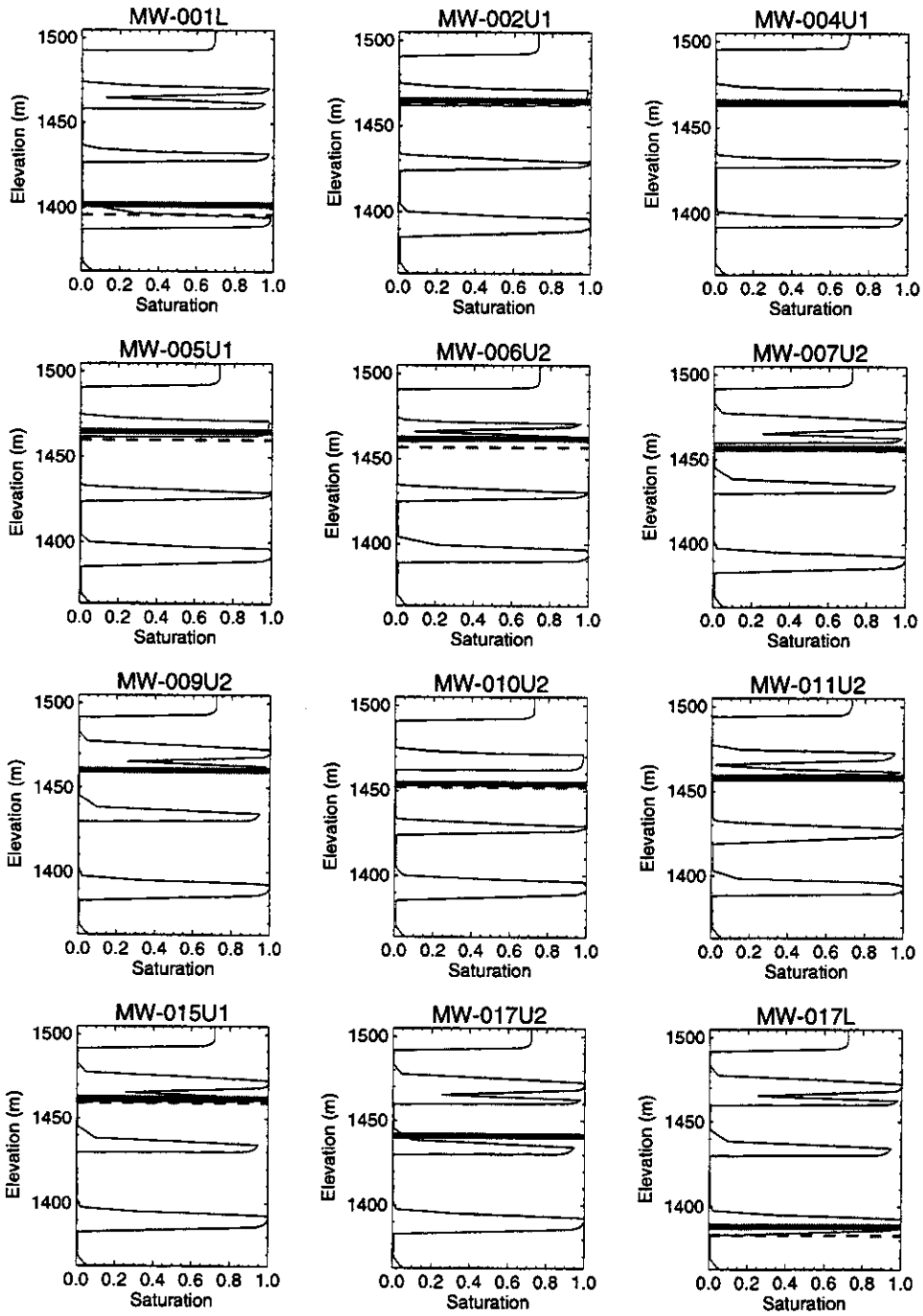


Figure 3-105 Water saturation as a function of elevation in wells that should show perched water. The dotted line is center of the screened interval, the thick dark line is the top of the perched water zone, and the thin line is the water saturation predicted from the model.

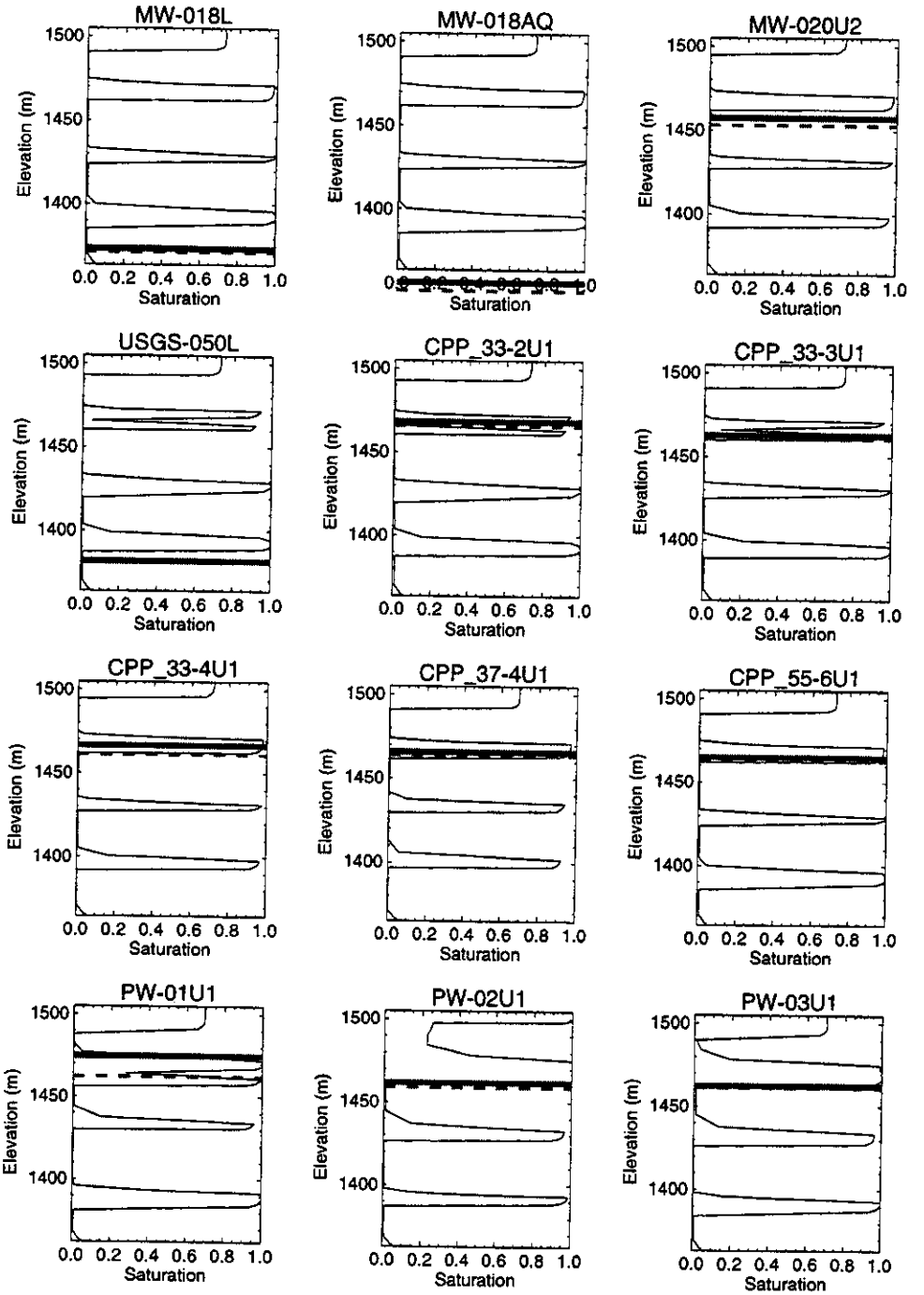


Figure 3-106 Water saturation as a function of elevation in wells that should show perched water. The dotted line is center of the screened interval, the thick dark line is the top of the perched water zone, and the thin line is the water saturation predicted from the model.

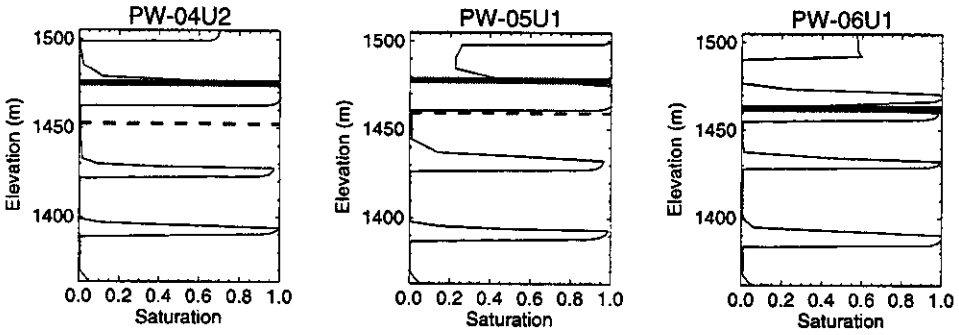


Figure 3-107 Water saturation as a function of elevation in wells that should not show perched water. The dotted line is center of the screened interval, and the thin line is the water saturation predicted from the model.

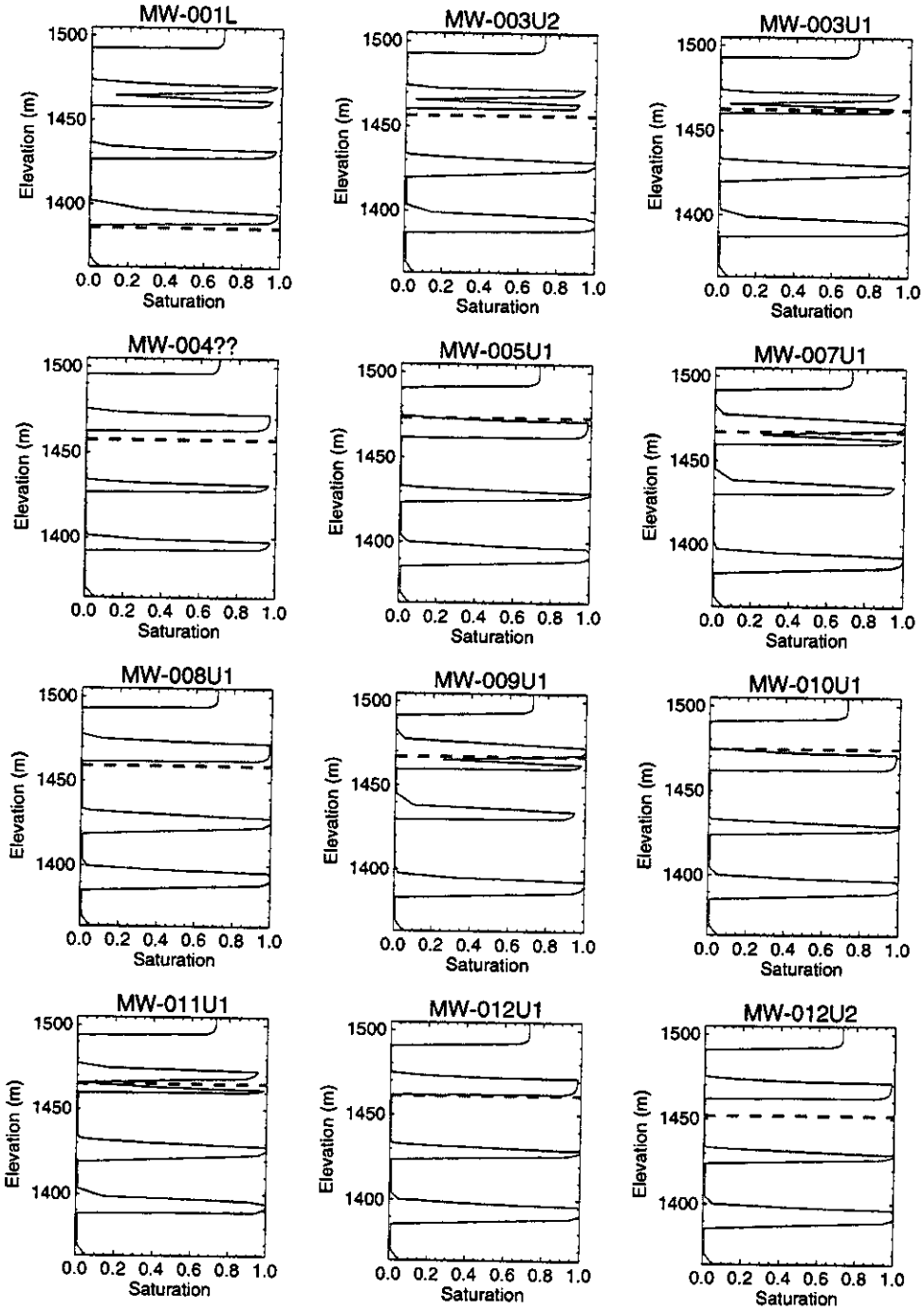


Figure 3-108 Water saturation as a function of elevation in wells that should not show perched water. The dotted line is center of the screened interval, and the thin line is the water saturation predicted from the model.

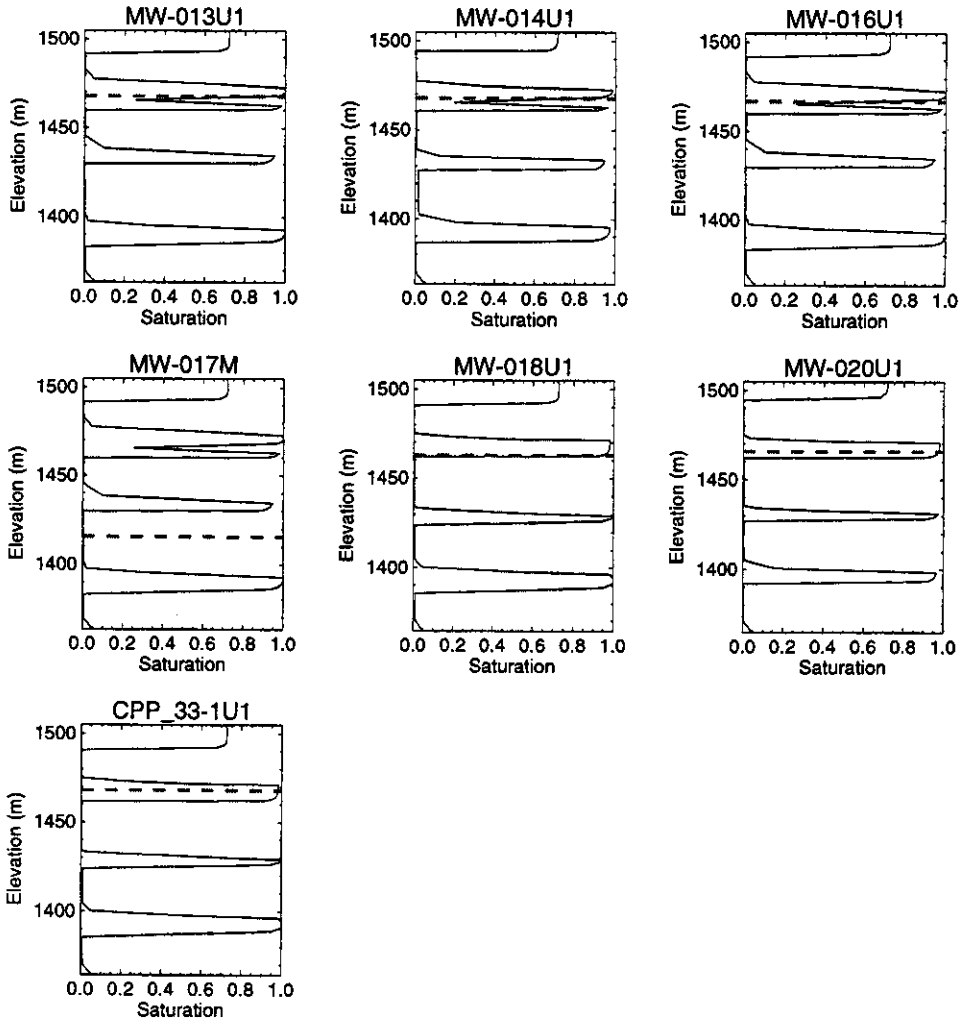


Figure 3-109 Water saturation as a function of elevation in wells that should not show perched water. The dotted line is center of the screened interval, and the thin line is the water saturation predicted from the model.

3.3 Aquifer Model Head Calibration Results

Unlike the calibration process for the vadose zone, where an extensive sensitivity study was performed during the perched water calibration, the aquifer sensitivity study was done as a part of transport calibration. As a result, only the heads resulting from the final transport calibration run will be given here. The primary reason for this is that transport is governed by the insitu velocity which is equal to the Darcy velocity divided by the porosity:

$$v = \frac{k\nabla h}{\phi} \tag{1}$$

Thus, matching the heads does not imply that transport velocity is appropriate.

For the purposes of aquifer flow and transport calibration, it was decided to concentrate on matching the breakthrough curves of tritium to field data rather than matching heads at those wells. This was done in part because we are using a steady state head model to try to capture long term effect of the transient head on transport. This is different than the calibration of the vadose zone model because there were sufficient field data to calibrate the transient infiltration (pressure and saturation), but not enough to extensively calibrate to chemical transport.

The heads given in Figures 3-110 and 3-111correspond to the simulation discussed in detail in Section 4.2.8. Figures 3-110 and 3-111 are representations of the aquifer head in the first layer of the aquifer model, at increasing time slices. There is little variation over the vertical because of the boundary conditions, so depth slices are not included. These boundary conditions include (1) a steady state flux from the vadose zone representative of pre 1984 surface water sources (includes background infiltration, line leakage, sewage lagoons); (2) steady state Big Lost River fluxes; (3) the injection well water influx from 1953 through 1984; and (4) steady state pumping from CPP-04. The time slice contours illustrate that there is very little change resulting in predicted aquifer heads as these water source rates are varied.

In order to assure that the amount of water moving through the WAG-3 model domain is consistent with that defined in the WAG-10 model, the flux across the boundaries in the WAG-3 and WAG-10 models were compared. The orientation and scale of the WAG-10 and WAG-3 models are very different; therefore, it is difficult to exactly compare the mass balances between the models. However, a rough comparison was done. The comparison indicates that the WAG-10 (MODFLOW) and WAG-3 (TETRAD) models have essentially the same mass flux when using the WAG-10 hydraulic conductivity values. This is not surprising as the WAG-3 model used fixed head boundaries that were interpolated from the WAG-10 model. Subsequent calibration was needed in order to refine the aquifer flow directions in the immediate vicinity of the ICPP and the I basalt flow was added to more accurately represent the aquifer geology. The parameter changes during the calibration phase changed the overall mass flux through the system by about 11%. This mass balance difference is within the uncertainty of the WAG-10 simulation results.

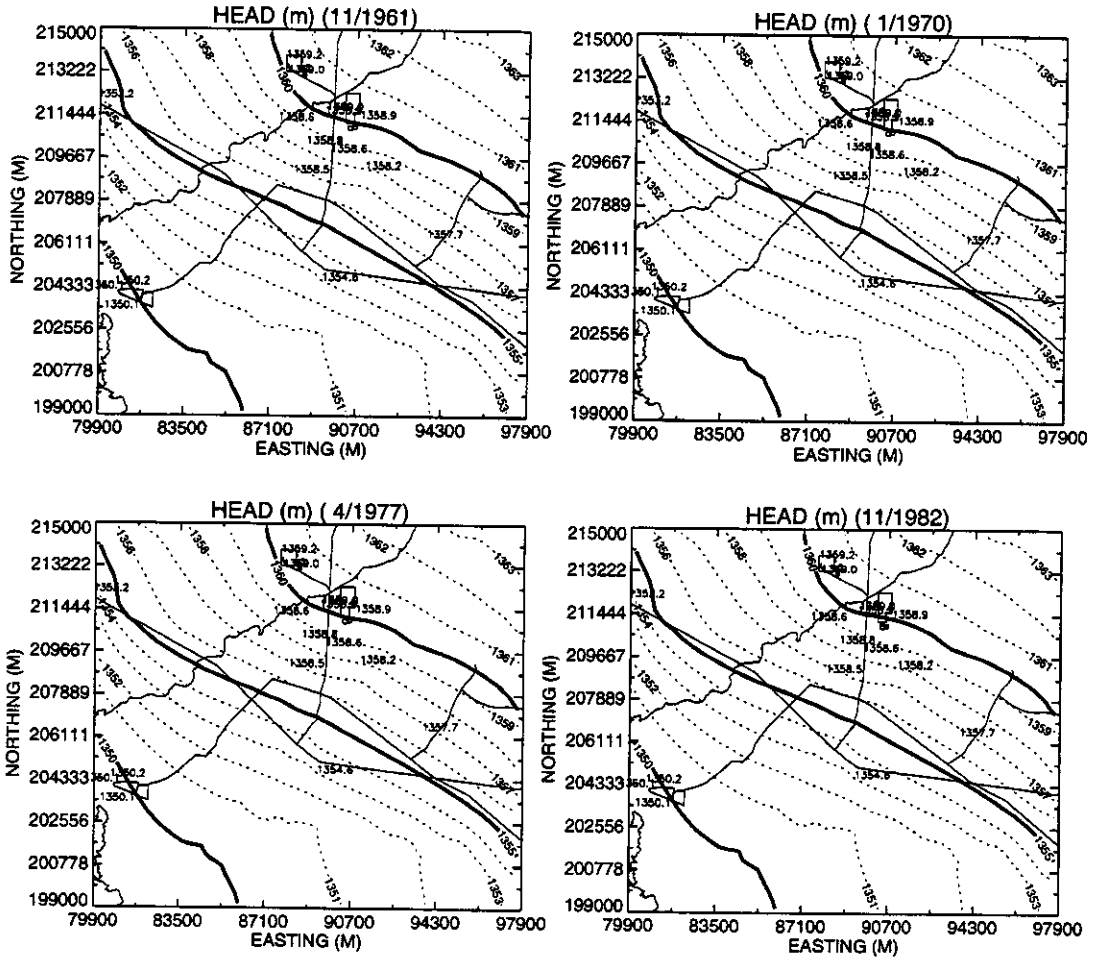


Figure 3-110 Simulated hydraulic head (m) in the aquifer as a function of time. Surface infiltration, injection at CPP-03, and fluxes from the vadose zone prior to the percolation ponds are accounted for. Field data is given for the spring of 1980.

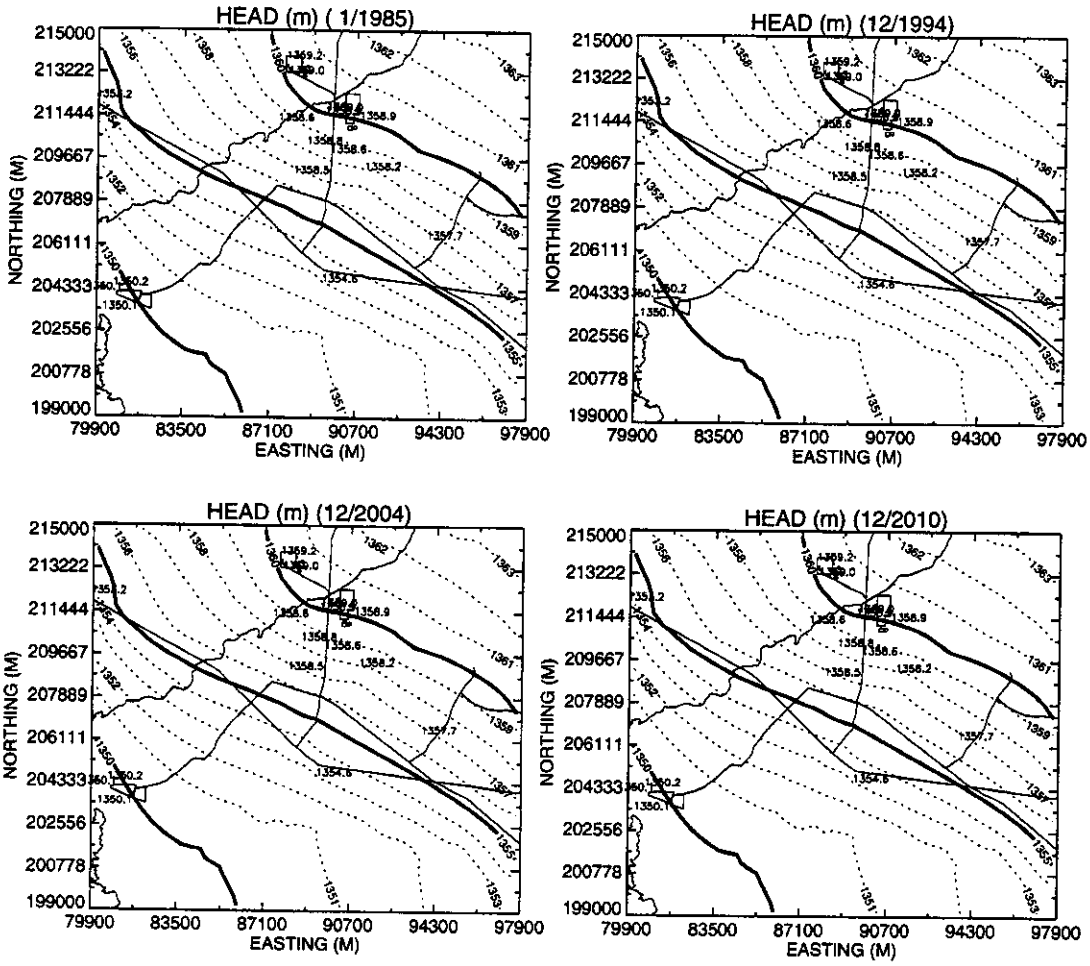


Figure 3-111 Simulated hydraulic head (m) in the aquifer as a function of time. Surface infiltration, injection at CPP-03, and fluxes from the vadose zone prior to the percolation ponds are accounted for. Field data is given for the spring of 1980.

4 VADOSE ZONE AND AQUIFER TRANSPORT MODEL CALIBRATION

In this section, field data for transport calibration is presented and compared to model predictions of transport. Vadose zone transport uses the percolation pond chloride disposal history, and transport in the aquifer is simulated using tritium as conservative tracers. Following the format of the previous sections, simulation results for the vadose zone are presented first in Section 4.1, with the aquifer results presented in Section 4.2 as given below:

4.1 Vadose Zone Transport Model Calibration

4.2 Aquifer Transport Model Calibration

- 4.2.1 Base case simulation with WAG-10 permeability
- 4.2.2 Adding a single layer I basalt flow
- 4.2.3 Adding the HI interbed above the I basalt flow
- 4.2.4 Adding the higher-permeability upper I basalt flow
- 4.2.5 Adding the local ICPP permeabilities
- 4.2.6 Reducing the upper I basalt flow permeability by a factor of 10
- 4.2.7 Increasing the lower permeability cutoff in the local ICPP area:
- 4.2.8 Decreasing the porosity by a factor of two

4.1 Vadose Zone Transport Model Calibration

To calibrate the vadose zone transport model, it was necessary to select an existing contaminant that was disposed of at or near land surface for use as a tracer. In addition, the mass of the tracer needed to be identifiable, observed in the perched water, and it needed to be unique to a particular source location. Although many different chemicals were disposed of at the ICPP, most of these are of questionable mass, disposal time and location, and in low enough concentrations not to be observed in the perched water bodies. Noted exceptions include the chloride and sodium that exist in the process water discharged to the percolation ponds. Because chloride is measured in the upper perched water body under the percolation pond and some distance north and west of the percolation ponds, it was selected as the best tracer. In addition, it was assumed that chloride was transported without adsorbing to the alluvium, basalt, and sediment comprising the vadose zone material.

The USGS (D. Cecil, personal communication, 3/96) has recently compiled a validated history of the percolation pond chloride mass disposal from 1982-1996. This data was shown in Figure 4-1 and indicates that the primary use of the percolation ponds began in 1984 with a short period of use in 1982 (2months). During 1985, use declined from March through August, resuming full disposal in September of 1985.

To reduce the computational complexity, the source term shown in the figure labeled "Raw Chloride Data" was integrated into discrete step functions as shown in the figure labeled "Lumped Chloride Data". These step functions of chloride release preserve the total mass and the character of actual release. In the numerical model, the chloride mass flux was placed into the 72.9 $kg/m^2/day$ infiltrating percolation pond water. Parameters for the remainder of the water balance and hydraulic properties are consistent with those used for the vadose zone simulation presented in Section 3.2.15. Chloride was introduced at a simulation time of 10,531 days corresponding to 1/1/1982.

The concentration distribution at increasing simulation times are given in Figures 4-2 through 4-4. The vertical profiles were taken at a 90,500 m Easting cross-section which is consistent with that used for the perched water calibration plots. Contour intervals are nonuniform and are given at 5, 10, 25, 50, 75, 100, 150, 200, 250, 300, and 350 ppm. The title of each plot indicates the elapsed time from 1/1/1982, with the subtitle showing the total elapsed time from 1/1/1953.

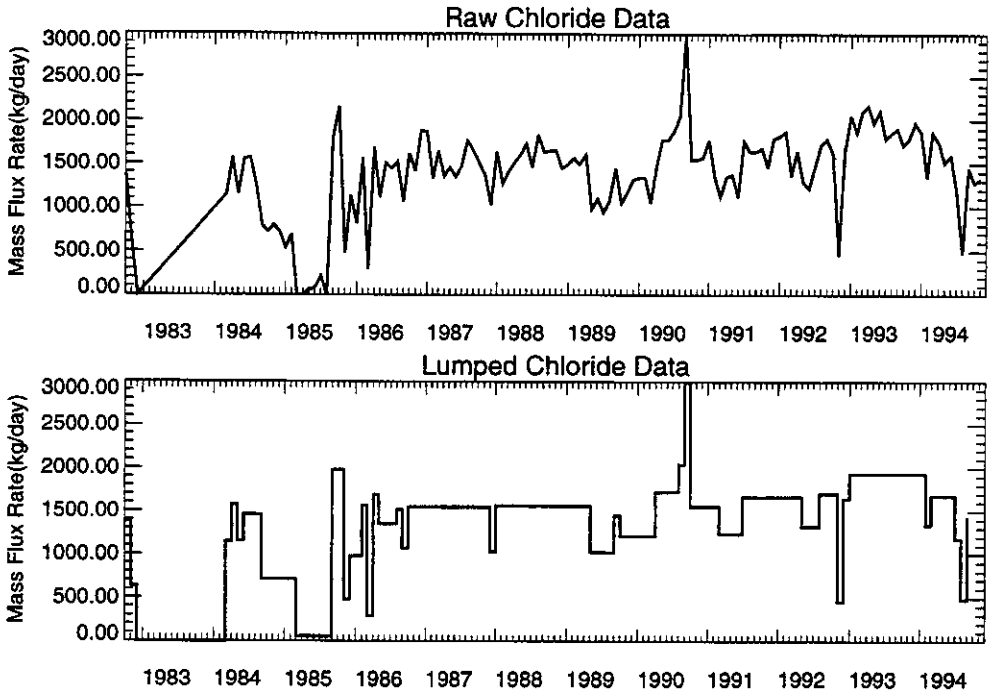


Figure 4-1 Chloride release flux to the percolation ponds. Top figure shows daily flux of chloride (kg/day) discharged to the percolation ponds (80,000 m^2) for two months in 1982 and then from 1984 to 1996 with declined use from March-August in 1985. Bottom figure shows the step functions used to model the actual chloride releases. Total mass is preserved with the step functions shown.

At a simulation time of 31 days, the chloride has reached the upper interbeds at very low concentration, and by 61 days and is spreading out laterally. By 517 days, the chloride has migrated through the upper interbed in very low concentrations. These reduced concentrations and absence of chloride in the upper basalt unit result from turning the source flux rate off through 1983. After reintroducing chloride in 1984, the concentrations increase again and migrate downward. By April 1984, the chloride has just reached the middle interbed and begins to spread laterally as shown in the May 1984 plot.

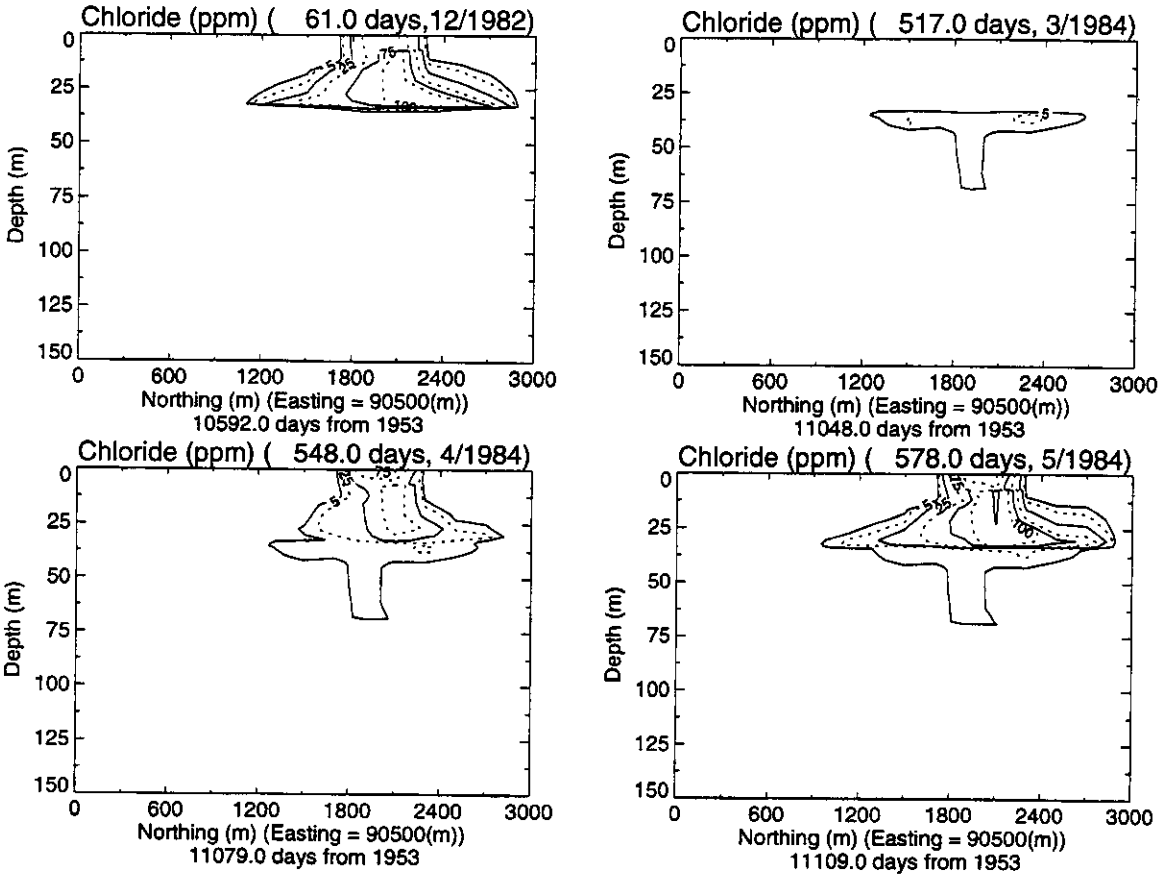


Figure 4-2 Simulated chloride concentration resulting from discharges to the percolation pond. Contour intervals are 5, 10, 25, 50, 75, 100, 150, 200, 250, 300, and 350 ppm.

This simulation predicts that the chloride in the upper interbed extends as far north as the tank farm facilities or 1800m north of the percolation ponds as shown in Figure 4-3. By 1987, the chloride has begun to migrate through the basalt unit below the middle interbed and by 1990 has begun to spread across the lower interbed. In 1990, chloride from the percolation ponds has reached the aquifer.

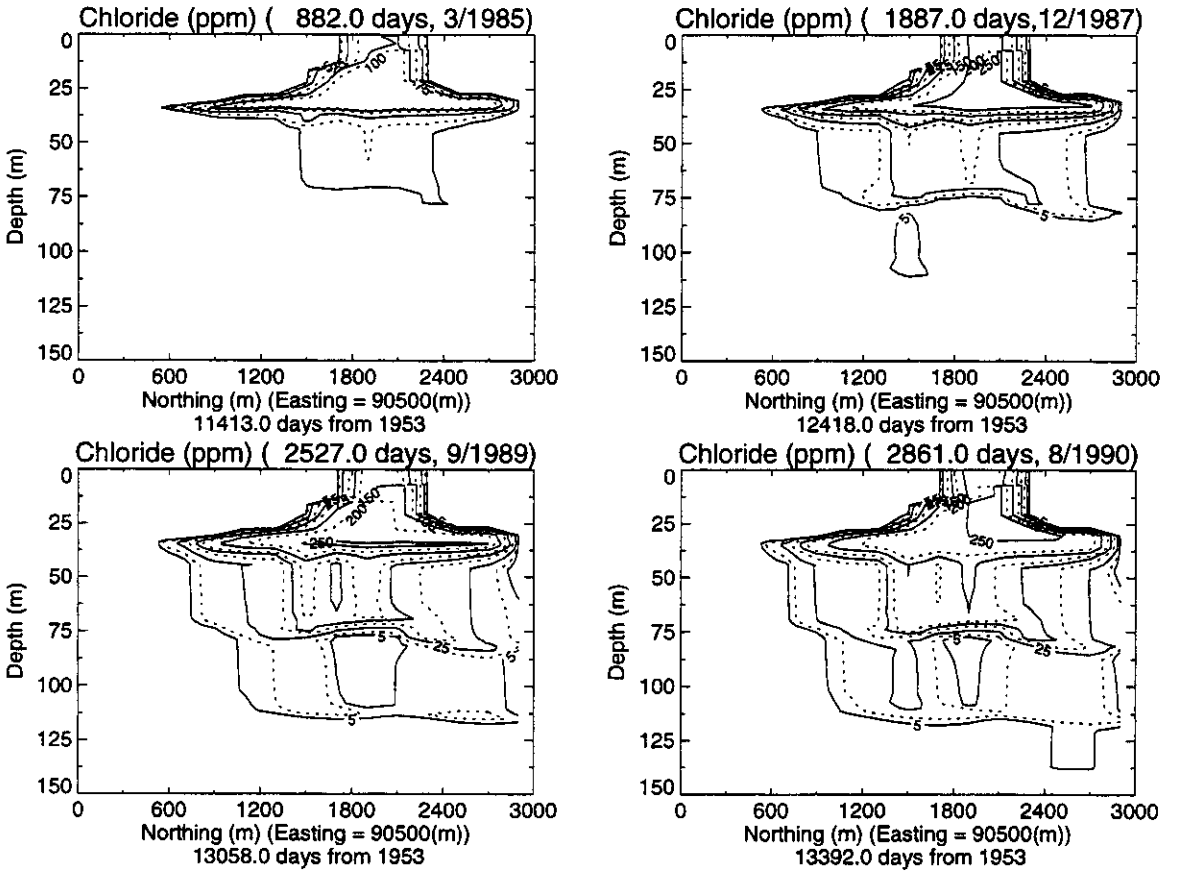


Figure 4-3 Simulated chloride concentration resulting from discharges to the percolation pond. Contour intervals are 5, 10, 25, 50, 75, 100, 150, 200, 250, 300, and 350 ppm.

Simulation times past 1991 indicate that the chloride reaches a maximum lateral extent in the lower and middle interbeds by the year 2000 and that the concentration is essentially at steady state. This steady state is allowed by a continued source concentration equal to that observed in 1996. Note that the aquifer outflow boundary condition allows an abrupt change from a concentration greater than zero to a concentration of zero. This is consistent with the physical process of chloride removal by flow in the aquifer.

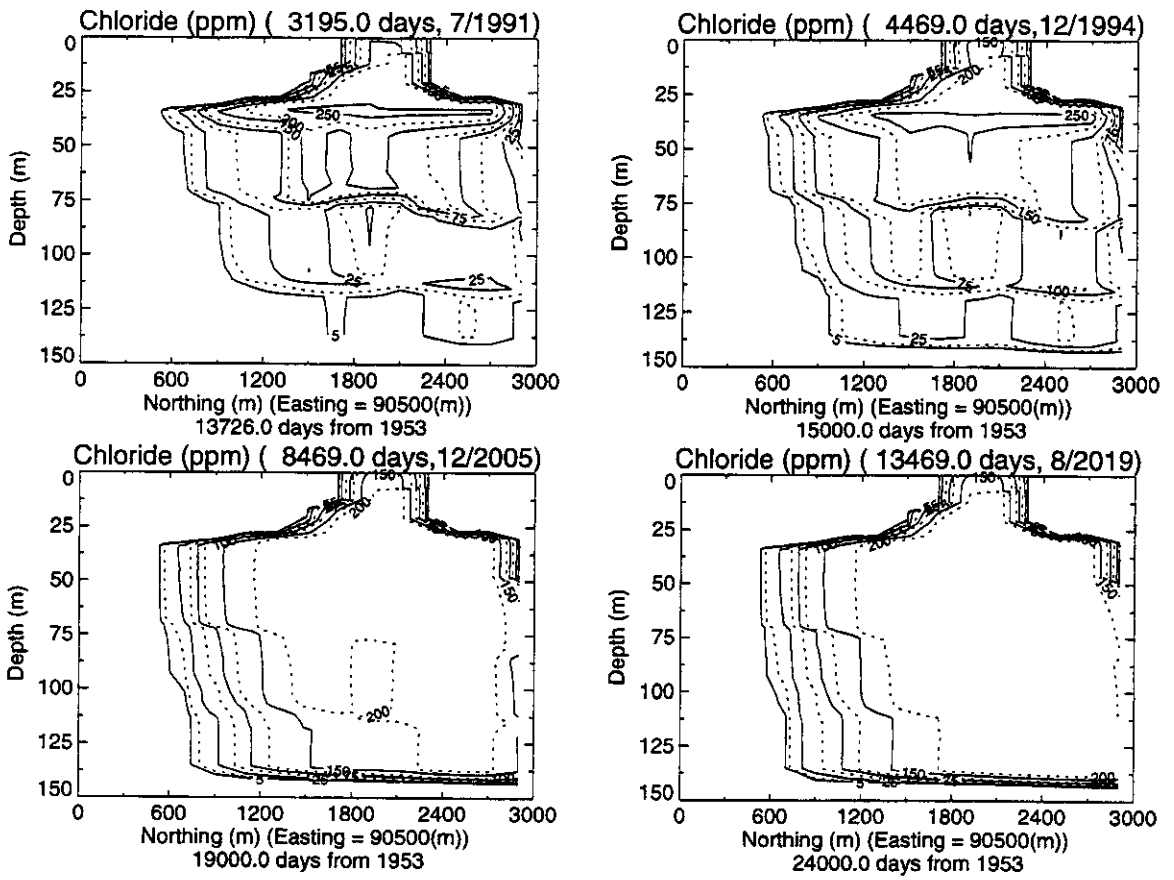


Figure 4-4 Simulated chloride concentration resulting from discharges to the percolation pond. Contour intervals are 5, 10, 25, 50, 75, 100, 150, 200, 250, 300, and 350 ppm.

These model predictions were compared to field data collected in the perched water wells near the percolation ponds as shown in Figures 4-5 and 4-6 with locations for these wells given in Figure 1-16. Wells PW-01, PW-02, PW-03, PW-04 and PW-05 are all within 100 m of the percolation ponds, PW-06 is roughly 500 m west and USGS-50 is roughly 500 m north. The PW wells are all completed in the upper interbed and USGS-50 is completed in the lower interbed. The screened interval allows contaminants to be sampled from throughout the interbeds.

The breakthrough of chloride at the top of the upper interbed as a function of time is plotted in Figure 4-5. This data can be compared to the field data if it is assumed that the screened interval in the wells samples primarily water from near the top of the interbed. Early time model predictions can be compared to field data from the PW-02 and PW-03 wells, and mid-range to long-term average behavior can be compared in all of the wells (with the short, mid, and long term simply based on lateral distance from the percolation ponds). This comparison indicates that the model predicts overall behavior very well in the PW-01, PW-02, PW-03, PW-04 and PW-05 wells, with deviations in PW-06 and USGS-50. Key points to note are:

- first arrival of chloride is predicted early in PW-06, but is correct in the other PW wells. This indicates that the vertical basalt characteristics are adequately represented, but that the lateral spreading in the horizontal direction in the basalt prior to reaching the first interbed is slightly fast i.e. the horizontal basalt permeability may be slightly high.

- the time rate of chloride concentration increase in PW-02 and PW-03 very closely match field data. This is another indication that the vertical permeability is adequately represented in the model.
- the steady-state (long-term here) concentrations in the PW wells are very close to being correct. This indicates that the overall dilution is adequate, i.e. the water source terms and chloride mass is being input in correct proportions and that they are not being overly influenced by dispersion in the basalts.
- model predictions do not match the field data in the USGS-50 well. This is primarily because the USGS-50 well is completed at an elevation of 1380.9 m while the other wells for which field data is presented are completed at a much shallower depth or at elevations around 1470 m. The vadose zone model calibration was based only on the chloride originating in the percolation ponds that were brought on line in the 1980's. However, chloride had been disposed of in the injection well as early as 1959, and had been introduced into the vadose zone as a result of completion failure in the injection well. Peak chloride concentrations reported for the USGS-50 well are as high as 900 mg/L, and the field data indicates that the concentration is declining to around 100 mg/L. The model predictions are not consistent with the field data because the vadose zone model calibration did not include the additional chloride released into the vadose zone as a result of the failed injection well. As a result, the model is simply predicting the arrival of chloride from the surface (which arrives at very small concentrations) as opposed to predicting the declining concentrations observed in the USGS-50 well as the chloride leaches on down into the aquifer.

The breakthrough of chloride at the bottom of the upper interbed as a function of time is plotted in Figure 4-6. Using these figures as model-to-field-data comparisons assumes that the wells are sampling closer to the bottom of the screened intervals. Key points to note in this comparison are:

- in all wells, the predicted first arrival of chloride is after the actual arrival. However, the delay is on the order of 1000 days, small relative to the 100+ year predictions required for the remedial investigation report. Delayed simulated arrival could be either because 1) the wells sample the upper portion of the interbed or 2) because the model interbed permeability is too low and thus retards downward migration, or 3) because the model porosity is too high reducing the average linear velocity and slowing migration. Increasing the interbed permeability would result in losing the perched water in the northern ICPP wells as shown in Section 3.2. Decreasing the porosity would effect the water calibration as well. The model results accurately simulate the measure data and further adjustments in the porosity and permeability were not made.
- the predicted arrival of chloride at the top of the interbed unit in PW-06 was late, and the arrival at the bottom of the interbed in PW-06 was nearly correct. This indicates that either 1) the lateral dispersion in the interbed is too low restricting the migration of chloride from the percolation ponds to PW-06; 2) that the vertical permeability in the sediments is slightly high; or 3) that the lateral permeability in the sediments is slightly low. Because the arrival at the bottom of the interbed in the other wells is predicted to be too late, it is more probable that the lateral permeability or dispersivity in the sediments is slightly low. Because of the late arrival through the basalt and subsequent early transport through the sediments, the net effect on simulated transport time is negligible.

Based on this transport calibration, and the results of the perched water analysis, the vadose zone model adequately represents the ICPP unsaturated domain. The final calibrated set of hydraulic parameters that will be used in all further vadose zone simulations is given in Table 4-1.

Table 4-1 Final calibrated hydrologic parameters.

Parameter	Value
Surficial and Interbed Sediments	
k_s	Surficial sediments: 78 mDarcy Interbed sediments: 4 milliDarcy (mD), isotropic
θ	0.487 cm^3/cm^3
S_{wr}	0.292
S_{ar}	0.0
α	1.066 m^{-1}
β	1.523
Basalt	
A_{aw}	32 kPa
B_{aw}	1.5
A_w	1.0
B_w	1.0
S_{wr}	0.0
A_o	0.0
B_o	1.1
S_{or}	0.0
A_a	1.0
B_a	1.2
S_{ar}	0.0
θ_b	0.01 to 0.05
$k_{v,b}$ (vertical)	300 mDarcy
$k_{h,b}$ (horizontal)	90000 mDarcy
Other	
ρ_{fw}	1000 kg/m^3
characteristic matrix block length	2 m

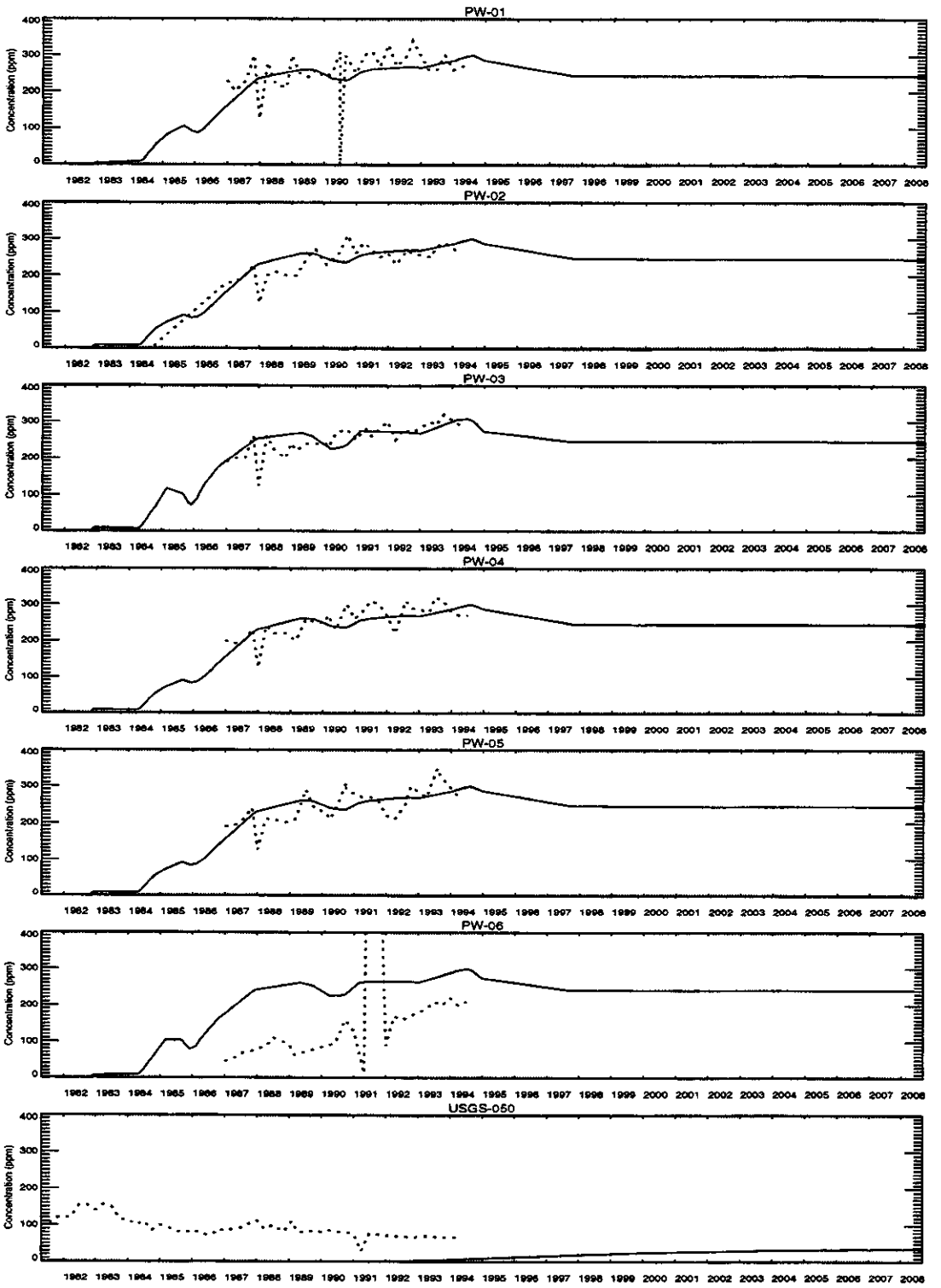


Figure 4-5 Model predicted (solid line) and field data (dotted line) history of chloride in the wells completed in the upper perched (PW wells) and lower perched (USGS-50) zones. Model prediction is taken from the top grid block of the upper interbed layer.

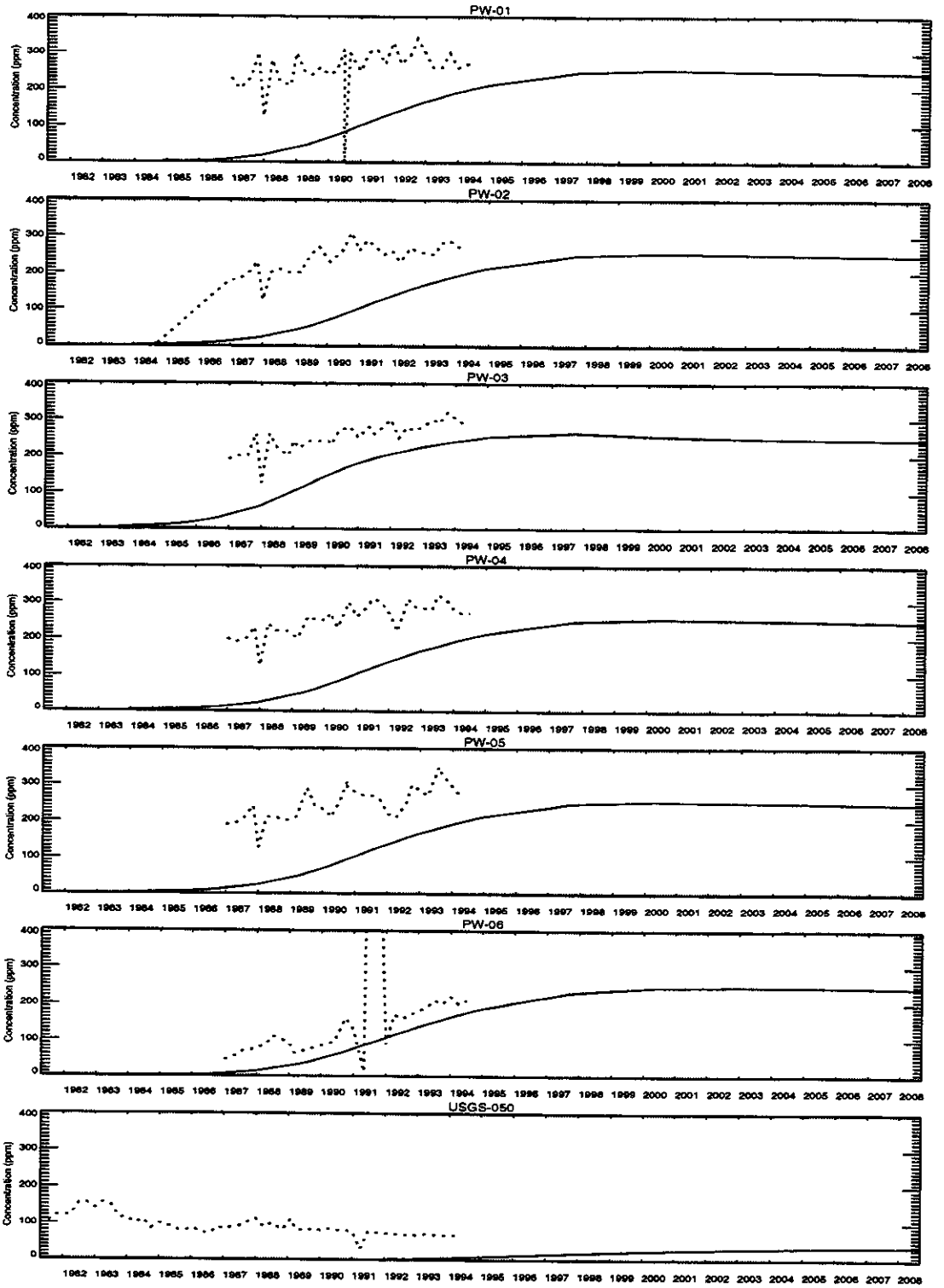


Figure 4-6 Model predicted (solid line) and field data (dotted line) history of chloride in the wells completed in the upper perched (PW wells) and lower perched (USGS-50) zones. Model prediction is taken from the bottom grid block of the upper interbed layer.

4.2 Aquifer Transport Model Calibration

Calibration of the aquifer transport model used the tritium disposal history in the CPP-03 injection well. Tritium disposal from TRA was included, although transport from that site was not used as a calibration measure. Tritium was used because it is non-sorbing, estimates of mass disposal from 1953 to 1984 are available and time histories at wells down gradient are available to adequately characterize the tritium transport over time.

Figure 4-7 gives a history of the CPP-03 injection well mass disposal from 1953-1985. Annual estimates are given prior to 1962, with monthly data available thereafter. The key features for calibration include the large mass disposed of from 1959 to 1961, and the two large releases in 1963 and 1964.

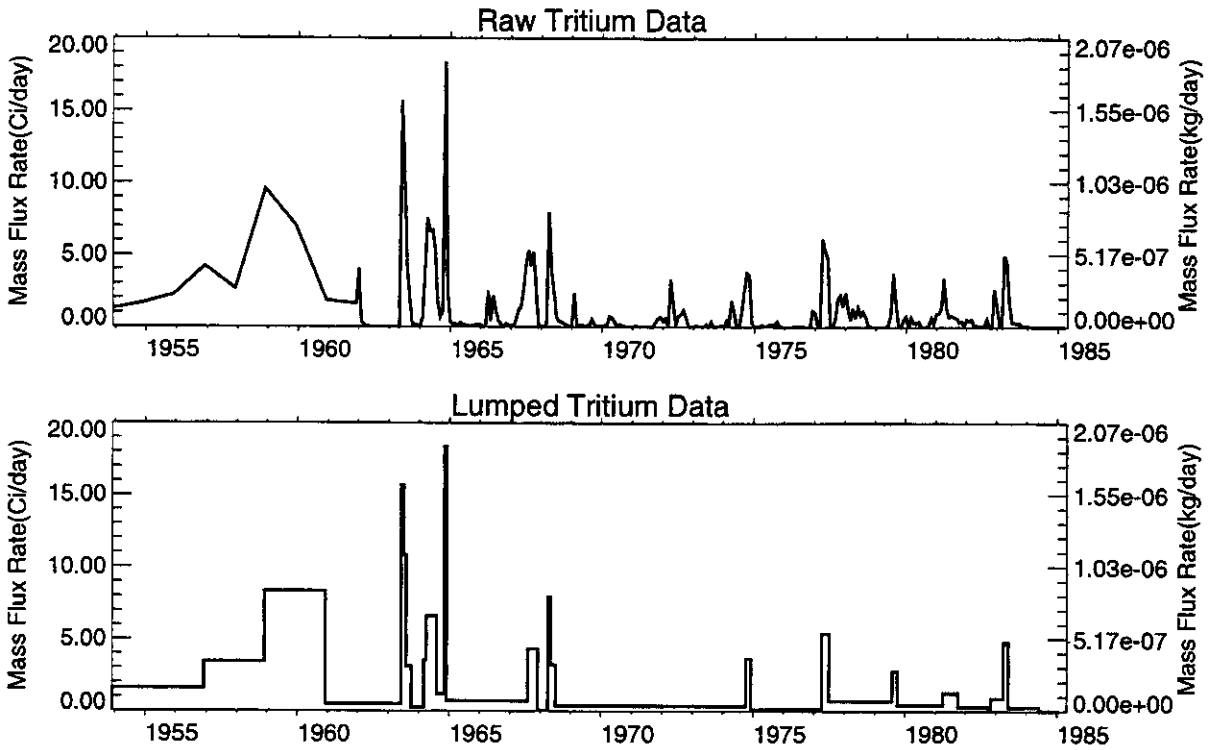


Figure 4-7 Tritium release history to CPP-03. Top figure shows daily flux of tritium (Ci/day on the left axis and kg/day on the right) discharged to CPP-03 from 1953 to 1985. Bottom figure shows the step functions used to model the actual tritium releases. Total mass is preserved with the step functions shown.

To reduce the computational complexity, the source term shown in the figure labeled "Raw Tritium Data" was integrated into discrete step functions as shown in the figure labeled "Lumped Tritium Data". These step functions preserve the total mass and the character of actual release. In the numerical model, the tritium mass flux was placed into water discharged from the injection well. This history is shown in Figure 4-8 and for the purposes of modeling was reduced to step functions as was the tritium mass flux. The injection rate of water over the time period of interest is constant relative to the fairly large fluctuation in tritium mass flux. If the water influx rate were more variable, it would be difficult to associate breakthrough response at wells to the tritium discharge curves given here.

There are primary features to note in the combined CPP-03 tritium and water discharges. The first is that the disposal history prior to 1963 is an annual estimate, and a monthly estimate thereafter. The second

feature is the relatively large mass entering the aquifer during the 1959 to 1961 time period. The reason the annual vs. monthly estimates are important is because the time-history of mass arrival at down gradient monitoring wells is a point measurement. Because the down gradient wells measure instantaneous data, and have adequate sampling data (as shown in the calibration curves to follow), relatively sharp changes in the mass influx rates (i.e. 1961 and 1964 peaks) can be distinguished in the field data. The annual data, on the other hand, are input into the model over a large period of time at an average rate. This will result in a time offset and slight underestimation in the magnitude of concentration in all of the calibration plots.

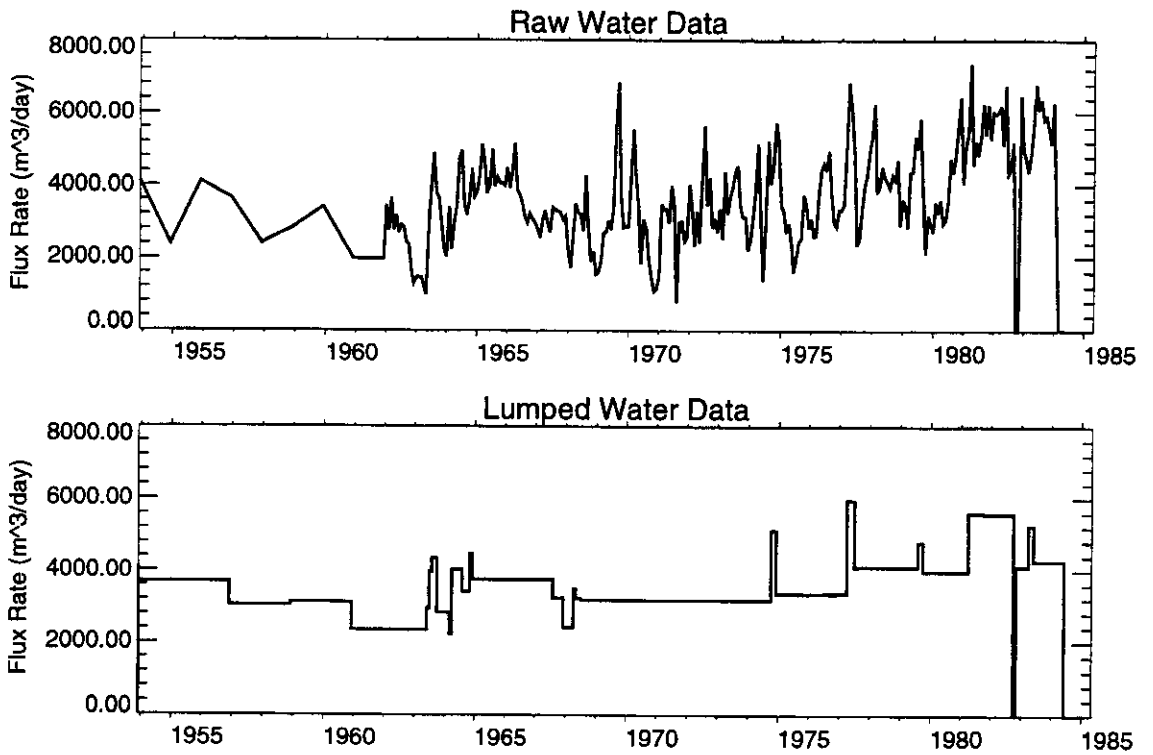


Figure 4-8 CPP-03 water discharge history. Top figure shows daily influx of water (m^3/day) discharged from 1953 to 1985. Bottom figure shows the step functions used to model the actual water rate. Total mass is preserved with the step functions shown.

In addition to including the CPP-03 tritium injection history, the injected flux at TRA was accounted for during model calibration. This mass flux was estimated as part of the WAG-02 RI/FS effort and details will not be presented here beyond mentioning that the source is applied as an areally distributed volume flux (as described in Section 5.2.6). As with the CPP-03 tritium fluxes, for use in the model, the TRA tritium fluxes were converted to step functions as shown in Figure 4-9. Note that the mass flux in Ci/day is an order of magnitude smaller than injected into the CPP-03 injection well. This in combination with the areally distributed source as opposed to a point injection source confirms that the CPP-03 injection source is much larger.

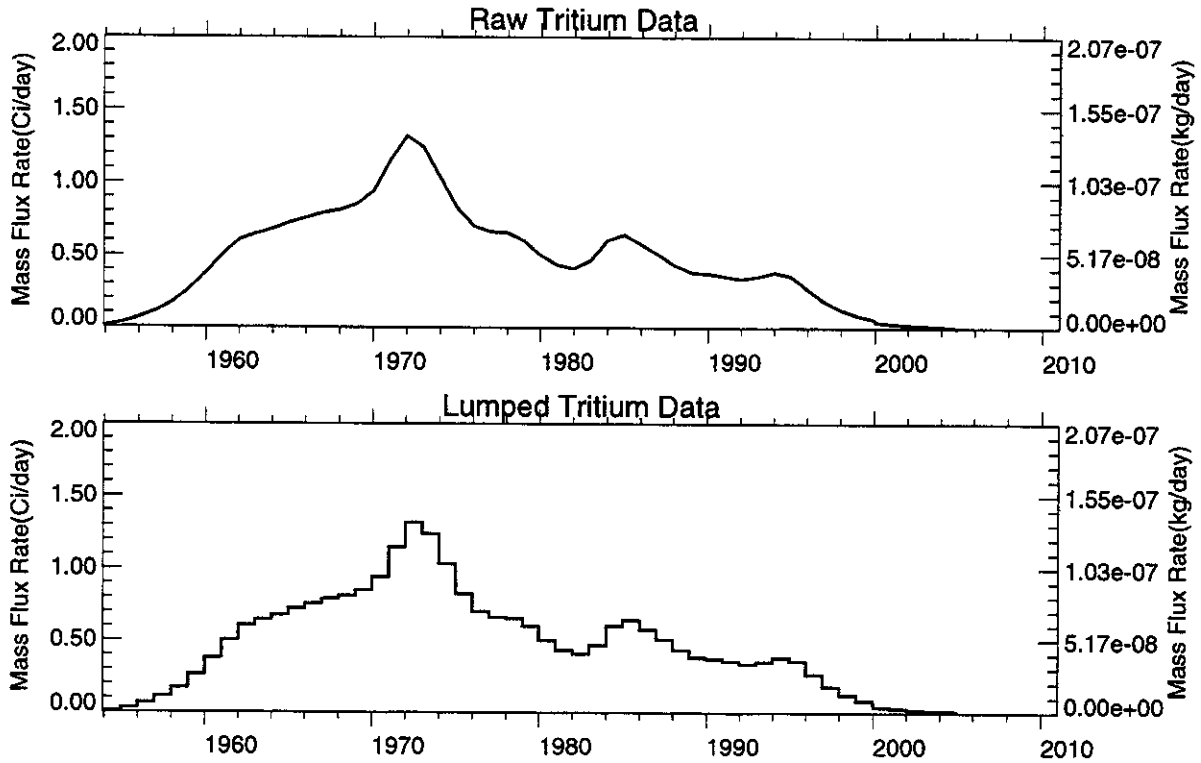


Figure 4-9 TRA tritium discharge history. Top figure shows daily influx of tritium (Ci/day) discharged from 1950 to 1995, with estimates for the discharge through 2010. Bottom figure shows the step functions used to model the actual tritium mass flux rate. Total mass is preserved with the step functions shown.

Unlike the calibration process for the vadose zone, where an extensive sensitivity study was performed during the perched water calibration, the aquifer sensitivity study was done as a part of transport calibration. The primary reason for this is that transport is governed by the insitu velocity which is equal to the Darcy velocity divided by the porosity:

$$v = \frac{k\nabla h}{\phi} \tag{1}$$

Thus, matching the heads does not imply that transport velocity is appropriate. Thus, for the purposes of aquifer flow and transport calibration, it was decided to concentrate on matching the breakthrough curves of tritium to field data rather than matching heads at those wells. This was done in part because a steady state head model was used to try to capture long term effects of the transient head on transport rather than attempting to incorporate unknown underflow recharge boundary conditions. This is different than the calibration of the vadose zone model when enough field data were available to calibrate the transient infiltration (pressure and saturation), but not enough to extensively calibrate to chemical transport.

Parameterization forming the basis of the sensitivity study is given in Table 4-2. Essentially, the aquifer model was built in order of increasing complexity. By this it is meant that the hydraulic parameters began with the basic WAG-10 permeabilities. Then, the I basalt flow, HI interbed, upper I basalt flow, and local ICPP permeabilities were added sequentially. Final calibration was achieved by adjusting the actual values assigned to the stratigraphic units and by adjusting the porosity. In all of the simulations, the Big Lost

River and WAG-10 boundary heads were used. In addition, the water flux from the vadose zone prior to turning on the percolation ponds was incorporated.

Table 4-2 Parameter groups used in the key stages of aquifer transport model calibration.

Simulation Stage	Key Feature	Permeability, k (mD)				ϕ_B	ϕ_S	α_L	α_T
		Upper I Basalt Flow	Lower I Basalt Flow	HI Interbed	Local ICPP Lower Cutoff	%	%	(m)	(m)
4.2.1 (aqtrw10a)	Base case with steady-state Big Lost River, WAG-10 heads, and WAG-10 permeability.	WAG-10 values	WAG-10 values	WAG-10 values	WAG-10 values	12.5	NA	5	0
4.2.2 (aqtriba)	4.2.1 with the entire I basalt flow represented by the lower I basalt flow values.	8.5E4	8.5E4	WAG-10 values	WAG-10 values	12.5	NA	5	0
4.2.3 (aqtribia)	4.2.2 with the HI interbed overlying the I basalt flow uniformly (7.6 m).	8.5E4	8.5E4	4	WAG-10 values	12.5	48.7	5	0
4.2.4 (aq2ibia)	4.2.3 with the more permeable upper I basalt flow.	1.3e6	8.5E4	4	WAG-10 values	12.5	48.7	5	0
4.2.5 (aq2ibila)	4.2.4 with the local ICPP permeability using a minimum cutoff value of 1.8e4 mD.	1.3e6	8.5E4	4	1.8E4	12.5	48.7	5	0
4.2.6 (aqr1a)	4.2.5 with a less permeable upper I basalt flow	1.3e5	8.5E4	4	1.8E4	12.5	48.7	5	0
4.2.7 (aqr3a)	4.2.5 with a higher cutoff for the local ICPP permeability	1.3e6	8.5E4	4	9.0E4	12.5	48.7	5	0
4.2.8 (aqr2a)	4.2.5 with reduced basalt porosity	1.3e6	8.5E4	4	1.8E4	6.25	48.7	5	0

In the following sections, the concentration distributions at the upper layer of the three-dimensional system are given in addition to presenting calibration plots at key wells. These calibration wells are shown in Figure 4-10. Calibration curves showing the model predicted and field data time-history of tritium concentration are given for all of the simulations listed in Table 4-2, in the Sections listed in Column 1 of that table. In addition, contour maps are presented illustrating the spatial distribution of tritium for various time slices. The first of the contour maps shown in each section is for 1961. Figure 4-11 presents the contour map by Barraclough (1967) of the peak concentration observed from the 1961 discharge constructed from the data collected at the key calibration wells. This figure is reproduced here in lieu of contour maps for all of the time slices to be given later.

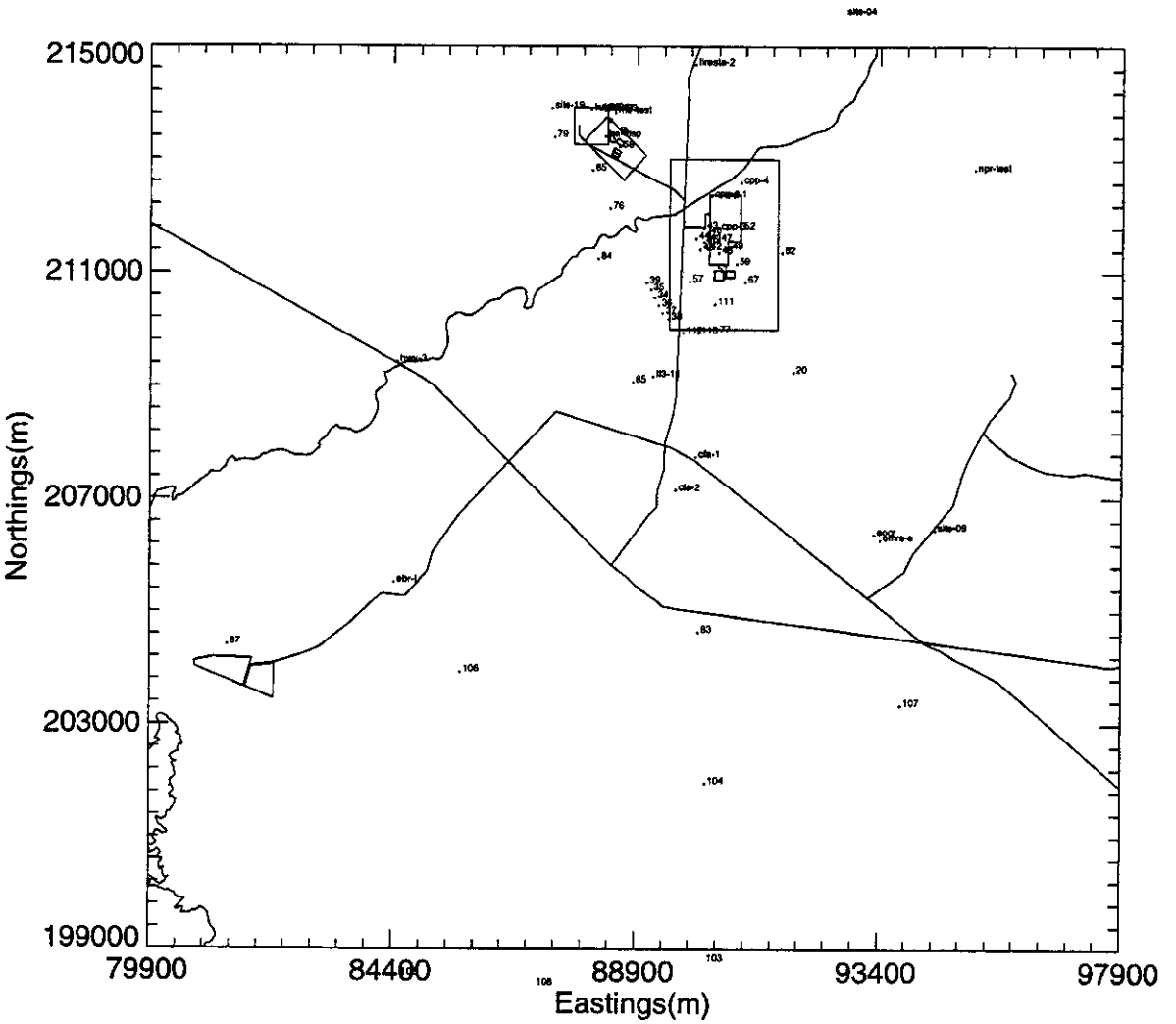


Figure 4-10 Wells used in the calibration of the aquifer transport model. Numbered wells without a prefix (i.e. 104) are the USGS wells (USGS-104).

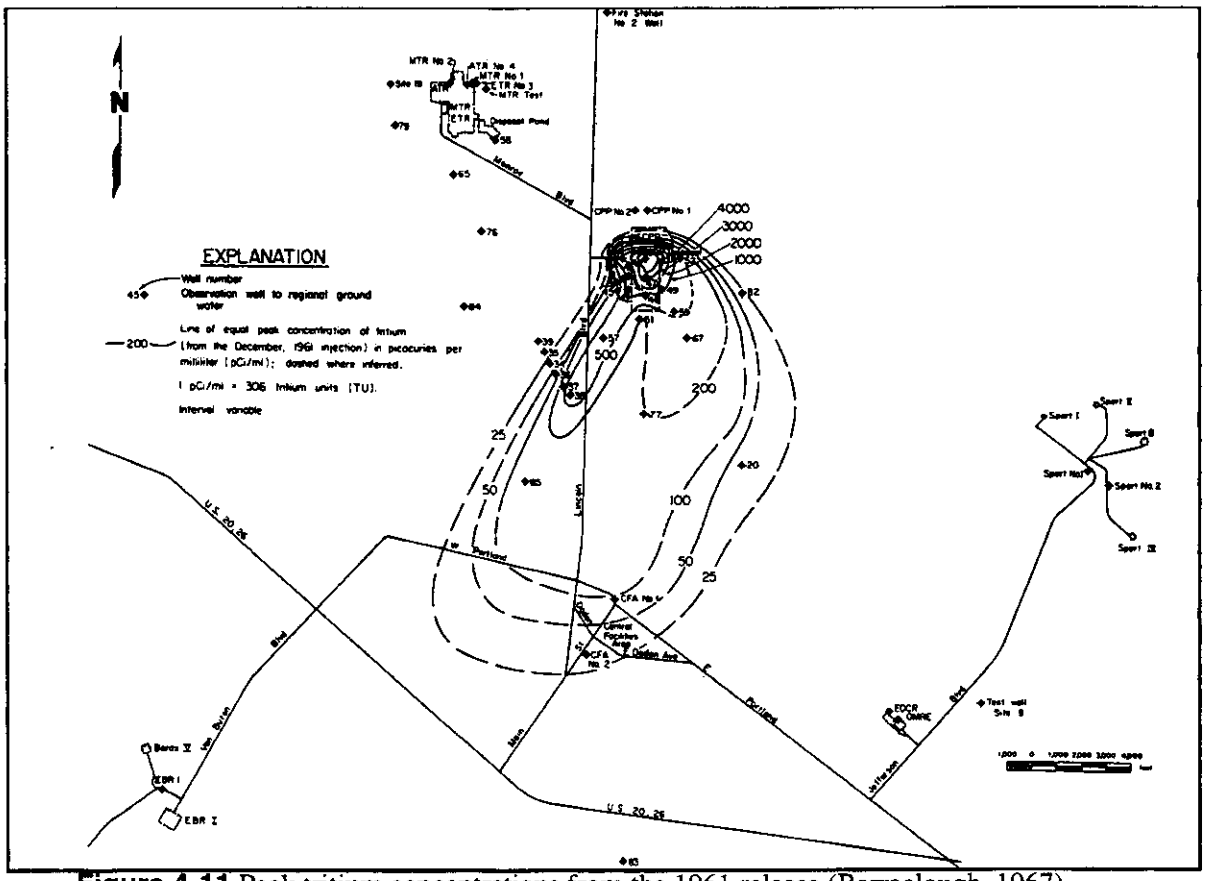


Figure 4-11 Peak tritium concentrations from the 1961 release (Barraclough, 1967).

4.2.1 Base case simulation with WAG-10 permeability

The first level of hydrologic complexity included the WAG-10 permeabilities assigned to each grid block of the WAG-3 aquifer model domain. Figures 4-13 and 4-14 present contours of the tritium in pCi/mL for the top slice of the 3-dimensional model domain. The top slice is given for convenience although there is significant vertical variability as shown in the following calibration plots (Figures 4-16 and 4-17). The contours as a function of depth will be given only for the final aquifer calibration result. Contour levels are given for 25, 50, 100, 200, 500, 1000, 2000, 3000, and 4000 pCi/mL. Field data indicate that maximum tritium concentrations from the 12/1961 release were 20 pCi/mL at CFA-02, and were about 100 pCi/L at USGS-085 (Barraclough et al. 1967). The contour plots shown indicate that model predicted concentrations of 25 pCi/mL do not extend to the CFA area. More complete comparisons for key wells are given in Figures 4-16 and 4-17. For reference, these key wells are plotted in Figure 4-12.

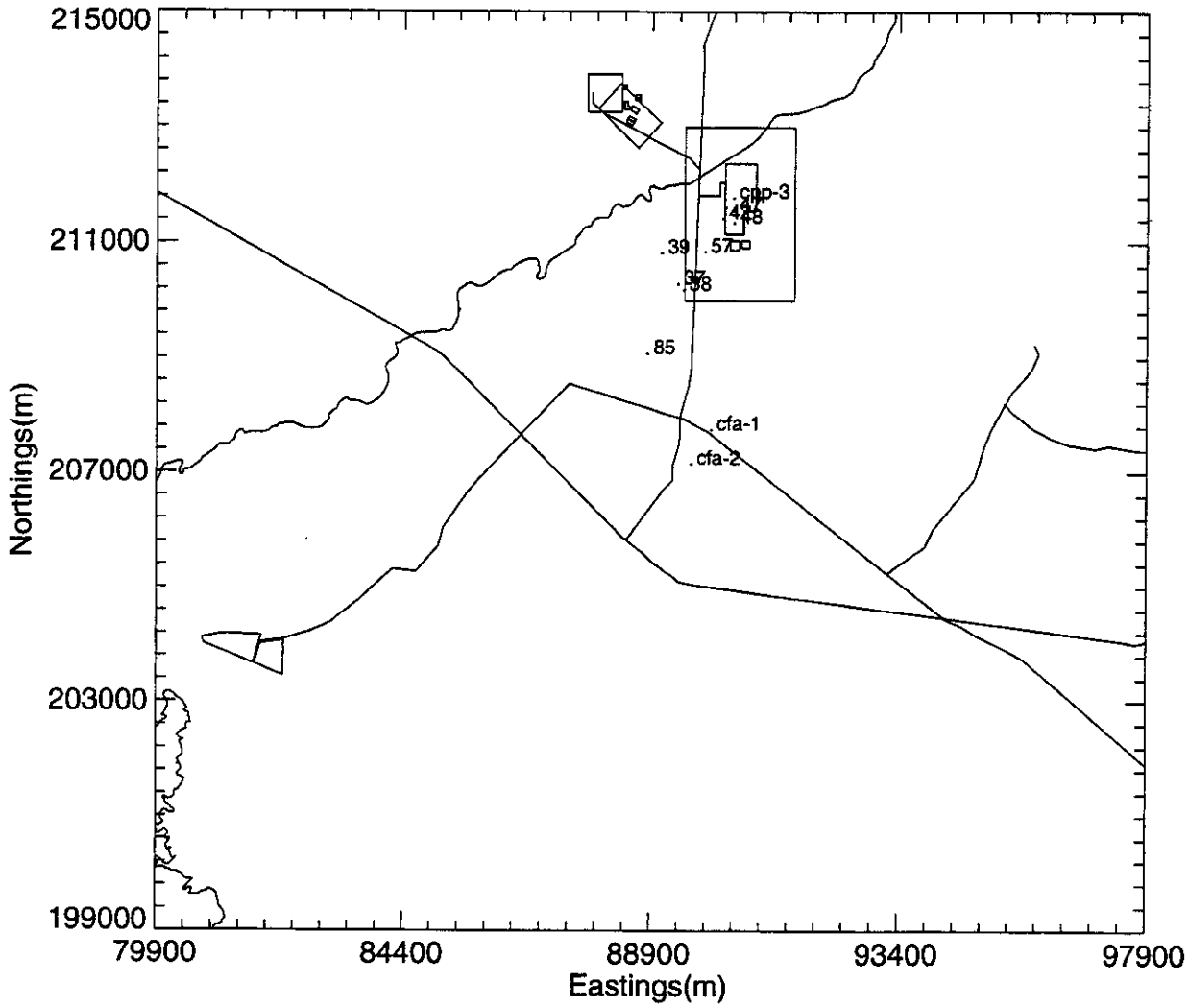


Figure 4-12 Key wells used in the calibration of the aquifer transport model. Numbered wells without a prefix (i.e. 37) are the USGS wells (USGS-037).

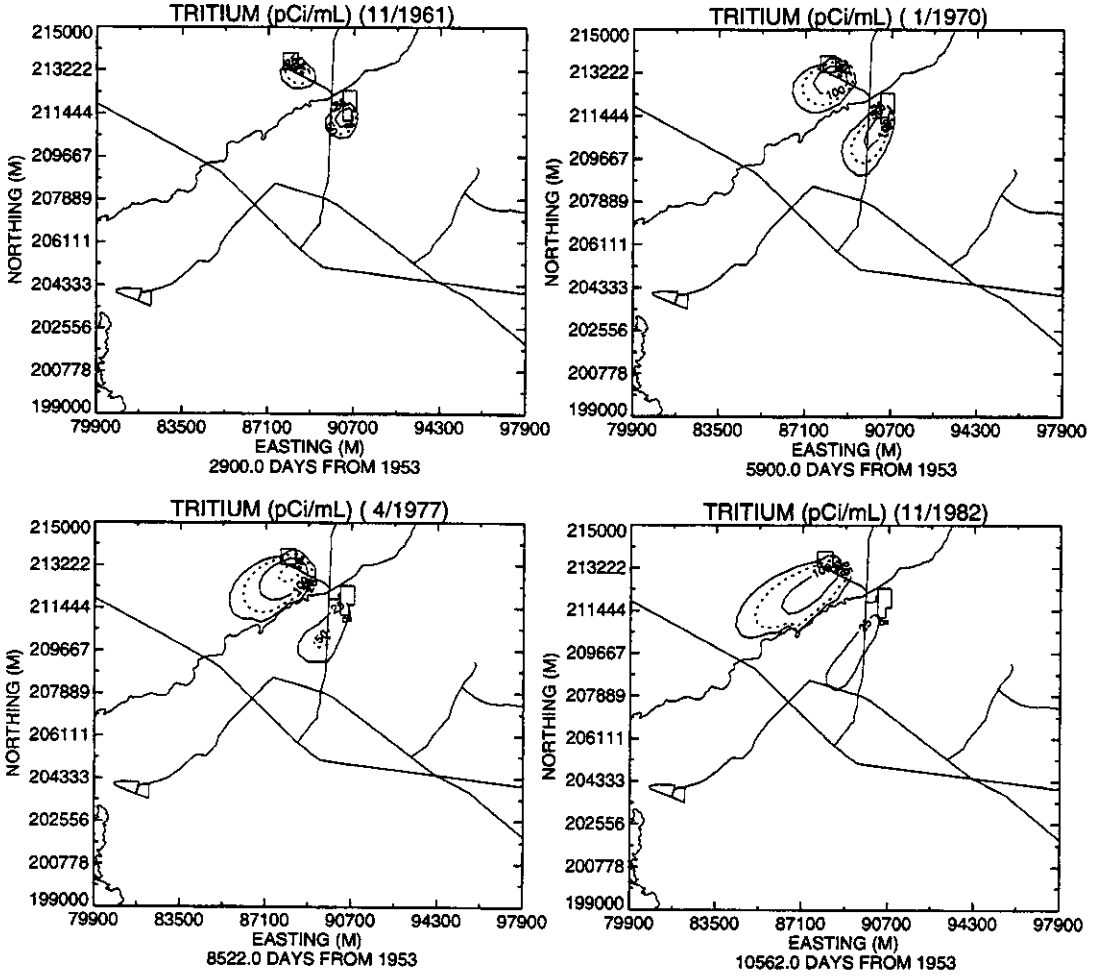


Figure 4-13 Model predicted tritium concentration in 1961, 1970, 1977, and 1982, corresponding to the hydraulic parameterization of Section 4.2.1.

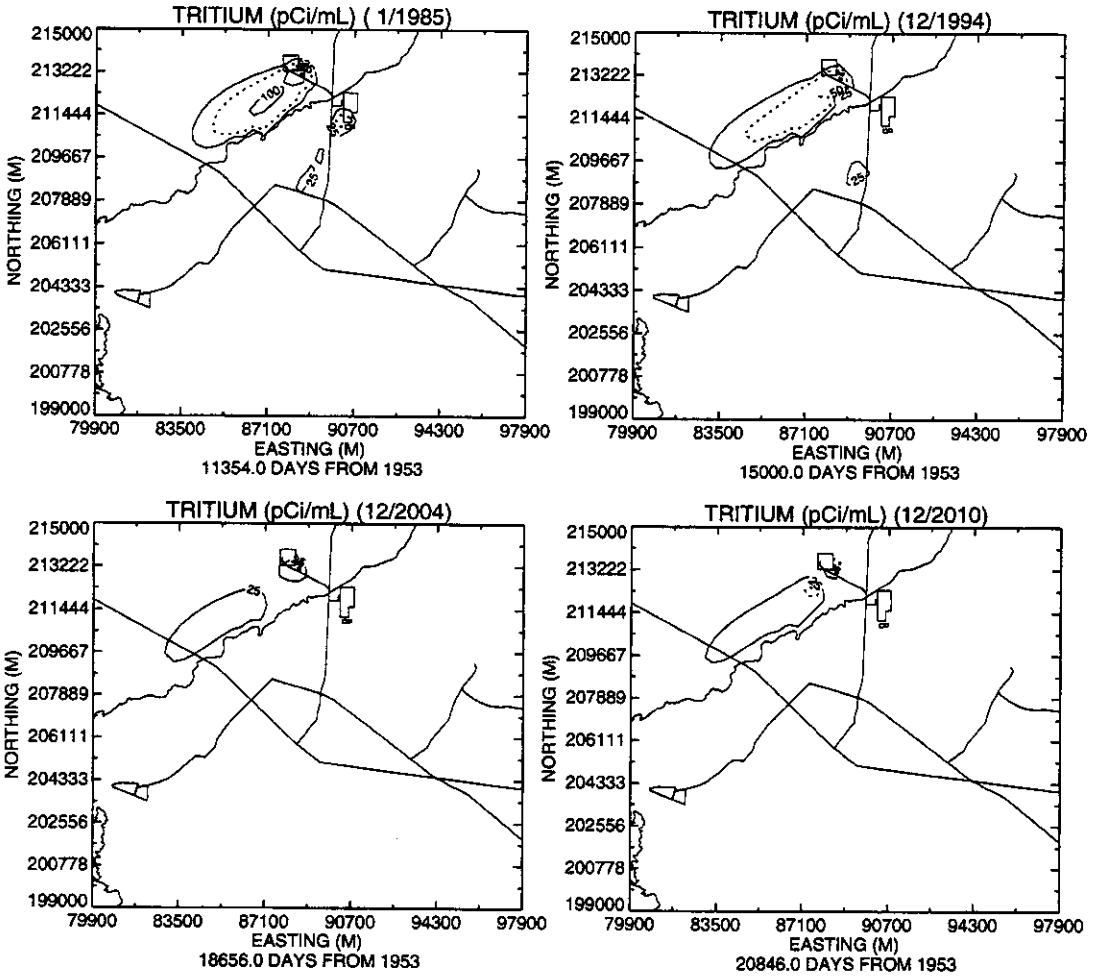


Figure 4-14 Model predicted tritium concentration in 1985, 1994, 2004, and 2010, corresponding to the hydraulic parameterization of Section 4.2.1.

Because this is a three-dimensional model, the breakthrough at various depths is not uniform. In the presentation of the breakthrough curves: (a) the field data are indicated by the thick solid line, (b) the model predicted value corresponding to the center of the screened interval for each well is indicated by the thick light dashed line, (c) a depth averaged concentration (not flux averaged) is given by the thick dark line, and (d) for every depth the model predicted concentration is indicated by the light shaded lines. The depth averaged (thick dashed line) was used as the basis of comparison to the field data (thick solid line) rather than using the center

of the screened interval because the depth of influence sampled during data collections is unknown. These line types are as follows:

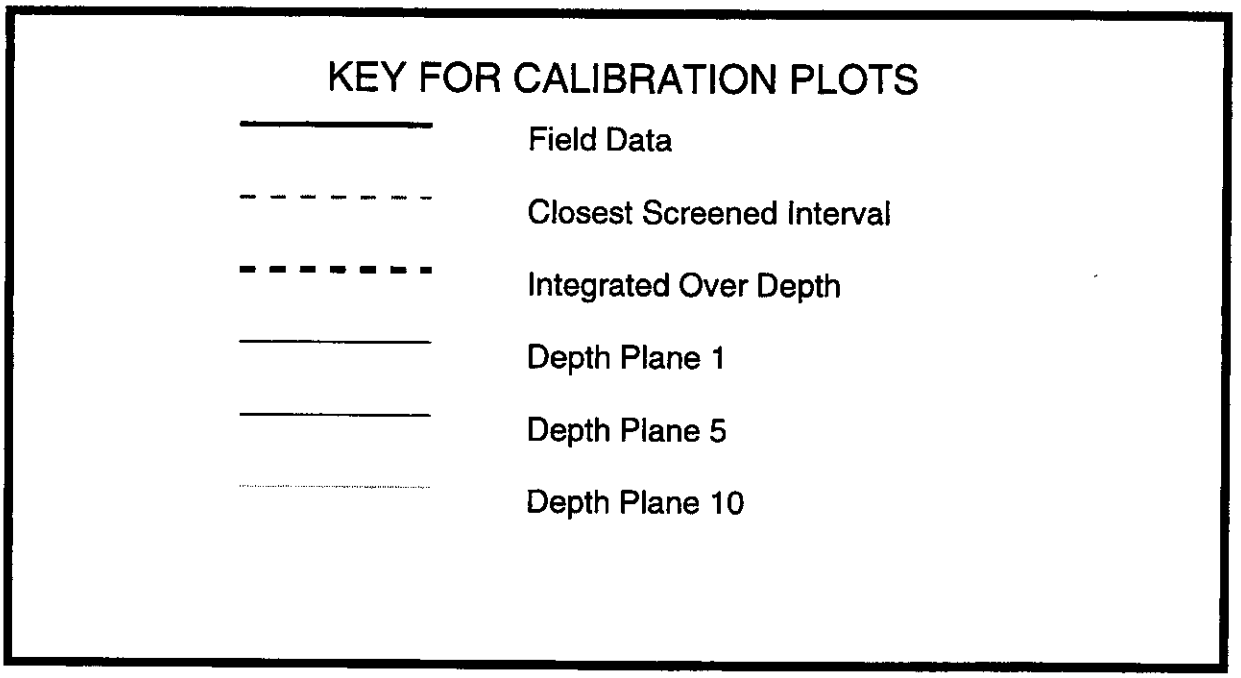


Figure 4-15 Key for aquifer tritium calibration plots.

By distance from the CPP-03 injection well, the calibration plots show:

- NEAR WELLS (USGS-047, USGS-042, and USGS-048): the field data for these wells indicate a sharp response to injection well mass flux changes, however, the model predicted response to those changes is very smooth (disperse). This is indicative of the simulated aquifer having too much water available for the tritium to disperse in, and of the water moving the tritium out too slowly. This can be attributed to overly large thickness, slow velocity, and high porosity. Matching long-term concentrations is expected this close to the injection well, and the match simply reflects the decrease in mass going into the injection well.
- MID-DISTANCE WELLS (USGS-057, USGS-037, USGS-038, and USGS-039): the model predicted initial breakthrough is late at least 10 years and the peak concentrations are lower than observed in the field data (for all but USGS-039). The response in the USGS-039 well indicates that the model is predicting the plume to move somewhat further north than observed in field data.
- FAR-DISTANCE WELLS (USGS-085, CFA-01, and CFA-02): the peak concentration is under predicted and the arrival time is predicted to be too late for these down gradient wells.

Based on these observations, it was felt that adding the lower I basalt unit was warranted to effectively reduce the saturated thickness, thereby lowering the total aquifer storage capacity.

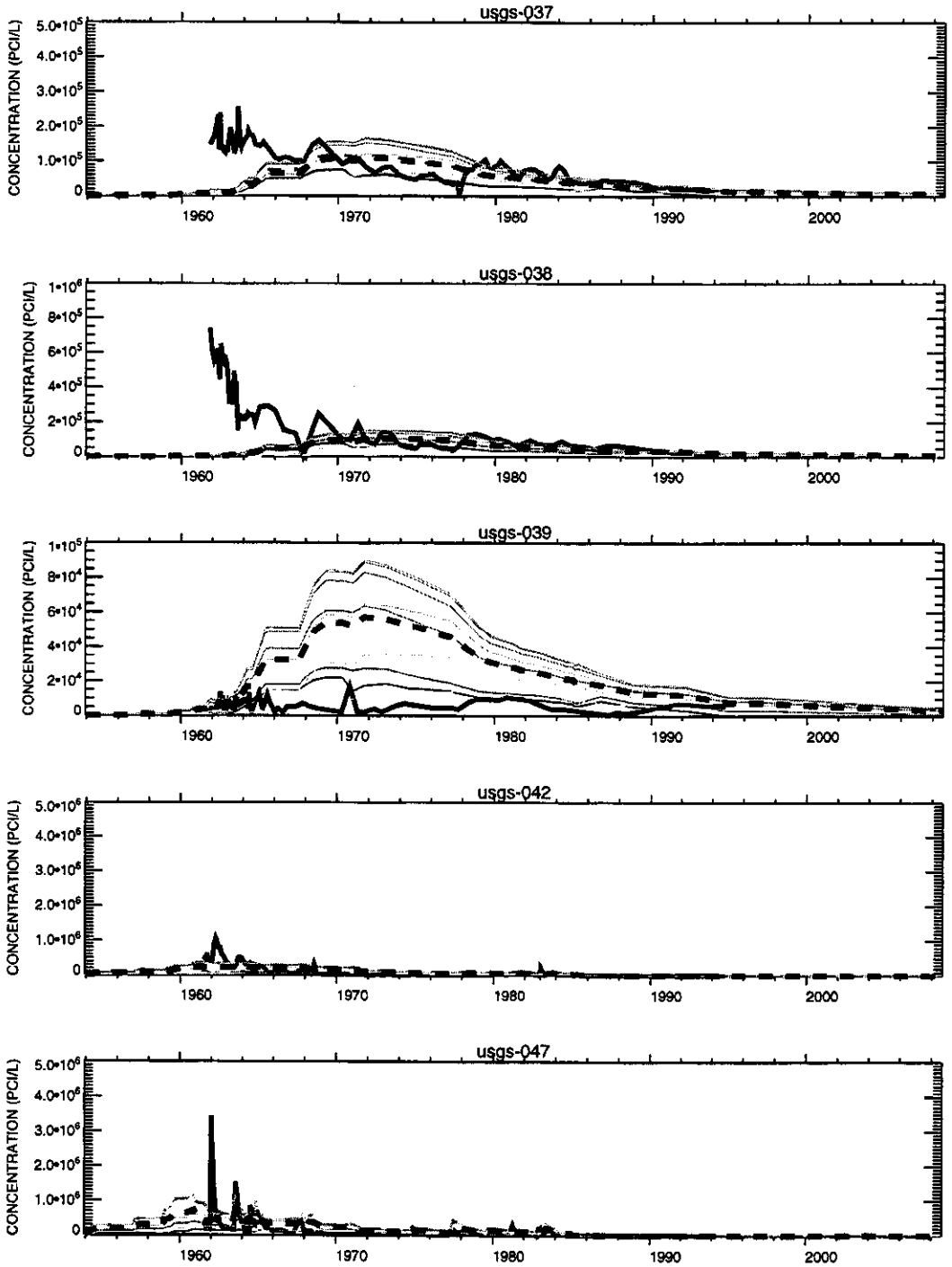


Figure 4-16 Tritium concentration versus time for the key wells plotted in Figure 4-12 corresponding to the hydraulic parameterization of Section 4.2.1.

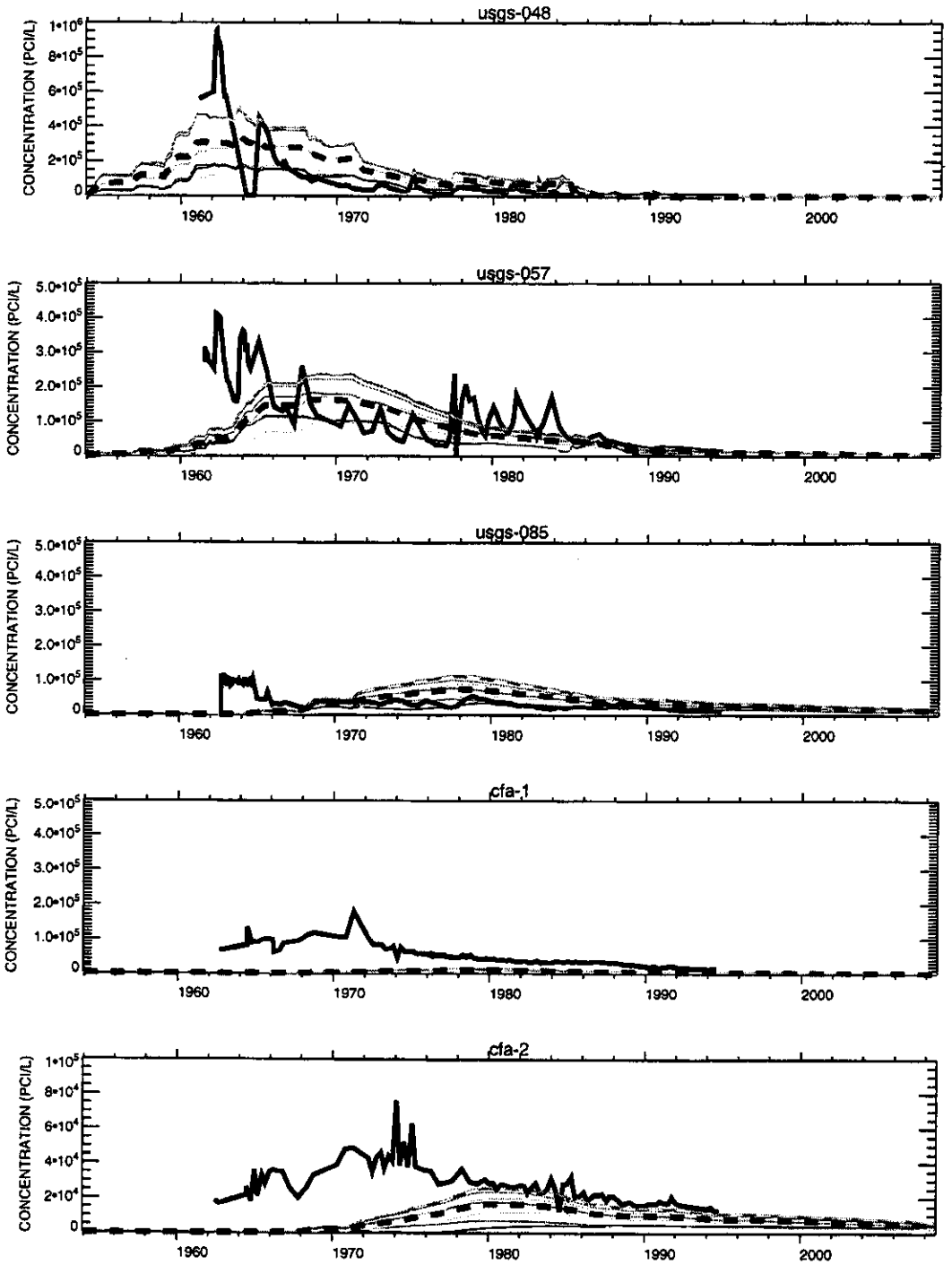


Figure 4-17 Tritium concentration versus time for the key wells plotted in Figure 4-12 corresponding to the hydraulic parameterization of Section 4.2.1.

4.2.2 Adding a single layer I basalt flow

The second level of hydrologic complexity included the I basalt flow as a single unit. It was placed according to the stratigraphic analysis and essentially underlies the WAG-10 permeabilities. A single I basalt flow unit was used as opposed to adding the upper and lower I basalt flow at the same time for its use in sensitivity analysis. The permeability assigned to the entire I basalt flow unit was equal to the average from pumping test conducted in wells completed in the lower I basalt unit.

Model predicted concentrations for this simulation are shown in Figures 4-18 through 4-21 can be compared to the base case concentrations given in Figures 4-13 through 4-17. The contour plots shown in Figures 4-18 and 4-19 indicate that model predicted concentrations of 25 pCi/mL do not extend to the CFA area in 1961 (for comparison to Figure 4-11. From the key well comparisons, adding the I basalt flow had a significant impact on the key wells, and we are matching late time history although not the early time breakthrough.

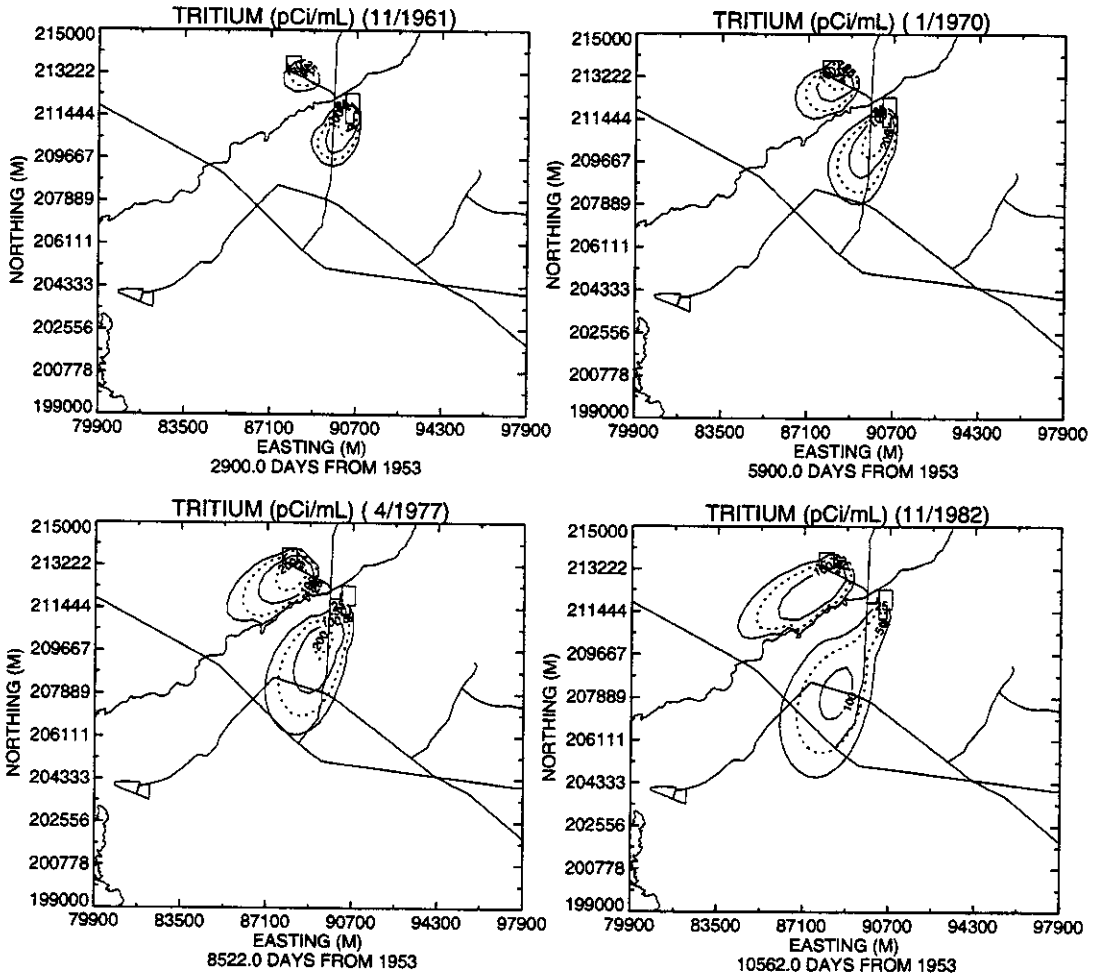


Figure 4-18 Model predicted tritium concentration in 1961, 1970, 1977, and 1982, corresponding to the hydraulic parameterization of Section 4.2.2.

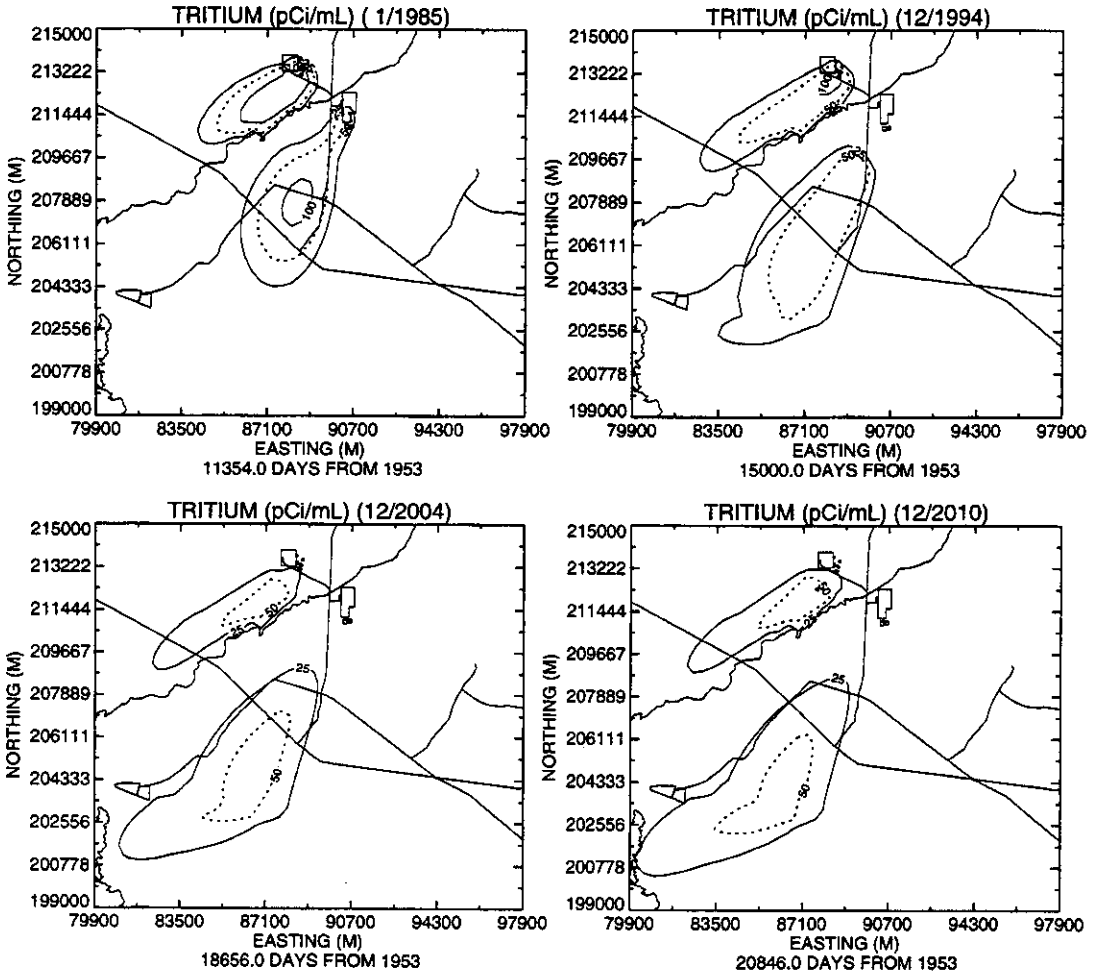


Figure 4-19 Model predicted tritium concentration in 1985, 1994, 2004, and 2010, corresponding to the hydraulic parameterization of Section 4.2.2.

By distance from the CPP-03 injection well, the calibration plots show:

- NEAR WELLS (USGS-047, USGS-042, and USGS-048): the peak concentration in the field data for USGS-042 is $1x10^6$ pCi/mL, and is predicted to be $8x10^5$ pCi/mL in this simulation. Without the lower I basalt flow, the peak predicted concentration was $1x10^5$ pCi/mL. This relative concentration increase was observed in the predicted values for all of the near wells. In addition, the overall response to injection well changes has sharpened to more closely reflect the observed data. However, the model predicted response to those changes is still fairly smooth (disperse), indicating that the aquifer water volume is still high, and that fluid movement is still slow.

- MID-DISTANCE WELLS (USGS-057, USGS-037, USGS-038, and USGS-039): the model predicted initial breakthrough is much closer relative to the 10 year lag with only the WAG-10 permeabilities. In addition, the peak concentrations have increased although the depth averaged concentration is still much lower than observed in the field data. As before, the concentrations for the USGS-039 well seem to be predicted fairly accurately.
- FAR-DISTANCE WELLS (USGS-085, CFA-01, and CFA-02): the time to reach the peak concentration is predicted to be too late, and the concentrations are still under predicted.

At this point, the HI interbed was added to the simulations as shown in Section 4.2.3.

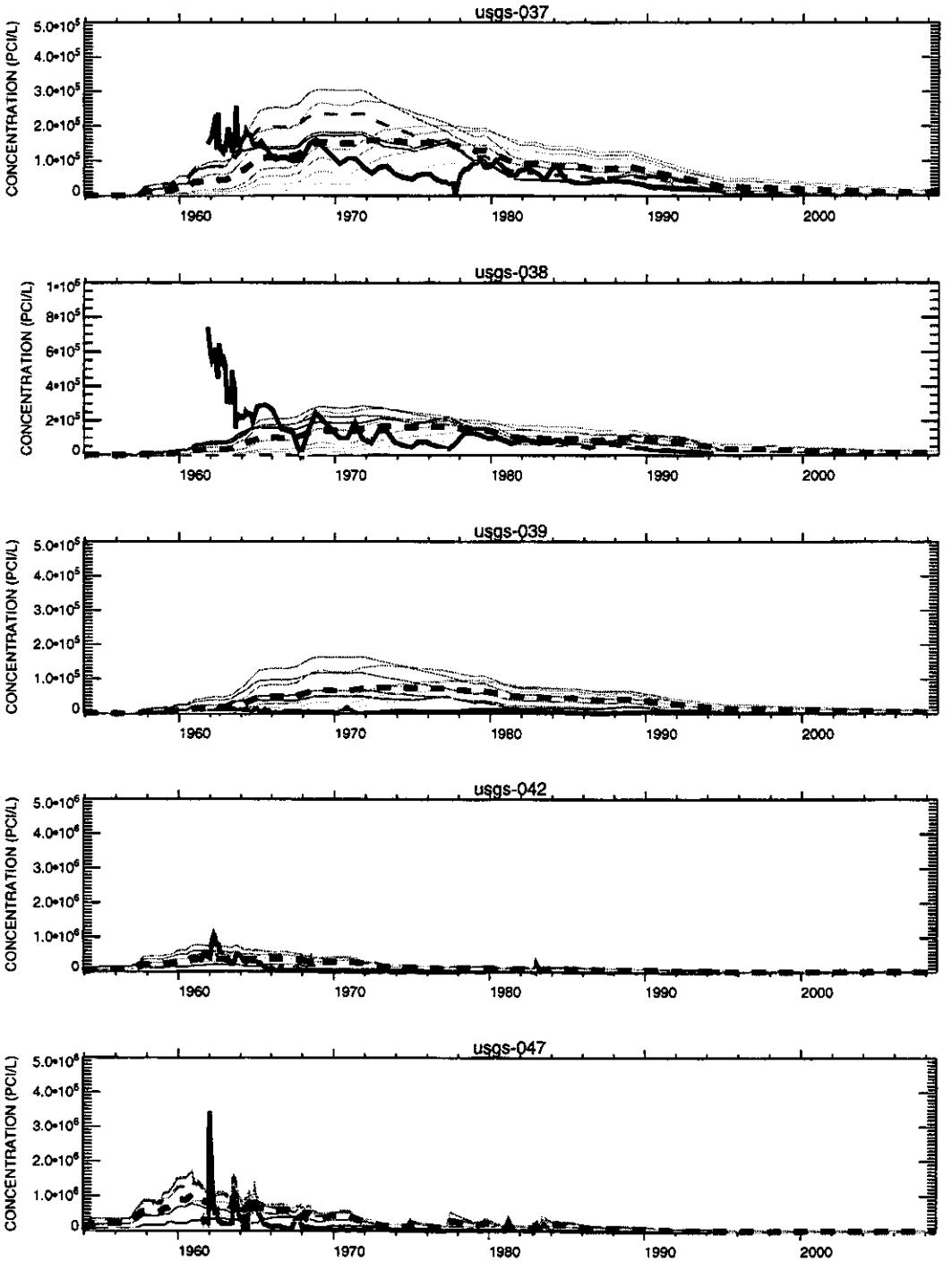


Figure 4-20 Tritium concentration versus time for the key wells plotted in Figure 4-12 corresponding to the hydraulic parameterization of Section 4.2.2.

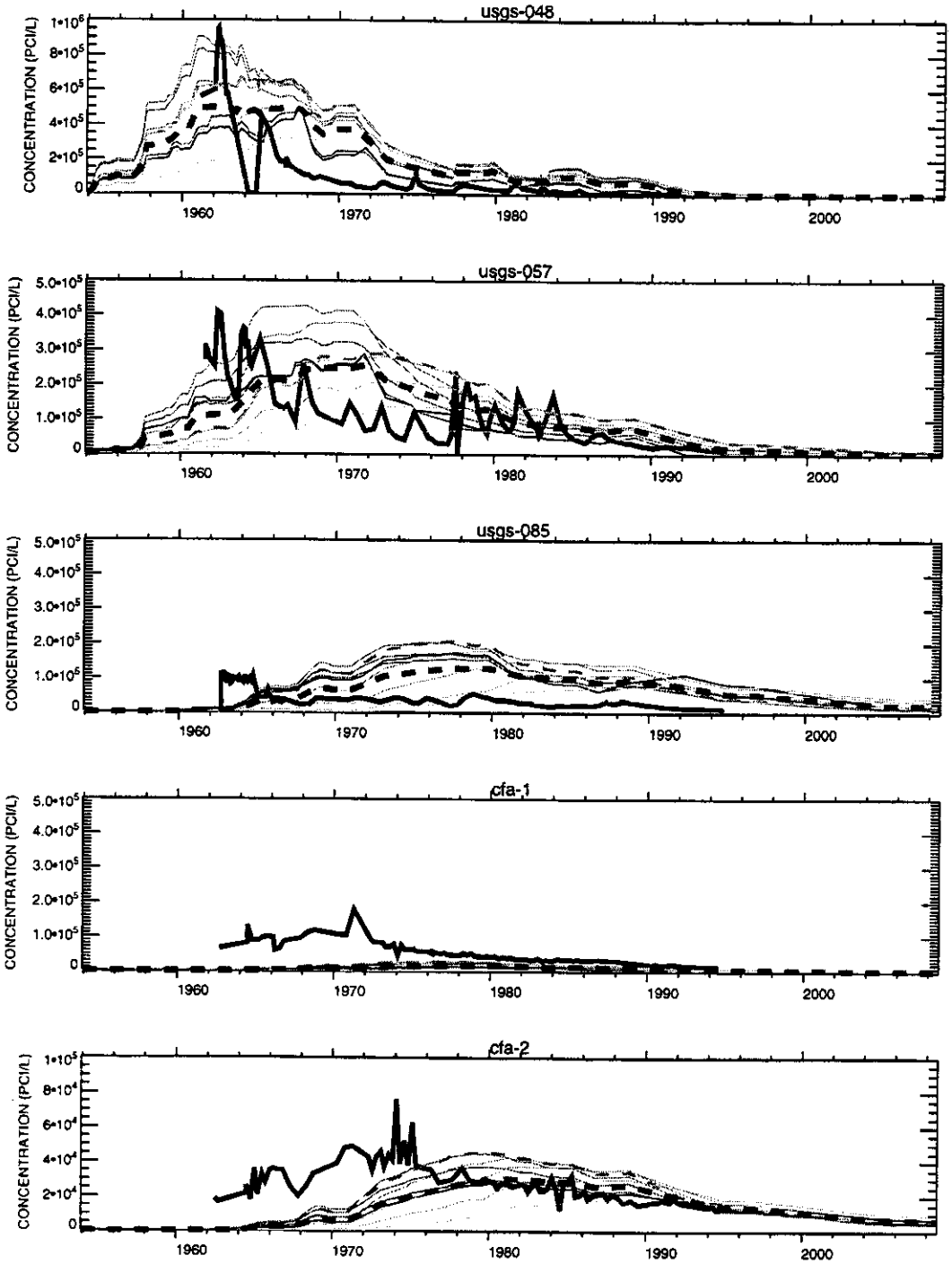


Figure 4-21 Tritium concentration versus time for the key wells plotted in Figure 4-12 corresponding to the hydraulic parameterization of Section 4.2.2.

4.2.3 Adding the HI interbed above the I basalt flow

The third level of hydrologic complexity included the HI interbed overlying the I basalt flow. Model predicted concentrations shown in Figures 4-22 through 4-25 for this simulation can be compared to the concentrations including just the I basalt flow and WAG-10 permeability given in Figure 4-18 through Figure 4-21. The contour plots shown in Figures 4-18 and 4-19 indicate that model predicted concentrations of 25 pCi/mL reach the CFA area by 1961. In addition, the predicted breakthrough time in most of the key wells is close to that observed in the field data. However, the sharpness in the field data is still not reproduced in the breakthrough curves. Adding the HI interbed effectively reduces the easily accessible aquifer thickness, reducing the available contaminant mixing volume.

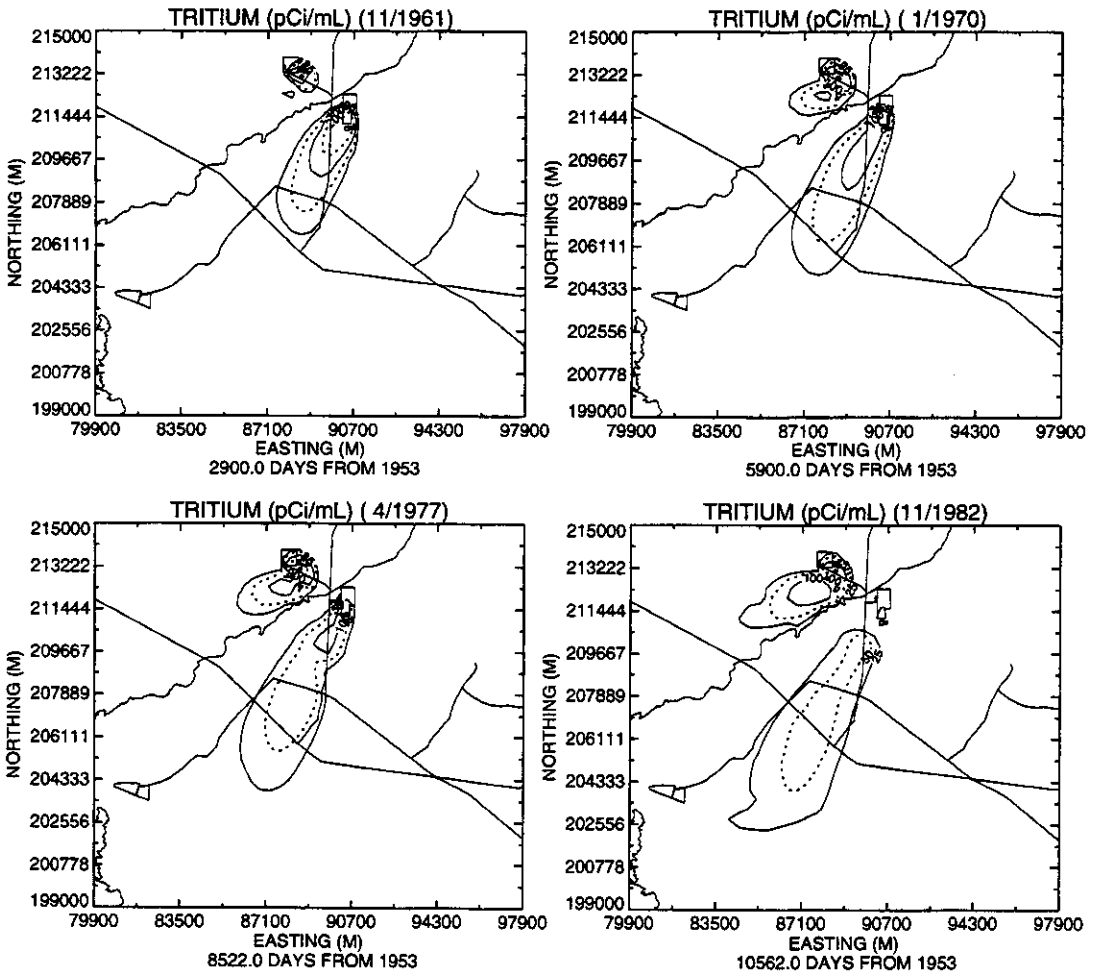


Figure 4-22 Model predicted tritium concentration in 1961, 1970, 1977, and 1982, corresponding to the hydraulic parameterization of Section 4.2.3.

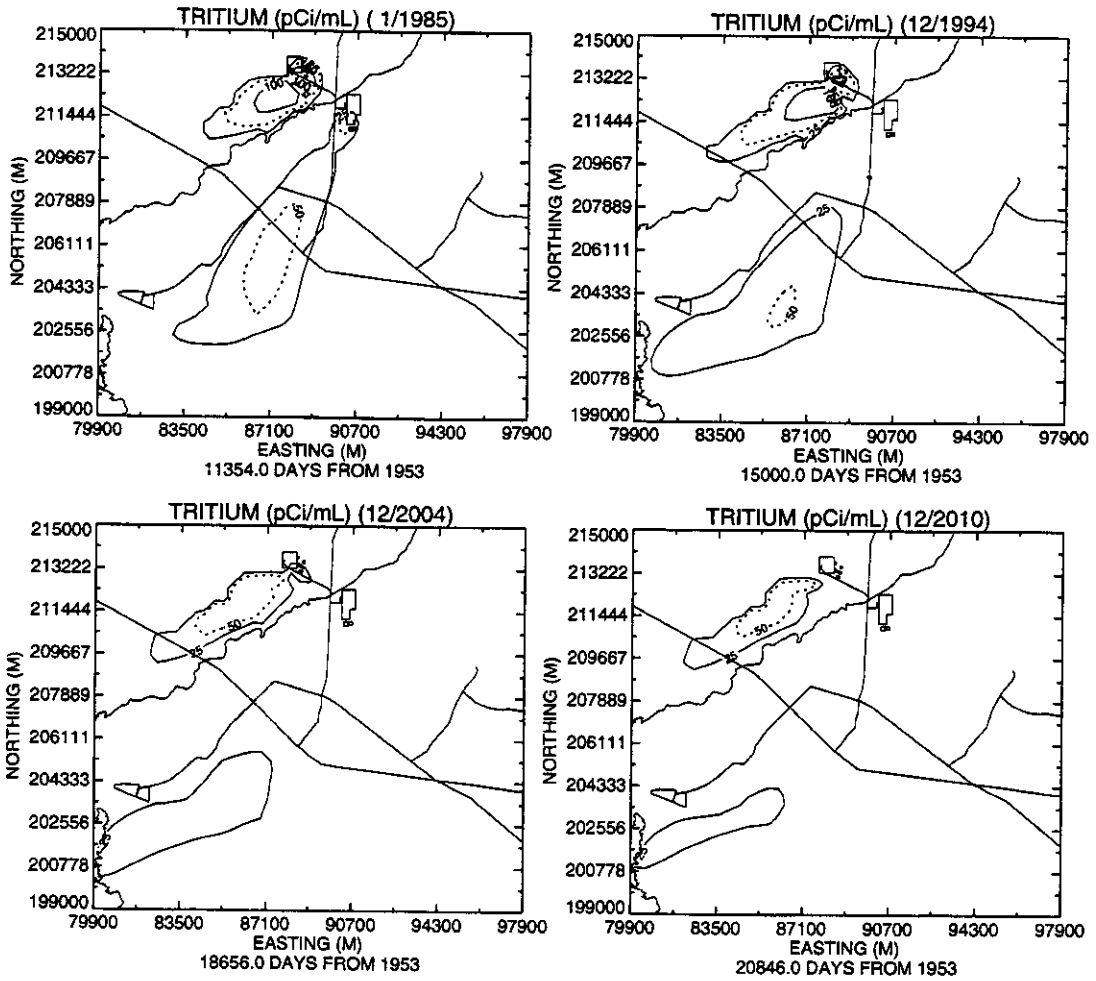


Figure 4-23 Model predicted tritium concentration in 1985, 1994, 2004, and 2010, corresponding to the hydraulic parameterization of Section 4.2.3.

By distance from the CPP-03 injection well, the calibration plots show:

- NEAR WELLS (USGS-047, USGS-042, and USGS-048): the sharp peak in concentration at 1961 in USGS-047 indicates that the predicted arrival time of tritium is slightly early, and that predicted peak concentrations are lower than they should be. The model predicted concentrations in USGS-042 and USGS-048 are slightly early, and are very close in magnitude. Based on USGS-047, the overall response to injection well changes has sharpened to more closely reflect the observed data, but is relatively smooth.

- MID-DISTANCE WELLS (USGS-057, USGS-037, USGS-038, and USGS-039): the model predicted concentrations and breakthrough curves in these mid-distance wells are initially very close to field data. However, at longer simulation times, predicted concentrations are too high, indicating that the mass is being held in place as opposed to being allowed to move through the system.
- FAR-DISTANCE WELLS (USGS-085, CFA-01, and CFA-02): the time to reach the peak concentration is predicted to be too early in USGS-085, but about right in the CFA wells. However, like the mid-distance wells, the longer simulation time concentrations are too high in USGS-085. CFA-01 concentrations may be missed because the predicted plume is slightly north of the observed plume.

These results indicate that the permeability in the ICPP footprint is probably too high. In addition, either the porosity is too high, or the permeability away from the footprint is too low. The next simulation adds the higher permeability upper I basalt flow values which increases the downgradient velocity.

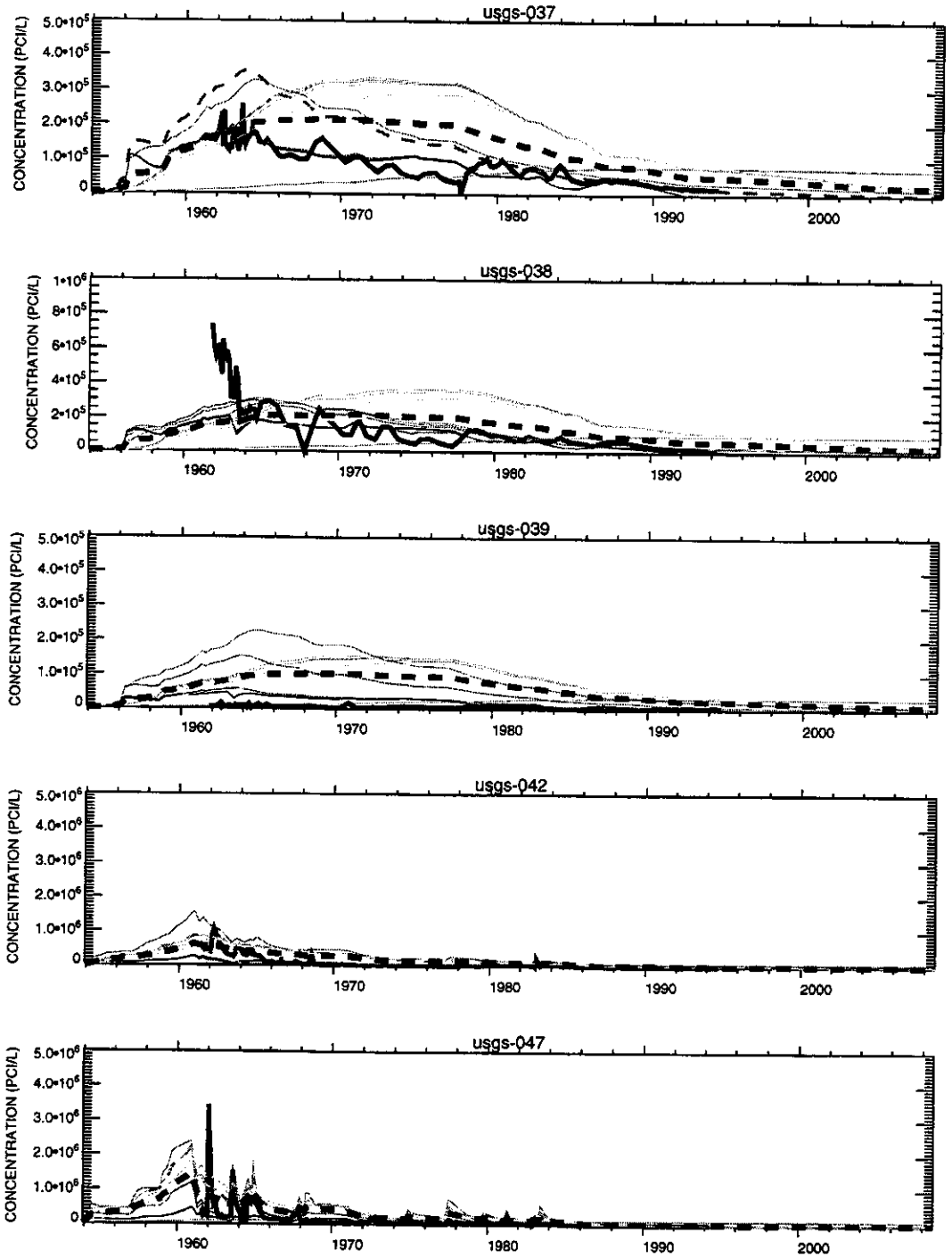


Figure 4-24 Tritium concentration versus time for the key wells plotted in Figure 4-12 corresponding to the hydraulic parameterization of Section 4.2.3.

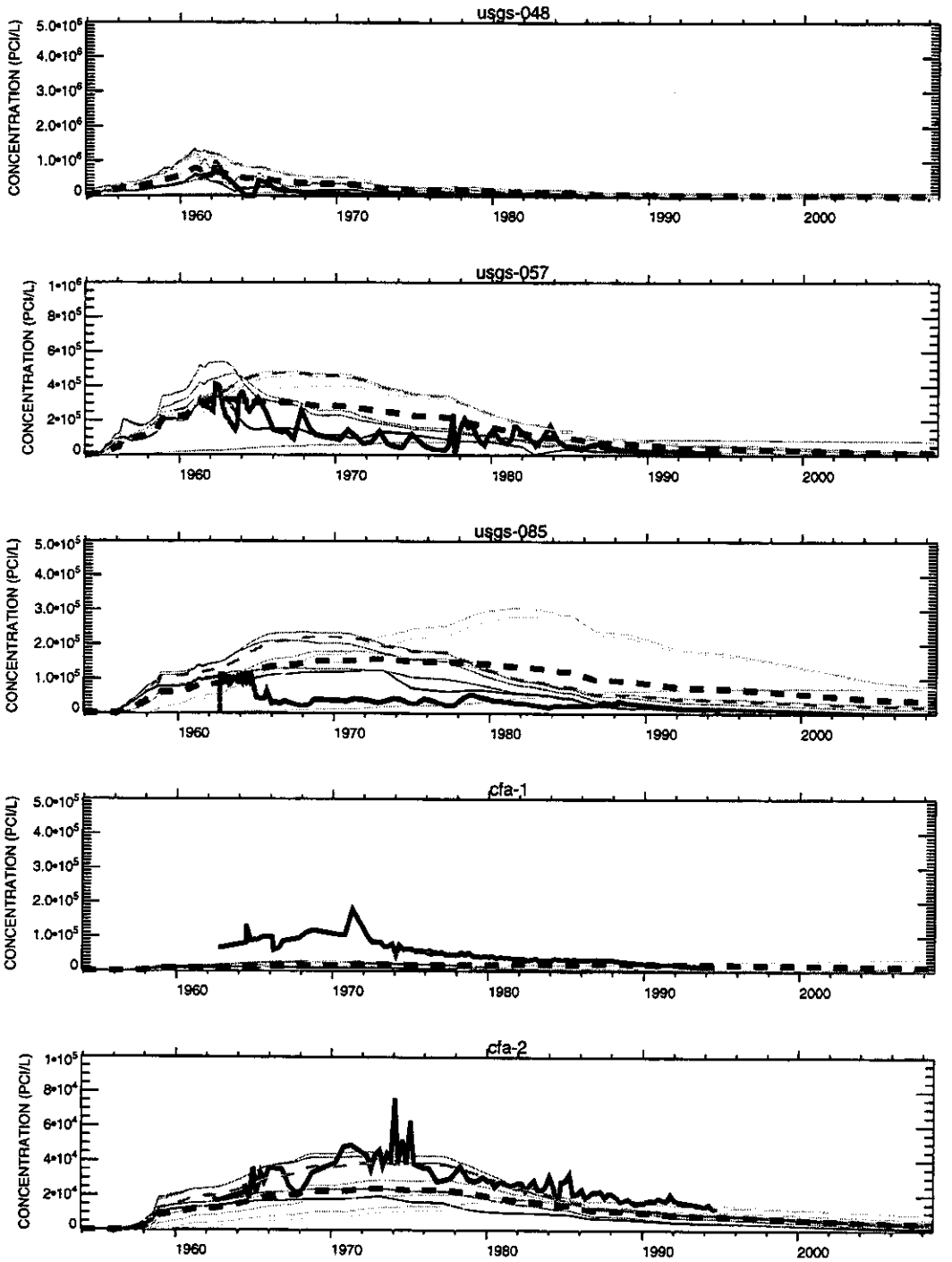


Figure 4-25 Tritium concentration versus time for the key wells plotted in Figure 4-12 corresponding to the hydraulic parameterization of Section 4.2.3.

4.2.4 Adding the higher-permeability upper I basalt flow

The fourth level of hydrologic complexity split the I basalt flow into a lower- less permeable unit and an upper, much more permeable I basalt flow. Model predicted concentrations are shown in Figures 4-26 through 4-29 for this simulation. They can be compared to the concentrations given in Figures 4-22 through 4-25. The contour plot for 1961 indicates that the higher permeability unit has allowed the plume to migrate out faster, reducing the concentrations, and causing the 25 pCi/mL contour level to recede further north than the CFA area. The calibration curves show that the higher upper I basalt permeability had the desired effect of lowering long-term concentrations in the far wells, but also delayed the breakthrough time of significant concentration in those wells.

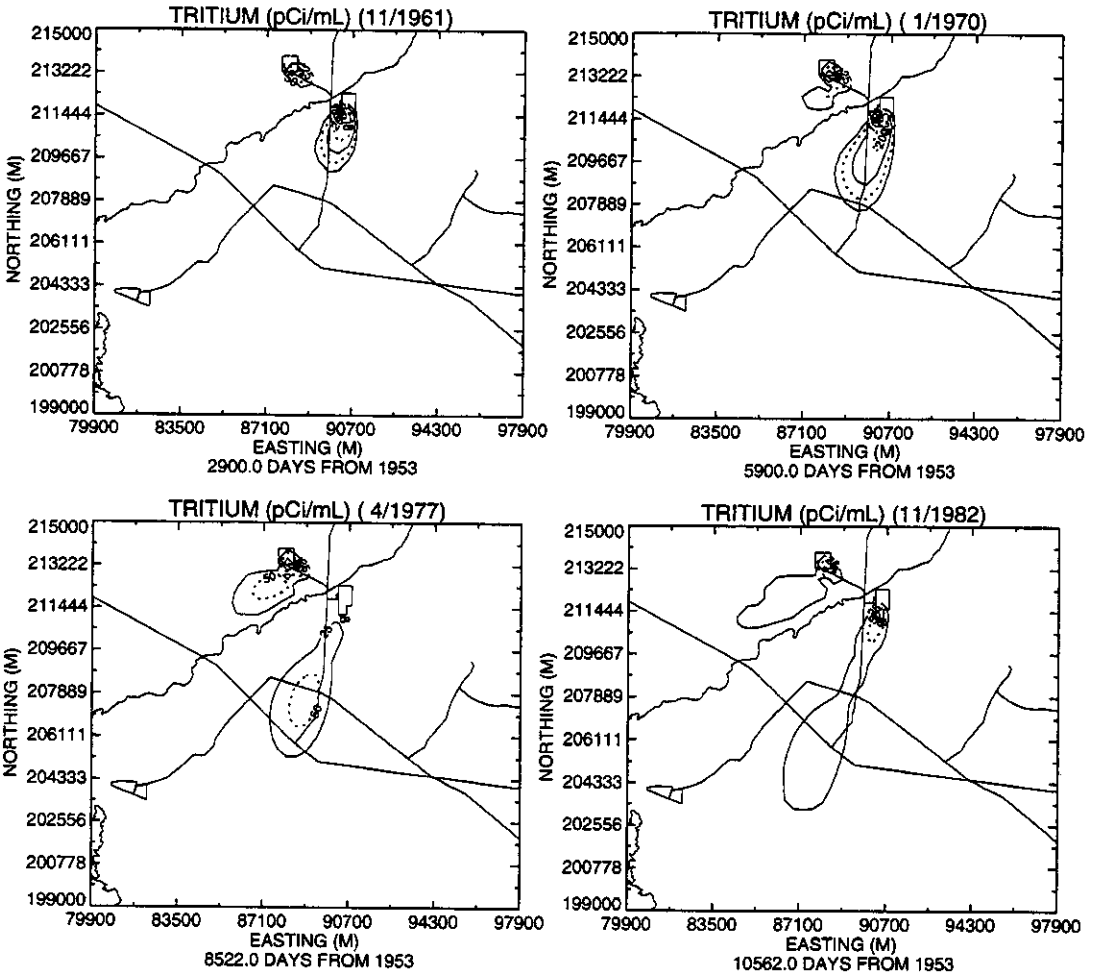


Figure 4-26 Model predicted tritium concentration in 1961, 1970, 1977, and 1982, corresponding to the hydraulic parameterization of Section 4.2.4.

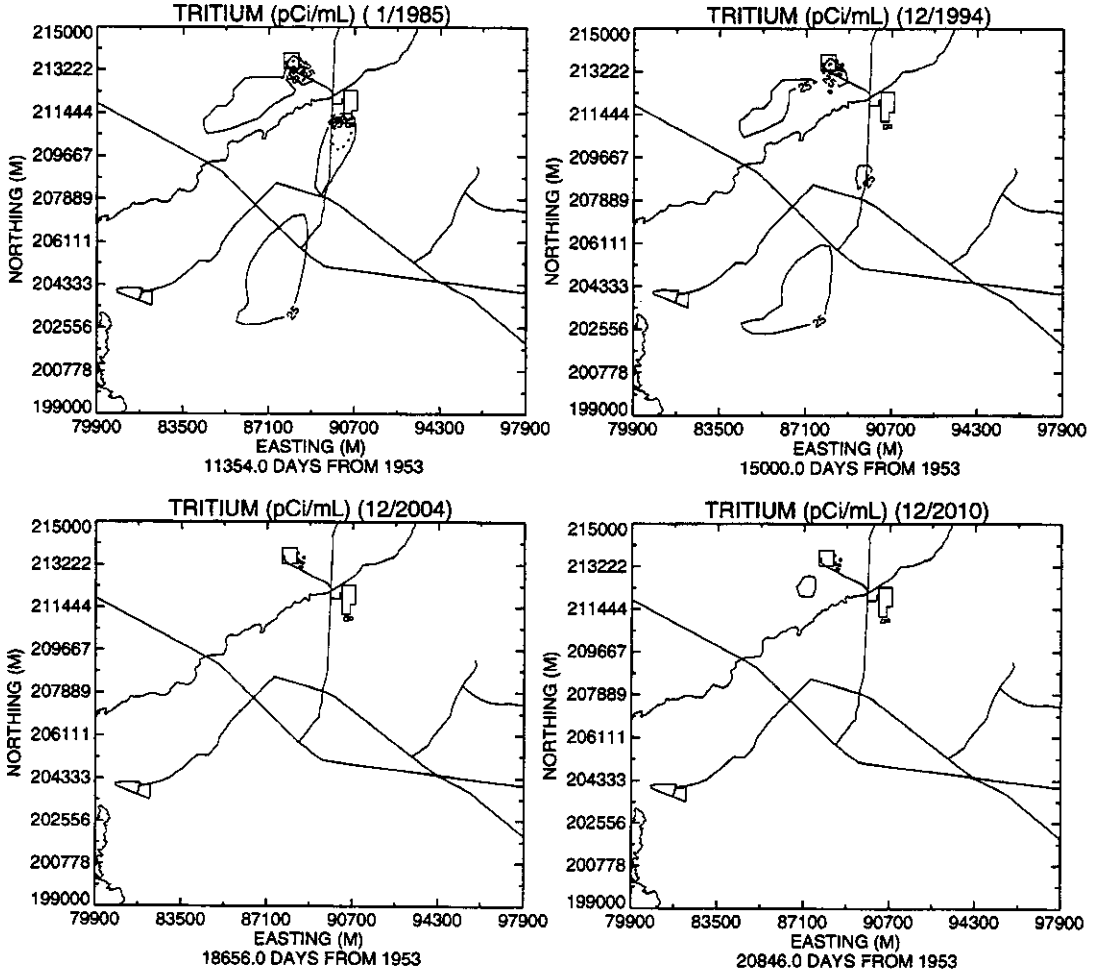


Figure 4-27 Model predicted tritium concentration in 1985, 1994, 2004, and 2010, corresponding to the hydraulic parameterization of Section 4.2.4.

By distance from the CPP-03 injection well, the calibration plots show:

- NEAR WELLS (USGS-047, USGS-042, and USGS-048): the sharper peak introduced by the addition of the HI interbed has been lost to a large extent in the near wells. In addition, the mass from the injection well is not moving out of the footprint of the ICPP as fast as it should.
- MID-DISTANCE WELLS (USGS-057, USGS-037, USGS-038, and USGS-039): as with the near wells, predicted concentrations more closely predicted field data without the high permeability upper basalt flow.
- FAR-DISTANCE WELLS (USGS-085, CFA-01, and CFA-02): the time to reach the peak concentration is predicted to be too late in all of these wells, and the peak concentration is low relative to the field data.

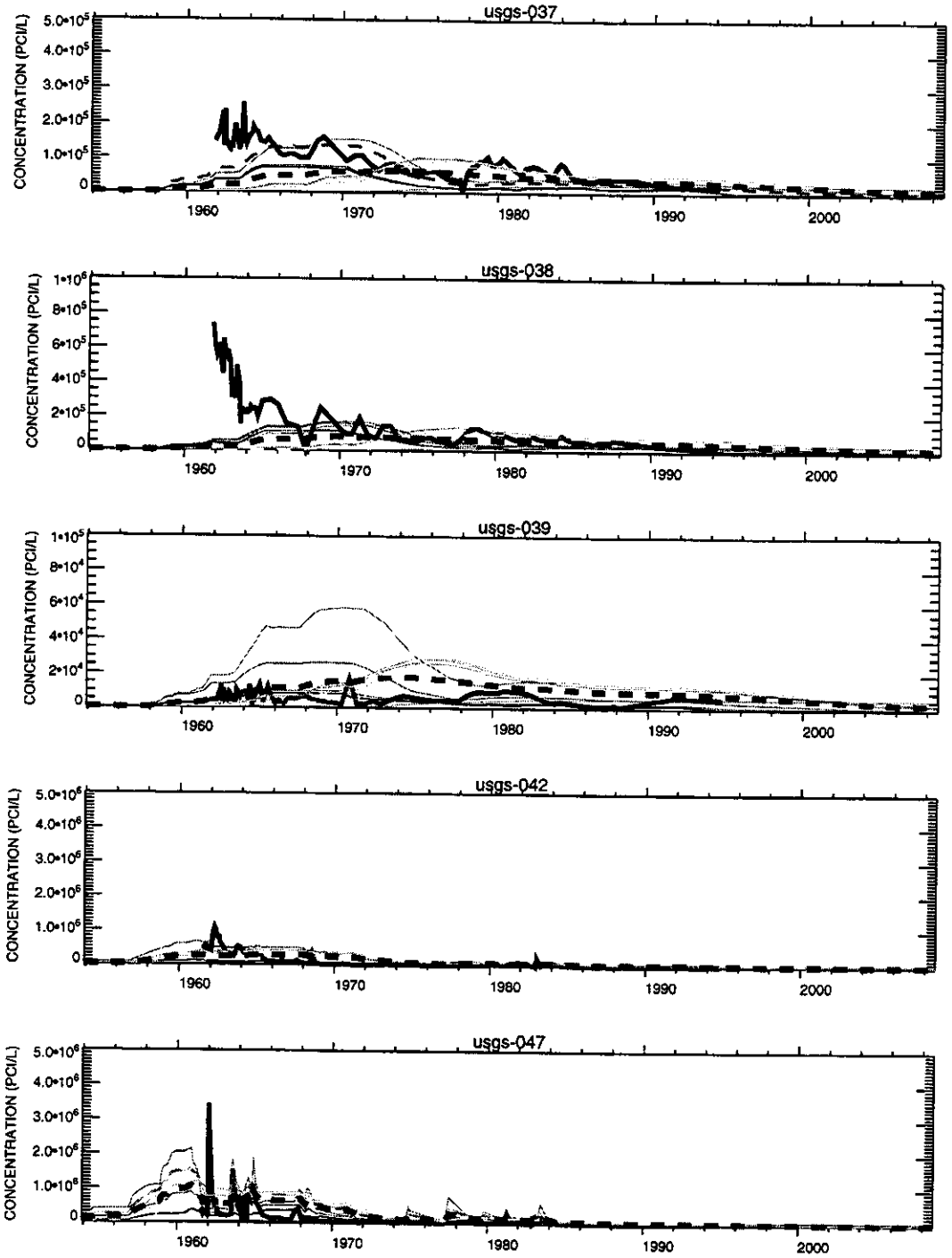


Figure 4-28 Tritium concentration versus time for the key wells plotted in Figure 4-12 corresponding to the hydraulic parameterization of Section 4.2.4.

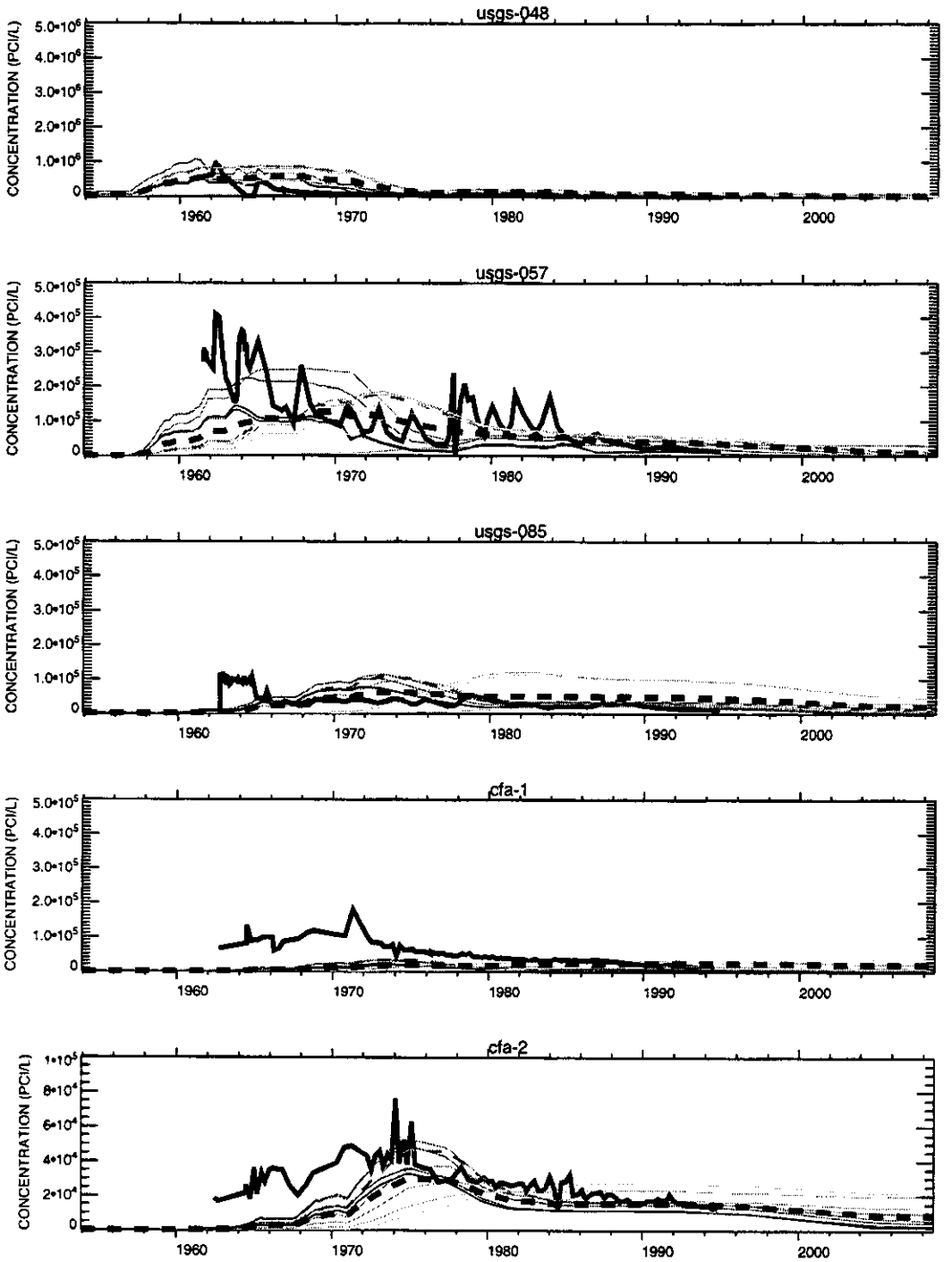


Figure 4-29 Tritium concentration versus time for the key wells plotted in Figure 4-12 corresponding to the hydraulic parameterization of Section 4.2.4.

4.2.5 Adding the local ICPP permeabilities

The last level of hydrologic complexity introduces lower permeability in the footprint of the ICPP vadose zone model. These local values are used because field data indicates that the permeability is relatively low in the vicinity of the ICPP. In addition, the head maps, (not shown) suggest that slightly lower permeability is needed in the ICPP area. On the other hand, using the actual field measured values of permeability is unjustified because many of the wells span the HI interbed resulting in extremely low permeability. This extreme lowering results in groundwater mounding (high heads above the ICPP footprint) when the vadose zone fluxes are applied. This mounding is not observed in the field data. Model predicted concentrations shown in the following figures. They can be compared to the concentrations given in Figures 4-26 through 4-29. The contour plots shown in Figures 4-30 through 4-31 indicate that the reduction in local permeability has severely retarded the movement of tritium out of the footprint by 1961. However, 1977 concentrations are higher north of the CFA area because the mass is not allowed to disperse throughout as wide an area initially.

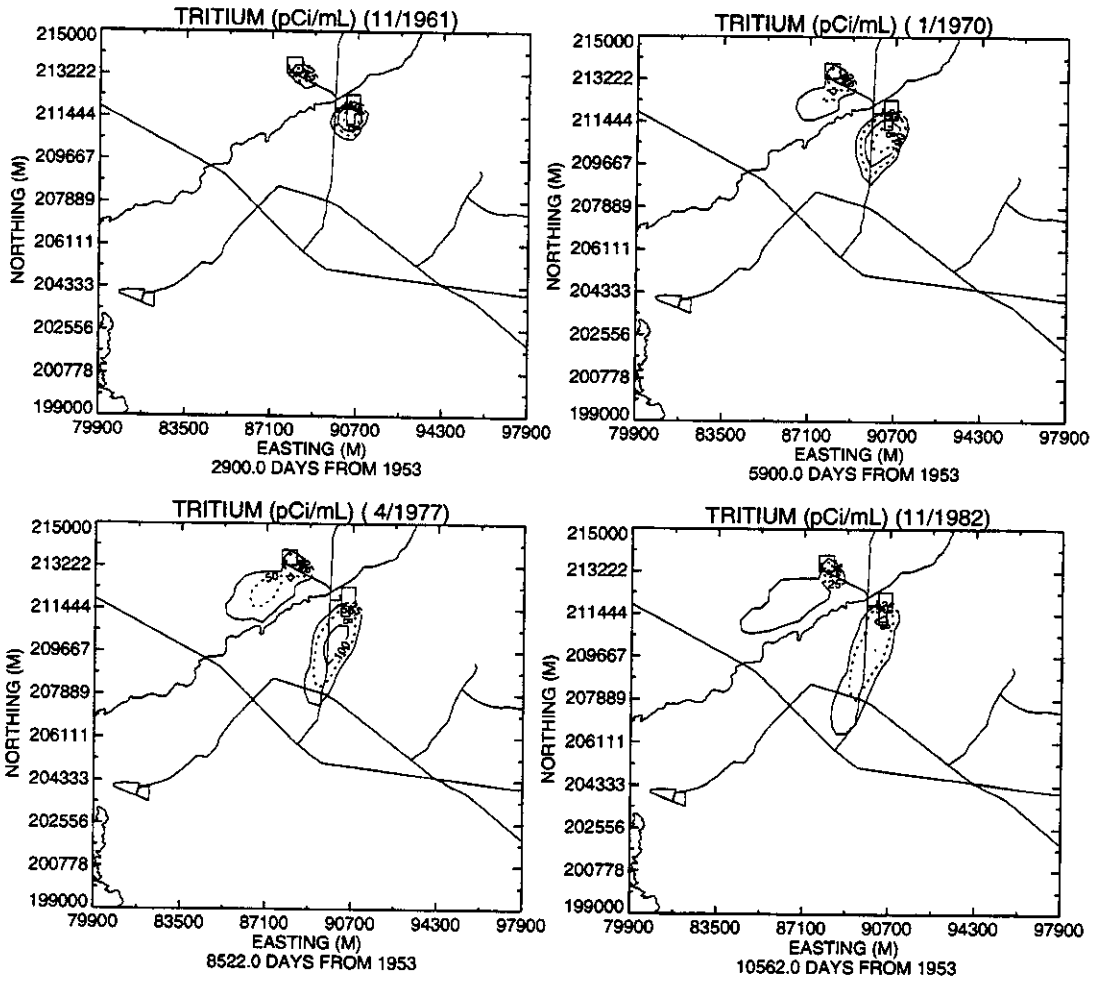


Figure 4-30 Model predicted tritium concentration in 1961, 1970, 1977, and 1982, corresponding to the hydraulic parameterization of Section 4.2.5.

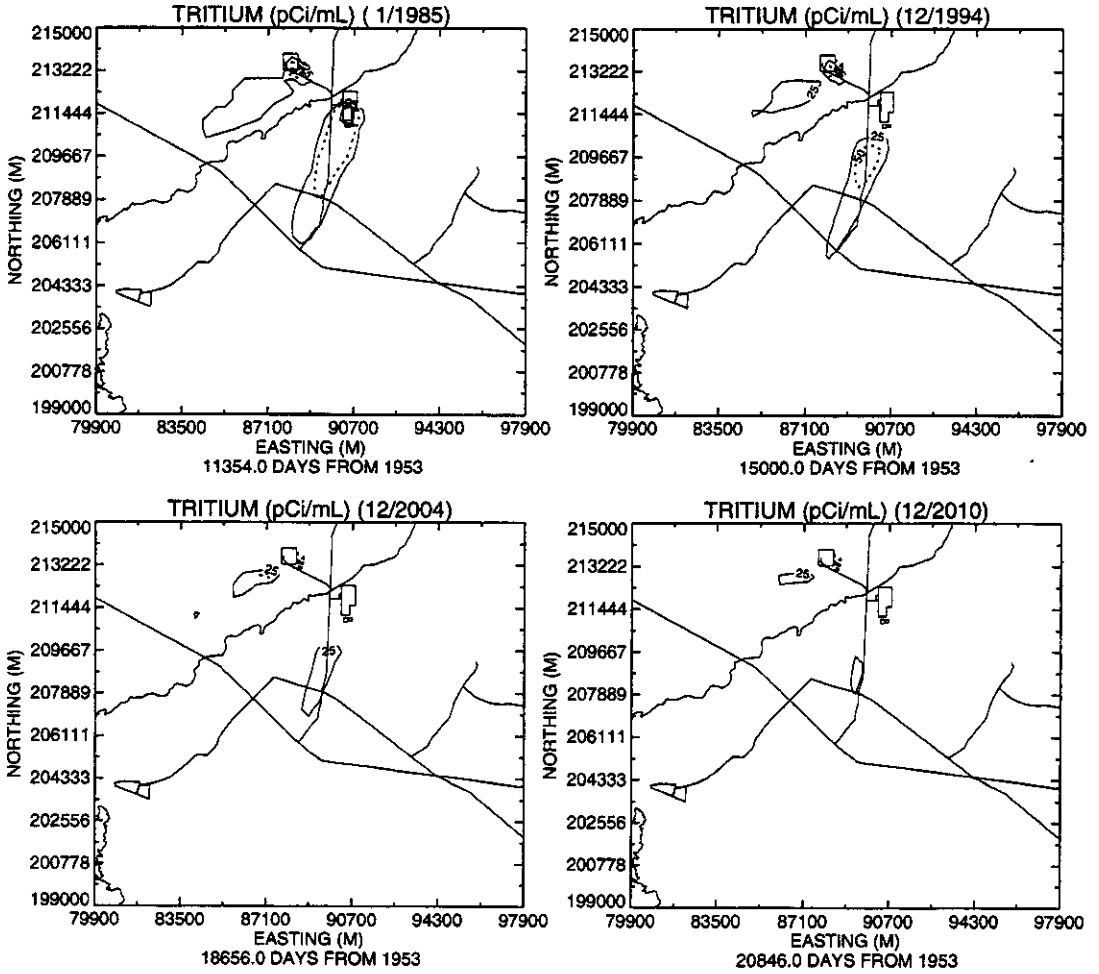


Figure 4-31 Model predicted tritium concentration in 1985, 1994, 2004, and 2010, corresponding to the hydraulic parameterization of Section 4.2.5.

By distance from the CPP-03 injection well, the calibration plots show:

- NEAR WELLS (USGS-047, USGS-042, and USGS-048): both short term and long term peak concentrations are very close in the near wells. With the exception of USGS-047, the time of initial breakthrough is also captured fairly well.
- MID-DISTANCE WELLS (USGS-057, USGS-037, USGS-038, and USGS-039): the model predicted concentrations and breakthrough curves in these mid-distance wells are still reasonably close to field data if adjustments for the angle of the plume is accounted for. Model predicted trajectory is slightly north-west of that indicated by the field data. In addition, the plume is slightly narrow.

- FAR-DISTANCE WELLS (USGS-085, CFA-01, and CFA-02): the time to reach the peak concentration is predicted to be too late in all of the far wells, and the peak concentrations are too low.

These results indicate that the permeability in the ICPP upper I basalt unit is too high (better match without it), that the permeability in the local ICPP area is too low, and that the porosity is also too low. The effects on these changes are given in order in the following simulations.

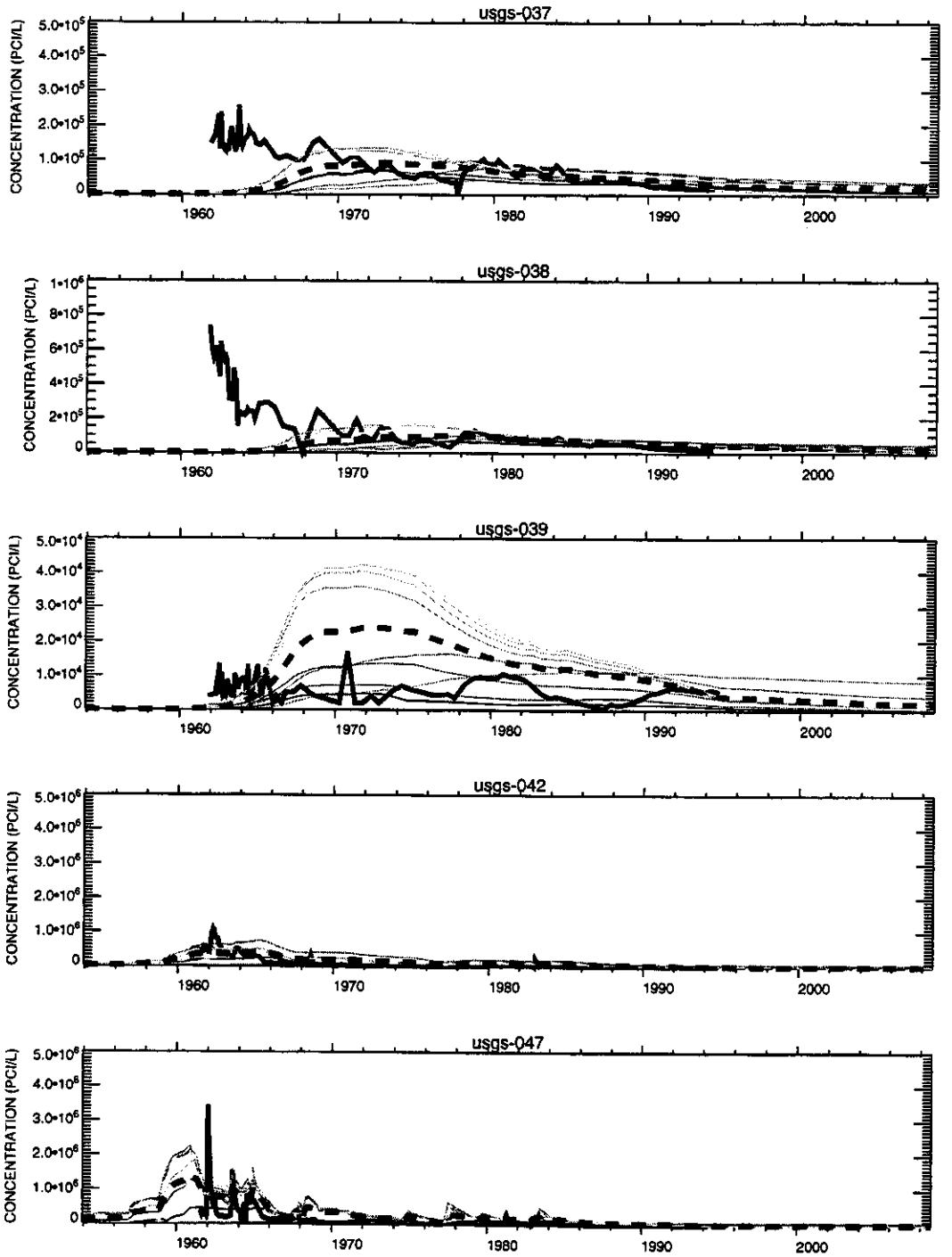


Figure 4-32 Tritium concentration versus time for the key wells plotted in Figure 4-12 corresponding to the hydraulic parameterization of Section 4.2.5.

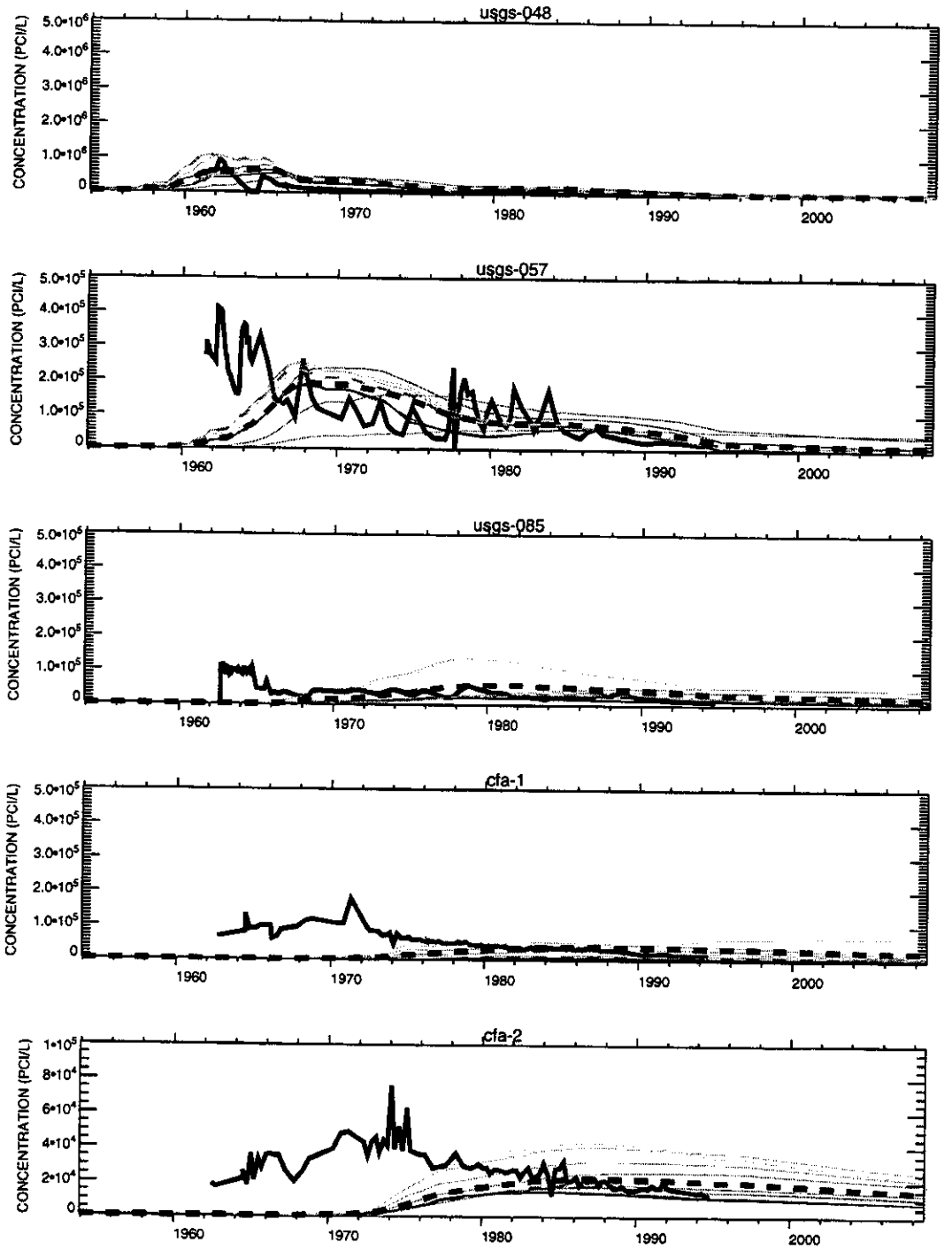


Figure 4-33 Tritium concentration versus time for the key wells plotted in Figure 4-12 corresponding to the hydraulic parameterization of Section 4.2.5.

4.2.6 Reducing the upper I basalt flow permeability by a factor of 10

All of the field data have been incorporated thus far, and indicate that the upper I basalt permeability may be too high. Figures 4-34 through 4-37 illustrate the effect of lowering the upper I basalt permeability by an order of magnitude. Other parameters are the same as given in Section 4.2.5. Reducing the upper basalt flow permeability has reduced the lateral dispersion, allowing model predicted concentrations of 25 pCi/mL to migrate further to the south toward the CFA area. These results indicate that reducing the upper I basalt flow permeability did improve the overall ability of the model to represent the observed field data. However, the response of the wells near the injection well is still damped and the arrival at the mid- and far-distance wells is predicted to be too late.

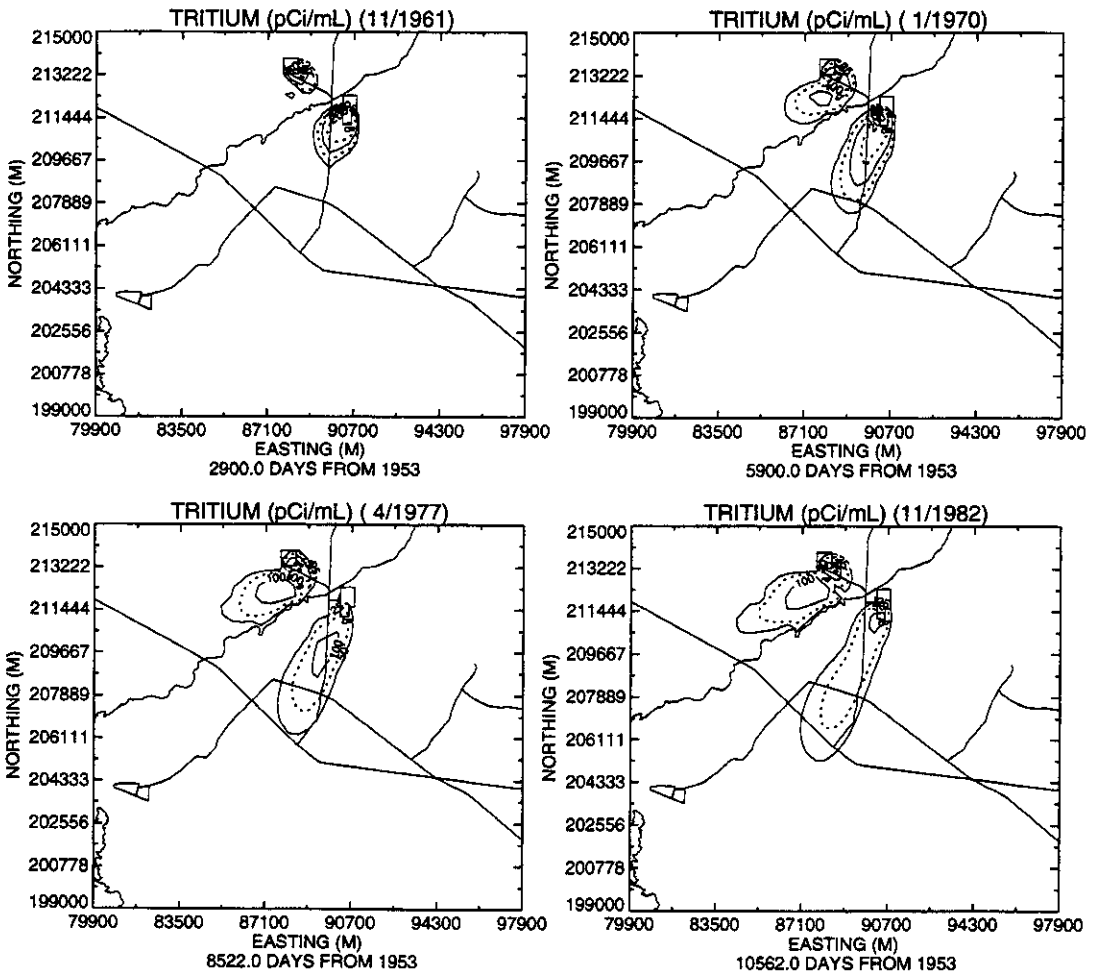


Figure 4-34 Model predicted tritium concentration in 1961, 1970, 1977, and 1982, corresponding to the hydraulic parameterization of Section 4.2.6.

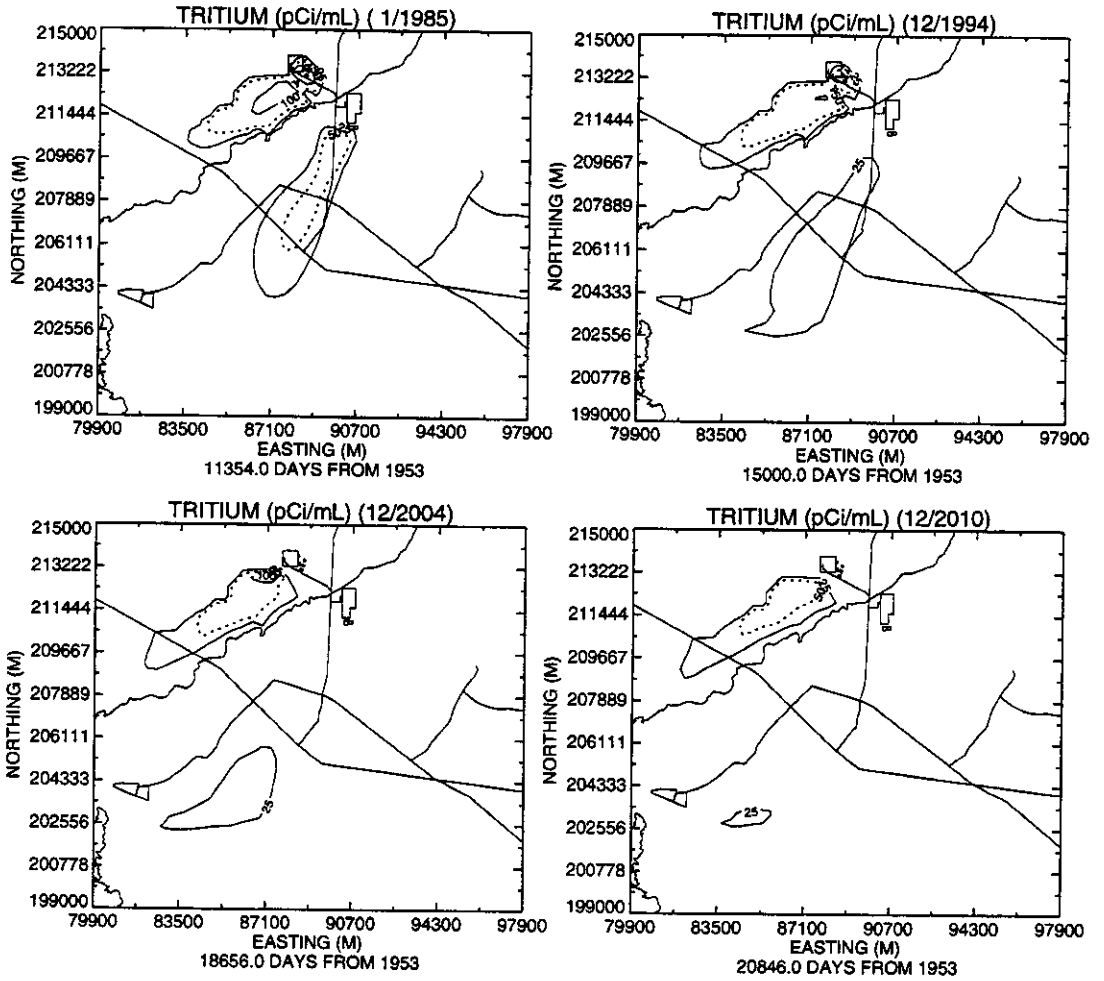


Figure 4-35 Model predicted tritium concentration in 1985, 1994, 2004, and 2010, corresponding to the hydraulic parameterization of Section 4.2.6.

By distance from the CPP-03 injection well, the calibration plots show:

- NEAR WELLS (USGS-047, USGS-042, and USGS-048): the sharpness in response has improved over the simulation shown in Section 4.2.5. Overall, the model represents the field data very well.
- MID-DISTANCE WELLS (USGS-057, USGS-037, USGS-038, and USGS-039): the predicted arrival time of the 1961 mass influx has improved over the simulation shown in Section 4.2.5. In addition, with the exception of USGS-039, model predicted concentrations are close to field data. However, the first arrival is still predicted to occur late relative to field observations.
- FAR-DISTANCE WELLS (USGS-085, CFA-01, and CFA-02): the time to reach the peak concentration is predicted to be too late and the predicted concentrations are low.

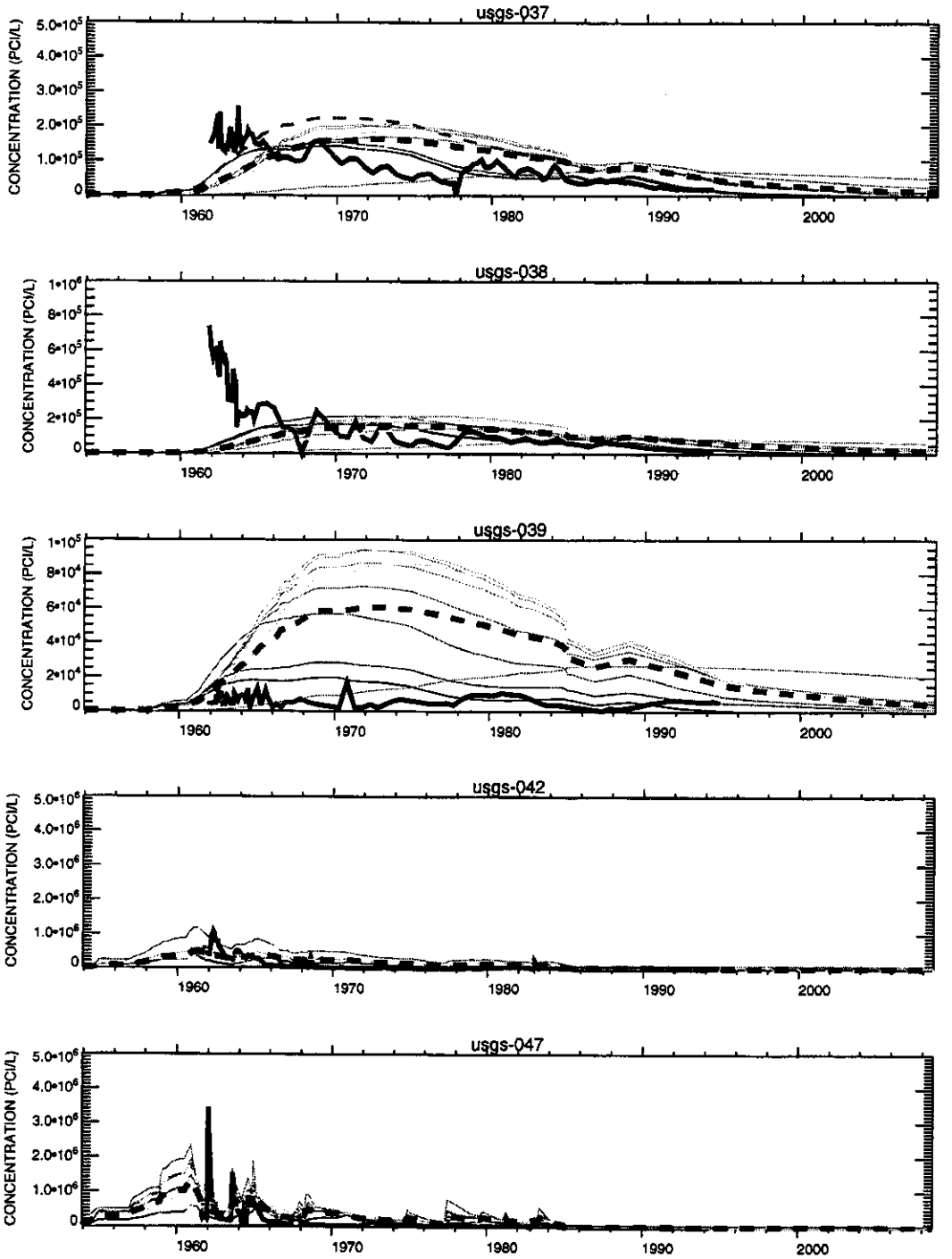


Figure 4-36 Tritium concentration versus time for the key wells plotted in Figure 4-12 corresponding to the hydraulic parameterization of Section 4.2.6.

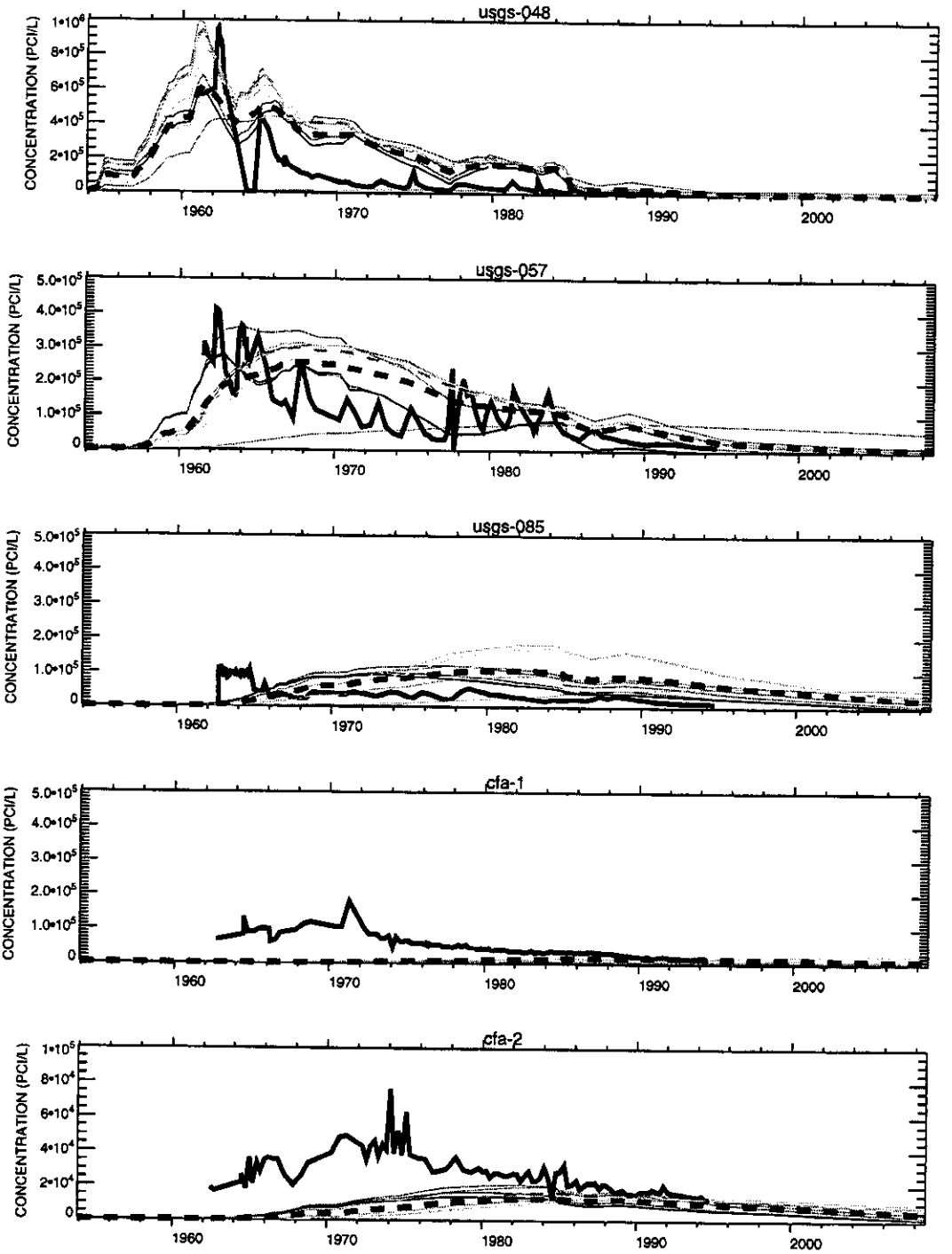


Figure 4-37 Tritium concentration versus time for the key wells plotted in Figure 4-12 corresponding to the hydraulic parameterization of Section 4.2.6.

4.2.7 Increasing the lower permeability cutoff in the local ICPP area:

Increasing the lower permeability cutoff in the local ICPP area allows the mass to move out faster initial, although the long-term movement will be controlled by the permeability in the upper- and lower I basalt unit. Other parameters for this simulation are the same as given in Section 4.2.5. Figures 4-38 through 4-41 show the effects of the local scale variability in the ICPP permeability. Increasing the lowest permeability cutoff has allowed model predicted concentrations of 25 pCi/mL to migrate further to the south toward the CFA area, although not to the extent observed by Barraclough (1967).

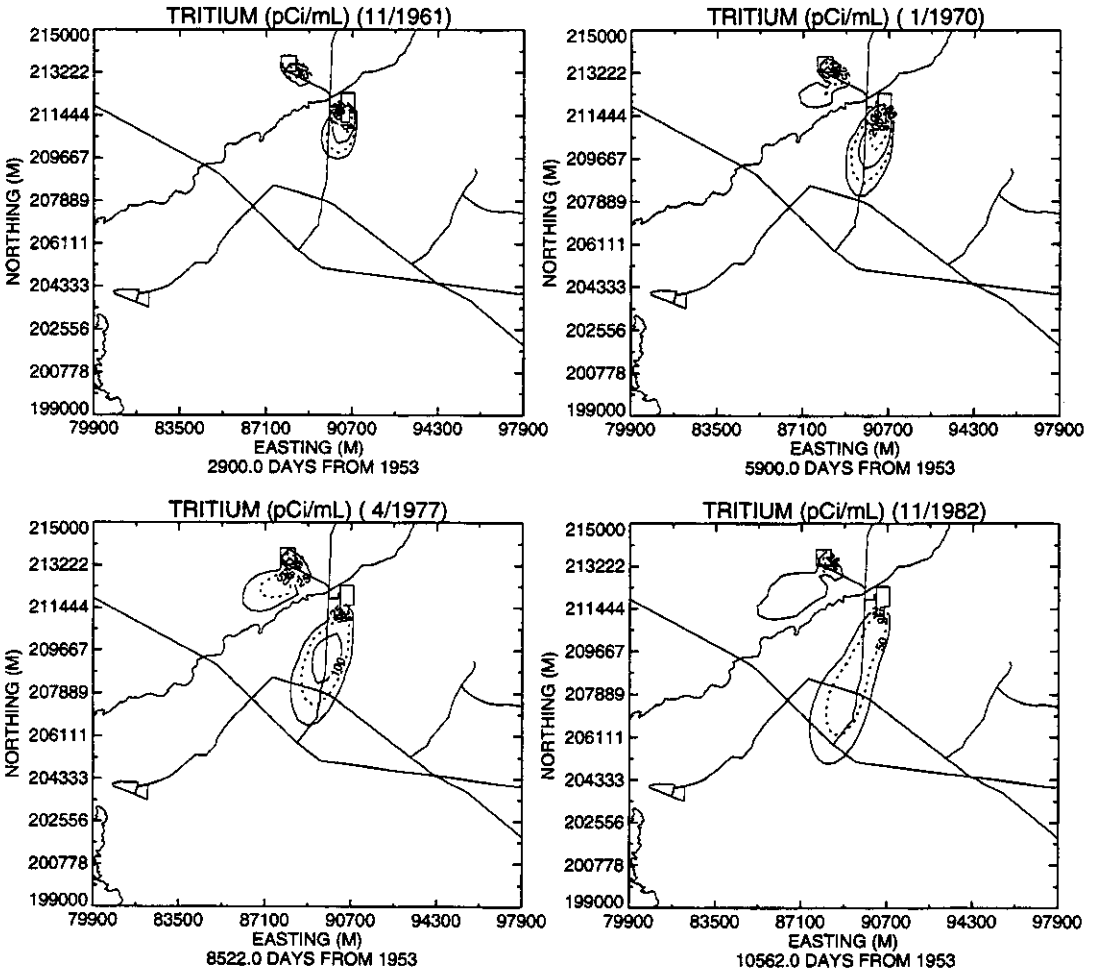


Figure 4-38 Model predicted tritium concentration in 1961, 1970, 1977, and 1982, corresponding to the hydraulic parameterization of Section 4.2.7.

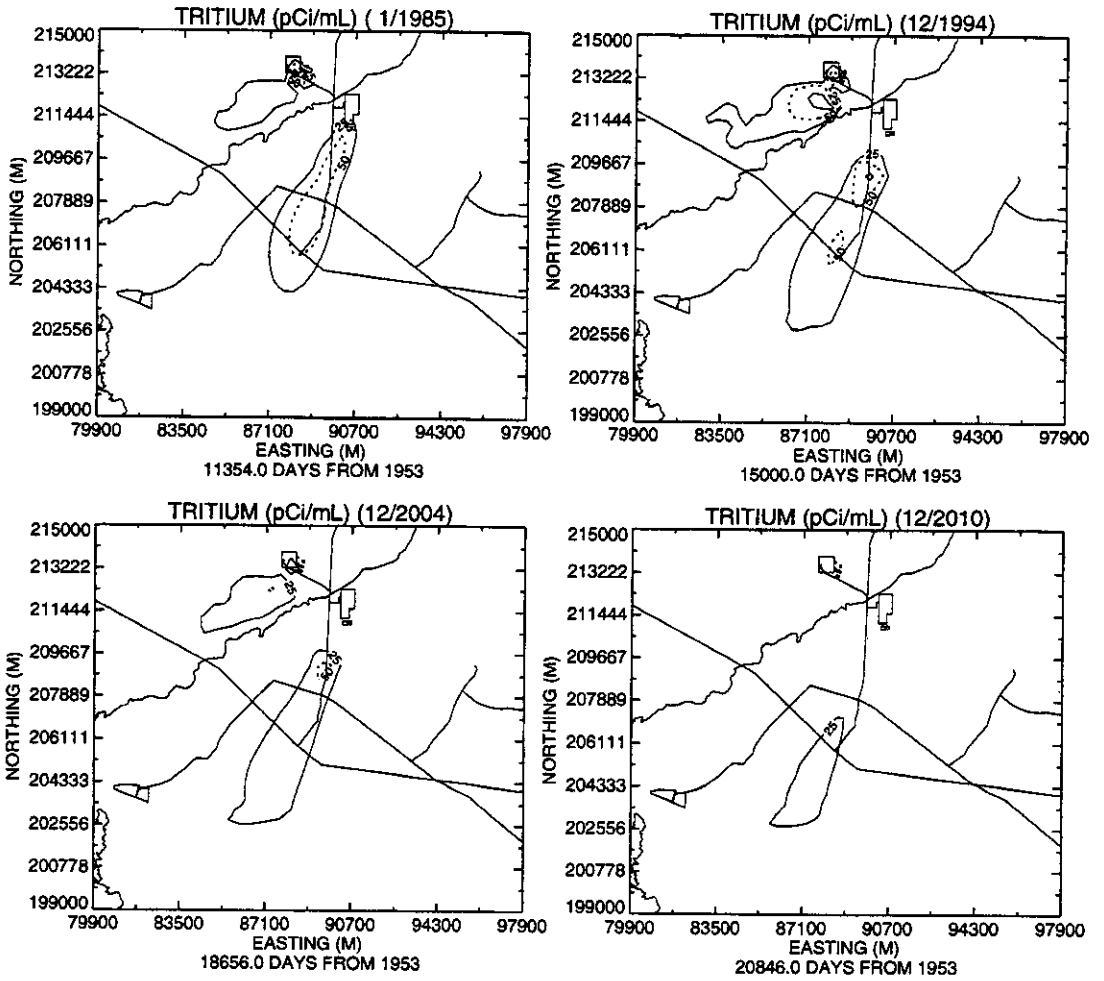


Figure 4-39 Model predicted tritium concentration in 1985, 1994, 2004, and 2010, corresponding to the hydraulic parameterization of Section 4.2.7.

By distance from the CPP-03 injection well, the calibration plots show:

- NEAR WELLS (USGS-047, USGS-042, and USGS-048): the overall response in these near wells has not changed significantly from the predictions shown in Section 4.2.5. Overall, the model represents the field data very well.
- MID-DISTANCE WELLS (USGS-057, USGS-037, USGS-038, and USGS-039): the predicted arrival time of the 1961 mass influx has improved slightly over the simulation shown in Section 4.2.5. However, the first arrival is still predicted to occur late relative to field observations. In addition, with the exception of USGS-039, model predicted concentrations are low relative to the field data.
- FAR-DISTANCE WELLS (USGS-085, CFA-01, and CFA-02): the time to reach the peak concentration is predicted to be too late, however the predicted concentrations are adequate.

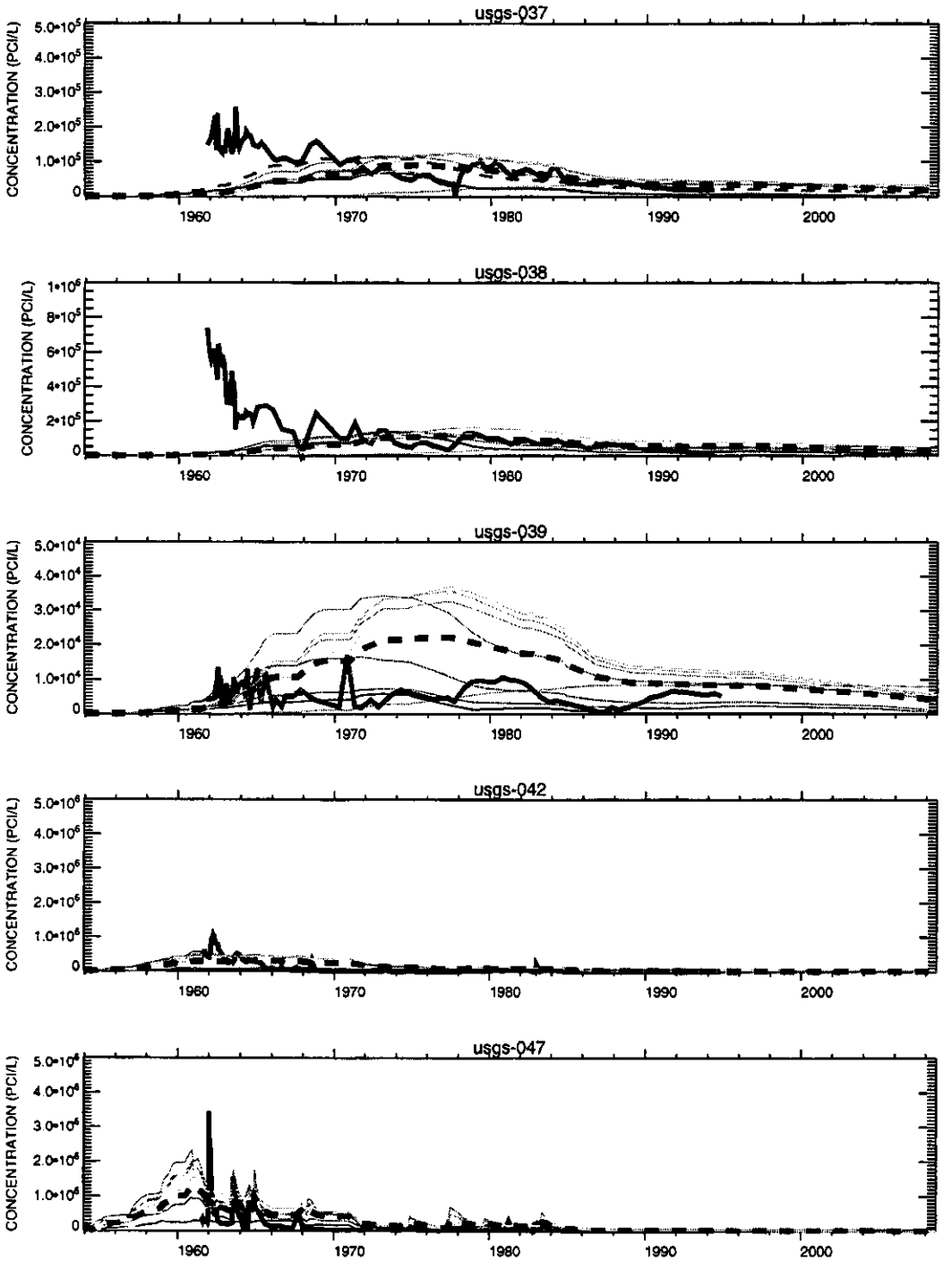


Figure 4-40 Tritium concentration versus time for the key wells plotted in Figure 4-12 corresponding to the hydraulic parameterization of Section 4.2.7.

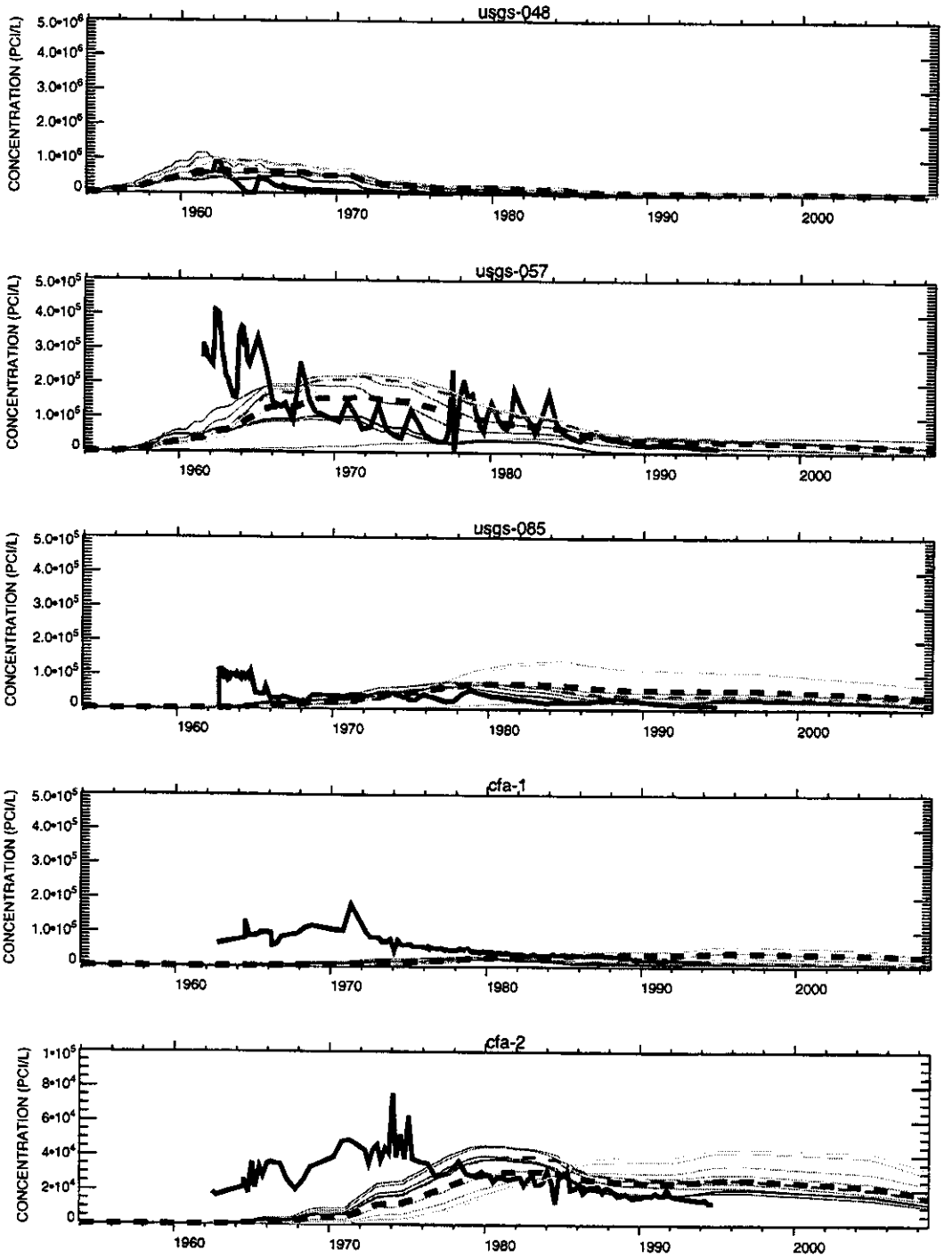


Figure 4-41 Tritium concentration versus time for the key wells plotted in Figure 4-12 corresponding to the hydraulic parameterization of Section 4.2.7.

4.2.8 Decreasing the porosity by a factor of two

In all of the simulations presented thus far, the response in the mid- and far-distance wells has been disperse. In addition, in most of the simulations, the predicted arrival time at those wells has been too late. This is basically an indication that the overall ability of the system to damp the response of the injection fluxes is too high. Typically, this can be related to overestimating the transmissivity, porosity, or dispersion. Because the dispersion here has been limited to longitudinal dispersion, with lateral dispersion accounted for by numerical dispersion, the probability is high that the mismatch is being caused by porosity.

Figures 4-42 through 4-45 illustrate the effect of decreasing the porosity by a factor of two (0.0625 vs. 0.125). Other parameters are the same as given in Section 4.2.5. In addition to reducing the overall storage capacity of the aquifer, reducing the porosity increases the transport velocity as indicated in Figures 4-42 and 4-43.

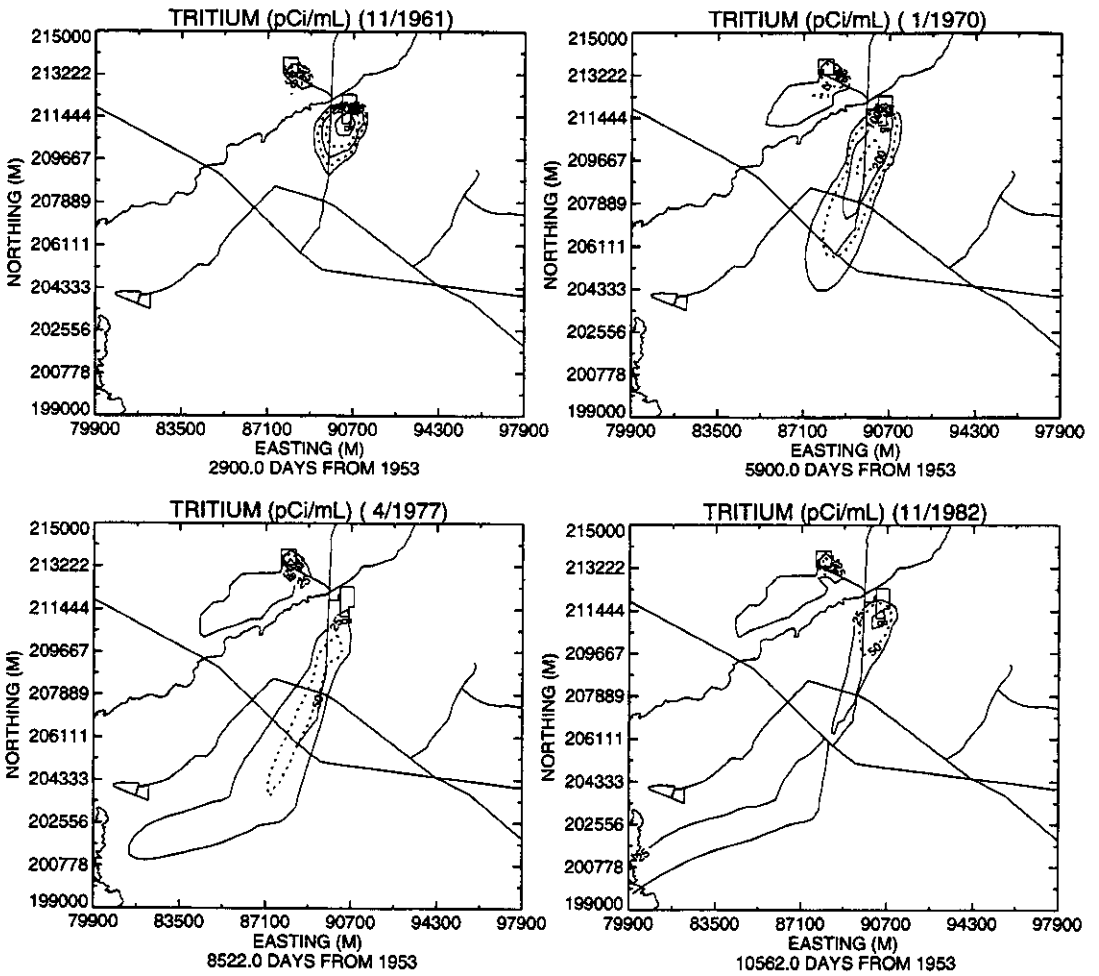


Figure 4-42 Model predicted tritium concentration in 1961, 1970, 1977, and 1982, corresponding to the hydraulic parameterization of Section 4.2.8.

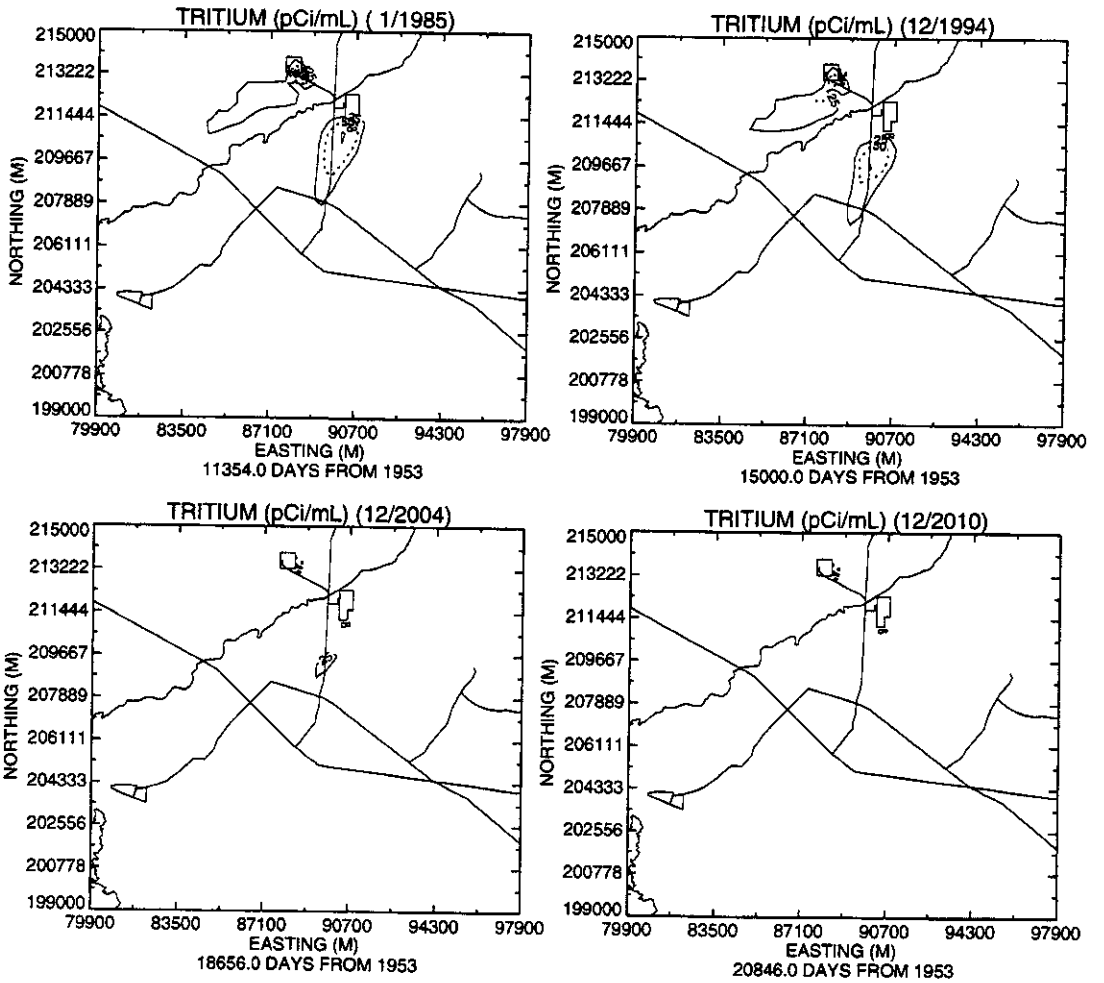


Figure 4-43 Model predicted tritium concentration in 1985, 1994, 2004, and 2010, corresponding to the hydraulic parameterization of Section 4.2.8.

By distance from the CPP-03 injection well, the calibration plots show:

- NEAR WELLS (USGS-047, USGS-042, and USGS-048): the sharpness in predicted concentration compared to the predictions shown in Section 4.2.5 is an extremely good match to the field data. The shift in the predicted first large peak and its width is a result of having yearly flux data at the injection well shown in Figure 4-7. The overall match would indicate that in fact, the mass was probably introduced over 3 months and toward the latter part of the year.
- MID-DISTANCE WELLS (USGS-057, USGS-037, USGS-038, and USGS-039): the predicted arrival time of the 1961 mass influx is excellent. The higher model predicted concentrations in USGS-039 are an indication of the predicted plume migrating slightly further north

than observed in the field data. However, those concentrations are on the order of 1×10^4 pCi/mL (field data) and are much smaller than the concentrations in USGS-038. Thus, this slight shift is not significant.

- FAR-DISTANCE WELLS (USGS-085, CFA-01, and CFA-02): the time to reach the peak concentration is fairly close and the overall concentration matches the observed field data very well.

Overall, this is an excellent match to the field data, and these parameters will be used in all subsequent transport calculations. In order to show the concentration variation over depth, contour plots at 80% of the total model depth of 76 m are given in Figures 4-46 and 4-47.

To verify the match to other wells, calibration plots for all wells showing tritium are given in Figures 4-48 through 4-59. Locations for all of these wells were given in Figure 4-10. The order of presentation is in distance from the injection well. Although not specifically included as part of the calibration goal, calibration plots are also given for the TRA wells.

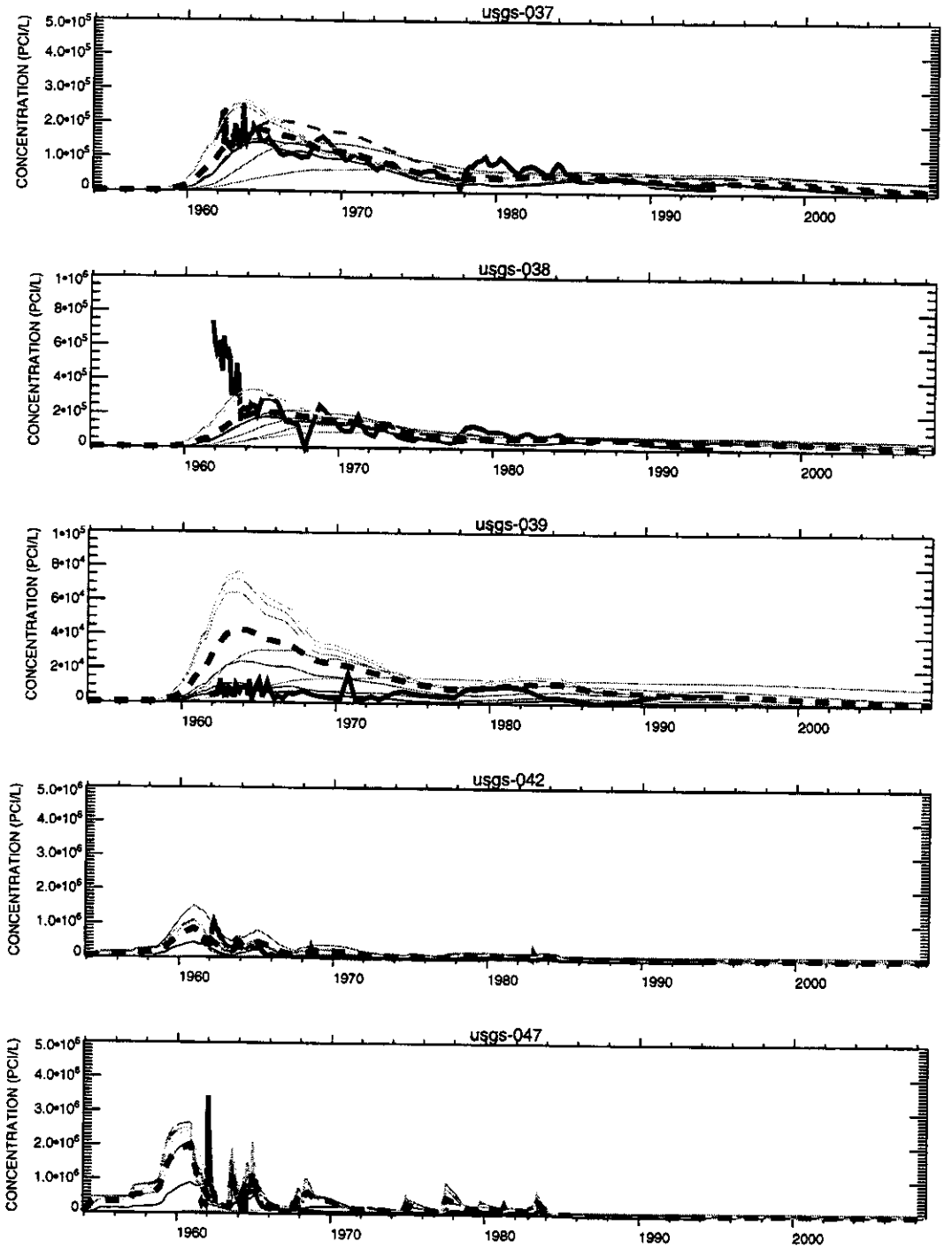


Figure 4-44 Tritium concentration versus time for the key wells plotted in Figure 4-12 corresponding to the hydraulic parameterization of Section 4.2.8.

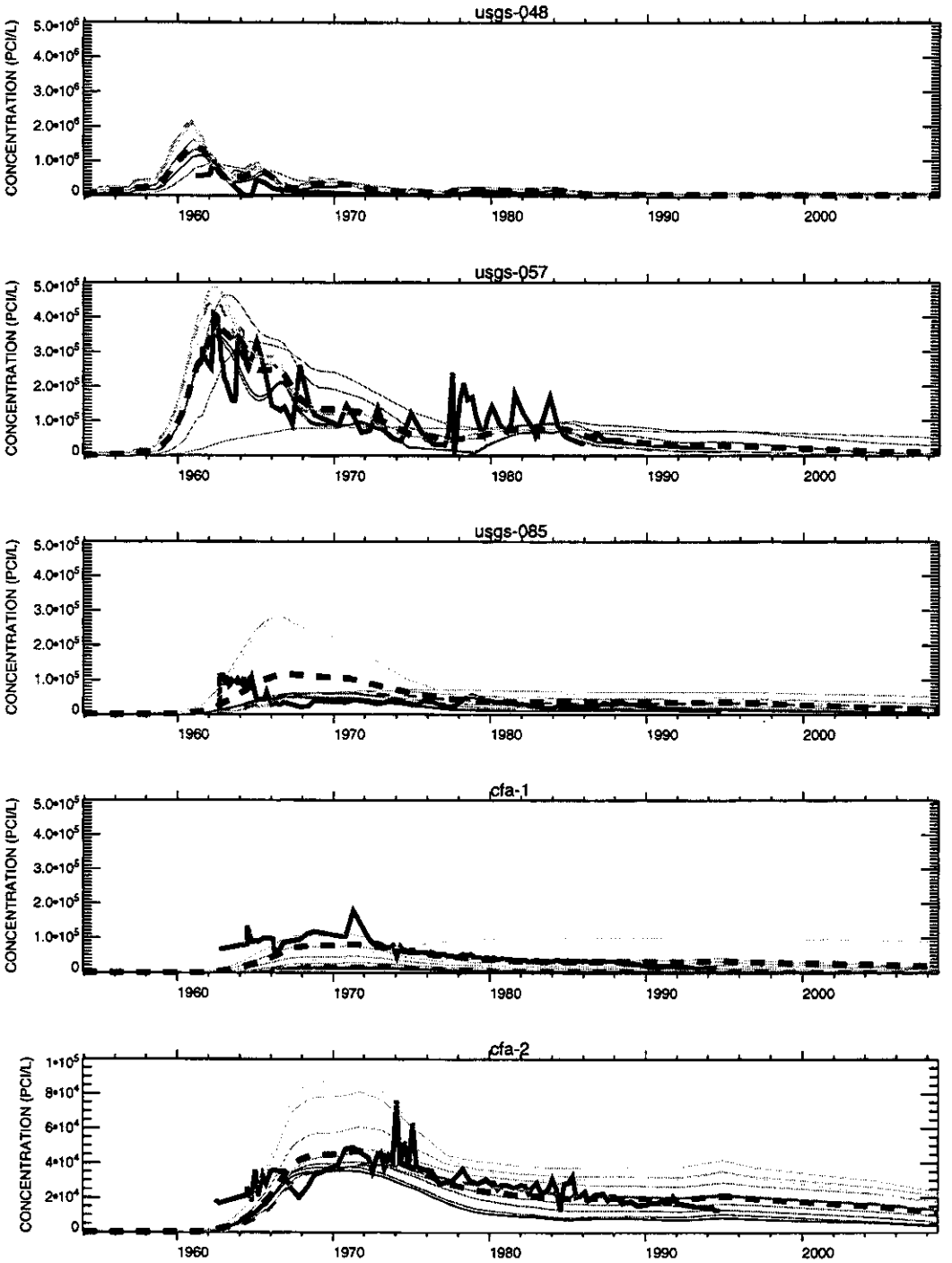


Figure 4-45 Tritium concentration versus time for the key wells plotted in Figure 4-12 corresponding to the hydraulic parameterization of Section 4.2.8.

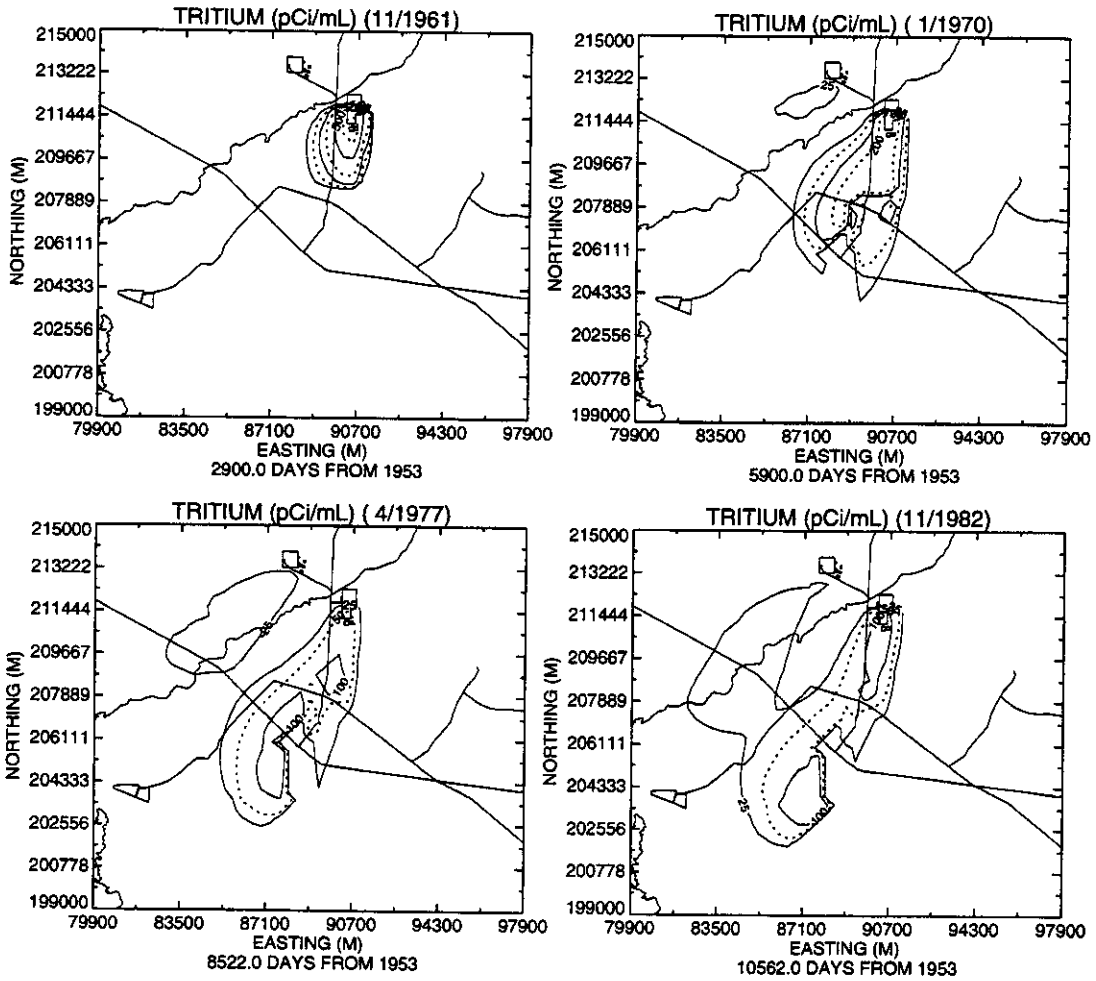


Figure 4-46 Model predicted tritium concentration in 1961, 1970, 1977, and 1982, corresponding to the hydraulic parameterization of Section 4.2.8. These contour plots are at a depth of 570m.

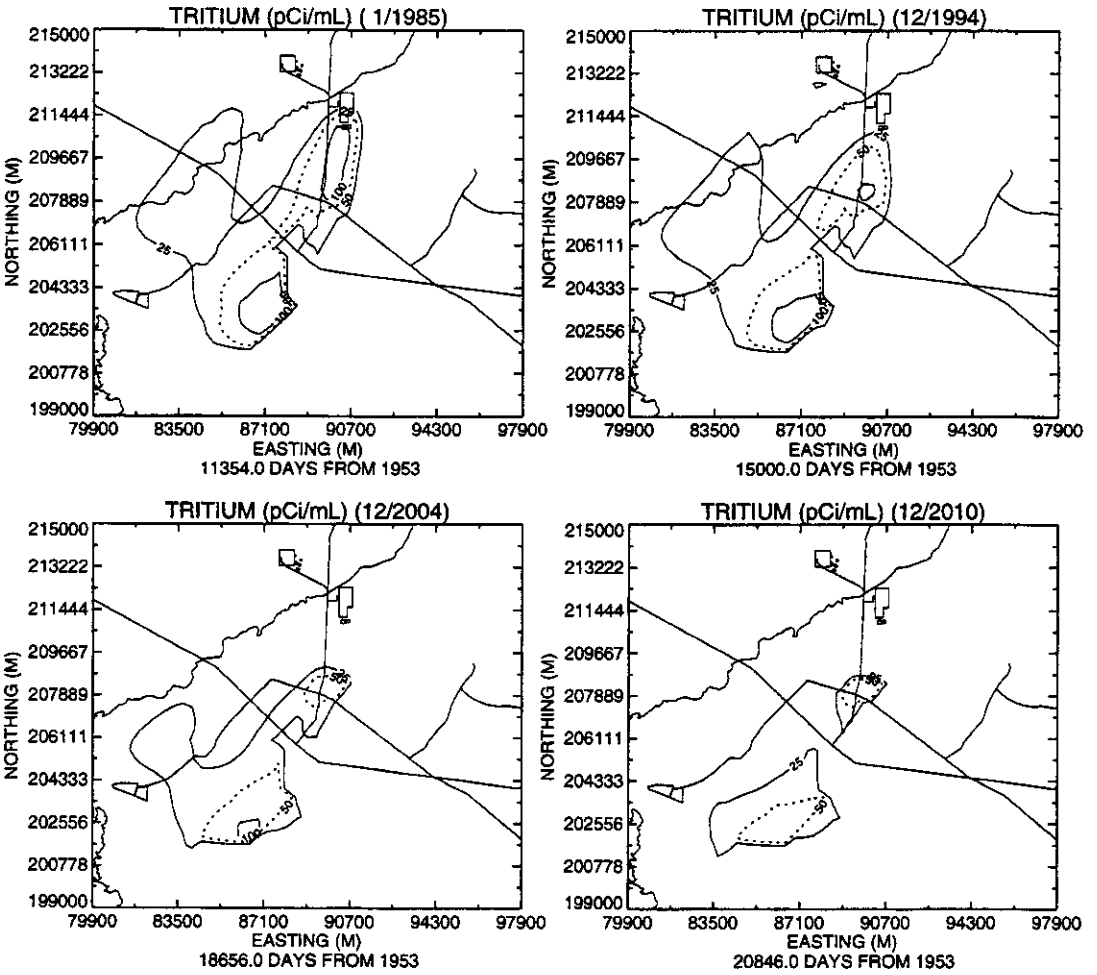


Figure 4-47 Model predicted tritium concentration in 1985, 1994, 2004, and 2010, corresponding to the hydraulic parameterization of Section 4.2.8. These contour plots are for a depth of 570 m.

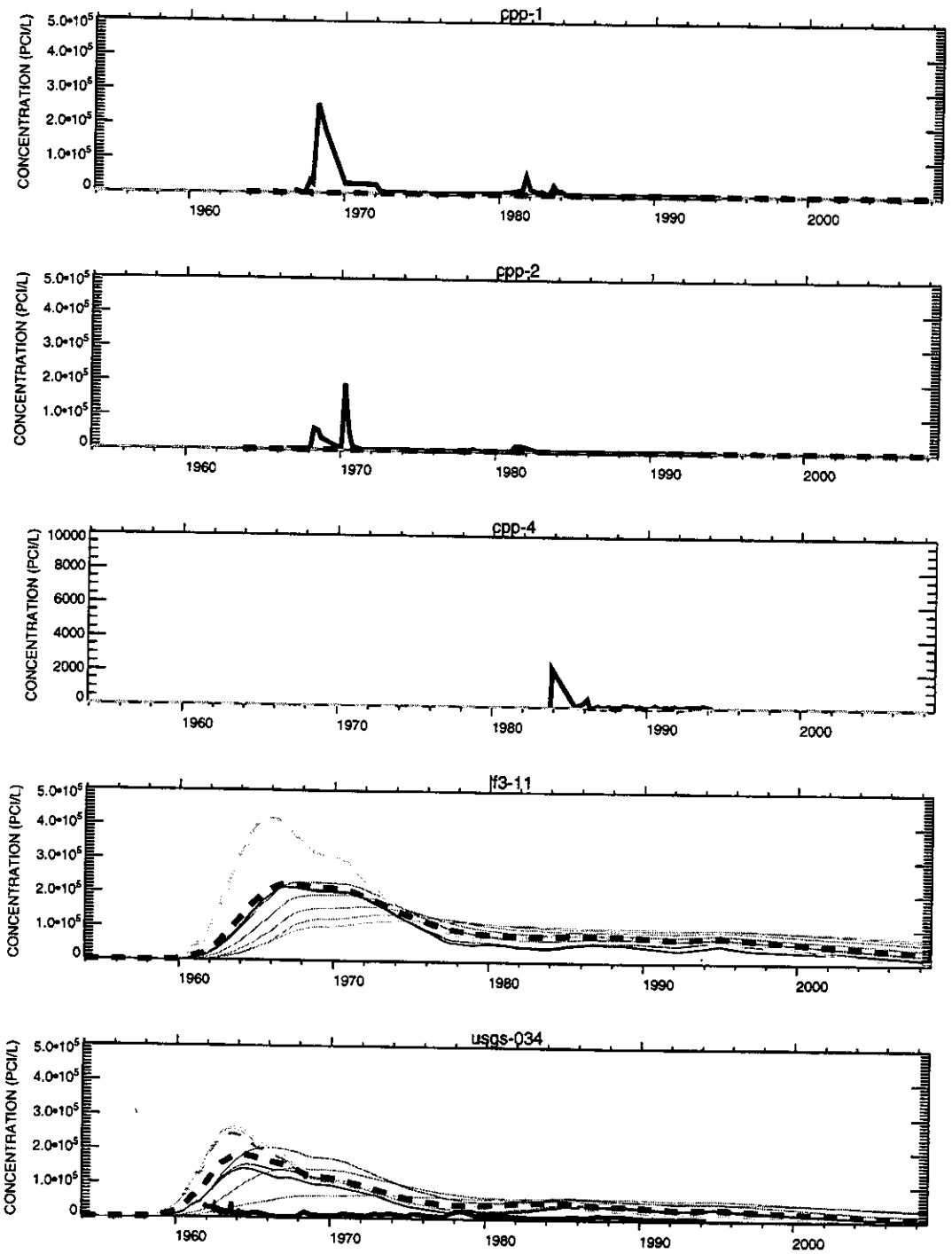


Figure 4-48 Tritium concentration versus time for the key wells plotted in Figure 4-10 corresponding to the hydraulic parameterization of Section 4.2.8.

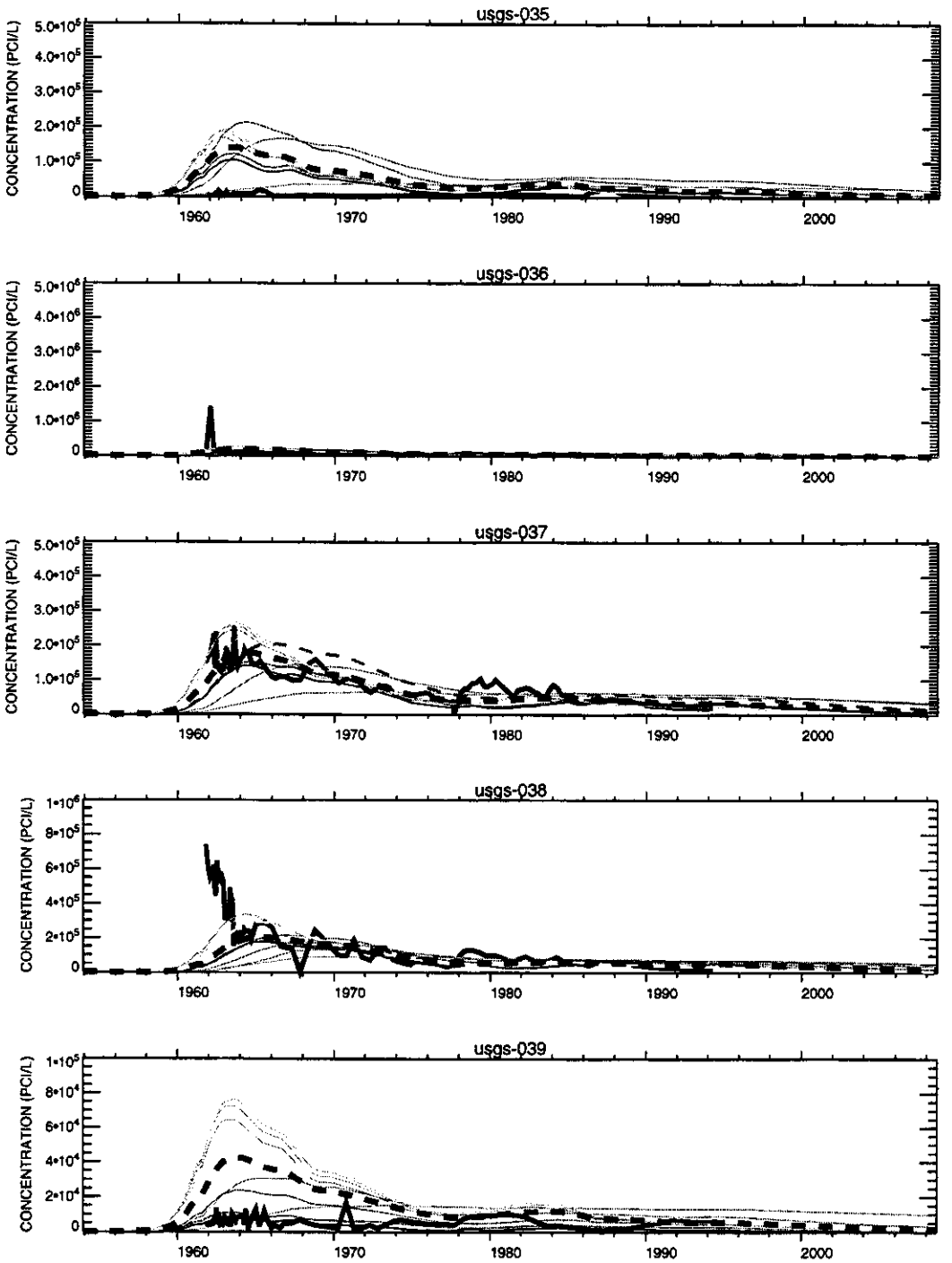


Figure 4-49 Tritium concentration versus time for the key wells plotted in Figure 4-10 corresponding to the hydraulic parameterization of Section 4.2.8.

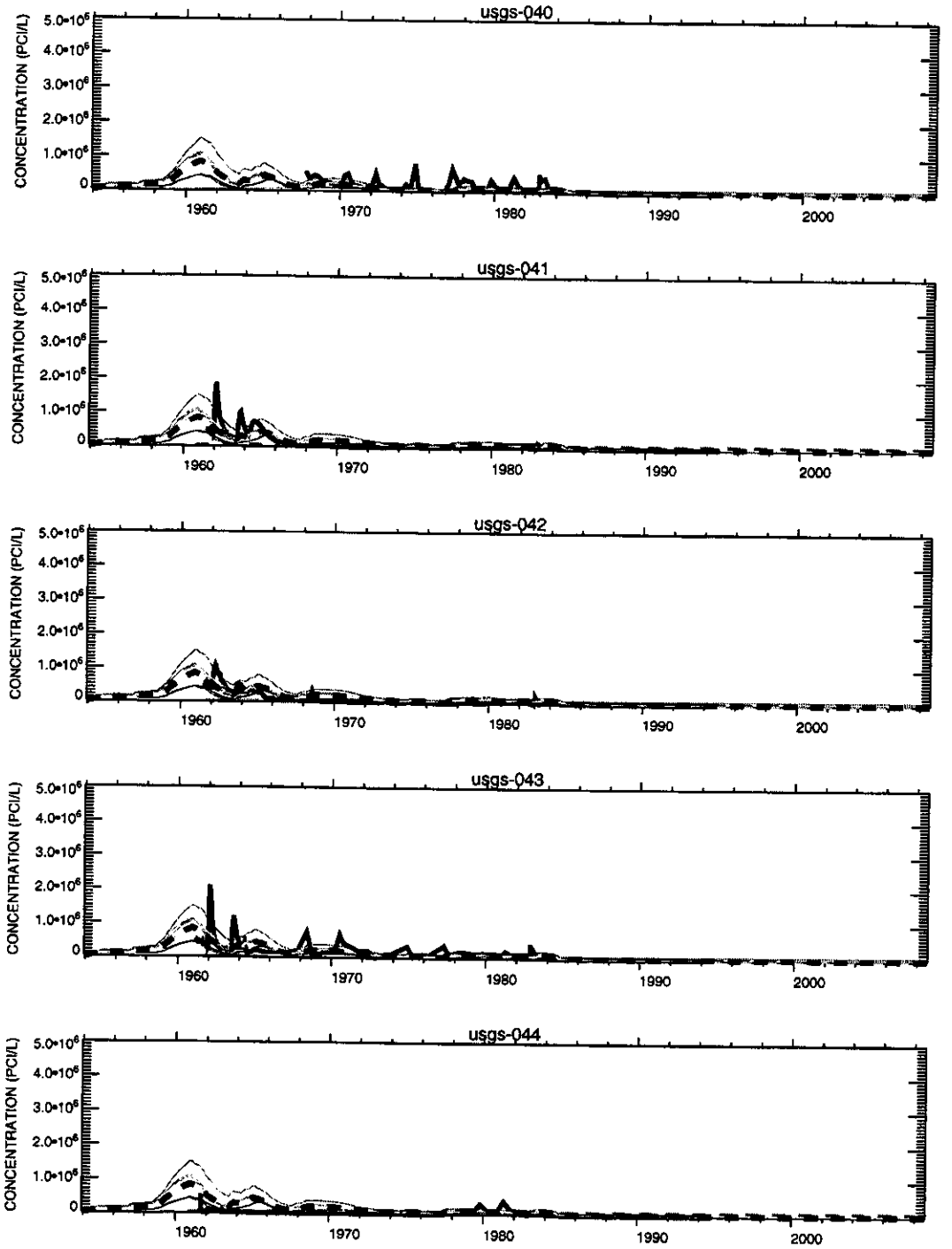


Figure 4-50 Tritium concentration versus time for the key wells plotted in Figure 4-10 corresponding to the hydraulic parameterization of Section 4.2.8.

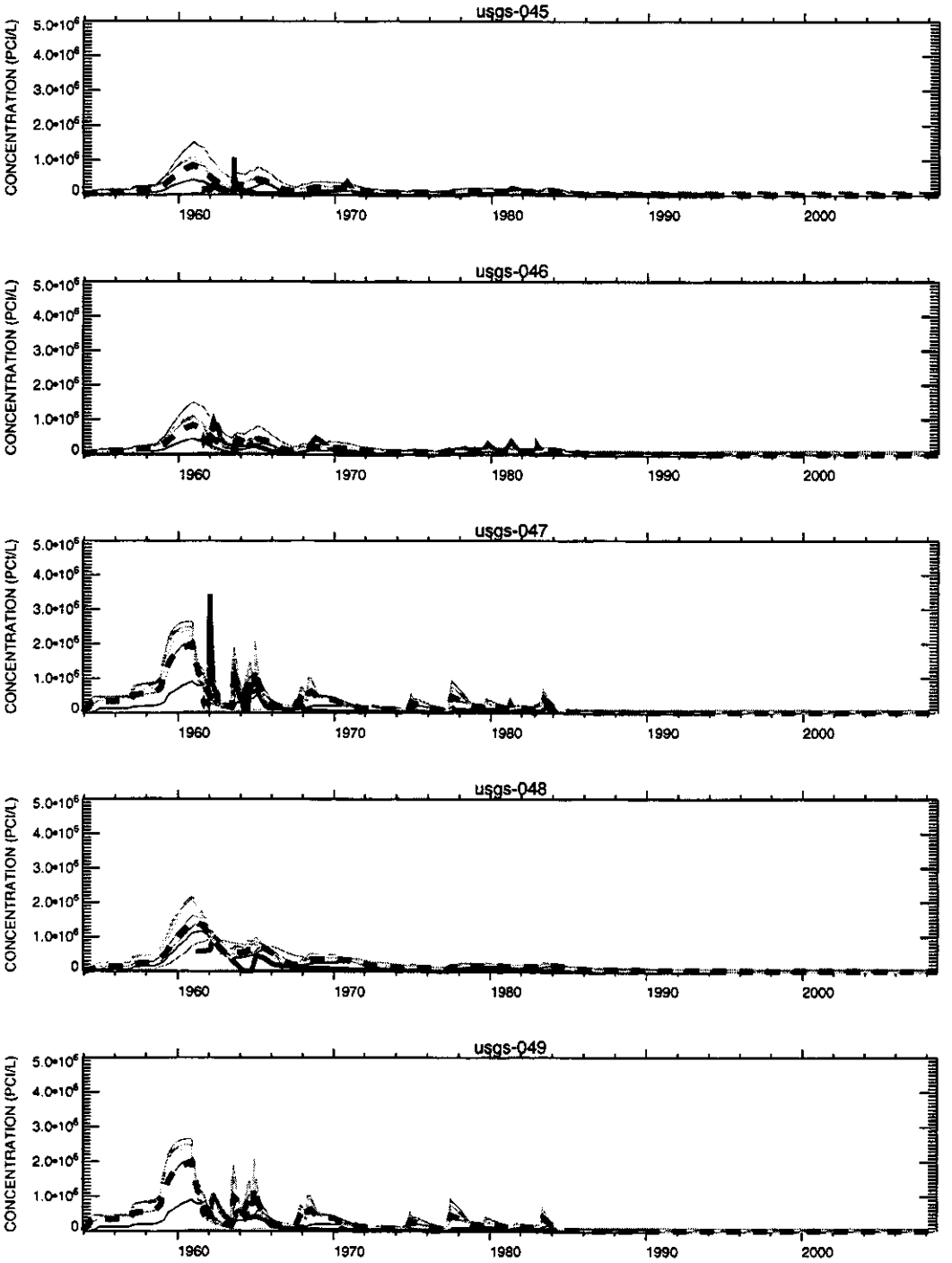


Figure 4-51 Tritium concentration versus time for the key wells plotted in Figure 4-10 corresponding to the hydraulic parameterization of Section 4.2.8.

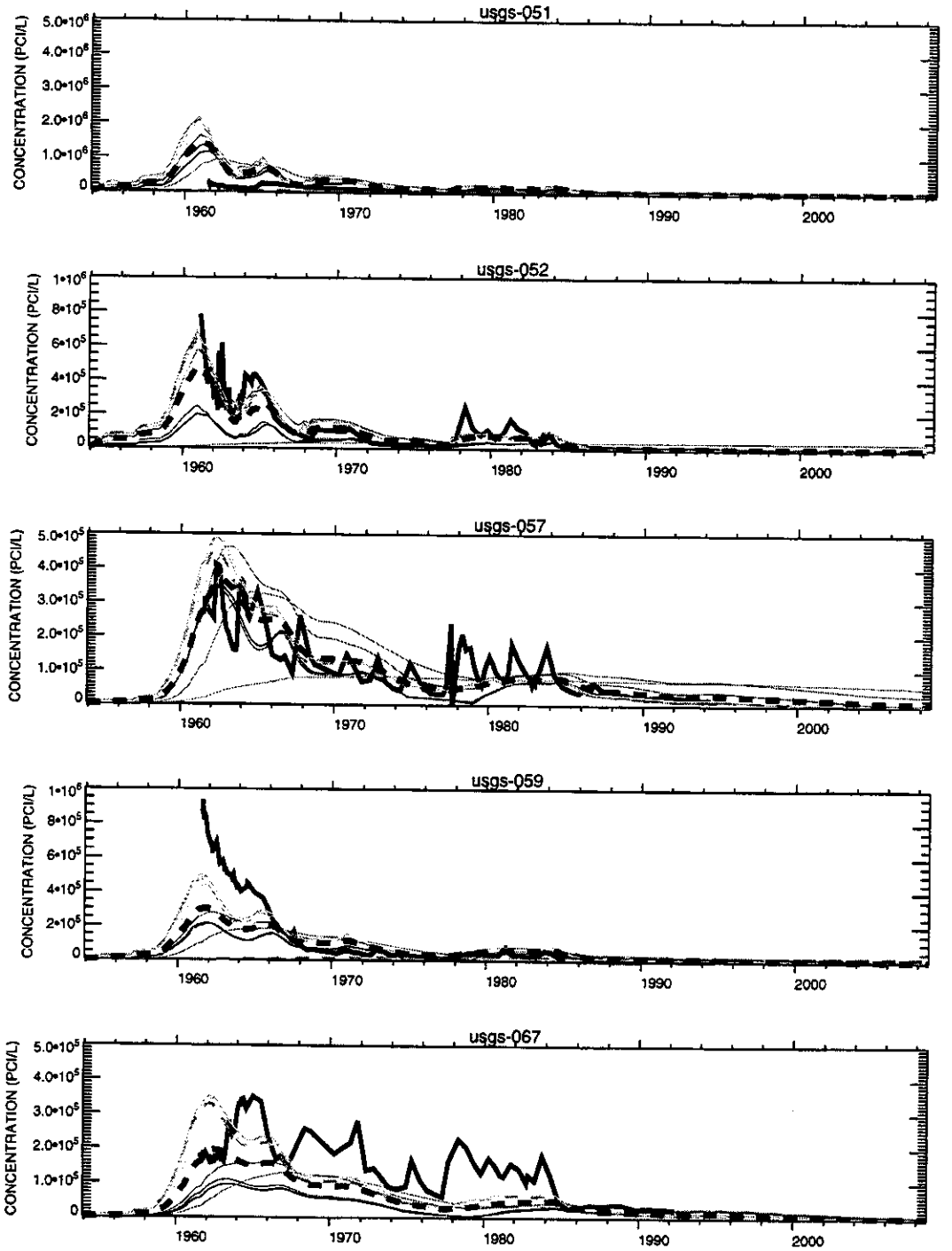


Figure 4-52 Tritium concentration versus time for the key wells plotted in Figure 4-10 corresponding to the hydraulic parameterization of Section 4.2.8.

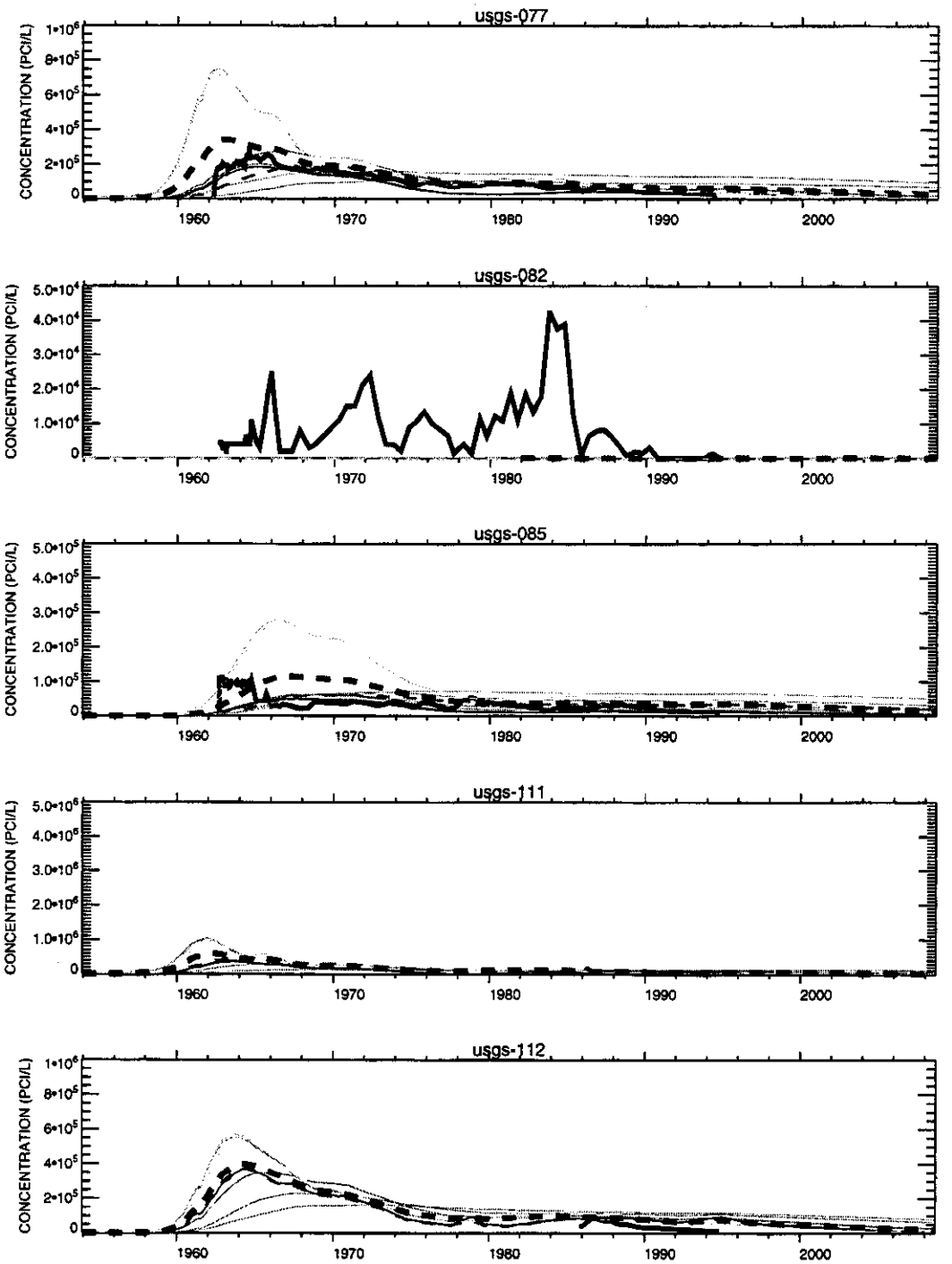


Figure 4-53 Tritium concentration versus time for the key wells plotted in Figure 4-10 corresponding to the hydraulic parameterization of Section 4.2.8.

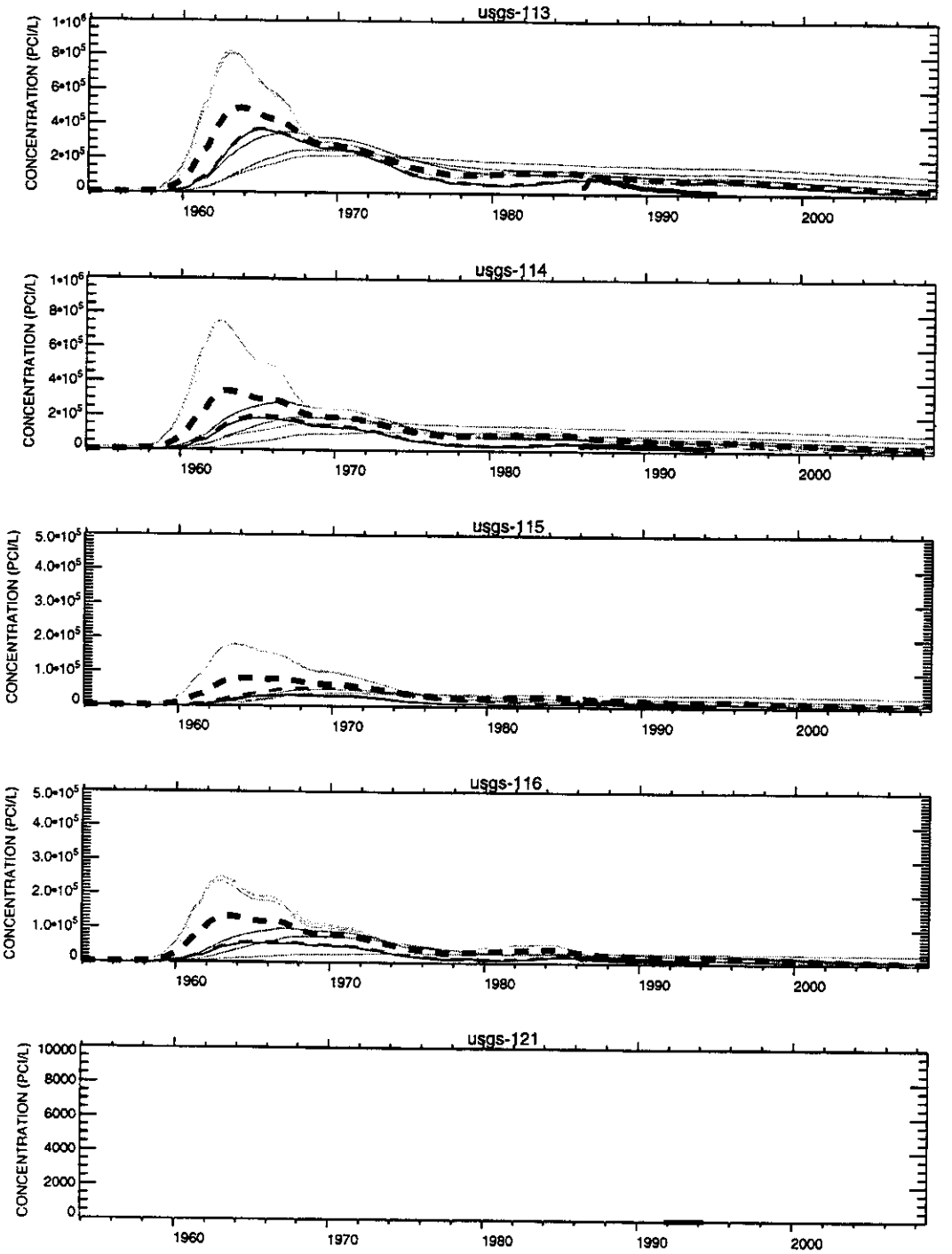


Figure 4-54 Tritium concentration versus time for the key wells plotted in Figure 4-10 corresponding to the hydraulic parameterization of Section 4.2.8.

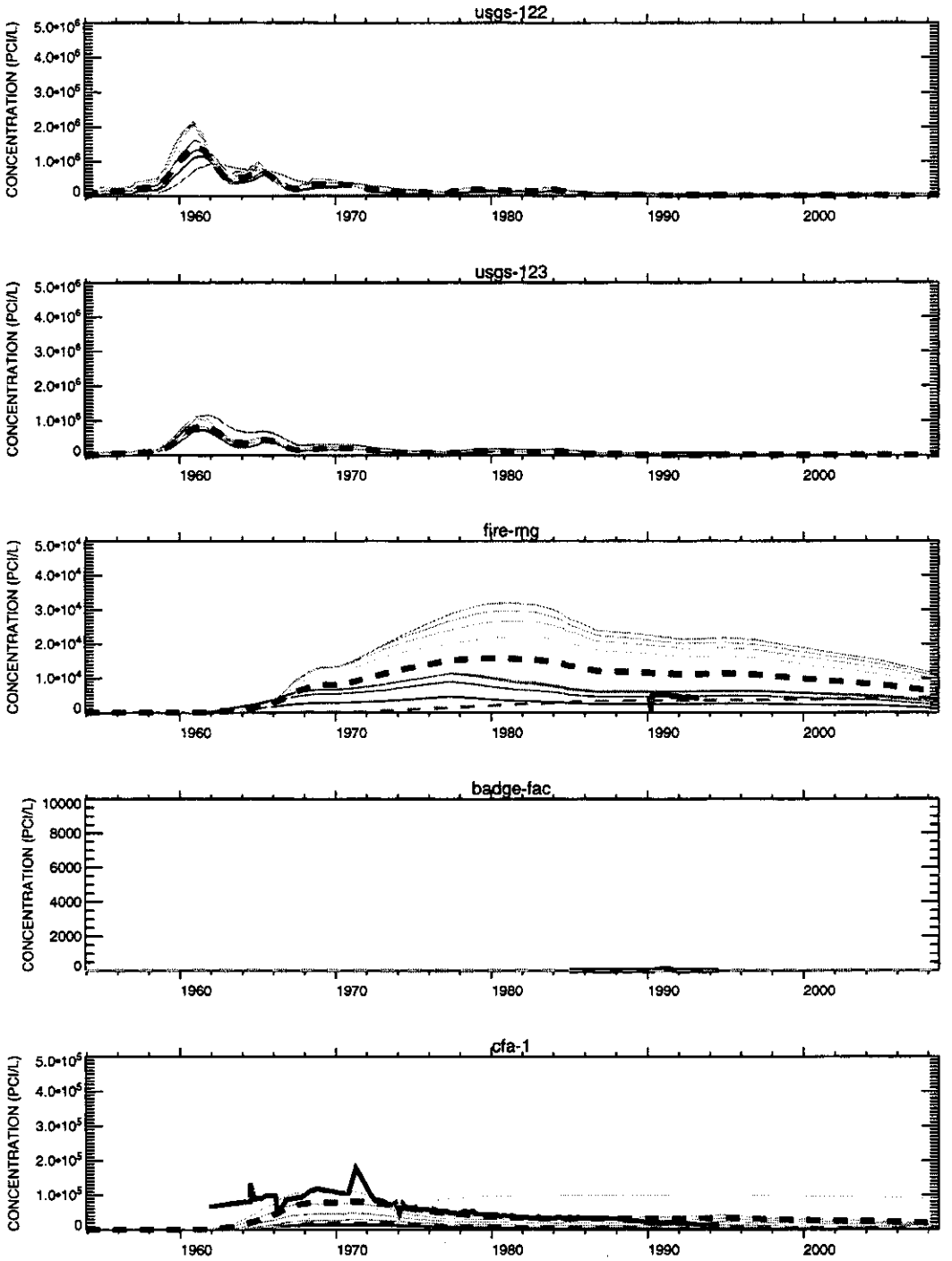


Figure 4-55 Tritium concentration versus time for the key wells plotted in Figure 4-10 corresponding to the hydraulic parameterization of Section 4.2.8.

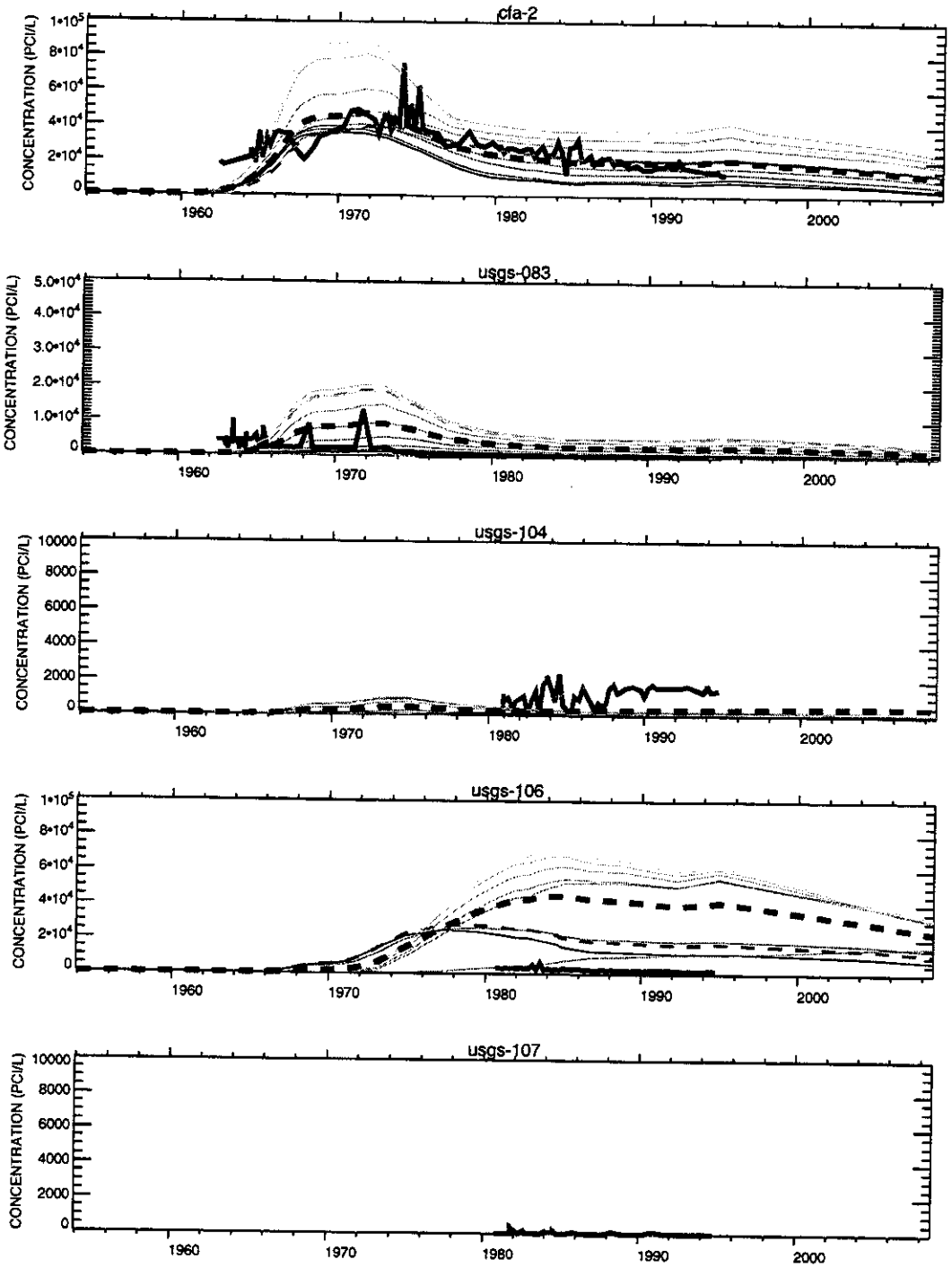


Figure 4-56 Tritium concentration versus time for the key wells plotted in Figure 4-10 corresponding to the hydraulic parameterization of Section 4.2.8.

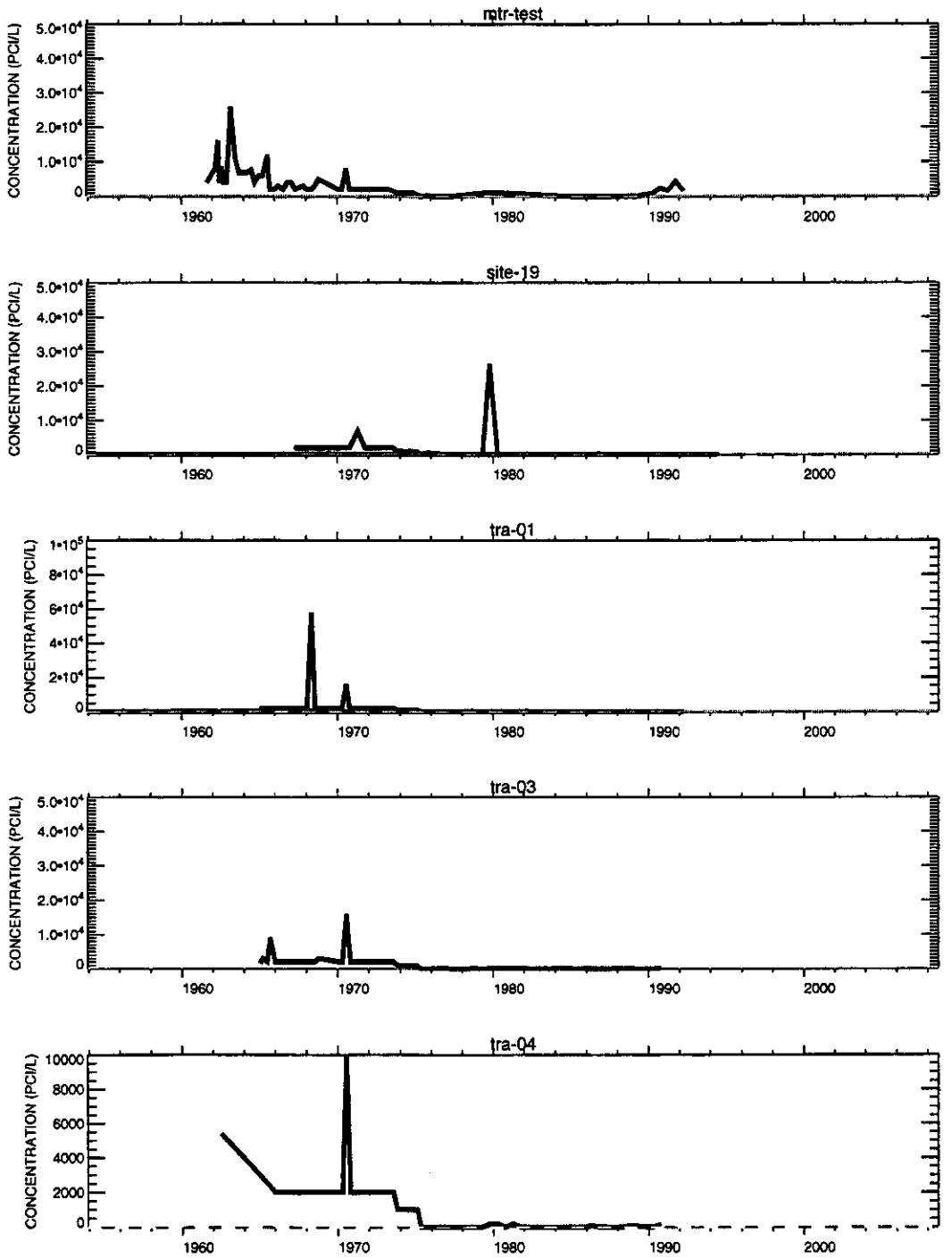


Figure 4-57 Tritium concentration versus time for the key wells plotted in Figure 4-12 corresponding to the hydraulic parameterization of Section 4.2.8.

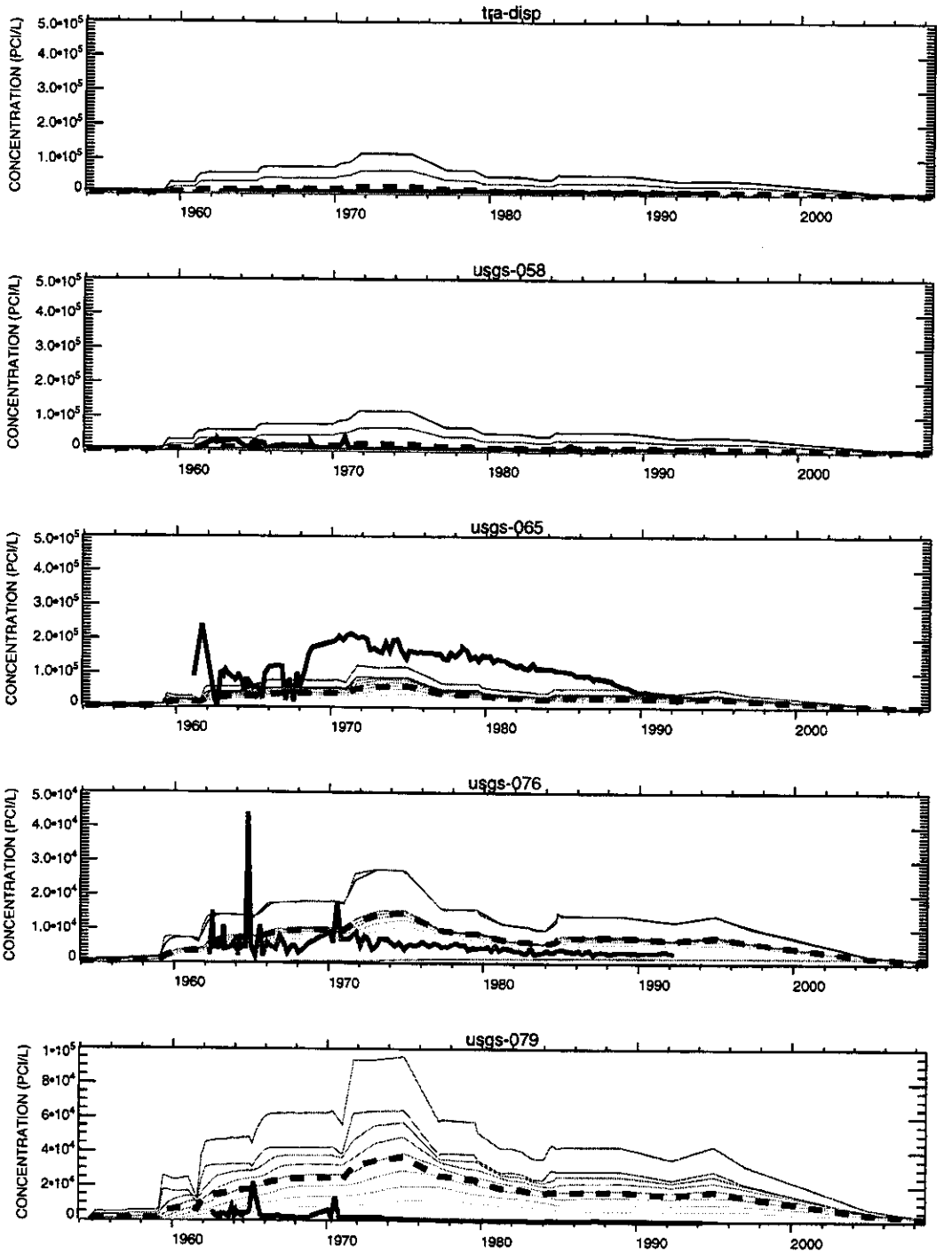


Figure 4-58 Tritium concentration versus time for the key wells plotted in Figure 4-10 corresponding to the hydraulic parameterization of Section 4.2.8.

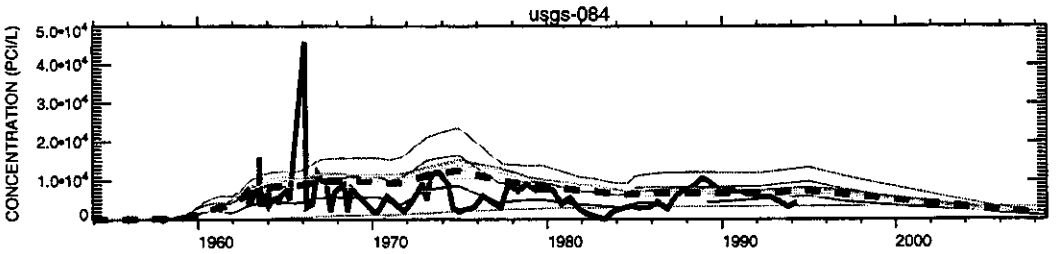


Figure 4-59 Tritium concentration versus time for the key wells plotted in Figure 4-10 corresponding to the hydraulic parameterization of Section 4.2.8.

5 IDENTIFICATION OF GROUNDWATER PATHWAY COPCs AND DEFINITION OF CONTAMINANT SOURCES

The contaminants discharged to the surface and subsurface at the ICPP are numerous in chemical composition and have been discharged at many locations. For the purposes of modeling the potential risk via the groundwater pathway, the entire inventory of contaminants must be reduced to those posing a potential risk. These contaminants will be referred to as groundwater contaminants of potential concern (COPCs). Following contaminant identification, their mass or activity, locations, and time of disposal must be put into a modeling framework. Section 5.1 describes how the groundwater pathway COPCs were identified. Section 5.2 presents the procedure used to calculate the mass or activity for each of the contaminant sources.

In Section 5.1, the data are presented in terms of the maximum observed concentration of a given chemical species and the associated risk based concentration. These data originate from (1) aquifer and perched water sample information, (2) service wastewater source logs, and (3) measurements of soil contamination. Mass or activity for all COPCs are presented based on these three source type categories. In Section 5.2, the COPCs are presented and analyzed by source location, a necessary step prior to integrating the data into model predictions. The actual source terms used in the model are not presented until Section 6. The remainder of Section 5 will be presented in the following order:

5.1 Identification of All ICPP COPCs
- 5.1.1 COPCs Identified Based on Water Samples
- 5.1.2 COPCs Identified Based on Maximum Potential Risk From the Soil Contamination
- 5.1.3 COPCs Identified Based on Other Factors
- 5.1.4 COPCs Results and Summary

5.2 Contaminant Source Definition
- 5.2.1 Description of the Types of Contaminant Sources
- 5.2.2 Contaminant Sources Based on Known Releases
- 5.2.3 Sewage Treatment Facility
- 5.2.4 Service Wastewater Disposal
- 5.2.5 Contaminant Sources Based on Soil Contamination
- 5.2.6 TRA Contaminant Sources
- 5.2.7 Summary Comparison of the Relative Magnitude of the Contaminant Sources

5.1 Identification of All ICPP COPCs

Contaminants of potential concern (COPCs) were identified using three steps. First, an initial set of contaminants was identified by comparing the maximum concentrations measured in the aquifer and perched water to the limiting concentration defined by either the water concentration based on a 10^{-6} risk level, a Hazard Quotient of 1 (HQ=1), or the EPA Maximum Contaminant Level (MCL). Basically, this step identified those contaminants that currently pose a risk to the perched water or aquifer regions. The first identification step is presented in Section 5.1.1. The second identification step designed and applied a screening process to evaluate the potential for groundwater contamination from contaminated soils. Contaminants in the soils were evaluated for their maximum risk in the alluvium pore-water, their propensity to infiltrate through the alluvium, and the expected reduction in concentration resulting from radioactive decay. This second identification step is presented in Section 5.1.2. Contaminants of concern based on other factors are identified in the third identification step and presented in Section 5.1.3. In each identification step, possible COPCs are identified with these relatively conservative screens. Then all the historical data is evaluated in order to determine whether or not the possible COPC should be added to the list of COPCs for quantitative evaluation. In Section 10.3.2, COPCs are identified based on the known processes that produced the CPP-31 radionuclide contamination. The analysis was part of a contaminant source uncertainty analysis designed to verify that the COPCs identified in Section 5.1 did not miss any radionuclide COPCs.

The initial list of COPCs was identified by comparing limiting water concentrations with aquifer and perched water samples. Additional COPCs were added by evaluating the potential for groundwater contamination from contaminated soil sites. Because most of these contaminants occur in both sources, the parameters used in the identification of COPCs for all of the contaminants are given in Tables 5-1 and 5-2. As with much of the information presented in this section, these tables are broken into radionuclides and non-radionuclides. Column 1 in these tables gives the list of all chemicals evaluated, and then for each chemical evaluated, the columns present the (2) soil-water partitioning coefficient (Kd) determining the ratio of water to soil concentration; (3) origin for the partitioning coefficient; (4) half-life for radionuclides, (5) slope factor used in calculating the risk from concentration; (6) reference dose (RFD) used in calculating Hazard Quotient; (7) drinking water concentration resulting in a 10^{-6}risk for carcinogens; (8) drinking water concentration resulting in a Hazard Quotient of 1 for the non-carcinogens; (9) federal drinking water standard; and (10) limiting concentration for each chemical in drinking water. The limiting water concentration was assumed to be the minimum of the 10^{-6} risk or HQ=1 risk-based water concentration, or the MCL from the National Primary Drinking Water Standards (Primary MCL). If no Primary MCL is available, then the limiting concentration is based on the 10^{-6} risk or HQ=1 risk-based water concentration. If no 10^{-6} risk or HQ=1 risk-based water concentration or Primary MCL is available, then the limiting concentration is based on a proposed, secondary, action level, under review, or being remanded MCL.

The Kd values are assigned to all of the sediment layers in both the vadose zone and aquifer model. The vadose zone basalt Kd is assumed to be zero because the water is expected to move very quickly through vertical fractures in the vadose zone allowing very little time for the contaminant to sorb to the basalt. In the aquifer, water moves very slowly through the basalt fractures and well as matrix and there is sufficient time for the contaminants to sorb in the basalt. Based on Kd experiments done at the ICPP (Del Debbio and Thomas, 1989), the ratio of the Kd on sediments to Kd in basalts is approximately 25 to 1. Therefore, the Kd in the aquifer basalts is assumed to be 1/25th the Kd value shown in Table 5-1.

Table 5-1 Parameters used in the screening process for all the non-radionuclides evaluated as possible groundwater pathway COPCs.

Non-radionuclides Evaluated	Sediment Kd (cm^3/g)	Kd Reference	Half-Life (year)	Slope Factor (kg-D/mg)	RFD (mg/kg/d)	10^{-6} Risk Based Water Concentration (mg/L)	HQ=1 Based Water Concentration (mg/L)	Federal Drinking Water Standard[6] (mg/L)	Limiting Water Concentration (mg/L)
Aroclor-1260	100	2	NA	7.70E+00	2.0E-05	1.10E-05	7.30E-04	NS	1.10E-05
Benzo(a)pyrene	1200	1	NA	7.3E+00	---	1.16E-05	---	0.002	1.16E-05
bis(2-Ethylhexyl) phthalate	18.0	2	NA	1.4E-02	2.0E-02	6.07E-03	7.30E-01	NS	6.07E-03
Phenanthrene	---	---	NA	no tox	no tox	---	---	NS	---
Tetrachloroeth-ene (Tetrachloroeth-ylene)	0.8	2	NA	0.052	2.0E-01	1.64E-03	7.30E+00	0.005	1.64E-03

1. Kd = Koc * (%OC/100) with %OC assumed to be 0.3% (Track 2 Guidance, Appendix F) (DOE 1994).
2. Track 2 Guidance, Appendix F (DOE 1994).
3. Use 0.0 as a conservative estimate.
4. Track 2 Summary Report for INEL OU 2-11 (Golder Associates, 1993)
5. Assumed to be the same as beryllium, values taken from the Track 2 Guidance, Appendix F (DOE 1994).
6. Maximum contaminant level drinking water standards from "Drinking Water Regulations and Health Advisories", by the Office of Water, USEPA, May 1995. The regulation status is final unless otherwise noted.
7. The HQ=1 based water concentration for nitrate is 58.4 mg/L. The nitrogen component of that is 13.2 mg/L

NS - No Standard
P - proposed MCL. This is not assumed to be a limiting concentration if risk based information is available.
S - secondary final MCL. This is not assumed to be a limiting concentration if risk based information is available.
AL - action level. This is not assumed to be a limiting concentration if risk based information is available.
UR - under review. This is not assumed to be a limiting concentration if risk based inform
BR - being remanded. This is not assumed to be a limiting concentration if risk based information is available
no tox = no toxicity value is available

Table 5-1 Parameters used in the screening process for all the non-radionuclides evaluated as possible groundwater pathway COPCs.

Non-radionuclides Evaluated	Sediment Kd (cm^3/g)	Kd Reference	Half-Life (year)	Slope Factor (kg-D/mg)	RFD (mg/kg/d)	10^{-6} Risk Based Water Concentration (mg/L)	HQ=1 Based Water Concentration (mg/L)	Federal Drinking Water Standard[6] (mg/L)	Limiting Water Concentration (mg/L)
Toluene	1.0	2	NA	---	2.0E-01	---	7.30E+00	1	1.00E+00
Trichloroethene (Trichloroethyl-ene)	0.4	2	NA	1.1E-02	6.0E-03	7.73E-03	2.19E-01	0.005	5.00E-03
Aluminum	250	5	NA	---	1.0E+00	---	3.65E+01	0.2[S]	3.65E+01
Ammonia-N	---	---	NA	---	1.6E+00	---	5.84E+01	NS	5.84E+01
Antimony	50	2	NA	---	4.0E-04	---	1.46E-02	0.006	6.00E-02
Arsenic	3.0	2	NA	1.5E+00	3.0E-04	5.67E-05	1.10E-02	0.05[UR]	5.67E-05
Barium	50	2	NA	---	7.0E-02	---	2.56E+00	2	2.00E+00
Beryllium	250	---	NA	4.3E+00	5.0E-03	1.98E-05	1.83E-01	0.004	1.98E-05
Cadmium	6.0	2	NA	---	5.0E-04	---	1.83E-02	0.005	5.00E-03
Calcium	---	---	NA	essential	nutrient	---	---	NS	---
Carbonate	---	---	NA	no tox	no tox	---	---	NS	---
Chloride	0.0	---	NA	---	---	---	---	250[S]	2.50E+02
Chromium	1.2	2	NA	---	5.0E-03	---	1.83E-01	0.1	1.00E-01
Cobalt	---	---	NA	---	6.0E-02	---	2.19E+00	NS	2.19E+00
Copper	20	2	NA	---	4.0E-02	---	1.46E+00	1.3[AL]	1.46E+00
Fluoride	0.0	---	NA	---	6.0E-02	---	2.19E+00	4	2.19E+00
Iron	---	---	NA	---	---	---	---	0.3[S]	3.00E-01
Kepone	---	---	NA	no tox	no tox	---	---	NS	---
Lead	---	---	NA	no tox	no tox	---	---	0.015[AL]	1.50E-02
Magnesium	---	---	NA	essential	nutrient	---	---	NS	---
Manganese	50.0	2	NA	---	5.0E-03	---	1.83E-01	NS	1.83E-01
Mercury	100.0	2	NA	---	8.6E-05	---	3.14E-03	0.002	2.00E-03
Nickel	100.0	2	NA	---	2.0E-02	---	7.30E-01	0.1[BR]	7.30E-01
Nitrate (as N)	0.0	---	NA	---	1.6E-00	---	1.32E+01[7]	10	1.00E+01
Phenols	---	---	NA	---	1.0E-01	---	3.65E+00	NS	3.65E+00
Potassium	---	---	NA	no tox	no tox	---	---	NS	---
Selenium	4.0	2	NA	---	5.0E-03	---	1.83E-01	0.05	5.00E-02
Silver	90.0	2	NA	---	5.0E-03	---	1.83E-01	0.1[S]	1.83E-01

1. Kd = Koc * (%OC/100) with %OC assumed to be 0.3% (Track 2 Guidance, Appendix F) (DOE 1994).
2. Track 2 Guidance, Appendix F (DOE 1994).
3. Use 0.0 as a conservative estimate.
4. Track 2 Summary Report for INEL OU 2-11 (Golder Associates, 1993)
5. Assumed to be the same as beryllium, values taken from the Track 2 Guidance, Appendix F (DOE 1994).
6. Maximum contaminant level drinking water standards from "Drinking Water Regulations and Health Advisories", by the Office of Water, USEPA, May 1995. The regulation status is final unless otherwise noted.
7. The HQ=1 based water concentration for nitrate is 58.4 mg/L. The nitrogen component of that is 13.2 mg/L
NS - No Standard
P - proposed MCL. This is not assumed to be a limiting concentration if risk based information is available.
S - secondary final MCL. This is not assumed to be a limiting concentration if risk based information is available.
AL - action level. This is not assumed to be a limiting concentration if risk based information is available.
UR - under review. This is not assumed to be a limiting concentration if risk based inform
BR - being remanded. This is not assumed to be a limiting concentration if risk based information is available
no tox = no toxicity value is available

Table 5-1 Parameters used in the screening process for all the non-radionuclides evaluated as possible groundwater pathway COPCs.

Non-radionuclides Evaluated	Sediment Kd (cm^3/g)	Kd Reference	Half-Life (year)	Slope Factor (kg-D/mg)	RFD (mg/kg/d)	10^{-6} Risk Based Water Concentration (mg/L)	HQ=1 Based Water Concentration (mg/L)	Federal Drinking Water Standard[6] (mg/L)	Limiting Water Concentration (mg/L)
Sodium	---	---	NA	no tox	no tox	---	---	NS	---
Sulfate	---	---	NA	---	---	---	---	500[P]	5.00E+02
TDS	---	---	NA	---	---	---	---	500[S]	5.00E+02
Thallium	100	2	NA	no tox	no tox	---	---	0.002	2.00E-03
Uranium	6	2	NA	---	3.0E-03	---	1.10E-01	0.02	2.00E-02
Vanadium	6.0	2	NA	---	7.0E-03	---	2.56E-01	NS	2.56E-01
Zinc	---	---	NA	---	---	---	---	5[S]	5.00E+00
Zirconium	---	---	NA	no tox	no tox	---	---	NS	---

1. Kd = Koc * (%OC/100) with %OC assumed to be 0.3% (Track 2 Guidance, Appendix F) (DOE 1994).
2. Track 2 Guidance, Appendix F (DOE 1994).
3. Use 0.0 as a conservative estimate.
4. Track 2 Summary Report for INEL OU 2-11 (Golder Associates, 1993)
5. Assumed to be the same as beryllium, values taken from the Track 2 Guidance, Appendix F (DOE 1994).
6. Maximum contaminant level drinking water standards from "Drinking Water Regulations and Health Advisories", by the Office of Water, USEPA, May 1995. The regulation status is final unless otherwise noted.
7. The HQ=1 based water concentration for nitrate is 58.4 mg/L. The nitrogen component of that is 13.2 mg/L

NS - No Standard
P - proposed MCL. This is not assumed to be a limiting concentration if risk based information is available.
S - secondary final MCL. This is not assumed to be a limiting concentration if risk based information is available.
AL - action level. This is not assumed to be a limiting concentration if risk based information is available.
UR - under review. This is not assumed to be a limiting concentration if risk based inform
BR - being remanded. This is not assumed to be a limiting concentration if risk based information is available
no tox = no toxicity value is available

Table 5-2 Parameters used in the screening process for all the radionuclides evaluated as possible groundwater pathway COPCs.

Radionuclides Evaluated	Sediment Kd (cm^3/g)	Kd Reference	Half-Life[1] (year)	Slope Factor (pCi^{-1})	RFD (mg/kg/d)	10^{-6} Risk Based Water Concentration (pCi/L)	HQ=1 Based Water Concentration (pCi/L)	Federal Drinking Water Standards[7] (pCi/L)	Limiting Water Concentration (pCi/L)
Am-241	340	2	4.32E+02	3.3E-10	---	1.46E-01	---	<15	1.46E-01
Co-57	10	2	7.42E-01	9.7E-13	---	4.95E+01	---	1,000	4.95E+01
Co-58	10	2	1.94E-01	2.8E-12	---	1.71E+01	---	9,000	1.71E+01
Co-60	10	2	5.27E+00	1.9E-11	---	2.54E+00	---	100	2.54E+00
Cs-134	500	2	2.06E+00	4.7E-11	---	1.01E+00	---	80	1.01E+00
Cs-137	500	2	3.02E+01	3.2E-11	---	1.52E+00	---	200	1.52E+00

1. Half lifes are from "Nuclear Wallet Cards", July 1990, National Nuclear Data Center and the Chart of the Nuclides, published by Knolls Atomic Power Laboratory, 14th Edition.
2. Track 2 Guidance, Appendix F (DOE 1994).
3. Use 0.0 as a conservative estimate.
4. Track 2 Summary Report for INEL OU 2-11 (Golder Associates, 1993)
5. Taken from Maheras et al., 1994.
6. From Dicke, 1997.
7. Based on the National Interim Primary Drinking Water Regulations, EPA-570/9-76-003.
8. The uranium MCL is based on the chemical toxicity of uranium.
9. One half the Track 2 Guidance, Appendix F (DOE 1994). Conservative value is chosen because the vadose zone mass flux to the aquifer will be dominated by dispersive flux that is very difficult to calibrate. Therefore a conservative value is used.

Table 5-2 Parameters used in the screening process for all the radionuclides evaluated as possible groundwater pathway COPCs.

Radionuclides Evaluated	Sediment Kd (cm^3/g)	Kd Reference	Half-Life[1] (year)	Slope Factor (pCi^{-1})	RFD (mg/kg /d)	10^{-6} Risk Based Water Concentration (pCi/L)	HQ=1 Based Water Concentration (pCi/L)	Federal Drinking Water Standards[7] (pCi/L)	Limiting Water Concentration (pCi/L)
Eu-152	340	4	1.36E+01	5.7E-12	---	8.42E+00	---	200	8.42E+00
Eu-154	340	4	8.80E+00	9.4E-12	---	5.12E+00	---	60	5.12E+00
Eu-155	340	4	4.96E+00	1.7E-12	---	2.91E+01	---	600	2.91E+01
H-3	0.0	2	1.23E+01	7.2E-14	---	6.71E+02	---	20,000	6.71E+02
I-129	0.0	2	1.57E+07	1.8E-10	---	2.61E-01	---	1	2.61E-01
K-40	15	2	1.28E+09	1.3E-11	---	3.84E+00	---	NA	3.84E+00
Nb-93M	100	6	1.61E+01	6.6E-13	---	7.17E+01	---	NA	7.17E+01
Nb-95	100	6	9.61E-02	2.3E-12	---	2.13E+01	---	300	2.13E+01
Np-237	8	6	2.14E+06	3.0E-10	---	1.60E-01	---	<15	1.60E-01
Pu-238	22	2	8.78E+01	3.0E-10	---	1.63E-01	---	<15	1.63E-01
Pu-239	22	2	2.41E+04	3.2E-10	---	1.52E-01	---	<15	1.52E-01
Pu-240	22	2	6.56E+03	3.2E-10	---	1.52E-01	---	<15	1.52E-01
Pu-241	22	2	1.44E+01	3.3E-10	---	1.45E-01	---	<15	1.45E-01
Pu-242	22	2	3.73E+05	3.0E-10	---	1.60E-01	---	<15	1.60E-01
Ru-103	0.0	3	1.08E-01	3.3E-12	---	1.45E+01	---	200	1.45E+01
Ru-106	0.0	3	1.02E+00	3.5E-11	---	1.39E+00	---	30	1.39E+00
Sb-125	50	2	2.73E+00	3.5E-12	---	1.36E+01	---	300	1.36E+01
Sr-90	12	9	2.91E+01	5.6E-11	---	8.59E-01	---	8	8.59E-01
Tc-99	0.2	5	2.11E+05	1.4E-12	---	3.43E+01	---	900	3.43E+01
U-234	6	2	2.45E+05	4.4E-11	---	1.08E+00	---	---[8]	1.08E+00
U-235	6	2	7.04E+08	4.7E-11	---	1.02E+00	---	---[8]	1.02E+00
U-238	6	2	4.47E+09	6.2E-11	---	7.74E-01	---	---[8]	7.74E-01

1. Half lifes are from "Nuclear Wallet Cards", July 1990, National Nuclear Data Center and the Chart of the Nuclides, published by Knolls Atomic Power Laboratory, 14th Edition.
2. Track 2 Guidance, Appendix F (DOE 1994).
3. Use 0.0 as a conservative estimate.
4. Track 2 Summary Report for INEL OU 2-11 (Golder Associates, 1993)
5. Taken from Maheras et al., 1994.
6. From Dicke, 1997.
7. Based on the National Interim Primary Drinking Water Regulations, EPA-570/9-76-003.
8. The uranium MCL is based on the chemical toxicity of uranium.
9. One half the Track 2 Guidance, Appendix F (DOE 1994). Conservative value is chosen because the vadose zone mass flux to the aquifer will be dominated by dispersive flux that is very difficult to calibrate. Therefore a conservative value is used.

5.1.1 COPCs Identified Based on Water Samples

This section presents the analysis of water samples for COPCs. For the purposes of this evaluation, a contaminant was considered to be a groundwater pathway COPC if the maximum concentration observed in the water samples was greater than the limiting water concentration. Contaminants with no toxicity information could not be quantitatively evaluated and were eliminated from the set of COPCs. Chemicals considered to be essential nutrients were also eliminated as possible COPCs.

Data are available from water samples that were taken from the aquifer, perched water, the ICPP injection well, and the percolation ponds. Although water sample and inventory information were available for the service waste discharges to the injection well and percolation ponds, it was assumed that the aquifer and

perched water samples adequately identify all COPCs from the service waste. This is a valid assumption because the injection well discharged directly to the aquifer; therefore, the COPCs from discharges to the injection well are known from the COPCs identified from the aquifer water samples. Similarly, the percolation ponds discharge a very large volume of water that quickly moves through the vadose zone and perches on the interbeds; therefore, the COPCs from discharges to the percolation ponds are known from the COPCs identified from the perched water samples. As a result of these assumptions, this analysis is restricted to aquifer and perched water sample data.

Contaminant data from the analysis of aquifer and perched water contaminant samples were obtained from the Environmental Restoration Information System (ERIS) database. The samples were taken from 36 aquifer and 27 perched water wells in the vicinity of the ICPP. These wells are listed in Table 5-3. The sample dates range from 9/22/94 to 9/22/95 for the aquifer wells and 8/5/93 to 10/12/95 for the perched water wells. The more recent aquifer and perched water samples were assumed to be the best available information for defining which contaminants should be considered groundwater pathway COPCs from the ICPP.

Table 5-3 List of aquifer and perched water wells at which samples were taken and used for the identification of COPCs.

Aquifer Wells		Perched Water Wells	
CPP-1	USGS-052	37-4	MW-9
CPP-2	USGS-057	55-06	PW-1
MW-18	USGS-059	CPP 33-2	PW-2
USGS-034	USGS-067	CPP 33-3	PW-4
USGS-035	USGS-077	CPP 33-4	PW-5
USGS-036	USGS-082	CPP 33-4-E	TF-2
USGS-037	USGS-084	CPP 37-4	TF-3
USGS-038	USGS-085	CPP 55-06	TF-4E
USGS-039	USGS-111	MW-10	USGS-50
USGS-040	USGS-112	MW-15	
USGS-041	USGS-113	MW-15	
USGS-042	USGS-114	MW-17	
USGS-044	USGS-115	MW-2	
USGS-045	USGS-116	MW-20	
USGS-046	USGS-121	MW-4	
USGS-047	USGS-122	MW-5	
USGS-048	USGS-123	MW-6	
USGS-051	USGS-052	MW-7	

5.1.1.1 Aquifer water samples

Table 5-4 presents a summary of the non-radionuclide aquifer concentration information. For each non-radionuclide, the maximum sample concentration was compared to the limiting water concentration. Some of the non-radionuclides do not have toxicity information and therefore, they cannot be quantitatively evaluated. These contaminants can only be treated as a source of uncertainty. Based on the aquifer sample data, arsenic, beryllium, cadmium, nitrate/nitrite-N, and TDS were identified as possible COPCs. A detailed evaluation of the sampling data showed that the arsenic, beryllium, lead, and thallium data were all either below the detection limits or flagged as having the contaminant in the blank as well as in the sample. For arsenic, the levels detected were greater than the limiting concentrations, so that it appears to be a contaminant of concern. However, there is no known anthropogenic arsenic source and the arsenic concentrations were not significantly different from the background concentrations reported in Knobel et al., 1992 (0.002 - 0.003 mg/L). Therefore, it was assumed that arsenic is not a COPC. Cadmium was detected in 6 of the 64 aquifer

samples. The largest of these had a concentration that is 3 times the MCL and less than the HQ=1 based water concentration. Therefore, cadmium was not added as a COPC. Nitrate/nitrite-N was detected slightly above the MCL (and less than the HQ=1 limiting water concentration) in one aquifer measurement out of 14. The average concentration is approximately background (Burgess, 1996). Therefore, nitrate was not added as a COPC. TDS concentrations were not significantly above the limiting concentration and there was no information available to simulate the TDS transport; therefore, it was also eliminated as a COPC. As a result, given the aquifer water sample data that were evaluated, no non-radionuclides were identified as COPCs.

Table 5-4 Summary of the non-radionuclide aquifer concentration information.

Non-radionuclides Evaluated	Maximum (If measured above the detection limit)	Minimum (or Detection Limit)	Mean (Including Detection Limit for Nondetects)	Limiting Water Concentration	Possible COPCs
	mg/L				
Aluminum	1.54E-01	2.52E-02	4.26E-02	3.65E+01	
Ammonia-N	1.00E-01	3.00E-02	5.33E-02	5.84E+01	
Antimony	U	U	U	6.00E-03	
Arsenic	1.08E-02	1.80E-03	4.04E-03	5.67E-05	Arsenic
Barium	2.50E-01	5.00E-02	1.17E-01	2.00E+00	
Beryllium	5.00E-03	1.00E-04	1.08E-03	1.98E-05	Beryllium
Cadmium	1.50E-02	3.00E-04	2.17E-03	5.00E-03	Cadmium
Calcium	8.20E+01	3.00E+01	5.75E+01	No Tox	
Chloride	1.99E+02	1.18E+01	9.16E+01	2.50E+02	
Chromium	3.88E-02	4.10E-03	1.02E-02	1.00E-01	
Cobalt	1.90E-02	5.00E-04	4.61E-03	2.19E+00	
Copper[1]	1.35E-02	1.30E-03	4.72E-03	1.46E+00	
Fluoride	2.20E-01	1.00E-01	1.63E-01	2.19E+00	
Iron	1.29E-01	3.00E-03	2.53E-02	3.E-01	
Lead[1]	1.75E-02	1.00E-03	2.28E-03	1.5E-02	Lead
Magnesium	2.17E+01	8.02E-02	1.58E+01	No Tox	
Manganese[1]	4.40E-02[1]	8.00E-04	2.98E-03	1.83E-01	
Mercury[1]	3.20E-04	1.00E-04	1.07E-04	2.00E-03	
Nickel[1]	U	U	U	7.30E-01	
Nitrate/Nitrite (as N)	1.16E+01	5.80E-01	3.18E+00	1.00E+01	Nitrate/Nitrite (as N)
Phenols	5.00E-03	5.00E-03	5.00E-03	3.65E+00	
Potassium	8.48E+00	1.96E+00	3.73E+00	No Tox	
Selenium	1.00E-02	1.20E-03	3.25E-03	5.00E-02	
Silver	6.50E-03	6.00E-04	1.90E-03	1.83E-01	
Sodium	8.80E+01	7.34E+00	2.60E+01	No Tox	
Sulfate	6.95E+01	2.38E+01	3.89E+01	2.50E+02	
TDS	6.68E+02	2.32E+02	3.98E+02	5.E+02	TDS
Thallium	9.60E-03	2.30E-03	4.70E-03	2.E-03	Thallium
Vanadium	2.10E-02	1.80E-03	7.51E-03	2.56E-01	

U - undetected
1. the peak concentrations in Table 4-2 of Book 1 are larger because they include the CFA area wells.

Table 5-4 Summary of the non-radionuclide aquifer concentration information.

Non-radionuclides Evaluated	Maximum (If measured above the detection limit)	Minimum (or Detection Limit)	Mean (Including Detection Limit for Nondetects)	Limiting Water Concentration	Possible COPCs
	mg/L				
Zinc	4.54E-01	1.30E-03	1.02E-01	5.E+00	
Zirconium	3.13E-02	1.00E-03	2.47E-02	1.35E+02	

U - undetected
1. the peak concentrations in Table 4-2 of Book 1 are larger because they include the CFA area wells.

A summary of the radionuclide data from the analysis of aquifer water samples is presented in Table 5-5. For each radionuclide, the maximum sample concentration was compared to the limiting water concentration. The radionuclides Am-241, H-3, I-129, Np-237, Sr-90, Tc-99, U-234, and U-238 were identified as possible COPCs based on the aquifer sample data. Because these radionuclides are already in the aquifer, they were identified as COPCs for the groundwater pathway. Pu-238 and Pu-239/240 were reported in the data but never at a concentration greater than the uncertainty. Therefore, they have not been identified as COPCs.

Table 5-5 Summary of the radionuclide aquifer concentration information.

Radionuclides Evaluated	Maximum (If measured above the detection limit)	Minimum (or Detection Limit	Mean (Including Detection Limit for Nondetects)	Limiting Water Concentration	Possible COPCs
	pCi/L				
Am-241	5.70E-01	0.00E+00	1.21E-01	1.46E-01	Am-241
Ce-144	U	U	U	1.62E+00	
Co-57	NR	NR	NR	4.95E+01	
Co-58	U	U	U	1.71E+01	
Co-60	U	U	U	2.54E+00	
Cs-134	U	U	U	1.01E+00	
Cs-137	U	U	U	1.52E+00	
Eu-152	NR	NR	NR	8.42E+00	
Eu-154	U	U	U	5.12E+00	
Eu-155	U	U	U	2.91E+01	
H-3	7.55E+04	0.00E+00	1.34E+04	6.71E+02	H-3
I-129[1]	1.00E+00	0.00E+00	4.21E-02	2.61E-01	I-129
K-40	NR	NR	NR	3.84E+00	
Nb-95	U	U	U	2.13E+01	
Np-237	8.70E+00	0.00E+00	1.68E+00	1.60E-01	Np-237
Pu-238	U[2]	U[2]	U[2]	1.63E-01	
Pu-239/240	U[2]	U[2]	U[2]	1.52E-01	
Ru-103	U	U	U	1.45E+01	
Ru-106	U	U	U	1.39E+00	
Sb-125	U	U	U	1.36E+01	

U = undetected
NR = not reported
1. the peak concentrations in Table 4-2 of Book 1 are larger because they include the CFA area wells.
2. reported but in each case, the reported concentration is less than the reported uncertainty.

Table 5-5 Summary of the radionuclide aquifer concentration information.

Radionuclides Evaluated	Maximum (If measured above the detection limit)	Minimum (or Detection Limit	Mean (Including Detection Limit for Nondetects)	Limiting Water Concentration	Possible COPCs
	pCi/L				
Sr-90	2.98E+03	0.00E+00	5.28E+01	8.59E-01	Sr-90
Tc-99	7.36E+02	3.00E-02	5.10E+01	3.43E+01	Tc-99
U-234	2.60E+00	6.00E-01	1.24E+00	1.08E+00	U-234
U-235	U	U	U	1.02E+00	
U-238	1.10E+00	3.00E-01	6.47E-01	7.74E-01	U-238

U = undetected
NR = not reported
1. the peak concentrations in Table 4-2 of Book 1 are larger because they include the CFA area wells.
2. reported but in each case, the reported concentration is less than the reported uncertainty.

5.1.1.2 Perched water samples

Non-radionuclide perched water concentration data are summarized in Table 5-6. As with the aquifer water sample data, for each non-radionuclide the maximum sample concentration was compared to the limiting water concentration. COPCs not having a toxicity value were disregarded. Based on the perched water sample data, antimony, arsenic, beryllium, cadmium, chloride, iron, lead, manganese, nitrate, TDS, and thallium are identified as possible non-radionuclide COPCs. A detailed evaluation of the sampling data showed that;

- the arsenic and thallium data were all either below the detection limits or flagged as showing the contaminant in the blank as well as in the sample. The detection limits were greater than the limiting concentrations, so that arsenic appeared to be a contaminant of concern even though there was no evidence in the perched water. In addition, the arsenic concentrations were similar to the background concentrations presented in Knobel et al., 1992 (0.002 - 0.003 mg/L). Therefore, it is assumed that arsenic and thallium cannot be added as COPCs based on the perched water sampling data.
- as with the aquifer water samples, the TDS concentrations were not significantly above the limiting concentration and there is no information available to simulate the TDS transport; therefore, TDS was also eliminated as a COPC.

The remaining contaminants (antimony, beryllium, cadmium, chloride, iron, lead, manganese, and nitrate) had at least one sample with concentrations greater than the limiting water concentration. However, because these are perched water samples there will be some dilution in the aquifer as well as in the vadose zone. Simulations indicate approximately two orders of magnitude dilution in the aquifer. Therefore, about 100 times the limiting concentration is used as a qualitative limit to evaluate the possibility that a perched water contaminant could pose a problem to the groundwater quality. An implied assumption is that the perched water is not a potable water source. Therefore, the perched water concentrations must be significantly larger than the limiting drinking water level in order to justify adding a COPC to the COPCs list developed from the aquifer water sample analysis. A detailed evaluation of the sampling data showed that;

- Of 32 antimony samples, 14 were above the detection limit. Of the 14, 9 were below the MCL and 5 above. The maximum concentration was two times the MCL and no concentration was above the HQ=1 based water concentration.
- Of 32 beryllium samples, one was above the detection limit and not found in the blank sample. The concentration was below the MCL and above the 10^{-6} risk based concentration.

- Of 58 cadmium samples, 7 were above the detection limit which is equal to the MCL. The maximum concentration was less than two times the MCL and no concentration was above the HQ=1 based water concentration.
- Of 56 chloride samples, only two samples had concentrations significantly above the limiting water concentration (one two times higher and one 10 times higher).
- Of 42 iron samples, only five were above the detection limit and not found in the blank samples. Of the five, three were higher than the limiting water concentration.
- Of 58 lead samples, only four samples had concentrations above the detection limit and the maximum concentration was only twice the limiting water concentration.
- Of 48 manganese samples, only six were above the limiting water concentration, the largest by a factor of two. None of the non-radionuclide contaminants are measured in the perched water, in concentrations large enough to justify adding them as COPCs.
- Of 64 nitrate (as N) samples, most were above the detection limit and many are above the MCL. The maximum concentration was seven times the MCL (limiting concentration). The average concentration is 44% above the limiting concentration and slightly above the HQ=1 based concentration of 13.2 mg-N/L.

None of the perched water approach 100 times the limiting water concentration. Therefore, none are added as COPCs based on the perched water samples.

Table 5-6 Summary of the non-radionuclide perched water concentration information.

Non-radionuclides Evaluated	Maximum (If measured above the detection limit)	Minimum (or Detection Limit)	Mean (Including Detection Limit for Nondetects)	Limiting Water Concentration	Possible COPCs
	mg/L				
Aluminum	1.40E+01	2.68E-02	7.04E-01	3.65E+01	
Ammonia-N	1.00E-01	3.00E-02	8.60E-02	5.84E+01	
Antimony	1.22E-02	1.90E-03	3.58E-03	6.00E-03	Antimony
Arsenic	7.90E-03	2.00E-03	4.40E-03	5.67E-05	Arsenic
Barium	8.52E-01	2.00E-03	2.13E-01	2.00E+00	
Beryllium	1.20E-04	U	U	1.98E-05	Beryllium
bis(2-Ethylhexyl) phthalate	1.50E-01	4.00E-03	3.13E-02	no tox	
Cadmium	9.00E-03	3.00E-04	3.56E-03	5.00E-03	Cadmium
Calcium	5.42E+02	2.21E+01	8.66E+01	no tox	
Carbonate	5.40E+00	5.40E+00	5.40E+00	no tox	
Chloride	2.11E+03	1.51E-02	1.21E+02	2.50E+02	Chloride
Chromium	1.93E-02	1.60E-03	6.78E-03	1.00E-01	
Cobalt	5.02E-02	5.00E-04	9.30E-03	2.19E+00	
Copper	2.73E-02	1.30E-03	7.11E-03	1.46E+00	
Fluoride	4.80E-01	4.80E-01	4.80E-01	2.19E+00	
Iron	4.15E+01	5.30E-03	1.61E+00	3.E-01	Iron
Lead	1.02E-01	1.00E-03	4.29E-03	1.5E-02	Lead
Magnesium	1.42E+02	9.25E+00	2.44E+01	no tox	

U = undetected

Table 5-6 Summary of the non-radionuclide perched water concentration information.

Non-radionuclides Evaluated	Maximum (If measured above the detection limit)	Minimum (or Detection Limit)	Mean (Including Detection Limit for Nondetects)	Limiting Water Concentration	Possible COPCs
	mg/L				
Manganese	3.97E-01	8.00E-04	4.81E-02	1.83E-01	Manganese
Mercury	4.80E-04	1.00E-04	1.16E-04	2.00E-03	
Nickel	1.97E-01	3.00E-03	1.75E-02	7.30E-01	
Nitrate/Nitrite-N	6.96E+01	9.85E-03	1.44E+01	1.00E+01	Nitrate/Nitrite-N
Phenols	-	-	-	3.65E+00	
Potassium	4.68E+01	1.91E+00	6.58E+00	no tox	
Selenium	1.00E-02	1.00E-03	3.95E-03	5.00E-02	
Silver	7.30E-03	6.00E-04	1.63E-03	1.83E-01	
Sodium	5.31E+02	1.30E+01	7.04E+01	no tox	
Sulfate	1.74E+02	3.53E-02	4.35E+01	2.50E+02	
TDS	7.46E+04	0.00E+00	2.24E+03	5.00E+02	TDS
Tetrachloroethene	2.00E-03	3.00E-04	1.17E-03	7.30e+00	
Thallium	7.00E-03	3.30E-03	5.22E-03	2.00E-03	Thallium
Toluene	7.00E-02	1.00E-04	8.58E-03	1.00E+00	
Vanadium	2.20E-02	1.10E-03	1.15E-02	2.56E-01	
Zinc	6.93E-02	2.60E-03	1.44E-02	5.E+00	
Zirconium	3.13E-02	1.00E-03	1.71E-02	1.35E+02	

U = undetected

The perched water radionuclide data are summarized in Table 5-7. For each radionuclide, the maximum sample concentration was compared to the limiting water concentration. The radionuclides Am-241, H-3, I-129, Np-237, Sr-90, Tc-99, U-234, and U-238 were identified as possible COPCs based on the perched water data. All of these radionuclides had already been identified as COPCs based on the aquifer sample concentrations. Therefore, no new radionuclides were added to the list of COPCs based on the perched water sample information.

Table 5-7 Summary of the radionuclide perched water concentration information.

Radionuclides Evaluated	Maximum (If measured above the detection limit)	Minimum (or Detection Limit)	Mean (Including Detection Limit for Nondetects)	Limiting Water Concentration	Possible COPCs
	pCi/L				
Am-241	4.40E-01	0.00E+00	9.68E-02	1.46E-01	Am-241
Ce-144	U	U	U	1.62E+00	
Co-57	NR	NR	NR	4.95E+01	
Co-58	U	U	U	1.71E+01	
Co-60	U	U	U	2.54E+00	

U = undetected
NR = not reported
* = reported but in each case, the reported concentration is less than the reported uncertainty.

Table 5-7 Summary of the radionuclide perched water concentration information.

Radionuclides Evaluated	Maximum (If measured above the detection limit)	Minimum (or Detection Limit)	Mean (Including Detection Limit for Nondetects)	Limiting Water Concentration	Possible COPCs
	pCi/L				
Cs-134	U	U	U	1.01E+00	
Cs-137	U	U	U	1.52E+00	
Eu-152	U	U	U	8.42E+00	
Eu-154	U	U	U	5.12E+00	
Eu-155	2.00E-01	2.00E-01	2.00E-01	2.91E+01	
H-3	6.28E+04	2.40E+01	1.03E+04	6.71E+02	Tritium
I-129	1.10E+00	0.00E+00	8.14E-02	2.61E-01	I-129
K-40	NR	NR	NR	3.84E+00	
Nb-95	U	U	U	2.13E+01	
Np-237	4.00E+00	0.00E+00	9.67E-01	1.60E-01	Np-237
Pu-238	U*	U*	U*	1.63E-01	
Pu-239/240	U*	U*	U*	1.52E-01	
Ru-103	U	U	U	1.45E+01	
Ru-106	U	U	U	1.39E+00	
Sb-125	U	U	U	1.36E+01	
Sr-90	5.16E+05	0.00E+00	3.71E+04	8.59E-01	Sr-90
Tc-99	5.92E+02	0.00E+00	3.94E+01	3.43E+01	Tc-99
U-234	1.18E+01	0.00E+00	2.32E+00	1.08E+00	U-234
U-235	5.00E-01	0.00E+00	6.74E-02	1.02E+00	
U-238	3.30E+00	0.00E+00	1.29E+00	7.74E-01	U-238

U = undetected
NR = not reported
* = reported but in each case, the reported concentration is less than the reported uncertainty.

5.1.1.3 Summary of the identification of COPCs based on water samples

Based on data from the analysis of water samples in the aquifer and perched water, no non-radionuclides and 10 radionuclides have been identified as COPCs. The radionuclide COPCs are Am-241, H-3, I-129, Np-237, Sr-90, Tc-99, U-234, and U-238.

5.1.2 COPCs Identified Based on Maximum Potential Risk From the Soil Contamination

The soil screening process presented in Chapter 5 of the Book 1 identified 41 soils-related COPCs. These COPCs are listed in Table 5-8 and are evaluated in this section to identify those that may be a groundwater COPC, but that have not been defined based on the water samples from the aquifer and perched water. This analysis considers all soil contamination sample data from sites that are treated as soil contamination sources to the groundwater. Many of the soil COPCs are either (a) present in much smaller amounts than could conceivably pose a risk to the aquifer, (b) have Kd values sufficiently large so that they will bind to the alluvium and not be transported to the aquifer, or (c) decay before they reach the aquifer. A screening analysis to filter those contaminants that exist in low concentrations, or will not reach the aquifer, or

that will decay before they reach the aquifer is presented in Section 5.1.2.1. Evaluation of each COPC (listed in Table 5-8) using the screening procedure is presented in Section 5.1.2.2

Table 5-8 List of soils COPCs from Chapter 5 of Book 1.

Non-radionuclide Soils COPCs		Radionuclide Soils COPCs	
Aluminum	Phenanthrene	Americium-241	Neptunium-237
Antimony	Silver	Antimony-125	Niobium-95
Aroclor-1260	Thallium	Cerium-144	Plutonium-238
Arsenic	Toluene	Cesium-134	Plutonium-239
Benzo(a)pyrene	Trichloroethene	Cesium-137	Plutonium-239/240
Cadmium	Zirconium	Cobalt-57	Potassium-40
Calcium		Cobalt-58	Strontium-90
Chromium		Cobalt-60	Technetium-99
Copper		Europium-152	Uranium-234
Kepone		Europium-154	Uranium-235
Manganese		Europium-155	Uranium-238
Mercury		Iodine-129	

5.1.2.1 Description of the COPC identification methods

In order to identify additional groundwater COPCs, three soil contamination COPC screens were used. The first screen analyzed the toxicity that would be present in the pore water of the alluvium given the soil-water partitioning coefficient for each COPC; the second screen computes the time necessary for a given COPC to travel through the alluvium given the soil-water partitioning coefficient; and the third screen evaluates the number of half-lives a radionuclide would experience given the travel time necessary to migrate through the ICPP vadose zone sediments. Each of these screens is described in detail below.

Alluvium pore water toxicity:

The pore water toxicity screen compares the estimated pore water concentration for each contaminant to 100 times the limiting water concentration given in Tables 5-1 and 5-2. The screen is designed to eliminate from further evaluation any contaminant that is not sufficiently toxic given the measured soil concentrations to pose a risk to the groundwater. Computing the concentration expected in the pore water neglects the dilution and dispersion processes that occur as a contaminant migrates through the vadose zone and into the aquifer. Multiplying the limiting water concentration by 100 removes some of that conservatism by introducing an arbitrary dilution factor. On the other hand, a dilution and dispersion factor of 100 is still probably very conservative because the soil concentration used in computing the pore water concentration is equal to the maximum concentration observed. The maximum soil sample is often orders of magnitude larger than most of the measurements for a given contaminant at a given site. This introduces a large measure of conservatism into the soil concentration used to calculate the pore water concentrations.

The pore water concentrations are defined as:

$$C_{pw}\left(\frac{mg}{l}\right) = 1000\left(\frac{ml}{l}\right) \cdot \frac{C\left(\frac{mg}{kg}\right) \cdot \rho\left(\frac{kg}{1000g}\right)}{\theta + \rho \cdot Kd} \text{ for non-radionuclides,} \qquad (1)$$

and

$$C_{pw}\left(\frac{pCi}{l}\right) = 1000\left(\frac{ml}{l}\right) \cdot \frac{C\left(\frac{pCi}{g}\right) \cdot \rho}{\theta + \rho \cdot Kd} \text{ for radionuclides,} \tag{2}$$

where:

C_{pw}	pore water concentration in mg/l or pCi/l
C	soil concentration in mg/kg or pCi/g
ρ	soil bulk density (1.5 g/cc)
θ	soil moisture content (0.3)
Kd	soil-water partitioning coefficient (contaminant dependent (cc/g))

The limiting water concentration is defined as follows:

$$C_{Lrc}\left(\frac{pCi}{l}\right) = \frac{4.8 \cdot 10^{-11}}{SF} \tag{3}$$

$$C_{Lrnc}\left(\frac{mg}{l}\right) = \frac{8.5 \cdot 10^{-5}}{SF} \tag{4}$$

$$C_{Lnn}\left(\frac{mg}{l}\right) = 36.5 \cdot RFD \tag{5}$$

with:

C_{Lrc}	Limiting water concentration for radionuclides (pCi/l)
C_{Lnc}	Limiting water concentration for chemical carcinogens (mg/l)
C_{Lnn}	Limiting water concentration for chemical non-carcinogens (mg/l
SF	Slope factor (pCi^{-1}) or (mg^{-1})
RFD	Reference dose (mg/kg/d)

If the pore water concentration is less than 100 times the corresponding limiting water concentration, then when leached to the aquifer, that contaminant cannot pose a risk to the groundwater.

Non-Radionuclide travel time through the alluvium:

The second screen computes the time necessary for a contaminant to travel through the alluvium. It was assumed that if a contaminant is estimated to take more than 1000 years to move through the alluvium (surface sediments), then that contaminant may be a long-term surface risk but not a risk to groundwater. This screen is designed to eliminate all non-radionuclides with very high Kd values that cannot reach the aquifer within the time frame of interest. The travel time through the aquifer is calculated as:

$$TT_a = \frac{D_a}{V_c} \tag{6}$$

$$V_c = \frac{I}{\theta R} \tag{7}$$

$$R = 1 + \frac{(\rho \cdot Kd)}{\theta} \tag{8}$$

where:

TT_a	travel time through the alluvium (years)
D_a	average alluvium depth (11 m)
V_c	average linear contaminant velocity (m/y)
I	Infiltration rate (conservative at 1 m/y)
R	Retardation (dimensionless, contaminant specific)
ρ	soil bulk density (1.5 g/cc)
θ	soil moisture content (0.3)
Kd	contaminant specific equilibrium partition coefficient (ml/g)

The assumed infiltration rate through the alluvium of 1 m/y is conservative for all areas at the ICPP except the percolation ponds and sewage treatment facility. Therefore, the travel time through the alluvium should be a conservative estimate.

Estimated radionuclide travel time through the sediments versus half-life

Radioactive contaminants that will travel through the sediments in more than 10 half-lives are generally not considered to be a groundwater risk. During 10 half-lives, the activity of a radionuclide will be reduced by 99.9%, with only 0.1% of the original activity remaining. Because the activity concentration is linearly related to the risk, the risk will be reduced by a factor of 1000.

$$C = C_0 \cdot e^{-\lambda t} \text{ where:} \tag{9}$$

C	concentration at time = t	λ	decay constant for the radionuclide ($\ln(2) / t_{1/2}$)
C_o	concentration at time = 0	$t_{1/2}$	radioactive half life

If an instantaneous travel time through the basalts is assumed, the travel time through the sediments is a conservative estimate of the total travel time to the aquifer. For this analysis, conservative estimates have been used for the sediment thickness, infiltration rate, and volumetric soil moisture content. The sediment thickness is assumed to be 19 m, which is the average thickness of the interbeds beneath the ICPP. This is conservative because the radionuclide concentrations are measured in the surface sediments. Therefore, the total travel time will be the travel time through the surficial sediments plus the travel time through the interbeds. The surficial sediments have an average thickness of 11 m.

The model average infiltration rate over the ICPP is 1.53 m/y, and the range of interbed hydraulic conductivities used in the model is approximately 3 m/y (10 mD). The average infiltration rate used for these travel time calculations is 10 m/y, which is conservative by at least a factor of three. Some conservatism is needed to account for uncertainty in the water losses from the ICPP facility and variations in the Big Lost River infiltration rate.

The volumetric soil moisture content is assumed to be 0.3 for this analysis. This is lower than the actual soil moisture content in the interbeds (over 0.4) and therefore provides a conservative estimate for the travel time.

5.1.2.2 Results of the screening procedure

The first test applied the pore water toxicity screen to both the non-radionuclides and radionuclides. Table 5-9 shows the results of this screen for the non-radionuclides. The maximum soil concentrations are taken from the soil sample database that is in Appendix G of Book 1. These data were obtained from the ERIS database. Of the 18 non-radionuclide contaminants, all but aroclor-1260, arsenic, cadmium, chromium, and mercury were eliminated using the pore water toxicity screen. These were the only pore water estimates that were greater than the limiting groundwater concentration. Of these, cadmium was eliminated after a closer evaluation of the soils data. Out of the 31 soil sites, cadmium was only reported in three sites and of those three sites, only one site concentration results in a pore water concentration above the limiting concentration. Therefore, when combined with the other soil sites, the cadmium concentration will be extremely low and will not be expected to pose a risk to the groundwater quality. Table 5-10 shows the results of this screen for the radionuclides. Only Co-57, Co-58, Nb-95, and Sb-125 have pore water concentrations less than the limiting concentration and can be eliminated as a COPC, based on this screen. The maximum concentration of K-40 is above background, but the upper confidence limit (UCL) on the soil concentration is below background. Because the concentrations are similar to background and it is not a COPC based on the aquifer and perched water concentrations, it was eliminated as a possible COPC based on the soil concentrations. Therefore, 18 of the radionuclides were estimated to have pore water concentrations greater than the limiting water concentration of 10^{-4} risk. The four non-radionuclides and 18 radionuclides that fail this screening analysis are evaluated further in either the alluvium travel time screen (non-radionuclides) or travel time through the sediments versus half-life screen (radionuclides).

Table 5-9 Results of the pore water toxicity screen for the non-radionuclides.

Non-radionuclides Evaluated	Maximum Soil Concentration (mg/kg)	Pore Water Concentration (mg/l)	10^{-4}, HQ=100, or 100 X MCL Water Concentration (mg/l)	COPCs that are Retained After the Pore Water Toxicity Screen
Aluminum	120,000	4.80E+02	3.65E+03	
Antimony	9.5	1.89E-01	6.00E-01	
Aroclor-1260	23	2.30E-01	1.10E-03	Aroclor-1260
Arsenic	29.5	9.22E+00	5.67E-03	Arsenic
Benzo(a)pyrene	0.34	2.85E-04	1.16E-03	
Cadmium	5.1	8.23E-01	5.00E-01	Cadmium
Calcium	232,000	1.16E+06	---	
Chromium	37.3	2.66E+01	1.00E+01	Chromium
Copper	31.1	1.54E+00	1.46E+02	
Kepone	0.4	2.00E+00	---	
Manganese	534	1.06E+01	1.83E+01	
Mercury	140	1.40E+00	2.00E-01	Mercury
Phenanthrene	0.37	---	No Toxicity Data	
Silver	8.3	9.20E-02	1.83E+01	

Table 5-9 Results of the pore water toxicity screen for the non-radionuclides.

Non-radionuclides Evaluated	Maximum Soil Concentration (mg/kg)	Pore Water Concentration (mg/l)	10^{-4}, HQ=100, or 100 X MCL Water Concentration (mg/l)	COPCs that are Retained After the Pore Water Toxicity Screen
Thallium	4.85	4.85E-02	2.00E-1	
Toluene	0.001	8.33E-04	1.00E+02	
Trichloroethene	0.001	1.67E-03	5.00E-01	
Zirconium	14.3	7.15E+01	No Toxicity Data	

Table 5-10 Results of the pore water toxicity screen for the radionuclides.

Radionuclides Evaluated	Maximum Soil Concentration (pCi/g)	Pore Water Concentration (pCi/l)	10^{-4} Risk Based Water Concentration (pCi/l)	COPCs that are Retained After the Pore Water Toxicity Screen
Am-241	763	2.24E+03	1.46E+01	Am-241
Ce-144	2390	4.78E+03	1.62E+02	Ce-144
Co-57	1.02	1.00E+02	4.95E+03	
Co-58	0.07	6.86E+00	1.71E+03	
Co-60	21600	2.12E+06	2.54E+02	Co-60
Cs-134	1450	2.90E+03	1.01E+02	Cs-134
Cs-137	586000	1.17E+06	1.52E+02	Cs-137
Eu-152	87600	2.57E+05	8.42E+02	Eu-152
Eu-154	53500	1.57E+05	5.12E+02	Eu-154
Eu-155	9620	2.83E+04	2.91E+03	Eu-155
I-129	1.57	7.85E+03	2.61E+01	I-129
K-40	24.9	1.64E+03	3.84E+02	K-40
Nb-95	0.13	1.30E+00	2.13E+03	
Np-237	5.5	6.71E+02	1.60E+01	Np-237
Pu-238	8180	3.68E+05	1.63E+01	Pu-238
Pu-239	324	1.46E+04	1.52E+01	Pu-239
Pu-239/240	825	3.72E+04	1.52E+01	Pu-239/240
Sb-125	0.1	1.99E+00	1.36E+03	
Sr-90	586000	4.80E+07	8.59E+01	Sr-90
Tc-99	36.7	1.05E+05	3.43E+03	Tc-99
U-234	6.89	1.11E+03	1.08E+02	U-234
U-235	2.36	3.81E+02	1.02E+02	U-235
U-238	52.1	8.40E+03	7.74E+01	U-238

The second set of analyses applied the alluvium travel time screen to the non-radionuclides. Any of the four remaining non-radionuclides (aroclor-1260, arsenic, chromium, and mercury) with a travel time through the alluvium of greater than 1000 years were eliminated as COPCs. Table 5-11 shows the results of this screen. Of the four non-radionuclide contaminants remaining after the first screen, aroclor-1260 and mercury were eliminated, with arsenic and chromium remaining as nonradioactive COPCs. Neither of these contaminants

were identified as COPCs based on the aquifer and perched water sample data. However, based on the soil contamination data, they were added as COPCs.

Table 5-11 Results of the alluvium travel time screen for non-radionuclides.

Non-Radionuclides Evaluated	Kd (cm^3/g)	Retardation	Travel Time (years)	COPCs Retained After Screen 2 (Alluvium Travel Time Test)
Aroclor-1260	1.00E+02	5.01E+02	1.7E+3	
Arsenic	3.00E+00	1.60E+01	5.3E+1	Arsenic
Chromium	1.20E+00	7.00E+00	2.3E+1	Chromium
Mercury	1.00E+02	5.01E+02	1.7E+3	

The final analysis compared the estimated travel time necessary for radionuclides to migrate through the vadose zone sediments (alluvium and interbeds) to each radionuclide half-life. All radionuclides eliminated required more time than 10 half-lives to migrate through the sedimentary layers. The results of this screen are shown in Table 5-12. Of the 18 radionuclides, six were eliminated using this screen. Of the remaining 12 radionuclides, only Co-60 had not been previously identified through aquifer or perched water samples as a COPC.

Table 5-12 Results of estimated travel time through the sediments versus half-life screen.

Radionuclides Evaluated	Kd (cm^3/g)	Half-Life (years)	Retardation	Travel Time (years)	Number of Half-Lives in the Sediments	COPCs Retained After Screen 3 (Sediment Half-Life Test)
Am-241	3.40E+02	4.32E+02	1.70E+03	9.7E+2	2.2	Am-241
Ce-144	5.00E+02	7.78E-01	2.50E+03	1.4E+3	1833.5	
Co-60	1.00E+01	5.27E+00	5.10E+01	2.9E+1	5.5	Co-60
Cs-134	5.00E+02	2.06E+00	2.50E+03	1.4E+3	692.0	
Cs-137	5.00E+02	3.02E+01	2.50E+03	1.4E+3	47.2	
Eu-152	3.40E+02	1.36E+01	1.70E+03	9.7E+2	71.3	
Eu-154	3.40E+02	8.80E+00	1.70E+03	9.7E+2	110.2	
Eu-155	3.40E+02	4.96E+00	1.70E+03	9.7E+2	195.5	
I-129	0.00E+00	1.57E+07	1.00E+00	5.7E-1	0.0	I-129
Np-237	0.00E+00	2.14E+06	1.00E+00	5.7E-1	0.0	Np-237
Pu-238	2.20E+01	8.78E+01	1.11E+02	6.3E+1	0.7	Pu-238
Pu-239	2.20E+01	2.41E+04	1.11E+02	6.3E+1	0.0	Pu-239
Pu-239/240	2.20E+01	6.56E+03	1.11E+02	6.3E+1	0.0	Pu-239/240
Sr-90	1.20E+01	2.91E+01	6.10E+01	3.5E+1	1.2	Sr-90
Tc-99	1.50E-01	2.13E+05	1.75E+00	1.0E+0	0.0	Tc-99
U-234	6.00E+00	2.45E+05	3.10E+01	1.8E+1	0.0	U-234
U-235	6.00E+00	7.04E+08	3.10E+01	1.8E+1	0.0	U-235
U-238	6.00E+00	4.47E+09	3.10E+01	1.8E+1	0.0	U-238

5.1.3 COPCs Identified Based on Other Factors

It was assumed for this analysis that the methodology used for identification of COPCs, based on the water sample information and the soil contamination screens, was applicable to the contamination from known releases (such as the service waste and tank farm releases). The non-radionuclide screening based on alluvium travel time and the radionuclide screening based on the travel time versus the half-lives were not concentration or source mass dependent. Therefore, these screens apply to the known release sources as well as to the soil

contamination sources. The toxicity screen does not apply to the known release source; however, it was assumed that the perched water sample screening would have identified additional COPCs related to these releases. Exceptions and possible additions were evaluated based on the known relatively large releases of Cs-137 and mercury and the results of an evaluation of the radioactive waste inventory that would be expected to be in the Tank Farm liquid wastes.

A relatively large activity of Cs-137 and large mass of mercury have been released to the environment near the ground surface in the area of the ICPP. In addition, Cs-137 was in the waste stream injected into the aquifer from CPP-23. Though the COPC identification process had not identified Cs-137 or mercury as COPCs and they are not expected to be groundwater pathway concerns, they were added as COPCs because of the relatively large amount that has been released to the environment. The inclusion of these two contaminants will be used to show the extremely long vadose zone travel times and low vadose zone contaminant flux to the aquifer, expected from contaminants with very large Kd values. The Cs-137 disposed of to the injection well, could show a significant risk, but the vadose zone flux to the aquifer should be negligible.

5.1.4 COPCs Results and Summary

The final list of COPCs includes three non-radionuclides and 10 radionuclides as shown in Table 5-13. These are the COPCs identified based on the aquifer and perched water sample analysis, maximum potential risk from soil contamination, other considerations, and the final list of COPCs. In the case of plutonium and uranium, the individual isotopes of each of these radionuclides were combined and simulated as Total Pu and Total U because they are often reported as total values rather than individual isotope values. Total Pu and Total U masses will be used for the simulations assuming the longest half-lives for each (2.41E+04 years for Pu-239, and 4.47E+09 years for U-238) in order to be conservative.

An evaluation of the COPCs screening, based on process knowledge, is presented in Section 10.

Table 5-13 Summary of the identified groundwater COPCs.

COPCs Based on Water Samples				
Aquifer Based COPCs	Additional COPCs Based on Perched Water	Additional COPCs Based on Soil Contamination	Additional COPCs Based on Other Considerations	Final List of the COPCs for the Groundwater Pathway
Am-241	none	Arsenic	Cs-137	Arsenic
H-3		Chromium	Mercury	Chromium
I-129		Co-60		Mercury
Np-237		U-235		Am-241
Sr-90		Pu-238		Co-60
Tc-99		Pu-239		Cs-137
U-234		Pu-240		H-3
U-238				I-129
				Np-237
				Total Pu
				Sr-90
				Tc-99
				Total U

5.2 Contaminant Source Definition

The contaminant sources for the groundwater pathway are summarized in this section. Even though a list of 13 groundwater COPCs have been identified, a much broader range of potential contaminant sources are reported in this chapter. In this way, the information used for the identification of the COPCs is available for

review. If additional COPCs need to be evaluated in the future, the essential information will be available in a consistent format.

5.2.1 Description of the Types of Contaminant Sources

Each contaminant source of interest for the groundwater pathway at the ICPP is either a defined source distributed over time or as a mass of contaminant existing in the alluvium at a fixed time. Time dependent sources include:

- Contaminants from known or estimated liquid releases. These include the known releases from the tank farm consisting of (a) CPP-28 (which is assumed to cause the Site 79 contamination), (b) the 1986 tank farm Release, and (c) CPP-31. Known releases outside the tank farm include (a) CPP-02, which is a former french drain west of CPP-603, and (b) CPP-80, which is also known as the CPP-601 vent tunnel drain leak.
- Waste or process water that is currently disposed of in the sewage treatment system or the percolation ponds and process water that was disposed of directly in the aquifer via the CPP injection well.
- Chromium and tritium entering the aquifer from the Test Reactor Area (TRA) which must be incorporated into the ICPP aquifer model because of cumulative risk considerations.

Sources existing in the alluvium will be based on the soil concentration and estimates of the contaminated soil volume. Typically, these contaminants cannot be quantified based on known releases. The locations of each of these releases are shown in Figure 5-2 in Book 1, and to reduce the number of figures, will not be presented here.

The perched water contamination can be thought of as a source to groundwater but is a result of near-surface contamination releases. Thus, the surface contamination releases, and not the perched water, will be treated as a contaminant source to the aquifer. Perched water concentrations will be used to help calibrate the transport model and evaluate which of the contaminants moving through the vadose zone will pose a risk to the aquifer. Discussions of perched water contamination are contained in Book 1 Chapters 4 and 9.6.

5.2.2 Contaminant Sources Based on Known Releases

The following are the contaminant sources based on known or estimated releases:

- Tank Farm Releases

  CPP-28/79 - contaminated soil south of WM-181 by valve box A6.

  CPP-31 - contaminated soil south of WM-183.

  The 1986 Release.
- Other Releases

  CPP-02 - former french drain west of CPP-603.

  CPP-80 - CPP-601 vent tunnel drain leak (VT-300).

The tank farm releases are discussed below in Section 5.2.2.1, and the non-tank farm releases are discussed in Section 5.2.2.2

5.2.2.1 Tank Farm releases

The source terms for three known vadose zone releases related to tank farm operations were estimated. The three releases are (a) the high level liquid waste (HLLW) loss identified with CPP-28 and CPP-79; (b) the HLLW release identified with CPP-31; and (c) the 1986 release of process equipment waste (PEW). Table 5-14 summarizes the estimates of volume, duration, and quantity of radioactivity released at each of the three tank farm sites as well as the other two known or estimated release sites.

Table 5-14 Release estimate summary for CPP liquid release sites in the vadose zone.

Release Name	Release[a] Volume (l)	Release[b] Duration (days)	Begin[b] Date	End[b] Date	Estimate[c] of Total Activity Released (Ci)
CPP-28/79	13,736	6,848	1/1/56	10/1/74	32,661
CPP-31	52,990	29	11/1/72	11/30/72	28,000
1986	9,508	26	7/7/86	8/2/86	43
CPP-02	181,074,400	4,747	1/1/54	12/31/66	493
CPP-80	399,318	2,556	1/1/83	12/31/89	550

[a] Release volume for CPP-28/79 is determined by bounding calculations on the maximum throughput of a 1/8" diameter hole in a transfer line assuming a total volume of 1.234×10^7 L (3.26×10^6 gal) passed through the line under a pressure of 1.83 m (6 ft) see Appendix; the release volume for CPP-31 is provided in Allied Chemical Corp. (1975); the release volume for the 1986 is provided in WINCO (1986); the release volume for CPP-02 is provided in USGS (1974); the release volume for CPP-80 is provided in WINCO (1993).

[b] The release duration and dates for CPP-28/79 are estimated by assuming the release occurred from the time of construction (approximately 1/1/56) until time of discovery of the release (10/1/74); release duration and dates for CPP-31 are provided in Allied Chemical Corp. (1975); the release duration and dates for the 1986 are provided in WINCO (1986); the release duration and dates for CPP-02 are provided in USGS (1974); the release duration and dates for CPP-80 are provided in WINCO (1993).

[c] The total activity release estimate for CPP-28/79 is determined using a release volume of 13,736 L (3,629 gal) with an activity concentration of 2.38 Ci/L (9 Ci/gal); total activity release estimate for CPP-31 is provided in Allied Chemical Corp. (1975); the total activity release estimate for the 1986 is determined using a maximum process equipment waste (PEW) activity concentration of 1×10^7 d/min/ml (0.017 Ci/gal) and a release volume of 9508 L (2512 gal); the total activity release estimate for CPP-02 is provided in USGS (1974); the total activity release estimate for CPP-80 is provided in WINCO (1993).

Estimation of radionuclide composition and distribution in released Tank Farm waste:

Estimates of probable radionuclide composition and the subsequent distribution of the radionuclides as percent activity in the released waste were made for the three sites. Historical analytical data on HLLW composition were used in making the estimates. For each site, a maximum, minimum, and average estimate of activity distribution was made for each radionuclide potentially present in the waste.

- **CPP-28/79**

The release identified with CPP-28 and CPP-79 is assumed to be first cycle waste; therefore, the radionuclide estimates relied exclusively on data from the analysis of first cycle waste. The data of Rhodes (1972) provides the results of radionuclide analyses of first cycle waste samples obtained from the tank farm in September 1971. The data are shown in Table 5-15. The data were first converted into Ci/L, and the total activity per liter was determined for each tank sample, as shown in Table 5-16. Radionuclides originally reported in terms of mass were converted to activity values by using the specific activity of the respective nuclide:

$$SA = \left(\frac{activity}{mass}\right) = \frac{\lambda A_v}{M} \tag{10}$$

where:

SA	specific activity	λ	decay constant for the radionuclide ($\ln(2) / t_{1/2}$)
A_v	Avogadro's number = 6.02×10^{23} (nuclei/mole)	$t_{1/2}$	radioactive half life
M	Molecular (atomic) weight of the radionuclide		

After conversion of all radionuclide quantities to common units of Ci/L, the activity distribution as a percent of the total activity can be obtained. For each tank, the percentage of activity of the total activity was calculated for each radionuclide. The results are shown in Table 5-17.

Table 5-15 Results of radionuclide analyses of first cycle waste samples obtained from the tank farm in September 1971 reported by Rhodes (1972).

Radionuclide	Tank			Units
	WM-185	WM-187	WM-188	
Ce-144	3.85E+07	3.32E+07	7.22E+06	Bq/mL
Co-60	5.64E+04	3.34E+04	5.50E+04	Bq/mL
Cs-134	7.74E+06	7.72E+06	4.32E+06	Bq/mL
Cs-137	3.70E+07	2.59E+07	2.97E+07	Bq/mL
Eu-154	5.63E+05	4.03E+05	4.73E+05	Bq/mL
Gross Beta	2.42E+08	1.76E+08	1.20E+08	Bq/mL
H-3	3.01E+04	6.34E+03	4.49E+03	Bq/mL
Nb-95	1.82E+05	4.84E+05	3.28E+04	Bq/mL
Np	1.19E-05	1.57E-05	9.74E-06	g/L
Pu-239	7.22E+01	6.71E+01	7.04E+01	wt% of Pu
Pu-240	1.76E+01	2.05E+01	1.89E+01	wt% of Pu
Pu-241	7.80E+00	9.20E+00	8.20E+00	wt% of Pu
Pu-242	2.50E+00	3.40E+00	2.70E+00	wt% of Pu
Pu Total	1.93E-03	1.19E-03	1.54E-03	g/L
Ru-106	4.19E+06	3.32E+06	9.26E+05	Bq/mL
Sb-125	1.23E+06	1.10E+06	6.53E+05	Bq/mL
Sr-90	3.49E+07	6.98E+06	1.09E+07	Bq/mL
U-234	1.70E+00	1.20E+00	1.30E+00	wt% of U
U-235	5.61E+01	7.26E+01	3.08E+01	wt% of U
U-236	5.90E+00	6.30E+00	3.60E+00	wt% of U
U-238	3.63E+01	1.99E+01	6.43E+01	wt% of U
U Total	4.70E-04	9.13E-02	2.80E-03	g/L
Zr-95	1.60E+05	3.23E+05	5.82E+04	Bq/mL

Table 5-16 Conversion of radionuclide analyses of first cycle waste samples to common units of Ci/L and resulting total activity per L for each tank sample.

Radionuclide	Tank WM-185	Tank WM-187	Tank WM-188
Ce-144	1.041E+00	8.973E-01	1.951E-01
Co-60	1.524E-03	9.027E-04	1.486E-03
Cs-134	2.092E-01	2.086E-01	1.168E-01
Cs-137	1.000E+00	7.000E-01	8.027E-01
Eu-154	1.522E-02	1.089E-02	1.278E-02
H-3	8.135E-04	1.714E-04	1.214E-04
Nb-95	4.919E-03	1.308E-02	8.865E-04
Np-237[a]	8.383E-09	1.106E-08	6.862E-09
Pu-239	8.644E-05	4.953E-05	6.725E-05
Pu-240	7.709E-05	5.536E-05	6.605E-05
Pu-241	1.550E-02	1.127E-02	1.300E-02
Pu-242	1.900E-07	1.593E-07	1.637E-07
Ru-106	1.132E-01	8.973E-02	2.503E-02
Sb-125	3.324E-02	2.973E-02	1.765E-02
Sr-90	9.432E-01	1.886E-01	2.946E-01
U-234	4.959E-08	6.800E-06	2.259E-07
U-235	5.694E-10	1.432E-07	1.863E-09
U-236	1.793E-09	3.718E-07	6.516E-09
U-238	5.730E-11	6.102E-09	6.047E-10
Zr-95	4.324E-03	8.730E-03	1.573E-03
Total	3.382E+00	2.159E+00	1.482E+00

[a] Isotopes of Np are not specified in the analytical data; therefore all Np is assumed to be ^{237}Np.

Table 5-17 Activity distribution of radionuclides within each tank sample.

Radionuclide	Tank WM-185	Tank WM-187	Tank WM-188
Ce-144	3.077E-01	4.156E-01	1.317E-01
Co-60	4.507E-04	4.181E-04	1.003E-03
Cs-134	6.186E-02	9.663E-02	7.879E-02
Cs-137	2.957E-01	3.242E-01	5.417E-01
Eu-154	4.499E-03	5.044E-03	8.627E-03
H-3	2.405E-04	7.936E-05	8.189E-05
Nb-95	1.454E-03	6.058E-03	5.982E-04
Np-237	2.479E-09	5.122E-09	4.630E-09
Pu-239	2.556E-05	2.294E-05	4.538E-05
Pu-240	2.279E-05	2.564E-05	4.457E-05
Pu-241	4.584E-03	5.221E-03	8.775E-03
Pu-242	5.617E-08	7.377E-08	1.105E-07
Ru-106	3.348E-02	4.156E-02	1.689E-02

Table 5-17 Activity distribution of radionuclides within each tank sample.

Radionuclide	Tank WM-185	Tank WM-187	Tank WM-188
Sb-125	9.830E-03	1.377E-02	1.191E-02
Sr-90	2.789E-01	8.737E-02	1.988E-01
U-234	1.466E-08	3.149E-06	1.525E-07
U-235	1.684E-10	6.630E-08	1.257E-09
U-236	5.301E-10	1.722E-07	4.397E-09
U-238	1.694E-11	2.826E-09	4.080E-10
Zr-95	1.279E-03	4.043E-03	1.061E-03
Total	1	1	1

The activity distributions (as shown in Table 5-17) allow for the estimation of the activity contribution of each individual radionuclide for any given total activity quantity. For the CPP-28 site, it was estimated that a maximum total of 32,661 Ci could have been released. The radionuclide contribution estimates for the release are calculated by multiplying the total activity of 32,661 Ci by the tank sample activity distribution values of Table 5-17. The results are shown in Table 5-18. For each radionuclide, the maximum, minimum, and average activity release estimates were then determined from the values in Table 5-18 and are shown in Table 5-19.

Table 5-18 Activity contribution of each radionuclide that yields a total activity of 32,661 Ci.

Radionuclide	Tank WM-185	Tank WM-187	Tank WM-188
Ce-144	1.005E+04	1.357E+04	4.301E+03
Co-60	1.472E+01	1.365E+01	3.276E+01
Cs-134	2.020E+03	3.156E+03	2.573E+03
Cs-137	9.658E+03	1.059E+04	1.769E+04
Eu-154	1.470E+02	1.648E+02	2.818E+02
H-3	7.857E+00	2.592E+00	2.675E+00
Nb-95	4.750E+01	1.979E+02	1.954E+01
Np-237	8.096E-05	1.673E-04	1.512E-04
Pu-239	8.348E-01	7.492E-01	1.482E+00
Pu-240	7.445E-01	8.374E-01	1.456E+00
Pu-241	1.497E+02	1.705E+02	2.866E+02
Pu-242	1.835E-03	2.409E-03	3.608E-03
Ru-106	1.094E+03	1.357E+03	5.516E+02
Sb-125	3.210E+02	4.497E+02	3.890E+02
Sr-90	9.109E+03	2.854E+03	6.493E+03
U-234	4.790E-04	1.029E-01	4.980E-03
U-235	5.499E-06	2.165E-03	4.105E-05
U-236	1.731E-05	5.624E-03	1.436E-04
U-238	5.534E-07	9.230E-05	1.333E-05
Zr-95	4.176E+01	1.320E+02	3.467E+01
Total	3.266E+04	3.266E+04	3.266E+04

Table 5-19 Radionuclide release estimates for CPP-28[a].

Radionuclide	Maximum (Ci)	Minimum (Ci)	Average (Ci)
Ce-144	1.357E+04	4.301E+03	9.308E+03
Co-60	3.276E+01	1.365E+01	2.038E+01
Cs-134	3.156E+03	2.020E+03	2.583E+03
Cs-137	1.769E+04	9.658E+03	1.265E+04
Eu-154	2.818E+02	1.470E+02	1.978E+02
H-3	7.857E+00	2.592E+00	4.374E+00
Nb-95	1.979E+02	1.954E+01	8.830E+01
Np-237[b]	1.673E-04	8.096E-05	1.332E-04
Pu-239	1.482E+00	7.492E-01	1.022E+00
Pu-240	1.456E+00	7.445E-01	1.013E+00
Pu-241	2.866E+02	1.497E+02	2.023E+02
Pu-242	3.608E-03	1.835E-03	2.617E-03
Ru-106	1.357E+03	5.516E+02	1.001E+03
Sb-125	4.497E+02	3.210E+02	3.866E+02
Sr-90	9.109E+03	2.854E+03	6.152E+03
U-234	1.029E-01	4.790E-04	3.611E-02
U-235	2.165E-03	5.499E-06	7.373E-04
U-236	5.624E-03	1.731E-05	1.928E-03
U-238	9.230E-05	5.534E-07	3.539E-05
Zr-95	1.320E+02	3.467E+01	6.949E+01
Total	4.628E+04	2.007E+04	3.266E+04

[a] Release estimates were calculated using percent activity for each radionuclide as determined from first cycle raffinate analytical data of Rhodes, 1972 (Rhod-4-72) and assuming a release activity of 32,661 Ci for CPP-28. The release activity is based on a release volume of 13,736 L (3,629 gal) with an activity concentration of 2.38 Ci/L (9 Ci/gal).
[b] Isotopes of Np are not specified in the analytical data; therefore all Np is assumed to be 237Np.

- **CPP-31**

The release identified with CPP-31 is known to be tank farm HLLW (Allied Chemical Corp. 1975). The average radiochemical composition of tank farm waste reported in the tank farm inventory data of Donovan (1989) provides the basis for determining the radionuclide distribution in the CPP-31 release and is shown in Table 5-20. As in the estimation for CPP-28/79, the data were first converted into common units of Ci/L, and the total activity per liter was determined for each tank sample as shown in Table 5-21. Radionuclides reported in terms of mass were converted to activity values by using the specific activity of the respective nuclide.

For the total uranium and total plutonium reported in terms of mass, the distribution of the specific isotopes of uranium and plutonium were estimated by using the combined average weight percent distributions of the isotopes measured in first and second cycle raffinate reported in Rhodes (1972). For the total plutonium reported in terms of activity, the combined average intrinsic activity distributions of the isotopes were determined from the weight percent data and thus applied. Table 5-22 provides the activity distribution fractions and the weight percent distributions, which were used to estimate the uranium and plutonium isotope distributions.

The data in Table 5-21 were then converted to activity distribution values. For each tank, the activity fraction of the total activity were calculated for each radionuclide and shown in Table 5-23. For the CPP-31

site, it was estimated that a total of 28,000 Ci was released. The radionuclide contribution estimates for the CPP-31 release are calculated by multiplying the total activity of 28,000 Ci by the tank sample activity distribution values of Table 5-23, and for each radionuclide, the maximum, minimum, and average activity release estimates are determined. The results are shown in Table 5-24.

Further investigation into the Dononvan (1989) data used to calculate CPP-31 release lead to the discovery of a significant error for Am-241 and minors errors for Np-237 and Pu. These errors are footnoted in Table 5-20 but the simulations (Section 7) were not rerun because the change in estimates have negligible affect on the simulation solutions. Although these errors do not significantly effect the simulation results presented in Section 7, an alternative approach was used to calculate the CPP-31 source estimate in order to evaluate the accuracy of these original estimates. The results of the CPP-31 source reestimation are presented in Section 10.

Table 5-20 Average radiochemical composition of tank farm waste reported in the tank farm inventory data of Donovan (1989).

Radionuclide	WM-180	WM-181	WM-182	WM-183	WM-184	WM-185	WM-186	WM-187	WM-188	WM-189	Units
Am-241		0.25[a]			0.02	0.02					mg/L
Ce-144		4.29	41.71	2.35		5.50	2.19	2.54		5.41	mCi/L
Co-60		0.41		0.43		0.12	0.15	0.36		0.59	mCi/L
Cs-134	0.89	4.37	41.35	6.12	0.03	2.38	1.98	5.25		15.61	mCi/L
Cs-137	54.05	34.92	651.35	257.46	23.70	151.55	37.57	451.39		235.49	mCi/L
Eu-154		0.68	8.87	1.75	0.04	0.56	0.25	3.66		1.60	mCi/L
Eu-155			3.80	1.59				1.56			mCi/L
H-3		0.09		0.25	0.03	0.01		0.36			mCi/L
I-129[b]		0.04		0.04	0.01	0.08					uCi/L
Np-237		1.18[c]			0.65	2.25					mg/L
Pu total		0.27[d]			1.53[d]	1.32[d]					mg/L
Pu total	0.76		2.37					2.67			mCi/L
Ru-106		1.92	0.85				0.59				mCi/L
Sb-125		0.80	0.78				0.25	1.84			mCi/L
Sr-90	46.93	32.71	557.60	221.45	27.43	122.17	35.27	471.67		82.72	mCi/L
Tc-99				0.98	0.51		0.46				mg/L
U total		75.45		96.50	57.00	83.71		6.49	6.99		mg/L

a. Based on the revisions of Siemer (1994) of the Donovan (1989) date, the Am-241 concentration should be 0.014 mg/L. This would change the average Am-241 concentration from 9.7E-02 to 1.8E-02 mg/L. This is a factor of 5 decrease in concentration.
b. I-129 values were erroneously reported as mCi/L instead of the correct units of uCi/L. The data have been corrected accordingly.
c. Based on the revisions of Siemer (1994) of the Donovan (1989) data, the Np-237 concentration should be 0.31 mg/L. This would change the average Np-237 concentration from 1.36 to 1.07 mg/L. This is a concentration decrease of 21%.
d. Based on the revisions of Siemer (1994) of the Donovan (1989) date, the Pu concentrations for WM-181, WM-184, and WM-185 should be 0.29, 1.22, and 1.05 mg/L. This would change the average Pu concentration from 1.04 to 0.85 mg/L. This is a concentration decrease of 18%.

Table 5-21 Conversion of tank farm average radiochemical composition data to common units of Ci/L and resulting total activity per L for each tank.

Radio-nuclide	WM-180	WM-181	WM-182	WM-183	WM-184	WM-185	WM-186	WM-187	WM-188	WM-189
Am-241		8.565E-04			6.852E-05	6.852E-05				
Ce-144		4.290E-03	4.171E-02	2.350E-03		5.500E-03	2.190E-03	2.540E-03		5.410E-03
Co-60		4.100E-04		4.300E-04		1.200E-04	1.500E-04	3.600E-04		5.900E-04
Cs-134	8.900E-04	4.370E-03	4.135E-02	6.120E-03	3.000E-05	2.380E-03	1.980E-03	5.250E-03		1.561E-02
Cs-137	5.405E-02	3.492E-02	6.514E-01	2.575E-01	2.370E-02	1.516E-01	3.757E-02	4.514E-01		2.355E-01
Eu-154		6.800E-04	8.870E-03	1.750E-03	4.000E-05	5.600E-04	2.500E-04	3.660E-03		1.600E-03
Eu-155			3.800E-03	1.590E-03				1.560E-03		
H-3		9.000E-05		2.500E-04	3.000E-05	1.000E-05		3.600E-04		
I-129[a]		4.000E-08		4.000E-08	1.000E-08	8.000E-08				
Np-237		8.313E-07			4.579E-07	1.585E-06				
Pu-239	1.248E-05	1.316E-05	3.890E-05		7.455E-05	6.432E-05		4.383E-05		
Pu-240	6.268E-06	8.716E-06	1.955E-05		4.939E-05	4.261E-05		2.202E-05		
Pu-241	7.412E-04	1.585E-03	2.312E-03		8.981E-03	7.748E-03		2.604E-03		
Pu-242	7.943E-09	1.736E-08	2.477E-08		9.839E-08	8.488E-08		2.790E-08		
Ru-106		1.920E-03	8.500E-04				5.900E-04			
Sb-125		8.000E-04	7.800E-04				2.500E-04	1.840E-03		
Sr-90	4.693E-02	3.271E-02	5.576E-01	2.215E-01	2.743E-02	1.222E-01	3.527E-02	4.717E-01		8.272E-02
Tc-99				1.661E-05	8.643E-06		7.796E-06			
U-234		4.597E-06		5.880E-06	3.473E-06	5.101E-06		3.955E-07	4.259E-07	
U-235		7.426E-08		9.498E-08	5.610E-08	8.239E-08		6.388E-09	6.880E-09	
U-236		1.745E-07		2.232E-07	1.319E-07	1.936E-07		1.501E-08	1.617E-08	
U-238		1.264E-08		1.616E-08	9.546E-09	1.402E-08		1.087E-09	1.171E-09	
Total	1.026E-01	8.270E-02	1.309E+00	4.915E-01	6.043E-02	2.903E-01	7.826E-02	9.413E-01	1.465E+00	3.414E-01

a. I-129 values were erroneously reported as mCi/L instead of the correct units of uCi/L. The data have been corrected accordingly.

Table 5-22 Distribution factors used in estimating plutonium and uranium isotopes for the CPP-31 and 1986 releases.

First Cycle Waste				Second Cycle Waste			Averages			Units
Radio-nuclide	WM-185	WM-187	WM-188	WM-181	WM-184	WM-186	First Cycle	Second Cycle	Combined	Unit
Pu-239	5.518E-03	4.353E-03	5.119E-03	1.043E-02	4.523E-02		4.997E-03	2.783E-02	1.642E-02	activity fraction
Pu-240	4.921E-03	4.865E-03	5.028E-03	3.813E-03	1.930E-02		4.938E-03	1.156E-02	8.248E-03	activity fraction
Pu-241	9.895E-01	9.908E-01	9.898E-01	9.858E-01	9.355E-01		9.901E-01	9.606E-01	9.753E-01	activity fraction
Pu-242	1.213E-05	1.400E-05	1.246E-05	3.077E-06	1.301E-05		1.286E-05	8.041E-06	1.045E-05	activity fraction
U-234	9.535E-01	9.288E-01	9.618E-01	9.423E-01	9.443E-01	8.779E-01	9.480E-01	9.215E-01	9.348E-01	activity fraction
U-235	1.095E-02	1.955E-02	7.928E-03	2.204E-02	2.227E-02	1.989E-02	1.281E-02	2.140E-02	1.711E-02	activity fraction
U-236	3.446E-02	5.079E-02	2.774E-02	3.141E-02	3.178E-02	5.283E-02	3.766E-02	3.867E-02	3.817E-02	activity fraction
U-238	1.102E-03	8.334E-04	2.574E-03	4.202E-03	1.699E-03	4.936E-02	1.503E-03	1.842E-02	9.962E-03	activity fraction

Table 5-22 Distribution factors used in estimating plutonium and uranium isotopes for the CPP-31 and 1986 releases.

	First Cycle Waste			Second Cycle Waste			Averages			Units
Radio-nuclide	WM-185	WM-187	WM-188	WM-181	WM-184	WM-186	First Cycle	Second Cycle	Combined	Unit
Pu-239	7.220E+01	6.710E+01	7.040E+01	8.610E+01	8.830E+01		6.990E+01	8.720E+01	7.855E+01	weight% of Pu
Pu-240	1.760E+01	2.050E+01	1.890E+01	8.600E+00	1.030E+01		1.900E+01	9.450E+00	1.423E+01	weight% of Pu
Pu-241	7.800E+00	9.200E+00	8.200E+00	4.900E+00	1.100E+00		8.400E+00	3.000E+00	5.700E+00	weight% of Pu
Pu-242	2.500E+00	3.400E+00	2.700E+00	4.000E-01	4.000E-01		2.867E+00	4.000E-01	1.633E+00	weight% of Pu
U-234	1.700E+00	1.200E+00	1.300E+00	6.500E-01	9.500E-01	9.000E-02	1.400E+00	5.633E-01	9.817E-01	weight% of U
U-235	5.610E+01	7.260E+01	3.080E+01	4.370E+01	6.439E+01	5.860E+00	5.317E+01	3.798E+01	4.558E+01	weight% of U
U-236	5.900E+00	6.300E+00	3.600E+00	2.080E+00	3.070E+00	5.200E-01	5.267E+00	1.890E+00	3.578E+00	weight% of U
U-238	3.630E+01	1.990E+01	6.430E+01	5.357E+01	3.159E+01	9.353E+01	4.017E+01	5.956E+01	4.987E+01	weight% of U

Table 5-23 Activity distribution of radionuclides within each tank for average radiochemical composition data used in estimating the CPP-31 and 1986 releases.

Radio-nuclide	WM-180	WM-181	WM-182	WM-183	WM-184	WM-185	WM-186	WM-187	WM-188	WM-189
Am-241		1.036E-02			1.134E-03	2.360E-04				
Ce-144		5.187E-02	3.187E-02	4.782E-03		1.895E-02	2.798E-02	2.698E-03		1.585E-02
Co-60		4.958E-03		8.749E-04		4.134E-04	1.917E-03	3.824E-04		1.728E-03
Cs-134	8.672E-03	5.284E-02	3.160E-02	1.245E-02	4.965E-04	8.198E-03	2.530E-02	5.577E-03		4.572E-02
Cs-137	5.266E-01	4.223E-01	4.977E-01	5.239E-01	3.922E-01	5.220E-01	4.801E-01	4.795E-01		6.897E-01
Eu-154		8.223E-03	6.778E-03	3.561E-03	6.620E-04	1.929E-03	3.195E-03	3.888E-03		4.686E-03
Eu-155			2.904E-03	3.235E-03				1.657E-03		
H-3		1.088E-03		5.087E-04	4.965E-04	3.445E-05		3.824E-04		
I-129[b]		4.837E-07		8.139E-08	1.655E-07	2.756E-07				
Np-237		1.005E-05			7.578E-06	5.460E-06				
Pu-239	1.216E-04	1.591E-04	2.973E-05		1.234E-03	2.216E-04		4.656E-05		
Pu-240	6.108E-05	1.054E-04	1.494E-05		8.174E-04	1.468E-04		2.340E-05		
Pu-241	7.223E-03	1.916E-02	1.766E-03		1.486E-01	2.669E-02		2.767E-03		
Pu-242	7.739E-08	2.099E-07	1.893E-08		1.628E-06	2.924E-07		2.965E-08		
Ru-106		2.322E-02	6.495E-04				7.539E-03			
Sb-125		9.674E-03	5.960E-04				3.195E-03	1.955E-03		
Sr-90	4.573E-01	3.955E-01	4.261E-01	4.506E-01	4.539E-01	4.208E-01	4.507E-01	5.011E-01		2.423E-01
Tc-99				3.379E-05	1.430E-04		9.962E-05			
U-234		5.559E-05		1.196E-05	5.748E-05	1.757E-05		4.201E-07	2.908E-07	
U-235		8.980E-07		1.933E-07	9.285E-07	2.838E-07		6.786E-09	4.697E-09	
U-236		2.110E-06		4.542E-07	2.182E-06	6.670E-07		1.595E-08	1.104E-08	

a. Specific radionuclide concentrations for the bulk of the total activity concentration for Tank WM-188 were not reported. A total activity concentration of 1464.86 mCi/L was reported for Tank WM-188 and only total uranium was specifically in the data at 6.99 mg/L. The resulting uranium isotope activity distribution for Tank WM-188 is calculated using the total activity concentration of 1464.86 mCi/L (see Table 5-21).

b. I-129 values were erroneously reported as mCi/L instead of the correct units of uCi/L. The data have been corrected accordingly.

Table 5-23 Activity distribution of radionuclides within each tank for average radiochemical composition data used in estimating the CPP-31 and 1986 releases.

Radio-nuclide	WM-180	WM-181	WM-182	WM-183	WM-184	WM-185	WM-186	WM-187	WM-188	WM-189
U-238		1.528E-07		3.288E-08	1.580E-07	4.829E-08		1.155E-09	7.991E-10	
Total	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	a	1.00E+00

a. Specific radionuclide concentrations for the bulk of the total activity concentration for Tank WM-188 were not reported. A total activity concentration of 1464.86 mCi/L was reported for Tank WM-188 and only total uranium was specifically in the data at 6.99 mg/L. The resulting uranium isotope activity distribution for Tank WM-188 is calculated using the total activity concentration of 1464.86 mCi/L (see Table 5-21).

b. I-129 values were erroneously reported as mCi/L instead of the correct units of uCi/L. The data have been corrected accordingly.

Table 5-24 Radionuclide release estimates for CPP-31[a].

Radionuclide	Maximum (Ci)	Minimum (Ci)	Average (Ci)
Am-241	2.900E+02	6.609E+00	1.09E+02[b]
Ce-144	1.452E+03	7.556E+01	6.16E+02
Co-60	1.388E+02	1.071E+01	4.79E+01
Cs-134	1.480E+03	1.390E+01	5.94E+02
Cs-137	1.931E+04	1.098E+04	1.41E+04
Eu-154	2.302E+02	1.854E+01	1.15E+02
Eu-155	9.059E+01	4.640E+01	7.28E+01
H-3	3.047E+01	9.645E-01	1.41E+01
I-129[c]	1.354E-02	2.279E-03	7.04E-03
Np-237	2.815E-01	1.529E-01	2.16E-01[d]
Pu-239[c]	3.454E+01	8.324E-01	8.46E+00[e]
Pu-240[c]	2.289E+01	4.182E-01	5.46E+00
Pu-241[c]	4.161E+03	4.946E+01	9.62E+02
Pu-242[c]	4.559E-02	5.300E-04	1.05E-02
Ru-106	6.501E+02	1.819E+01	2.93E+02
Sb-125	2.709E+02	1.669E+01	1.08E+02
Sr-90	1.403E+04	6.784E+03	1.18E+04
Tc-99	4.005E+00	9.462E-01	2.58E+00
U-234	1.609E+00	8.141E-03	6.69E-01
U-235	2.600E-02	1.315E-04	1.08E-02
U-236	6.110E-02	3.091E-04	2.54E-02
U-238	4.423E-03	2.238E-05	1.84E-03
Total	4.221E+04	1.803E+04	2.89E+04

a. Release estimates were calculated from percent activities determined from 1989 tank farm Inventory data of Donovan (1989) assuming a release activity of 28,000 Ci for CPP-31. Distribution of uranium and plutonium isotopes, total uranium activity, and total plutonium activity were estimated from the first and second cycle raffinate analytical data of Rhodes, 1972 (Rhod-4-72).

b. Based on revisions of Siemer (1994), the Am-241 release is overestimated by a factor of 5. See the footnotes in Table 5-20.

c. I-129 values were erroneously reported as mCi/L instead of the correct units of uCi/L. The data have been corrected accordingly.

d. Based on revisions of Siemer (1994), the Np-237 release is overestimated by 21%. See the footnotes in Table 5-20.

e. Based on revisions of Siemer (1994), the Pu release is somewhat overestimated. See the footnotes in Table 5-20. The Pu estimates are based on mass estimates from some tanks and activity from others. Only the tanks with mass estimates were identified as inaccurate. For those tanks the release is overestimated by 18%.

• **The 1986 Release**

Between 7/7/86 and 8/2/86 PEW waste was released during transfers from WC-119 (WCF sump tank) to WL-102 (PEW feed tank). The release is documented in WINCO 1986. The average radiochemical composition of tank farm waste reported in the tank farm inventory data of Donovan (1989) conservatively estimates potential radionuclides in the 1986 release. These estimates are shown in Table 5-20.

For the 1986 site, it was estimated that a total of 43 Ci was released. Therefore, the radionuclide contribution estimates for the 1986 release are calculated by multiplying the total activity of 43 Ci by the tank sample activity distribution values of Table 5-23. For each radionuclide, the maximum, minimum, and average activity release estimates are determined and are shown in Table 5-25.

Table 5-25 Radionuclide release estimates for the 1986 release[a].

Radionuclide	Maximum (Ci)	Minimum (Ci)	Average (Ci)
Am-241	4.454E-01	1.015E-02	1.68E-01[b]
Ce-144	2.231E+00	1.160E-01	9.46E-01
Co-60	2.132E-01	1.645E-02	7.36E-02
Cs-134	2.272E+00	2.135E-02	9.12E-01
Cs-137	2.966E+01	1.687E+01	2.17E+01
Eu-154	3.536E-01	2.846E-02	1.77E-01
Eu-155	1.391E-01	7.126E-02	1.12E-01
H-3	4.680E-02	1.481E-03	2.16E-02
I-129[c]	2.080E-05	3.500E-06	1.08E-05
Np-237	4.322E-04	2.348E-04	3.31E-04[d]
Pu-239[e]	5.305E-02	1.278E-03	1.30E-02
Pu-240[e]	3.515E-02	6.423E-04	8.38E-03
Pu-241[e]	6.391E+00	7.595E-02	1.48E+00
Pu-242[e]	7.001E-05	8.139E-07	1.62E-05
Ru-106	9.983E-01	2.793E-02	4.50E-01
Sb-125	4.160E-01	2.563E-02	1.66E-01
Sr-90	2.155E+01	1.042E+01	1.81E+01
Tc-99	6.151E-03	1.453E-03	3.96E-03
U-234	2.472E-03	1.250E-05	1.03E-03
U-235	3.992E-05	2.020E-07	1.66E-05
U-236	9.383E-05	4.746E-07	3.90E-05
U-238	6.793E-06	3.436E-08	2.82E-06
Total	6.483E+01	2.769E+01	4.43E+01

a. Release estimates were calculated from percent activities determined from 1989 tank farm Inventory data of Donovan (1989) assuming a release activity of 43 Ci for the 1986 release. The release activity is based on a maximum process equipment waste (PEW) activity concentration of 1 x 10^7 d/min/ml (0.017 Ci/gal) and a release volume of 9508 L (2512 gal). Distribution of uranium and plutonium isotopes, total uranium activity, and total plutonium activity were estimated from the first and second cycle raffinate analytical data of Rhodes, 1972 (Rhod-4-72).
b. Based on revisions of Siemer (1994), the Am-241 release is overestimated by a factor of 5. See the footnotes in Table 5-20.
c. I-129 values were erroneously reported as mCi/L instead of the correct units of uCi/L. The data have been corrected accordingly.
d. Based on revisions of Siemer (1994), the Np-237 release is overestimated by 21%. See the footnotes in Table 5-20.
e. Based on revisions of Siemer (1994), the Pu release is somewhat overestimated. See the footnotes in Table 5-20. The Pu estimates are based on mass estimates from some tanks and activity from others. Only the tanks with mass estimates were identified as inaccurate. For those tanks the release is overestimated by 18%.

Estimation of non-radioactive constituents in released Tank Farm waste

• CPP-28/79

The data of Rhodes (1972) provides the results of non-radioactive chemical analyses of first cycle waste samples obtained from the tank farm in September 1971. These data are shown in Table 5-26. The data were converted into common units of kg/L, and multiplying by the total release volume yields the total mass release estimate of each constituent. Table 5-27 provides the maximum, minimum, and average value of the total mass release estimates for nonradioactive constituents from CPP-28/79.

• CPP-31

The data of Donovan (1989) provides average non-radioactive chemical composition of tank farm waste. These data are shown in Table 5-28. The data were converted into common units of kg/L as shown in Table 5-29, and multiplying by the total release volume yields the total mass release estimate of each constituent. Table 5-30 provides the maximum, minimum, and average value of the total mass release estimates for nonradioactive constituents from CPP-31.

Table 5-26 Non-radioactive chemical constituents of first cycle waste from Rhodes (1972)

Non-radionuclide	WM-185	WM-187	WM-188	Units
H^+	1.51	1.62	1.72	M
Al^{+3}	0.68	0.64	0.69	M
Zr^{+4}	0.44	0.44	0.48	M
F^-	3.12	3	3.52	M
B	2.16	2.08	2.34	g/L
$NO3^-$	2.36	2.32	2.4	M
Fe^{+3}	0.257	0.225	0.298	g/L
Cl^-	9	12	37	mg/L
Na	29	60	74	mg/L
H^+	1.522E-03	1.633E-03	1.734E-03	kg/L
Al^{+3}	1.835E-02	1.727E-02	1.862E-02	kg/L
Zr^{+4}	4.014E-02	4.014E-02	4.379E-02	kg/L
F^-	5.928E-02	5.700E-02	6.687E-02	kg/L
B	2.160E-03	2.080E-03	2.340E-03	kg/L
$NO3^-$	1.463E-01	1.439E-01	1.488E-01	kg/L
Fe^{+3}	2.570E-04	2.250E-04	2.980E-04	kg/L
Cl^-	9.000E-06	1.200E-05	3.700E-05	kg/L
Na	2.900E-05	6.000E-05	7.400E-05	kg/L

Table 5-27 Release estimates of non-radioactive constituents for CPP-28[a].

Nonradionuclide	Maximum (kg)	Minimum (kg)	Average (kg)
H^+	23.81	20.90	22.38
Al^{+3}	255.72	237.19	248.31
Zr^{+4}	601.43	551.31	568.02
F^-	918.57	782.87	838.54
B	32.14	28.57	30.13
NO_3^-	2044.04	1975.91	2009.98
Fe^{+3}	4.09	3.09	3.57
Cl^-	0.51	0.12	0.27
Na	1.02	0.40	0.75

[a] Release estimates were calculated from first cycle raffinate analytical data of Rhodes, 1972 (Rhod-4-72) assuming a release volume of 13,736 L (3,629 gal) for CPP-28.

Table 5-28 Non-radioactive chemical constituents of tank farm waste from Donovan (1989).

Nonradionuclide	WM-180	WM-181	WM-182	WM-183	WM-184	WM-185	WM-186	WM-187	WM-188	WM-189	Units
H^+	1.92	1.51	0.83	1.77	0.43	1.71	1.49	1.51	1.79	1.8	Normal
NO_3	5.79	3.24	4.11	4.53	4.63	5.05	2.93	1.39	1.78	2.28	M
Al	0.55	0.21	1.19	0.52	0.81	0.71	0.35	0.43	0.29	0.18	M
Na	1.78	0.83	0.02	0.78	1.98	1.38	0.96	0.02	0.03	0.05	M
K	0.23	0.12		0.10	0.13	0.18	0.16		0.01	0.04	M
F	0.05	0.08	0.07	0.04	0.04	0.15	0.04	2.32	1.74	0.28	M
Zr		0.01	0.01			0.01		0.31	0.26	0.03	M
B	0.26	0.17	0.13	0.15	0.08	0.29	0.22	1.62	1.81	0.26	g/L
Cd	0.17	0.49	0.20	0.13	0.02	0.10	0.19	5.82	11.59	1.22	g/L
Ca		1.78		1.51	0.44	2.55	2.52			4.35	g/L
Cl	0.74	0.27	0.05	0.28	1.54	1.08	0.7	0.05	0.05	0.12	g/L
Cr		0.13		0.67	0.11	0.28				0.09	g/L
Fe	1.41	0.66	1.14	3.02	1.11	1.22	1.01	0.3	0.37	0.25	g/L
Pb		0.21		0.27	0.20	0.17					g/L
Hg		0.10		0.53	0.31	0.86					g/L
Mo		0.05		0.07	0.05	0.05				0.05	g/L
Mn		0.71		0.75	0.46	1.05.16					g/L
Ni		0.07		0.32	0.07	0.10				0.05	g/L
P		0.19		0.19	0.73	0.08					g/L
SO_4	2.97	3.85	4.18	0.81	6.66	3.73	3.2	3.49	6.59	0.86	g/L

Table 5-29 Non-radioactive chemical constituents of tank farm waste from Donovan (1989) expressed in kg/L.

Non-radio-nuclide	WM-180	WM-181	WM-182	WM-183	WM-184	WM-185	WM-186	WM-187	WM-188	WM-189
H^+	1.935E-03	1.522E-03	8.366E-04	1.784E-03	4.334E-04	1.724E-03	1.502E-03	1.522E-03	1.804E-03	1.814E-03
NO_3	3.590E-01	2.009E-01	2.548E-01	2.809E-01	2.871E-01	3.131E-01	1.817E-01	8.619E-02	1.104E-01	1.414E-01
Al	1.484E-02	5.666E-03	3.211E-02	1.403E-02	2.186E-02	1.916E-02	9.444E-03	1.160E-02	7.825E-03	4.857E-03
Na	4.092E-02	1.908E-02	4.598E-04	1.793E-02	4.552E-02	3.173E-02	2.207E-02	4.598E-04	6.897E-04	1.149E-03
K	8.993E-03	4.731E-03		3.910E-03	5.083E-03	7.038E-03	6.256E-03		3.910E-04	1.564E-03
F	9.499E-04	1.520E-03	1.330E-03	7.599E-04	7.599E-04	2.850E-03	7.599E-04	4.408E-02	3.306E-02	5.320E-03
Zr		9.122E-04	9.122E-04			9.122E-04		2.828E-02	2.372E-02	2.737E-03
B	2.600E-04	1.700E-04	1.300E-04	1.500E-04	8.000E-05	2.900E-04	2.200E-04	1.620E-03	1.810E-03	2.600E-04
Cd	1.700E-04	4.900E-04	2.000E-04	1.300E-04	2.000E-05	1.000E-04	1.900E-04	5.820E-03	1.159E-02	1.220E-03
Ca		1.780E-03		1.510E-03	4.400E-04	2.550E-03	2.520E-03			4.350E-03
Cl	7.400E-04	2.700E-04	5.000E-05	2.800E-04	1.540E-03	1.080E-03	7.000E-04	5.000E-05	5.000E-05	1.200E-04
Cr		1.300E-04		6.700E-04	1.100E-04	2.800E-04				9.000E-05
Fe	1.410E-03	6.600E-04	1.140E-03	3.020E-03	1.110E-03	1.220E-03	1.010E-03	3.000E-04	3.700E-04	2.500E-04
Pb		2.100E-04		2.700E-04	2.000E-04	1.700E-04				
Hg		1.000E-04		5.300E-04	3.100E-04	8.600E-04				
Mo		5.000E-05		7.000E-05	5.000E-05	5.000E-05				5.000E-05
Mn		7.100E-04		7.500E-04	4.600E-04	1.050E-03				
Ni		7.000E-05		3.200E-04	7.000E-05	1.000E-04				5.000E-05
P		1.900E-04		1.900E-04	7.300E-04	8.000E-05				
SO_4	2.970E-03	3.850E-03	4.180E-03	8.100E-04	6.660E-03	3.730E-03	3.200E-03	3.490E-03	6.590E-03	8.600E-04

Table 5-30 Release estimates of non-radioactive constituents for CPP-31[a].

Nonradionuclide	Maximum (kg)	Minimum (kg)	Average (kg)
H^+	1.017E+02	2.279E+01	7.821E+01
NO_3	1.902E+04	4.567E+03	1.174E+04
Al	1.701E+03	2.574E+02	7.492E+02
Na	2.412E+03	2.436E+01	9.539E+02
K	4.765E+02	2.072E+01	2.515E+02
F	2.336E+03	4.027E+01	4.842E+02
Zr	1.498E+03	4.834E+01	5.075E+02
B	9.591E+01	4.239E+00	2.644E+01
Cd	6.142E+02	1.060E+00	1.056E+02
Ca	2.305E+02	2.332E+01	1.161E+02
Cl	8.160E+01	2.650E+00	2.586E+01
Cr	3.550E+01	4.769E+00	1.357E+01

[a] Release estimates were calculated from 1989 tank farm Inventory data assuming a release volume of 52990 L (14000 gal) for CPP-31.

Table 5-30 Release estimates of non-radioactive constituents for CPP-31[a].

Nonradionuclide	Maximum (kg)	Minimum (kg)	Average (kg)
Fe	1.600E+02	1.325E+01	5.559E+01
Pb	1.431E+01	9.008E+00	1.126E+01
Hg	4.557E+01	5.299E+00	2.385E+01
Mo	3.709E+00	2.650E+00	2.861E+00
Mn	3.974E+01	2.438E+01	3.391E+01
Ni	1.696E+01	2.650E+00	6.465E+00
P	3.868E+01	4.239E+00	1.576E+01
SO_4	3.529E+02	4.292E+01	1.926E+02

[a] Release estimates were calculated from 1989 tank farm Inventory data assuming a release volume of 52990 L (14000 gal) for CPP-31.

- **The 1986 Release**

The non-radioactive chemical composition data of Donovan (1989) are used to estimate maximum, minimum, and average value of the total mass for potential nonradioactive constituents from the 1986 release. The results are shown in Table 5-31.

Table 5-31 Release estimates of non-radioactive constituents for the 1986 release[a].

Nonradionuclide	Maximum (kg)	Minimum (kg)	Average (kg)
H^+	1.826E+01	4.088E+00	1.403E+01
NO3	3.413E+03	8.195E+02	2.106E+03
Al	3.053E+02	4.618E+01	1.344E+02
Na	4.328E+02	4.372E+00	1.712E+02
K	8.550E+01	3.717E+00	4.512E+01
F	4.191E+02	7.225E+00	8.689E+01
Zr	2.689E+02	8.673E+00	9.107E+01
B	1.721E+01	7.600E-01	4.740E+00
Cd	1.102E+02	1.900E-01	1.895E+01
Ca	4.136E+01	4.180E+00	2.084E+01
Cl	1.464E+01	4.800E-01	4.640E+00
Cr	6.370E+00	8.600E-01	2.430E+00
Fe	2.871E+01	2.380E+00	9.970E+00
Pb	2.570E+00	1.620E+00	2.020E+00
Hg	8.180E+00	9.500E-01	4.280E+00
Mo	6.700E-01	4.800E-01	5.100E-01
Mn	7.130E+00	4.370E+00	6.090E+00
Ni	3.040E+00	4.800E-01	1.160E+00
P	6.940E+00	7.600E-01	2.830E+00
SO_4	6.332E+01	7.700E+00	3.455E+01

[a] Release estimates were calculated from 1989 tank farm inventory data assuming a release volume of 9508 L (2512 gal) for the 1986 release.

5.2.2.2 Other releases

Release estimates of radionuclides were made for two additional CPP- sites: CPP-02 and CPP-80. Table 5-14 summarizes the estimates of volume, duration, and quantity of radioactivity released at the two sites.

- **CPP-02**

The CPP-02 release resulted from the subsurface disposal of low-level radioactivity contaminated water from the 603 fuel storage facility (USGS 1974). Disposal data reported in USGS (1974) are used to estimate the quantity of radionuclides released at CPP-02. These data are shown in Table 5-32.

- **CPP-80**

The CPP-80 release resulted from the failure of a drain line and the inadvertent loss of liquid low-level radioactive waste. This release is discussed in Section 9.5 of Book 1. An estimated 550 Ci of activity was released at CPP-80 (WINCO 1993). Because radionuclide composition data are not available for the CPP-80 release, the conservative assumption has been made that the 550 Ci is evenly distributed between the two primary fission product wastes: Sr-90 and Cs-137. Therefore, it is assumed that 275 Ci of Sr-90 and 275 Ci of Cs-137 were released from CPP-80.

Table 5-32 Radionuclide release estimates (Ci) for CPP-02[a].

Year	Sr-89	Sr-90	I-131	Cs-137	Ce-144	Ru-106	Zr-Nb-95	H-3	Unidentified	Total
1954					0.10		0.36		1.56	2.02
1955							1.00		4.00	5.00
1956							1.04		4.00	5.04
1957			4.72				0.10		0.17	5.00
1958	0.04	0.03	3.65	0.05	0.70	0.05	0.28		0.20	5.00
1959		0.55	3.46		4.76	1.34	1.63		1.30	13.04
1960	0.08	0.12	1.84	0.16	0.44	0.44			0.88	3.97
1961										0.00
1962	1.50	22.60		20.60	0.70	0.60	0.40	194.00	2.80	243.20
1963	2.00	10.40		13.40	0.30			58.20	0.40	84.70
1964		0.10		0.10				72.50	0.30	73.00
1965								37.90		37.90
1966								15.50		15.50
Total	3.62	33.80	13.68	34.31	7.00	2.44	4.81	378.10	15.61	493.36

a. Estimates are based on disposal data reported in USGS (1974).

5.2.2.3 Known release source time frames

The releases from CPP-28/-79, 1986 Release, CPP-31, and CPP-80 are each assumed to be uniform release sources over the time frame given in Table 5-14. The release from CPP-02 is assumed to be a variable release based on the liquid and radionuclide release information in Table IX in Robertson et al., 1974. The release time frame for CPP-02 was 1954 through 1966 (see Table 5-14).

For all known release sources with maximum, minimum, and average release estimates, the average estimate was used to define the release in the simulation model. The estimated liquid volume is also incorporated into the model.

5.2.3 Sewage Treatment Facility

The sewage treatment facility (site CPP-65) has an average flow rate that has been steadily increasing since the early 1980s. Depending on the time frame chosen to calculate an average, the flow rate ranges from 4.5×10^7 to 5.68×10^7 L/year (1.2×10^7 to 1.5×10^7 gal/year). All of the flow discharges into the four infiltration/percolation (I/P) trenches. The areas of the four I/P trenches are approximately 890 m^2 (9,580 ft^2) each. The Track 1 Decision Document for site CPP-65 (WINCO, 1994) contains the chemical concentrations measured in the effluent from the sewage treatment lagoons. Table 5-33 presents a summary of the maximum effluent and limiting water concentrations (10^{-6} risk, HQ=1 or Federal Drinking Water Standard) for the chemicals. All seven chemicals have maximum water concentrations that are less than the limiting water concentration. Therefore, neither the radionuclides or non-radionuclides in the sewage treatment plant effluent pose a risk to aquifer. Thus, the sewage treatment plant is a water source but not a contaminant source.

Table 5-33 Sewage treatment facility (CPP-65) maximum effluent and limiting water concentrations.

Radio & Nonradionuclide	Maximum Effluent Water Concentration	Limiting Water Concentration
	mg/L or pCi/L	mg/L or pCi/L
Barium	8.40E-02	2.56E+00 mg/L
Cadmium	5.00E-03	1.83E-02 mg/L
Lead	2.80E-03	5.00E-02 mg/L
Silver	1.00E-03	1.83E-01 mg/L
Zinc	2.70E-02	5.00E+00 mg/L
Plutonium-239/-240	1.90E-03	1.52E-01 pCi/L
Strontium-90	3.60E-01	8.59E-01 pCi/L

5.2.4 Service Wastewater Disposal

Service wastewater is the major source of water discharged at the ICPP. The service wastewater consists primarily of cooling water and condensed steam generated by various ICPP operations. Current ICPP service wastewater contains only traces of radioactivity. However, in the 1960s, 1970s, and early 1980s, concentrations of radionuclides were disposed of in this wastewater that were much higher than is acceptable today.

The disposal of service wastewater has been almost exclusively to the ICPP injection well (CPP-23) and the two ICPP service waste percolation ponds (CPP-67), which will be referred to as the SWPs. The service wastewater was disposed to the injection well from 1953 until 1984 and to the SWPs thereafter. It is assumed that the service wastewater will continue to be disposed to the SWPs for the next 100 years or until the year 2095, after which time, the ICPP will be closed down, eliminating future discharge of service wastewater.

This section describes the service wastewater contaminant sources to the vadose zone and aquifer. Section 5.2.4.1 describes the source to the injection well, Section 5.2.4.2 describes the source to the SWPs, and Section 5.2.4.3 describes the source to other locations.

5.2.4.1 Injection well (CPP-23)

The ICPP injection well (Site CPP-23) was drilled 182 m (597 ft) deep to about 47 m (140 ft) below the water table, during the 1950-1951 time frame. The borehole has a diameter of 61 cm (24 in.) and is cased with 41 cm (16 in.) diameter carbon steel. It is perforated from 125.6 m to 137.8 m (412 to 452 ft) and 149.4 to 180.7 m (490 to 593 ft) below land surface. Portions of the casing were found to have corroded and collapsed in 1971 and again in 1982. In both cases it was reopened. The well was used regularly from 1952 to 1984 and then periodically until 1986. It was used to dispose of service wastewater and contained small amounts of radionuclides.

A total of 4.2×10^{10} L (1.1×10^{10} gal) of water and 22,200 Ci of mainly H-3, Sr-90, and Cs-137 were disposed of to the well. See Section 9.2 in Book 1 for a complete discussion of the disposal to the injection well. Based on the nature and extent of contamination described in Section 9.2.3 of Book 1, Cs-137, H-3, and Sr-90 are the primary contaminants in the aquifer related to the injection well, and only tritium and Sr-90 are aquifer COPCs. However, other radionuclide COPCs defined in this analysis are also measured in the aquifer at concentrations above the 10^{-6} risk limit. Although the other radionuclides do not appear to be risk drivers, they will be incorporated into the injection well discharges. Therefore, this section summarizes the data available for discharges of all the radionuclides to the injection well.

The RWMIS and INWMIS databases are used to define the contaminant flux to the injection well. Comparisons of the measured and simulated aquifer concentrations (Section 7) indicate that the source estimates are reasonably accurate.

In general, cesium is very insoluble in water and therefore is very seldom a groundwater contaminant of concern. Although significant concentrations of Cs-137 were measured in the aquifer in the early 80s, between 1986 and 1993, it was detected only once in each well and the spring 1995 sampling round did not detect any Cs-137 in the aquifer. Therefore, Cs-137 is not considered to be a COPC from the injection well, which is consistent with the COPC identification analysis presented previously. However, because Cs-137 has been added to the list of COPCs based on the large amount that has been discharged to the environment of the ICPP, the subsurface flow and transport model will include the Cs-137 discharges to the injection well.

Of the nonradionuclide COPCs, only mercury is included in the injection well inventory. The reported chromium concentrations to the injection well (average 1.78×10^{-2} mg/L) are below the limiting water concentration (0.1 mg/L). For the arsenic, the concentrations (average 5×10^{-3}mg/L) are approximately equal to background concentrations. Tc-99 is the only radionuclide with no reported source to the injection well.

Table 5-34 summarizes the discharges of Cs-137, H-3, and Sr-90 from the injection well and the total activity of H-3 and Sr-90 disposed to the well. The time histories of the Cs-137, H-3, and Sr-90 flux to the injection well are included in Figures 5-1, 5-2, and 5-3. The discharge information for the period from January 1962 until the discharges stopped in 1986 are from the RWMIS database. During this period, there are some missing information in the database that had to be estimated based on annual averages. The early data for tritium were found in Mann and Cecil (1990). The early Cs-137 and Sr-90 data are based on information in Table IX of Robertson et al (1974).

Table 5-34 CPP-23 COPCs maximum concentrations and maximum annual flux.

COPCs	Total Activity Over the Operating Life Based, on RWMIS Data	Estimated Activity Contribution Pre-1962
	Ci	Ci
Cs-137	25.8	5.2
H-3	20,100	11,700
Sr-90	24.3	5.1

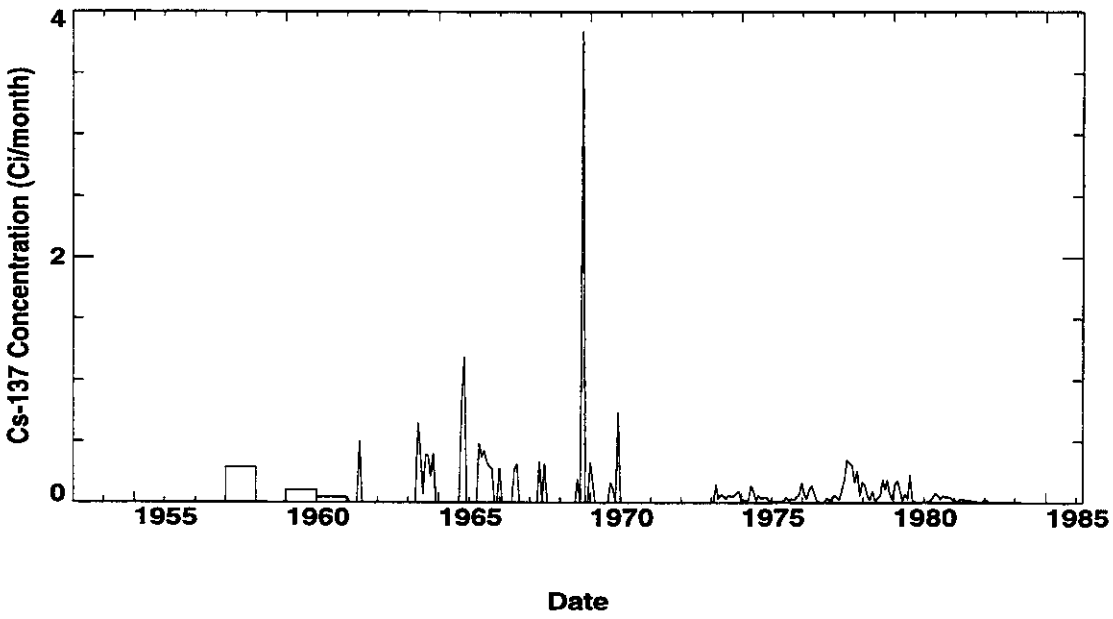


Figure 5-1 Time history of the Cs-137 disposal to the injection well.

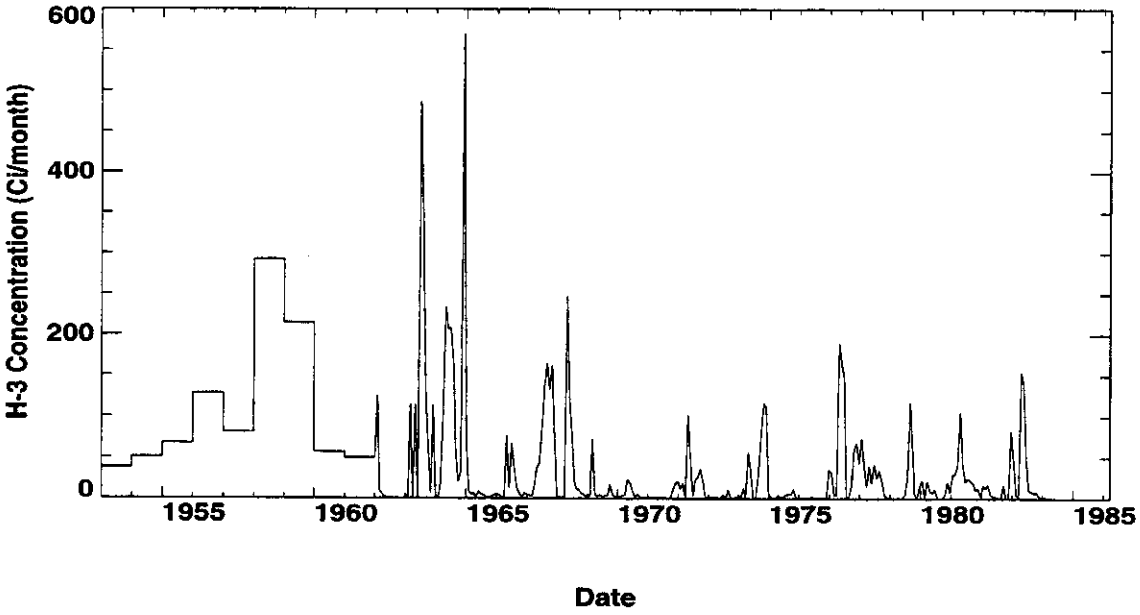


Figure 5-2 Time history of the H-3 disposal to the injection well.

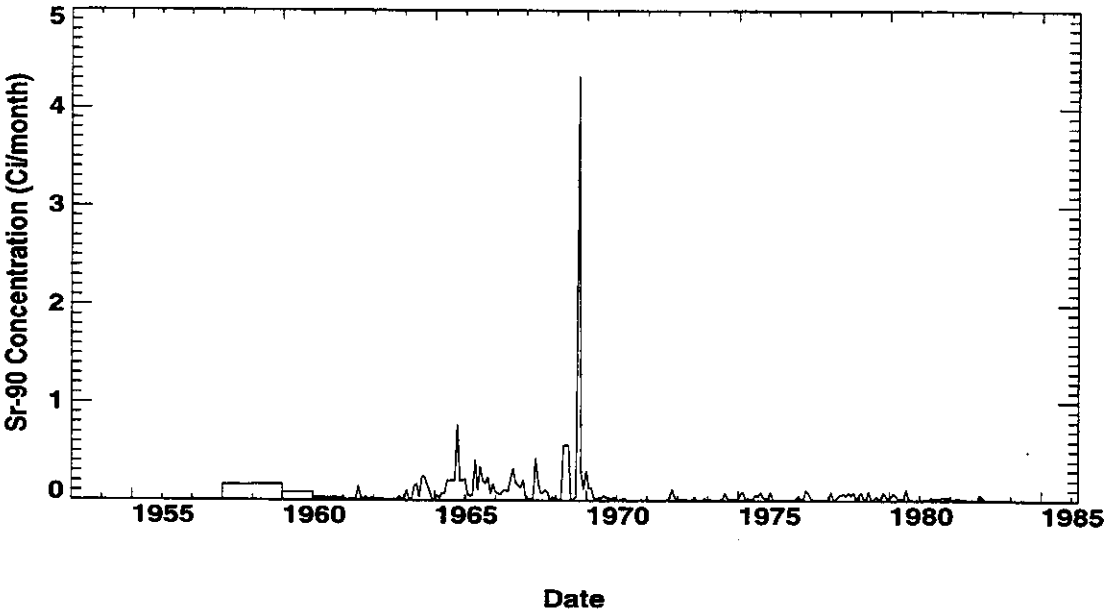


Figure 5-3 Time history of the Sr-90 disposal to the injection well.

Discharges of the remaining contaminants to the injection well are not well defined in the RWMIS database and therefore must be estimated. Table 5-35 is a summary of the available information. It shows the monthly average and total discharge reported in the RWMIS database and the time frame over which it is reported. The earliest report discharges are from 1970 and the latest are from 1985. There are discharges reported in only one month for Am-241 and two months for Np-237. The sixth column is an estimate of the total activity that would have been discharged to the injection well if the calculated average discharge is representative of the operational life of the well. This assumes that the well was operating for 389 months between 1952 and 1986. Primarily it was operating between the time between 1952 and March 1984.

Table 5-35 Injection well average reported monthly activity or mass fluxes for the contaminants with limited source information and potential risk.

	Monthly Average	Total Discharge Reported	Time Frame Over Which Reported		Total Discharge Over the Injection Well Service Life	
COPCs	(Ci or mg / month)	(Ci or mg)	Start	End	(Ci or mg)	Comments
Mercury	1.10E+06	5.48E+07	1/1/80	12/1/83	4.00E+08	
Am-241	3.17E-04	3.17E-04	5/26/77	5/26/77	1.23E-01	One reported measurement
Co-60	3.18E-03	1.49E-01	9/30/70	4/19/85	1.24E+00	
I-129	3.57E-03	2.78E-01	5/26/76	4/19/85	1.39E+00	
Np-237	2.74E-03	5.48E-03	4/26/75	5/26/75	1.07E+00	Two reported measurements
Pu-238	1.13E-03	1.32E-01	8/26/74	4/19/85	4.38E-01	
Pu-239	5.23E-04	1.05E-02	8/26/74	12/26/78	2.03E-01	

Table 5-35 Injection well average reported monthly activity or mass fluxes for the contaminants with limited source information and potential risk.

COPCs	Monthly Average (Ci or mg / month)	Total Discharge Reported (Ci or mg)	Time Frame Over Which Reported Start	Time Frame Over Which Reported End	Total Discharge Over the Injection Well Service Life (Ci or mg)	Comments
Pu-239/240	3.94E-04	3.74E-02	12/26/74	4/19/85	1.53E-01	
Pu-240	7.15E-05	1.14E-03	8/26/77	12/26/78	2.78E-02	
Total Pu	2.11E-03				8.22E-01	
Tc-99	-	-	-	-	0.00E+00	not reported
U-234	5.07E-04	2.28E-02	9/19/80	4/19/85	1.97E-01	
U-235	4.06E-05	1.95E-03	5/19/80	4/19/85	1.58E-02	
U-238	1.45E-04	6.81E-03	5/19/80	4/19/85	5.63E-02	
Total U	6.92E-04				2.69E-01	

5.2.4.2 Percolation ponds

Site CPP-67 consists of two unlined service waste percolation ponds (SWPs). Since 1984, these ponds have received the ICPP service waste water, which consists primarily of cooling water and condensed steam generated by various ICPP operations. ICPP wastewater that contains only traces of radioactivity are disposed of in the SWPs. These ponds are discussed in detail in Section 16 of Book 1, and the location is shown in Figure 16-1. The water flux rate to the SWPs has been discussed in Section 1 of this report.

The Non-radionuclide Waste Management Information System (NWMIS) and RWMIS databases have monthly estimates of the contaminant discharges to the SWPs. The discharge estimates have not been regularly reported over the years, making the data difficult to use to define actual contaminant flux to the ponds. However, sufficient information is available to calculate an approximate daily discharge to the ponds for most of the contaminants. Table 5-36 shows the maximum, minimum, and average concentrations reported for each of the groundwater COPCs. Chromium, Am-241, Co-60, and Tc-99 are either not reported or have average concentrations for the reported values that are less than the 10^{-6} or HQ=1 risk-based limiting water concentration. For chromium, the maximum reported concentration is also less than the limiting water concentration. The arsenic concentrations are much greater than the limiting water concentration, but they are very uniform and similar to the background water concentrations. Therefore, arsenic is not a significant SWP source. The other groundwater COPCs each have significant water concentrations in the water disposed of to the SWPs and must be incorporated into the transport model.

Table 5-36 Comparison of the limiting water concentration to the maximum, minimum, and mean discharges to the SWPs.

Groundwater COPCs	Maximum	Minimum	Mean	Limiting Water Concentration	Units
Arsenic	3.60E-03	1.10E-03	2.03E-03	5.67E-05	mg/L
Chromium	6.30E-02	3.50E-03	1.35E-02	1.83E-01	mg/L
Mercury	NR	NR	NR	3.14E-03	mg/L
Am-241	NR	NR	NR	1.46E-01	pCi/L
Co-60	2.67E+01	1.19E-02	1.42E+00	2.54E+00	pCi/L
Cs-137	1.73E+02	1.53E-02	2.49E+01	1.52E+00	pCi/L
H-3	1.06E+06	2.38E+02	9.37E+04	6.71E+02	pCi/L
I-129	5.87E+01	6.04E-03	8.94E+00	2.61E-01	pCi/L

Table 5-36 Comparison of the limiting water concentration to the maximum, minimum, and mean discharges to the SWPs.

Groundwater COPCs	Maximum	Minimum	Mean	Limiting Water Concentration	Units
Np-237	0.00E+00	0.00E+00	0.00E+00	1.60E-01	pCi/L
Total Pu	9.32E+01	1.74E-04	2.64E+00	1.52E-01	pCi/L
Sr-90	7.98E+01	5.69E-01	1.50E+01	8.59E-01	pCi/L
Tc-99	NR	NR	NR	3.43E+01	pCi/L
Total U	1.41E+01	3.24E-05	1.57E+00	7.74E-01	pCi/L

As a result of the uniformity and relatively low concentration of the water disposed of to the SWPs (in particular in the 1990s), contamination disposed to the SWPs are essentially two uniform mass or activity fluxes, one for the period 1984 through 1990 and one for the period 1990 through 2095. The 1984 through 1990 flux rate is calculated based on the reported total mass or activity disposed of at the SWPs during that period. The 1990 through 2095 flux rate is calculated based on the reported total mass or activity disposed of at the SWPs from 1990 through 1995. Table 5-37 is a summary of the average mass or activity fluxes from the 1980s and 1990s data. No arsenic, chromium, mercury, Am-241, Np-237, or Tc-99 were reported in the SWPs waste stream. However, Am-241 and Np-237 were found in the SWP sediments, as reported in Table 5-6 in Book 1.

Of the 20 SWP sediment samples evaluated for Am-241, four had concentrations above the detection limit. The maximum concentrations was 7.8 pCi/g which is nearly twice the concentration needed to fail the earlier pore water toxicity screen. The other three samples with concentrations above the detection limit were 1.03, 0.94, and 0.56 pCi/L. These are all well below the pore water toxicity screen levels; therefore, the assumption of no Am-241 to the SWPs is reasonable.

Of the 9 SWP sediment samples evaluated for Np-237, all had concentrations above the detection limit. The maximum concentration was 1.63 pCi/L and the minimum concentration was 0.63 pCi/L. This seems to indicate that is or has been Np-237 in the service waste to the SWPs. However, no Np-237 is reported in the RWMIS database. In addition, a significant activity of Np-237 is estimated to have been put into the injection well as service waste. Because the Np-237 is assumed to have a small Kd, if there is a significant activity of Np-237 discharged to the SWPs (not incorporated in the model), a review of the simulation results will show concentrations of Np-237 that are significantly smaller than the measured concentrations.

Table 5-37 Summary of the mass or activity fluxes that are used to estimate the contaminant fluxes to the SWPs.

Groundwater COPCs	Total Mass or Activity Disposed to the SWPs (kg) or (Ci)		
	1984-1990	1990-1995	Total
Arsenic	0.00E+00	0.00E+00	0.00E+00
Chromium	0.00E+00	0.00E+00	0.00E+00
Mercury	0.00E+00	0.00E+00	0.00E+00
Am-241	0.00E+00	0.00E+00	0.00E+00
Co-60	5.56E-03	5.64E-03	1.12E-02
Cs-137	4.59E-01	7.50E-02	5.34E-01
H-3	9.96E+02	3.00E+00	9.99E+02
I-129	8.20E-02	0.00E+00	8.20E-02

Table 5-37 Summary of the mass or activity fluxes that are used to estimate the contaminant fluxes to the SWPs.

Groundwater COPCs	Total Mass or Activity Disposed to the SWPs (kg) or (Ci)		
	1984-1990	1990-1995	Total
Np-237	0.00E+00	0.00E+00	0.00E+00
Total Pu	6.80E-02	1.20E-03	6.92E-02
Sr-90	2.47E-01	4.80E-02	2.95E-01
Tc-99	0.00E+00	0.00E+00	0.00E+00
Total U	3.48E+00	3.53E+00	7.01E-02

5.2.4.3 Other service waste disposal

The service waste has been disposed almost exclusively to the injection well and the SWPs. However, there have been the following exceptions or interest.

1. In June 1970, it was discovered that the injection well casing had collapsed and the service wastewater was being disposed to the vadose zone approximately 69 m (226 ft) below the ground surface. Collapse of the well in early 1968 was indicated by water level increases in the deep perched water well USGS-50. The injection well was repaired during September and October of 1970. During that time, the service wastewater was disposed to USGS-50. Therefore, from early 1968 until November 1970, the service wastewater was not disposed directly to the aquifer but rather was disposed to the deep perched water either in the injection well or in well USGS-50. This is a significant period of time and therefore must be incorporated into the vadose zone portion of the transport model.
2. In September 1982, the injection well casing was again found to have collapsed. It is not known how long or how much of the service waste water was disposed to the vadose zone. During September to November 1982, the injection well was repaired and the service waste was routed to the ICPP gravel pits and the area of SWP number 1. Because the time frame is relatively short (three months) and the contaminant concentrations in the service waste are relatively small, this failure was neglected for purposes of the transport model. It is assumed that the water and contaminants during these months were put into the injection well.

Although there have been some breaks in the disposal of the service waste to the injection well, it is assumed for this analysis that the service waste goes to the injection well from 1953 until March 1984 and to the SWPs from March 1984 until the present. The service wastewater is assumed to continue to be disposed to the SWPs for the next 100 years.

5.2.5 Contaminant Sources Based on Soil Contamination

Sections 5.2.2 through 5.2.4 describe known contaminant disposal processes, either wastewater disposal systems or known accidental contaminant releases. In addition to those releases, contaminants have been discharged to the environment through unrecorded activities. These releases cannot be quantified from records but can be estimated based on soil contamination sampling programs. These soil contamination sources have been defined in Chapter 5 of Book 1 and the soil contamination for each site is discussed in detail in Chapters 10 through 26. Most, but not all, of the soil contamination site areas defined in Book 1 are possible groundwater contamination sources. Table 5-38 lists all of the soil contamination site areas and a comment on whether or not the site is a soil source that may contribute to the groundwater contamination. Figure 5-4(copy of Figure 5-2 in Book 1) shows the locations of each of the soil contamination sites.

For purposes of the groundwater source definition, one soil contamination site (CPP-89) had to be added to those listed in Chapter 5 of Book 1 and one site had to redefined (CPP-36/-91). The description of these sites is provided in Section 5.2.5.1 The method used to calculate the contaminant mass or activity at each

soil contamination site is described in Section 5.2.5.2 The total mass or activity is also presented in Section 5.2.5.2, for each soil contamination site that is a possible contributing source to the groundwater.

Table 5-38 List of all the WAG 3 retained soil contamination sites.

Wag 3 Soil Contamination Sites	Comments
Sites with negligible soil contamination	
CPP-40	Negligible soil contamination, not a groundwater source
CPP-46	Negligible soil contamination, not a groundwater source
CPP-61	Negligible soil contamination, not a groundwater source
CPP-78	Negligible soil contamination, not a groundwater source
Tank Farm	
CPP-20/-25	Soil source that may contribute a source to the groundwater
CPP-26	Soil source that may contribute a source to the groundwater
CPP-28	Defined leak, not treated as a soil contamination source to groundwater
CPP-31	Defined leak, not treated as a soil contamination source to groundwater
CPP-32E/W	Soil source that may contribute a source to the groundwater
CPP-79 - zone 1 CPP-79 - zone 2	Defined leak, not treated as a soil contamination source to groundwater
Tank Farm South	
CPP-15 - zone 1W CPP-15 - zone 1E CPP-15 - zone 2	Soil source that may contribute a source to the groundwater
CPP-27/-33	Soil source that may contribute a source to the groundwater
CPP-58E/W	Soil source that may contribute a source to the groundwater
WCF	
CPP-35	Soil source that may contribute a source to the groundwater
CPP-36/-91 - zone 1 CPP-36/-91 - zone 2	Soil source that may contribute a source to the groundwater
CPP-85	Non-release site, not a groundwater source
Old Storage Pool	
CPP-01/-04/-05	Soil source that may contribute a source to the groundwater
CPP-08/09	Soil source that may contribute a source to the groundwater
CPP-10	Soil source that may contribute a source to the groundwater
CPP-11	Soil source that may contribute a source to the groundwater
Storage Yard East	
CPP-03	Soil source that may contribute a source to the groundwater
CPP-17A	Soil source that may contribute a source to the groundwater
CPP-17B	Soil source that may contribute a source to the groundwater
WAG 3 individual sites	
CPP-06	Soil source that may contribute a source to the groundwater
CPP-13	Soil source that may contribute a source to the groundwater
CPP-14 Imhoff	Soil source that may contribute a source to the groundwater
CPP-14 Plant	Soil source that may contribute a source to the groundwater
CPP-14 Drain	Soil source that may contribute a source to the groundwater
CPP-19	Soil source that may contribute a source to the groundwater

Table 5-38 List of all the WAG 3 retained soil contamination sites.

Wag 3 Soil Contamination Sites	Comments
CPP-22	Soil source that may contribute a source to the groundwater
CPP-34	Soil source that may contribute a source to the groundwater
CPP-37A	Soil source that may contribute a source to the groundwater
CPP-37B	Soil source that may contribute a source to the groundwater
CPP-67	SWP sediments, not a groundwater source. Source is defined by the SWP discharges.
CPP-89	Soil source that may contribute a source to the groundwater
CPP-90	Soil source that may contribute a source to the groundwater
CPP-92	Non-release site, not a groundwater source
CPP-93	Soil source that may contribute a source to the groundwater

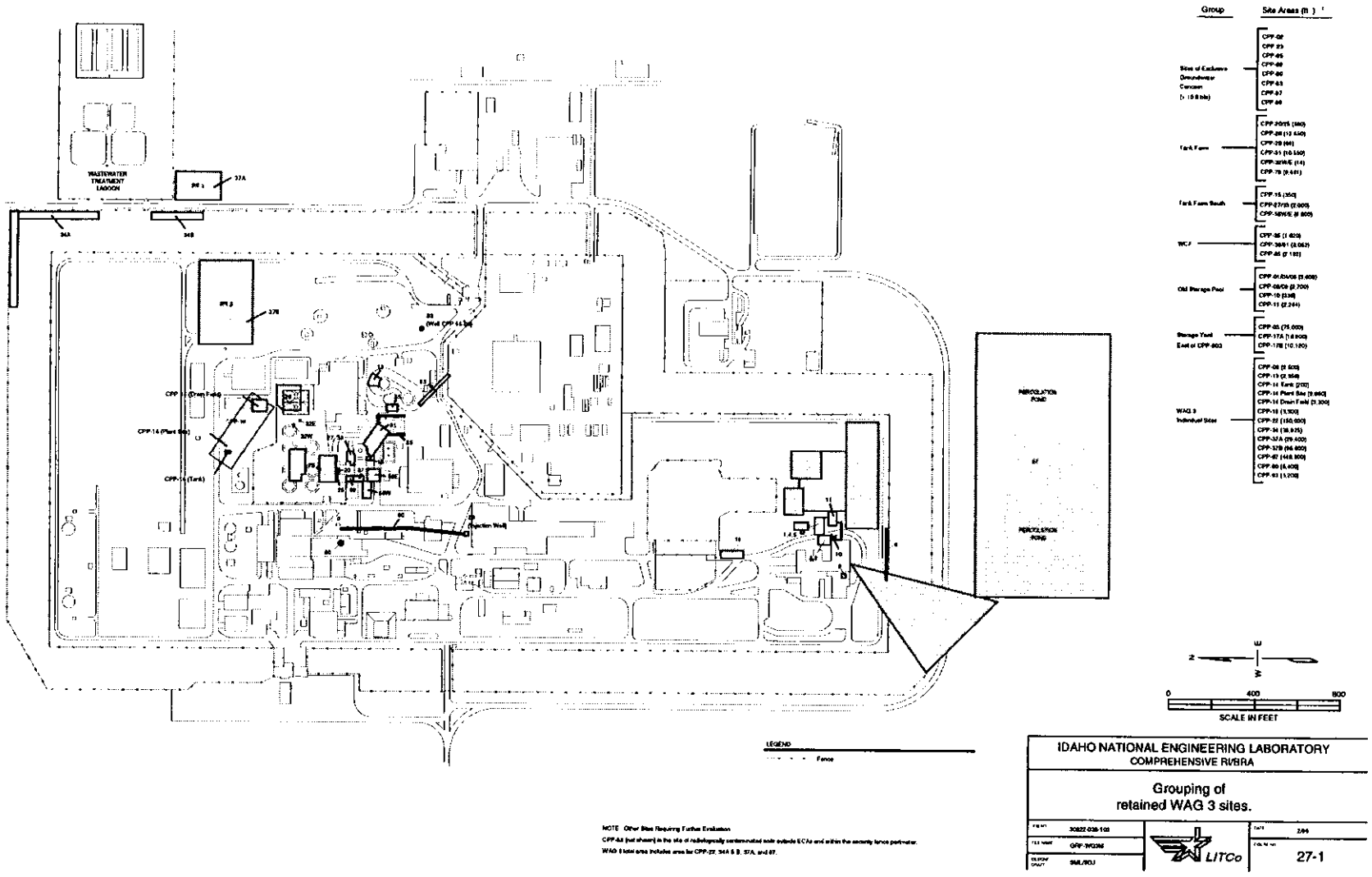


Figure 5-4 Locations of all the WAG 3 soil contamination site groupings.

5.2.5.1 Description of sites CPP-89 and CPP-36/-91

For purposes of the groundwater source definition, one soil contamination site (CPP-89) had to be added to those listed in Chapter 5 of Book 1 and one site had to redefined (CPP-36/-91).

As explained in Chapter 9.8 of Book 1, Site CPP-89 consists of the contaminated soil remaining under building CPP-604/605. The area was excavated in 1991 and 1992 to install an emergency fire exit. At that time, soil contamination was discovered that is related to a number of abandoned waste lines under Building CPP-604. Soil adjacent to the deteriorated pipes was removed and put in waste boxes. The waste boxes are now a part of site CPP-92. Not all of the contaminated soil was removed. The volume of contaminated soil remaining at site CPP-89 is not known but was estimated during the Track 1 analysis (LITCO,1995_) as 6,475 m^3. Because the site is located under a building, it is not exposed to the surface and is not treated as a soil contamination source for the surface risk pathways. Therefore, it is not included as a soil contamination site in Chapter 5 of Book 1, but is defined as a site of exclusive groundwater concern.

In general, the source terms for sites of exclusive groundwater concern can be defined based on known releases to the environment. However, Site 89 is a site that the source release is not well defined and the source can only be defined based on soil contamination sampling. For the purposes of defining a source term to the groundwater from this site, it is treated in the same way as the soil contamination sites. Soil samples from site CPP-92 are used to estimate the soil concentrations expected to be at site CPP-89.

Sites CPP-36 and CPP-91 were combined into one soil contamination area. Site 36 consists of contaminated soil southeast of the ICPP stack (Figure 5-4). The nature and extent of contamination at CPP-36 is described in Chapter 12.2 of Book 1. Site 91 falls within the area defined for CPP-36 (Figure 5-4) and the nature and extent of contamination are described in Chapter 12.4 of Book 1. The assumptions made in defining the soil concentrations in Book 1 are extremely conservative when applied to the groundwater source concentration estimates. Therefore, both the areal definition of site CPP-36/-91 and the concentrations used to define the source were modified.

For purposes of defining the sources to groundwater, Site CPP-36/-91 has been divided into two portions based on information provided in the OU 3-08 Track 2 Summary Report (Westinghouse Idaho Nuclear, inc., 1993). The areas will be referred to as CPP-36/-91 Zone-1 and CPP-36/-91-Zone 2. The area defined by CPP-36/-91-Zone 1 is chosen as the northwestern portion of site CPP-36. The area is defined as 255 m^2 to correspond to the area defined in the GWSCREEN runs in the Track 2 report. The remaining portion of the CPP-36 area is defined as CPP-36/-91-Zone 2. Since, the original area of CPP-36 is 748 m^2, the area of CPP-36/-91-Zone 2 is 493 m^2.

The estimated contaminated thickness for sites CPP-36/-91-Zone 1 and 2 are based on the results of radiation measurements from 7 observation wells drilled to characterize the site. On page 4-48 of the Track 2 document, it says that the average thickness of contamination measured from the observation wells is 6.5 feet. For the purposes of defining the contaminated soil source to the groundwater, the contaminated thickness was assumed to be 2.13 m (7 feet).

The results of the radiation field measurements at the observation wells were used to choose the locations of two boreholes for defining the soil contamination at the site. The boreholes are numbered 36-1 and 36-2. These two boreholes are in the northwestern portion of the CPP-36 area. Therefore, the maximum concentrations found in these two boreholes are assumed to be representative of the soil concentrations in CPP-36/-91-Zone 1. The maximum concentrations from the remaining wells in the CPP-36 area (CPP-36-A1, A2, A3, and A4, and CPP-91-1, and 2) were assumed to be representative of the soil concentrations in CPP-36/-91-Zone 2.

5.2.5.2 Calculation of total mass or activity from soil sources

The total mass or activity present in the soil contamination sources was calculated for each of the soil contamination sites that may contribute a source to the groundwater. The mass or activity was calculated by;

1. estimating the contaminated soil volume based on the estimated area and thickness of the contaminated soil for each site.
2. calculating the mass of contaminated soil at each of the soil contamination sites based on the estimated soil volume and an assumed soil density of 1.5 g/cm^3.
3. estimating a representative soil concentration for each contaminant at each soil contamination site.
4. estimating the total mass or activity of each contaminant at each site by multiplying the representative soil concentration for each contaminant by the mass of contaminated soil at that site.

The areas and thicknesses of the contaminated soil at each site were estimated for the surface pathways risk assessment (see Book 1). These values are assumed to be relatively conservative which means the estimated contaminated volume is also conservative. For each of the soil contamination sites, the site area, thickness, volume, top and bottom depth of contamination, and contaminated soil mass are shown in Table 5-39.

As discussed in Chapter 5 of Book 1, the entire inventory of chemicals measured in the soil samples were screened to a list of 41 soils related COPCs. The soil sample results for the soils COPCs are included in Book 1, Appendix G. These data were use to define 95% concentration upper confidence limits (UCL) for each contaminant at each site. The 95% UCL is on the mean and assumes a log normal distribution. The UCL calculations are described in Section 7.1.3 of Book 1. Table 5-40 lists the contaminant sources defined for each of the soil contamination sites, the detected contaminants, the maximum measured concentrations, the calculated UCLs, and the total mass or activity for that contaminant at that site.

Table 5-39 Summary of the soil volumes and masses for each of the soil contamination sites.

Site Identification	Area	Thickness	Volume	Top of Contamination	Bottom of Contamination	Contaminated Soil Mass
	m^2	m	m^3	m bgs	m bgs	kg
Tank Farm						
CPP-20/-25	5.20E+01	1.22E+01	6.34E+02	0.00E+00	1.22E+01	9.52E+05
CPP-26	1.19E+03	4.57E-01	5.46E+02	7.62E-01	1.22E+00	818349.9
CPP-32E/W	1.30E+00	4.57E-01	5.95E-01	5.79E-01	1.04E+00	891.15
Tank Farm South						
CPP-15 - zone 1W [a]	3.25E+01	9.14E-01	2.97E+01	2.13E+00	3.05E+00	44580.807
CPP-15 - zone 1E [a]	3.25E+01	2.13E+00	6.94E+01	6.10E-01	3.05E+00	1.04E+05
CPP-15 - zone 2 [a]	6.50E+01	3.05E+00	1.98E+02	3.05E+00	6.10E+00	297375
CPP-27/-33	1.86E+02	7.62E+00	1.42E+03	2.13E+00	9.75E+00	2.12E+06
CPP-58E/W	6.32E+02	1.22E+01	7.70E+03	1.83E+00	1.40E+01	1.16E+07
WCF						
CPP-35	1.51E+02	6.10E+00	9.17E+02	0.00E+00	6.10E+00	1.38E+06

a. The depth of CPP-15 varies due to past excavation of the west half of the site. Therefore, the site is broken into three sites, two for the upper part and one for the lower part.
b. The depth of CPP-13 varies due to the shape of the berm. It varies from 25 ft. above ground surface to 2.5 ft below ground surface. The average thickness is 13.1 ft.

Table 5-39 Summary of the soil volumes and masses for each of the soil contamination sites.

Site Identification	Area	Thickness	Volume	Top of Contamination	Bottom of Contamination	Contaminated Soil Mass
	m^2	m	m^3	m bgs	m bgs	kg
CPP-36/-91 - zone 1	2.55E+02	2.13E+00	5.45E+02	5.18E+00	7.32E+00	8.16E+05
CPP-36/-91 - zone 2	4.92E+02	2.13E+00	1.05E+03	5.18E+00	7.32E+00	1.57E+06
Old Storage Pool						
CPP-01/-04/-05	3.35E+02	9.75E+00	3.27E+03	0.00E+00	9.75E+00	4.90E+06
CPP-08/09	2.51E+02	9.45E+00	2.37E+03	0.00E+00	9.45E+00	3.56E+06
CPP-10	3.12E+01	1.04E+01	3.24E+02	0.00E+00	1.04E+01	4.85E+05
CPP-11	2.08E+02	5.49E+00	1.14E+03	0.00E+00	5.49E+00	1.72E+06
Storage Yard East						
CPP-03	6.97E+03	1.22E+00	8.50E+03	0.00E+00	1.22E+00	1.27E+07
CPP-17A	1.57E+03	1.22E+00	1.91E+03	0.00E+00	1.22E+00	2.87E+06
CPP-17B	9.40E+02	1.22E+00	1.15E+03	0.00E+00	1.22E+00	1.72E+06
WAG 3 individual sites						
CPP-06	2.32E+02	1.52E+00	3.54E+02	0.00E+00	1.52E+00	5.30E+05
CPP-13 [b]	2.19E+02	4.15E+00	9.08E+02	-7.62E+00	7.62E-01	1.36E+06
CPP-14 Imhoff	1.86E+01	9.14E-01	1.70E+01	2.44E+00	3.35E+00	2.55E+04
CPP-14 Plant	8.99E+02	8.23E+00	7.40E+03	1.52E+00	9.75E+00	1.11E+07
CPP-14 Drain	3.07E+02	3.35E+00	1.03E+03	4.27E+00	7.62E+00	1.54E+06
CPP-19	3.07E+02	9.45E+00	2.90E+03	0.00E+00	9.45E+00	4.35E+06
CPP-22	1.39E+04	1.22E+00	1.70E+04	0.00E+00	1.22E+00	2.55E+07
CPP-34	3.43E+03	6.10E+00	2.09E+04	0.00E+00	6.10E+00	3.14E+07
CPP-37A	2.73E+03	3.05E+00	8.33E+03	0.00E+00	3.05E+00	1.25E+07
CPP-37B	9.18E+03	8.53E+00	7.83E+04	1.52E+00	1.01E+01	1.17E+08
CPP-89	—	1.10E+01	6.48E+03	—	—	9.71E+06
CPP-90	5.02E+02	1.47E+01	7.36E+03	0.00E+00	1.47E+01	1.10E+07
CPP-93	2.97E+02	6.86E+00	2.04E+03	7.62E-01	7.62E+00	3.06E+06

a. The depth of CPP-15 varies due to past excavation of the west half of the site. Therefore, the site is broken into three sites, two for the upper part and one for the lower part.
b. The depth of CPP-13 varies due to the shape of the berm. It varies from 25 ft. above ground surface to 2.5 ft below ground surface. The average thickness is 13.1 ft.

Table 5-40 Summary of the soil concentration and estimated total mass or activity for each COPC at each of the sites with sources defined by soil contamination data.

Site Identification	Soils Defined COPCs	Max. Concentration. mg/kg or pCi/g	UCL Concentration. mg/kg or pCi/g	Mass/Act. mg or Ci	Site Identification	Soils Defined COPCs	Max. Concentration. mg/kg or pCi/g	UCL Concentration. mg/kg or pCi/g	Mass/Act. mg or Ci
CPP-89	Arsenic	5.90E+00	4.71E+00	4.57E+07	3-09/CPP-11	Arsenic	6.40E+00	5.83E+00	1.00E+07
CPP-89	Mercury	1.04E+01	1.04E+01	1.01E+08	3-09/CPP-11	Cesium-137	7.27E+01	7.27E+01	1.25E-01
CPP-89	Americium-241	2.36E+01	4.48E+00	4.35E-02	3-09/CPP-11	Cobalt-60	6.10E-01	6.10E-01	1.05E-03
CPP-89	Cesium-137	7.73E+03	7.73E+03	7.51E+01	3-09/CPP-11	Europium-154	1.80E+00	1.80E+00	3.09E-03
CPP-89	Plutonium-238	2.59E+02	8.34E+01	8.10E-01	3-09/CPP-11	Neptunium-237	1.50E-01	1.50E-01	2.57E-04
CPP-89	Plutonium-239/240	2.47E+01	1.21E+01	1.18E-01	3-09/CPP-11	Strontium-90	1.31E+01	1.31E+01	2.25E-02
CPP-89	Strontium-90	1.08E+04	1.01E+04	9.78E+01	3-09/CPP-11	Thallium	1.30E+00	6.97E-01	1.20E-03
CPP-89	Uranium-234	5.10E+00	5.10E+00	4.95E-02					
					3-09/CPP-11	Uranium-234	1.20E+00	1.20E+00	2.06E-03
3-07/CPP-20/-25	Arsenic	5.90E+00	4.79E+00	4.56E+06	3-09/CPP-11	Uranium-238	1.00E+00	1.00E+00	1.72E-03
3-07/CPP-20/-25	Mercury	1.00E-01	7.20E-02	6.85E+04					
3-07/CPP-20/-25	Americium-241	1.70E-01	1.06E-01	1.01E-04	3-09/CPP-03	Cesium-137	6.51E+01	6.34E+01	8.07E-01
3-07/CPP-20/-25	Cesium-134	1.90E-01	1.90E-01	1.81E-04	3-09/CPP-03	Europium-152	2.13E+00	2.13E+00	2.71E-02
3-07/CPP-20/-25	Cesium-137	1.14E+02	8.80E+01	8.37E-02	3-09/CPP-03	Strontium-90	4.39E+01	4.39E+01	5.59E-01
3-07/CPP-20/-25	Cobalt-60	9.00E-02	9.00E-02	8.56E-05					
3-07/CPP-20/-25	Europium-154	4.80E-01	4.80E-01	4.57E-04	3-09/CPP-17a	Cesium-137	1.94E+01	1.94E+01	5.57E-02
3-07/CPP-20/-25	Neptunium-237	1.70E-01	1.52E-01	1.45E-04	3-09/CPP-17a	Europium-152	2.07E+00	2.07E+00	5.94E-03
3-07/CPP-20/-25	Plutonium-238	4.30E-01	4.30E-01	4.09E-04	3-09/CPP-17a	Europium-154	1.88E+00	1.88E+00	5.40E-03
3-07/CPP-20/-25	Strontium-90	3.30E+02	1.99E+02	1.89E-01	3-09/CPP-17a	Strontium-90	2.72E+00	2.72E+00	7.81E-03
3-07/CPP-20/-25	Technicium-99	2.20E+00	2.20E+00	2.09E-03					
					3-09/CPP-17b	Cobalt-57	5.43E-01	5.43E-01	9.34E-04
3-07/CPP-26	Americium-241	1.34E+00	9.90E-01	8.10E-04	3-09/CPP-17b	Cesium-137	1.05E+01	1.05E+01	1.81E-02
3-07/CPP-26	Cesium-137	6.73E+03	6.46E+03	5.29E+00					
3-07/CPP-26	Europium-154	1.07E+01	1.07E+01	8.76E-03	3-02/CPP-37A	Arsenic	7.30E+00	6.04E+00	7.55E+07
3-07/CPP-26	Plutonium-238	3.58E+00	3.58E+00	2.93E-03	3-02/CPP-37A	Mercury	9.60E-01	8.61E-01	1.08E+07
3-07/CPP-26	Plutonium-239	8.41E-01	8.41E-01	6.88E-04	3-02/CPP-37A	Americium-241	9.90E-01	9.90E-01	1.24E-02
3-07/CPP-26	Strontium-90	1.58E+04	8.39E+03	6.87E+00	3-02/CPP-37A	Cesium-137	3.82E+00	3.82E+00	4.77E-02

Table 5-40 Summary of the soil concentration and estimated total mass or activity for each COPC at each of the sites with sources defined by soil contamination data.

Site Identification	Soils Defined COPCs	Max. Concentration. mg/kg or pCi/g	UCL Concentration. mg/kg or pCi/g	Mass/Act. mg or Ci
3-07/CPP-26	Uranium-234	2.21E+00	1.82E+00	1.49E-03
3-07/CPP-26	Uranium-235	1.04E+00	7.70E-02	6.30E-05
3-07/CPP-32W/E	Mercury	3.00E-01	3.00E-01	2.67E+02
3-07/CPP-32W/E	Toluene	1.00E-03	1.00E-03	8.91E-01
3-07/CPP-32W/E	Cesium-137	2.77E+02	2.77E+02	2.47E-04
3-07/CPP-32W/E	Europium-154	8.11E-01	6.73E-01	6.00E-07
3-07/CPP-32W/E	Strontium-90	2.78E+02	2.78E+02	2.48E-04
3-08/CPP-15-zone1W	Thallium	4.85E+00	4.85E+00	2.16E+05
3-08/CPP-15-zone1W	Zirconium	1.14E+01	1.14E+01	5.08E+05
3-08/CPP-15-zone1W	Cesium-137	4.34E+04	4.34E+04	1.93E+00
3-08/CPP-15-zone1W	Strontium-90(added)	4.34E+04	4.34E+04	1.93E+00
3-08/CPP-15-zone1E	Thallium	4.85E+00	4.85E+00	5.04E+05
3-08/CPP-15-zone1E	Zirconium	1.14E+01	1.14E+01	1.18E+06
3-08/CPP-15-zone1E	Cesium-137	4.34E+04	4.34E+04	4.51E+00
3-08/CPP-15-zone1E	Strontium-90(added)	4.34E+04	4.34E+04	4.51E+00
3-08/CPP-15-zone2	Americium-241	5.38E+02	5.38E+02	1.60E-01
3-08/CPP-15-zone2	Cesium-137	5.86E+05	5.86E+05	1.74E+02
3-08/CPP-15-zone2	Europium-154	2.43E+02	2.43E+02	7.23E-02
3-08/CPP-15-zone2	Neptunium-237	6.30E-01	6.30E-01	1.87E-04
3-08/CPP-15-zone2	Plutonium-238	4.57E+03	4.57E+03	1.36E+00
3-08/CPP-15-zone2	Plutonium-239/240	8.25E+02	8.25E+02	2.45E-01
3-08/CPP-15-zone2	Strontium-90 (added)	5.86E+05	5.86E+05	1.74E+02
3-08/CPP-15-zone2	Technicium-99	3.67E+01	3.67E+01	1.09E-02
3-08/CPP-15-zone2	Uranium-235	2.03E-02	2.03E-02	6.04E-06

Site Identification	Soils Defined COPCs	Max. Concentration. mg/kg or pCi/g	UCL Concentration. mg/kg or pCi/g	Mass/Act. mg or Ci
3-02/CPP-37A	Neptunium-237	1.07E+00	8.93E-01	1.12E-02
3-02/CPP-37A	Plutonium-238	1.20E-01	6.10E-02	7.62E-04
3-02/CPP-37A	Strontium-90	6.90E-01	6.90E-01	8.62E-03
3-02/CPP-37A	Uranium-235	5.00E-02	3.10E-02	3.87E-04
3-02/CPP-37A	Uranium-238	3.99E+00	1.88E+00	2.35E-02
3-02/CPP-37B	Aroclor-1260	4.20E-01	4.20E-01	4.93E+07
3-02/CPP-37B	Americium-241	1.95E+00	2.85E-01	3.35E-02
3-02/CPP-37B	Arsenic	1.14E+01	5.03E+00	5.91E-01
3-02/CPP-37B	Cesium-137	6.31E+00	6.31E+00	7.41E-01
3-02/CPP-37B	Iodine-129	1.57E+00	3.31E-01	3.89E-02
3-02/CPP-37B	Kepone	4.00E-01	4.00E-01	4.70E-02
3-02/CPP-37B	Neptunium-237	8.60E-01	5.56E-01	6.53E-02
3-02/CPP-37B	Plutonium-238	5.00E-01	1.15E-01	1.35E-02
3-02/CPP-37B	Strontium-90	4.31E+00	3.05E+00	3.58E-01
3-02/CPP-37B	Uranium-235	7.00E-02	3.37E-02	3.96E-03
3-02/CPP-37B	Uranium-238	7.44E+00	1.03E+00	1.21E-01
3-05/CPP-14-Imhoff Tanks	Aroclor-1260	2.30E+01	2.30E+01	5.86E+05
3-05/CPP-14-Imhoff Tanks	Benzo(a)pyrene	3.40E-01	3.40E-01	8.66E+03
3-05/CPP-14-Imhoff Tanks	Cadmium	1.00E+00	1.00E+00	2.55E+04
3-05/CPP-14-Imhoff Tanks	Phenanthrene	3.70E-01	3.70E-01	9.43E+03
3-05/CPP-14-Imhoff Tanks	Cesium-137	6.21E+00	6.21E+00	1.58E-04
3-05/CPP-14-Imhoff Tanks	Neptunium-237	1.98E+00	1.98E+00	5.04E-05
3-05/CPP-14-Imhoff Tanks	Strontium-90	1.07E+00	1.07E+00	2.73E-05
3-05/CPP-14-Imhoff Tanks	Uranium-235	5.00E-02	5.00E-02	1.27E-06
3-05/CPP-14-Plant Site	Aroclor-1260	7.20E-01	7.20E-01	7.99E+06

Table 5-40 Summary of the soil concentration and estimated total mass or activity for each COPC at each of the sites with sources defined by soil contamination data.

Site Identification	Soils Defined COPCs	Max. Concentration. mg/kg or pCi/g	UCL Concentration. mg/kg or pCi/g	Mass/Act. mg or Ci	Site Identification	Soils Defined COPCs	Max. Concentration. mg/kg or pCi/g	UCL Concentration. mg/kg or pCi/g	Mass/Act. mg or Ci
					3-05/CPP-14-Plant Site	Copper	3.11E+01	1.45E+01	1.61E+08
3-08/CPP-27/-33	Trichloroethene	1.00E-03	1.00E-03	2.12E+03	3-05/CPP-14-Plant Site	Mercury	3.80E-01	2.78E-01	3.09E+06
3-08/CPP-27/-33	Arsenic	4.70E+00	4.59E+00	9.75E+06	3-05/CPP-14-Plant Site	Silver	8.30E+00	4.25E+00	4.72E+07
3-08/CPP-27/-33	Cadmium	5.10E+00	4.55E+00	9.66E+06	3-05/CPP-14-Plant Site	Cesium-137	3.89E+00	3.89E+00	4.32E-02
3-08/CPP-27/-33	Chromium	2.90E+01	2.90E+01	6.16E+07	3-05/CPP-14-Plant Site	Neptunium-237	5.50E+00	3.90E+00	4.33E-02
3-08/CPP-27/-33	Mercury	2.85E-01	2.31E-01	4.91E+05	3-05/CPP-14-Plant Site	Antimony-125	1.00E-01	6.00E-02	6.66E-04
3-08/CPP-27/-33	Americium-241	9.59E+00	6.01E+00	1.28E-02	3-05/CPP-14-Plant Site	Strontium-90	5.70E-01	5.70E-01	6.33E-03
3-08/CPP-27/-33	Cesium-137	1.37E+03	1.37E+03	2.91E+00	3-05/CPP-14-Plant Site	Uranium-234	6.89E+00	4.52E+00	5.02E-02
3-08/CPP-27/-33	Europium-154	4.23E+00	4.23E+00	8.98E-03	3-05/CPP-14-Plant Site	Uranium-235	6.80E-01	6.80E-01	7.55E-03
3-08/CPP-27/-33	Plutonium-238	1.41E+00	9.45E-01	2.01E-03	3-05/CPP-14-Plant Site	Uranium-238	5.21E+01	5.21E+01	5.78E-01
3-08/CPP-27/-33	Plutonium-239	1.66E-01	1.66E-01	3.53E-04					
3-08/CPP-27/-33	Strontium-90	4.86E+02	4.29E+02	9.11E-01	3-05/CPP-14-Drain Field	Arsenic	4.70E+00	4.70E+00	7.24E+06
3-08/CPP-27/-33	Uranium-235	6.90E-02	3.55E-02	7.54E-05	3-05/CPP-14-Drain Field	Neptunium-237	1.40E+00	1.40E+00	2.16E-03
					3-05/CPP-14-Drain Field	Phenanthrene	8.70E-02	8.70E-02	1.34E-04
3-11/CPP-58W/E	Mercury	1.50E+00	1.50E+00	1.73E+07	3-05/CPP-14-Drain Field	Strontium-90	5.30E-01	5.30E-01	8.17E-04
3-11/CPP-58W/E	Americium-241	1.01E-01	2.95E-02	3.41E-04					
3-11/CPP-58W/E	Cesium-137	6.36E+01	6.36E+01	7.35E-01	3-06/CPP-34	Arsenic	7.10E+00	5.10E+00	1.60E+08
3-11/CPP-58W/E	Europium-154	2.48E-01	2.48E-01	2.86E-03	3-06/CPP-34	Cesium-137	2.00E+03	2.00E+03	6.28E+01
3-11/CPP-58W/E	Plutonium-238	2.95E-01	2.95E-01	3.41E-03	3-06/CPP-34	Neptunium-237	7.00E-01	3.35E-01	1.05E-02
3-11/CPP-58W/E	Plutonium-239	4.03E-02	4.03E-02	4.66E-04	3-06/CPP-34	Plutonium-238	5.10E+00	5.12E-01	1.61E-02
3-11/CPP-58W/E	Strontium-90	9.56E+01	9.56E+01	1.10E+00	3-06/CPP-34	Strontium-90	6.00E+03	6.00E+03	1.88E+02
3-11/CPP-58W/E	Uranium-235	6.79E-02	6.79E-02	7.84E-04	3-06/CPP-34	Uranium-234	2.50E+00	1.15E+00	3.61E-02
					3-06/CPP-34	Uranium-238	2.80E+00	1.43E+00	4.48E-02
3-08/CPP-35	Mercury	7.20E+00	7.20E+00	9.92E+06					
3-08/CPP-35	Americium-241	1.21E+00	1.21E+00	1.67E-03	3-08/CPP-13	Arsenic	8.30E+00	6.89E+00	9.39E+06
3-08/CPP-35	Cesium-137	8.64E+03	8.64E+03	1.19E+01	3-08/CPP-13	Mercury	9.10E-01	2.80E-01	3.81E+05
3-08/CPP-35	Europium-154	1.18E+01	1.18E+01	1.63E-02	3-08/CPP-13	Cobalt-60	9.00E-01	9.00E-01	1.23E-03
3-08/CPP-35	Plutonium-238	1.32E+01	1.32E+01	1.82E-02	3-08/CPP-13	Cesium-134	6.00E-01	6.00E-01	8.17E-04
3-08/CPP-35	Plutonium-239	7.25E-01	7.25E-01	9.98E-04	3-08/CPP-13	Cesium-137	4.63E+03	4.63E+03	6.31E+00

Table 5-40 Summary of the soil concentration and estimated total mass or activity for each COPC at each of the sites with sources defined by soil contamination data.

Site Identification	Soils Defined COPCs	Max. Concentration. mg/kg or pCi/g	UCL Concentration. mg/kg or pCi/g	Mass/Act. mg or Ci
3-08/CPP-35	Strontium-90	3.24E+03	3.24E+03	4.46E+00
3-08/CPP-35	Uranium-235	7.16E-02	7.16E-02	9.86E-05
3-08/CPP-36/-91-zone1	Mercury	1.66E+01	1.66E+01	1.36E+07
3-08/CPP-36/-91-zone1	Americium-241	7.63E+02	7.63E+02	6.23E-01
3-08/CPP-36/-91-zone1	Cesium-137	4.08E+05	4.08E+05	3.33E+02
3-08/CPP-36/-91-zone1	Europium-154	4.74E+03	4.74E+03	3.87E+00
3-08/CPP-36/-91-zone1	Plutonium-238	8.18E+03	8.18E+03	6.68E+00
3-08/CPP-36/-91-zone1	Plutonium-239	3.24E+02	3.24E+02	2.64E-01
3-08/CPP-36/-91-zone1	Potassium-40	2.49E+01	2.49E+01	2.03E-02
3-08/CPP-36/-91-zone1	Strontium-90	5.13E+04	5.13E+04	4.19E+01
3-08/CPP-36/-91-zone1	Uranium-234	2.81E+00	2.81E+00	2.29E-03
3-08/CPP-36/-91-zone1	Uranium-235	9.95E-02	9.95E-02	8.12E-05
3-08/CPP-36/-91-zone1	Uranium-238	1.84E+00	1.84E+00	1.50E-03
3-08/CPP-36/-91-zone2	Arsenic	1.03E+01	1.03E+01	1.62E+07
3-08/CPP-36/-91-zone2	Cadmium	3.30E+00	3.30E+00	5.19E+06
3-08/CPP-36/-91-zone2	Chromium	3.73E+01	3.73E+01	5.87E+07
3-08/CPP-36/-91-zone2	Manganese	5.34E+02	5.34E+02	8.40E+08
3-08/CPP-36/-91-zone2	Thallium	1.80E+00	1.80E+00	2.83E+06
3-08/CPP-36/-91-zone2	Cesium-137	1.96E+02	1.96E+02	3.08E-01
3-08/CPP-36/-91-zone2	Europium-154	6.90E+01	6.90E+01	1.09E-01
3-08/CPP-36/-91-zone2	Strontium-90	7.58E+03	7.58E+03	1.19E+01
3-09/CPP-01/-04/-05	Americium-241	1.78E+00	1.78E+00	8.73E-03
3-09/CPP-01/-04/-05	Cobalt-57	1.02E+00	1.02E+00	5.00E-03
3-09/CPP-01/-04/-05	Cobalt-60	2.39E+03	2.39E+03	1.17E+01
3-09/CPP-01/-04/-05	Cerium-144	2.39E+03	2.39E+03	1.17E+01
3-09/CPP-01/-04/-05	Cesium-134	1.45E+03	1.45E+03	7.11E+00

Site Identification	Soils Defined COPCs	Max. Concentration. mg/kg or pCi/g	UCL Concentration. mg/kg or pCi/g	Mass/Act. mg or Ci
3-08/CPP-13	Europium-154	3.10E+01	3.10E+01	4.22E-02
3-08/CPP-13	Strontium-90	4.18E+03	4.18E+03	5.69E+00
3-08/CPP-13	Technicium-99	2.70E+00	2.70E+00	3.68E-03
3-08/CPP-13	Zirconium	1.43E+01	1.27E+01	1.73E-02
3-09/CPP-06	Cesium-137	1.44E+01	1.44E+01	7.63E-03
3-09/CPP-06	Strontium-90	6.98E+00	6.98E+00	3.70E-03
3-09/CPP-19	Arsenic	8.30E+00	6.05E+00	2.63E+07
3-09/CPP-19	Calcium	2.32E+05	1.51E+05	6.58E+11
3-09/CPP-19	Mercury	1.50E-01	1.50E-01	6.52E+05
3-09/CPP-19	Americium-241	1.97E+00	1.97E+00	8.56E-03
3-09/CPP-19	Cobalt-60	2.16E+04	2.16E+04	9.39E+01
3-09/CPP-19	Cesium-134	6.00E-02	6.00E-02	2.61E-04
3-09/CPP-19	Cesium-137	4.08E+05	4.08E+05	1.77E+03
3-09/CPP-19	Europium-152	8.76E+04	8.76E+04	3.81E+02
3-09/CPP-19	Europium-154	5.35E+04	5.35E+04	2.33E+02
3-09/CPP-19	Europium-155	9.62E+03	9.62E+03	4.18E+01
3-09/CPP-19	Niobium-95	9.00E-02	9.00E-02	3.91E-04
3-09/CPP-19	Plutonium-239	1.41E+02	1.41E+02	6.13E-01
3-09/CPP-19	Strontium-90	1.25E+05	1.25E+05	5.43E+02
3-09/CPP-19	Uranium-235	2.36E+00	2.36E+00	1.03E-02
3-09/CPP-19	Uranium-238	4.53E-01	4.53E-01	1.97E-03
3-09/CPP-22	Cesium-137	1.43E+01	1.43E+01	3.65E-01
3-09/CPP-22	Strontium-90	5.40E+00	5.40E+00	1.38E-01
3-09/CPP-22	Technicium-99	3.50E+00	3.50E+00	8.93E-02
3-13/CPP-90	Antimony	9.50E+00	1.77E+00	1.95E+07

Table 5-40 Summary of the soil concentration and estimated total mass or activity for each COPC at each of the sites with sources defined by soil contamination data.

Site Identification	Soils Defined COPCs	Max. Concentration. mg/kg or pCi/g	UCL Concentration. mg/kg or pCi/g	Mass/Act. mg or Ci
3-09/CPP-01/-04/-05	Cesium-137	4.60E+04	4.60E+04	2.26E+02
3-09/CPP-01/-04/-05	Europium-152	3.50E+04	3.50E+04	1.72E+02
3-09/CPP-01/-04/-05	Europium-154	3.50E+04	3.50E+04	1.72E+02
3-09/CPP-01/-04/-05	Europium-155	7.60E+03	7.60E+03	3.73E+01
3-09/CPP-01/-04/-05	Plutonium-239	1.20E+01	1.20E+01	5.88E-02
3-09/CPP-01/-04/-05	Strontium-90	4.85E+03	4.85E+03	2.38E+01
3-09/CPP-01/-04/-05	Uranium-235	3.02E-01	3.02E-01	1.48E-03
3-09/CPP-08/-09	Cesium-137	1.08E+03	1.08E+03	3.84E+00
3-09/CPP-08/-09	Europium-152	4.38E+00	4.38E+00	1.56E-02
3-09/CPP-08/-09	Europium-154	2.95E+00	2.95E+00	1.05E-02
3-09/CPP-08/-09	Strontium-90	1.40E+02	1.40E+02	4.98E-01
3-09/CPP-08/-09	Uranium-235	2.61E-02	2.61E-02	9.28E-05
3-09/CPP-08/-09	Uranium-238	1.61E-01	1.61E-01	5.72E-04
3-09/CPP-10	Cobalt-60	3.18E+00	3.18E+00	1.54E-03
3-09/CPP-10	Cesium-137	1.19E+03	1.19E+03	5.77E-01
3-09/CPP-10	Europium-152	9.16E+00	9.16E+00	4.44E-03
3-09/CPP-10	Europium-154	5.70E+00	5.70E+00	2.77E-03
3-09/CPP-10	Europium-155	1.48E+00	1.48E+00	7.18E-04
3-09/CPP-10	Strontium-90	5.83E+01	5.83E+01	2.83E-02
3-09/CPP-10	Uranium-235	1.42E-02	1.42E-02	6.89E-06

Site Identification	Soils Defined COPCs	Max. Concentration. mg/kg or pCi/g	UCL Concentration. mg/kg or pCi/g	Mass/Act. mg or Ci
3-13/CPP-90	Arsenic	2.95E+01	8.38E+00	9.25E+07
3-13/CPP-90	Mercury	1.10E+00	9.67E-01	1.07E+07
3-13/CPP-90	Benzo(a)pyrene	1.50E-01	1.50E-01	1.65E+06
3-13/CPP-90	Phenanthrene	2.90E-01	2.90E-01	3.20E+06
3-13/CPP-90	Cesium-134	9.00E-02	9.00E-02	9.93E-04
3-13/CPP-90	Cesium-137	7.50E+00	7.50E+00	8.27E-02
3-13/CPP-90	Cobalt-58	7.00E-02	7.00E-02	7.72E-04
3-13/CPP-90	Europium-155	2.60E-01	2.60E-01	2.87E-03
3-13/CPP-90	Niobium-95	1.30E-01	1.30E-01	1.43E-03
3-13/CPP-90	Strontium-90	6.30E+00	6.30E+00	6.95E-02
3-13/CPP-90	Thallium	1.40E+00	1.40E+00	1.54E-02
3-13/CPP-93	Aluminum	1.20E+05	1.20E+05	3.67E+11
3-13/CPP-93	Mercury	1.40E+02	1.40E+02	4.28E+08

5.2.6 TRA Contaminant Sources

The influence of cross-gradient contaminant releases to the aquifer could potentially influence the measured aquifer contaminant concentrations downgradient from the ICPP. The Test Reactor Area (TRA) is relatively close. Although not directly upgradient from the ICPP, the locations of the TRA and ICPP are close enough that the contaminant plumes may merge downgradient from both facilities. Therefore, significant TRA releases to the aquifer are incorporated into the ICPP transport modeling.

Based on the TRA Remedial Investigation, chromium and tritium are the major risk drivers to the aquifer and the only contaminants that could significantly influence aquifer concentrations at the ICPP (Arnett, 1996). Therefore, chromium and tritium mass fluxes were obtained for incorporation into the ICPP transport modeling.

There are two TRA contaminant sources simulated, the TRA injection well and the Warm Waste Pond liquid disposal. Chromium was discharged to both the injection well and the Warm Waste Pond. Tritium was only disposed of to the Warm Waste Pond. The estimated chromium discharge to the injection well was 4.61 kg/d from Jan 1, 1964 through Dec. 31, 1972. The total chromium discharge to the injection well is estimated to be 13,478 kg. The chromium and tritium fluxes to the aquifer from the Warm Waste Pond disposal are 8,070 kg and 8,920 Ci, respectively.

These mass fluxes to the aquifer from the vadose zone are shown in Table 5-41 and include both historic fluxes and the future predicted fluxes. The flux is assumed to be zero after the year 2015 because no more water will be infiltrating into the TRA ponds so that the major water driving force will be gone. In reality, there will be continuing ambient infiltration, but it is assumed that the contaminant flux to the aquifer will be reduced to a negligible amount.

Table 5-41 Summary of the predicted TRA chromium and H-3 fluxes to the aquifer from the vadose zone.

Date (year)	Average H-3 Flux (Ci/d)	Average Chromium Flux (kg/d)	Date (year)	Average H-3 Flux (Ci/d)	Average Chromium Flux (kg/d)
1952	6.87e-04	3.46e-04	1984	6.42e-01	5.77e-01
1953	8.33e-03	2.75e-03	1985	5.75e-01	5.62e-01
1954	2.97e-02	9.81e-03	1986	5.09e-01	5.46e-01
1955	6.37e-02	2.32e-02	1987	4.35e-01	5.31e-01
1956	1.08e-01	4.32e-02	1988	3.82e-01	5.15e-01
1957	1.71e-01	6.95e-02	1989	3.74e-01	5.00e-01
1958	2.61e-01	1.01e-01	1990	3.56e-01	4.84e-01
1959	3.75e-01	1.38e-01	1991	3.36e-01	4.69e-01
1960	5.02e-01	1.78e-01	1992	3.52e-01	4.53e-01
1961	6.04e-01	2.23e-01	1993	3.82e-01	4.31e-01
1962	6.44e-01	2.71e-01	1994	3.57e-01	4.02e-01
1963	6.78e-01	3.24e-01	1995	2.67e-01	3.67e-01
1964	7.21e-01	3.80e-01	1996	1.83e-01	3.33e-01
1965	7.55e-01	4.37e-01	1997	1.25e-01	3.00e-01
1966	7.89e-01	4.90e-01	1998	8.53e-02	2.70e-01
1967	8.08e-01	5.36e-01	1999	5.89e-02	2.42e-01
1968	8.49e-01	5.74e-01	2000	4.09e-02	2.18e-01
1969	9.39e-01	6.04e-01	2001	2.86e-02	1.95e-01
1970	1.15e+00	6.28e-01	2002	2.01e-02	1.76e-01

Table 5-41 Summary of the predicted TRA chromium and H-3 fluxes to the aquifer from the vadose zone.

Date	Average H-3 Flux	Average Chromium Flux	Date	Average H-3 Flux	Average Chromium Flux
(year)	(Ci/d)	(kg/d)	(year)	(Ci/d)	(kg/d)
1971	1.32e+00	6.45e-01	2003	1.41e-02	1.58e-01
1972	1.24e+00	6.57e-01	2004	9.99e-03	1.42e-01
1973	1.03e+00	6.64e-01	2005	7.08e-03	1.28e-01
1974	8.24e-01	6.68e-01	2006	5.03e-03	1.16e-01
1975	7.01e-01	6.67e-01	2007	3.59e-03	1.04e-01
1976	6.60e-01	6.64e-01	2008	2.56e-03	9.41e-02
1977	6.54e-01	6.59e-01	2009	1.83e-03	8.50e-02
1978	6.00e-01	6.51e-01	2010	1.31e-03	7.68e-02
1979	5.00e-01	6.41e-01	2011	9.40e-04	6.95e-02
1980	4.34e-01	6.30e-01	2012	6.75e-04	6.29e-02
1981	4.06e-01	6.18e-01	2013	4.86e-04	5.69e-02
1982	4.65e-01	6.05e-01	2014	3.49e-04	2.71e-02
1983	6.02e-01	5.91e-01	2015 - on	0	0

5.2.7 Summary Comparison of the Relative Magnitude of the COPC Sources

For purposes of this study, the contaminant sources have been discretized into known releases, service waste, contaminated soils, and releases to the aquifer from the TRA. Table 5-43 summarizes the total amount of mass or activity for each of the COPCs, from each of these sources. Table 5-42 presents a summary of the percentage of each of the contaminants that comes from each of the general sources. The tank farm known releases provide the vast majority of the Am-241, Cs-137, I-129, Total Pu, Sr-90, and Tc-99. The injection well provides most of the Np-237 and H-3. The soil contamination provides all of the arsenic and most of the mercury and Co-60. The TRA provides almost all of the chromium and much of the H-3. Overall, the tank farm known releases accounts for the majority of the contamination to the environment.

Table 5-42 Summary of the total mass or activity for each of the COPCs, from each of groundwater contamination sources.

		Known Release		Service Waste[1]				
COPCs	Units	Tank Farm	Other	Injection Well	SWPs	Soil Contamination	TRA	Total
Arsenic	kg	0	0	0	0	4.57E+02	0	4.57E+02
Chromium	kg	1.60E+01	0	0	0	1.20E+02	2.15E+04	2.17E+04
Mercury	kg	2.81E+01	0	4.00E+02	0	5.96E+02	0	1.02E+03
Am-241	Ci	1.10E+02	0	1.23E-01	0	9.05E-01	0	1.11E+02
Co-60	Ci	6.84E+01	0	1.24E+00	1.12E-02	1.06E+02	0	1.76E+02
Cs-137	Ci	2.68E+04	3.09E+02	2.58E+01	5.34E-01	2.68E+03	0	2.98E+04
H-3	Ci	1.85E+01	3.78E+02	2.01E+04	9.99E+02	0	8.92E+03	3.04E+04
I-129	Ci	7.05E-03	0	1.39E+00	8.20E-02	3.89E-02	0	1.52E+00
Np-237	Ci	2.16E-01	0	1.07E+00	0	1.33E-01	0	1.42E+00
Total Pu	Ci	1.18E+03	0	8.22E-01	6.92E-02	1.02E+01	0	1.19E+03
Sr-90	Ci	1.80E+04	3.09E+02	2.43E+01	2.95E-01	1.11E+03	0	1.94E+04

1. Time period over which the estimates are available (from RWMIS) varies by contaminant.

Table 5-42 Summary of the total mass or activity for each of the COPCs, from each of groundwater contamination sources.

COPCs	Units	Known Release		Service Waste[1]		Soil Contamination	TRA	Total
		Tank Farm	Other	Injection Well	SWPs			
Tc-99	Ci	2.58E+00	0	0	0	1.06E-01	0	2.69E+00
Total U	Ci	7.47E-01	0	2.69E-01	7.01E-02	9.40E-01	0	2.03E+00

1. Time period over which the estimates are available (from RWMIS) varies by contaminant.

Table 5-43 Summary of the percent (%[1]) mass or activity for each of the COPCs, from each of groundwater contamination sources.

COPCs	Source (%)						Total[2]
	Known Release		Service Waste		Soil Contamination	TRA	
	Tank Farm	Other	Injection Well	SWPs			
Arsenic	0	0	0	0	100.00	0	100
Chromium	0.07	0	0	0	0.55	99.37	100
Mercury	2.74	0	39.06	0	58.2	0	100
Am-241	99.07	0	0.11	0.00	0.82	0	100
Co-60	38.94	0	0.71	0.01	60.35	0	100
Cs-137	89.89	1.04	0.09	0.00	8.99	0	100
H-3	0.06	1.24	66.08	3.28	0	29.33	100
I-129	0.46	0	91.57	5.40	2.56	0	100
Np-237	15.22	0	75.41	0	9.37	0	100
Total Pu	99.07	0	0.07	0.01	0.86	0	100
Sr-90	92.58	1.59	0.12	0.00	5.71	0	100
Tc-99	96.05	0	0	0	3.95	0	100
Total U	36.87	0	13.28	3.46	46.39	0	100

1.% mass =% activity for a given COPC with the exception of Total Pu and Total U which are given just in % activity.
2. for a given COPC, accumulating the percentage across the various sources results in 100% of the mass or activity.

6 SUMMARY OF THE CONTAMINANT SOURCES USED FOR THE TRANSPORT MODEL

Based on the screening described in Section 5.1 of this report, the contaminant transport modeling will be limited to three non-radionuclides (arsenic, chromium, and mercury) and 10 radionuclides (Am-241, Co-60, Cs-137, H-3, I-129, Np-237, Total Pu, Sr-90, Tc-99, and combined uranium). Each COPC will be incorporated into the model using the mass (radionuclide activity is converted to mass units) defined from the known releases, service waste, soil contamination, or TRA discharge to the aquifer. These contaminant mass sources are modeled as either a uniform release over a known time frame, a variable release over a known time frame, or a one-time release at a particular time. For the simulations, the plutonium isotopes are combined into a Total Pu run and the uranium isotopes are combined into a Total U run.

The first section of this chapter (Section 6.1) summarizes the simulated source time frames and locations of each source in the simulation model. The second section of this chapter (Section 6.2) is an explanation of how the total plutonium and total uranium sources were defined. Sections 6.3 through 6.6 describe how the sources are incorporated into the model. This chapter is presented in the following order:

6.1 Definition of Simulation Source Time Frame and Locations

6.2 Source Definition of Total Pu and Total U

- 6.2.1 Combining Pu-238, 239, 240, 241, and 242 Into Total Pu
- 6.2.2 Combining U-234, 235, and 238 Into Total U

6.3 Simulation of Sources Based on Known Releases

6.4 Simulation of Sources Based on Service Waste Disposal

- 6.4.1 Injection Well
- 6.4.2 Percolation Ponds

6.5 Simulation of Sources Based on Soil Contamination

6.6 Simulation of Sources Based on the TRA Contaminant Sources

6.1 Definition of Simulation Source Time Frame and Locations

Each of the contaminant sources are defined over some time frame and incorporated into the simulation model at a grid block or set of grid blocks. Table 6-1 summarizes the simulation time frame, location within the numerical domain, and liquid release assumed for each source. Figure 6-1 gives a plan view schematic of the numerical grid showing the numbering scheme used to define the source locations.The time frames assumed for the known releases, service waste discharges, and TRA discharges are defined based on the release and discharge history. The time frame assumed for the soil contamination sources is assumed to be 1992 because many of the soil samples were taken at about that time as part of the Track 2 investigations.

Table 6-1 Contaminant source simulation time frames, locations, and liquid release

Source Identification	Simulation Time Frame	Plan View Grid Location	Vertical Grid Location	Liquid Release Rate	Comments
Known Releases					
CPP-28/-91	1/56 - 10/74	7,5	13	2.01 kg/d	
1986 Tank Farm Release	7/7/86 - 8/2/86	7,5	13	366 kg/d	
CPP-31	11/1/72 - 11/30/72	7,4	13	1,827 kg/d	
CPP-80	1/1/83 - 12/31/89	8,5	2	156 kg/d	
CPP-02	1954 - 1966	8,12	2	variable rate, total 1.8E+08 kg	
Service Waste					

Table 6-1 Contaminant source simulation time frames, locations, and liquid release

Source Identification	Simulation Time Frame	Plan View Grid Location	Vertical Grid Location	Liquid Release Rate	Comments
Injection Well	1/53 - 12/67 1/68 - 9/70 10/70 - 3/86	8,7 8,7 8,7	3 - 7 in aquifer 45 in vadose zone 3 - 7 in aquifer	variable rate variable rate variable rate	aquifer model vadose zone model aquifer model
SWPs	4/84 - 12/2095	8,14 7,14 6,14 5,14 8,15 7,15 6,15 5,15	1	72.9 kg/m^2/d	
Soil Sources					
CPP-20/-25	1/92	7,5	7, 8, and 9	0	
CPP-26	1/92	3,4 4,4 5,4 5,3 4,3 3,3 4,2	7, 8, and 9	0	
CPP-32E/W	1/92	6,4	7, 8, and 9	0	
CPP-15 - zone 1W	1/92	7,5	7, 8, and 9	0	
CPP-15 - zone 1E	1/92	7,5	7, 8, and 9	0	
CPP-15 - zone 2	1/92	7,5	7, 8, and 9	0	
CPP-27/-33	1/92	7,5	7, 8, and 9	0	
CPP-58E/W	1/92	7,5	7, 8, and 9	0	
CPP-35	1/92	6,6	7, 8, and 9	0	
CPP-36/-91 - zone 1	1/92	6,5	7, 8, and 9	0	
CPP-36/-91 - zone 2	1/92	6,5	7, 8, and 9	0	
CPP-01/-04/-05	1/92	8,12	7, 8, and 9	0	
CPP-08/09	1/92	8,12	7, 8, and 9	0	
CPP-10	1/92	8,12	7, 8, and 9	0	
CPP-11	1/92	8,12	7, 8, and 9	0	
CPP-03	1/92	7,12	7, 8, and 9	0	
CPP-17A	1/92	7,11	7, 8, and 9	0	
CPP-17B	1/92	7,11	7, 8, and 9	0	
CPP-06	1/92	7,12	7, 8, and 9	0	
CPP-13 [b]	1/92	5,5	7, 8, and 9	0	
CPP-14 Imhoff	1/92	6,4	7, 8, and 9	0	
CPP-14 Plant	1/92	6,4	7, 8, and 9	0	
CPP-14 Drain	1/92	6,4	7, 8, and 9	0	
CPP-19	1/92	8,10	7, 8, and 9	0	
CPP-22	1/92	9,13 8,13 9,14	7, 8, and 9	0	
CPP-34A and B	1/92	4,1 3,2	7, 8, and 9	0	
CPP-37A	1/92	4,3	7, 8, and 9	0	
CPP-37B	1/92	4,3	7, 8, and 9	0	
CPP-89	1/92	7,4	7, 8, and 9	0	
CPP-90	1/92	8,6	7, 8, and 9	0	
CPP-93	1/92	6,6	7, 8, and 9	0	
TRA Source					
TRA Area	1952 - 2015	See Figure 2-26	1 in aquifer	variable	aquifer model

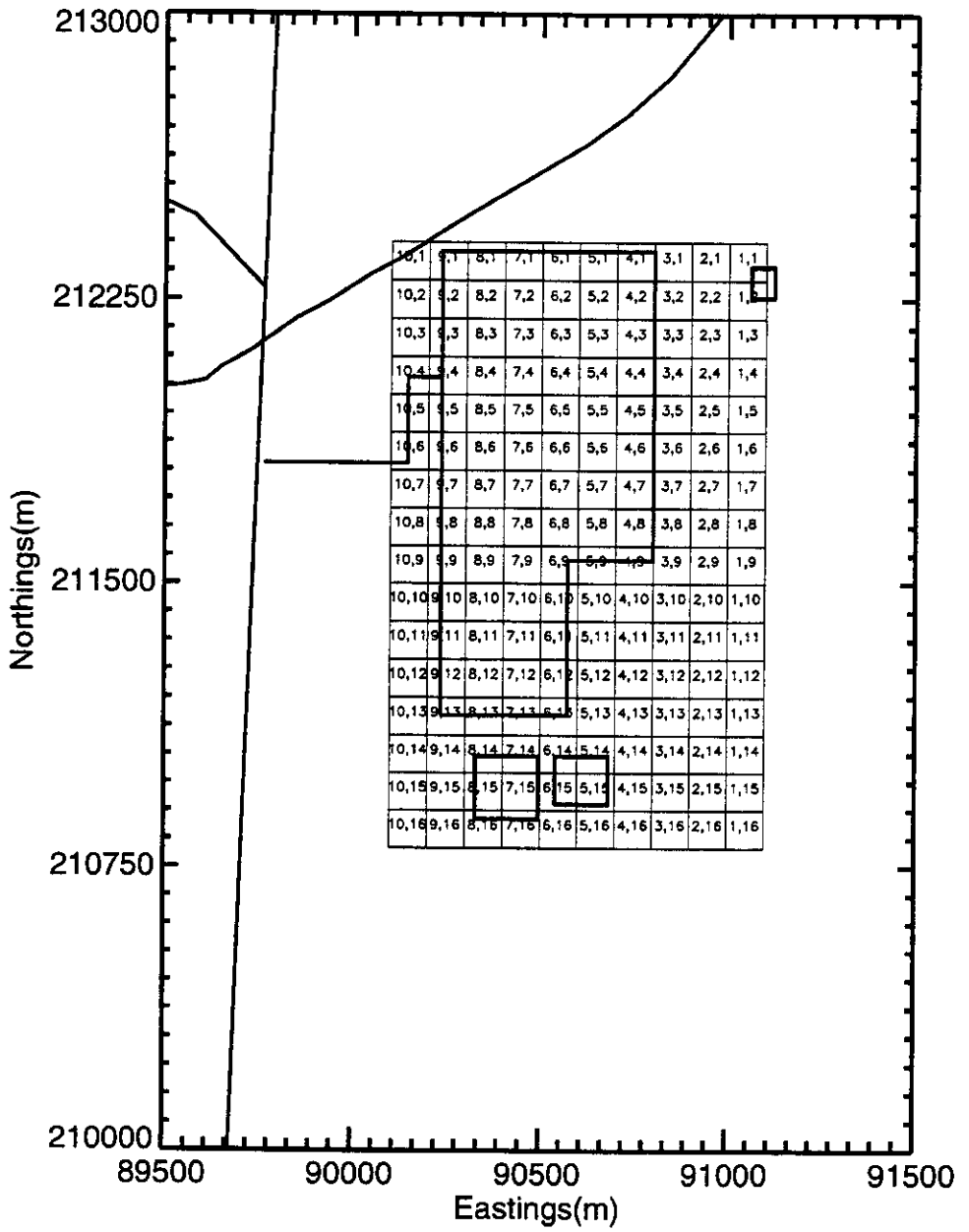


Figure 6-1 Numbering scheme used to define the source locations in the numerical grid.

In the numerical simulation model, the horizontal grid block location for all the sources were defined by overlaying the numerical grid on a map of the ICPP area. The grid block number corresponds to the refined grid number on the top layer of the model.

In the numerical simulation model, the vertical grid block locations for the known releases from the tank farm were chosen to be in the basalt below the alluvium. In the basalt portion of the vadose zone, there is a large hydraulic conductivity with no sorption; therefore, any contaminant put into the model below the alluvium will move quickly to the upper interbed. In reality, the known releases are distributed at different depths in the alluvium rather than released directly to the basalt. Therefore, the model incorporation of the

known releases is conservative. The primary reason for this conservative assumption is that the majority of the contamination comes from tank farm leaks that are a very low pH liquid. Because the liquid is low pH, it is possible that the K_d values for the contaminants are all much less than the K_d values used for this analysis. In addition, some of the liquid could have soaked through the alluvium to the basalt before sorbing to the soil at all. Because the contaminants are expected to move quickly through the alluvium, but the actual travel time is unknown, it is assumed that they move through instantaneously. In general, the injection well liquid distributed vertically over grids 3, 4, 5, 6, and 7 in the aquifer model. However, from January 1978 until November 1970, because the well casing had been corroded (as explained in Section 5.2.4.3), the service waste was being disposed of directly to the lower interbed zone in the vadose zone. The water and contaminants are incorporated into the vadose zone model in the 45th vertical grid from the top, which corresponds to the basalt zone grid directly above the lower interbed. The liquid disposal to the SWPs is assumed to be at the ground surface, or the first vertical grid. The soil sources are assumed to be uniformly distributed between the bottom three grids of the alluvium. In reality, the soil contamination can be distributed over a much larger vertical portion of the alluvium; therefore, this is a conservative assumption.

6.2 Source Definition of Total Pu and Total U

For the simulations, the plutonium isotopes are combined into a Total Pu run and the uranium isotopes are combined into a Total U run. These simplifications were made because the plutonium and uranium activities reported are not always reported as specific isotopes.

The mass transport can be simulated as combined plutonium and combined uranium because the retardation is chemical, not isotope dependent. However, the transformation from activity of individual isotopes to mass of the combined radionuclides (and from mass to activity) introduces errors into the calculations that have to be minimized. This section summarizes the assumptions made to define the Total Pu and Total U that are simulated as COPCs.

6.2.1 Combining Pu-238, 239, 240, 241, and 242 Into Total Pu

Based on the summary in Table 5-42, 99% of the Pu activity released at the ICPP is from the tank farm releases, 0.03% is from the service waste disposal, and 0.86% is from soil contamination. Virtually all the Pu mass and activity in the model simulations are from tank farm releases and have the characteristics of the Pu releases estimated from the tank farm. Therefore, Pu from the other sources are assumed to have the same isotopic composition as the tank farm releases. The isotopic composition of Pu from the tank farm is given in Table 5-22 and is repeated in columns 3 and 4 of Table 6-2. A limitation of this approach is that there was no Pu-238 reported for the tank farm. In Section 10, the contribution of Pu-238 is estimated and the influence on the simulation results is discussed.

Table 6-2 Summary of the Pu isotope distributions used to define the total Pu.

Pu Isotope	Half life (years)	Initial Isotope Distribution: Mass (From Table 5-22 %	Initial Isotope Distribution: Activity %	Fraction remaining in 2095	Isotope Distribution in 123 years (Year 2095): Mass %	Isotope Distribution in 123 years (Year 2095): Activity %
Pu-238	8.78E+01	-	-	0.379	-	-
Pu-239	2.41E+04	78.55	1.64	0.996	83.30	60.28
Pu-240	6.56E+03	14.23	0.83	0.987	14.95	30.04
Pu-241	1.44E+01	5.70	97.5	0.003	0.02	9.65
Pu-242	3.73E+05	1.63	0.00	1.000	1.74	0.04

Also included in Table 6-2 are the fractions of each Pu isotope that will remain in the year 2095 and the isotope distribution at that time. The Pu isotope distribution in the year 2095 is calculated by decaying the

activity fractions from the year 1972 until 2095 (123 years). The year 2095 is the primary risk assessment year of interest. The initial year is defined as 1972 because that was the year of the CPP-31 release, which accounts for the vast majority of the Pu discharged at the ICPP. Although the isotope distribution of mass does not change significantly, the activity distribution is dramatically different because the major activity contributor, Pu-241, has a half-life of 14.4 years, most of which will decay by the year 2095. The major mass contributor, Pu-239, has a half-life of 2.41E+04 years so that almost zero will decay by 2095. The isotope distribution from the year 2095 is used to transform the simulated mass concentrations back to activity concentrations.

Where available, the mass of each of the isotopes was estimated from the measured activities. For the Pu source activities reported as activity of Pu-239/240, the mass is calculated assuming it is all Pu-239 (conservative mass assumption by a factor of four). For the Pu source activities reported as activity of Total Pu, the mass is calculated based on the current isotope distribution presented in Table 6-2. The sum of all the Pu mass estimates are used as the Pu source to the transport model. Tables 6-3, 6-4, 6-5, and 6-6 contain summaries of the Total Pu mass calculations for each of the major sources. These are the source values used in the simulation model.

Table 6-3 Summary of the known release sources of Total Pu.

	CPP-28			1986 Release			CPP-31		
Isotope	(Ci)	(kg)	(kg/d)	(Ci)	(kg)	(kg/d)	(Ci)	(kg)	(kg/d)
Pu-239	1.02E+00	1.65E-02	2.41E-06	1.30E-02	2.09E-04	8.05E-06	8.46E+00	1.36E-01	4.70E-03
Pu-240	1.01E+00	4.46E-03	6.52E-07	8.38E-03	3.69E-05	1.42E-06	5.46E+00	2.40E-02	8.29E-04
Pu-241	2.02E+02	1.96E-03	2.87E-07	1.48E+00	1.44E-05	5.52E-07	9.62E+02	9.35E-03	3.22E-04
Pu-242	2.62E-03	6.65E-04	9.71E-08	1.62E-05	4.11E-06	1.58E-07	1.05E-02	2.67E-03	9.22E-05
Total Pu	**2.04E+02**	**2.36E-02**	**3.44E-06**	**1.50E+00**	**2.65E-04**	**1.02E-05**	**9.76E+02**	**1.72E-01**	**5.94E-03**

Table 6-4 Injection well source of Total Pu.

Isotope	Specific Activity (Ci/g)	Half life (years)	Activity% Based on the Tank Farm Releases	Reported Activity From 8/74-4/85 (Ci/m)	Calculated Activity Over the 389-Month Life of the Well (Ci)	Calculated Mass Over the 389-Month Life of the Well (kg)	Calculated Steady State Daily Mass Flux (kg/d)
Reported Total Pu Activity				2.11E-03	8.21E-01		
Pu-238	1.71E+01	8.78E+01	-	-	-	0.00E+00	0.00E+00
Pu-239	6.20E-02	2.41E+04	1.64%	3.46E-05	1.35E-02	2.17E-04	1.83E-08
Pu-240	2.27E-01	6.56E+03	0.83%	1.74E-05	6.77E-03	2.98E-05	2.52E-09
Pu-241	1.03E+02	1.44E+01	97.50%	2.06E-03	8.00E-01	7.77E-06	6.56E-10
Pu-242	3.96E-03	3.73E+05	0.00%	2.19E-08	8.54E-06	2.16E-06	1.82E-10
Total			**99.97%**	**2.11E-03**	**8.21E-01**	**2.57E-04**	**2.17E-08**

Table 6-5 Percolation pond sources for Total Pu.

Isotope	Specific Activity (Ci/g)	Half life (years)	Activity %	Activity 1980s (Ci)	Activity 1990s (Ci)	Mass 1980s (kg)	Mass 1990s (kg)	Mass 1980s (kg/d)	Mass 1990s (kg/d)
Pu-238	1.71E+01	8.78E+01	-	-	-	-	-	-	-
Pu-239	6.20E-02	2.41E+04	1.64%	1.12E-03	1.97E-05	1.80E-05	3.17E-07	8.32E-09	1.45E-10
Pu-240	2.27E-01	6.56E+03	0.83%	5.61E-04	9.90E-06	2.47E-06	4.36E-08	1.14E-09	1.99E-11
Pu-241	1.03E+02	1.44E+01	97.5%	6.63E-02	1.17E-03	6.44E-07	1.14E-08	2.98E-10	5.19E-12
Pu-242	3.96E-03	3.73E+05	0.00%	7.07E-07	1.25E-08	1.79E-07	3.15E-09	8.27E-11	1.44E-12
			Total	**6.80E-02**	**1.20E-03**	**2.13E-05**	**3.75E-07[a]**	**9.85E-09**	**1.71E-10**

a. total mass after 1990 is the mass estimated from 1990 to 1995 plus twenty times the 1990 to 1995 mass to account for discharges from 1995 to 2095.

Table 6-6 Soil contamination sources for Total Pu.

	Specific Activity (Ci/g)	Max. Concentration pCi/g	UCL Concentration pCi/g	Activity Ci	Mass (kg)
Pu-238					
CPP-89	17.10191676	259	83.4	8.10E-01	4.74E-05
3-07/CPP-26	17.10191676	3.58	3.58	2.93E-03	1.71E-07
3-08/CPP-15 - zone 2	17.10191676	4570	4570	1.36E+00	7.95E-05
3-08/CPP-27 / -33	17.10191676	1.41	0.945	2.01E-03	1.17E-07
3-11/CPP-58W/E	17.10191676	0.295	0.295	3.41E-03	1.99E-07
3-08/CPP-35	17.10191676	13.2	13.2	1.82E-02	1.06E-06
3-08/CPP-36 /-91 - zone 1	17.10191676	8180	8180	6.68E+00	3.90E-04
3-02/CPP-37A	17.10191676	0.12	0.061	7.62E-04	4.46E-08
3-02/CPP-37B	17.10191676	0.5	0.115	1.35E-02	7.90E-07
3-06/CPP-34	17.10191676	5.1	0.512	1.61E-02	9.40E-07
Total				**8.91E+00**	**5.20E-04**
Pu-239					
3-07/CPP-26	0.062044218	0.841	0.841	6.88E-04	1.11E-05
3-08/CPP-27 / -33	0.062044218	0.166	0.166	3.53E-04	5.68E-06
3-11/CPP-58W/E	0.062044218	0.0403	0.0403	4.66E-04	7.50E-06
3-08/CPP-35	0.062044218	0.725	0.725	9.98E-04	1.61E-05
3-08/CPP-36 /-91 - zone 1	0.062044218	324	324	2.64E-01	4.26E-03
3-09/CPP-01/-04/-05	0.062044218	12	12	5.88E-02	9.48E-04
3-09/CPP-19	0.062044218	141	141	6.13E-01	9.88E-03
Total				**9.38E-01**	**1.51E-02**
Pu-239/240 (assume 240)					
CPP-89	0.226987102	24.7	12.1	1.18E-01	5.18E-04
3-08/CPP-15 - zone 2	0.226987102	825	825	2.45E-01	1.08E-03

Table 6-6 Soil contamination sources for Total Pu.

	Specific Activity	Max. Concen-tration	UCL Concen-tration	Activity	Mass
	(Ci/g)	pCi/g	pCi/g	Ci	(kg)
Total				**3.63E-01**	**1.60E-03**
Total Pu					
CPP-89				9.28E-01	5.65E-04
3-07/CPP-26				3.62E-03	1.13E-05
3-08/CPP-15 - zone 2				1.60E+00	1.16E-03
3-08/CPP-27 / -33				2.36E-03	5.80E-06
3-11/CPP-58W/E				3.87E-03	7.70E-06
3-08/CPP-35				1.92E-02	1.72E-05
3-08/CPP-36 /-91 - zone 1				6.94E+00	4.65E-03
3-09/CPP-01/-04/-05				5.88E-02	9.48E-04
3-02/CPP-37A				7.62E-04	4.46E-08
3-02/CPP-37B				1.35E-02	7.90E-07
3-06/CPP-34				1.61E-02	9.40E-07
3-09/CPP-19				6.13E-01	9.88E-03
Total				**1.02E+01**	**1.72E-02**

The known releases only include the tank farm releases because there are no plutonium releases reported from CPP-80 or CPP-02. The results are summarized in Table 6-3. Plutonium disposal to the injection well and percolation ponds are calculated by finding the total activity disposed to that source and using the current isotope distribution presented in Table 6-2 to distribute the activity. The results are summarized in Tables 6-3 and 6-4. Then the mass is calculated for each isotope and a total mass is calculated by summing the mass of the individual isotopes. This total mass is used in the simulations model. This may not accurately account for the plutonium mass from the service waste system, but because a consistent set of isotope distributions will be used to transform the mass concentrations back to activity concentrations, it will accurately account for the plutonium activity. In any case, the plutonium in the service waste is a small portion of the total plutonium, and any errors will have a minimal effect on the simulated results.

Rather than distributing the total activity of the soil sources based on the tank farm distribution, the reported isotopic activities are simply converted to mass and summed. The results are summarized in Table 6-6. This allows for an accurate estimate of the mass at each of the soil contamination sites, but may not accurately account for the activity. This approach was necessary because there are many different soil contamination sites with dramatically different isotopes reported at each site. If the tank farm isotopic distribution was used, one site could be simulated as having much more mass of plutonium than another site, when it in fact has much less. Of particular interest is the fact that a large portion of the soil contamination plutonium is Pu-238, and no Pu-238 was estimated from the tank farm releases. Pu-238 has a relatively short half-life (87.8 years), but a significant fraction of it will remain in 100 years. Pu-238 will be neglected when the mass concentrations are transformed to activity concentrations, but because the soil contamination plutonium accounts for less than 1% of the total plutonium source, this will have very little effect on the simulation results.

The total Pu mass estimates from all of the different sources are compiled and distributed into the numerical grids of the simulation model. In order to be conservative, the Pu half-life is assumed to be that of Pu-239 (24,100 years). Therefore, very little of the mass will decay during the simulation runs. However, because much of Pu-241 is assumed to decay away, the total activity will be significantly reduced.

As a result of the decay of Pu-241, Am-241 is produced. Pu-241 has a half-life of 14.4 years, and Am-241 has a half-life of 432.7 years. Therefore, by the year 2095, most of the Pu-241 in the system has changed to Am-241. This analysis did not incorporate progeny ingrowth into the model. Therefore, the production of Am-241 from Pu-241 was not simulated. In the 123 years from 1972 until 2095, 99.7% of Pu-241 is estimated to have decayed from Pu-241 to Am-241. Since Pu-241 makes up approximately 5.7% of the Pu mass initially, and there is very little decay from the other isotopes, approximately 6% of the simulated Pu mass at the year 2095 will be assumed to be Am-241. The risk of the Am-241 produced from Pu-241 will be added to the Am-241 simulation results. It is reasonable to simulate the Am-241 transport in this way because the K_d of Am-241 is much higher than Pu-241 (340 versus 22 cm^3/g), and therefore, the Am-241 that is produced from Pu-241 will have moved much farther in the vadose zone or aquifer than the Am-241 that is assumed to be discharged at the surface sources.

6.2.2 Combining U-234, 235, and 238 Into Total U

Based on the summary in Table 5-42, 39% of the U activity released at the ICPP is from the tank farm releases, 13% is from the service waste disposal, and 48% is from soil contamination. The isotope ratios estimated for the primary releases from the tank farm (CPP-31 and the 1986 release) are shown in Table 5-22. They indicate that U-234 makes up 93% of the activity but only 1% of the mass, U-238 makes up 1% of the activity and 50% of the mass, U-235 makes up 1.7% of the activity and 45% of the mass, and U-236 makes up 3% of the activity and 0.5% of the mass. The soil contamination data indicates that U-234 makes up 15% of the activity and very little of the mass, while U-238 makes up 82% of the activity and 99% of the mass, and U-235 makes up 2.6% of the activity and 0.5% of the mass.

Because the total U activity flux is primarily from two different sources (the tank farm releases and the soil contamination) and the activity ratios of the isotopes are very different in each source, a mixture of isotope ratios is assumed to partition the U isotopes for all sampling data reported as total uranium. When the uranium activity is simply reported as total uranium (as in the injection well and much of the SWP disposal records), 50% is attributed to U-234 and 50% to U-238. This ratio is used because of the primary uranium sources, the tank farm releases are primarily U-234 and the soil contamination releases are primarily U-238.

Table 6-7, 6-8, 6-9, and 6-10 are summaries of the U activity and mass estimates for each of the major sources. These tables give the source mass values that are used in the simulation model. The simulation mass concentration results are transformed back to activity concentrations using the sum of the mass fractions of the isotopes. The total uranium mass source is 99.38% U-238, 0.60% U-235, 0.015% U-236, and 0.006% U-234. Because the activity to mass and mass to activity calculations use exactly the same overall ratios, the total activity will be preserved. However, areal distribution of the isotopes will not be preserved because the isotopic ratios are different in different sources but lumped as one set of ratios when transforming the solution from mass concentration to activity concentration. Because of the mixing in the vadose zone and aquifer, this is assumed to be a negligible error.

Table 6-7 Summary of the known release sources of Total U.

	CPP-28			1986 Release			CPP-31			Activity Sum	Mass Sum
Isotope	(Ci)	(kg)	(kg/d)	(Ci)	(kg)	(kg/d)	(Ci)	(kg)	(kg/d)	(Ci)	(kg)
U-234	3.61E-02	5.82E-03	8.49E-07	1.03E-03	1.65E-04	6.36E-06	6.69E-01	1.08E-01	3.72E-03	7.06E-1	1.14E-1
U-235	7.37E-04	3.41E-01	4.99E-05	1.66E-05	7.68E-03	2.95E-04	1.08E-02	5.00E+00	1.72E-01	1.16E-2	5.35E+0
U-236	1.93E-03	2.98E-02	4.36E-06	3.90E-05	6.03E-04	2.32E-05	2.54E-02	3.93E-01	1.35E-02	2.74E-2	4.20E-1
U-238	3.54E-05	1.05E-01	1.54E-05	2.82E-06	8.41E-03	3.23E-04	1.84E-03	5.47E+00	1.89E-01	1.88E-3	5.58E+0
Total U	**3.88E-02**	**4.82E-01**	**7.04E-05**	**1.09E-03**	**1.69E-02**	**6.48E-04**	**7.07E-01**	**1.10E+01**	**3.78E-01**	**7.47E-1**	**1.15E+1**

Table 6-8 Injection well source of Total U.

Isotope	Specific Activity (Ci/g)	Half life (years)	Assumed Activity %	Reported Activity From 5/90-4/85 (Ci/m)	Calculated Activity Over the 389-Month Life of the Well (Ci)	Calculated Mass Over the 389-Month Life of the Well (kg)	Calculated Steady State Daily Mass Flux (kg/d)
U-234	6.23E-03	2.45E+05	50.00	3.46E-04	1.35E-01	2.16E-02	1.82E-06
U-235	2.16E-06	7.04E+08	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
U-238	3.36E-07	4.47E+09	50.00	3.46E-04	1.35E-01	4.01E+02	3.38E-02
Total			**100**	**6.92E-04**	**2.69E-01**	**4.01E+02**	**3.38E-02**

Table 6-9 Percolation pond sources for Total U

Isotope	Specific Activity (Ci/g)	Half life (years)	Assumed Activity %	Activity 1984 - 1995 (Ci)	Mass 1984 - 1995 (kg)	Mass Flux 1984 - 1995 (kg/d)
U reported as Total U				3.75E-02		
U-234 reported as U-234	6.23E-03	2.45E+05		2.15E-02		-
U-234 reported as Total U	6.23E-03	2.45E+05	50%	1.88E-02		
Sum U-234	6.23E-03	2.45E+05		4.03E-02	6.46E-03	1.48E-06
U-235 reported as U-235	2.16E-06	7.04E+08		5.90E-04	2.73E-01	6.28E-05
U-236 reported as U-236	6.47E-05	2.34E+07		0.00E+00	0.00E+00	0.00E+00
U-238 reported as U-238	3.36E-07	4.47E+09		1.06E-02		
U-238 reported as Total U	3.36E-07	4.47E+09	50%	1.88E-02		
Sum U-238	3.36E-07	4.47E+09		2.94E-02	8.74E+01	2.01E-02
Total				**7.02E-02**	**87.65**	**2.01E-02**

Table 6-10 Soil contamination sources for Total U.

	Specific Activity (Ci/g)	Max. Concentration pCi/g	UCL Concentration pCi/g	Activity Ci	Mass (kg)
U-234					
CPP-89	0.006233534	5.1	5.1	4.95E-02	7.95E-03
3-07/CPP-26	0.006233534	2.21	1.815	1.49E-03	2.38E-04
3-08/CPP-36 /-91 - zone 1	0.006233534	2.81	2.81	2.29E-03	3.68E-04
3-09/CPP-11	0.006233534	1.2	1.2	2.06E-03	3.30E-04
3-05/CPP-14 - Plant Site	0.006233534	6.89	4.52	5.02E-02	8.05E-03
3-06/CPP-34	0.006233534	2.5	1.15	3.61E-02	5.79E-03
Total				**1.42E-01**	**2.27E-02**

Table 6-10 Soil contamination sources for Total U.

	Specific Activity	Max. Concentration	UCL Concentration	Activity	Mass
	(Ci/g)	pCi/g	pCi/g	Ci	(kg)
		U-235			
3-07/CPP-26	2.16011E-06	1.04	0.077	6.30E-05	2.92E-02
3-08/CPP-15 - zone 2	2.16011E-06	0.0203	0.0203	6.04E-06	2.79E-03
3-08/CPP-27 / -33	2.16011E-06	0.069	0.0355	7.54E-05	3.49E-02
3-11/CPP-58W/E	2.16011E-06	0.0679	0.0679	7.84E-04	3.63E-01
3-08/CPP-35	2.16011E-06	0.0716	0.0716	9.86E-05	4.56E-02
3-08/CPP-36 /-91 - zone 1	2.16011E-06	0.0995	0.0995	8.12E-05	3.76E-02
3-09/CPP-01/-04/-05	2.16011E-06	0.302	0.302	1.48E-03	6.85E-01
3-09/CPP-08/-09	2.16011E-06	0.0261	0.0261	9.28E-05	4.30E-02
3-09/CPP-10	2.16011E-06	0.0142	0.0142	6.89E-06	3.19E-03
3-02/CPP-37A	2.16011E-06	0.05	0.031	3.87E-04	1.79E-01
3-02/CPP-37B	2.16011E-06	0.07	0.0337	3.96E-03	1.83E+00
3-05/CPP-14 - Imhoff Tanks	2.16011E-06	0.05	0.05	1.27E-06	5.90E-04
3-05/CPP-14 - Plant Site	2.16011E-06	0.68	0.68	7.55E-03	3.49E+00
3-09/CPP-19	2.16011E-06	2.36	2.36	1.03E-02	4.75E+00
		Total		**2.49E-02**	**1.15E+01**
		U-238			
3-08/CPP-36 /-91 - zone 1	3.35917E-07	1.84	1.84	1.50E-03	4.47E+00
3-09/CPP-08/-09	3.35917E-07	0.161	0.161	5.72E-04	1.70E+00
3-09/CPP-11	3.35917E-07	1	1	1.72E-03	5.11E+00
3-02/CPP-37A	3.35917E-07	3.99	1.882	2.35E-02	7.00E+01
3-02/CPP-37B	3.35917E-07	7.44	1.03	1.21E-01	3.60E+02
3-05/CPP-14 - Plant Site	3.35917E-07	52.1	52.1	5.78E-01	1.72E+03
3-06/CPP-34	3.35917E-07	2.8	1.428	4.48E-02	1.33E+02
3-09/CPP-19	3.35917E-07	0.453	0.453	1.97E-03	5.86E+00
		Total		**7.73E-01**	**2.30E+03**
		Total U			
CPP-89				4.95E-02	7.95E-03
3-07/CPP-26				1.55E-03	2.94E-02
3-08/CPP-15 - zone 2				6.04E-06	2.79E-03
3-08/CPP-27 / -33				7.54E-05	3.49E-02
3-11/CPP-58W/E				7.84E-04	3.63E-01
3-08/CPP-35				9.86E-05	4.56E-02
3-08/CPP-36 /-91 - zone 1				3.88E-03	4.51E+00
3-09/CPP-01/-04/-05				1.48E-03	6.85E-01
3-09/CPP-08/-09				6.65E-04	1.75E+00
3-09/CPP-10				6.89E-06	3.19E-03
3-09/CPP-11				3.77E-03	5.11E+00
3-02/CPP-37A				2.39E-02	7.02E+01
3-02/CPP-37B				1.25E-01	3.62E+02
3-05/CPP-14 - Imhoff Tanks				1.27E-06	5.90E-04
3-05/CPP-14 - Plant Site				6.36E-01	1.73E+03

Table 6-10 Soil contamination sources for Total U.

	Specific Activity	Max. Concentration	UCL Concentration	Activity	Mass
	(Ci/g)	pCi/g	pCi/g	Ci	(kg)
3-06/CPP-34				8.09E-02	1.33E+02
3-09/CPP-19				1.22E-02	1.06E+01
Total				9.40E-01	2.31E+03

All of the uranium isotopes have half-lives that are very long compared to the simulation time frame of interest. Therefore, there would be essentially zero decay of uranium during the simulations regardless of which isotope half-life was simulated. Therefore, the longest half-life (4.47E+09 years) was chosen to be conservative.

The known releases only include the tank farm releases because no uranium releases are reported from CPP-80 or CPP-02. The results are summarized in Table 6-7. Uranium disposal to the injection well is calculated by finding the total activity disposed to the injection well and assuming 50% is U-234 and 50% is U-238. The results are summarized in Table 6-8. Uranium disposal to the percolation ponds is estimated by assuming that the uranium activity reported as Total Uranium is 50% U-234 and 50% U-238. The estimated U-234 and U-238 mass is added to the mass of U-234 and U-238 calculated from reported activities. The results are summarized in Table 6-9. The mass of uranium in the contaminated soil is calculated directly from the estimated activity concentrations reported from the soil sampling. The results are summarized in Table 6-10.

The total U mass estimates from all of the different sources are compiled and distributed into the numerical grids of the simulation model. In order to be conservative, the U half-life is assumed to be that of U-238 (4.47 billion years). Using this half-life, very little of the mass will decay during the simulation runs.

6.3 Simulation of Sources Based on Known Releases

As discussed in Section 5.2.2 there are five contaminant sources at the ICPP for which the contaminant sources are defined as known releases. There are three known releases from the tank farm area and two elsewhere. The three tank farm area releases are:

- CPP-28/-79 - contaminated soil south of WM-181 by valve box A6.
- The 1986 tank farm release.
- CPP-31 - contaminated soil south of WM-183.

The two other releases are:

- CPP-02 - former french drain west of CPP-603.
- CPP-80 - CPP-601 vent tunnel drain leak (VT-300).

CPP-28/-79, the 1986 release, CPP-31, and CPP-80 are all treated as uniform releases over some period of time. The time frame for these releases are fairly well known, but there is no information regarding the variability of the release over time. Therefore, a uniform release rate has been estimated for each contaminant at each source. Table 6-11 lists the time frames and uniform release rates used for each COPC. The release rates are given in consistent units of kg/d as used in the model.

CPP-02 is a variable release over the time period 1954 to 1966. Although a number of radionuclides were reported as released, only Cs-137, H-3, and Sr-90 are COPCs for this analysis. Table 6-12 lists the variable release rate assumed from CPP-02 for each COPC.

Table 6-11 Source information for the known release sources with uniform release rates.

	Uniform Release Rate (kg/d)			
	CPP-28/79	1986 Release	CPP-31	CPP-80
Arsenic	0	0	0	0
Chromium	0	9.346E-02	4.678E-01	0
Mercury	0	1.65E-01	8.22E-01	0
Am-241	0	1.887E-06	1.102E-03	0
Co-60	2.634E-09	2.506E-09	1.463E-06	0
Cs-137	2.136E-05	9.637E-06	5.626E-03	1.244E-06
H-3	6.596E-11	8.574E-11	5.005E-08	0
I-129	0	2.358E-06	1.376E-03	0
Np-237	2.760E-08	1.807E-05	1.055E-02	0
Total Pu	3.44E-06	1.02E-05	5.94E-03	0
Sr-90	6.584E-06	5.115E-06	2.986E-03	7.885E-07
Tc-99	0	8.993E-06	5.250E-03	0
Total U	7.04E-05	6.48E-04	3.78E-01	0

Table 6-12 Source information for CPP-02. A known release source with variable release rates.

Date	Mass (kg/d)		
	Cs-137	H-3	Sr-90
1954	0	0	0
1955	0	0	0
1956	0	0	0
1957	0	0	0
1958	1.611E-09	0	5.541E-10
1959	0	0	1.105E-08
1960	4.926E-09	0	2.452E-09
1961	0	0	0
1962	6.523E-07	5.484E-08	4.535E-07
1963	4.243E-07	1.645E-08	2.087E-07
1964	3.167E-09	2.050E-08	2.006E-09
1965	0	1.071E-08	0
1966	0	4.382E-09	0
Total	1.086E-06	1.069E-07	6.782E-07

6.4 Simulation of Sources Based on Service Waste Disposal

The disposal of service wastewater has been almost exclusively to the ICPP injection well (CPP-23) and the ICPP service waste percolation ponds 1 and 2 (CPP-67), which is referred to as the SWPs. The service wastewater was disposed to the injection well from 1953 until 1984 and to the SWPs thereafter. It is assumed that the service wastewater will continue to be discharged into the SWPs for the next 100 years or until the year 2095. At that time, it is assumed that the ICPP will be closed down, and that no additional water will be discharged at the surface.

This section describes the incorporation of the service wastewater contaminant sources to the vadose zone and aquifer simulation models. Section 5.2.4.1 described the data defining the source to the injection well. Section 5.2.5.1 described the data defining the source to the SWPs. Section 5.2.4.3 described the data defining the source to other locations.

6.4.1 Injection Well

A total of 4.2×10^{10} L (1.1×10^{10} gal) of water and 22,200 Ci of mainly H-3 and Sr-90 were discharged into the injection well as discussed in Section 9.2 of Book 1. Based on the nature and extent of contamination described in Section 9.2.3 of Book 1 and Section 5.2.4.1 of this report, Cs-137, H-3, and Sr-90 are the primary contaminants in the aquifer related to the injection well. Secondary contaminants include Am-241, Co-60, I-129, Mercury, Np-237, Total Pu, and Total U. The fluxes of these contaminants are incorporated into the model as annual fluxes from 1952 until 1961 and as monthly fluxes from 1962 through 1984.

The injection well was operated regularly from 1952 until 1984 and periodically until 1986. The source mass of water, Am-241, Co-60, Cs-137, H-3, I-129, Mercury, Np-237, Total Pu, Sr-90 and Total U are incorporated directly into the aquifer simulation model for the period from 1952 to 1984 with the exception of the period January 1968 until November 1970. During that period (as explained in Section 5.2.4.1), the injection well casing was corroded and the service waste was being disposed directly to the lower interbed zone in the vadose zone. Figures 6-2 through 6-20 give the service water, and daily discharges to the injection well and vadose zone. These figures also include the smoothed (lumped) discharge history actually used in the model. The smoothing was done to simplify and reduce the variability of the injection well source term.

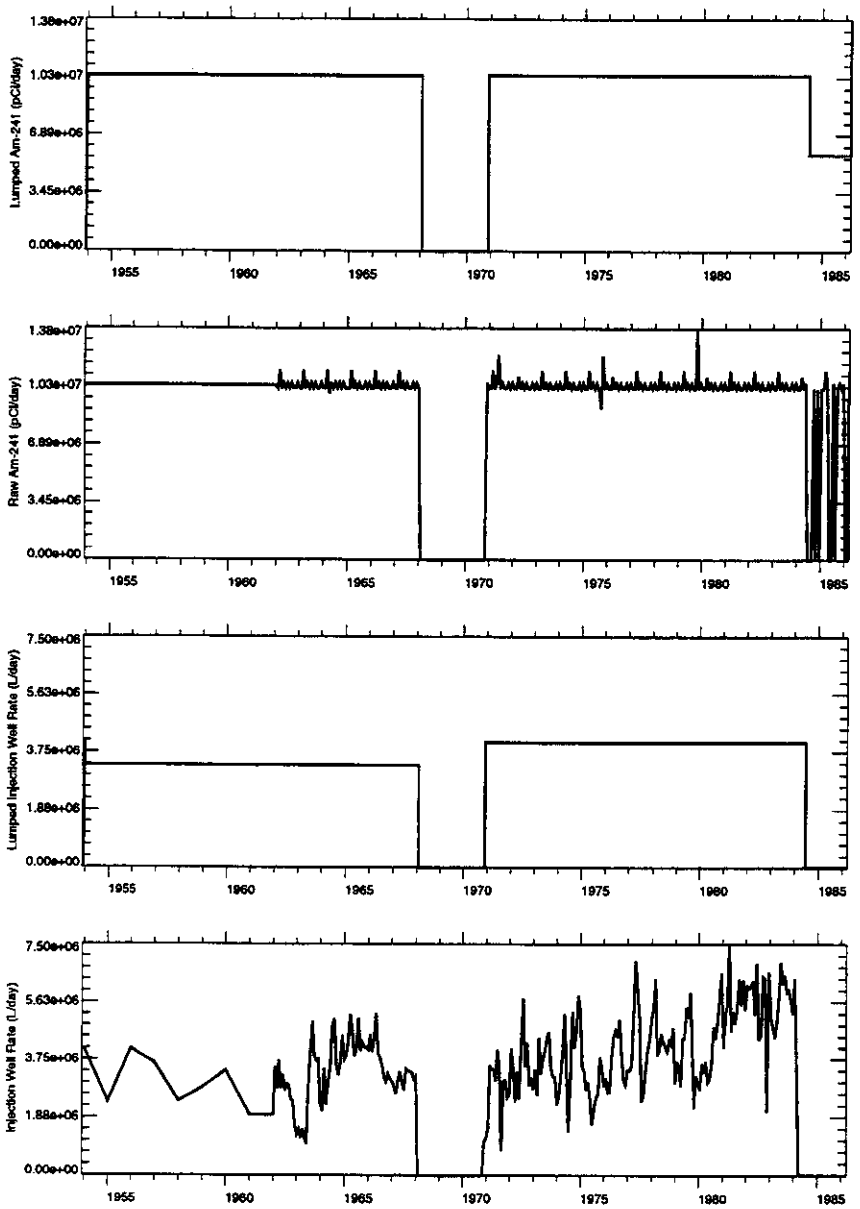


Figure 6-2 Am-241 disposal history to the aquifer injection well. From the bottom upward: a) raw water injection history, b) lumped water injection history used in this model, c) raw contaminant disposal history, d) lumped contaminant disposal history.

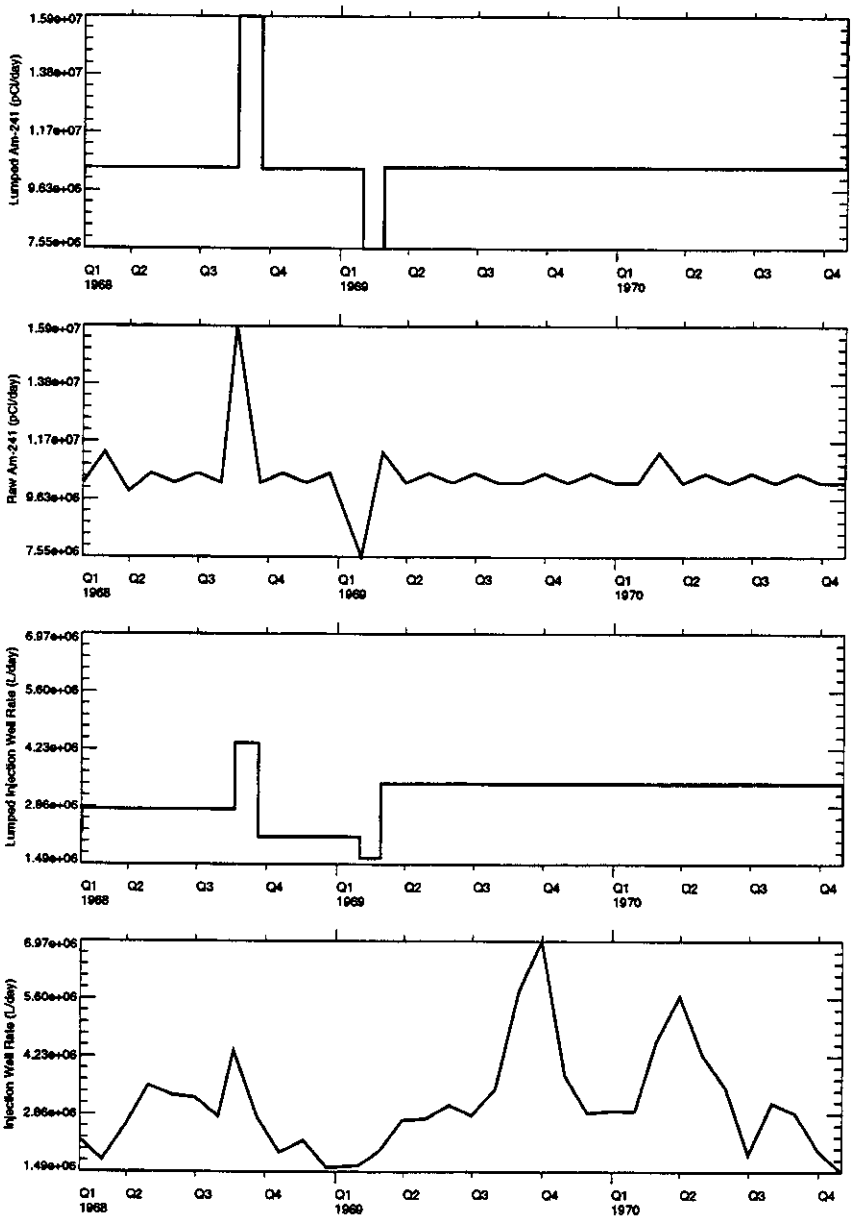


Figure 6-3 Am-241 disposal history to the vadose zone resulting from the failed injection well. From the bottom upward: a) raw water injection history, b) lumped water injection history used in this model, c) raw contaminant disposal history, d) lumped contaminant disposal history.

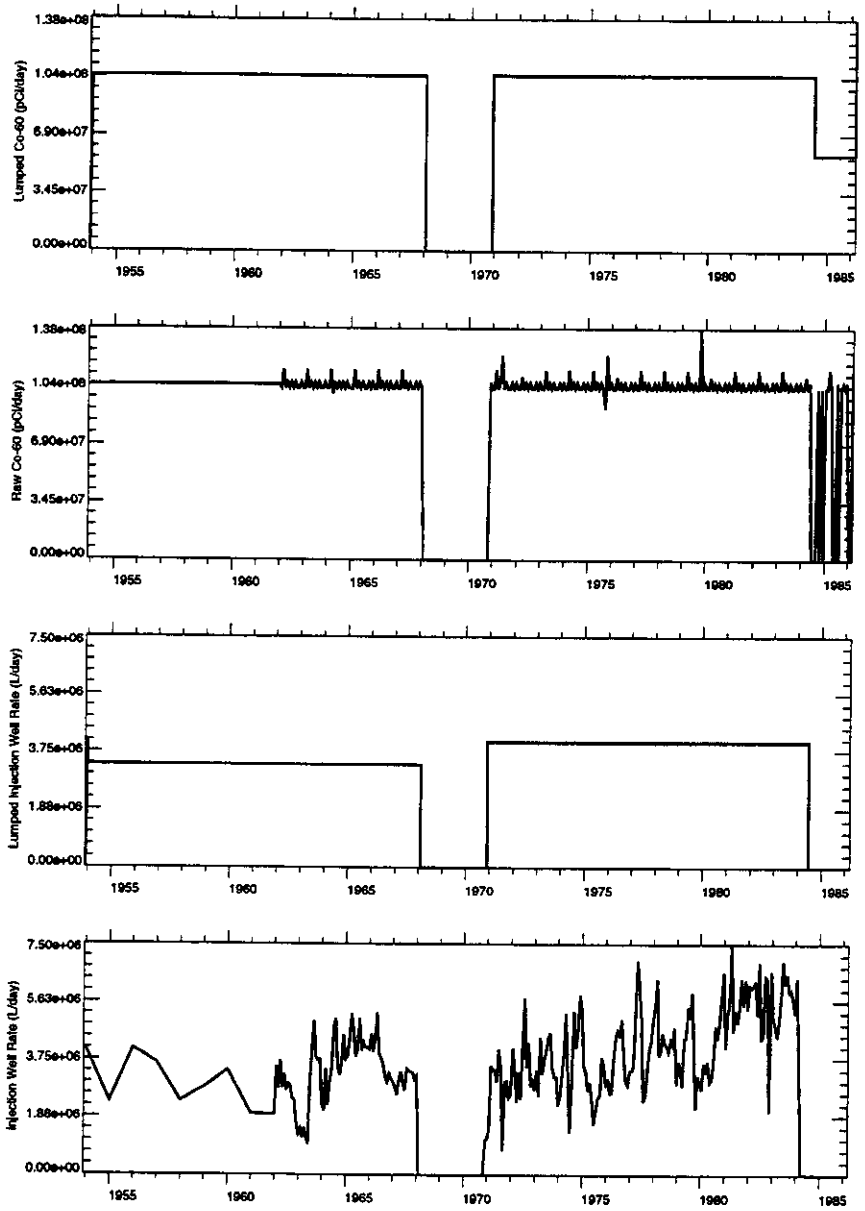


Figure 6-4 Co-60 disposal history to the aquifer injection well. From the bottom upward: a) raw water injection history, b) lumped water injection history used in this model, c) raw contaminant disposal history, d) lumped contaminant disposal history.

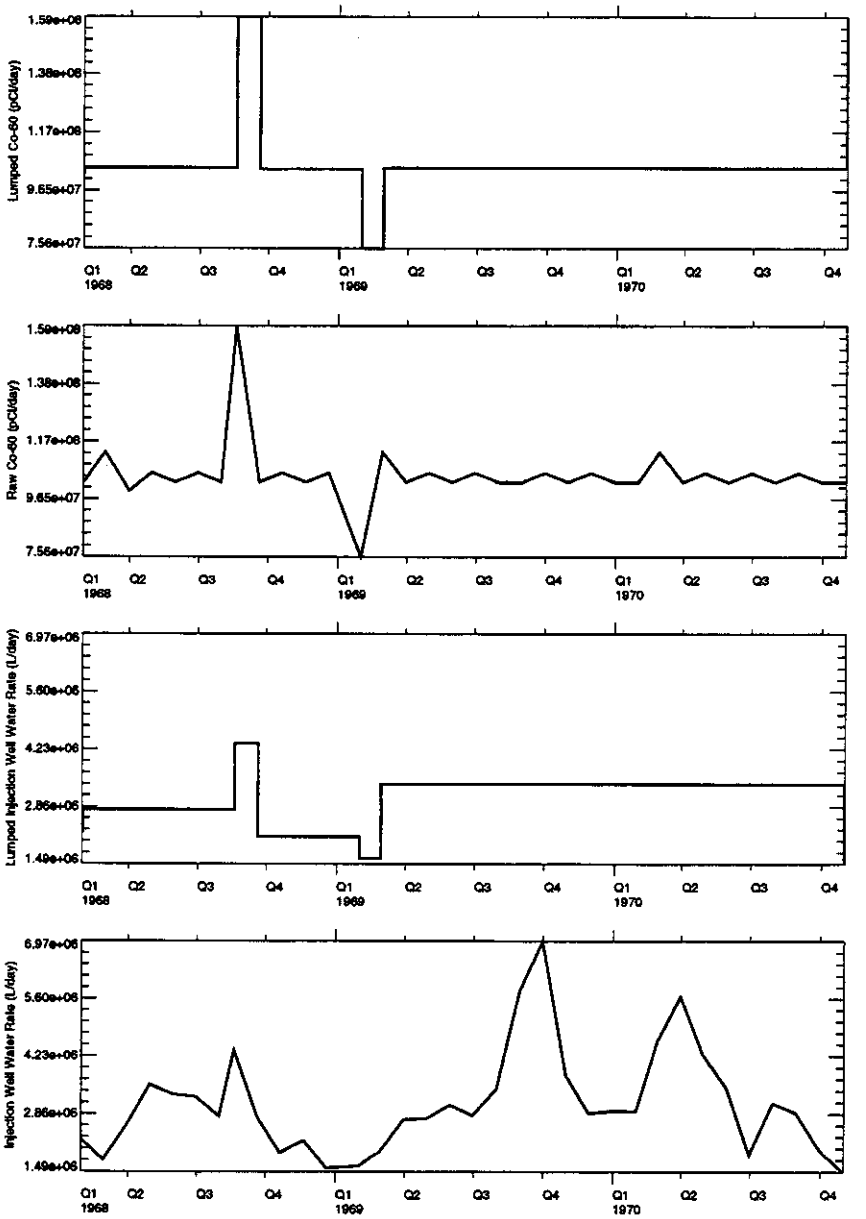


Figure 6-5 Co-60 disposal history to the vadose zone resulting from the failed injection well. From the bottom upward: a) raw water injection history, b) lumped water injection history used in this model, c) raw contaminant disposal history, d) lumped contaminant disposal history.

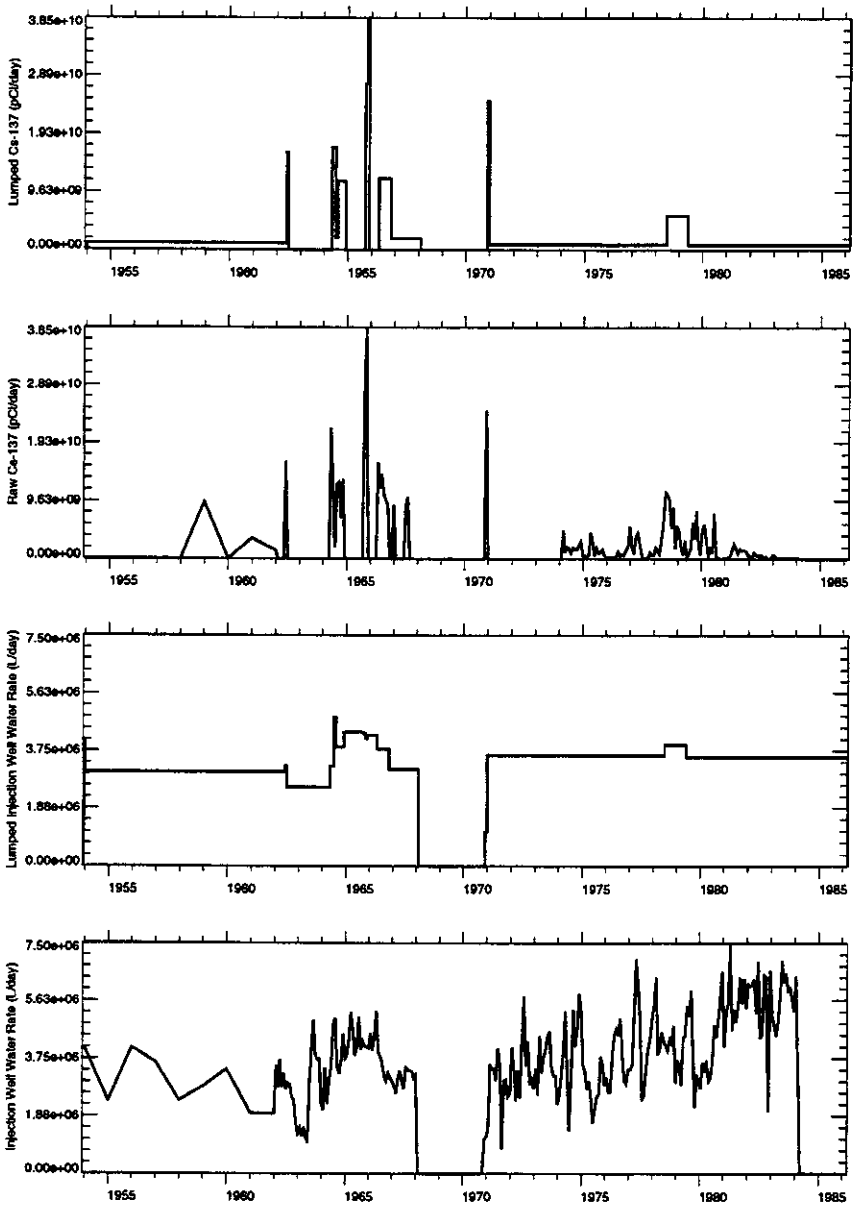


Figure 6-6 Cs-137 disposal history to the aquifer injection well. From the bottom upward: a) raw water injection history, b) lumped water injection history used in this model, c) raw contaminant disposal history, d) lumped contaminant disposal history.

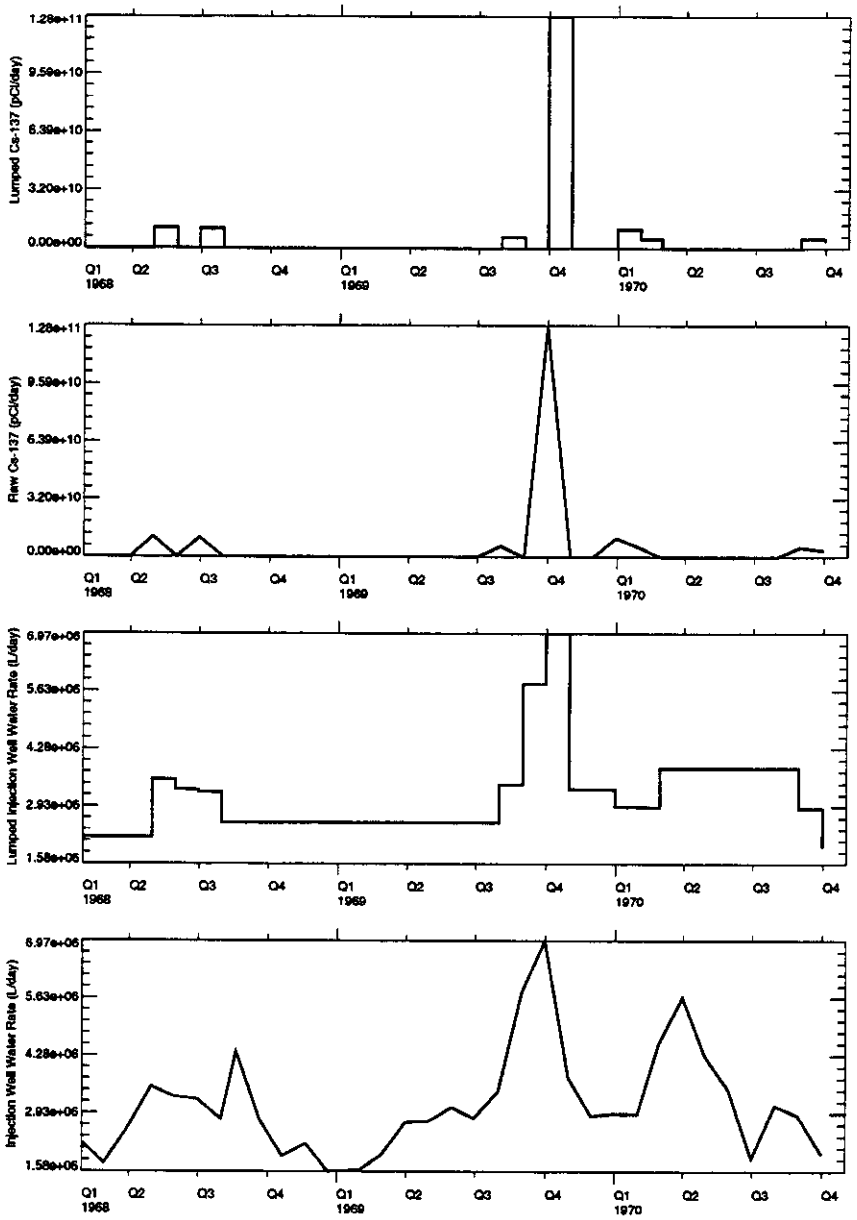


Figure 6-7 Cs-137 disposal history to the vadose zone resulting from the failed injection well. From the bottom upward: a) raw water injection history, b) lumped water injection history used in this model, c) raw contaminant disposal history, d) lumped contaminant disposal history.

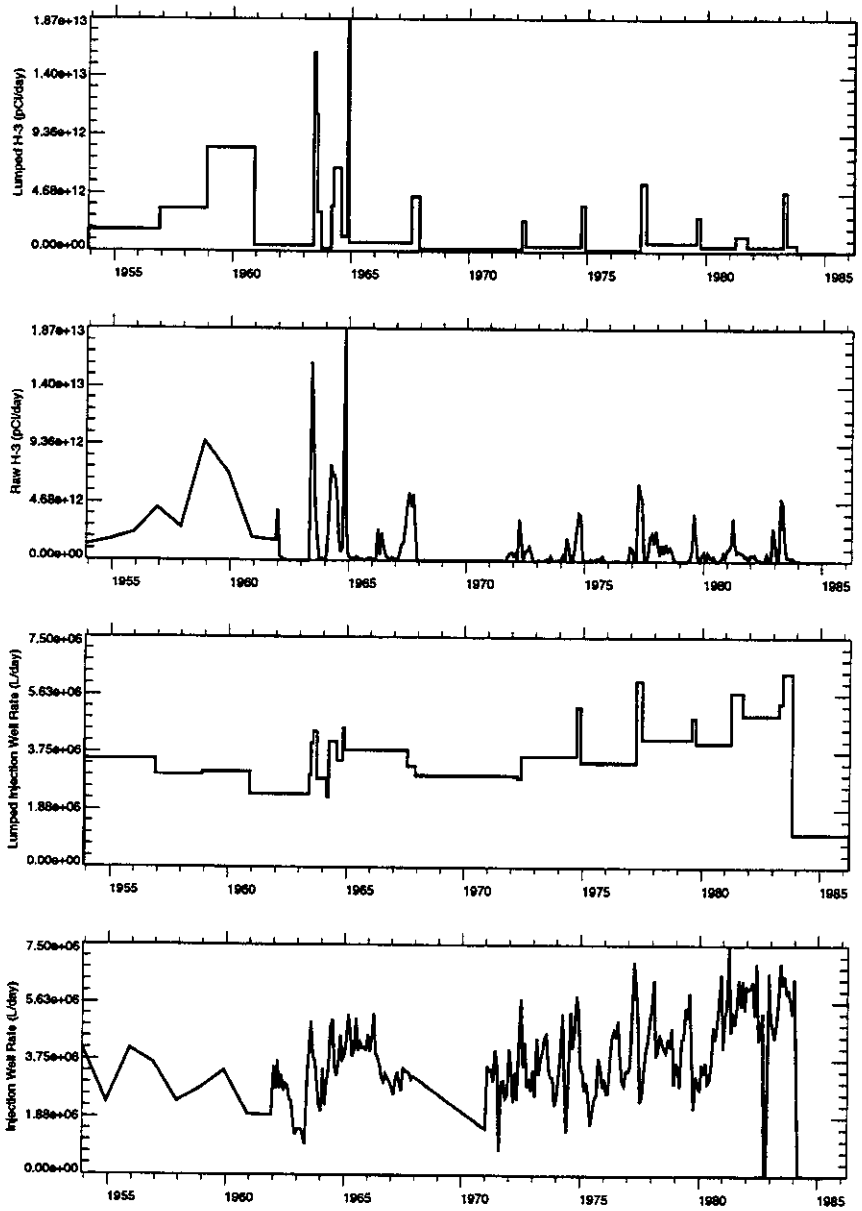


Figure 6-8 H-3 disposal history to the aquifer injection well. From the bottom upward: a) raw water injection history, b) lumped water injection history used in this model, c) raw contaminant disposal history, d) lumped contaminant disposal history.

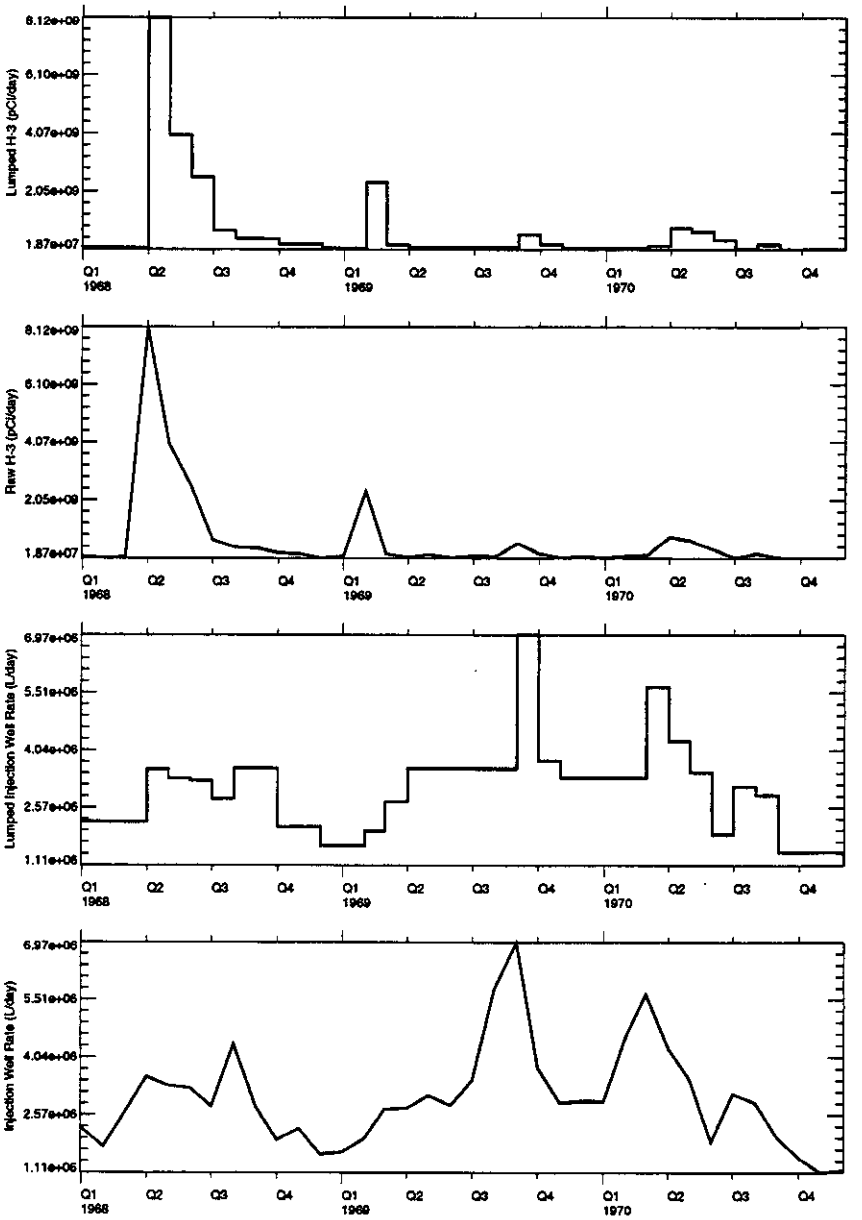


Figure 6-9 H-3 disposal history to the vadose zone resulting from the failed injection well. From the bottom upward: a) raw water injection history, b) lumped water injection history used in this model, c) raw contaminant disposal history, d) lumped contaminant disposal history.

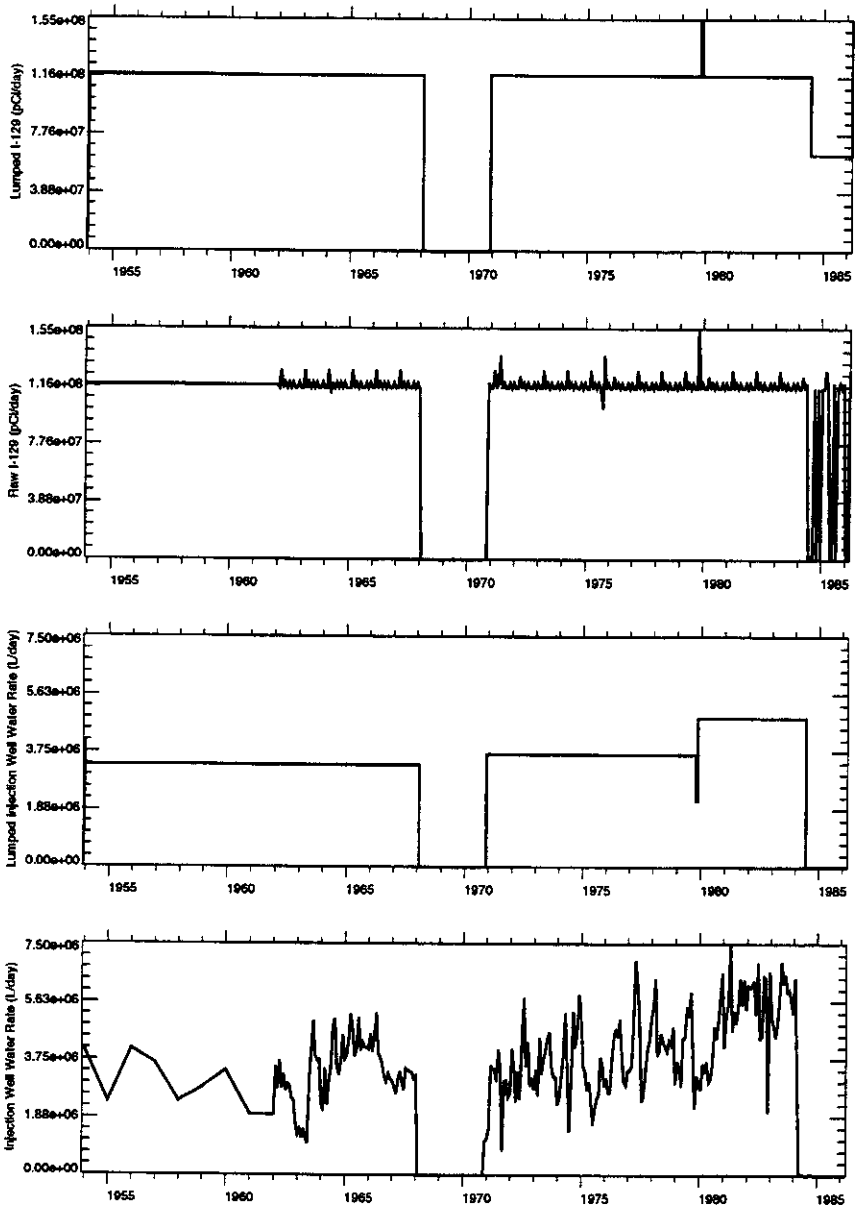


Figure 6-10 I-129 disposal history to the aquifer injection well. From the bottom upward: a) raw water injection history, b) lumped water injection history used in this model, c) raw contaminant disposal history, d) lumped contaminant disposal history.

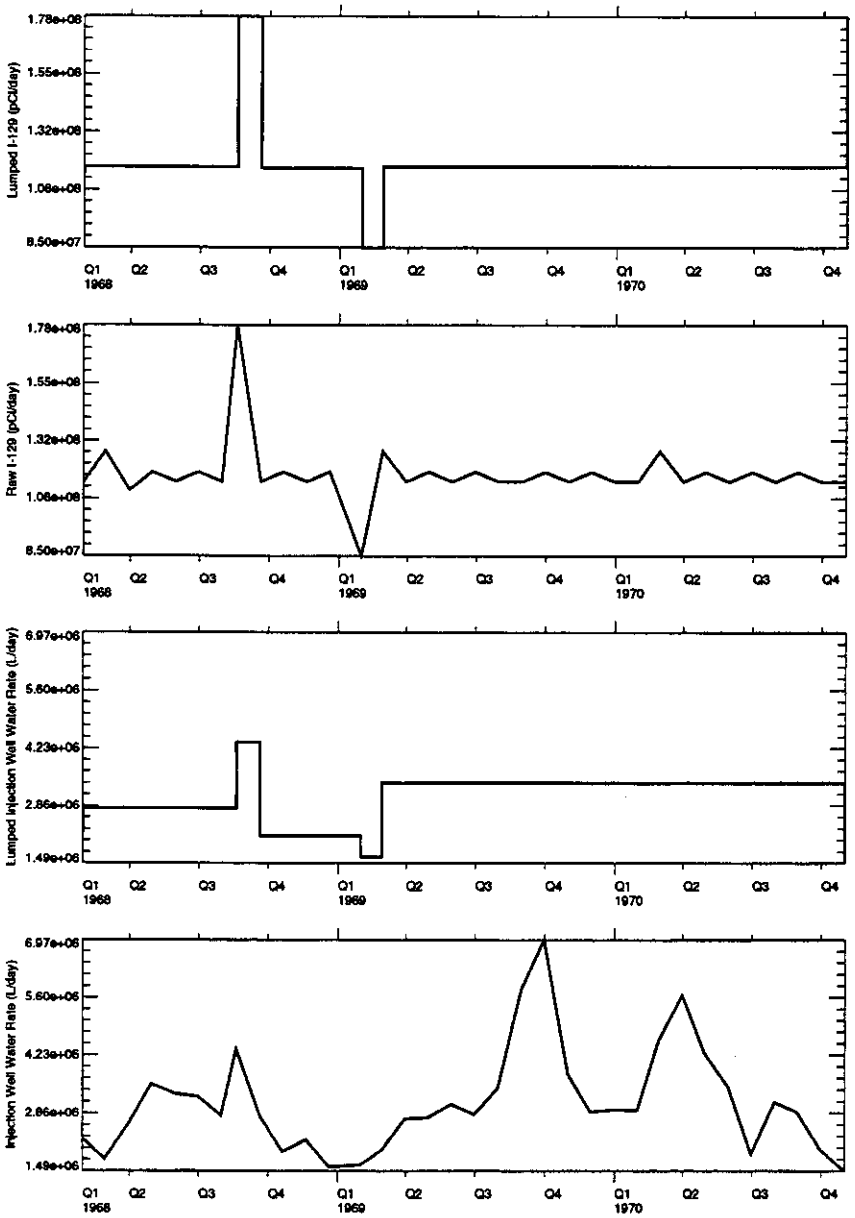


Figure 6-11 I-129 disposal history to the vadose zone resulting from the failed injection well. From the bottom upward: a) raw water injection history, b) lumped water injection history used in this model, c) raw contaminant disposal history, d) lumped contaminant disposal history.

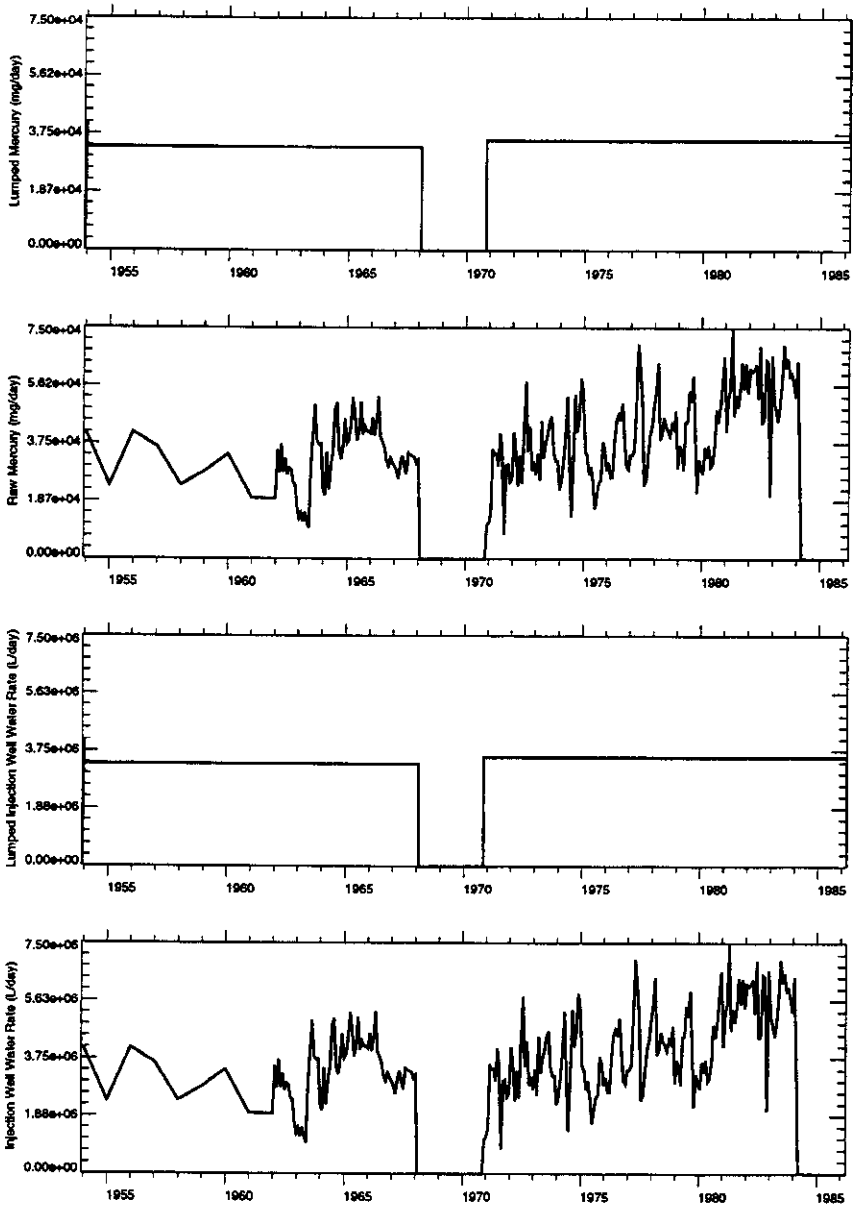


Figure 6-12 Mercury disposal history to the aquifer injection well. From the bottom upward: a) raw water injection history, b) lumped water injection history used in this model, c) raw contaminant disposal history, d) lumped contaminant disposal history.

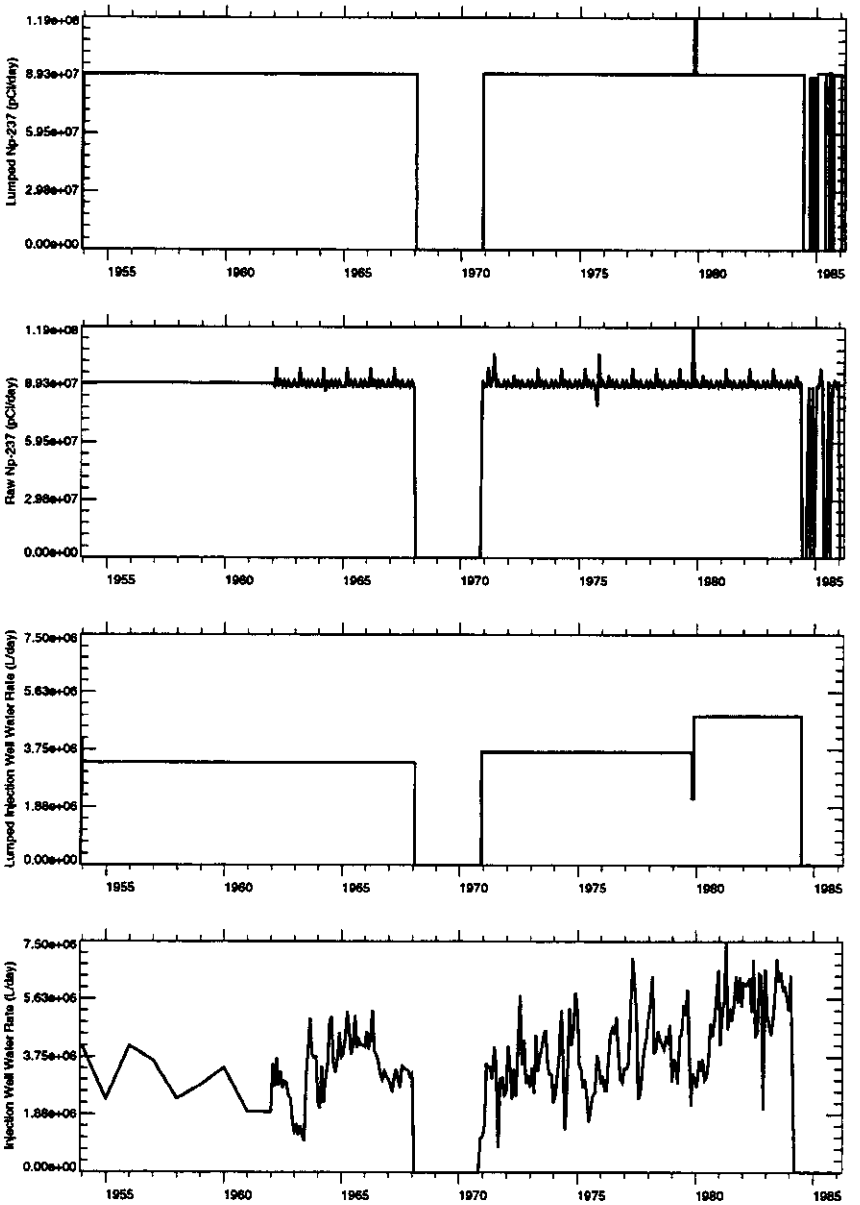


Figure 6-13 Np-237 disposal history to the aquifer injection well. From the bottom upward: a) raw water injection history, b) lumped water injection history used in this model, c) raw contaminant disposal history, d) lumped contaminant disposal history.

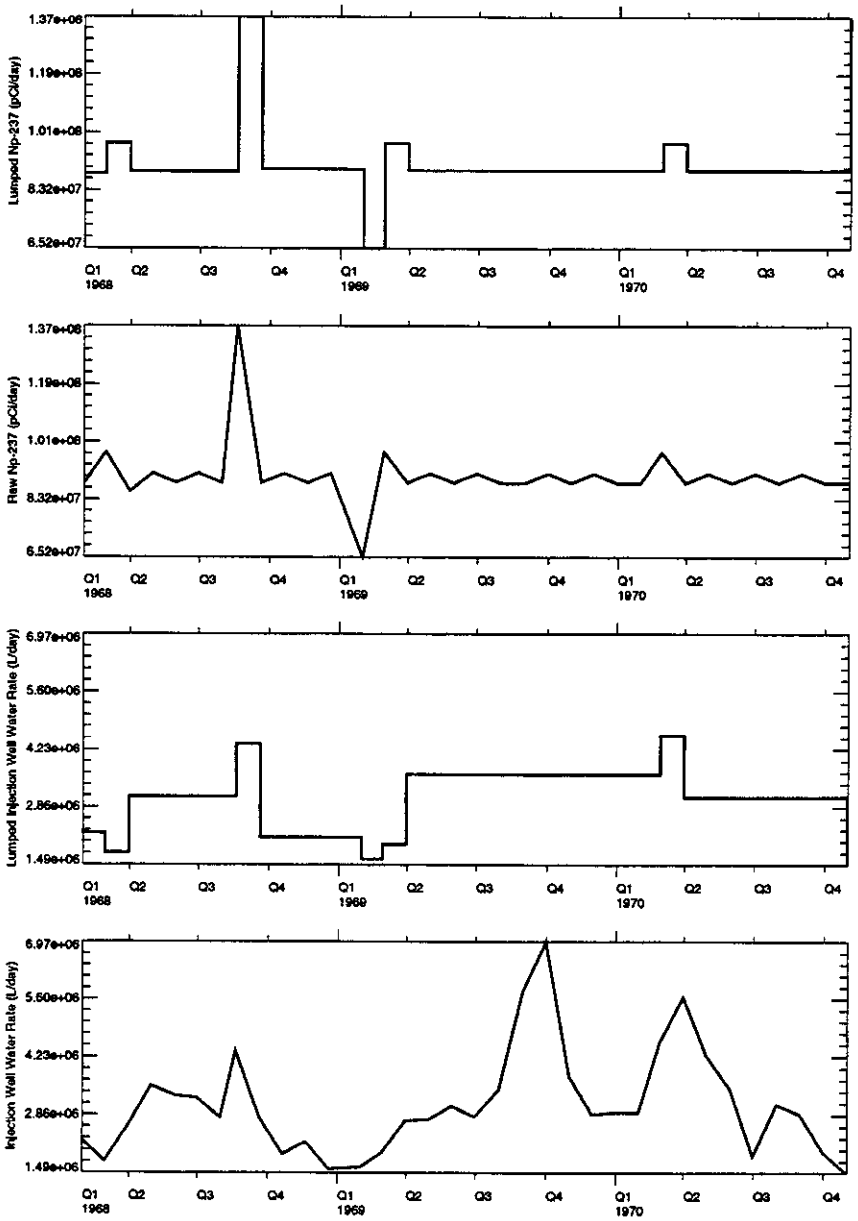


Figure 6-14 Np-237 disposal history to the vadose zone resulting from the failed injection well. From the bottom upward: a) raw water injection history, b) lumped water injection history used in this model, c) raw contaminant disposal history, d) lumped contaminant disposal history.

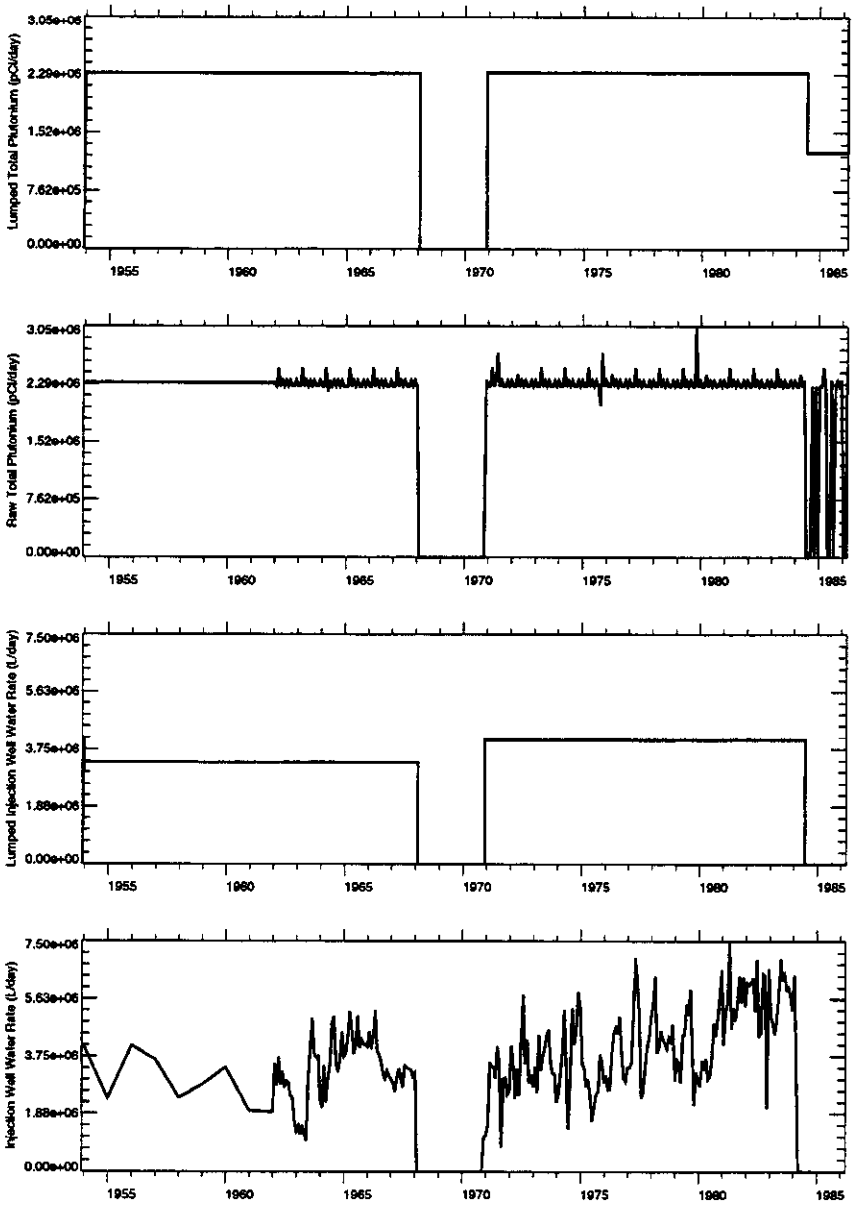


Figure 6-15 Total Pu disposal history to the aquifer injection well. From the bottom upward: a) raw water injection history, b) lumped water injection history used in this model, c) raw contaminant disposal history, d) lumped contaminant disposal history.

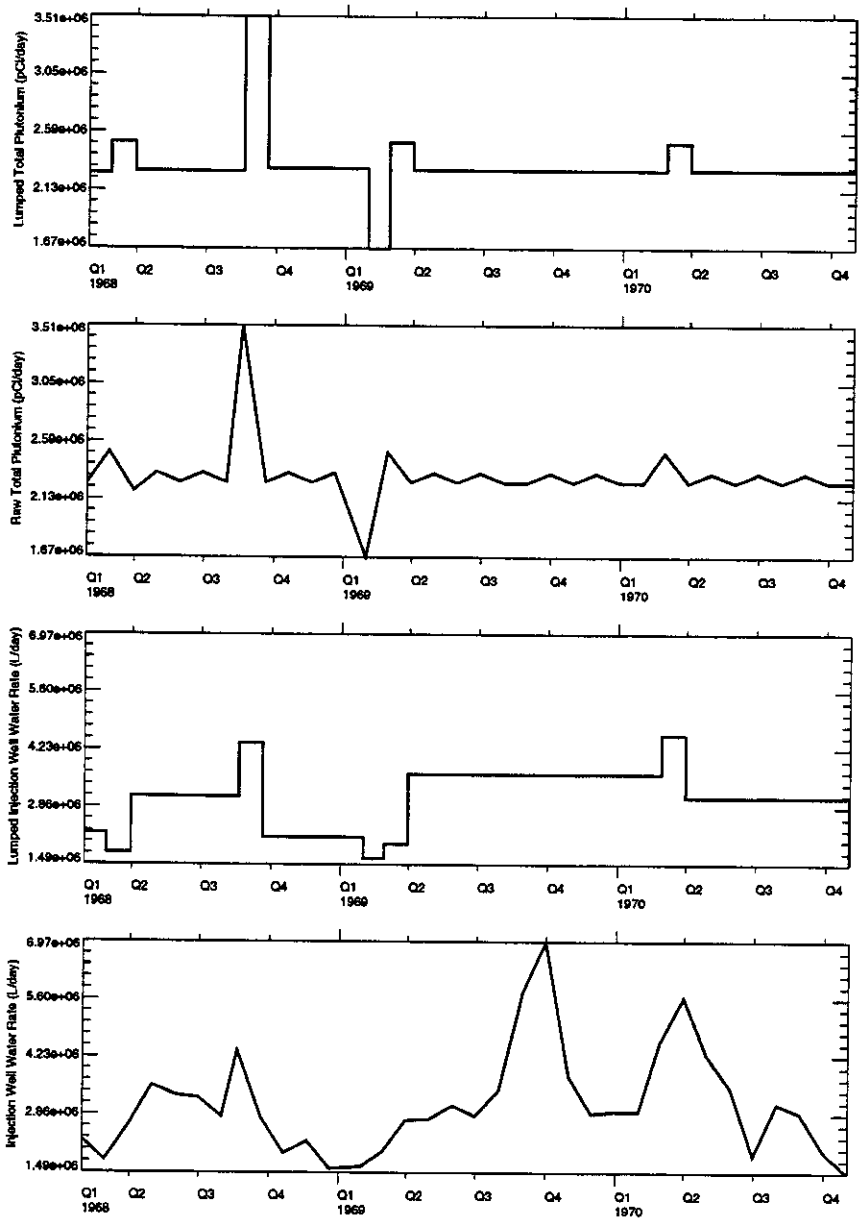


Figure 6-16 Total Pu disposal history to the vadose zone resulting from the failed injection well. From the bottom upward: a) raw water injection history, b) lumped water injection history used in this model, c) raw contaminant disposal history, d) lumped contaminant disposal history.

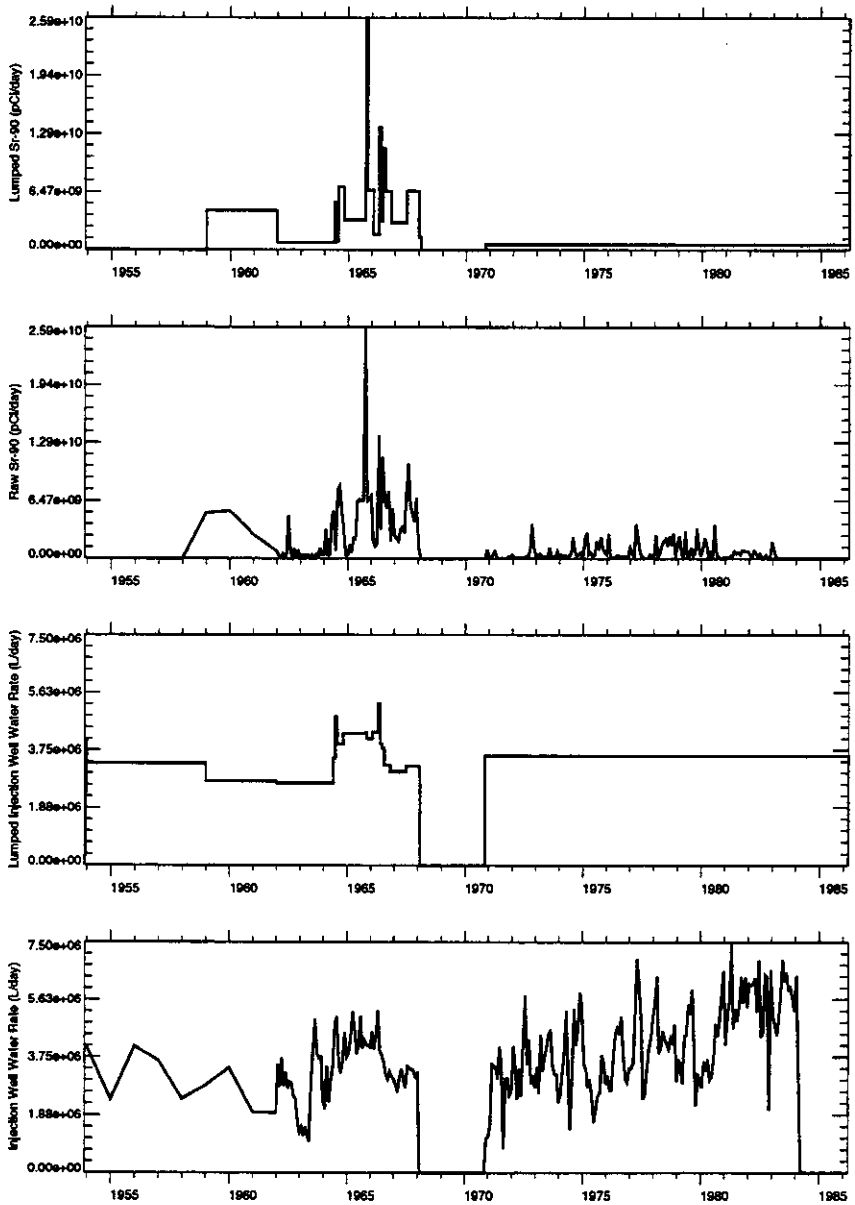


Figure 6-17 Sr-90 disposal history to the aquifer injection well. From the bottom upward: a) raw water injection history, b) lumped water injection history used in this model, c) raw contaminant disposal history, d) lumped contaminant disposal history.

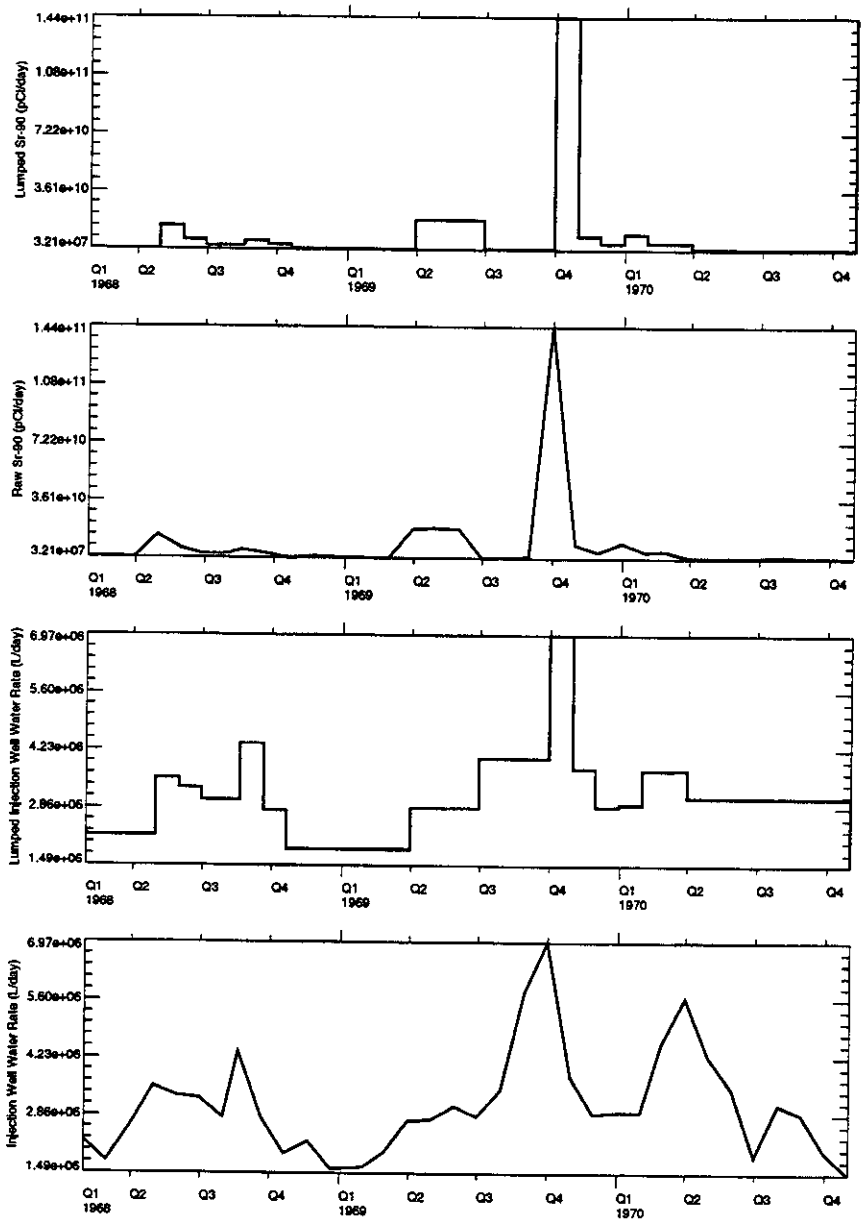


Figure 6-18 Sr-90 disposal history to the vadose zone resulting from the failed injection well. From the bottom upward: a) raw water injection history, b) lumped water injection history used in this model, c) raw contaminant disposal history, d) lumped contaminant disposal history.

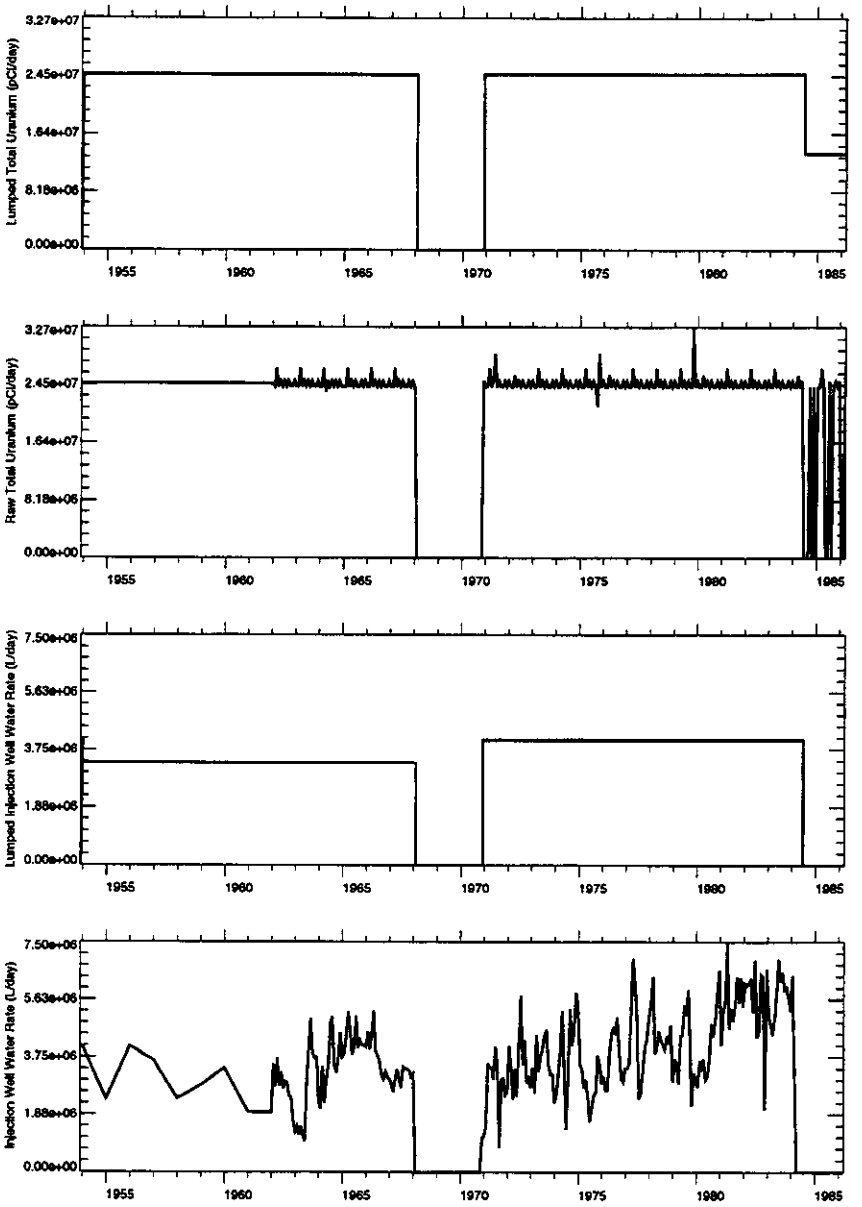


Figure 6-19 Total U disposal history to the aquifer injection well. From the bottom upward: a) raw water injection history, b) lumped water injection history used in this model, c) raw contaminant disposal history, d) lumped contaminant disposal history.

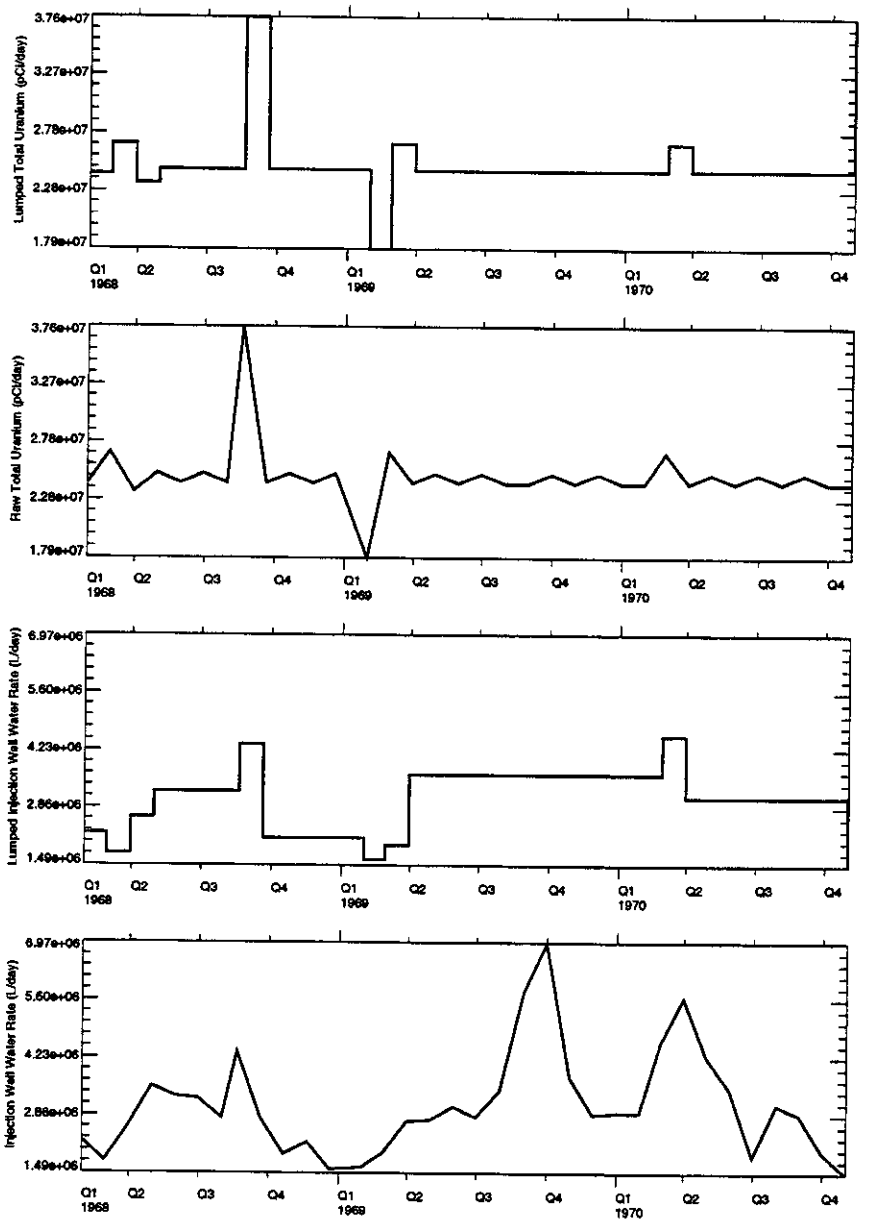


Figure 6-20 Total U disposal history to the vadose zone resulting from the failed injection well. From the bottom upward: a) raw water injection history, b) lumped water injection history used in this model, c) raw contaminant disposal history, d) lumped contaminant disposal history.

Most of the COPCs discharged to the injection well were essentially discharged as uniform fluxes based on the small variability in the monthly reported activity. Table 5-35 presents a summary of the average monthly discharges and the time frame over which discharges are reported for the essentially constant discharges. Table 6-13 summarizes the average monthly discharge and total activity assumed to be disposed to

the injection well for modeling purposes. This table simply provides a means of summarizing the figures above. The chromium was not incorporated into the source flux from the injection well because the aquifer and perched water concentrations are below the limiting water concentrations and arsenic injection well fluxes were neglected because the concentrations were approximately equal to the background level. There is no Tc-99 reported as being discharged to the injection well, therefore Tc-99 is also not incorporated as a source flux to the injection well.

Table 6-13 Injection well source summary for COPCs assumed to have uniform (or no) disposal.

COPCs	Monthly Average (Ci/month) or (mg/month)	Total Discharge Over the Injection Well Service Life (Ci) or (Kg)	Total Discharge Over the Injection Well Service Life (kg)	Steady State Daily Flux (kg/d)
Arsenic (mg/m)		0	0	0
Am-241	3.17E-04	1.23E-01	3.58E-05	3.03E-09
Chromium (mg/m)	0	0	0	0
Co-60	3.18E-03	1.24E+00	1.10E-06	9.27E-11
I-129	3.57E-03	1.39E+00	7.88E+00	6.65E-04
Mercury (mg/m)	1.10E+06	4.00E+02	4.00E+02	3.37E-02
Np-237	2.74E-03	1.07E+00	1.52E+00	1.28E-04
Total Pu	2.11E-03	8.22E-01	2.57E-04	2.17E-08
Tc-99	0	0	0	0
Total U	6.92E-04	2.69E-01	4.01E+02	3.38E-02

6.4.2 Percolation Ponds

In general, the source to the SWPs is a relatively large uniform contaminant flux rate in the 1980s and a reduced flux rate in the 1990s. As a result of the uniformity and relatively low concentration of the water disposed to the SWPs (in particular in the 1990s), contamination disposed to the SWPs can be treated as at most two uniform mass or activity fluxes, one for the period 1984 to 1990 and one for the period 1990 to 2095. The 1984 to 1990 flux rate is calculated based on the reported total mass or activity disposed of at the SWPs during that period. The 1990 to 2095 flux rate is calculated based on the reported total mass or activity disposed at the SWPs from 1990 through 1995. Table 5-36 presents a summary of the mass or activity fluxes that are used to estimate the contaminant fluxes to the SWPs. Table 6-14 is a summary of the estimated daily mass fluxes incorporated into the model.

Table 6-14 Summary of the mass or activity fluxes that are used to estimate the contaminant fluxes to the SWPs

COPCs	Estimated Daily Mass Flux (kg/d)	
	1984 - 1990	1990 - 2095
Arsenic	0	0
Chromium	0	0
Mercury	0	0
Am-241	0	0
Co-60	2.28E-12	2.28E-12

Table 6-14 Summary of the mass or activity fluxes that are used to estimate the contaminant fluxes to the SWPs

COPCs	Estimated Daily Mass Flux (kg/d)	
	1984 - 1990	1990 - 2095
Cs-137	2.46E-09	3.96E-10
H-3	4.76E-08	1.41E-10
I-129	2.15E-04	0
Np-237	0	0
Total Pu	5.10E-07	8.87E-09
Sr-90	8.38E-10	1.62E-10
Tc-99	0	0
Total U	4.79E+00	4.79E+00

6.5 Simulation of Sources Based on Soil Contamination

The data used to define the contaminant sources based on the soil contamination were discussed in Section 5.2.5.2. Table 5-38 gives a summary of all the soil-contaminated site areas, thicknesses, and soil volumes. Table 5-39 lists of all the soils-related COPCs at each site, the soil concentrations, and the estimated mass or activity for each COPC at that site. The masses presented in Table 5-39 are used directly in the simulation model. Tables 6-15 and 6-16 are summaries of the estimated mass incorporated into the model for each groundwater COPC. Table 6-15 summarizes the non-radioactivity soil contamination information, and Table 6-16 summarizes the radioactivity soil contamination information.

Table 6-15 Summary of the soil contamination mass incorporated into the model for the non-radionuclide COPCs.

Non-radionuclide COPCs	Site Identification	Mass (mg)	Mass (kg)
Arsenic			
	CPP-89	4.57E+07	4.57E+01
	3-07/CPP-20 / -25	4.56E+06	4.56E+00
	3-08/CPP-27 / -33	9.75E+06	9.75E+00
	3-08/CPP-36 /-91 - zone 2	1.62E+07	1.62E+01
	3-09/CPP-11	1.00E+07	1.00E+01
	3-02/CPP-37A	7.55E+07	7.55E+01
	3-02/CPP-37B	5.91E-01	5.91E-07
	3-05/CPP-14 - Drain Field	7.24E+06	7.24E+00
	3-06/CPP-34	1.60E+08	1.60E+02
	3-08/CPP-13	9.39E+06	9.39E+00
	3-09/CPP-19	2.63E+07	2.63E+01
	3-13/CPP-90	9.25E+07	9.25E+01
Arsenic Total Mass		**4.57E+08**	**4.57E+02**
Chromium			
	3-08/CPP-27 / -33	6.16E+07	6.16E+01
	3-08/CPP-36 /-91 - zone 2	5.87E+07	5.87E+01
Chromium Total Mass		**1.20E+08**	**1.20E+02**

Table 6-15 Summary of the soil contamination mass incorporated into the model for the non-radionuclide COPCs.

Non-radionuclide COPCs	Site Identification	Mass (mg)	Mass (kg)
Mercury			
	CPP-89	1.01E+08	1.01E+02
	3-07/CPP-20 / -25	6.85E+04	6.85E-02
	3-07/CPP-32W/E	2.67E+02	2.67E-04
	3-08/CPP-27 / -33	4.91E+05	4.91E-01
	3-11/CPP-58W/E	1.73E+07	1.73E+01
	3-08/CPP-35	9.92E+06	9.92E+00
	3-08/CPP-36 /-91 - zone 1	1.36E+07	1.36E+01
	3-02/CPP-37A	1.08E+07	1.08E+01
	3-05/CPP-14 - Plant Site	3.09E+06	3.09E+00
	3-08/CPP-13	3.81E+05	3.81E-01
	3-09/CPP-19	6.52E+05	6.52E-01
	3-13/CPP-90	1.07E+07	1.07E+01
	3-13/CPP-93	4.28E+08	4.28E+02
Mercury Total Mass		**5.96E+08**	**5.96E+02**

Table 6-16 Summary of the soil contamination mass incorporated into the model for the radionuclide COPCs.

Radionuclide COPCs	Site Identification	Activity (Ci)	Mass (kg)
Am-241			
	CPP-89	4.35E-02	1.27E-05
	3-07/CPP-20 / -25	1.01E-04	2.94E-08
	3-07/CPP-26	8.10E-04	2.36E-07
	3-08/CPP-15 - zone 2	1.60E-01	4.66E-05
	3-08/CPP-27 / -33	1.28E-02	3.72E-06
	3-11/CPP-58W/E	3.41E-04	9.93E-08
	3-08/CPP-35	1.67E-03	4.85E-07
	3-08/CPP-36 /-91 - zone 1	6.23E-01	1.81E-04
	3-09/CPP-01/-04/-05	8.73E-03	2.54E-06
	3-02/CPP-37A	1.24E-02	3.60E-06
	3-02/CPP-37B	3.35E-02	9.75E-06
	3-09/CPP-19	8.56E-03	2.49E-06
Am-241 Total Activity/ Mass		**9.05E-01**	**2.64E-04**
Co-60			
	3-07/CPP-20 / -25	8.56E-05	7.58E-11
	3-09/CPP-01/-04/-05	1.17E+01	1.04E-05
	3-09/CPP-10	1.54E-03	1.36E-09
	3-09/CPP-11	1.05E-03	9.26E-10

Table 6-16 Summary of the soil contamination mass incorporated into the model for the radionuclide COPCs.

Radionuclide COPCs	Site Identification	Activity (Ci)	Mass (kg)
	3-08/CPP-13	1.23E-03	1.08E-09
	3-09/CPP-19	9.39E+01	8.31E-05
Co-60 Total Activity/Mass		**1.06E+02**	**9.34E-05**
Cs-137			
	CPP-89	7.51E+01	8.68E-04
	3-07/CPP-20 / -25	8.37E-02	9.69E-07
	3-07/CPP-26	5.29E+00	6.11E-05
	3-07/CPP-32W/E	2.47E-04	2.86E-09
	3-08/CPP-15 - zone 1W	1.93E+00	2.24E-05
	3-08/CPP-15 - zone 1E	4.51E+00	5.21E-05
	3-08/CPP-15 - zone 2	1.74E+02	2.02E-03
	3-08/CPP-27 / -33	2.91E+00	3.37E-05
	3-11/CPP-58W/E	7.35E-01	8.50E-06
	3-08/CPP-35	1.19E+01	1.38E-04
	3-08/CPP-36 /-91 - zone 1	3.33E+02	3.85E-03
	3-08/CPP-36 /-91 - zone 2	3.08E-01	3.57E-06
	3-09/CPP-01/-04/-05	2.26E+02	2.61E-03
	3-09/CPP-08/-09	3.84E+00	4.44E-05
	3-09/CPP-10	5.77E-01	6.68E-06
	3-09/CPP-11	1.25E-01	1.44E-06
	3-09/CPP-03	8.07E-01	9.34E-06
	3-09/CPP-17a	5.57E-02	6.44E-07
	3-09/CPP-17b	1.81E-02	2.09E-07
	3-02/CPP-37A	4.77E-02	5.52E-07
	3-02/CPP-37B	7.41E-01	8.57E-06
	3-05/CPP-14 - Imhoff Tanks	1.58E-04	1.83E-09
	3-05/CPP-14 - Plant Site	4.32E-02	4.99E-07
	3-06/CPP-34	6.28E+01	7.26E-04
	3-08/CPP-13	6.31E+00	7.29E-05
	3-09/CPP-06	7.63E-03	8.82E-08
	3-09/CPP-19	1.77E+03	2.05E-02
	3-09/CPP-22	3.65E-01	4.22E-06
	3-13/CPP-90	8.27E-02	9.57E-07
Cs-137 Total Activity/Mass		**2.68E+03**	**3.10E-02**
H-3	No soil sources reported		
I-129			
	3-02/CPP-37B	3.89E-02	2.20E-01
I-129 Total Activity/Mass		**3.89E-02**	**2.20E-01**
Np-237			
	3-07/CPP-20 / -25	1.45E-04	2.05E-04
	3-08/CPP-15 - zone 2	1.87E-04	2.66E-04

Table 6-16 Summary of the soil contamination mass incorporated into the model for the radionuclide COPCs.

Radionuclide COPCs	Site Identification	Activity (Ci)	Mass (kg)
	3-09/CPP-11	2.57E-04	3.65E-04
	3-02/CPP-37A	1.12E-02	1.58E-02
	3-02/CPP-37B	6.53E-02	9.26E-02
	3-05/CPP-14 - Imhoff Tanks	5.04E-05	7.16E-05
	3-05/CPP-14 - Plant Site	4.33E-02	6.14E-02
	3-05/CPP-14 - Drain Field	2.16E-03	3.06E-03
	3-06/CPP-34	1.05E-02	1.49E-02
Np-237 Total Activity/Mass		**1.33E-01**	**1.89E-01**
Total Pu			
	CPP-89	NA	5.65E-04
	3-07/CPP-26	NA	1.13E-05
	3-08/CPP-15 - zone 2	NA	1.16E-03
	3-08/CPP-27 / -33	NA	5.80E-06
	3-11/CPP-58W/E	NA	7.70E-06
	3-08/CPP-35	NA	1.72E-05
	3-08/CPP-36 /-91 - zone 1	NA	4.65E-03
	3-09/CPP-01/-04/-05	NA	9.48E-04
	3-02/CPP-37A	NA	4.46E-08
	3-02/CPP-37B	NA	7.90E-07
	3-06/CPP-34	NA	9.40E-07
	3-09/CPP-19	NA	9.88E-03
Total Pu Total Activity/Mass		**NA**	**1.72E-02**
Sr-90			
	CPP-89	9.78E+01	7.17E-04
	3-07/CPP-20 / -25	1.89E-01	1.39E-06
	3-07/CPP-26	6.87E+00	5.03E-05
	3-07/CPP-32W/E	2.48E-04	1.82E-09
	3-08/CPP-27 / -33	9.11E-01	6.68E-06
	3-11/CPP-58W/E	1.10E+00	8.09E-06
	3-08/CPP-35	4.46E+00	3.27E-05
	3-08/CPP-36 /-91 - zone 1	4.19E+01	3.07E-04
	3-08/CPP-36 /-91 - zone 2	1.19E+01	8.74E-05
	3-09/CPP-01/-04/-05	2.38E+01	1.74E-04
	3-09/CPP-08/-09	4.98E-01	3.65E-06
	3-09/CPP-10	2.83E-02	2.07E-07
	3-09/CPP-11	2.25E-02	1.65E-07
	3-09/CPP-03	5.59E-01	4.10E-06
	3-09/CPP-17a	7.81E-03	5.72E-08
	3-02/CPP-37A	8.62E-03	6.32E-08
	3-02/CPP-37B	3.58E-01	2.63E-06
	3-05/CPP-14 - Imhoff Tanks	2.73E-05	2.00E-10

Table 6-16 Summary of the soil contamination mass incorporated into the model for the radionuclide COPCs.

Radionuclide COPCs	Site Identification	Activity (Ci)	Mass (kg)
	3-05/CPP-14 - Plant Site	6.33E-03	4.64E-08
	3-05/CPP-14 - Drain Field	8.17E-04	5.98E-09
	3-06/CPP-34	1.88E+02	1.38E-03
	3-08/CPP-13	5.69E+00	4.17E-05
	3-09/CPP-06	3.70E-03	2.71E-08
	3-09/CPP-19	5.43E+02	3.98E-03
	3-09/CPP-22	1.38E-01	1.01E-06
	3-13/CPP-90	6.95E-02	5.09E-07
	3-08/CPP-15 - zone 1W	1.93E+00	1.42E-05
	3-08/CPP-15 - zone 1E	4.51E+00	3.30E-05
	3-08/CPP-15 - zone 2	1.74E+02	1.28E-03
Sr-90 Total Activity/Mass		**1.11E+03**	**8.12E-03**
Tc-99			
	3-07/CPP-20 / -25	2.09E-03	1.24E-04
	3-08/CPP-15 - zone 2	1.09E-02	6.44E-04
	3-08/CPP-13	3.68E-03	2.17E-04
	3-09/CPP-22	8.93E-02	5.27E-03
Tc-99 Total Activity/Mass		**1.06E-01**	**6.25E-03**
Total U			
	CPP-89	NA	7.95E-03
	3-07/CPP-26	NA	2.94E-02
	3-08/CPP-15 - zone 2	NA	2.79E-03
	3-08/CPP-27 / -33	NA	3.49E-02
	3-11/CPP-58W/E	NA	3.63E-01
	3-08/CPP-35	NA	4.56E-02
	3-08/CPP-36 /-91 - zone 1	NA	4.51E+00
	3-09/CPP-01/-04/-05	NA	6.85E-01
	3-09/CPP-08/-09	NA	1.75E+00
	3-09/CPP-10	NA	3.19E-03
	3-09/CPP-11	NA	5.11E+00
	3-02/CPP-37A	NA	7.02E+01
	3-02/CPP-37B	NA	3.62E+02
	3-05/CPP-14 - Imhoff Tanks	NA	5.90E-04
	3-05/CPP-14 - Plant Site	NA	1.73E+03
	3-06/CPP-34	NA	1.33E+02
	3-09/CPP-19	NA	1.06E+01
Total U Total Activity/Mass		**NA**	**2.31E+03**

6.6 Simulation of Sources Based on the TRA Contaminant Sources

The influence of cross-gradient contaminant releases from TRA are discussed in Section 5.2.6. Based on the TRA Remedial Investigation, chromium and tritium are the major risk drivers to the aquifer and the only contaminants that could significantly influence aquifer concentrations at the ICPP. Therefore, chromium and tritium mass fluxes were obtained for incorporation into the ICPP transport modeling. These mass fluxes are shown in Table 5-41 and includes both historic fluxes and the future predicted fluxes. The flux is assumed to be zero after the year 2015 because no more water will be infiltrating into the TRA ponds so that the major water driving force will be gone. In reality, there will be continuing ambient infiltration, but it is assumed that the contaminant flux to the aquifer will be reduced to a negligible amount. The H-3 and chromium fluxes to the aquifer model are taken directly from the fluxes in Table 5-41. The location of the TRA fluxes into the aquifer model is shown in Figure 2-26.

7 VADOSE ZONE AND AQUIFER SIMULATION RESULTS

Simulation results for the transport of the thirteen COPCs through the vadose zone and aquifer are presented by section as given in Table 7-1 with summary observations given in Section 7.14. In all cases, each contaminant was simulated using all of the available sources. Information about these source terms was presented in Sections 5 and 6. Specific tables, figures, or sections containing source term information for each contaminant are given in Table 7-1 below.

Table 7-1 Vadose Zone and Aquifer Simulations

COPCs	Simulation Results Section	Sections, Tables, or Figures for Source Term Information						
		Isotope to Total COPC Section	Uniform Releases	Non-Uniform Releases	Injection Well	Percolation Pond	Soil Contamination	TRA Sources
Arsenic	7.1		Table 6-11				Table 6-15	
Chromium	7.2		Table 6-11				Table 6-15	
Mercury	7.3		Table 6-11		Figures 6-2 through 6-20		Table 6-15	
Co-60	7.4		Table 6-11		Table 6-13, and Figures 6-2 through 6-20	Table 6-14	Table 6-16	
Cs-137	7.5		Table 6-11	Table 6-12	Figures 6-2 through 6-20	Table 6-14	Table 6-16	Table 5-41
H-3	7.6		Table 6-11	Table 6-12	Figures 6-2 through 6-20	Table 6-14	Table 6-16	Table 5-41
I-129	7.7		Table 6-11		Table 6-13, and Figures 6-2 through 6-20	Table 6-14	Table 6-16	
Np-237	7.8		Table 6-11		Table 6-13, and Figures 6-2 through 6-20		Table 6-16	
Total Pu	7.9	Section 6.2.1	Table 6-11		Table 6-13, and Figures 6-2 through 6-20	Table 6-14	Table 6-16	
Sr-90	7.10		Table 6-11	Table 6-12	Figures 6-2 through 6-20	Table 6-14	Table 6-16	
Tc-99	7.11		Table 6-11		Table 6-13		Table 6-16	
Total Uranium	7.12	Section 6.2.2	Table 6-11		Table 6-13, and Figures 6-2 through 6-20	Table 6-14	Table 6-16	
Am-241	7.13		Table 6-11		Table 6-13, and Figures 6-2 through 6-20		Table 6-16	

Using the surface source term information, the transport of each contaminant was first simulated through the vadose zone to determine the mass flux entering the aquifer. That mass flux rate was then used in addition to injection well mass fluxes to simulate the transport of each contaminant in the aquifer. Therefore, each contaminant has two sets of simulation results representing the vadose zone transport and the aquifer transport respectively. For consistency, each of the simulation results sections will follow the same format and will begin with the vadose zone results consisting of:

- contour plots of the peak concentration compressed horizontally at eight different time frames with the concentrations indicative of the MCL and orders of magnitude above and below,

- contour plots of the peak concentration compressed vertically at eight different time frames with the concentrations indicative of the MCL and orders of magnitude above and below,
- the time history of the peak concentration and the corresponding risk plotted at 2 different scales,
- the time history of the areal mass flux of the contaminant to the aquifer.

Risk in the vadose zone pore water is given because it was used in most cases to determine when to stop the vadose zone simulations and not because it has inherent value. The only value vadose zone risk numbers would have is if the perched water bodies were used as a water supply which is unlikely given the relatively small volume of water available for that purpose.

The aquifer transport simulation results are similar in presentation format with the exception that the peak concentration has been distinguished between the entire aquifer, the TRA, and the ICPP footprints (shown in Figure 7-1). These results consist of:

- contour plots of the peak concentration at eight different time frames centered about the MCL
- contours of either the hazard quotient (HQ, also called hazard index, HI) or risk number depending on applicability for eight time frames centered on the 10^{-6} risk (or HQ=1)
- the time history of the peak concentration and corresponding risk (or HQ) for the entire aquifer, for the TRA footprint, and for the ICPP footprint.

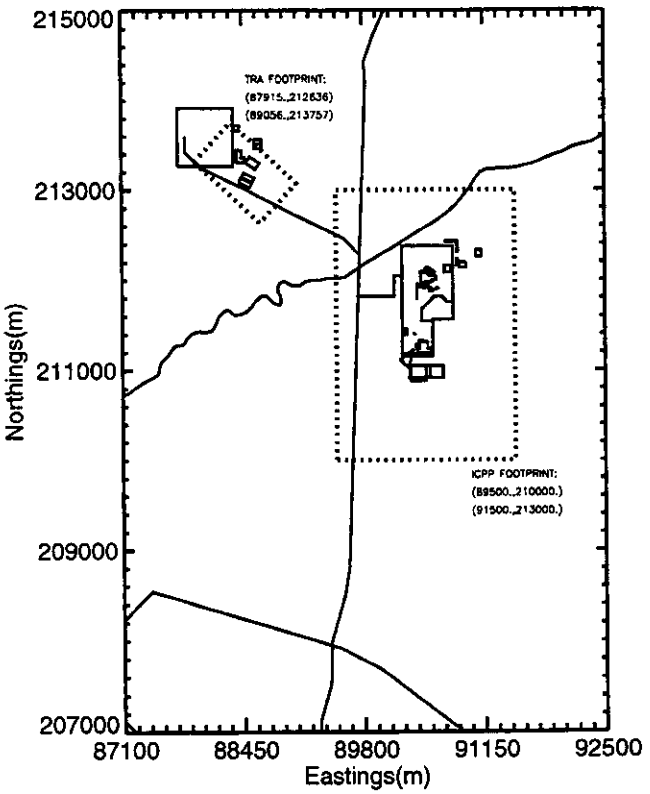


Figure 7-1 TRA and ICPP footprints.bounded by the dotted lines in this small aquifer model domain

In order to present the concentration for the three-dimensional vadose zone and aquifer systems, the concentrations were first collapsed into a single plane. For example, vadose zone simulations are first

presented as a vertical cross-section represented by Depth on the y-axis and the Northing coordinate on the x-axis. To determine the values presented in that plane, the maximum value at a given Northing and Depth coordinate pair over all Easting coordinates was determined. Thus, the concentration contour plots presented here are not for a particular physical vertical cross-section, but represent the maximum concentration over all vertical cross-sections. The second set of contour maps for the vadose zone simulation domain were constructed by finding the maximum concentration over all depths at a given Northing and Easting coordinate pair, and contouring the resultant peak values. Horizontal cross-section maps were also constructed for the aquifer domain by finding the maximum concentration over all depths at a given Northing and Easting coordinate pair and contouring the resultant peak values. As a result, many of the contour maps are not as smooth as they would be for a given vertical or horizontal cross-section.

In all of the concentration contour maps given in this report, concentrations greater than the MCL are represented by solid lines, the MCL is given by the dark solid line, and concentrations lower than the MCL are indicated by dotted lines. Where there are no solid lines, the concentration does not exceed the MCL, and where the concentration is less than 1/100th of the MCL, there are no dotted lines. The MCL and contour levels represented for each contaminant is given in the discussion text for each contaminant. Because many of the concentration contours are highly irregular, and are close together, labeling of the contour lines is incomplete. To facilitate interpreting the contour plots, the peak concentration at each time period is given in the subtitle of each of the concentration contour subplots.

Risk maps or hazard index maps were determined from the aquifer peak concentration contour maps. These maps represent the maximum value over aquifer depth and differ only in scaling from the concentration contour plots. For these plots, the contour levels are given for the 10^{-7}, 10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}, or 10^{-2} risk and 10^{-1}, 1, 10^{+1}, 10^{+2}, 10^{+3}, or 10^{+4} hazard index levels. Contour levels above the 10^{-6} (or HQ=1) value are indicated by solid lines. Risk less than 10^{-6} (or HQ<1) is indicated by dotted lines, the 10^{-6} (or HI=1)a level is indicated by the thick line, and the 10^{-4} (HQ=10) level is indicated by the medium solid line. The peak risk (or HQ) at each simulation time shown in the contour plot appears in the individual plot subtitle.

For the vadose zone and aquifer transport simulations, a peak concentration vs. time plot is presented. In both cases, the peak concentration vs. time plot includes the corresponding risk. In order to facilitate interpretation, the peak risk is plotted as a dark line against a logarithmic (left side) axis, and the concentration is plotted as a dotted line against a linear (right side) axis. The risk and concentration axes do not have points in common because the risk axis is the log of a linearly scaled concentration and points in common would compress the concentration plot to the point of being unable to see the true range. In addition to the risk and concentration lines, there is a solid horizontal line drawn at the 10^{-6} (or HQ=1) level and a horizontal dotted line drawn at the concentration representing the MCL for each contaminant. For presentation purposes, the peak concentration axis was occasionally truncated to allow representation of the data at lower concentrations (i.e. closer to MCLs) when the peak concentration for a given COPC far exceeds either the risk based limit, the MCL, or a "representatively average" behavior. Truncating the peak concentration (risk, HQ) figures was done when the peak value was relatively high for a short duration in time. The simulated peak concentration is given within the text for each contaminant, and is also summarized for all of the contaminants in Tables 7-2 through 7-5 which are presented in Section 7.14.

It will become apparent in the following presentation that transport for each contaminant was simulated out to a different total time. Total simulation time was varied because:

1. the relative travel time necessary to reach the aquifer from the surface is a function of Kd and is contaminant specific. The simulation time was based on a) observing the bulk of the mass (or activity) to move through the vadose zone and into the aquifer and b) allowing the peak mass flux from the vadose zone to reach the aquifer.

2. as radioactive contaminants traverse the vadose zone, the decay rate is (in some cases) fast enough to allow the contaminant to reach peak concentrations below both risk based and MCL levels prior to 2095 (the 100 year risk time period).

3. the predicted peak mass flux from the vadose zone had occurred and it was apparent that concentrations would not fall below the 10^{-6} risk (or HQ=1) levels within a (subjective) 1000 year time frame.

The actual simulation time for each contaminant is given in the descriptive text, and in Tables 7-2 through 7-5 (Section 7.14).

Field data used to determine the source terms for each COPC was discussed in Section 5, and the incorporation of the source term into the model was discussed in Section 6. These source terms will not be discussed in detail in this section, although reference to local maxima observed in peak concentration will be attributed to specific releases.

Comparisons between the model predicted concentrations and field data are presented for Am-241, Chromium, Co-60, Cs-137, H-3, I-129, Mercury, Np-237, Sr-90, and Tc-99. Comparisons are not presented for arsenic because measured concentrations are only slightly above background levels and there are no known anthropogenic sources of arsenic at the ICPP, however, there was one source term identified for arsenic from soil samples. The maximum measured soils concentration was 10.3 mg/kg which is only twice as large as the reported background soils concentration of 5 mg/kg (Knobel et al, 1992), and given the pore water variability noted in that source could very well be within the range of background concentrations. Comparisons are not presented for total Pu because there are no field samples with concentrations greater than the measurement error. Comparisons are not presented for total U because it was simulated as total U but field data exists for a) random numbers of the various isotopes at a given sample times; b) single isotopes at a given time; or c) total U at a given time. As a result of offset sampling intervals and the combination of isotopic and total data, direct comparison of the model predicted concentration to the field data would be at best subjective, and at the minimum very difficult to interpret. Therefore, these comparisons are not presented. For the cases in which the comparisons are presented, they are not meant to imply that this model has been calibrated to the field data for those contaminants. In contrast, the only transport calibration that has been done was presented in Section 4 for chloride discharged to the vadose zone and tritium discharged to the aquifer in the vicinity and downgradient of the ICPP. Information that can be gathered from the comparison curves includes an assessment of the model assumed Kd, the model assumed source concentration, and the impact of sampling field data on irregular intervals. For most of the vadose zone and aquifer comparison curves presented, there is relatively little field data available, and the model predictions span a much larger period in time. As a result, the field data is often a single data point or are closely spaced pairs of data points plotted on curves spanning a much larger time period.

Presentation format for the vadose zone comparison curves consist of the field data and three curves showing a) the center of the screened interval, represented by a dotted line; b) the average of nine grid blocks centered vertically on the middle of the screened interval, represented by a solid line; and c) the grid block (of the seven) that most closely matches the peak concentration for the screened interval, represented by a dashed line. Presentation of the model block representing the center of the screened interval is consistent with the presentation of the chloride calibration data. As opposed to the aquifer region, there are very sharp contrasts in concentration that exist across material (basalt to sediment) interfaces. This is true because of adsorption that effectively lowers the concentration in the sediment. Note that in the chloride calibration that was presented in Section 4.1, this wasn't an issue because the chloride was assumed to be non-reactive (non-sorbing). Presenting an average concentration over several grid blocks centered on the screened interval allows assessing the relative difference in the magnitude of the concentration when the actual screened interval occurs in (or adjacent to) a material property contrast. The third curve represents the best fit match of the nine grid blocks to the field data simply based on the peak concentration during the time period during which the field data were collected. In cases where the screened interval falls in the center of a column of sediment grid blocks, the three curves are very similar. On the other hand, where the model screened interval is clearly in a basalt block, the average and screened interval curves typically over estimate the field data.

Presentation of the aquifer calibration curves is exactly like the presentation of the H-3 calibration curves shown in Section 4.2. As with the vadose zone comparison curves, the aquifer comparison is difficult

because of the three-dimensionality of the model. As a result of the third dimension, the concentration over time at various depths is not uniform. To illustrate the relative impact of the dimensionality, the concentration curves at well locations are presented as: (a) field data indicated by the thick solid line; (b) a depth averaged concentration (not flux averaged) given by the thick dark line; and (c) the model predicted concentration (at every depth) indicated by the light shaded lines. The depth averaged (thick dashed line) was used as the basis of comparison to the field data in the discussion of the H-3 calibration process. An average was used rather than using the center of the screened interval because the depth of influence sampled during data collections is unknown. These line types were shown in Figure 4-15.

7.1 ARSENIC

There are no known anthropogenic sources of arsenic at the INEL, however, there was one source term identified for arsenic corresponding to soils measurements. The maximum measured soils concentration was 10.3 mg/kg which is only twice as large as the reported background soils concentration of 5 mg/kg (Knobel et al, 1992), and given the pore water variability noted in that source could very well be within the range of background concentrations. Using this single soils source introduced in 1990, simulations for arsenic were carried out to the year 3095. Simulation results for the transport through the vadose zone are given in Figures 7-2 through 7-7, with results for transport through the aquifer given in Figures 7-8 through 7-12. Concentration contour levels for the vadose zone and aquifer (Figures 7-2 through 7-5, 7-8, and 7-9) are given for $5x10^{-4}$, $5x10^{-3}$, $5x10^{-2}$, $5x10^{-1}$, 5, $5x10^{-1}$ mg/L, with the dark line representing the 0.05 mg/L value corresponding to the MCL for arsenic. The corresponding aquifer risk contour maps are shown in Figures 7-10 and 7-11. In the risk contour maps, the levels correspond to the 10^{-7}, 10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}, and 10^{-2} risk based levels. Risk levels above the 10^{-6} ($5.67x10^{-5}$ mg/L) value are indicated by solid lines.

VADOSE ZONE: The contour plots and Figure 7-6 indicate that the predicted vadose zone arsenic concentration drops below the MCL (0.05 mg/L) after 2211, but that it is predicted to remain above the 10^{-6} risk level within the total simulation time (year 3095). Figure 7-6 also shows that the peak concentration in the vadose zone occurs in 1990 with the vadose zone contour plots showing that it occurs near the surface as a result of the incorporation of soils contamination into the model at that time.

The arsenic vadose zone and aquifer transport was simulated out to the year 3095 rather than stopping at the 100 year minimum time (2095) even though concentrations were below the MCL (dotted horizontal line). Continuing the simulation out for a longer period of time allowed 91% of the initial mass in place to reach the aquifer and concentrations to approach the 10^{-4} risk level. This is seen in the mass flux vs. time plot (Figure 7-7) which gives the rate of mass passing from the vadose zone and into the aquifer. This figure shows that the peak mass flux from the vadose zone is predicted to occur in 2096 with a smaller peak in mass flux occurring in 2300. Although the largest concentration going into the aquifer is predicted to occur in 2096, by 2095 only 0.6% of the total source mass is predicted to have left the vadose zone. As a result, the simulation was carried out to 3095 when 91% of the total mass had entered the aquifer. At this point, the simulation was stopped although the risk levels in the vadose zone were still predicted to be above the risk based limit.

AQUIFER: Concentrations in the aquifer (Figures 7-8, and 7-9) never exceed the MCL. However, Figures 7-10, and 7-11 indicate that the risk based limit is exceeded throughout the 1000 year total simulation time. The peak aquifer concentration and risk as a function of time are given in Figure 7-12. As shown in the upper figure, there is a slight time period around 2095 where the risk level is above 10^{-7} in the TRA area. As shown in the contour plots, this is a result of the source at ICPP and not from disposal practices in the TRA area. The middle figure gives the peak concentration for the ICPP area, and indicates that concentrations are much less than the MCL for the entire simulation period ($2x10^{-3}$ vs. $5x10^{-2}$ mg/L) but that the 10^{-6} risk based limit is exceeded for the majority of the simulation period. Reexamination of the vadose zone peak concentration and mass flux to the aquifer suggests that the concentration of arsenic in the aquifer will decrease very slowly, and that it will remain above the risk based limits for at least out to the year 3095.

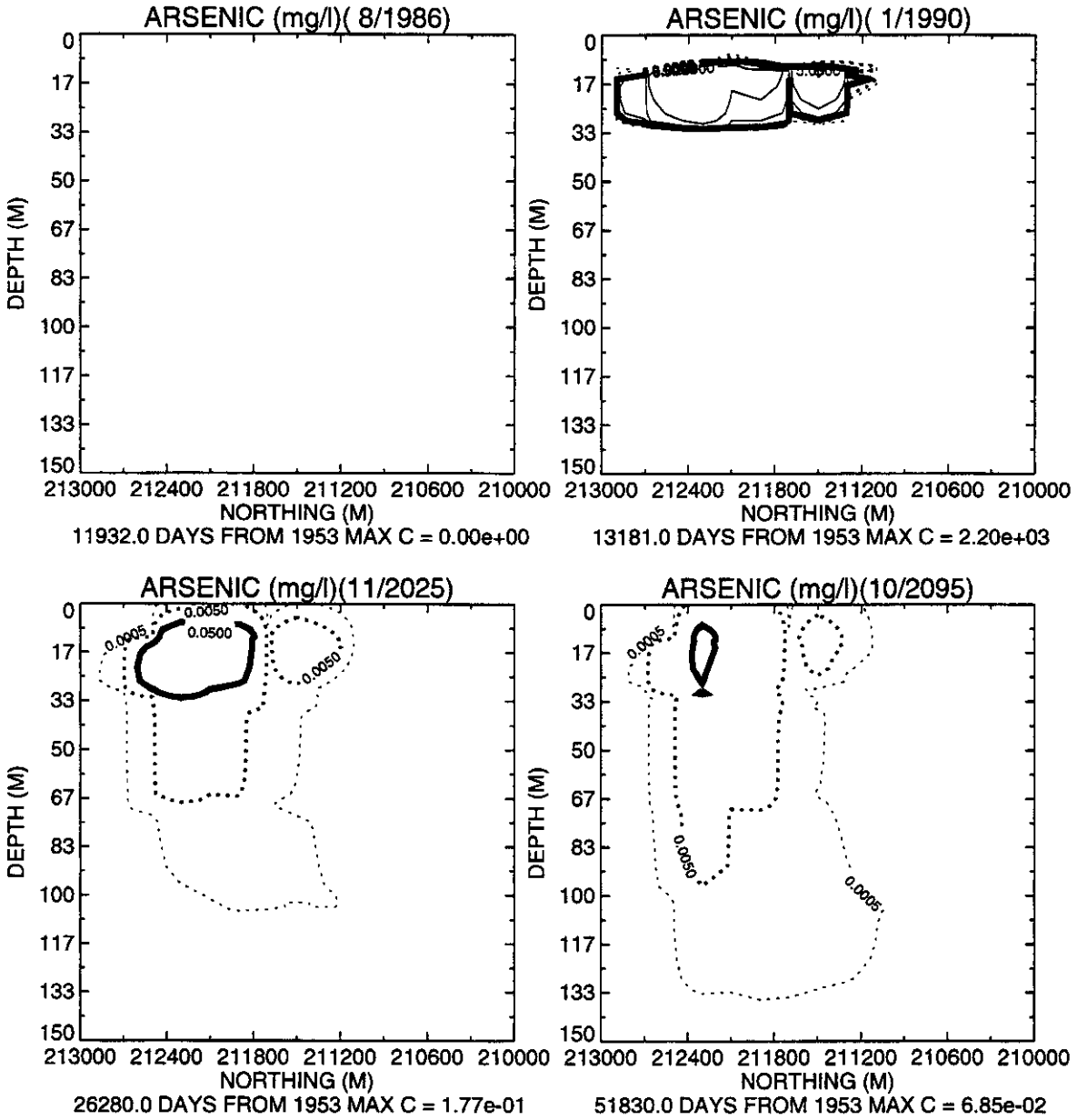


Figure 7-2 Vadose zone arsenic peak concentration contours.

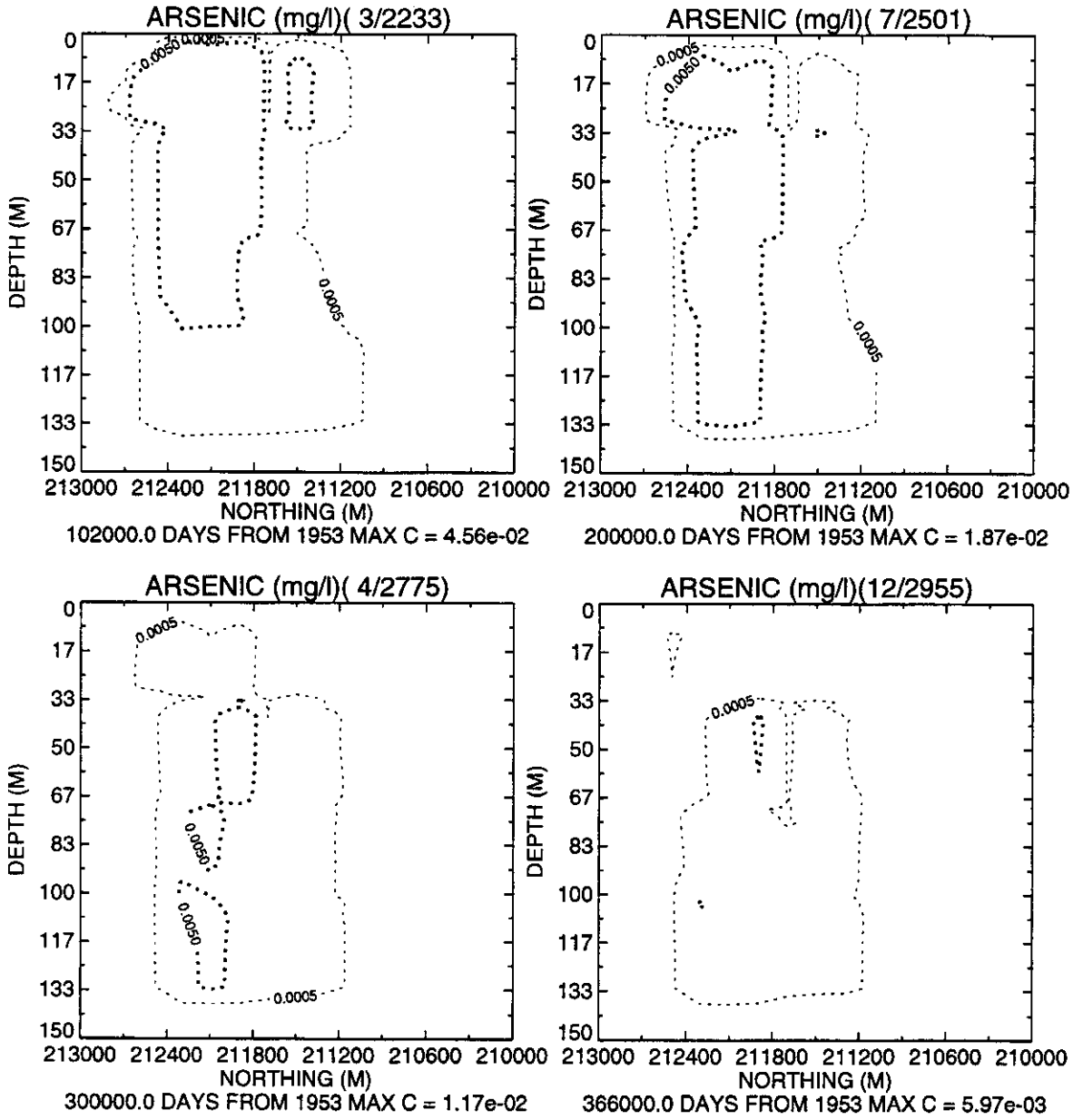


Figure 7-3 Vadose zone arsenic peak concentration contours.

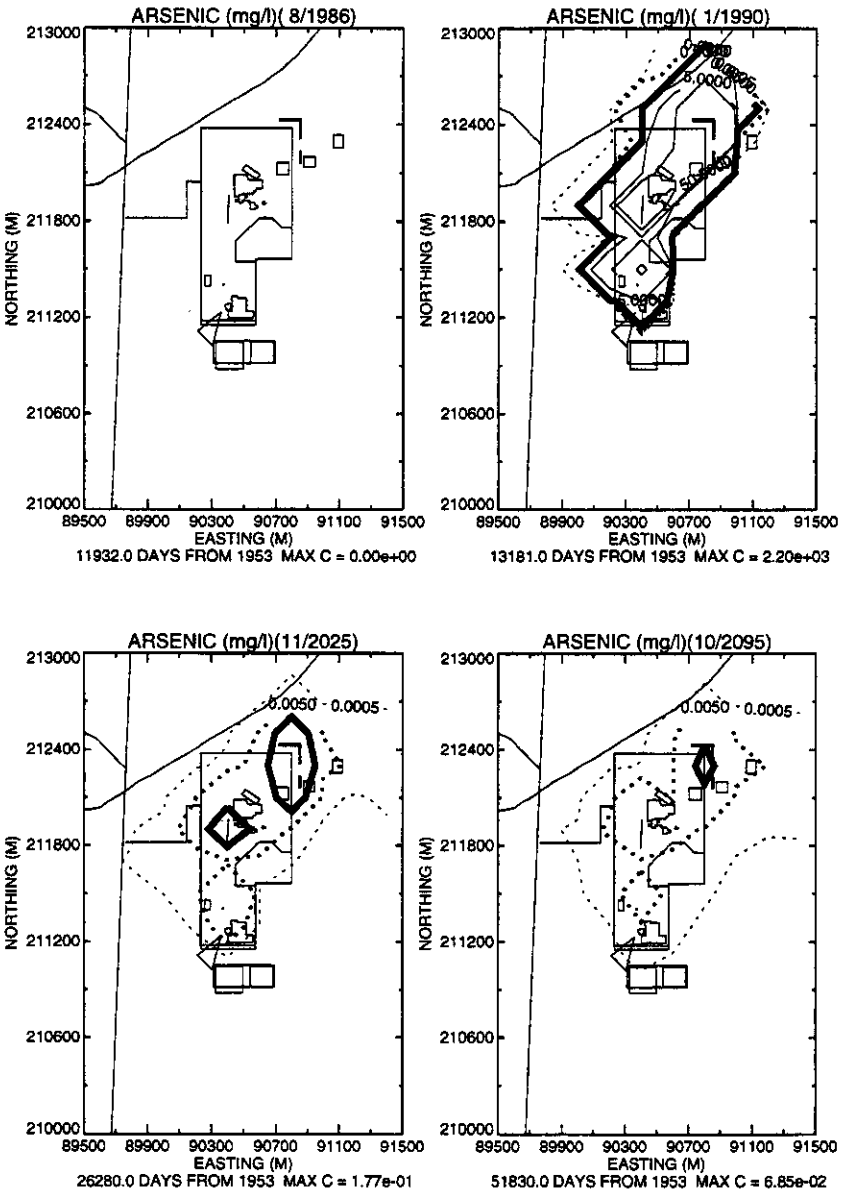


Figure 7-4 Vadose zone arsenic peak concentration contours.

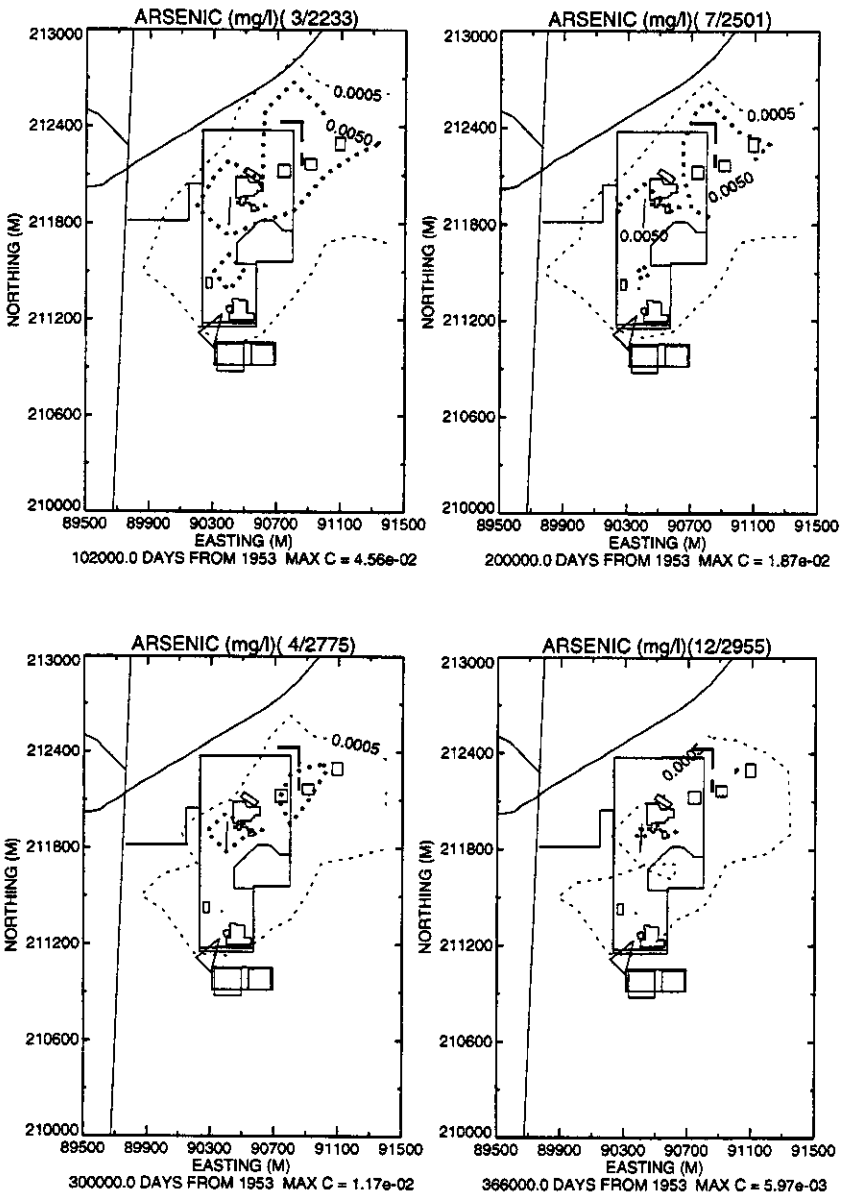


Figure 7-5 Vadose zone arsenic peak concentration contours.

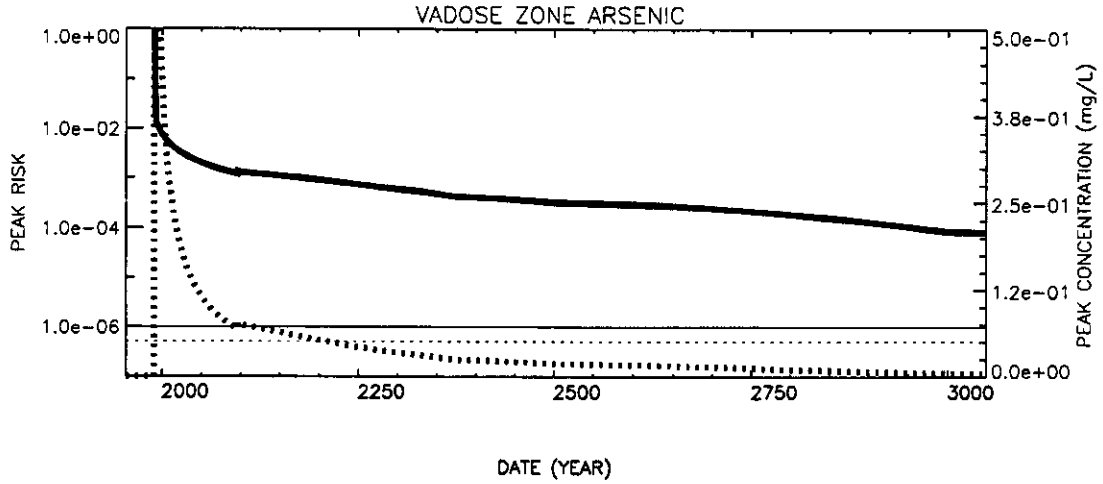


Figure 7-6 Peak vadose zone risk and concentration for arsenic. Risk indicated by the thick line on the log scale with the 10^{-6} value shown as the solid line. The dotted line represents concentration given by the linear scale on the right axis with the MCL shown as the straight horizontal line.

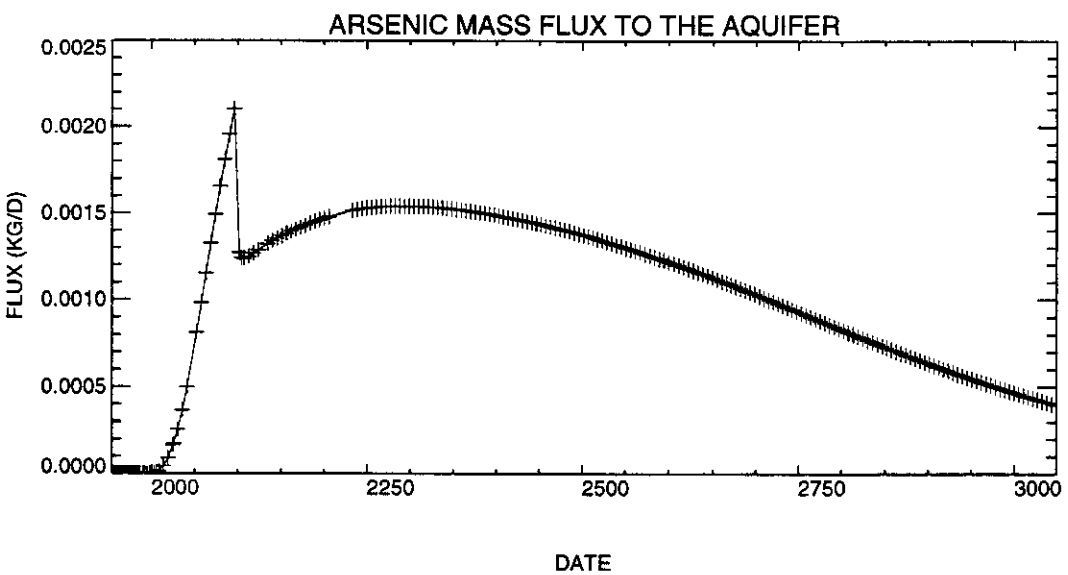


Figure 7-7 Mass flux of arsenic into the aquifer from the vadose zone.

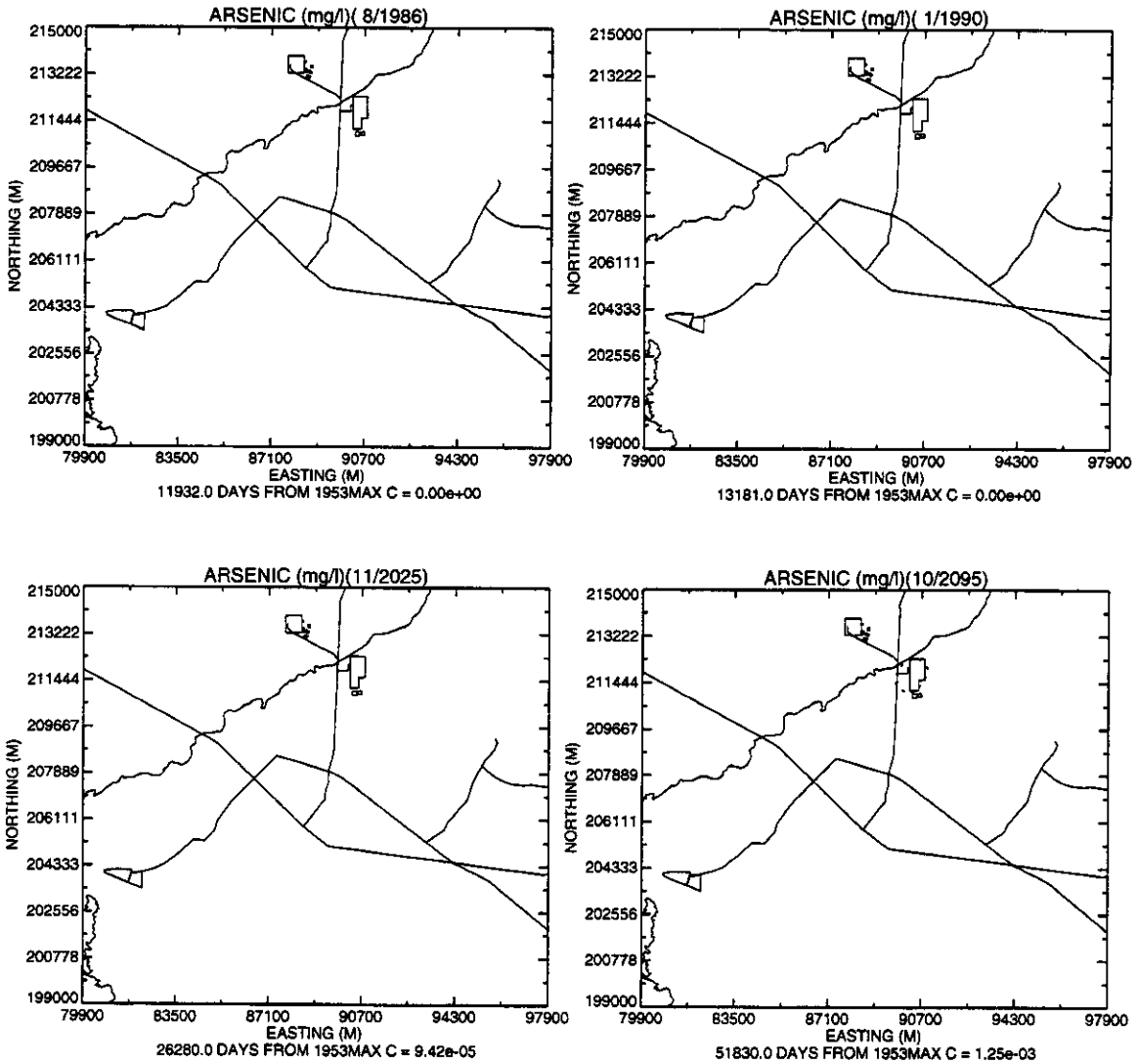


Figure 7-8 Aquifer arsenic peak concentration contours.

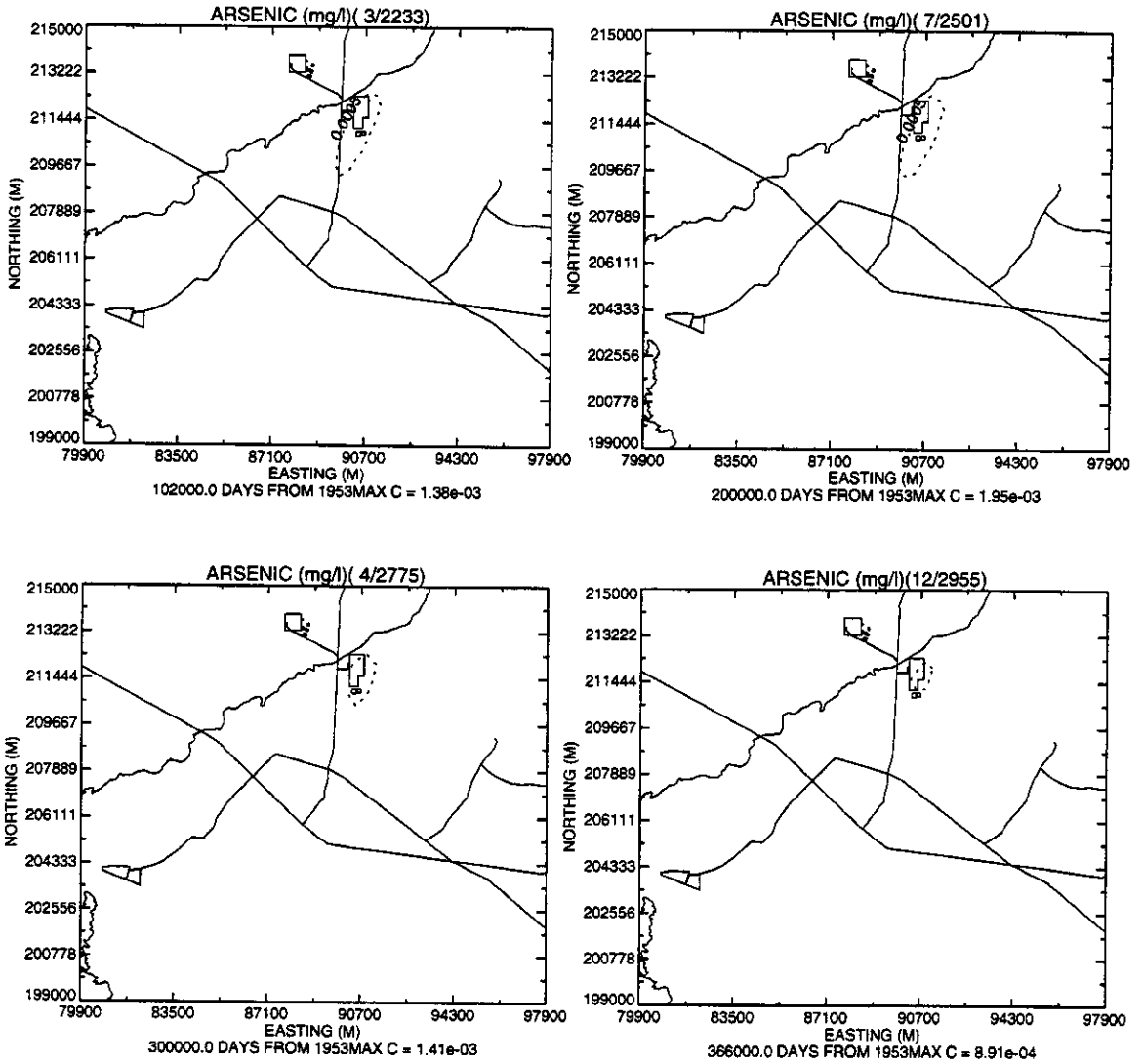


Figure 7-9 Aquifer arsenic peak concentration contours.

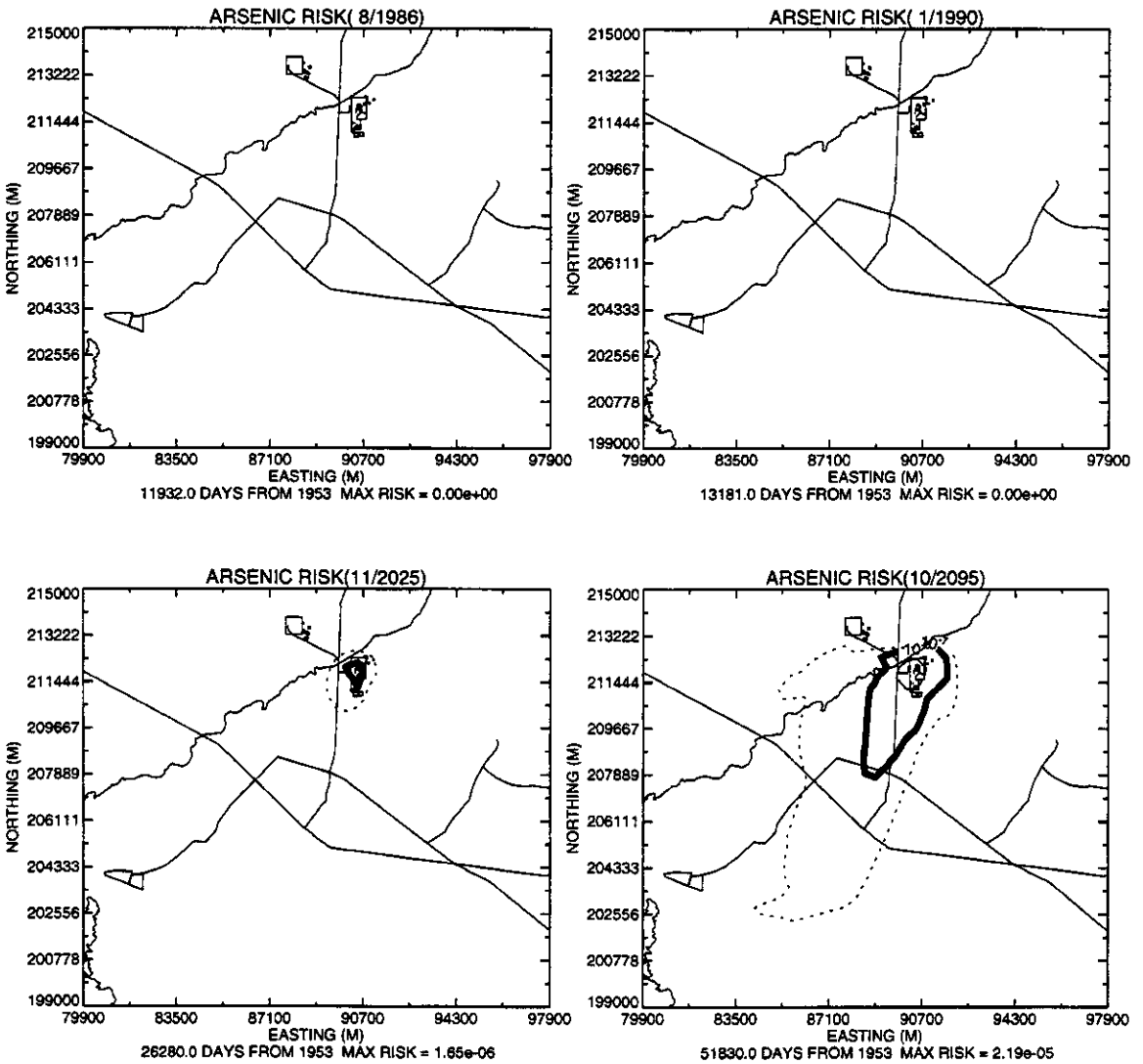


Figure 7-10 Aquifer arsenic peak risk contours.

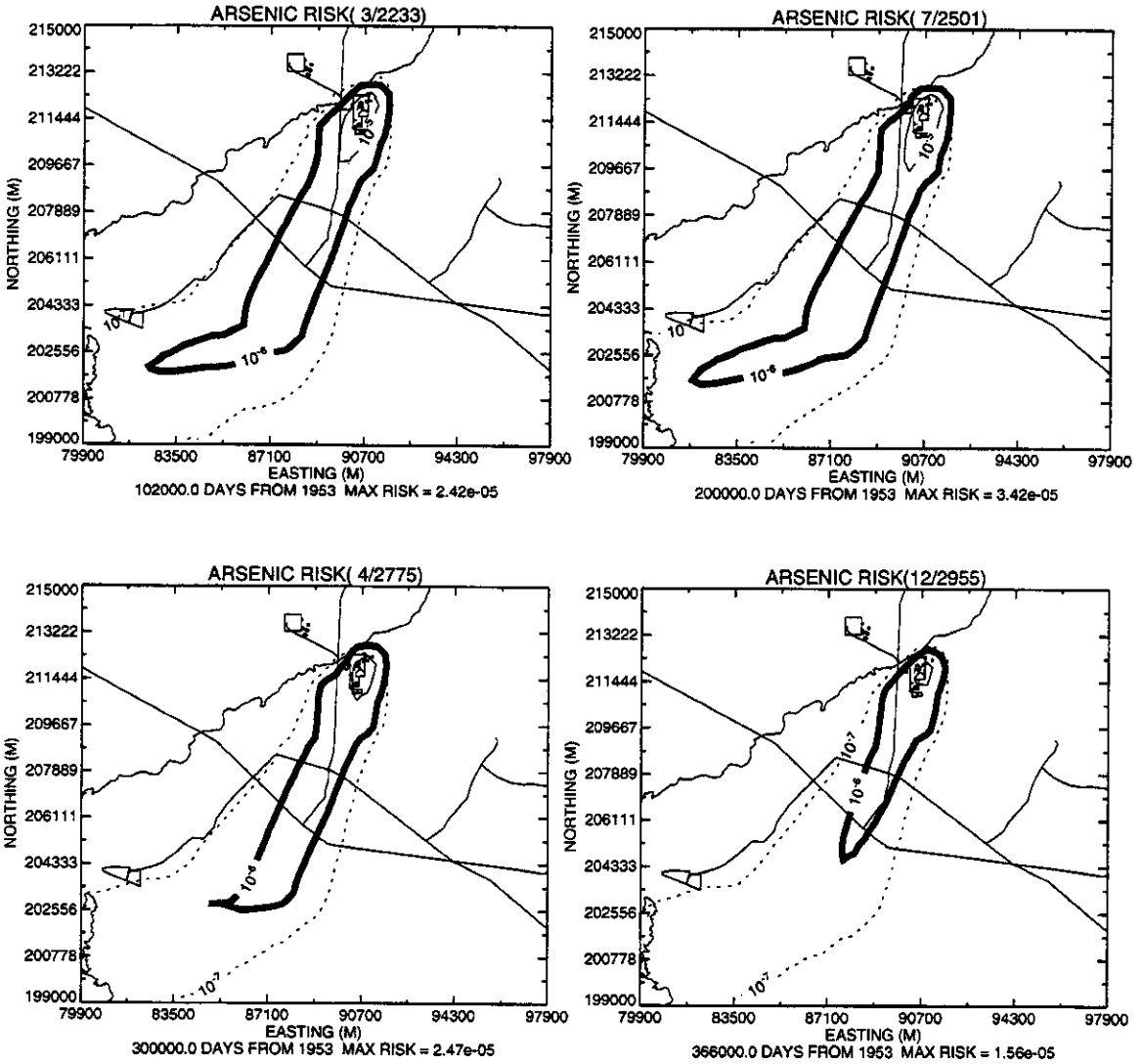


Figure 7-11 Aquifer arsenic peak risk contours.

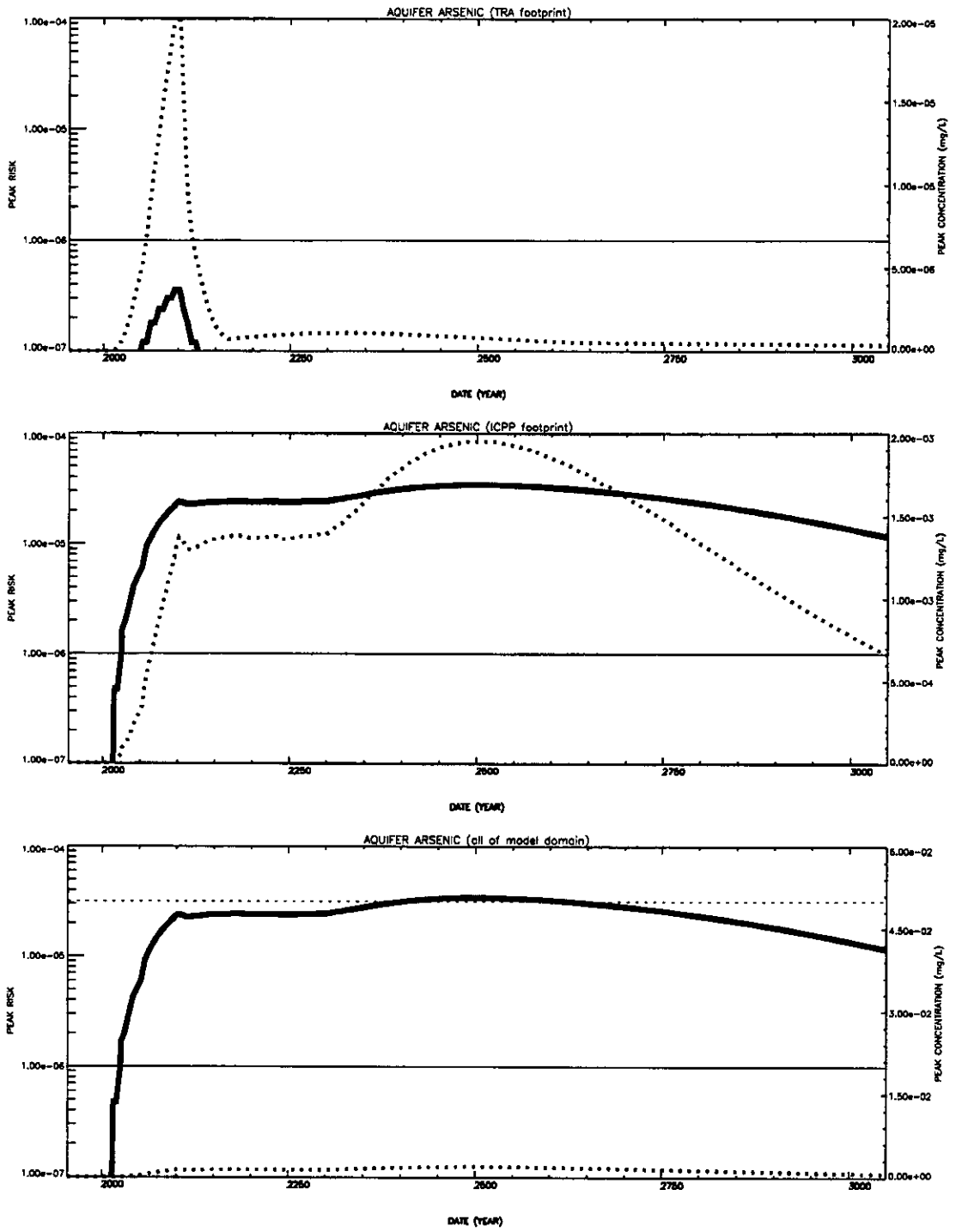


Figure 7-12 Peak aquifer concentration for arsenic. Top figure: TRA foot print, Middle figure: ICPP footprint, Bottom Figure: entire aquifer domain. Thick line risk (left scale), dotted line concentration (right scale) solid line 10^{-6} risk (left scale).

7.2 CHROMIUM

As with arsenic, the soils inventory is the primary source of chromium from the ICPP (88%). In addition, ICPP chromium sources include the CPP-31 (1972, 10%) and the 1986 release (1.79%). Although chromium was discharged to the ICPP injection well, the concentrations were below the MCL and not included as a model source. The chromium discharges from TRA were also simulated and account for 99.4% of the total chromium source. Because of the relatively small Kd (1.2 cm^3/g), chromium transport in the vadose zone and aquifer was simulated out to year 2113. Transport through the vadose zone is summarized in Figures 7-13 through 7-18, and for the aquifer in Figures 7-21 through 7-25. Contour levels in Figures 7-13 through 7-16, 7-21, and 7-22 are given for $1x10^{-3}$, $1x10^{-2}$, $1x10^{-1}$, 1, $1x10^{+1}$, and $1x10^{+2}$ mg/L, with a concentration equal to the MCL (0.1 mg/L) represented by the dark solid line. Corresponding contours for the hazard index for the aquifer concentrations are given in Figures 7-23, and 7-24. Contours are given for hazard indices of 10^{-1}, 1, 10^{+1}, 10^{+2}, 10^{+3}, and 10^{+4} with the HQ=1 (0.183 mg/L) level indicated by the thick solid line.

VADOSE ZONE: Unlike arsenic, the MCL for chromium is lower than the HQ=1 value. As a result, as shown in Figure 7-17, the concentration of chromium in the ICPP vadose zone drops below the HQ=1 level in 1997 before it falls below the MCL in 2014. Local maxima in the vadose zone concentrations occur as a result of the 1972 (CPP-31), 1986 (86 release), and 1990 (soils) releases.

The mass flux out of the vadose zone and into the aquifer is given in Figure 7-18. This figure shows that chromium concentrations resulting from transport through the vadose zone should increase in the aquifer until 2069, and decline at a relatively slow rate until 2095 when the percolation ponds are expected to be decommissioned (sharp drop in mass flux). The simulations were stopped 2113, leaving 55% of the initial mass in the vadose zone. The simulations were stopped at this point because predicted chromium concentrations were below both the MCL and the risk level. Continued simulation will supply additional source mass to the aquifer, but concentrations will be much less than both the HQ=1 and MCL concentration.

Comparisons of the model predicted concentrations to vadose zone field data (Figures 7-19 and 7-20) are very good for the vadose zone wells with the exception of USGS-50 in the deep perched zone. The primary source of chromium to the deep perched zone was injection well water from the times the injection well failed. However, because the reported chromium concentrations to the injection well were less than the MCL (100 ug/L) no chromium was incorporated into the modeled injection well. Therefore, the predicted concentrations at USGS-50 are low because no chromium was put into the vadose zone model, with the injection well water.

AQUIFER: As shown in Figures 7-21, and 7-22, most of the chromium reaching the aquifer results from past disposal practices at the TRA facilities. The chromium in the ICPP vicinity originates primarily as a result of contaminated soils which should be currently bound in the vadose zone sediments. The ICPP contribution is predicted to reach the aquifer in levels of 1/100th the MCL after year 2020. Figure 7-25 shows that the maximum concentration in the aquifer should have occurred during the 1966-1971 time period and Figures 7-21, and 7-22 indicate that this peak occurs in the TRA area. The peak chromium concentration in the aquifer falls below and remains below the HQ=1 level in 1984, and remains below the MCL by 2003. The middle plot in Figure 7-25 is the aquifer peak concentrations in the ICPP footprint. Because the chromium in the aquifer in this area comes from the vadose zone (no ICPP injection well source), the peak concentrations shown in this figure are very closely correlated to the mass flux from the vadose zone shown in Figure 7-18.

Comparisons of model predicted concentrations to aquifer field data are shown in Figures 7-27 through 7-36. The comparisons in Figures 7-27 through 7-32 are for the wells in the vicinity and downgradient of the ICPP. The comparisons in Figures 7-33 through 7-36 are for the wells in the vicinity and downgradient of the TRA. Locations of these comparison wells are given in Figure 7-26 and include near-, mid-, and far-field distances from the injection well. For the ICPP wells, the predicted concentrations are lower than the field data in all cases. In many cases, the field data is the concentration detection limit (concentrations less than 10 ug/L) or there was chromium found in the sample blank (some of the 10 - 20 ug/L concentrations). However, there

are field samples at USGS wells 34, 35, 36, 111, 114, and 116 that are above the detection limit and significantly above the model predictions. This is due in part to the fact that no chromium was incorporated into the model from the CPP injection well, because the reported injection well concentrations were less than the MCL (100 ug/L). Because the measured concentrations are significantly below the MCL, there was no effort made to calibrate the model results to the chromium source from the injection well.

For the TRA wells, the predicted concentrations are lower than the field data for upgradient wells MTR-TEST, SITE-19, and TRA-1, 3, and 4. The reported concentrations in these wells are from 0-10 ug/L, the background concentrations are 2-3 ug/L (USGS, 1992), and the detection limits are generally below 10 ug/L. Because there is no chromium source in the model upgradient of the TRA chromium source area, the predicted concentrations should be low for these wells. For the cross-gradient well USGS-79, the predicted concentrations are higher than the field data. For the downgradient wells TRA-6, 7, and 8, and USGS-58, 65, 76, and 83, some predictions are higher than the field data and some are lower. The peak predicted concentrations are in general close to the peak measured concentrations but there appears to be a time shift in the breakthrough curve with the model predicting the breakthrough sooner than shown in the field data. This time shift can be seen in the comparisons for wells TRA-7 in Figure 7-34, TRA-8 and USGS-65 in Figure 7-35, and USGS-84 in Figure 7-36.

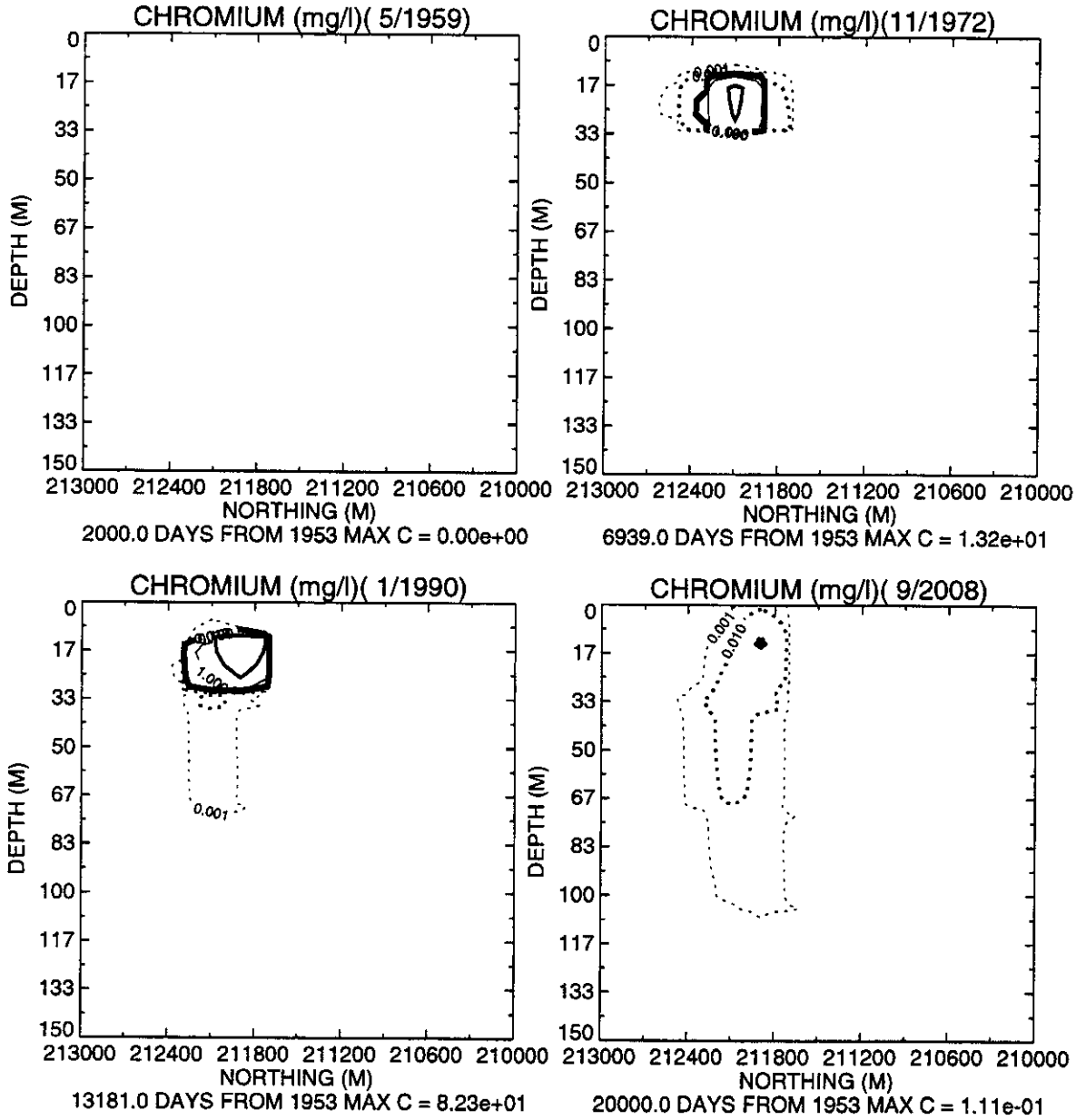


Figure 7-13 Vadose zone chromium peak concentration contours.

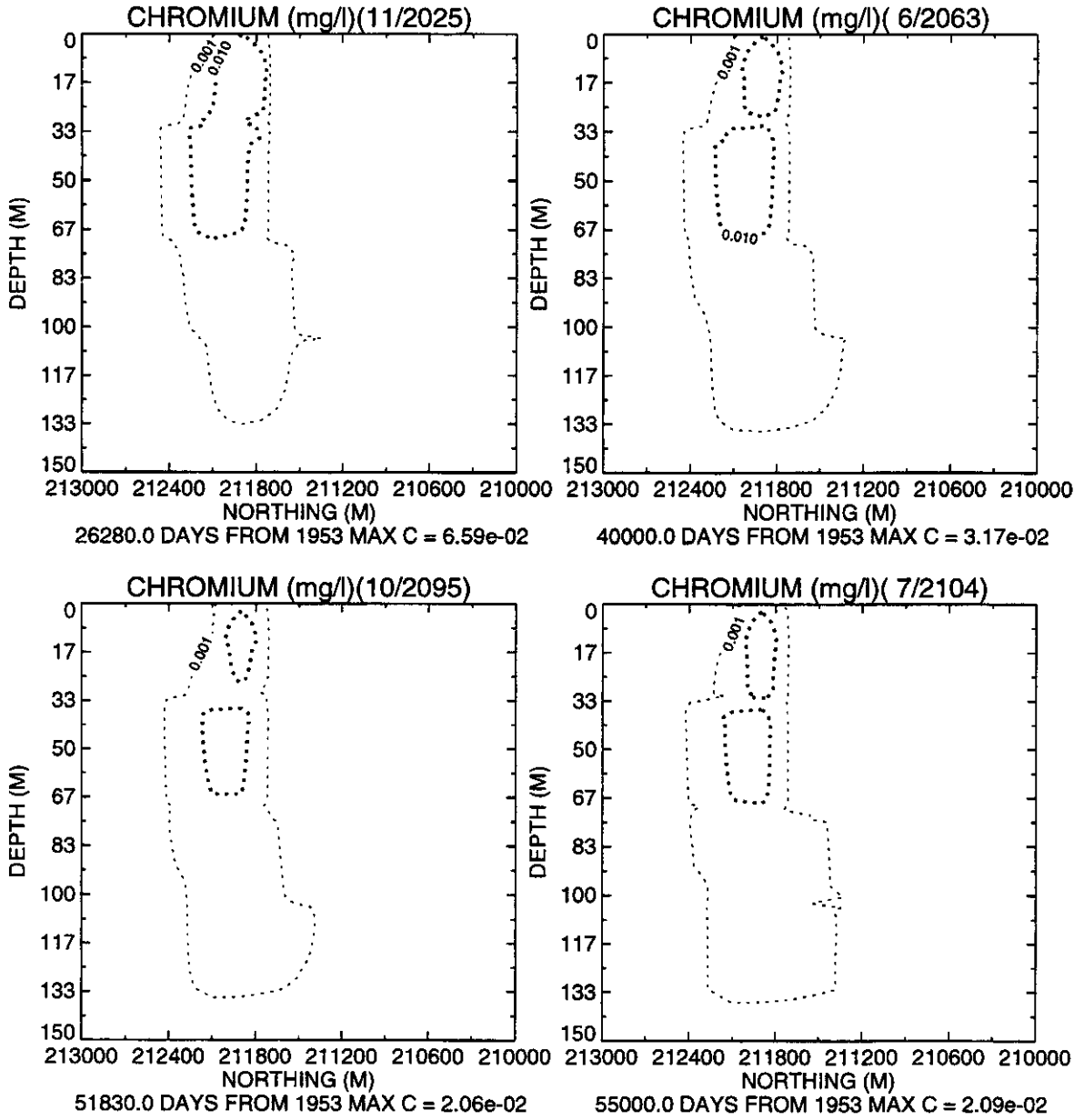


Figure 7-14 Vadose zone chromium peak concentration contours.

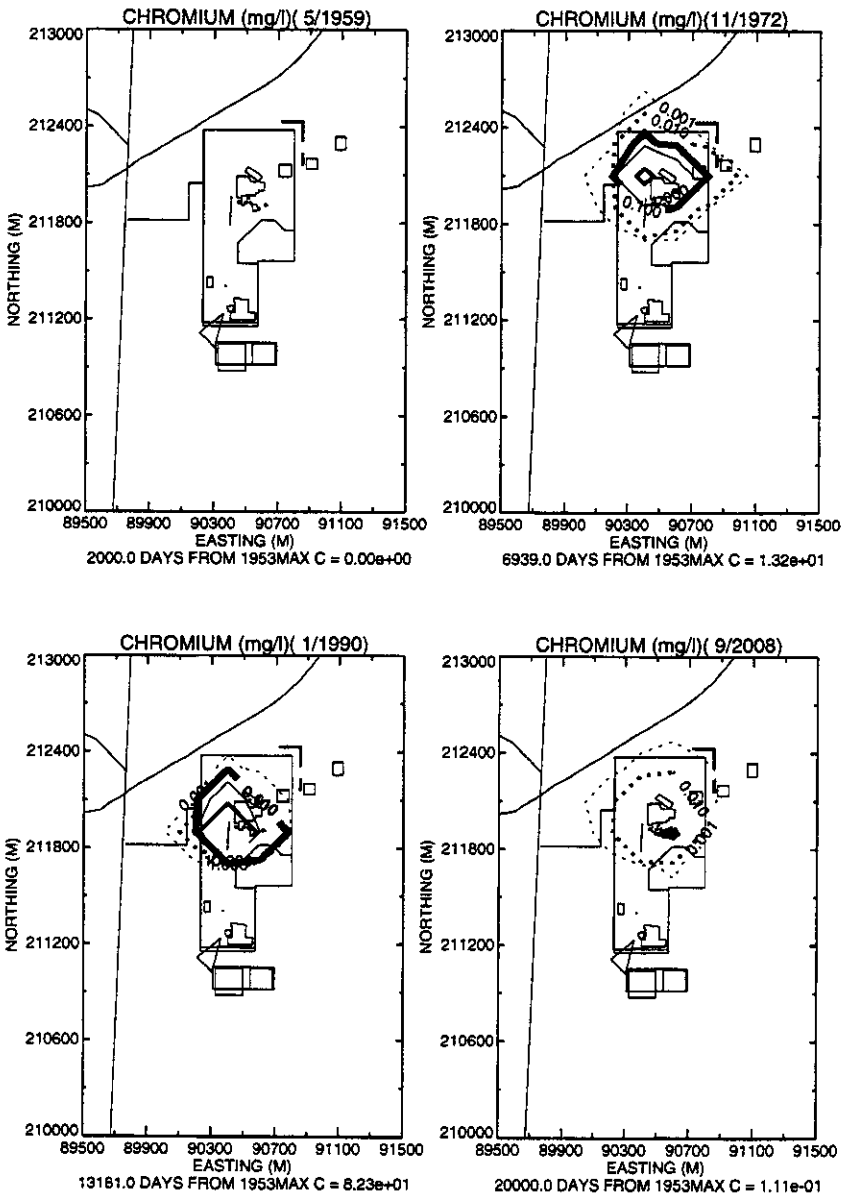


Figure 7-15 Vadose zone chromium peak concentration contours.

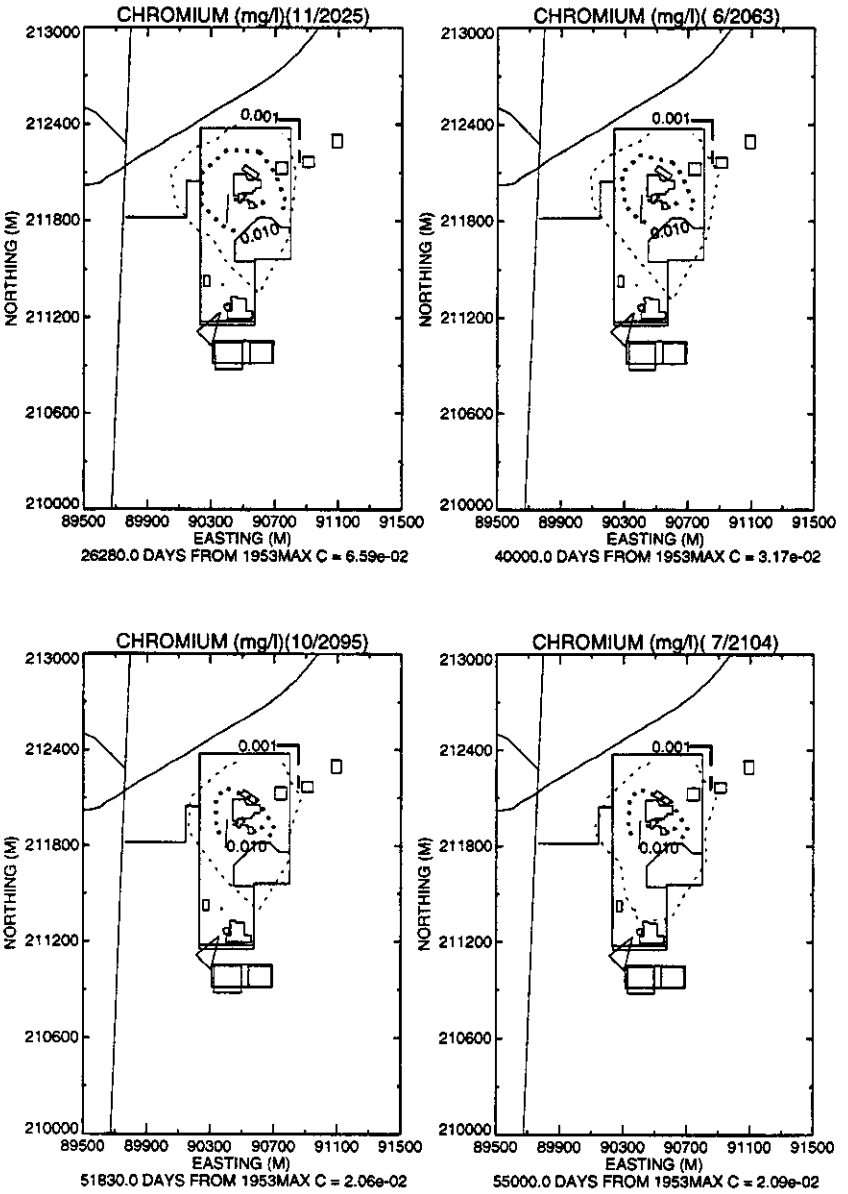


Figure 7-16 Vadose zone chromium peak concentration contours.

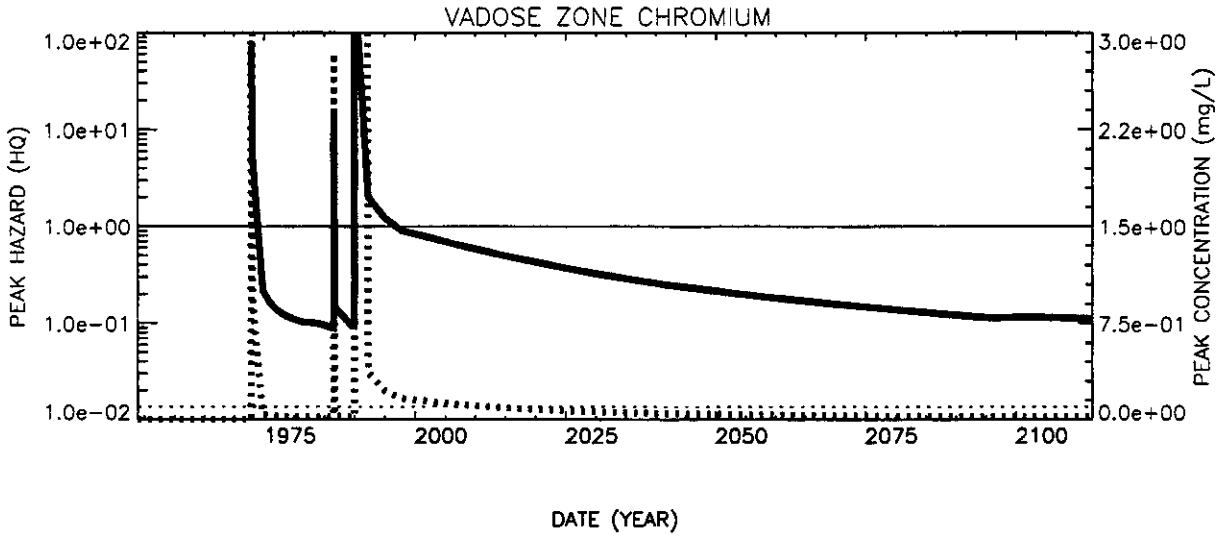


Figure 7-17 Peak vadose zone HQ and concentration for chromium. HQ indicated by the thick line on the log scale with the HQ=1 value shown as the solid line. The dotted line represents concentration given by the linear scale on the right axis with the MCL shown as the straight horizontal line.

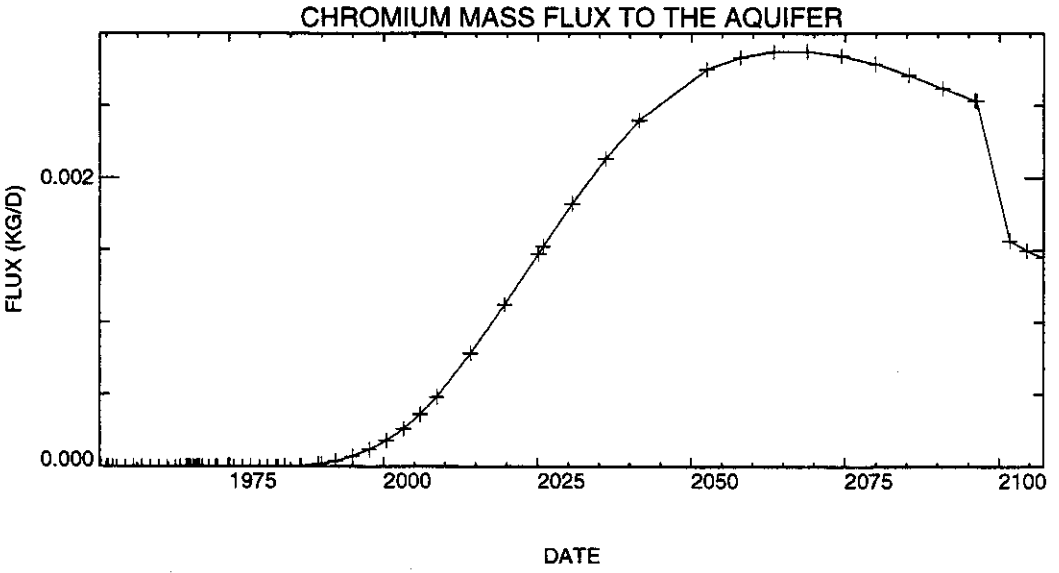


Figure 7-18 Mass flux of chromium into the aquifer from the vadose zone.

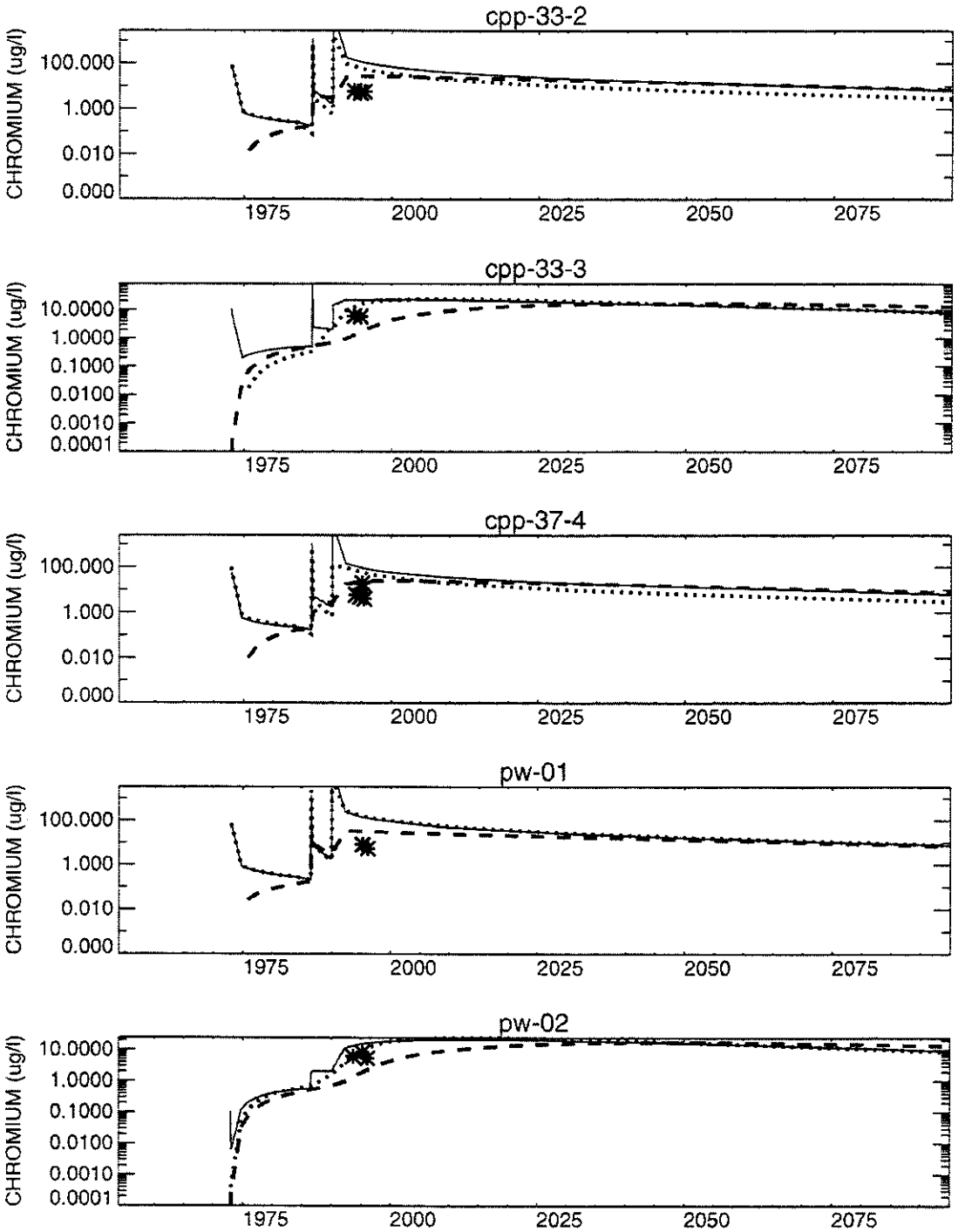


Figure 7-19 Comparison of vadose zone chromium to field data.

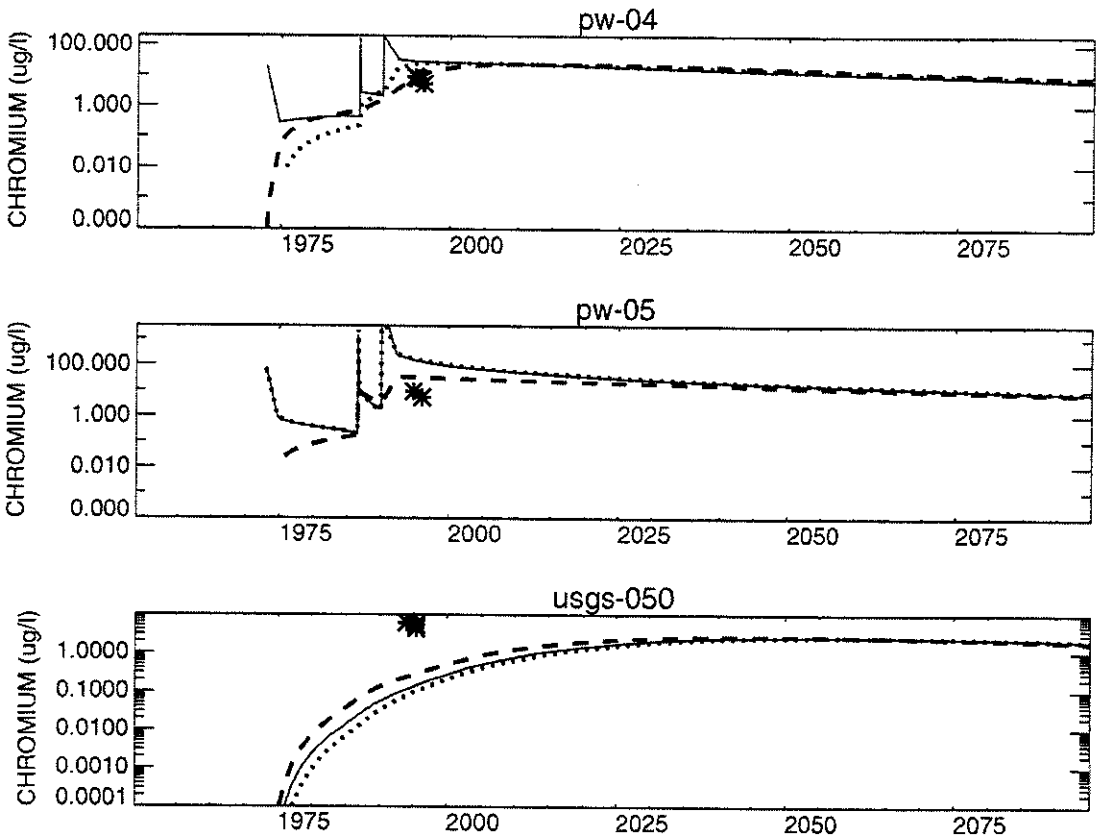


Figure 7-20 Comparison of vadose zone chromium to field data.

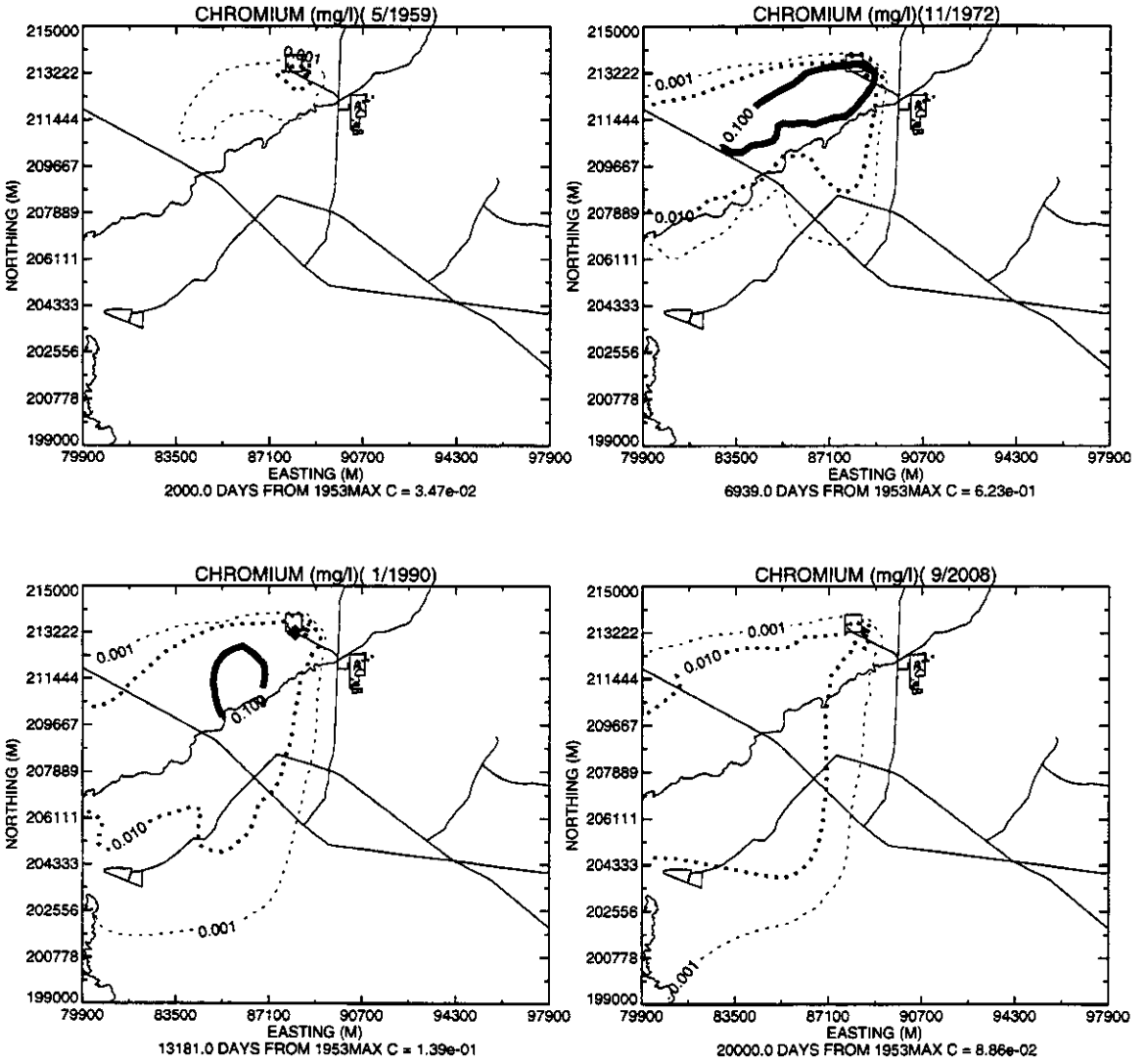


Figure 7-21 Aquifer chromium peak concentration contours.

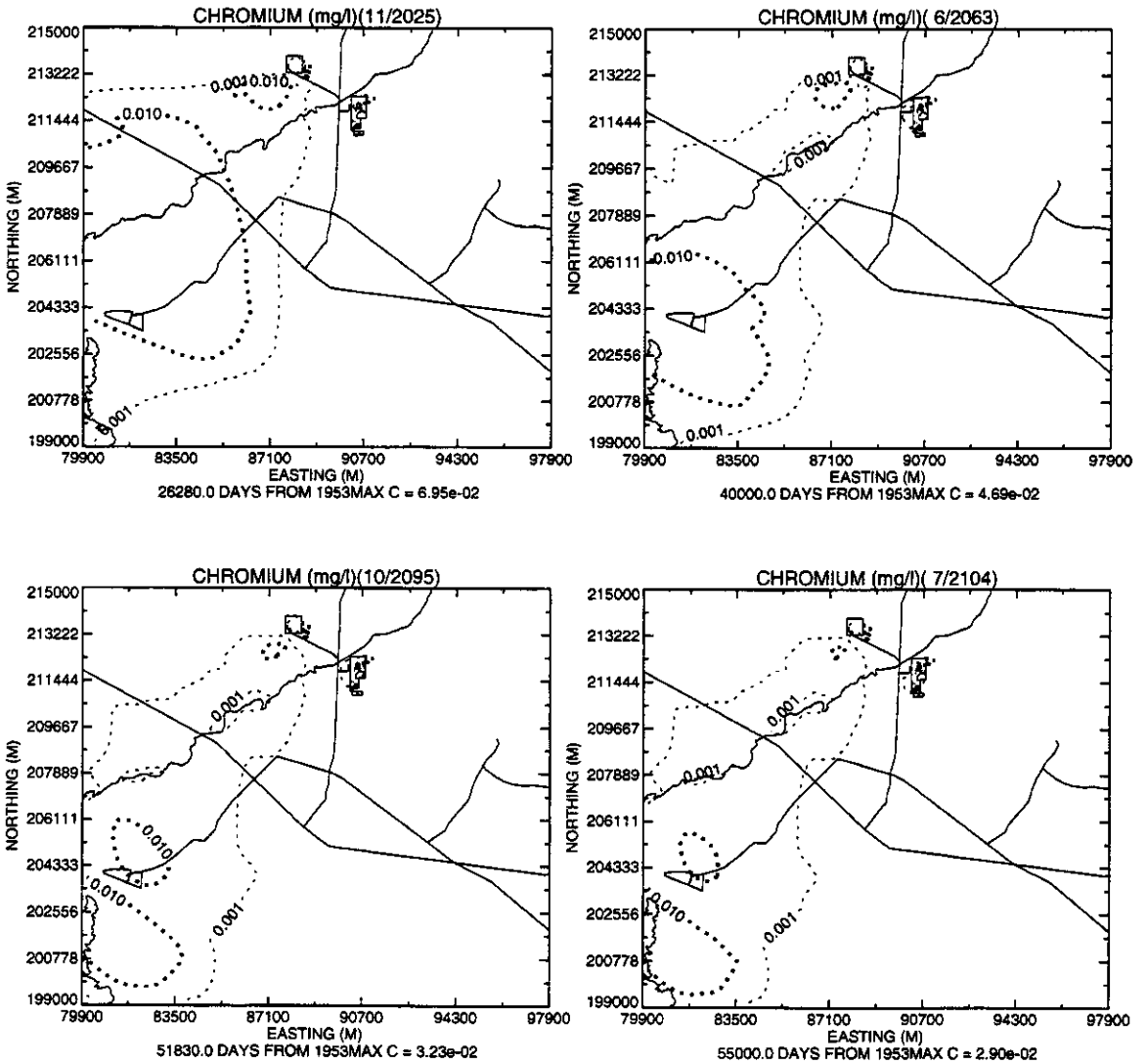


Figure 7-22 Aquifer chromium peak concentration contours.

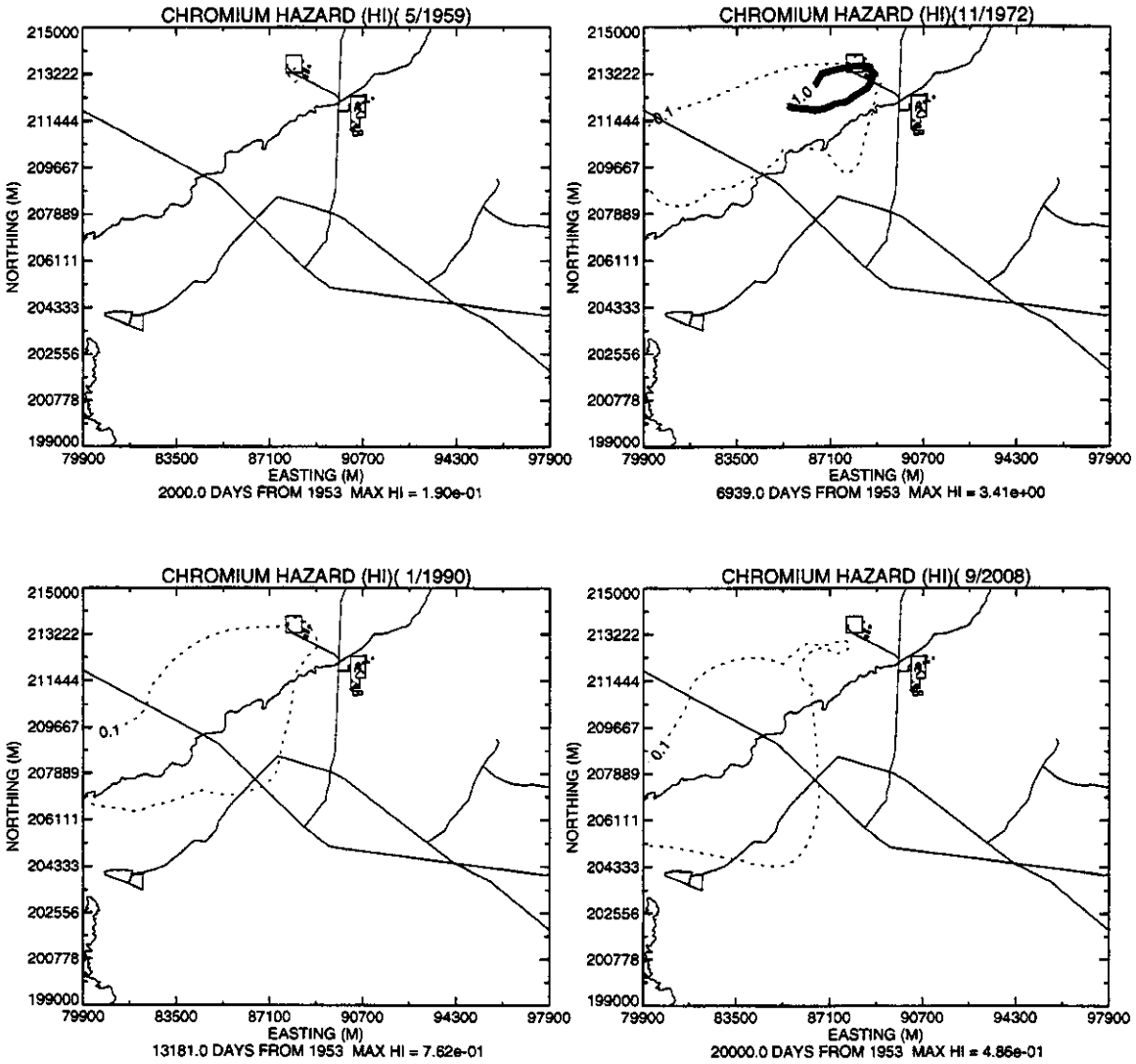


Figure 7-23 Aquifer chromium peak hazard index contours.

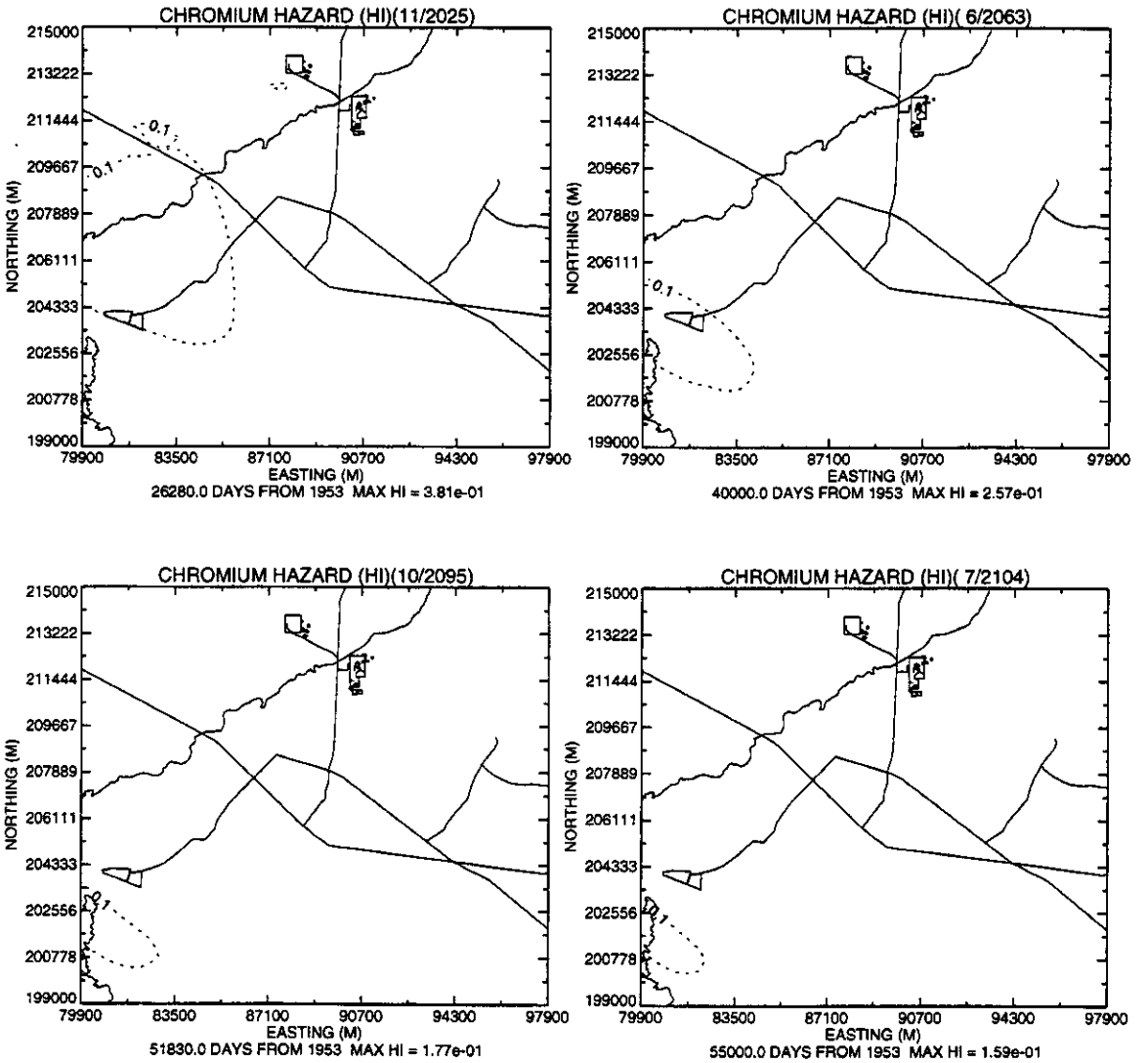


Figure 7-24 Aquifer chromium peak hazard index contours.

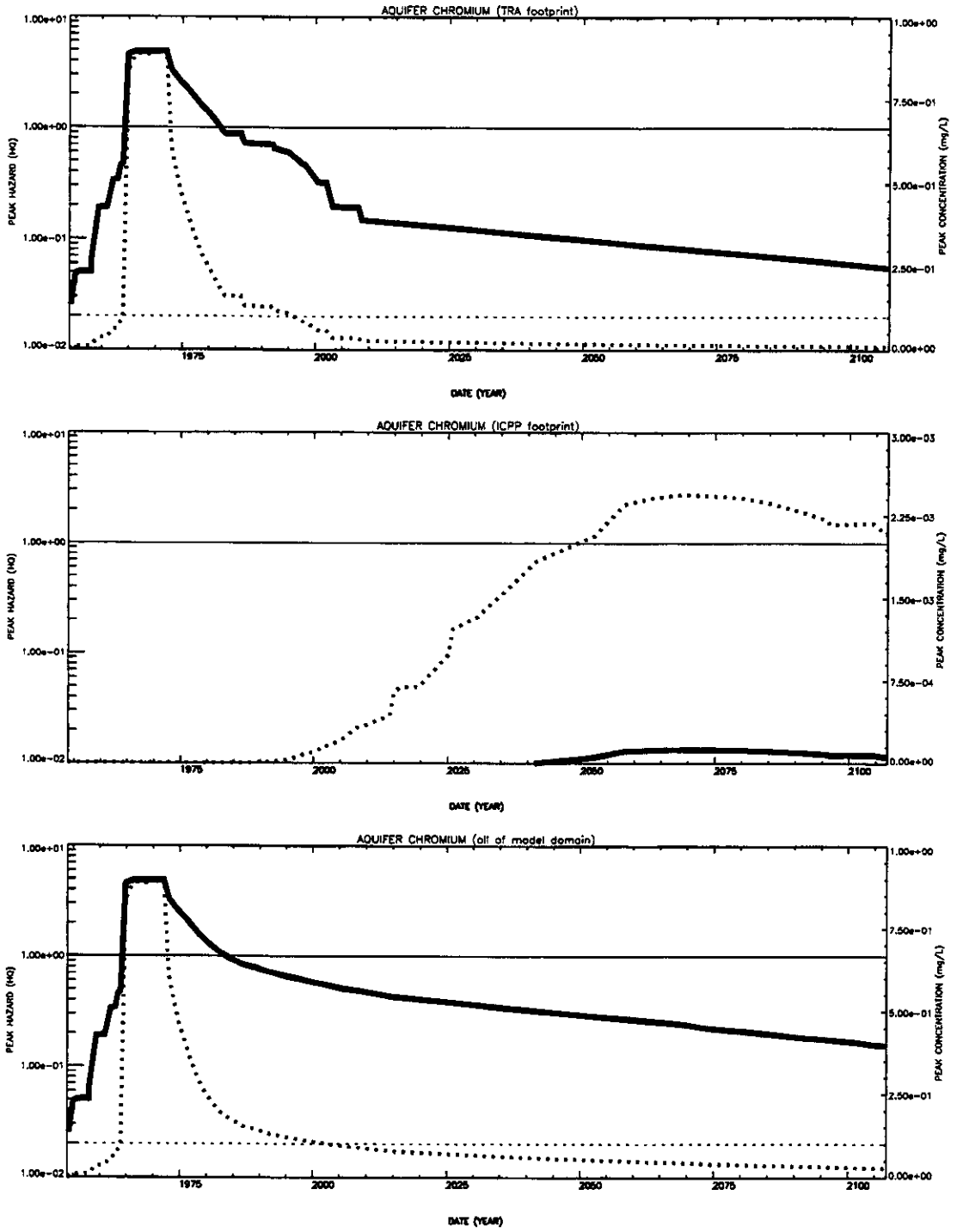
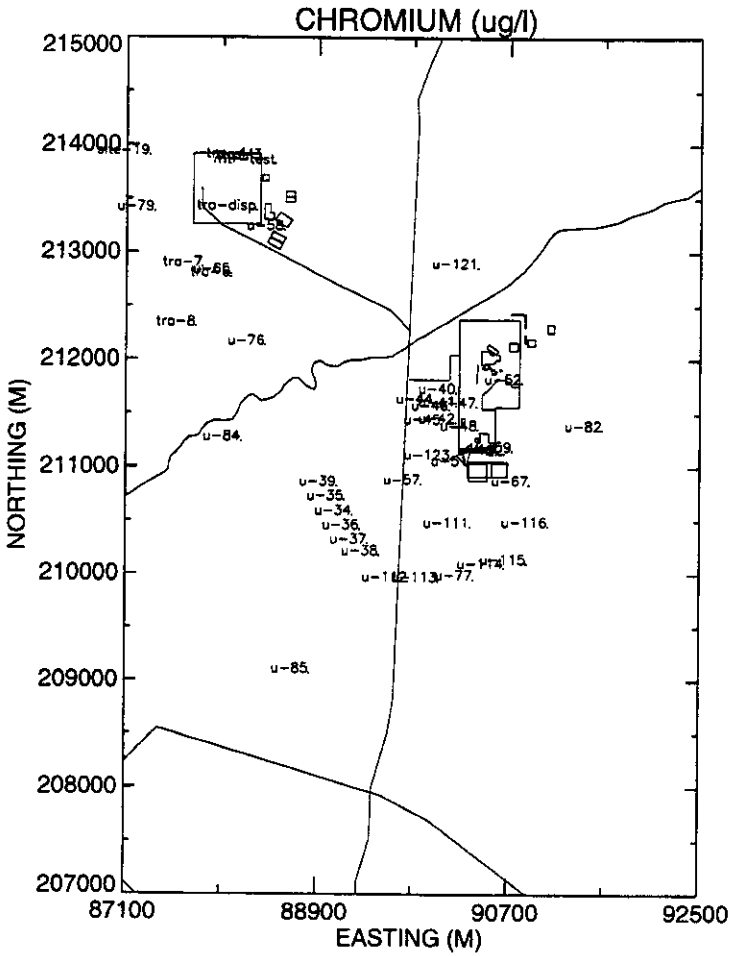


Figure 7-25 Peak aquifer concentration for chromium. Top figure: TRA foot print, Middle figure: ICPP footprint, Bottom Figure: entire aquifer domain. Thick line risk (left scale), dotted line concentration (right scale) solid line 10^{-6} risk (left scale).



hwy-3

Figure 7-26 Well locations for the comparison of aquifer chromium to field data.

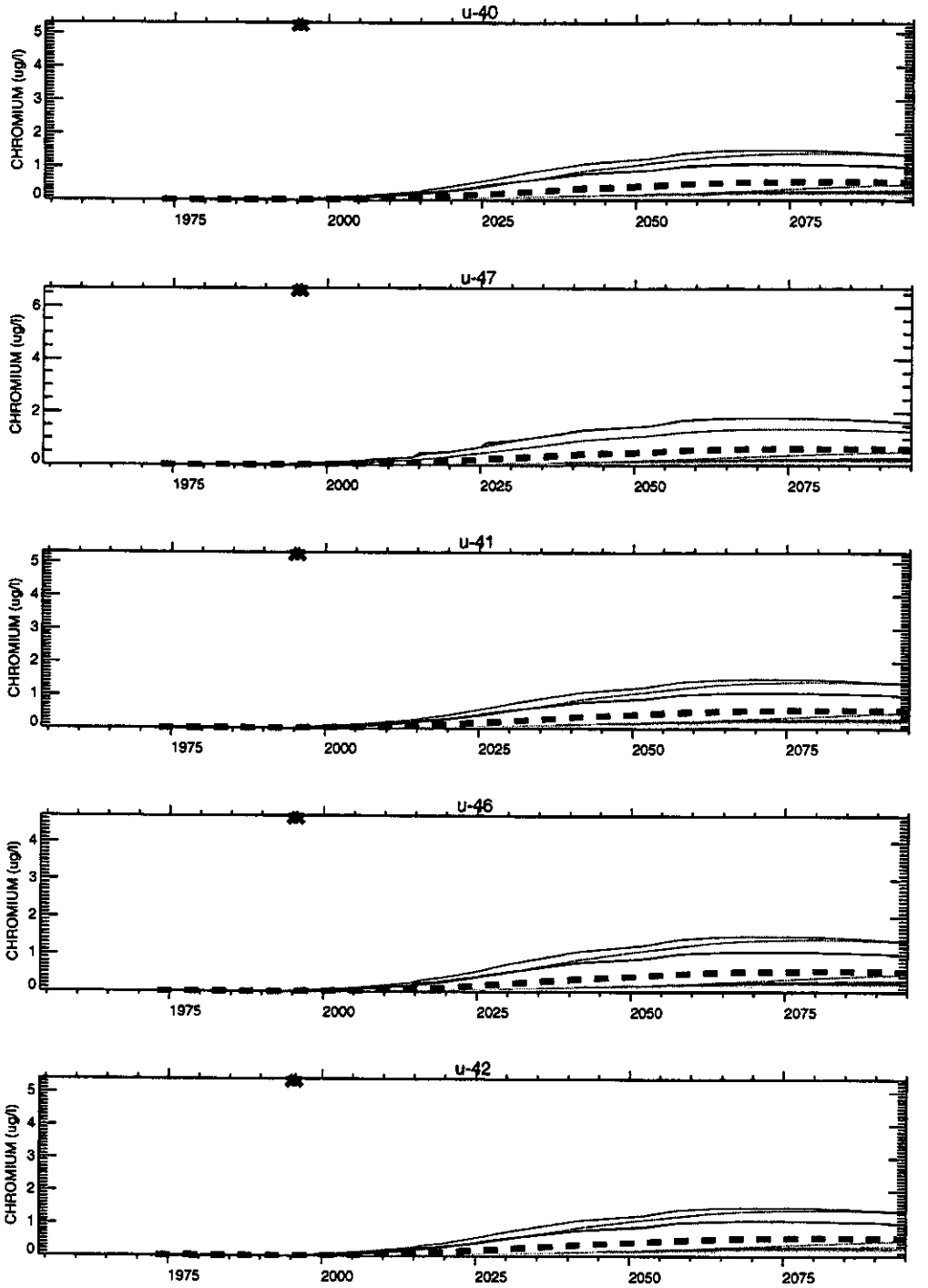


Figure 7-27 Comparison of aquifer chromium to field data.

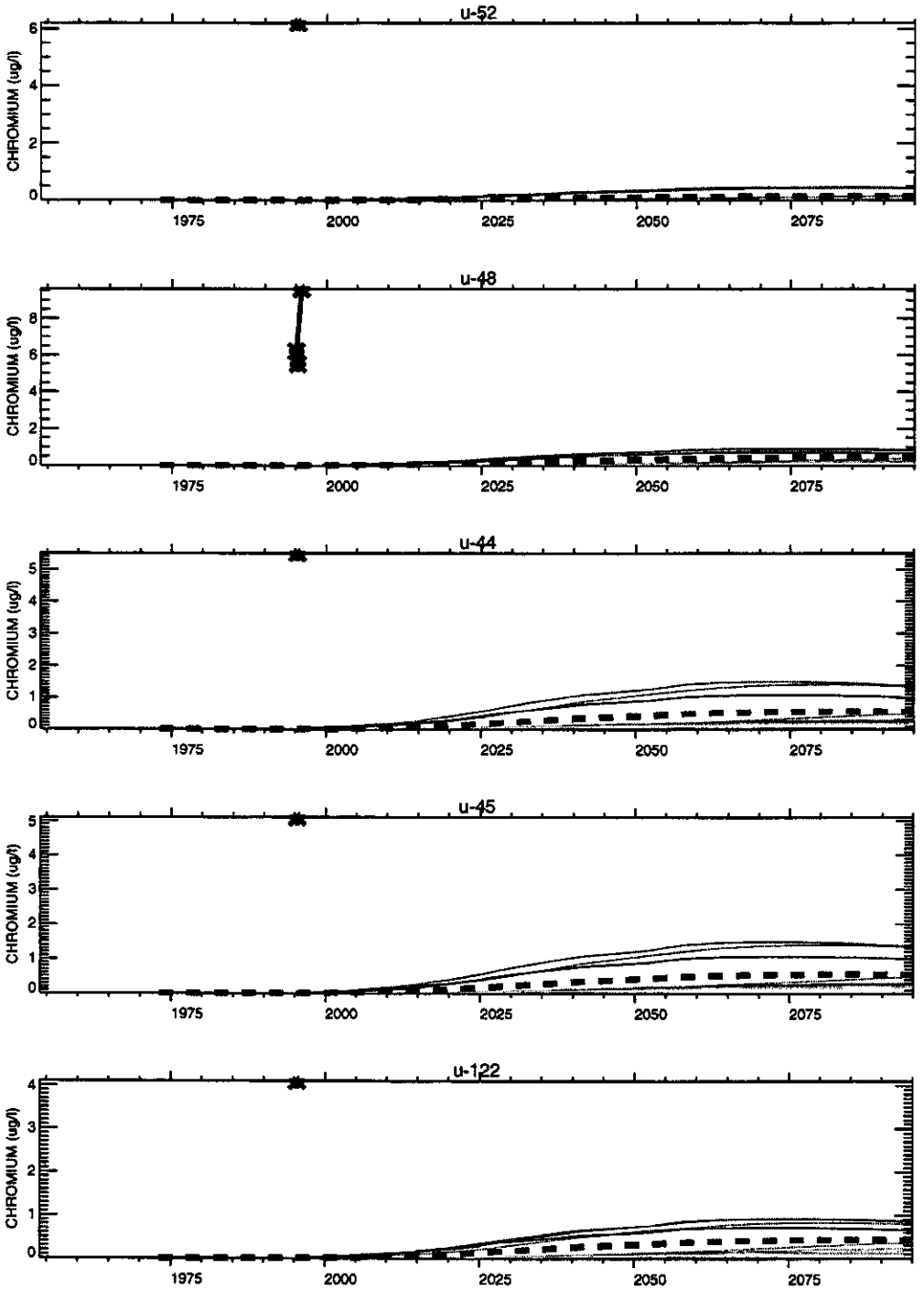


Figure 7-28 Comparison of aquifer chromium to field data.

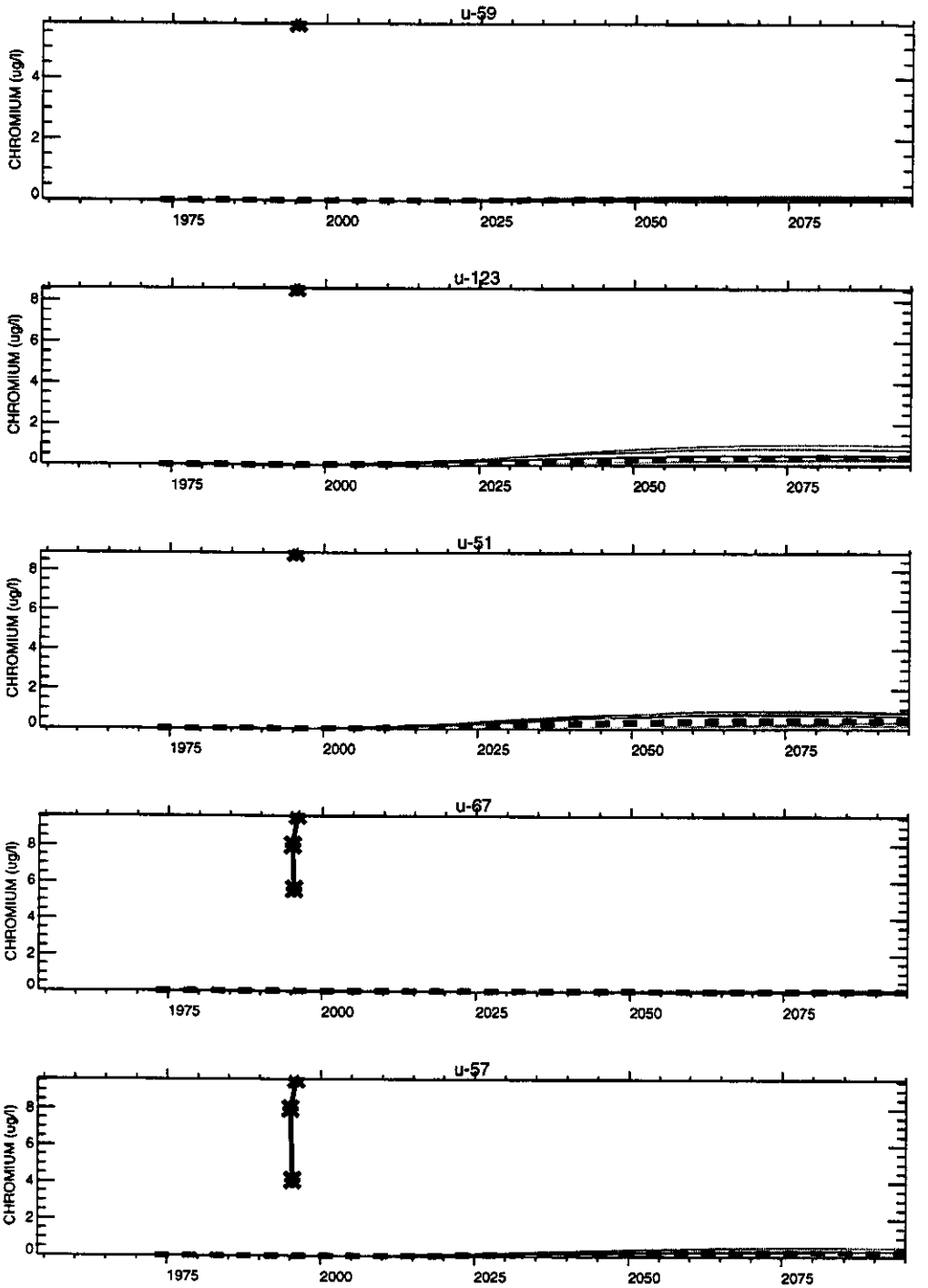


Figure 7-29 Comparison of aquifer chromium to field data.

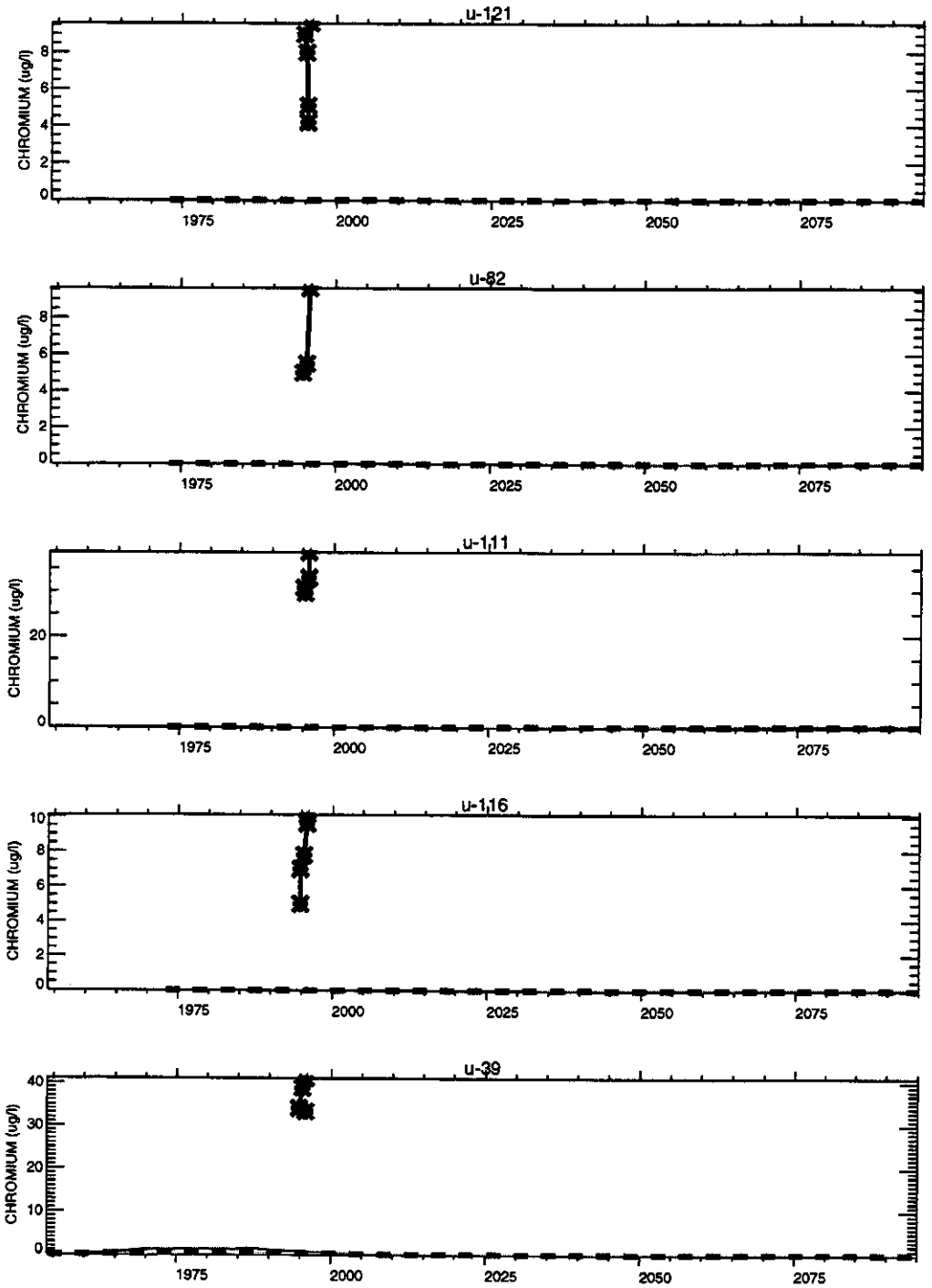


Figure 7-30 Comparison of aquifer chromium to field data.

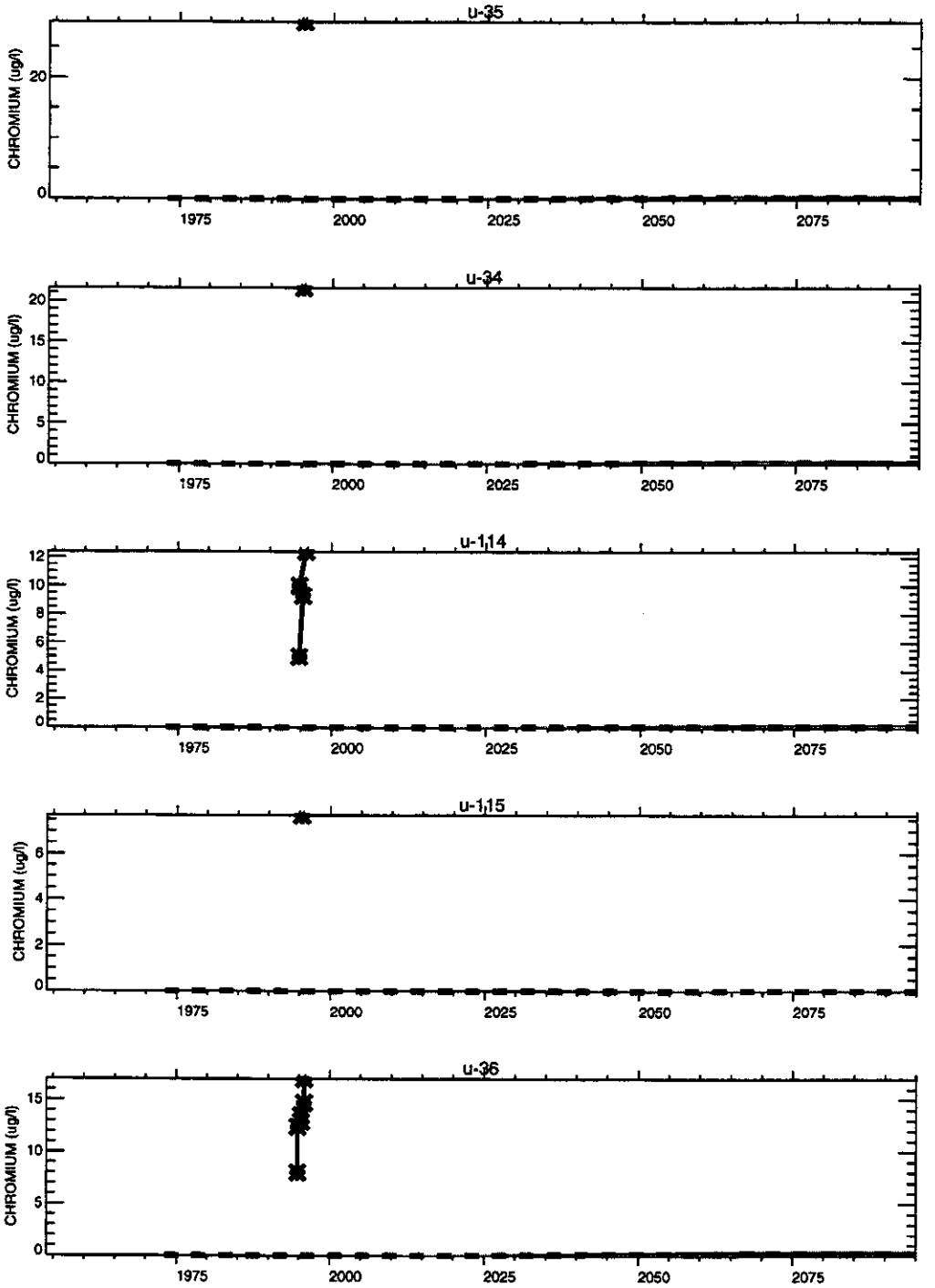


Figure 7-31 Comparison of aquifer chromium to field data.

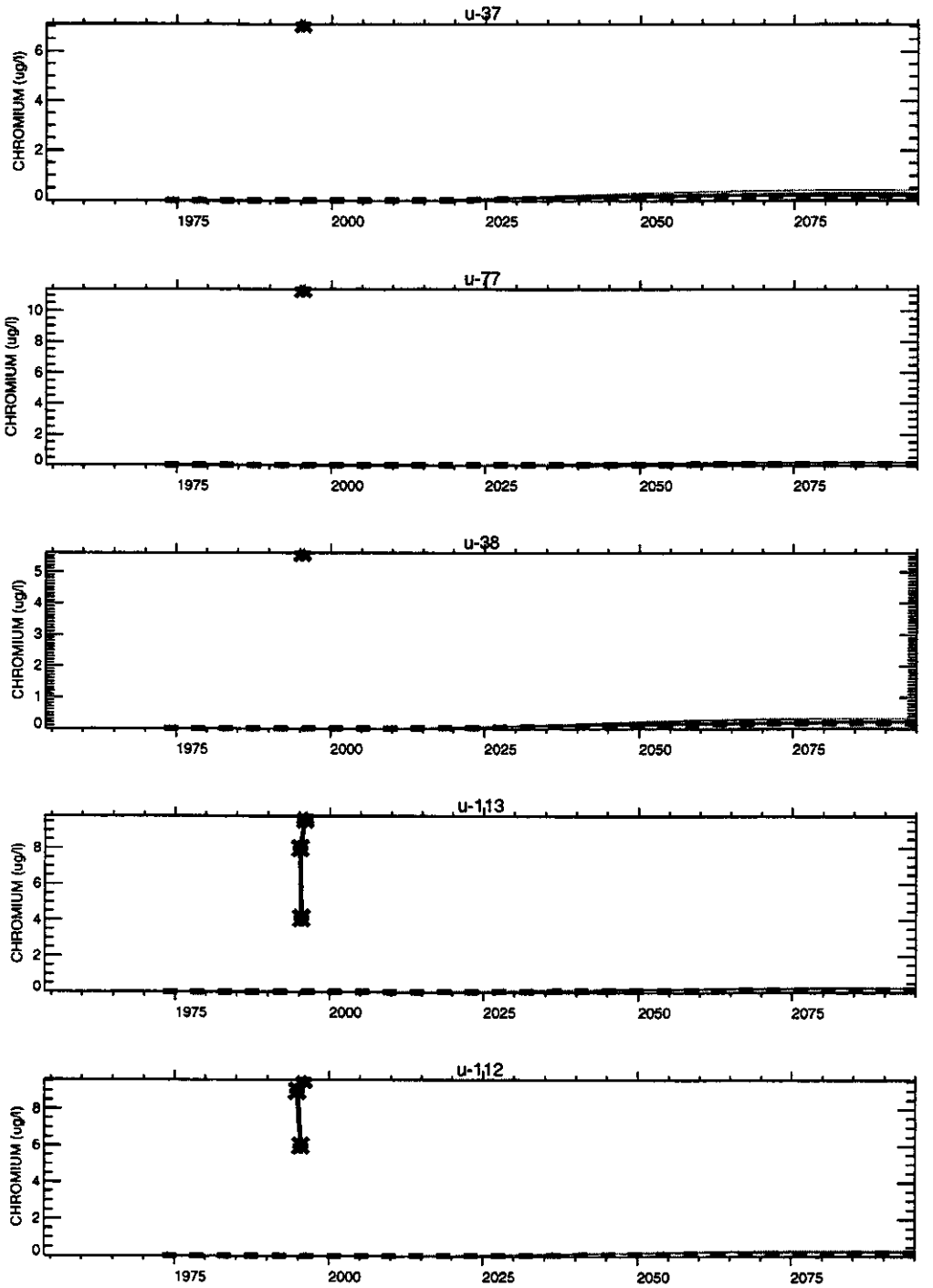


Figure 7-32 Comparison of aquifer chromium to field data.

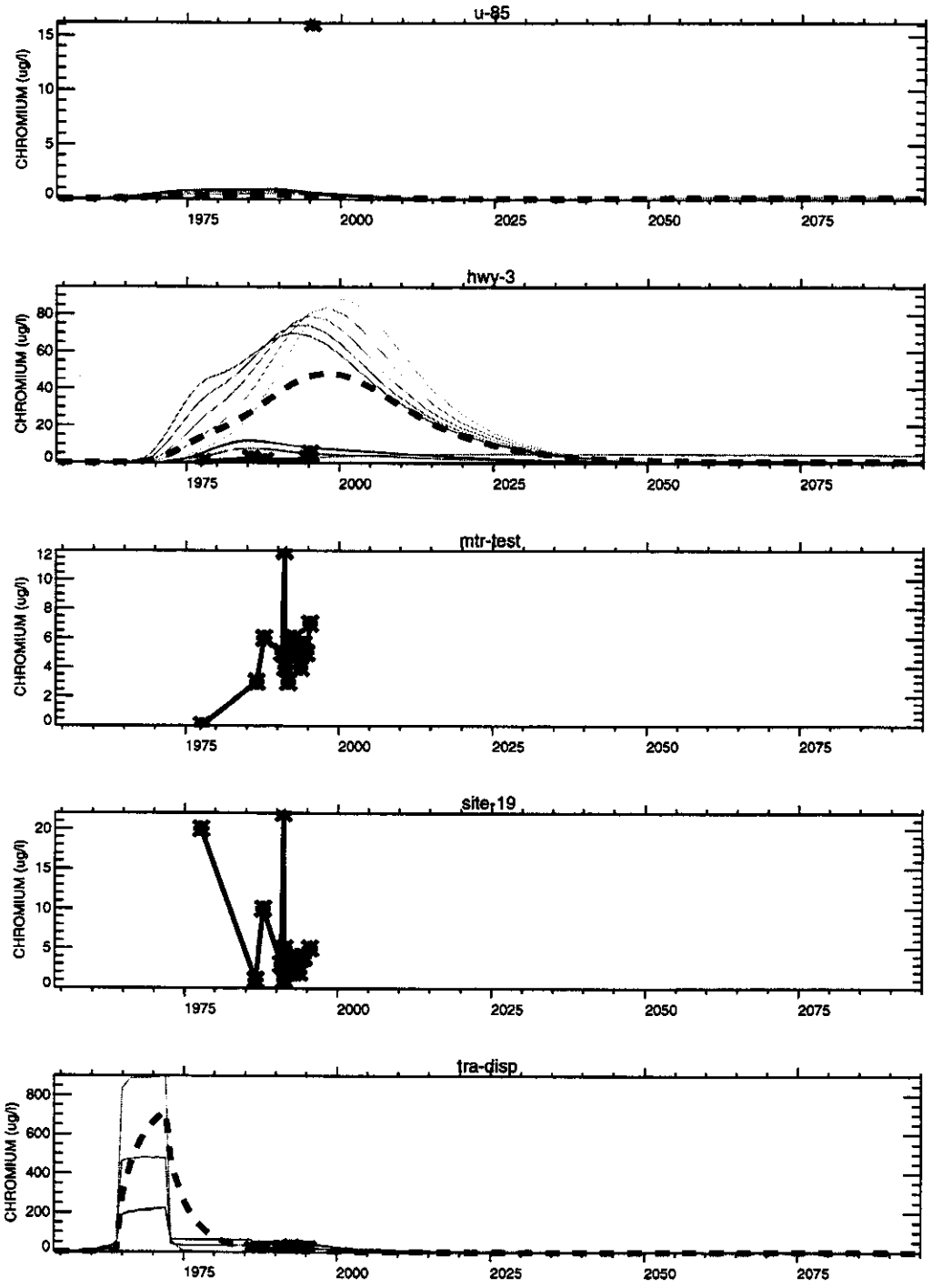


Figure 7-33 Comparison of aquifer chromium to field data.

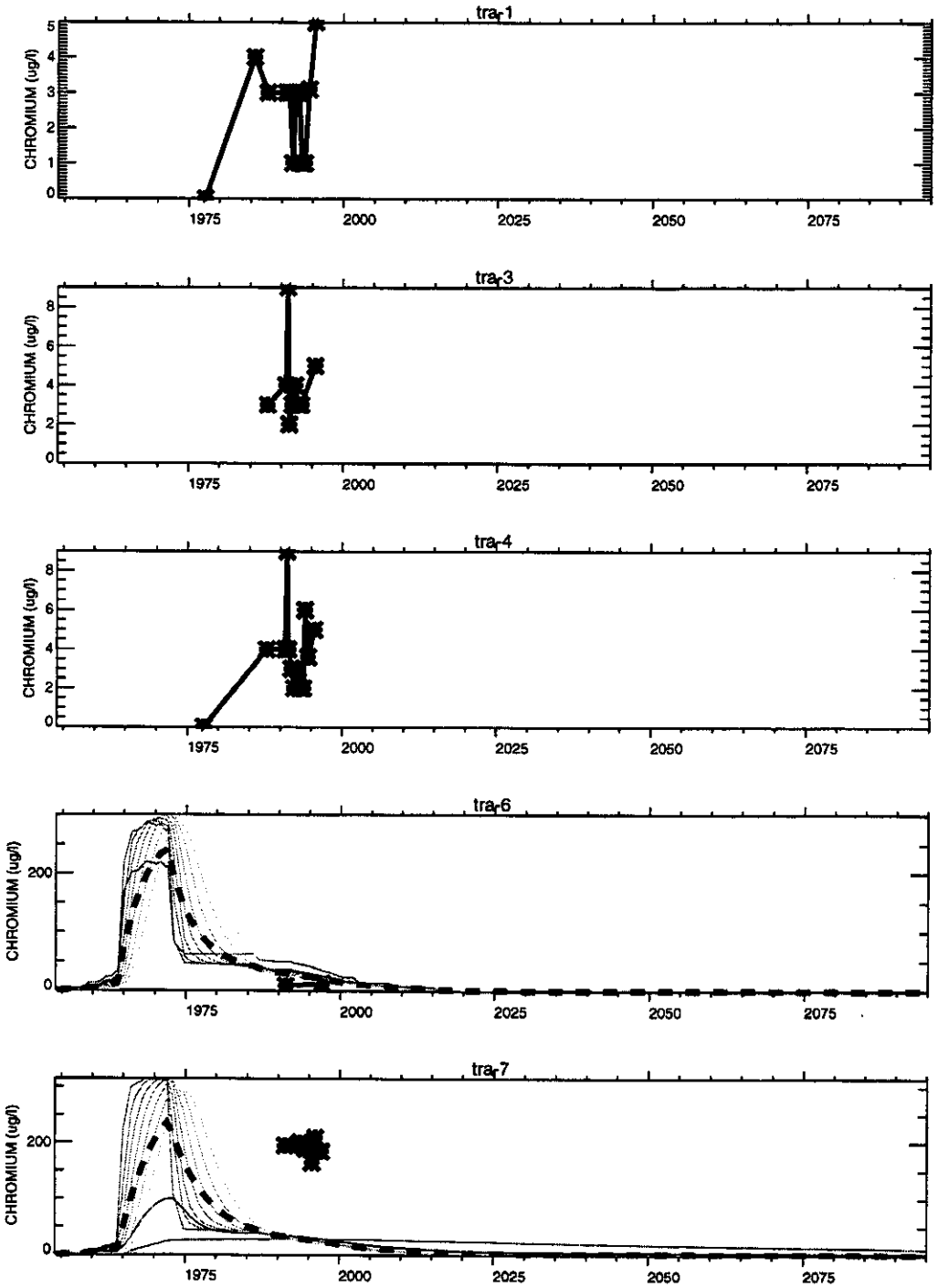


Figure 7-34 Comparison of aquifer chromium to field data.

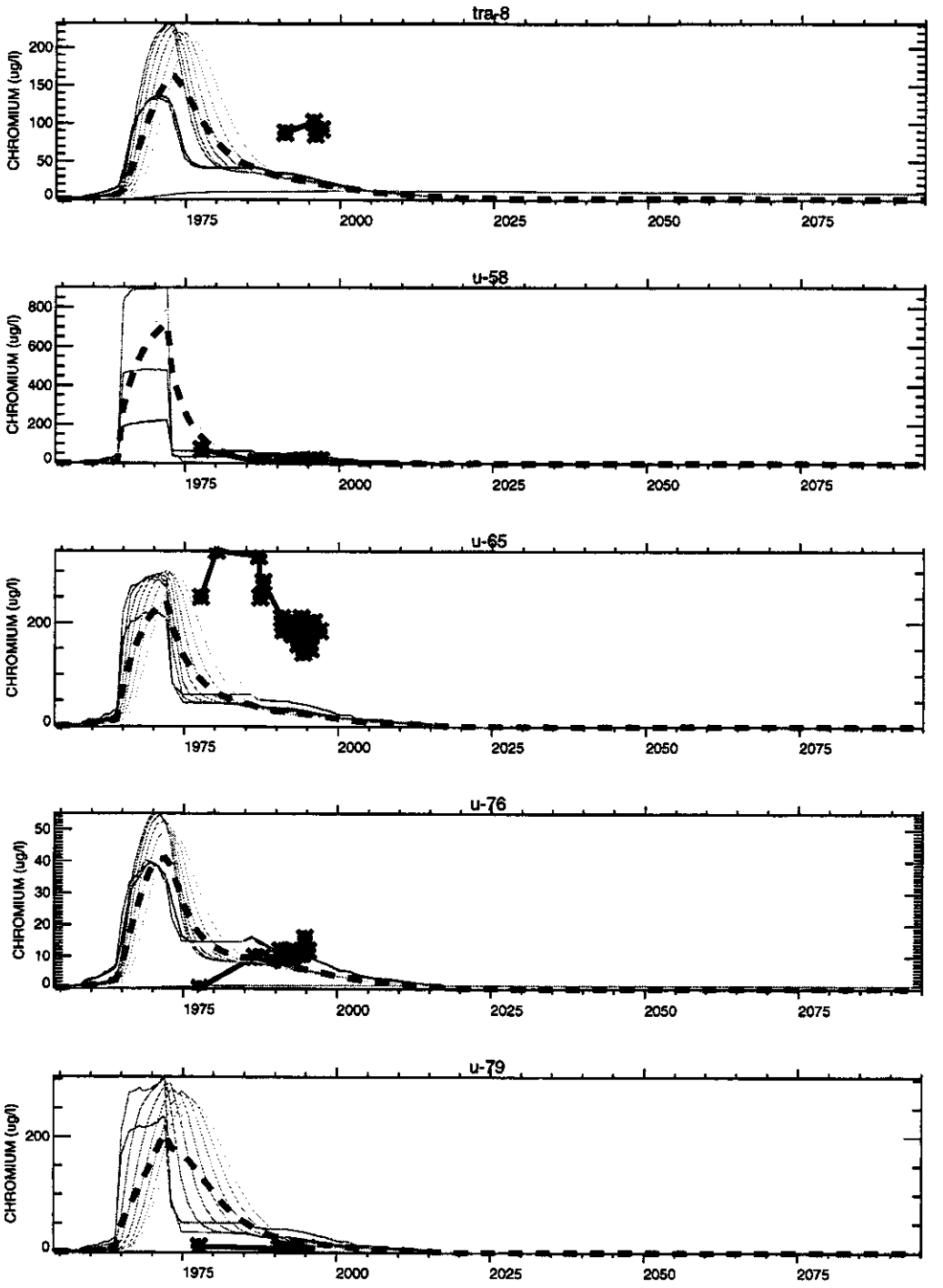


Figure 7-35 Comparison of aquifer chromium to field data.

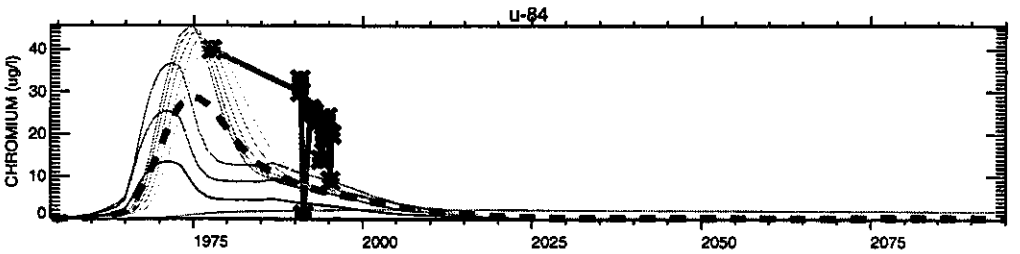


Figure 7-36 Comparison of aquifer chromium to field data.

7.3 MERCURY

Transport of mercury was simulated out to the year 2123 in the vadose zone and aquifer regions. Roughly half of the mercury originated at the surface in the soils inventory (58.2%), CPP-31 (2.32%), and the 1986 release (0.42%), and the remaining 39.06% was injected directly into the aquifer at the injection well. The Kd for mercury was assumed to be 0. cm^3/g in the tank farm corresponding to mercuric nitrate, but was nonzero outside of the tank farm corresponding to mercuric oxide. Because the Kd for mercury was assigned a nonzero value under the tank farm in the first basalt unit (and everywhere else), this basically assumes that the mercuric nitrate was transformed to mercuric oxide during transport through that unit.

Results for the simulated transport of mercury are given in Figures 7-37 through 7-42 for the vadose zone and Figures 7-45 through 7-49 for the aquifer region. Contour levels for concentration given in Figures 7-37 through 7-40, 7-45, and 7-46 are at the $2x10^{-5}$, $2x10^{-4}$, $2x10^{-3}$, $2x10^{-2}$, $2x10^{-1}$, and 2 mg/L levels with concentrations equal to the MCL (0.002 mg/L) represented by the dark solid line. Corresponding maps representing the hazard index for the aquifer region are given in Figures 7-47, and 7-48. In those two figures, the contour levels are given for hazard indices of 10^{-2}, 10^{-1}, 1, 10^{+1}, 10^{+2}, and 10^{+3} with the HQ=1 (0.00314 mg/L) level indicated by the thick solid line.

VADOSE ZONE: Figure 7-41 indicates that the concentration of mercury never drops below the MCL in the vadose zone water. This figure also indicates the local maxima in concentration occurring as a result of the three primary mercury sources indicated above. The concentration contour map and this figure illustrates that the mercury exists in the upper interbed regions, and that it is held essentially immobile by the chemical sorptive capacity of the interbed material. At some time well after 1000 years, the mercury will eventually reach the aquifer, but given the 100+ year time frame of interest here, the simulations were stopped in 2126.

The mass flux out of the vadose zone up through 2126 is given in Figure 7-42. This figure shows that a peak mass flux from the vadose zone is predicted to occur in 2096. Although the largest mass flux entering the aquifer is predicted to occur in 2096, by 2095 only $2.8x10^{-9}$% of the total source mass has left the vadose zone, and by 2126, only $4.73x10^{-9}$% has entered the aquifer. Continued simulation will not supply additional source mass to the aquifer within a time frame of less than several thousand years, and during that period, the concentration of mercury in the perched water will remain above the MCL. At that point, another peak on the mass flux from the vadose zone will occur.

Comparisons of model predicted concentrations to vadose zone field data (Figures 7-43 and 7-44) are very good for all wells in which data was collected except for USGS-50. However, with the exception of one USGS-50 and on PW-1 measurement, the field values plotted are the detection limit. Underpredicting the concentration in USGS-50 is a result of not incorporating; 1) the backflow of the injection well mercury into the vadose zone model, and 2) direct discharge to USGS-50 (into the vadose zone) while the injection well was reconstructed. The backflow of mercury in the injection well is accounted for by direct injection into the aquifer.

AQUIFER: Because the simulations were terminated before the bulk of the mass had left the vadose zone, the concentrations in the aquifer (Figures 7-45- 7-49) are the result of mercury discharged into the injection well and from dispersion downward from the soil sources. The overall maximum mercury concentration in the aquifer is $7.42x10^{-3}$ mg/L with the peak concentration in 2095 equal to $4.17x10^{-3}$ mg/L. The 2095 concentration is greater than both the MCL of 0.002 mg/L and the HQ=1 based concentration of $3.14x10^{-3}$ mg/L. If the vadose zone simulations had been run out another several thousand years, the mercury in the vadose zone would eventually reach the aquifer. However, the simulation was stopped before the concentrations dropped below the MCL and HQ=1 based concentration. This is justified because, as the aquifer contour plots shown indicate, the mercury source will remain beneath the ICPP and slowly decrease in concentration as a result primarily of dispersion.

Comparisons of model predicted concentrations to aquifer field data (Figures 7-51 through 7-58) show that predicted concentrations are above measured values for wells near the injection well and are below measured values in wells far from the injection well. However, only one field sample (at well USGS-47 in June 1995) was above the detection limit. The model results are approximately ten times larger than the measured value at well USGS-47. Locations for these comparison wells are given in Figure 7-50, and include near-, mid-, and far-field distances from the injection well. Field measurements of Mercury far from the injection well are at basically background levels (< 0.1 μg/L). The background levels were not taken into account in this simulation, but could be incorporated by simply adding 0.1 μg/L to the model predicted values. This would raise the far distance predictions to equal measured values (predicted values are essentially zero) and would also increase the predicted values in the near wells. This increase is relatively small relative to the overprediction 2. μg/L in the near wells. This indicates that a) the Kd used in this simulation is too small, b) the source term used in the injection well is too large, or c) the backflow mercury from the failed injection well should have been put into the vadose zone sediments. The most probable explanation for the overprediction is that the model Kd is too small, however, there is insufficient temporal data to identify the source of the prediction error.

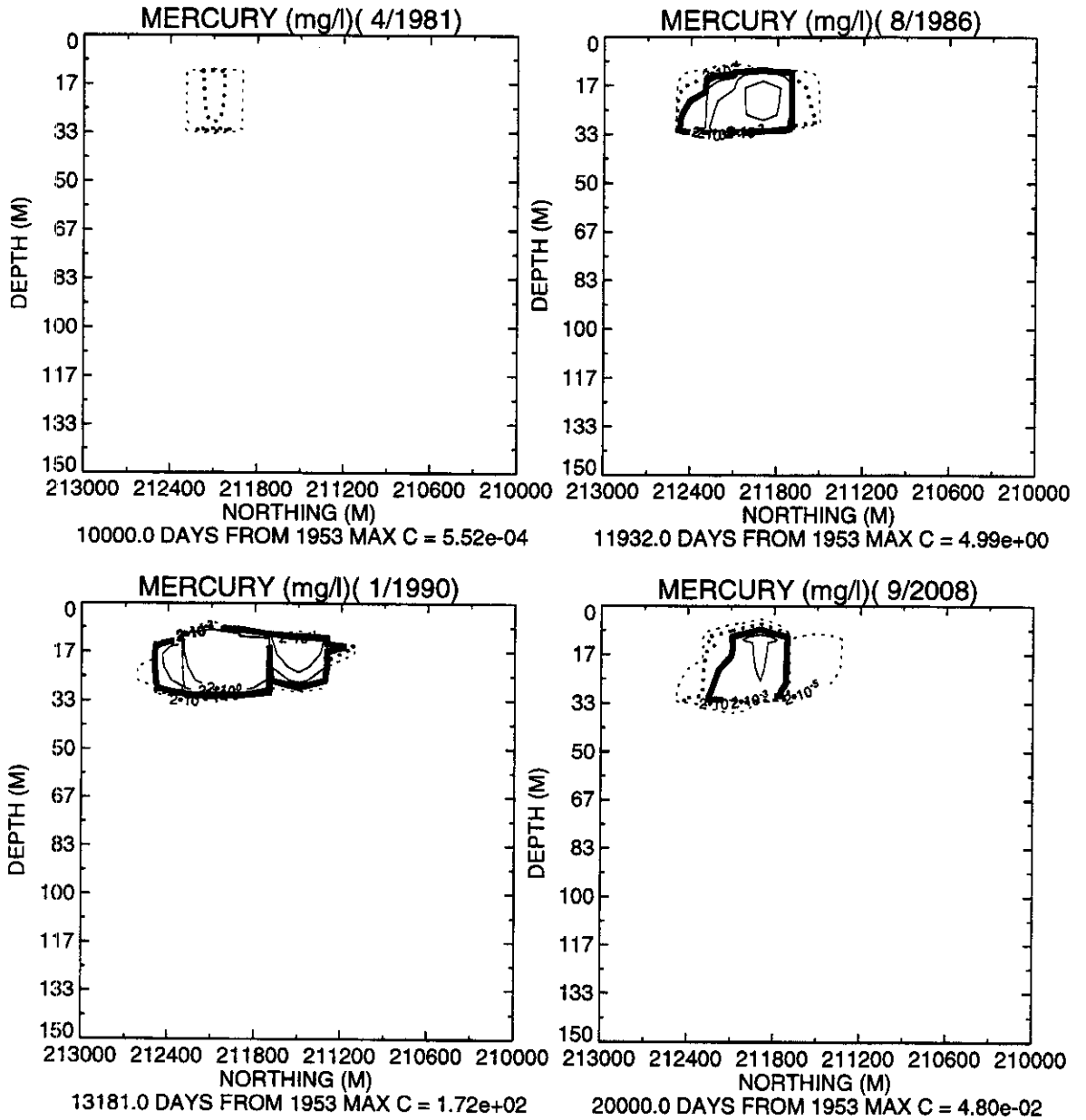


Figure 7-37 Vadose zone mercury peak concentration contours.

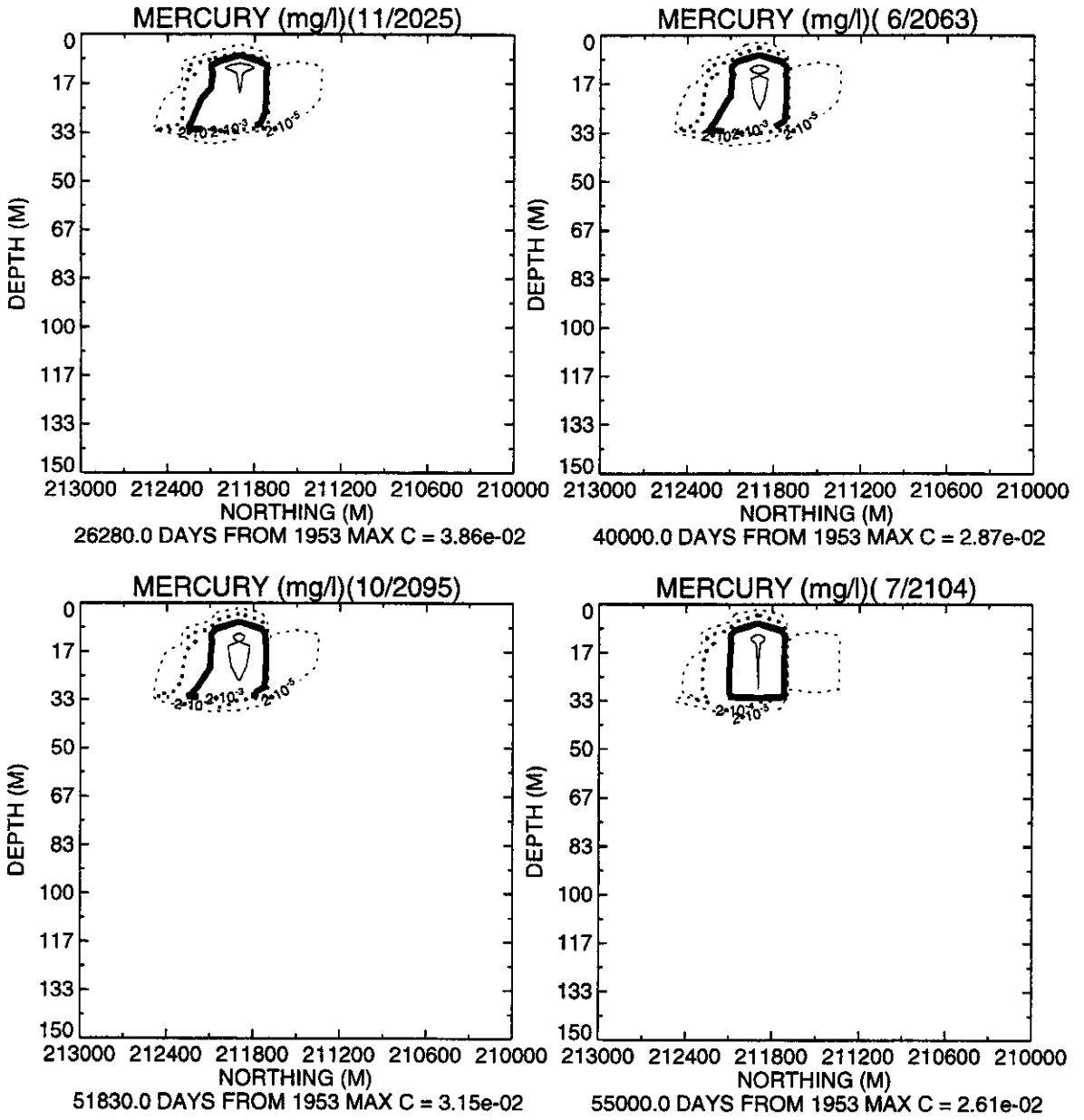


Figure 7-38 Vadose zone mercury peak concentration contours.

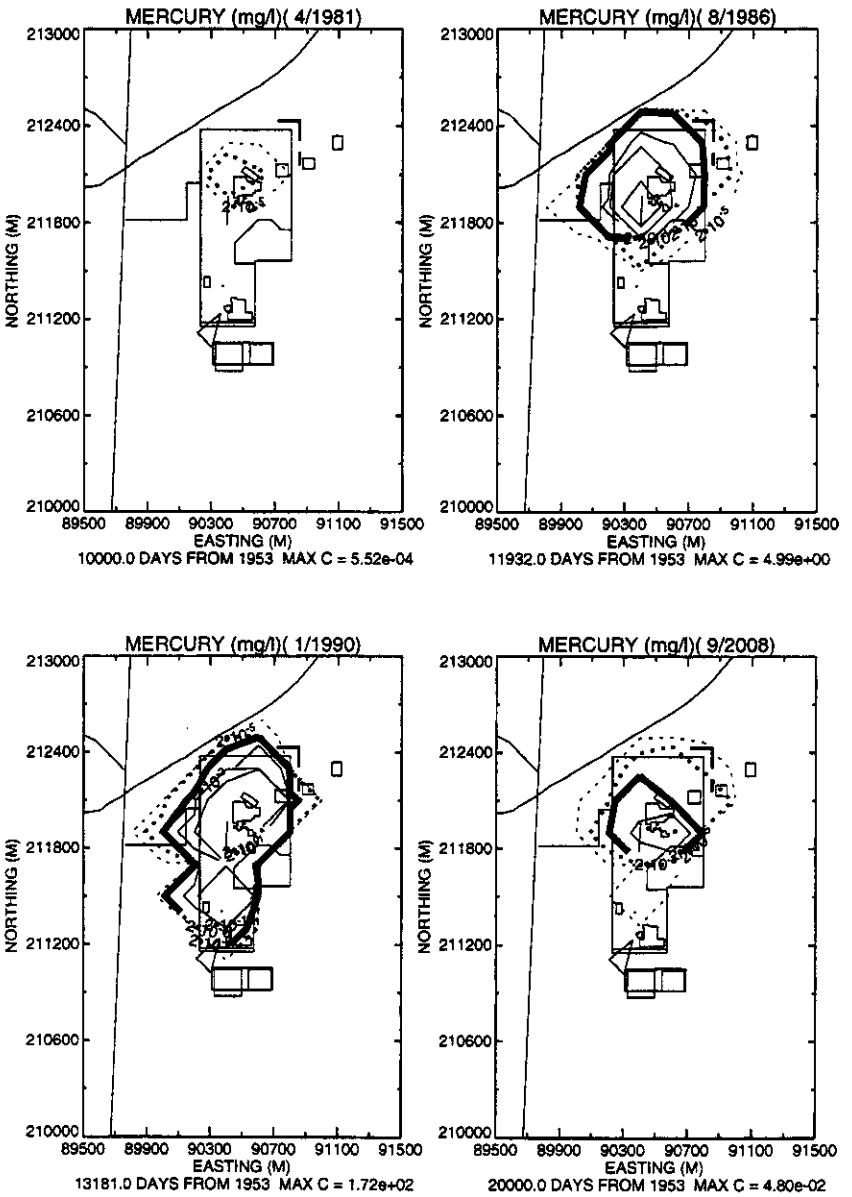


Figure 7-39 Vadose zone mercury peak concentration contours.

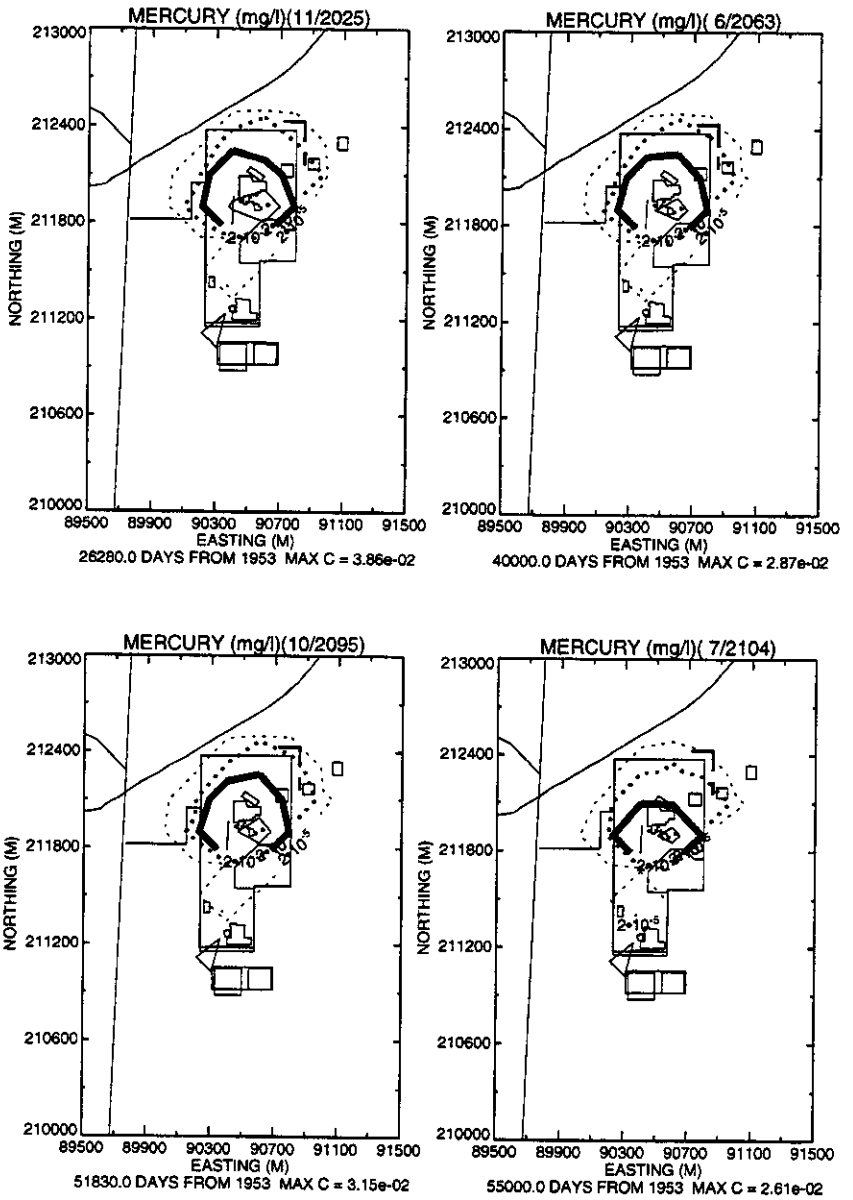


Figure 7-40 Vadose zone mercury peak concentration contours.

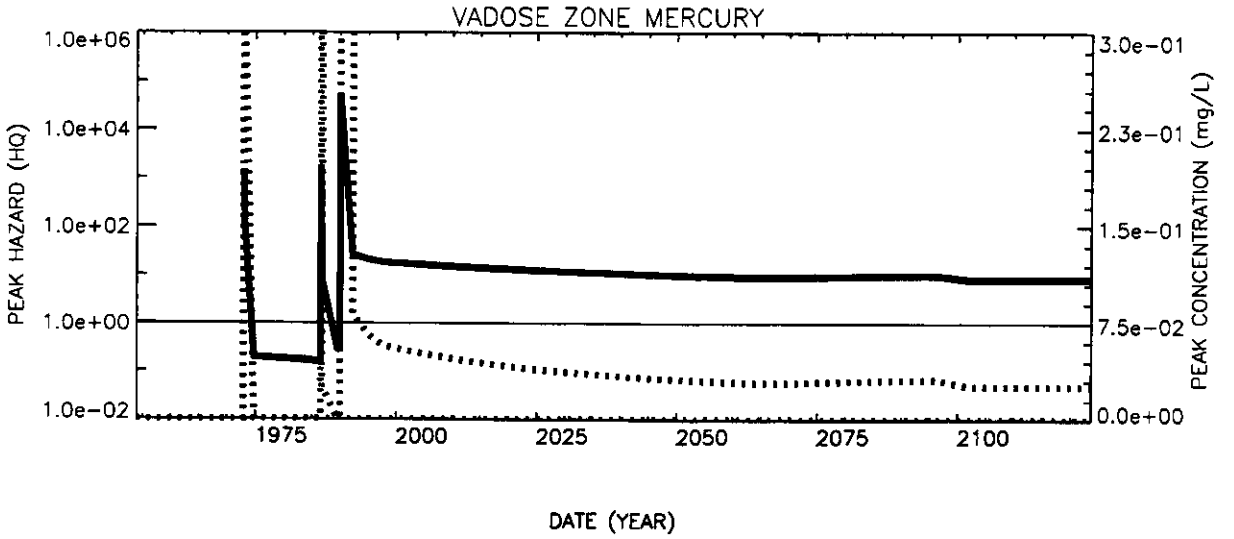


Figure 7-41 Peak vadose zone risk and concentration for mercury. Risk indicated by the thick line on the log scale with the 10^{-6} value shown as the solid line. The dotted line represents concentration given by the linear scale on the right axis with the MCL shown as the straight horizontal line.

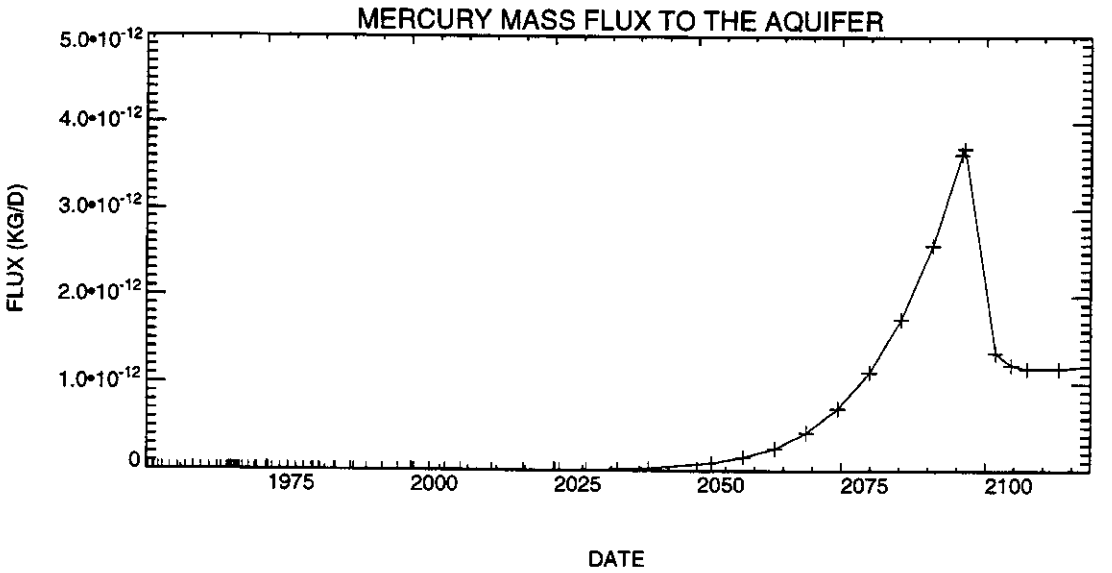


Figure 7-42 Mass flux of mercury into the aquifer from the vadose zone.

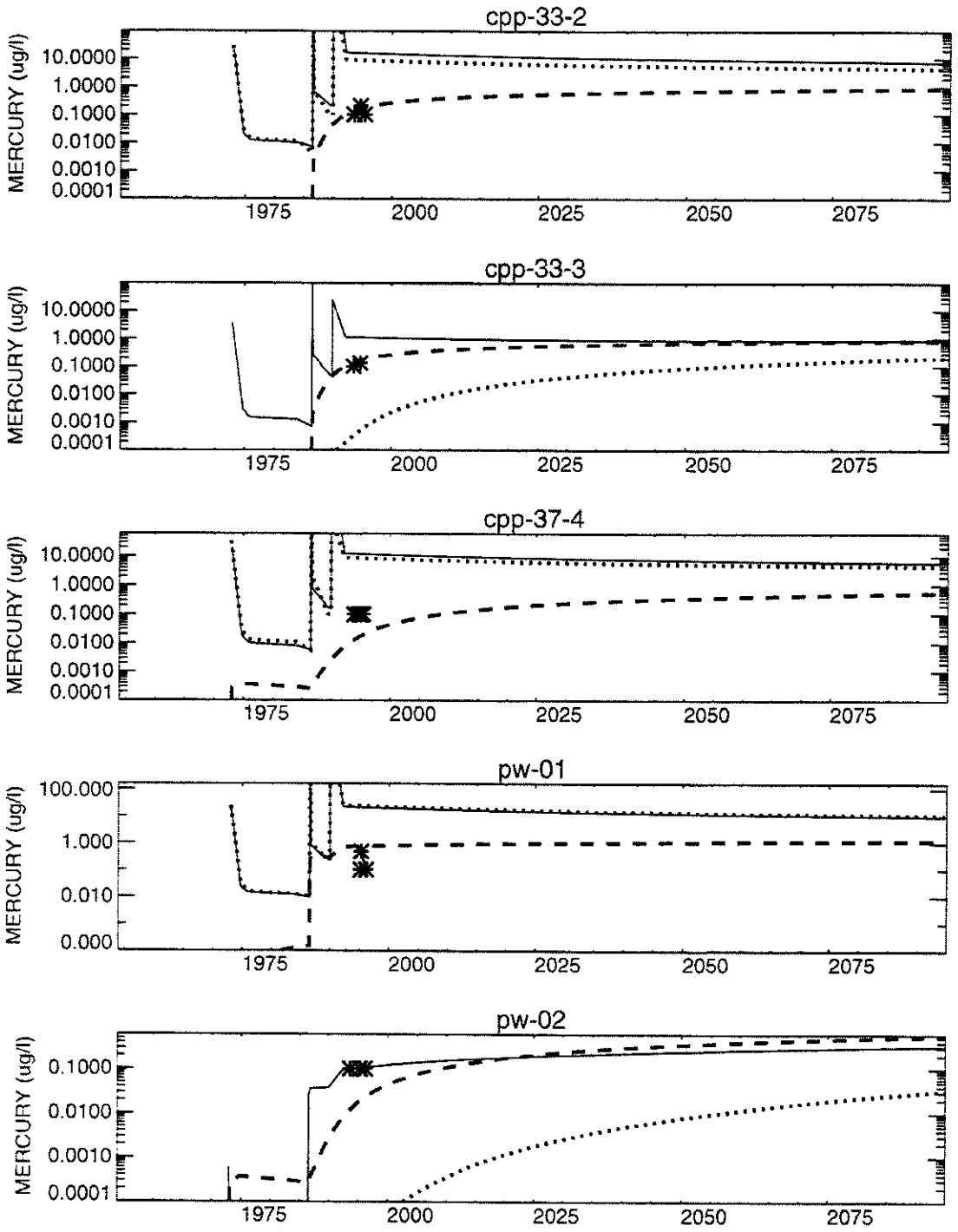


Figure 7-43 Comparison of vadose zone Mercury to field data.

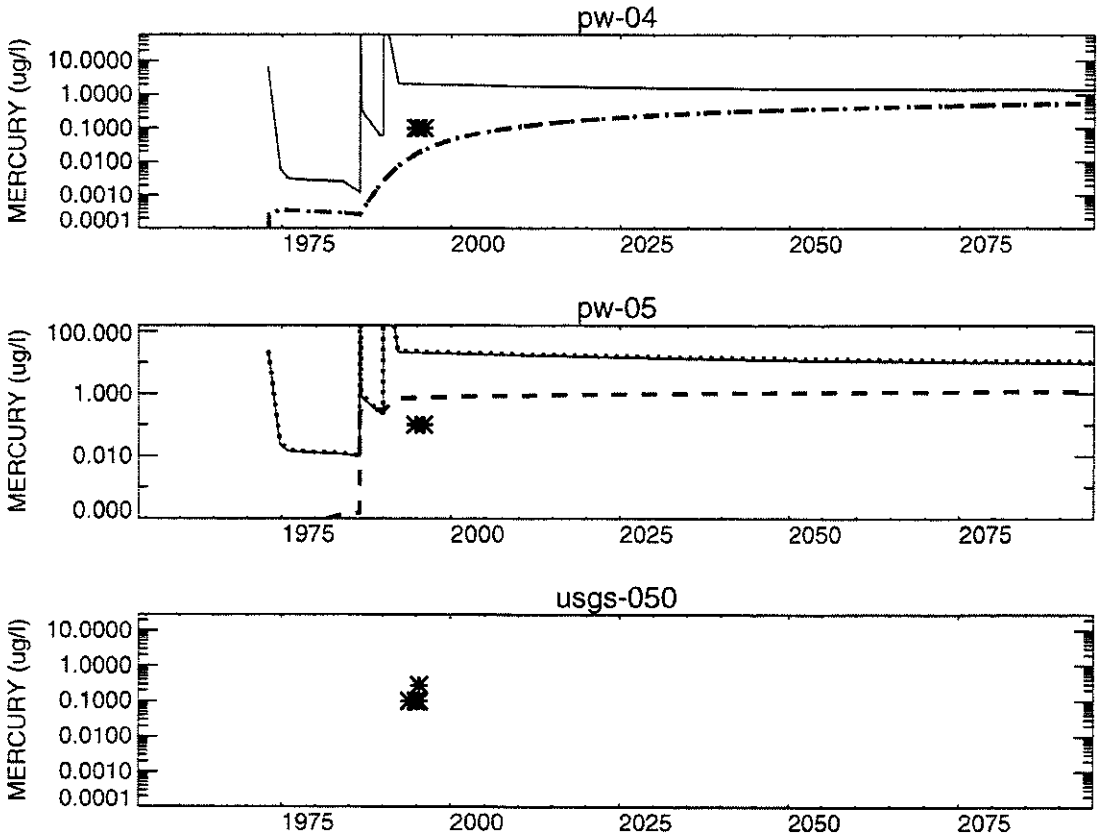


Figure 7-44 Comparison of vadose zone Mercury to field data.

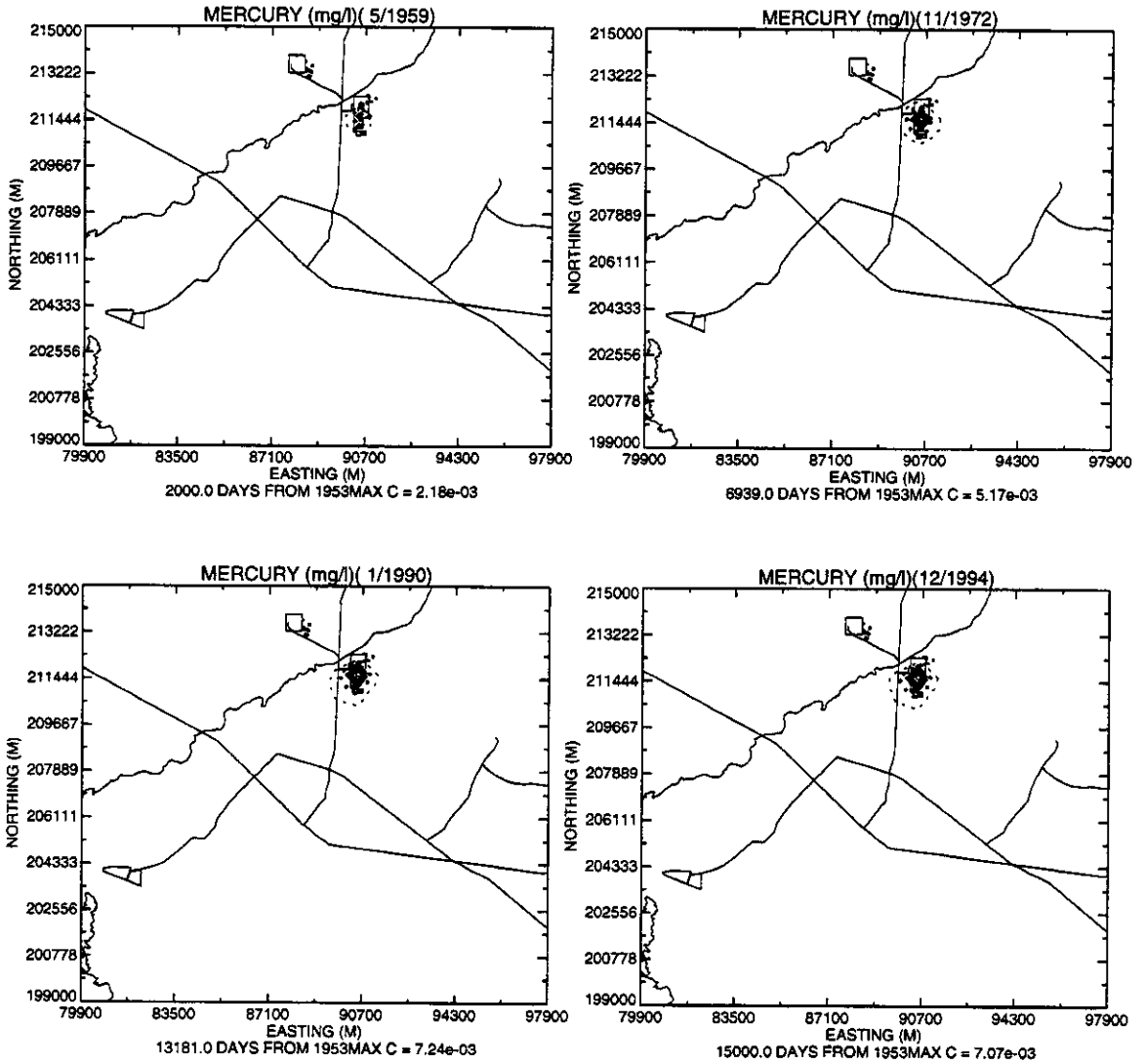


Figure 7-45 Aquifer mercury peak concentration contours.

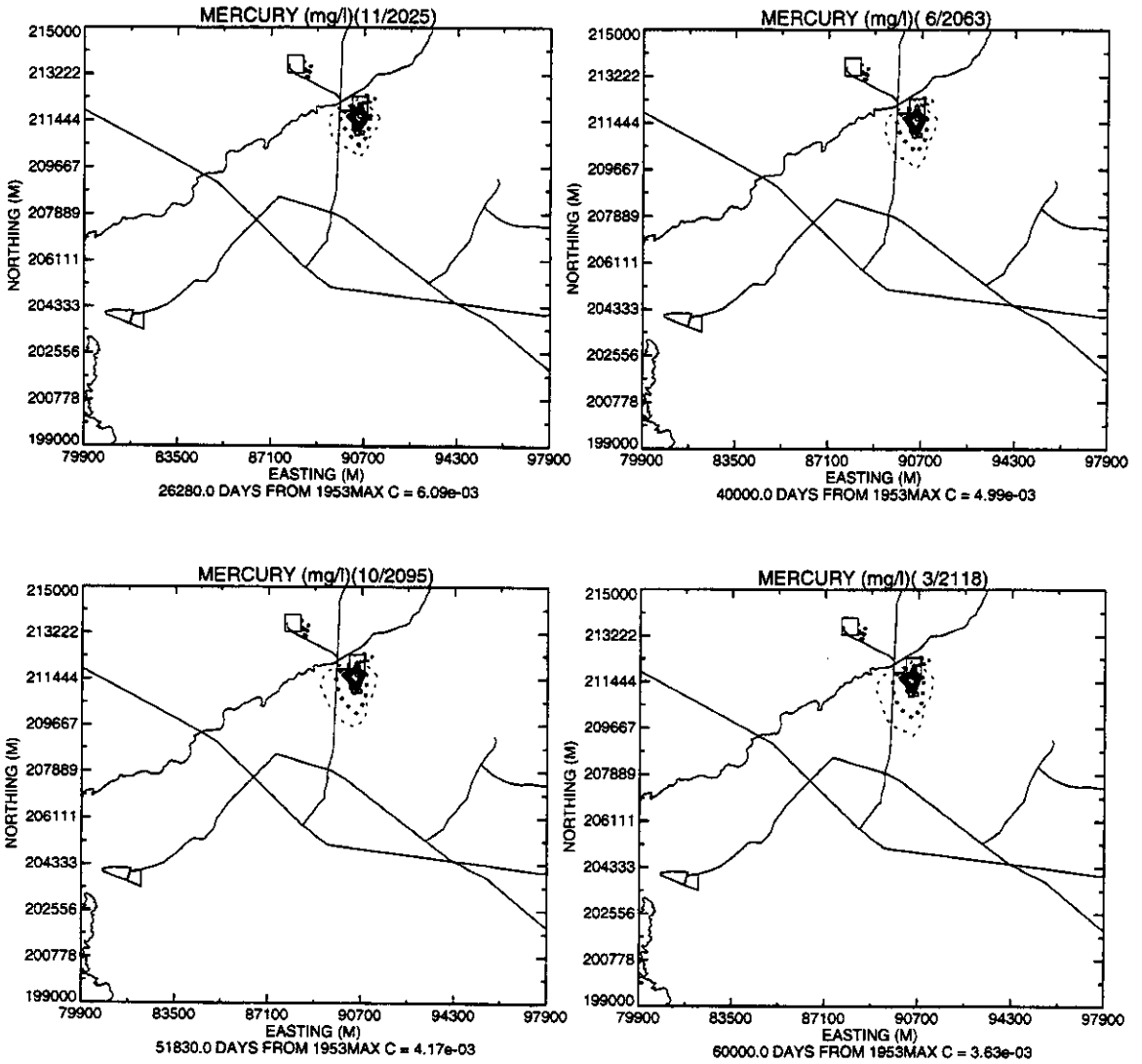


Figure 7-46 Aquifer mercury peak concentration contours.

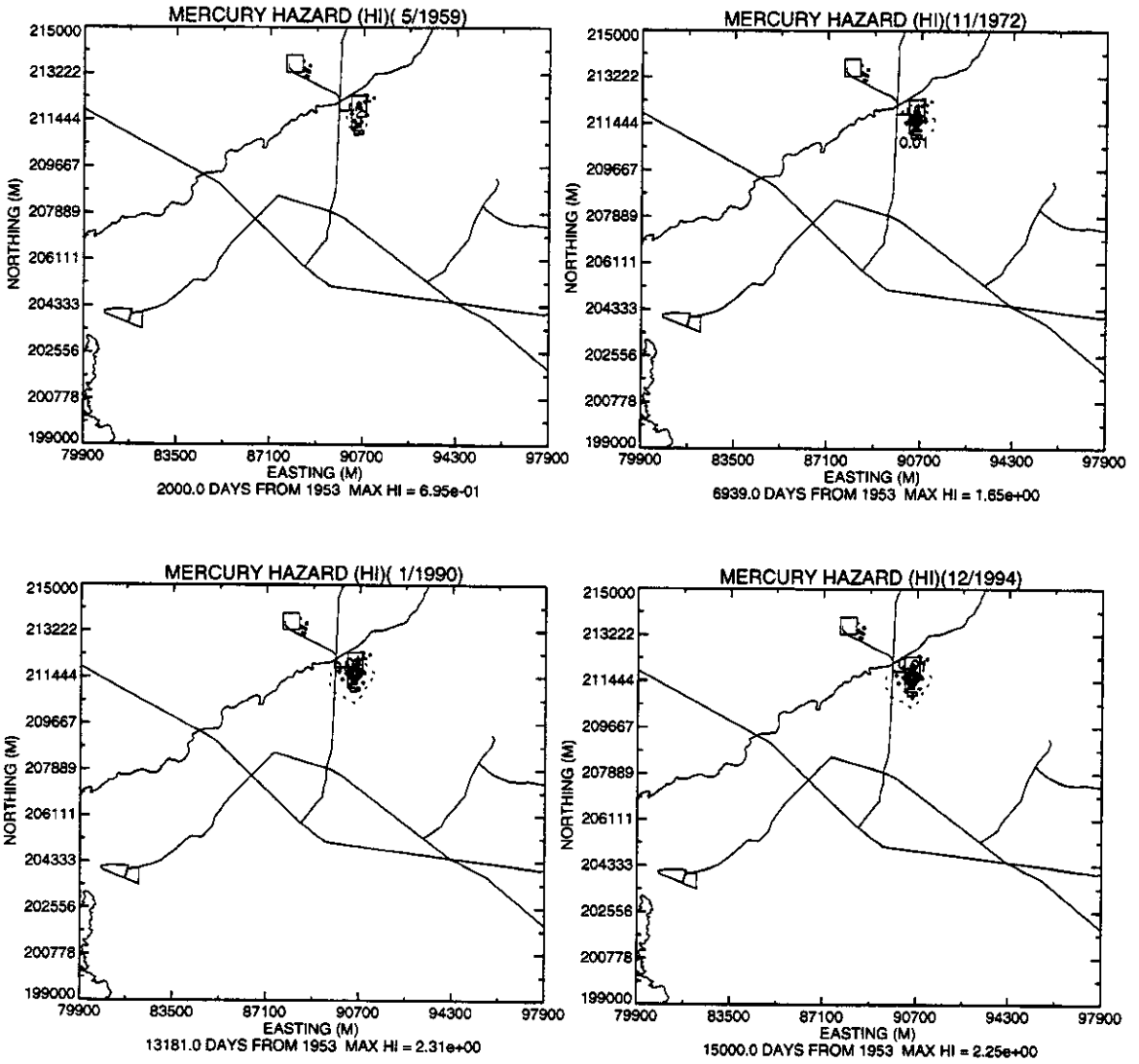


Figure 7-47 Aquifer mercury peak hazard index contours.

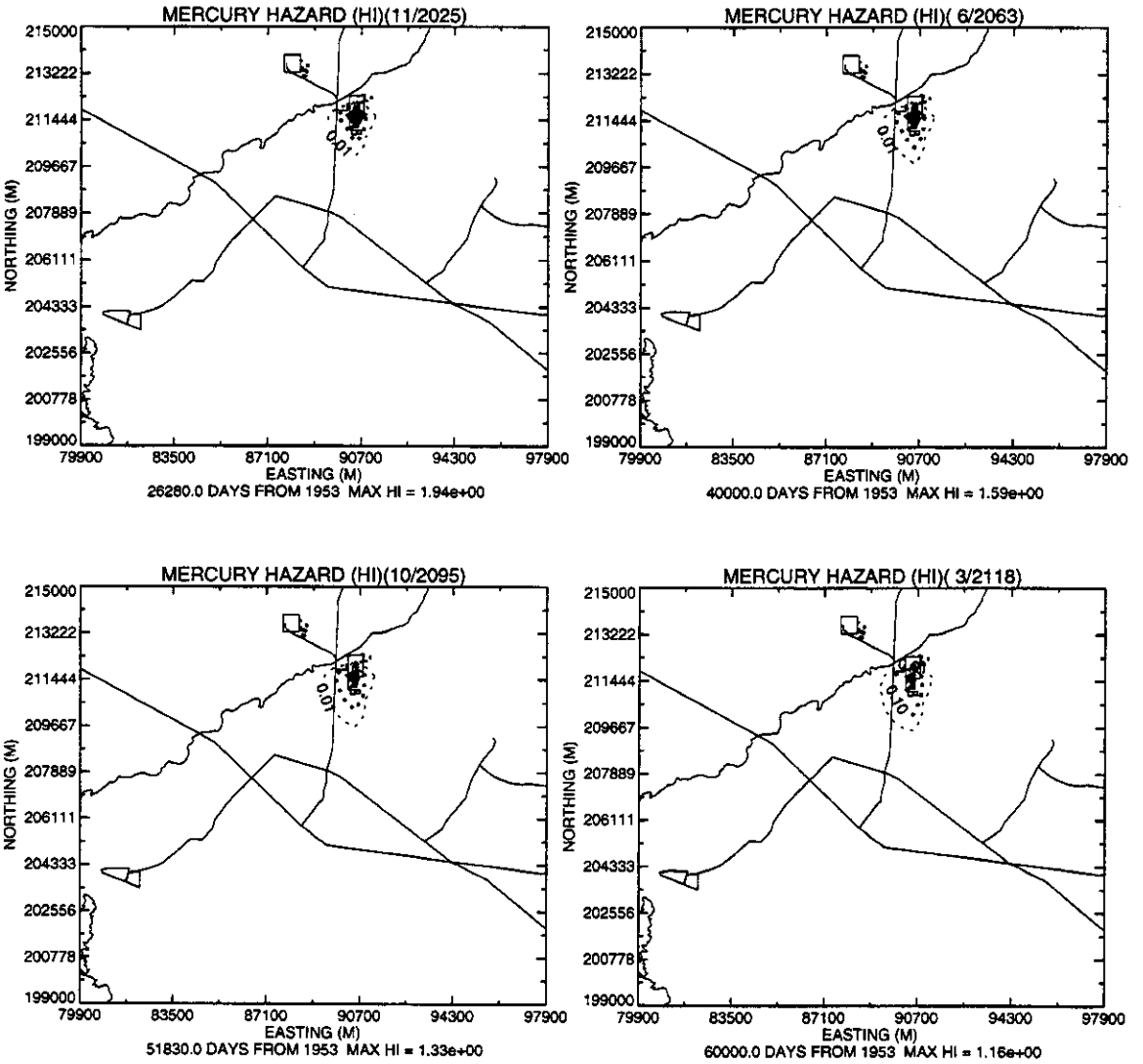


Figure 7-48 Aquifer mercury peak hazard index contours.

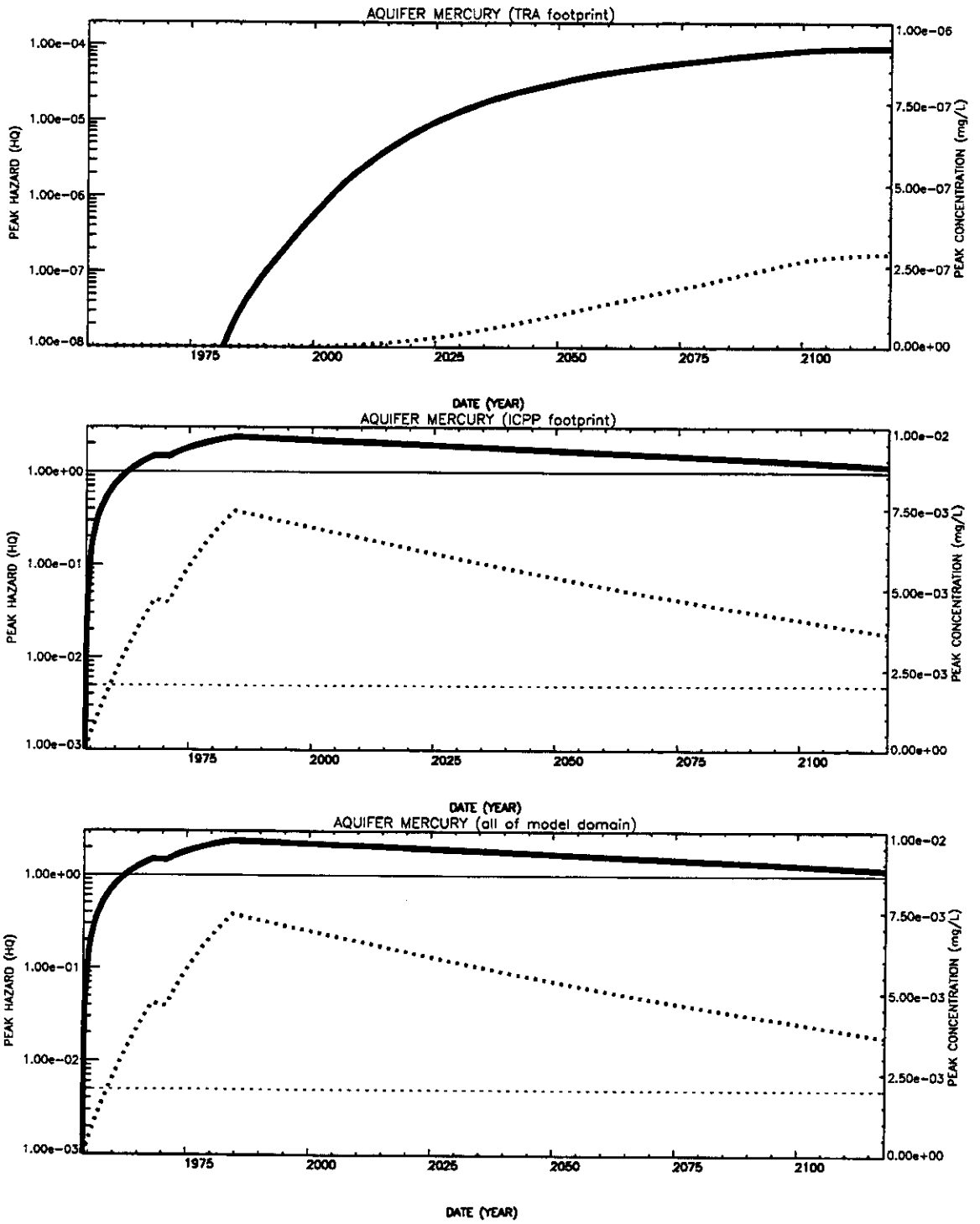


Figure 7-49 Peak aquifer concentration for mercury. Top figure: TRA foot print, Middle figure: ICPP footprint, Bottom Figure: entire aquifer domain. Thick line risk (left scale), dotted line concentration (right scale) solid line 10^{-6} risk (left scale).

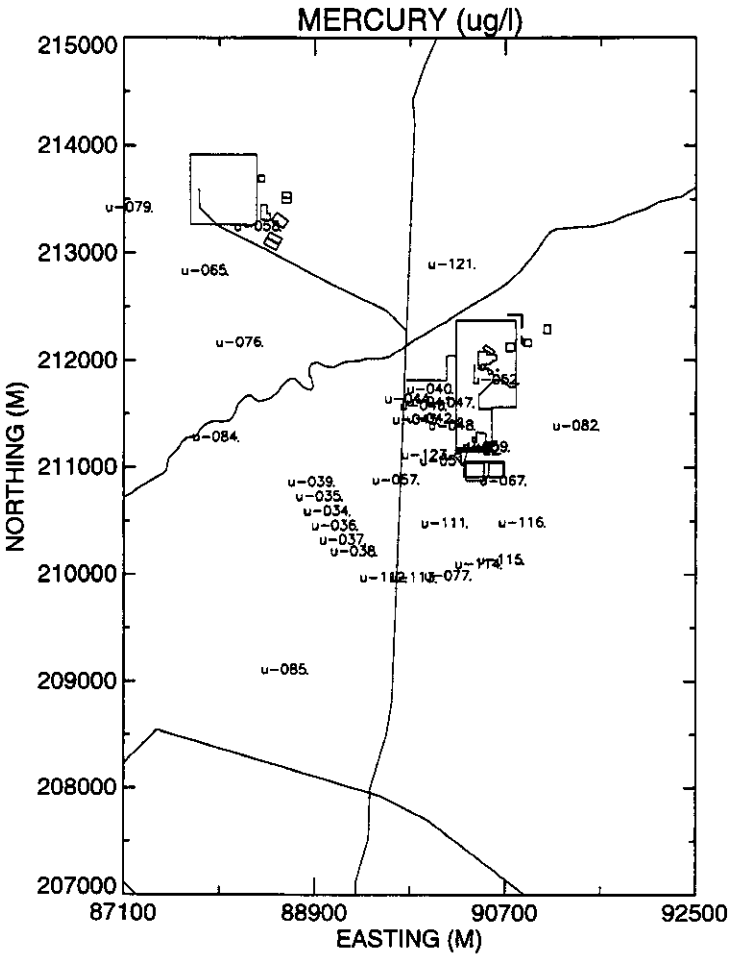


Figure 7-50 Well locations for the comparison of aquifer Mercury to field data.

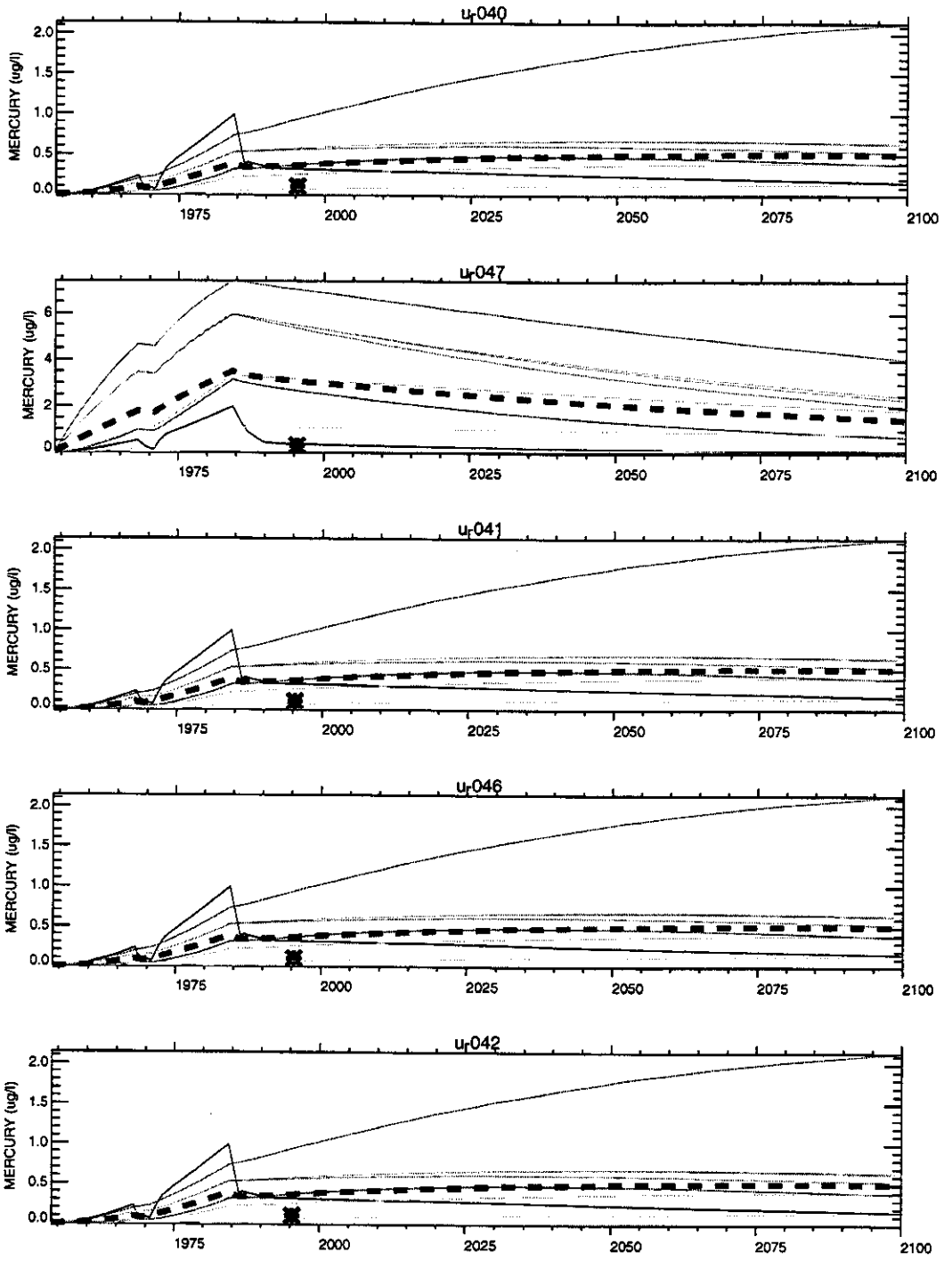


Figure 7-51 Comparison of aquifer Mercury to field data.

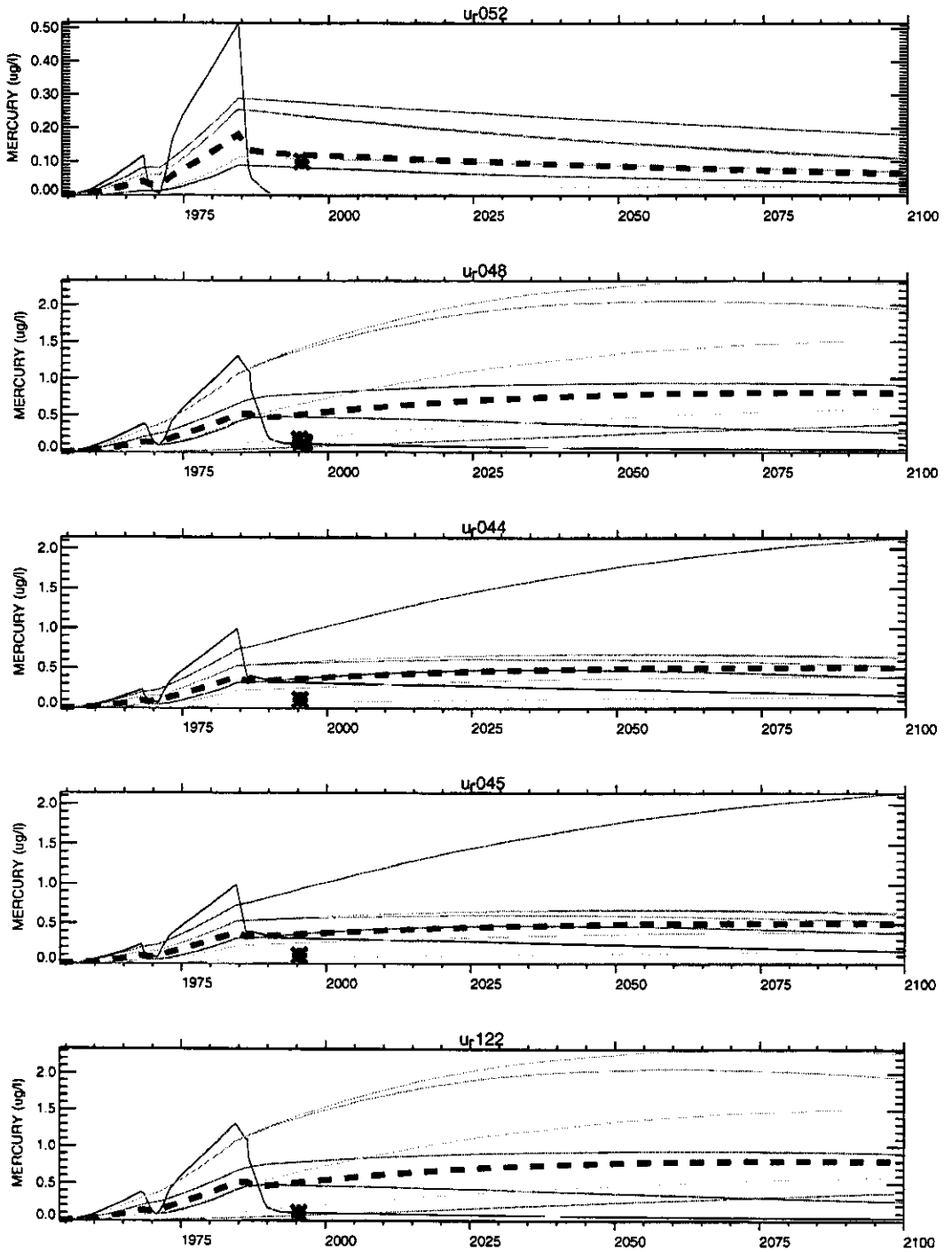


Figure 7-52 Comparison of aquifer Mercury to field data.

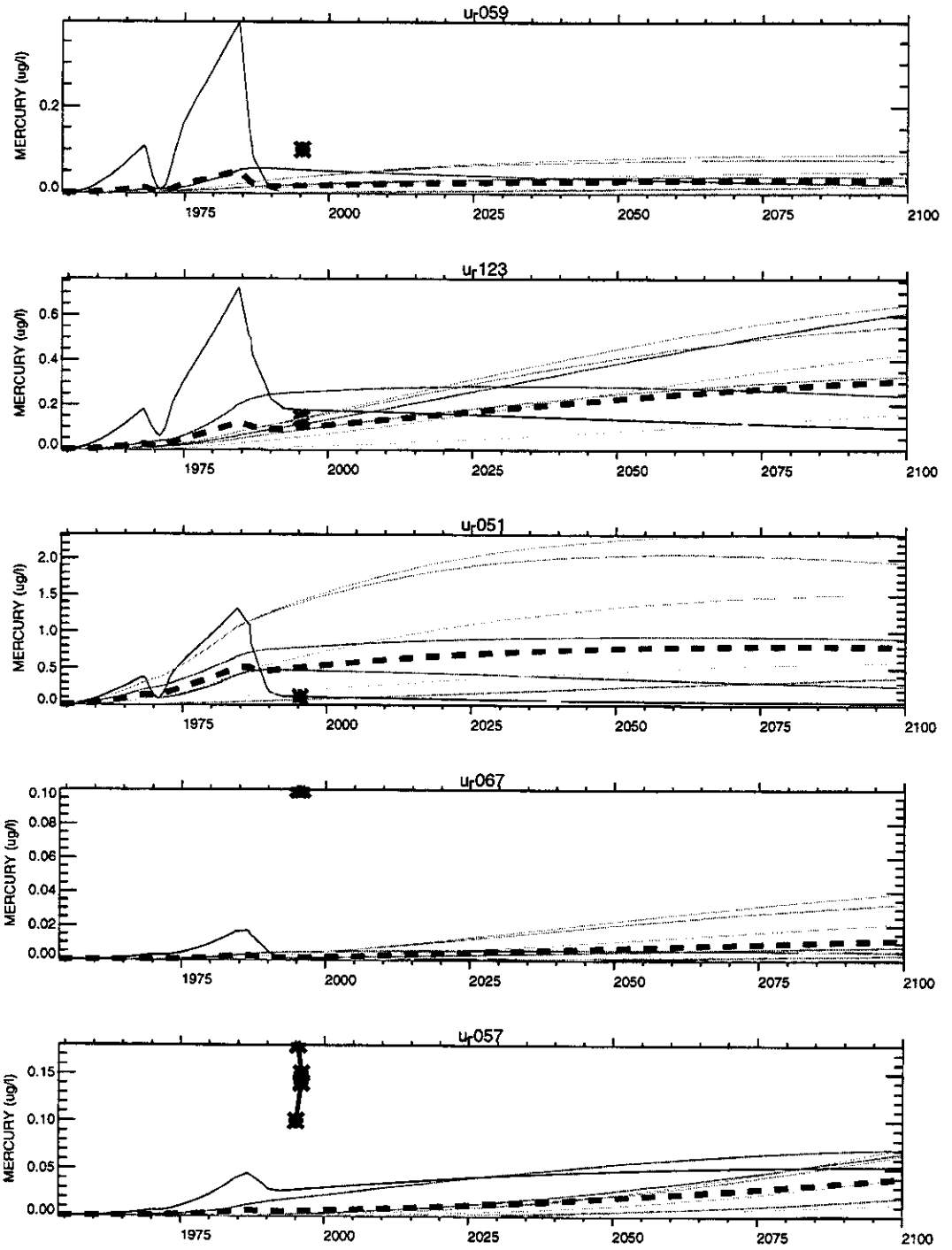


Figure 7-53 Comparison of aquifer Mercury to field data.

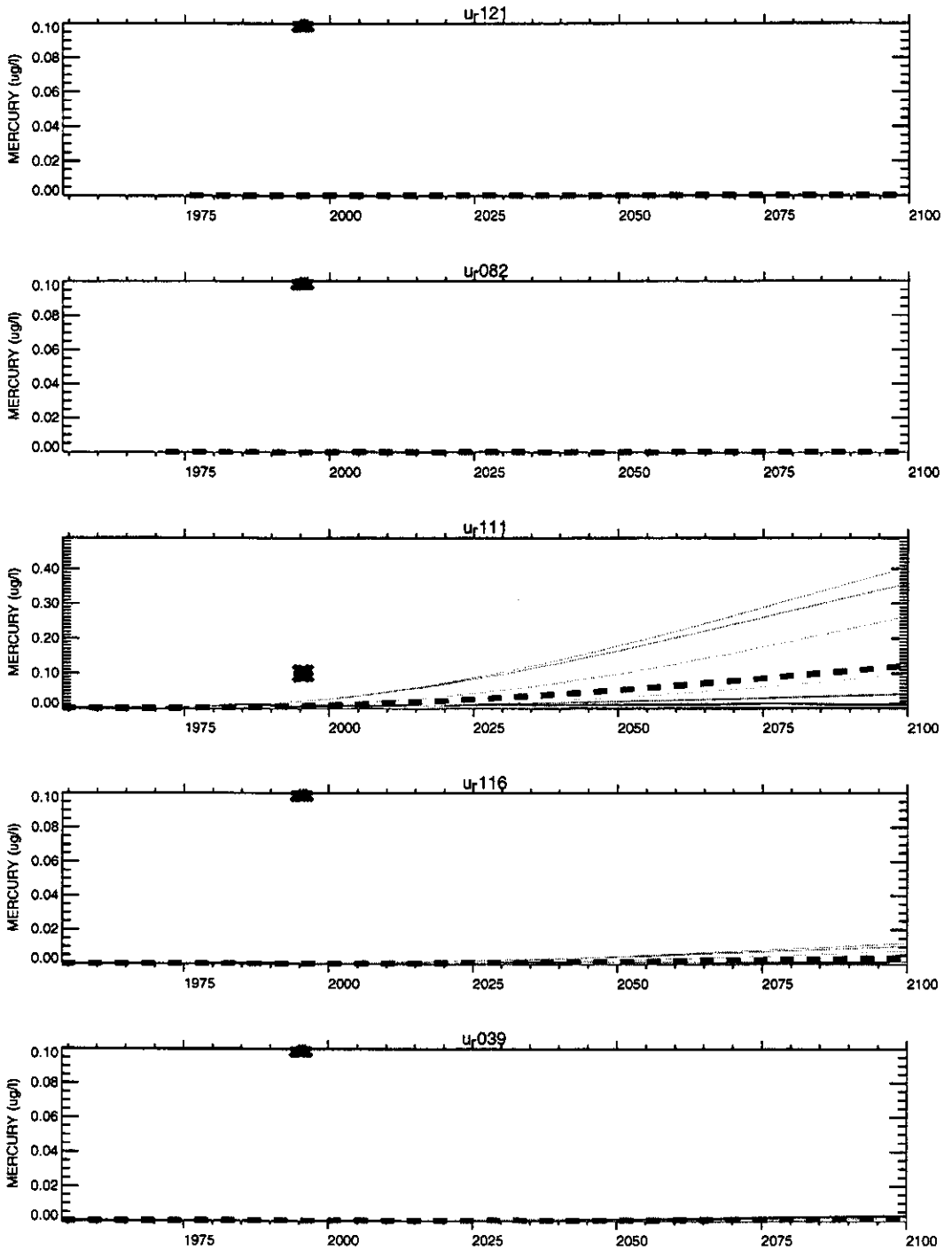


Figure 7-54 Comparison of aquifer Mercury to field data.

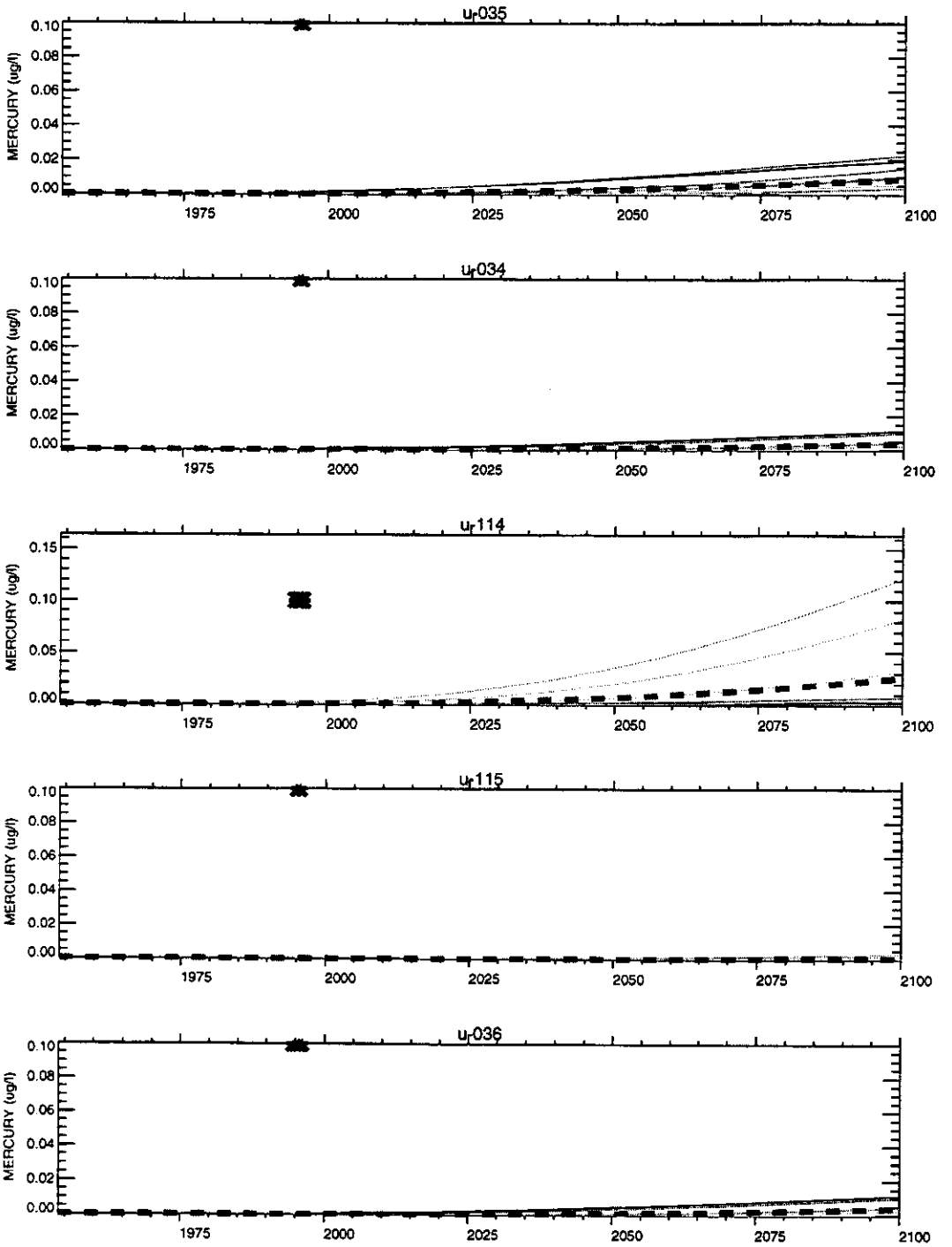


Figure 7-55 Comparison of aquifer Mercury to field data.

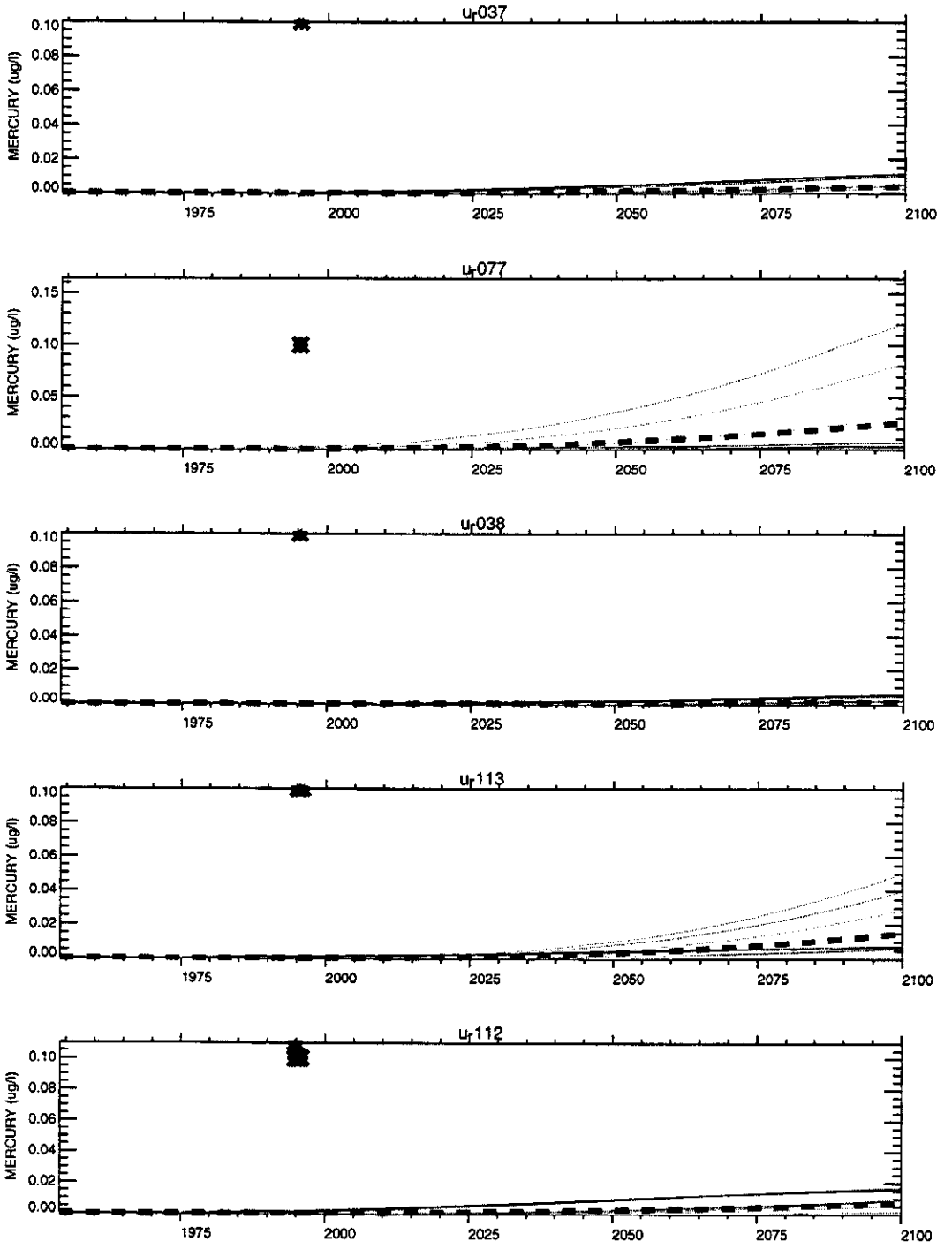


Figure 7-56 Comparison of aquifer Mercury to field data.

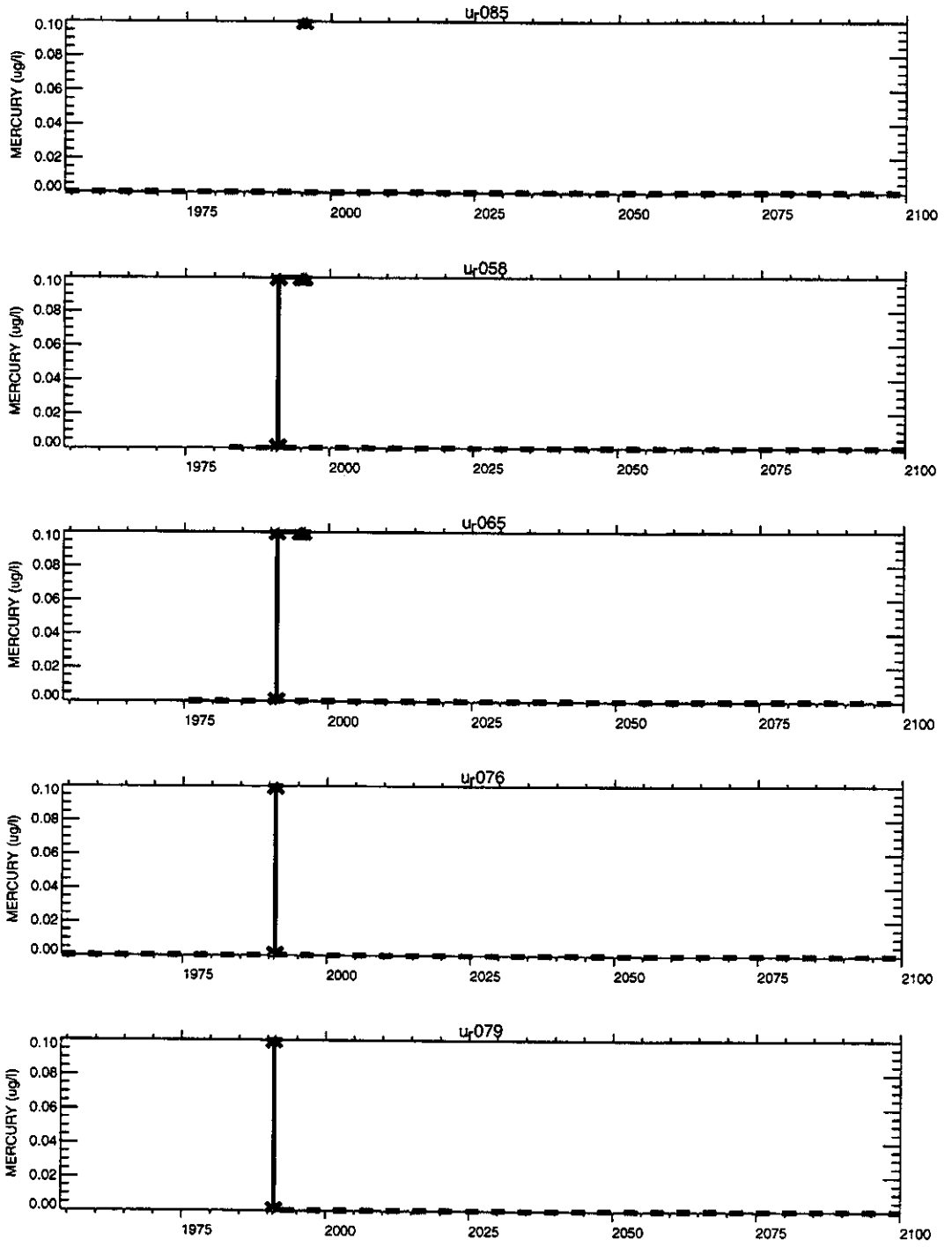


Figure 7-57 Comparison of aquifer Mercury to field data.

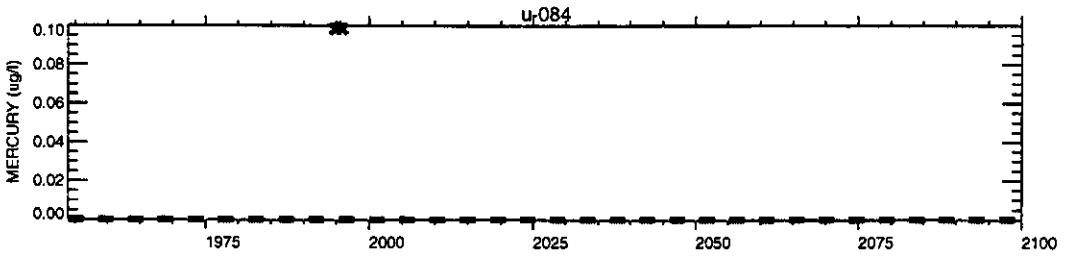


Figure 7-58 Comparison of aquifer Mercury to field data.

7.4 Co-60

Co-60 was found in most of the contaminated soils and liquid waste inventories. These sources included: a) site CPP-28 which accounted for 11.63% of the mass and occurred from 1956-1974; b) the injection well which accounted for 0.71% of the mass and was used from 1956 to 1978 (this includes the backflow period into the vadose zone when the injection well failed); c) the CPP-31 release in 1972 accounting for 27.36% of the total mass; d) a minor contribution from the '86 release (0.04% in 1986); e) the primary source (60.26%) consisting of contaminated soils (modeled as occurring in 1990); and f) a very minor contribution from the percolation ponds (0.01%) occurring from 1984 through 2095. The influx of Co-60 from these sources was simulated out through the year 2068 rather than through the 100 year time period because concentrations were below risk limits.

VADOSE ZONE: These simulation results for the vadose zone are given in Figures 7-59 through 7-64, with Figures 7-67 through 7-71 presenting simulation results for the aquifer region. Contour levels in Figures 7-59 through 7-62, 7-67, and 7-68 are given for 1.00, $1.00 \times 10^{+1}$, $1.00 \times 10^{+2}$, $1.00 \times 10^{+3}$, $1.00 \times 10^{+4}$, $1.00 \times 10^{+5}$ pCi/L, with concentrations equal to the MCL (100 pCi/L) represented by the dark solid line. Corresponding risk contours for the aquifer are given in Figures 7-69, and 7-70 where the 10^{-7}, 10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}, and 10^{-2} levels are presented. Contour levels above the 10^{-6} value (2.54 pCi/L) are indicated by solid lines with the 10^{-6} level indicated by thick line, and the 10^{-4} level indicated by the medium solid line. These contour plots show that the Co-60 is sorbed to the upper interbed, and that the bulk of the mass simply decays in place. In addition, the 1972 subplot in Figure 7-62 illustrates the very minor contribution to vadose zone contamination occurring as a result of the failed injection well.

Figure 7-63 shows that the predicted concentration of Co-60 in the vadose zone pore water drops below the MCL after 2041. In addition, it illustrates the effect of the short half life (5.27 years) which allows the local concentration maxima resulting from source application to decrease very rapidly. The difference in decay versus transport, dilution or dispersion is apparent from the linear decrease in the log of concentration (risk) plotted against the left axis. The mass flux out of the vadose zone and into the aquifer is given in Figure 7-64. This figure shows that the peak mass flux from the vadose zone occurs in 1992. Because of the short half life and discontinued disposal of Co-60, by 2068 nearly all of the mass had decayed or left the vadose zone and the simulation was stopped.

Figures 7-65 and 7-66 show the comparisons of the model predicted concentrations to the vadose zone field data. There are very few field samples, but the model predictions are much higher than the field data for all the wells but USGS-50. The model predictions are very good for USGS-50 but there are only two field samples.

AQUIFER: Co-60 concentrations in the aquifer result primarily from the injection well, and from the mass flux from the vadose zone during the brief period of time when the injection well failed. Co-60 from the surface sources don't reach the aquifer. Co-60 aquifer concentrations are always below the MCL and fall below the 10^{-6} risk level in year 2000. The peak aquifer concentration should have been observed in 1986 as shown in Figure 7-71.

As summarized in Section 10.5, the reestimated CPP-31 inventory for Co-60 is one third the original inventory (Table 10-7) and one half the total tank farm inventory (Table 10-9). However, there is little confidence in the source estimate because there is very little data upon which is make the estimation. Based on the simulation results shown here, the Co-60 decays away in place without posing a risk problem and a source uncertainty of 2 to 4 will have essentially no effect. Although the activation product source estimates could not be verified, based on the Co-60 half-life, a huge increase in Co-60 would be necessary in order for Co-60 to pose a risk to the aquifer.

Comparisons of the model predicted concentrations to the aquifer field data (Figure 7-73) show that the model predictions are lower than the field samples, however there are only five field samples from a total

of four wells (Figure 7-72). The field data concentrations are all significantly lower than the MCL (100 pCi/L). Therefore, no further calibration appears to be warranted for Co-60.

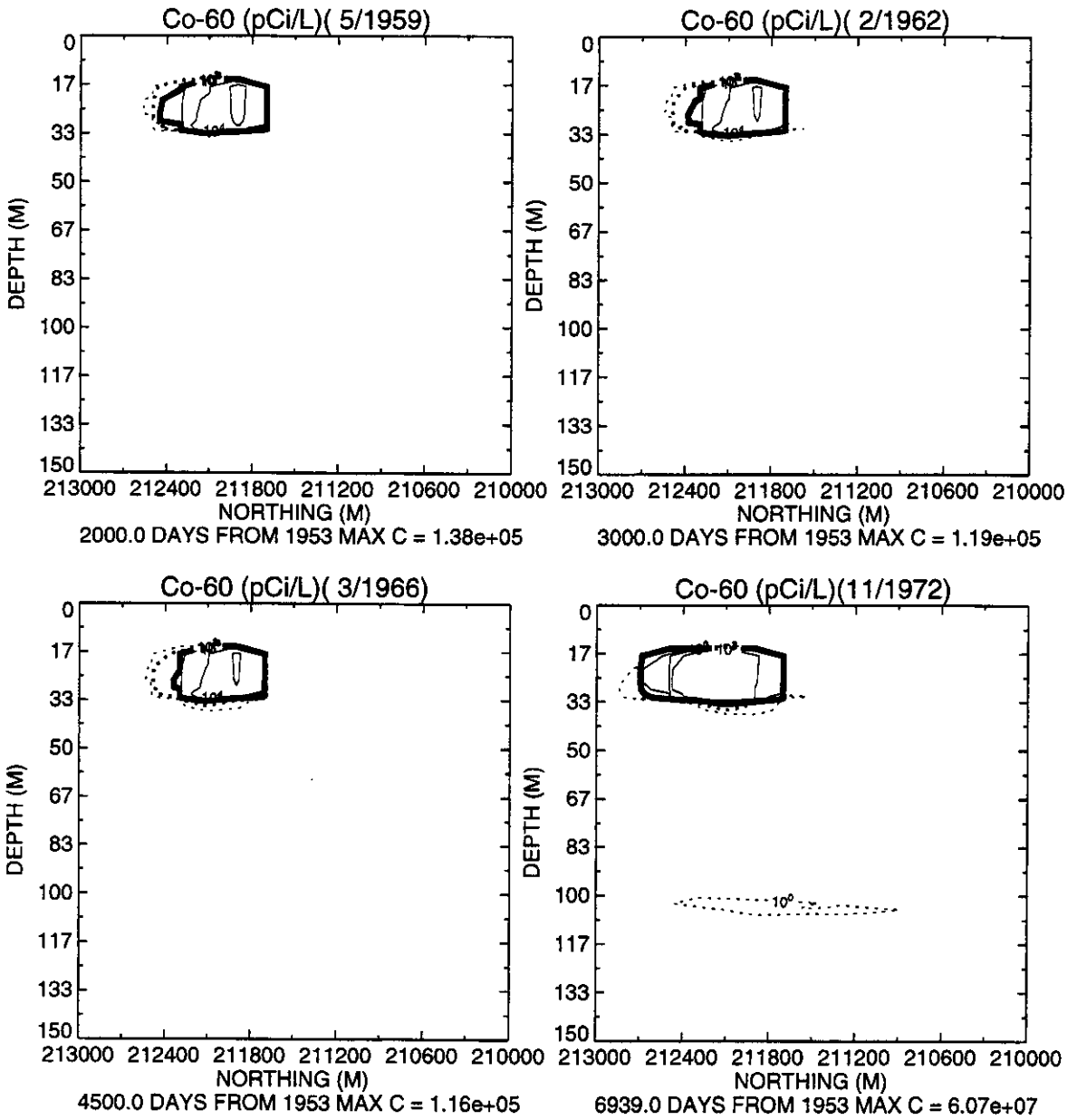


Figure 7-59 Vadose zone Co-60 peak concentration contours.

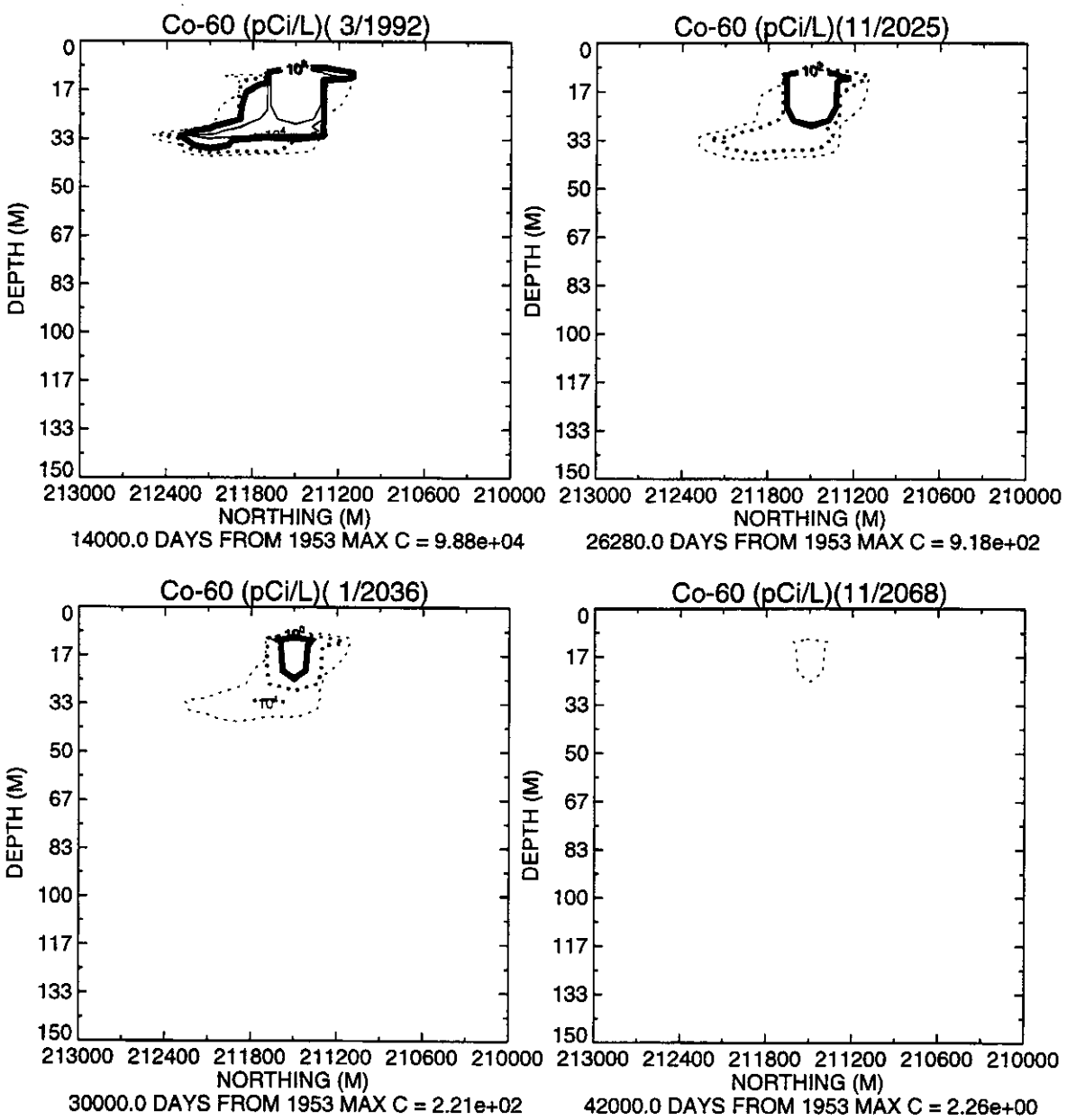


Figure 7-60 Vadose zone Co-60 peak concentration contours.

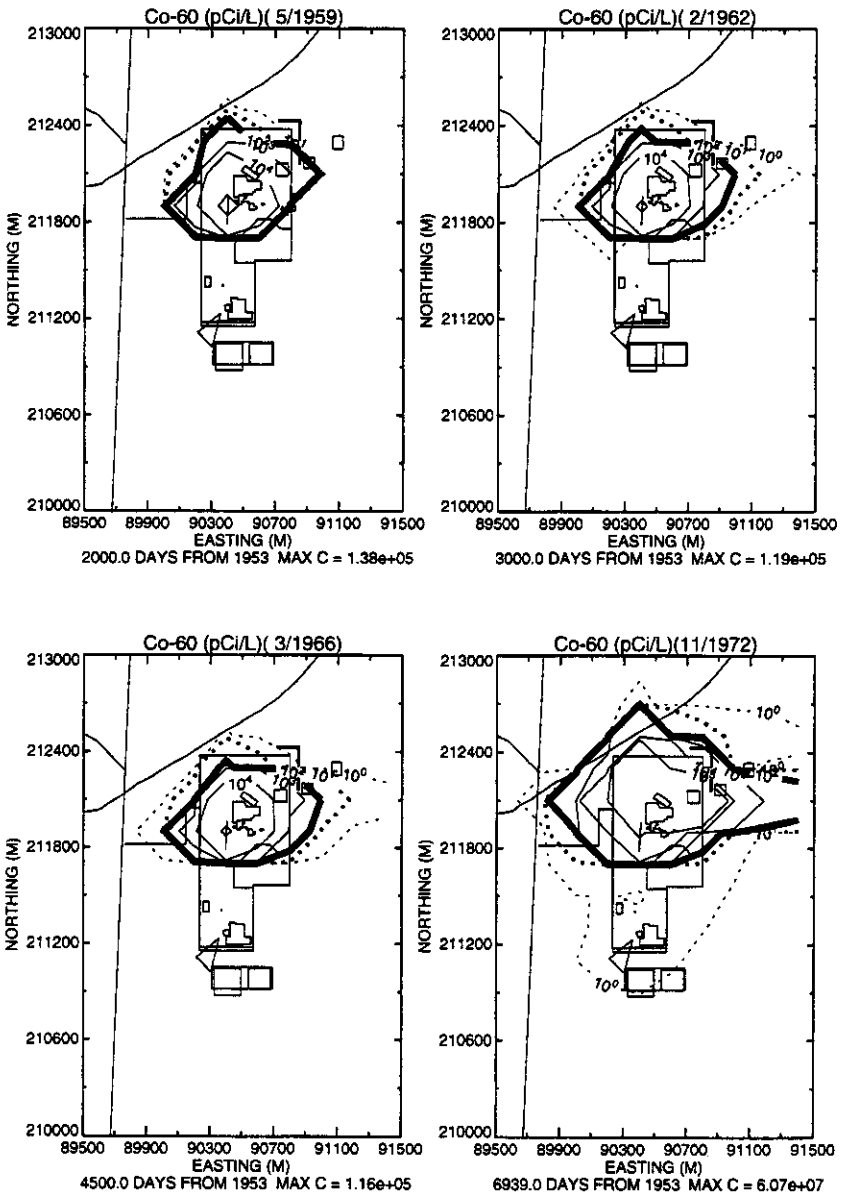


Figure 7-61 Vadose zone Co-60 peak concentration contours.

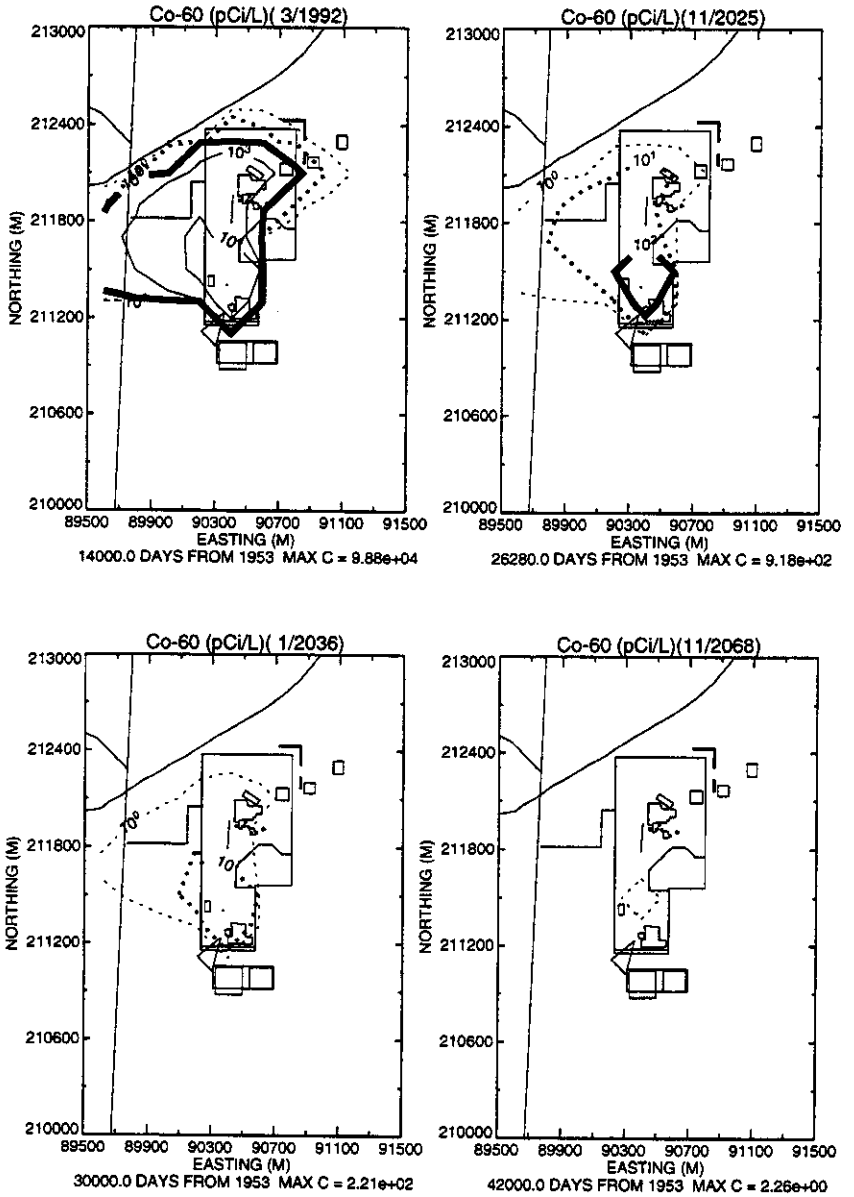


Figure 7-62 Vadose zone Co-60 peak concentration contours.

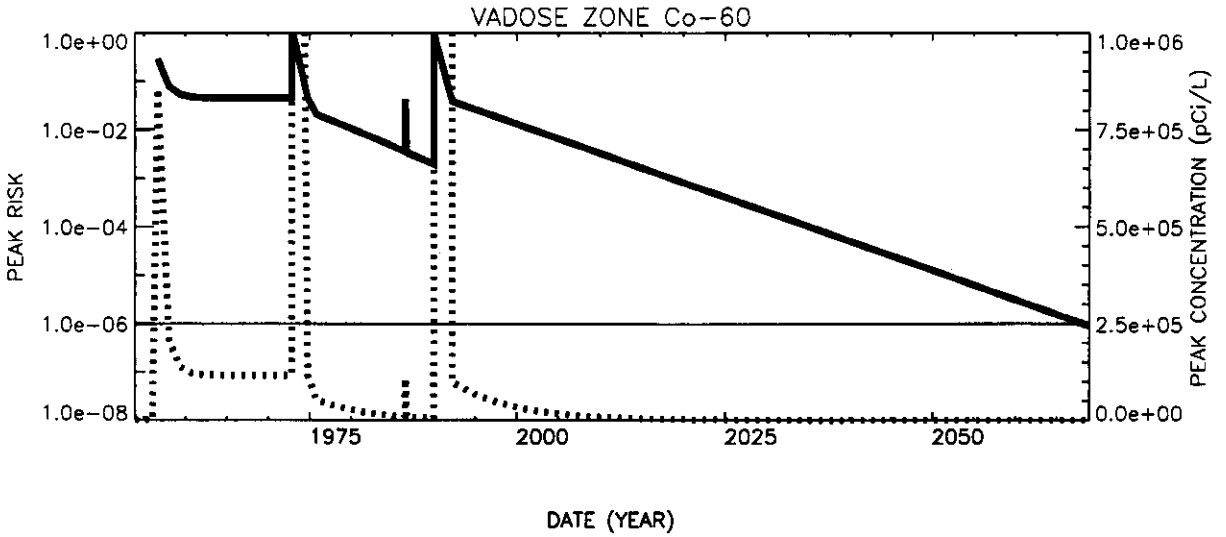


Figure 7-63 Peak vadose zone risk and concentration for Co-60. Risk indicated by the thick line on the log scale with the 10^{-6} value shown as the solid line. The dotted line represents concentration given by the linear scale on the right axis with the MCL (100 pCi/L) shown as the straight horizontal line.

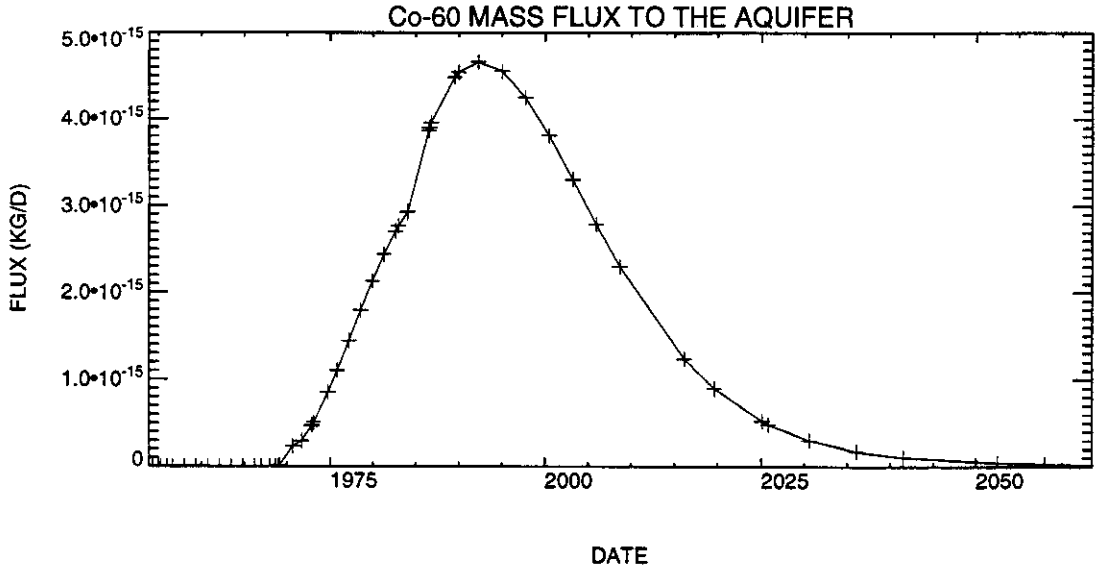


Figure 7-64 Mass flux of Co-60 into the aquifer from the vadose zone.

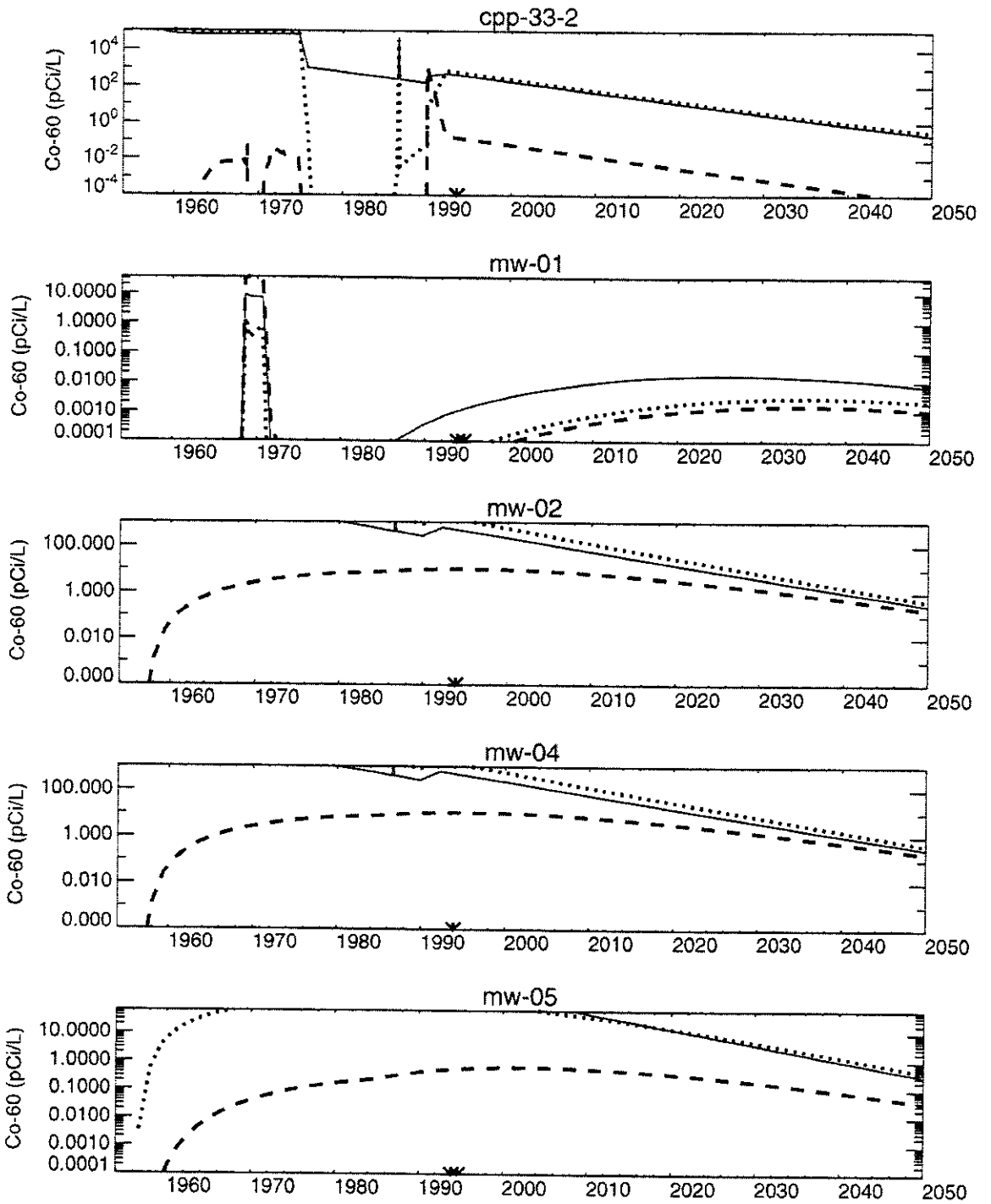


Figure 7-65 Comparison of vadose zone Co-60 to field data.

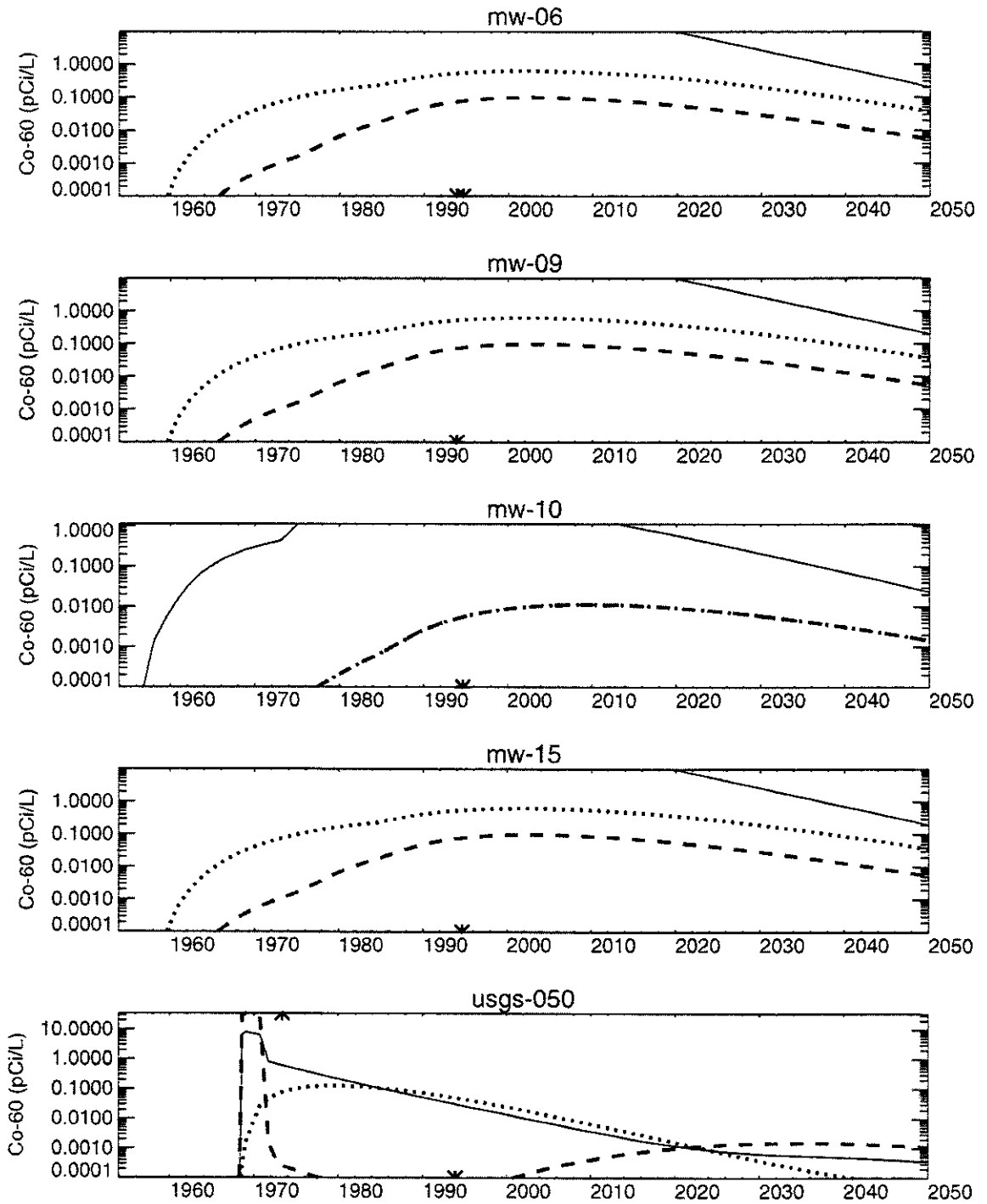


Figure 7-66 Comparison of vadose zone Co-60 to field data.

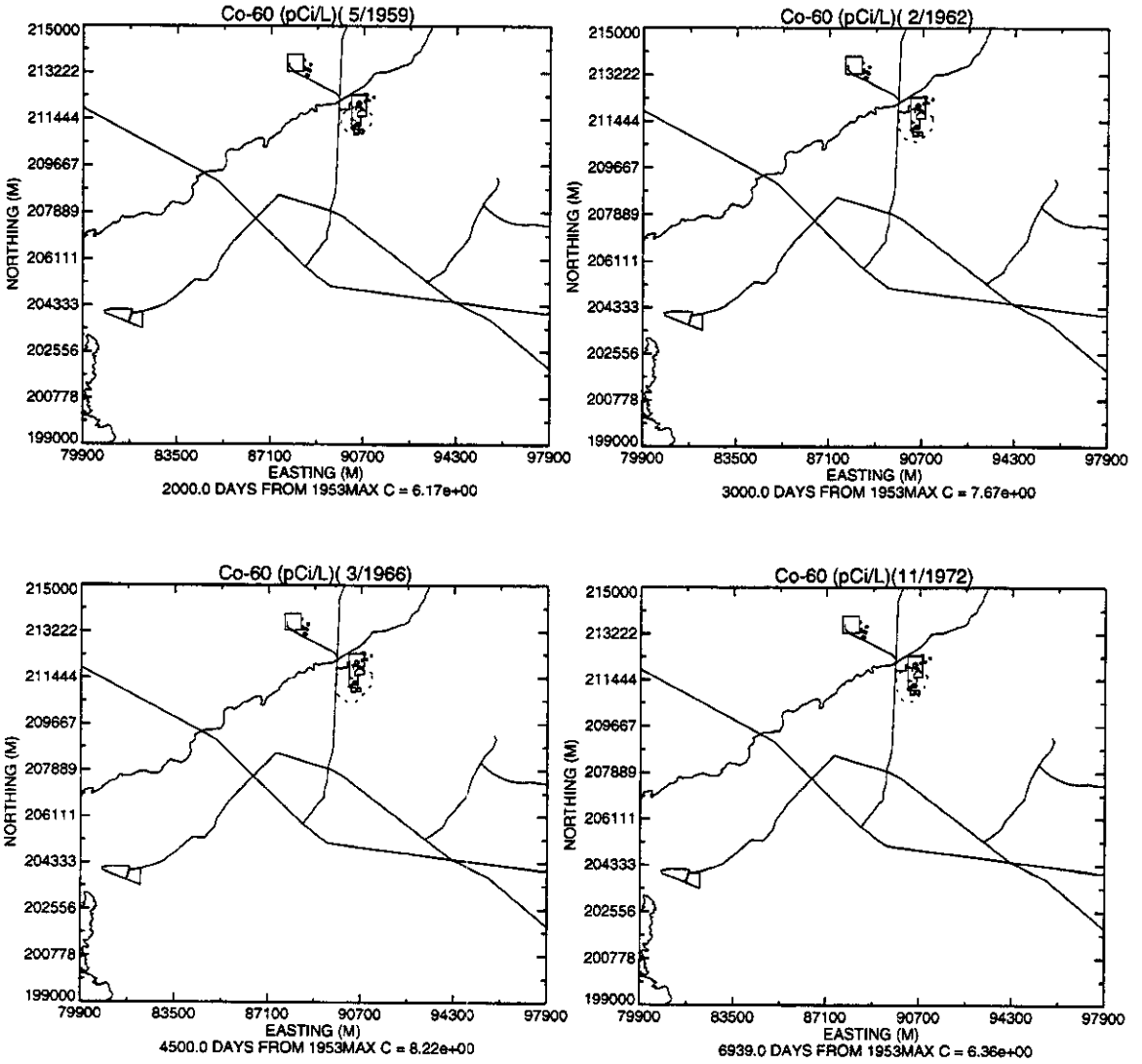


Figure 7-67 Aquifer Co-60 peak concentration contours.

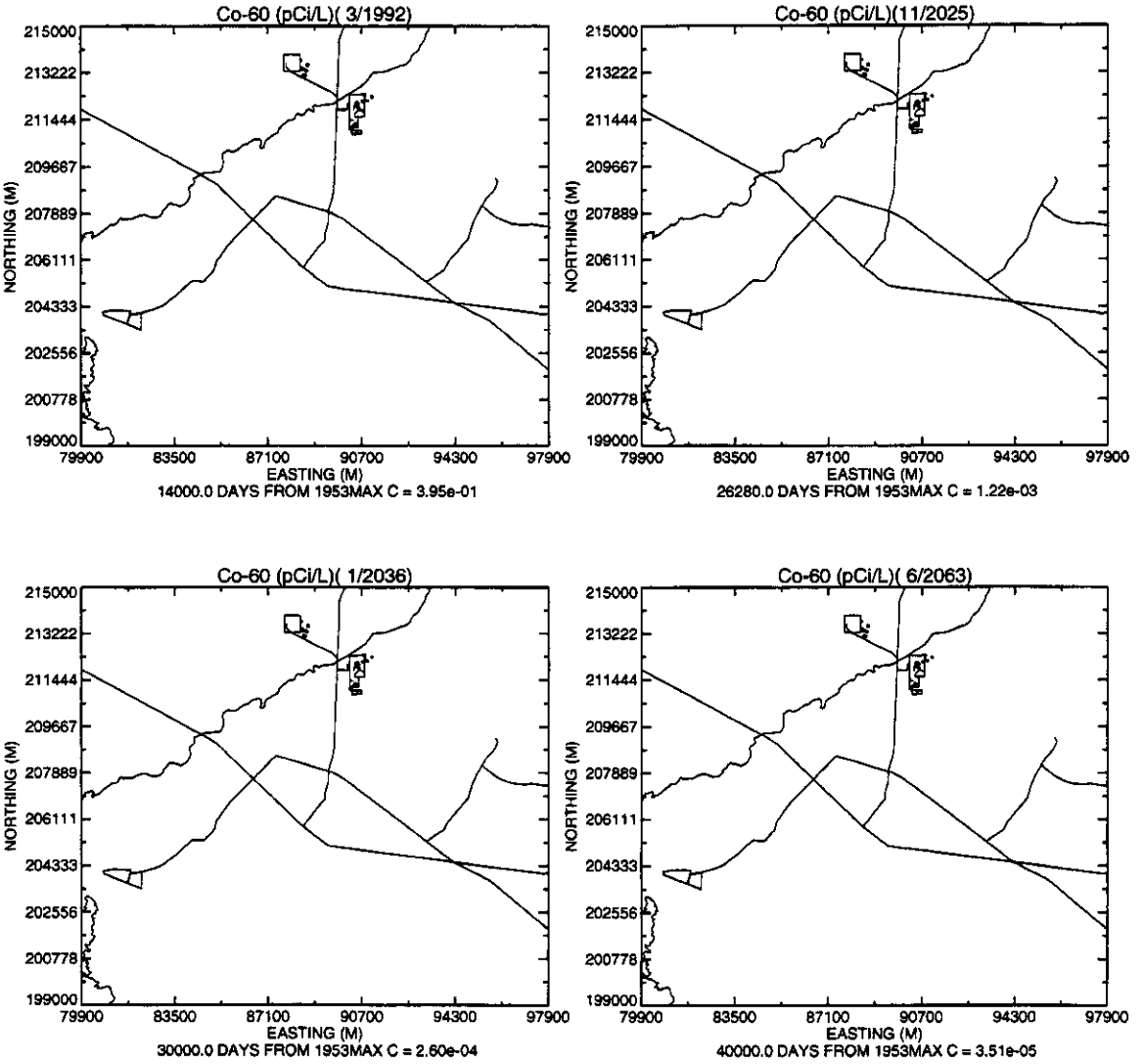


Figure 7-68 Aquifer Co-60 peak concentration contours.

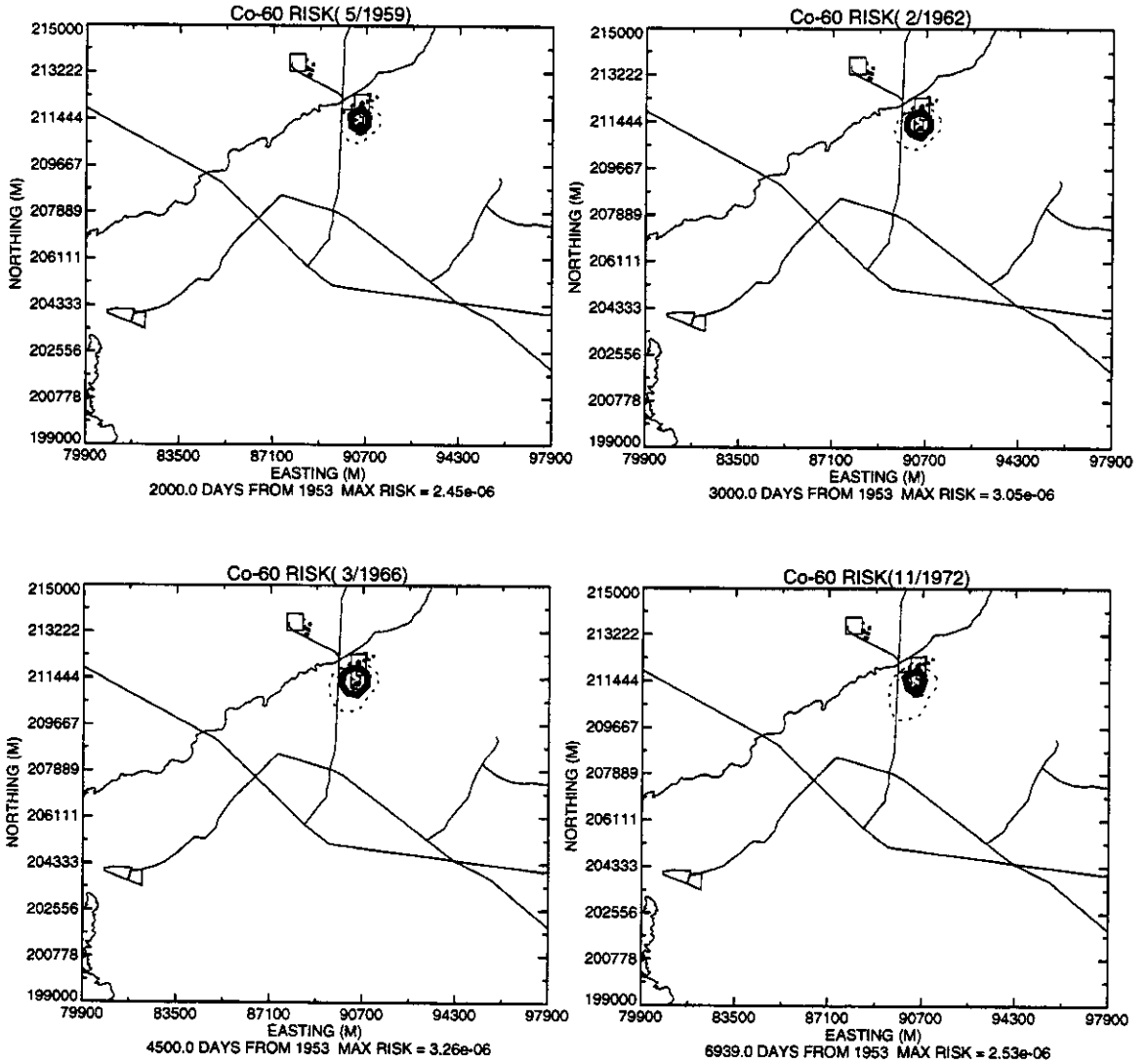


Figure 7-69 Aquifer Co-60 peak risk contours.

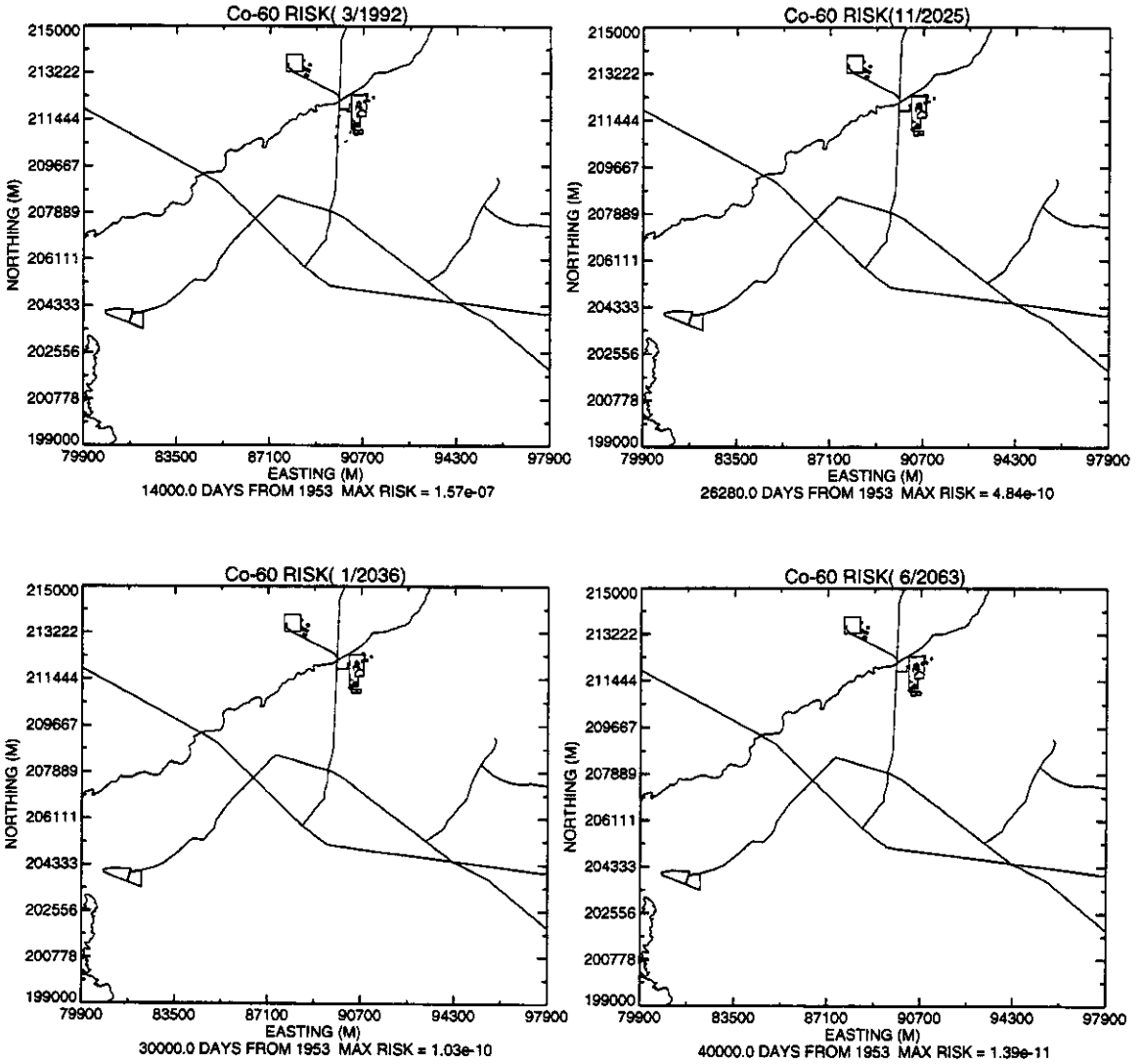


Figure 7-70 Aquifer Co-60 peak risk contours.

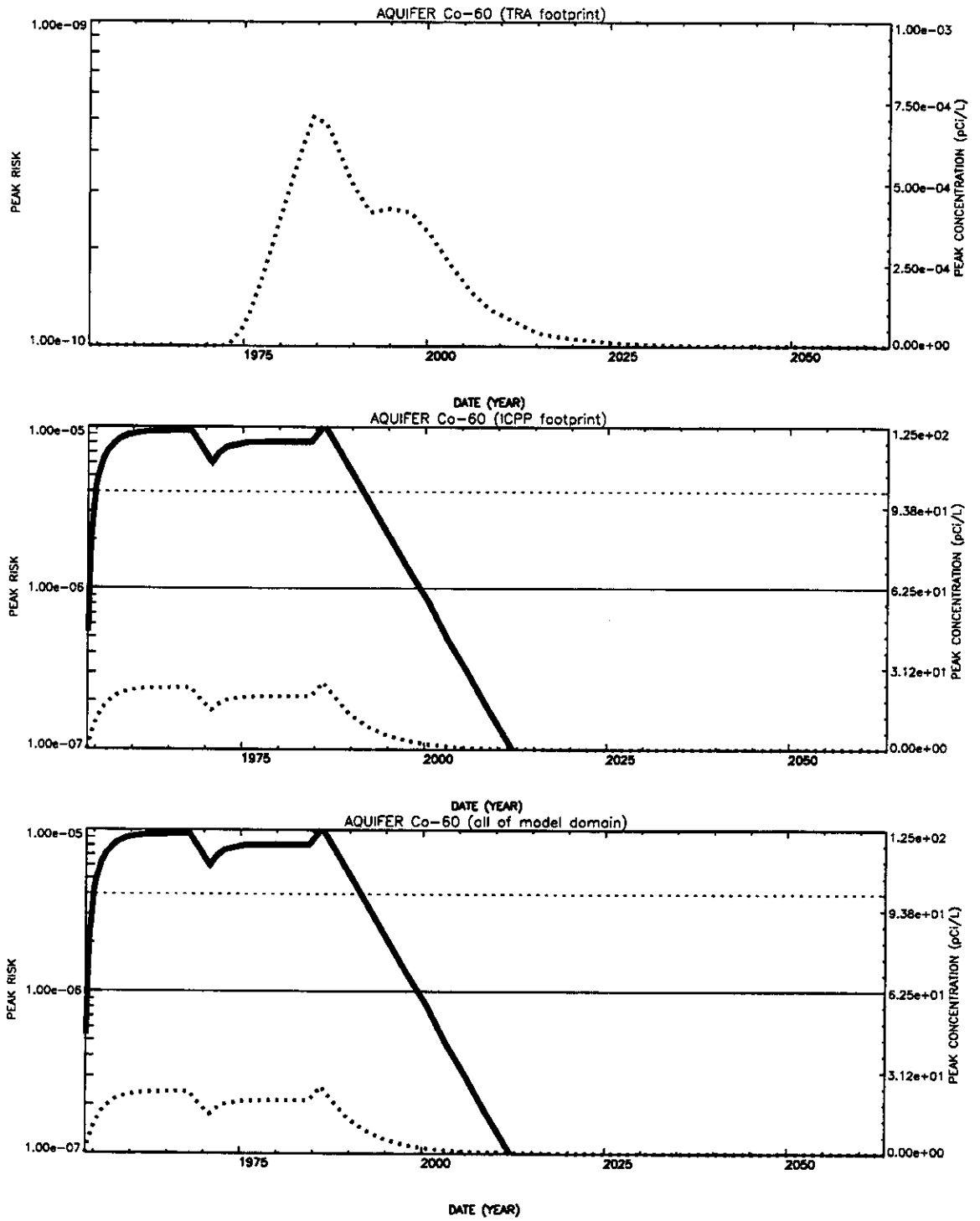


Figure 7-71 Peak aquifer concentration for Co-60. Top figure: TRA foot print, Middle figure: ICPP footprint, Bottom Figure: entire aquifer domain. Thick line risk (left scale), dotted line concentration (right scale) solid line 10^{-6} risk (left scale).

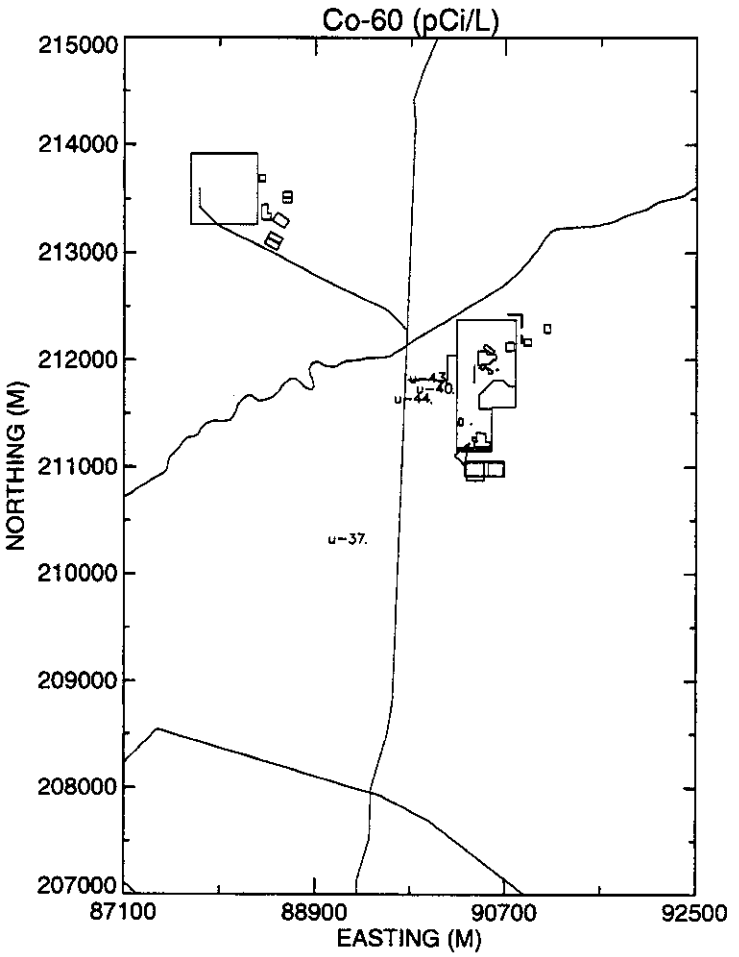


Figure 7-72 Well locations for the comparison of aquifer Co-60 to field data.

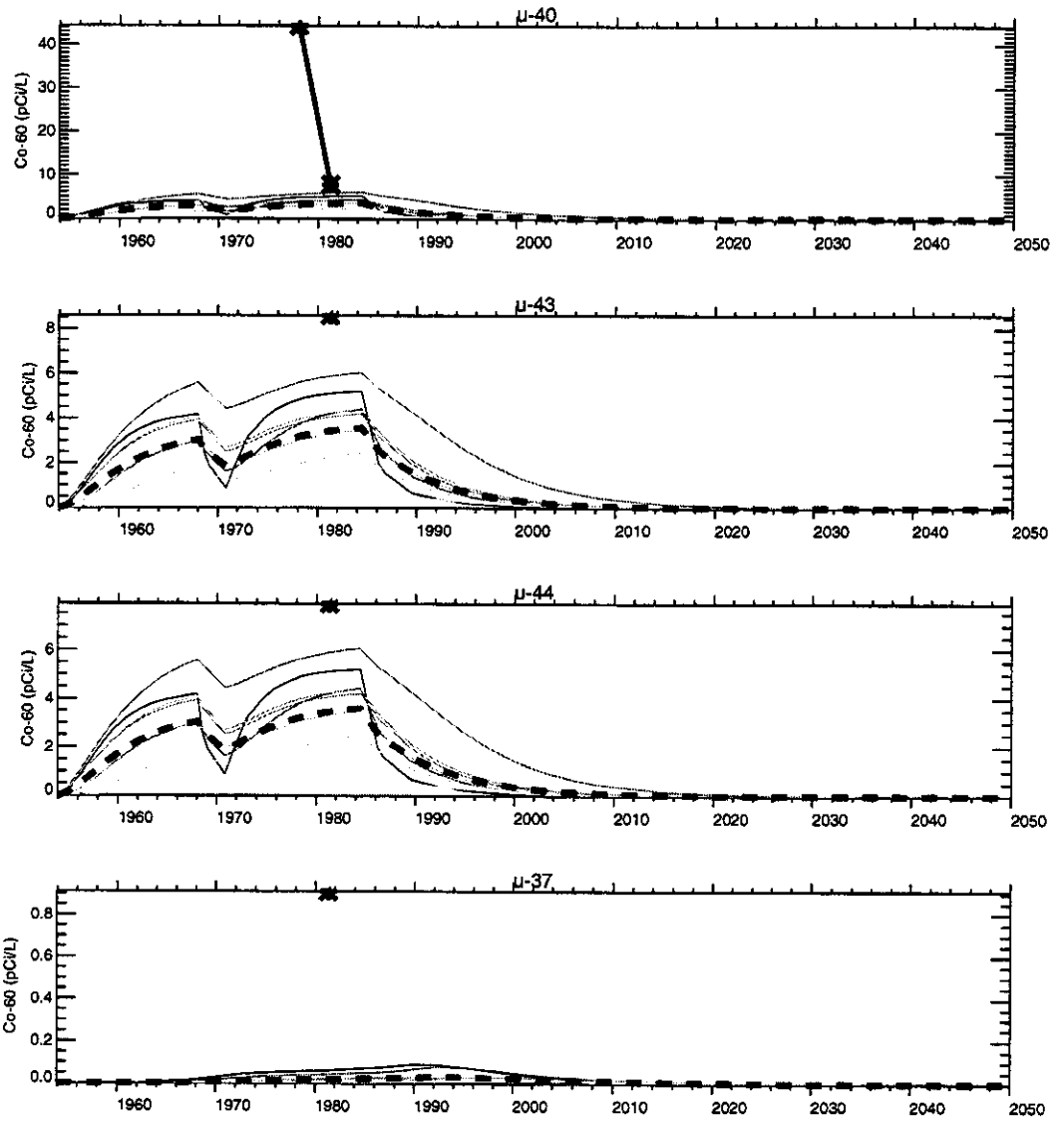


Figure 7-73 Comparison of aquifer Co-60 to field data.

7.5 Cs-137

Cs-137 is similar to Co-60 in that it was found in most of the contaminated soils and liquid waste inventories. These sources included: a) a small amount in CPP-02 (0.12% from 1952-1966); b) a larger amount at site CPP-28 (42.42% from 1956-1974); c) a small amount in the injection well (0.09% from 1956-1978); d) 47.36% of the mass resulting from the CPP-31 release in 1972; e) a small amount (0.92% from 1983-1989) fro CPP-80, f) a minor contribution from the '86 release (0.07% in 1986); and g) 10% of the mass applied as contaminated soils (modeled as occurring in 1990). The influx of Cs-137 from these sources was simulated out through the year 2227 to allow concentrations to be below risk limits.

Figures 7-74 through 7-83 present the simulation results for the transport of Cs-137 through the vadose zone, and Figures 7-84 through 7-93 present simulation results for the aquifer region. Contour levels for both the vadose zone and aquifer (Figures 7-74 through 7-77, 7-84, and 7-85) are given for 2.0, $2.0 \times 10^{+1}$, $2.0 \times 10^{+2}$, $2.0 \times 10^{+3}$, $2.0 \times 10^{+4}$, $2.0 \times 10^{+5}$ pCi/L with the MCL (200 pCi/L) represented by the dark line. The corresponding risk contour maps for the aquifer region are given in Figures 7-86, and 7-87. Risk contours are given for 10^{-7}, 10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}, and 10^{-2} levels with the 10^{-6} risk (1.52 pCi/L) indicated by the dark solid line and the 10^{-4} level indicated by the medium solid line.

VADOSE ZONE: The vadose zone contour plots indicate that the Cs-137 is sorbed to the upper interbed, and that like Co-60, the bulk of the mass will simply decay in place. In addition, the plots illustrate that the Cs-137 originating in the vadose zone as a result of the injection well failure should simply have decayed in place.

Figure 7-78 shows three local maxima in the vadose zone concentration. These correspond to releases during the 1956-57 time period from CPP-28, the CPP-31 leak in 1972, and from soils contamination which was simulated as occurring in 1990. This figure also indicates that the vadose zone maximum concentration of Cs-137 does not drop below the MCL level before 2227. As with Co-60, the exponential decay (linear concentration decrease on the log scale) shown in that figure indicates that the mass is simply decaying in place in the upper interbed. The large Kd for Cs-137 results in the magnitude of the mass flux out of the vadose zone being very small (essentially 0) as shown in Figure 7-79. Transport from the vadose zone is at the highest rate (peak mass flux rate) in 2030, and decreases rapidly after 2095 when it was assumed that the percolation ponds were decommissioned. By 2227, a very small fraction of the initial mass in place was predicted to have entered the aquifer with most of the Cs-137 remaining adsorbed in the vadose zone interbeds.

Comparisons of model predicted concentrations to vadose zone field data (Figures 7-80 through 7-83) are very good for the PW-01 through PW-05 wells which are near the percolation ponds and for USGS-50 which is completed in the lower interbed near the injection well. This indicates that the flux rates and source terms are reasonably accurate for those two sources. Cs-137 has been detected in PW-06, although the model does not predict arrival of Cs-137 that far west of the percolation ponds. This could be indicative of the Kd being slightly too large, or that there is more actual lateral spreading than this model predicts.

The northern wells near the tank farm area were sampled with negligible Cs-137 results in 1993, 1994, and 1995. The model predicts that the Cs-137 should not arrive in the screened (mid-sediment) region until roughly the year 2000, but that it should have already have arrived in fairly high concentrations in the overlying basalt. As a result, the averaged concentration is higher than observed. However, the best fit concentration curve indicates that continued sampling should show the arrival of Cs-137 within the next few years. Primary differences between the concentration predicted by the model and observed field data could also be attributed to the assumption that the sources originating in the tank farm are unretarded down to the first interbed. By allowing advective transport of all of the Cs-137 originating in the tank farm, the concentrations predicted by the model are higher and the mass arrives earlier in the upper interbed. In reality, Cs-137 from the tank farm probably adsorbs in the surficial sediments and has not yet moved through the vadose zone to the upper interbed.

AQUIFER: Even with essentially no mass flux from the vadose zone, the predicted peak Cs-137 aquifer concentration in 2095 (5.91 pCi/L from the injection well fluxes) is greater than the 10^{-6} risk concentration (1.52 pCi/L). However, it is less than the MCL (200 pCi/L). As shown in Figures 7-84 through 7-87, the aquifer area with concentrations greater than the 10^{-6} risk concentration is limited to the area under the ICPP facility. Figure 7-88 indicates that the predicted 10^{-6} risk level will be exceeded until the year 2156. It also shows that the predicted MCL should not ever be exceeded. The peak concentration in the aquifer was predicted to have been 86.2 pCi/L in 1979.

Comparisons of model predicted concentrations to aquifer field data (Figures 7-90 through 7-93) show that predicted concentrations are below measured values in most of the wells. Locations for these comparison wells are given in Figure 7-89, and include near-, mid-, and far-field distances from the injection well. Field measurements of Cs-137 taken in this decade should be a reflection of the mass disposed of to the injection well. However, where data are available, the shape of the predicted concentration-time curves appear to represent the data. The fact that model predictions are low is highly indicative of using a Kd that is too large. It was assumed that a Kd = 500 cm^3/g for the sediments and 1/25th of that in the basalts would be representative of transport in the aquifer based on Track II guidance.

Although the source terms for H-3 are different, the simulation results for the conservative (non-reactive) transport of H-3 (next section) provide an additional indications that the Kd used for Cs-137 is too high:

- in the Cs-137 simulation, the Cs-137 did not migrate to the PW-06 well, but the non-sorptive H-3 simulation shows that a flow path to that well exists.
- the northern wells near the tank farm area were sampled for H-3, and indicated that concentrations should have been roughly equal to the PW wells in the south; the model predicts concentrations for H-3 in the correct range for those wells.

If it is assumed that this model adequately reflects the advective-dispersive processes, the fact that Cs-137 concentrations are underpredicted here suggests that it may be more appropriate to use a smaller Kd when modeling the transport of Cs-137 in the ICPP basalts and sediments. However, it should not be modeled with a small Kd because

- Cs-137 has not been measured since soon after the injection well was turned off, indicating that the Cs-137 in the wells to the west of the injection well was probably a result of the failed injection well, and
- Cs-137 concentrations have been below the detection limit in the perched and aquifer wells throughout the 1990's, indicating that it does not move significantly.

Use of a slightly smaller Kd will allow the Cs-137 to be transported through the vadose zone in higher concentrations (less decay) but will probably not result in concentrations exceeding the MCL of 200 pCi/L.

In addition, the aquifer results suggest that the predicted plume orientation is rotated slightly more to the south than the actual plume as indicated by concentrations in USGS 116 and USGS 113 being over predicted while concentrations in USGS 39 and USGS 38 are slightly under predicted.

As summarized in Section 10.5, there is no information available to indicate that the Cs-137 source estimates are significantly under or over estimated. There is very little difference between the original and reestimated Cs-137 inventory from CPP-31 as shown in Table 10-7. Base on the results of this section, a huge increase in Cs-137 source would be necessary in order for Cs-137 to pose a risk to the aquifer.

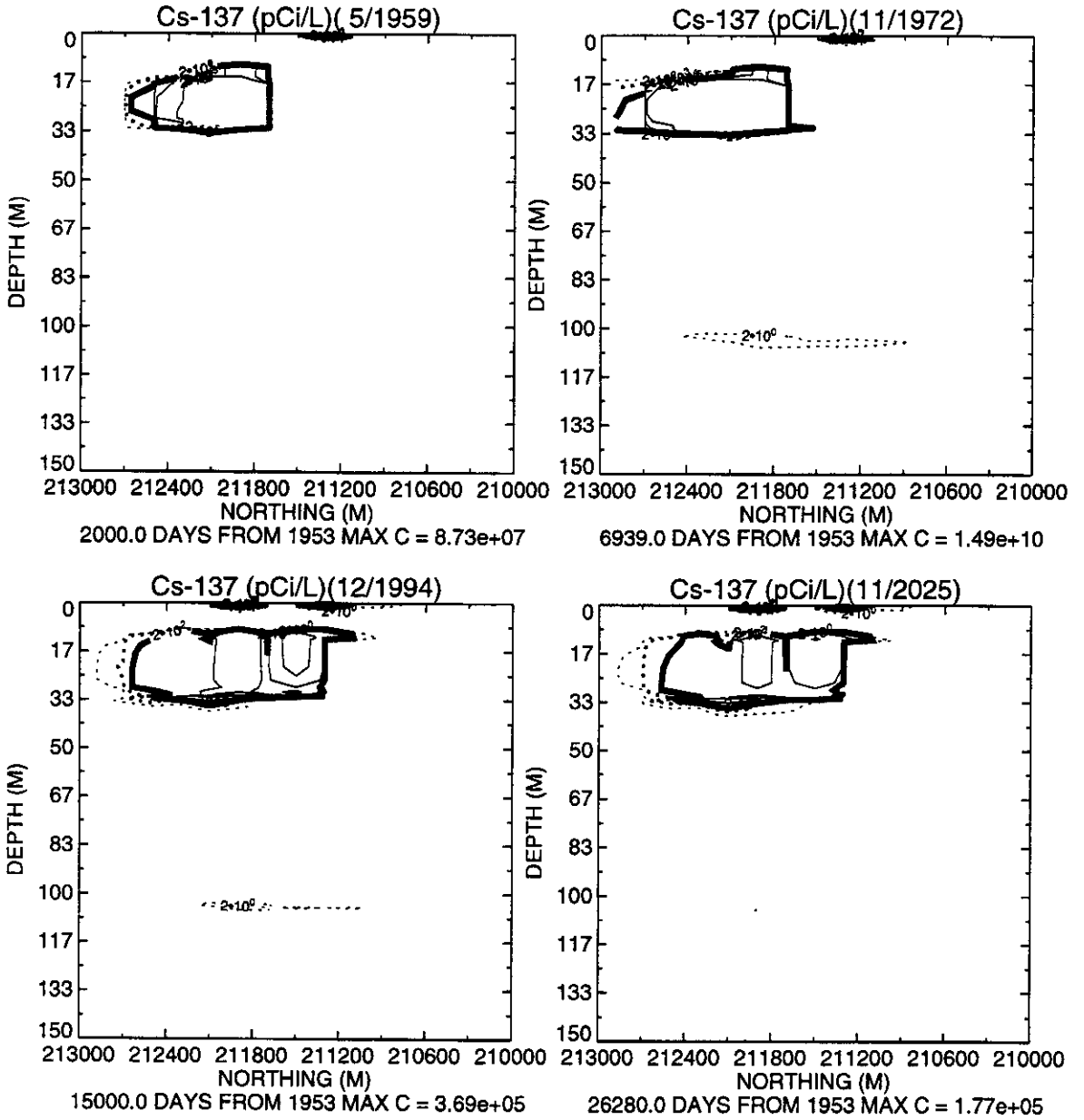


Figure 7-74 Vadose zone Cs-137 peak concentration contours.

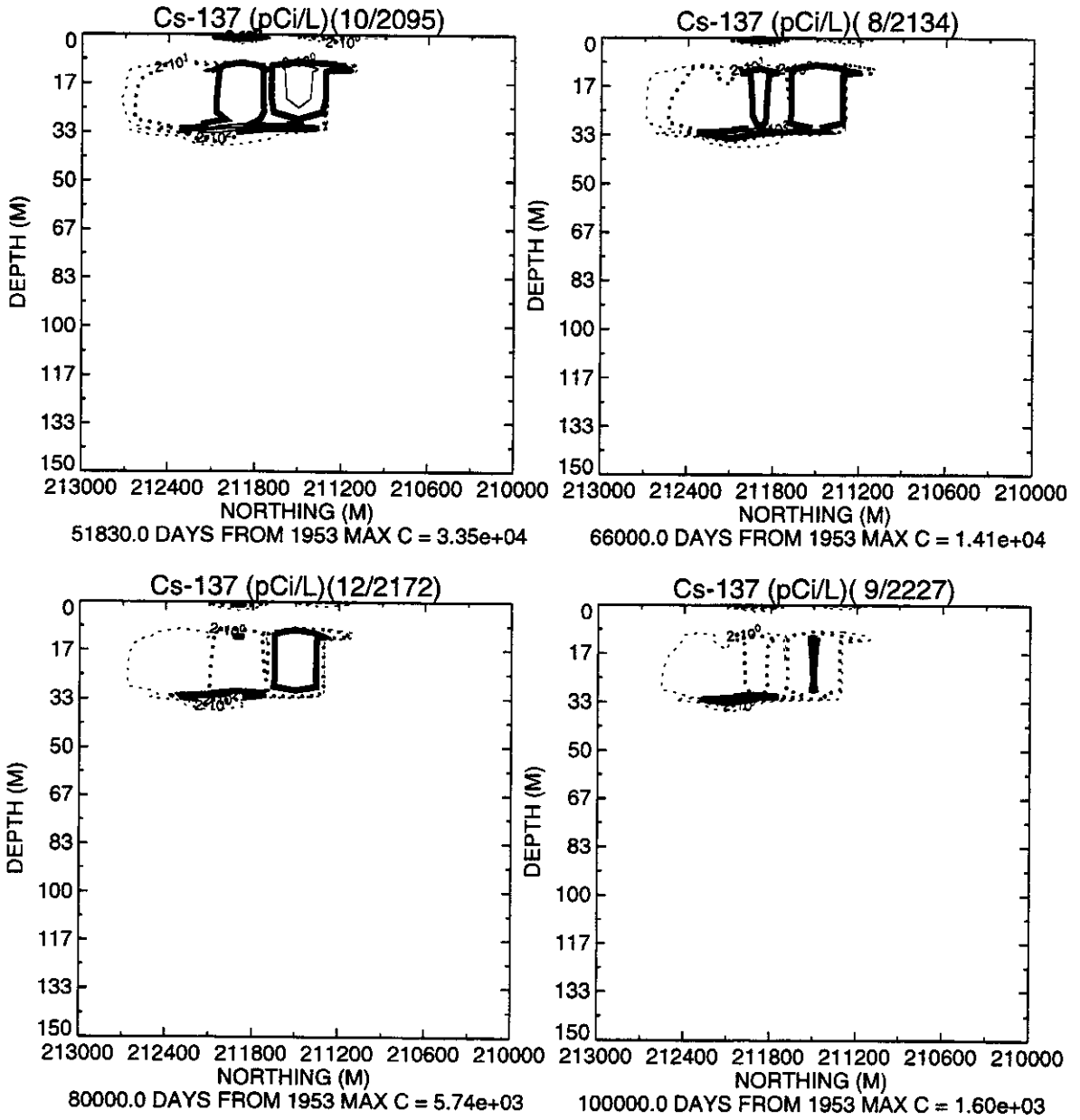


Figure 7-75 Vadose zone Cs-137 peak concentration contours.

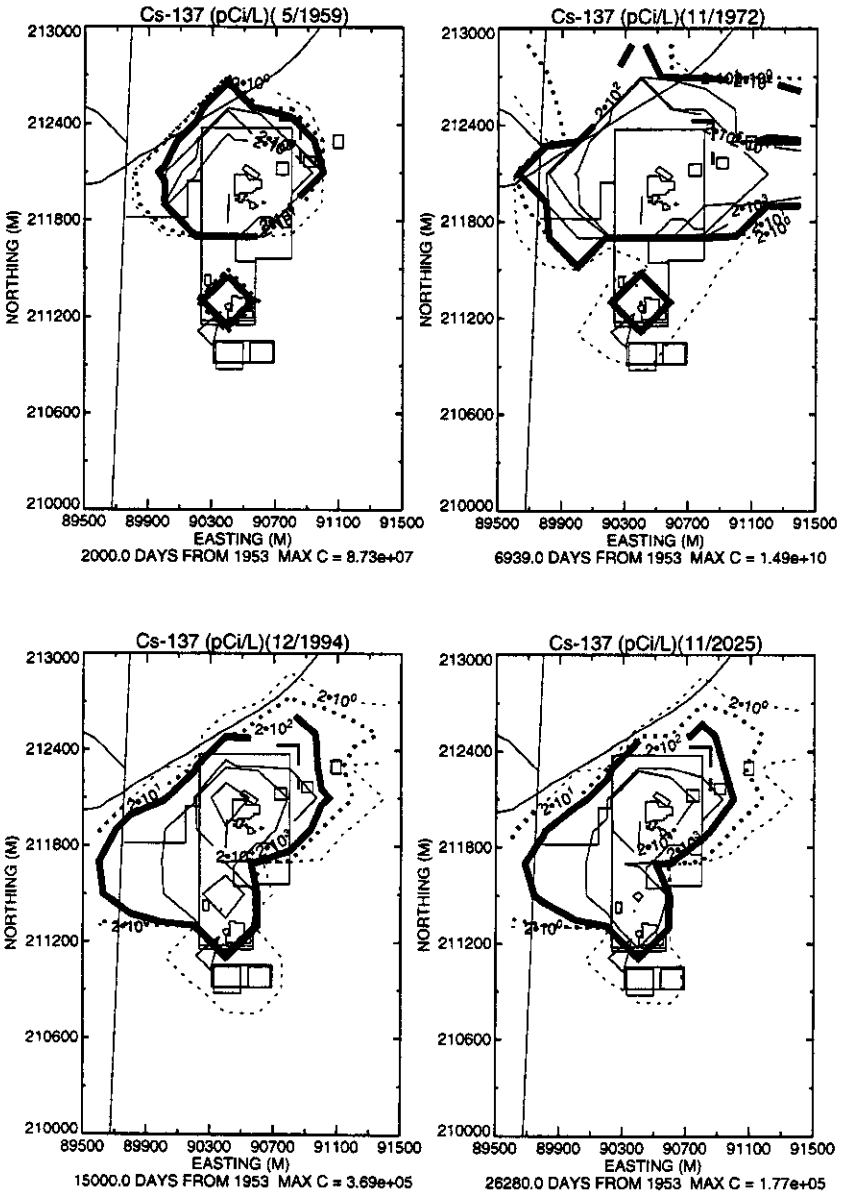


Figure 7-76 Vadose zone Cs-137 peak concentration contours.

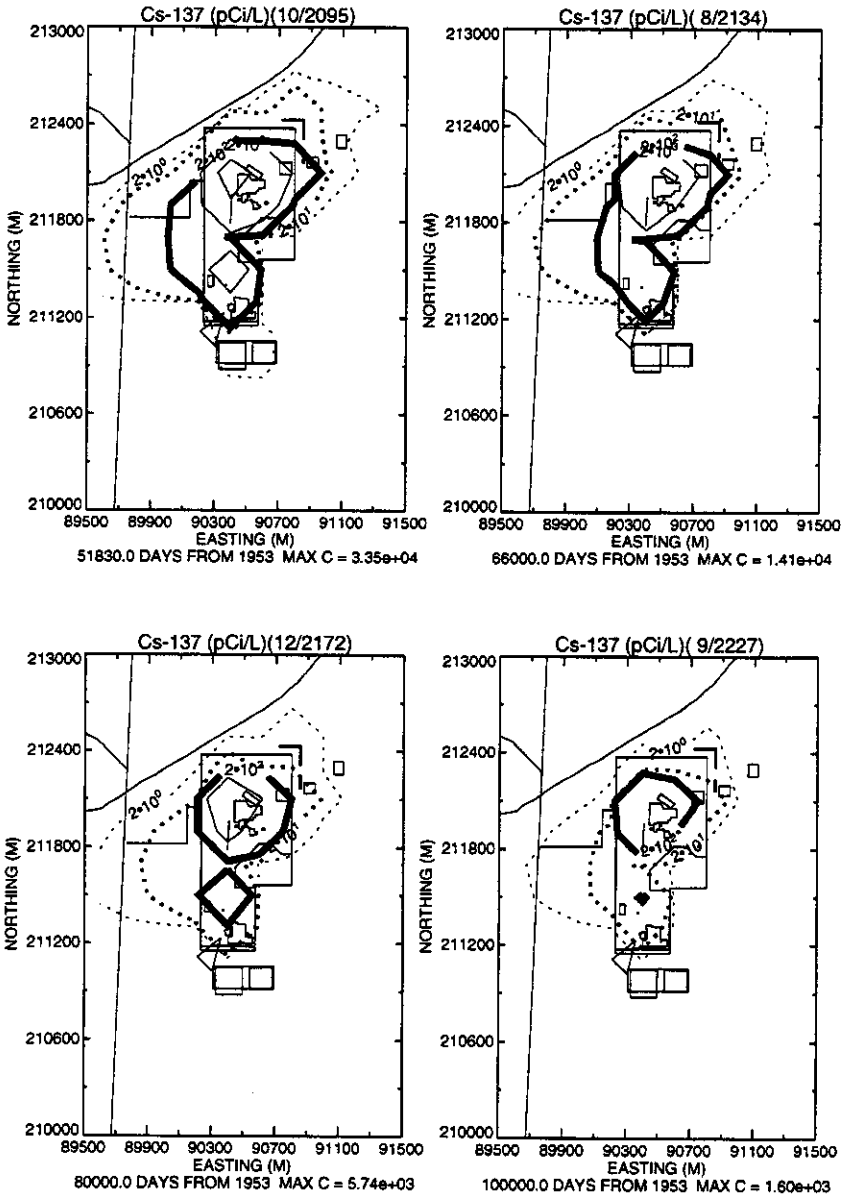


Figure 7-77 Vadose zone Cs-137 peak concentration contours.

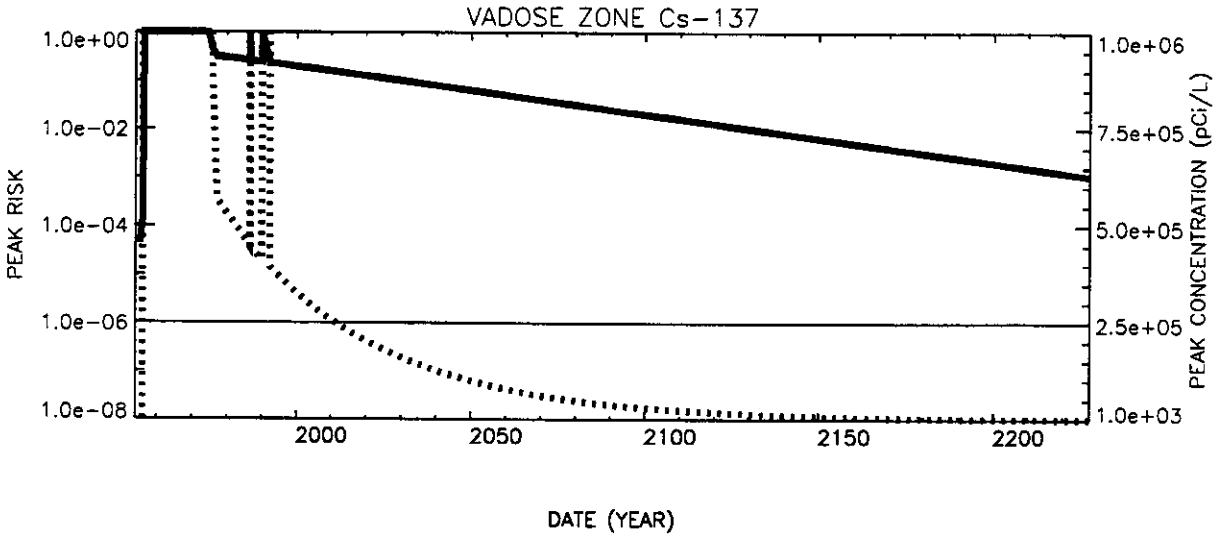


Figure 7-78 Peak vadose zone risk and concentration for Cs-137. Risk indicated by the thick line on the log scale with the 10^{-6} value shown as the solid line. The dotted line represents concentration given by the linear scale on the right axis with the MCL shown as the straight horizontal line.

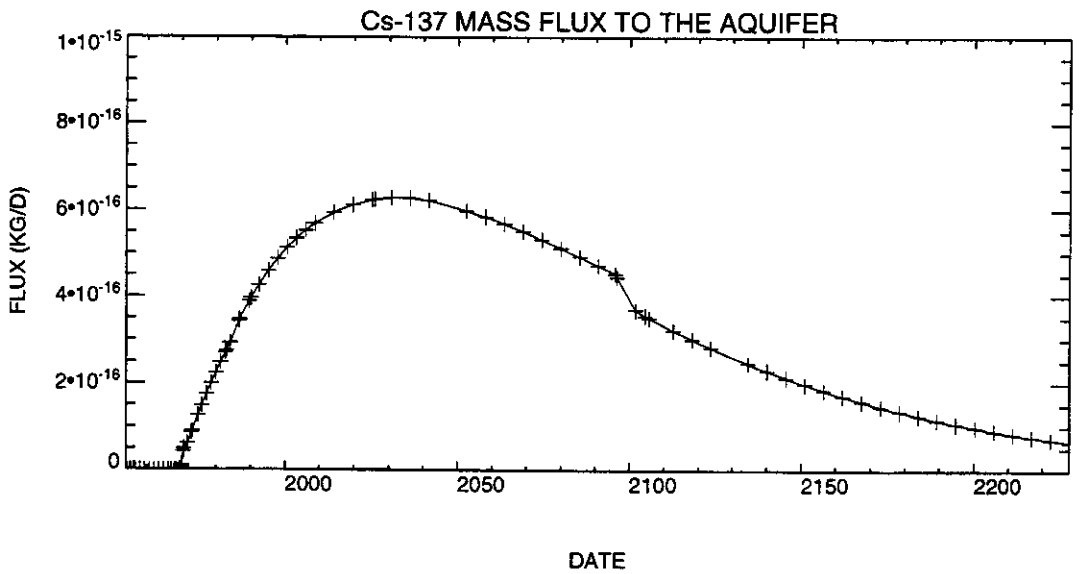


Figure 7-79 Mass flux of Cs-137 into the aquifer from the vadose zone.

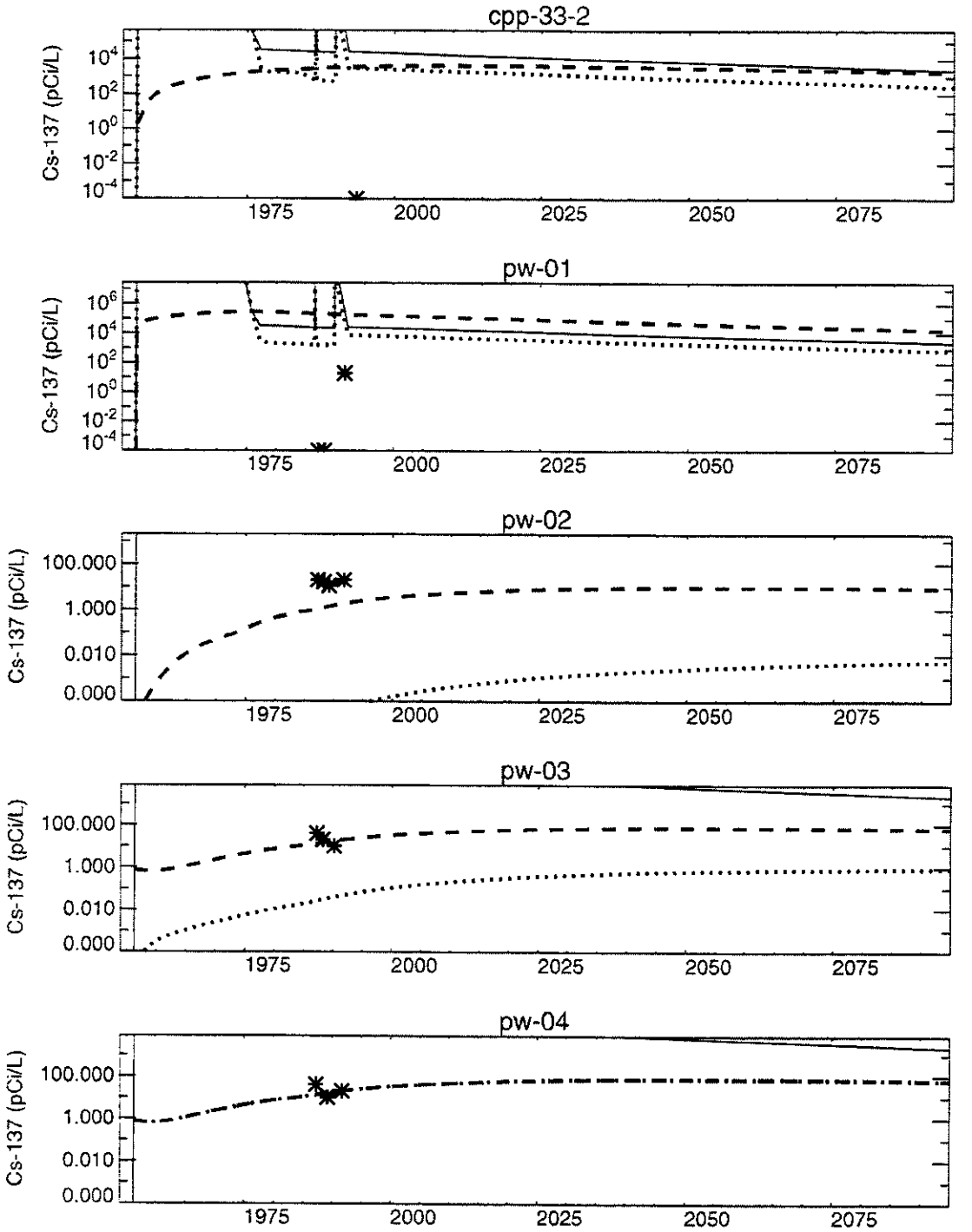


Figure 7-80 Comparison of vadose zone Cs-137 to field data.

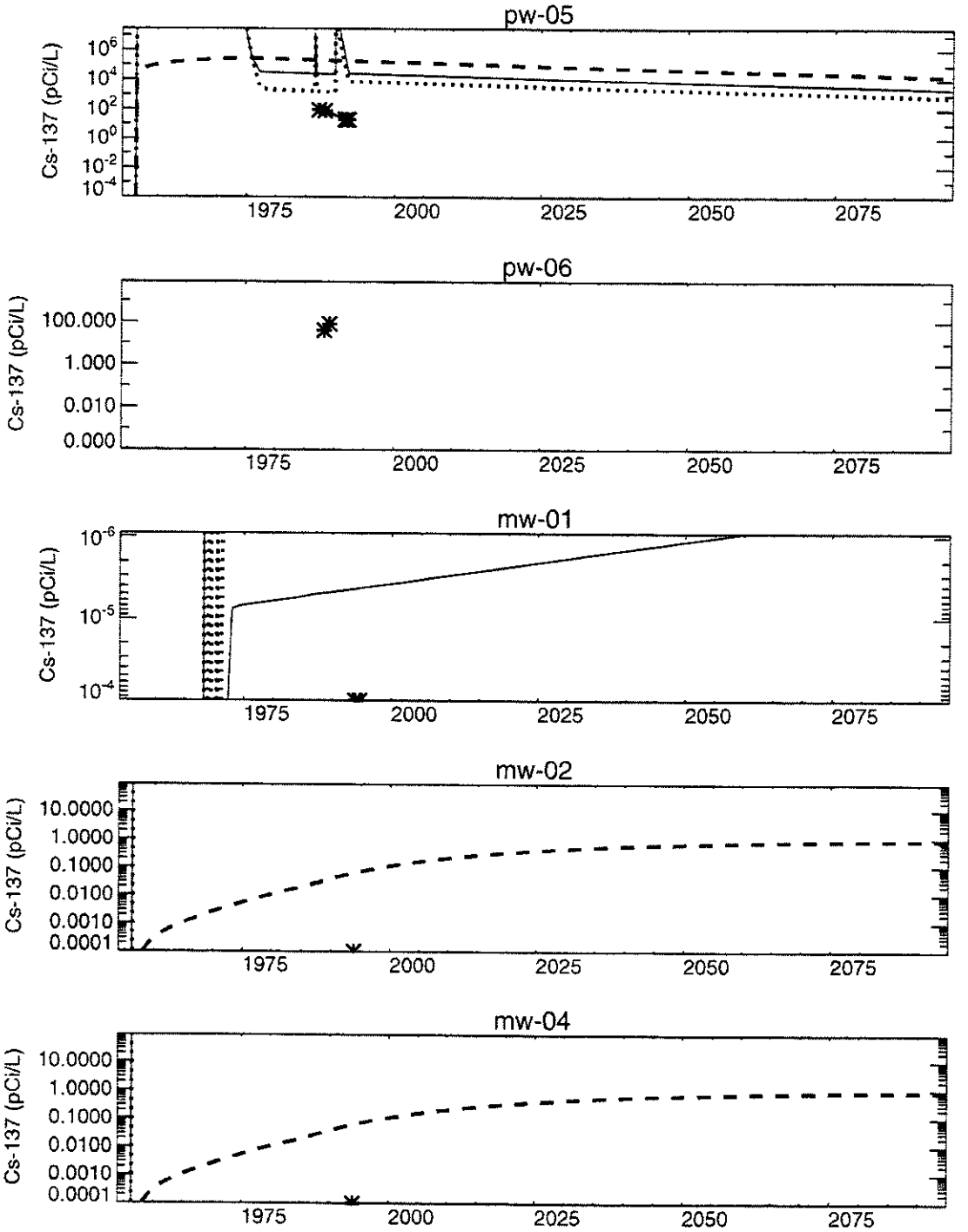


Figure 7-81 Comparison of vadose zone Cs-137 to field data.

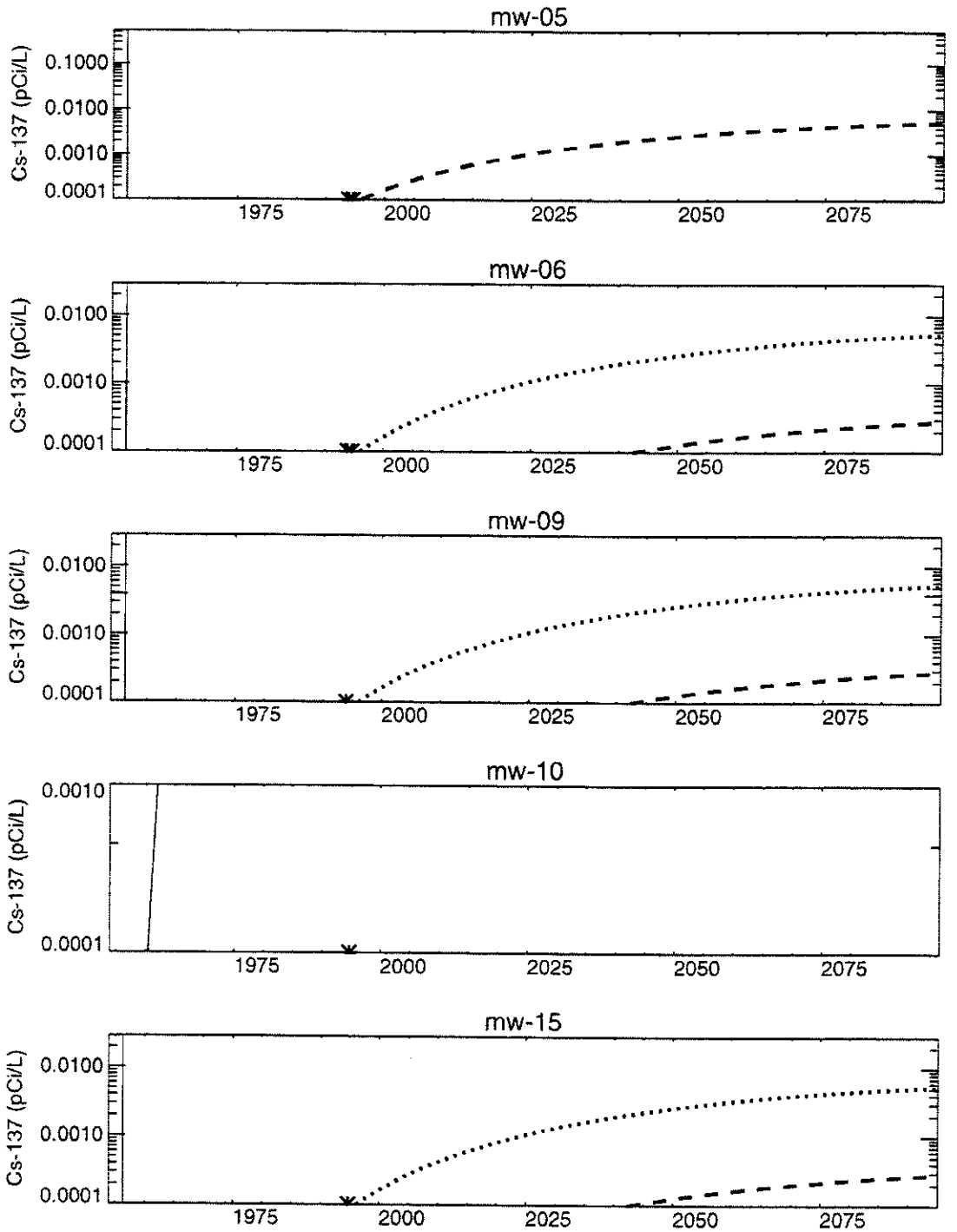


Figure 7-82 Comparison of vadose zone Cs-137 to field data.

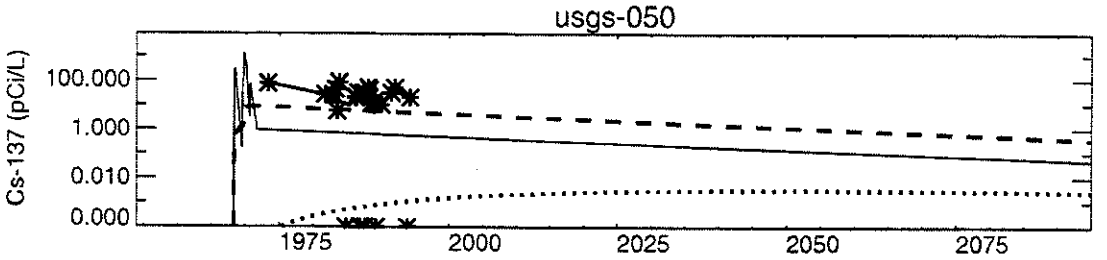


Figure 7-83 Comparison of vadose zone Cs-137 to field data.

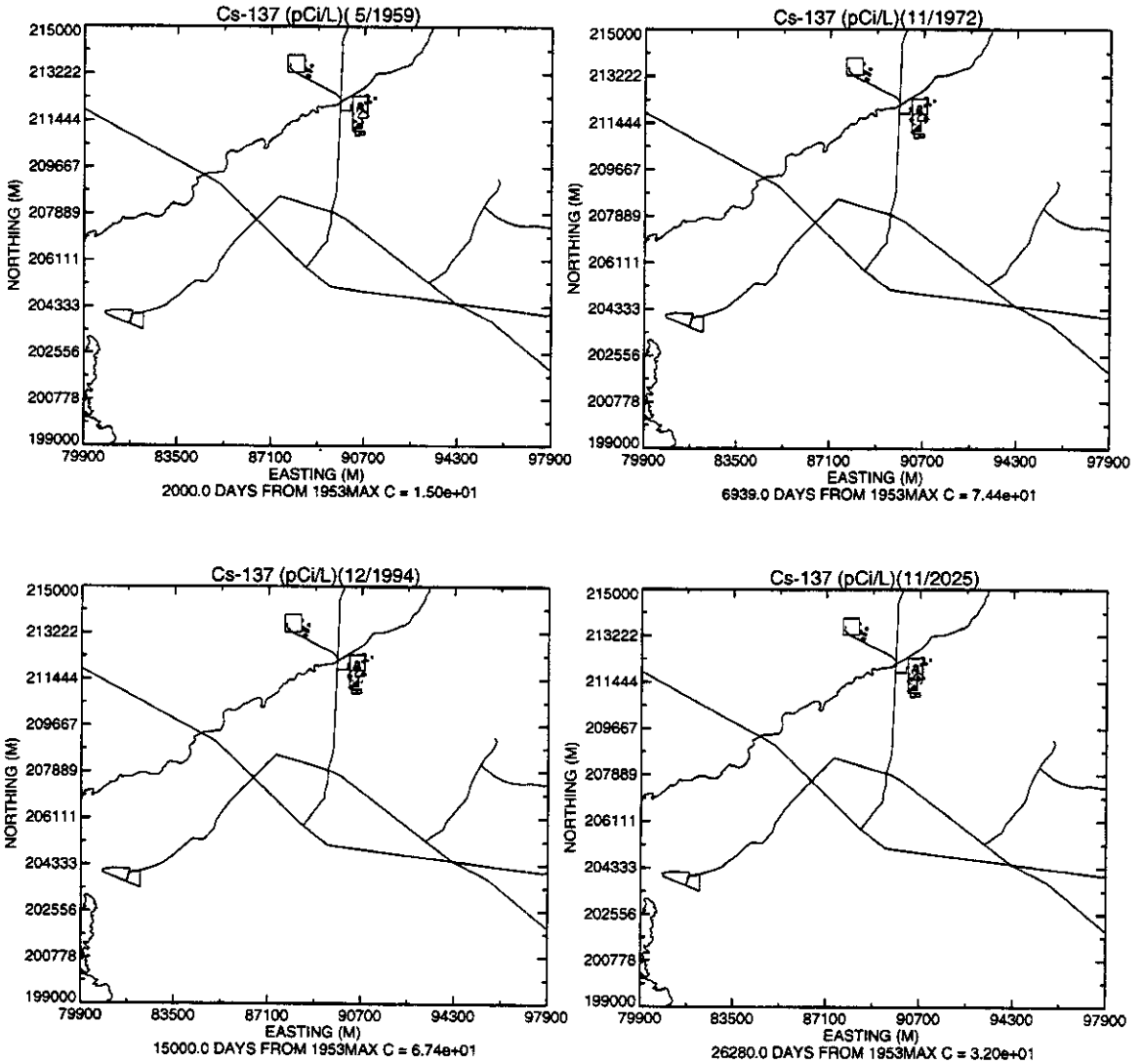


Figure 7-84 Aquifer Cs-137 peak concentration contours.

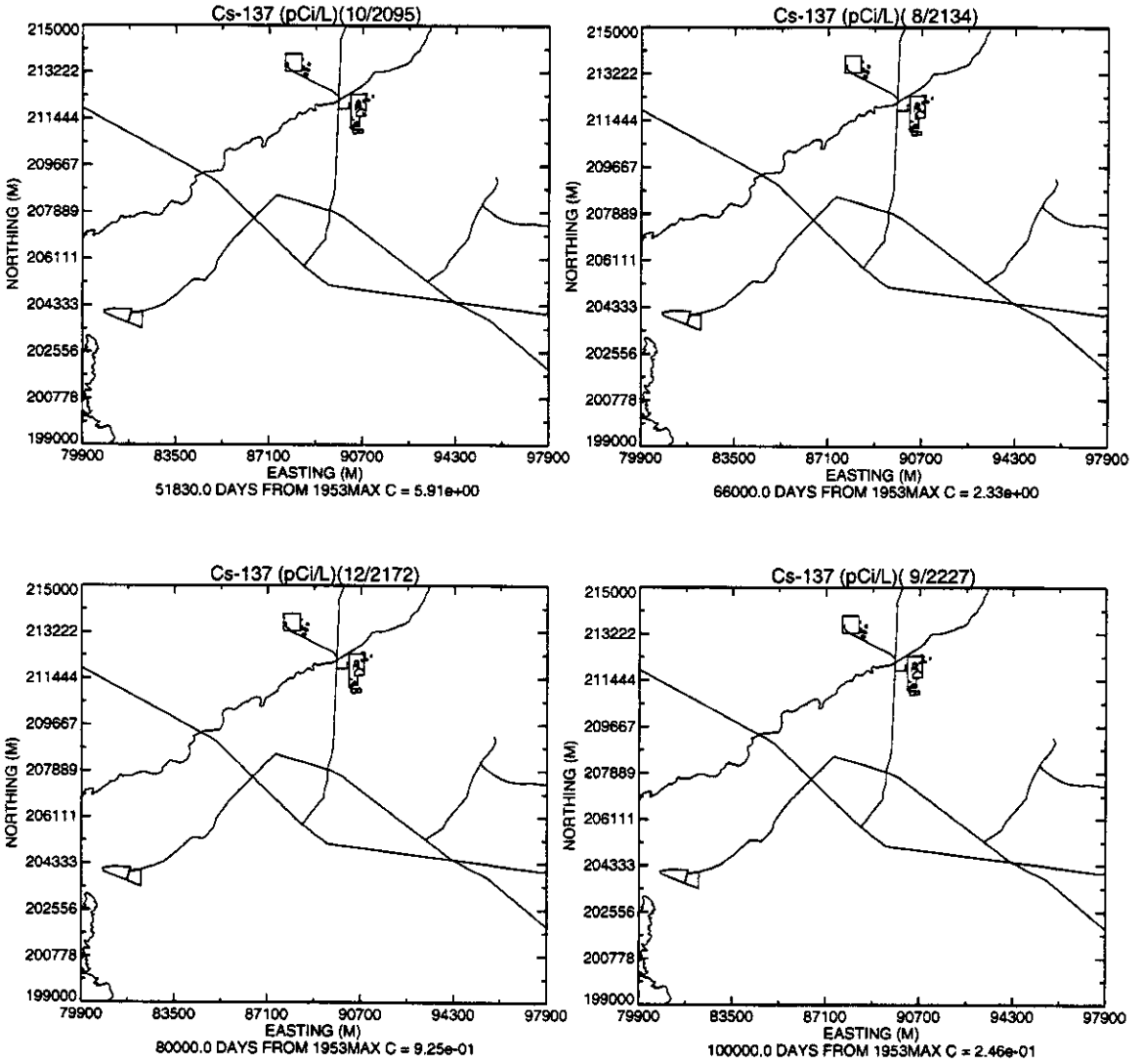


Figure 7-85 Aquifer Cs-137 peak concentration contours.

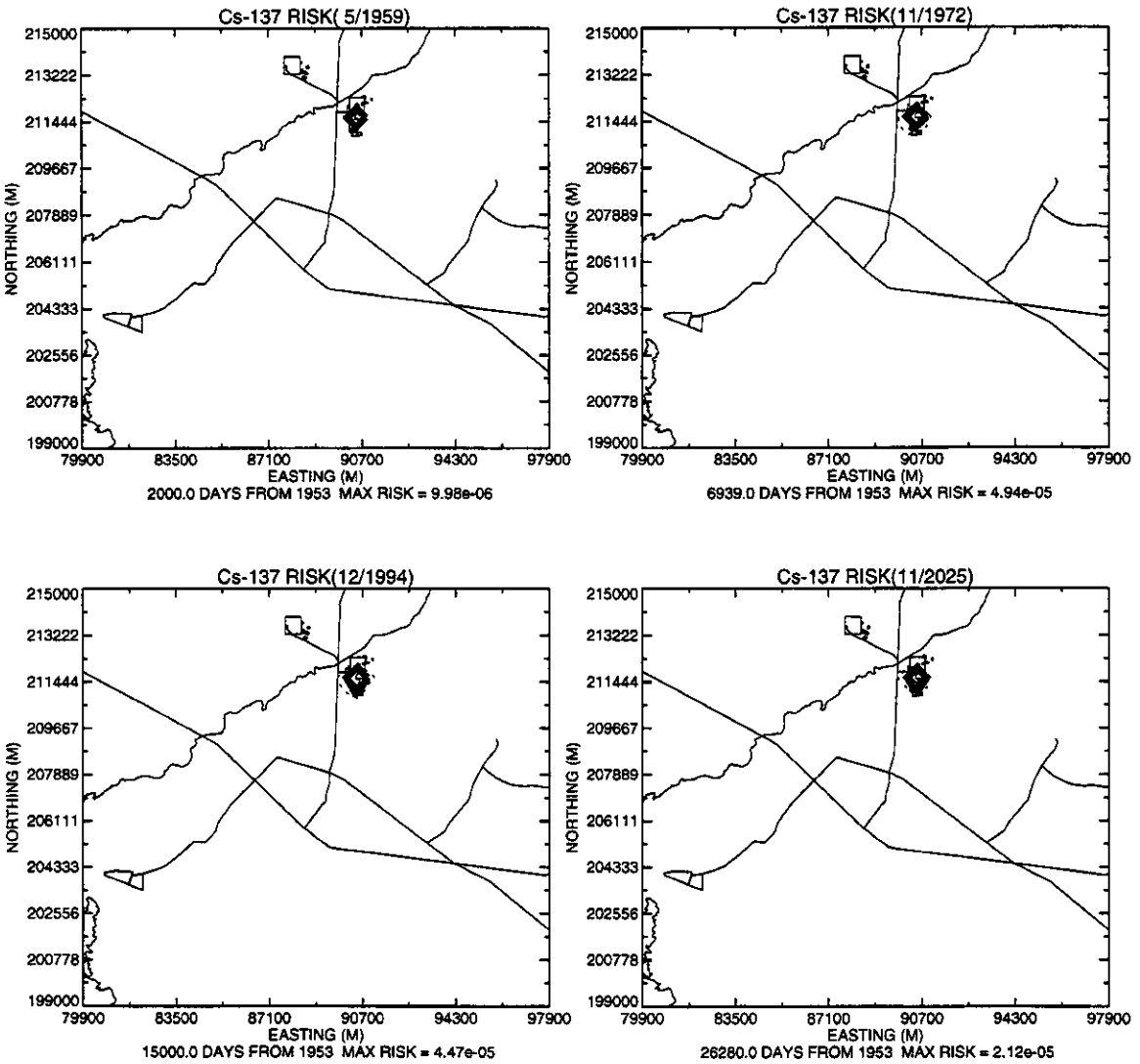


Figure 7-86 Aquifer Cs-137 peak risk contours.

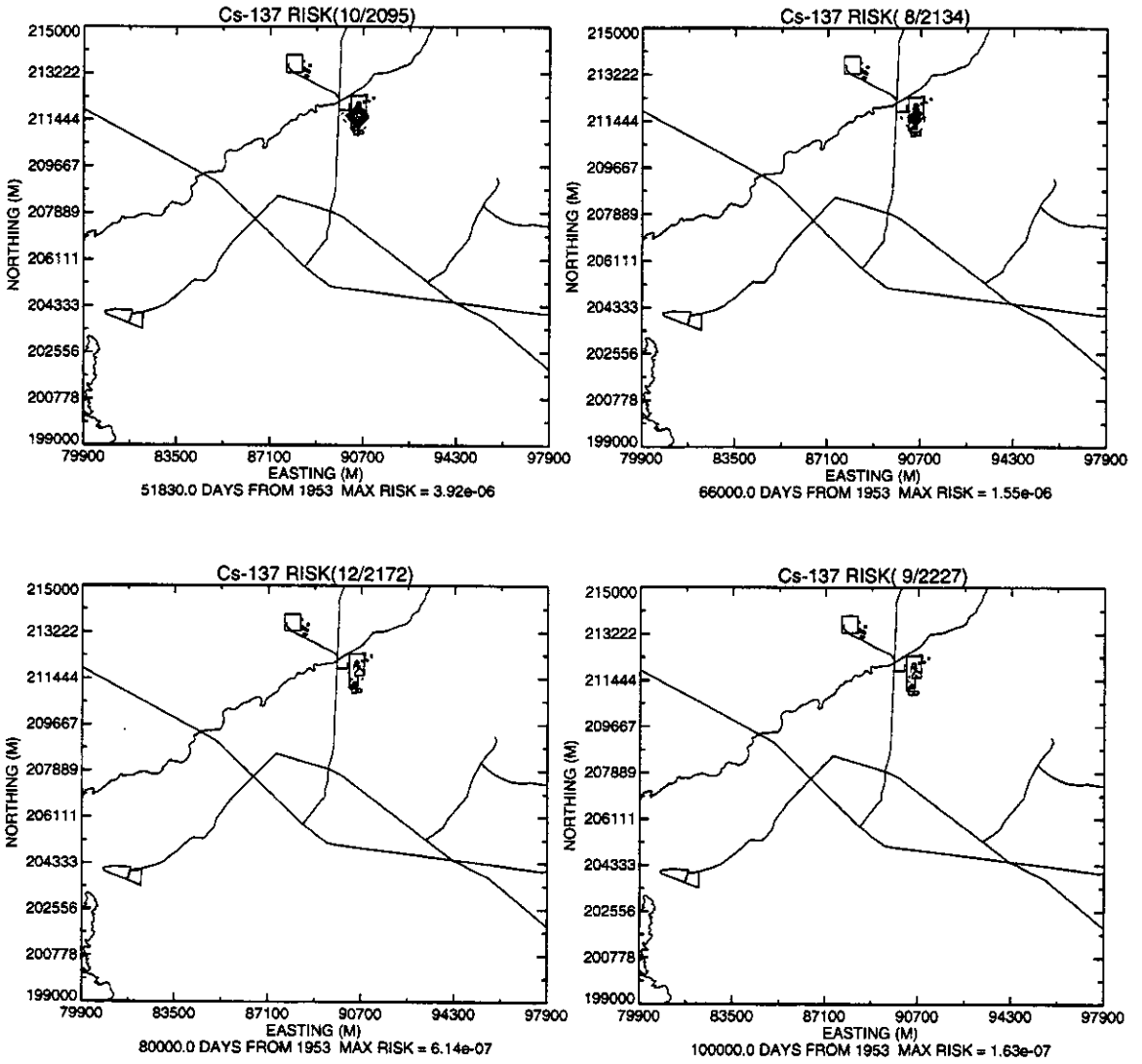


Figure 7-87 Aquifer Cs-137 peak risk contours.

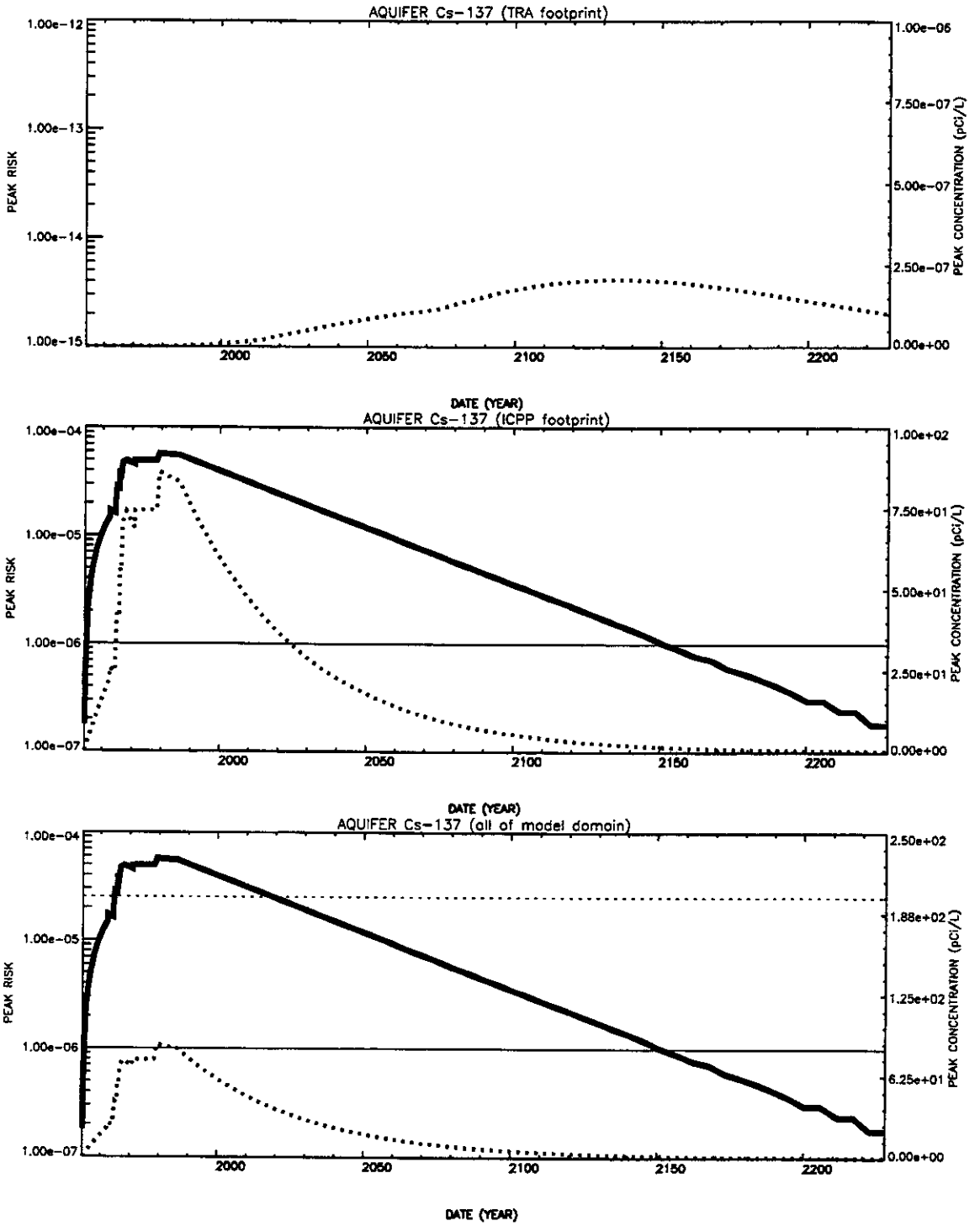


Figure 7-88 Peak aquifer concentration for Cs-137. Top figure: TRA foot print, Middle figure: ICPP footprint, Bottom Figure: entire aquifer domain. Thick line risk (left scale), dotted line concentration (right scale) solid line 10^{-6} risk (left scale).

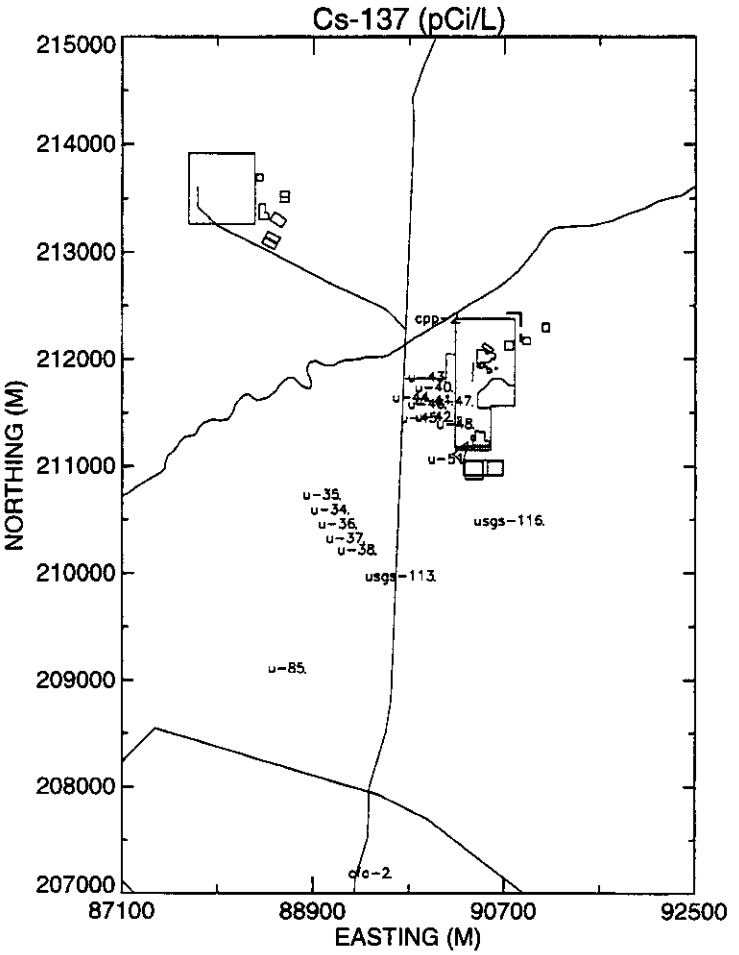


Figure 7-89 Well locations for the comparison of aquifer Cs-137 to field data.

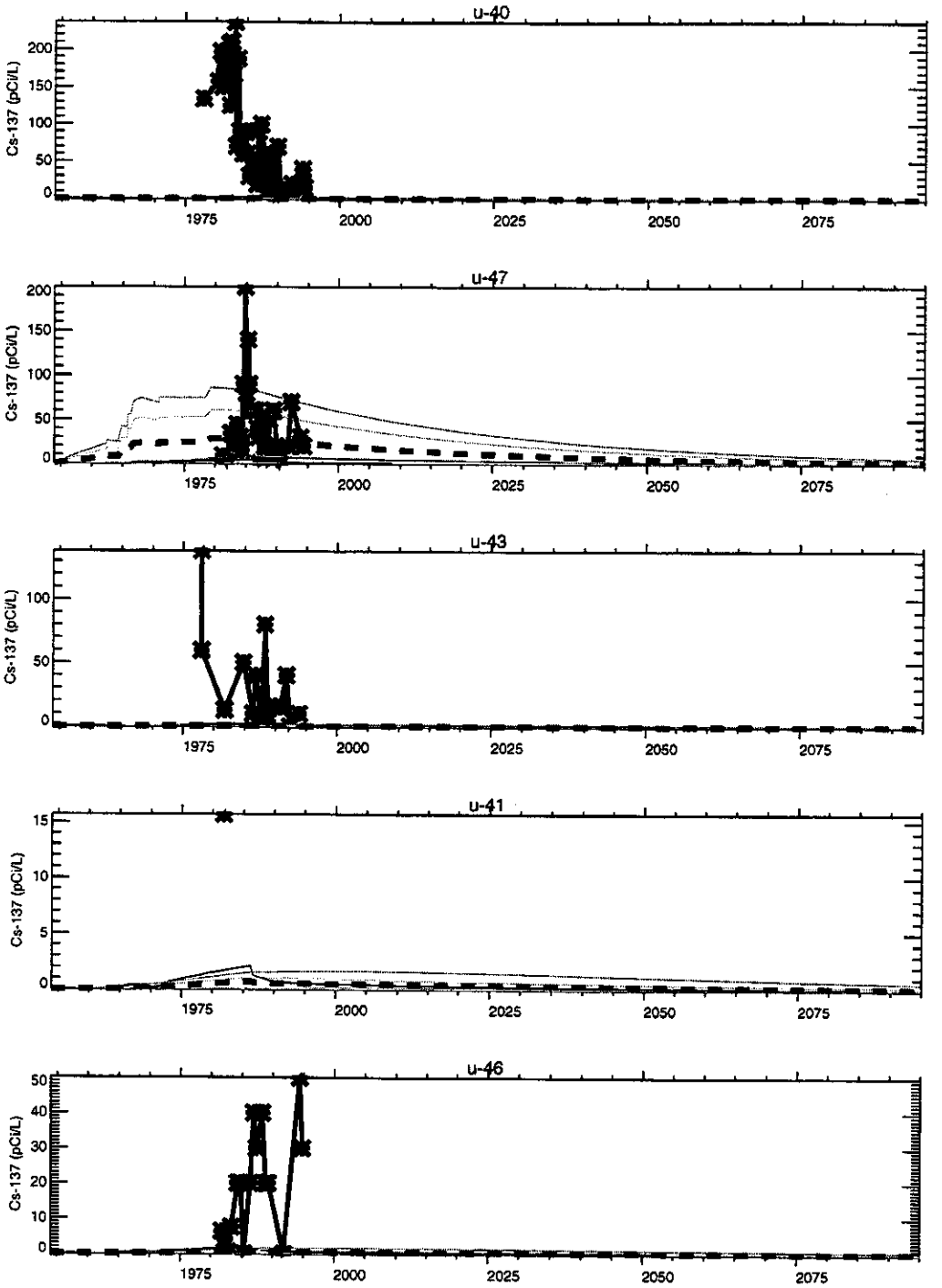


Figure 7-90 Comparison of aquifer Cs-137 to field data.

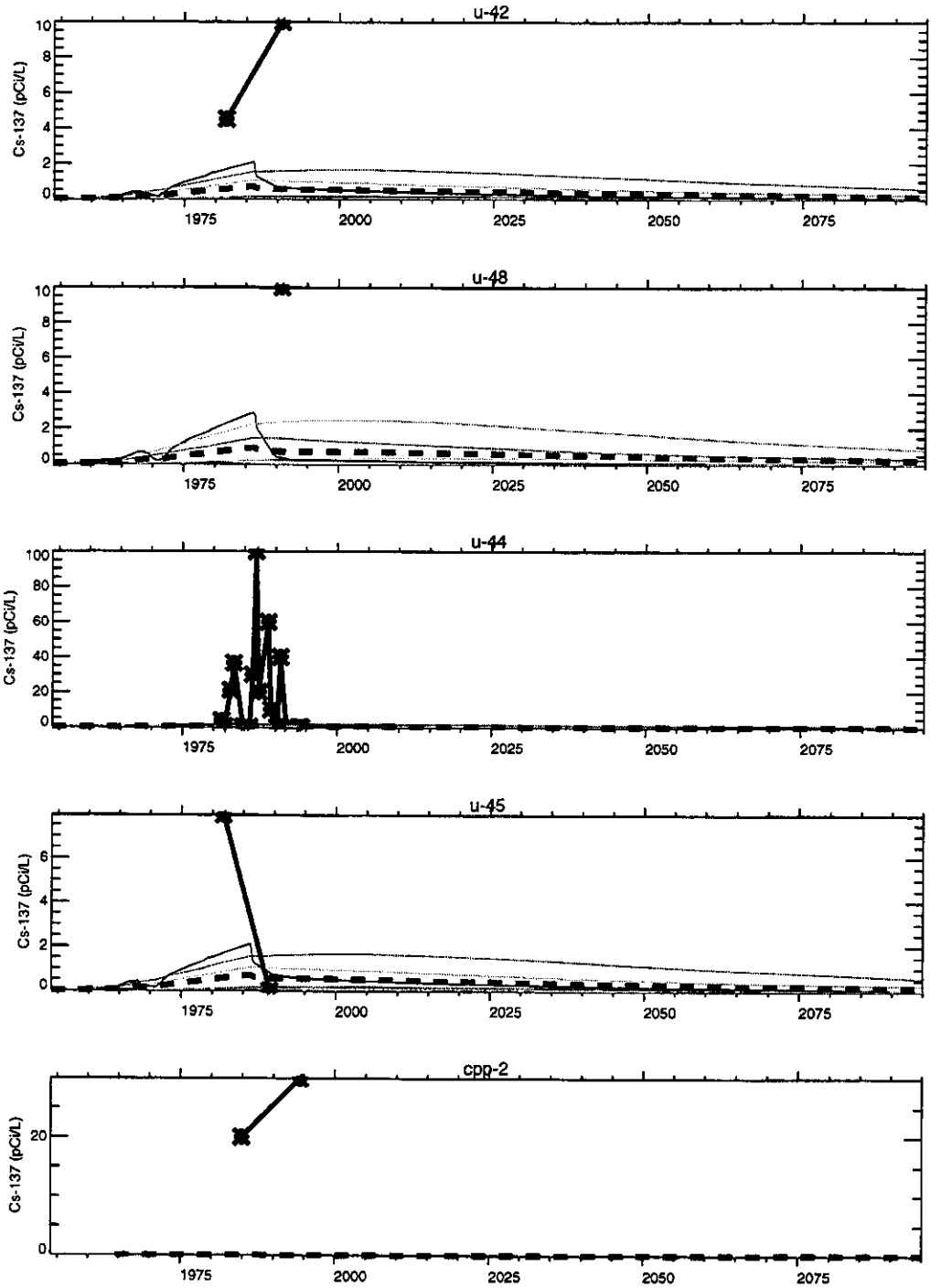


Figure 7-91 Comparison of aquifer Cs-137 to field data.

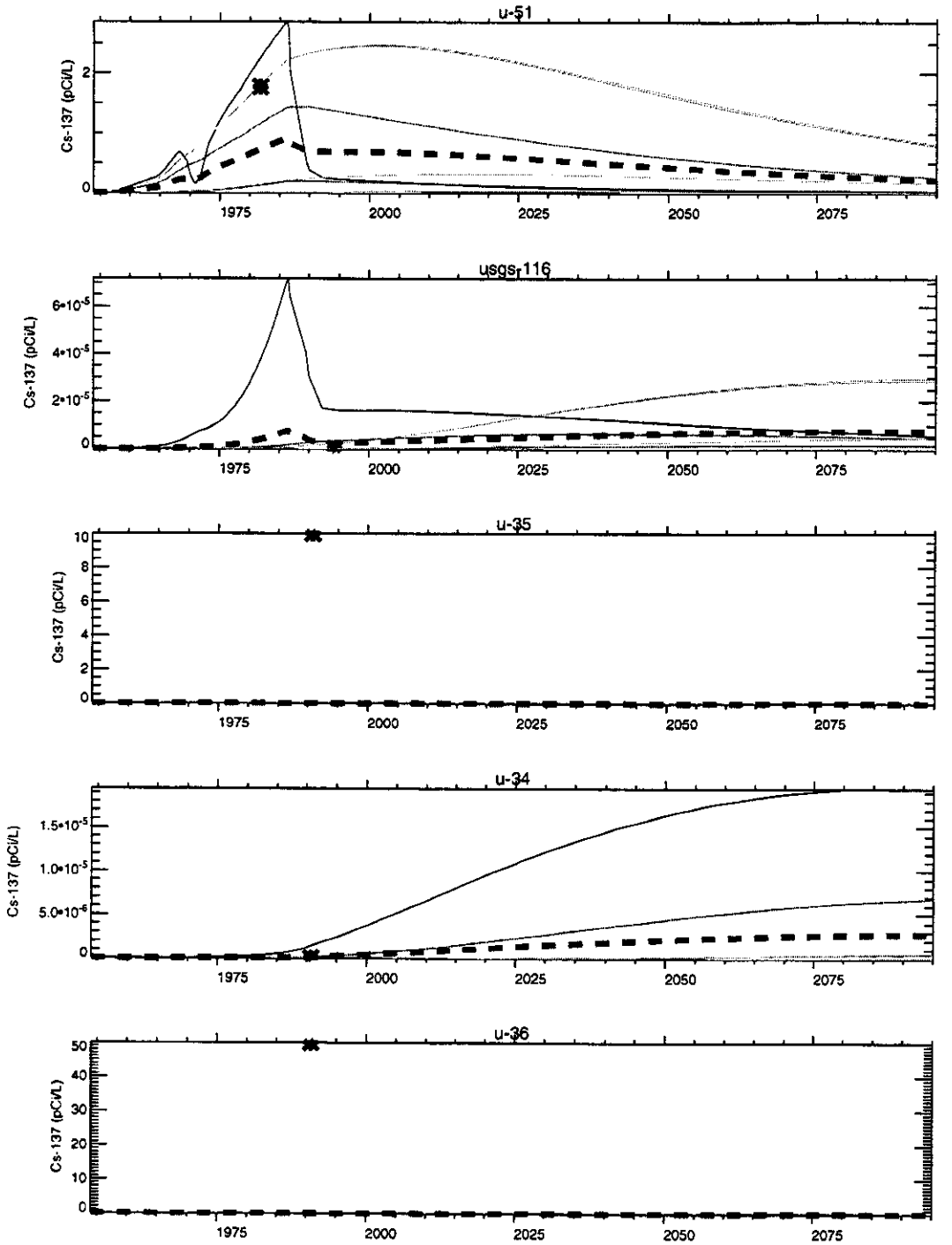


Figure 7-92 Comparison of aquifer Cs-137 to field data.

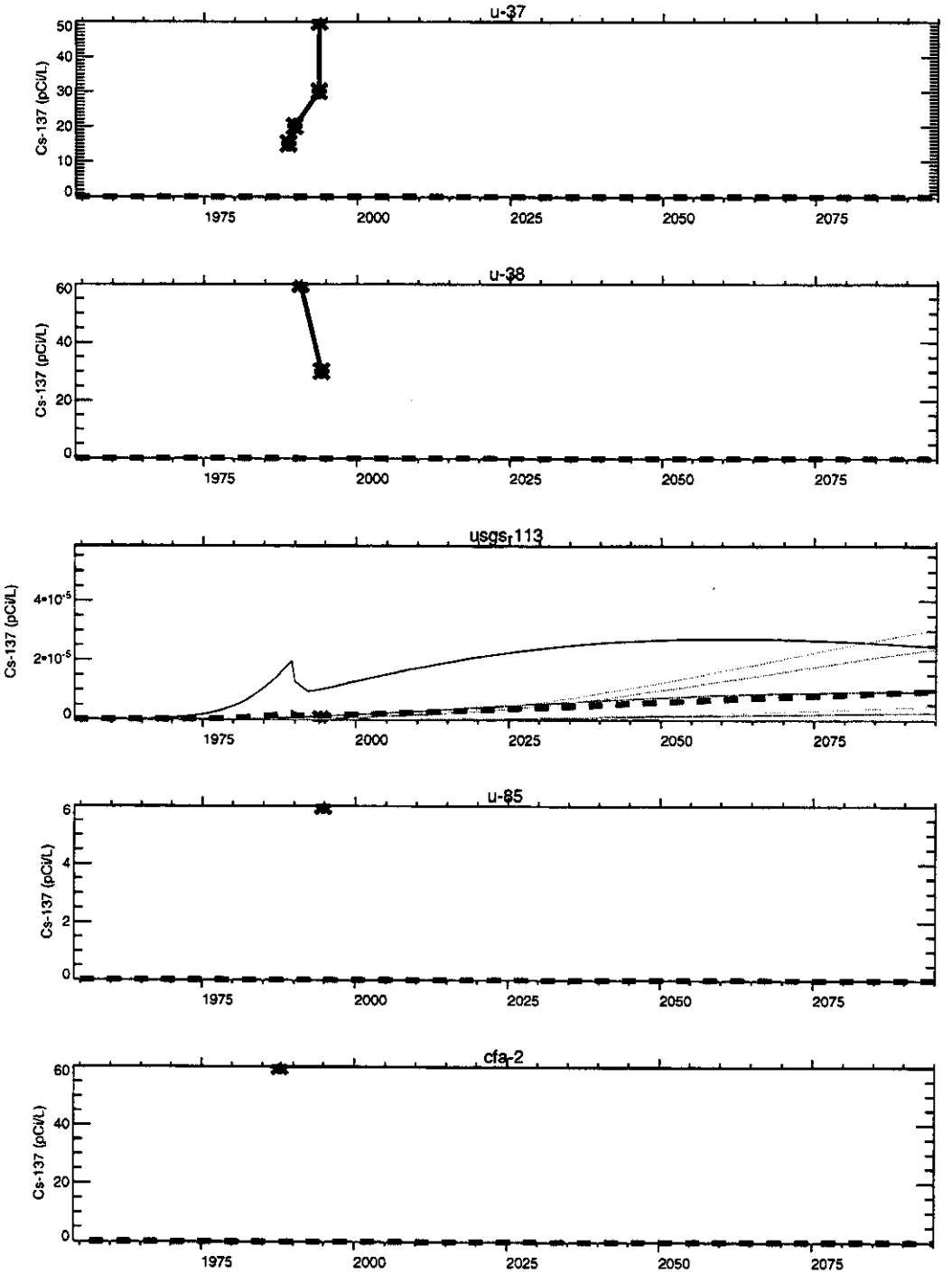


Figure 7-93 Comparison of aquifer Cs-137 to field data.

7.6 H-3

Figures 7-94 through 7-102 present the simulation results for the transport of H-3 through the vadose zone, and Figures 7-103 through 7-121 present simulation results for the aquifer region. Contour levels for both the vadose zone and aquifer (Figures 7-94 through 7-97, 7-103, and 7-106) are given for $2.0x10^{+2}$, $2.0x10^{+3}$, $2.0x10^{+4}$, $2.0x10^{+5}$, $2.0x10^{+6}$, $2.0x10^{+7}$ pCi/L, with the MCL (20000 pCi/L) represented by the dark solid line. The corresponding risk contour maps for the aquifer region are given in Figures 7-107, through 7-110. Risk contours are given for 10^{-7}, 10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}, and 10^{-2} levels with the 10^{-6} value (671 pCi/L) indicated by the thick line, and the 10^{-4} level indicated by the medium solid line.

VADOSE ZONE: H-3 is transported through the vadose zone and into the aquifer because of the zero assumed adsorption and thus provides an indication of the effective transport velocity. In addition, the H-3 simulations illustrate the relative influence on dilution caused by the large percolation pond water fluxes. This difference is apparent by comparing the vadose zone concentrations resulting from the combined CPP-28 and CPP-31 sources (0.02% and 0.07%, respectively) to the concentrations resulting from the mass originating in the percolation ponds (4.78%). Relative to the area beneath the percolation ponds, the small water fluxes coming from the tank farm area result in higher concentrations given the much smaller initial tank farm area mass. In both cases, because of the short half life, the bulk of the H-3 originating near the land surface decays on the way to the aquifer. However, the H-3 shown in the lower interbed at 1972 originates as a result of the injection well failure during that time period, and does reach the aquifer fairly rapidly.

Figure 7-98 shows two local maxima in the vadose zone peak concentration. The first peak corresponds to fluxes from the failed injection well in 1970 and the second from the surface fluxes. This figure also indicates that the vadose zone maximum concentration of H-3 drops below the MCL in 2038. Because the concentration was below the MCL and because the peak mass flux from the vadose zone had been predicted to occur earlier, the simulations were terminated in the year 2095.

Comparisons of model predicted concentrations to vadose zone field data (Figures 7-100 through 7-102) are very good for the PW-01 through PW-05 wells which are near the percolation ponds and for USGS-50 which is completed in the lower interbed near the injection well. This indicates that the flux rates and source terms are reasonably accurate for those two sources which is consistent with the percolation pond disposal records as compared to the records available for the other source terms. H-3 has been detected in PW-06, and the model predicts the arrival of H-3 to that far west well. This provides an indication that the Kd used for Cs-137 is too high. In that simulation, the Cs-137 did not migrate to the PW-06 well, but this non-sorptive simulation shows that a flow path to that well exists. The northern wells near the tank farm area were sampled and indicated that H-3 concentrations should have been roughly equal to the PW wells in the south. The model predicts concentrations in the correct range for those wells.

AQUIFER: At the end of the vadose zone and aquifer simulations (2095), the predicted peak H-3 aquifer concentration was 89 pCi/L. This concentration is less than both the 10^{-6} risk concentration (671 pCi/L) and the MCL (20,000 pCi/L). As shown in Figure 7-111, the 10^{-6} risk level for H-3 is predicted to be exceeded until the year 2050 and the MCL is exceeded until the year 2003. Because of the early injection of H-3 directly into the aquifer (95.14% of the total mass), the peak concentration was predicted to have been $2.6x10^{6}$ pCi/L in 1960. In addition, the aquifer area with predicted peak concentrations greater than the 10^{-6} risk concentration should remain relatively large (as shown in Figures 7-103 through 7-108) for the next 30 to 40 years. In addition, these figures show that the plumes from TRA and the ICPP merge at levels above 10^{-6} risk levels, but that the resultant mixing produces concentrations below the MCL.

Comparisons of model predicted concentrations to aquifer field data are shown in Figures 7-113 through 7-124. Comparisons of the ICPP area and far-field wells are shown in Figures 7-113 through 7-121. Comparisons of the TRA area wells are shown Figures 7-122 through 7-124. In the area of the ICPP, the predicted concentrations are very close to measured values in most of the wells. This is to be expected given the excellent vadose zone matches and the fact that the ICPP aquifer model was calibrated to the H-3 field data. Because the primary source of H-3 is the injection well, which is well defined, there is relatively little

uncertainty in the source estimates and the predictions. In the area immediately downgradient of TRA, the predicted concentrations are very close to the field data (wells TRA-6, 7, and 8, and USGS-84) as are the predicted concentrations for the TRA disposal well. The model predictions are very high for well hwy-3 to the southwest of TRA and the predictions are very low for the upgradient wells mtr-test, TRA-1, 3, and 4, and site-19.

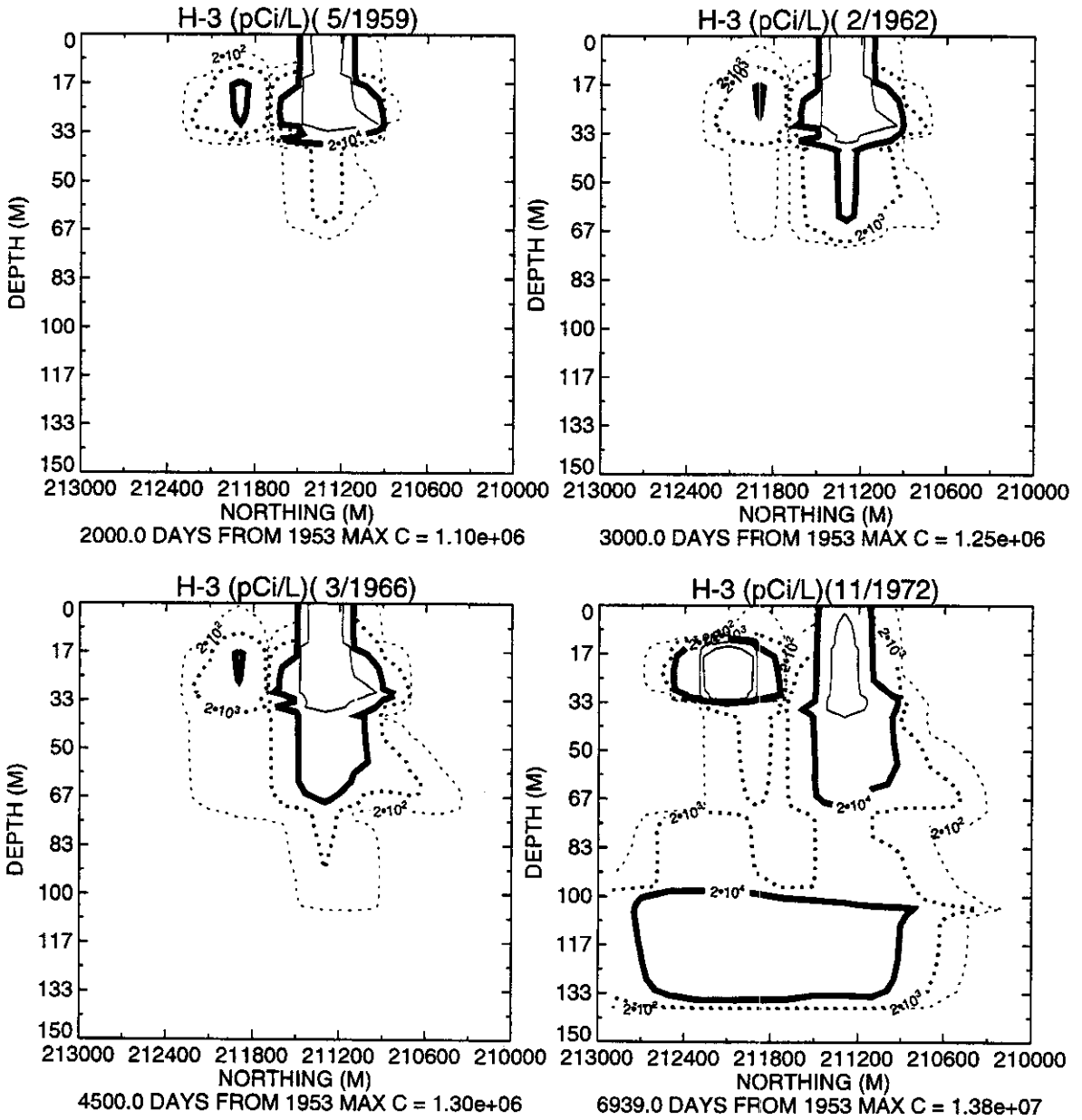


Figure 7-94 Vadose zone H-3 peak concentration contours.

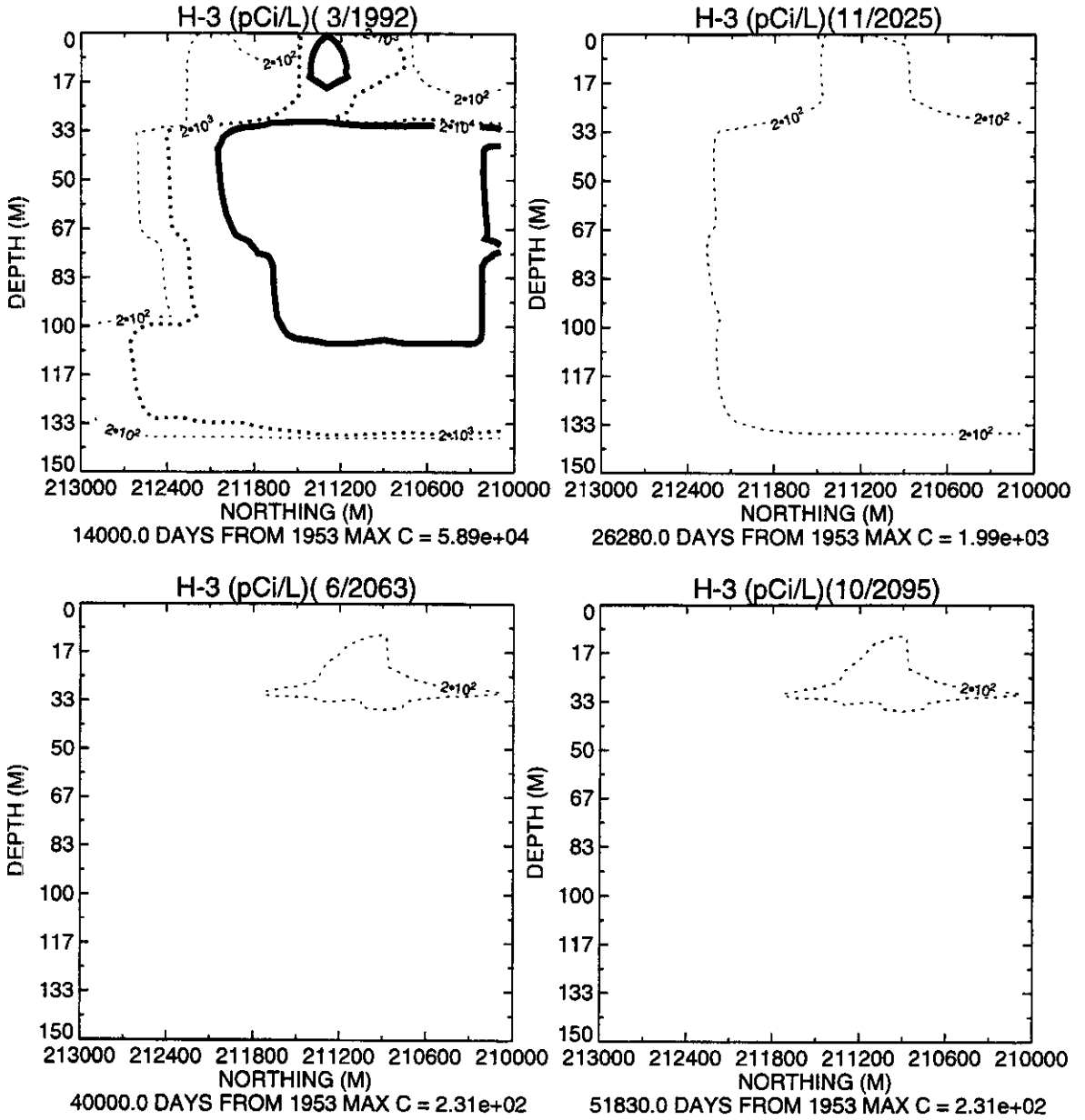


Figure 7-95 Vadose zone H-3 peak concentration contours.

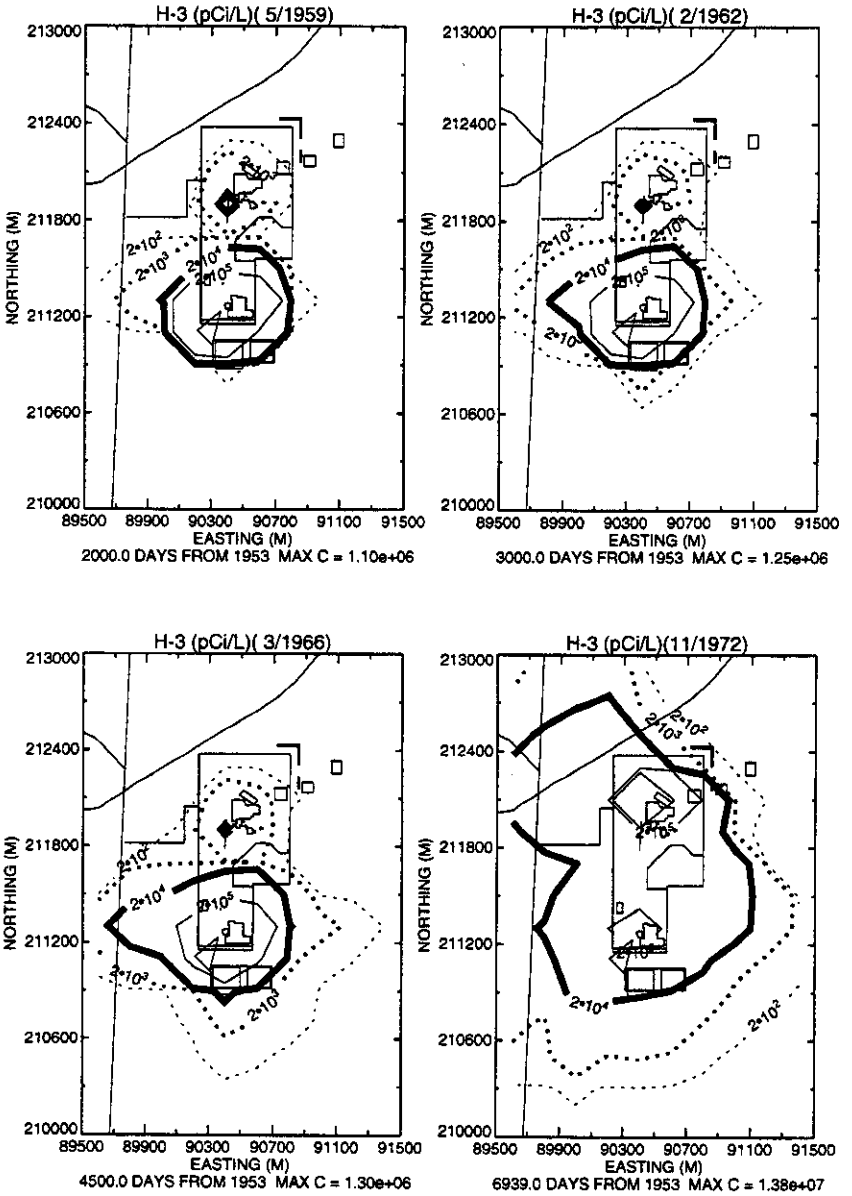


Figure 7-96 Vadose zone H-3 peak concentration contours.

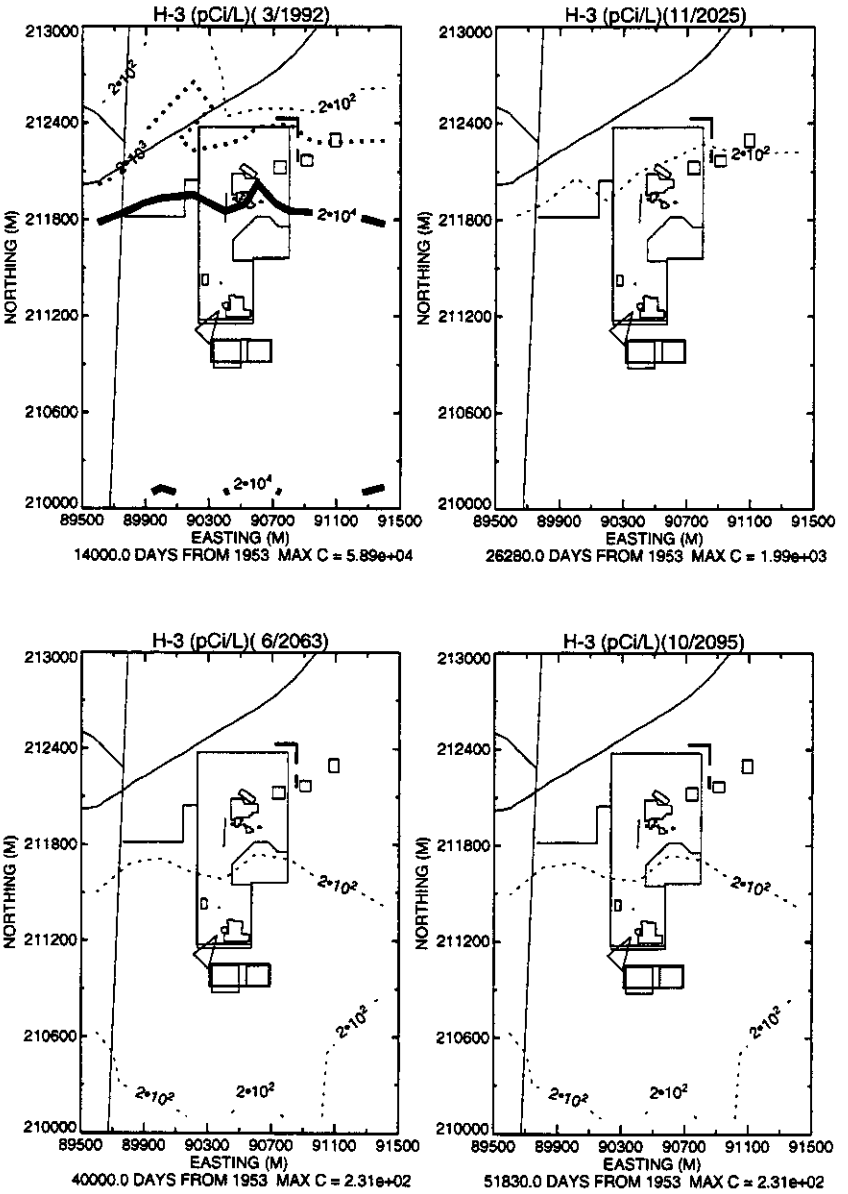


Figure 7-97 Vadose zone H-3 peak concentration contours.

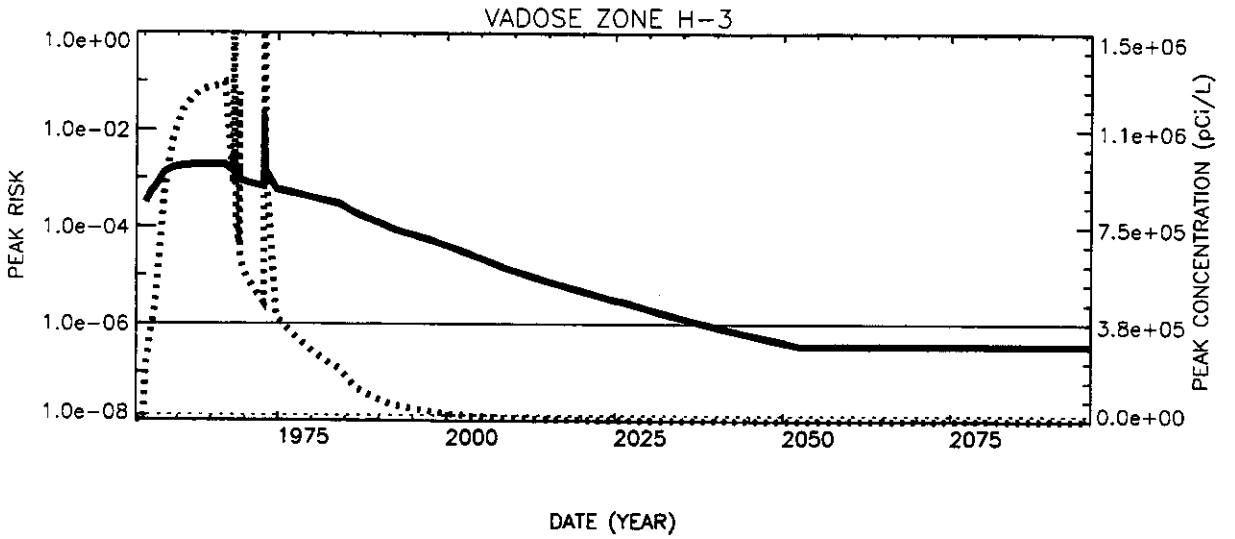


Figure 7-98 Peak vadose zone risk and concentration for H-3. Risk indicated by the thick line on the log scale with the 10^{-6} value shown as the solid line. The dotted line represents concentration given by the linear scale on the right axis with the MCL shown as the straight horizontal line.

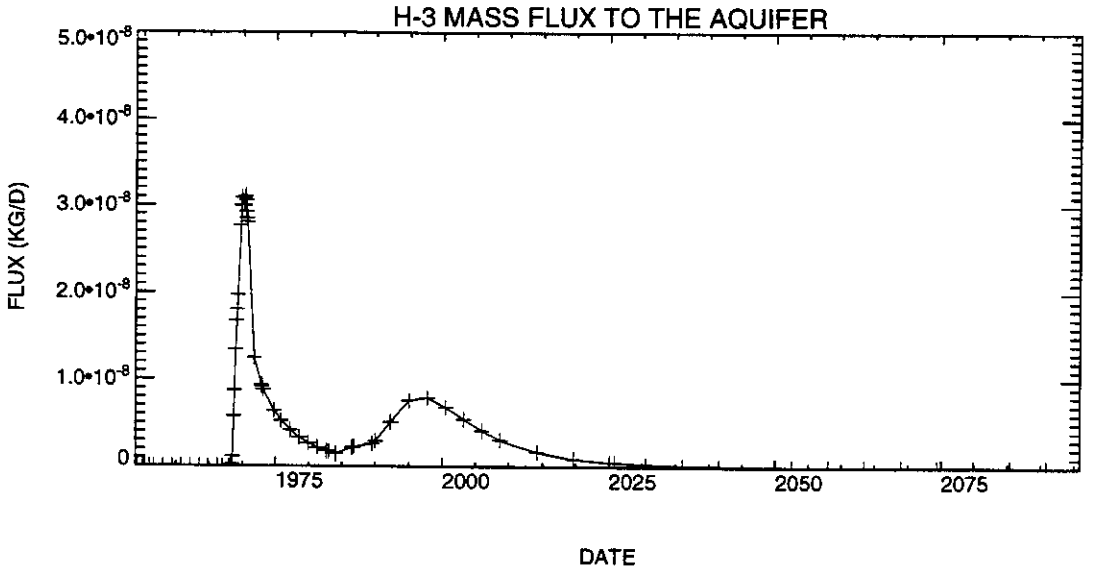


Figure 7-99 Mass flux of H-3 into the aquifer from the vadose zone.

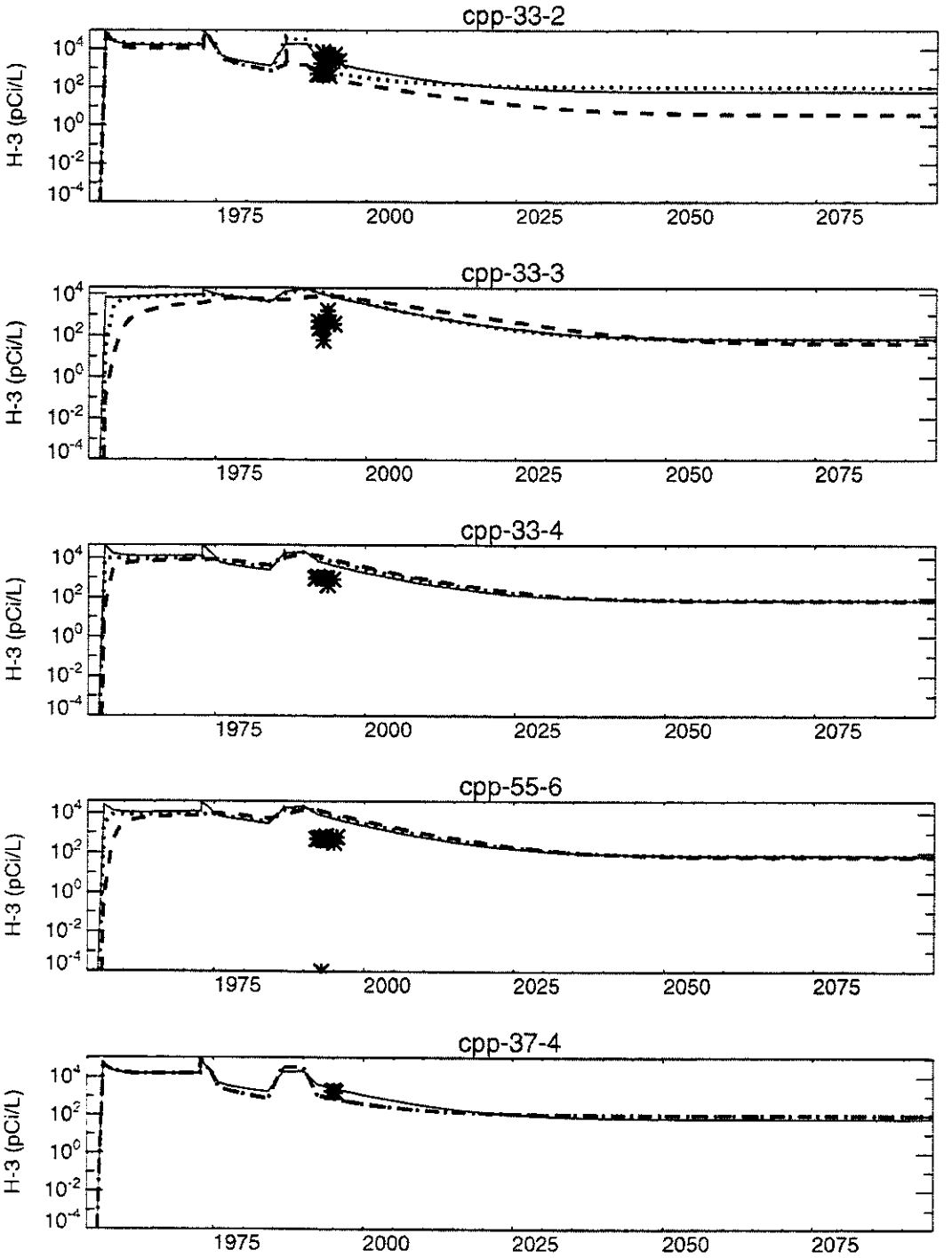


Figure 7-100 Comparison of vadose zone H-3 to field data.

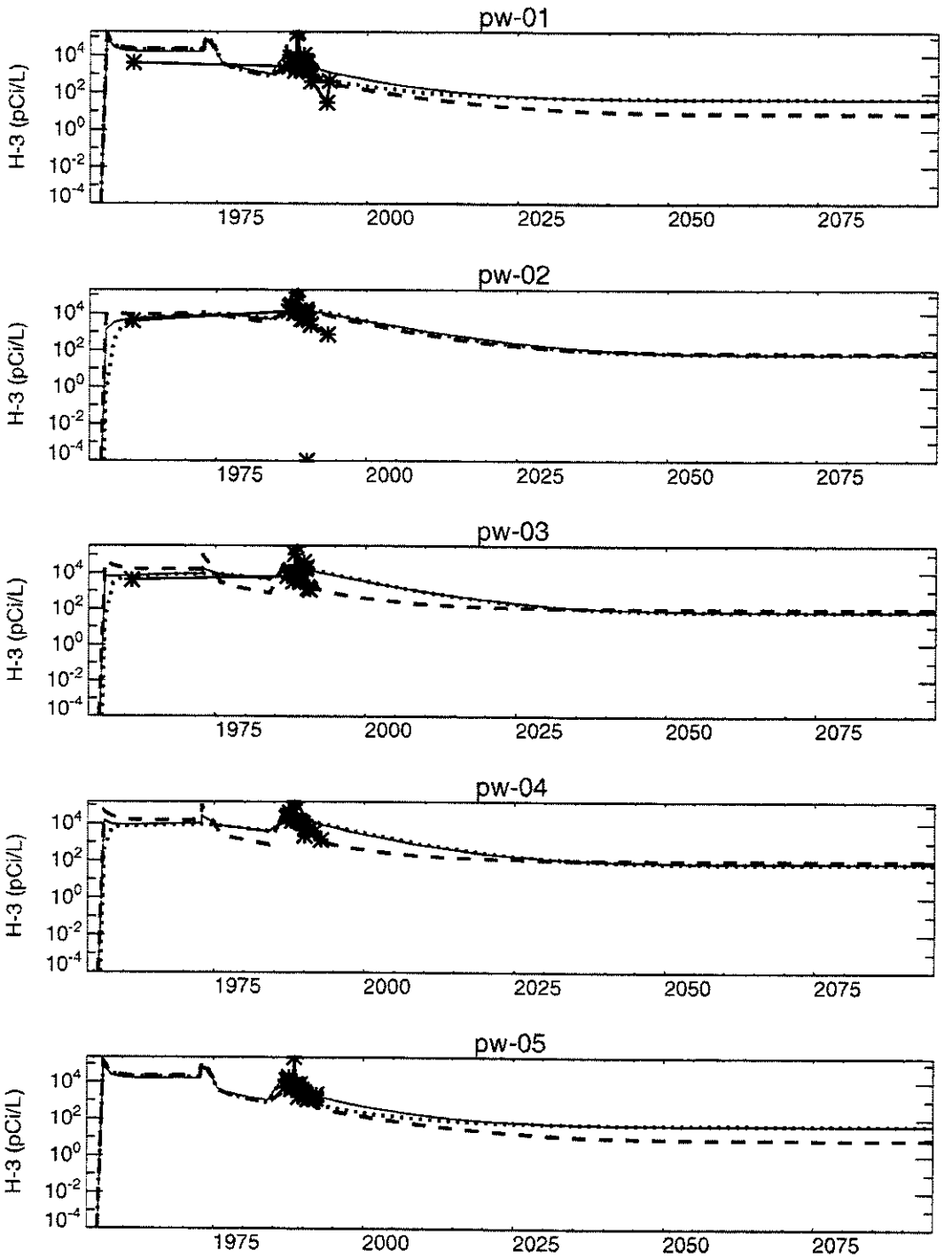


Figure 7-101 Comparison of vadose zone H-3 to field data.

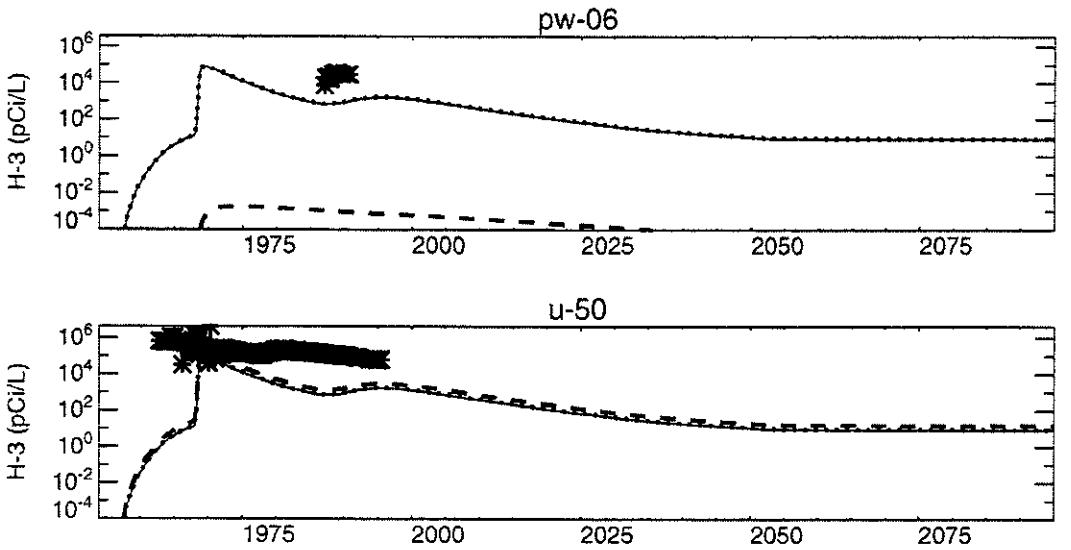


Figure 7-102 Comparison of vadose zone H-3 to field data.

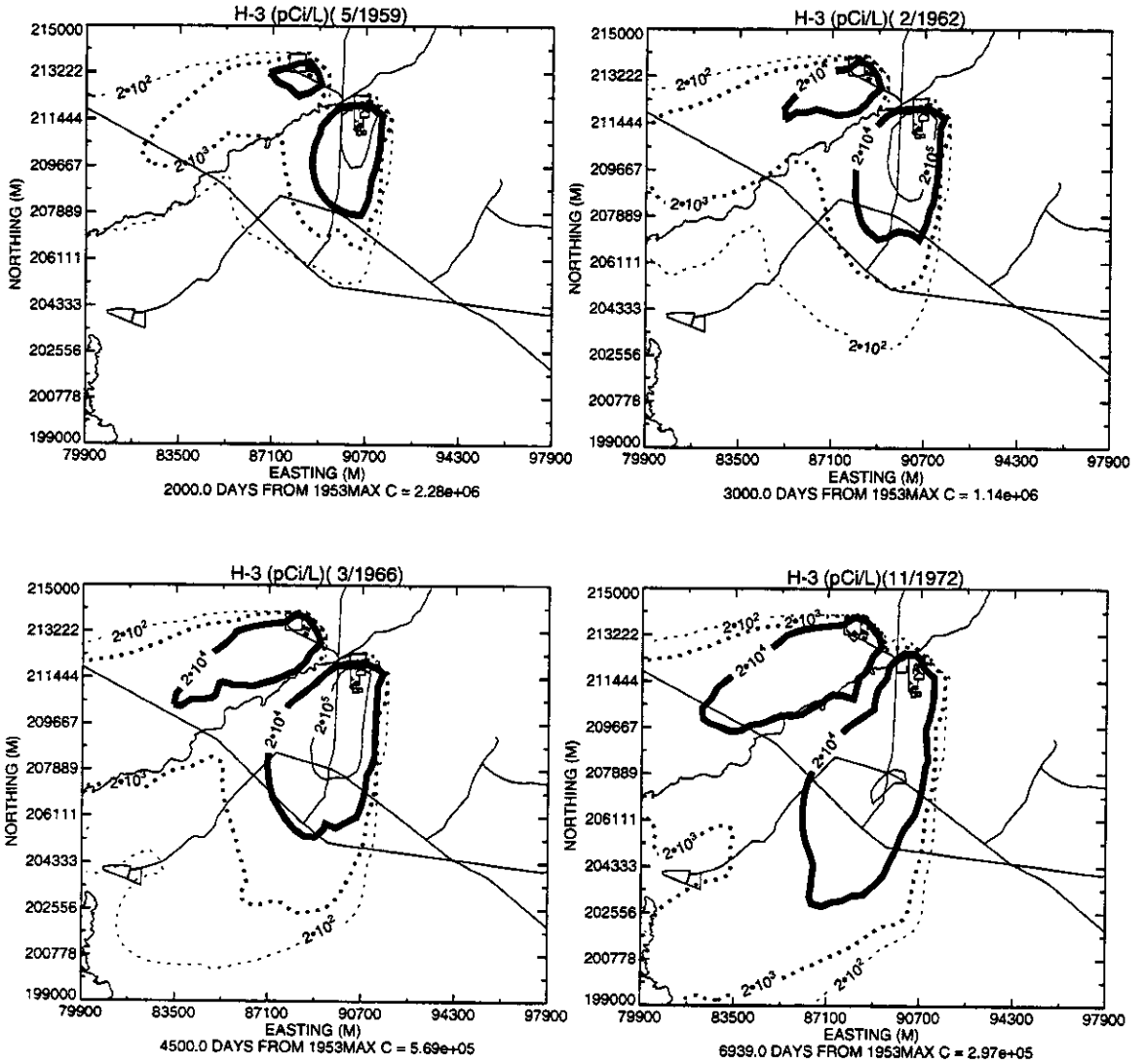


Figure 7-103 Aquifer H-3 peak concentration contours within the extent of the small aquifer model.

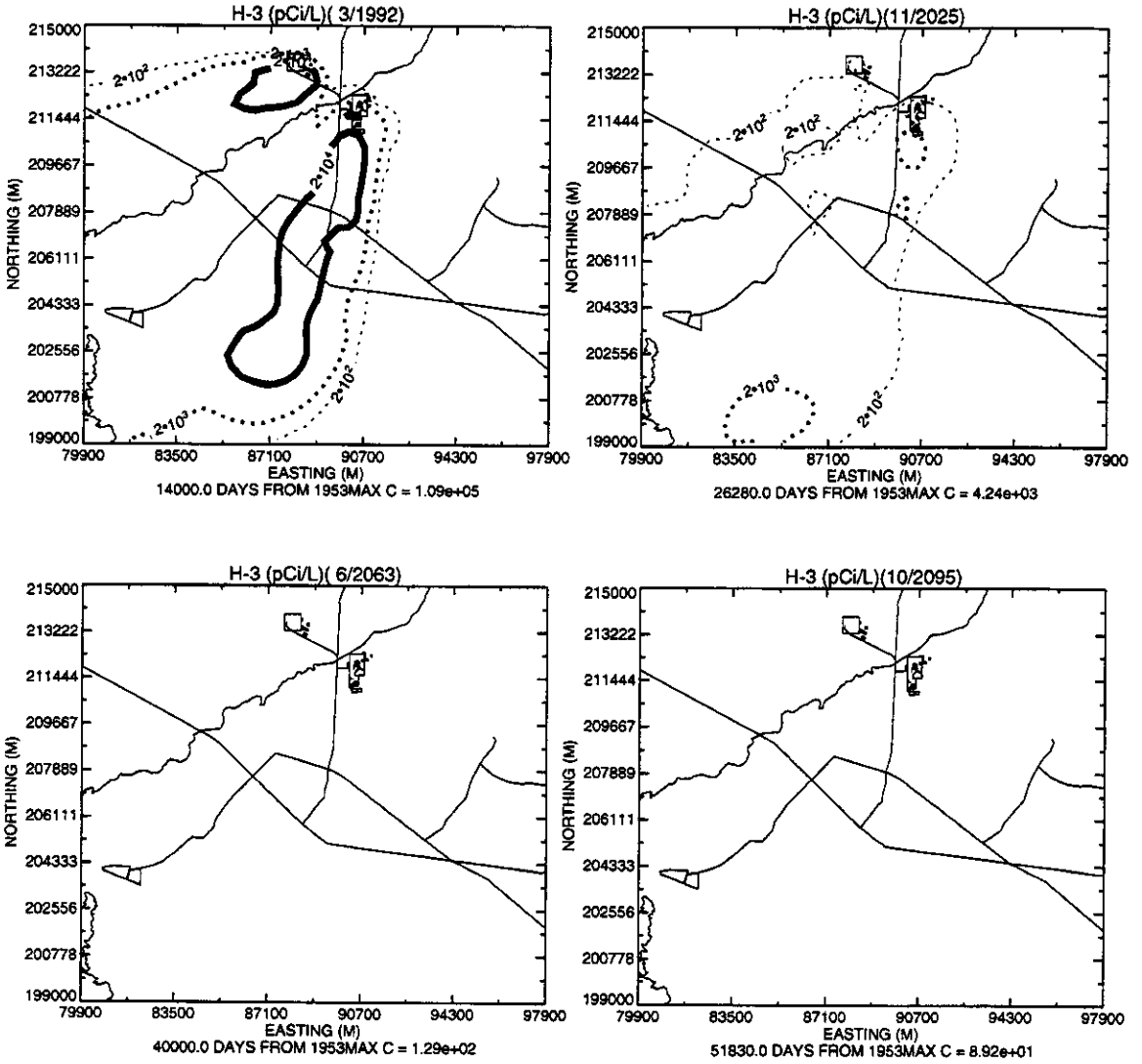


Figure 7-104 Aquifer H-3 peak concentration contours within the extent of the small aquifer model.

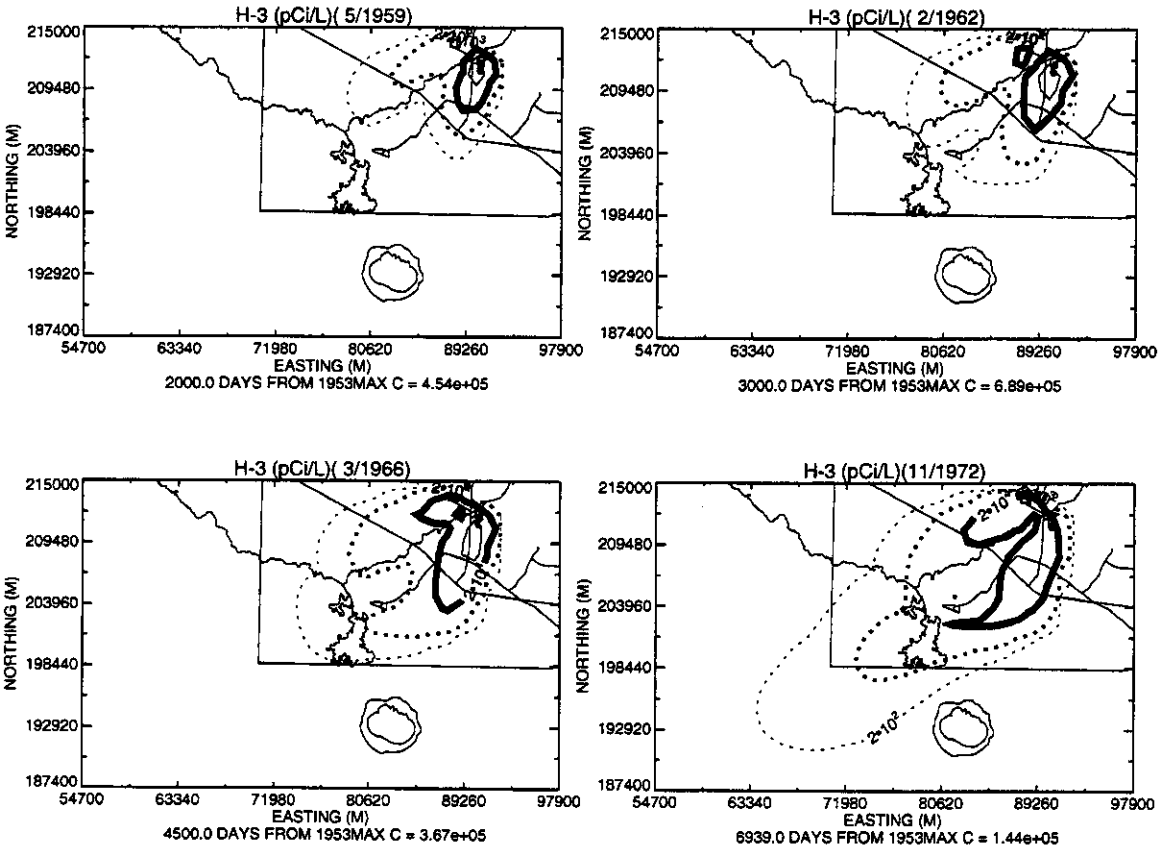


Figure 7-105 Aquifer H-3 peak concentration contours within the extent of the large aquifer model.

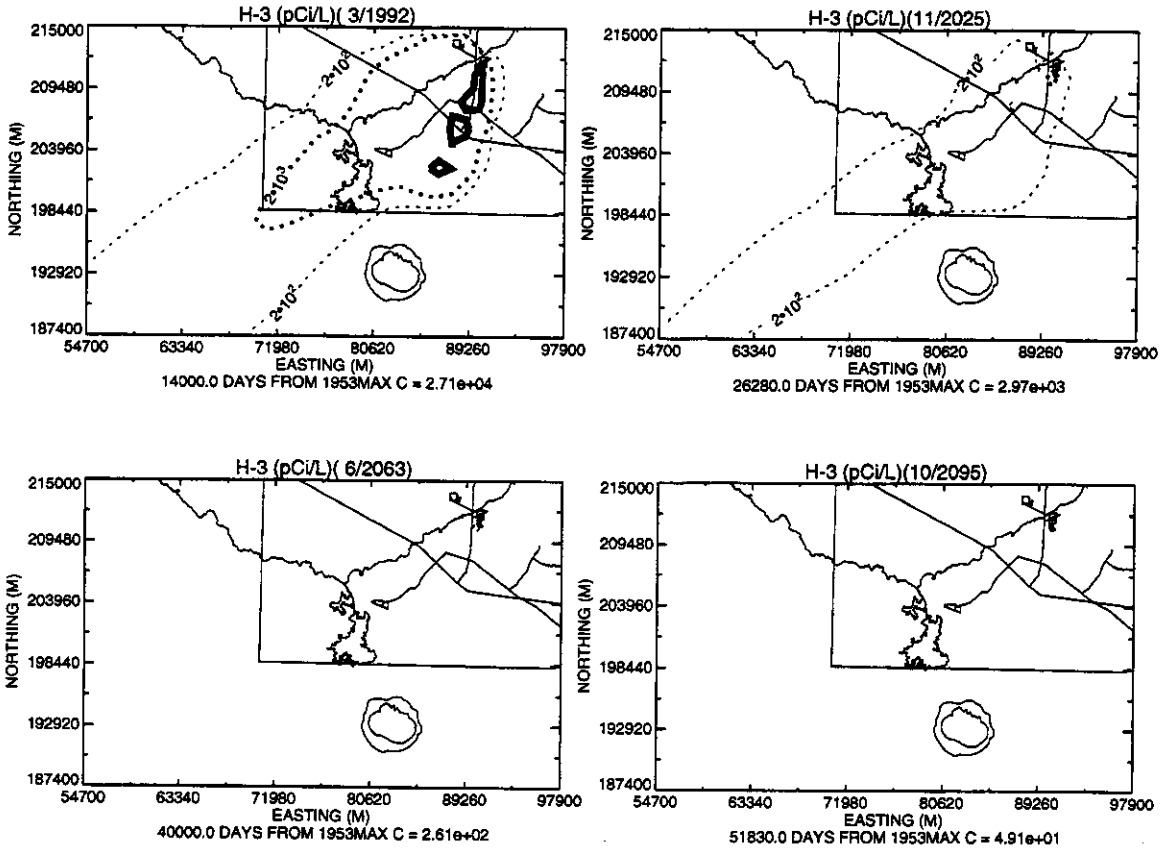


Figure 7-106 Aquifer H-3 peak concentration contours within the extent of the large aquifer model.

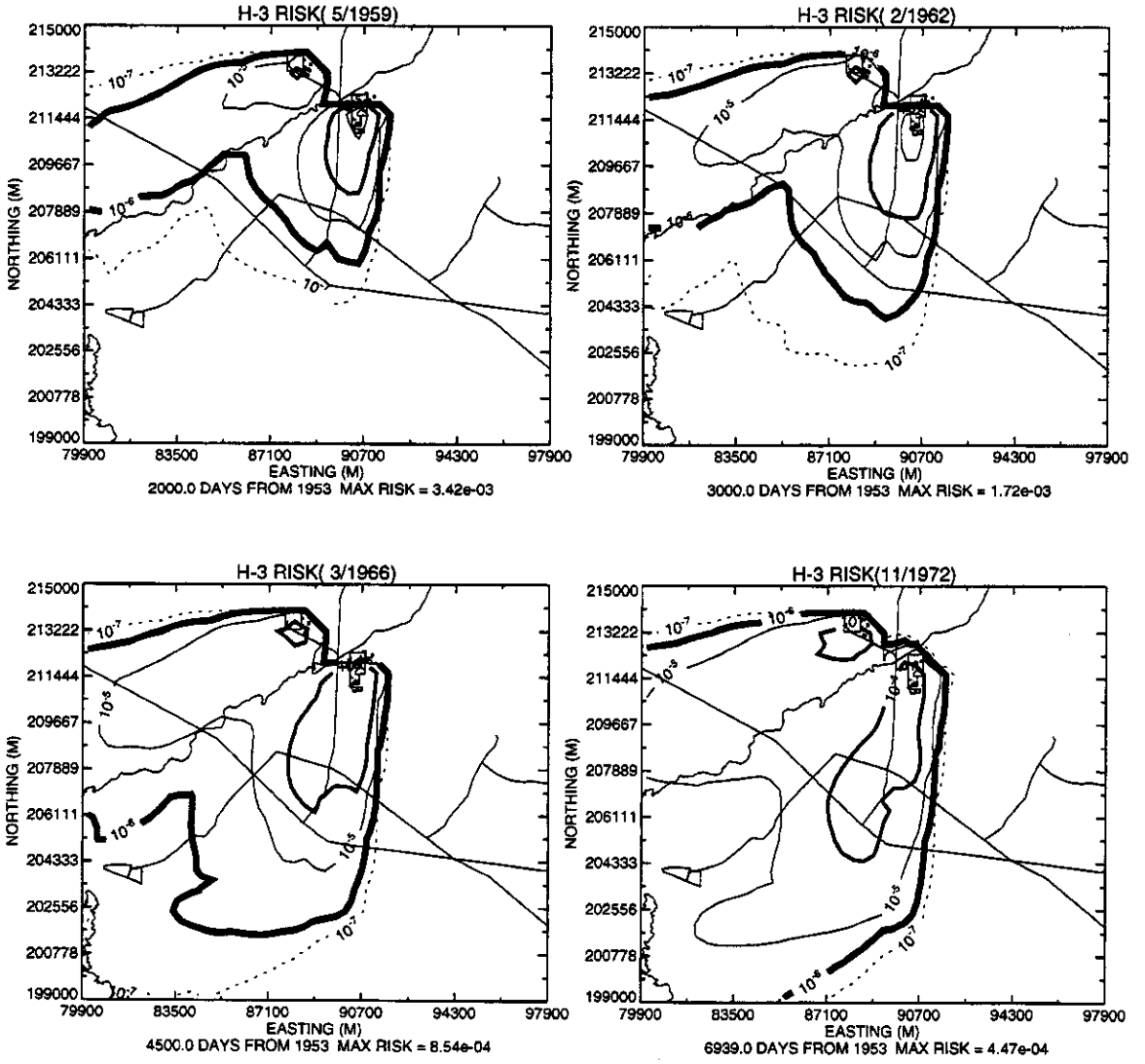


Figure 7-107 Aquifer H-3 peak risk contours within the extent of the small aquifer model.

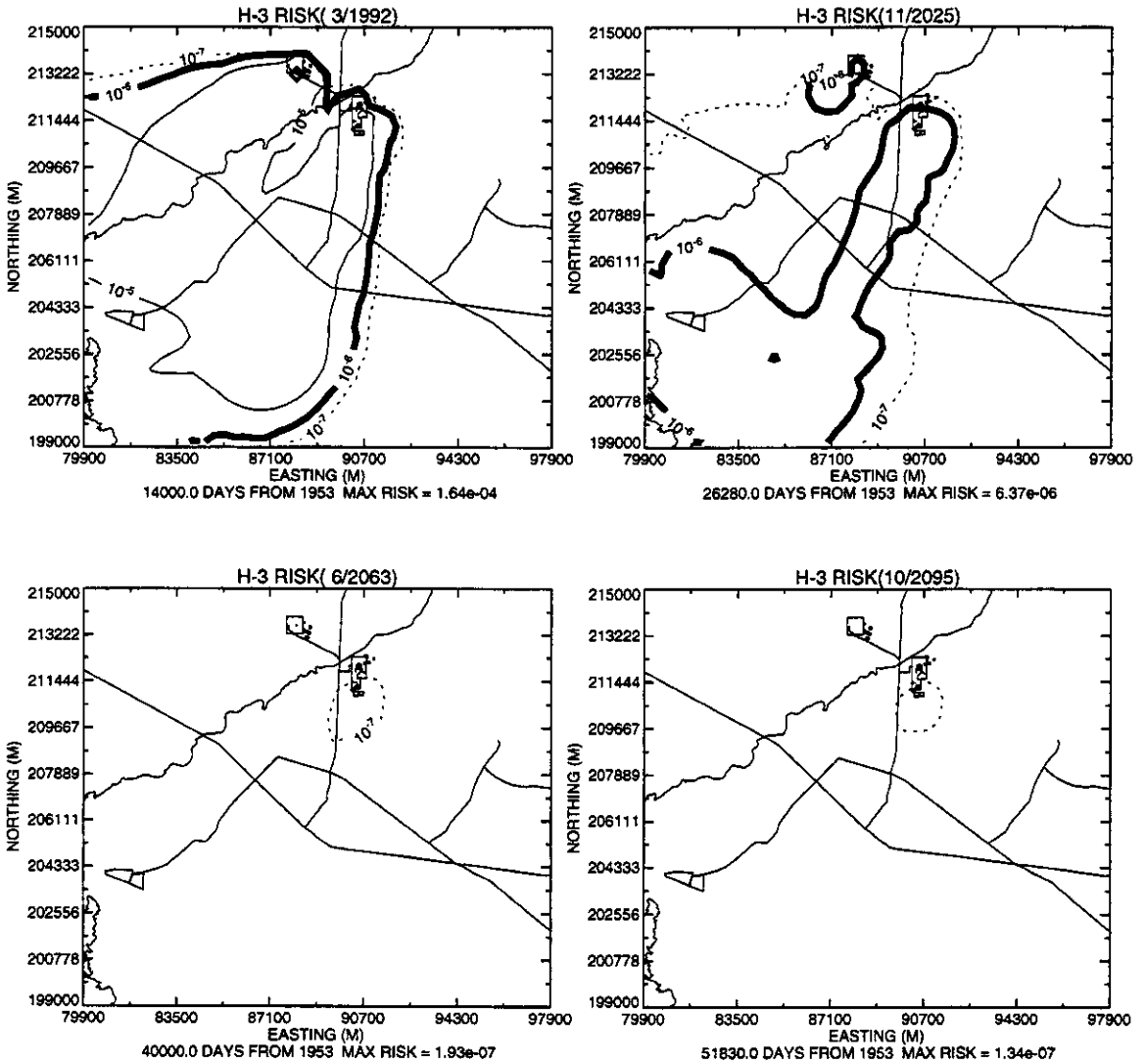


Figure 7-108 Aquifer H-3 peak risk contours within the extent of the small aquifer model.

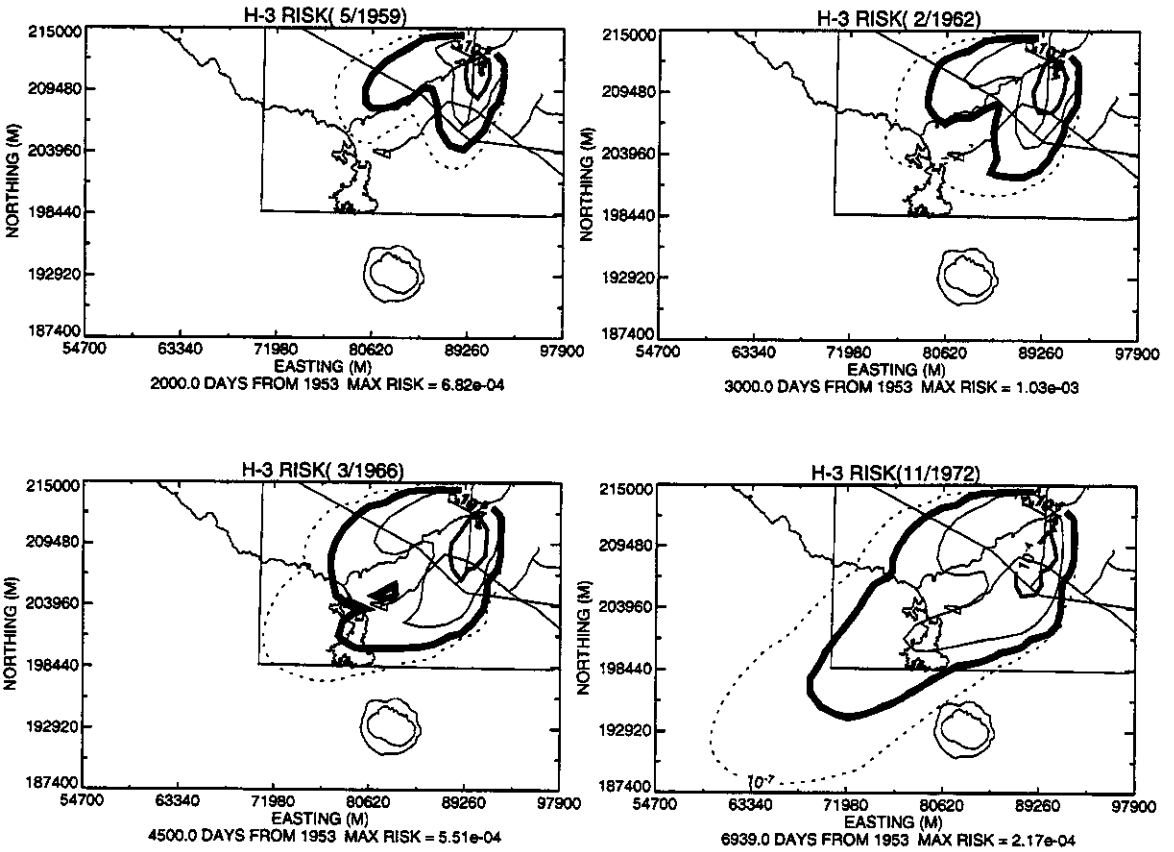


Figure 7-109 Aquifer H-3 peak risk contours within the extent of the large aquifer model.

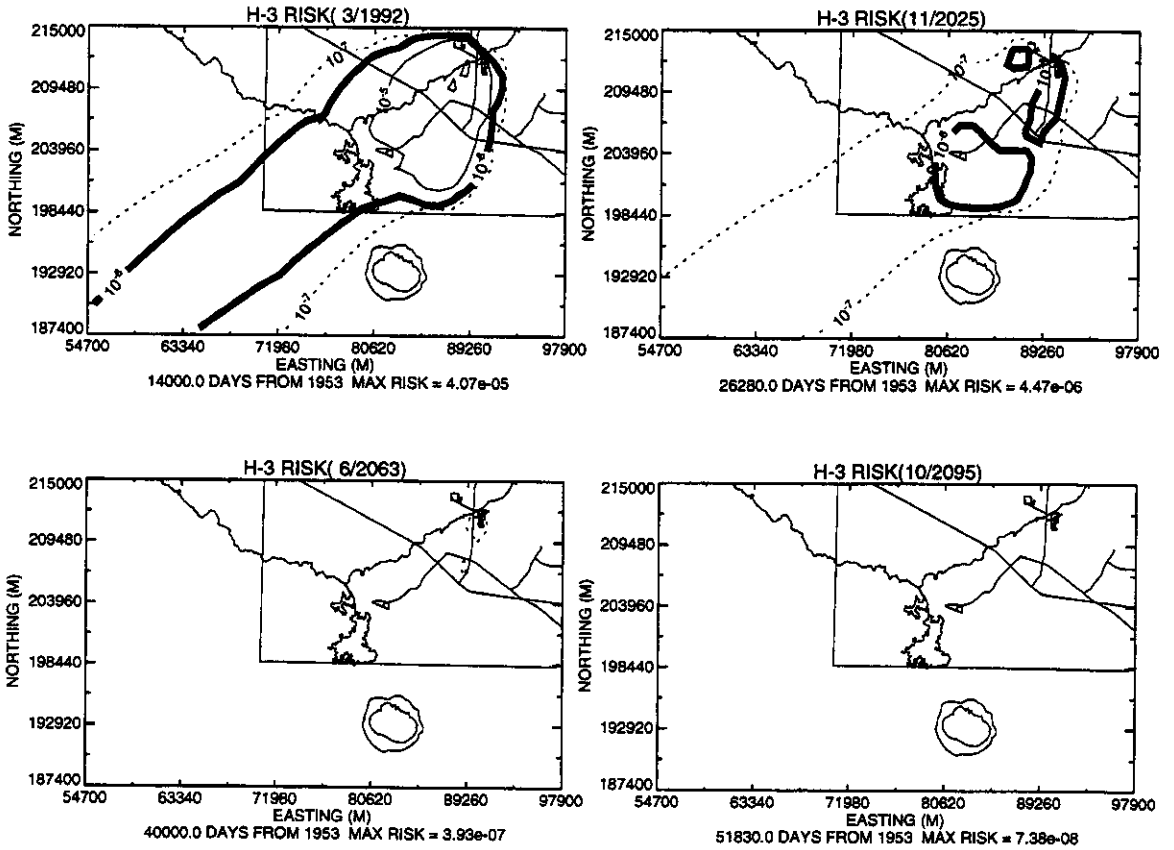


Figure 7-110 Aquifer H-3 peak risk contours within the extent of the large aquifer model.

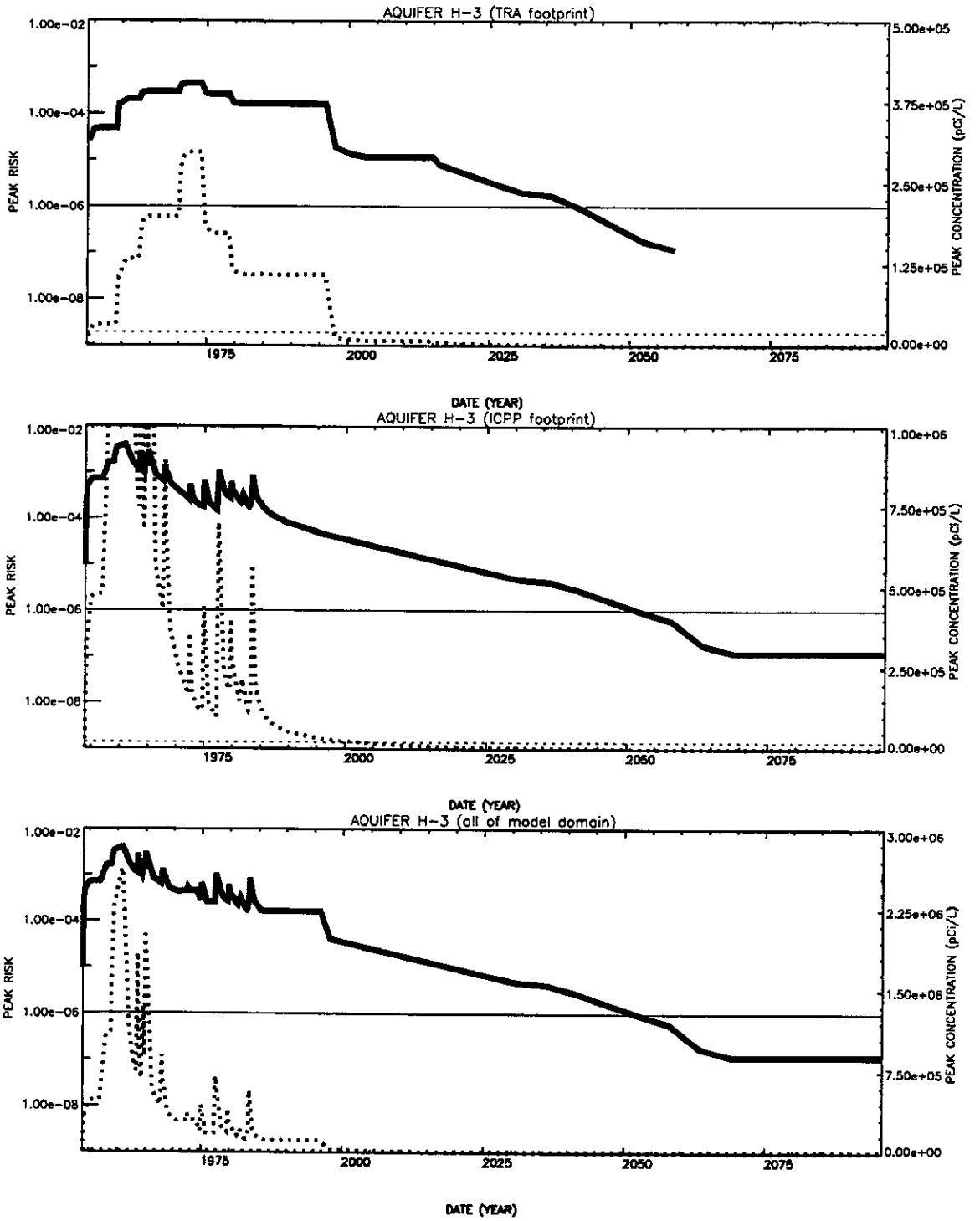


Figure 7-111 Peak aquifer concentration for H-3. Top figure: TRA foot print, Middle figure: ICPP footprint, Bottom Figure: entire aquifer domain. Thick line risk (left scale), dotted line concentration (right scale) solid line 10^{-6} risk (left scale).

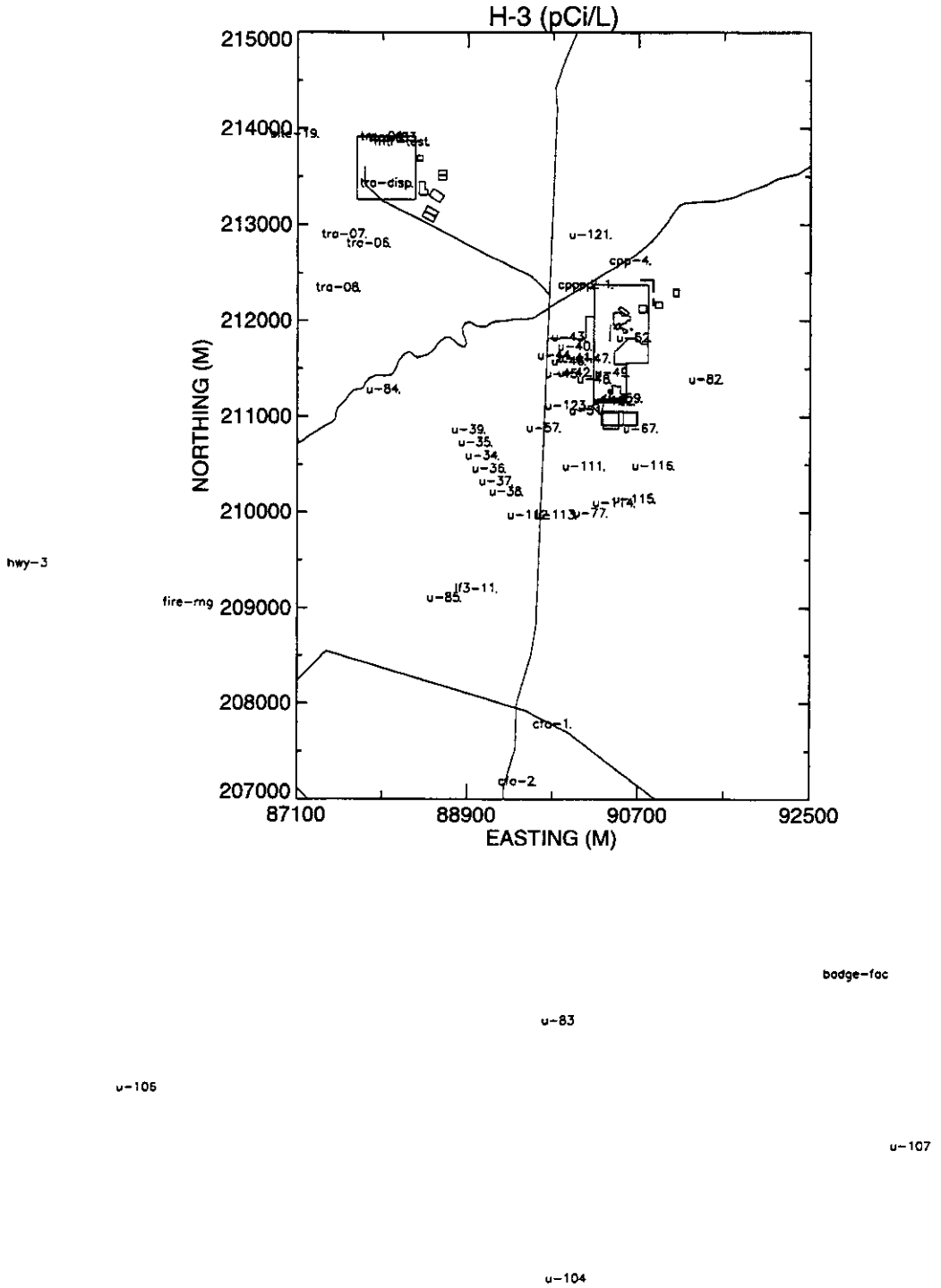


Figure 7-112 Well locations for the comparison of aquifer H-3 to field data.

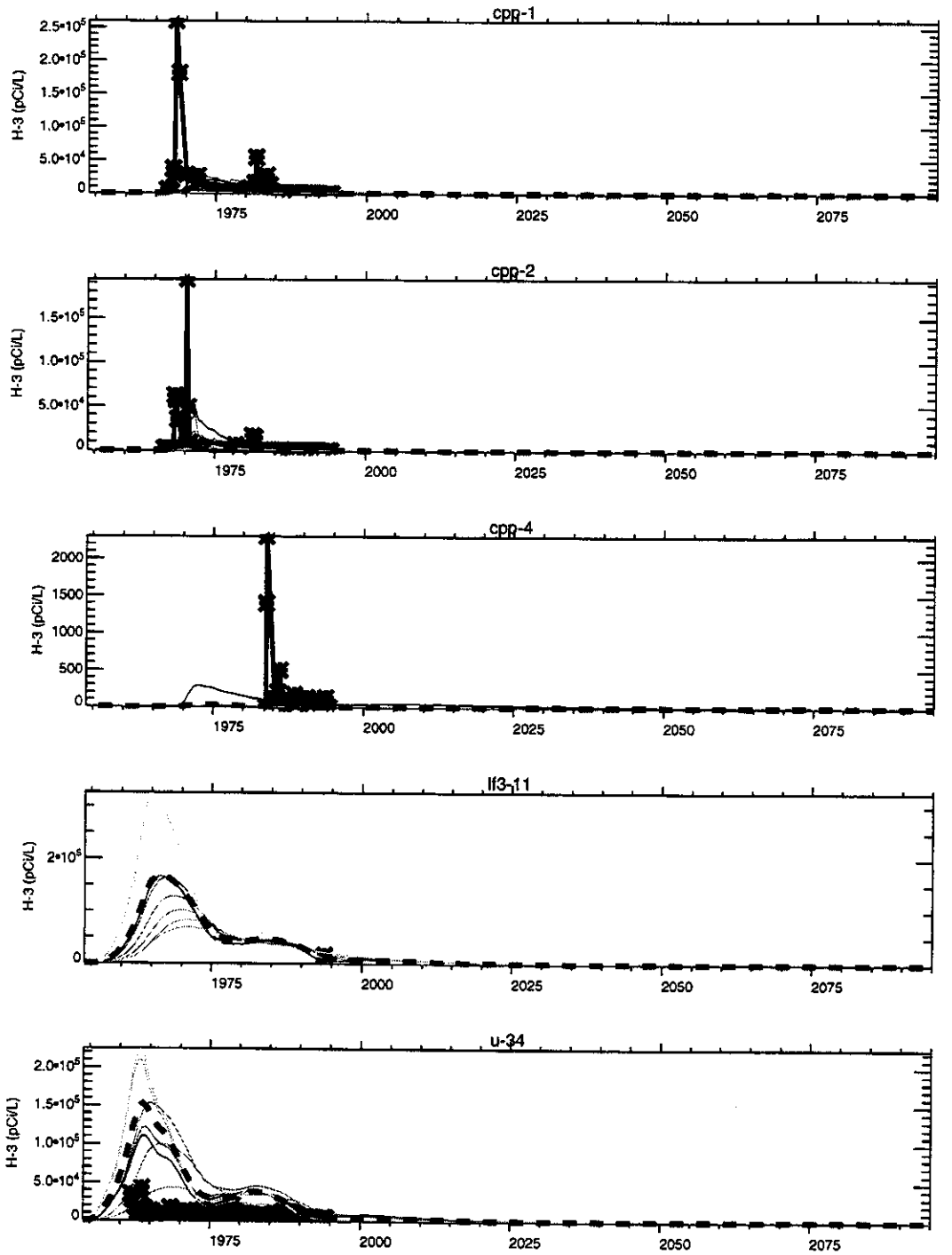


Figure 7-113 Comparison of aquifer H-3 to field data.

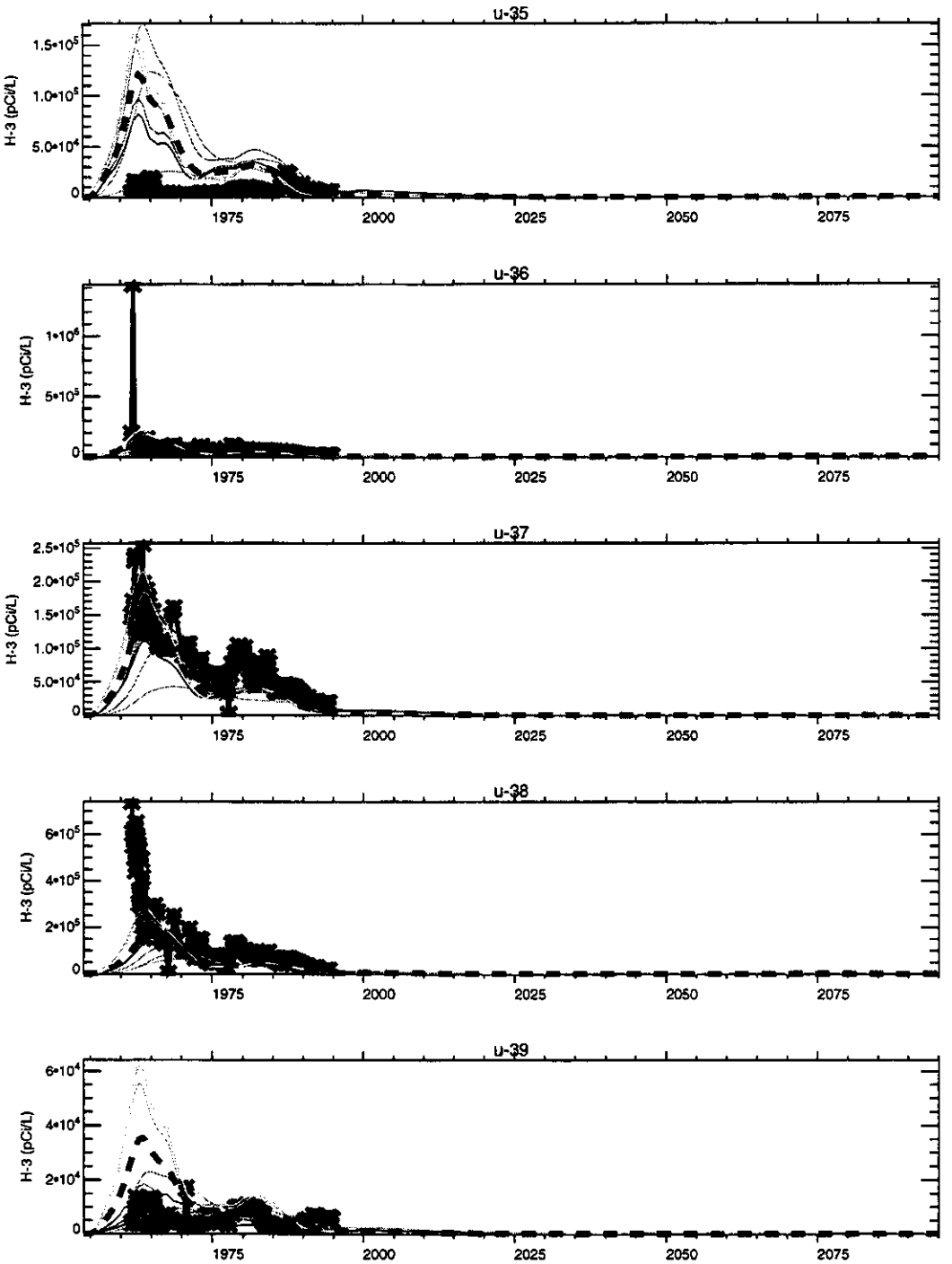


Figure 7-114 Comparison of aquifer H-3 to field data.

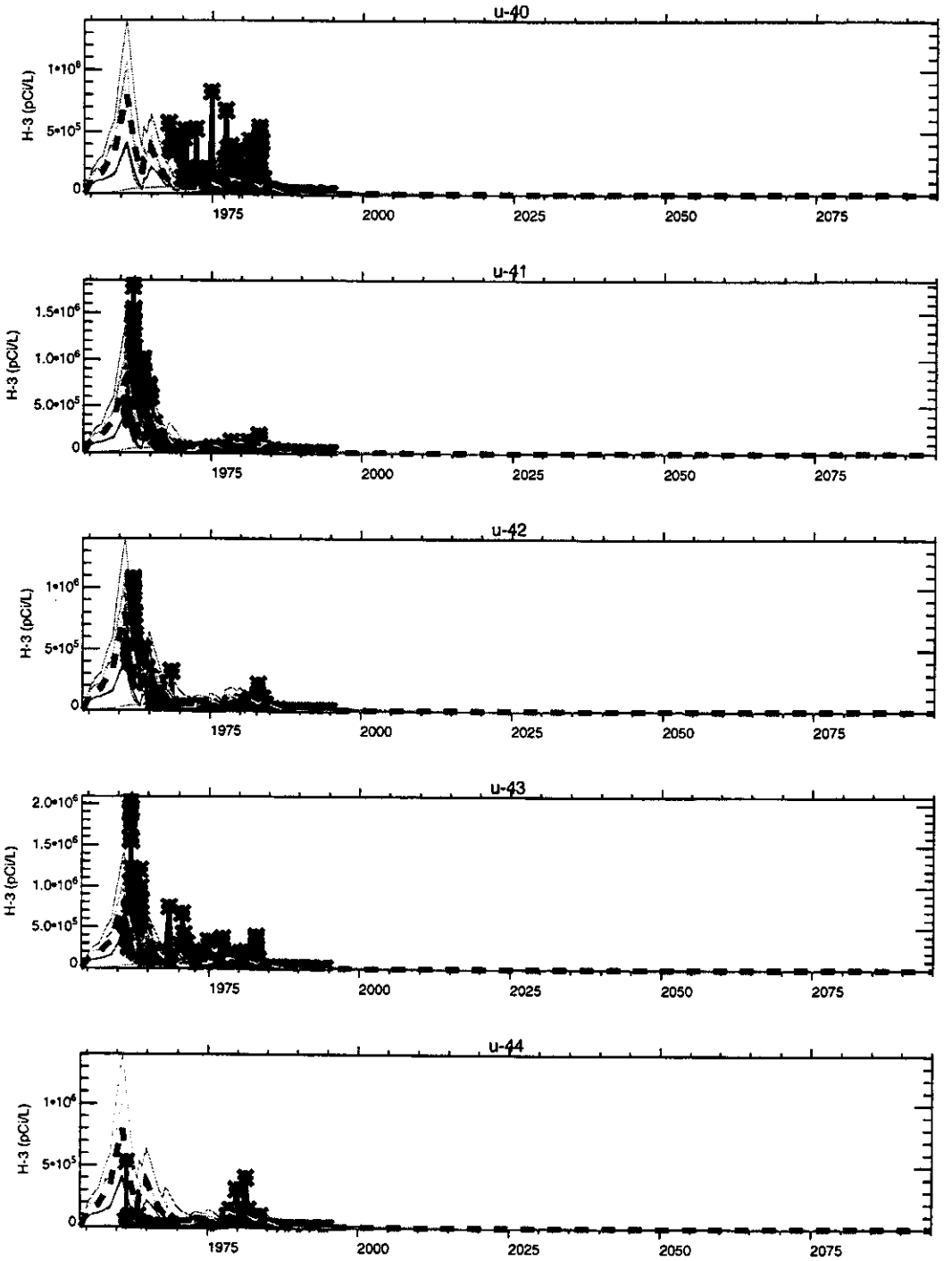


Figure 7-115 Comparison of aquifer H-3 to field data.

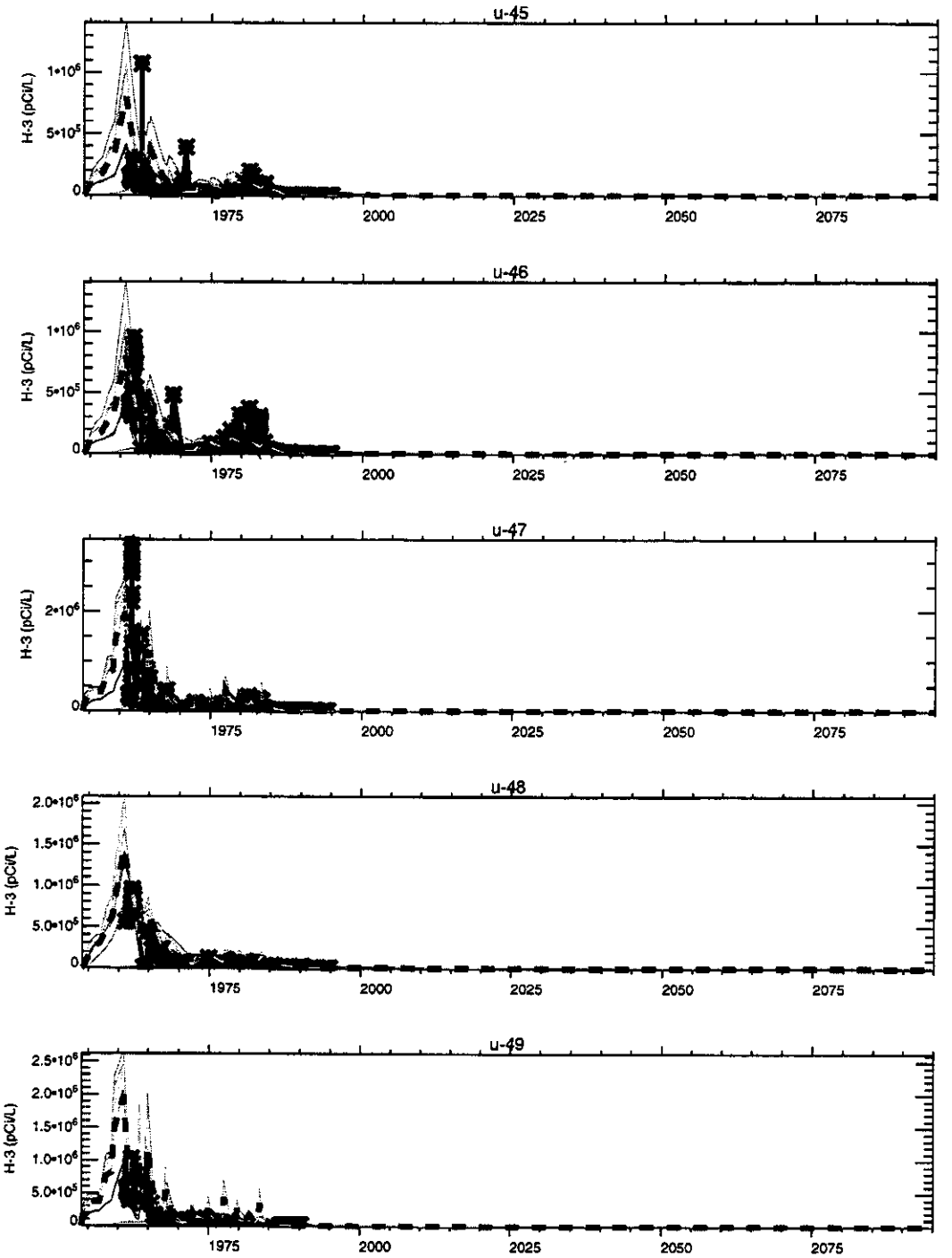


Figure 7-116 Comparison of aquifer H-3 to field data.

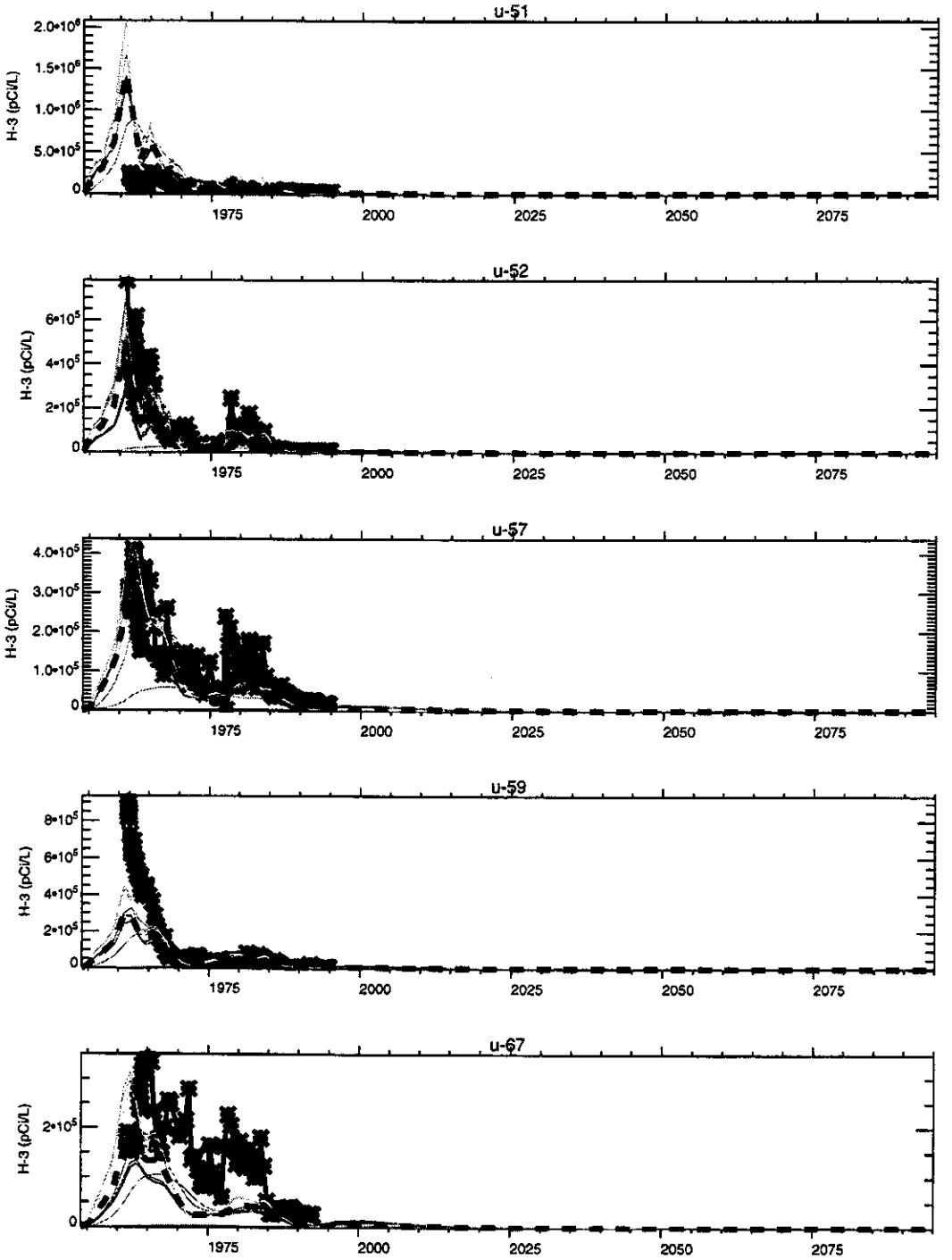


Figure 7-117 Comparison of aquifer H-3 to field data.

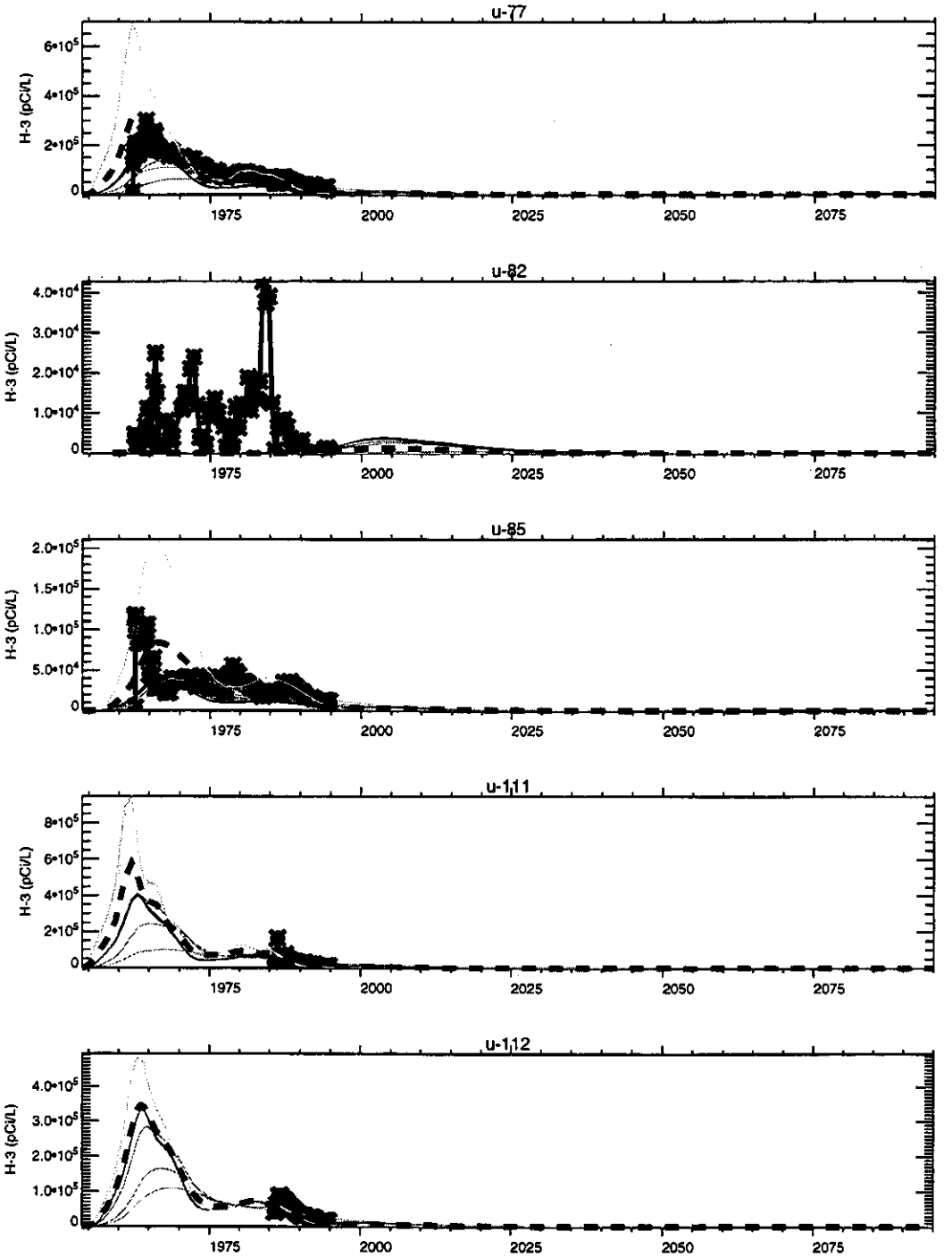


Figure 7-118 Comparison of aquifer H-3 to field data.

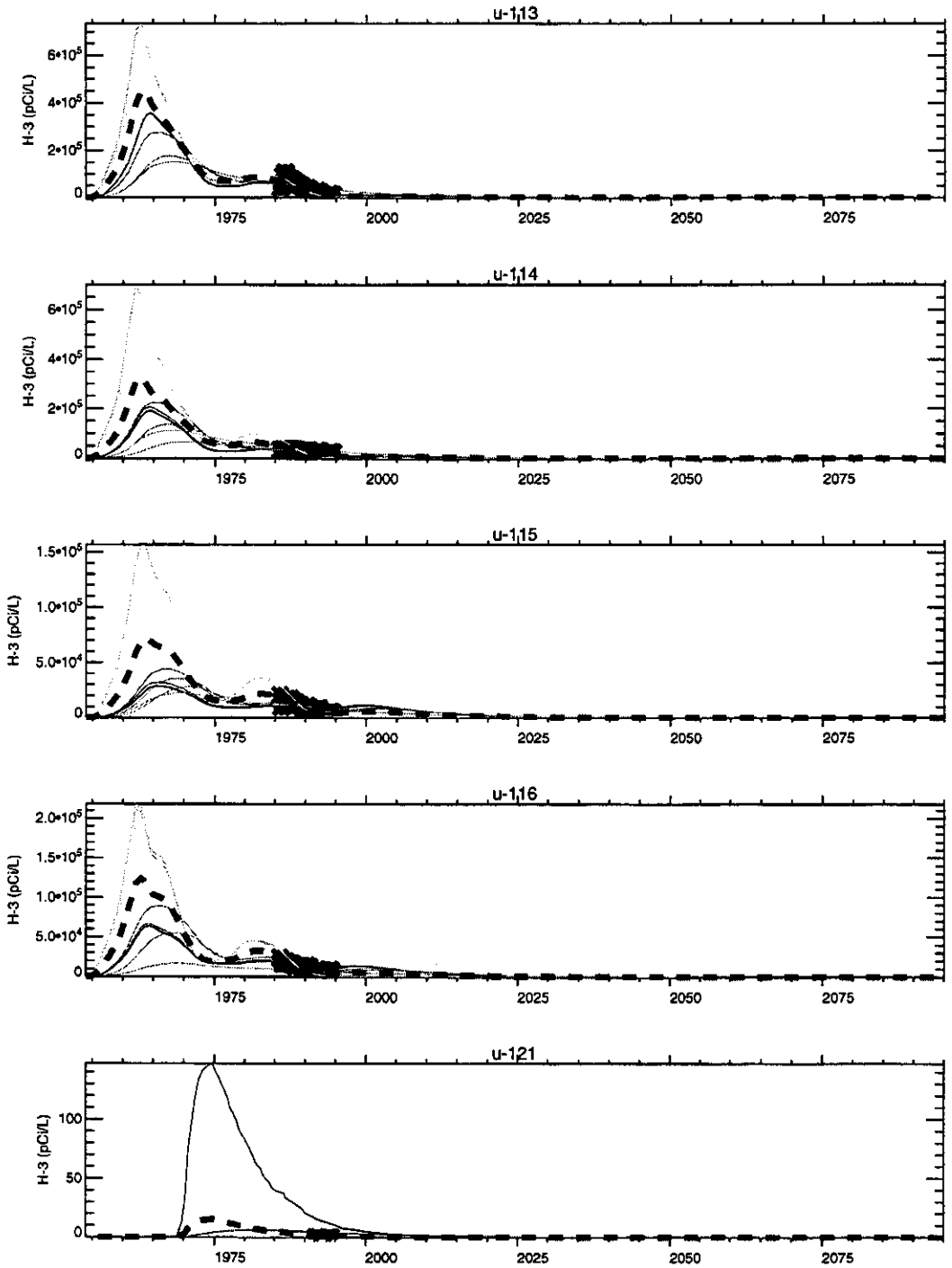


Figure 7-119 Comparison of aquifer H-3 to field data.

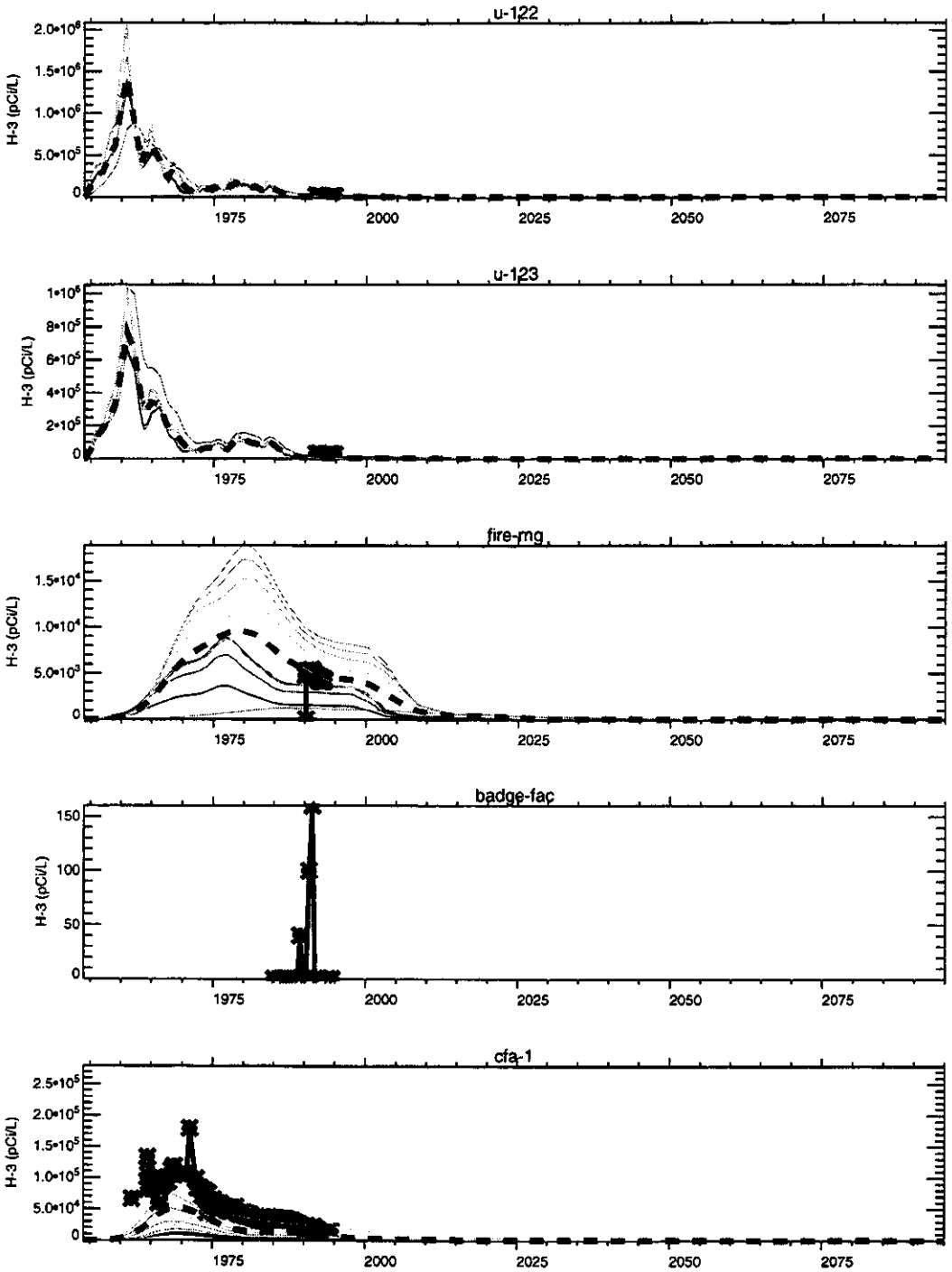


Figure 7-120 Comparison of aquifer H-3 to field data.

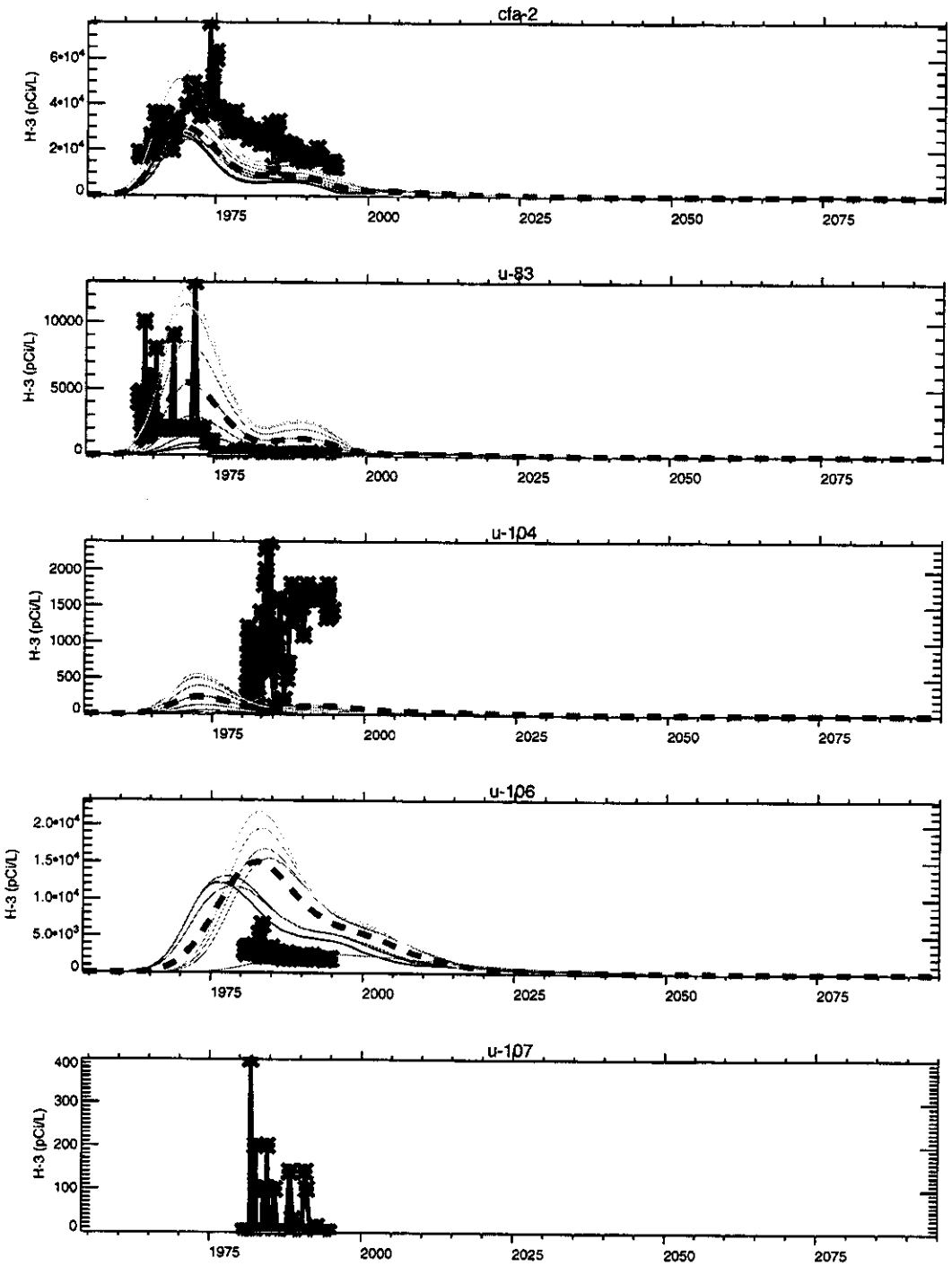


Figure 7-121 Comparison of aquifer H-3 to field data.

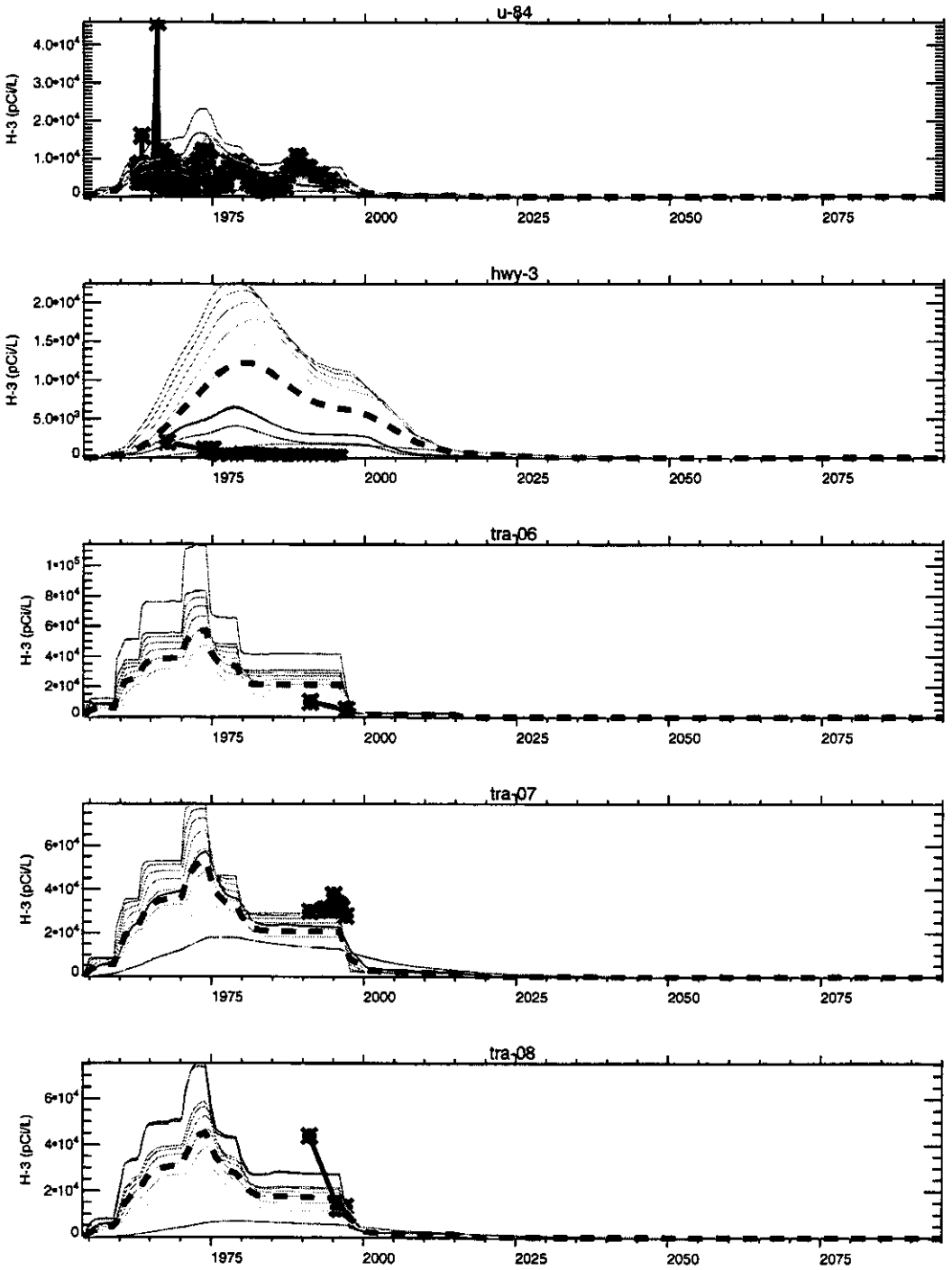


Figure 7-122 Comparison of aquifer H-3 to field data.

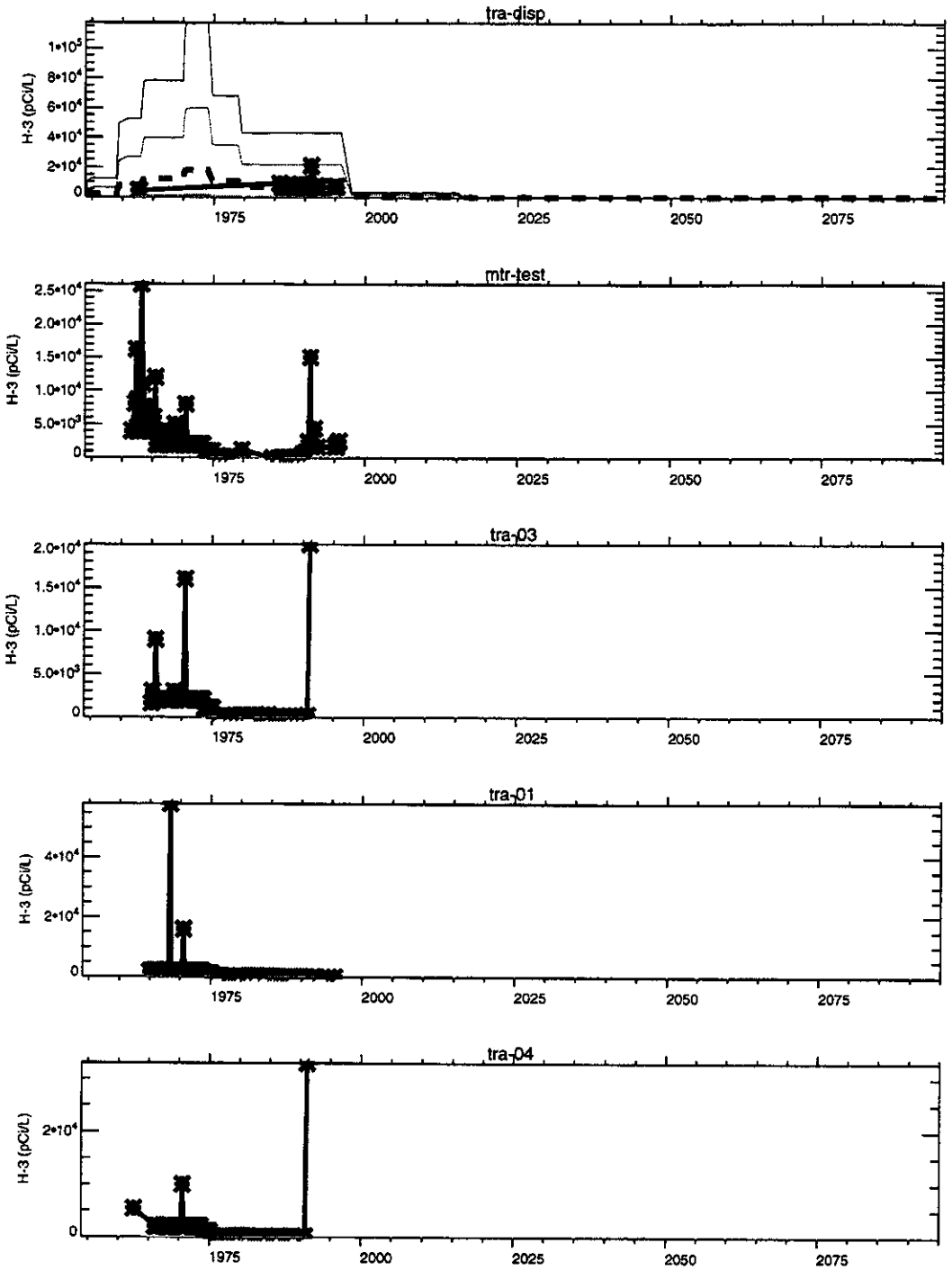


Figure 7-123 Comparison of aquifer H-3 to field data.

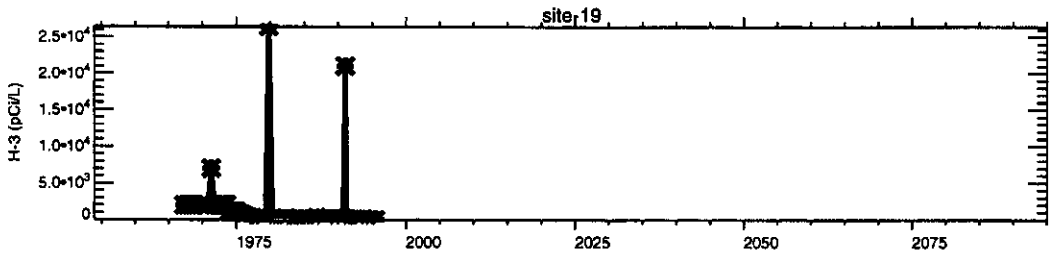


Figure 7-124 Comparison of aquifer H-3 to field data.

7.7 I-129

The I-129 vadose zone and aquifer transport was simulated through the years 2123 and 2961, respectively. Figures 7-125 through 7-133 present the simulation results for the transport of I-129 through the vadose zone, and Figures 7-134 through 7-150 present simulation results for the aquifer region. Contour levels for both the vadose and aquifer (Figures 7-125 through 7-128, and 7-134 through 7-137) are given for $1.x10^{-2}$, $1x10^{-1}$, 1., $1.x10^{+1}$, $1.x10^{+2}$, and $1.x10^{+3}$ pCi/L, with concentrations equal to the MCL (1 pCi/L) represented by the dark solid line. The corresponding aquifer risk contour maps are given in Figures 7-138, through 7-141. Risk contours are given for 10^{-7}, 10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}, and 10^{-2} levels. Contour levels above the 10^{-6} value (0.261 pCi/L) are indicated by the dark line.

For these simulations, there are five sources for the I-129. Most of the I-129 was discharged to the injection well (91.6% from 1968-1970) with smaller contributions from the percolation ponds (5.4% from 1984-2095), the soils inventory (2.6%), and the CPP-31 (0.46% in 1972) and 1986 (0.06%) releases. The vadose zone simulations are similar to H-3 in that it is assumed that I-129 does not adsorb to the basalt or interbed material. As a result of no adsorption and a long half life ($1.57x10^{7}$ years), the concentration of I-129 decreases only as a result of dilution and dispersion as I-129 moves through the vadose zone and into the aquifer.

VADOSE ZONE: Figure 7-129 shows that the peak vadose zone concentration of I-129 does not fall below the MCL by the year 2095. Figure 7-130 indicates that the peak mass flux from the vadose zone passes into the aquifer in 1992, and tails slowly throughout the total simulation time (2095). Although still above the 10^{-6} risk level in 2095, the vadose zone simulations were terminated because nearly 100% of the initial mass in place had exited the vadose zone.

Comparisons of model predicted concentrations to field data (Figures 7-131 through 7-133) are very good for the PW-01, PW-02, PW-04, PW-05 wells which are near the percolation ponds, and are also very good for MW-05, and CPP-33-2 which are all near the tank farm area. This indicates that the flux rates and source terms are reasonably accurate for the percolation ponds and the surface inventory is also reasonable. Further north of the percolation ponds, I-129 was not detected in the one available sample in MW-15, however, the model predicts that I-129 should have been observed at that well. This could be indicative of there being slight adsorption of I-129 occurring, allowing the I-129 to move downward more as opposed to moving laterally as predicted by the model. The predicted concentration compares well to the measured concentration in USGS-50, which is in the lower interbed near the injection well indicating that the injection well source term is reasonably accurate.

AQUIFER: The aquifer area with predicted peak concentrations greater than the MCL and 10^{-6} risk concentration is relatively large (as shown in Figures 7-134 through 7-141). The 2095 peak I-129 concentration is predicted to be 4.67 pCi/L (as shown in Figures 7-142). This concentration is greater than both the 10^{-6} risk concentration (0.261 pCi/L) and the MCL (1 pCi/L). The predicted maximum aquifer concentration is predicted to exceed the 10^{-6} risk level until well beyond the year 2095 and to exceed the MCL until about the year 2167. The peak concentration was predicted to have been 97.1 pCi/L in 1986, and would have been a result of discharges to the injection well. The vadose zone contribution (Figure 7-130) to the aquifer concentrations is very small.

Locations used to compare field data to model predictions are given in Figure 7-143, and include near-, mid-, and far-field distances from the injection well. The injection well was used to dispose of the majority of the I-129 from 1953-1986, with the remainder of the I-129 entering the aquifer from the surface sources. As a result, field measurements of I-129 taken in the last decade should be a reflection of the mass disposed of to the injection well with the contribution arriving from the vadose zone during the 1990's. The predicted peak concentration compares fairly well to field measurements observed on the order of 50 pCi/L. However, on the average, comparisons of aquifer model predicted concentrations to field data (Figures 7-144 through 7-150) show that predicted concentrations are on the order of measured values in all cases, and the model tends to underpredict the highest observed concentrations more than to overpredict the highest observed

values. In contrast, the prediction of mass arrival appears to be later than actually observed. In addition, the model predictions show that the I-129 is actually moving slower than predicted by the model.

The first and last observation are consistent because lower recorded peak concentrations are generally indicative of I-129 being adsorbed both in the aquifer and vadose zone interbed material which would be accompanied by transport being slightly slower than predicted and measured water concentrations being lower than predicted. These two observations would indicate that I-129 should not be modeled as a conservative (Kd = 0) tracer. This is consistent with predictions of a small I-129 Kd (0.14 cm^3/g as per personal communication with R. Smith, LMITCO, 1996) being appropriate for INEL materials than using a zero Kd. However, if this is true, the fact that the model tends to underpredict the highest observed value in other wells suggests that the source term might be slightly underestimated. In addition, note that there were very few measurements taken in the aquifer wells over time, which means that the true peak value was probably not recorded. To get a better overall match between arrival time and concentration, a combination of increasing the source term slightly and using a small Kd would be required. The result would be a relatively insignificant difference in the magnitude of predicted risk, but would result in a shift in the time period over which monitoring should be applied.

Because the primary source of the I-129 to the aquifer is the injection well and there exist long term monitoring of the plume in the aquifer, there is relatively small uncertainty in the I-129 predictions.

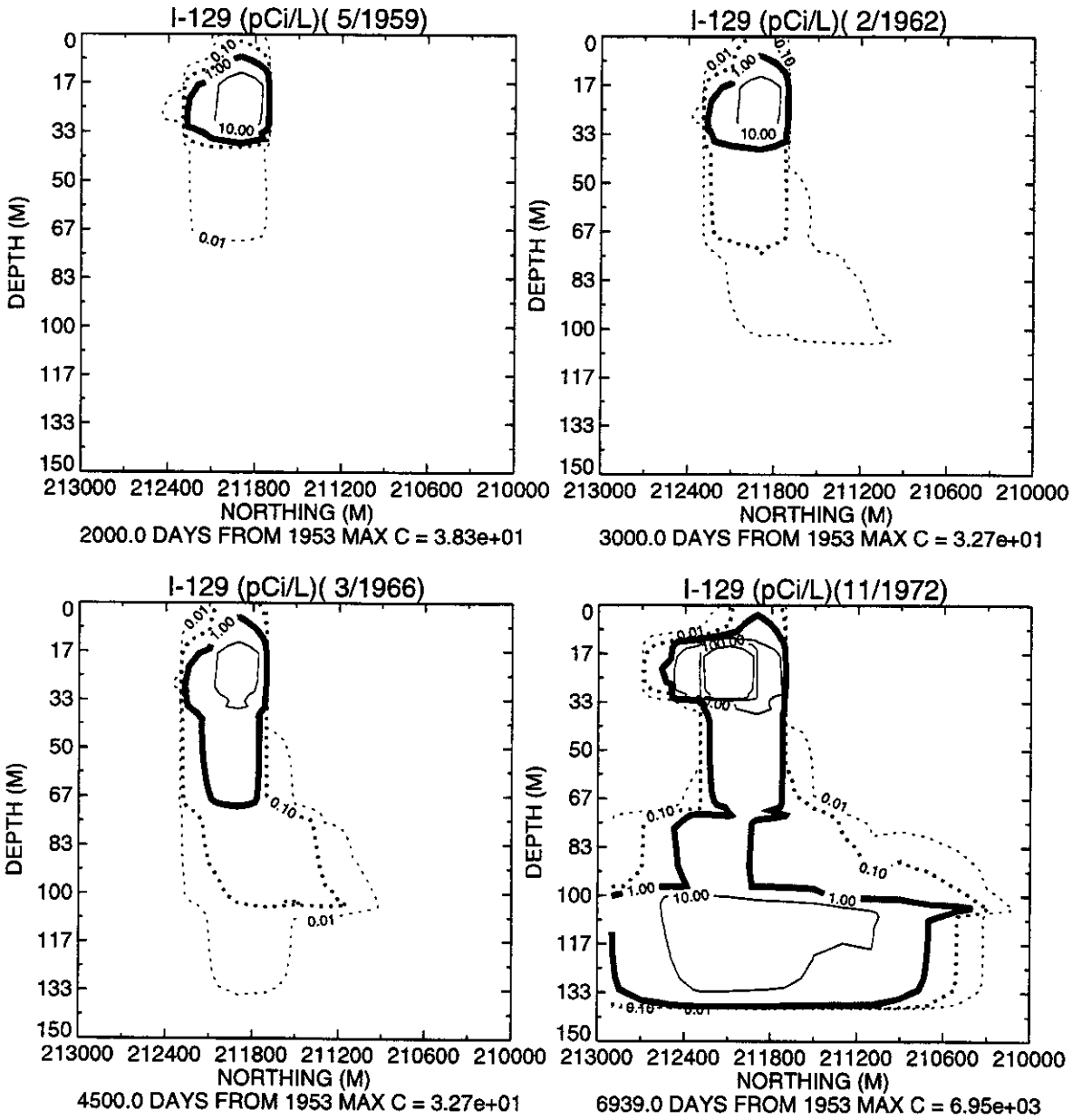


Figure 7-125 Vadose zone I-129 peak concentration contours.

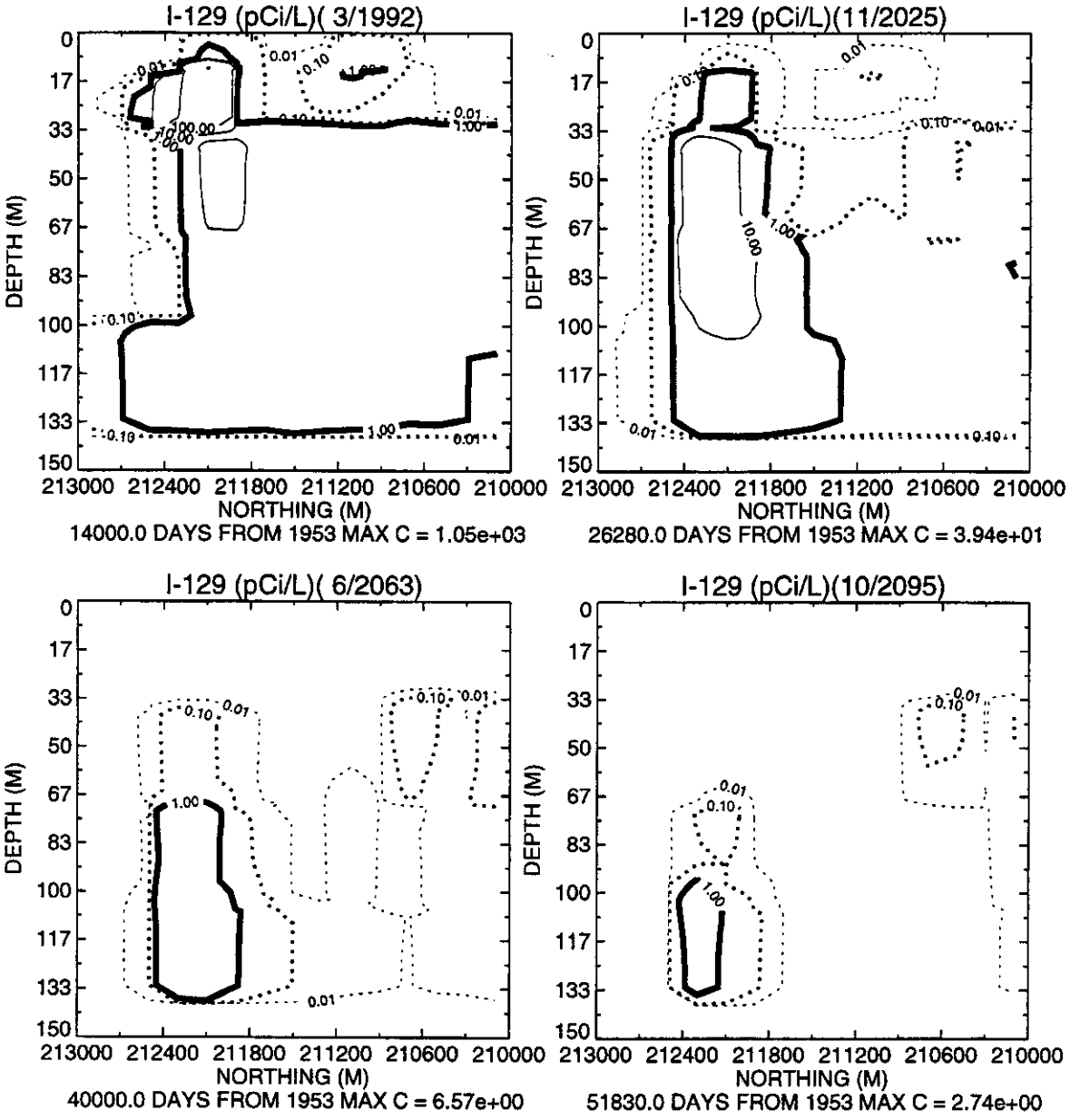


Figure 7-126 Vadose zone I-129 peak concentration contours.

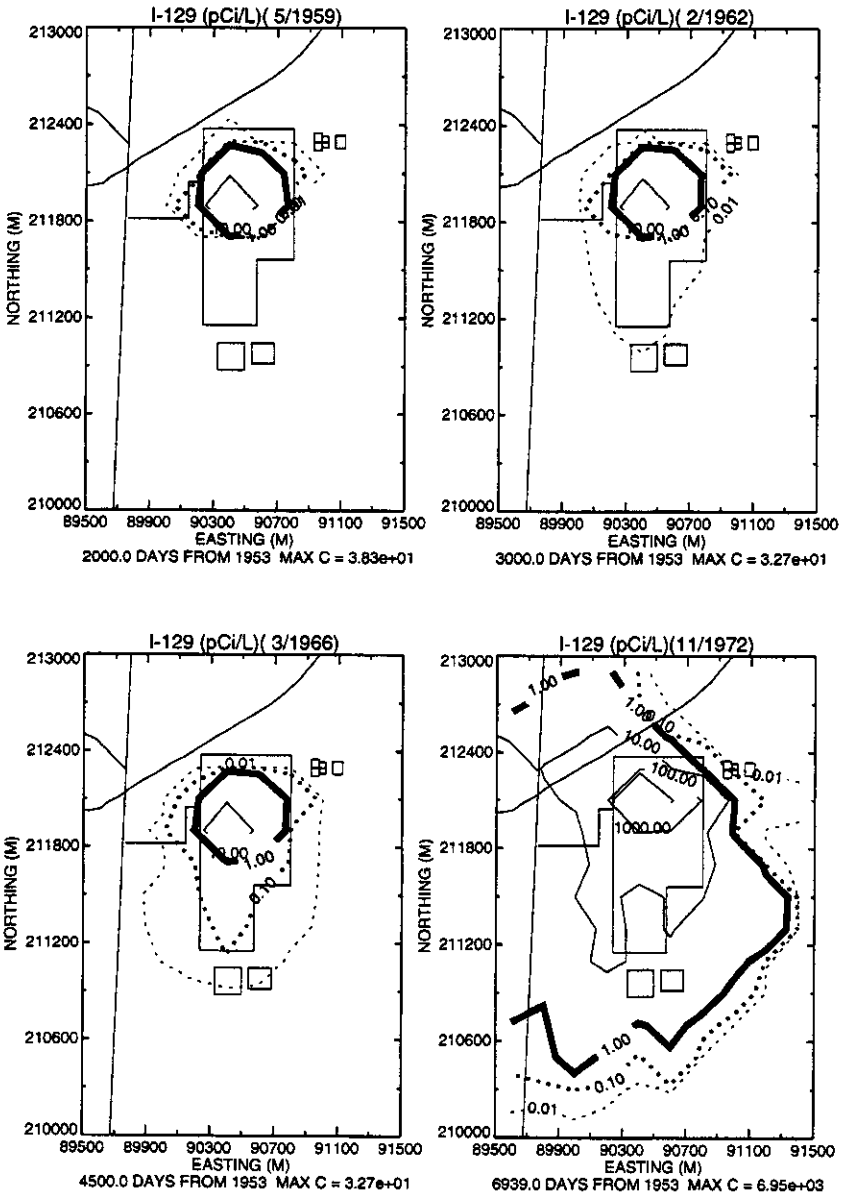


Figure 7-127 Vadose zone I-129 peak concentration contours.

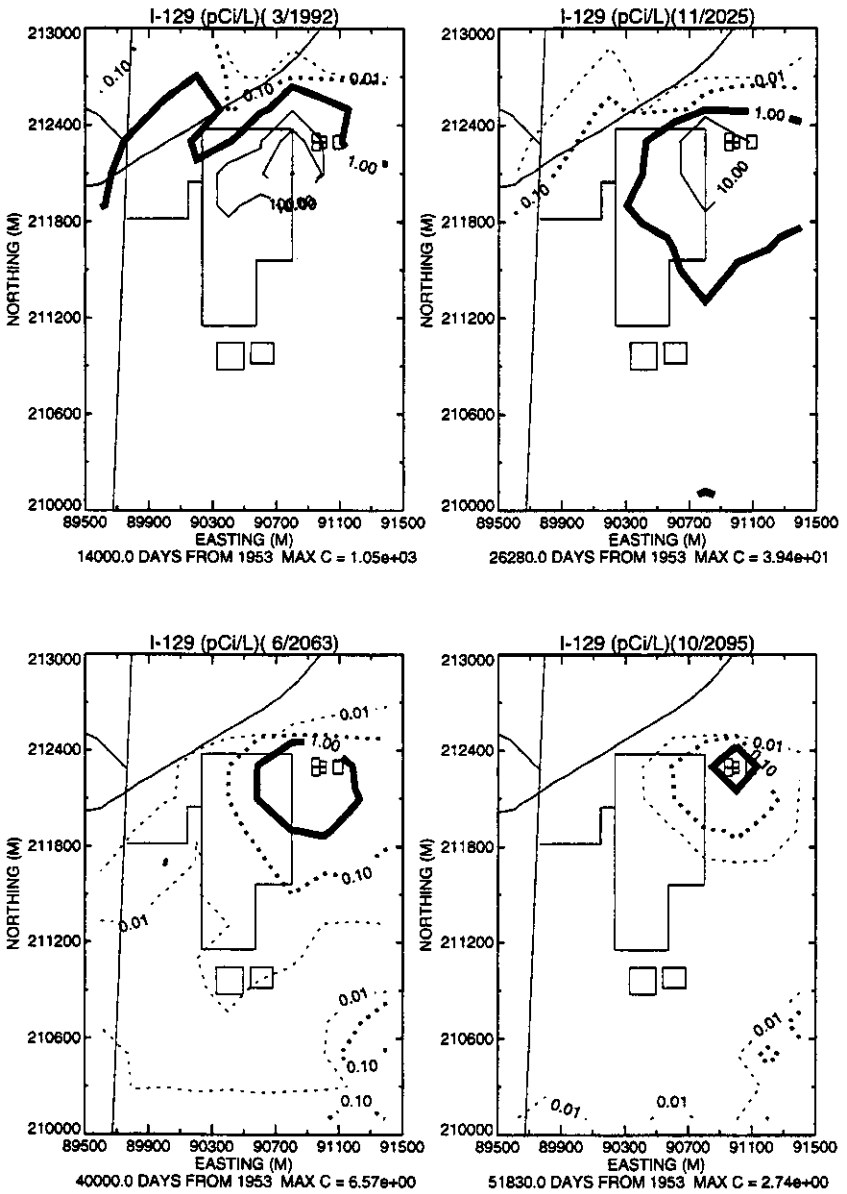


Figure 7-128 Vadose zone I-129 peak concentration contours.

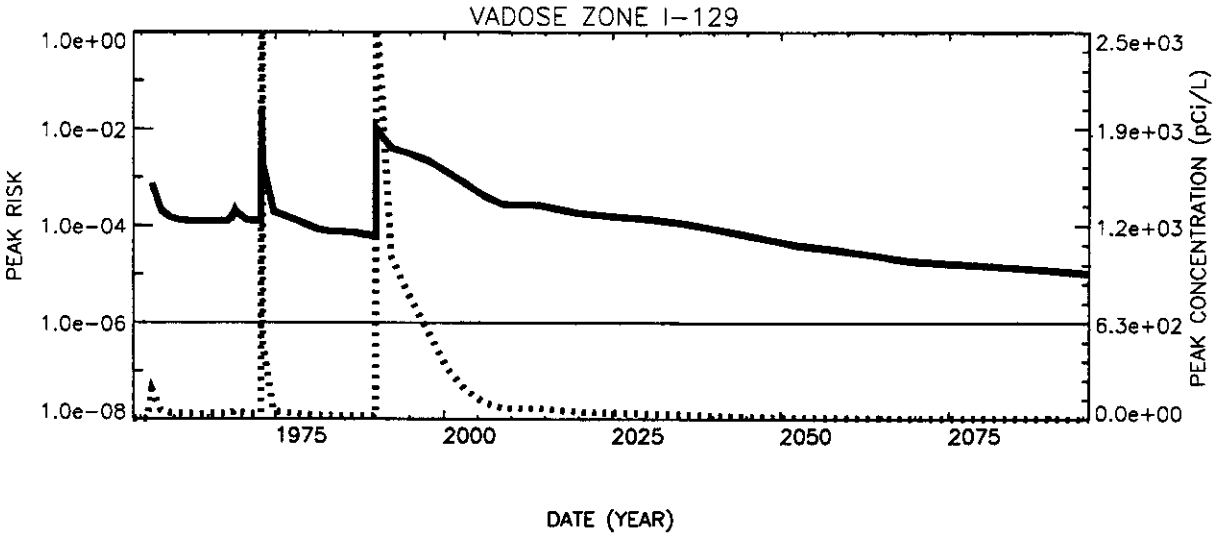


Figure 7-129 Peak vadose zone risk and concentration for I-129. Risk indicated by the thick line on the log scale with the 10^{-6} value shown as the solid line. The dotted line represents concentration given by the linear scale on the right axis with the MCL (1 pCi/L) shown as the straight horizontal line.

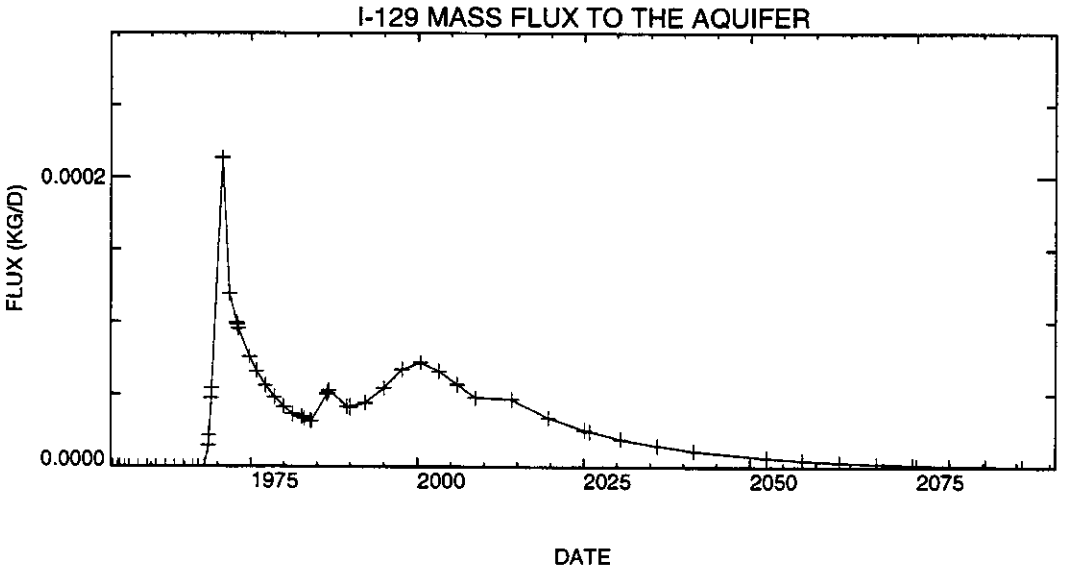


Figure 7-130 Mass flux of I-129 into the aquifer from the vadose zone.

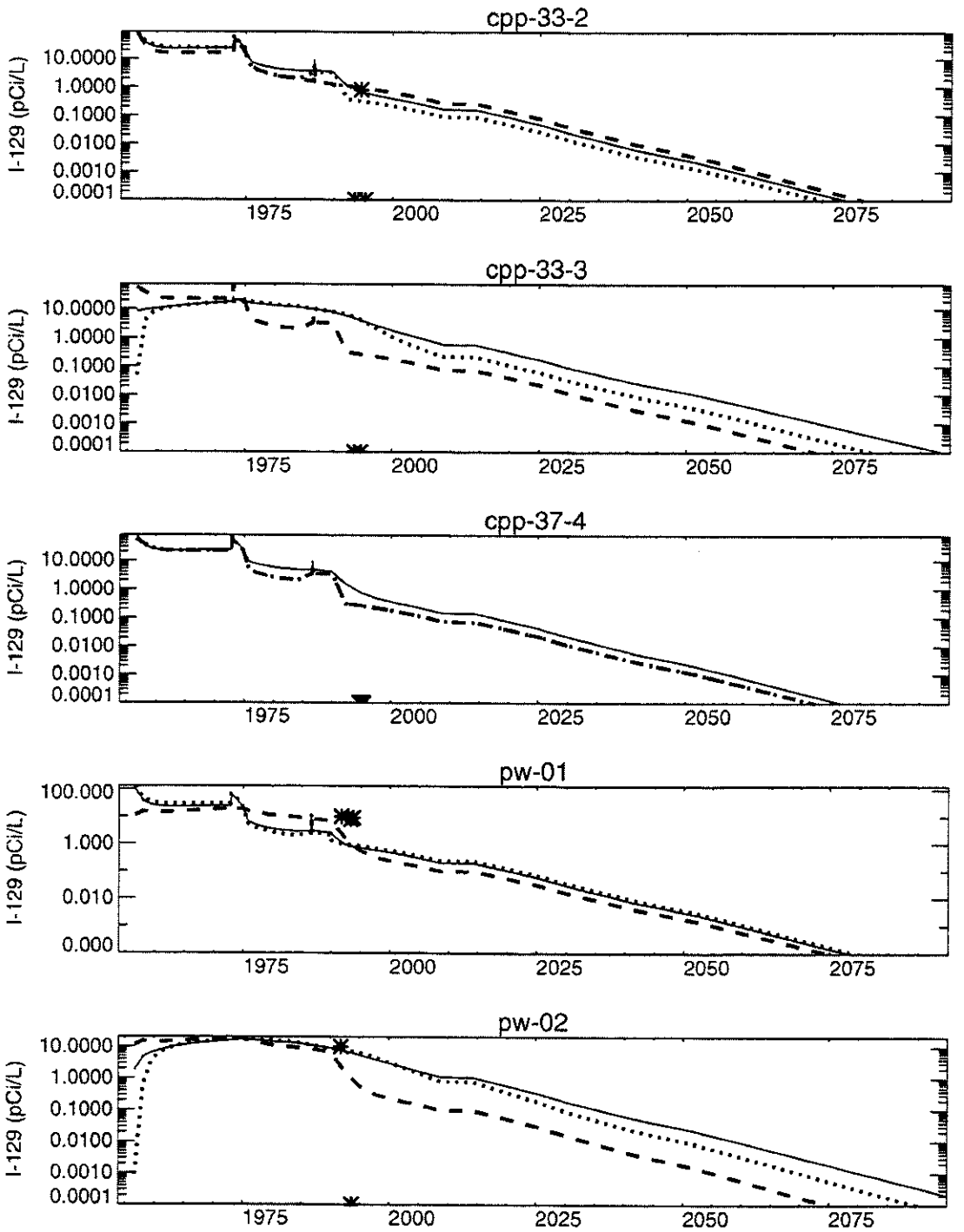


Figure 7-131 Comparison of vadose zone I-129 to field data.

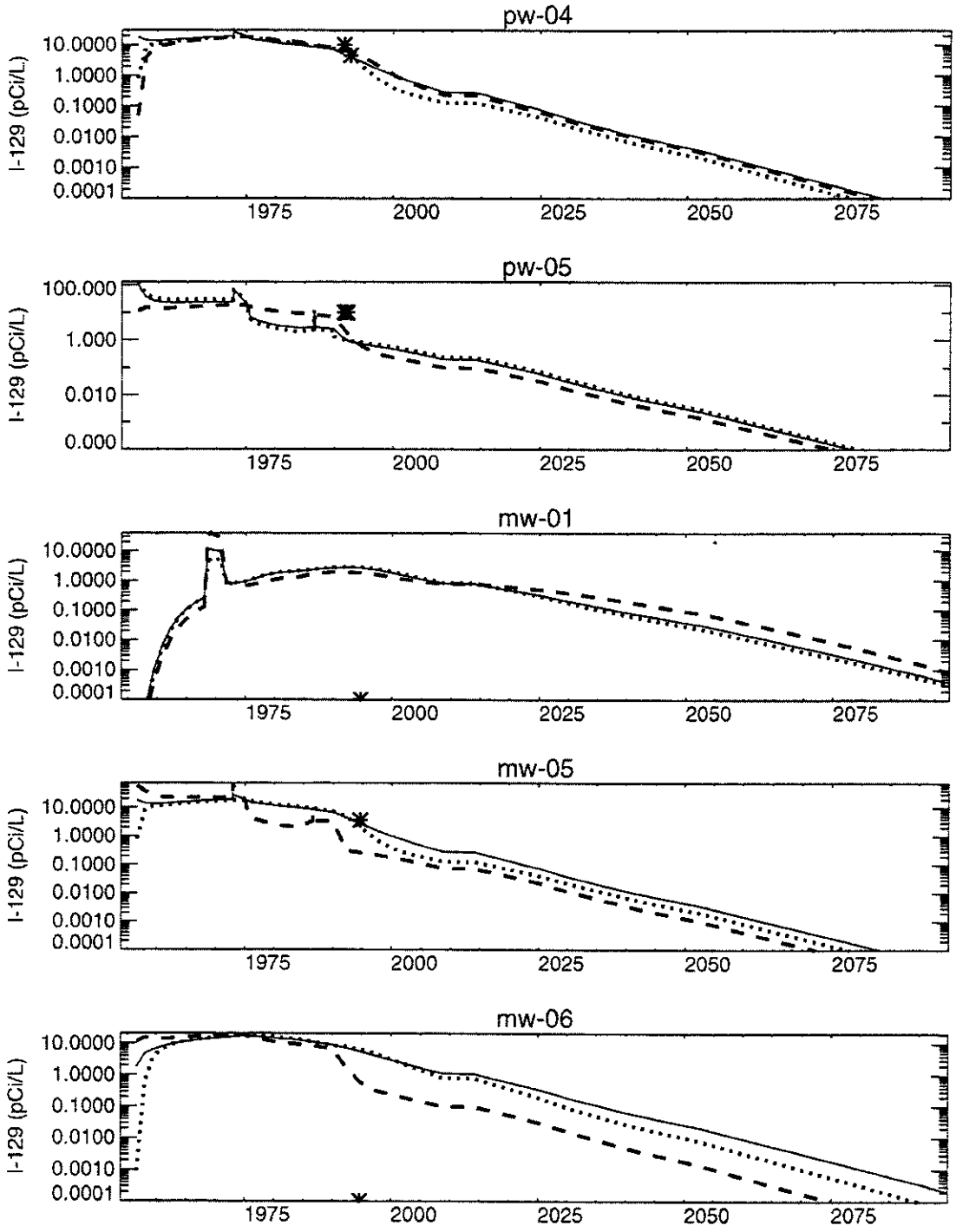


Figure 7-132 Comparison of vadose zone I-129 to field data.

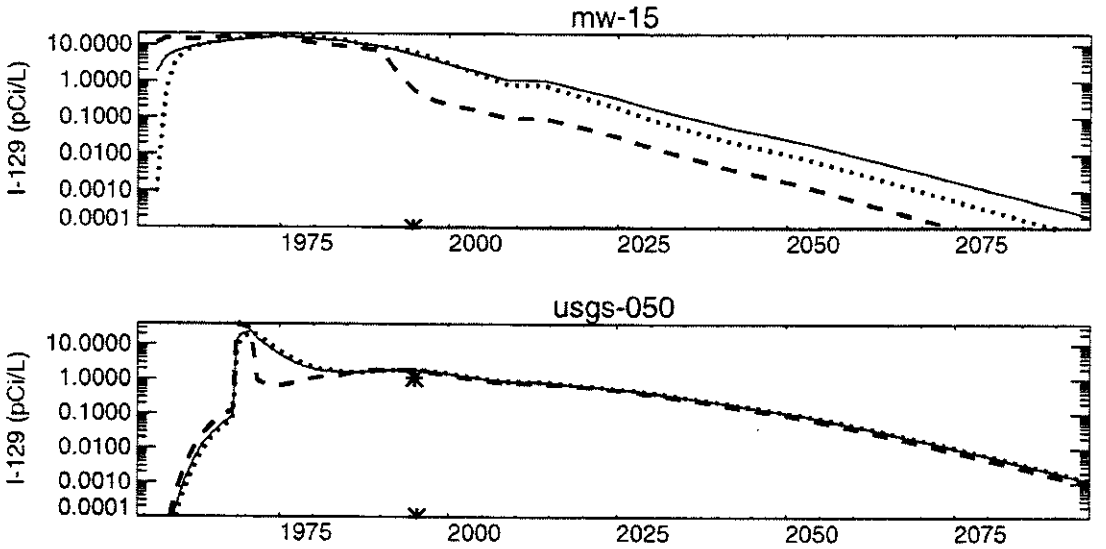


Figure 7-133 Comparison of vadose zone I-129 to field data.

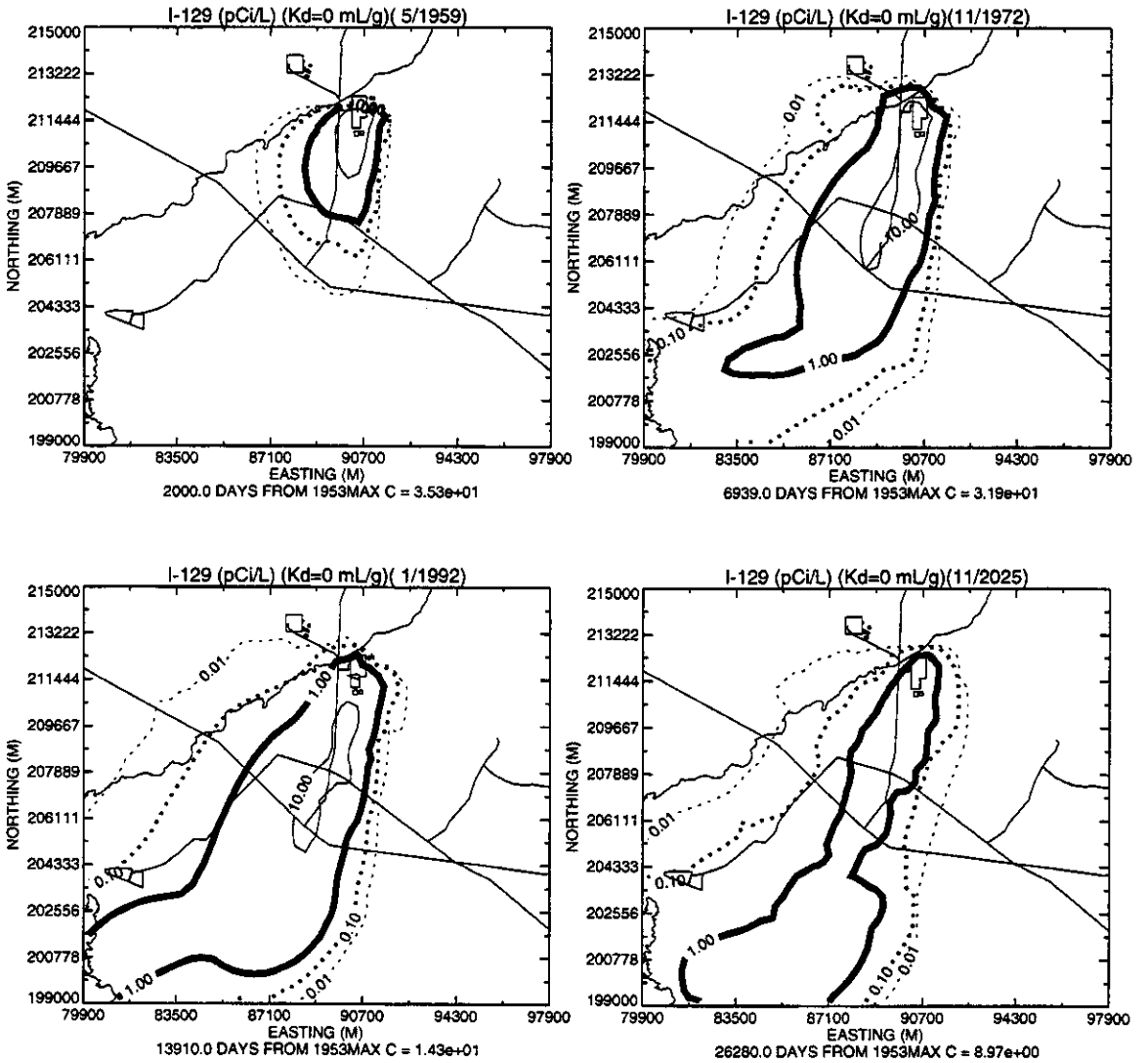


Figure 7-134 Aquifer I-129 peak concentration contours.

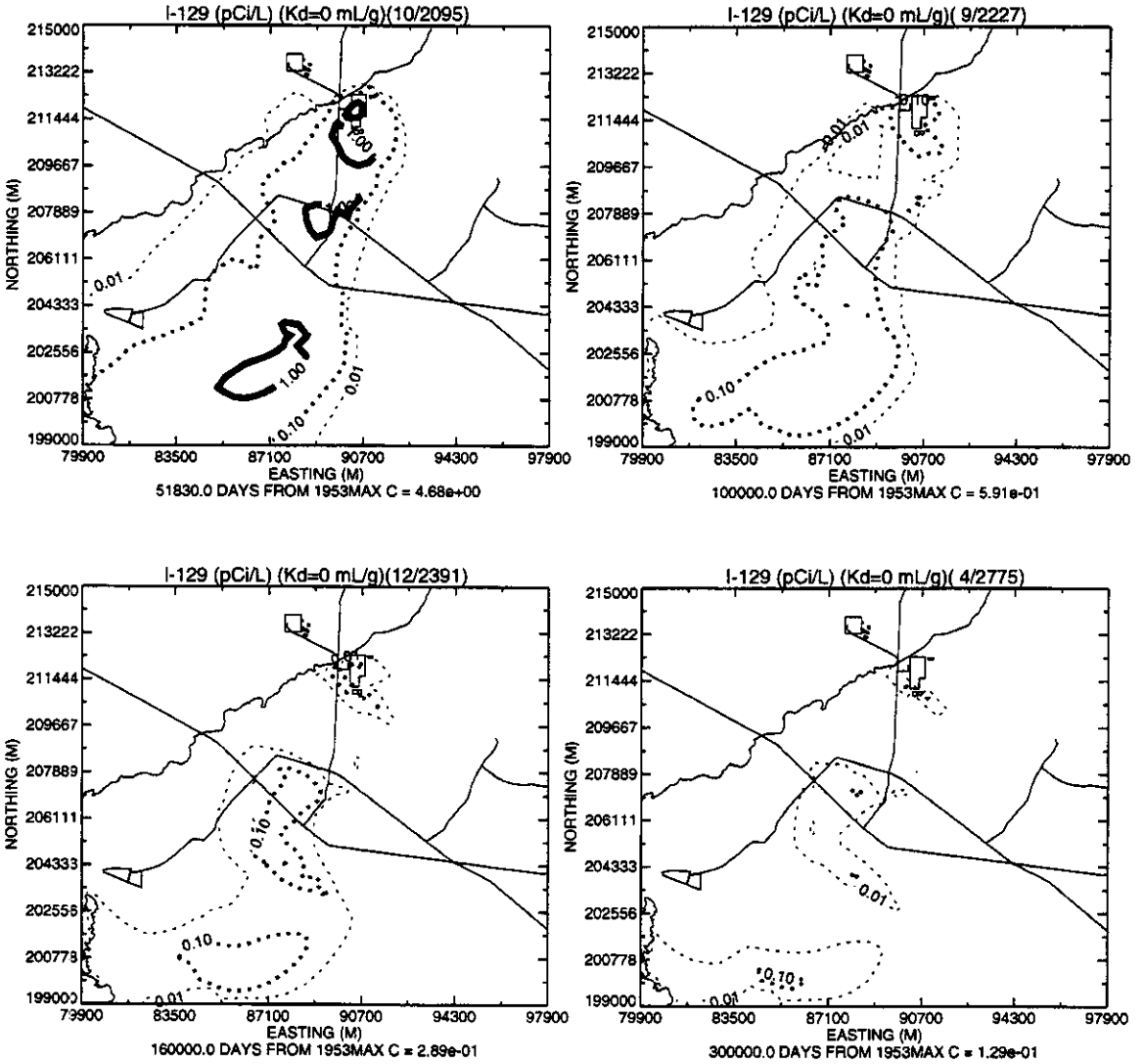


Figure 7-135 Aquifer I-129 peak concentration contours.

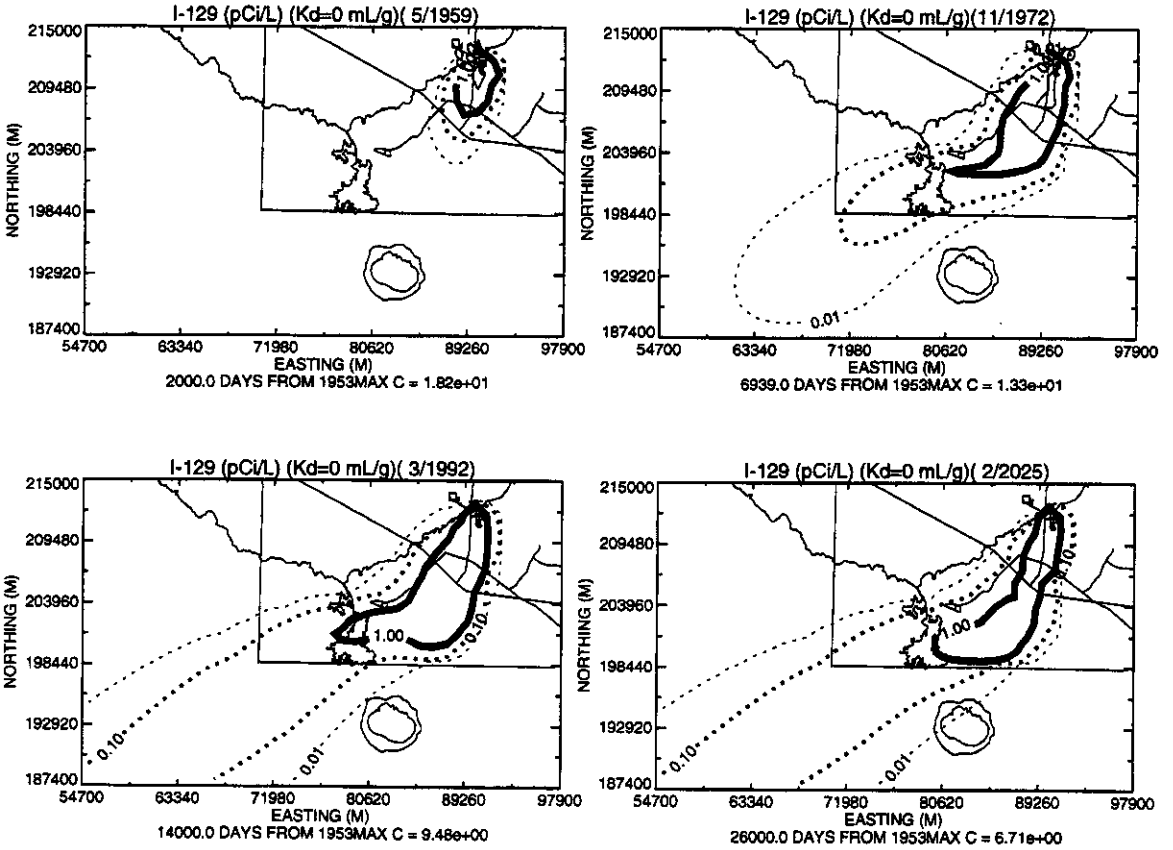


Figure 7-136 Aquifer I-129 peak concentration contours within the extent of the large aquifer model.

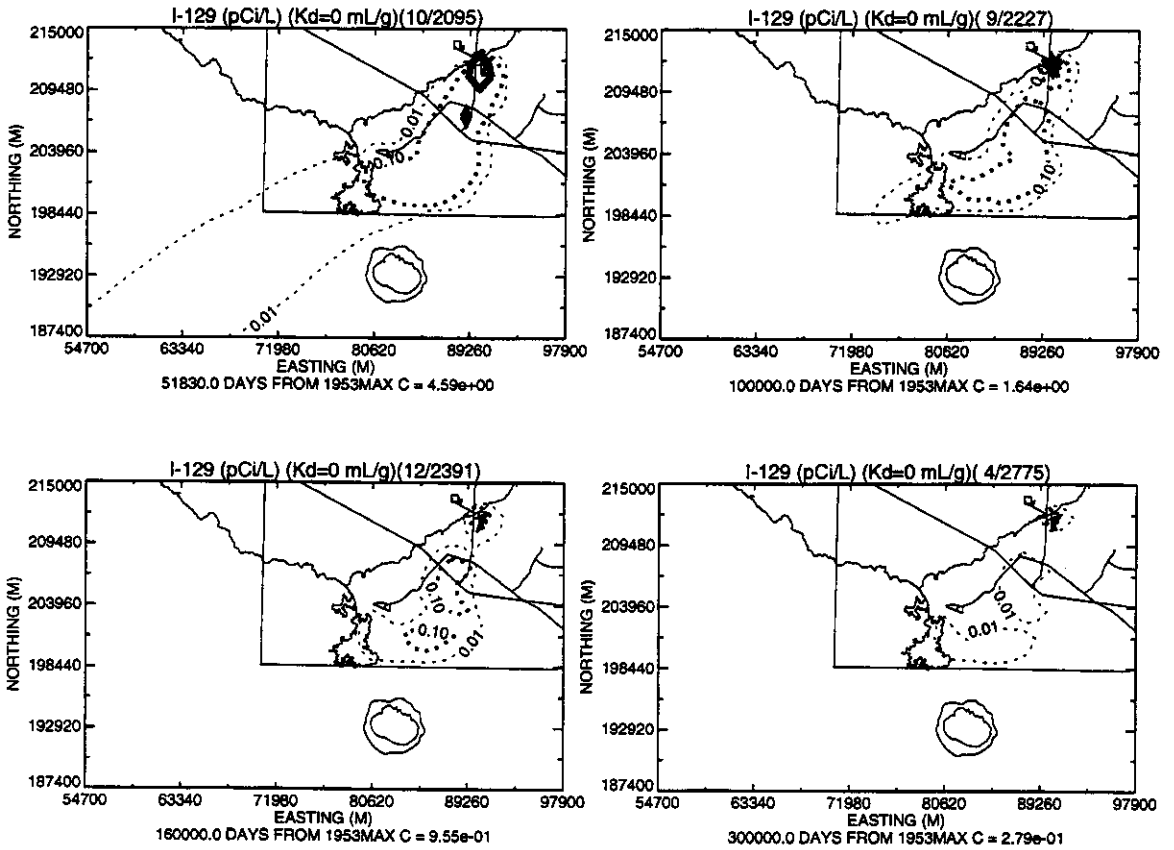


Figure 7-137 Aquifer I-129 peak concentration contours within the extent of the large aquifer model.

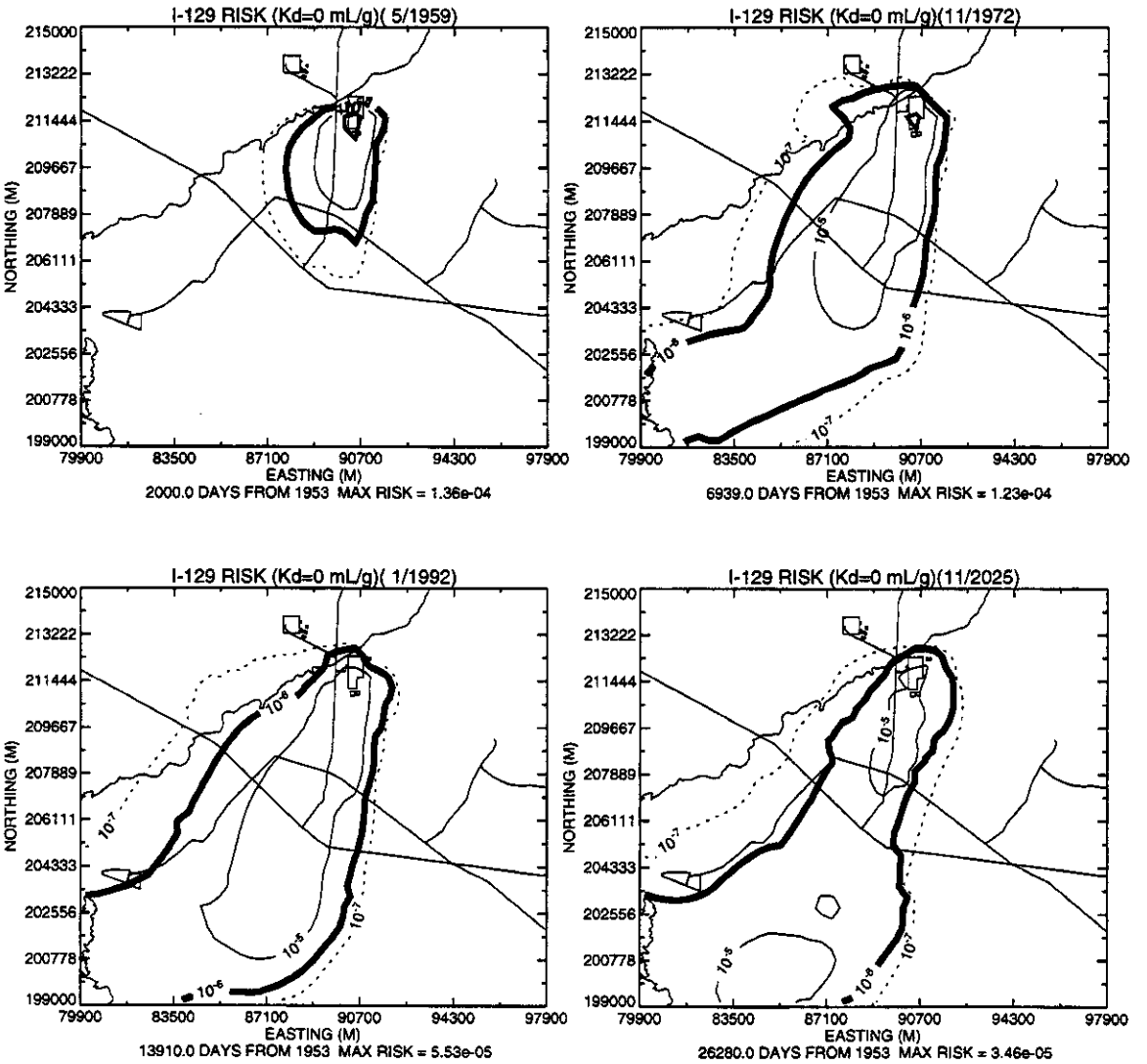


Figure 7-138 Aquifer I-129 peak risk contours.

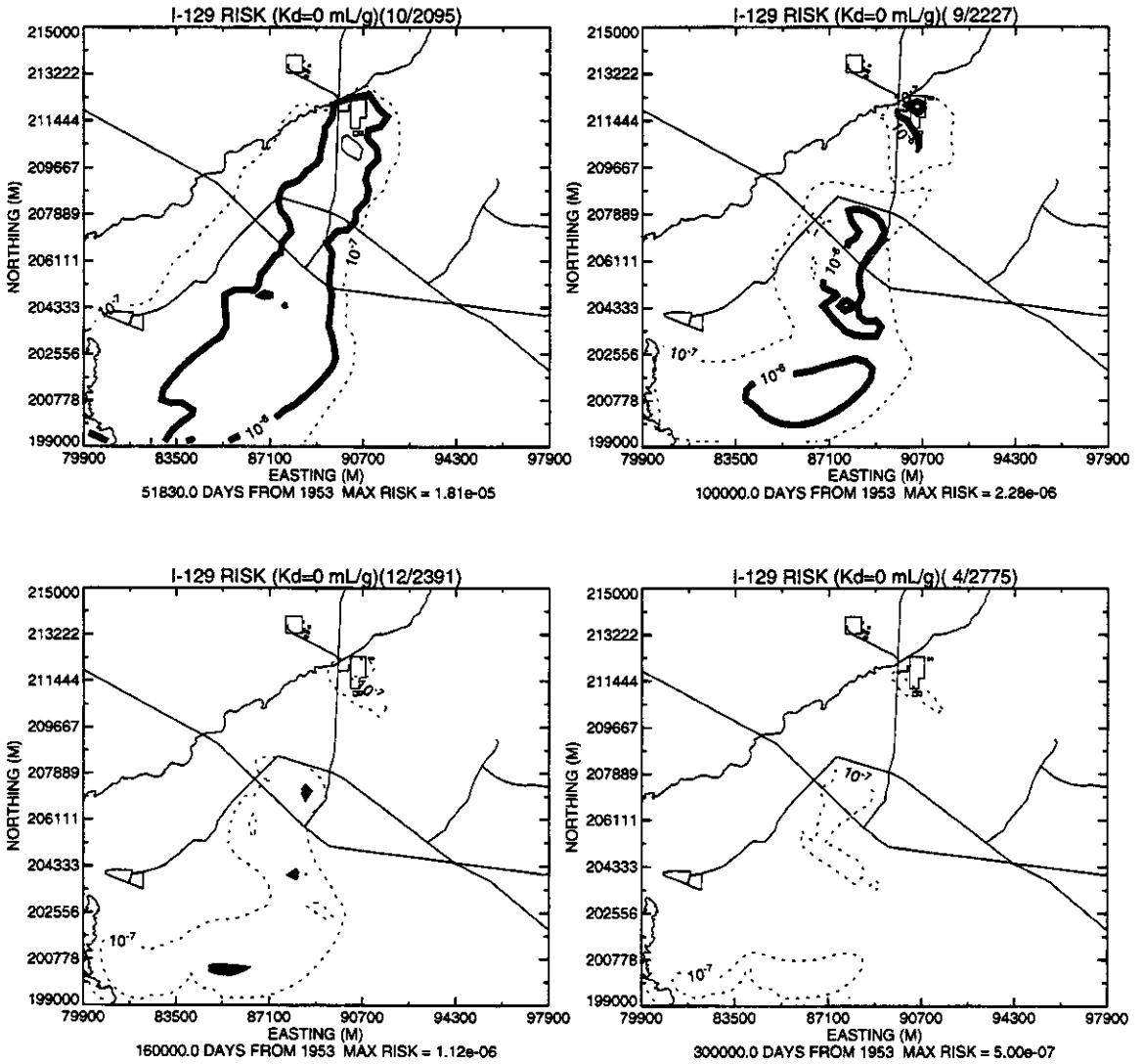


Figure 7-139 Aquifer I-129 peak risk contours.

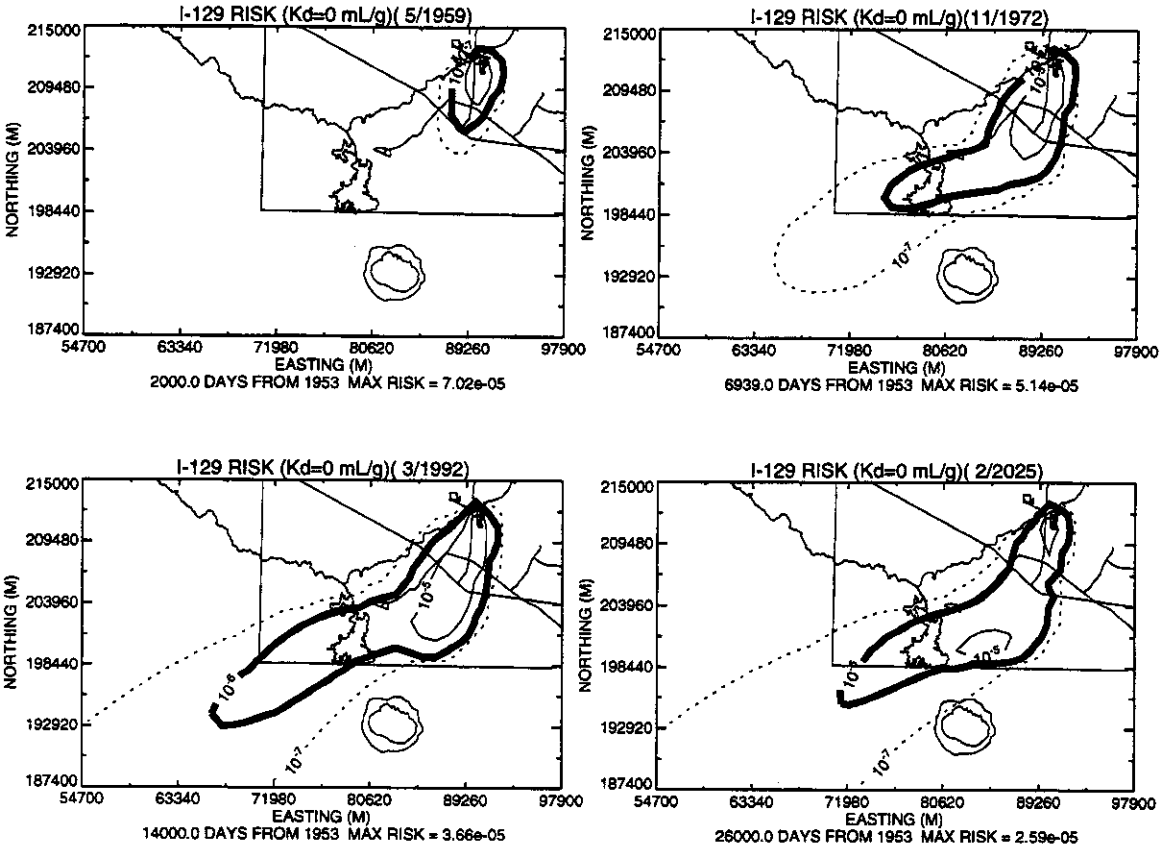


Figure 7-140 Aquifer I-129 peak risk contours within the extent of the large aquifer model.

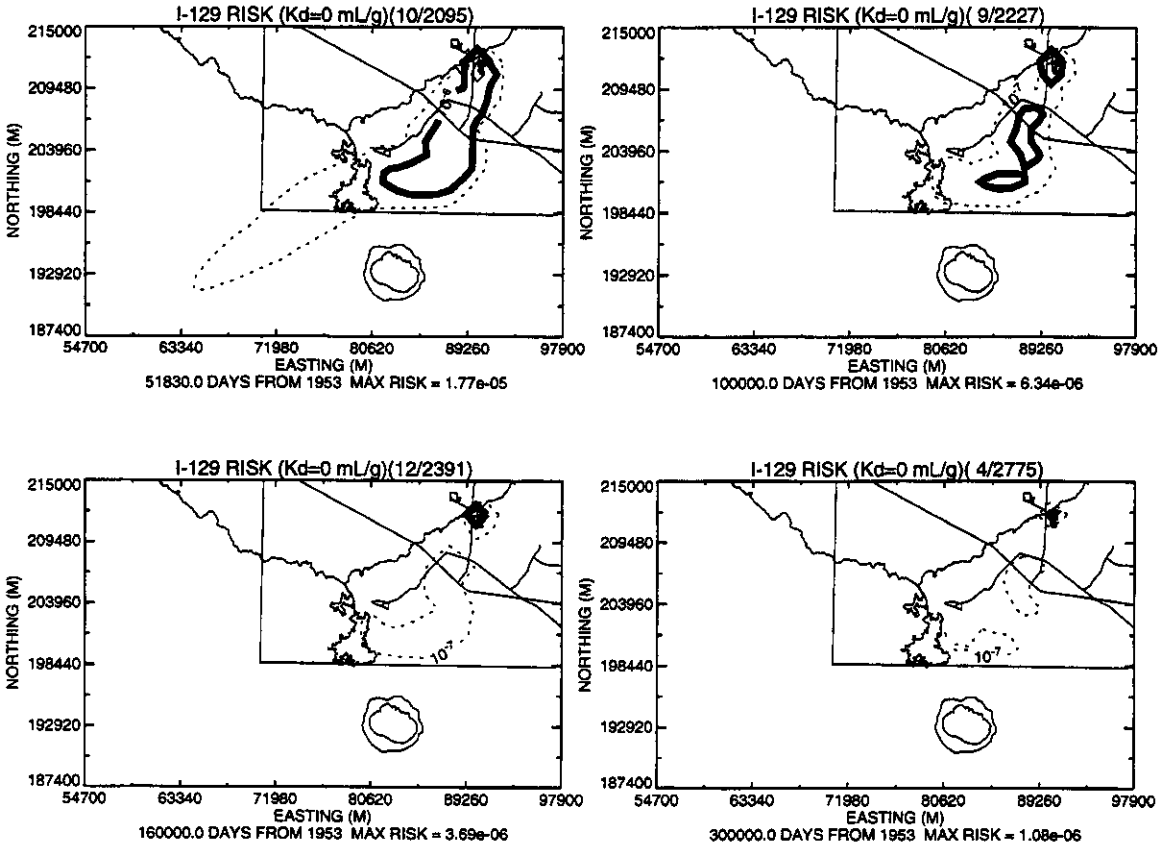


Figure 7-141 Aquifer I-129 peak risk contours within the extent of the large aquifer model.

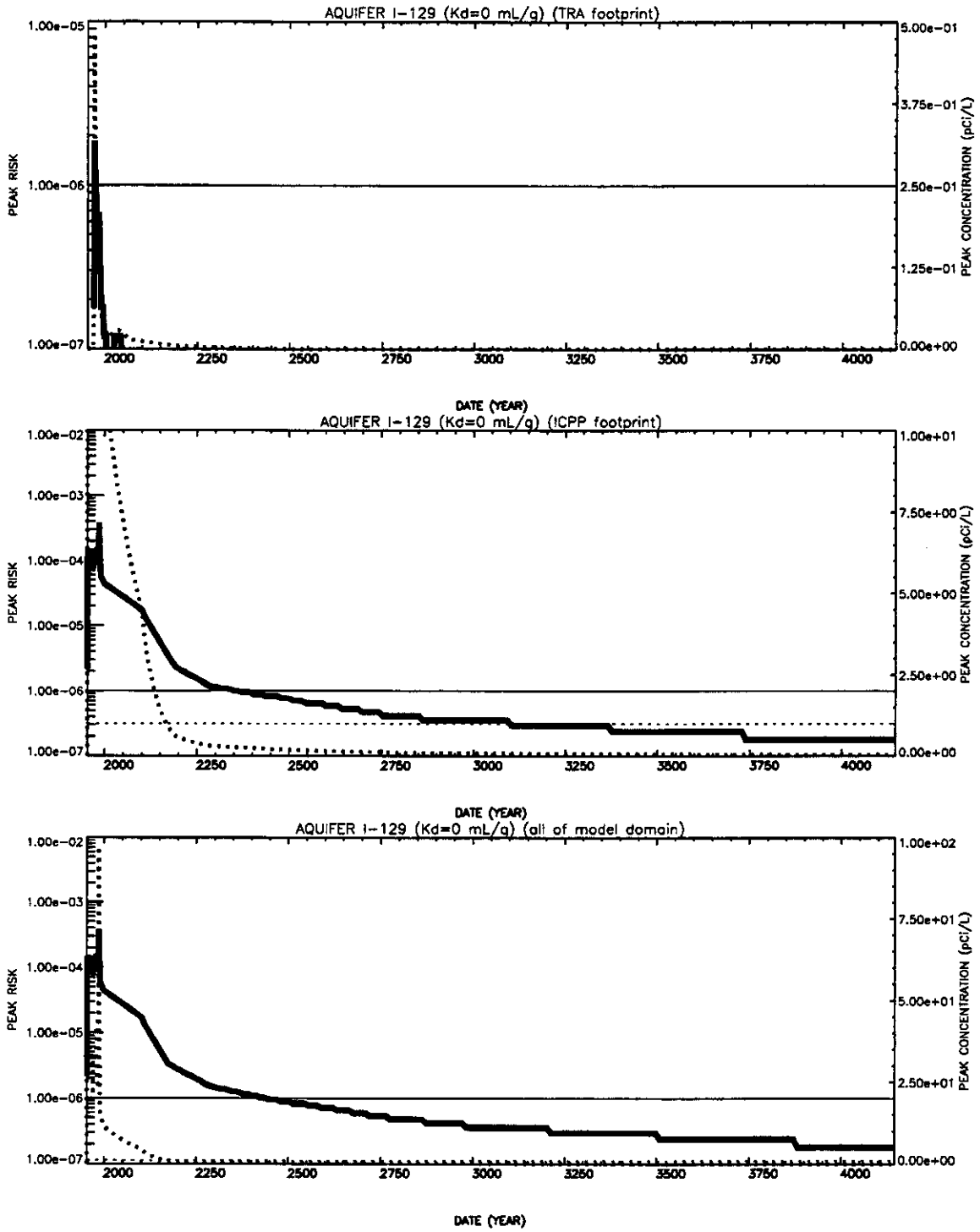


Figure 7-142 Peak aquifer concentration for I-129. Top figure: TRA foot print, Middle figure: ICPP footprint, Bottom Figure: entire aquifer domain. Thick line risk (left scale), dotted line concentration (right scale) solid line 10^{-6} risk (left scale).

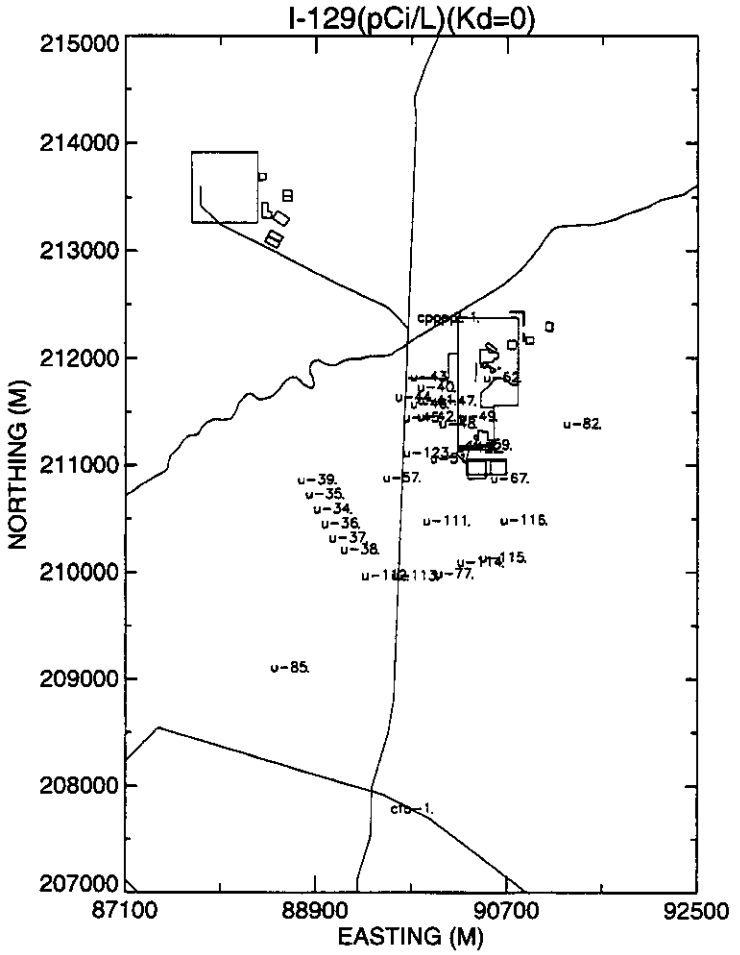


Figure 7-143 Well locations for the comparison of aquifer I-129 to field data.

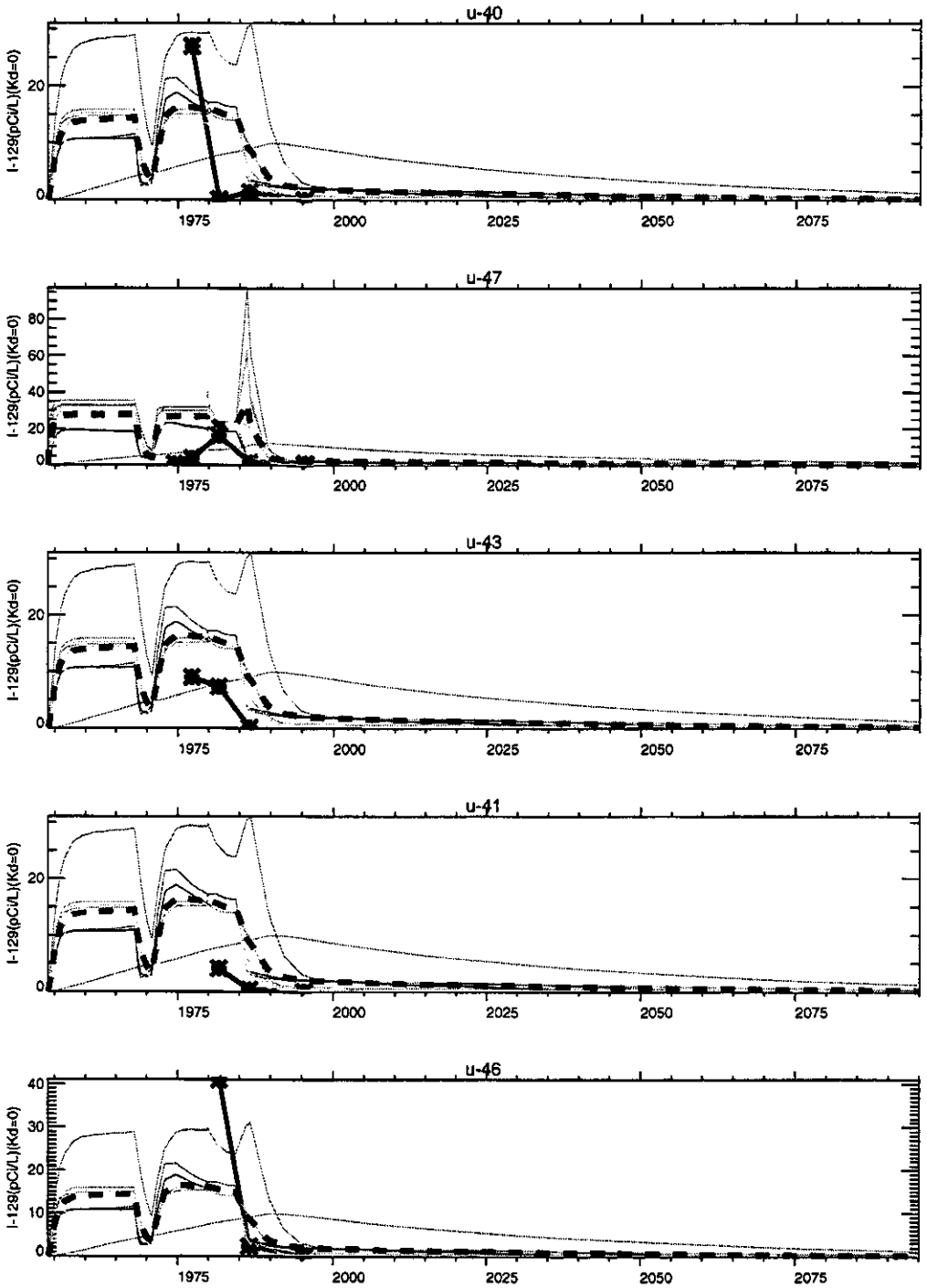


Figure 7-144 Comparison of aquifer I-129 to field data.

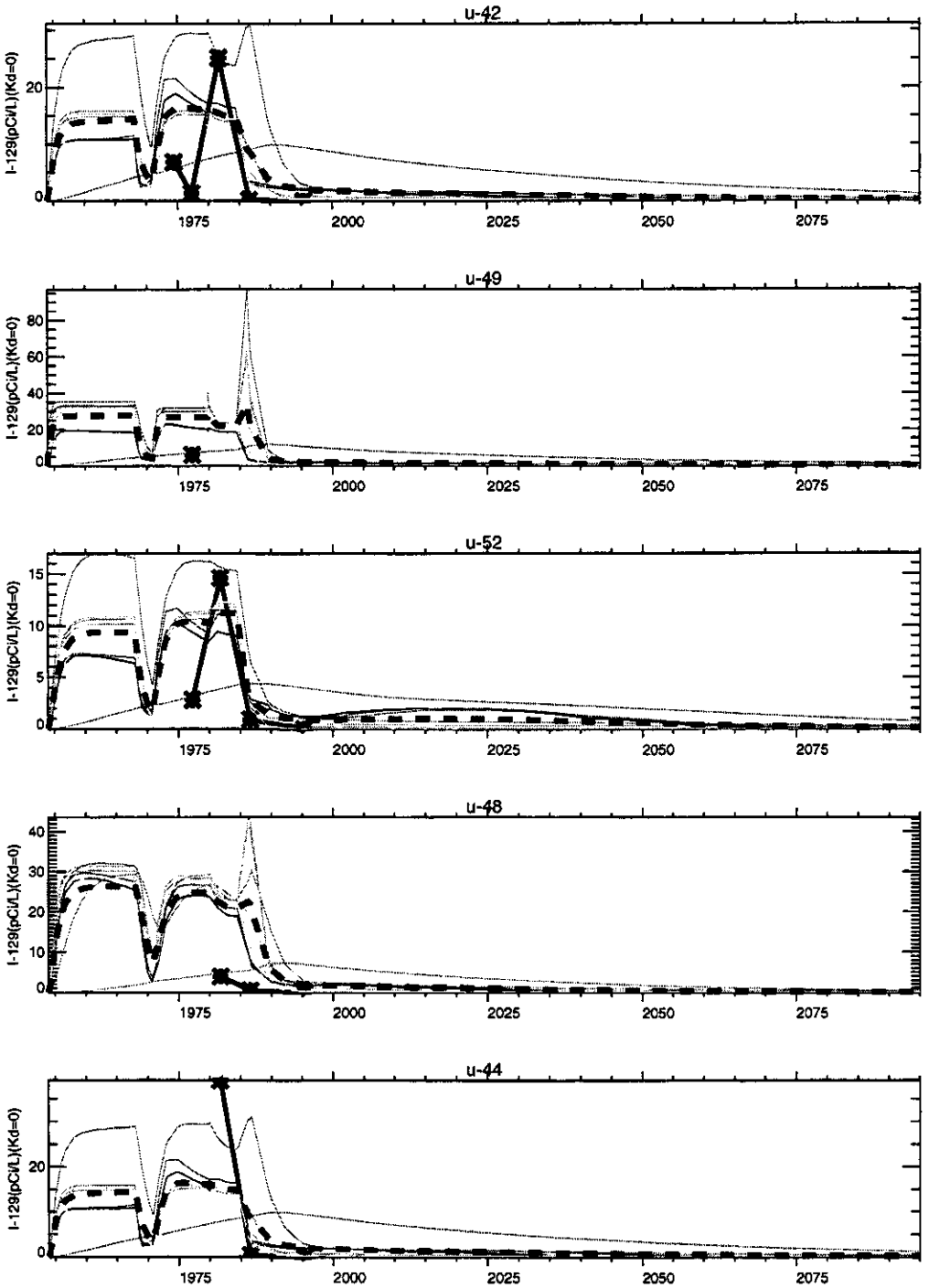


Figure 7-145 Comparison of aquifer I-129 to field data.

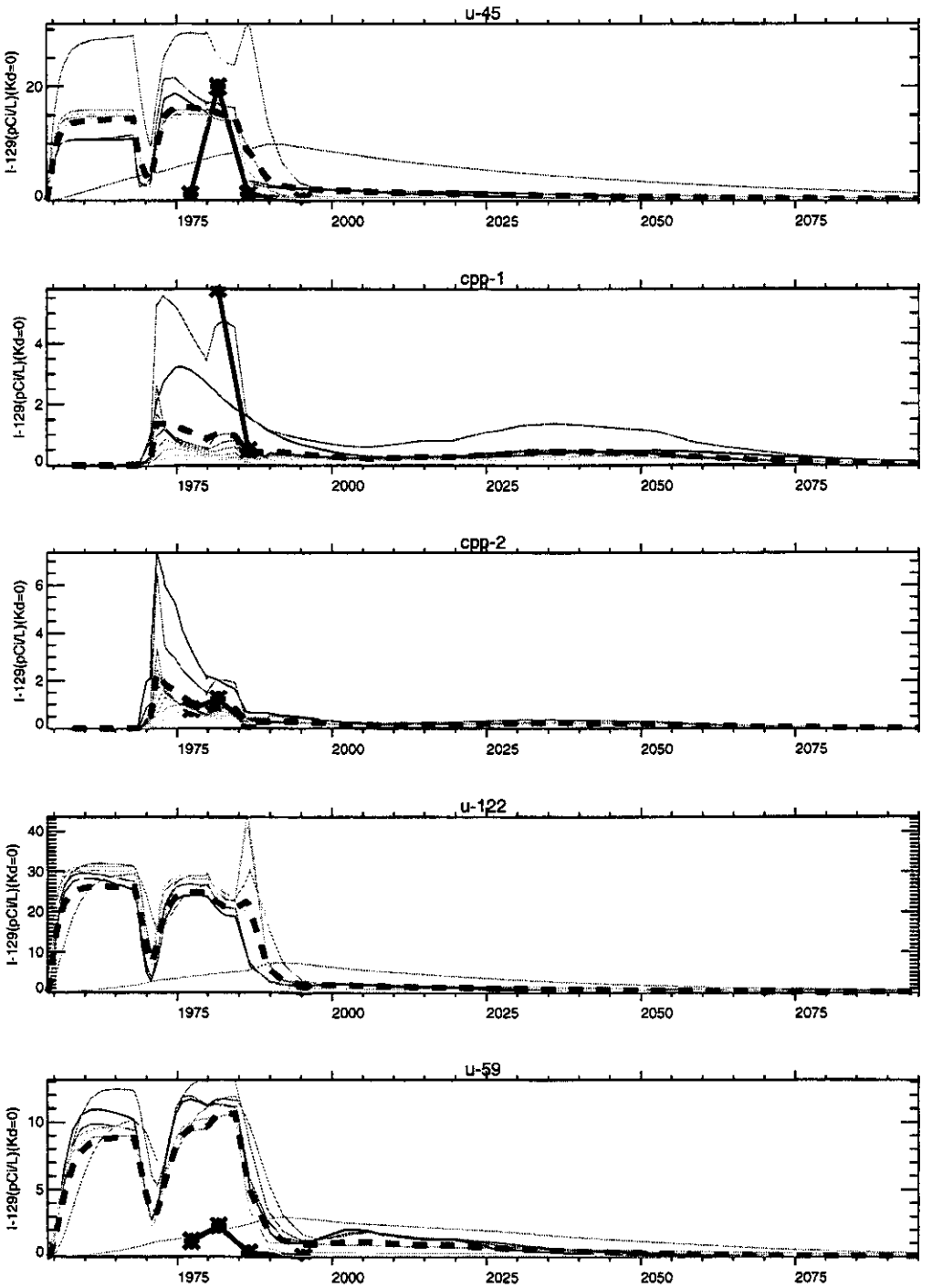


Figure 7-146 Comparison of aquifer I-129 to field data.

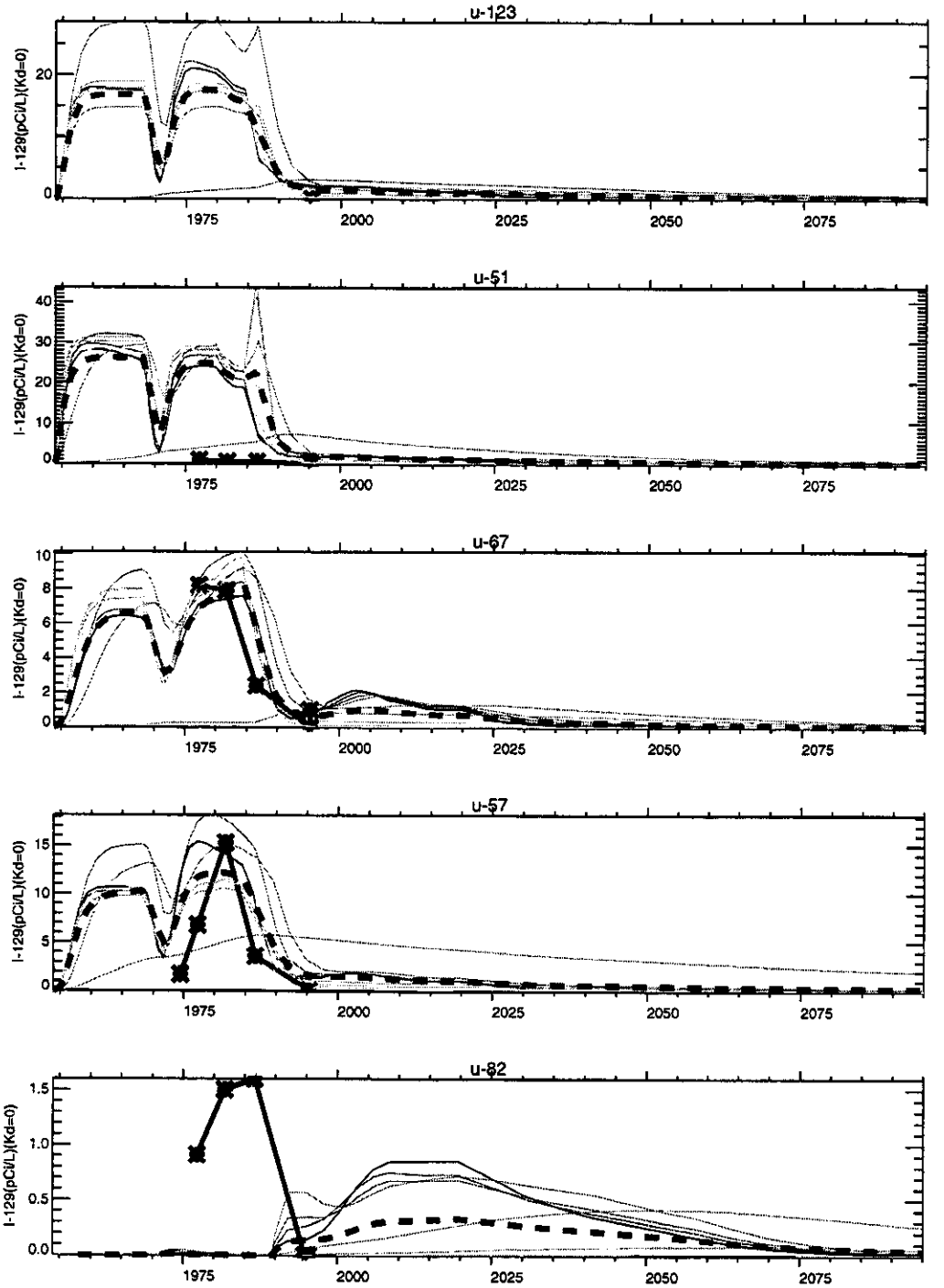


Figure 7-147 Comparison of aquifer I-129 to field data.

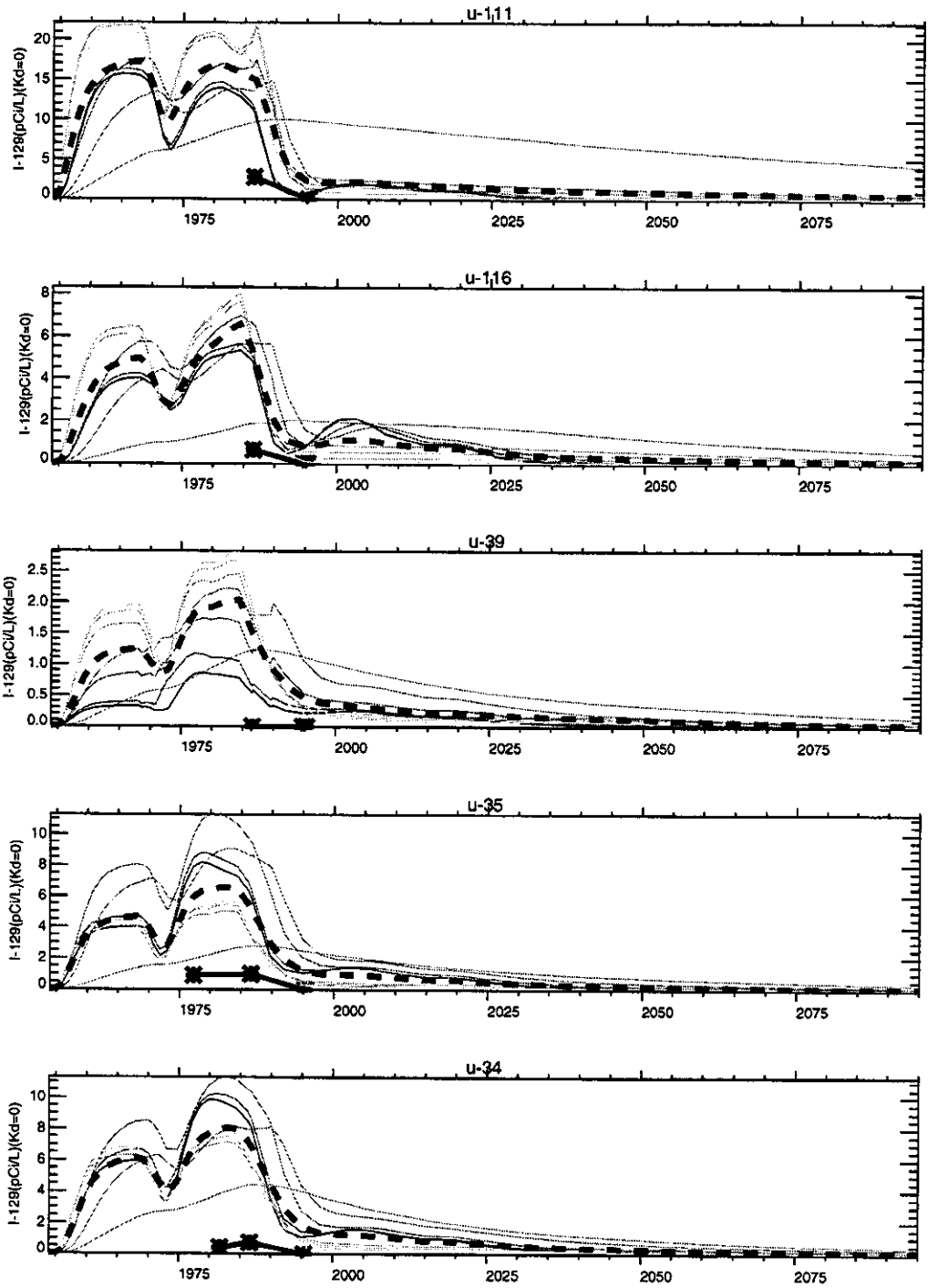


Figure 7-148 Comparison of aquifer I-129 to field data.

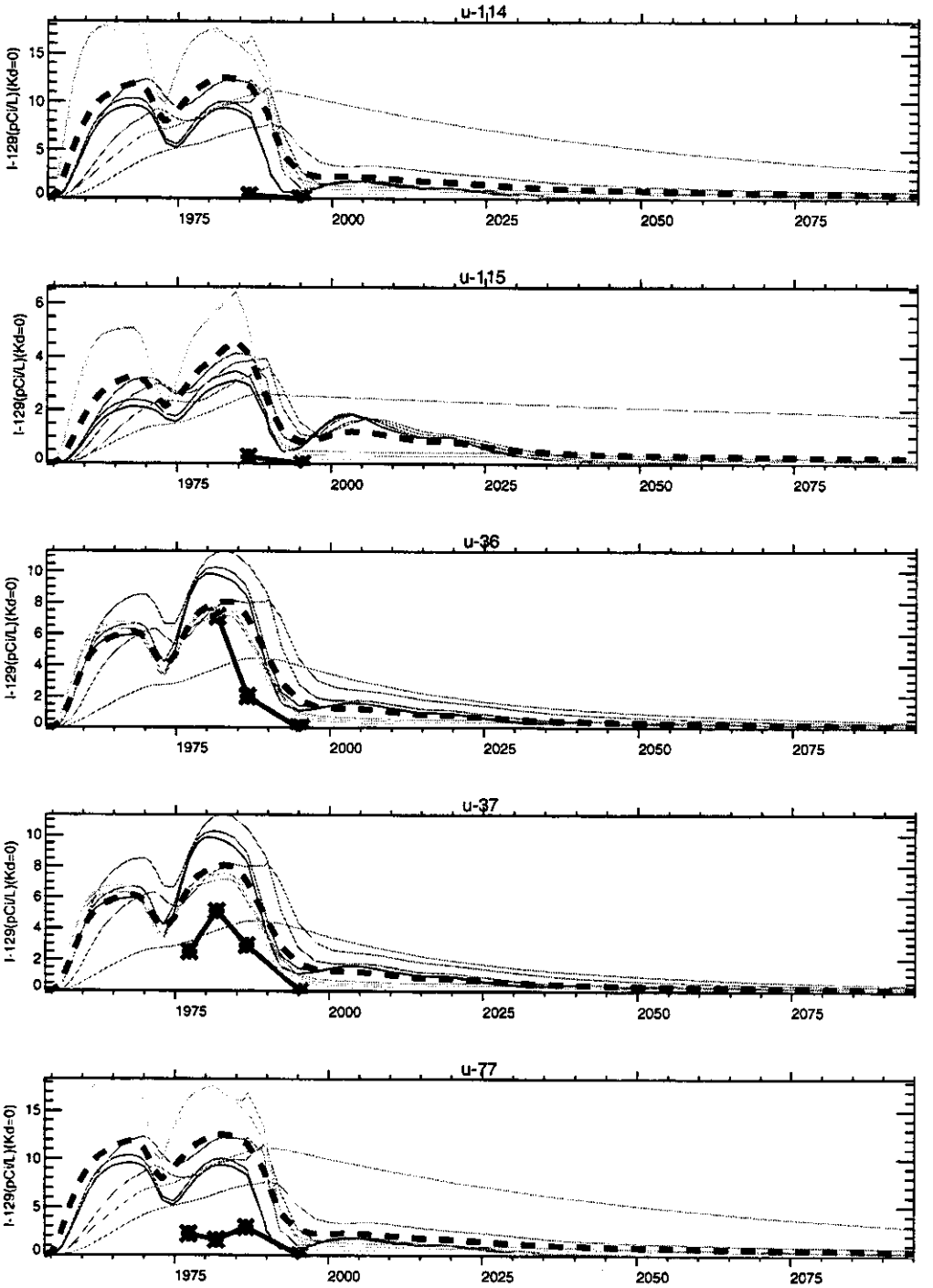


Figure 7-149 Comparison of aquifer I-129 to field data.

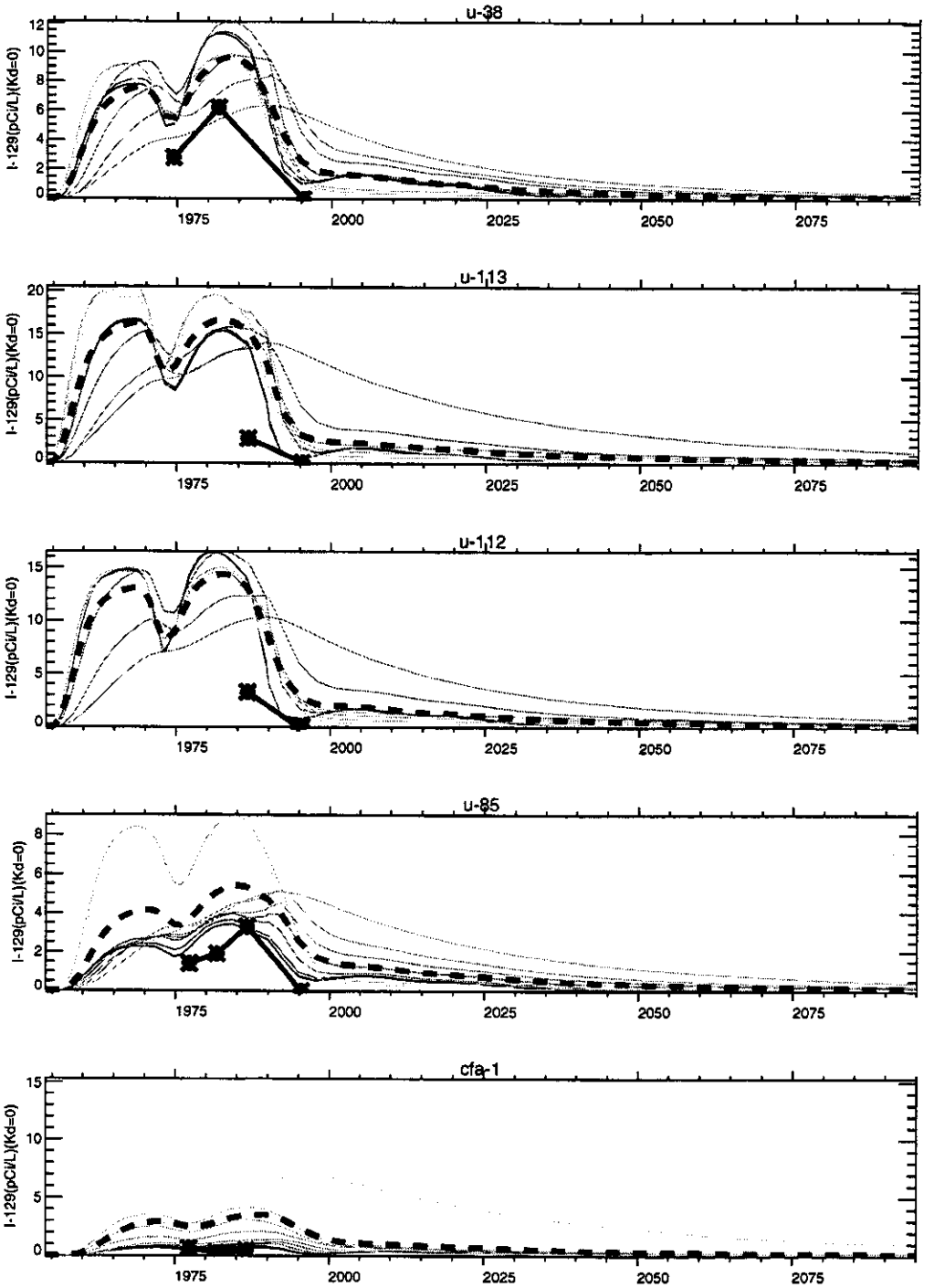


Figure 7-150 Comparison of aquifer I-129 to field data.

7.8 Np-237

Dicke (1997) has suggested that Np-237 is a sorptive species, and should be modeled with a Kd=8 cm^3/g. This results in retarded movement of Np-237 through the vadose zone and aquifer, and in lower predicted concentrations relative to the conservative species approach. The following simulation was done using a sediment Kd=8 cm^3/g, and an aquifer basalt Kd 1/25th of that value. For comparative purposes, the conservative species simulations are presented as a sensitivity run in Section 8.6.1.

Np-237 was primarily introduced to the aquifer through the injection well (75.32% from 1953-1984) and into the vadose zone from the CPP-31 (15.23% in 1972), CPP-28 (0.01% from 1956-1974), and '86 releases (0.02%) in addition to contributing to the soil inventory (9.41% in 1990). Some of the injection well disposal was during the period of time that the injection well was presumed to be backflowing into the vadose zone. As a result, there are two distinct break through curves from the vadose zone into the aquifer as the injection well source arrives before the surface sources are transported through the entire vadose zone depth. This is illustrated in Figures 7-151 through 7-158 for the transport of Np-237 through the vadose zone, and Figures 7-159 through 7-171 for the aquifer region. Contour levels for both the vadose zone and aquifer (Figures 7-151 through 7-154, and 7-159 through 7-162) are given for $1.5x10^{-1}$, 1.5, $1.5x10^{+1}$, $1.5x10^{+2}$, $1.5x10^{+3}$, and $15.0x10^{+4}$ pCi/L, with concentrations equal to the total alpha MCL (15.0 pCi/L) represented by the dark solid line. This value is used to represent the maximum concentration allowed for total alpha radiation under the MCL guidance. Contour maps representing the resultant risk are given in Figures 7-163 through 7-166 for the aquifer region. Risk contours are given for 10^{-7}, 10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}, and 10^{-2} levels with the 10^{-6} value (0.16 pCi/L) indicated by the dark solid line and the 10^{-4} level by the medium solid line.

VADOSE ZONE: These figures show that the Np-237 vadose zone and aquifer transport were simulated through the year 2800. The breakthrough of Np-237 into the aquifer from the vadose zone is given in Figure 7-156, with the peak vadose zone concentration given in Figure 7-155. These figures indicate that the predicted vadose zone concentration of Np-237 is predicted to be below the MCL in 2565, and that the peak vadose zone concentrations should have occurred in about 1990. Although still above the 10^{-6} risk level in 2800, the simulations were terminated because Figure 7-155 shows the simulations are past the peak mass flux from the vadose zone to the aquifer.

Comparisons of model predicted concentrations in the vadose zone to field data (Figures 7-157 through 7-158) are good for all of the observation wells, indicating that a Kd of 8 cm3/g is a reasonable estimate of the Kd for Np-237.

AQUIFER: The predicted maximum Np-237 aquifer concentration is 3.76 pCi/L in the year 2095 (Figure 7-167) which exceeds the 10^{-6} risk concentration (0.16 pCi/L) but is less than the total alpha MCL (15.0 pCi/L). The predicted maximum aquifer concentration is predicted to exceed the 10^{-6} risk level until well beyond the year 2800 and to exceed the total alpha MCL until about the year 2003. Although still above the 10^{-6} risk level, the peak concentration in 2095 is declining from a maximum of 30 pCi/L in 1986. The aquifer area with concentrations greater than the total alpha MCL is limited to the area of the ICPP after the year 2025 (Figure 7-160), but the area above the 10^{-6} risk concentration is still very large after the year 2095 (Figure 7-164). The Np-237 source to the injection well dominates the aquifer concentrations until about the year 2100. Afterwards, the vadose zone mass flux (from the surface sources) provides a relatively low level mass flux to the aquifer throughout the simulation time frame (Figure 7-156). The aquifer concentrations rise slightly in the long term due to the mass flux from the vadose zone (Figure 7-167) but the concentrations are low relative to aquifer concentrations from the injection well source.

There are very little data available for use in comparing model predictions to measured aquifer concentrations for Np-237. In a majority of the wells sampled, data were collected only once in 1994. Using this limited information, comparisons of model predicted concentrations to field data are presented in Figures 7-169 through 7-171. Because of the lack of time-concentration history, it is difficult to infer whether the predicted mass is arriving early or late. However, in the wells sampled, the predicted concentrations are fairly close to observed values. In general, the predictions are too high for the wells close to the injection well

and too low for the wells far from the injection well. This indicates that the Kd value may be slightly high. A sensitivity analysis simulation is presented for Np-237 to address the effects of modeling this contaminant as a conservative species in Section 8.6.1.

As summarized in Section 10.5, the reestimated CPP-31 inventory for Np-237 is one tenth the original inventory (Table 10-7) and one tenth the total tank farm inventory (Table 10-9). Based on the results shown in Table 10-8, decay of Am-241 will provide a negligible amount of mass to the Np-237 inventory over the next 100s to 1000s of years. Only 15% of the Np-237 released at the ICPP went to the tank farm while a conservatively estimated 75% went to the injection well. The results of reestimating the CPP-31 inventory would decrease the long term Np-237 aquifer concentrations by a factor of 10. Therefore, the Np-237 simulation results appear to be conservative based on the assumptions of this uncertainty section.

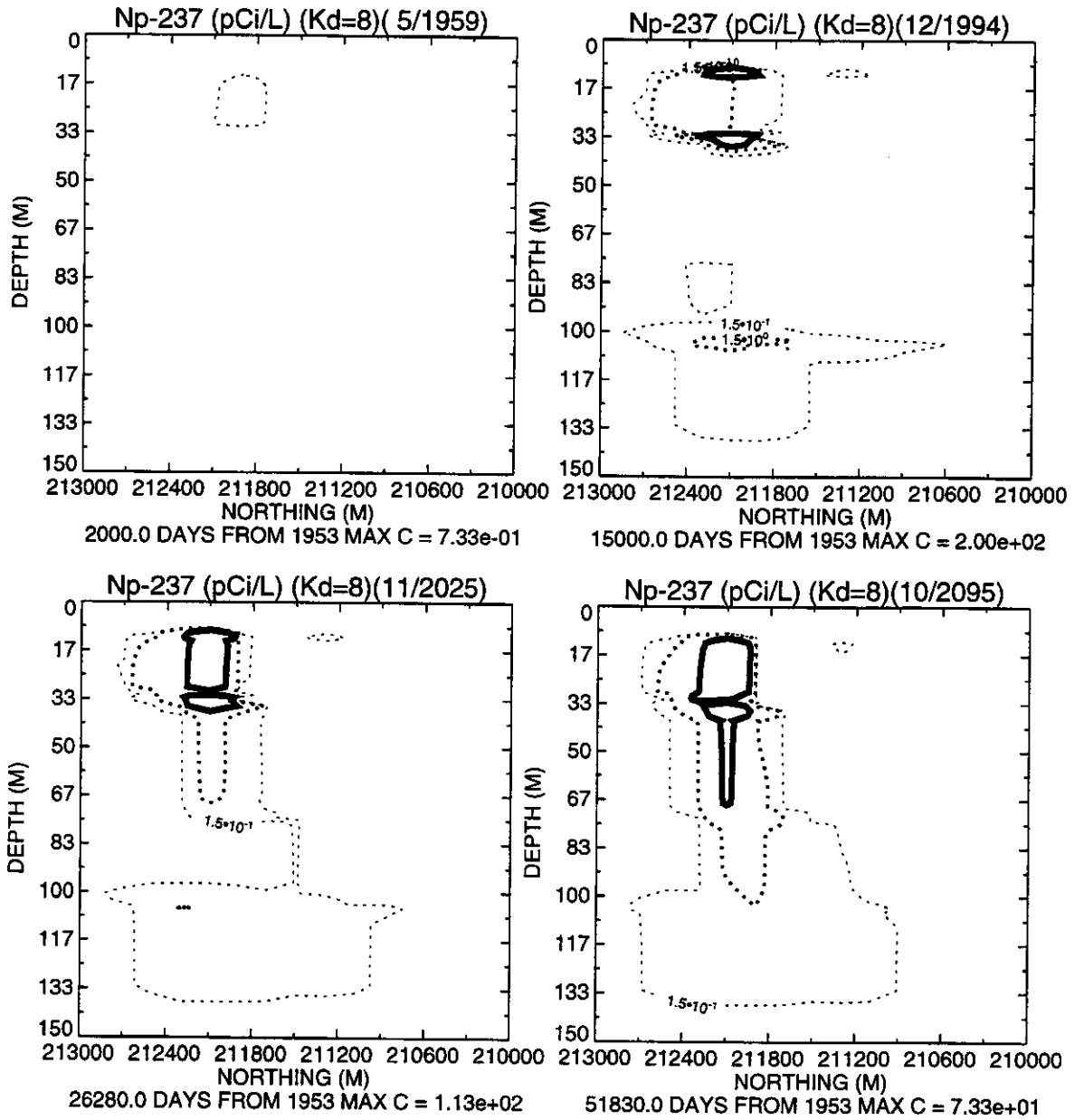


Figure 7-151 Vadose zone Np-237 peak concentration contours.

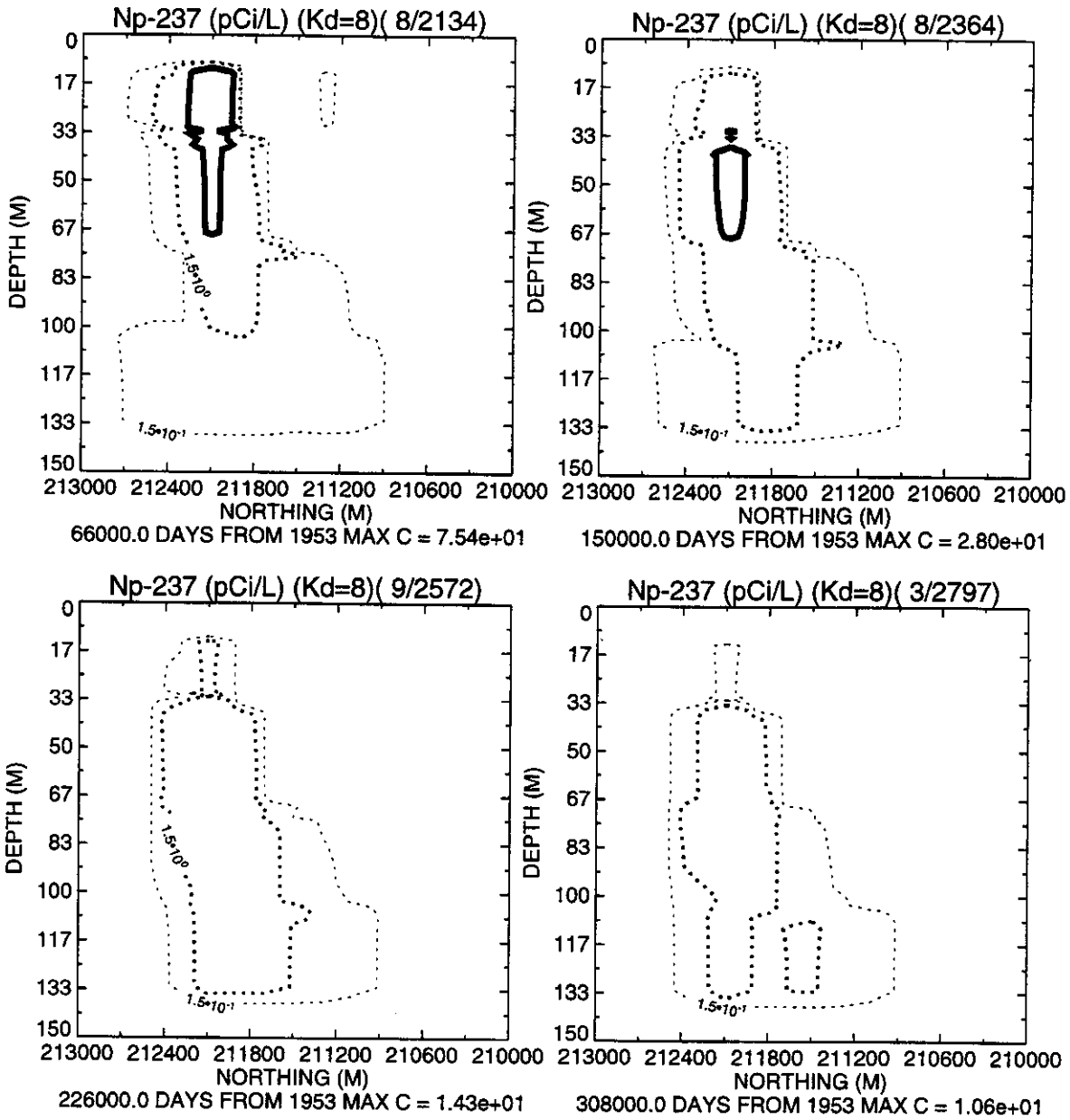


Figure 7-152 Vadose zone Np-237 peak concentration contours.

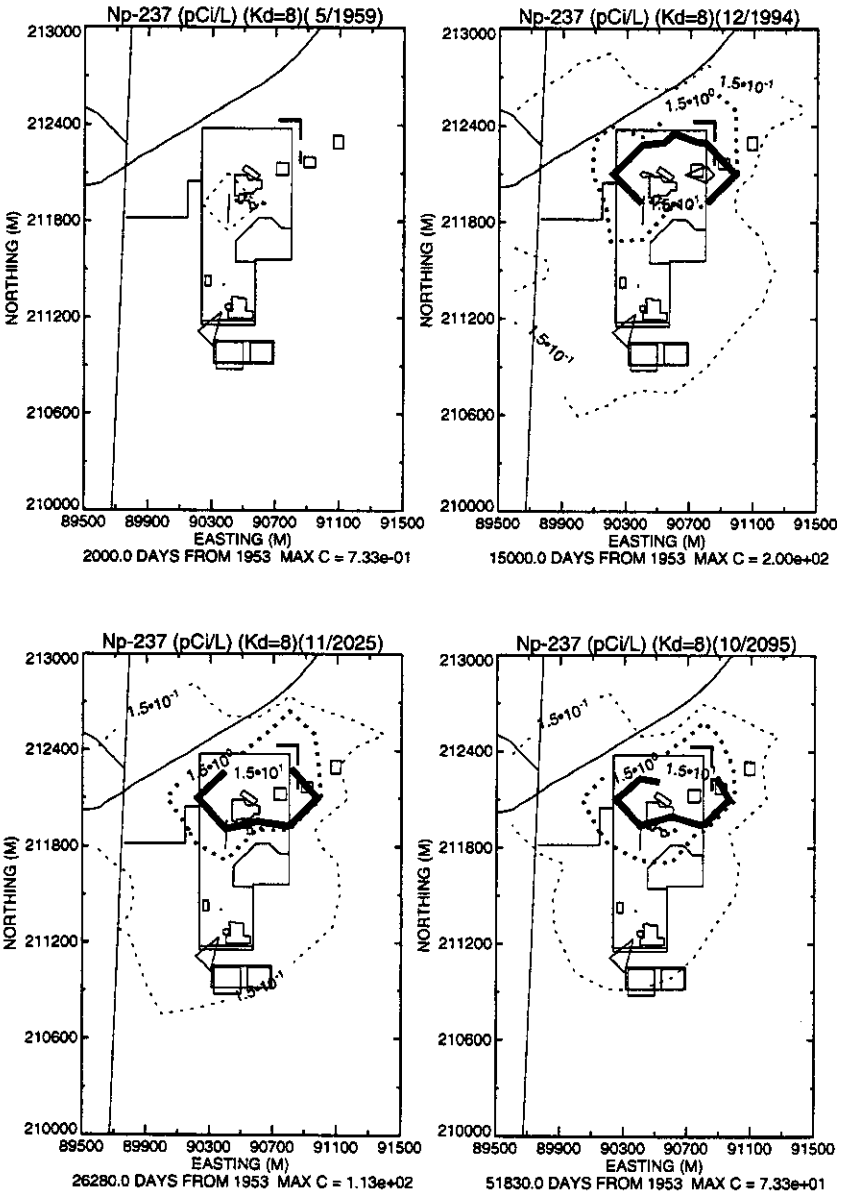


Figure 7-153 Vadose zone Np-237 peak concentration contours.

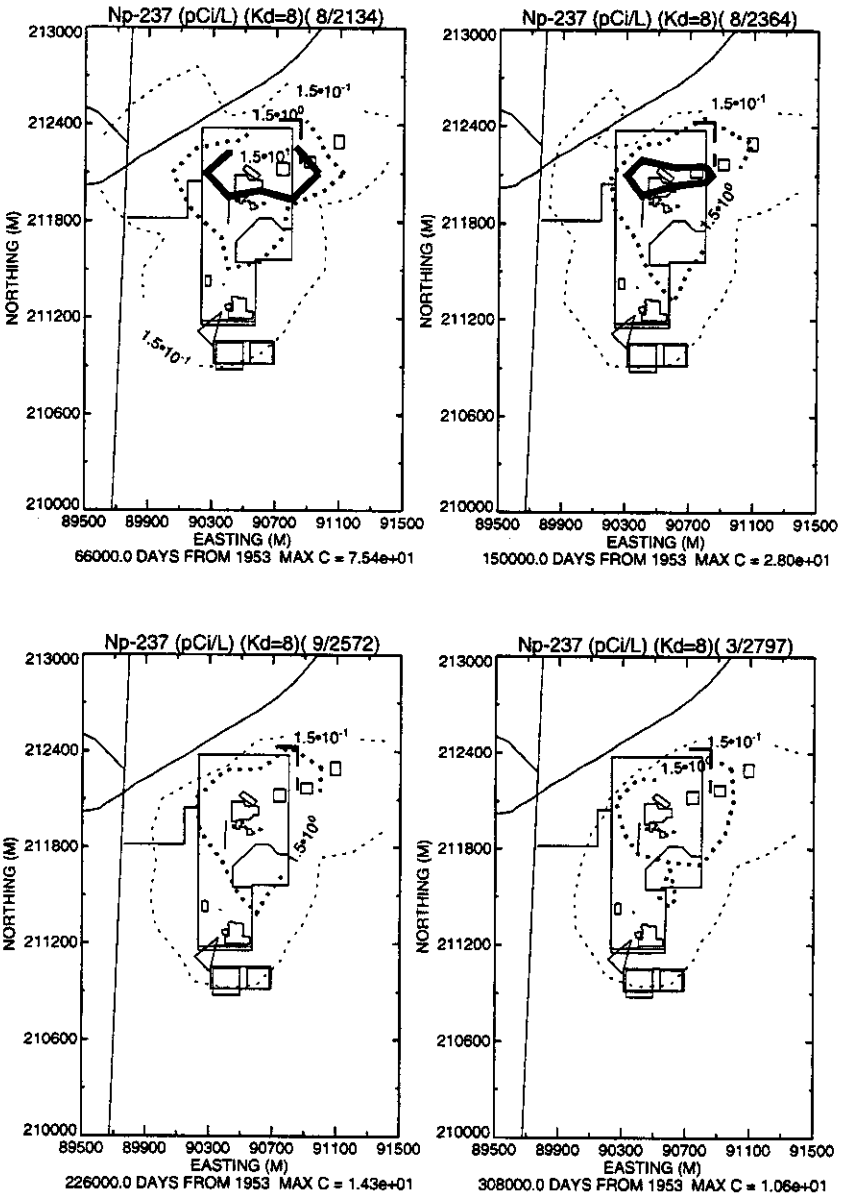


Figure 7-154 Vadose zone Np-237 peak concentration contours.

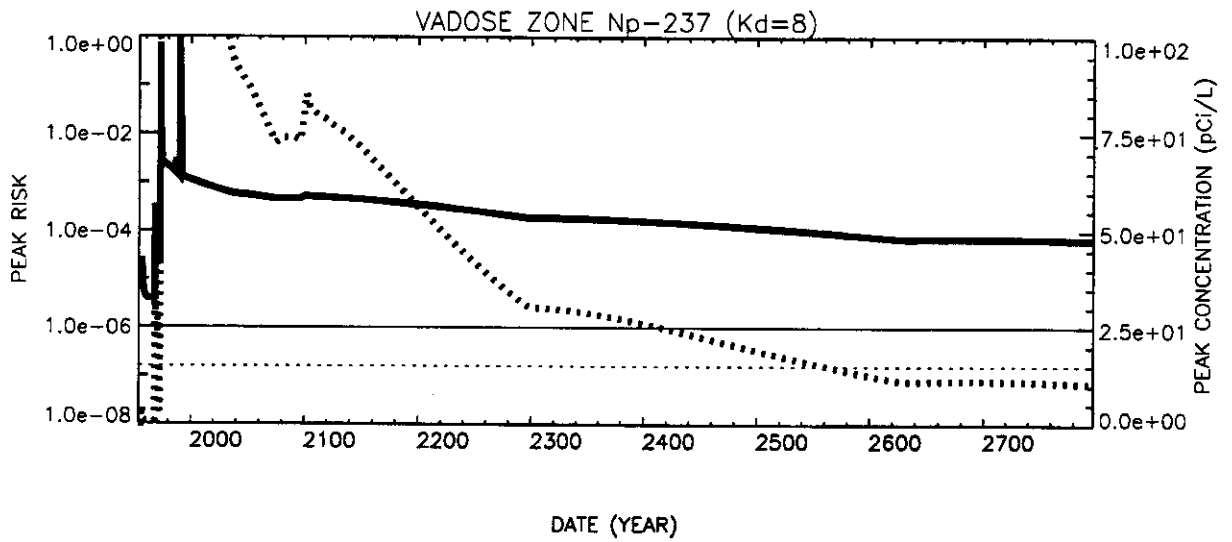


Figure 7-155 Peak vadose zone risk and concentration for Np-237. Risk indicated by the thick line on the log scale with the 10^{-6} value shown as the solid line. The dotted line represents concentration given by the linear scale on the right axis.

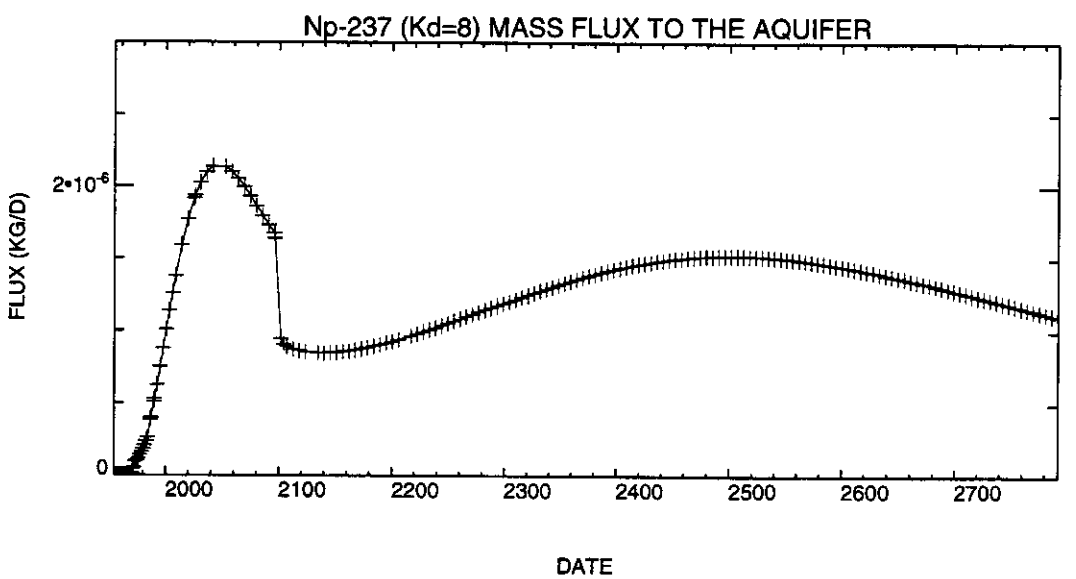


Figure 7-156 Mass flux of Np-237 into the aquifer from the vadose zone.

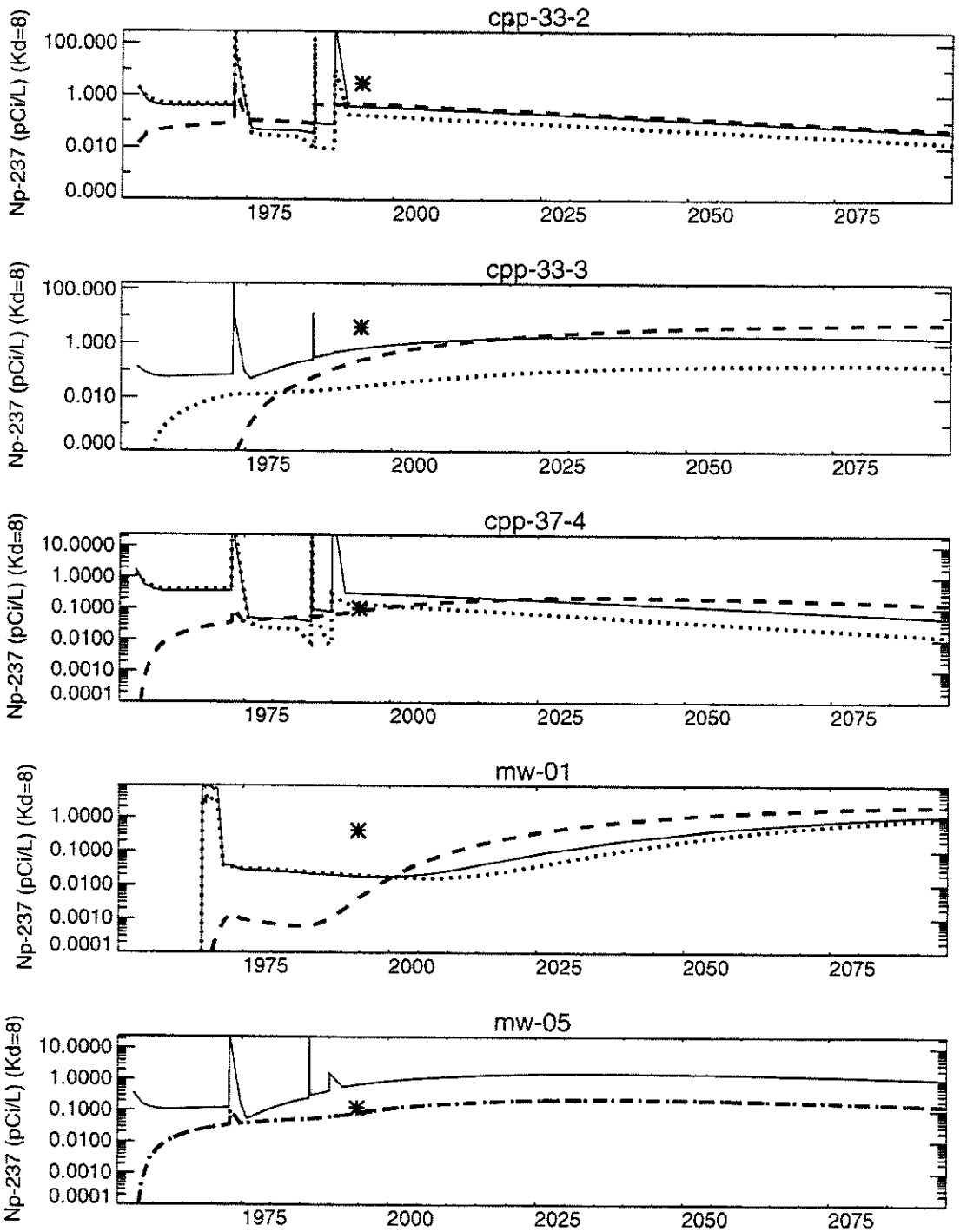


Figure 7-157 Comparison of vadose zone Np-237 to field data.

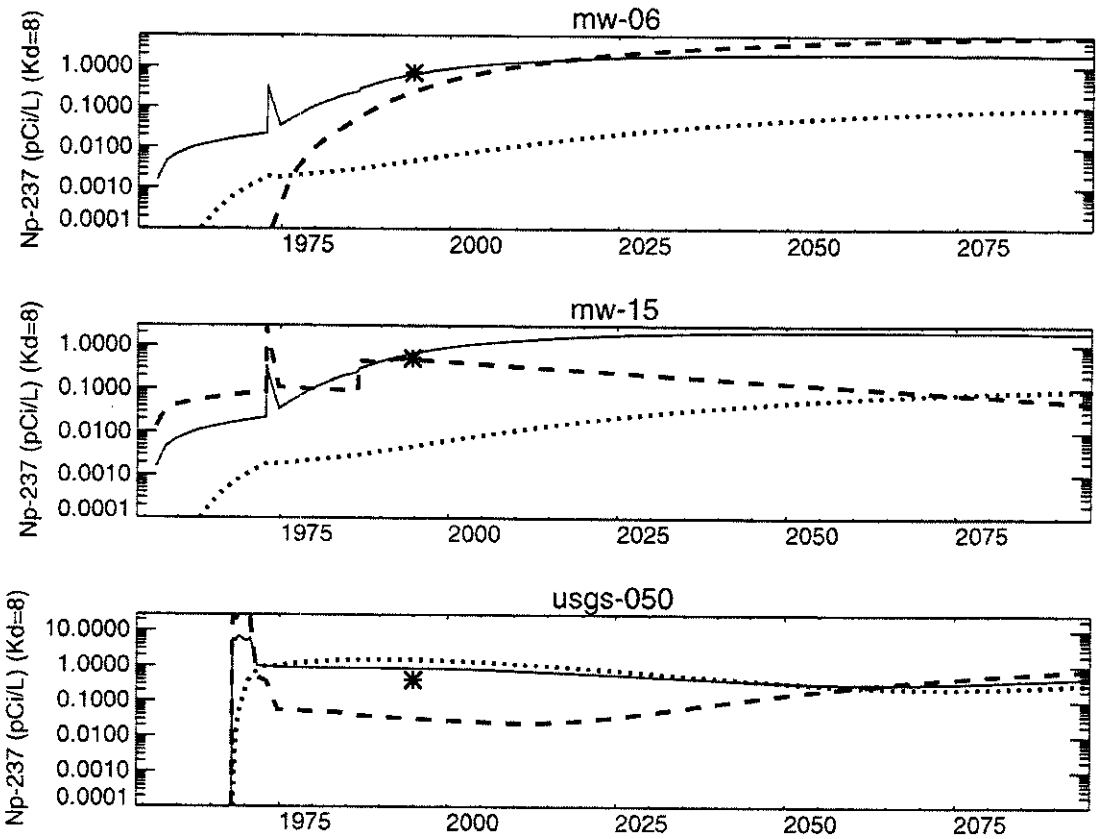


Figure 7-158 Comparison of vadose zone Np-237 to field data.

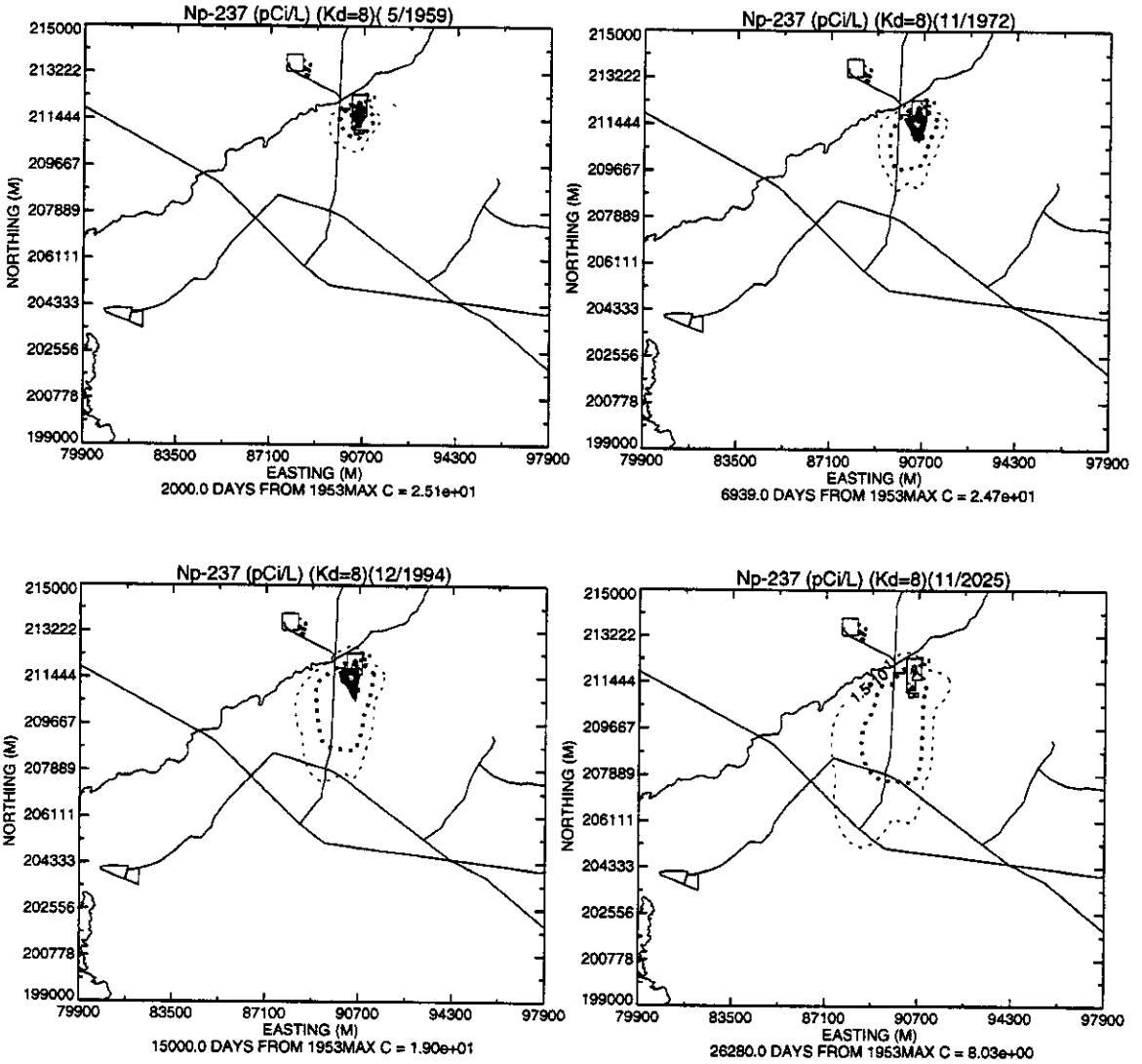


Figure 7-159 Aquifer Np-237 peak concentration contours within the extent of the small aquifer model

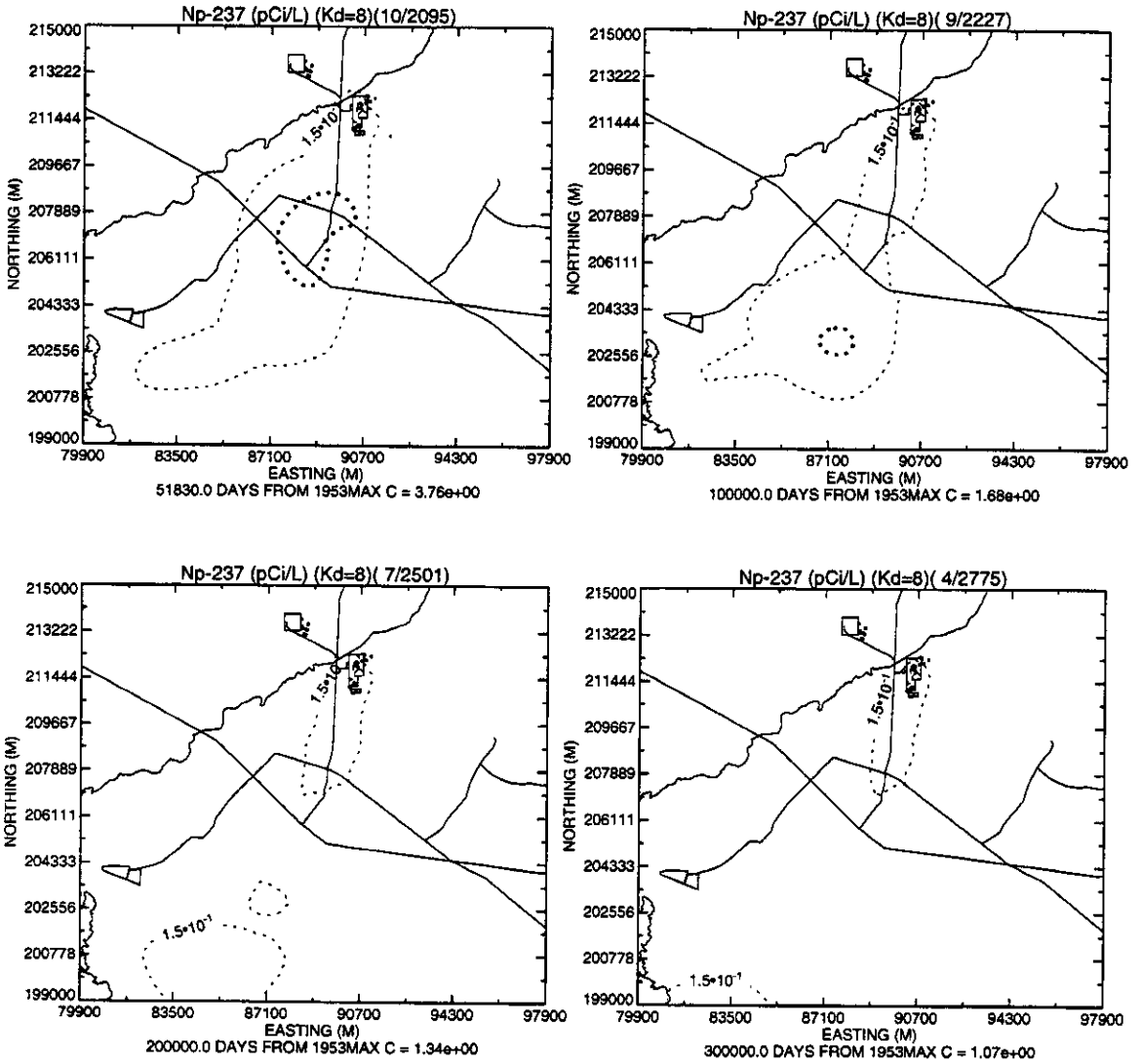


Figure 7-160 Aquifer Np-237 peak concentration contours within the extent of the small aquifer model

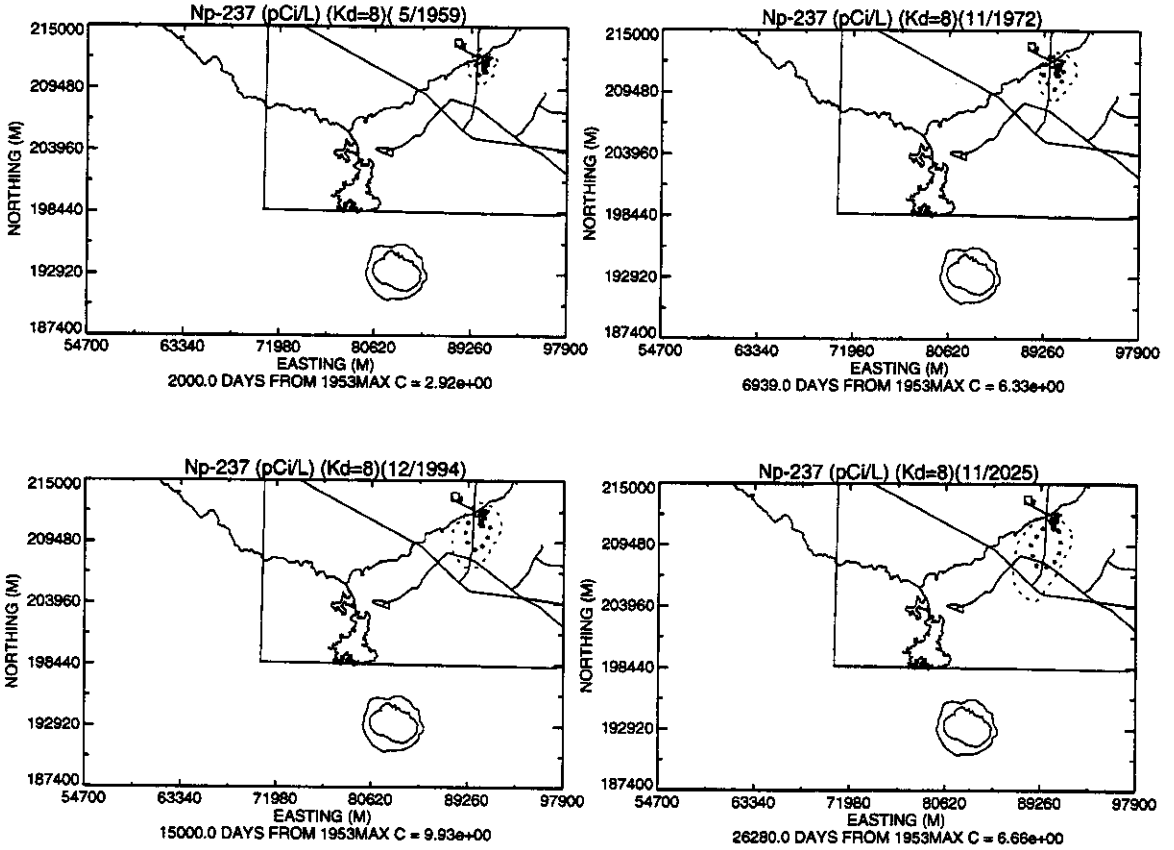


Figure 7-161 Aquifer Np-237 peak concentration contours within the extent of the large aquifer model.

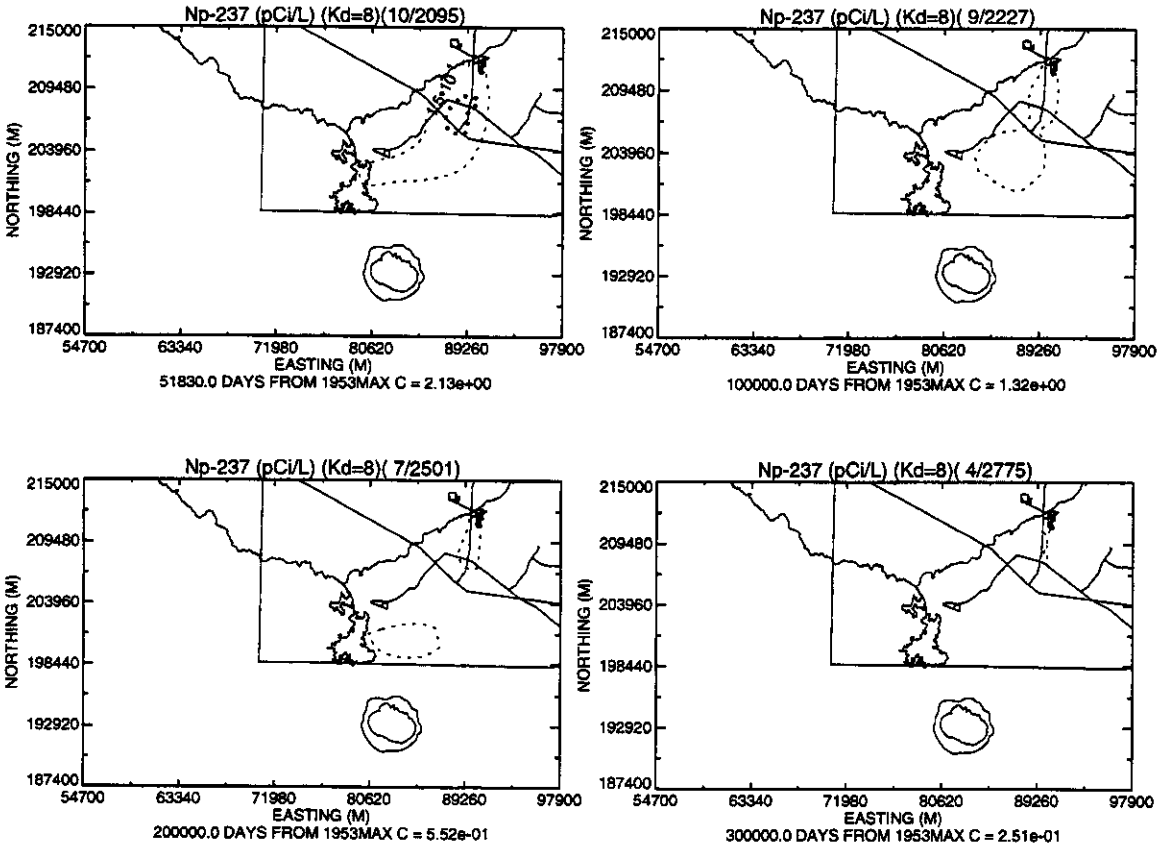


Figure 7-162 Aquifer Np-237 peak concentration contours within the extent of the large aquifer model.

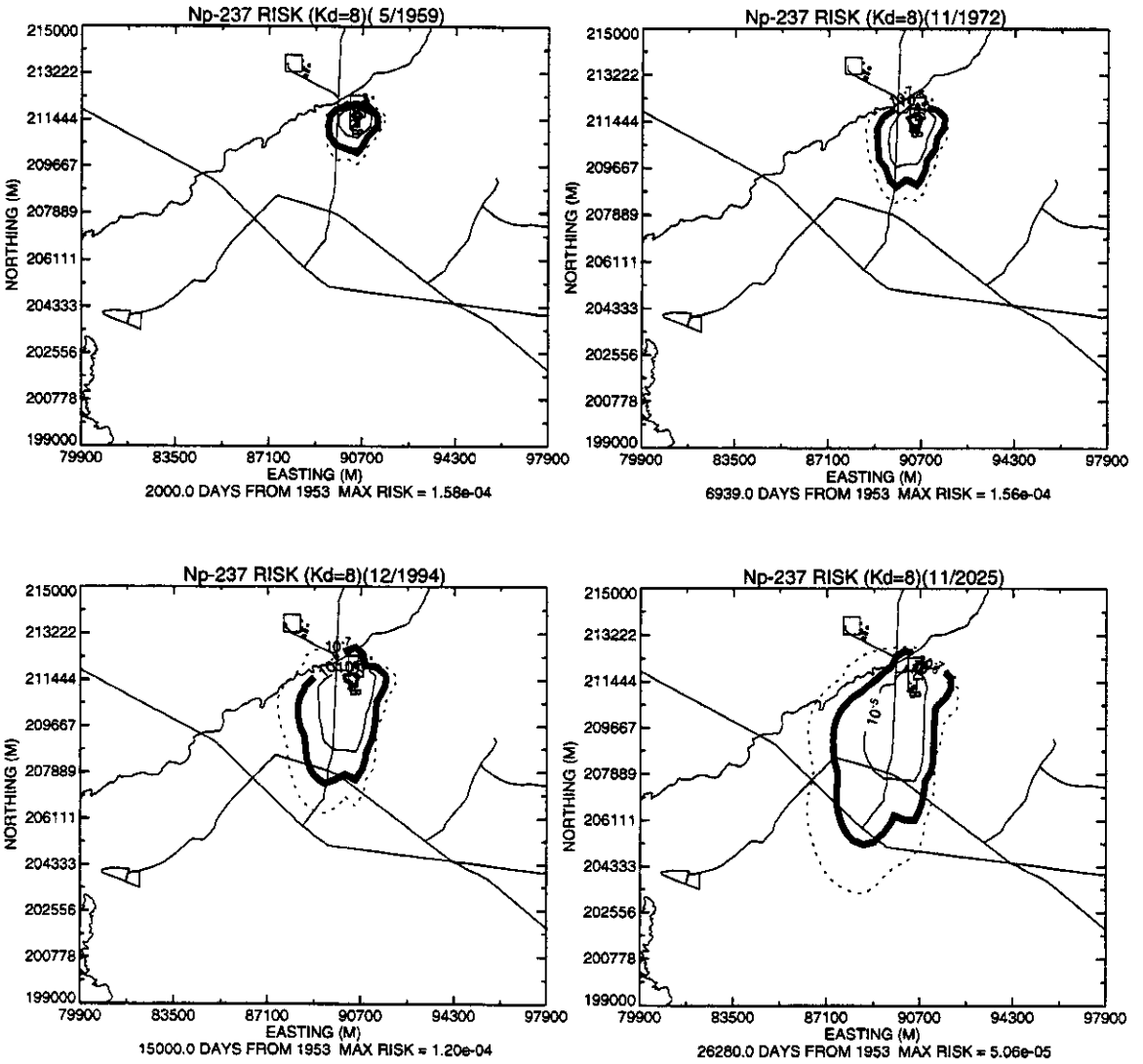


Figure 7-163 Aquifer Np-237 peak risk contours within the extent of the small aquifer model

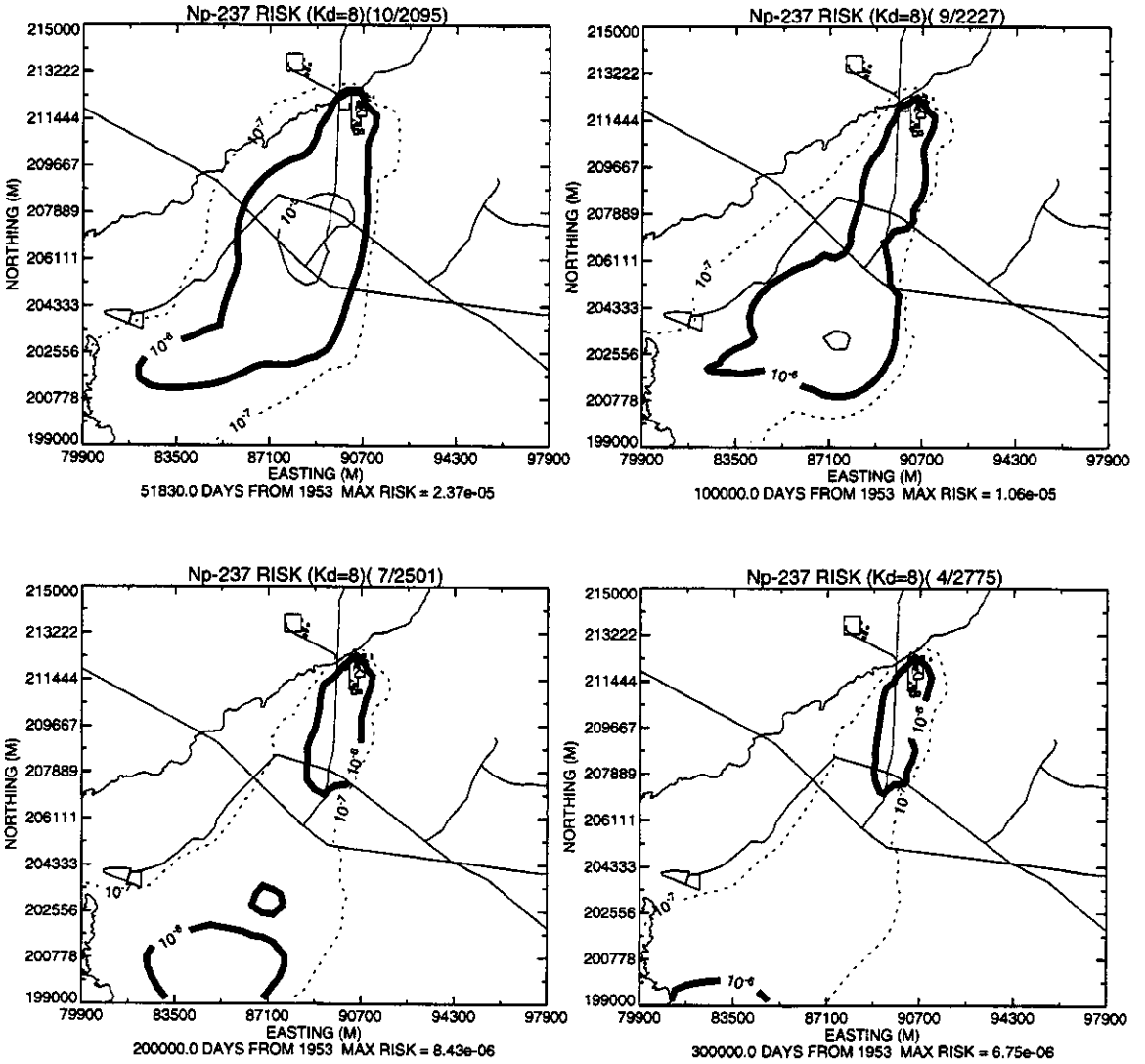


Figure 7-164 Aquifer Np-237 peak risk contours within the extent of the small aquifer model.

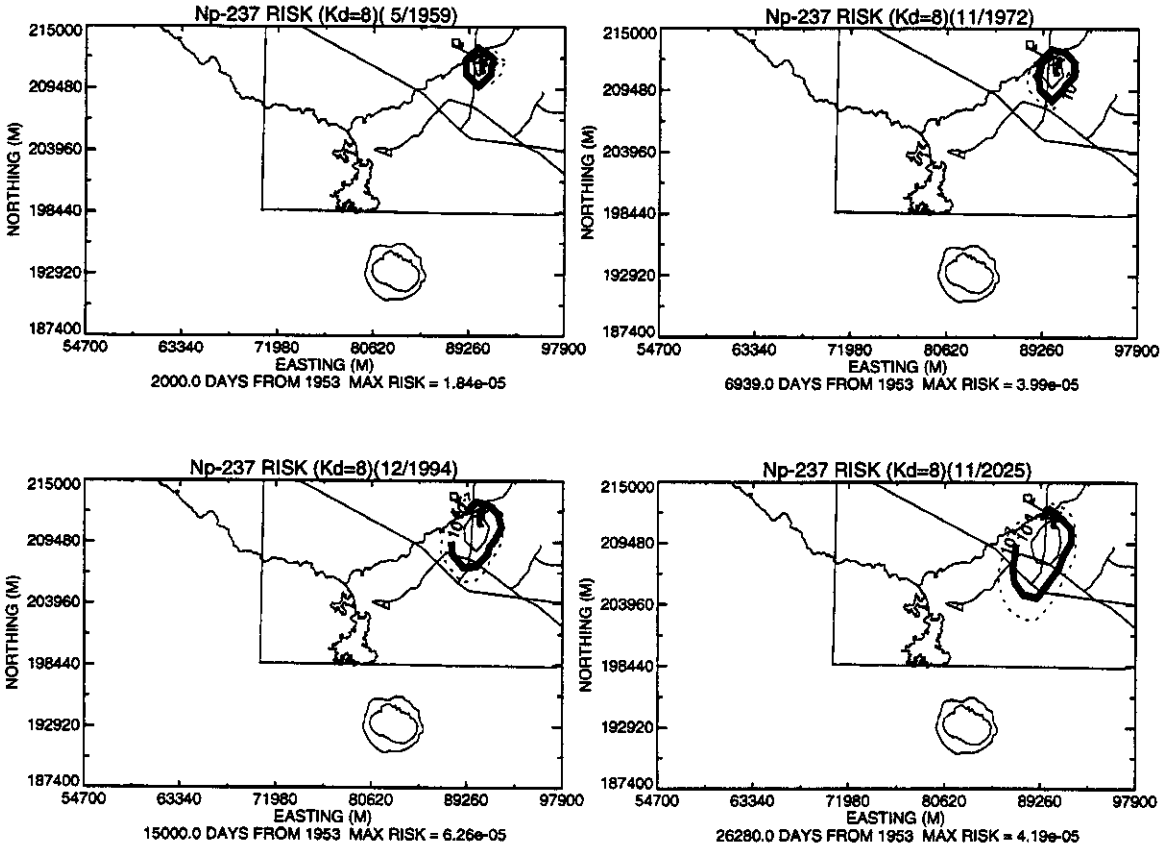


Figure 7-165 Aquifer Np-237 peak risk contours within the extent of the large aquifer model.

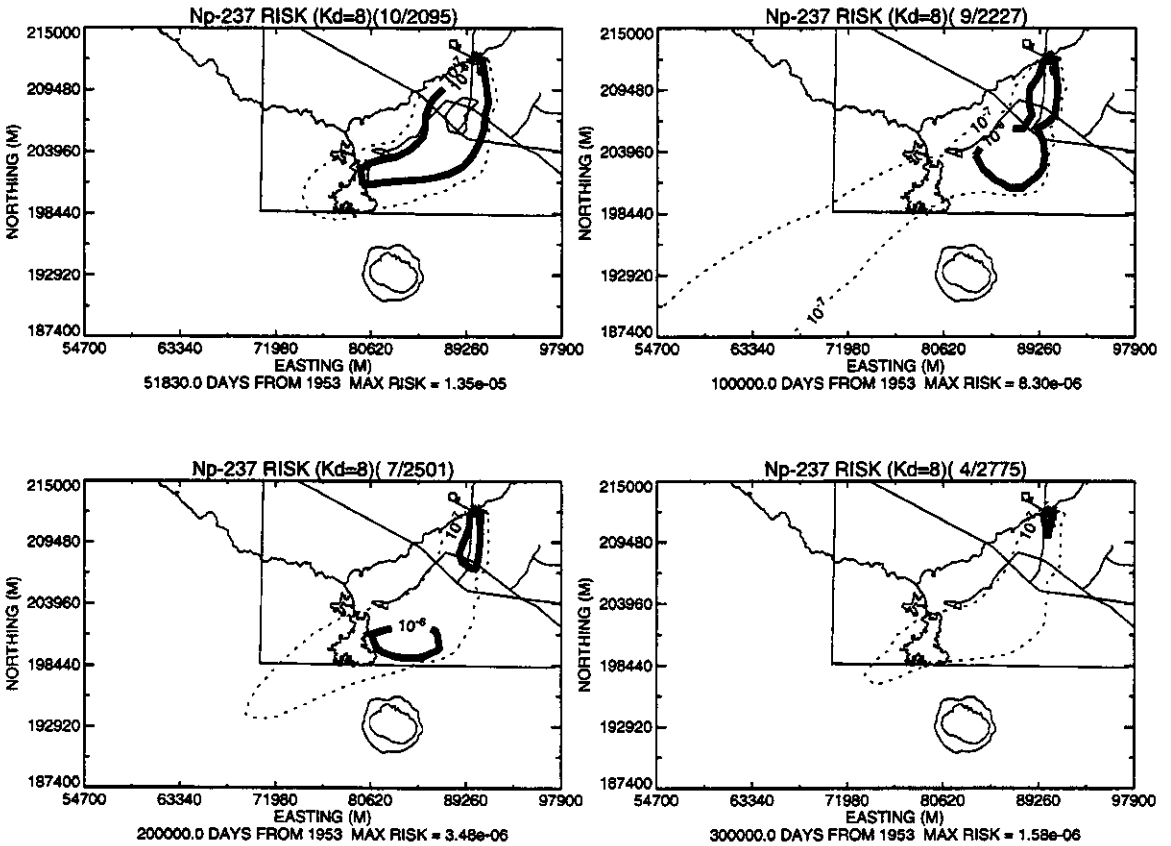


Figure 7-166 Aquifer Np-237 peak risk contours within the extent of the large aquifer model.

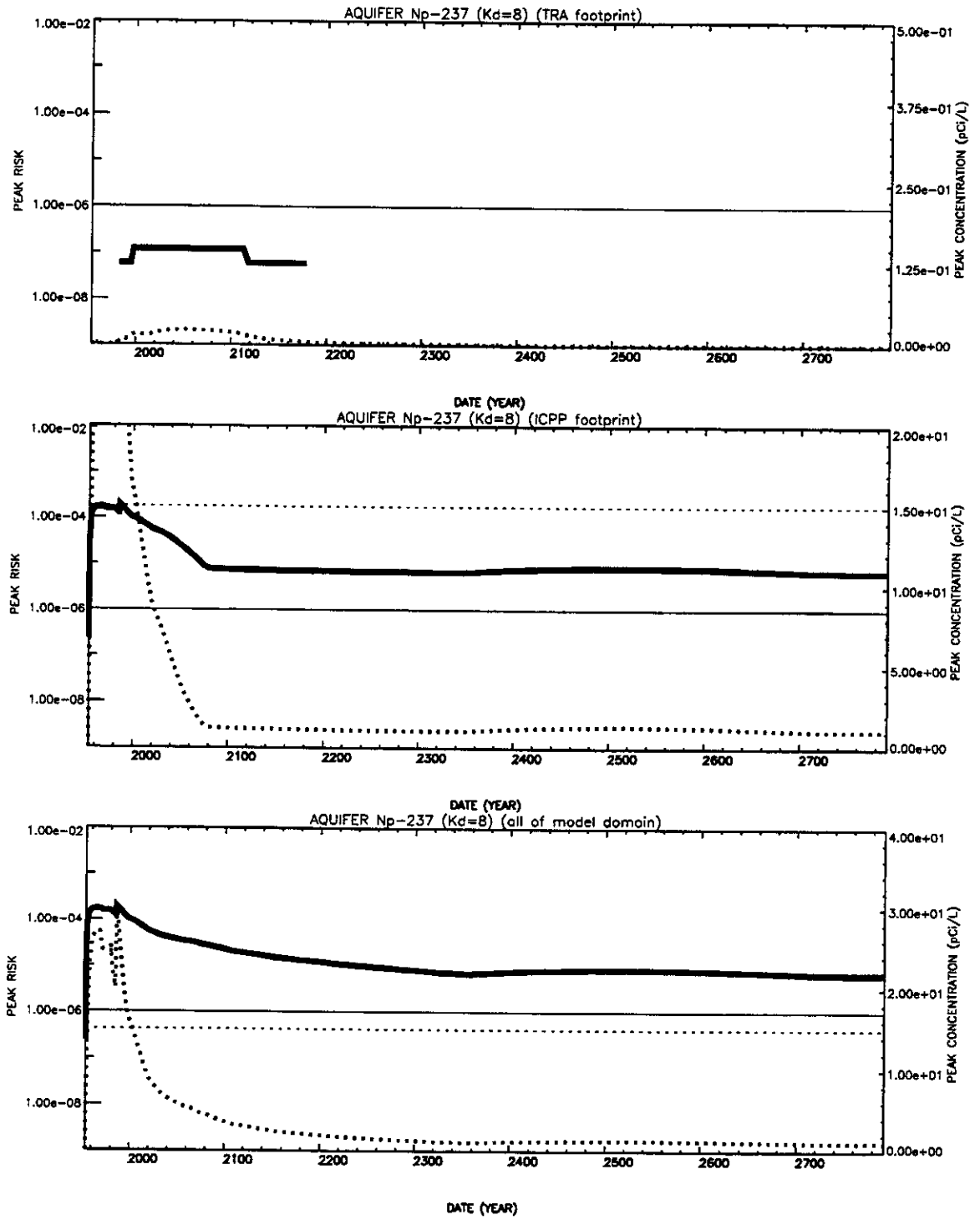


Figure 7-167 Peak aquifer concentration for Np-237. Top figure: TRA foot print, Middle figure: ICPP footprint, Bottom Figure: entire aquifer domain. Thick line risk (left scale), dotted line concentration (right scale) solid line 10^{-6} risk (left scale).

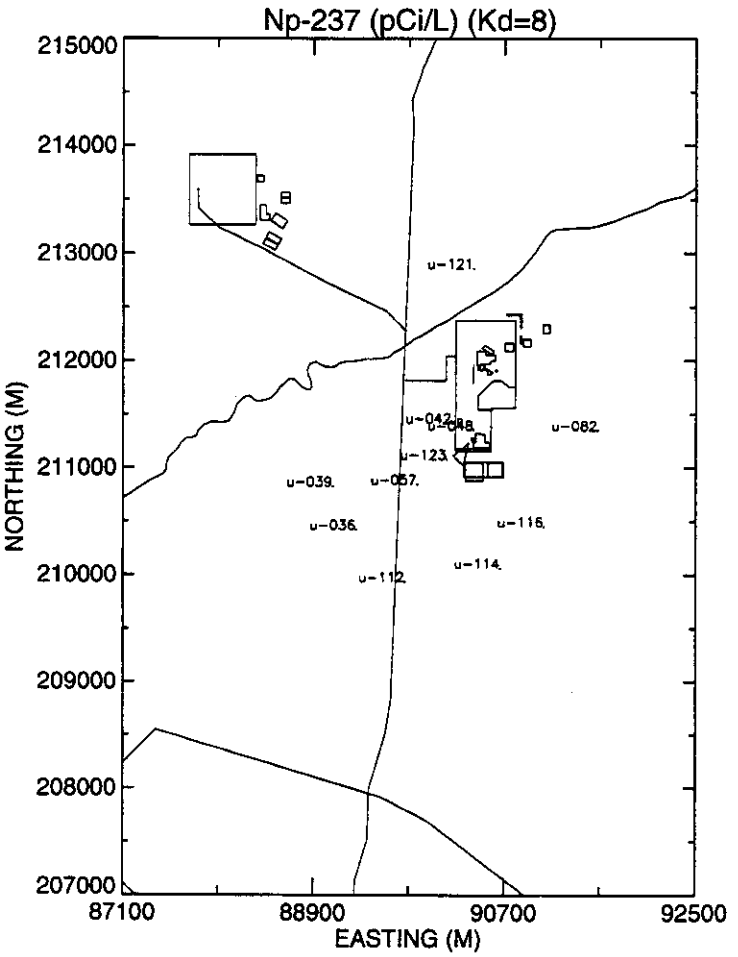


Figure 7-168 Well locations for the comparison of aquifer Np-237 to field data.

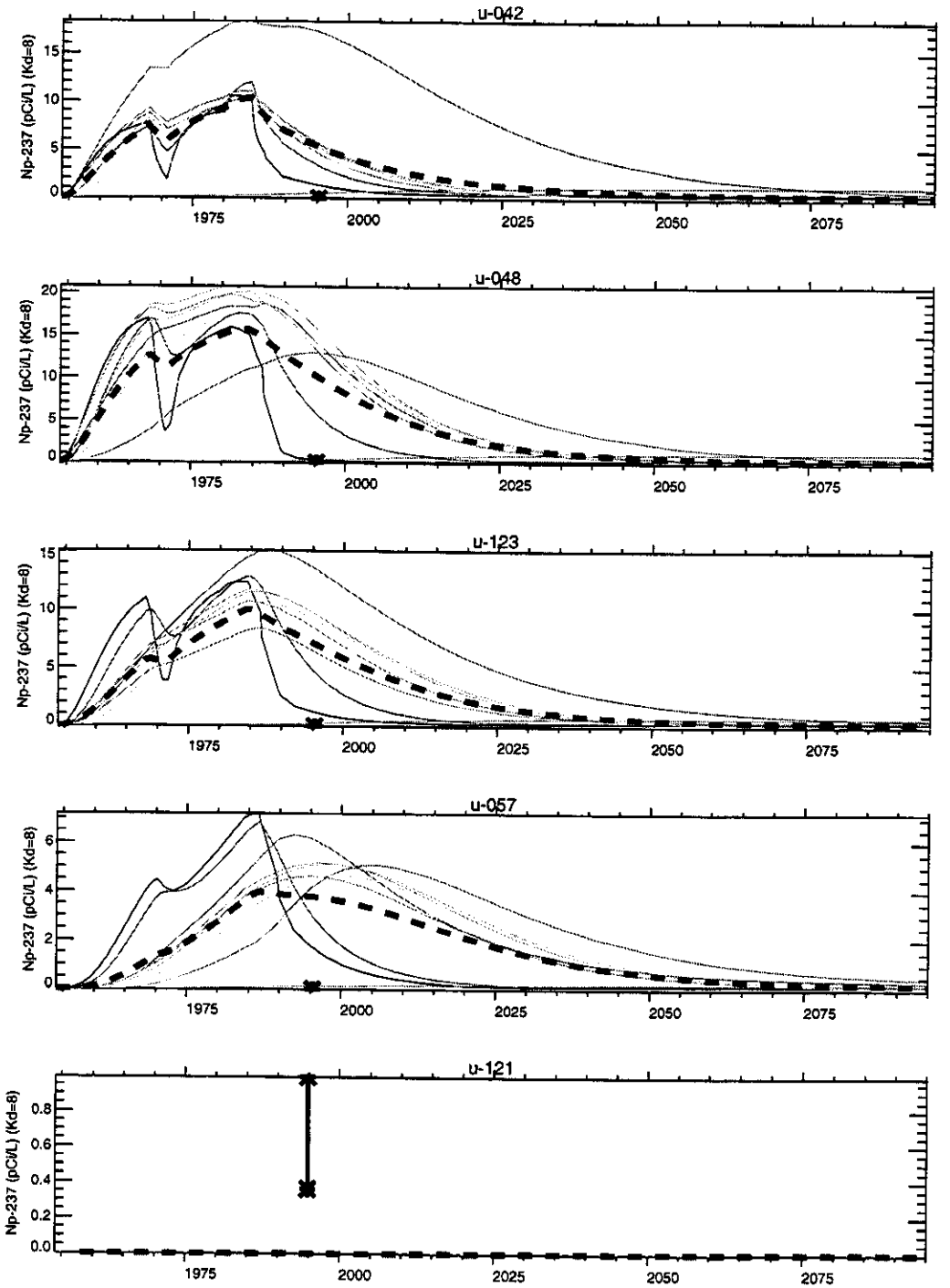


Figure 7-169 Comparison of aquifer Np-237 to field data.

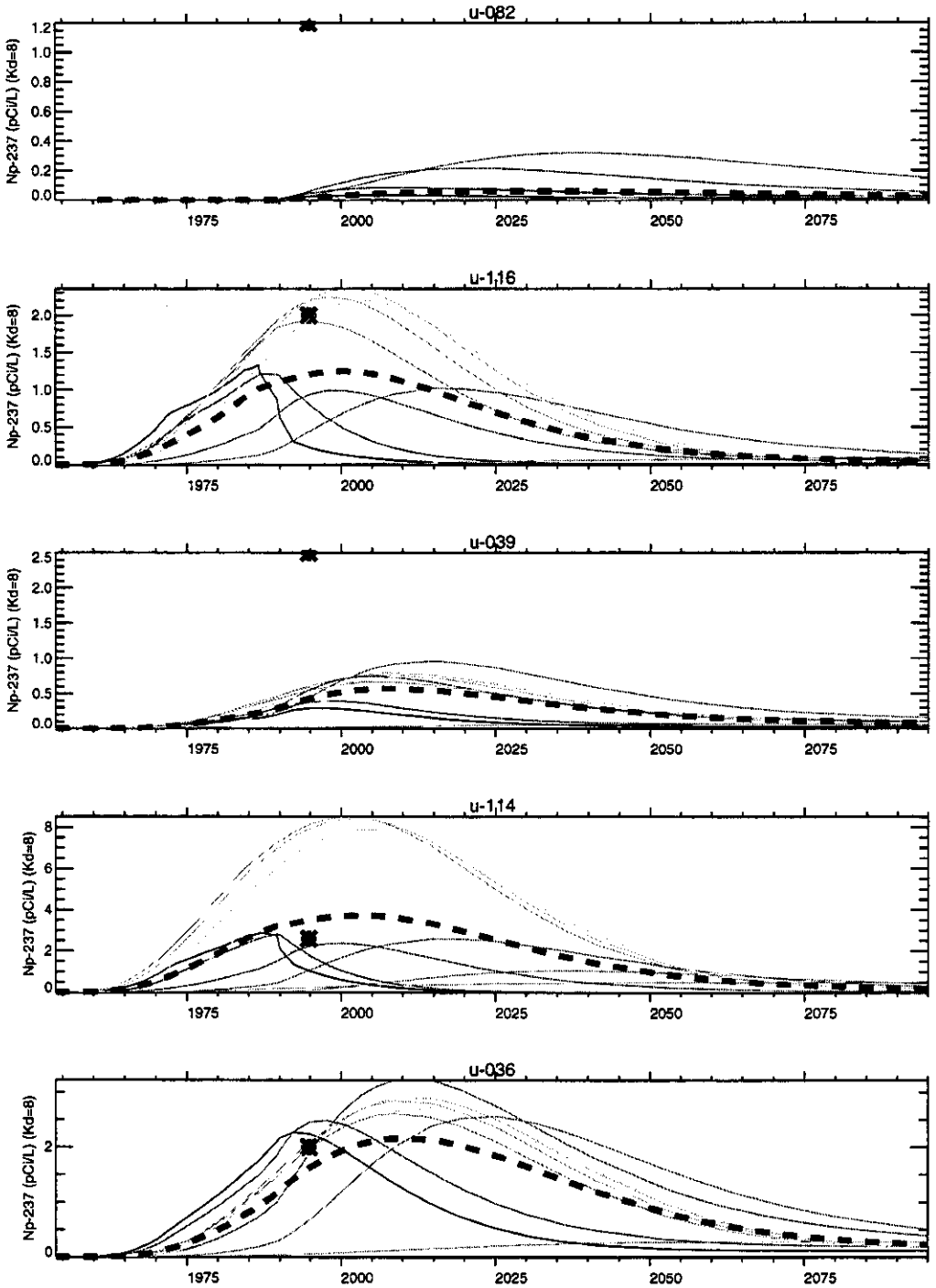


Figure 7-170 Comparison of aquifer Np-237 to field data.

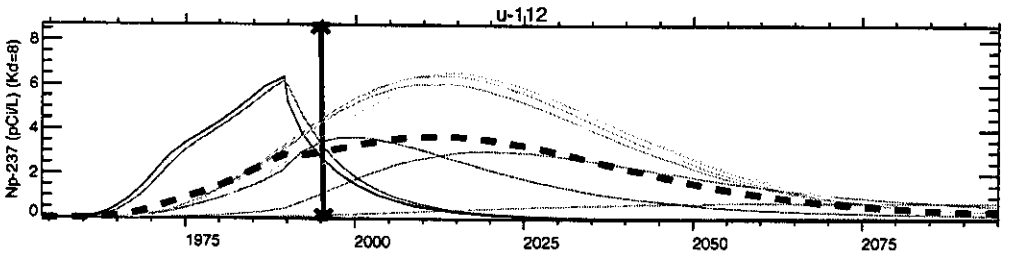


Figure 7-171 Comparison of aquifer Np-237 to field data.

7.9 Total Pu

Activity sources of Total Pu consist of the CPP-31 release in 1972 (80.66%), the CPP-28 release from 1956-1974 (11.04%), the soils inventory applied in 1990 (8.05%), the '86 release (0.12%), the percolation ponds where 0.01% was assumed to be discharged from 1984-2095, and a relatively small amount (0.12%) injected directly into the aquifer. The Total Pu was assumed to have a Kd of 22 cm^3/g, and a half life of $2.4x10^4$ years, which means that it moves relatively slowly and within a 1000 year time frame undergoes a small amount of decay. As a result, simulations were run through the year 3815 to allow the mass flux from the vadose zone to reach a maxima.

Figures 7-172 through 7-177 present the simulation results for the transport of Pu through the vadose zone, and Figures 7-178 through 7-186 present simulation results for the aquifer region. Contour levels for both the vadose zone and aquifer (Figures 7-172 through 7-175, and 7-178 through 7-181) are given for $1.5x10^{-1}$, 1.5, $1.5x10^{+1}$, $1.5x10^{+2}$, $1.5x10^{+3}$, and $1.5x10^{+4}$ pCi/L with concentrations equal to 15 pCi/L represented by the dark solid line. This value is used to represent the maximum concentration allowed for total alpha radiation under the MCL guidance. Thus, the cumulative alpha count can not exceed 15 pCi/L. Corresponding risk contour maps for the aquifer region are given in Figures 7-182 through 7-185. In those figures, the risk contours are given for 10^{-7}, 10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}, and 10^{-2} levels with the 10^{-6} value (0.15 pCi/L) indicated by the thick line, and the 10^{-4} level by the medium solid line.

As explained in Section 6.2.1 (Table 6-2), the total Pu mass concentration is used to calculate the activity assuming that the Total Pu mass is composed of 83.3% Pu-239, 14.95% Pu-240, 0.02% Pu-241, and 1.74% Pu-242. This corresponds to a Total Pu activity distribution of 60.3% Pu-239, 30.0% Pu-240, 9.6% Pu-241, and 0.04% Pu-242. The risk is calculated assuming that all of the Pu isotopes have the same limiting 10^{-6} risk concentration of 0.15 pCi/L corresponding to Pu-239 through Pu-242 isotopes. The 10^{-6} risk limits for each of the isotopes was given in Table 5-2 where the risk limits are shown to deviate by less than 4% from 0.15 pCi/L.

The absence of Pu-238 in the source inventory is a data gap. Pu-238 was reported in some contaminated soil but not in the major sources (the tank farm). The risk based limiting concentration for Pu-238 is essentially the same as the other plutonium isotopes. Qualitatively, the effects of neglecting Pu-238 on the risk assessment results is assessed in Sections 9 through 11. In addition, because field measurements of Total Pu are virtually nonexistent, Section 9.2 is included to assess the relative influence of the assumed Kd for Total Pu.

VADOSE ZONE: Figure 7-176 indicates that the concentration of Pu in the vadose zone will never drop below the 10^{-6} risk level or fall below the MCL in the time period simulated here (through 3800). By 2095, only 2% of the mass had left the vadose zone, and although still above the 10^{-6} risk level in 3815, the simulations were terminated with only 38% of the mass having left the vadose zone. Given the assumptions here, the Pu will act as a constant source (relatively constant rate and concentration) to the aquifer for much longer than the 1800 years simulated.

AQUIFER: In 2095, the predicted maximum total Pu aquifer concentration is 0.139 pCi/L. This concentration is less than both the 10^{-6} risk concentration (0.15 pCi/L) and the total alpha MCL (15 pCi/L). However, the peak concentration in the aquifer resulting from vadose zone infiltration begins to increase about year 2225 and continues to increase throughout the remainder of the simulation time. The predicted maximum aquifer concentration at the end of the simulation time is 35.1 pCi/L which exceeds the 10^{-6} risk concentration and also the total alpha MCL of 15 pCi/L. The aquifer area with predicted maximum concentrations greater than the 10^{-6} risk concentration is very large by the year 2095 (Figure 7-183).

As shown in Table 10-7 and explained in Section 10.3.3, the Total Pu inventory difference of concern for the groundwater pathway is limited to Pu-239 and Pu-240. The reestimated CPP-31 Pu-239 inventory is 41% of the modeled inventory and the reestimated tank farm inventory is 47% of the modeled inventory. The reestimated CPP-31 Pu-240 inventory is 14% of the modeled inventory and the reestimated tank farm

inventory is 27% of the modeled inventory. However, the reestimated CPP-31 may be underestimated by 39% based on soil samples at CPP-31 in 1975. Therefore, based on the reestimated inventory and relative to the long term groundwater risk, the modeled Total Pu concentrations in the aquifer from the tank farm are probably overestimated by about 50%. The information available is not sufficient to bound the uncertainty exactly.

In addition, the composite specific activity used to convert the simulation mass to activity concentration assumes decay to the year 2095 (123 years from the release). The initial mass was assumed based on an average of 1st and 2nd cycle waste (Table 5-22). The initial mass and activity distributions as well as the distributions after 123 years are given in Table 6-2. A composite specific activity was calculated based on the isotope distribution and used to convert the mass concentrations to activity concentrations. Decaying 1600 years to the time of the Total Pu aquifer peak concentration provides a factor of about 25% decrease in the predicted peak Total Pu concentration in the aquifer because at that time Pu-241 and Pu-238 will no longer contribute to the specific activity. Between the conservative source and conservatively defined isotope distributions, the Total Pu concentration may be overestimated by approximately 75%. The Total Pu simulation results appear to be conservative based on the assumptions of the uncertainty section.

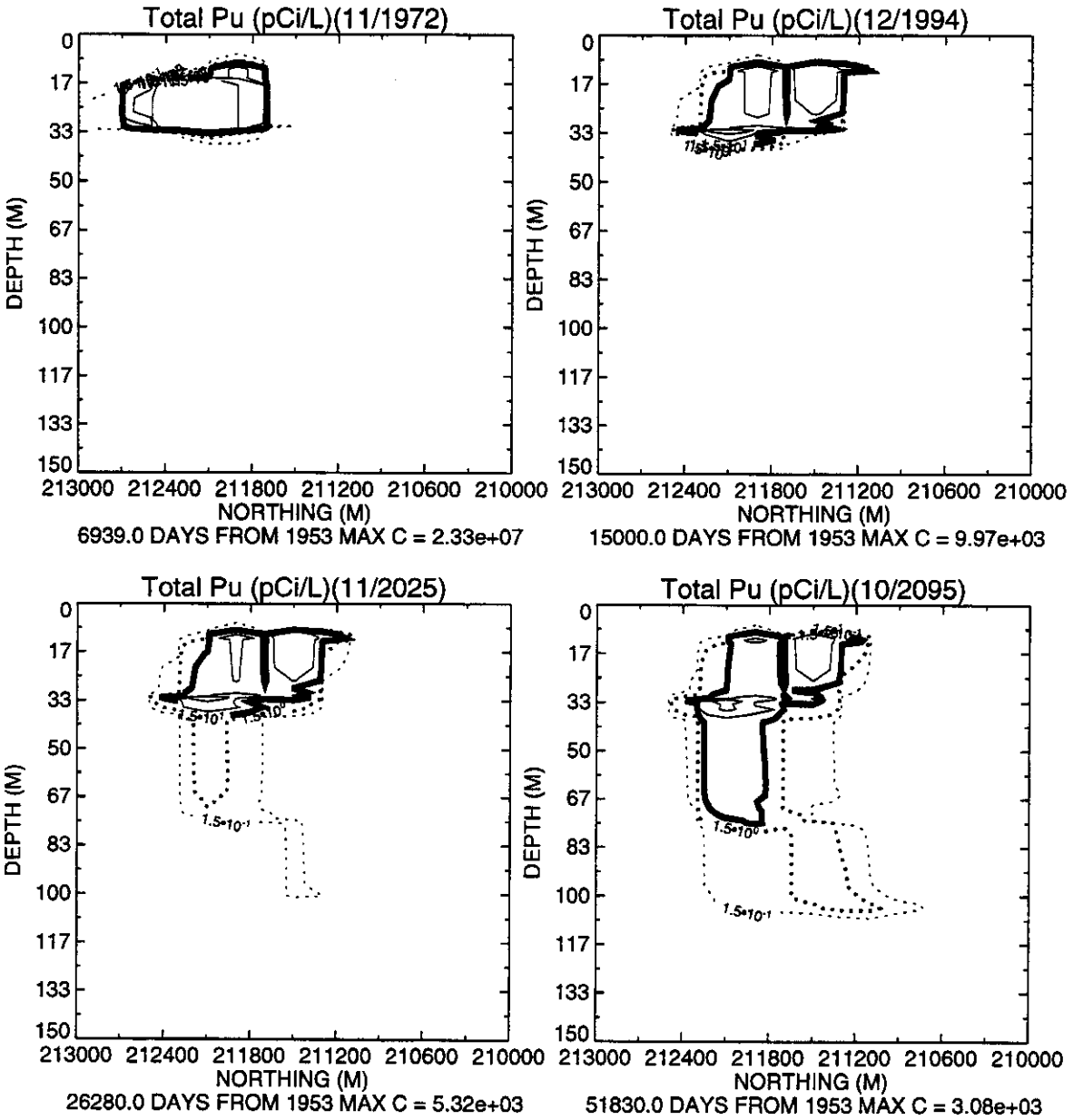


Figure 7-172 Vadose zone Pu peak concentration contours.

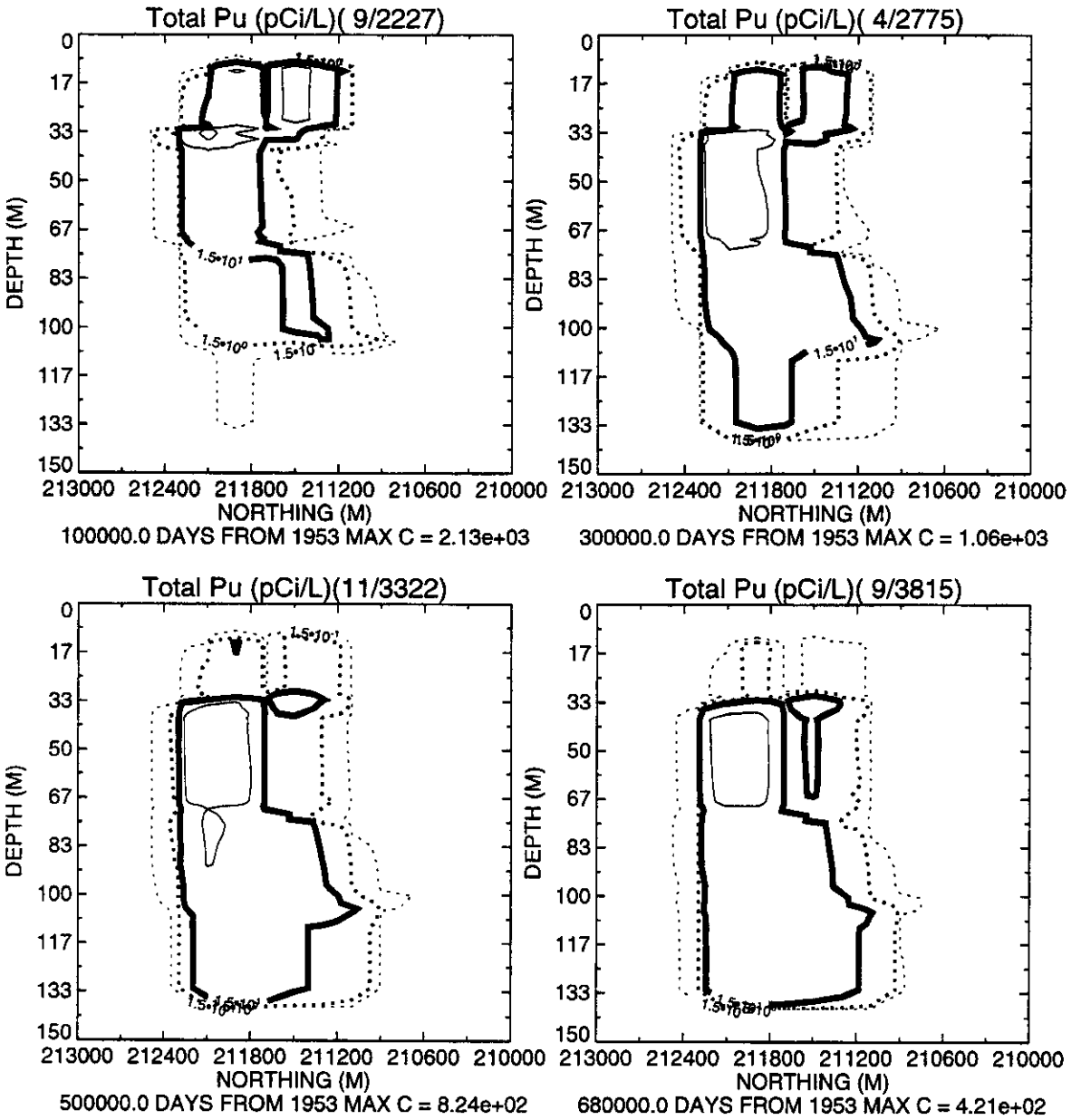


Figure 7-173 Vadose zone Pu peak concentration contours.

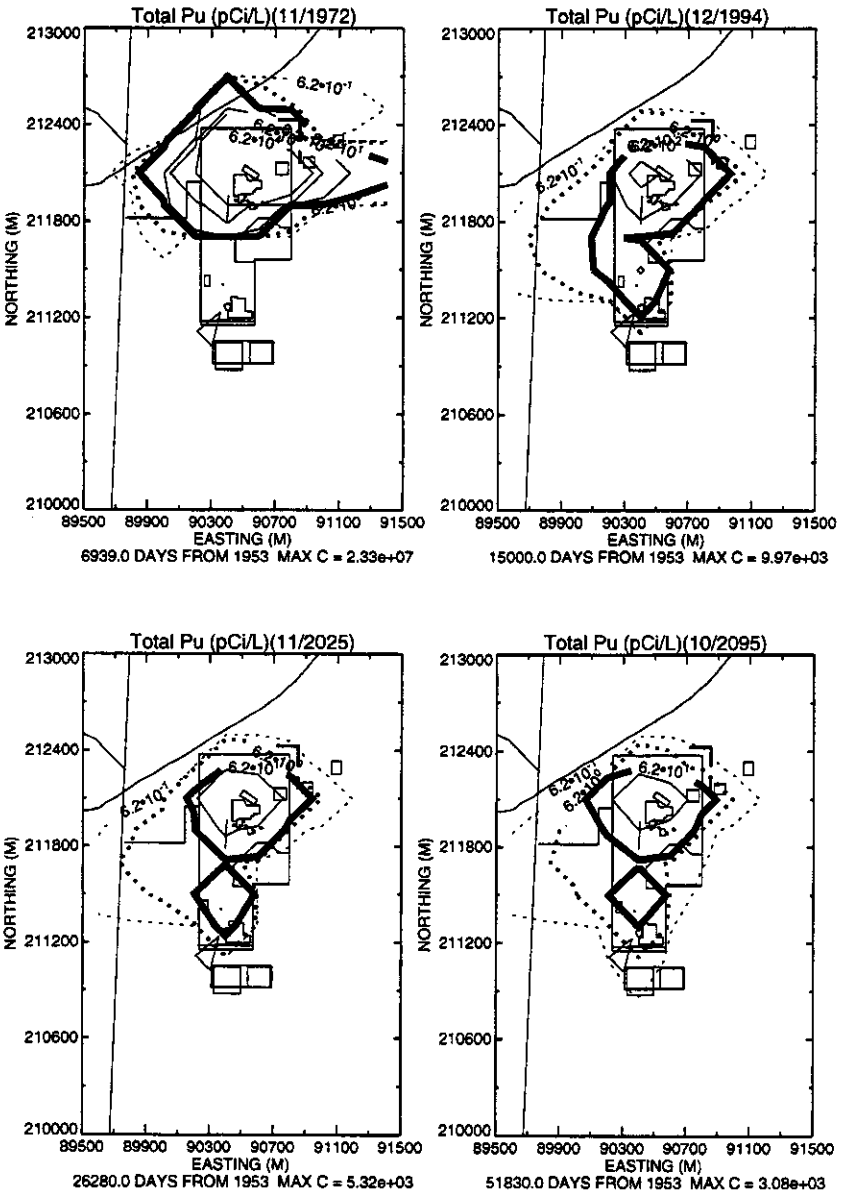


Figure 7-174 Vadose zone Pu peak concentration contours.

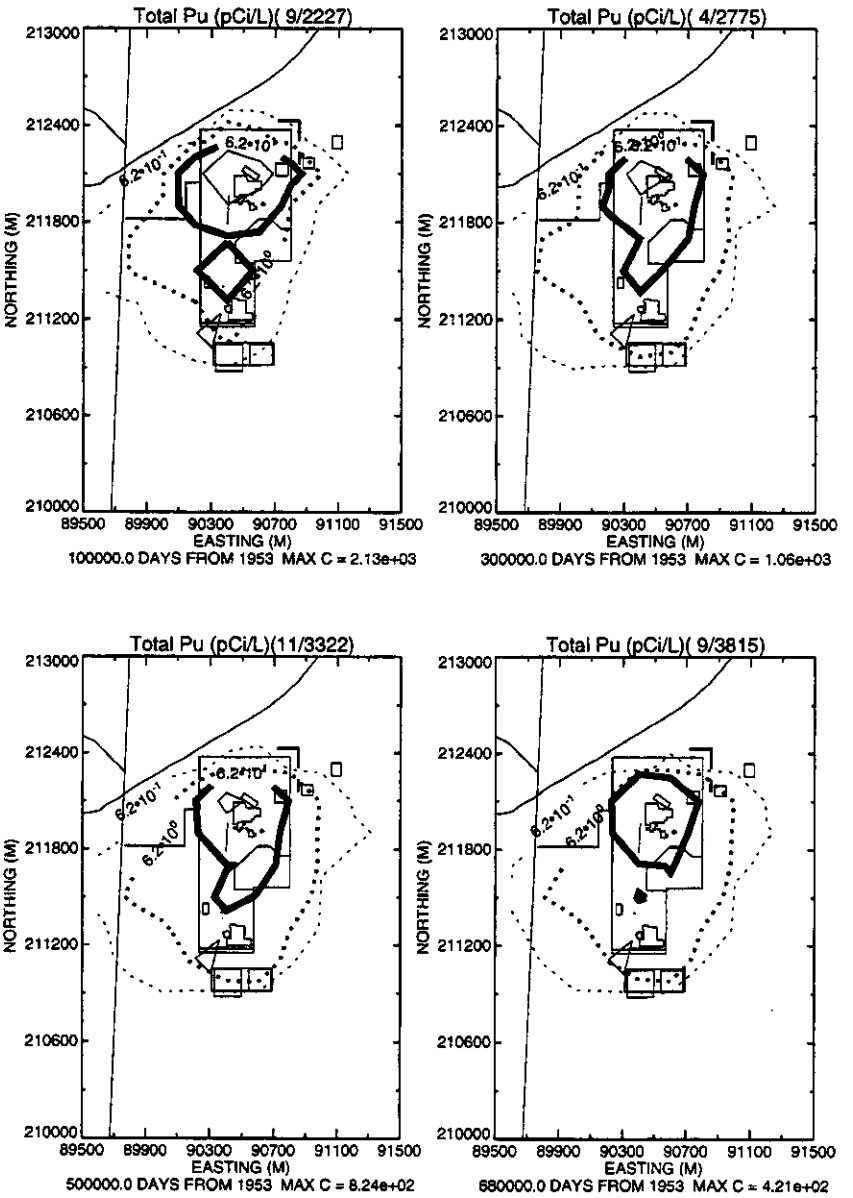


Figure 7-175 Vadose zone Pu peak concentration contours.

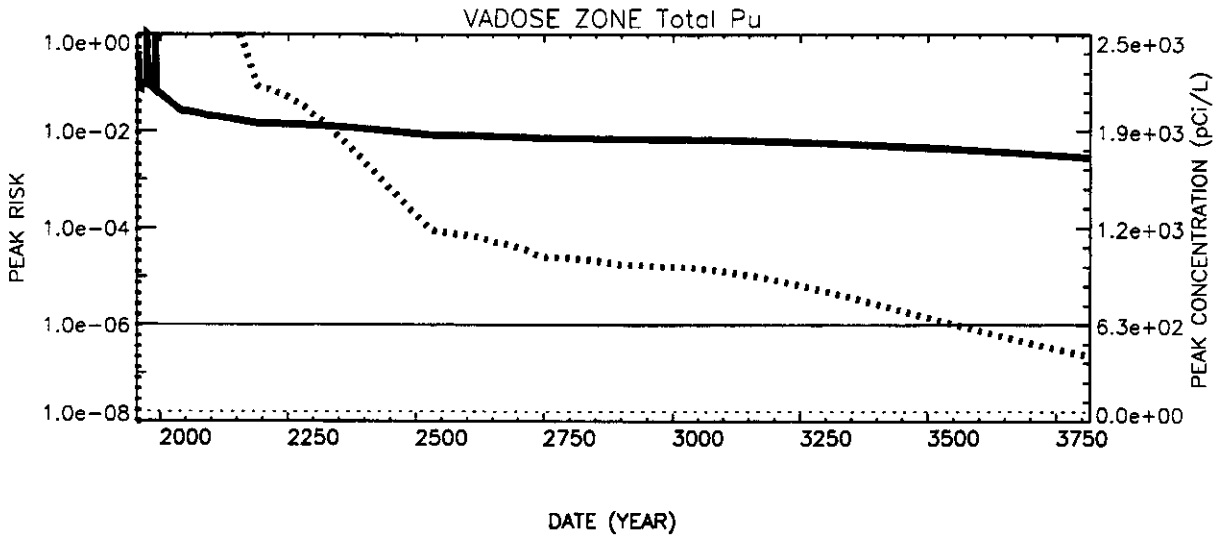


Figure 7-176 Peak vadose zone risk and concentration for Pu. Risk indicated by the thick line on the log scale with the 10^{-6} value shown as the solid line. The dotted line represents concentration given by the linear scale on the right axis with the MCL shown as the straight horizontal line.

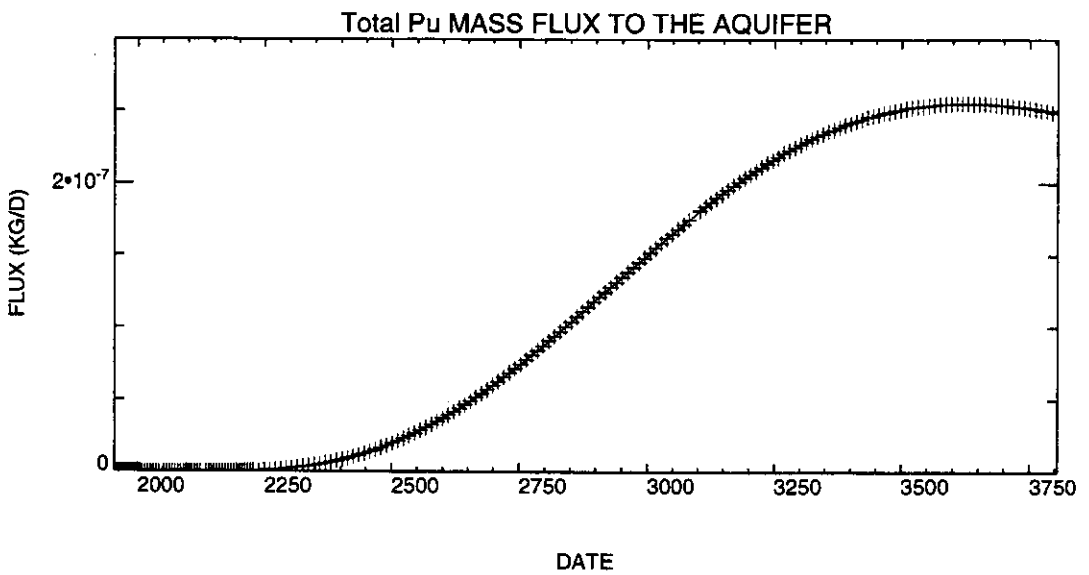


Figure 7-177 Mass flux of Pu into the aquifer from the vadose zone.

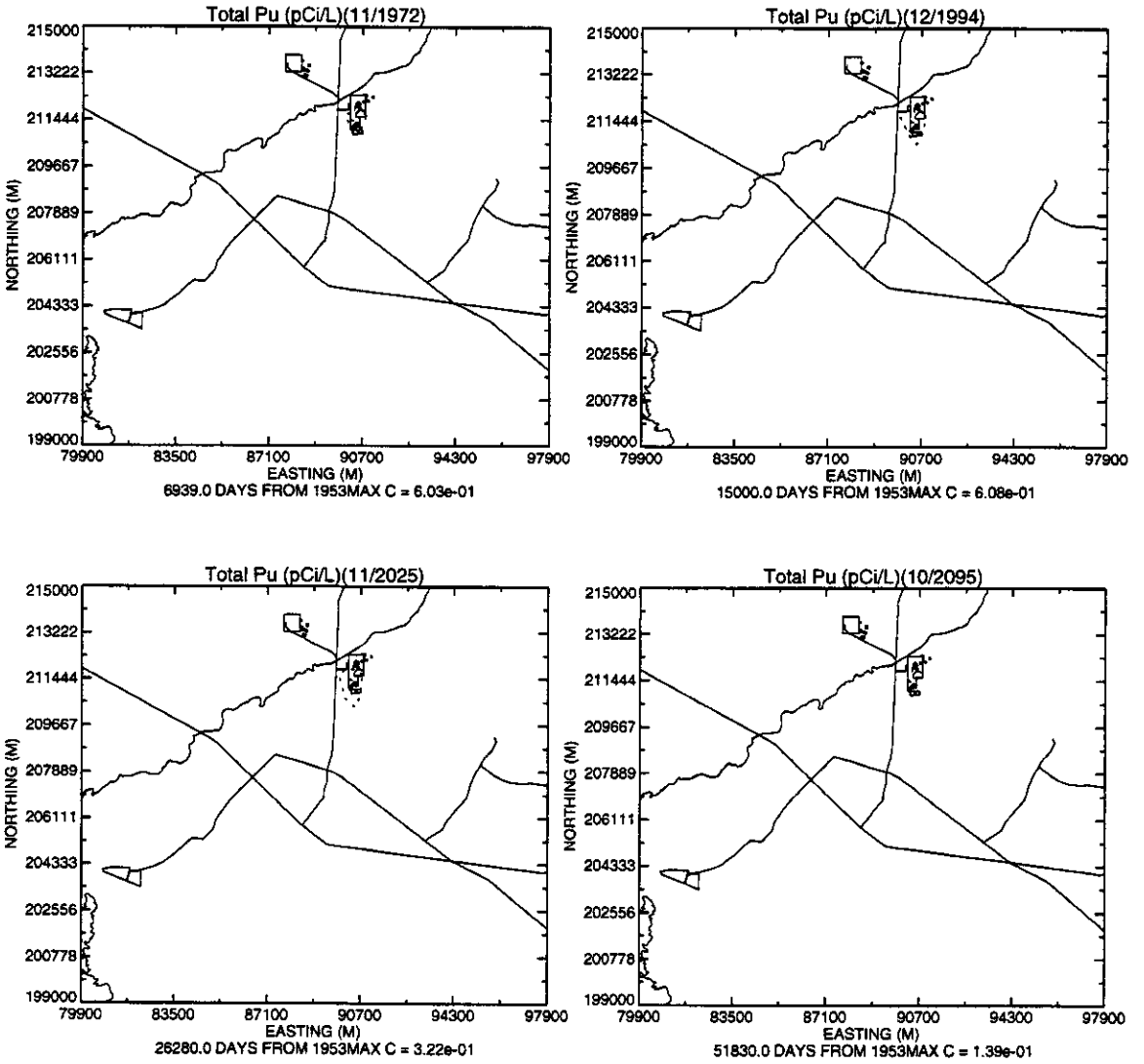


Figure 7-178 Aquifer Pu peak concentration contours.

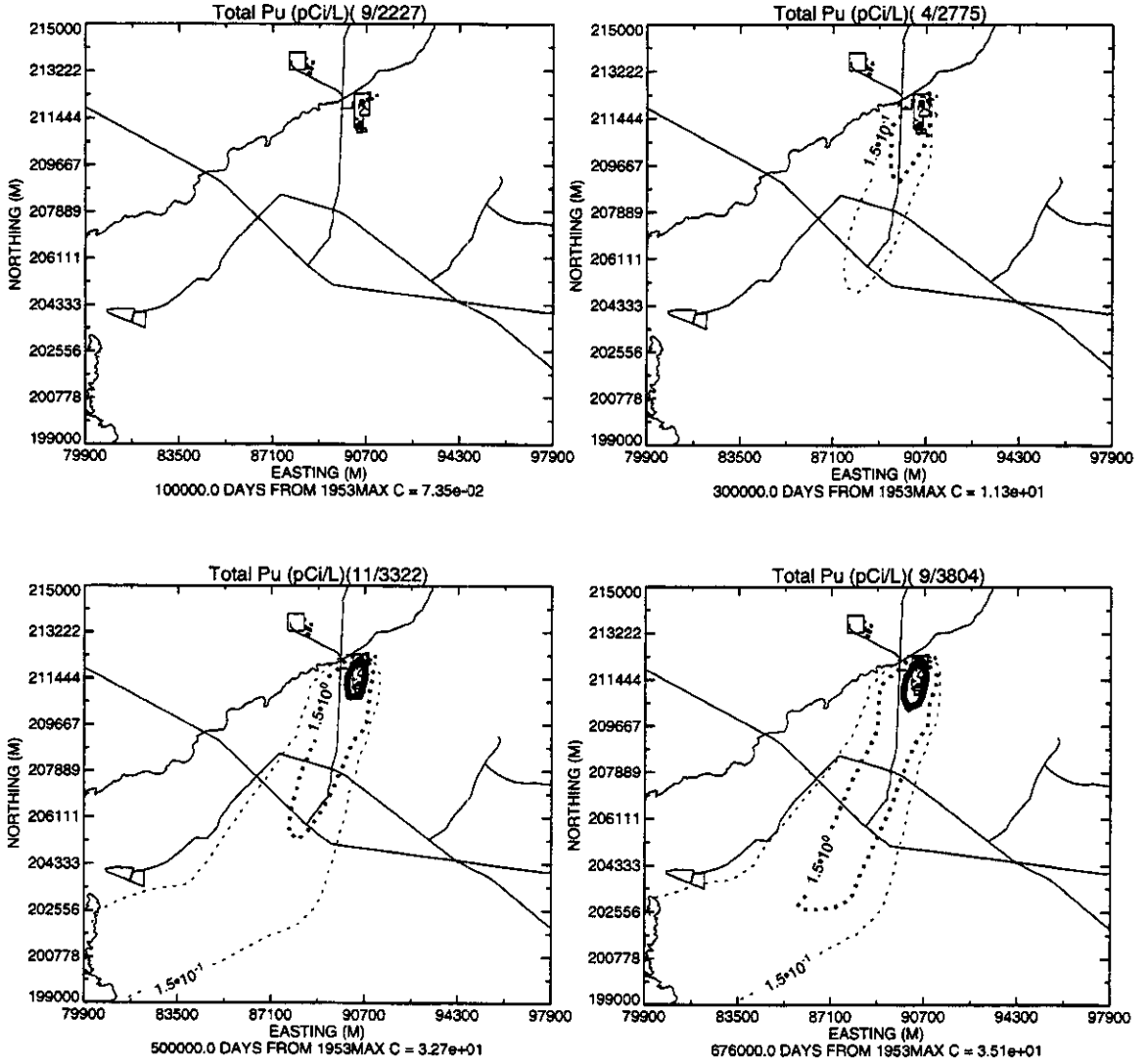


Figure 7-179 Aquifer Pu peak concentration contours.

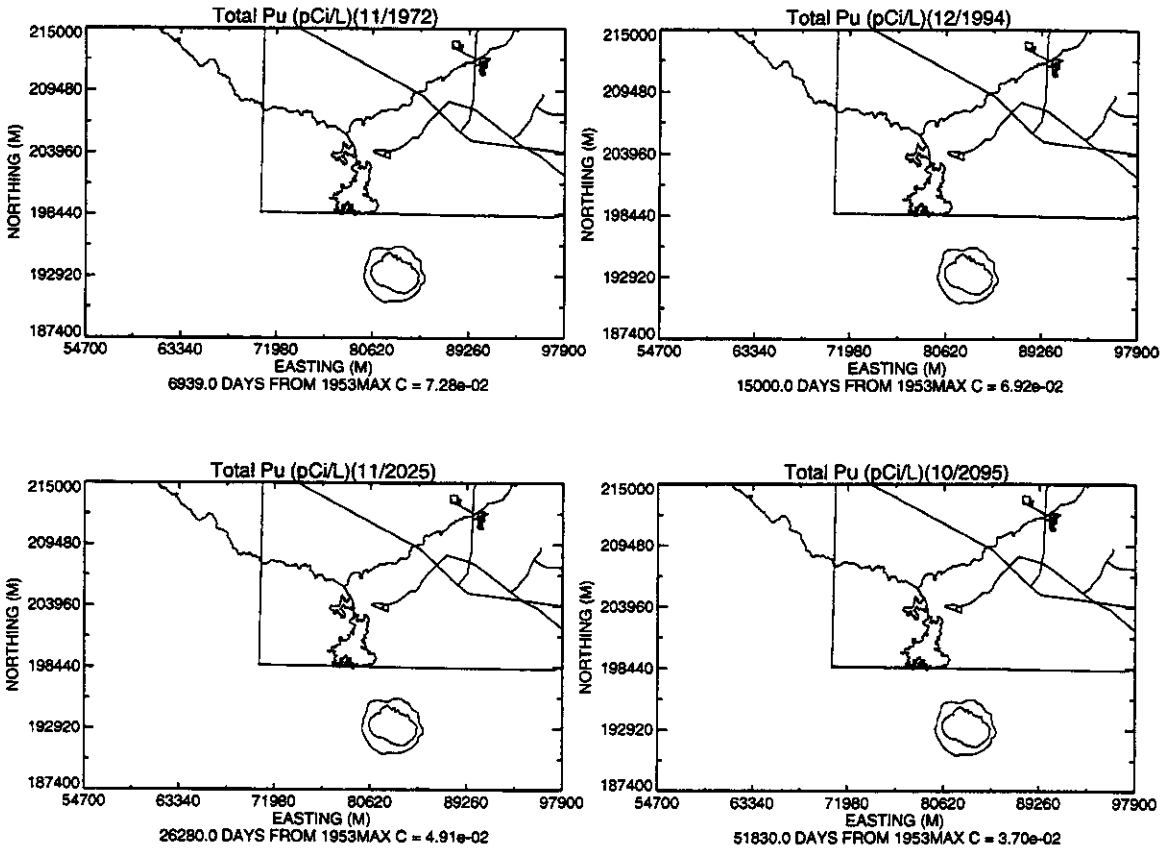


Figure 7-180 Aquifer total Pu peak concentration contours within the extent of the large aquifer model.

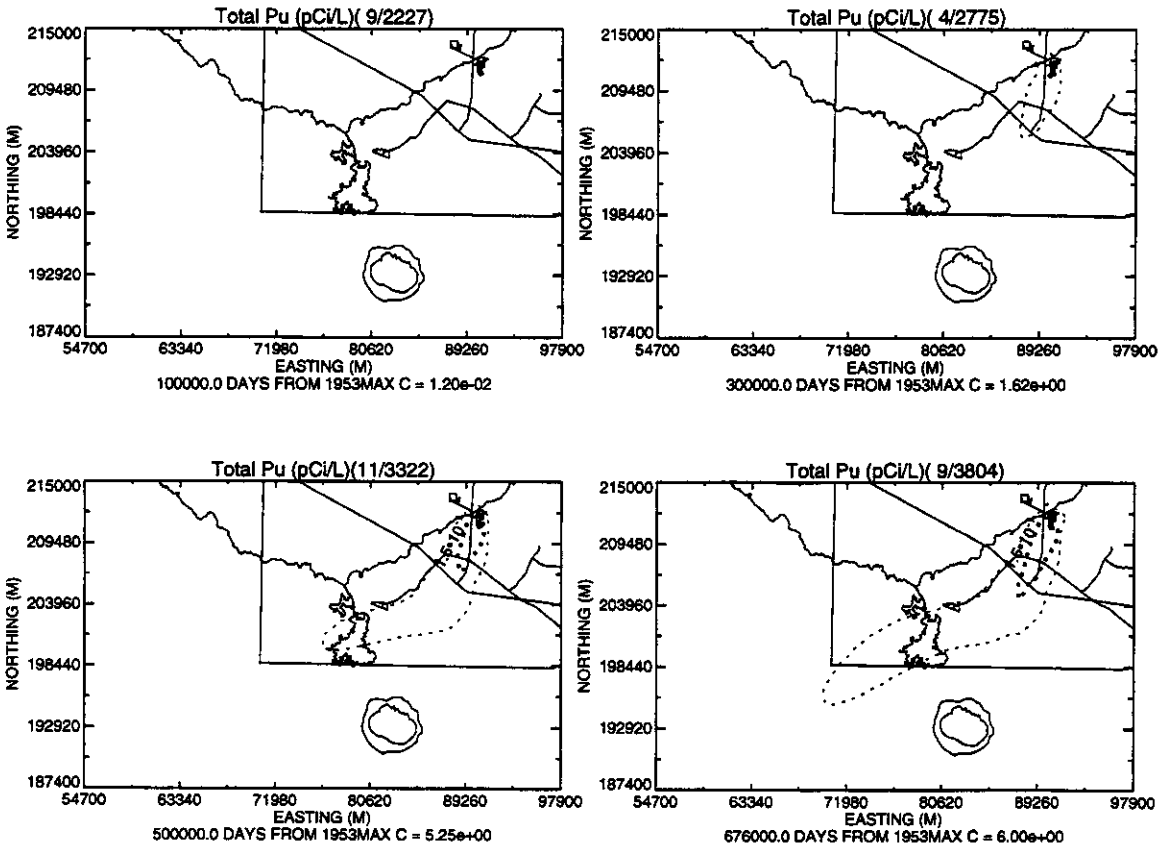


Figure 7-181 Aquifer total Pu peak concentration contours within the extent of the large aquifer model.

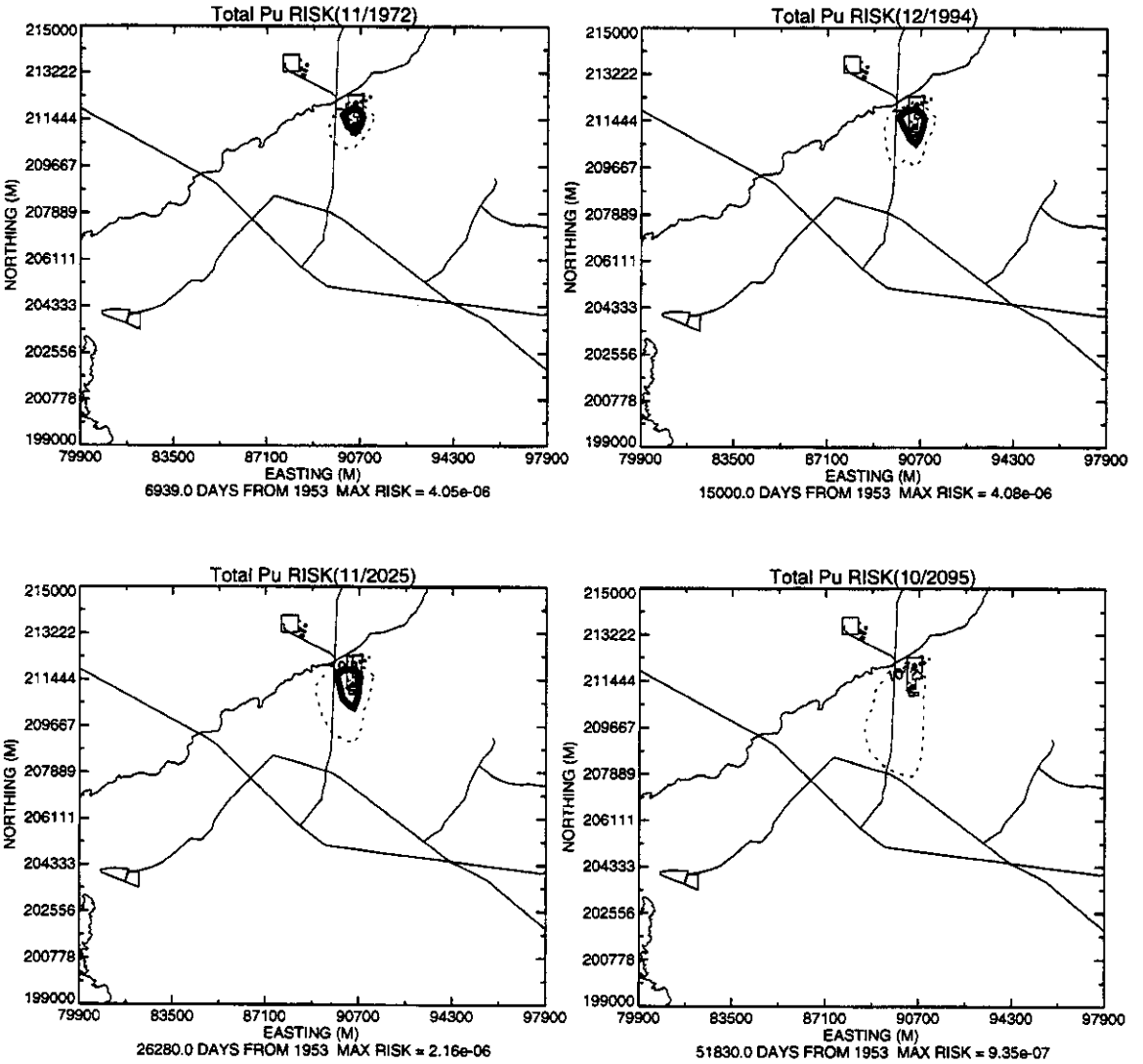


Figure 7-182 Aquifer total Pu peak risk contours within the extent of the small aquifer model.

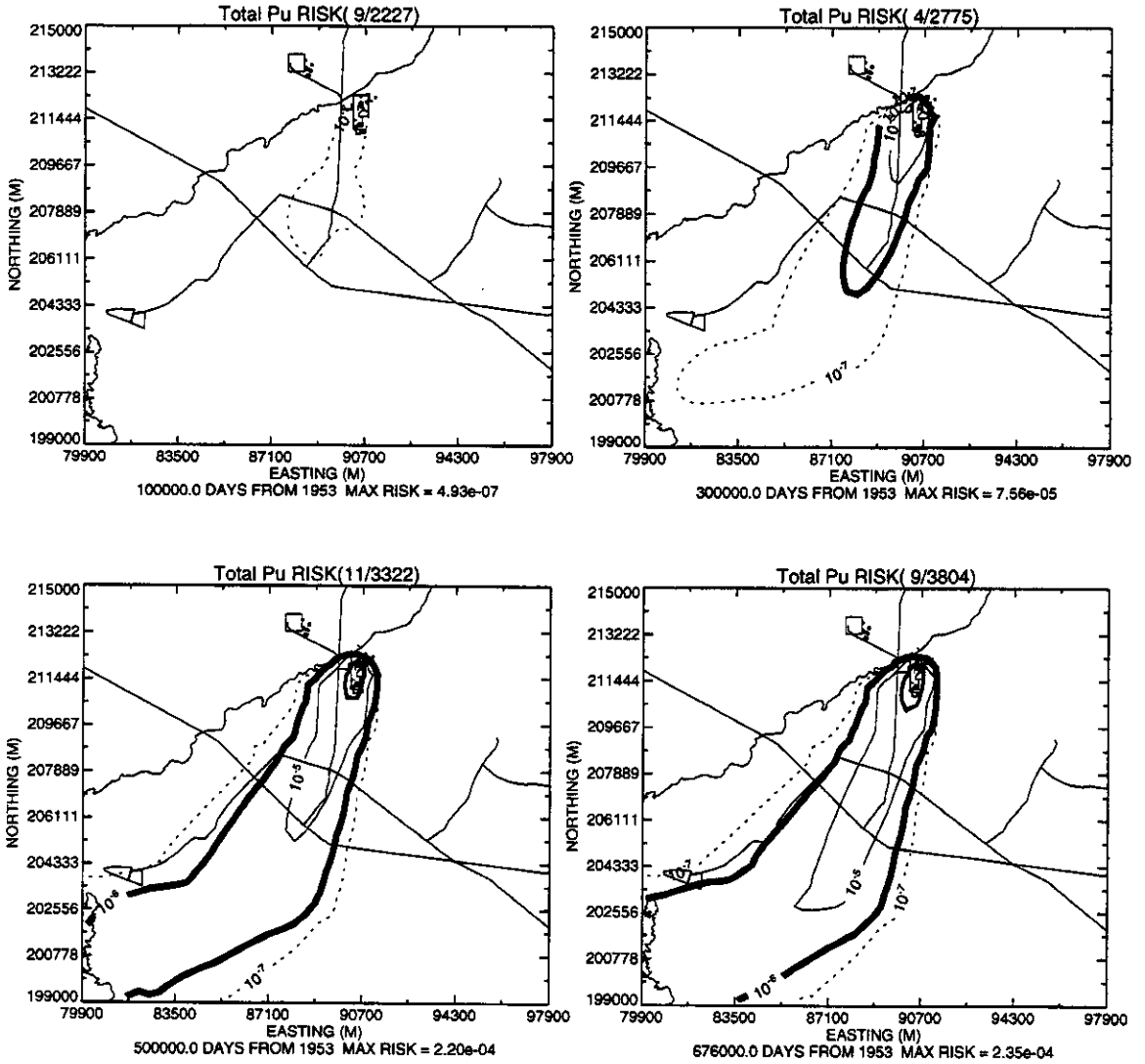


Figure 7-183 Aquifer total Pu peak risk contours within the extent of the small aquifer model.

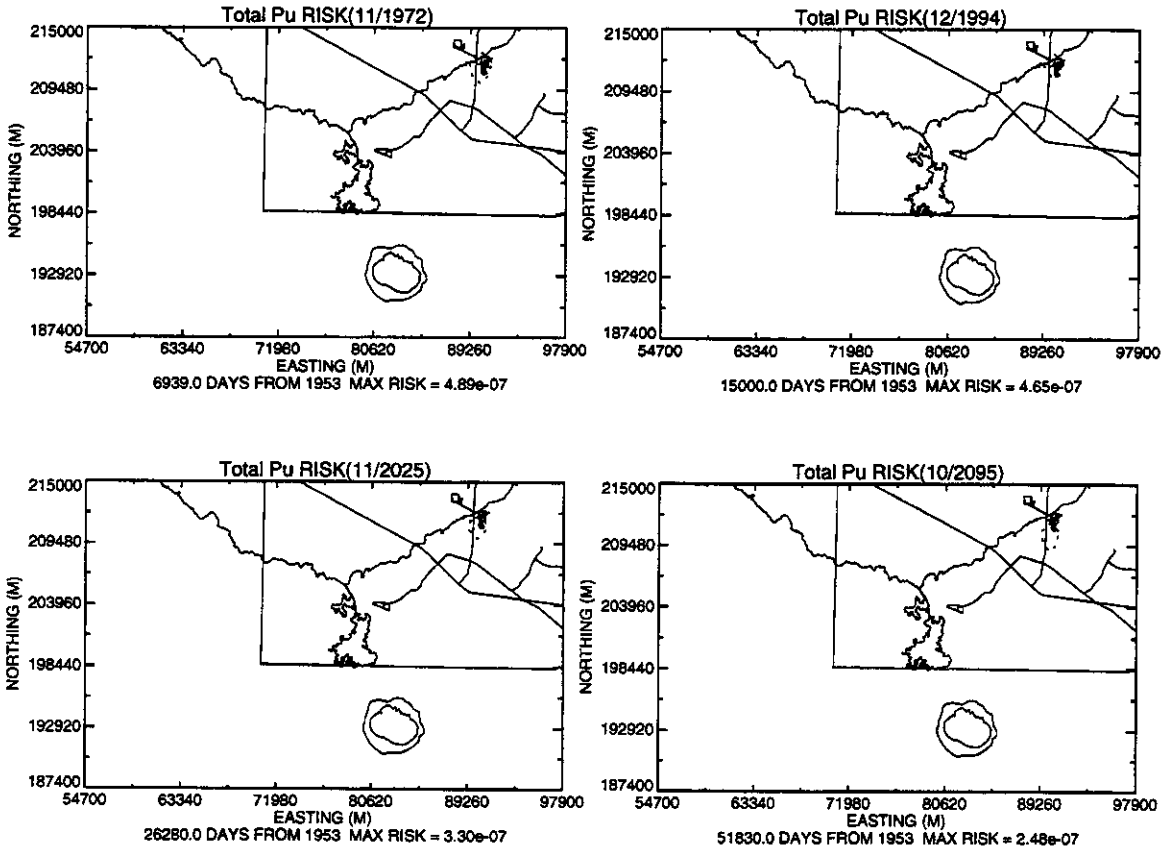


Figure 7-184 Aquifer total Pu peak risk contours within the extent of the large aquifer model.

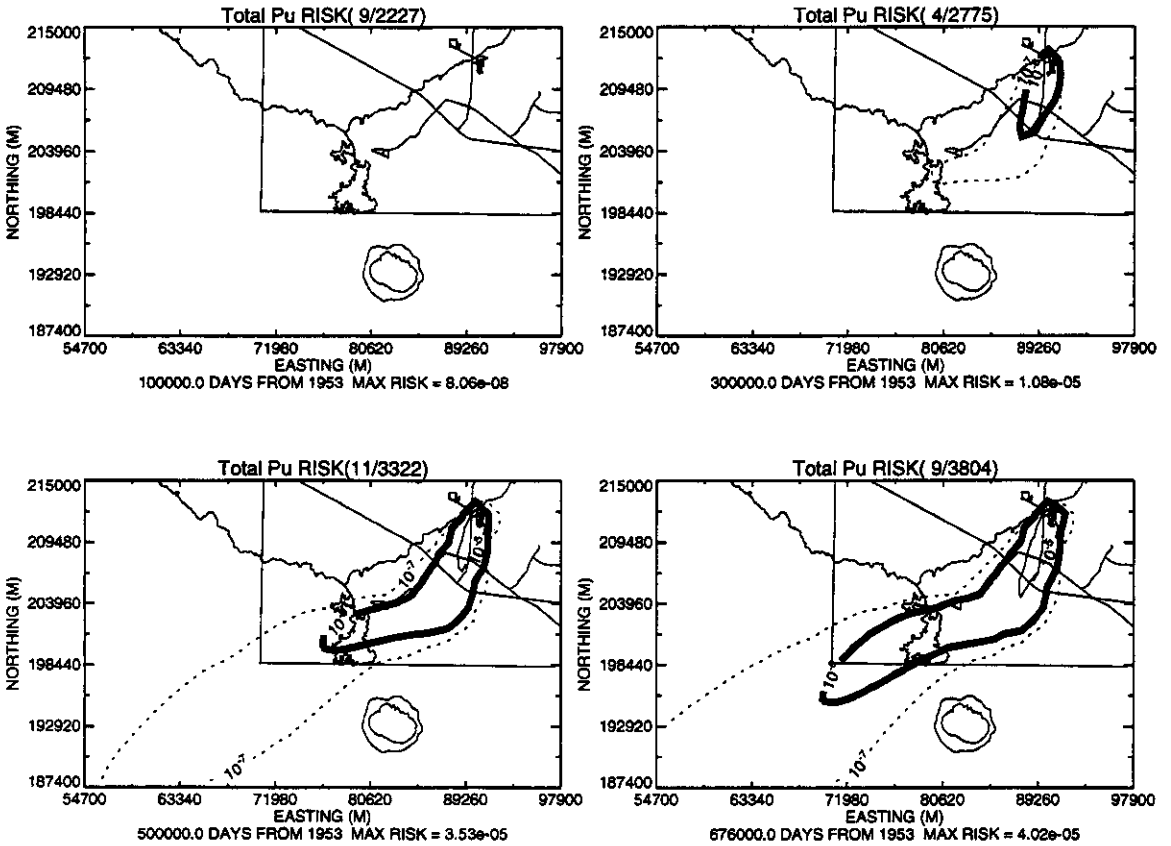


Figure 7-185 Aquifer total Pu peak risk contours within the extent of the large aquifer model.

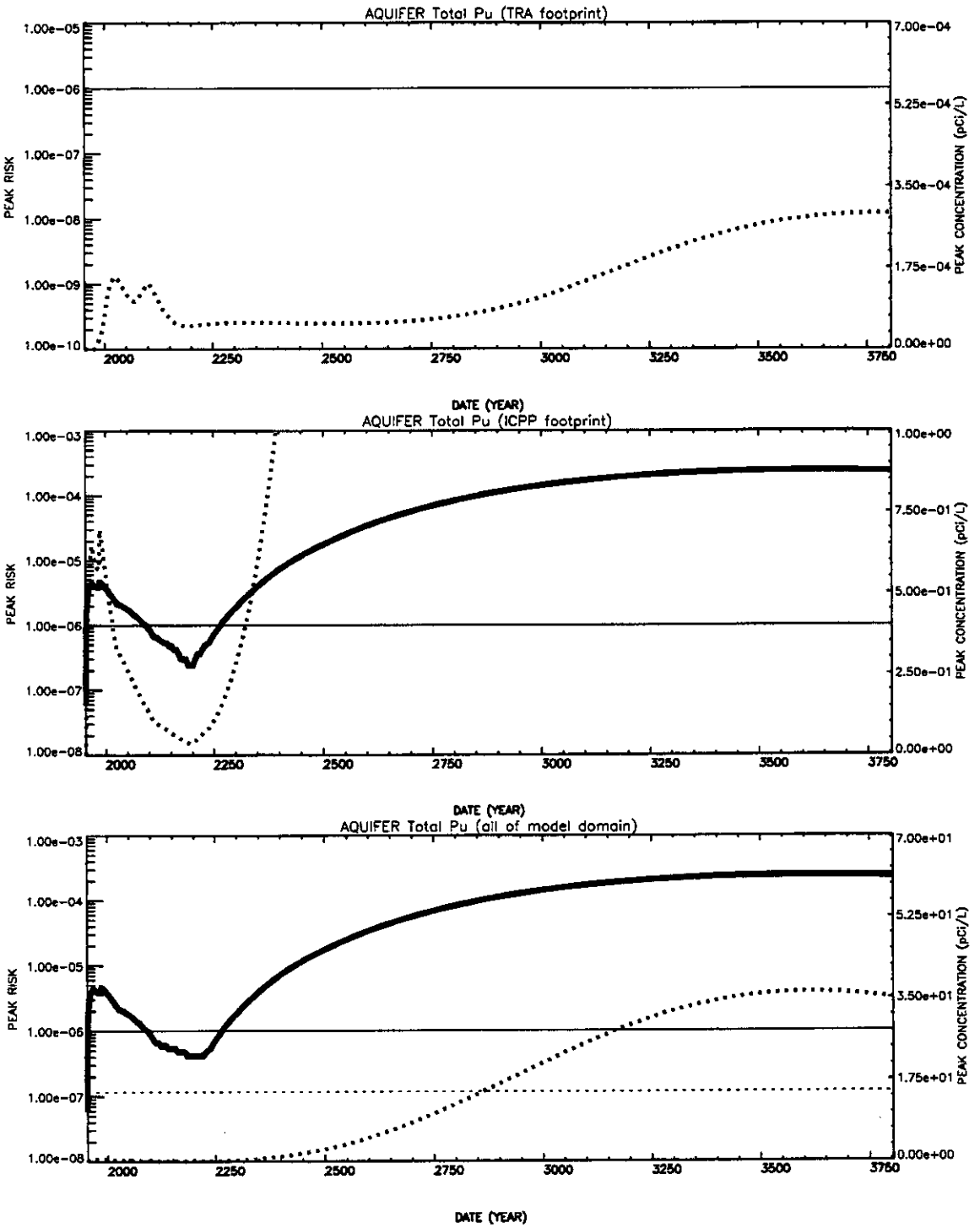


Figure 7-186 Peak aquifer concentration for Pu. Top figure: TRA foot print, Middle figure: ICPP footprint, Bottom Figure: entire aquifer domain. Thick line risk (left scale), dotted line concentration (right scale) solid line 10^{-6} risk (left scale).

7.10 Sr-90

Sr-90 was found in all of the primary contaminant sources. By mass, and in order of decreasing contribution, these sources were: a) CPP-31 (60.82%), b) CPP-28 (31.66%), c) Soils (5.71%), d) CPP-80 (1.42%), e) CPP-02 (0.17%), f) the injection well (0.12%), and g) the '86 release (0.09%). Transport through the vadose zone is represented in Figures 7-187 through 7-196 and Figures 7-197 through 7-210 present simulation results for the aquifer region. Contour levels for both the vadose zone and aquifer (Figures 7-187 through 7-190, 7-197, and 7-198) are given for $8x10^{-2}$, $8x10^{-1}$, 8, $8x10^{+1}$, $8x10^{+2}$, and $8x10^{+3}$ pCi/L, with concentrations equal to the MCL (8 pCi/L) represented by the dark solid line. The corresponding risk contour maps for the aquifer simulation are given in Figures 7-199, and 7-200. Risk contours are plotted at the 10^{-7}, 10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}, and 10^{-2} levels. Contour levels above the 10^{-6} value (0.859 pCi/L) are indicated by the dark solid line with the 10^{-4} level indicated by the medium solid line.

VADOSE ZONE: As indicated in these figures, Sr-90 vadose zone and aquifer transport was simulated through the year 2244. In addition, they show that relative to a conservative tracer, Sr-90 moves fairly slowly with a Kd of 12 cm^3/g but that it decays fairly rapidly with a half life of 29.1 years. As a result, much of the Sr-90 source decays while still resident in the vadose zone. The release of Sr-90 from the vadose zone to the aquifer is illustrated in Figure 7-192. This figure shows that the release of Sr-90 to the aquifer from the vadose zone occurs from 1990 through 2300, peaking in 2095 when the percolation ponds are turned off. The first local maximum (approximately year 2025) is the mass flux from the failed injection well fluxes and the last local maximum (approximately year 2170) is the mass flux from the surface sources (primarily the tank farm). The mass flux drop in the year 2095 is the result of the water from the percolation ponds being turned off. Figure 7-191 shows that the local maximum resulting from each additional source decreases rapidly after each introduction to the vadose zone. It also shows that the peak concentration reaches a value of 2570 pCi/L in 2244, but never falls below the 10^{-6} risk level in the vadose zone. Although still above the 10^{-6} risk level in 2244, the simulations were terminated because more than 99% of the initial mass in place had either entered the aquifer or decayed.

For the vadose zone, comparisons between model predicted concentrations and field data (Figures 7-193 through 7-196) suggest that most of the source terms and Kds are reasonable. The figures show that the predicted concentration matches the field data very well for most of the PW, MW, and USGS-50 wells. However, model predicted concentrations in the wells further north (CPP-33-3, CPP-33-2, CPP-37-4) are over predicted. On the other hand, concentrations in wells closer to the tank farm area are reasonably well predicted. Over predicting concentrations in the northern wells could be an indication that the source term in the Tank Farm area is slightly high, or that the model predicts more spreading to the north (into those wells) than actually occurs.

AQUIFER: The highest predicted Sr-90 aquifer concentration in 2095 was 8.08 pCi/L and the concentrations are predicted to continue to rise to a peak of 16.1 pCi/L in 2172. This predicted concentration is greater than both the 10^{-6} risk concentration (0.86 pCi/L) and the MCL (8 pCi/L). The Sr-90 concentration is predicted to remain above the MCL from 2095 until after the end of the aquifer simulation time in 2238 (still at 11 pCi/L). The overall highest concentration was predicted to have been 1200 pCi/L in 1967. After 2095, the aquifer areas with concentrations greater than the MCL are limited to the areas in the vicinity of the ICPP facility but the area above 10^{-6} risk concentration extends to the area of the CFA (as shown in Figures 7-197 through 7-200). The aquifer Sr-90 concentrations are the result of the Sr-90 flux to the injection well previous to the year 2070 and the result of vadose zone flux from surface sources (as shown in Figure 7-192) after the year 2070.

Locations for the wells used to compare field data to model predictions for Sr-90 are given in Figure 7-202. Included are wells spaced at near-, mid-, and far-field distances from the injection well. Comparison results given in Figures 7-203 through 7-210 indicate that the model is predicting arrival of Sr-90 originating in the injection well late and at concentrations below observed. If the Kd used in the model is correct, the field measurements of Sr-90 taken in this decade should be a reflection of the mass disposed of to the injection well, and not the arrival of Sr-90 from surface disposal through the vadose zone. Where data are

available, the shape of the predicted concentration-time curves appears to suggest that the Sr-90 should be a combination of aquifer injected mass and mass arriving from the vadose zone.

Based on the Track II guidance Kd estimates, a Kd = 24 cm^3/g (in the sediments and Kd = 1 cm^3/g in the aquifer basalts) would be representative of transport in the aquifer based on Track II guidance. Simulations using this Kd are presented as part of the sensitivity analysis results in Section 8.1.1. However, the Sr-90 predictions using this Kd may not be conservative because of other uncertainties in the simulations. In particular, because the predicted vadose zone travel time is long relative to the Sr-90 decay half-life, very little of the original Sr-90 source moves through the vadose zone to the aquifer. Therefore, the majority of the mass that does reach the aquifer is transported via dispersion rather than advective transport. The model dispersion is primarily numerical dispersion which can be used together with field data to calibrate a model, but there is not yet sufficient vadose zone Sr-90 transport data to calibrate the model. This model uncertainty combined with the uncertainty inherent in the vadose zone water travel time and source estimates were the basis for choosing a conservative base case Sr-90 sediment Kd of 12 cm^3/g (aquifer basalt Kd=0.5 cm^3/g). Comparison of the results in this section and the sensitivity results in Section 8.1.1 (using a Kd=24 cm^3/g) shows that the Sr-90 results for the time period past 2095 are extremely sensitive to the Kd value. The predicted peak concentration in 2172 is 16.1 pCi/L with a Kd of 12 cm^3/g and 0.35 pCi/L with a Kd of 24 cm^3/g.

As summarized in Section 10.5, there is very little difference between the original and reestimated Sr-90 inventory from CPP-31 (approximately a 4% increase). However, analytical results from soil samples taken at CPP-31 in 1975 indicate that the Sr-90 may be underestimated (by 20%). The Sr-90 source inventory modeled for CPP-31 does not appear to be conservative but is relatively accurate. However, it is recognized that the tank farm soils are not extensively characterized so that the past tank farm release estimates contain significant uncertainties.

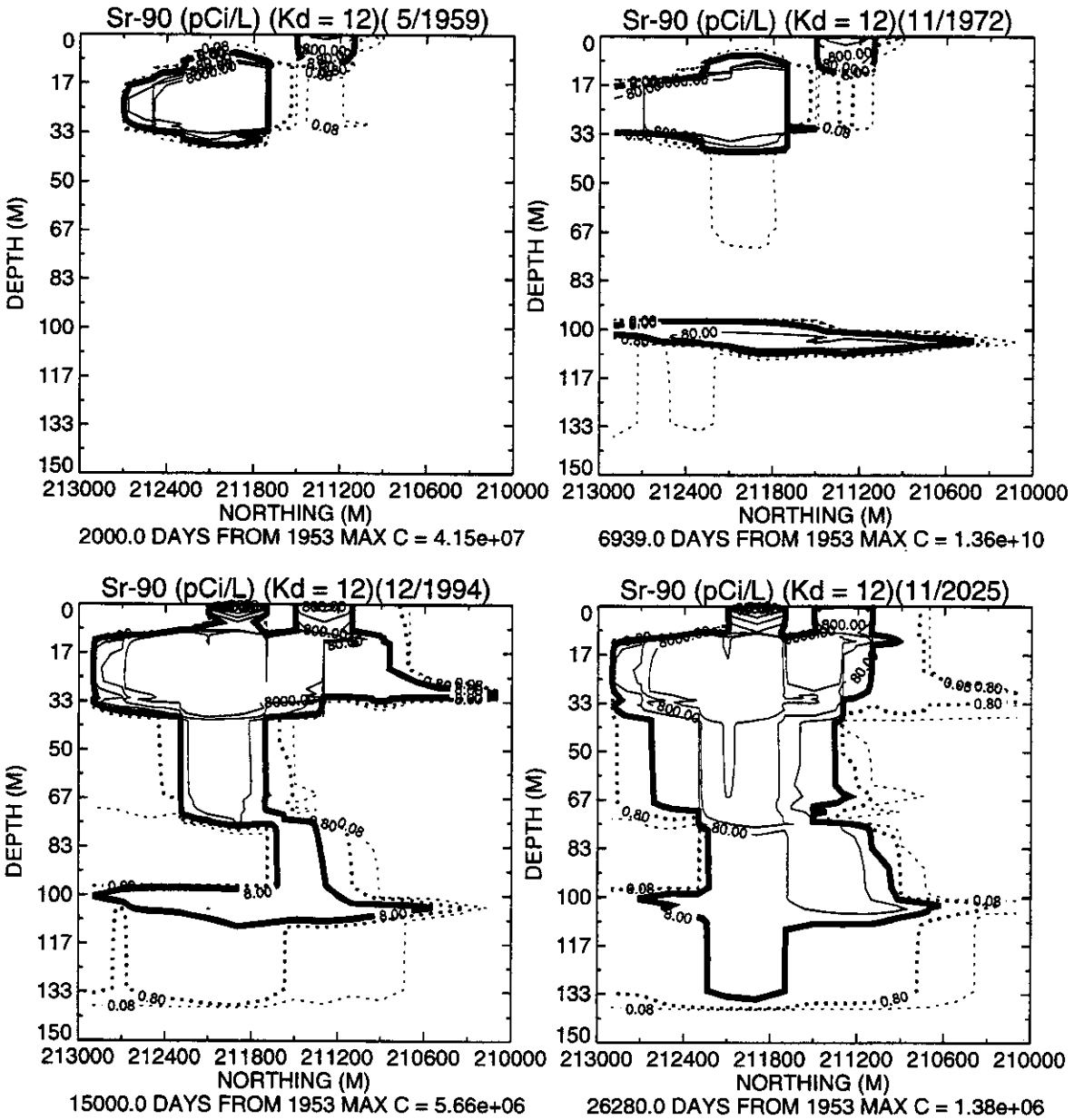


Figure 7-187 Vadose zone Sr-90 peak concentration contours.

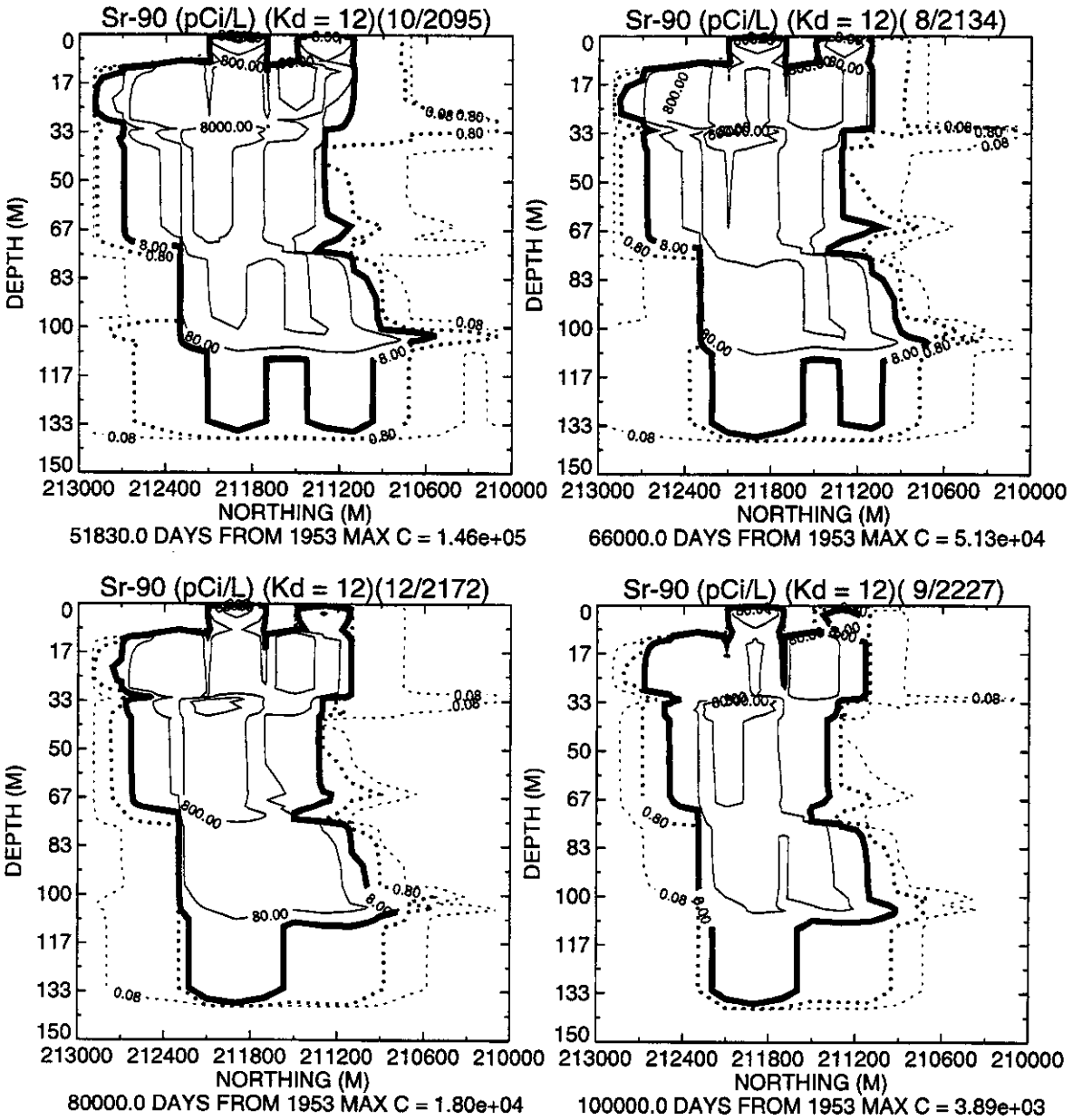


Figure 7-188 Vadose zone Sr-90 peak concentration contours.

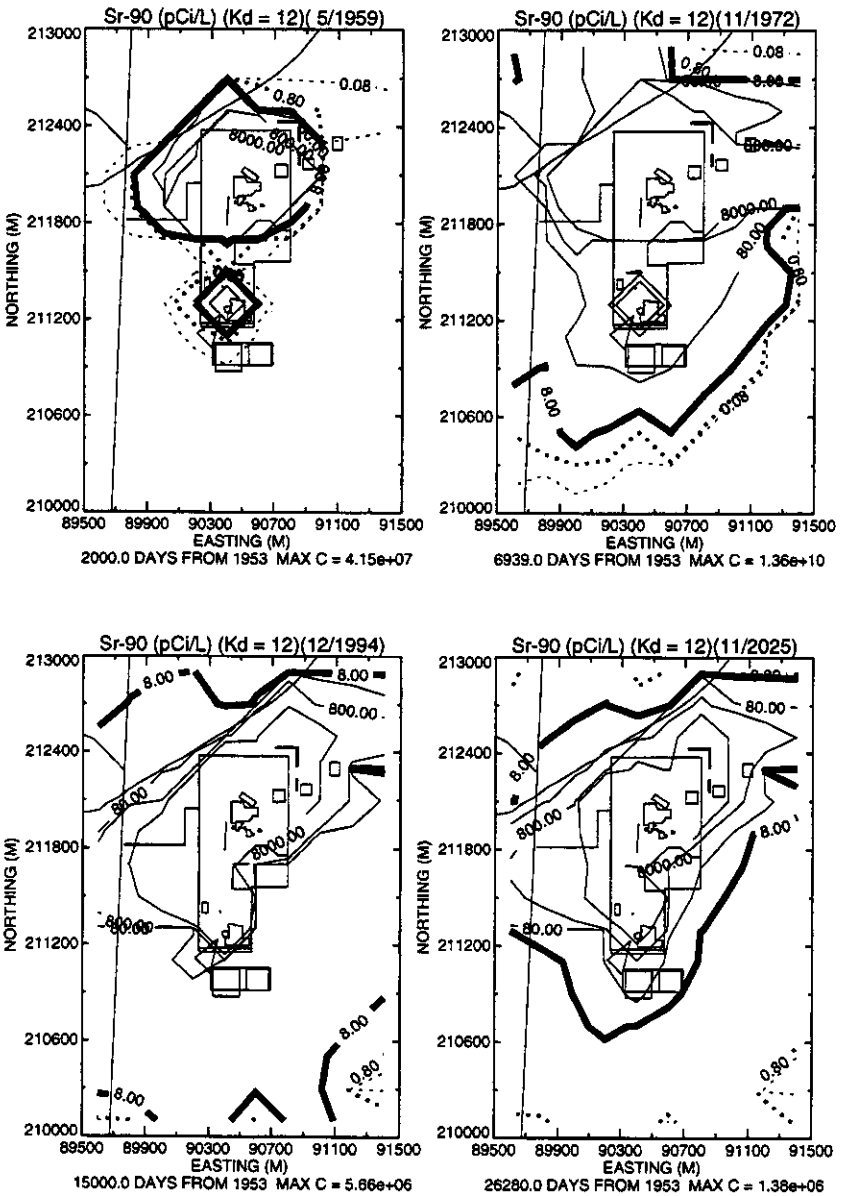


Figure 7-189 Vadose zone Sr-90 peak concentration contours.

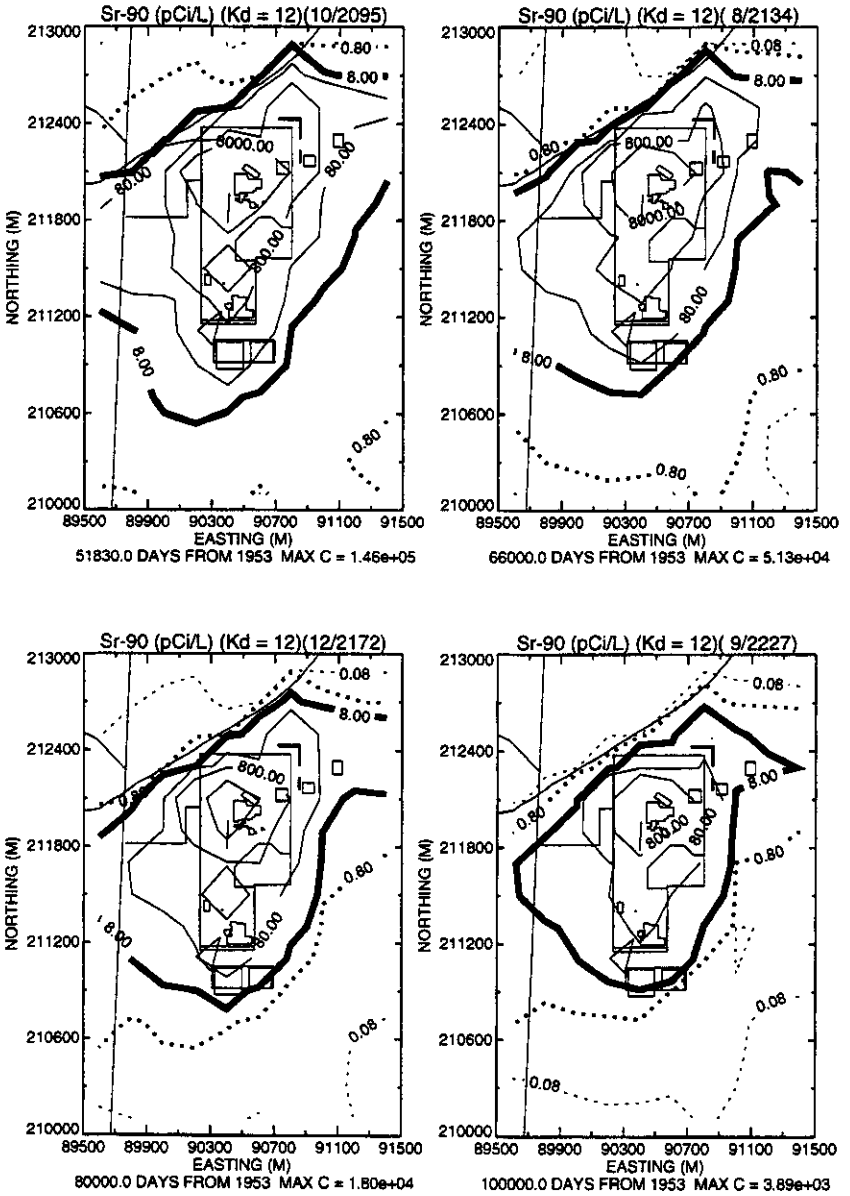


Figure 7-190 Vadose zone Sr-90 peak concentration contours.

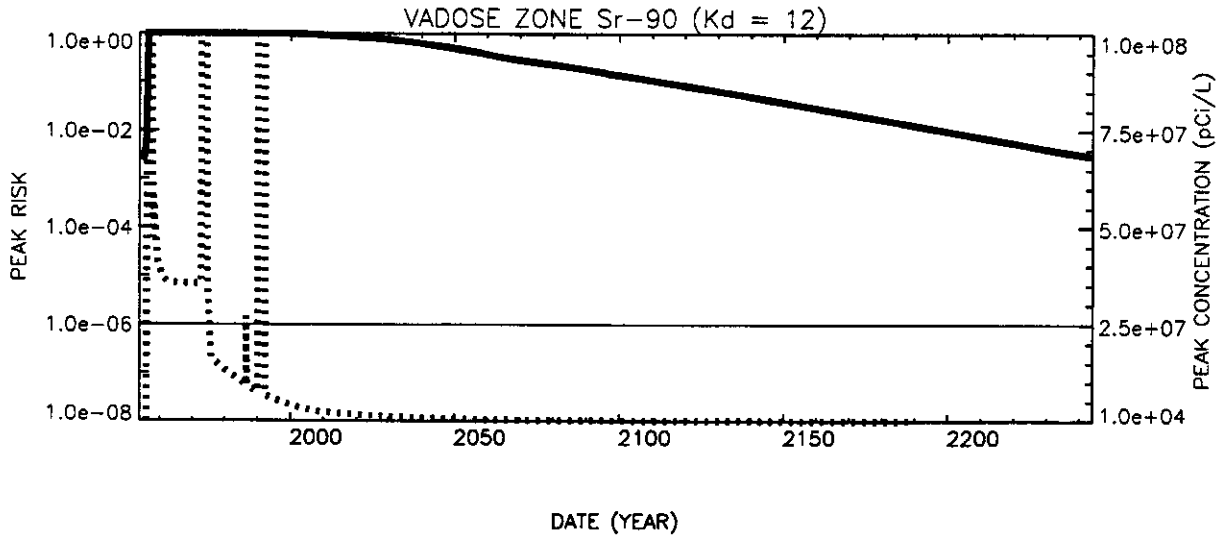


Figure 7-191 Peak vadose zone risk and concentration for Sr-90. Risk indicated by the thick line on the log scale with the 10^{-6} value shown as the solid line. The dotted line represents concentration given by the linear scale on the right axis, the MCL is 8 pCi/L.

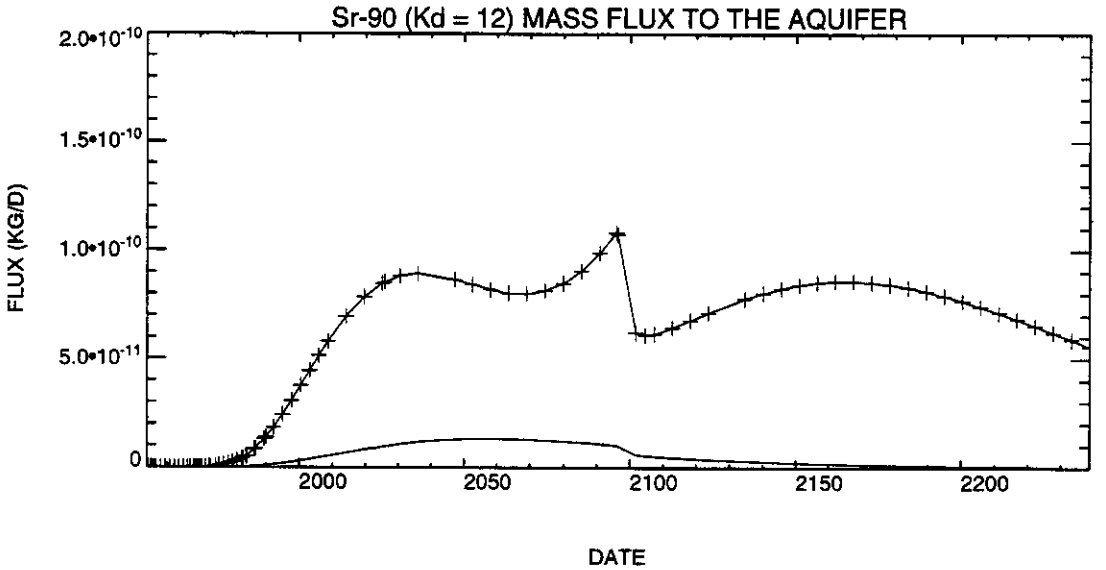


Figure 7-192 Mass flux of Sr-90 into the aquifer from the vadose zone. The solid line is the mass flux curve for Sr-90 with a Kd=24 cm^3/g (see Figure 8-6).

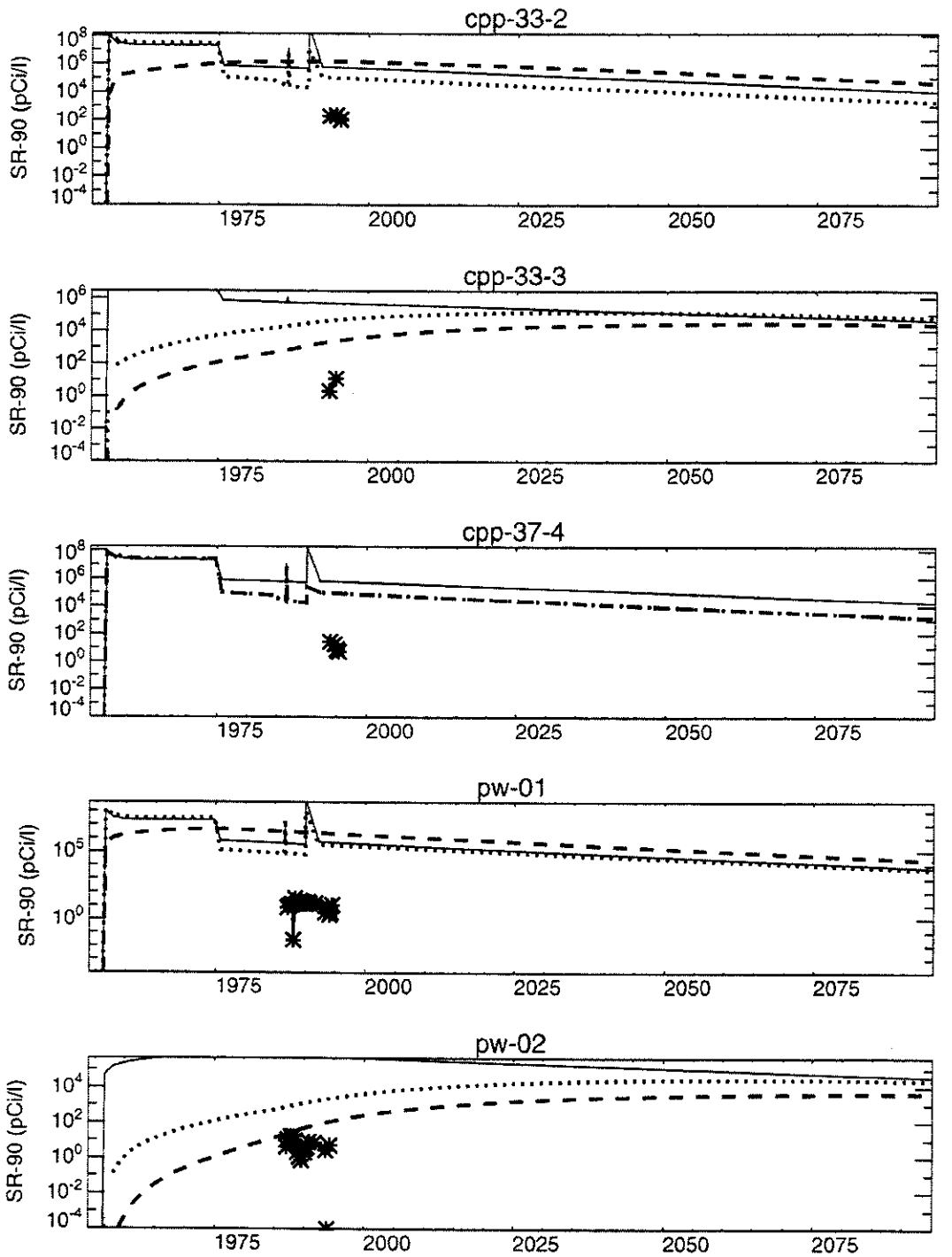


Figure 7-193 Comparison of vadose zone Sr-90 to field data.

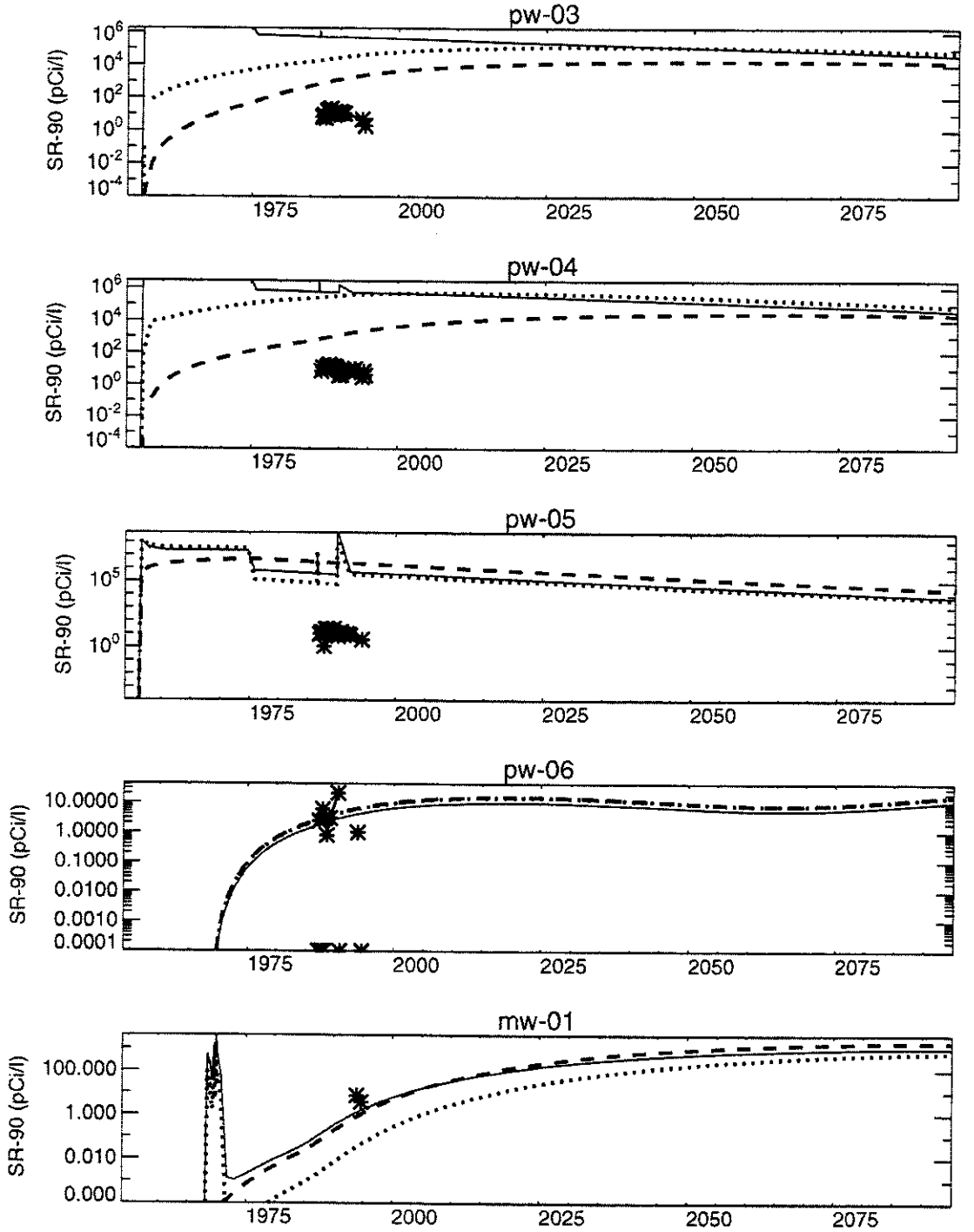


Figure 7-194 Comparison of vadose zone Sr-90 to field data.

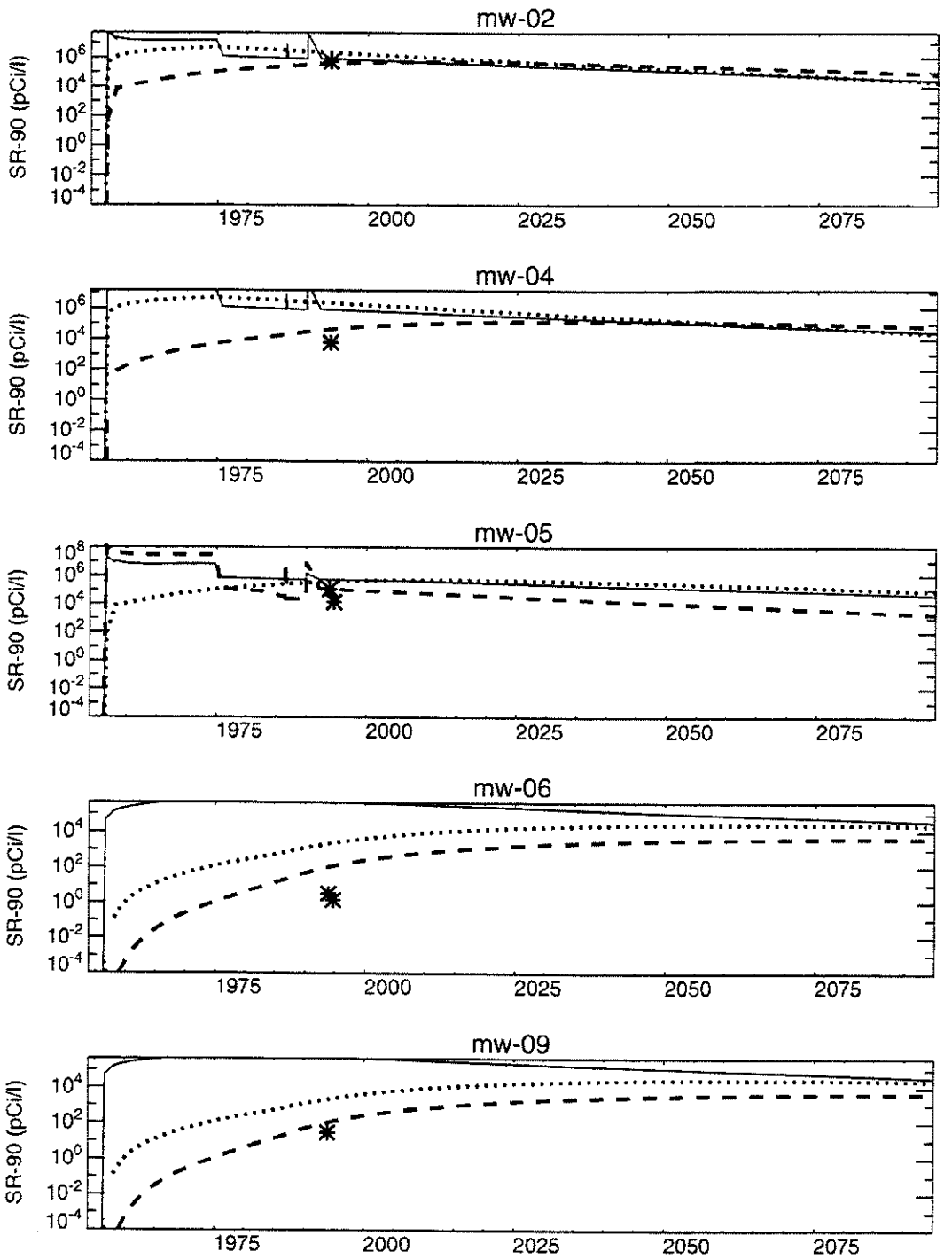


Figure 7-195 Comparison of vadose zone Sr-90 to field data.

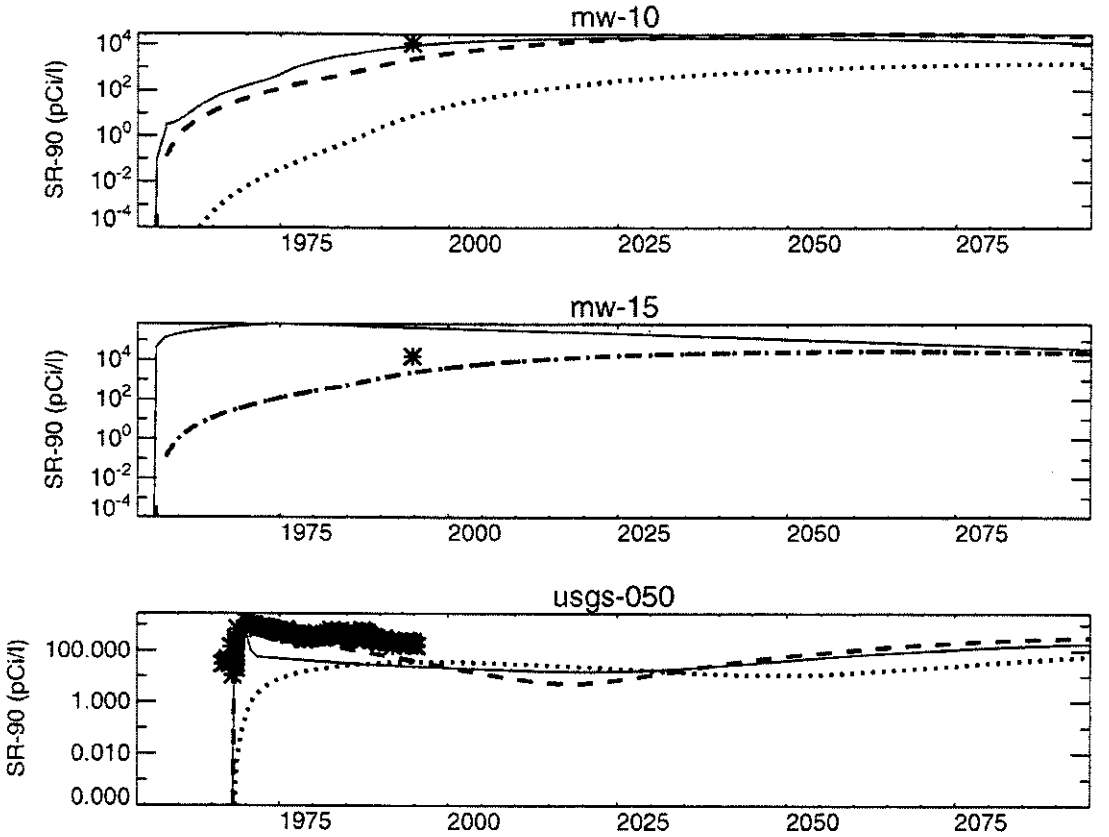


Figure 7-196 Comparison of vadose zone Sr-90 to field data.

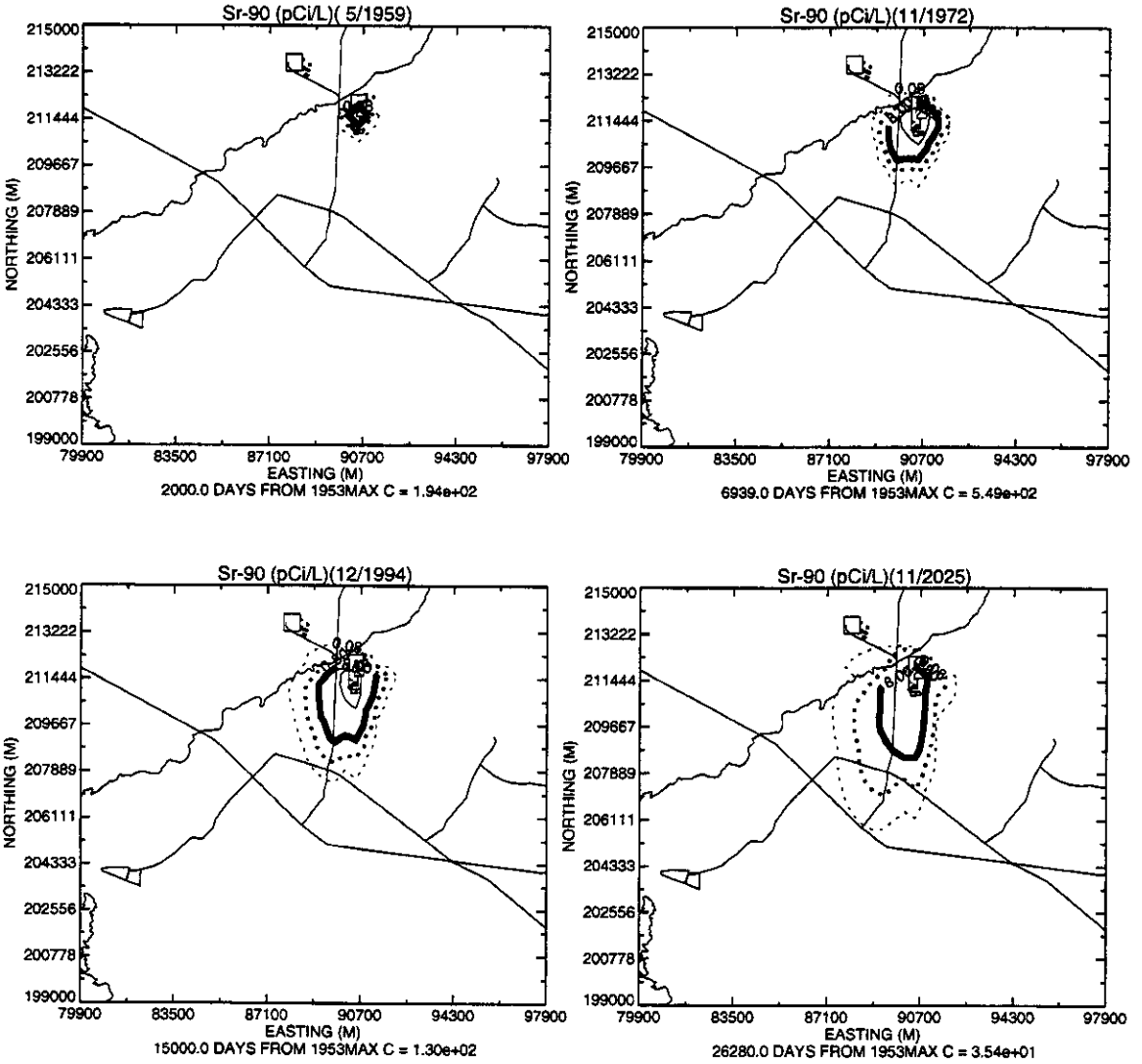


Figure 7-197 Aquifer Sr-90 peak concentration contours.

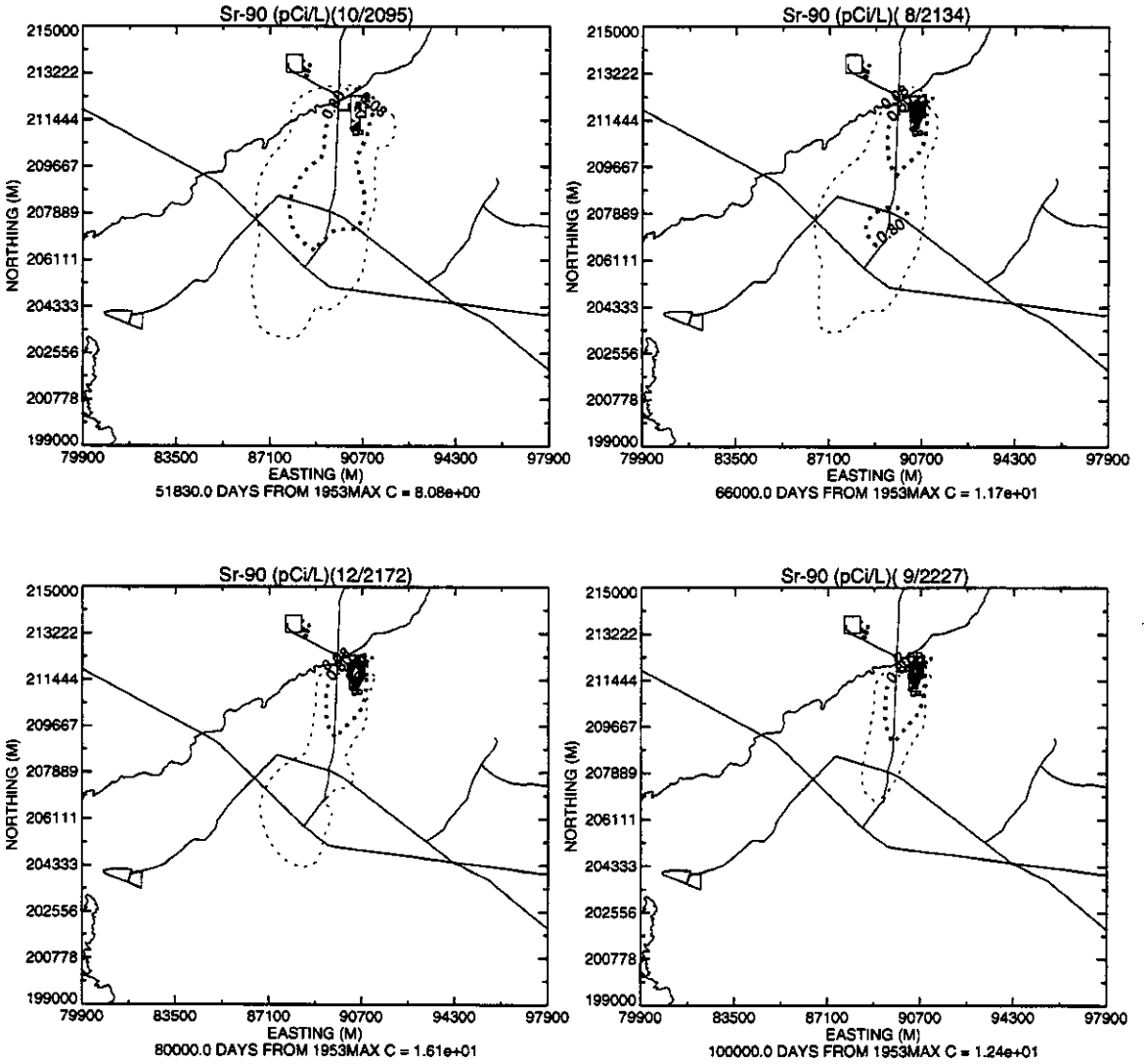


Figure 7-198 Aquifer Sr-90 peak concentration contours.

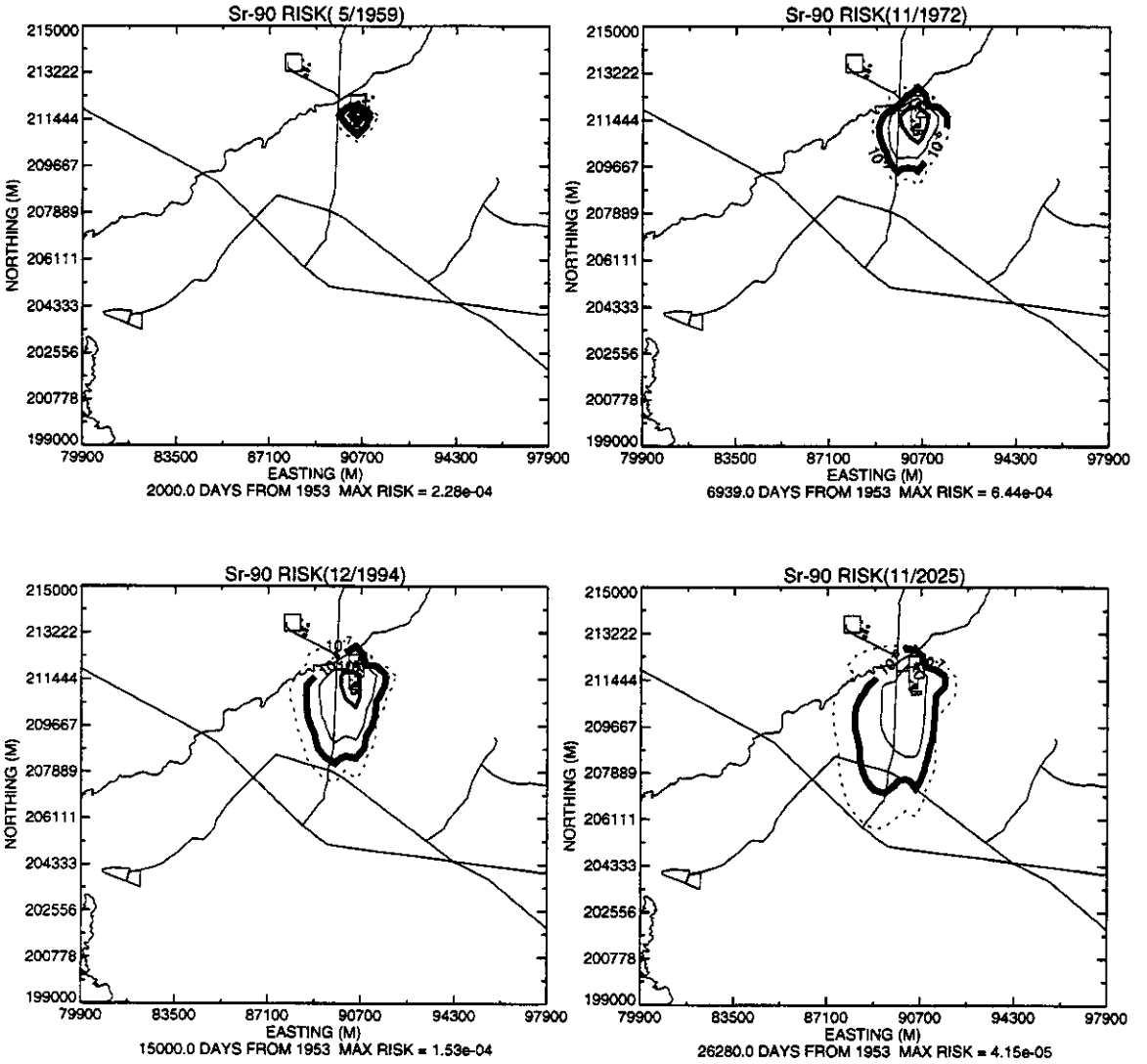


Figure 7-199 Aquifer Sr-90 peak risk contours.

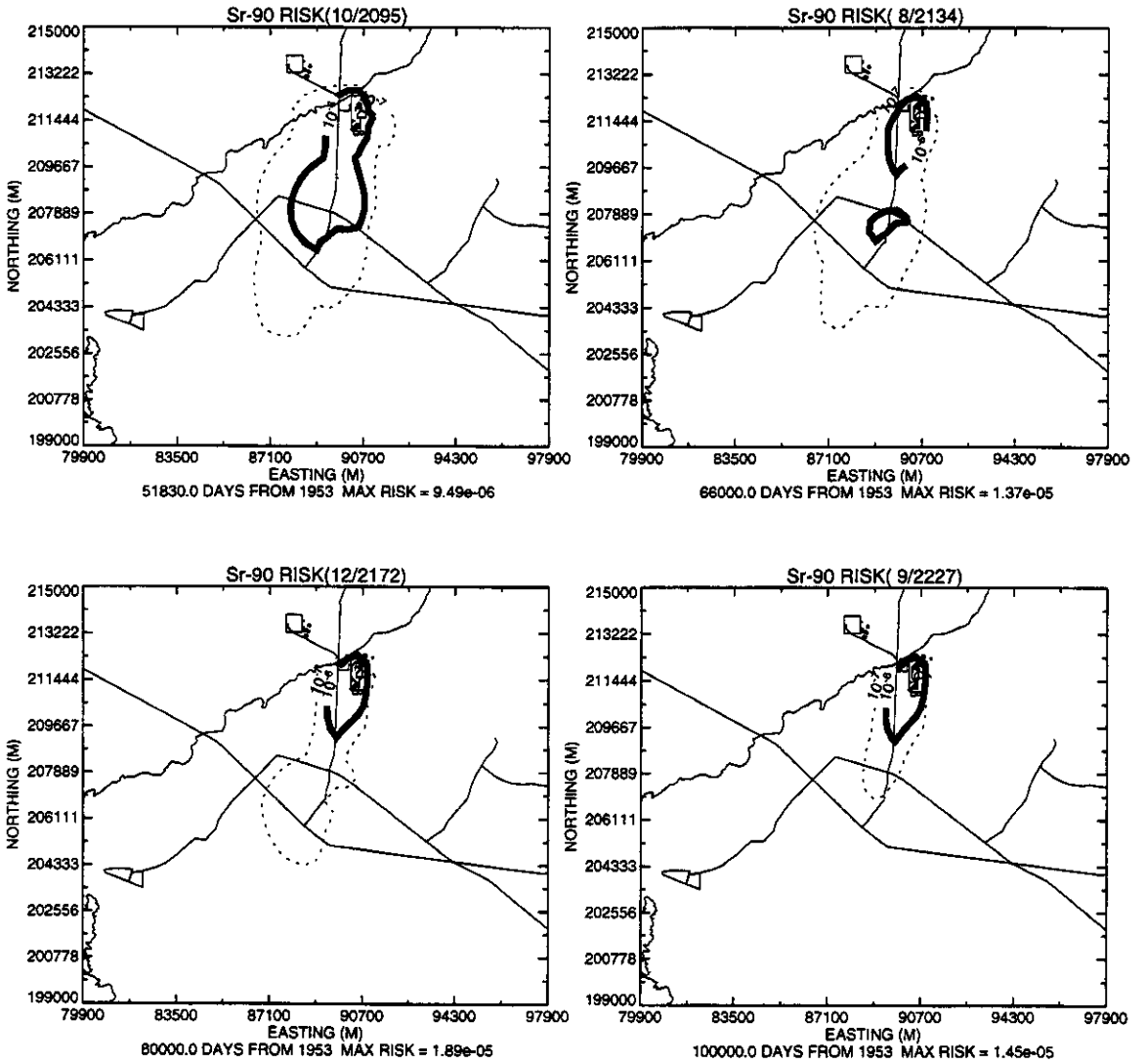


Figure 7-200 Aquifer Sr-90 peak risk contours.

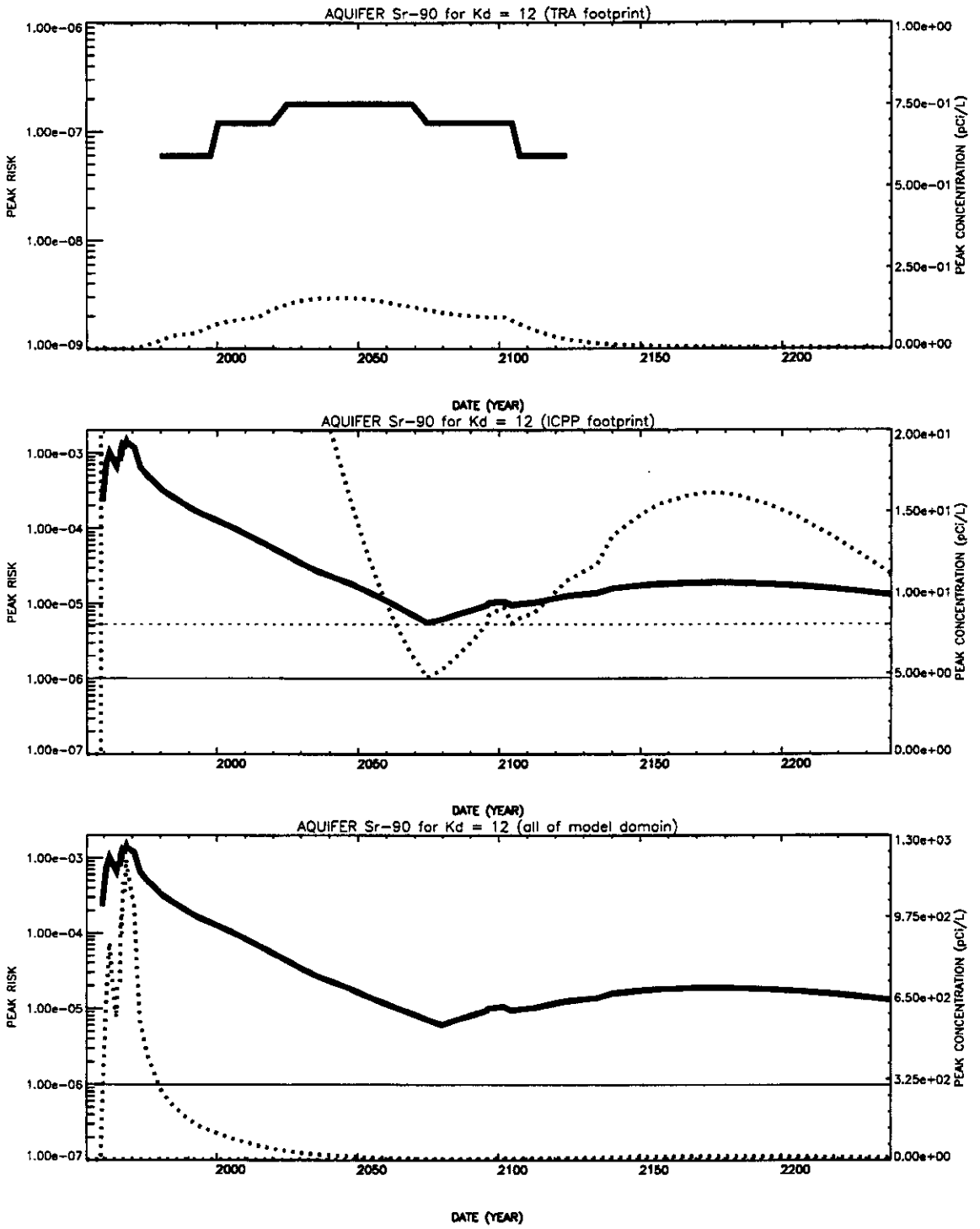


Figure 7-201 Peak aquifer concentration for Sr-90. Top figure: TRA foot print, Middle figure: ICPP footprint, Bottom Figure: entire aquifer domain. Thick line risk (left scale), dotted line concentration (right scale) solid line 10^{-6} risk (left scale).

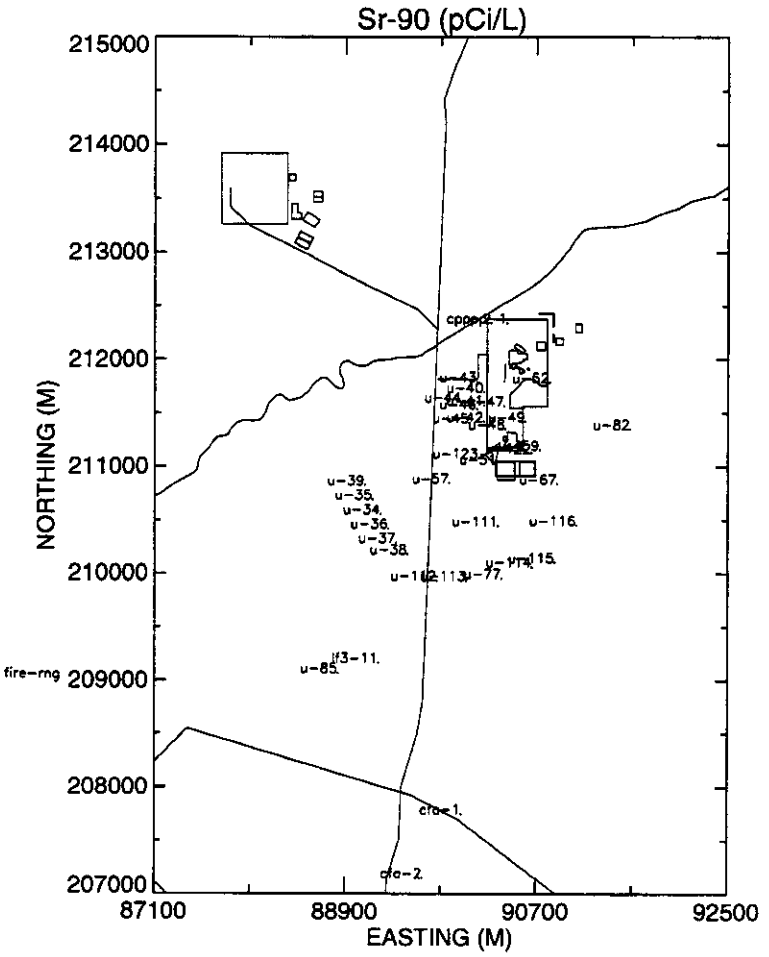


Figure 7-202 Well locations for the comparison of aquifer Sr-90 to field data.

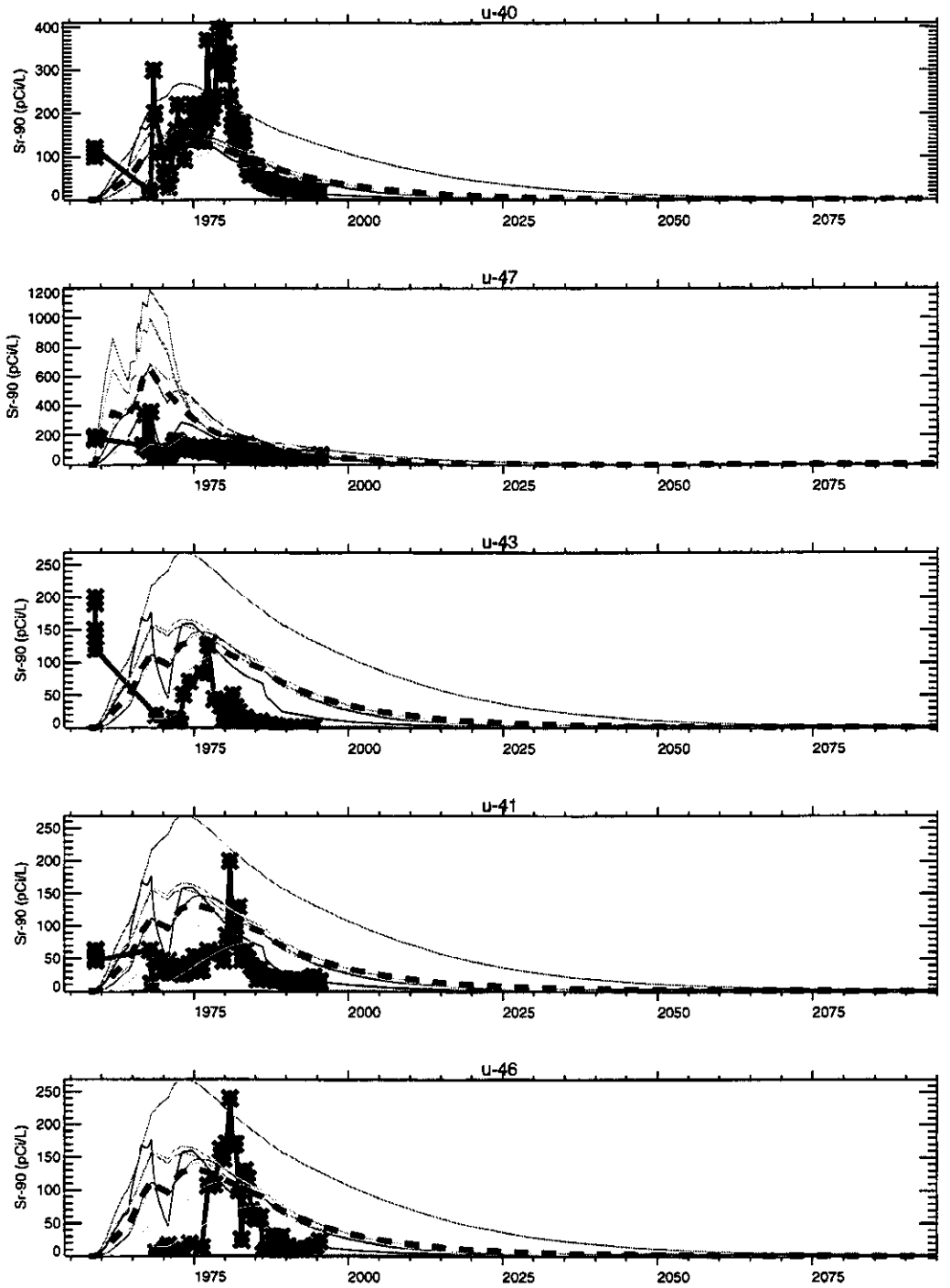


Figure 7-203 Comparison of aquifer Sr-90 to field data.

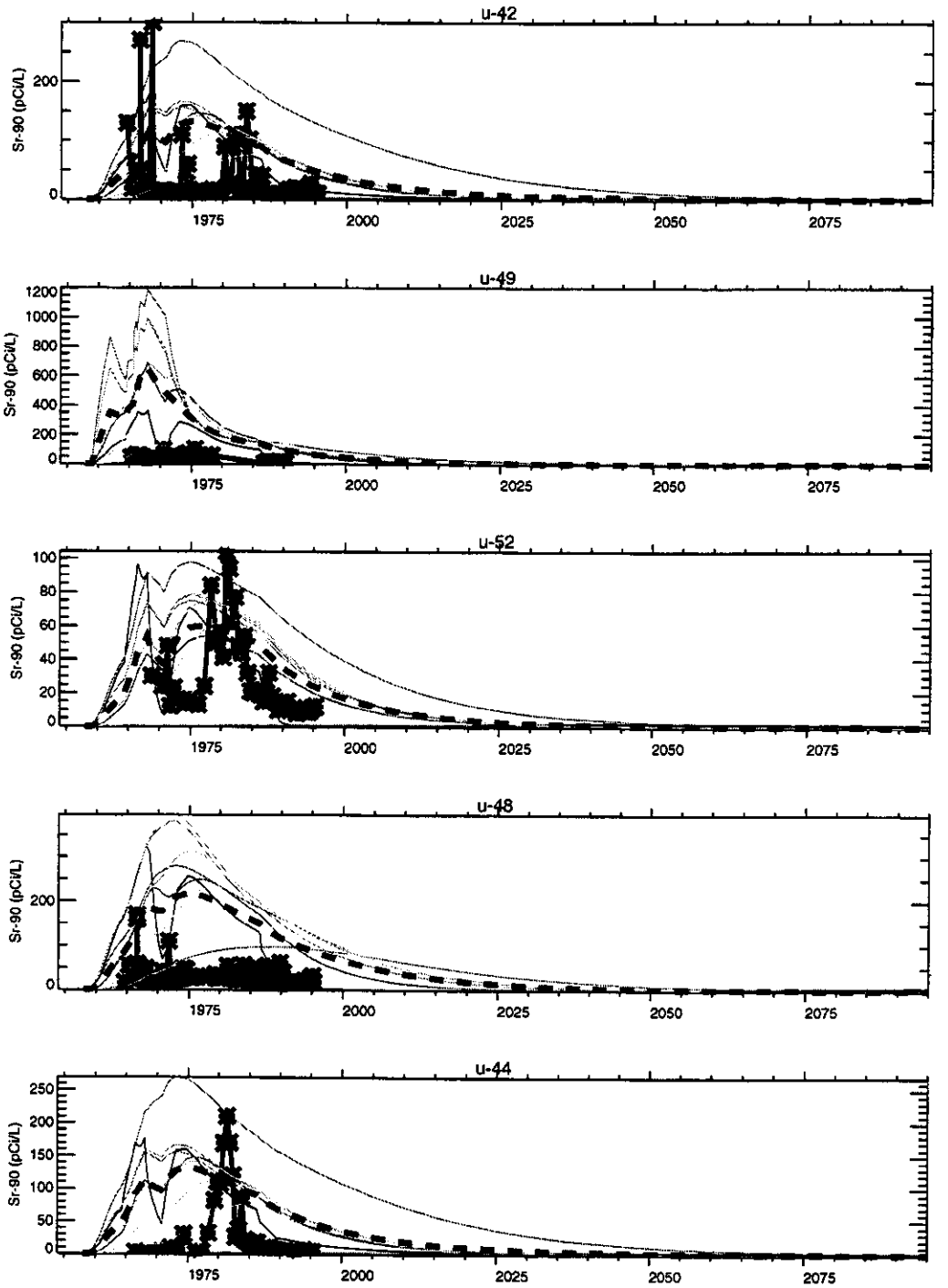


Figure 7-204 Comparison of aquifer Sr-90 to field data.

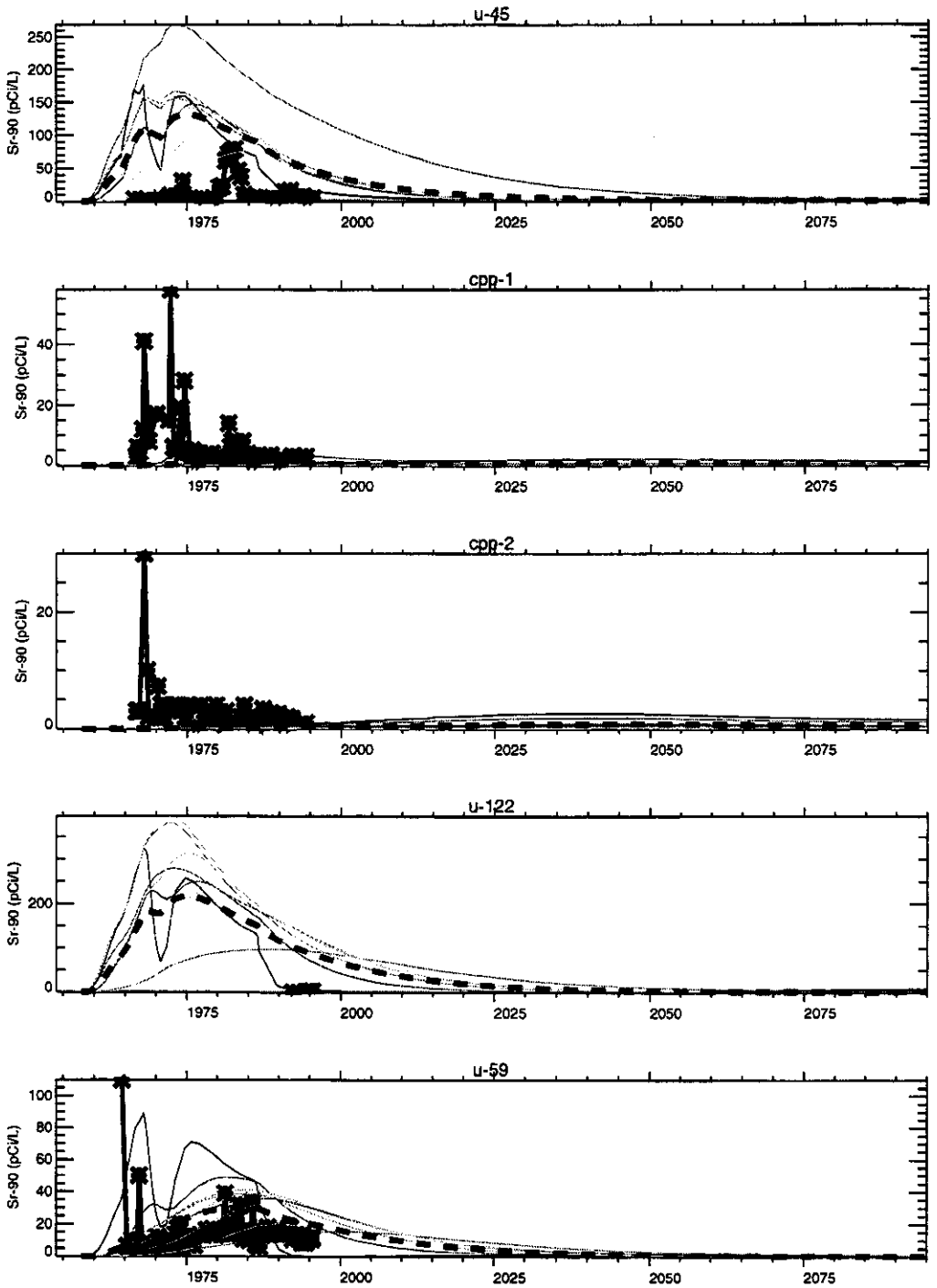


Figure 7-205 Comparison of aquifer Sr-90 to field data.

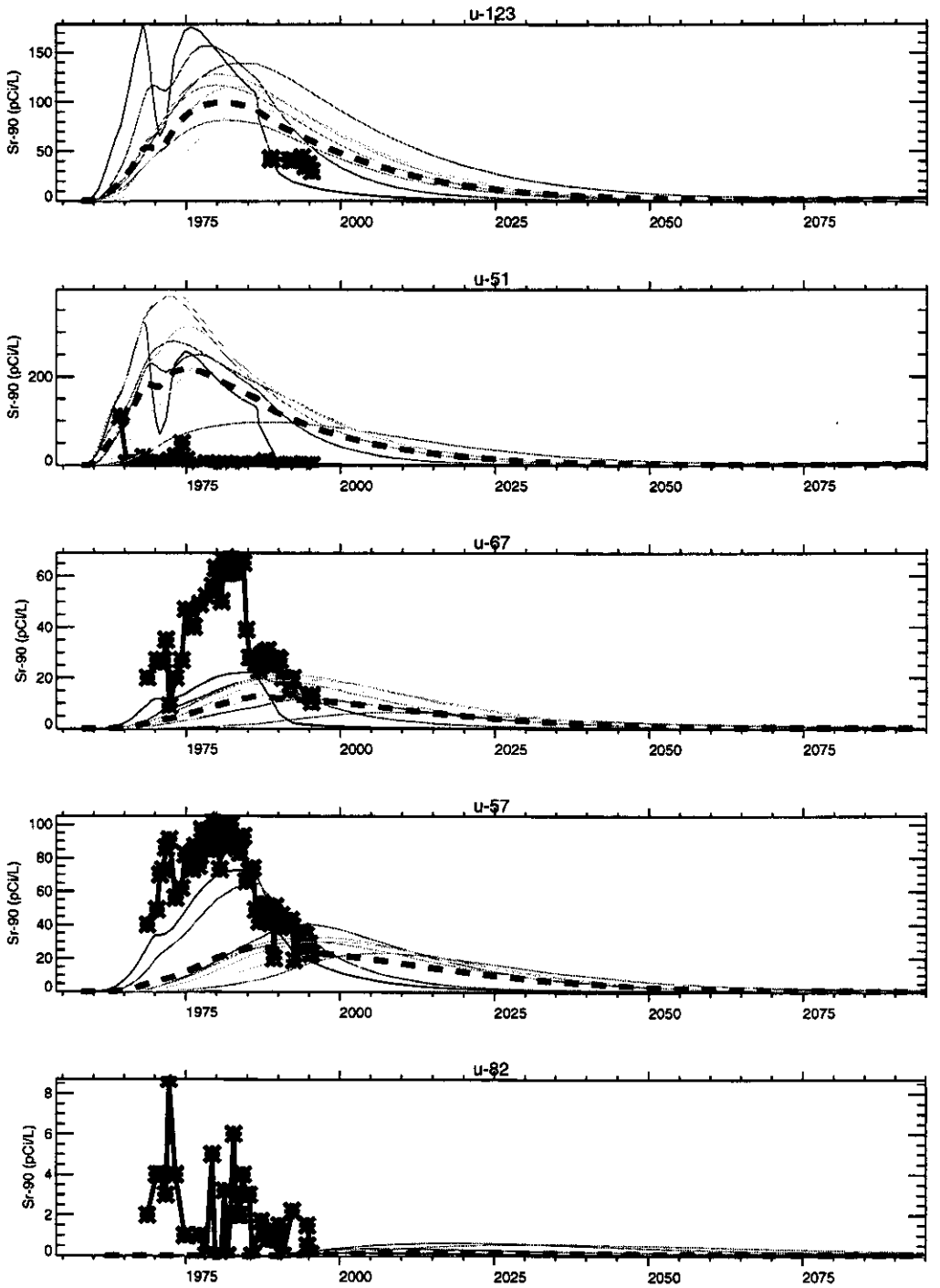


Figure 7-206 Comparison of aquifer Sr-90 to field data.

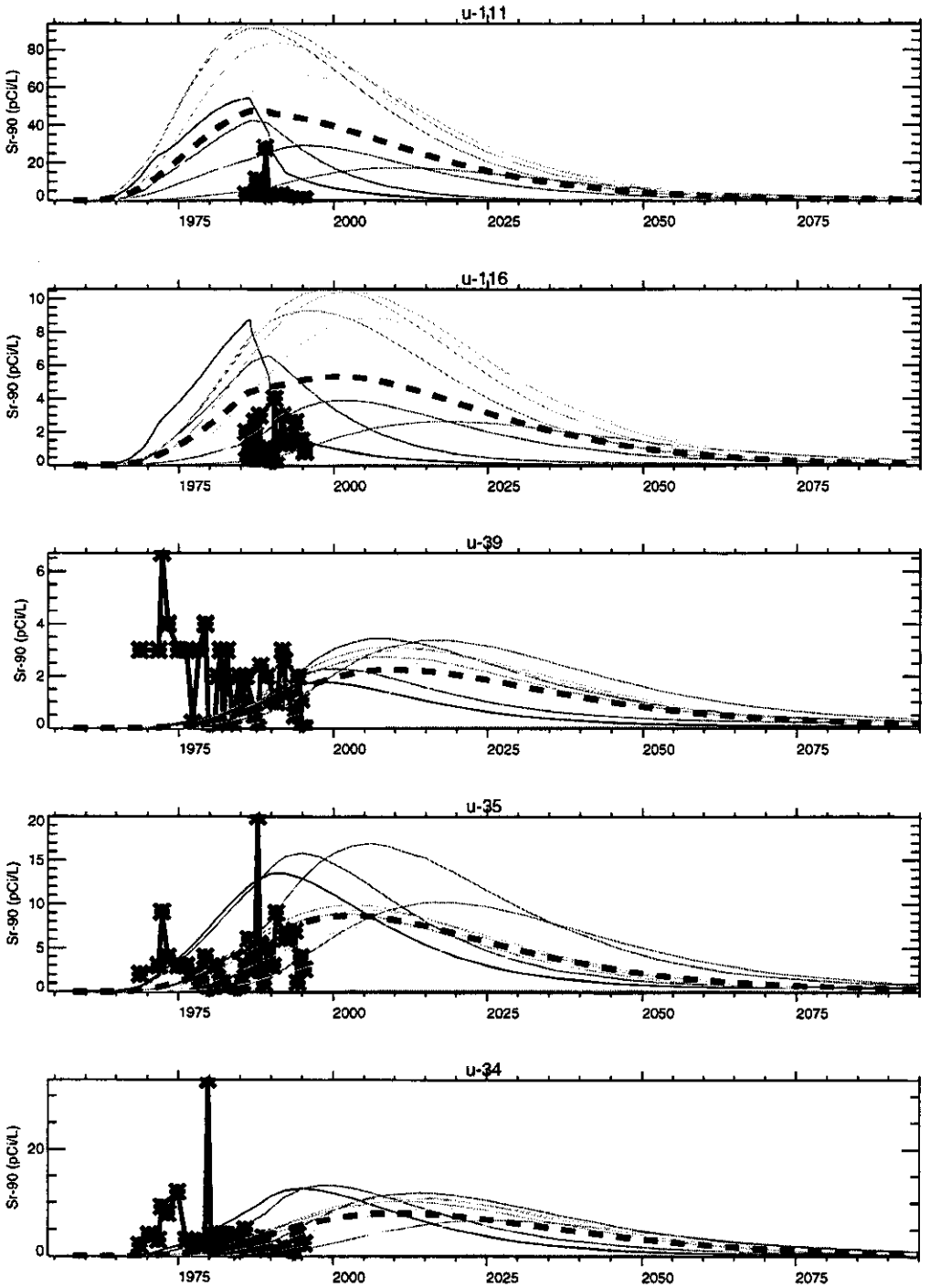


Figure 7-207 Comparison of aquifer Sr-90 to field data.

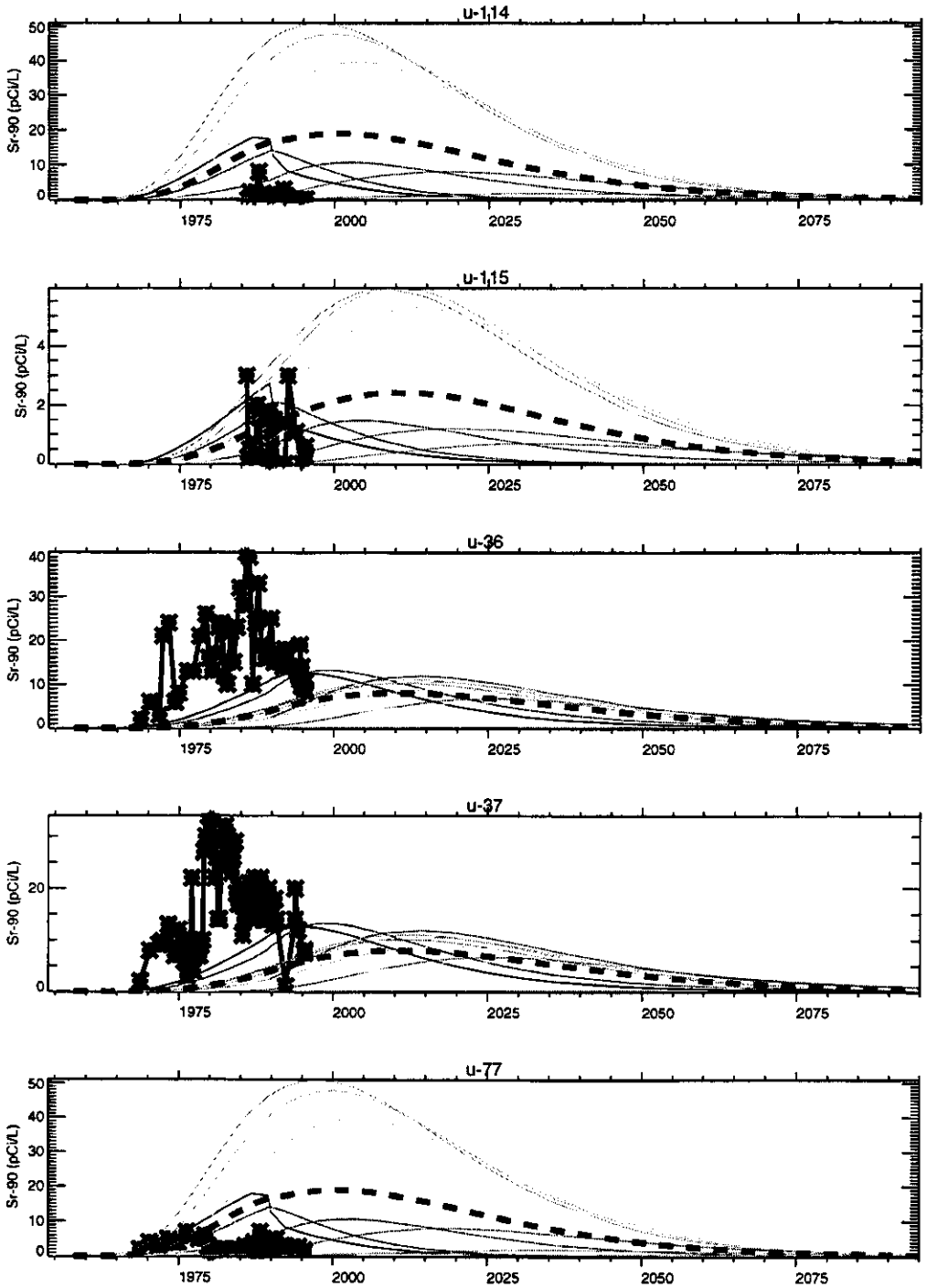


Figure 7-208 Comparison of aquifer Sr-90 to field data.

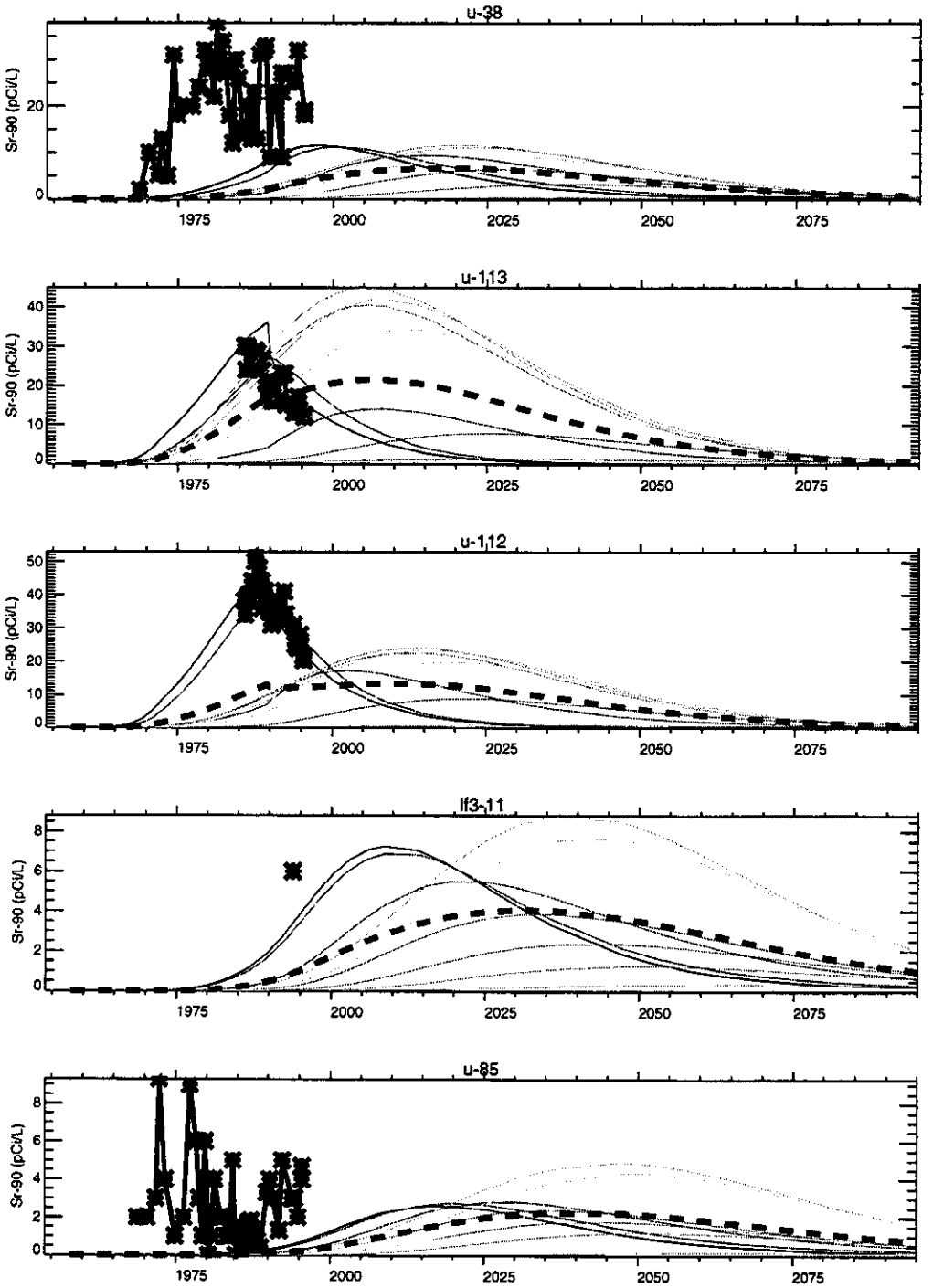


Figure 7-209 Comparison of aquifer Sr-90 to field data.

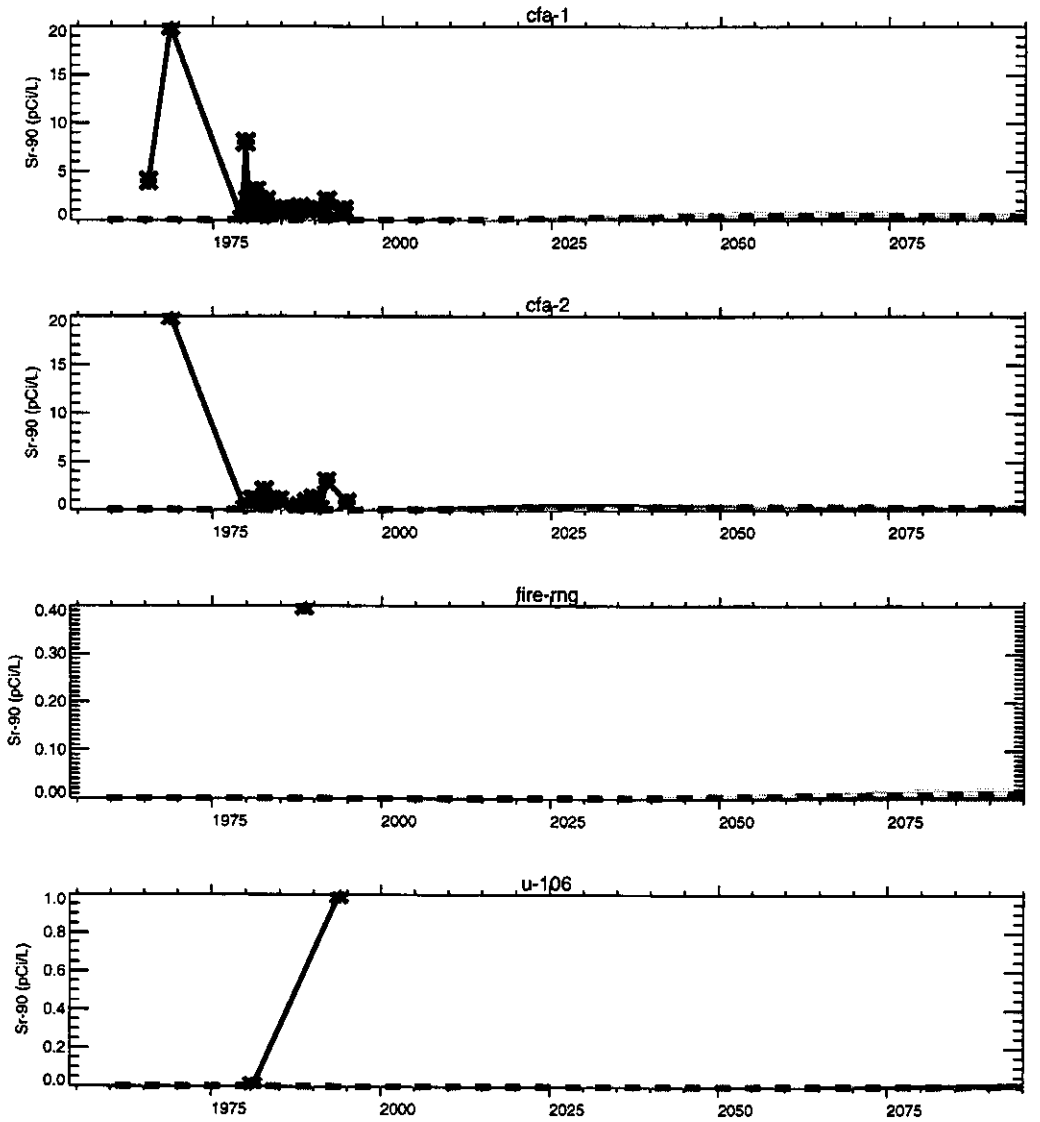


Figure 7-210 Comparison of aquifer Sr-90 to field data.

7.11 Tc-99

There were only three sources simulated for Tc-99 with the majority of the released mass originating from CPP-31 (95.91%) with much smaller contributions from the soils inventory (3.94%) and the '86 release (0.15%). Figures 7-211 through 7-219 present the simulation results for the transport of Tc-99 through the vadose zone, and Figures 7-220 through 7-224 present simulation results for the aquifer region. Contour levels for both the vadose zone and aquifer (Figures 7-211 through 7-214, 7-220, and 7-221) are given for 9.0, $9.0 \times 10^{+1}$, $9.0 \times 10^{+2}$, $9.0 \times 10^{+3}$, $9.0 \times 10^{+4}$, and $9.0 \times 10^{+5}$ pCi/L, with concentrations equal to the MCL (900 pCi/L) represented by the dark solid line. Corresponding risk contour maps for the aquifer region are given in Figures 7-222, and 7-223. In those plots, the contour levels represented are for 10^{-7}, 10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}, and the 10^{-2} risk. Contour levels above the 10^{-6} value (34.3 pCi/L) are indicated by solid lines. Risk less than 10^{-6} are indicated by the dotted lines, the 10^{-6} level is indicated by the thick line, and the 10^{-4} level is indicated by the medium solid line.

VADOSE ZONE: The Tc-99 vadose zone and aquifer transport was simulated until the year 2178. This relatively short simulation time allowed the mass to pass through the vadose zone because with a Kd of 0.2 cm^3/g, Tc-99 moves only slightly slower than a conservative tracer would. In addition, it decays very slowly with a half life of 2.11×10^5 years. As a result, much of the Tc-99 source moves through the vadose zone into the aquifer.

Figure 7-216 shows that the mass flux of Tc-99 to the aquifer from the vadose zone peaks in 1995, with most of the mass having past out of the vadose zone by 2178 when the simulation was stopped. Figure 7-215 shows that the peak concentration decreases rapidly from the high in 1972, and reaches a minimum value of 3.53 pCi/L in 2178. The peak concentration falls below the 10^{-6} risk level in 2071, and below the MCL in 2090.

For the vadose zone, comparisons between model predicted concentrations and field data (Figures 7-217 through 7-219) suggest that most of the source terms are reasonable. Due to the existence of at most four samples (average closer to one) per well, there are not enough data to evaluate the choice of Kd for Tc-99. The figures show that the predicted concentration matches the field data very well for most of the PW, MW, and USGS-50 wells. However, model predicted concentrations in MW-01 are slightly high which is consistent with simulations for the other contaminants. This is probably due to excessive lateral migration near that well.

AQUIFER: The overall maximum aquifer concentration was predicted to have been 203 pCi/L in 1997. By 2095, the peak concentration is predicted to be down an order of magnitude to 23.9 pCi/L which is less than both the 10^{-6} risk concentration (34.1 pCi/L) and the MCL (900 pCi/L). Figure 7-216 shows that the aquifer concentration is predicted not to exceed the MCL for the entire simulation time and to be below the 10^{-6} risk level after the year 2060. The contour plots of risk for the aquifer indicate that the area with maximum concentrations greater than the 10^{-6} risk concentration is limited to the vicinity of the ICPP facility (Figure 7-223).

Locations for the wells used to compare field data to model predictions for Tc-99 are given in Figure 7-225. Included are wells spaced at near-, mid-, and far-field distances from the injection well. Comparison results given in Figures 7-226 through 7-231 indicate that the model is predicting arrival of Tc-99 originating at the surface fairly accurately. The initial increase in concentration at the aquifer wells matches the field data fairly well. However, the time history at each well is more disperse in the model predictions than observed in the field data which show concentrations increasing very abruptly. Given the very good calibration of the aquifer model to the injection well tritium, and that all of the Tc-99 mass originates at the surface, the model predicted dispersion is probably being introduced from the vadose zone mass fluxes.

As summarized in Section 10.5, there is very little difference between the original and reestimated Tc-99 inventory from CPP-31. Therefore, the source uncertainty has little effect on the transport simulations.

However, because the tank farm soils have not been well characterized and Tc-99 was seldom sampled for, there is uncertainty in the past releases of Tc-99 from the tank farm and its transport in the subsurface.

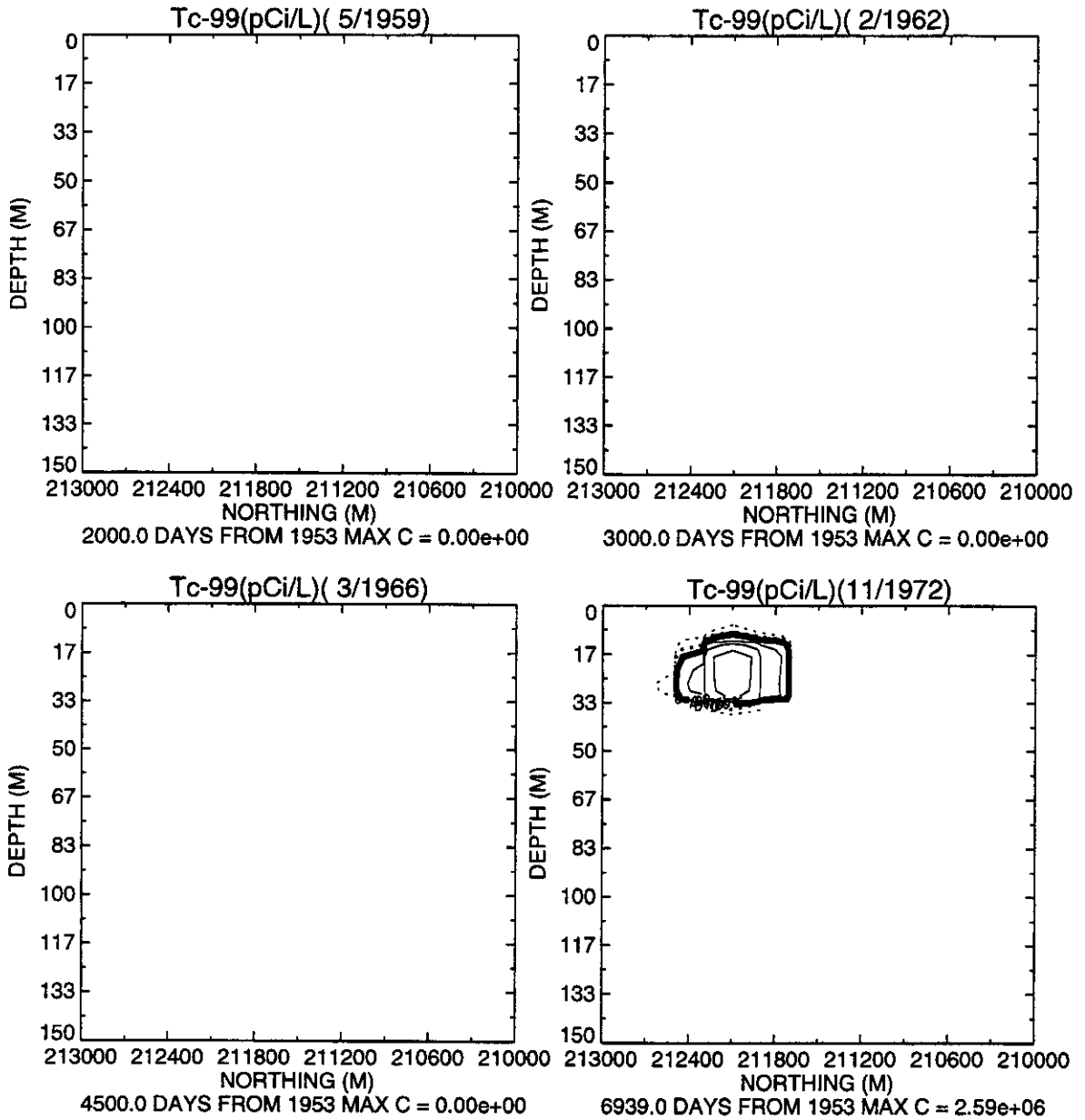


Figure 7-211 Vadose zone Tc-99 peak concentration contours.

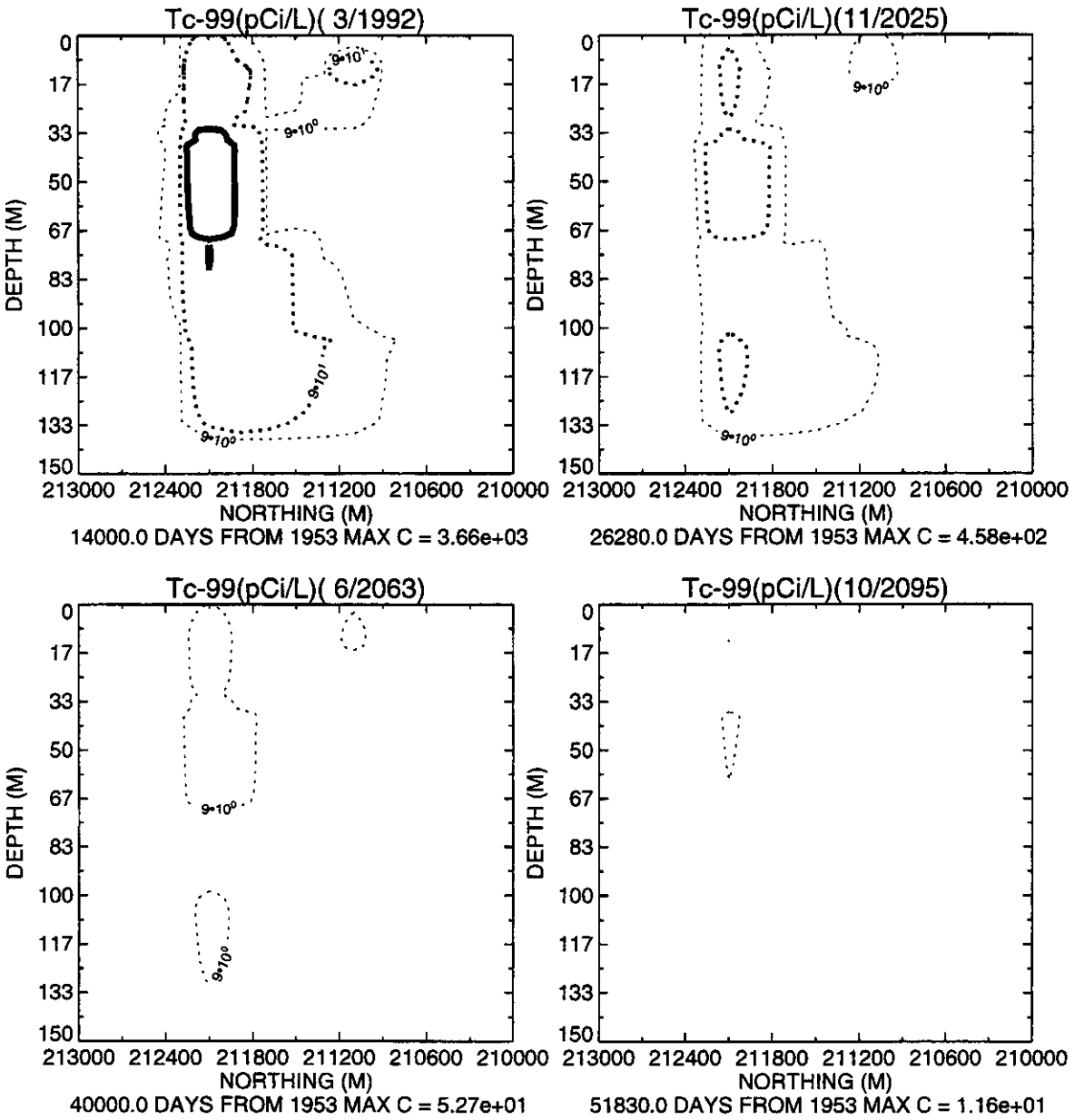


Figure 7-212 Vadose zone Tc-99 peak concentration contours.

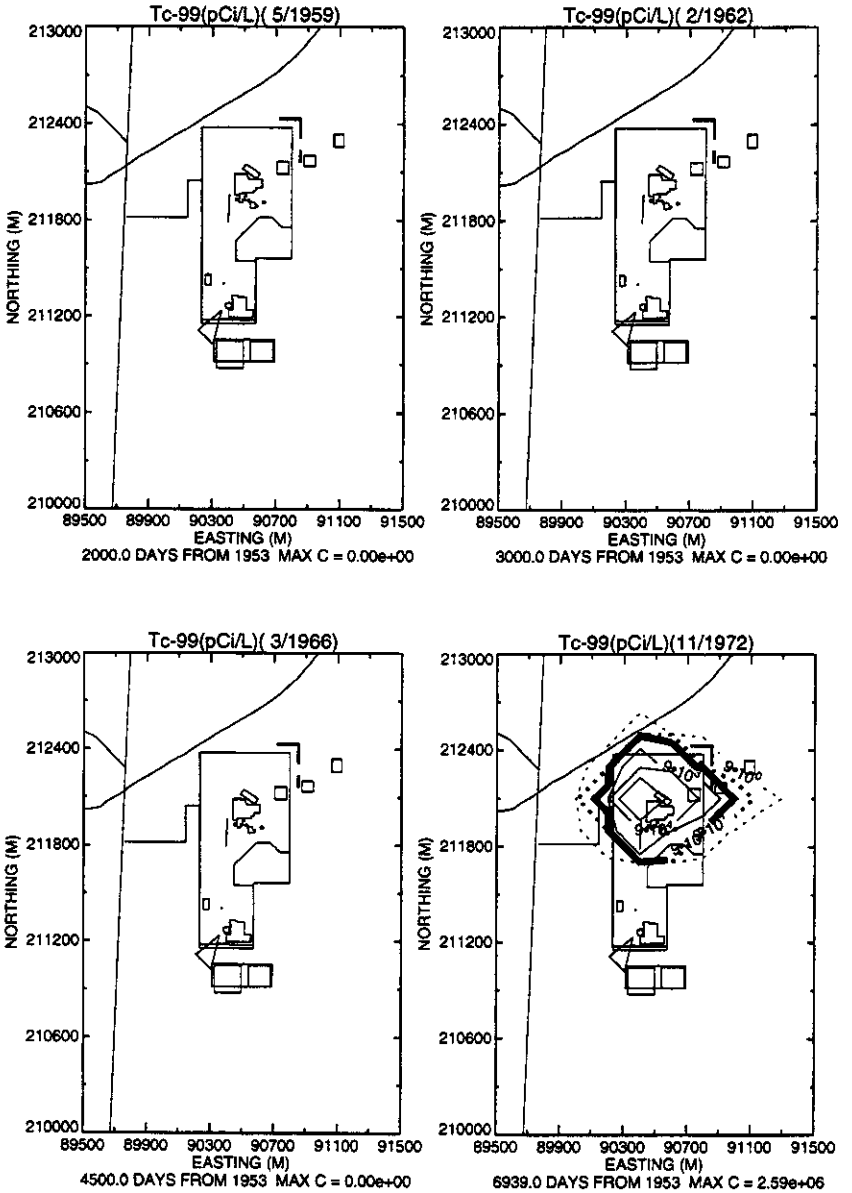


Figure 7-213 Vadose zone Tc-99 peak concentration contours.

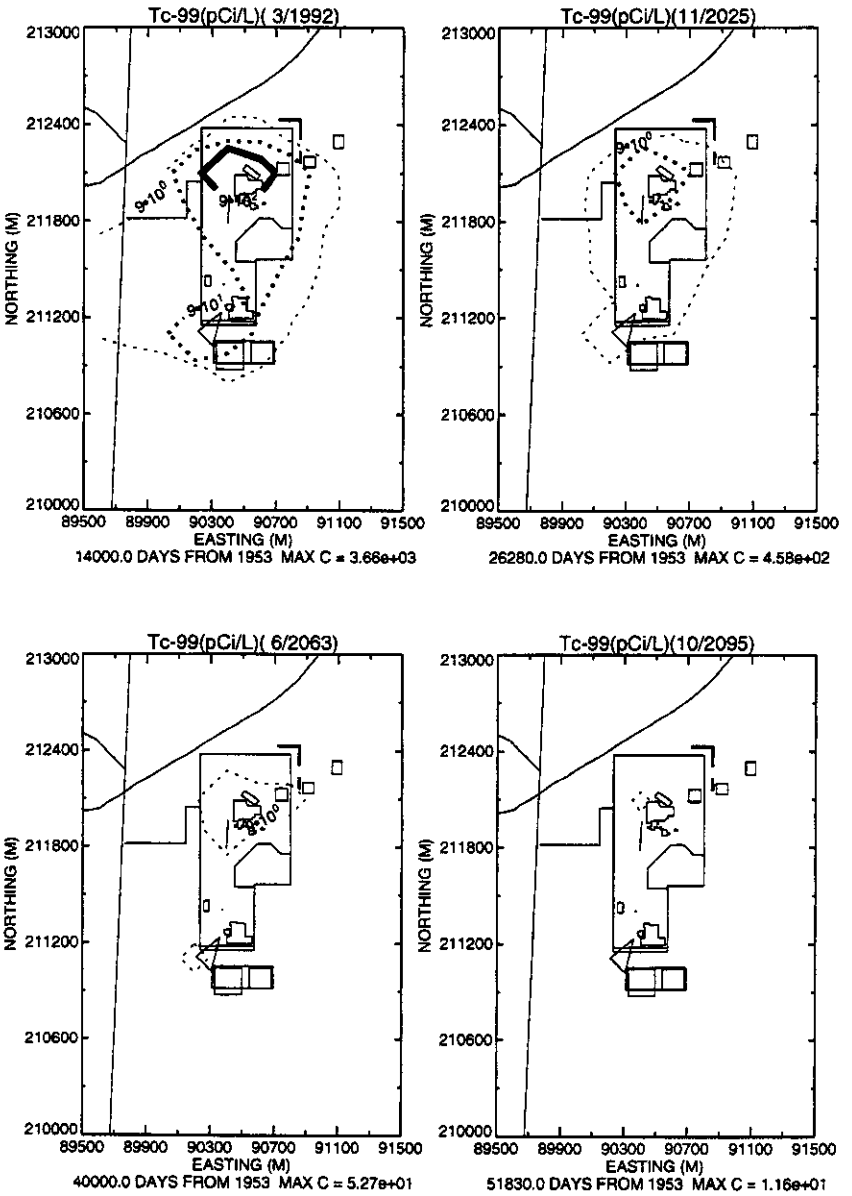


Figure 7-214 Vadose zone Tc-99 peak concentration contours.

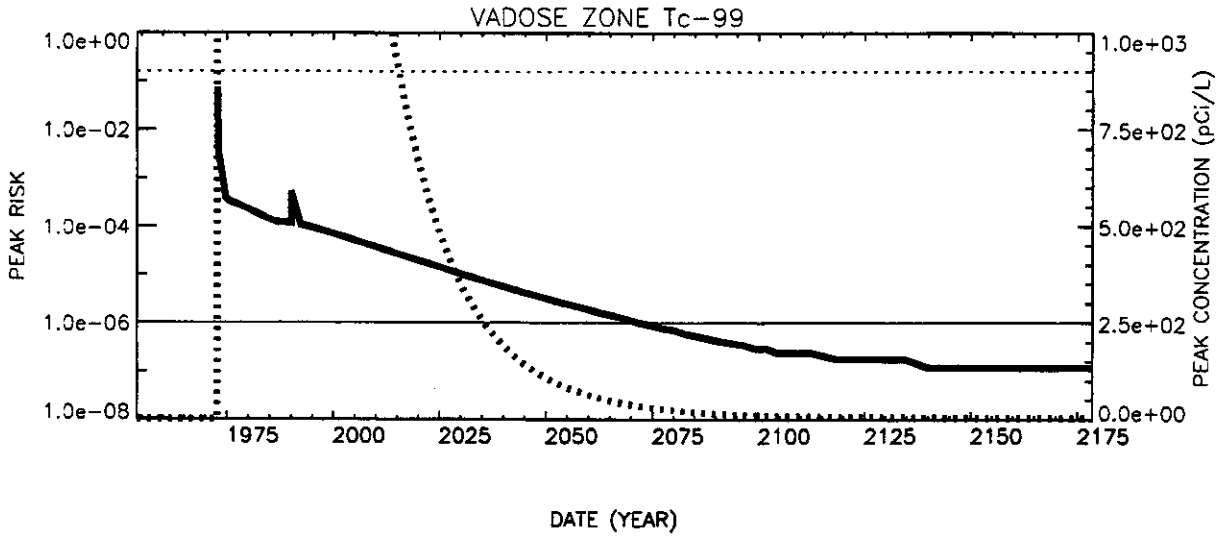


Figure 7-215 Peak vadose zone risk and concentration for Tc-99. Risk indicated by the thick line on the log scale with the 10^{-6} value shown as the solid line. The dotted line represents concentration given by the linear scale on the right axis with the MCL shown as the straight horizontal line.

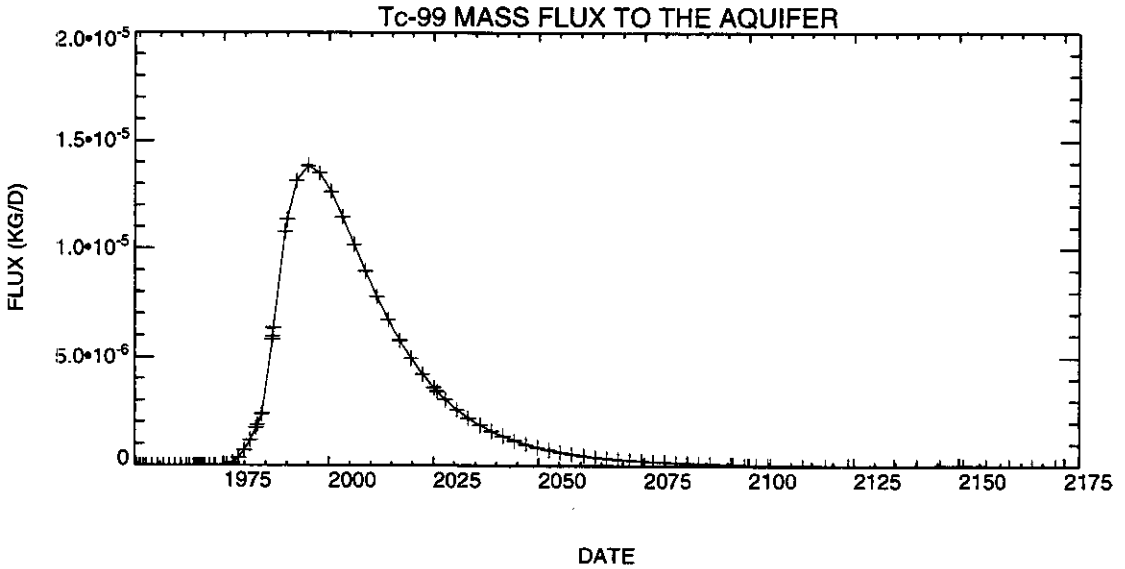


Figure 7-216 Mass flux of Tc-99 into the aquifer from the vadose zone.

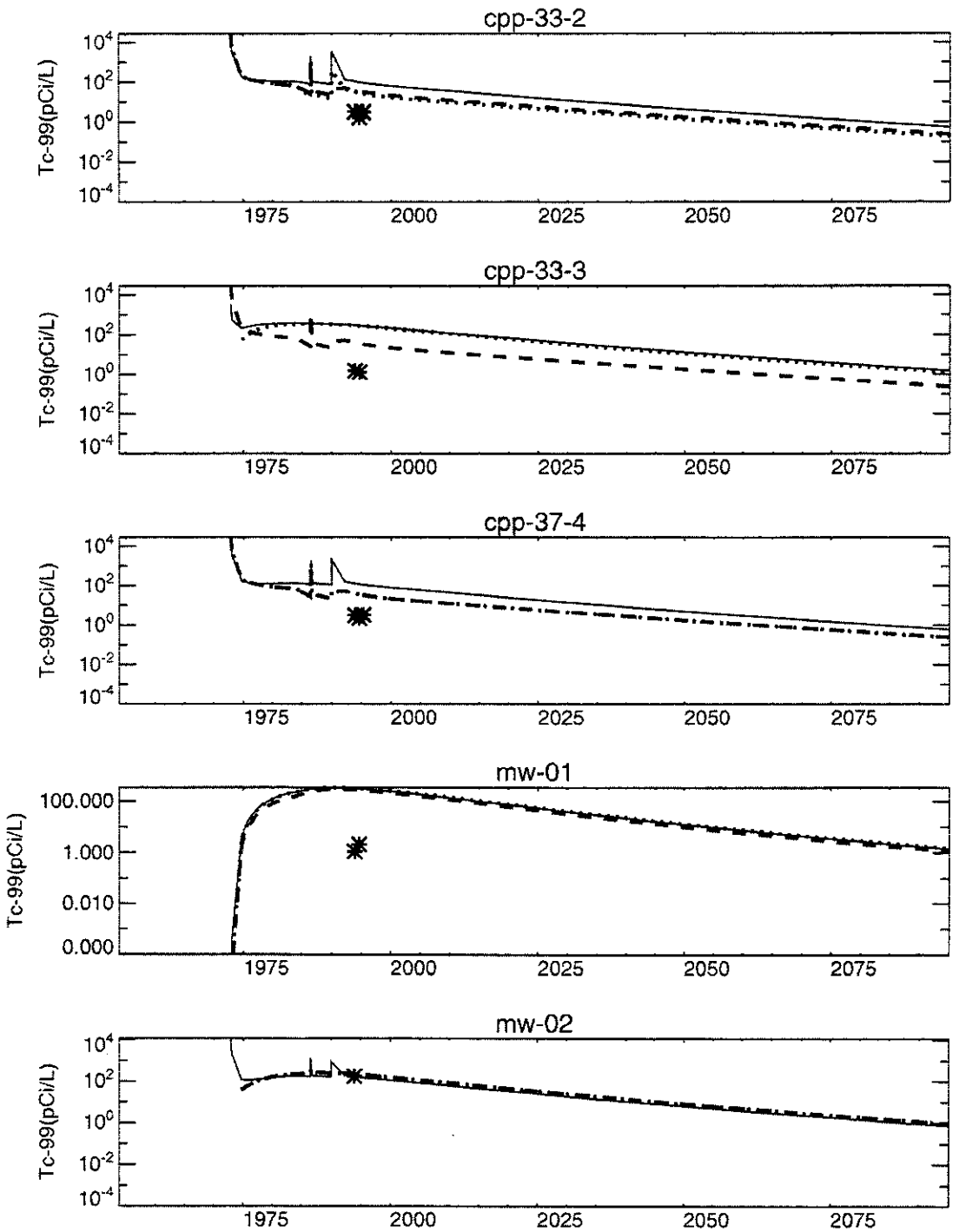


Figure 7-217 Comparison of vadose zone Tc-99 to field data.

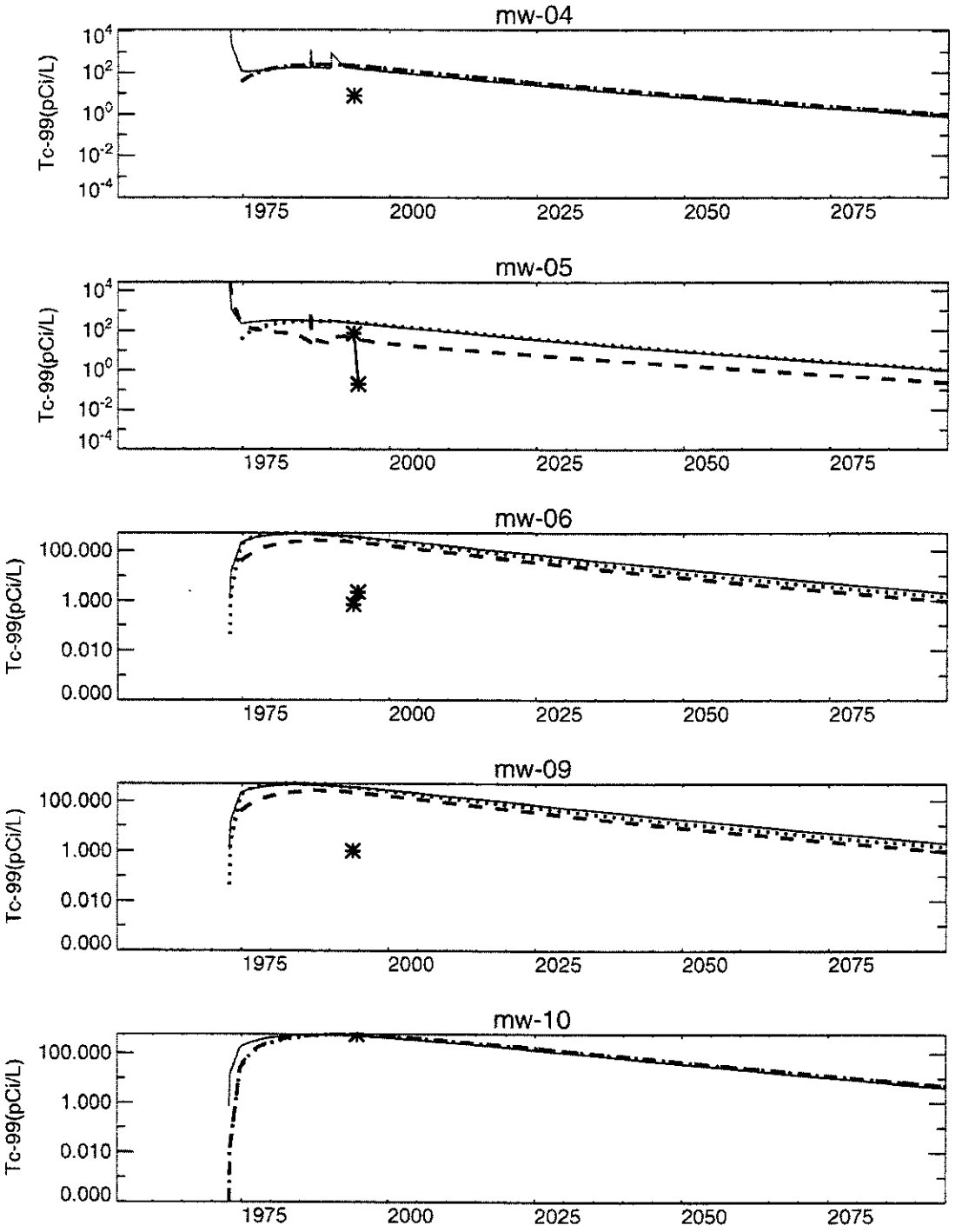


Figure 7-218 Comparison of vadose zone Tc-99 to field data.

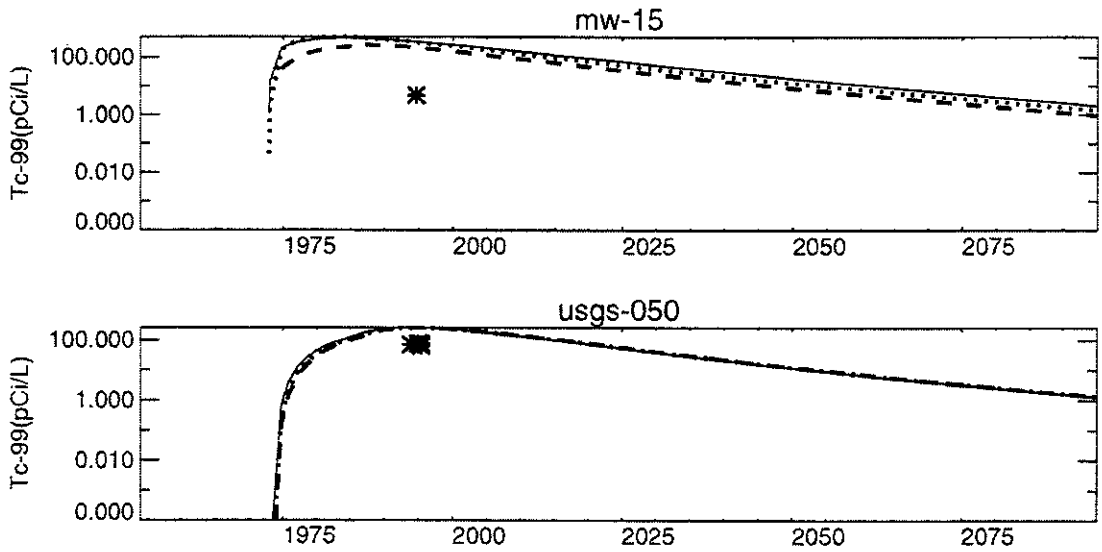


Figure 7-219 Comparison of vadose zone Tc-99 to field data.

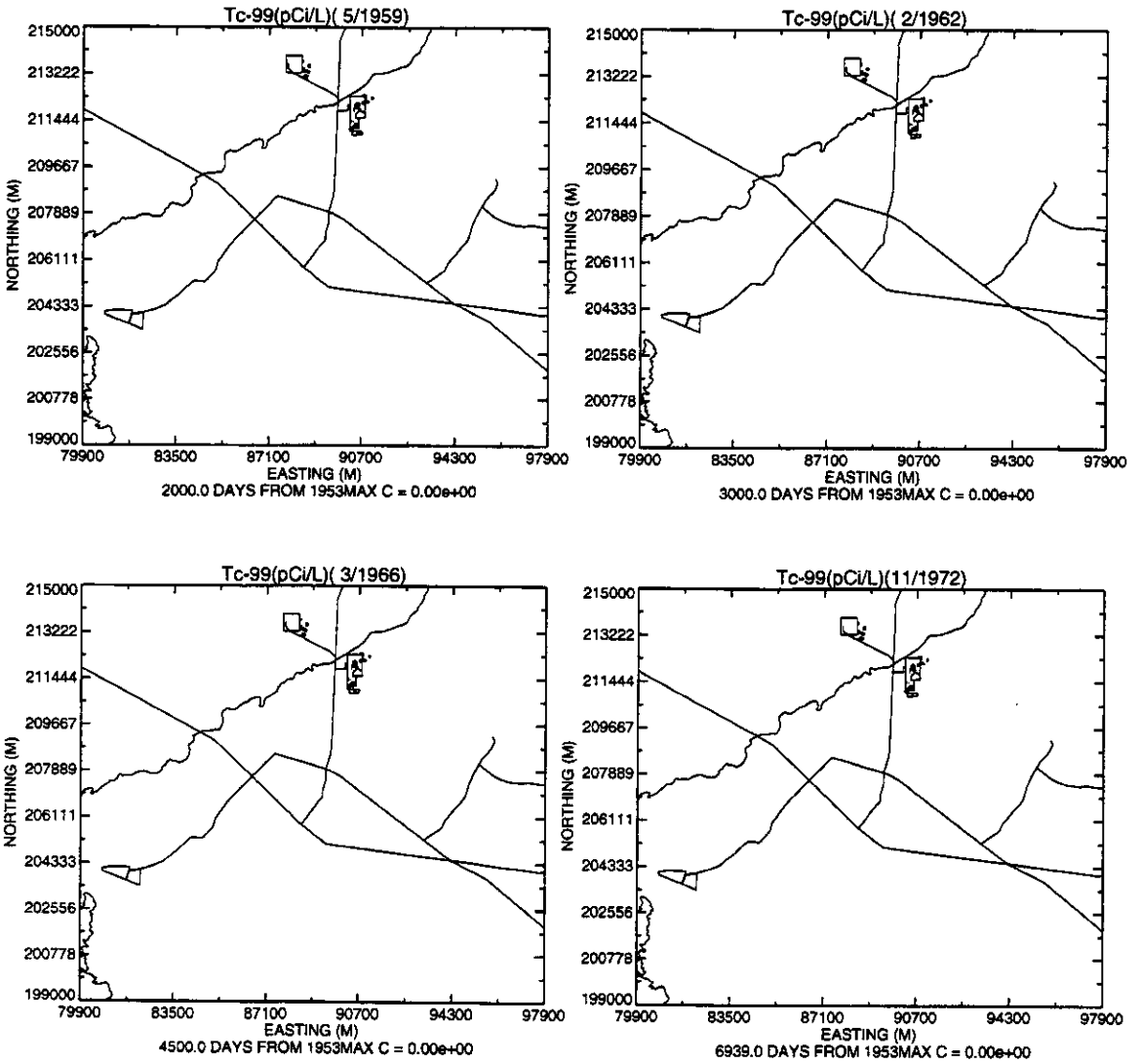


Figure 7-220 Aquifer Tc-99 peak concentration contours.

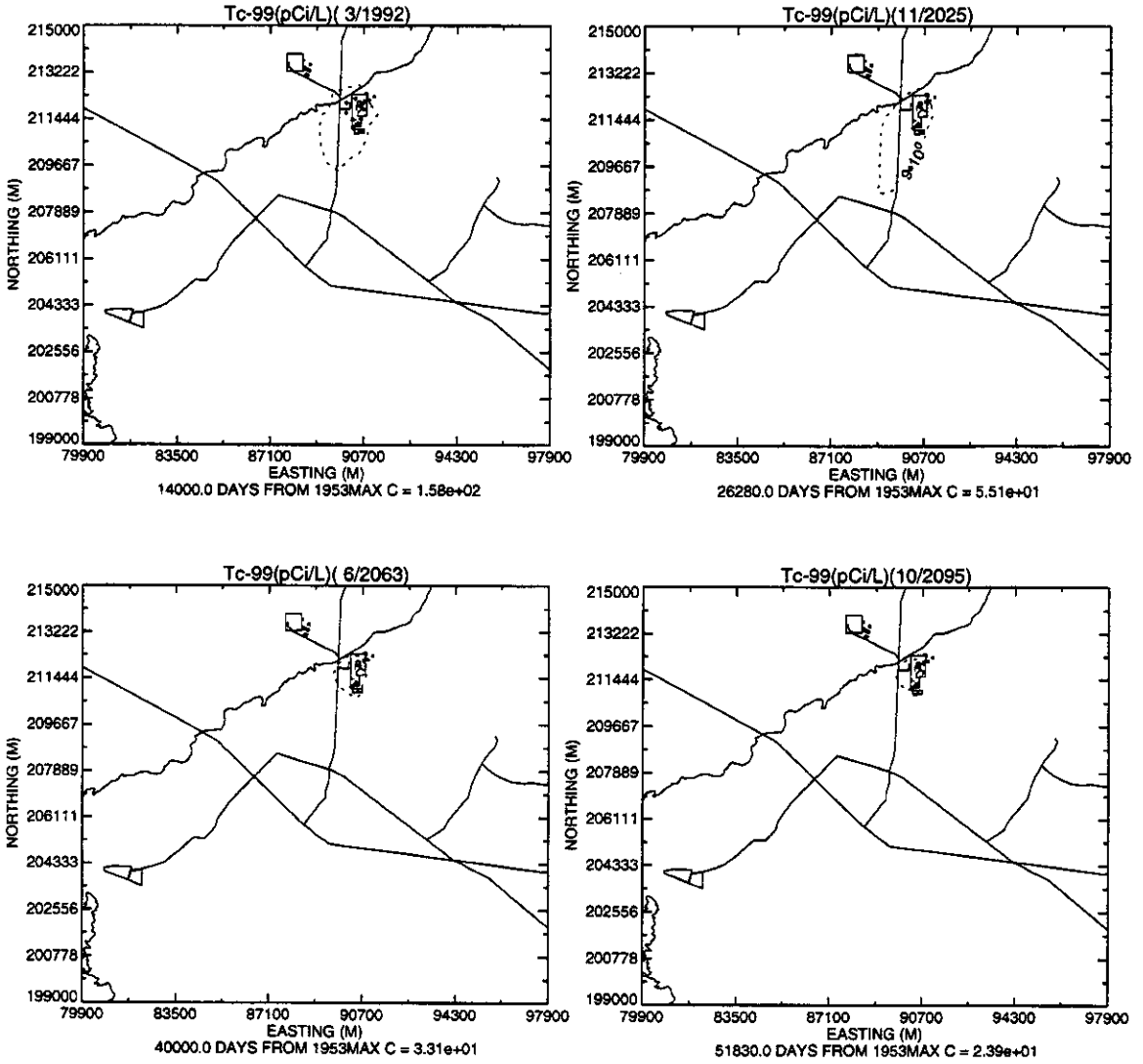


Figure 7-221 Aquifer Tc-99 peak concentration contours.

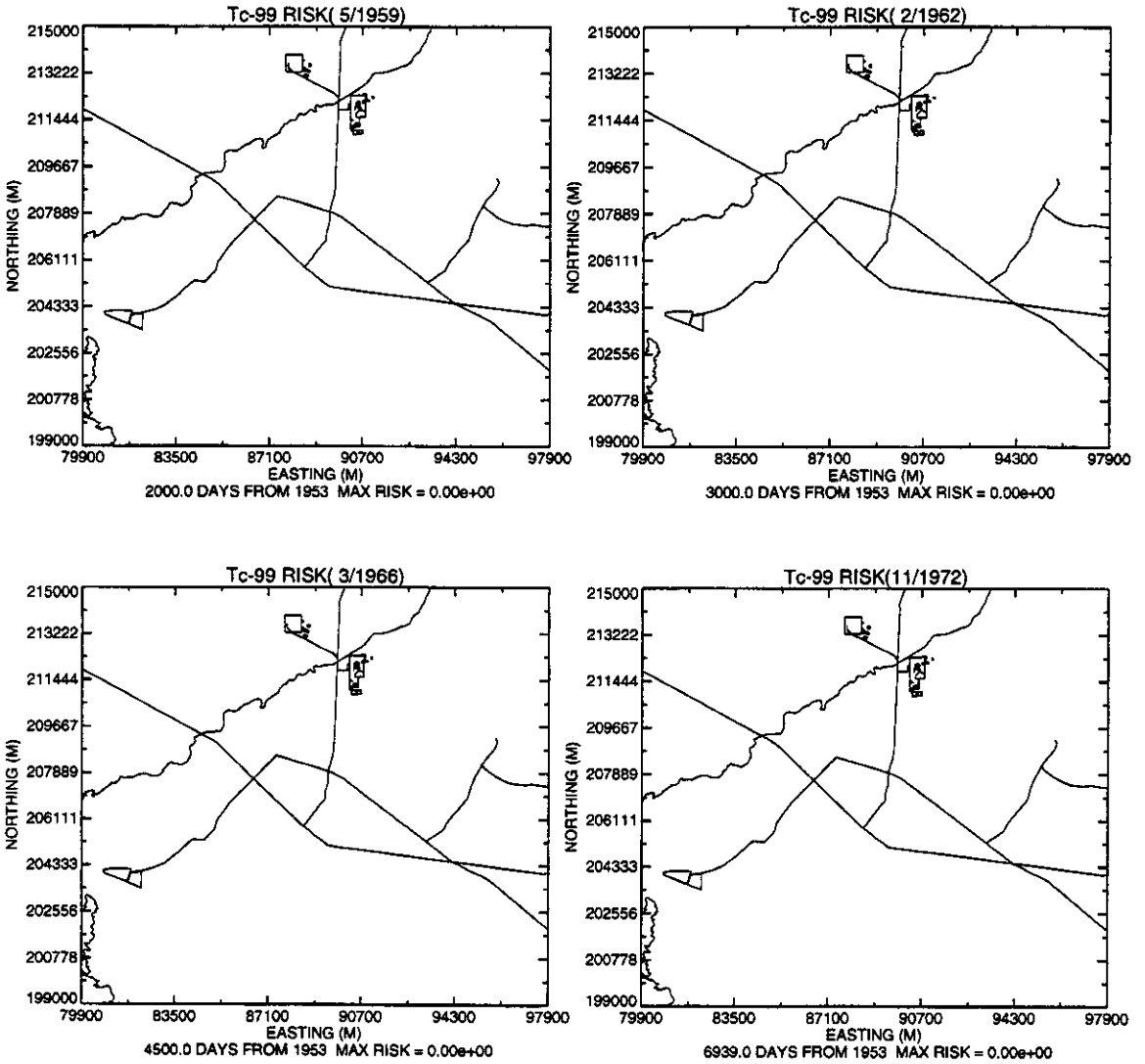


Figure 7-222 Aquifer Tc-99 peak risk contours.

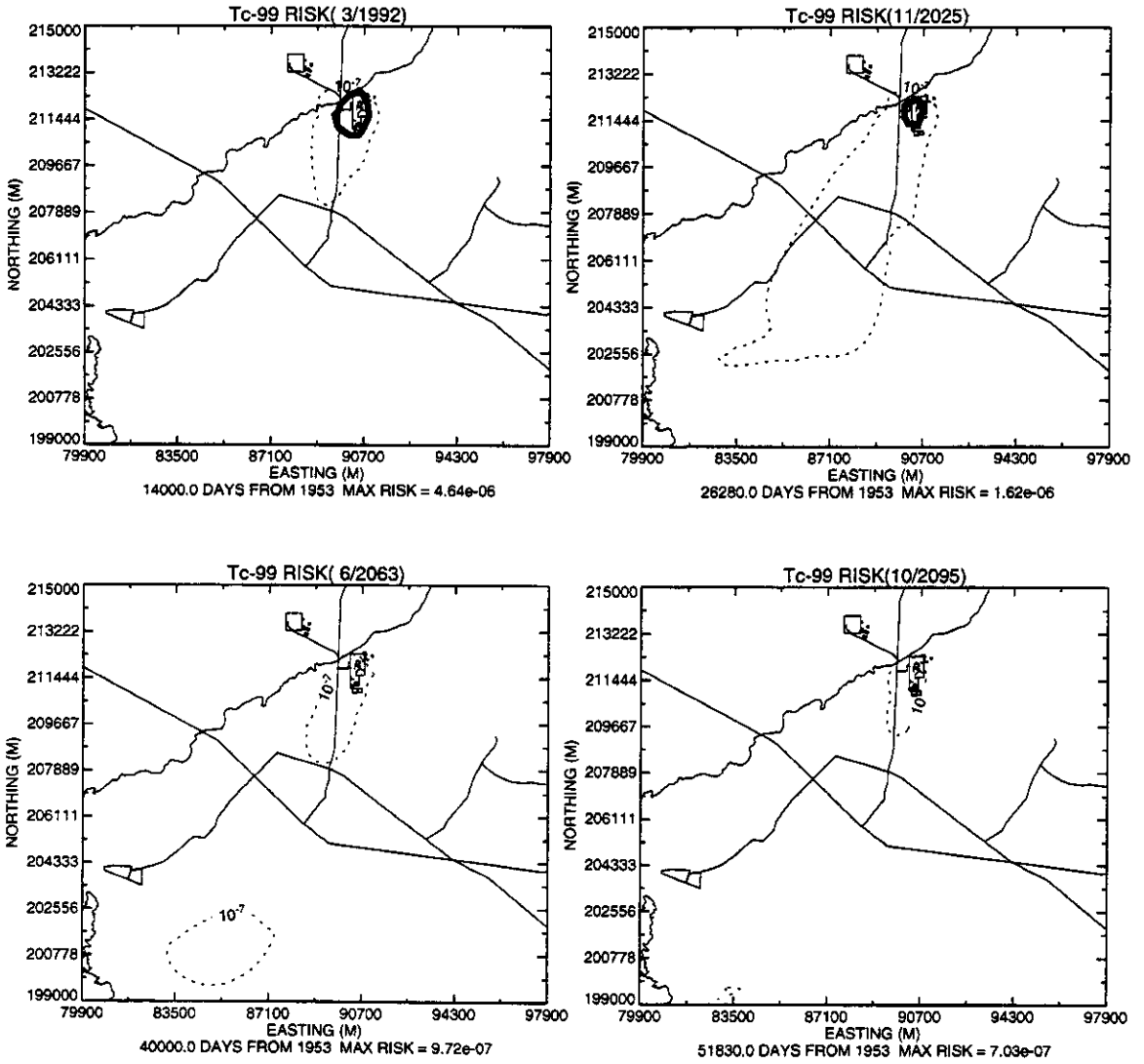


Figure 7-223 Aquifer Tc-99 peak risk contours.

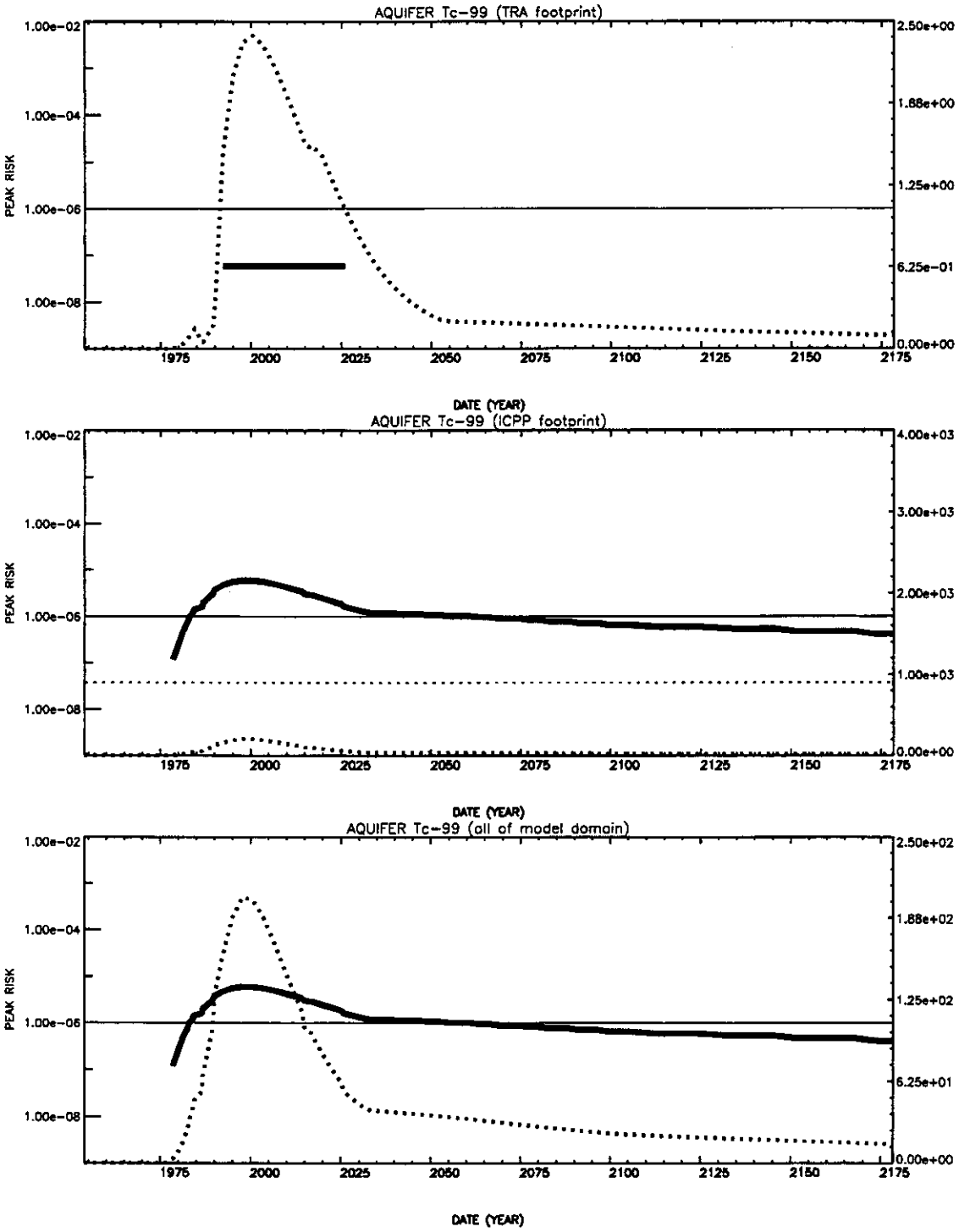


Figure 7-224 Peak aquifer concentration for Tc-99. Top figure: TRA foot print, Middle figure: ICPP footprint, Bottom Figure: entire aquifer domain. Thick line risk (left scale), dotted line concentration (right scale) solid line 10^{-6} risk (left scale).

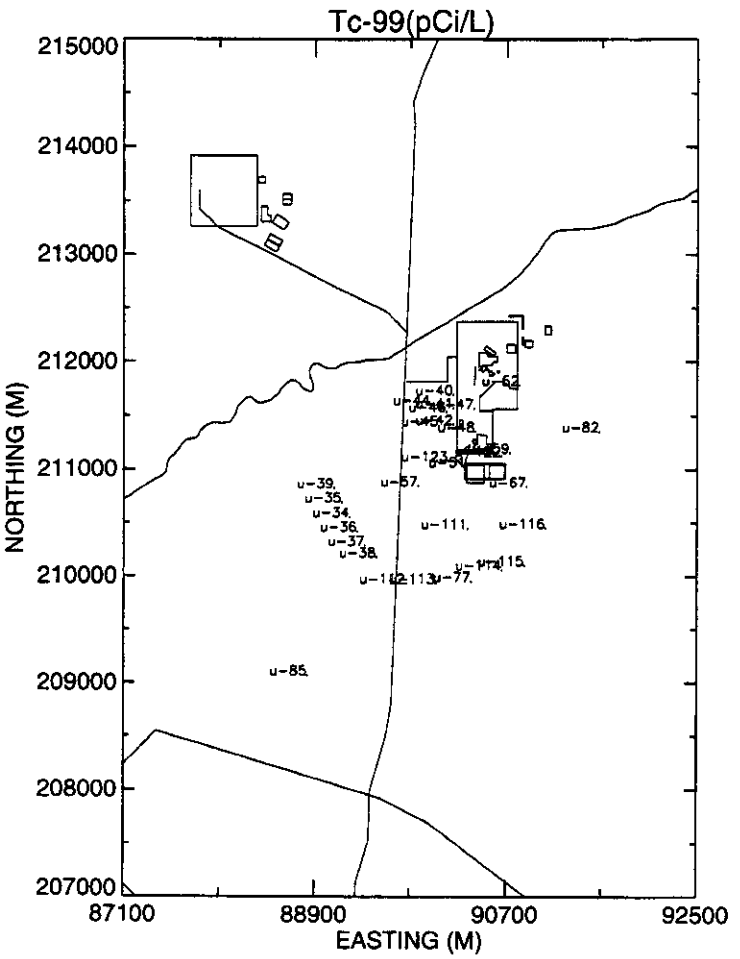


Figure 7-225 Well locations for the comparison of aquifer Tc-99 to field data.

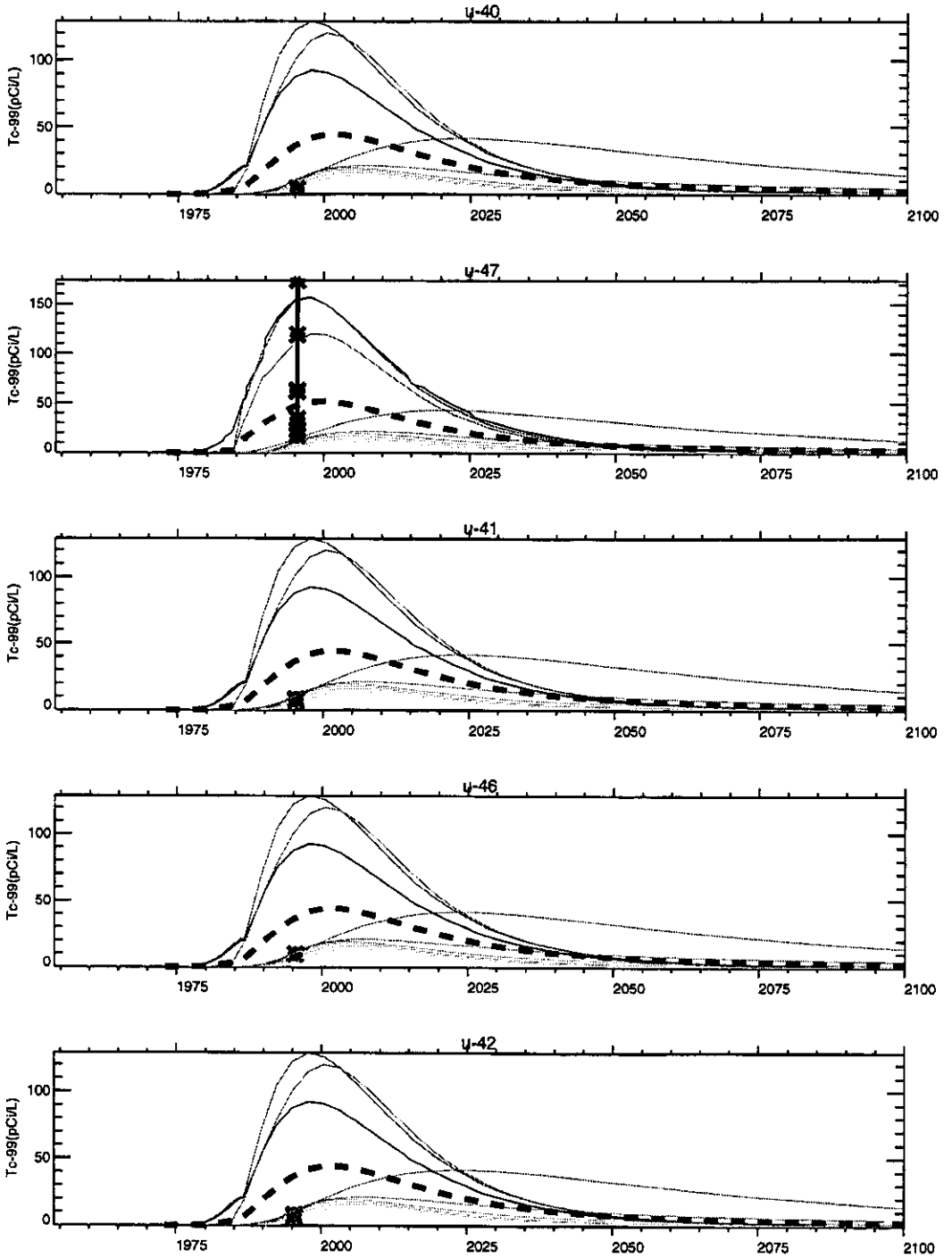


Figure 7-226 Comparison of aquifer Tc-99 to field data.

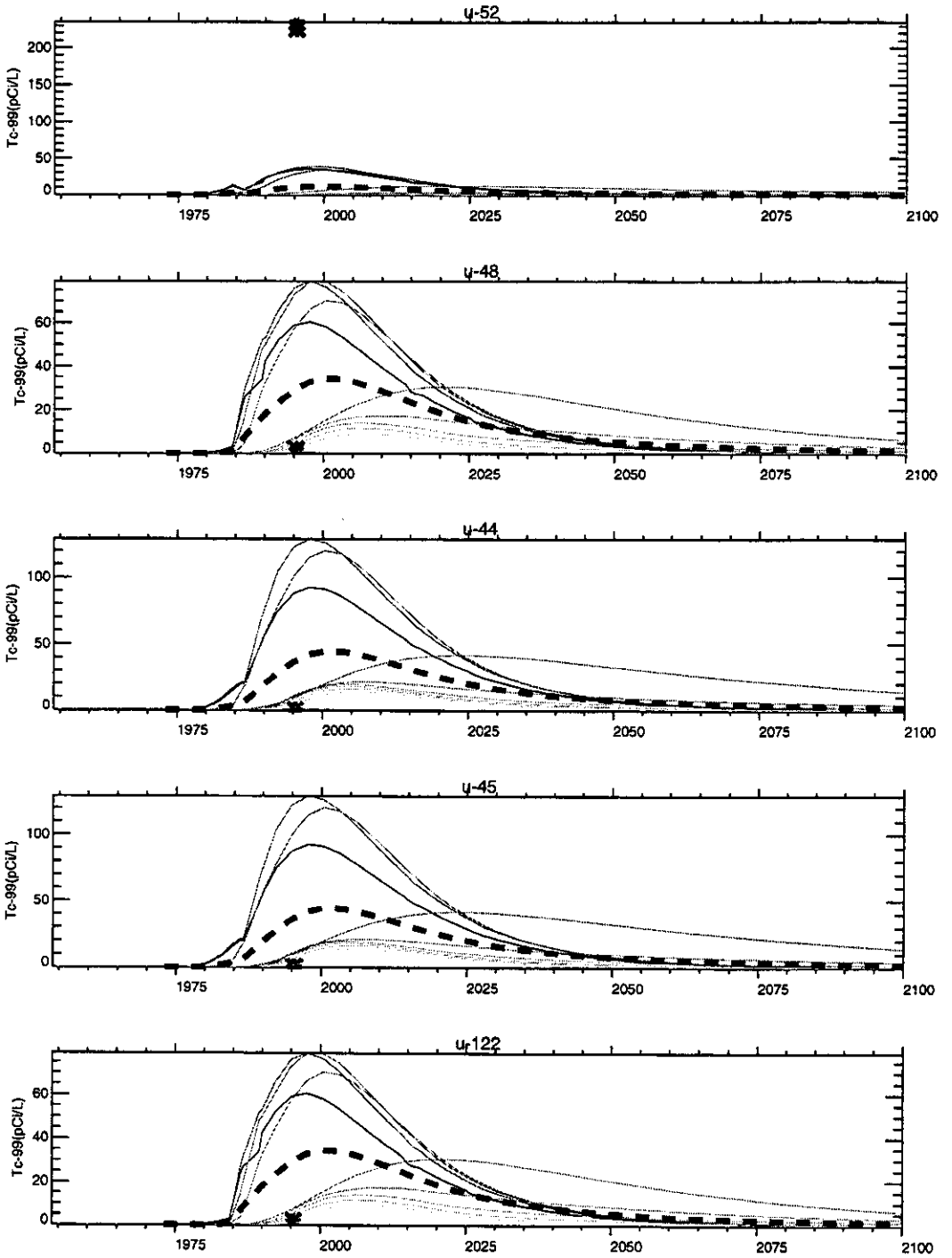


Figure 7-227 Comparison of aquifer Tc-99 to field data.

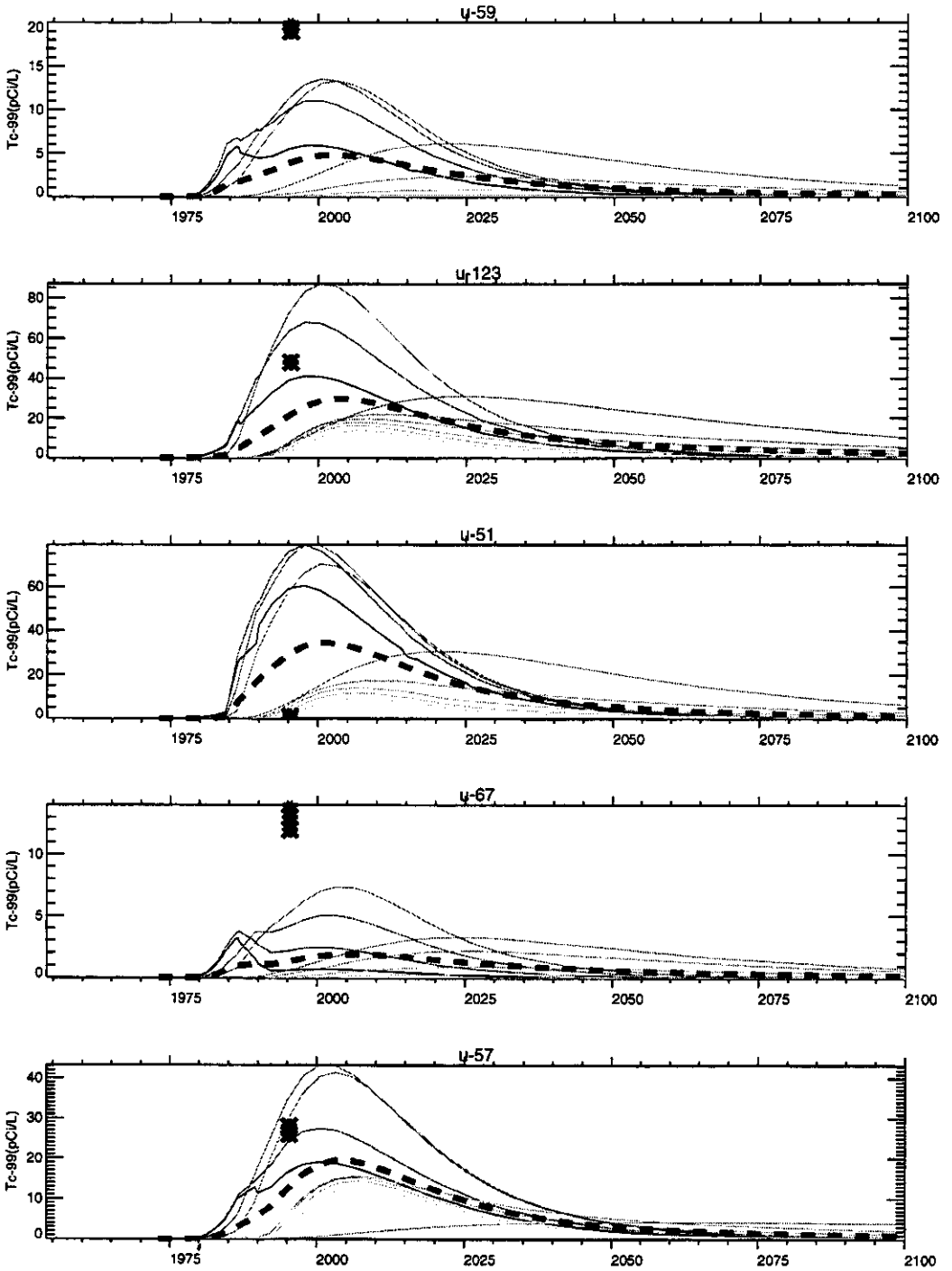


Figure 7-228 Comparison of aquifer Tc-99 to field data.

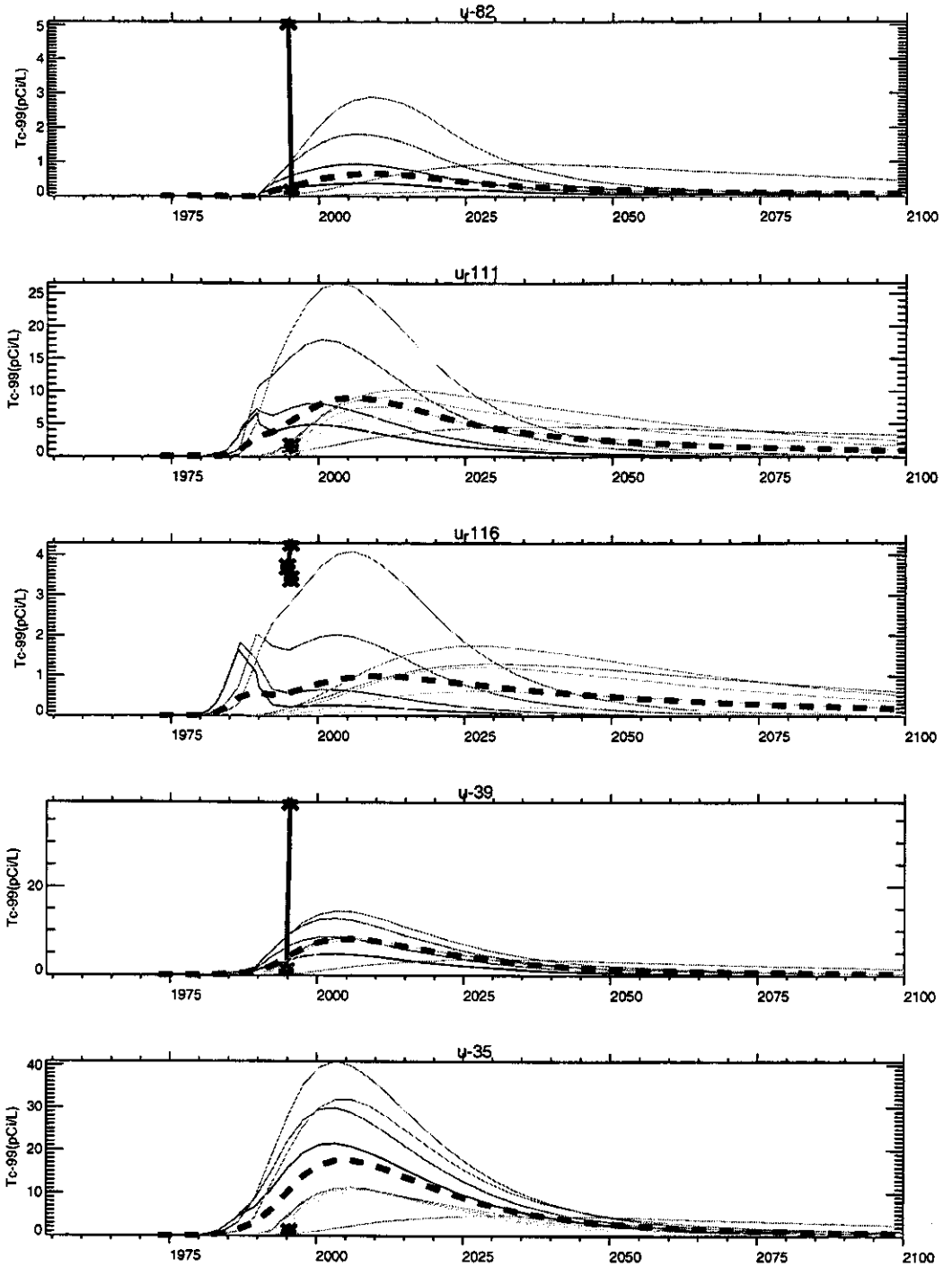


Figure 7-229 Comparison of aquifer Tc-99 to field data.

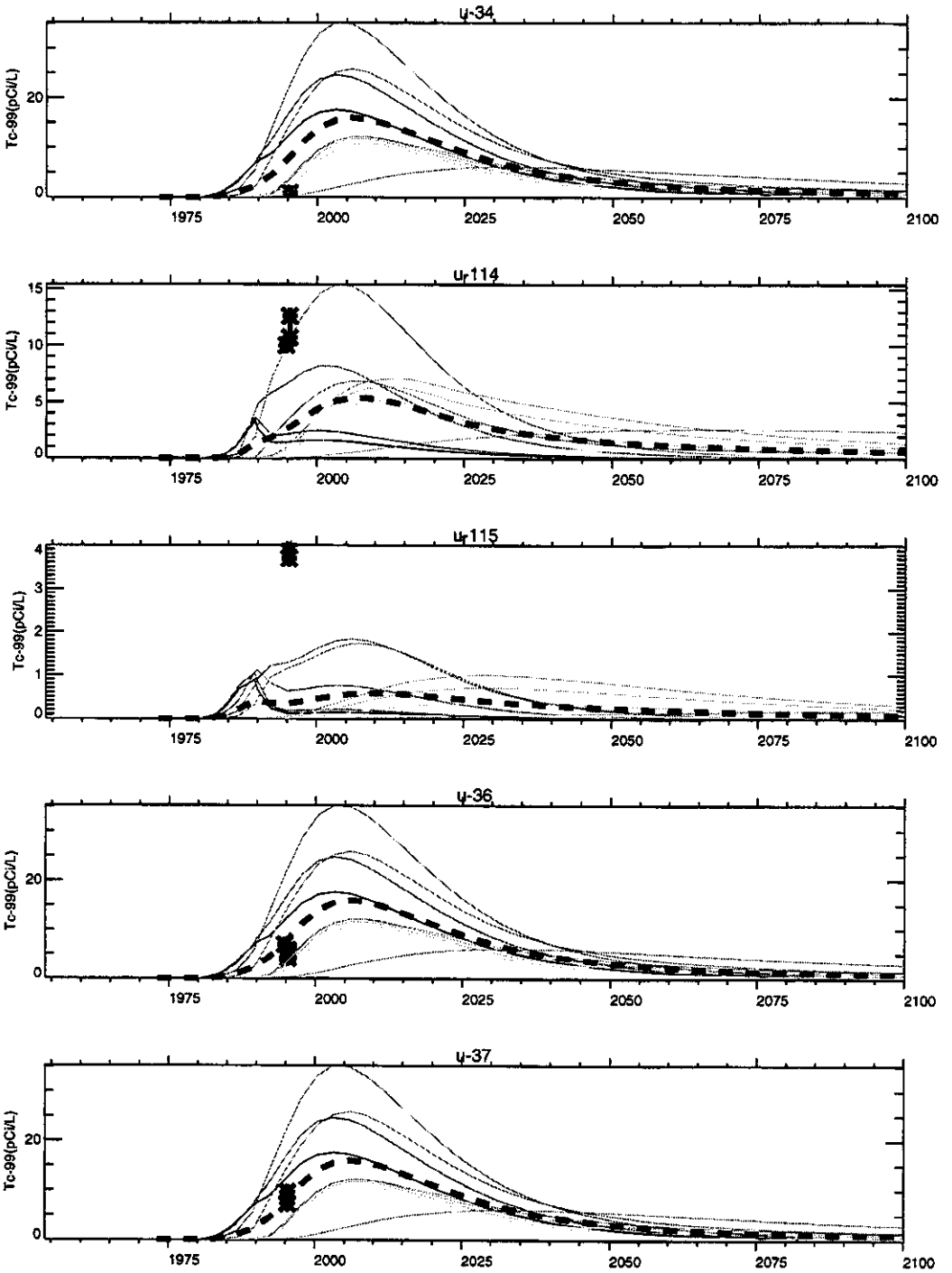


Figure 7-230 Comparison of aquifer Tc-99 to field data.

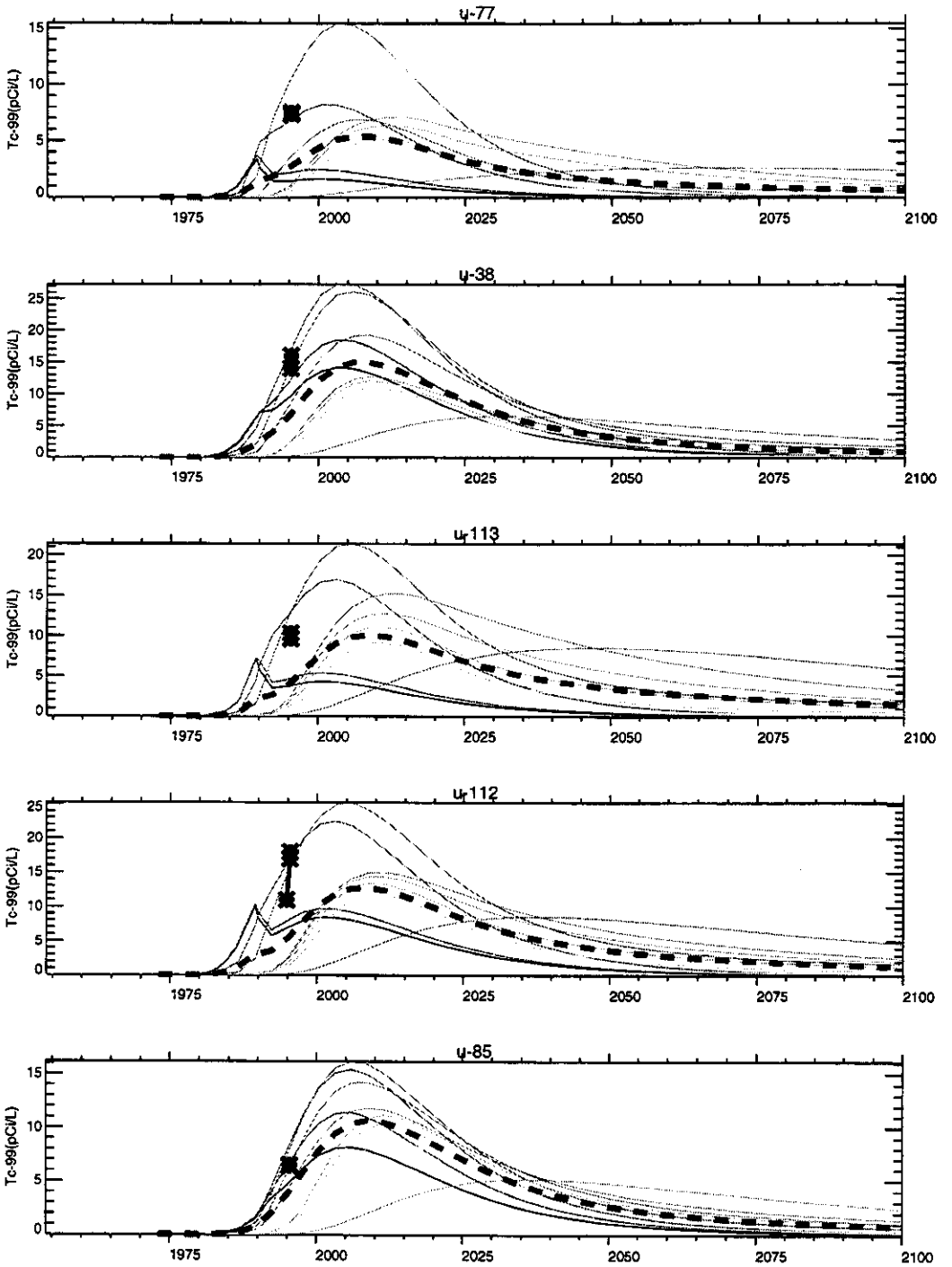


Figure 7-231 Comparison of aquifer Tc-99 to field data.

7.12 Total Uranium

Various uranium isotopes were found in the soils inventory (82.24%) and were discharged to the injection well (14.24%) and percolation ponds (3.11%), as well as being a part of the CPP-31 (0.39%) and CPP-28 (0.02%) releases. Although there are different isotopes of uranium, a single simulation for the Total U mass was run. Resultant concentrations and risk were calculated assuming that the Total U mass distribution is $6x10^{-3}$% U-234, 0.6% U-235, $1.5x10^{-2}$% U-236, and 99.38% U-238, as explained in Section 6.2.2. This corresponds to an activity distribution of 51.2% U-234, 1.8% U-235, 1.3% U-236, and 45.7% U-238. The uranium MCL is based on the chemical toxicity (0.02 mg/L) rather than the radiological risk. Therefore, the total uranium results are primarily presented and discussed in terms of the mass concentration rather than the activity concentration. Based on the activity distribution defined above, the MCL of 0.02 mg/L corresponds to an activity distribution of approximately 14 pCi/L. The 10^{-6} risk concentration is approximately 1 pCi/L and the U concentration corresponding to a HQ=1 is 0.11 mg/L which equates to an activity of 77 pCi/L. In the following simulations, the Total U half life was chosen to be conservative at greater than 10^9 years (corresponding to U-238), which allows the surface uranium sources to move through the vadose zone into the aquifer as shown in Figures 7-232 through 7-237. Transport through the aquifer is given in Figures 7-238 through 7-243. Concentration contours for both sets of simulations are given in Figures 7-232 through 7-235, 7-238, and 7-239 where the $2.0x10^{-4}$, $2.0x10^{-3}$, $2.0x10^{-2}$, $2.0x10^{-1}$, 2.0, and $2.0x10^{+1}$ mg/L are presented. The corresponding hazard index maps for the aquifer are given in Figures 7-240, and 7-241 where the 10^{-2}, 10^{-1}, 1, 10^{+1}, 10^{+2}, and 10^{+3} levels are represented. In those figures, the dark solid line corresponds to the HQ=1 level (0.11 mg/L).

VADOSE ZONE: Figure 7-237 shows that the mass flux of Total U to the aquifer from the vadose zone peaks in 2435, with only 1% of the mass leaving the vadose zone by 2095, and only 53.5% by 2939 when the simulation was stopped. Figure 7-236 shows that the peak concentrations decrease very slowly up through year 2200, and are essentially steady state through year 2900. The concentration does not fall below the MCL (0.02 mg/L) by that time but it does fall below the HQ=1 based concentration of 0.11 mg/L after the year 2370. The simulation was terminated because the mass flux to the aquifer had dropped significantly below the peak value.

AQUIFER: The predicted maximum aquifer concentrations are below the MCL and HQ=1 based concentrations for the entire simulation time. There are two early peaks in the aquifer concentration resulting from the disposal of uranium in the injection well. Of these, the maximum concentration was $1.38x10^{-2}$ mg/L in 1986. In addition, there is a late aquifer peak concentration of $9.99x10^{-3}$ from the vadose zone flux of the surface sources (Figure 7-237). The later aquifer peak concentration is predicted to occur in the year 2475 as shown in Figure 7-243. The concentration in 2475 is much higher than the concentration predicted for year 2095. This is a result of the delayed mass arrival from the vadose zone. In 2095, the predicted maximum Total U aquifer concentration is $1.3x10^{-3}$ mg/L which is below the HQ=1 based concentration (0.11 mg//L) and the MCL (0.02 mg/L). The maximum concentration remains below these limits throughout the simulation time period.

As summarized in Section 10.5, the reestimated CPP-31 inventory indicates that the uranium isotopes are overestimated by about a factor of 10 (Table 10-7) for CPP-31 and 6 (Table 10-9) for the tank farm. As explained in Section 10.3.3, the chemical toxicity of uranium dominates the radiological toxicity so that the primary risk drivers are the primary mass contributors (U-235 and U-238). U-234 and U-236 are minimal mass contributors and therefore negligible risk contributors. Decay ingrowth of U-234 provides a minimal uranium contribution based on the results shown in Table 10-8. Because the uranium toxicity is dominated by the chemical toxicity (not radiological toxicity), and the U-234 is a small fraction of the Total U mass, the ingrowth of U-234 has a negligible influence on the simulation results. The predicted long term Total U concentrations would decrease by approximately a factor of 6. The Total U simulation results appear to be conservative based on the assumptions of this uncertainty section.

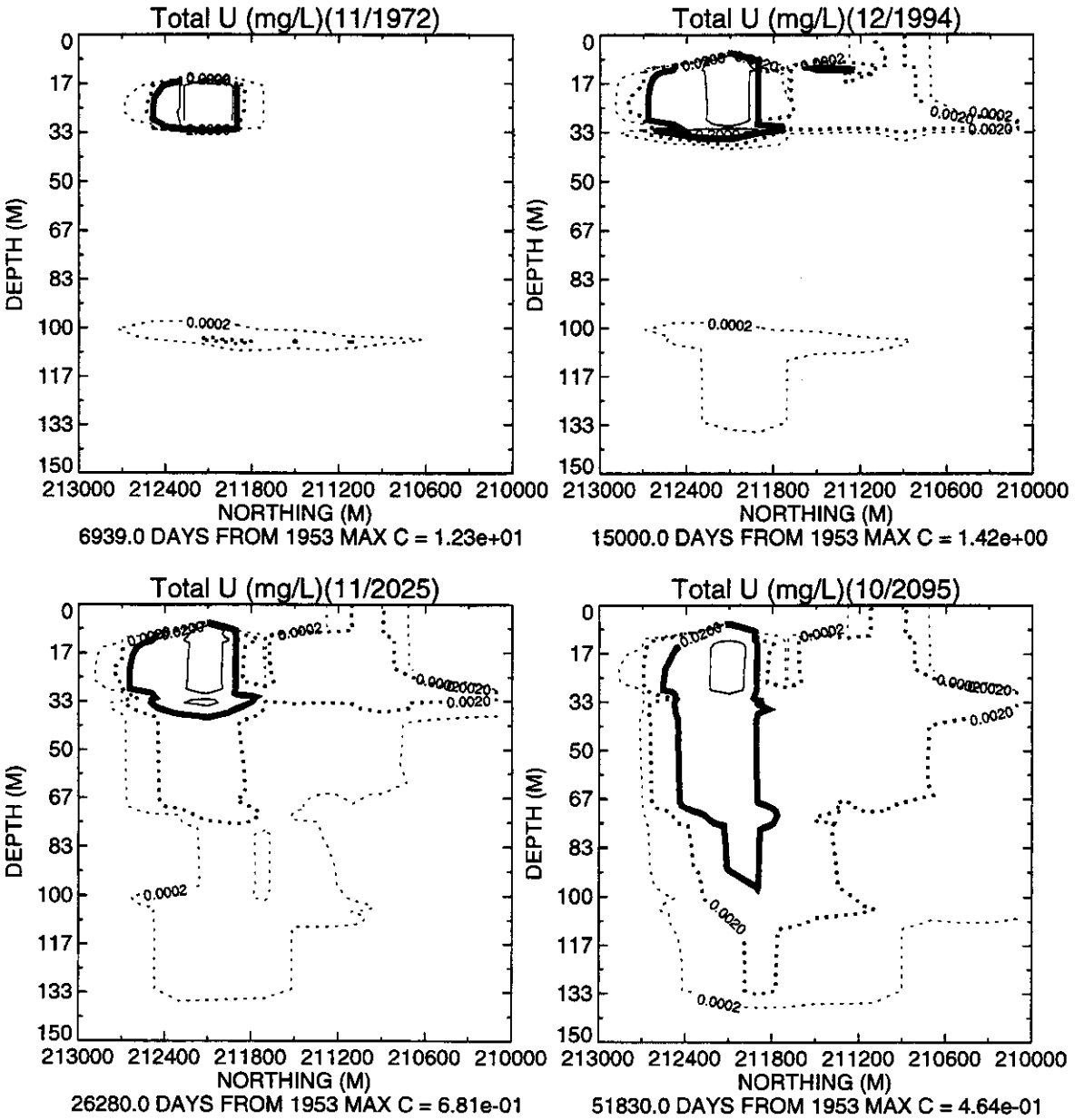


Figure 7-232 Vadose zone Uranium peak concentration contours.

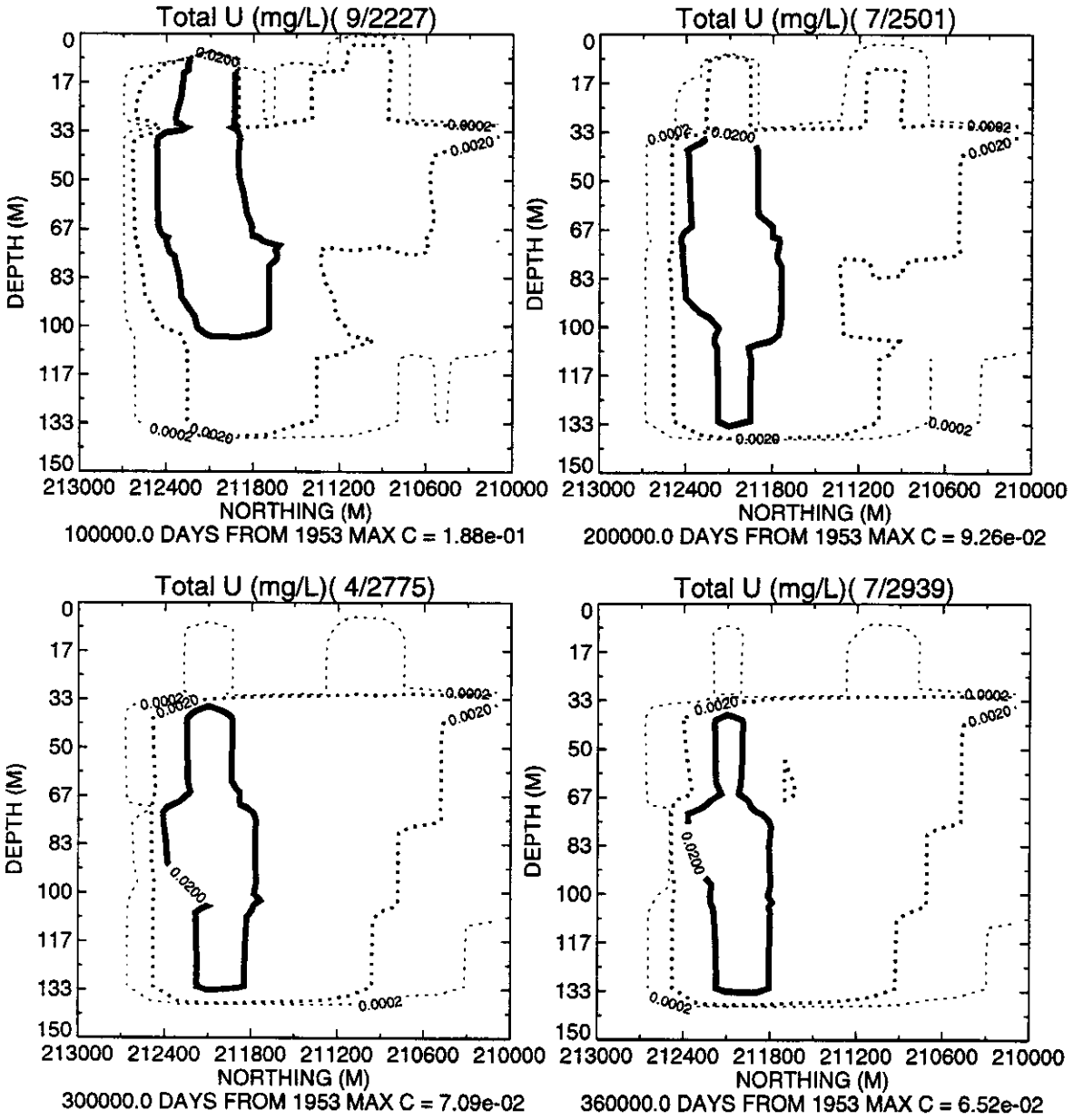


Figure 7-233 Vadose zone Uranium peak concentration contours.

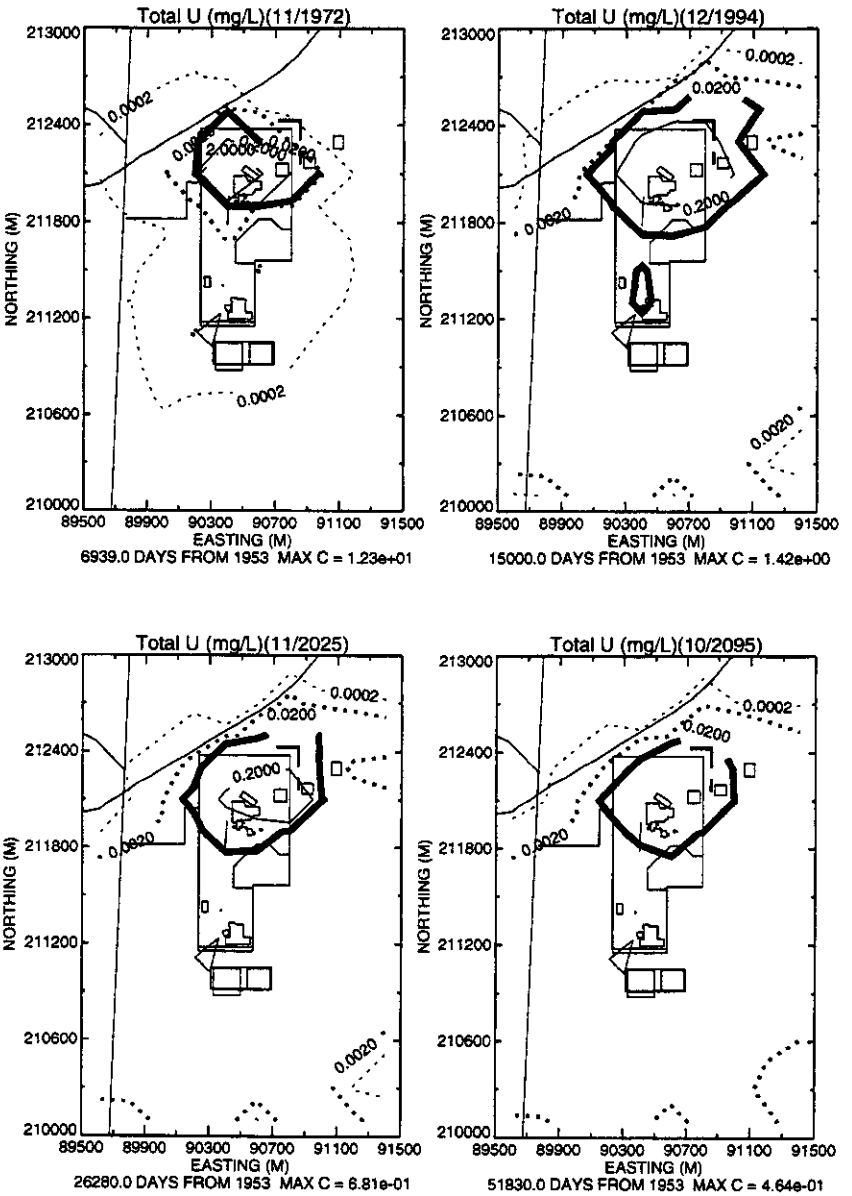


Figure 7-234 Vadose zone Uranium peak concentration contours.

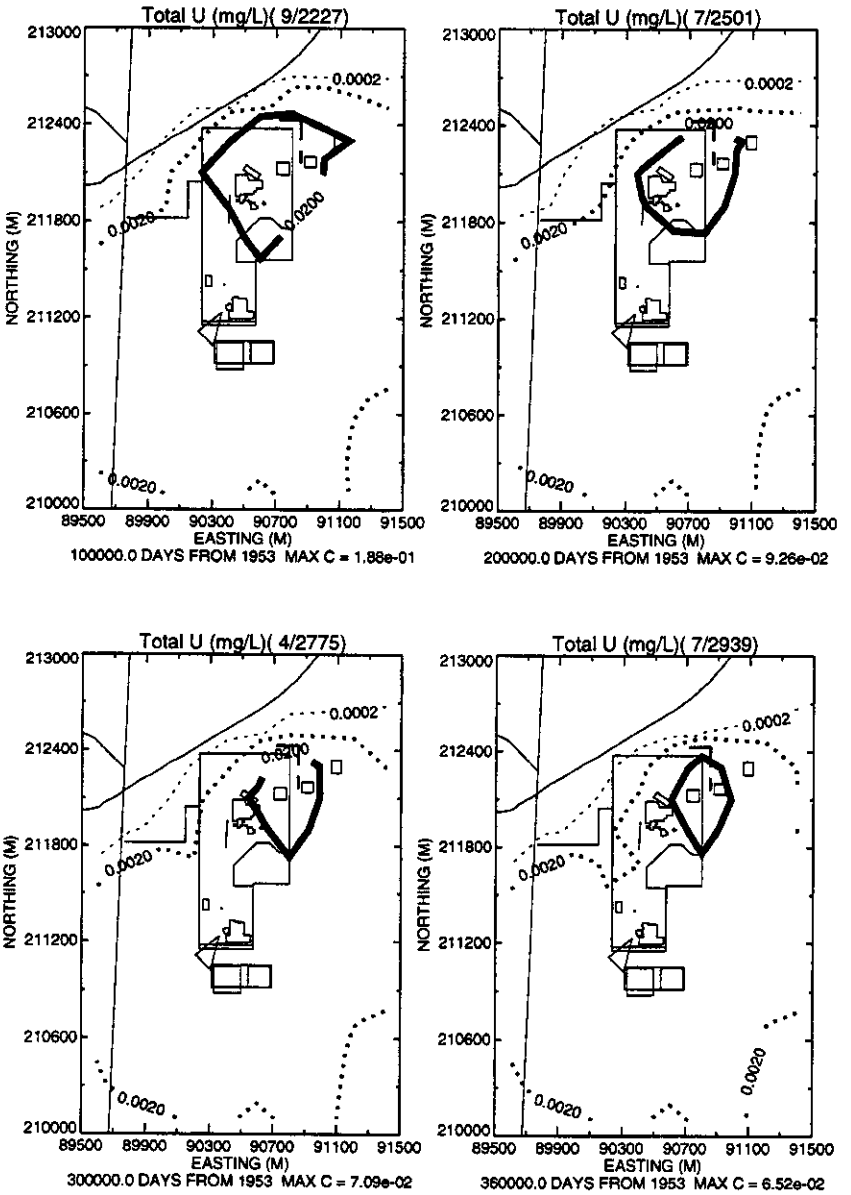


Figure 7-235 Vadose zone Uranium peak concentration contours.

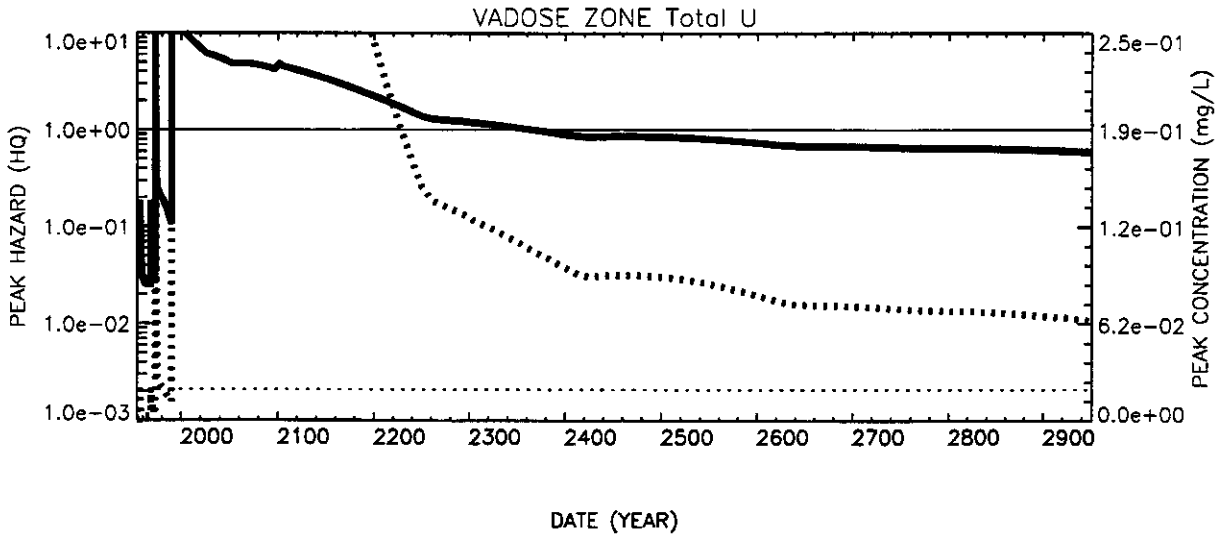


Figure 7-236 Peak vadose HQ and concentration for Uranium. HQ indicated by the thick line on the log scale with the HQ=1 value shown as the solid line. The dotted line represents concentration given by the linear scale on the right axis with the MCL shown as the straight horizontal line.

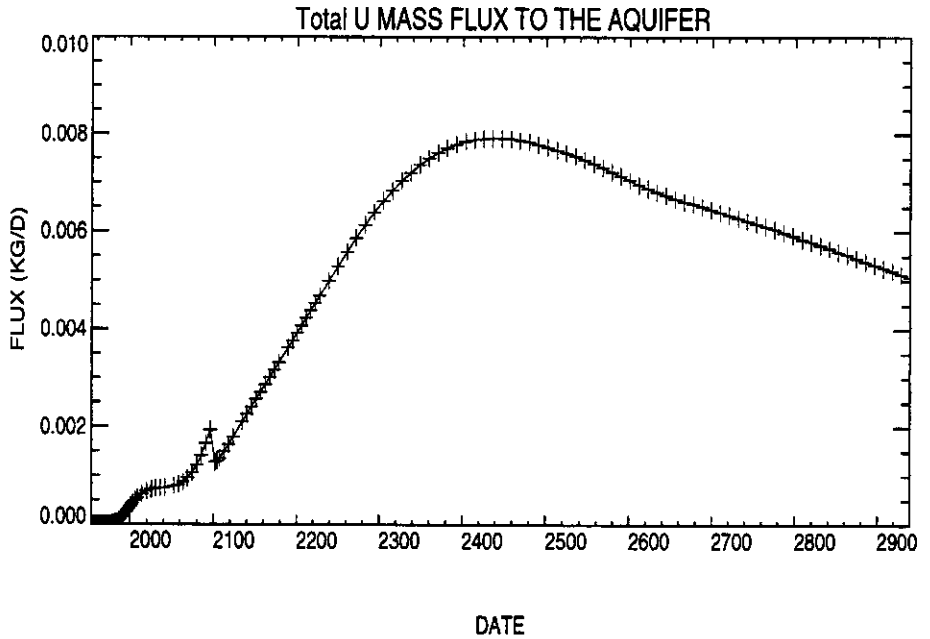


Figure 7-237 Mass flux of Uranium into the aquifer from the vadose zone.

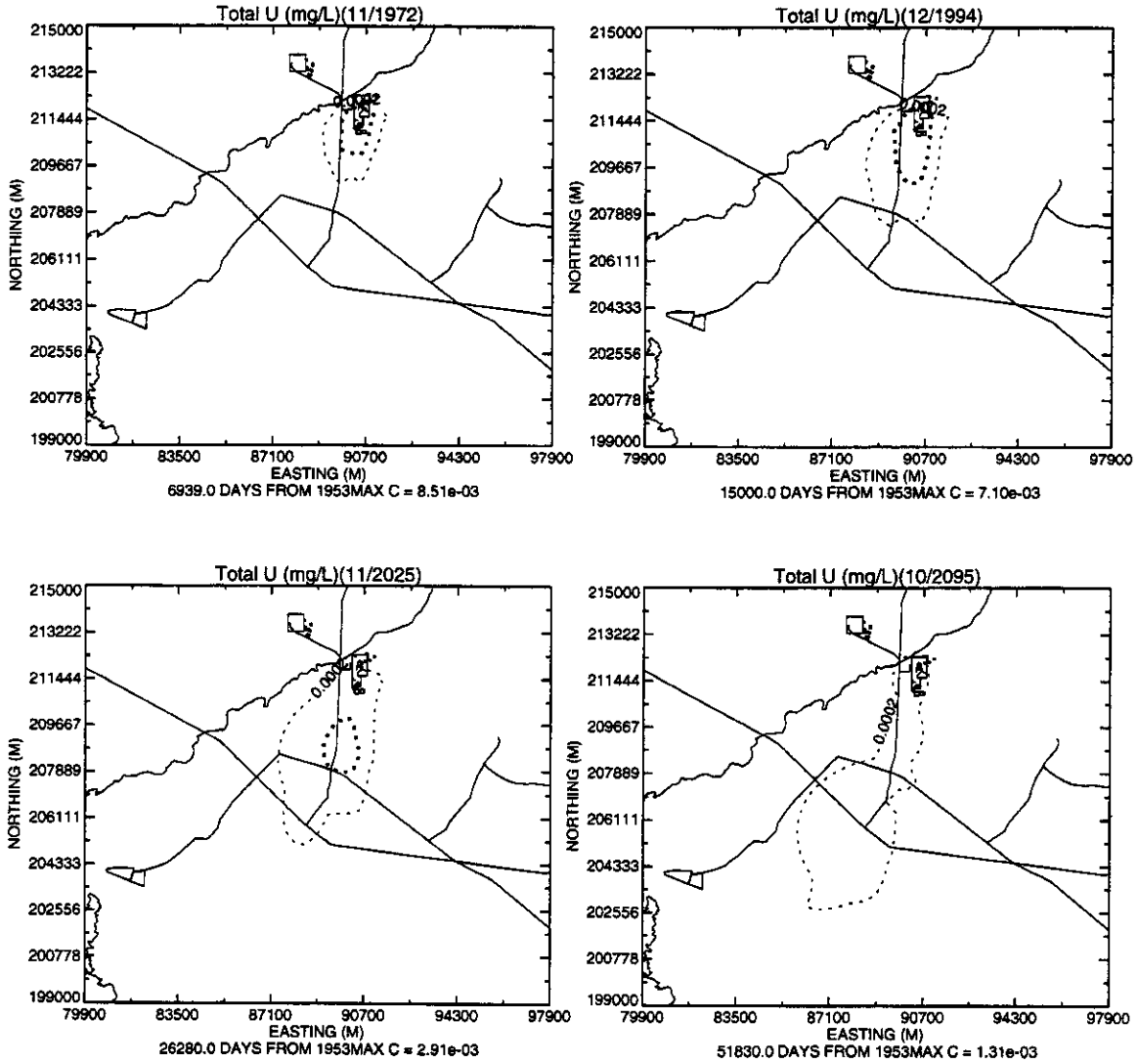


Figure 7-238 Aquifer Uranium peak concentration contours.

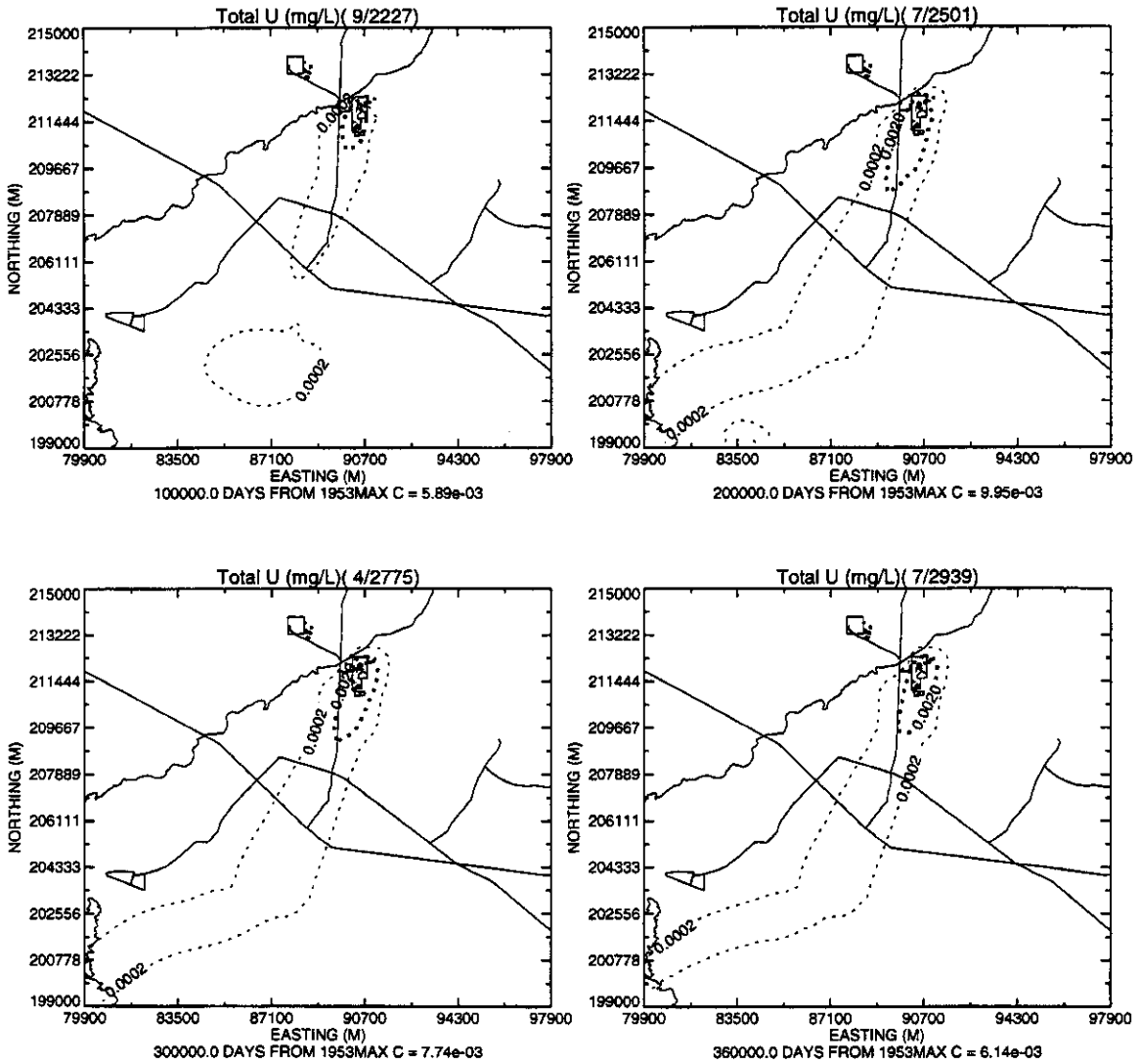


Figure 7-239 Aquifer Uranium peak concentration contours.

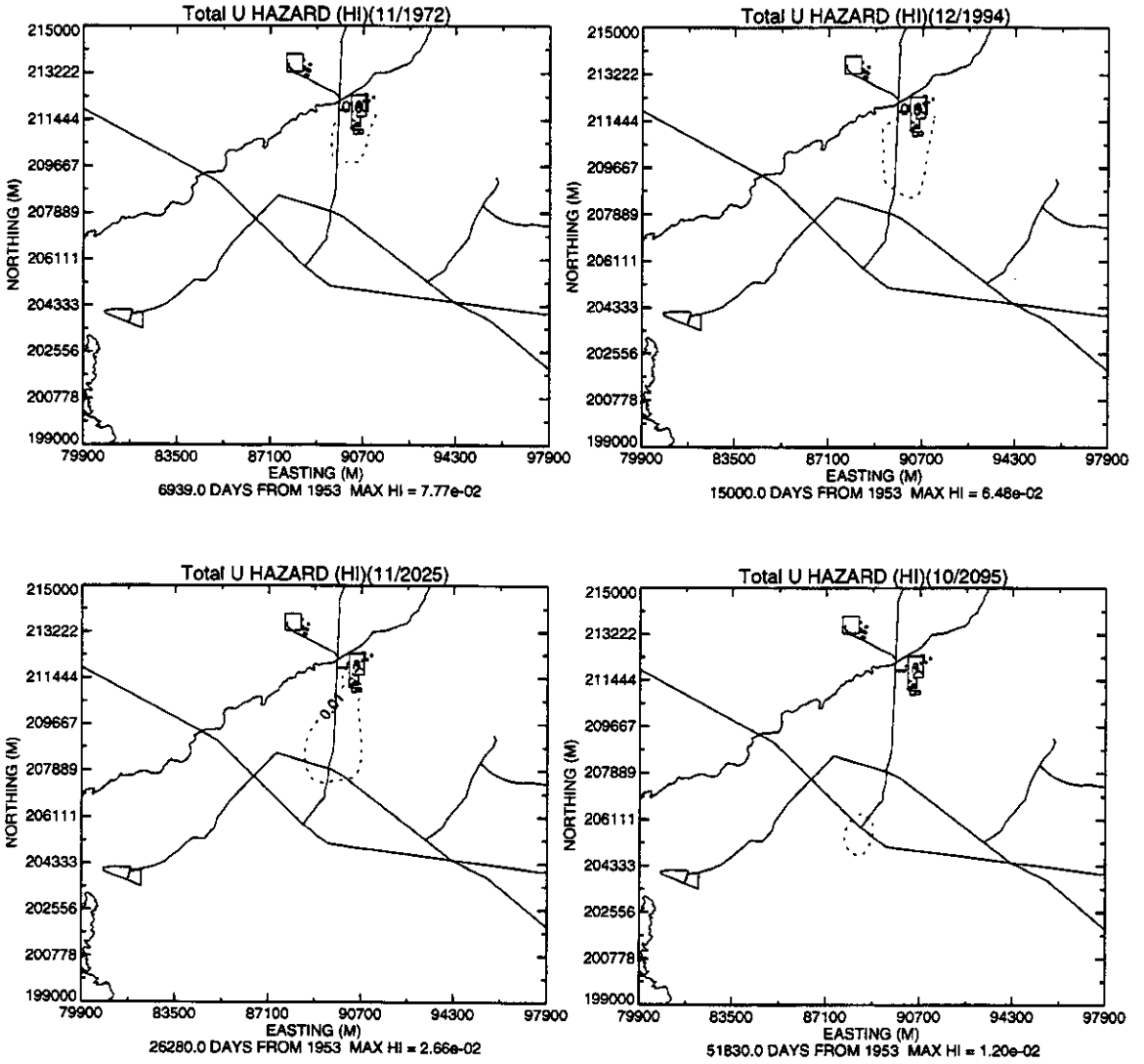


Figure 7-240 Aquifer Uranium peak risk contours.

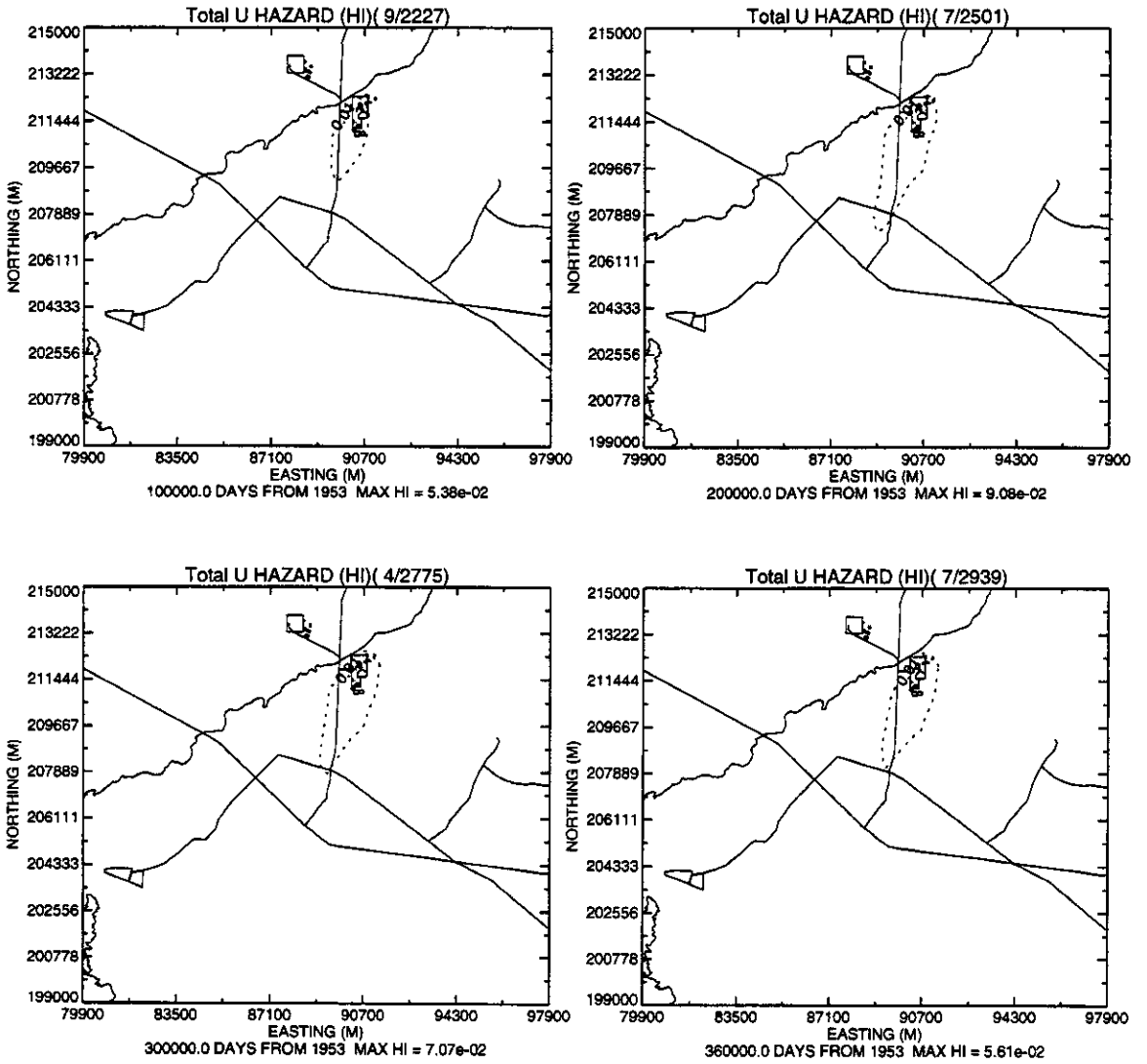


Figure 7-241 Aquifer Uranium peak risk contours.

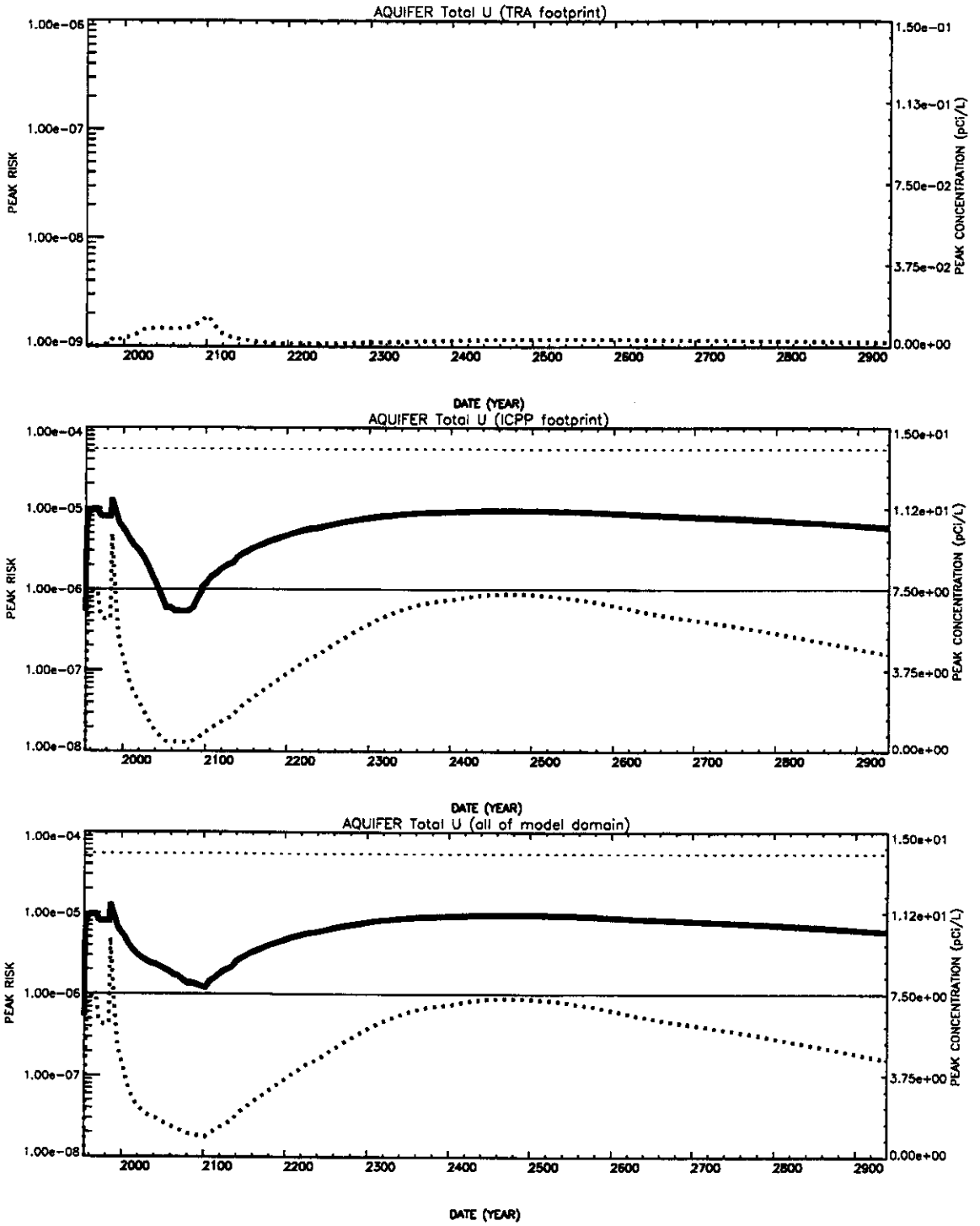


Figure 7-242 Peak aquifer concentration for Uranium. Top figure: TRA foot print, Middle figure: ICPP footprint, Bottom Figure: entire aquifer domain. Thick line represents the risk (left scale), the dotted line represents the concentration (right scale), solid line represents the 10^{-6} risk (left scale).

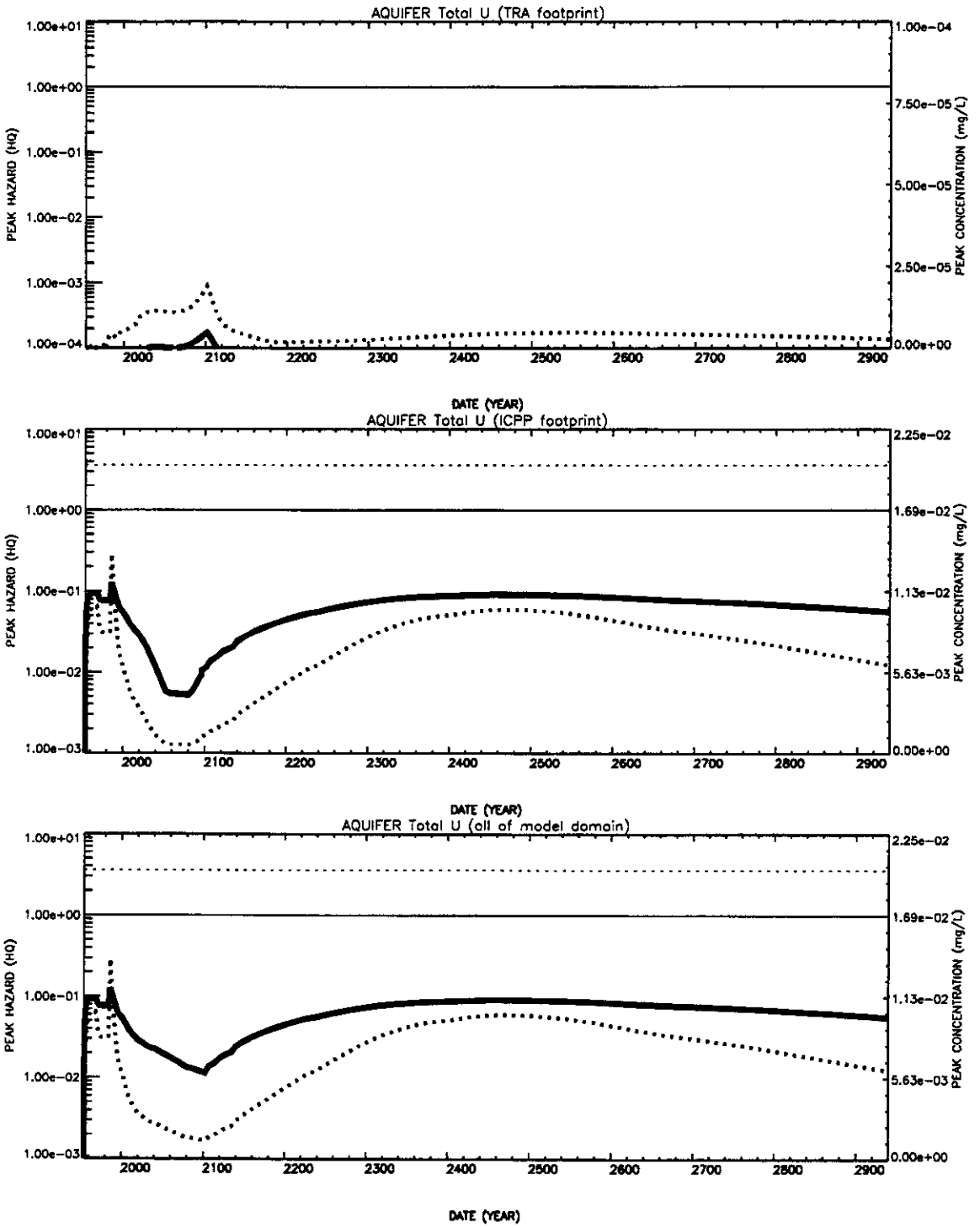


Figure 7-243 Peak aquifer concentration for Uranium. Top figure: TRA foot print, Middle figure: ICPP footprint, Bottom Figure: entire aquifer domain. Thick line HQ (left scale), dotted line concentration (right scale), solid line represents the HQ=1 (left scale).

7.13 Am-241

Am-241 sources consisted of CPP-31 (98.92%), the soils inventory (0.82%), the '86 release (0.15%), direct injection (0.11%), and from the decay of Pu-241. The first set of simulation results presented below are for the direct sources, with the discussion of the Pu-241 decay contribution following. Figures 7-244 through 7-249 present the simulation results for vadose zone with the aquifer results presented in Figures 7-253 through 7-257. Contour levels for both the vadose zone and aquifer (Figures 7-244 through 7-247, 7-253, and 7-254) are given for $1.5x10^{-1}$, 1.5, $1.5x10^{+1}$, 1.5, $1.5x10^{+2}$, $1.5x10^{+3}$, and $1.5x10^{+4}$ pCi/L, with concentrations equal to the total alpha MCL (<15 pCi/L) represented by the dark solid line. Corresponding aquifer risk contour maps are given in Figures 7-255, and 7-256 with levels represented at 10^{-7}, 10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}, and 10^{-2}. Contour levels above the 10^{-6} value (0.146 pCi/L) are indicated by solid lines. Risk less than 10^{-6} are indicated by the dotted lines, the 10^{-6} level is indicated by the thick line, and the 10^{-4} level is indicated by the medium solid line. The vadose zone contour plots show that because Am-241 has a large Kd of 340 cm^3/g it moves slowly through the vadose zone. In addition, because of the half life of 432 years after 1000 years, roughly one quarter remains near the original source location.

VADOSE ZONE: Figure 7-248 indicates that the concentration of Am-241 in the vadose zone does not drop below the 10^{-6} risk level after 1000 years of simulation, and that it does not fall below the total alpha MCL in the same time frame. However, the mass flux to the aquifer (Figure 7-249) will reach a peak value by 3191, but the flux rate is an insignificant contributor to the aquifer concentrations. Although still above the 10^{-6} risk level in 3454, the simulations were terminated leaving most of the initial mass in place in the upper interbed.

For the vadose zone, comparisons between model predicted concentrations and field data (Figures 7-250 through 7-252) suggest that most of the source terms and Kds are reasonable. These figures indicate that the predicted concentration matches the field data fairly well in USGS-50, and for most of the CPP, and MW wells. However, model predicted concentrations in the MW-01 and MW-09 wells are high. These over predicted wells are further to the north (CPP-33-3, CPP-33-2, CPP-37-4). On the other hand, concentrations in wells closer to the tank farm area are reasonably well predicted. Over predicting concentrations in the northern wells could be an indication that the source term in the Tank Farm area is high, or that the model predicts more spreading to the north (into those wells) than actually occurs.

AQUIFER: The overall maximum aquifer concentration was 0.91 pCi/L in 1986 (below the MCL) but because of the slow decay rate and high Kd, the concentrations in the aquifer decline slowly. In 2095, the predicted maximum Am-241 aquifer concentration is 0.63 pCi/L which is still higher than the 10^{-6} risk concentration (0.15 pCi/L) and less than the total alpha MCL (<15 pCi/L). After 2095, the concentrations continue to decline and are predicted to fall below the 10^{-6} risk level after the year 2500. During that time period, the aquifer area above the 10^{-6} risk concentration is limited to the areas in the vicinity of the ICPP facility (as shown in Figures 7-255 and 7-256). The Am-241 flux from the surface sources is never predicted to be a significant contributor to the aquifer concentrations.

In addition to the Am-241 identified as a source from the ICPP, Am-241 is created by the decay of Pu-241. As discussed in Chapter 6, approximately 5.7% of the initial mass of total Pu can be attributed to Pu-241. The Am-241 aquifer concentrations that result from the decay of Pu-241 are estimated by assuming that 5.7% of the total Pu mass is Am-241.

The total mass of Am-241 assumed to be a source for the model is $3.22x10^{-2}$ kg. Of this mass, only $3.59x10^{-5}$ kg is discharged to the injection well and $3.216x10^{-2}$ kg is discharged in or just below the surface sediments. The total assumed source mass for Pu is $2.14x10^{-1}$ kg. Of that mass, Pu-241 comprises 5.7% or $1.22x10^{-2}$ kg. If it is assumed that all of the Pu-241 decays to Am-241, by the year 2095 there will be a total of $4.44x10^{-2}$ kg of Am-241 in the vadose zone and aquifer. This is 38% more Am-241 than was simulated from known sources. The total Am-241 concentration can be estimated by simply scaling the previously presented simulation results by 38%. After scaling, Figure 7-258 shows the peak concentrations. This scaling is not conservative because 38% of the Am-241 that comes from Pu-241 will move as plutonium (Kd=22 cm^3/g)

while it decays into Am-241. The peak Pu flux from the vadose zone into the aquifer is predicted to occur 1500 years from now, but 99.9% of the Pu-241 will have decayed into Am-241 within a 150 year time period and 50% decays in 14.4 years.

Comparisons of model predicted concentrations to aquifer field data (Figures 7-260 through 7-264). The field data given here includes values at or equal to detection limits. Although the detection limit varies between measurements, concentrations less than 0.1 pCi/L are either equal to the detection limit, or the analytic uncertainty is greater than the reported concentration. For the wells with reported concentrations greater than 0.1 pCi/L, the predicted concentrations are below the measured peak values in USGS-40, USGS-42, and USGS-112. Predicted concentrations are above the measured peak value in USGS-47. Locations for these comparison wells are given in Figure 7-259, and include near-, mid-, and far-field distances from the injection well. Field measurements of Am-241 taken in this decade should be a reflection of the mass disposed of to the injection well. The Am-241 concentration contribution of Pu-241 has been ignored in the comparison of Am-241 model predictions to field data. Pu-241 moves faster than the Am-241 because of a lower adsorption coefficient which would result in higher predicted concentrations at the mid- and far-distance wells. In addition, it was assumed that a Kd = 340 cm^3/g in the sediments and 1/25th of that in the basalts would be representative of transport in the aquifer based on Track II guidance. Although not pursued here, it may be more appropriate to use a smaller Kd when modeling the transport of Am-241 in the ICPP basalts and sediments. However, there is not sufficient field data to support additional simulation.

Based on the source estimate reevaluation summarized in Section 10.5, the reestimated CPP-31 inventory for Am-241 is 70 times smaller than the original inventory (Table 10-7) and 60 times smaller for the tank farm (Table 10-9). As explained in Section 5.2.2 and footnote a in Table 5-20, errors in the Donovan (1989) data account for a factor of 5 of the CPP-31 source overestimation. Am-241 was not included in the original CPP-28/79 inventory. Therefore, Am-241 source estimate at CPP-28/79 was underestimated with respect to that source. Comparing the CPP-28/79 and CPP-31 actinide inventories, indicates that the two sources are within one order of magnitude in all cases. Therefore, it can be assumed that a factor of 70 conservatism for CPP-31 is overly conservative to account for the neglected Am-241 at CPP-28/79. The vast majority of the Pu-241 will become Am-241 within 100 years (see Table 10-8). Therefore, because the Pu-241 to Am-241 decay chain was not simulated, the initial inventory of Am-241 should be assumed to include the initial inventory of Pu-241. The simulations presented in this section used the original estimated Pu-241 mass which could include a potential overestimate of 38%. Because the Am-241 inventory was probably overestimated by an order of magnitude, minor inventory corrections based on Pu-241 decay are be negligible. The Am-241 simulation results appear to be conservative based on the assumptions of Section 10. Based on the simulation results shown in this section, Am-241 does not pose a risk problem. Therefore, decreases in the Am-241 CPP-31 inventory would not move Am-241 from a COPC to a contaminant of concern (COC)

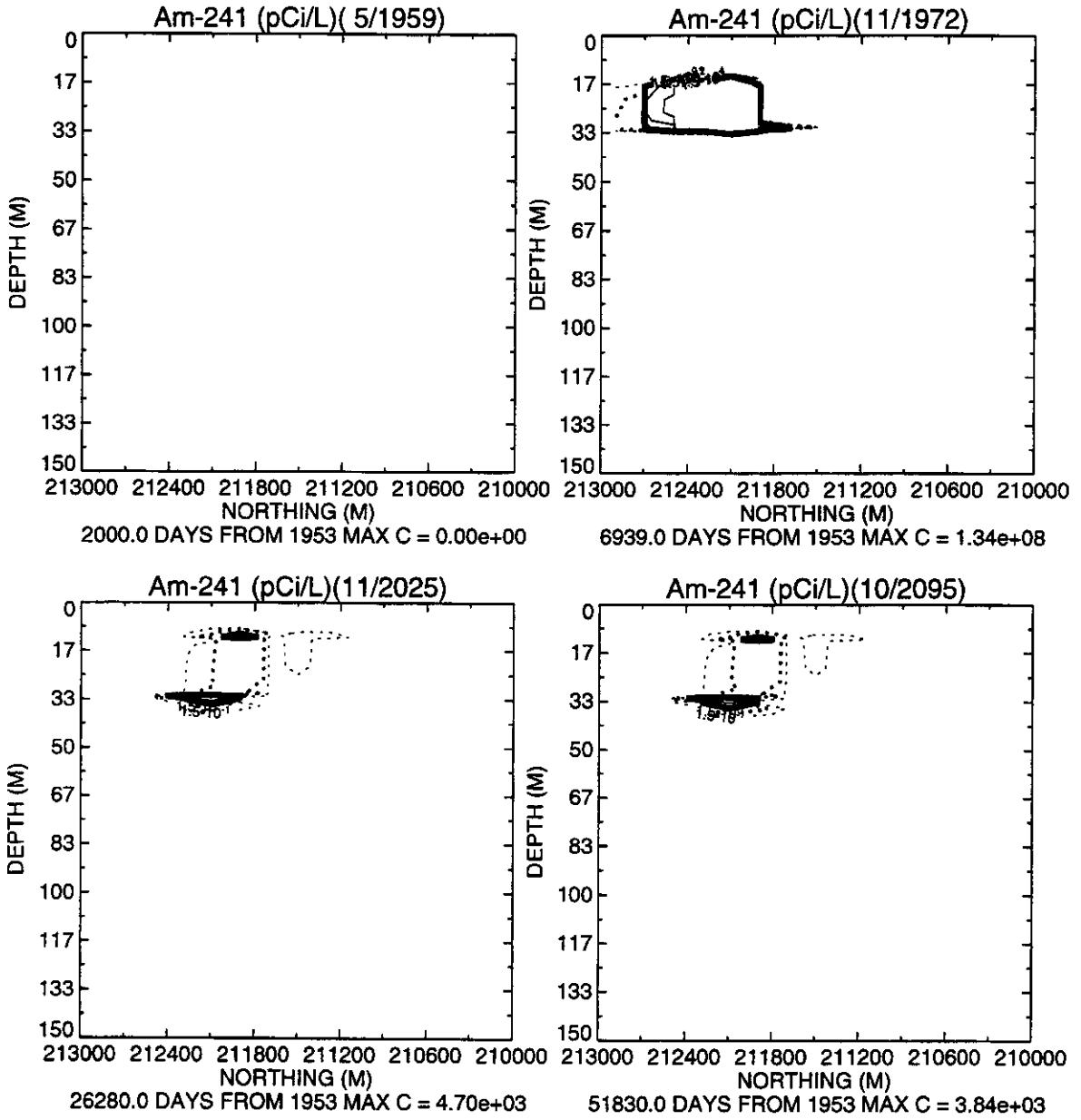


Figure 7-244 Vadose zone Am-241 peak concentration contours.

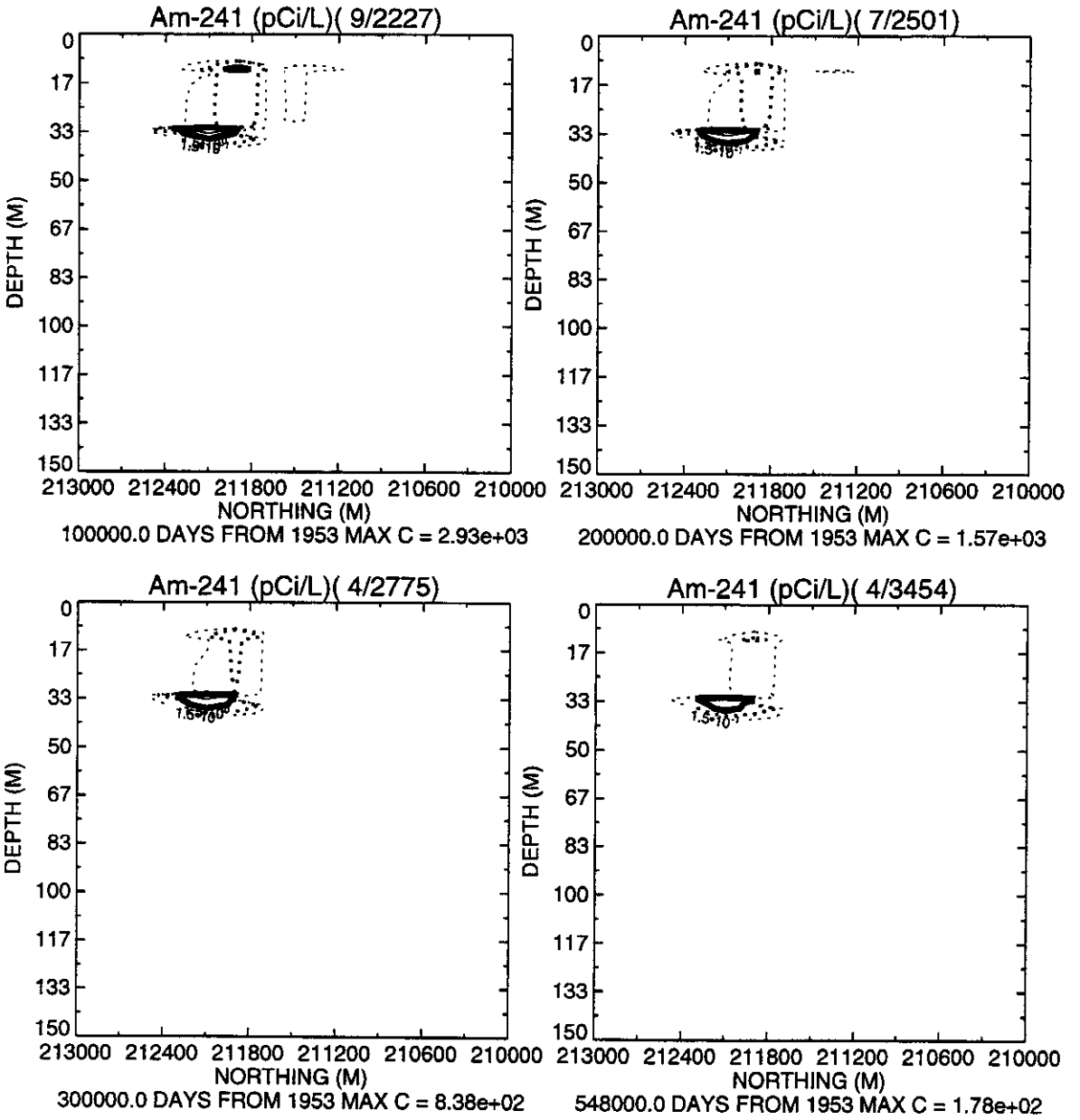


Figure 7-245 Vadose zone Am-241 peak concentration contours.

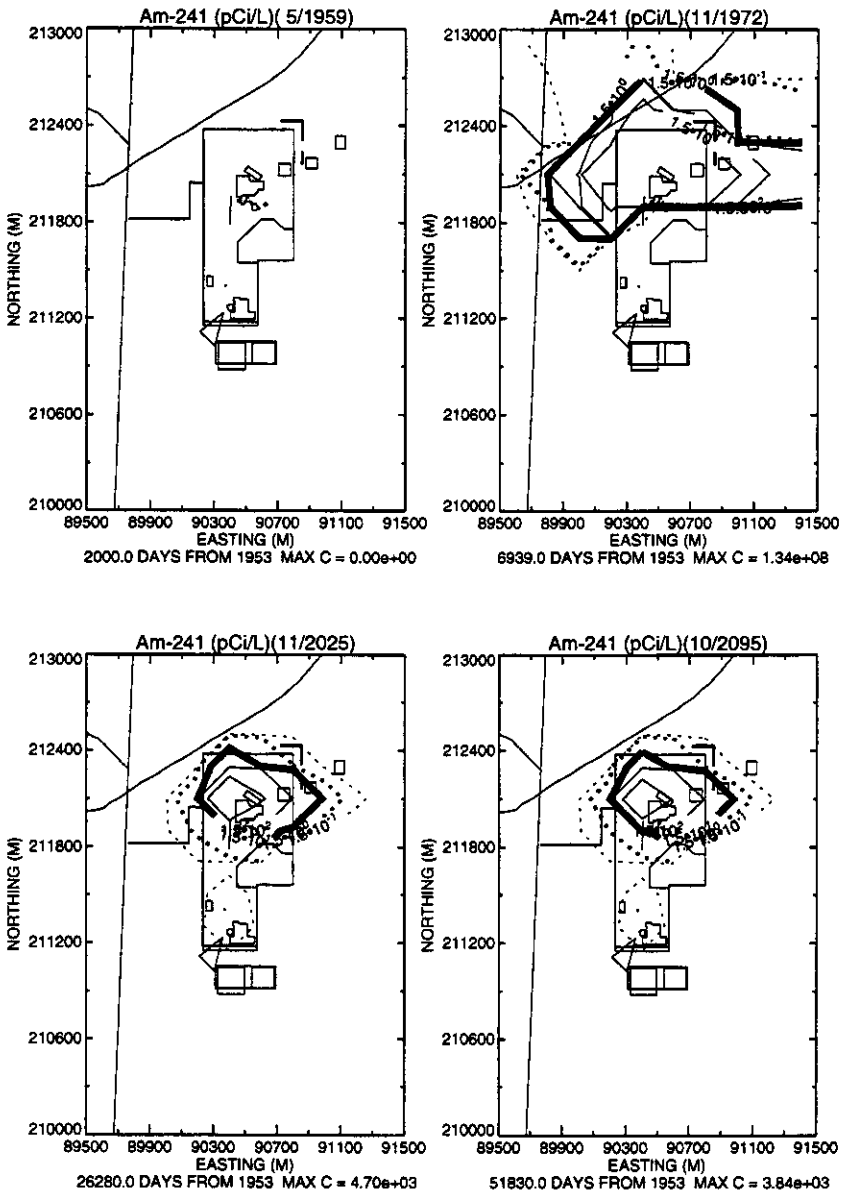


Figure 7-246 Vadose zone Am-241 peak concentration contours.

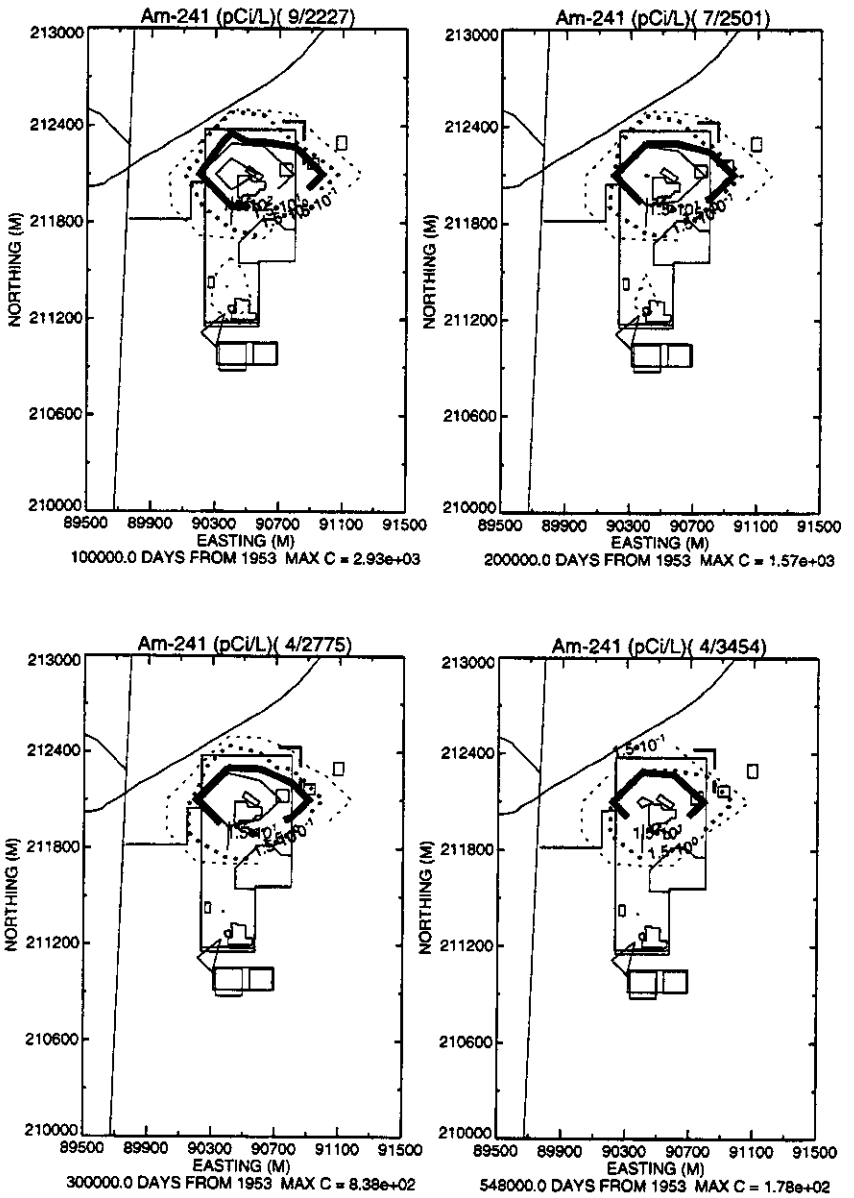


Figure 7-247 Vadose zone Am-241 peak concentration contours.

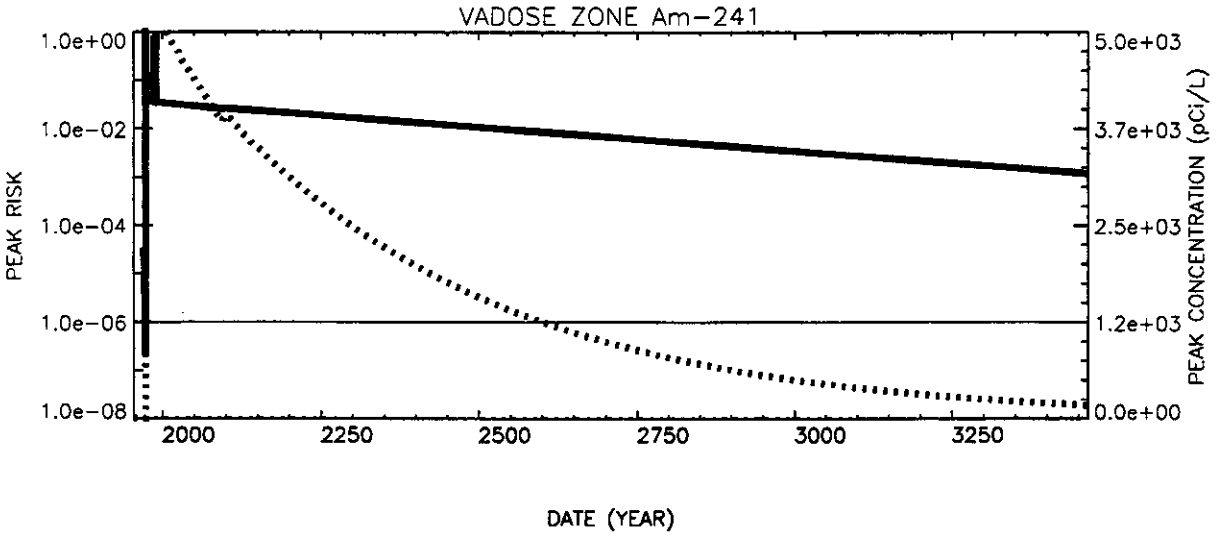


Figure 7-248 Peak vadose zone risk and concentration for Am-241. Risk indicated by the thick line on the log scale with the 10^{-6} value shown as the solid line. The dotted line represents concentration given by the linear scale on the right axis with the MCL shown as the straight horizontal line.

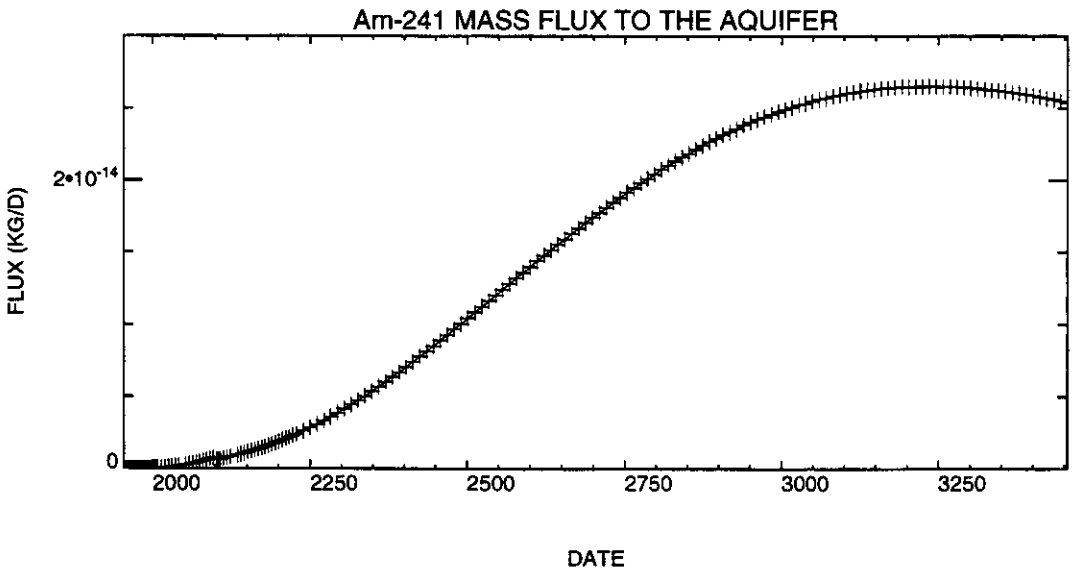


Figure 7-249 Mass flux of Am-241 into the aquifer from the vadose zone.

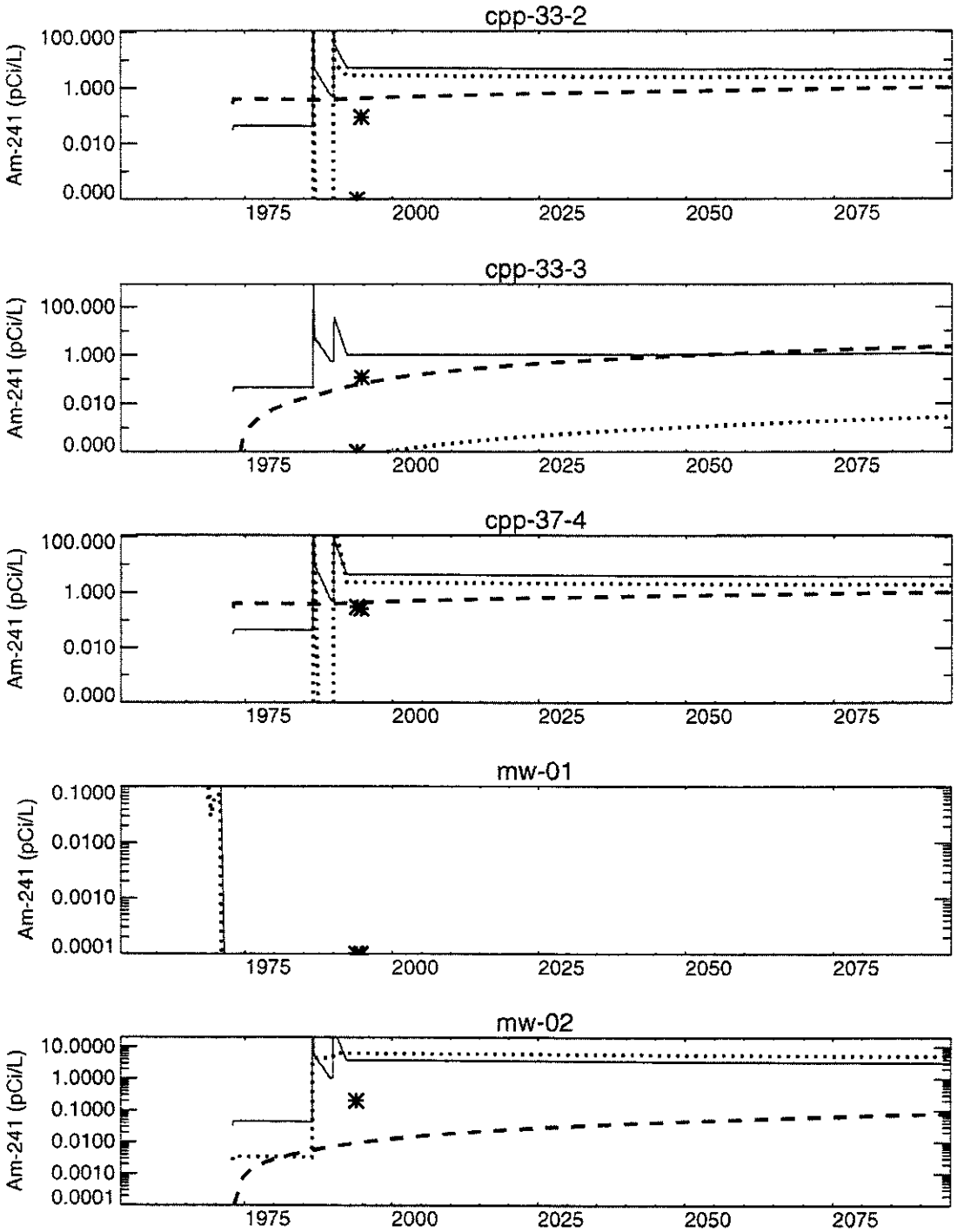


Figure 7-250 Comparison of vadose zone Am-241 to field data.

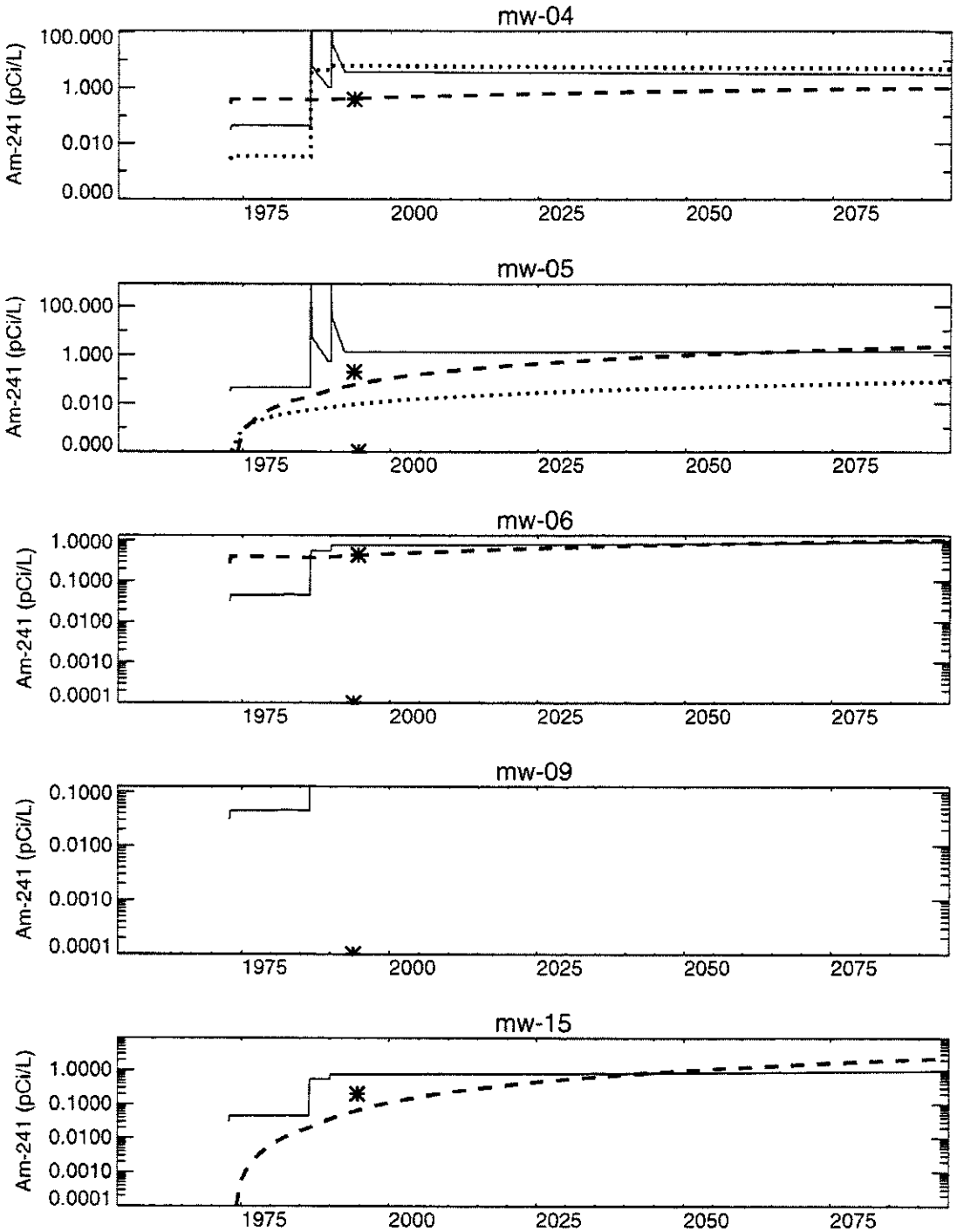


Figure 7-251 Comparison of vadose zone Am-241 to field data.

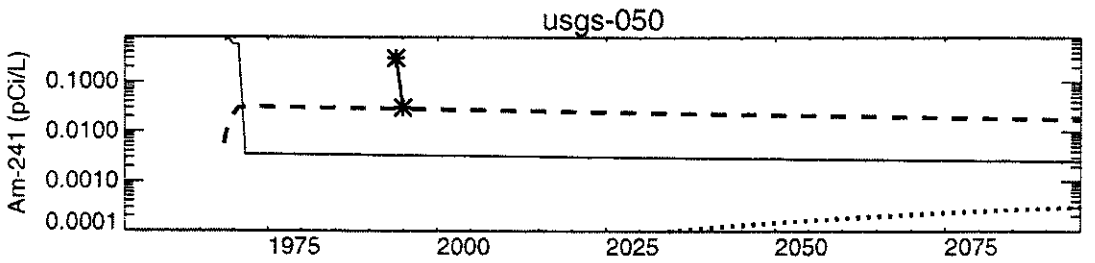


Figure 7-252 Comparison of vadose zone Am-241 to field data.

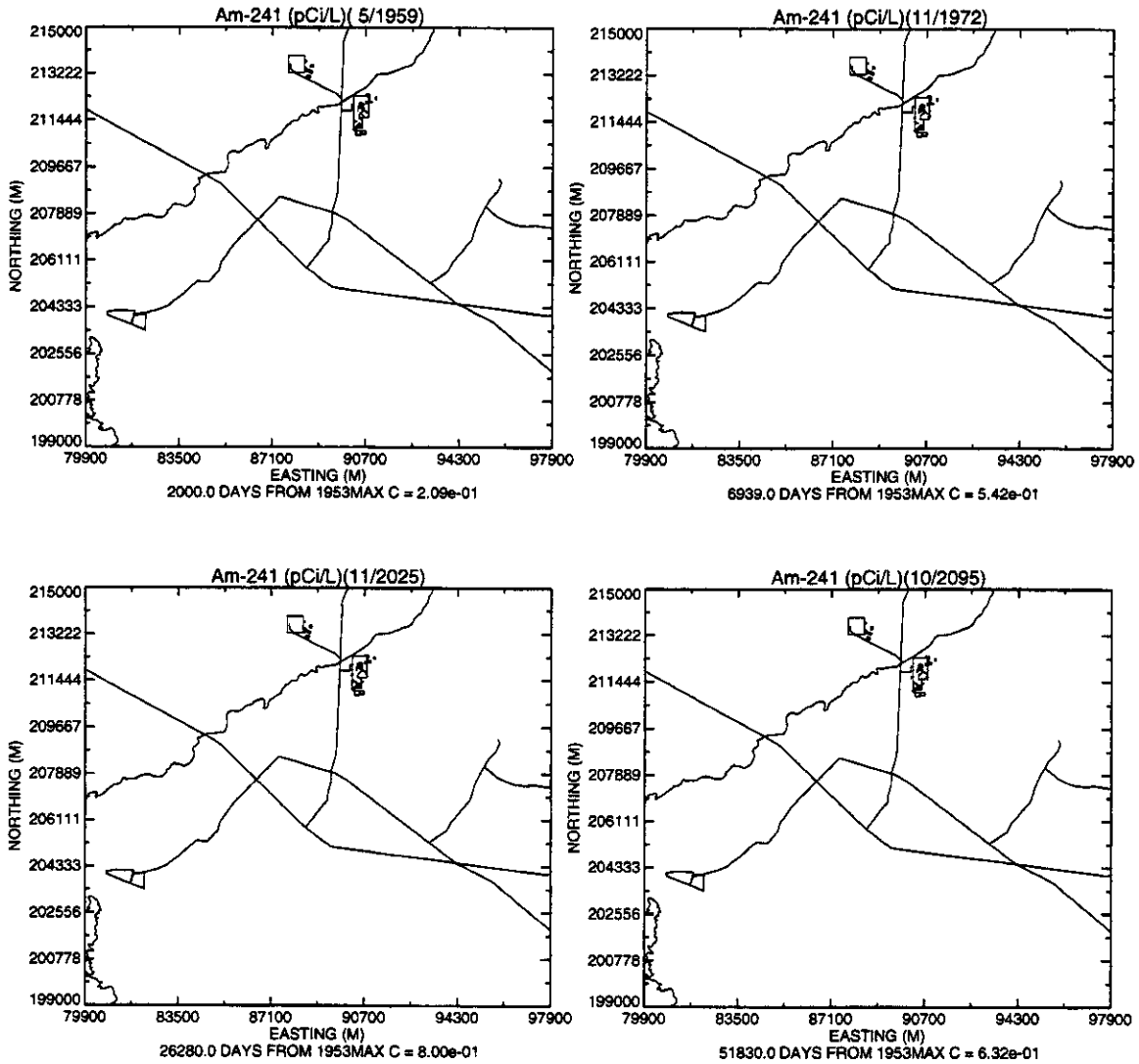


Figure 7-253 Aquifer Am-241 peak concentration contours.

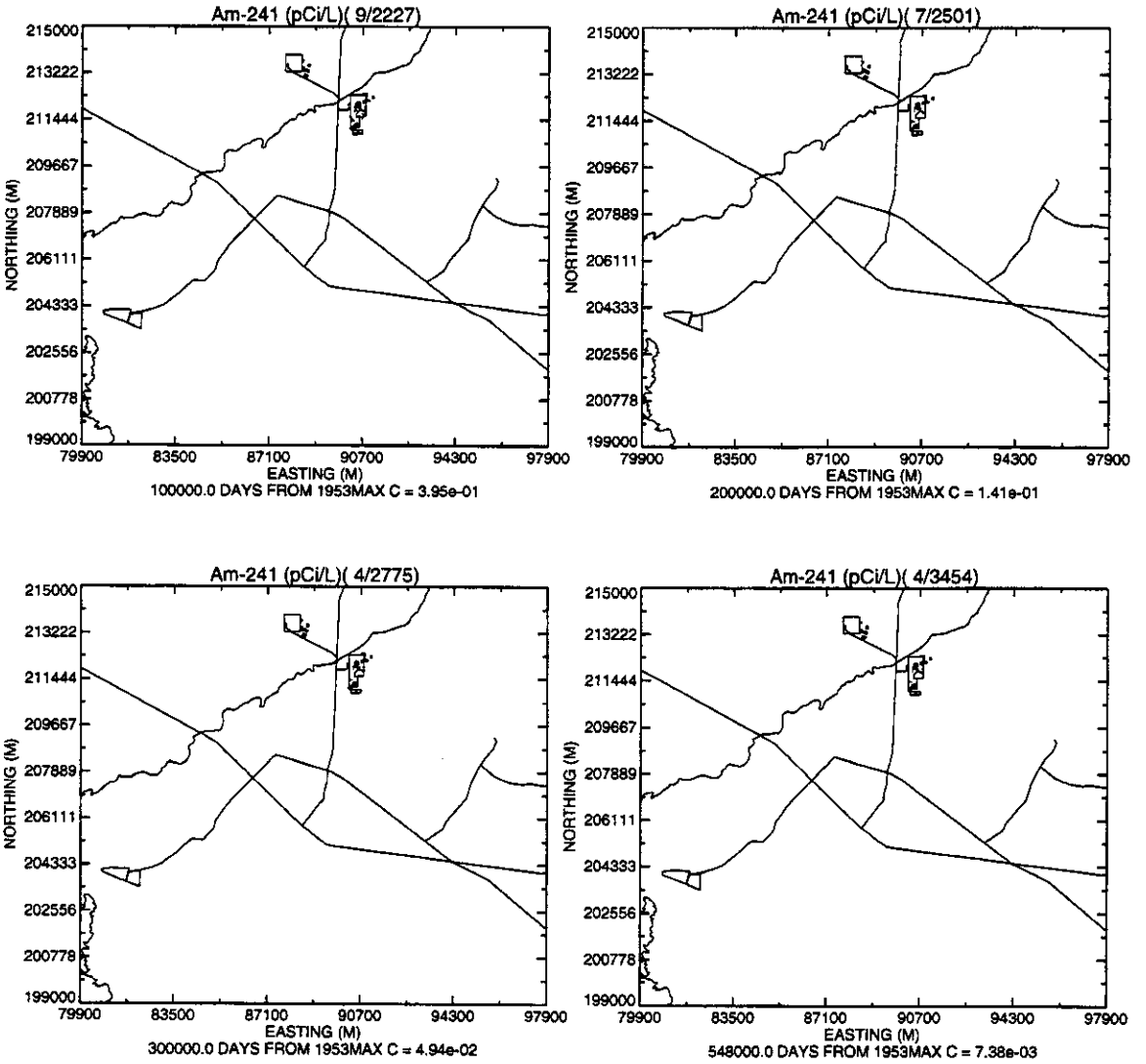


Figure 7-254 Aquifer Am-241 peak concentration contours.

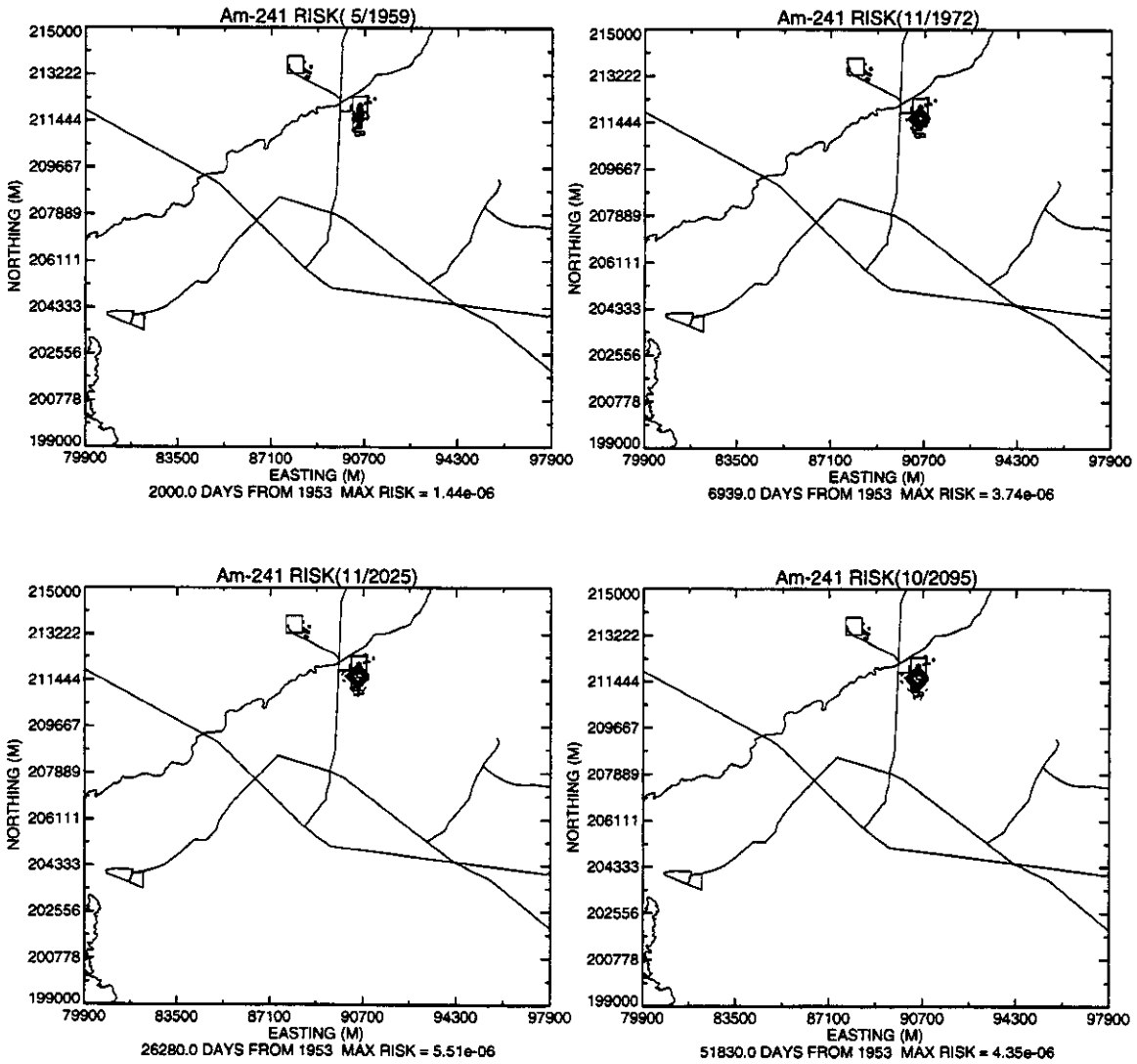


Figure 7-255 Aquifer Am-241 peak risk contours.

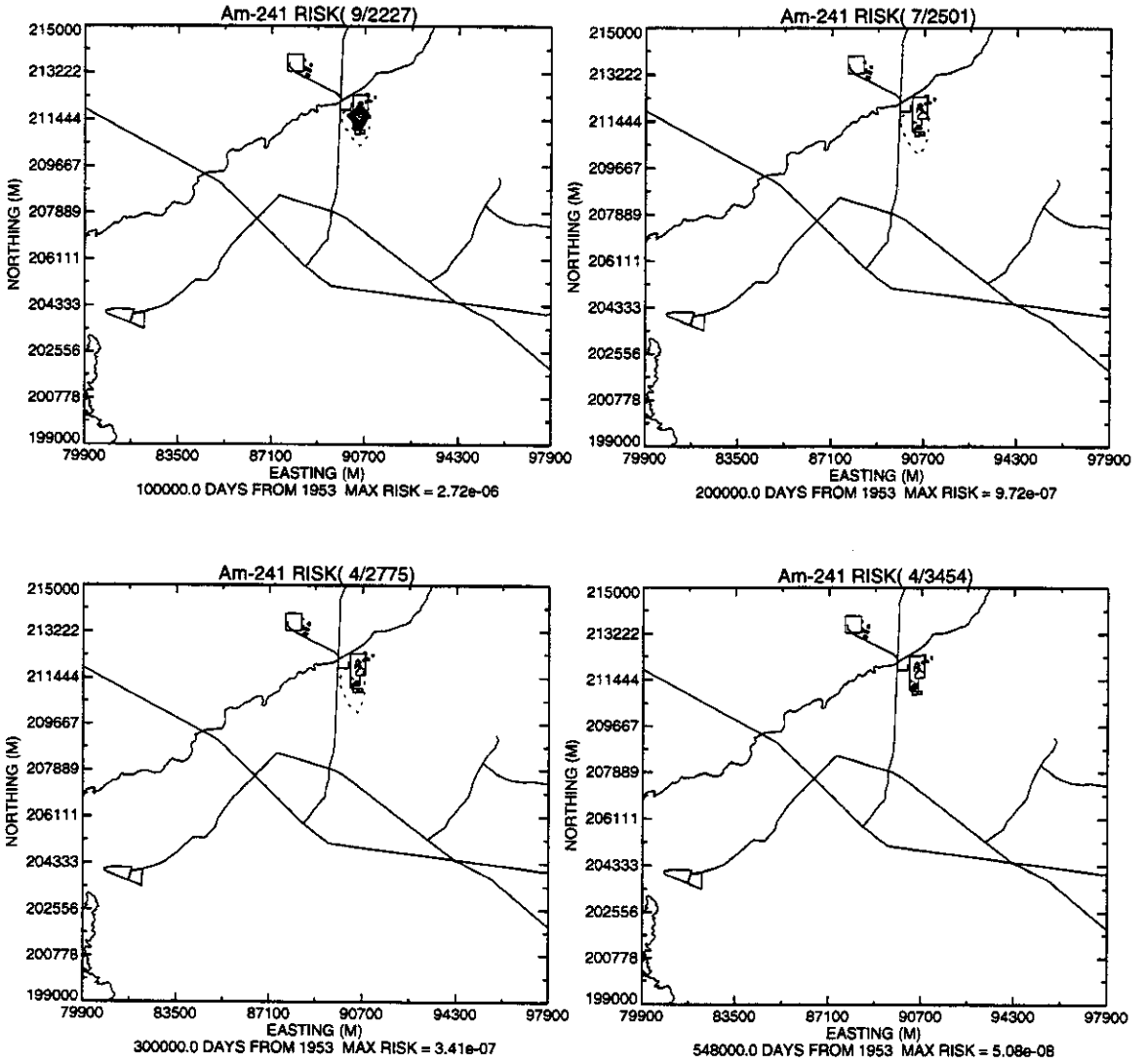


Figure 7-256 Aquifer Am-241 peak risk contours.

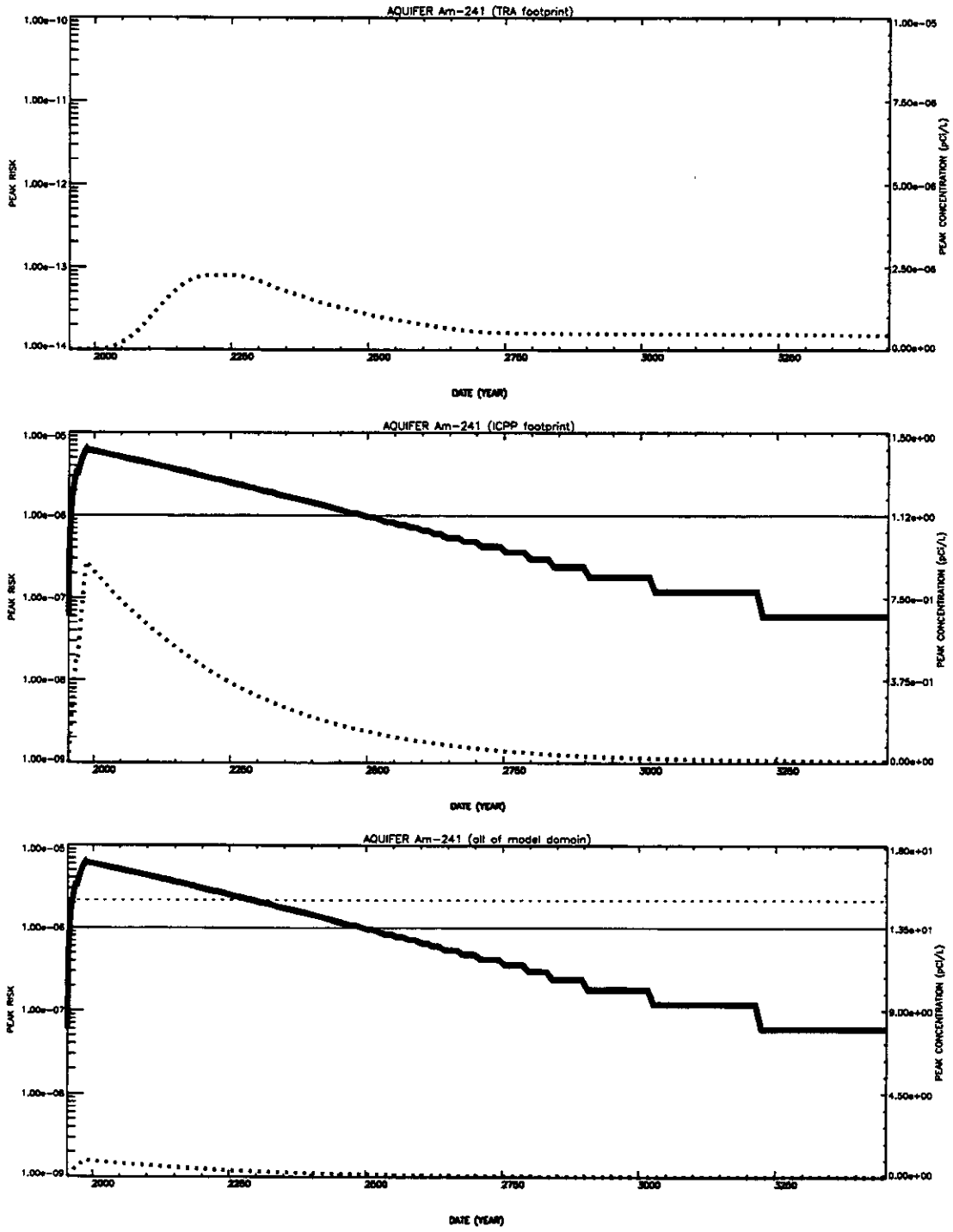


Figure 7-257 Peak aquifer concentration for Am-241. Top figure: TRA foot print, Middle figure: ICPP footprint, Bottom Figure: entire aquifer domain. Thick line risk (left scale), dotted line concentration (right scale) solid line 10^{-6} risk (left scale).

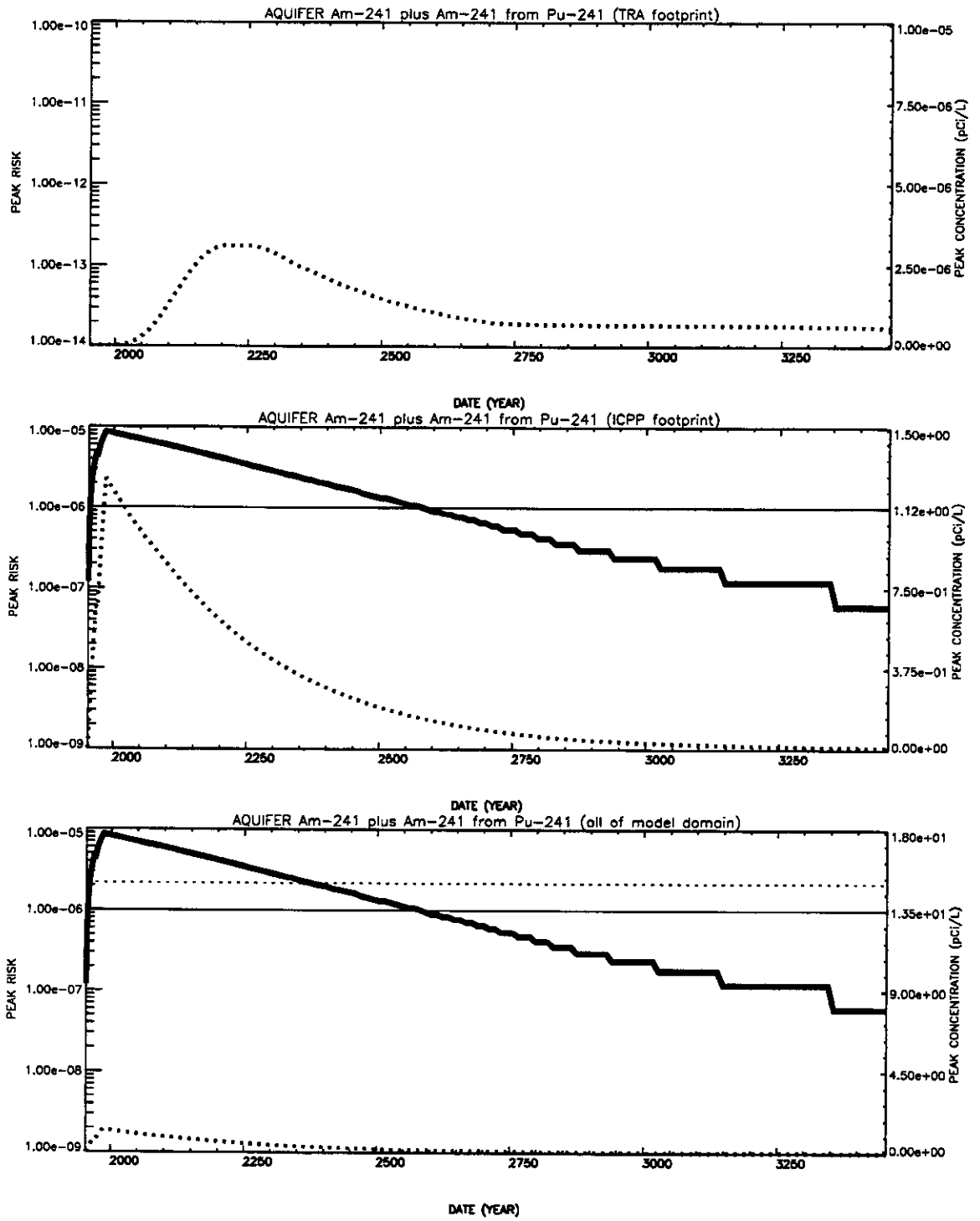


Figure 7-258 Peak aquifer concentration for Am-241. Total Am-241 is a sum of the discharged Am-241 and the ingrowth from Pu-241. Top figure: TRA foot print, Middle figure: ICPP footprint, Bottom Figure: entire aquifer domain. Thick line risk (left scale), dotted line

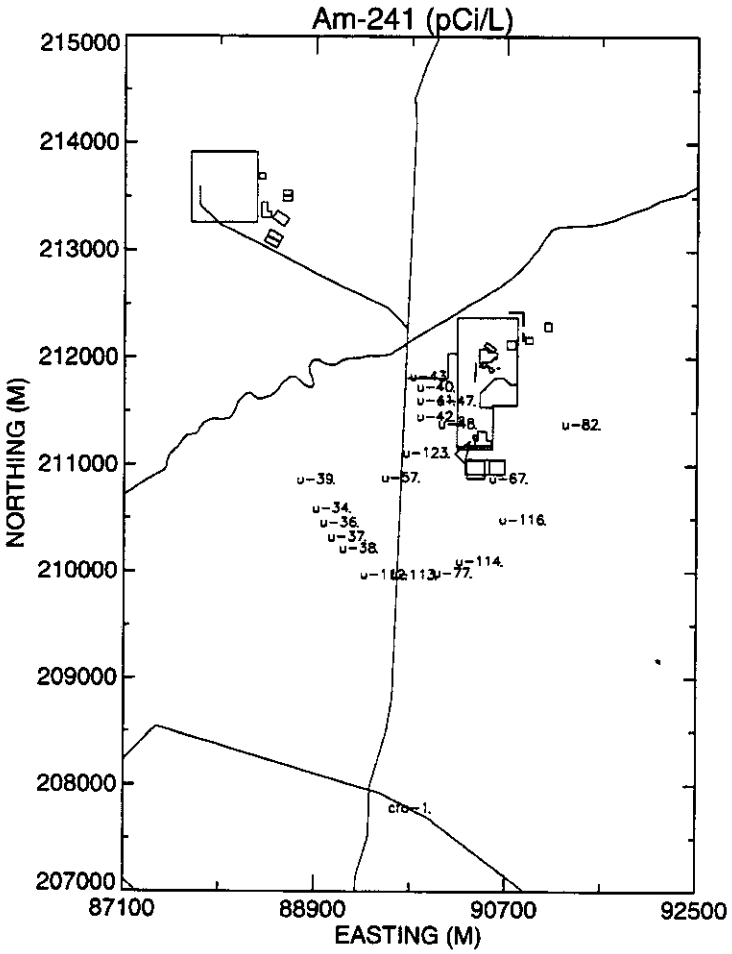


Figure 7-259 Well locations for the comparison of aquifer Am-241 to field data.

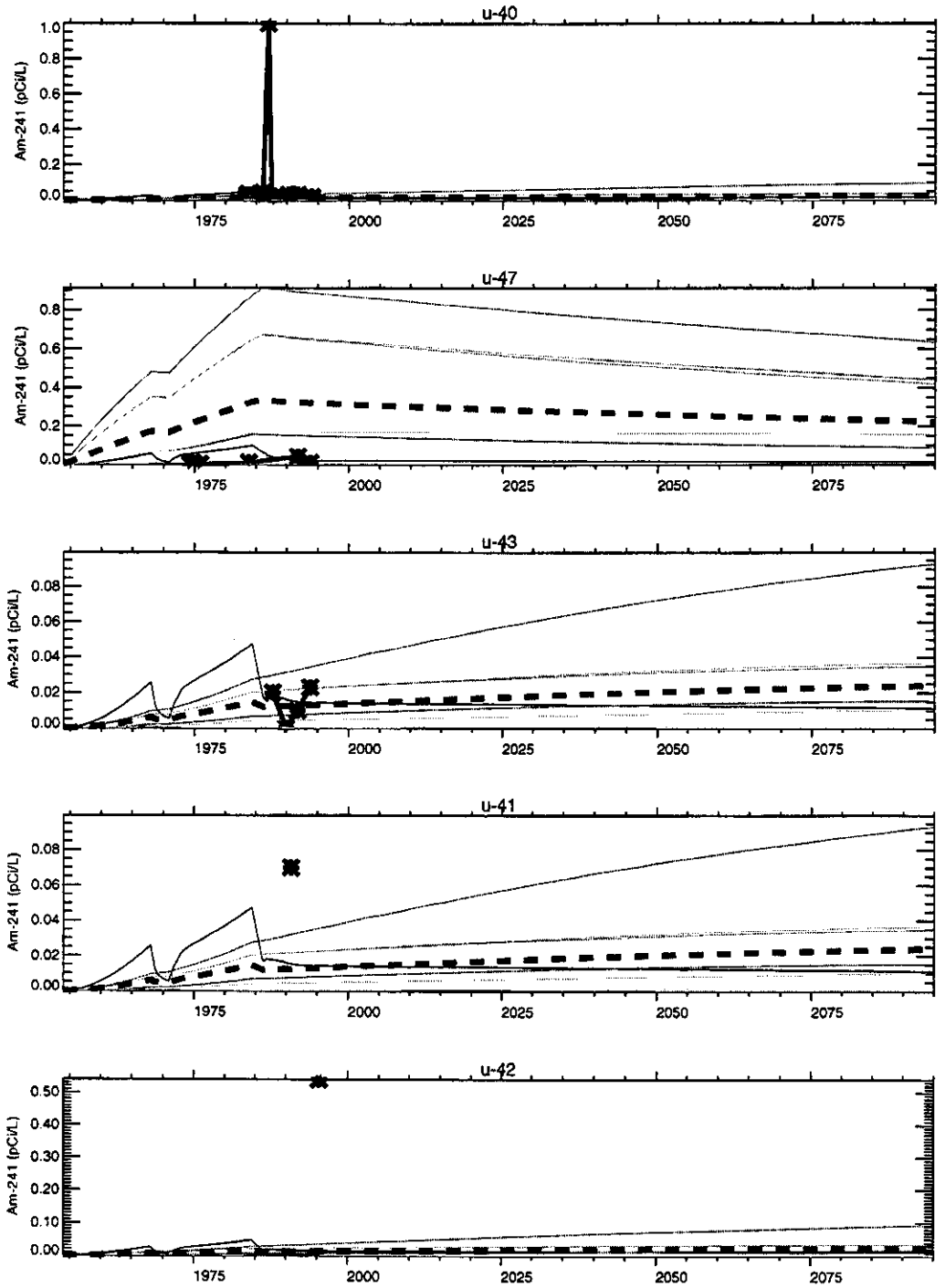


Figure 7-260 Comparison of aquifer Am-241 to field data.

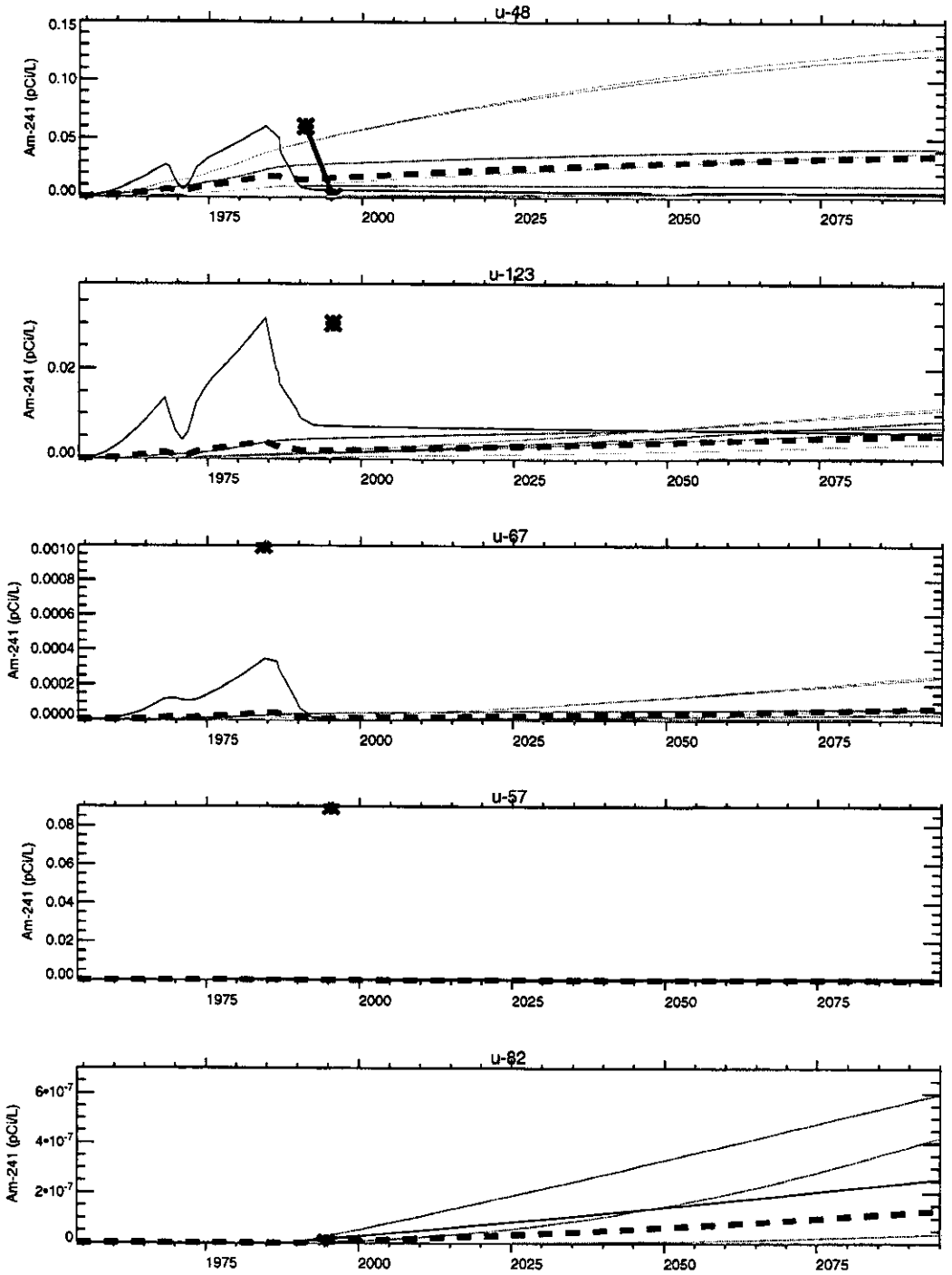


Figure 7-261 Comparison of aquifer Am-241 to field data.

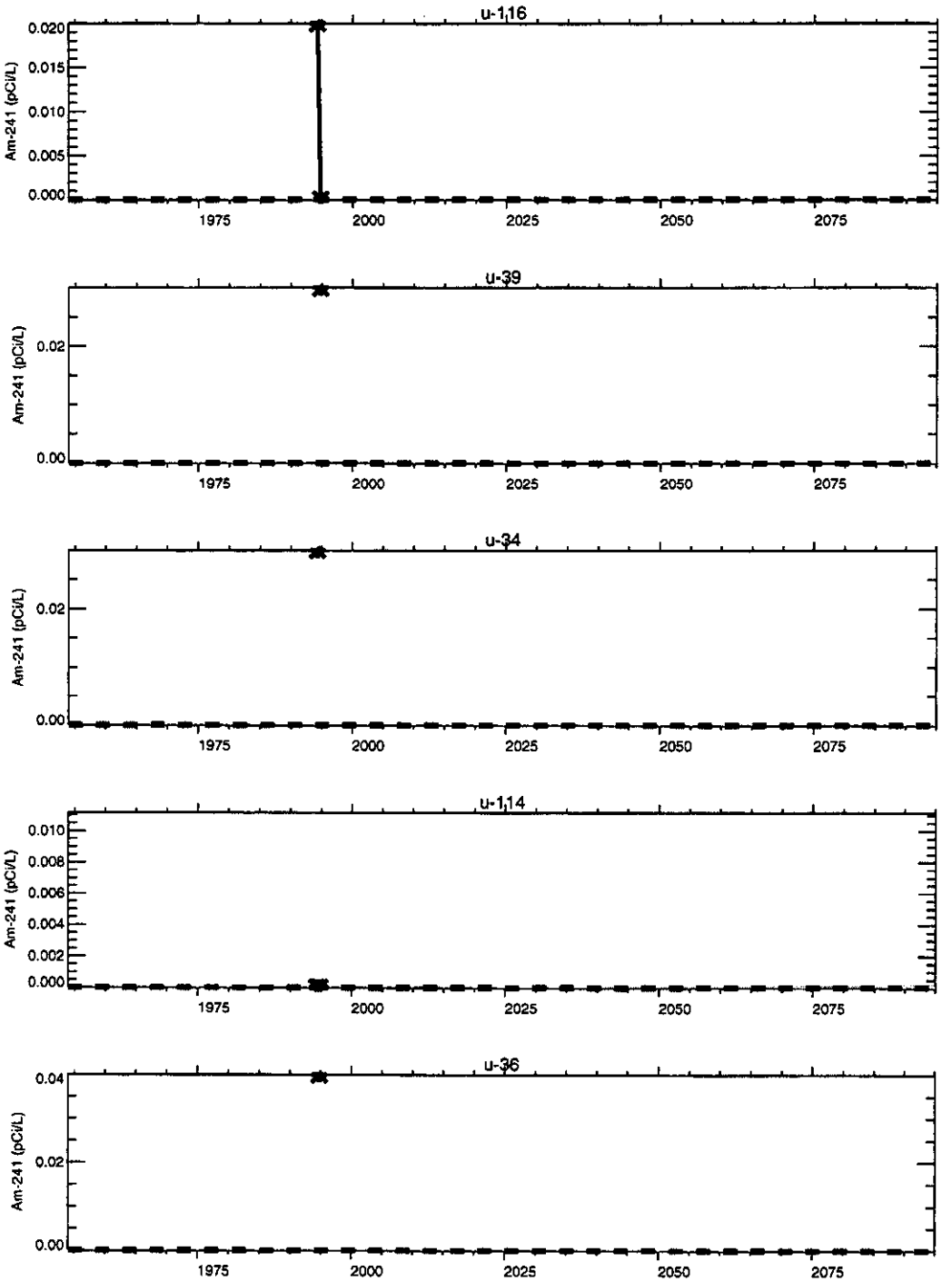


Figure 7-262 Comparison of aquifer Am-241 to field data.

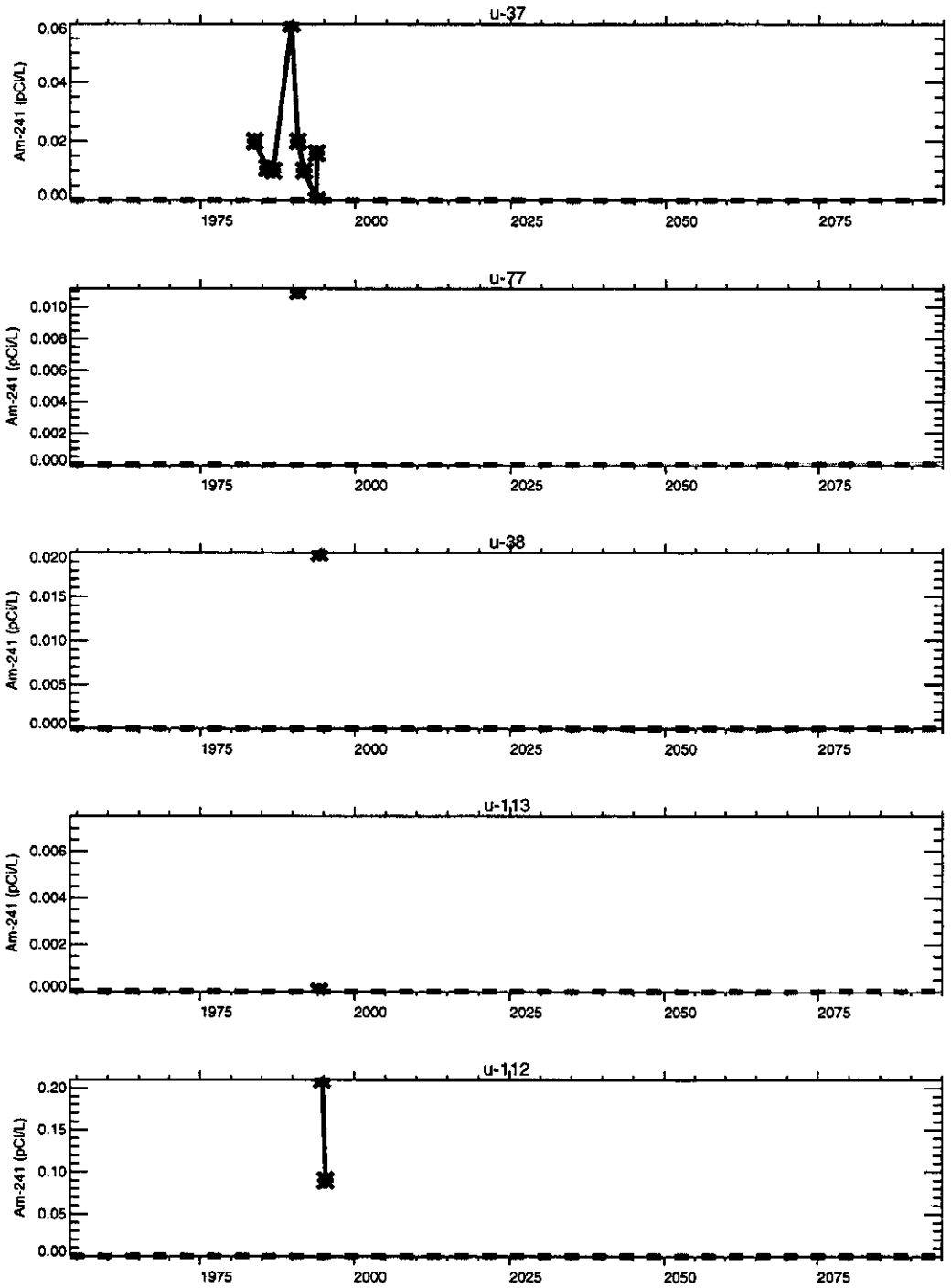


Figure 7-263 Comparison of aquifer Am-241 to field data.

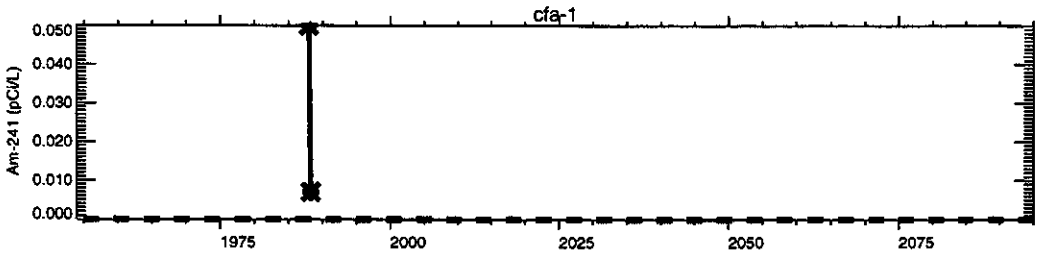


Figure 7-264 Comparison of aquifer Am-241 to field data.

7.14 SUMMARY OBSERVATIONS

Transport of 13 COPCs through the vadose zone and into the aquifer at the ICPP were simulated. These results are summarized in Tables 7-2 through 7-5 below for the vadose zone and aquifer, respectively. The COPCs simulated are Am-241, arsenic, chromium, Co-60, Cs-137, H-3, I-129, Np-237, mercury, Sr-90, Tc-99, total Pu, and total U.

VADOSE ZONE RESULTS: Table 7-2 contains the predicted peak concentration in the vadose zone for a) the entire simulation time (Column 4), b) the simulated time corresponding to 30 years from 1995 (Column 9), and c) the simulated time corresponding to 100 years from 1995 (Column 10).
Tables 7-3 through 7-5 summarize the peak concentration information for the aquifer transport results. The first column of these tables gives the COPC for which transport was simulated. The second column of Table 7-2 lists the concentration corresponding to the MCL for each COPC given in Column 1. Columns 3 through 8 summarize the simulation results for transport in the vadose zone for the entire simulation period. Column 3 lists the year at the end of the simulation time for each COPC. Column 4 gives the peak concentration predicted in the vadose zone throughout the entire simulation time for each COPC. Column 5 lists the time corresponding to the peak value, with Columns 6 through 8 indicating where the peak concentration was predicted to occur. The peak concentration 30 years from now is given in Column 9 and the predicted peak concentration 100 years in the future is given in Column 10. The values given in these last two columns can be compared against the MCL given in Column 2. This table indicates that with the exception of H-3, Tc-99, and Chromium, all of the COPCs exceed MCLs in the year 2025. The Co-60 peak concentrations also fall below the MCL by the year 2095.

Table 7-2 Vadose zone peak concentrations.

COPCs	MCL (mg/L or pCi/L)	Simulation Results For The Period Spanning 1953 Through The Total Simulation Time						Simulation Results For The Year 2025	Simulation Results For The Year 2095
		Year at the End of Simulation Time	Peak Concentration (mg/L or pCi/L)	Year of Peak	Easting (m)	Northing (m)	Depth From Surface (m)	Maximum Concentration in 2025 (mg/L or pCi/L)	Maximum Concentration in 2095 (mg/L or pCi/L)
Arsenic[a]	5.00E-02	3049	2.20E+03	1990	90800.	212300.	20.	1.77E-01	6.85E-02
Chromium[a]	1.00E-01	2112	8.23E+01	1990	90400.	211900.	20.	6.59E-02	2.06E-02
Co-60	1.00E+02	2068	1.97E+09	1990	90400.	211500.	18.	9.18E+02	0.00E+00
Cs-137	2.00E+02	2227	2.97E+10	1990	90400.	211500.	18.	1.77E+05	3.35E+04
H-3	2.00E+04	2095	1.38E+07	1973	90400.	212100.	26.	1.99E+03	2.31E+02
I-129	1.00E+00	2095	6.95E+03	1973	90400.	212100.	26.	3.94E+01	2.74E+00
Mercury[a]	2.00E-03	2123	1.72E+02	1990	90400.	211900.	20.	3.86E-02	3.15E-02
Np-237[b]	<1.50E+01	2797	2.15E+06	1990	90600.	212100.	20.	1.13E+02	7.33E+01
Total Pu[b]	<1.50E+01	3815	2.66E+07	1990	90400.	211500.	18.	5.32E+03	3.08E+03
Sr-90	8.00E+00	2244	1.36E+10	1973	90400.	212100.	26.	1.38E+06	1.46E+05
Tc-99	9.00E+02	2178	2.59E+06	1973	90400.	212100.	26.	4.58E+02	1.16E+01
Total U	1.40E+01	2950	7.30E+04	1990	90600.	212100.	21.	4.97E+02	3.39E+02
Total U[a]	2.00e-02	2950	9.99E+01	1990	90600.	212100.	21.	6.81E-01	4.64E-01
Am-241[b]	<1.50E+01	3465	1.34E+08	1973	90400.	212100.	26.	4.70E+03	3.84E+03
Total Am-241[b]	<1.50E+01	---	---	---	---	---	---	---	---

[a] mg/L
[b] total alpha MCL is 15 pCi/L

AQUIFER RESULTS: Table 7-3 contains the predicted peak concentration in the entire aquifer simulation domain. Results are presented for a) the entire simulation time, b) 30 years from 1995, and c) 100 years from 1995. Column 3 gives the year at the end of the simulation time for each COPC. Columns 4 through 10 summarize the simulation results for transport in the aquifer for the entire simulation period. Columns 4, 5 and 6 give the peak concentration and corresponding risk (or HQ) predicted in the aquifer throughout the entire simulation time for each COPC. Column 7 lists the year corresponding to that value, with Columns 8 through 10 indicating where the peak concentration was predicted to occur. The maximum concentration and corresponding risk 30 years from now is given in Columns 11, 12 and 13, while the predicted maximum concentration and corresponding risk 100 years in the future is given in Columns 14, 15 and 16. With the exception of chromium, there is little variation in the horizontal location of the peak concentration in the aquifer. The vertical peaks are 19 m below the water table for the COPCs for which the peak concentration is the result of disposal to the injection well and 4 m below the water table for COPCs for which the peak concentration is the result of disposal at the surface (primarily the tank farm).

Table 7-3 indicates that by the year 2025, the chemical concentrations of chromium and Total U will be below their HQ=1 based concentration and the Co-60 concentration will be below its 10^{-6} risk based concentration. By the year 2095, the concentrations of H-3, Total Pu, and Tc-99 will be below their 10^{-6} risk based concentrations. Chromium, Co-60, H-3, and Tc-99 concentrations will all continue to decrease in the future. Total U, and Total Pu concentrations will increase in the future. Of the remaining COPCs, the aquifer concentrations of Cs-137, I-129, mercury, Np-237, and Am-241 will all decrease after 2095 and the concentrations of arsenic and Sr-90 will increase. After the year 2095, the arsenic increase is predicted to be minor but the Total Pu (factor of 250), Sr-90 (factor of 2), and Total U (factor of 10) increases are predicted to be significant.

Table 7-3 Aquifer peak concentrations and risk for the entire aquifer domain.

COPCs	MCL (mg/L or pCi/L)	Simulation Results For The Period Spanning 1953 Through The Total Simulation Time								Simulation Results For The Year 2025			Simulation Results For The Year 2095		
		Year at the End of Simulation Time	Peak Concentration (mg/L or pCi/L)	Peak HQ	Peak Risk	Year of Peak	Easting (m)	Northing (m)	Depth Below Water Table (m)	Maximum Concentration (mg/L or pCi/L)	Maximum HQ	Maximum Risk	Maximum Concentration (mg/L or pCi/L)	Maximum HQ	Maximum Risk
Arsenic[a]	5.00E-02	3049	1.95E-03	---	3.42E-05	2479	90900.	212000.	4.	9.42E-05	---	1.67E-06	1.25E-03	---	2.19E-05
Chromium[a,b]	1.00E-01	2107	9.01E-01	4.94E+00	--	1971	88500.	213200.	19.	6.95E-02	3.81E-01	---	3.23E-02	1.77E-01	---
Co-60	1.00E+02	2063	2.59E+01	---	1.03E-05	1986	90500.	211600.	19.	3.36E-02	---	1.33E-08	0.00E+00	---	0.00E+00
Cs-137	2.00E+02	2227	8.62E+01	---	5.72E-05	1979	90500.	211600.	19.	3.20E+01	---	2.12E-05	5.91E+00	---	3.93E-06
H-3	2.00E+04	2095	2.62E+06	---	3.93E-03	1960	90500.	211600.	19.	4.24E+03	---	6.38E-06	8.92E+01	---	1.19E-07
I-129	1.00E+00	4144	9.71E+01	---	3.75E-04	1986	90500.	211600.	19.	8.97E+00	---	3.46E-05	4.68E+00	---	1.81E-05
Mercury[a,b]	2.00E-03	2118	7.42E-03	2.36E+00	---	1984	90500.	211600.	19.	6.09E-03	1.94E+00	---	4.17E-03	1.33E+00	---
Np-237	<1.50E+01	2791	3.05E+01	---	1.92E-04	1986	90500.	211600.	19.	8.03E+00	---	5.06E-05	3.76E+00	---	2.37E-05
Total Pu	<1.50E+01	3804	3.62E+01	---	2.43E-04	3585	90500.	211600.	4.	3.22E-01	---	2.15E-06	1.39E-01	---	9.54E-07
Sr-90	8.00E+00	2238	1.20E+03	---	1.41E-03	1967	90500.	211600.	19.	3.54E+01	---	4.15E-05	8.08E+00	---	9.48E-06
Tc-99	9.00E+02	2178	2.03E+02	---	5.96E-06	1997	90500.	212000.	4.	5.51E+01	---	1.61E-06	2.39E+01	---	7.15E-07
Total U	1.40E+01	2939	1.01E+01		1.31E-05	1986	90500.	211600.	19.	2.13E+00		2.74E-06	9.57E-01		1.25E-06
Total U[a,b]	2.00E-02	2939	1.38E-02	1.26E-01	---	1986	90500.	211600.	19.	2.91E-03	2.66E-02	---	1.31E-03	1.20E-02	---
Am-241	<1.50E+01	3454	9.13E-01	---	6.32E-06	1986	90500.	211600.	19.	8.00E-01	---	5.48E-06	6.32E-01	---	4.35E-06
Total Am-241	<1.50E+01	---	---	---	---	---	---	---	---	---	---	---	8.72E-01	---	6.02E-06

[a] mg/L
[b] Hazard Quotient

As indicated in Section 5.2, the primary source of chromium and one of the primary sources of H-3 were the disposal practices at TRA. As a result, the peak concentrations noted in Table 7-3 reflect the contribution to the aquifer at TRA. To distinguish the aquifer contamination between the ICPP and TRA areas, Tables 7-4 and 7-5 below present the peak concentrations underlying those local facility areas. By comparing the peak concentrations for the entire aquifer area, the ICPP area and the TRA area, it is clear that the source of primary aquifer concern resulting from chromium occurs as a result of TRA disposal practices. Although the TRA is the primary contributor of H-3 to the aquifer, by the year 2095, the short half-life and lack of adsorption allows H-3 concentrations to fall below risk based levels. However, in the case of contaminants not disposed of at TRA, the concentrations shown in Table 7-5 reflect the mass transported into that area from dispersion and lateral migration from the ICPP area.

Table 7-4 Aquifer peak concentrations and risk for the ICPP footprint area.

COPCs	MCL (mg/L or pCi/L)	Simulation Results For The Period Spanning 1953 Through The Total Simulation Time				Simulation Results For The Year 2025			Simulation Results For The Year 2095		
		Peak Concentration (mg/L or pCi/L)	Peak HQ	Peak Risk	Year of Peak	Maximum Concentration (mg/L or pCi/L)	Maximum HQ*	Maximum Risk	Maximum Concentration (mg/L or pCi/L)	Maximum HQ*	Maximum Risk
Arsenic[a]	5.00E-02	1.95E-03	---	3.42E-05	2479	9.42E-05	---	1.67E-06	1.25E-03	---	2.19E-05
Chromium[a,b]	1.00E-01	2.44E-03	1.34E-02	---	2068	1.22E-03	6.69E-03	---	2.21E-03	1.21E-02	---
Co-60	1.00E+02	2.59E+01	---	1.03E-05	1986	3.36E-02	---	1.33E-08	0.00E+00	---	0.00E+00
Cs-137	2.00E+02	8.62E+01	---	5.72E-05	1979	3.20E+01	---	2.12E-05	5.91E+00	---	3.93E-06
H-3	2.00E+04	2.62E+06	---	3.93E-03	1960	4.24E+03	---	6.38E-06	8.92E+01	---	1.19E-07
I-129	1.00E+00	9.71E+01	---	3.75E-04	1986	8.97E+00	---	3.46E-05	4.68E+00	---	1.81E-05
Mercury[a,b]	2.00E-03	7.42E-03	2.36E+00	---	1984	6.09E-03	1.94E+00	---	4.17E-03	1.33E+00	---
Np-237	<1.50E+01	3.05E+01	---	1.92E-04	1986	8.03E+00	---	5.06E-05	1.20E+00	---	7.57E-06
Total Pu	<1.50E+01	3.62E+01	---	2.43E-04	3585	3.22E-01	---	2.15E-06	1.39E-01	---	9.54E-07
Sr-90	8.00E+00	1.20E+03	---	1.41E-03	1967	3.54E+01	---	4.15E-05	8.08E+00	---	9.48E-06
Tc-99	9.00E+02	2.03E+02	---	5.96E-06	1997	5.51E+01	---	1.61E-06	2.39E+01	---	7.15E-07
Total U	1.40E+01	1.01E+01	---	1.31E-05	1986	1.86E+00	---	2.44E-06	7.38E-01	---	9.54E-07
Total U[a,b]	2.00E-02	1.38E-02	1.26E-01	---	1986	2.55E-03	2.33E-02	---	1.01E-03	9.22E-03	---
Am-241	<1.50E+01	9.13E-01	---	6.32E-06	1986	8.00E-01	---	5.48E-06	6.32E-01	---	4.35E-06
Total Am-241	<1.50E+01	---	---	---	---	---	---	---	8.72E-01	---	6.02E-06

[a] mg/L
[b] Hazard Quotient

Table 7-5 Aquifer peak concentrations and risk for the TRA footprint area.

COPCs	MCL (mg/L or pCi/L)	Simulation Results For The Period Spanning 1953 Through The Total Simulation Time				Simulation Results For The Year 2025			Simulation Results For The Year 2095		
		Peak Concentration (mg/L or pCi/L)	Peak HQ	Peak Risk	Year of Peak	Maximum Concentration (mg/L or pCi/L)	Maximum HQ*	Maximum Risk	Maximum Concentration (mg/L or pCi/L)	Maximum HQ*	Maximum Risk
Arsenic[a]	5.00E-02	2.13E-05	---	3.58E-07	2101	6.98E-07	---	1.17E-08	2.00E-05	---	3.58E-07
Chromium[a,b]	1.00E-01	9.01E-01	4.94E+00	---	1971	2.29E-02	1.25E-01	---	1.14E-02	6.25E-02	---
Co-60	1.00E+02	7.07E-04	----	2.81E-10	1984	1.16E-05	----	4.62E-12	0.00E+00	----	0.00E+00
Cs-137	2.00E+02	2.07E-07	----	1.37E-13	2134	4.42E-08	----	2.93E-14	1.68E-07	----	1.11E-13
H-3	2.00E+04	2.97E+05	----	4.46E-04	1972	2.08E+03	----	3.10E-06	2.28E-01	----	3.42E-10
I-129	1.00E+00	4.82E-01	----	1.85E-06	1971	2.56E-02	----	1.19E-07	1.21E-02	----	5.96E-08
Mercury[a,b]	2.00E-03	2.89E-07	9.21E-05	---	2118	3.21E-08	1.02E-05	---	2.54E-07	8.09E-05	---
Np-237	<1.50E+01	2.33E-02	----	1.19E-07	2052	2.00E-02	----	1.19E-07	1.96E-02	----	1.19E-07
Total Pu	<1.50E+01	2.91E-04	----	1.94E-09	3782	1.54E-04	----	1.03E-09	1.37E-04	----	9.13E-10
Sr-90	8.00E+00	1.56E-01	----	1.79E-07	2047	1.39E-01	----	1.79E-07	9.65E-02	----	1.19E-07
Tc-99	9.00E+02	2.39E+00	----	5.96E-08	2000	1.07E+00	----	5.96E-08	1.71E-01	----	9.52E-09
Total U	1.40E+01	1.39E-02	----	0.00E+00	2101	7.74E-03	----	0.00E+00	1.21E-02	----	0.00E+00
Total U[a,b]	2.00E-02	1.90E-05	1.73E-04	----	2101	1.06E-05	9.68E-05	----	1.65E-05	1.51E-04	----
Am-241	<1.50E+01	2.26E-06	----	1.56E-11	2211	5.94E-08	----	4.09E-13	8.69E-07	----	5.98E-12
Total Am-241	<1.50E+01	---	---	---	---	---	---	---	1.20E-06	----	8.25E-12

[a] mg/L
[b] Hazard Quotient

Institutional controls have been assumed to be in place until the year 2095. Of particular interest are the peak groundwater concentrations after the institutional control period. These peak concentrations and the time of peak are shown in Table 7-6. In the year 2095, peak concentrations in the aquifer are predicted to be decreasing for chromium, Co-60, Cs-137, H-3, I-129, mercury, Np-237, Tc-99, and Am-241. However, aquifer peak concentrations are predicted to rise after the year 2095 for Sr-90 (until year 2172), U (until year 2468), arsenic (until year 2479), and Pu (until year 3585).

Table 7-6 Aquifer peak concentrations and risk in the year 2095 or beyond.

COPCs	MCL (mg/L or pCi/L)	Peak Concentration For The Year 2095 And Beyond (mg/L or pCi/L)	Peak Risk (or HQ) For The Year 2095 And Beyond	Time of Peak Concentration
Arsenic[a]	5.00E-02	1.95E-03 (mg/L)	3.42E-05	2479
Chromium[a,b]	1.00E-01	3.23E-02 (mg/L)	1.77E-01 (HQ)	2095
Co-60	1.00E+02	0 (pCi/L)	0	2095
Cs-137	2.00E+02	5.91 (pCi/L)	3.92E-06	2095
H-3	2.00E+04	89.2 (pCi/L)	1.34E-07	2095
I-129	1.00E+00	4.68 (pCi/L)	1.81E-05	2095
Mercury[a,b]	2.00E-03	4.17E-03 (mg/L)	1.33 (HQ)	2095
Np-237	<1.50E+01	3.76 (pCi/L)	2.37E-05	2095
Total Pu	<1.50E+01	36.2 (pCi/L)	2.38E-04	3585
Sr-90	8.00E+00	16.1 (pCi/L)	1.87E-05	2172
Tc-99	9.0E+02	23.9 (pCi/L)	7.03E-07	2095
Total U	1.40E+01	7.3 (pCi/L)	7.30E-06	2468
Total U[a,b]	2.00E-02	0.01 (mg/L)	0.50 (HQ)	2468
Am-241	<1.50E+01	0.63 (pCi/L)	4.35E-06	2095
Total Am-241	<1.50E+01	0.87 (pCi/L)	6.00E-06	2095

[a] mg/L
[b] Hazard Quotient

Tables 5-42 and 5-43 present summaries of the initial COPCs inventories assumed to be discharged at each contaminant source. These tables are useful, but primarily as a result of radioactive decay in the vadose zone, can be misleading for interpreting which sources contribute significantly to the peak concentrations in the aquifer. By analyzing the information in Tables 5-42 and 5-43, the mass flux to the aquifer plots, and the peak aquifer concentration plots, the primary sources of the aquifer contamination at various time frames can be identified. Of the COPCs;

- contaminant discharges to the surface are the primary contributors to the aquifer peak concentrations and the discharges to the ICPP injection well are insignificant for arsenic, chromium (in the ICPP footprint), total Pu, and Tc-99. For these COPCs, the peak aquifer concentration curves are strongly correlated to the mass flux to the aquifer curves.
- contaminant discharges to the ICPP injection well are the primary contributors to the aquifer peak concentrations and surface discharges are insignificant for mercury, Co-60, Cs-137, H-3, I-129, Np-237, and Am-241. For these COPCs, there are is no correlation between the peak aquifer concentration curves and the mass flux to the aquifer curves, because the discharges to the ICPP injection well are not included in the mass flux to the aquifer curves.

- contaminant discharges to both the injection well and surface are significant contributors to the aquifer peak concentrations for Sr-90 and Total U. Therefore, the peak concentration curve is a composite of the aquifer response to the injection well discharge in early time and the mass flux to the aquifer curve (from the time of the failed injection well and surface sources) in later time.

Table 7-7 summarizes the primary contributing sources to the predicted peak aquifer concentrations, for the time periods pre- and post- the year 2095.

Table 7-7 Summarize the primary contributing sources to the predicted peak aquifer concentrations, for the time periods pre- and post- the year 2095.

COPC	Pre-2095	Post-2095
Arsenic	Soil Contamination	Soil Contamination
Chromium	Total aquifer domain - TRA ICPP footprint - Soil Contamination	Total aquifer domain - TRA ICPP footprint - Soil Contamination
Co-60	Injection Well	Injection well
Cs-137	Injection Well	Injection well
H-3	Injection Well	Injection well
I-129	Injection Well	Injection well
Mercury	Injection Well	Injection well[1]
Np-237	Injection Well	Injection well, Tank Farm, and Soil Contamination
Total Pu	Injection Well	Initially the Injection well. Tank Farm after the year 2200
Sr-90	Injection Well	Tank Farm
Tc-99	Tank Farm	Tank Farm
Total U	Injection Well	Tank Farm and Soil Contamination
Am-241	Injection Well	Injection Well

[1] the mercury from soil contamination is expected to reach the aquifer in approximately 10,00 years but the mercury flow and transport was only simulated for approximately 150 years because it was determined that the vadose zone concentrations could not pose a risk to the aquifer. Eventually, the soil contamination mercury source will be a larger contributor to the aquifer concentrations than the injection well.

The sensitivity analysis results are discussed below in Section 8. Uncertainty in the results and means of estimating the relative impact of some of the modeling assumptions is addressed as part of the model calibration activities presented in Sections 3 and 4, and as sensitivity studies in Sections 8 through 11.

8 VADOSE ZONE AND AQUIFER TRANSPORT SENSITIVITY

Eleven sensitivity simulation runs were evaluated in order to identify the sensitivity of the model results to 1) the Sr-90 assumed Kd, 2) increases in the Sr-90 source from the Tank Farm area, 3) increase in the assumed water leakage from the water supply and fire system lines, 4) possibly leaky well that allows water in the upper interbed to move directly to the aquifer, 5) the assumed Kd for I-129 and to assess the relative influence of Kd in the vadose zone vs. that in the sediments, 6) the Np-237 assumed Kd value, and 7) the aquifer Kd for Total Pu. Table 8-1 lists the sensitivity runs and the sections where the discussion is presented. These results will be summarized in Section 8.8.

Table 8-1 Sensitivity Analyses.

Purpose of Simulation Run	Section	Parameter Varied
Sr-90 Sensitivity to Kd	8.1.1	Sr-90 With A Kd=24 cm^3/g
	8.1.2	Sr-90 With A Kd=0 cm^3/g
Sr-90 With Increased Tank Farm Source Mass	8.2	Sr-90 With Increased Tank Farm Source Mass
Sr-90 With Increased Fire Water Leakage	8.3	Sr-90 With Increased Fire Water Leakage
Sr-90 Leakage From The Upper Interbed	8.4.1	Sr-90 With 1-GPM Leakage From The Upper Interbed
	8.4.2	Sr-90 With 5-GPM Leakage From The Upper Interbed
	8.4.3	Sr-90 With 10-GPM Leakage From The Upper Interbed
I-129 Sensitivity to Kd	8.5.1	I-129 With A Sediment Kd=0.4 cm^3/g, and Aquifer Basalt Kd=0.016 cm^3/g
	8.5.2	I-129 With A Sediment Kd=0.4 cm^3/g, and Aquifer Basalt Kd=0.4 cm^3/g
Np-237 Sensitivity to Kd	8.6.1	Np-237 With A Kd=0 cm^3/g
Total Pu Sensitivity to Kd	8.7.1	Total Pu With the Sediment Kd=220 cm^3/g and Aquifer Basalt Kd=8.8 cm^3/g

8.1 Sr-90 Sensitivity to Kd

The sensitivity to sorptive capacity of transport through the vadose zone is a non-linear function. The non-linearity is introduced as a complex function of travel time and radioactive decay. To analyze the net non-linearity in this model, Sr-90 was simulated using three different values of Kd. These include Kd=0, 12, and 24 cm^3/g. Simulation results using a Kd=12 cm^3/g were presented as part of the base-case analysis in Section 7.10. In Section 8.1.1, the results of increasing the Kd to 24 cm^3/g are presented. The limiting case simulation results with a Kd of 0 cm^3/g are presented in Section 8.1.2.

These simulations use the base contaminant sources for Sr-90 which included in order of decreasing contribution: a) CPP-31 (60.82%), b) CPP-28 (31.66%), c) Soils (5.71%), d) CPP-80 (1.42%), e) CPP-02 (0.17%), f) the injection well (0.12%), and g) the '86 release (0.09%). Transport through the vadose zone is represented in Figures 8-1 through 8-10 and Figures 8-11 through 8-24 present simulation results for the aquifer region. Contour levels for both the vadose zone and aquifer are given for $8x10^{-2}$, $8x10^{-1}$, 8 (the MCL), $8x10^{+1}$, $8x10^{+2}$, and $8x10^{+3}$ pCi/L. The corresponding risk contour maps for the aquifer simulation are plotted at the 10^{-7}, 10^{-6} (0.859 pCi/L), 10^{-5}, 10^{-4}, 10^{-3}, and 10^{-2} levels.

8.1.1 Sr-90 With A Kd=24 cm^3/g

The most useful way of comparing the results of this sensitivity simulation is to look at the model comparison plots to field data for the base case simulation (Figures 7-193 through 7-196 for the vadose zone and Figures 7-203 through 7-210 for the aquifer) and for this simulation (Figures 8-7 through 8-10 and Figures 8-17 through 8-24). Examination of the vadose zone comparison plots indicates that 1) the PW wells match the field data fairly well with either Kd=12 or Kd=24 cm^3/g in an area for which the source term is known reasonably well for the base case simulation, and 2) that the CPP wells are over predicted. This suggests two possibilities:

a. It was assumed that the tank farm sources were released at the surface in a waste stream with very low pH. Low pH typically reduces the Kd for most contaminants, and in these simulations, it was assumed that the Kd in the tank farm alluvium was zero. This was accomplished by placing the source mass in the top of the basalt just below the alluvium, in the model. As a result, the travel time through the alluvium was neglected, resulting in higher concentration Sr-90 in the upper basalt unit than would have been there if a non-zero Kd for the alluvium had been used. The non-zero Kd would have reduced the concentrations reaching the bottom of the alluvium through adsorption, and by increasing the residence time allowing radioactive decay to occur. As a result of the simulation assumptions and approach, the vadose zone simulation results suggest that the contaminants probably do adsorb in the alluvium underlying the tank farm.

b. If in fact, the Sr-90 does not adsorb to the underlying tank farm alluvium, the vadose zone comparison plots indicate that the tank farm source mass has been overestimated.

Of these two possibilities, the first is felt to be most likely in part because of the analysis of the aquifer comparison plots discussed below. However, in all probability, a better history match to the tank farm wells could be obtained by adjusting a combination of Kd and source mass.

Figures 7-192 and 8-6 indicate that the peak mass flux from the vadose zone to the aquifer arrives after year 2000. This means that field measurements taken prior to year 2000 provide an assessment of aquifer transport from the injection well because the vadose zone and aquifer sources can be separated. As a result, the aquifer comparison plots can be used to provide a means of analyzing the assumed aquifer basalt characteristics in as much as the vadose zone comparison plots provided a means of assessing those for the sediments. The sediment characteristics can be assessed by looking at the vadose zone transport results because the majority of the residence time in the vadose zone occurs in the lower permeability, higher sorptive capacity interbed layers. This happens because flow is nearly perpendicular to the interbed units, forcing the contaminants to flow through them. In contrast, transport in the aquifer occurs primarily parallel to the interbed layering and through the basalt units. As explained in Section 5.1, the basalt Kd in the aquifer is assumed to be 1/25th of the Kd applied in the sediment units (in both the vadose zone and aquifer) based on laboratory measurements of Kd.

Examination of Figures 7-203 through 7-210 and Figures 8-17 through 8-24 indicates that the wells near the injection well match the field data fairly well with basalt Kd=24/25 cm^3/g (sediment Kd=24 cm^3/g) as well as with a basalt Kd=12/25 cm^3/g (sediment Kd=12 cm^3/g). However, the arrival of Sr-90 in wells much further downstream is predicted to occur much later than indicated by the field data. In addition, predicted concentrations for those downstream wells are lower than observed in the field data. In contrast, predicted concentrations in the downstream wells for Kd=12/25 cm^3/g are higher, and the arrival more closely matches that observed in the field data. However, the predicted arrival is still slightly late. This suggests that a Kd of 8/25-10/25 cm^3/g may be more appropriate.

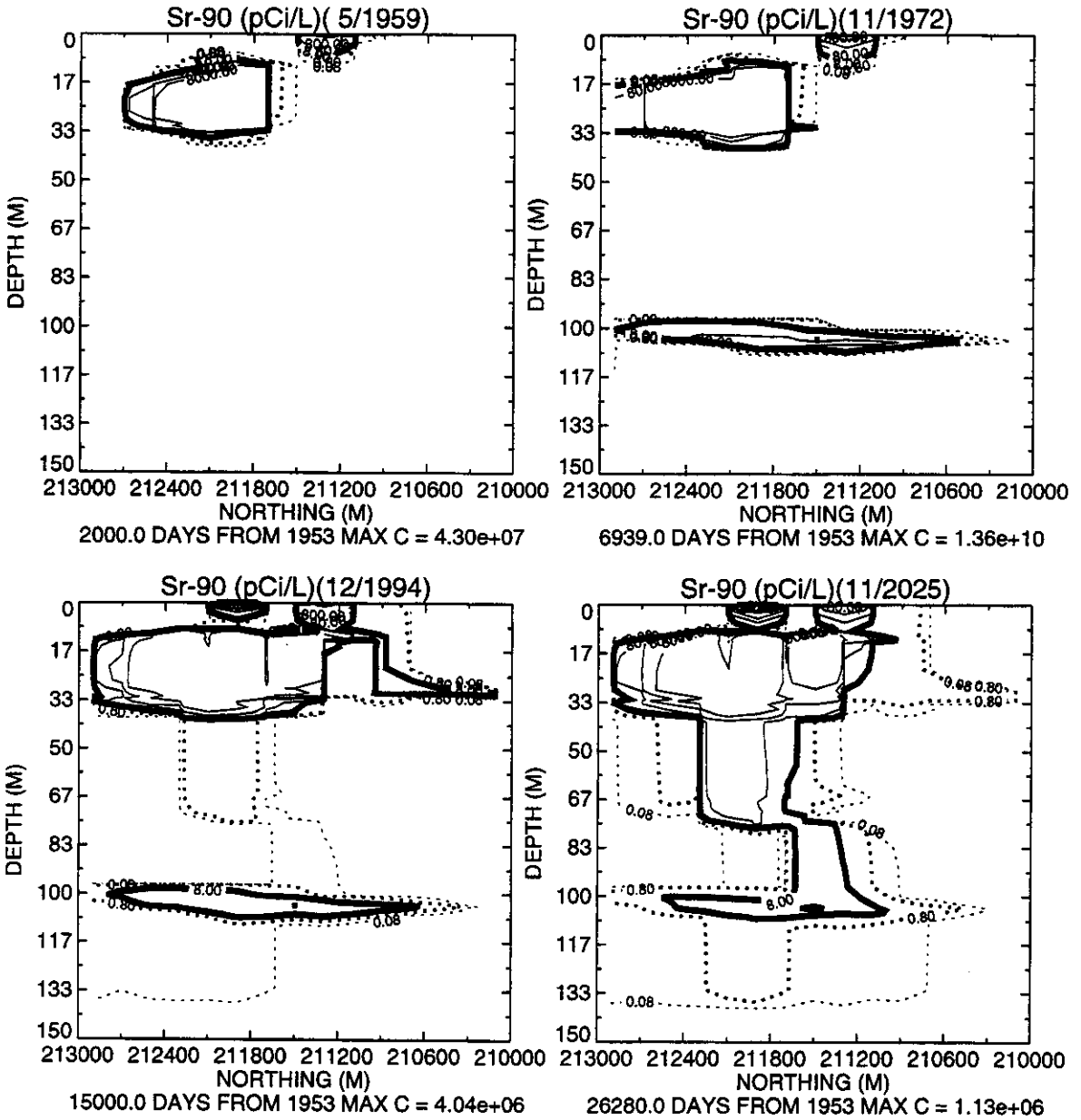


Figure 8-1 Vadose zone Sr-90 with a Kd=24 cm^3/g peak concentration contours.

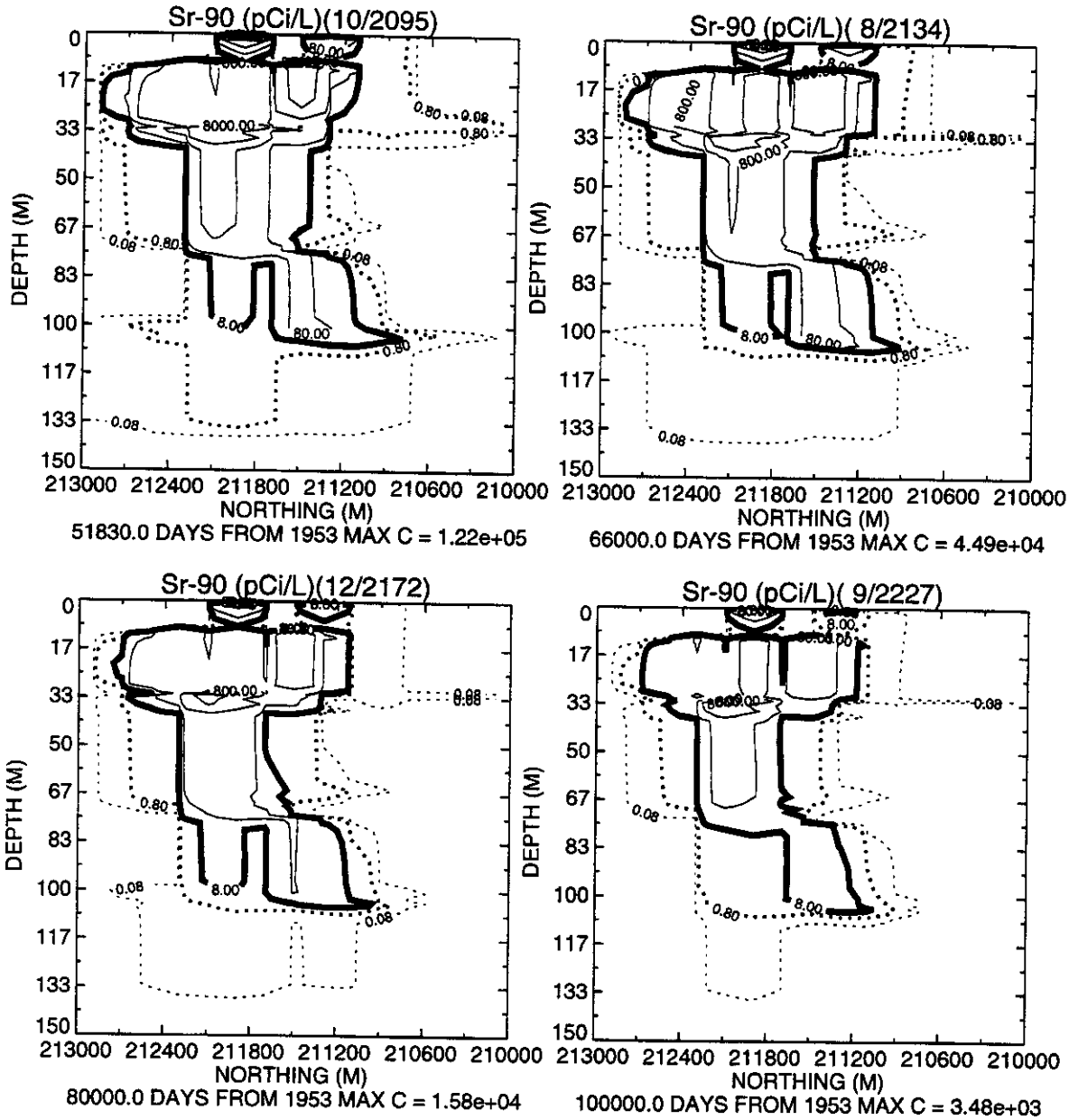


Figure 8-2 Vadose zone Sr-90 with a Kd=24 cm^3/g peak concentration contours.

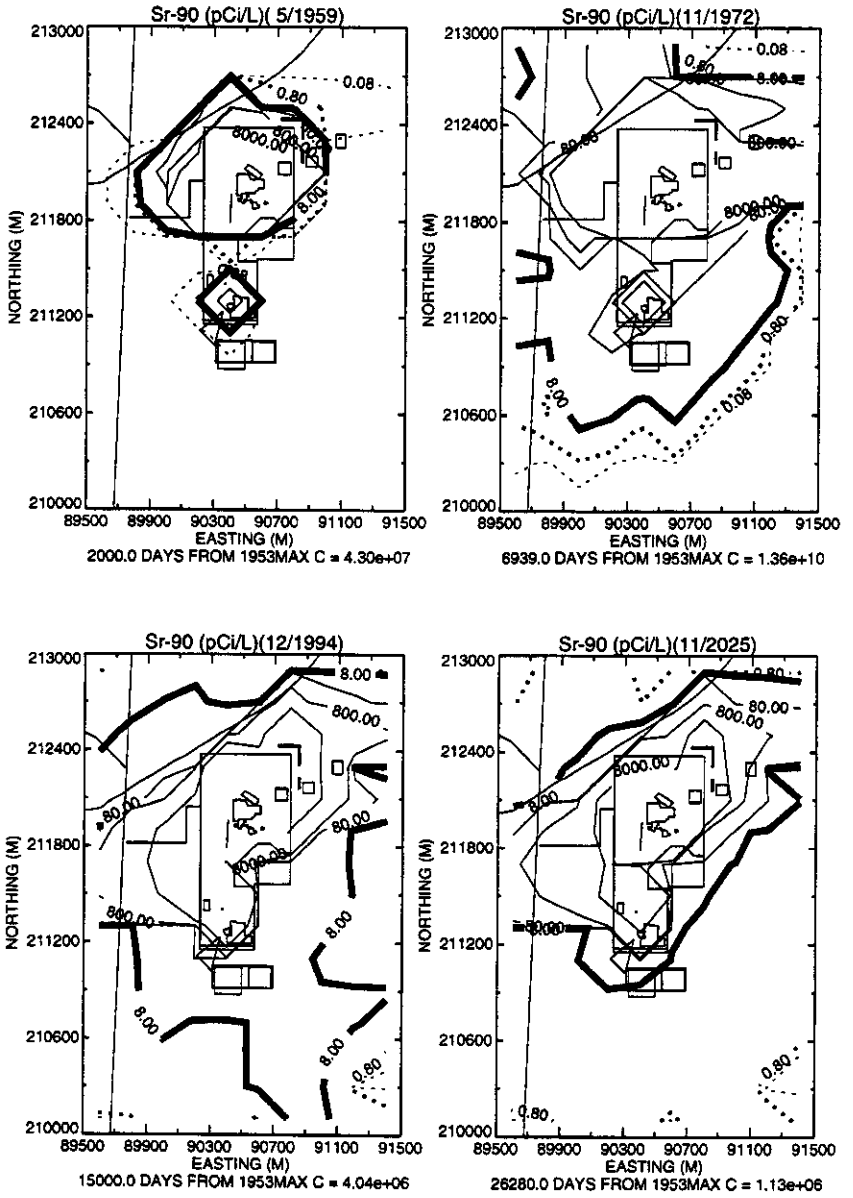


Figure 8-3 Vadose zone Sr-90 with a Kd=24 cm^3/g peak concentration contours.

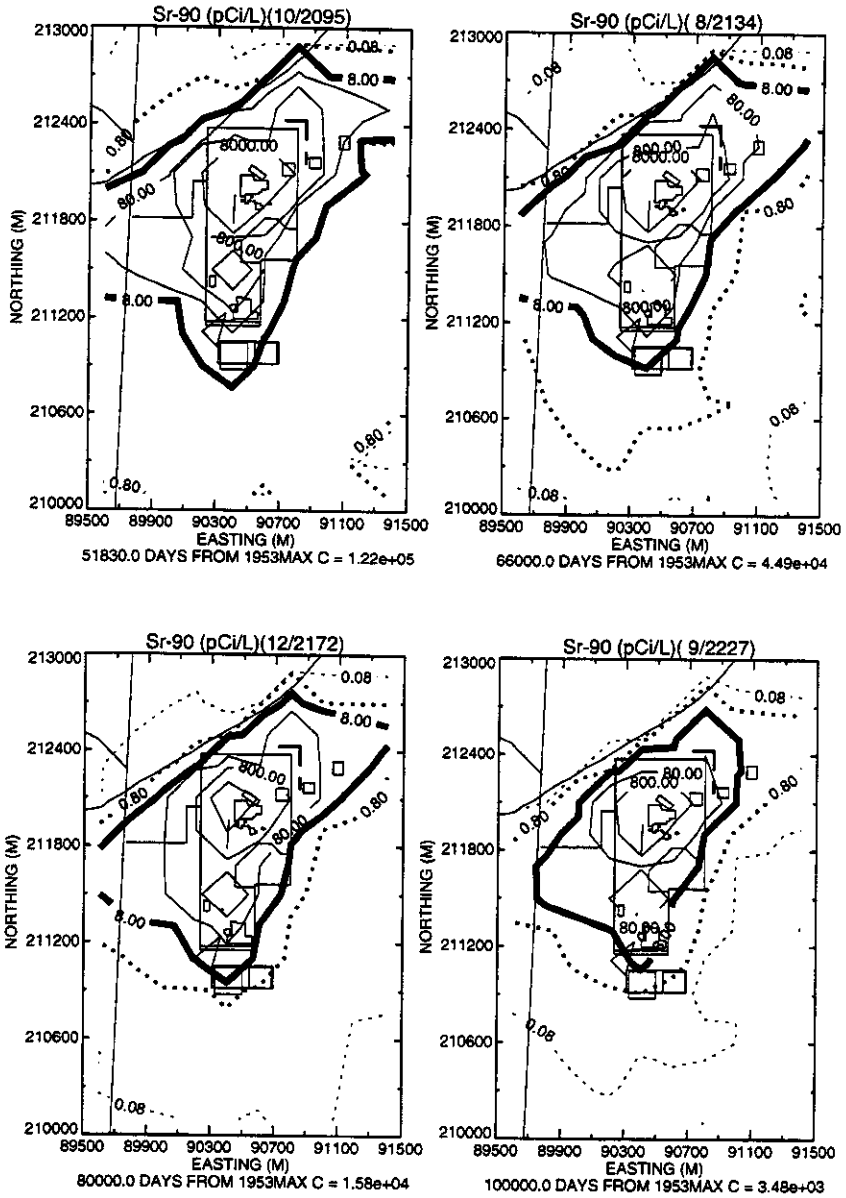


Figure 8-4 Vadose zone Sr-90 with a Kd=24 cm^3/g peak concentration contours.

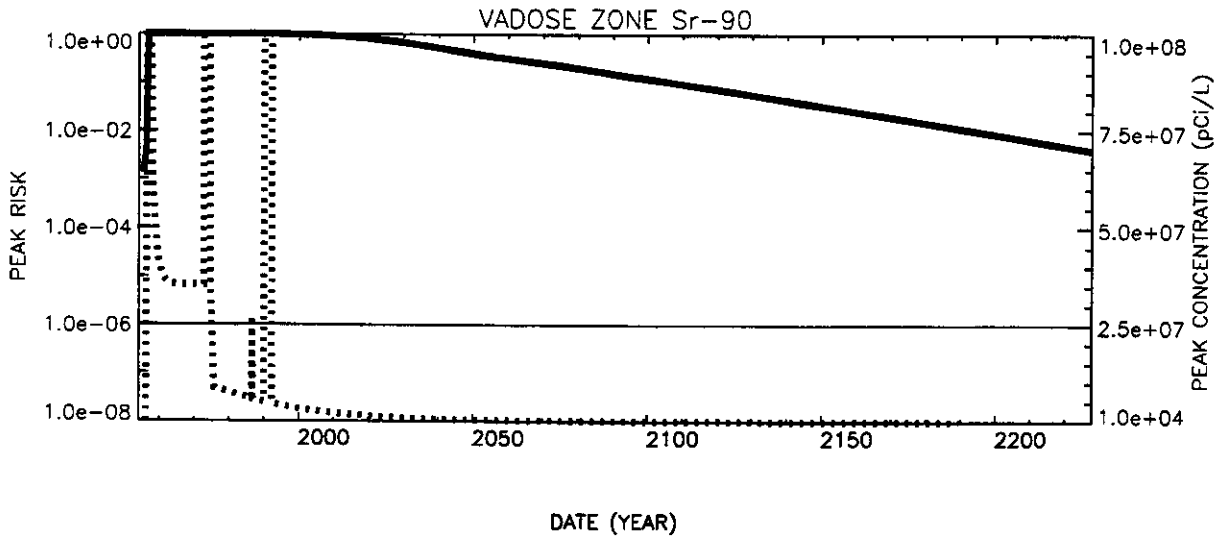


Figure 8-5 Peak vadose zone risk and concentration for Sr-90 with a Kd=24 cm^3/g. Risk indicated by the thick line on the log scale with the 10^{-6} value shown as the solid line. The dotted line represents concentration given by the linear scale on the right axis.

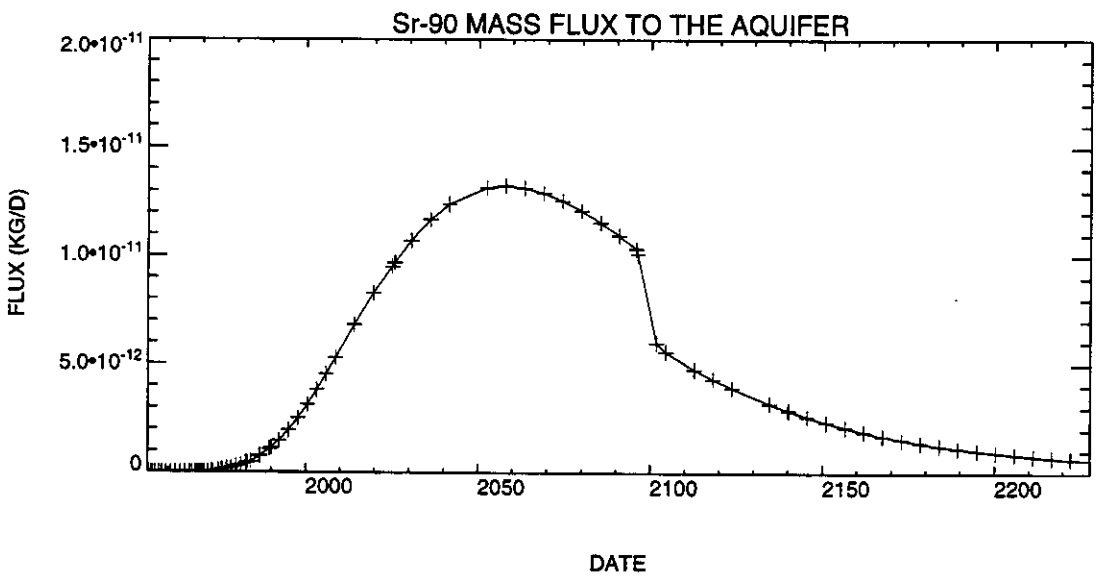


Figure 8-6 Mass flux of Sr-90 with a Kd=24 cm^3/g into the aquifer from the vadose zone.

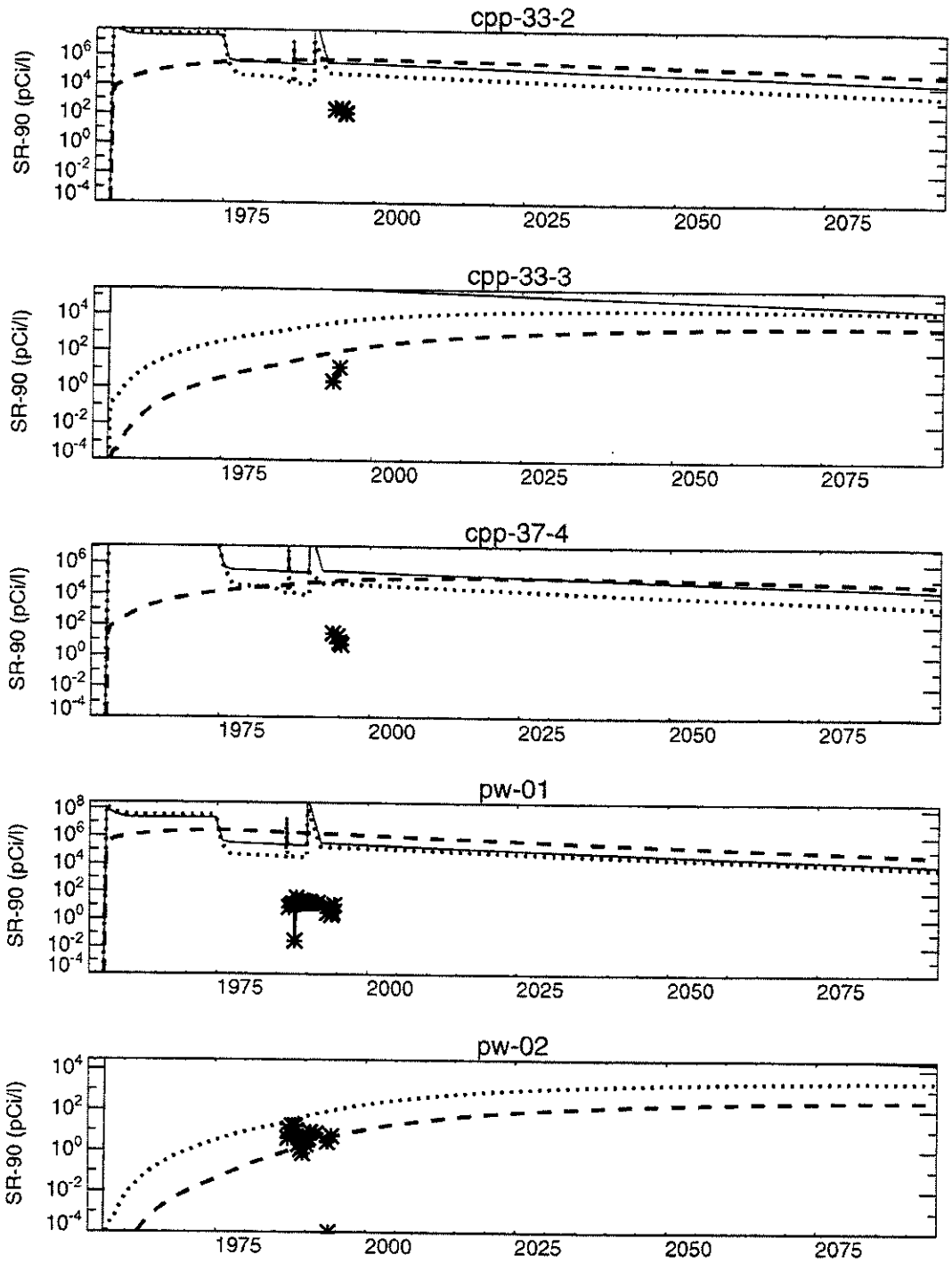


Figure 8-7 Comparison of vadose zone Sr-90 with a Kd=24 cm^3/g to field data.

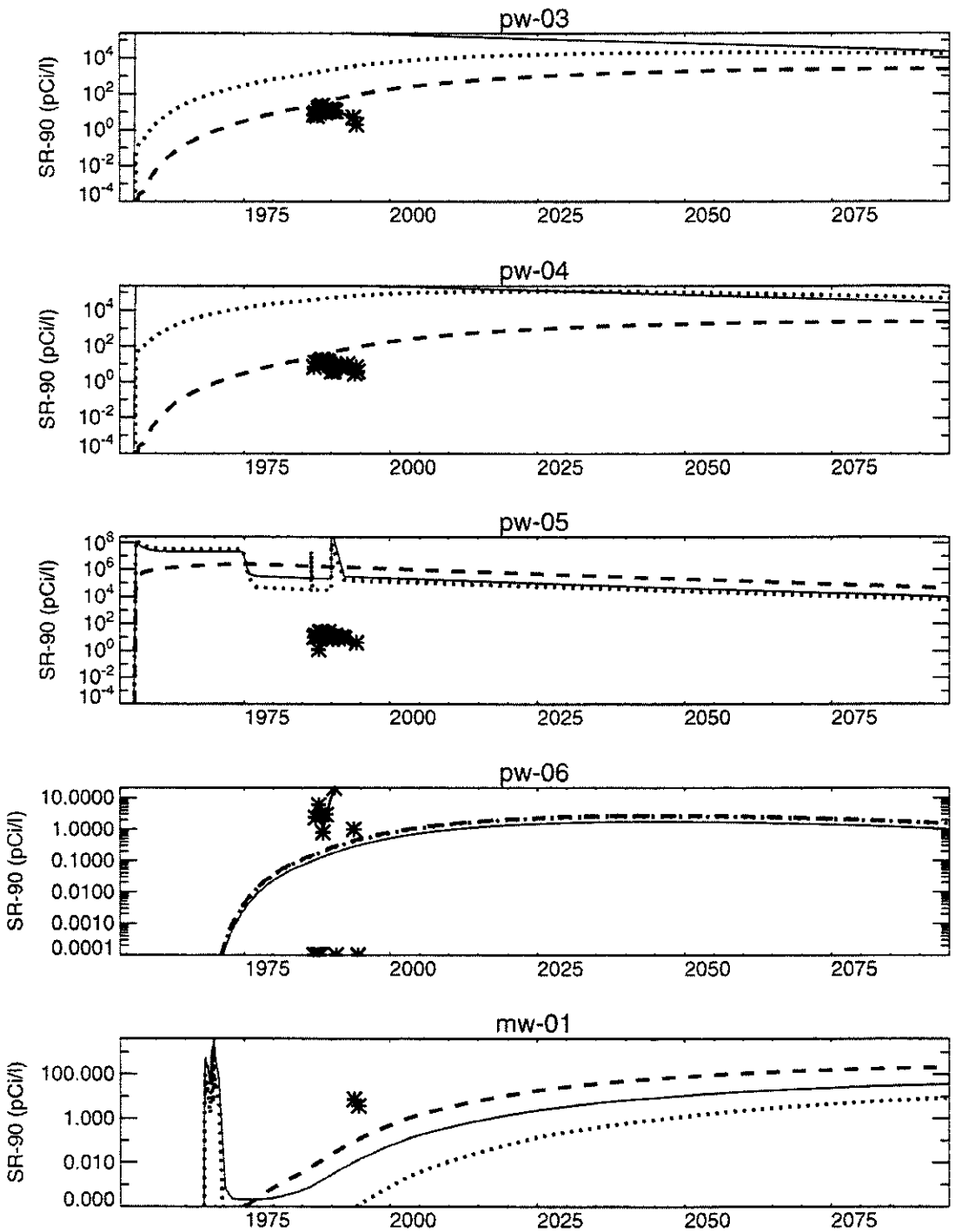


Figure 8-8 Comparison of vadose zone Sr-90 with a Kd=24 cm^3/g to field data.

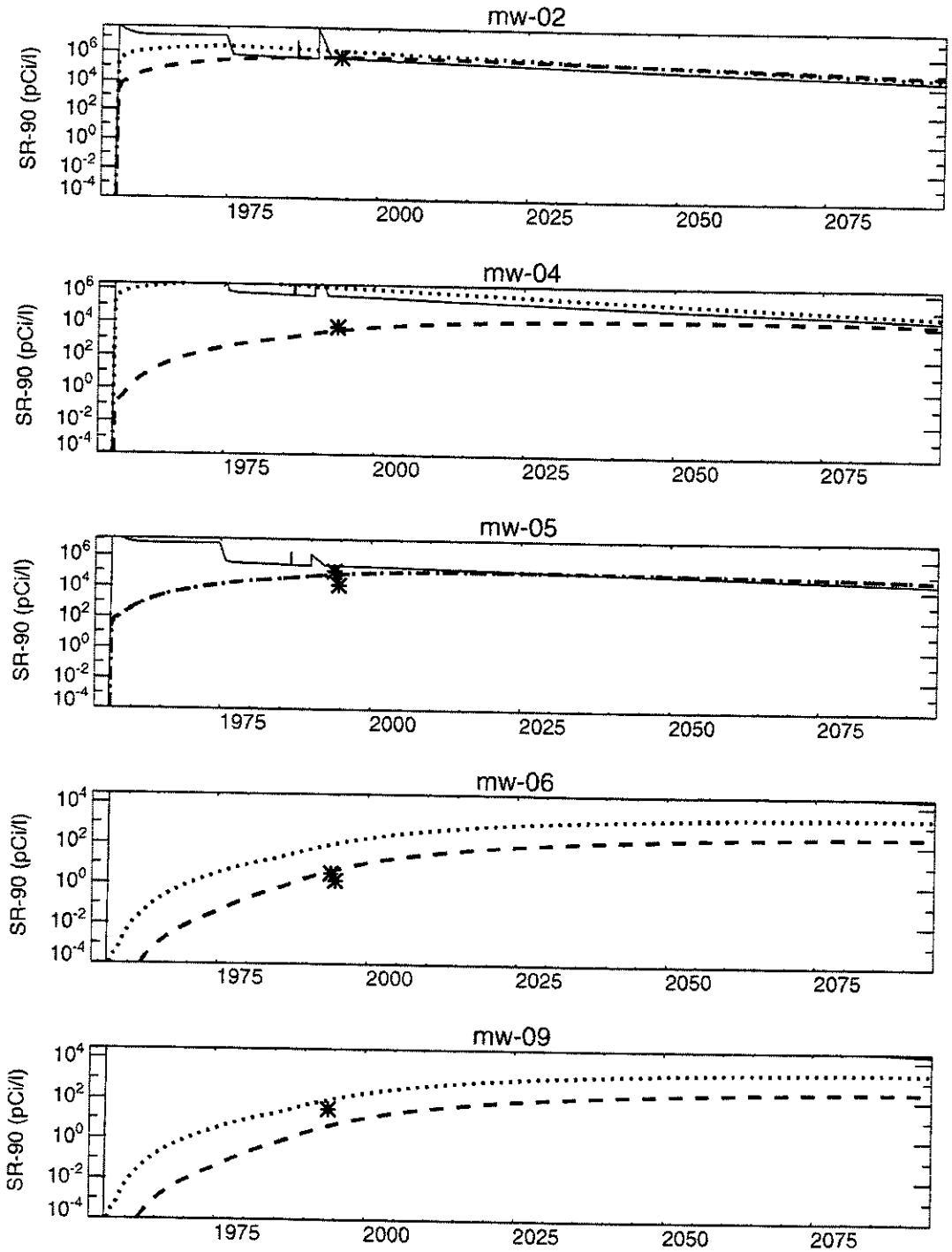


Figure 8-9 Comparison of vadose zone Sr-90 with a Kd=24 cm^3/g to field data.

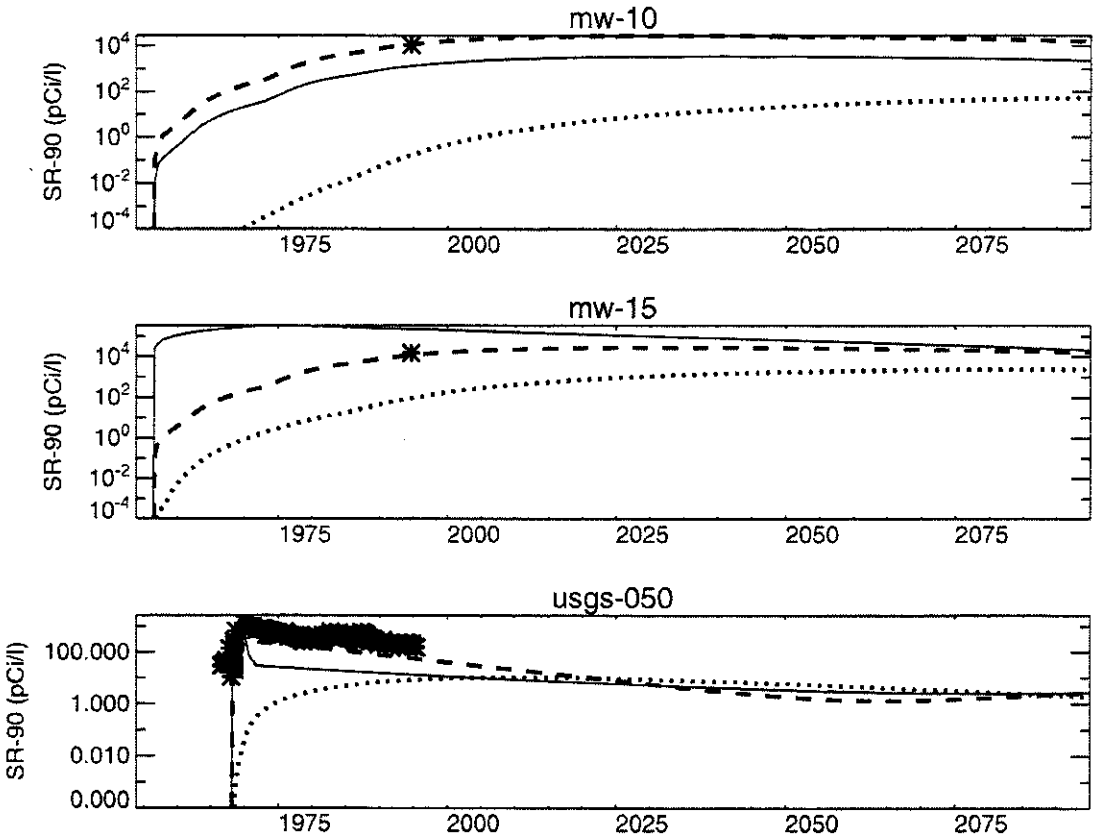


Figure 8-10 Comparison of vadose zone Sr-90 with a Kd=24 cm^3/g to field data.

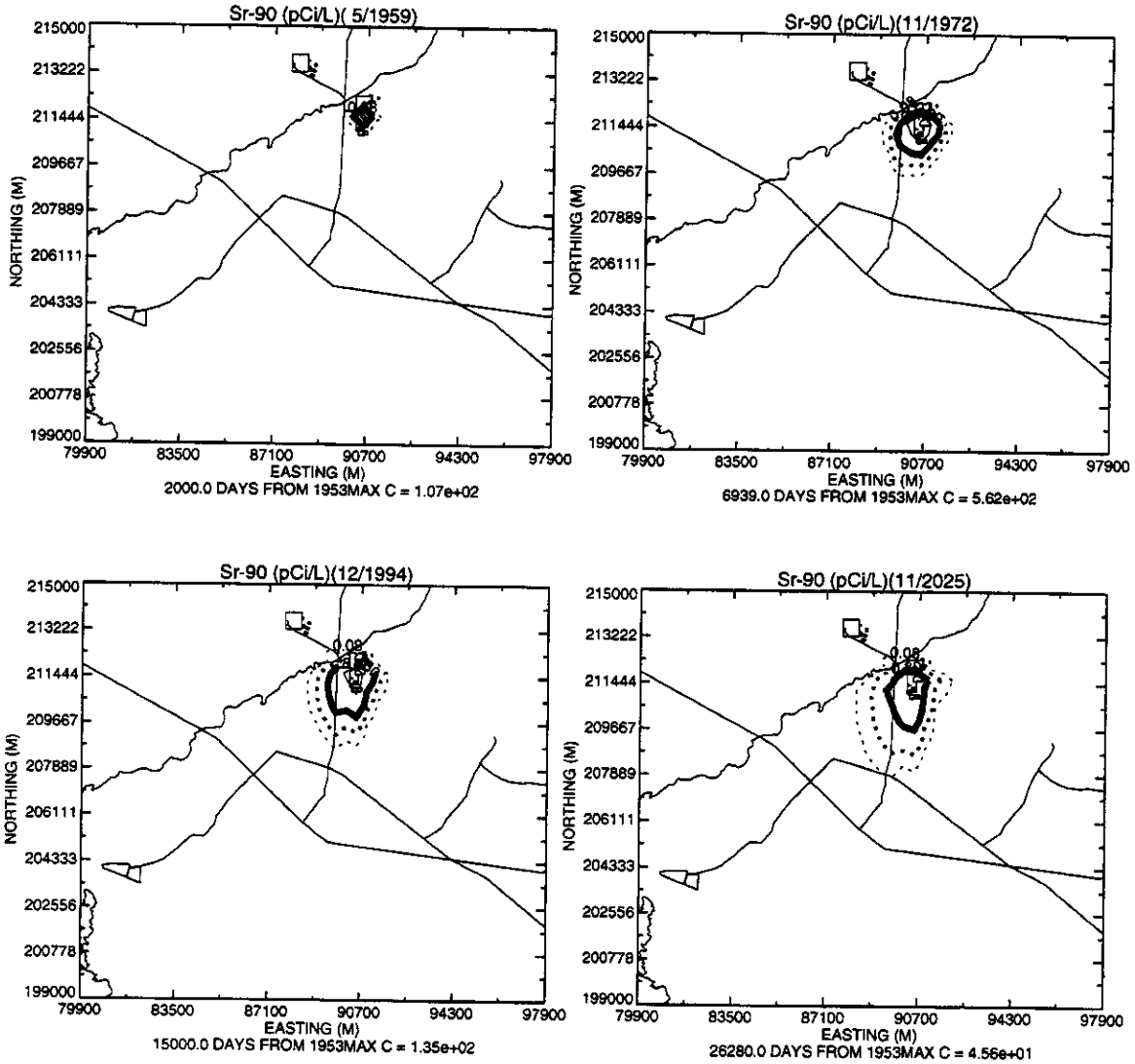


Figure 8-11 Aquifer Sr-90 with a Kd=24 cm^3/g peak concentration contours.

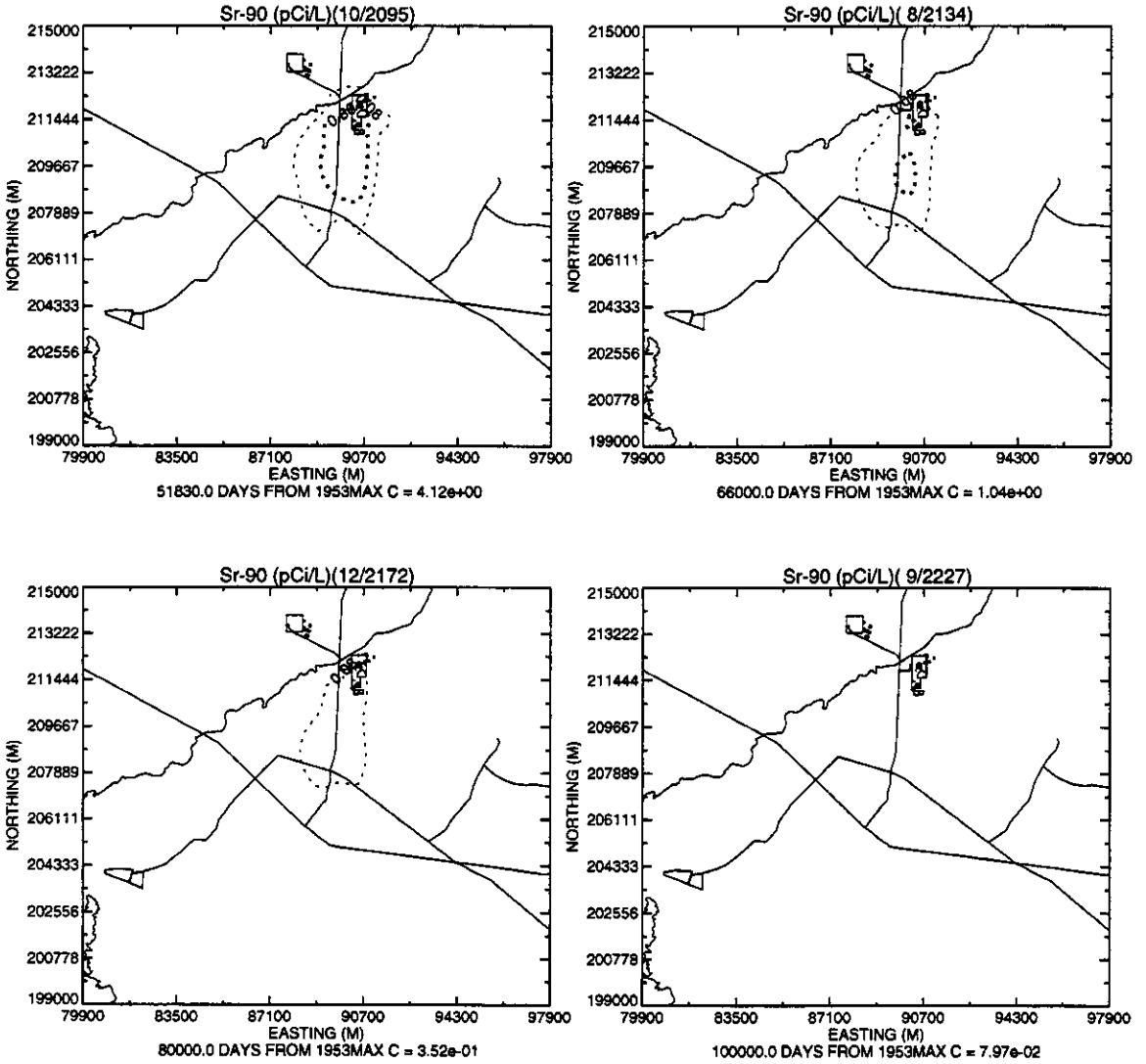


Figure 8-12 Aquifer Sr-90 with a Kd=24 cm^3/g peak concentration contours.

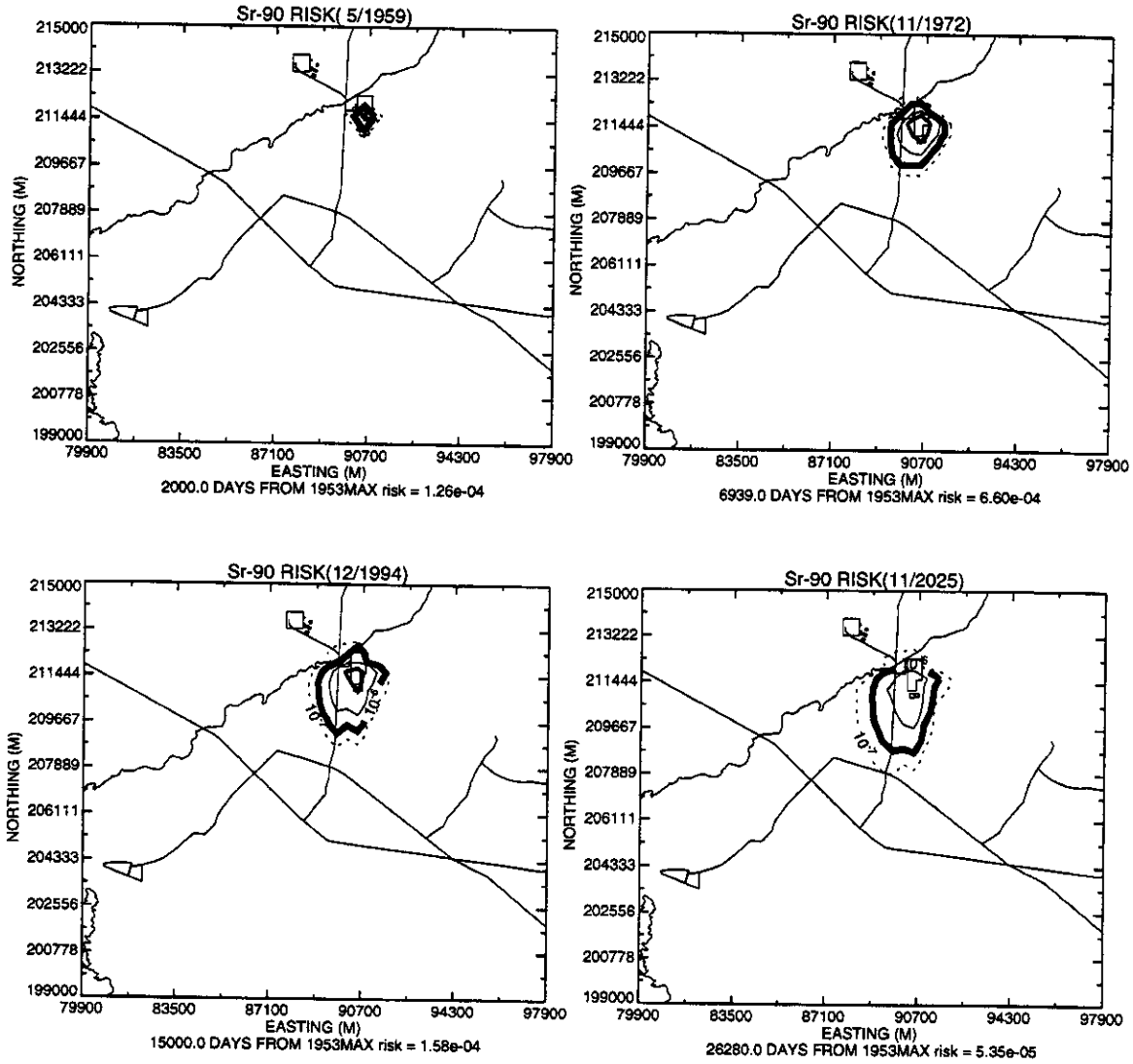


Figure 8-13 Aquifer Sr-90 with a Kd=24 cm^3/g peak risk contours.

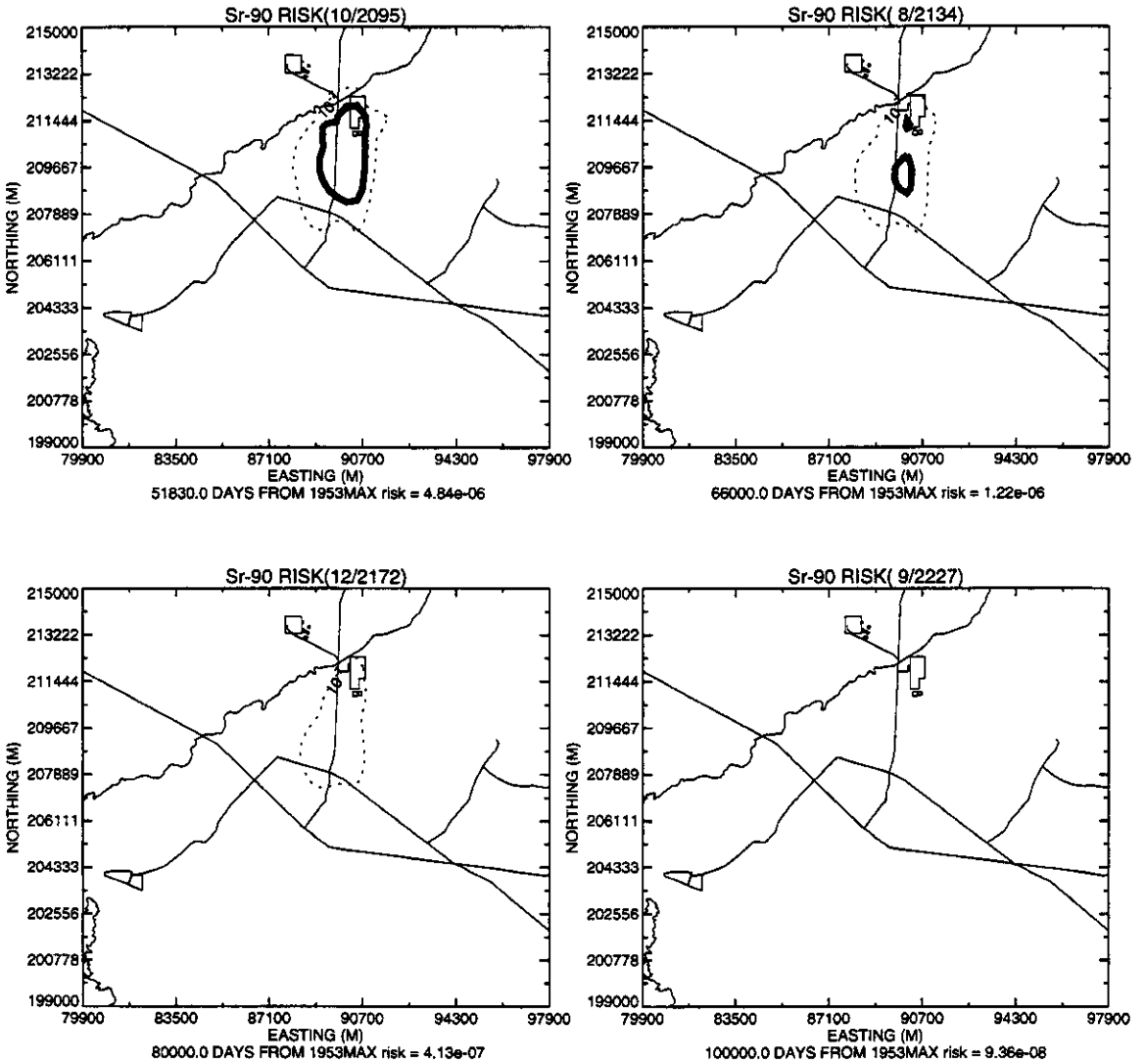


Figure 8-14 Aquifer Sr-90 with a Kd=24 cm^3/g peak risk contours.

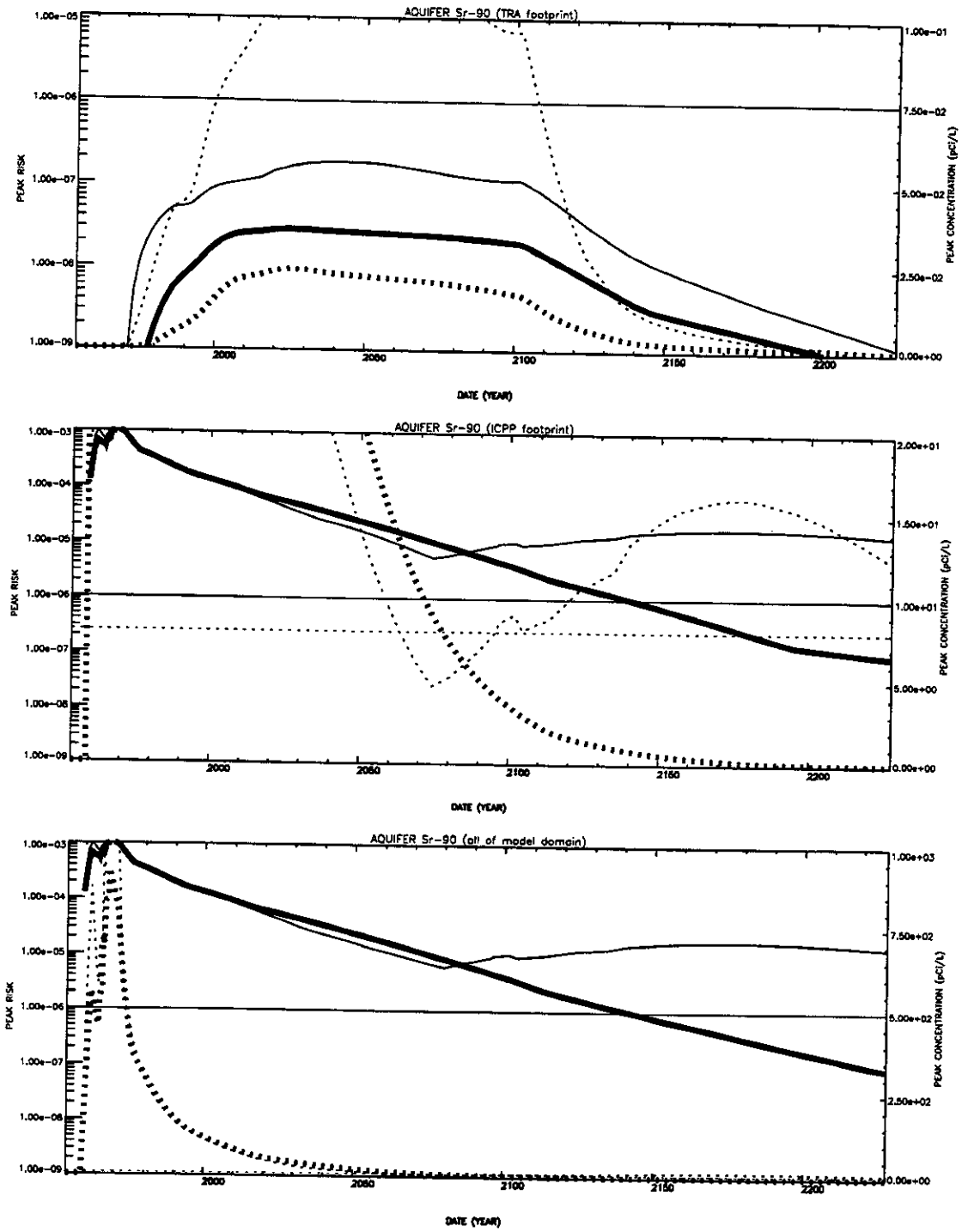


Figure 8-15 Peak aquifer concentration for Sr-90 with a Kd=24 cm^3/g. Top figure: TRA foot print, Middle figure: ICPP footprint, Bottom Figure: entire aquifer domain. Thick line risk (left scale), dotted line concentration (right scale) solid line 10^{-6} risk (left scale).

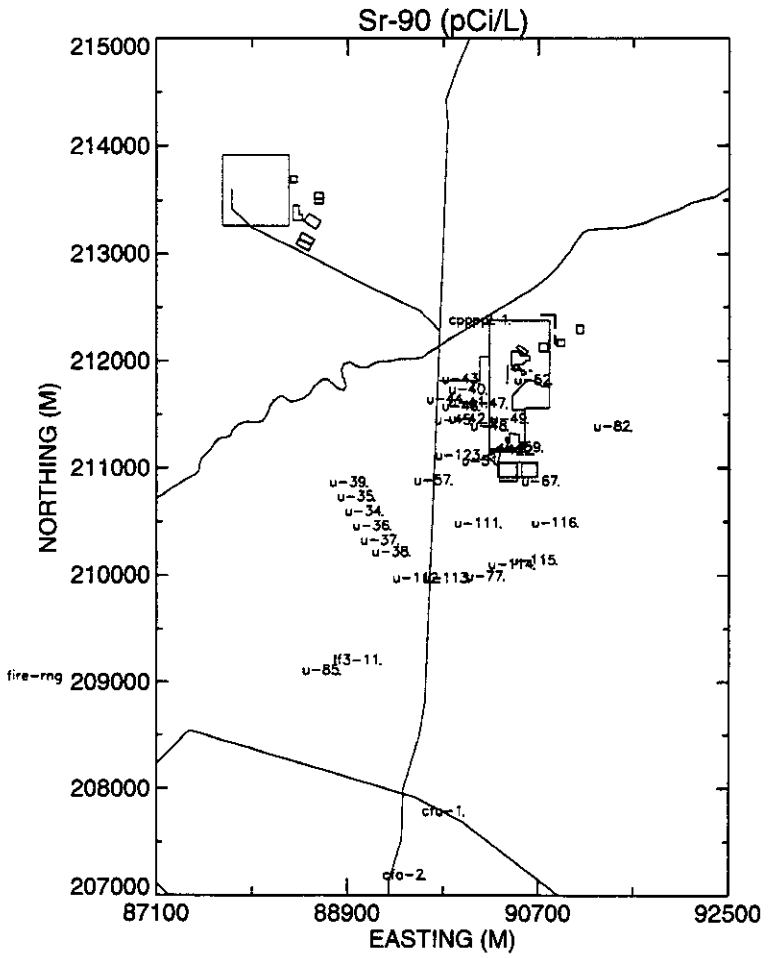


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Figure 8-16 Well locations for the comparison of aquifer Sr-90 with a Kd=24 cm^3/g to field data.

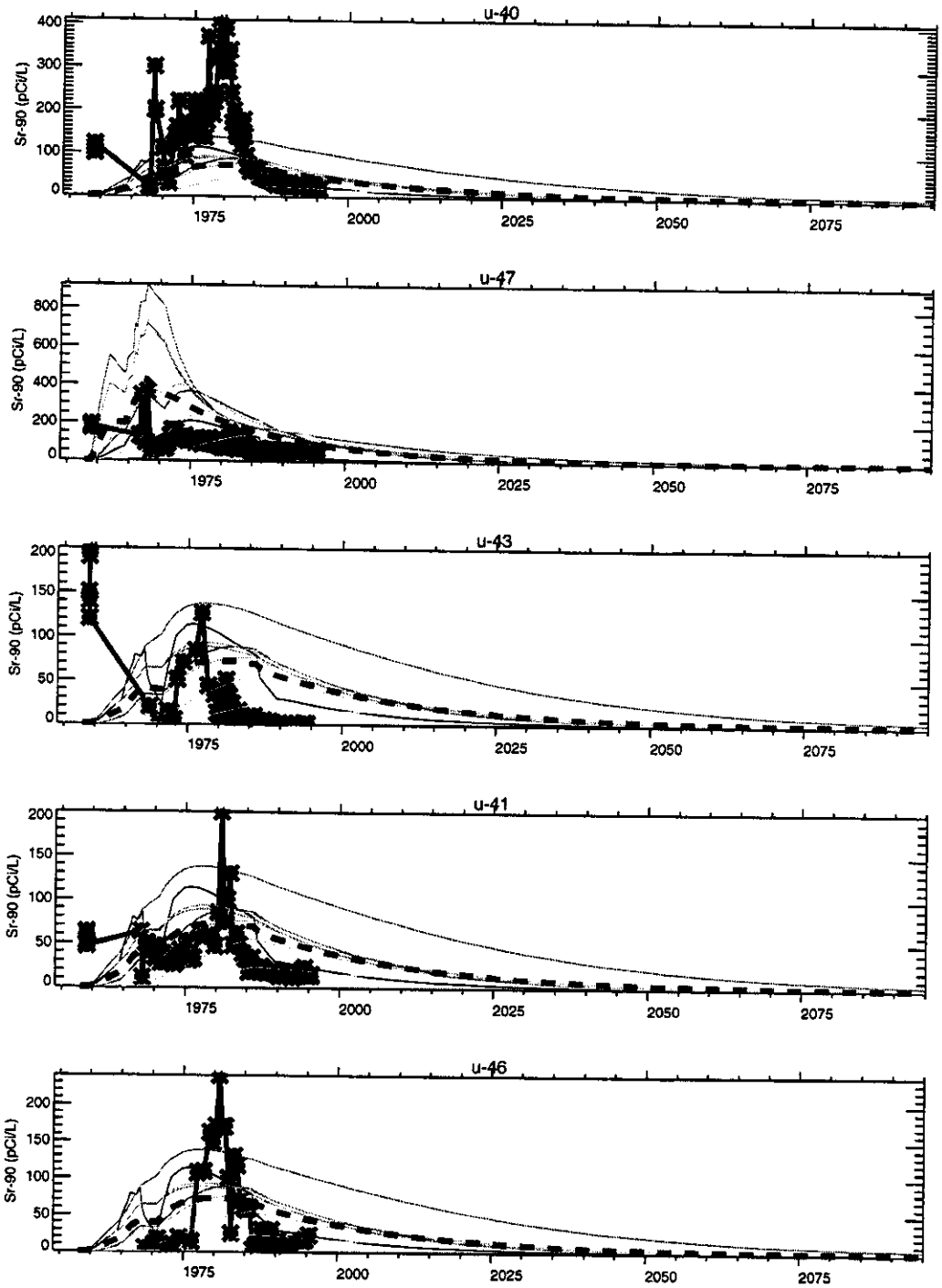

Figure 8-17 Comparison of aquifer Sr-90 with a Kd=24 cm^3/g to field data.

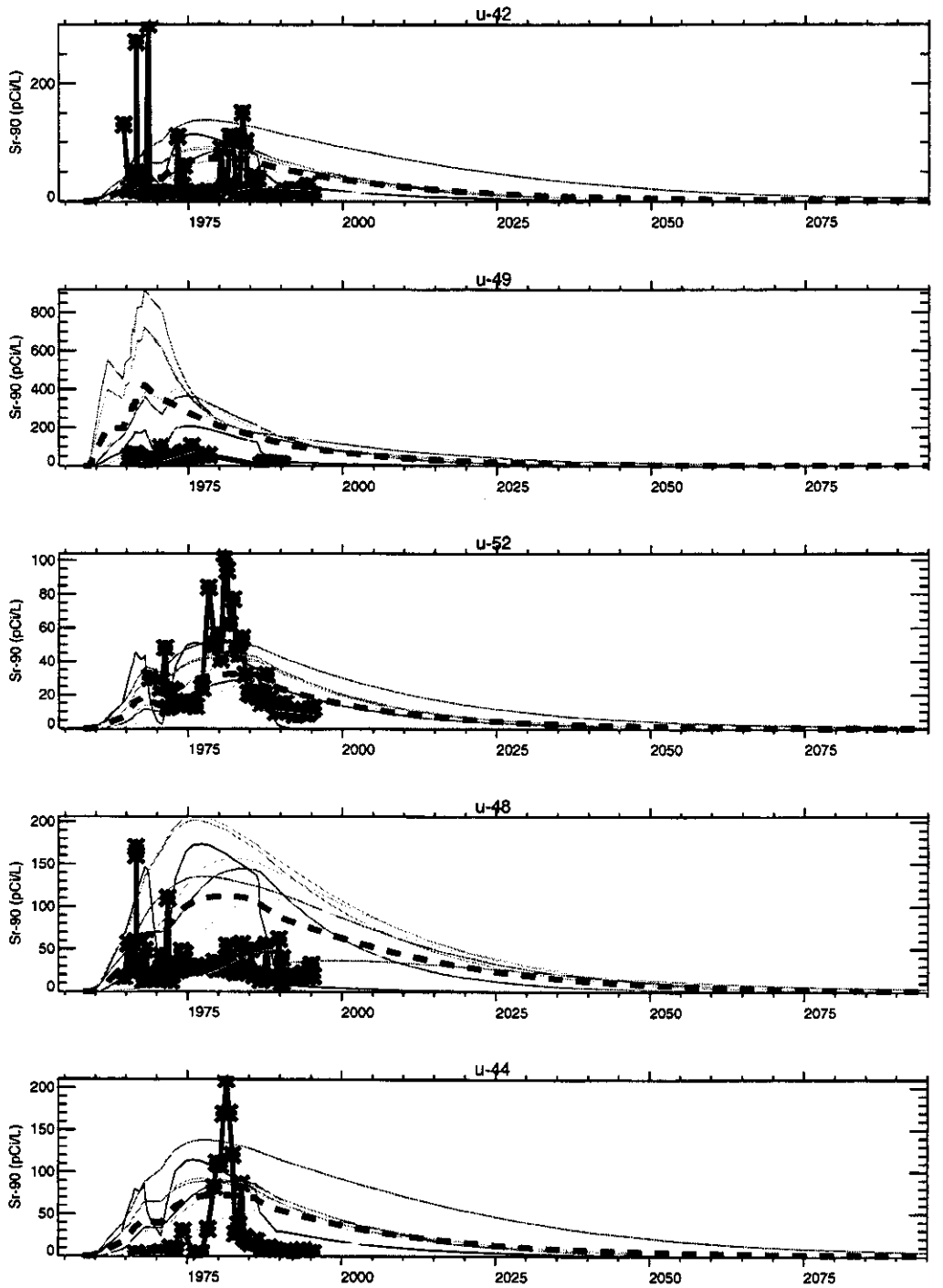

Figure 8-18 Comparison of aquifer Sr-90 with a Kd=24 cm^3/g to field data.

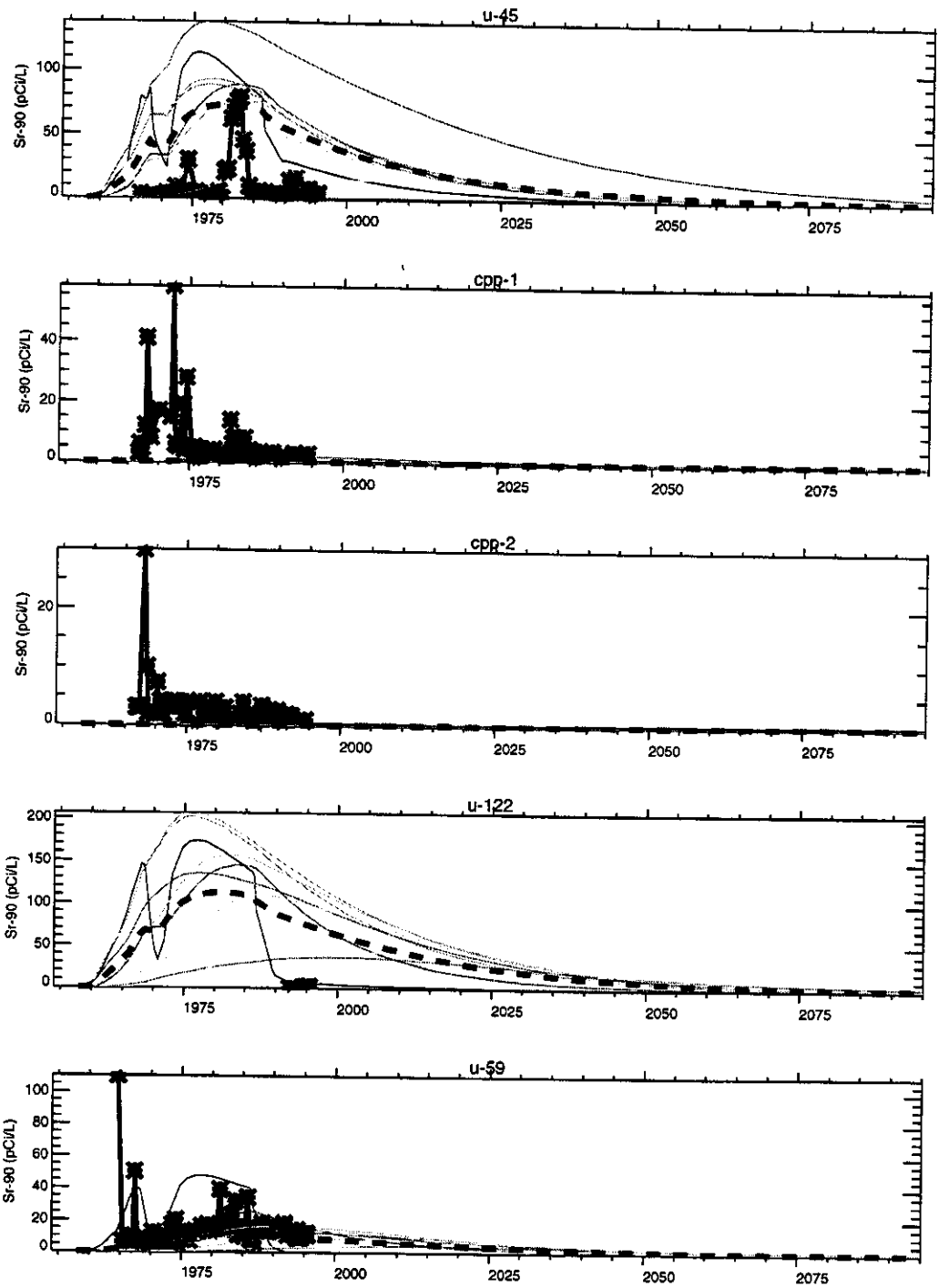

Figure 8-19 Comparison of aquifer Sr-90 with a Kd=24 cm^3/g to field data.

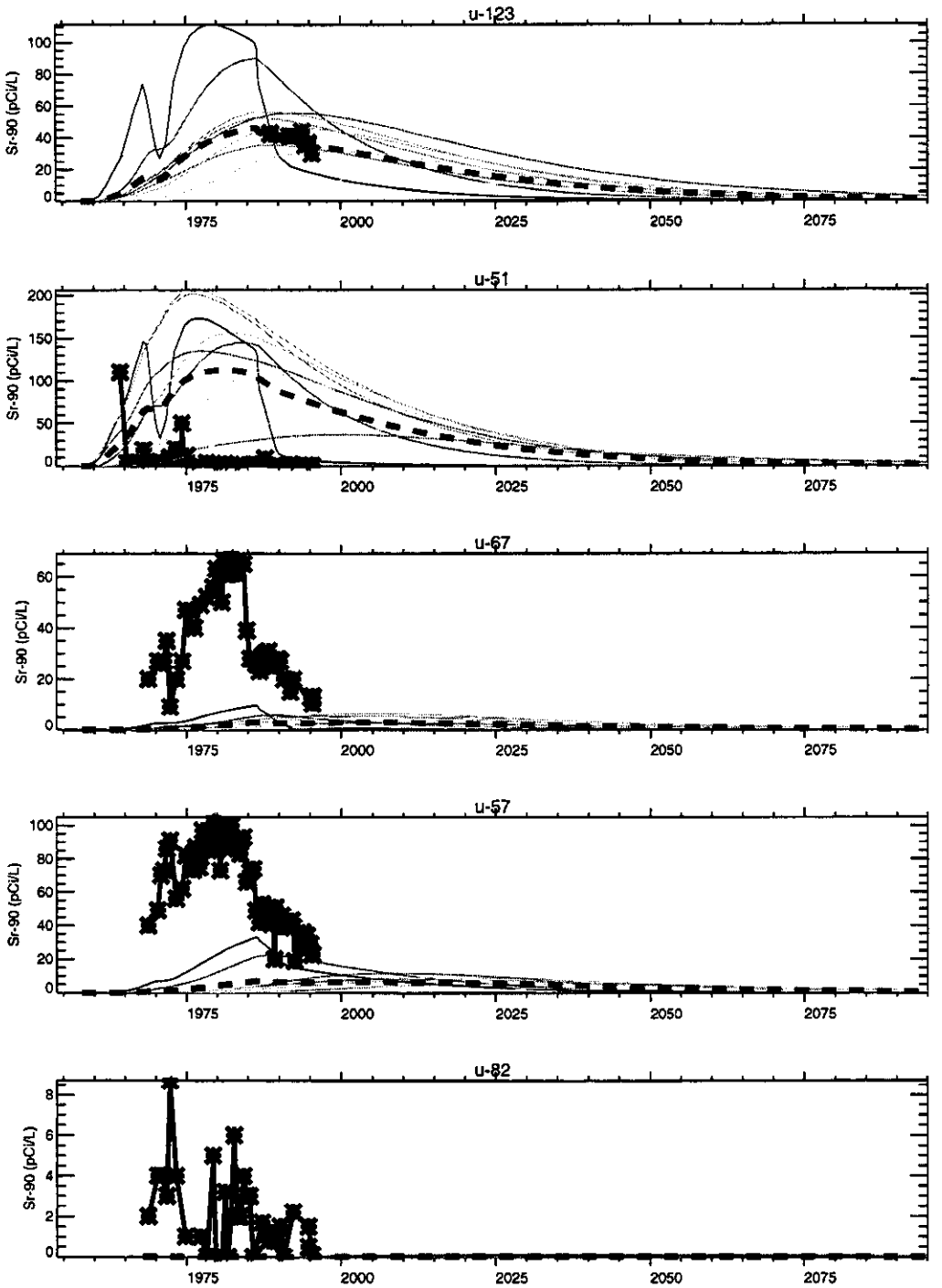

Figure 8-20 Comparison of aquifer Sr-90 with a Kd=24 cm^3/g to field data.

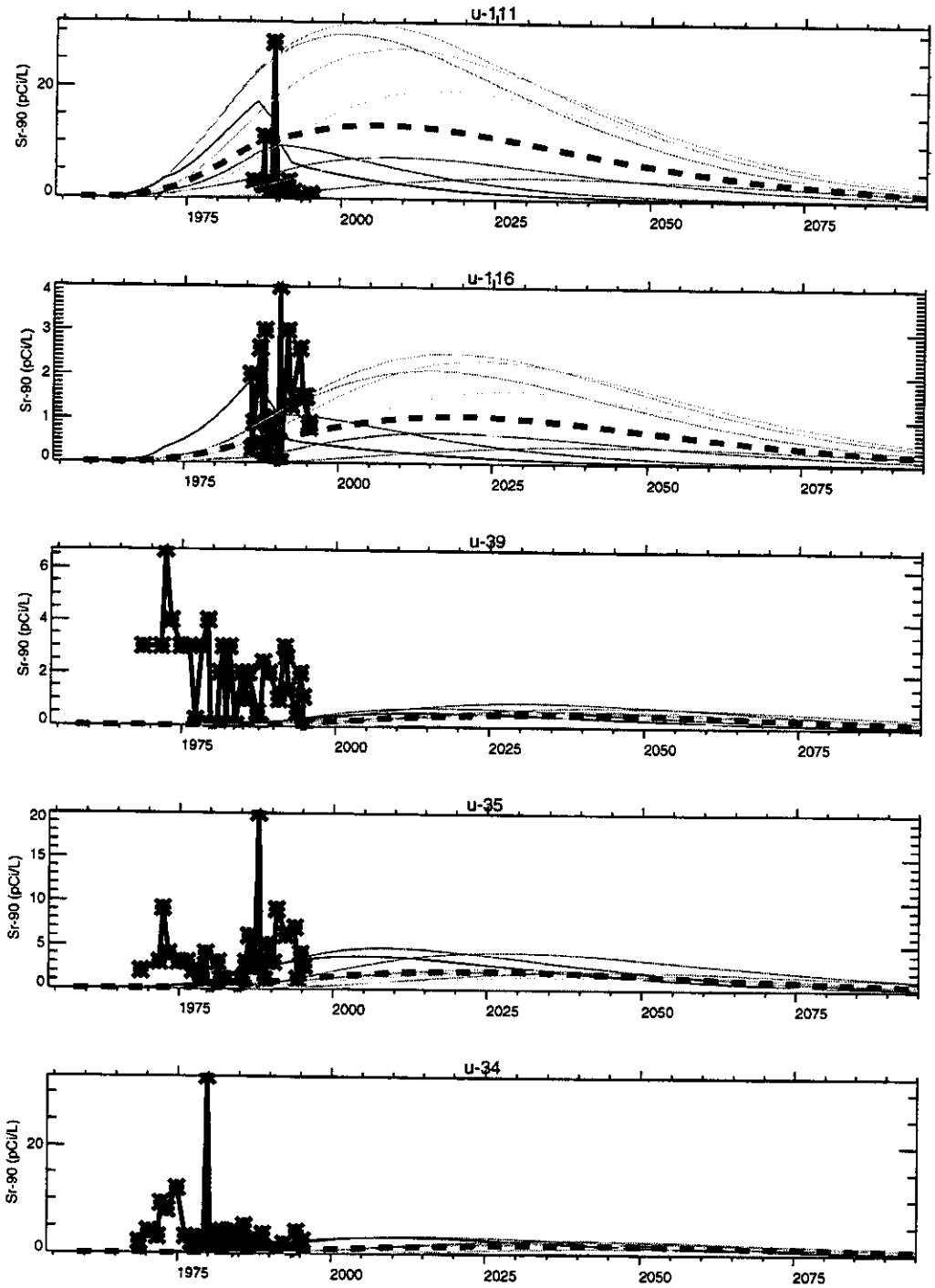

Figure 8-21 Comparison of aquifer Sr-90 with a Kd=24 cm^3/g to field data.

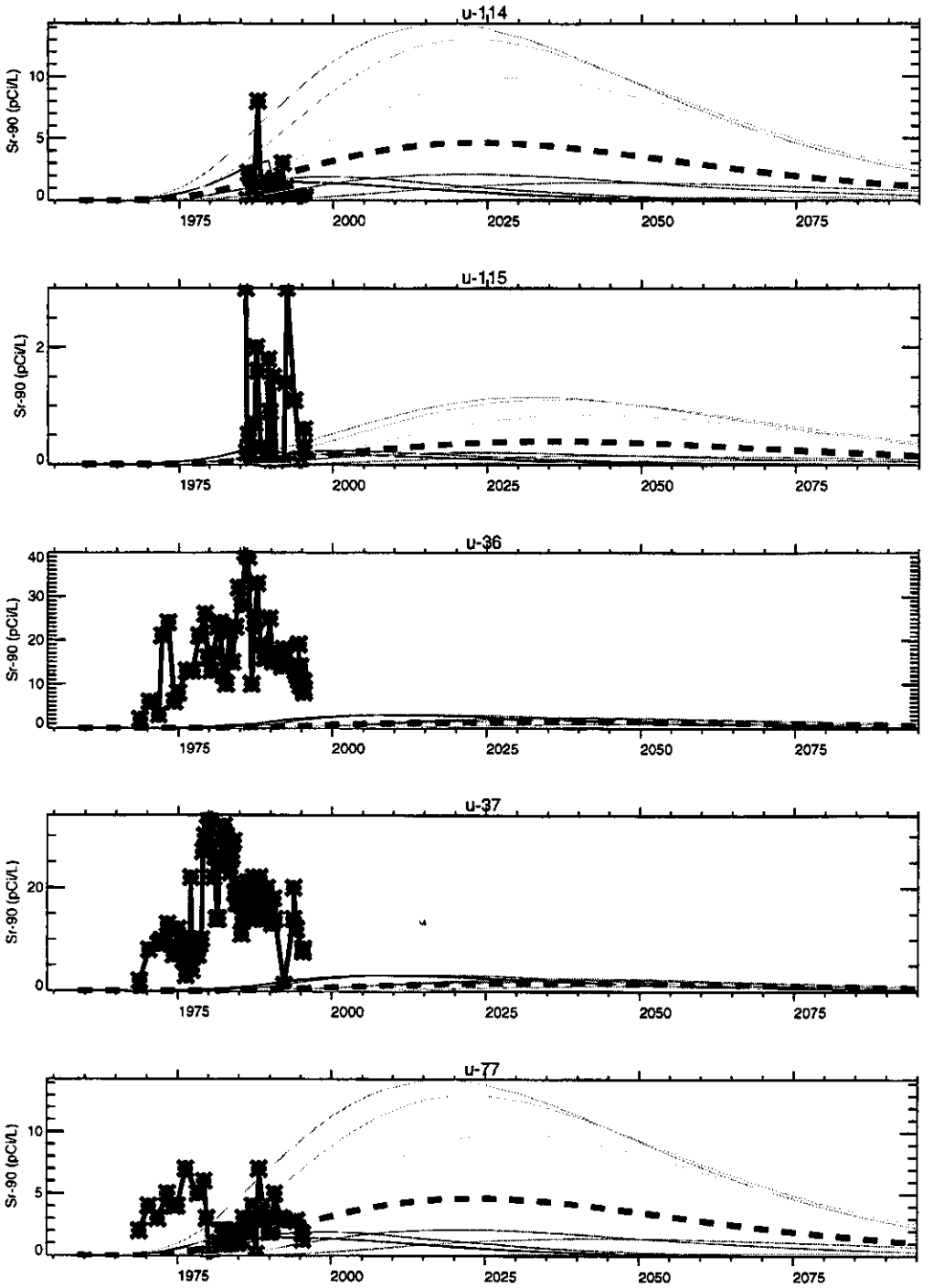

Figure 8-22 Comparison of aquifer Sr-90 with a Kd=24 cm^3/g to field data.

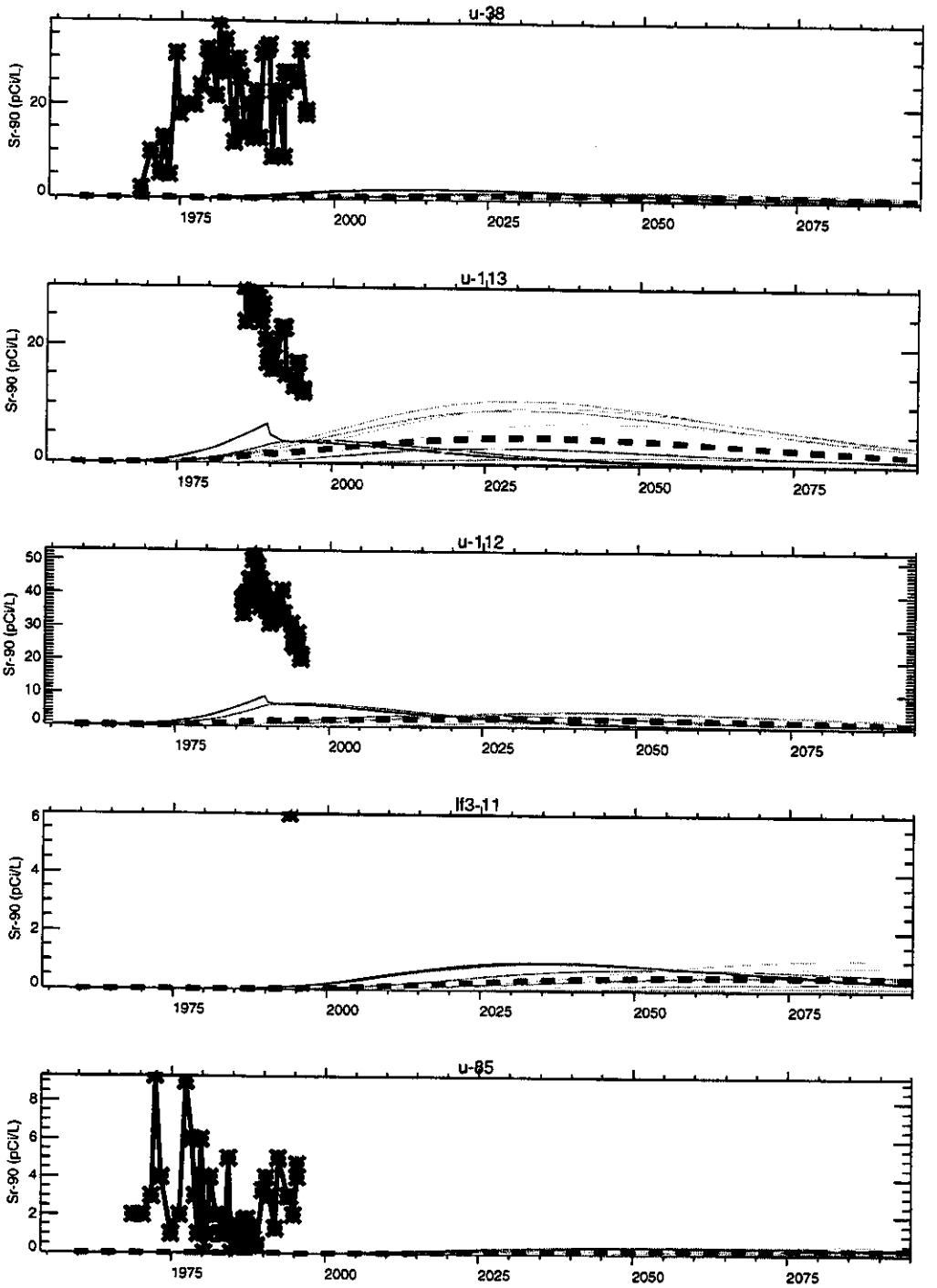

Figure 8-23 Comparison of aquifer Sr-90 with a Kd=24 cm^3/g to field data.

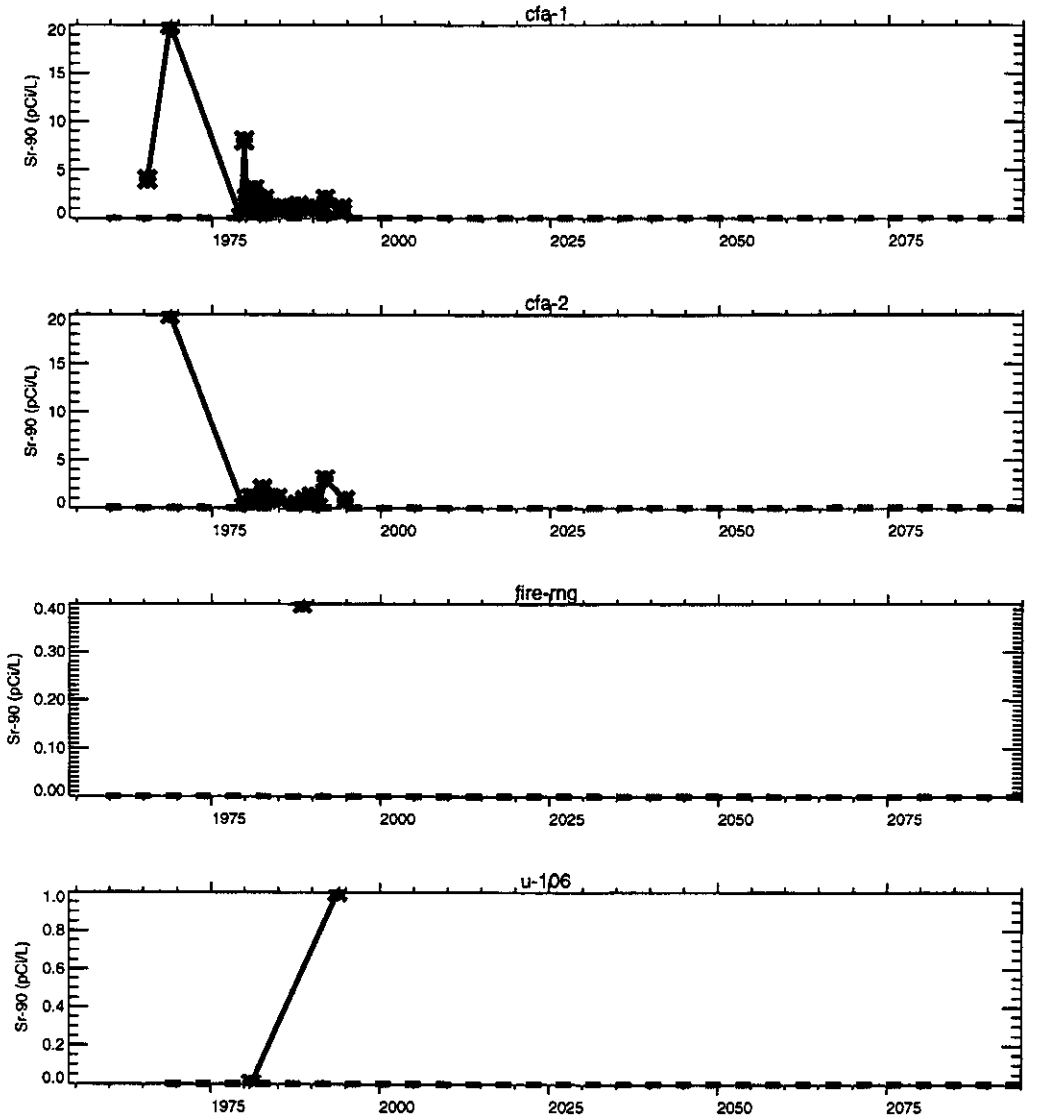

Figure 8-24 Comparison of aquifer Sr-90 with a Kd=24 cm^3/g to field data.

8.1.2 Sr-90 With A Kd=0 cm^3/g

This simulation uses the base contaminant sources for Sr-90 which included in order of decreasing contribution: a) CPP-31 (60.82%), b) CPP-28 (31.66%), c) Soils (5.71%), d) CPP-80 (1.42%), e) CPP-02 (0.17%), f) the injection well (0.12%), and g) the '86 release (0.09%). Transport through the vadose zone is represented in Figures 8-25 through 8-34 and Figures 8-35 through 8-48 present simulation results for the aquifer region. Contour levels for both the vadose zone and aquifer (Figures 8-25 through 8-28, 8-35, and 8-36) are given for $8x10^{-2}$, $8x10^{-1}$, 8 (the MCL), $8x10^{+1}$, $8x10^{+2}$, and $8x10^{+3}$ pCi/L. The corresponding risk contour maps for the aquifer simulation are given in Figures 8-37, and 8-38. Risk contours are plotted at the 10^{-7}, 10^{-6} (0.859 pCi/L), 10^{-5}, 10^{-4}, 10^{-3}, and 10^{-2} levels.

The most useful way of comparing the results of this simulation is to look at the model comparison plots to field data for the base case simulation (Figures 8-7 through 8-10 for the vadose zone and Figures 8-17 through 8-24 for the aquifer) and for this simulation (Figures 8-31 through 8-34 and Figures 8-41 through 8-48). These plots indicate that the predicted vadose zone concentrations are at least 2 orders of magnitude higher than the field data. Increased concentrations in the vadose zone are a result of not reducing the concentration in the water by removing mass to the soils. In addition to higher concentrations, the effective velocity is higher through the vadose zone, resulting in less residence time for decay to occur. In addition, the increased effective velocity allows the peak mass flux to enter the aquifer in 1989 as opposed to year 2060. As a result, the predicted concentrations in the aquifer is as many as 6 orders of magnitude higher than previously predicted, and as many as 5 orders of magnitude higher than observed in the field measurements. This clearly indicates that Sr-90 is retarded by adsorption in the vadose zone and in the aquifer.

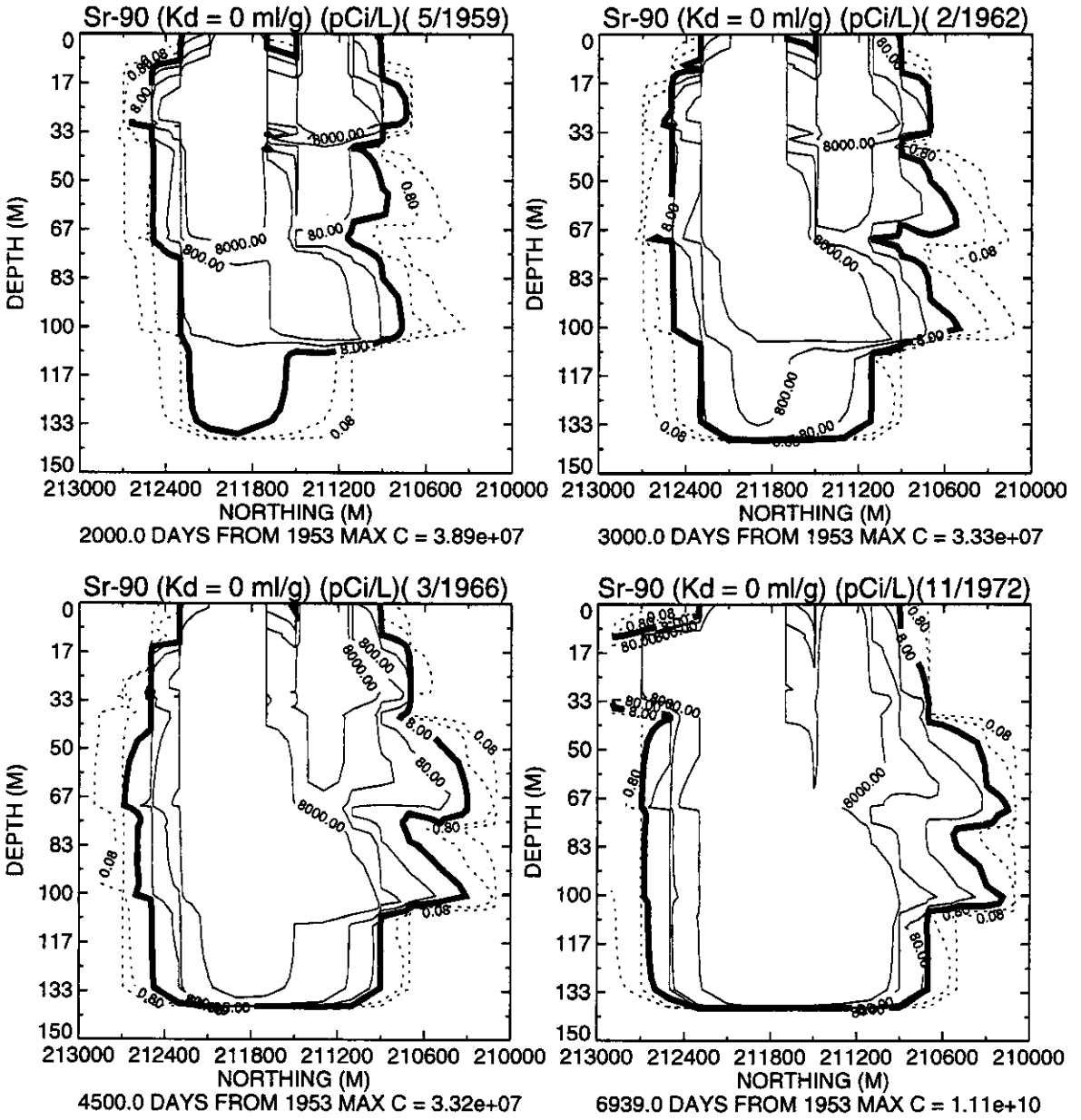

Figure 8-25 Vadose zone Sr-90 with a Kd=0 cm^3/g peak concentration contours.

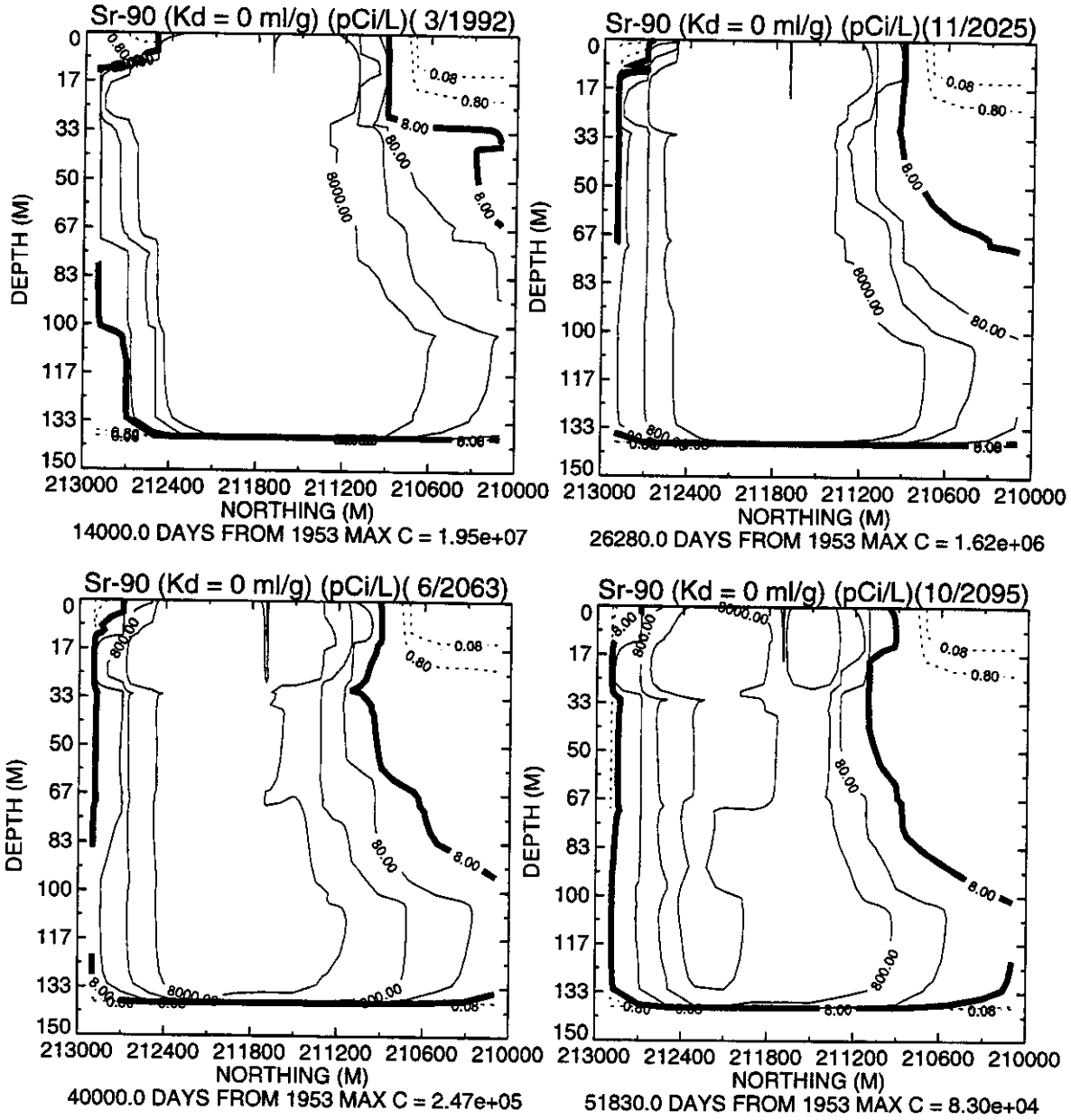

Figure 8-26 Vadose zone Sr-90 with a Kd=0 cm^3/g peak concentration contours.

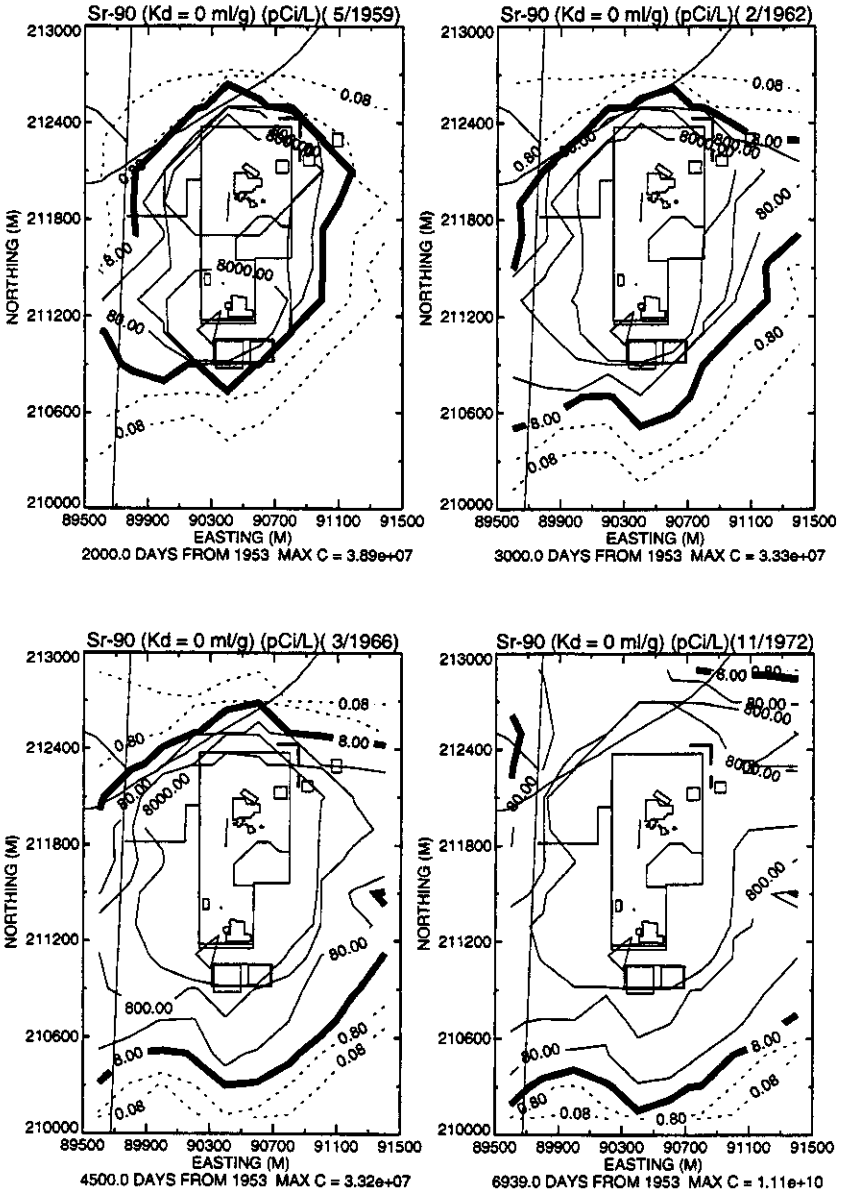

Figure 8-27 Vadose zone Sr-90 with a Kd=0 cm^3/g peak concentration contours.

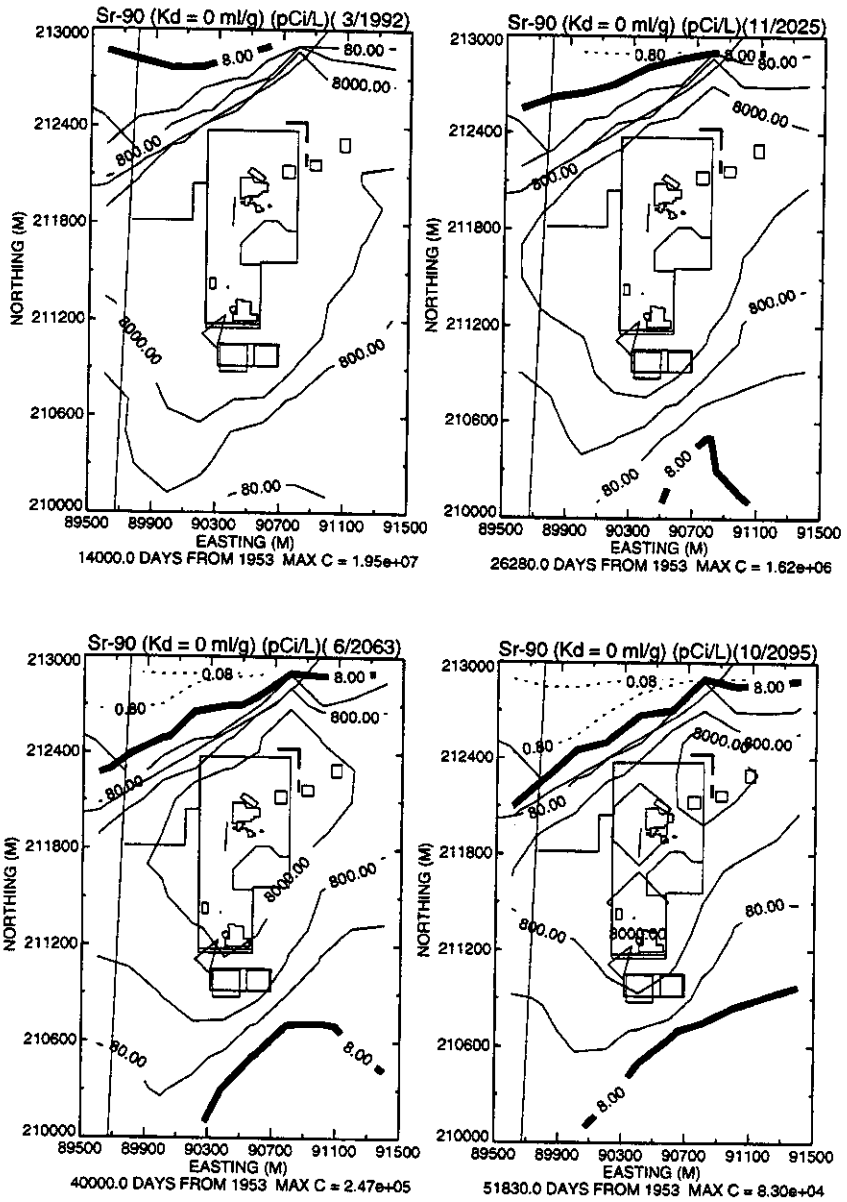

Figure 8-28 Vadose zone Sr-90 with a Kd=0 cm^3/g peak concentration contours.

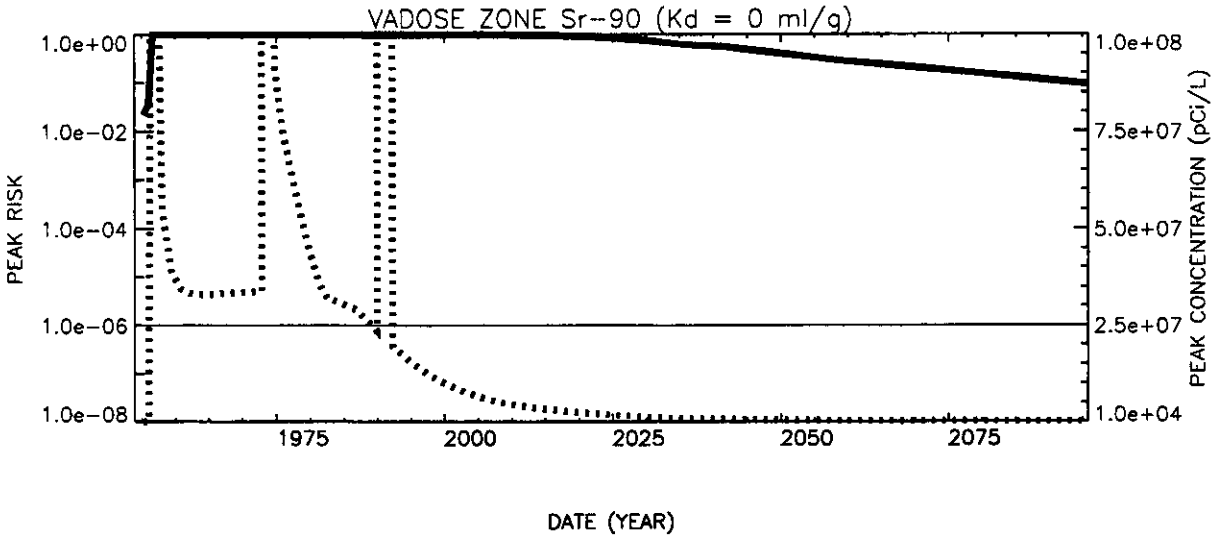

Figure 8-29 Peak vadose zone risk and concentration for Sr-90 with a Kd=0 cm^3/g. Risk indicated by the thick line on the log scale with the 10^{-6} value shown as the solid line. The dotted line represents concentration given by the linear scale on the right axis.

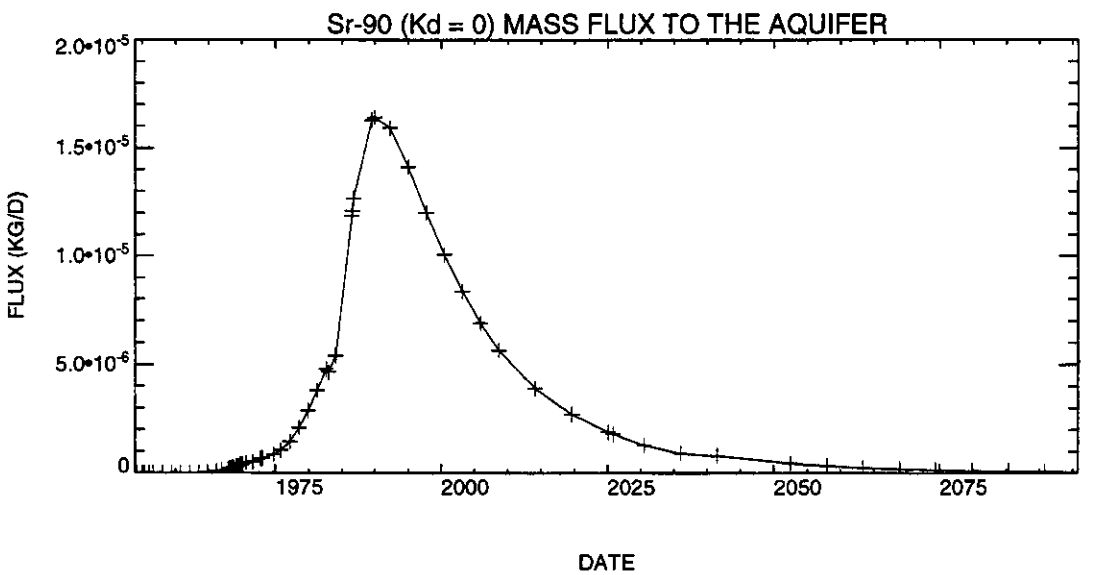

Figure 8-30 Mass flux of Sr-90 with a Kd=0 cm^3/g into the aquifer from the vadose zone.

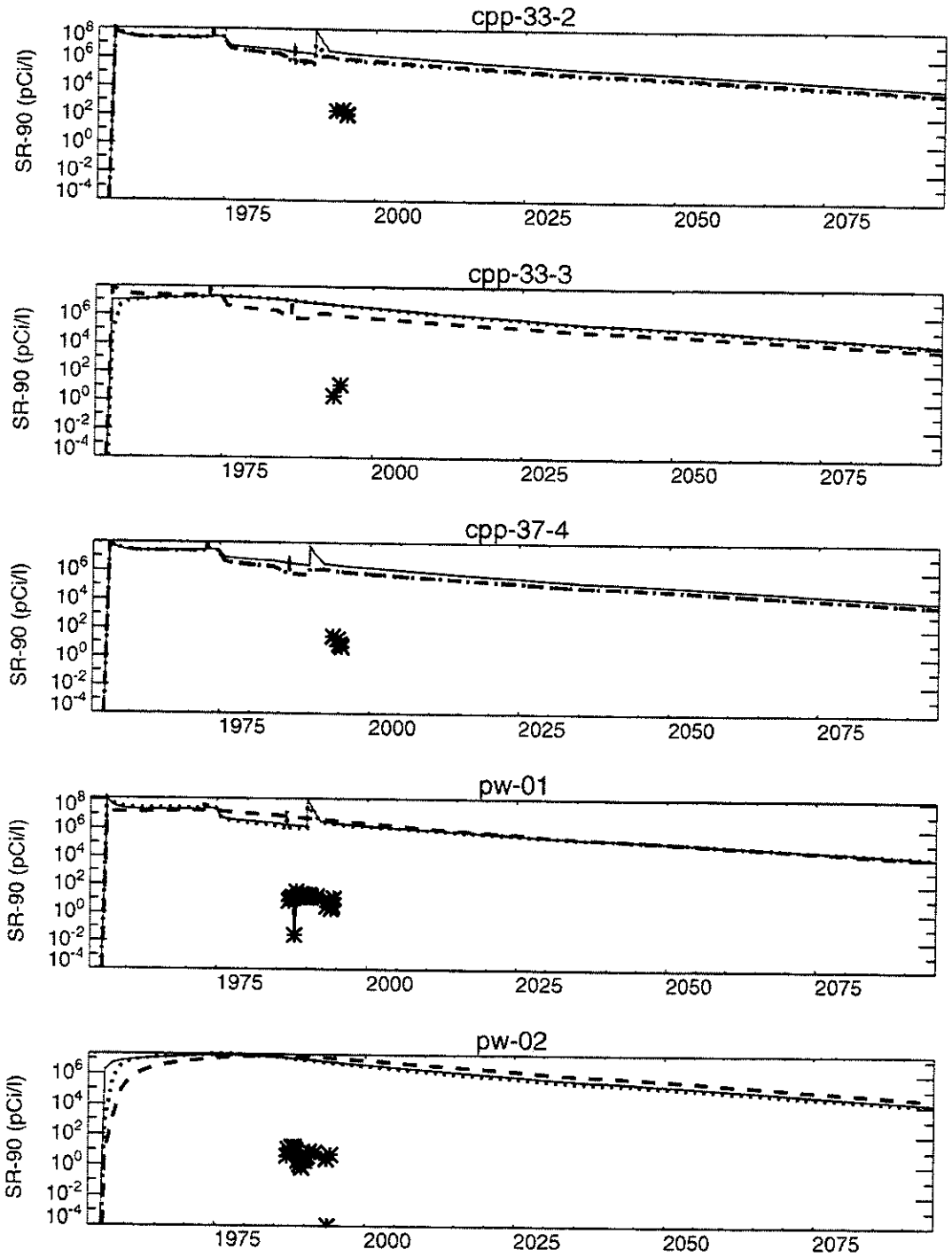

Figure 8-31 Comparison of vadose zone Sr-90 with a Kd=0 cm^3/g to field data.

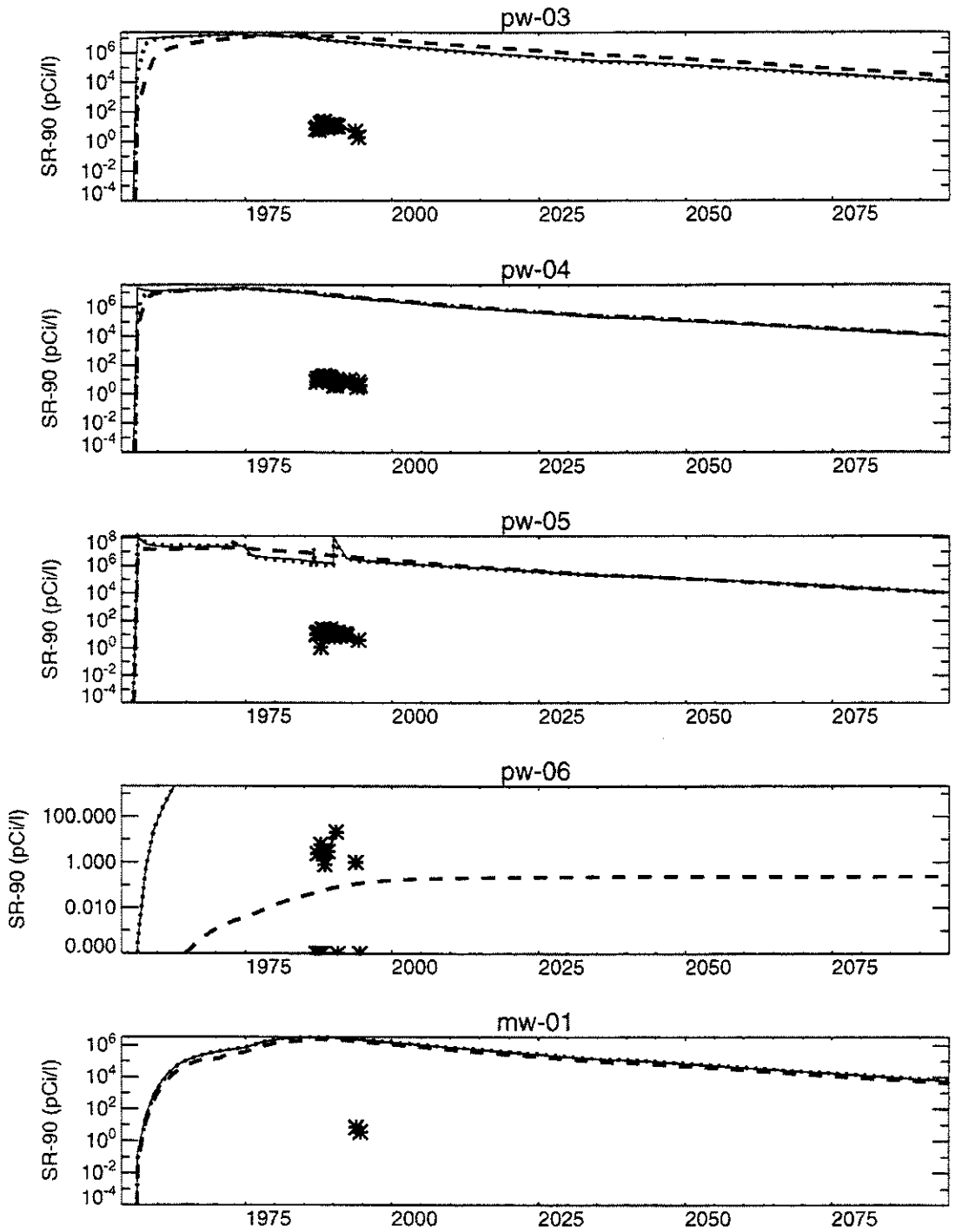

Figure 8-32 Comparison of vadose zone Sr-90 with a Kd=0 cm^3/g to field data.

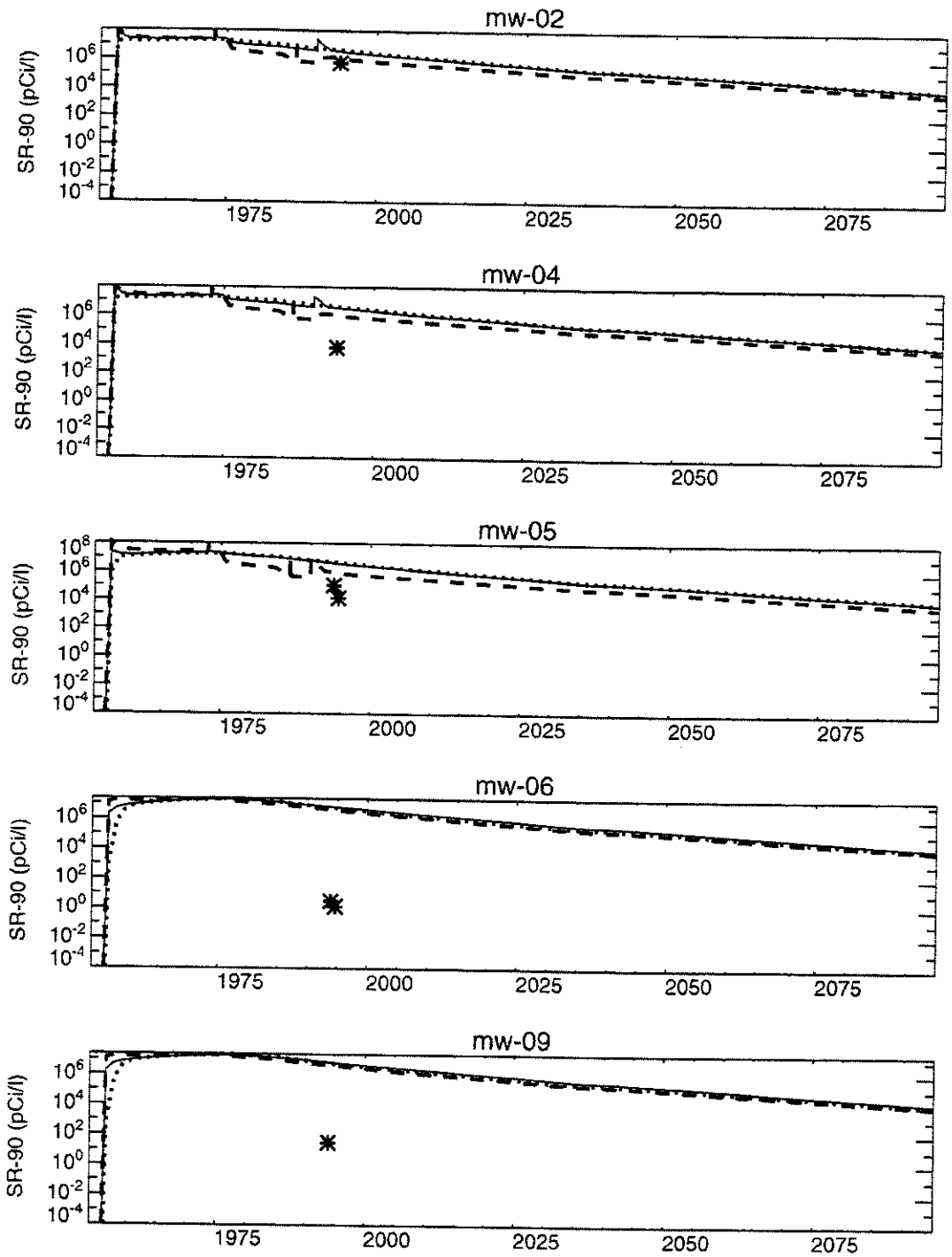

Figure 8-33 Comparison of vadose zone Sr-90 with a Kd=0 cm^3/g to field data.

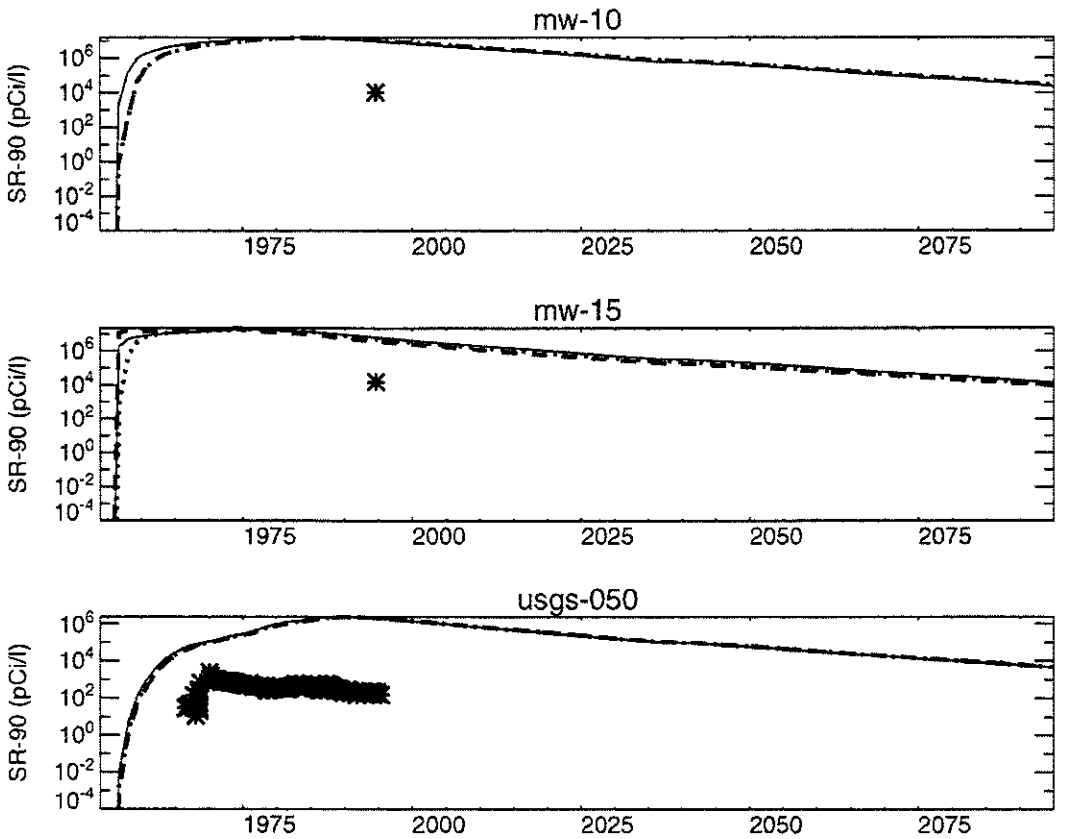

Figure 8-34 Comparison of vadose zone Sr-90 with a Kd=0 cm^3/g to field data.

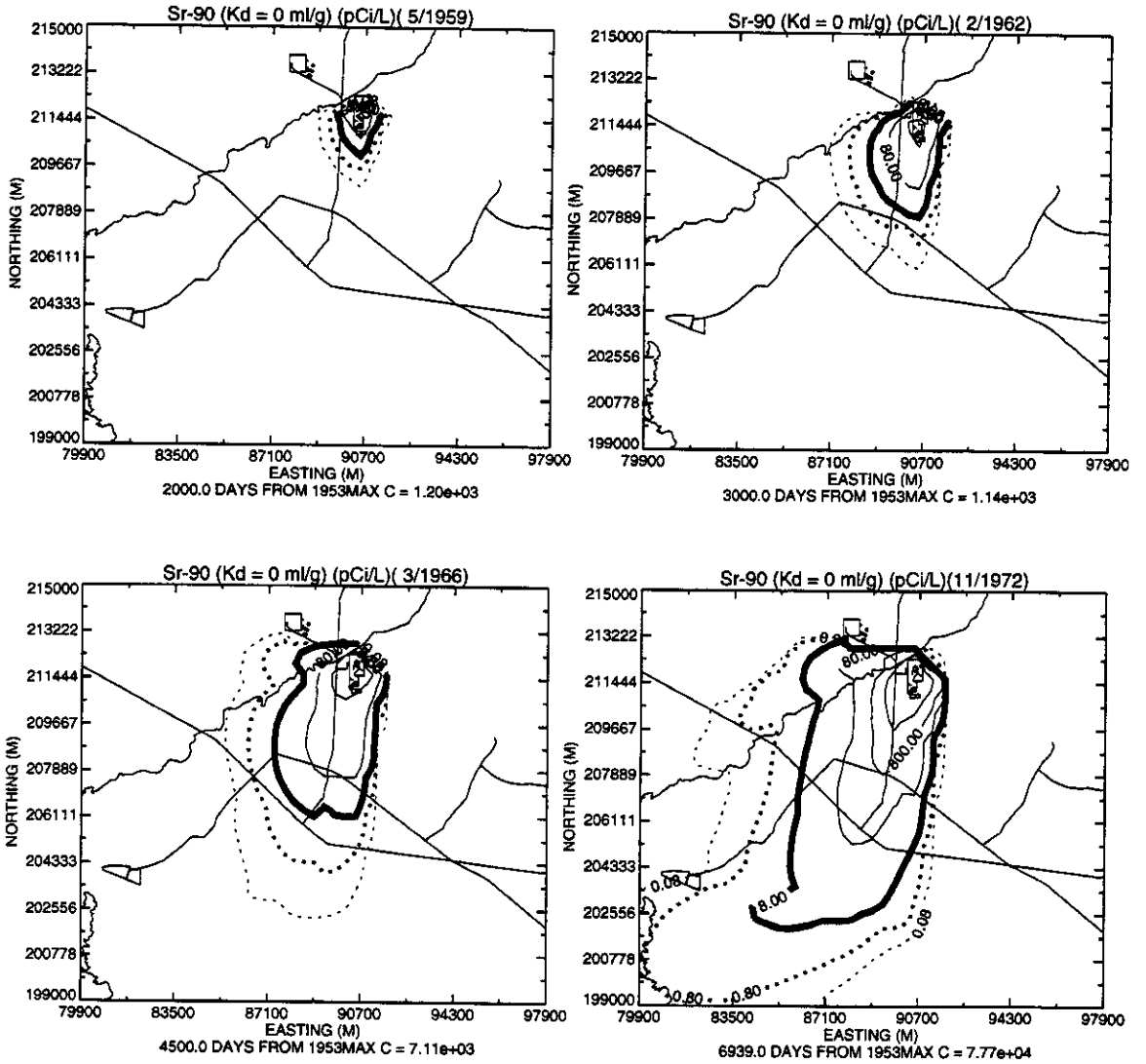

Figure 8-35 Aquifer Sr-90 with a Kd=0 cm^3/g peak concentration contours.

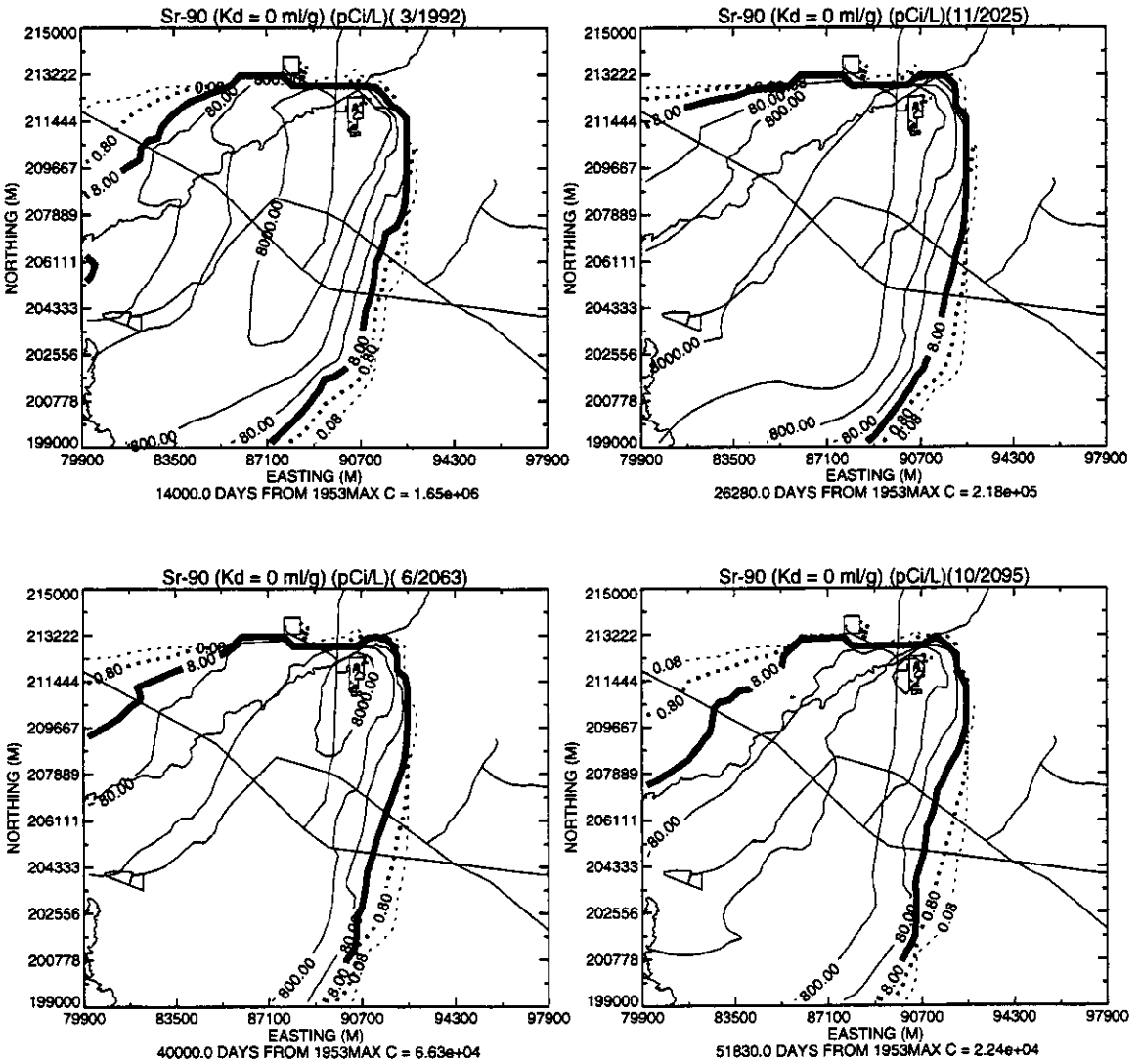

Figure 8-36 Aquifer Sr-90 with a Kd=0 cm^3/g peak concentration contours.

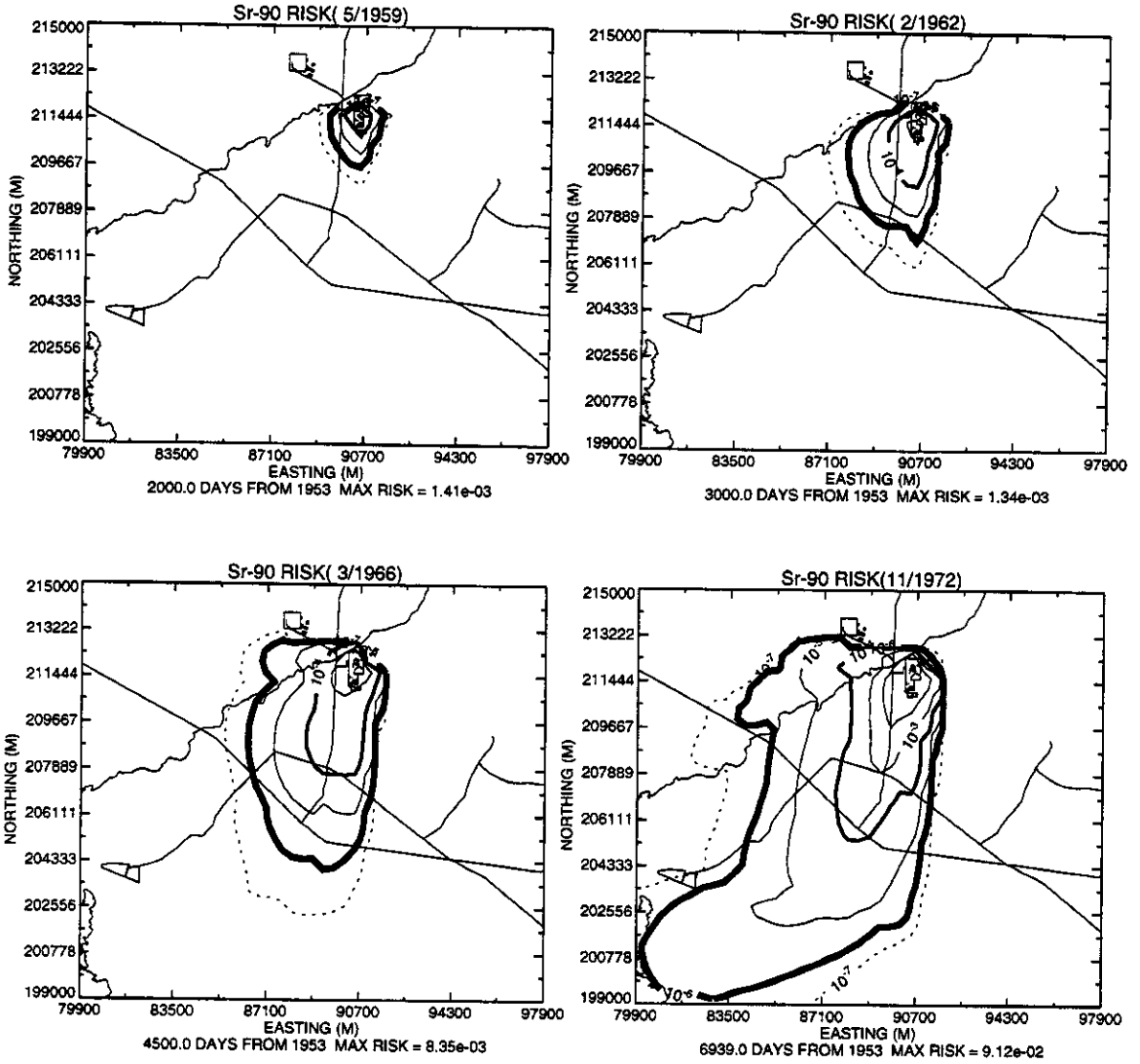

Figure 8-37 Aquifer Sr-90 with a Kd=0 cm^3/g peak risk contours.

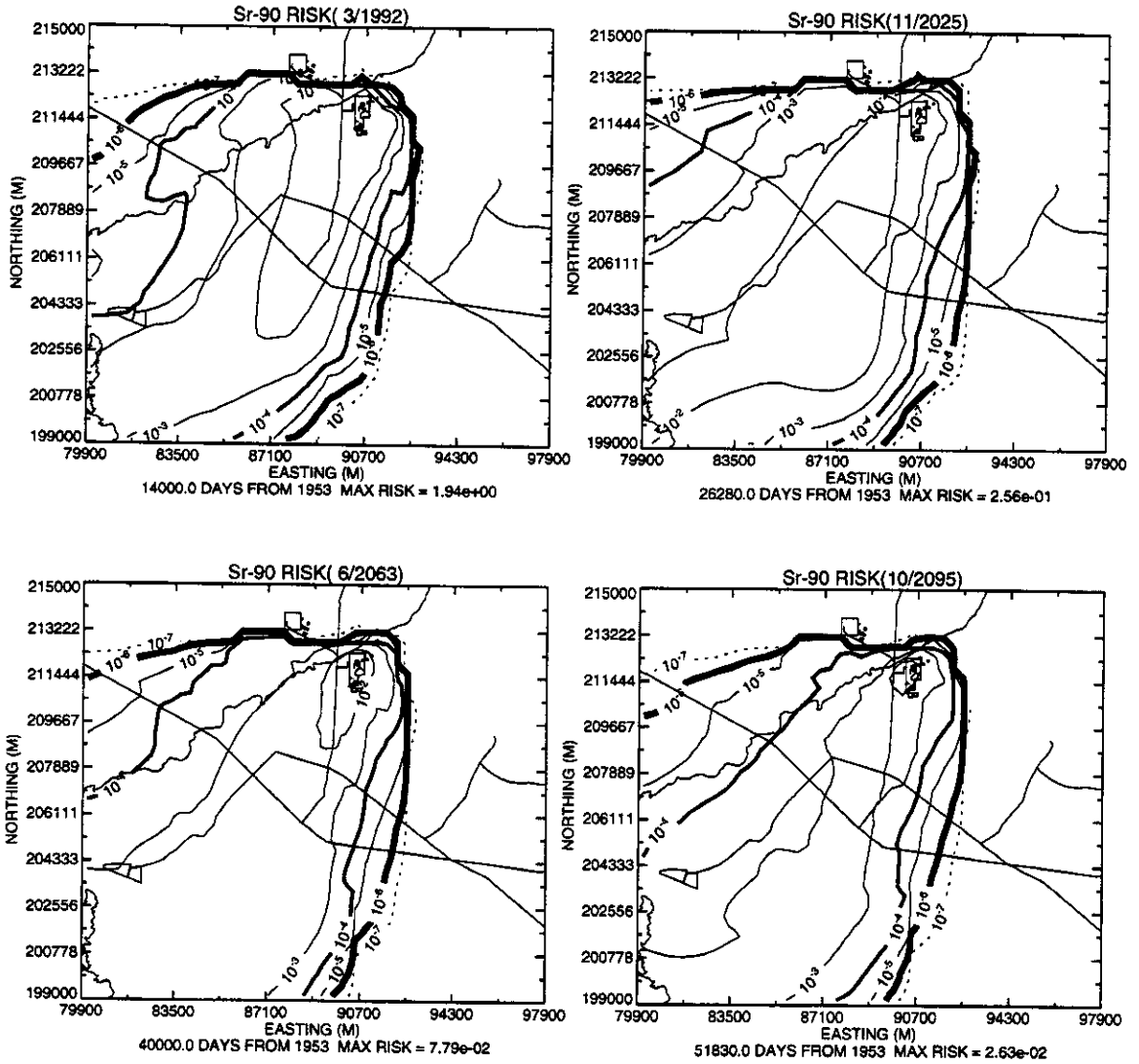

Figure 8-38 Aquifer Sr-90 with a Kd=0 cm^3/g peak risk contours.

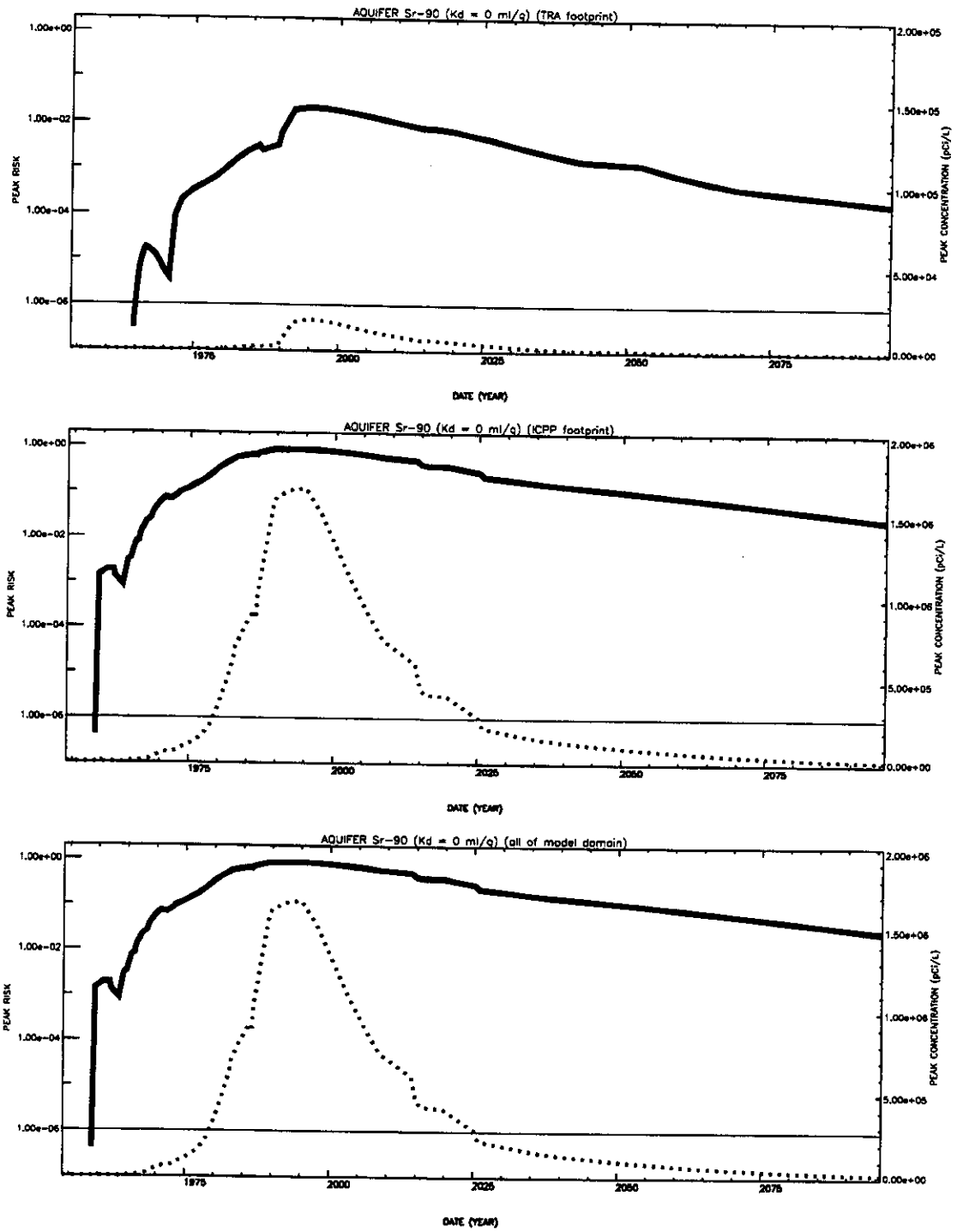

Figure 8-39 Peak aquifer concentration of Sr-90 with a Kd=0 cm^3/g. Top figure: TRA foot print, Middle figure: ICPP footprint, Bottom Figure: entire aquifer domain. Thick line risk (left scale), dotted line concentration (right scale) solid line 10^{-6} risk (left scale).

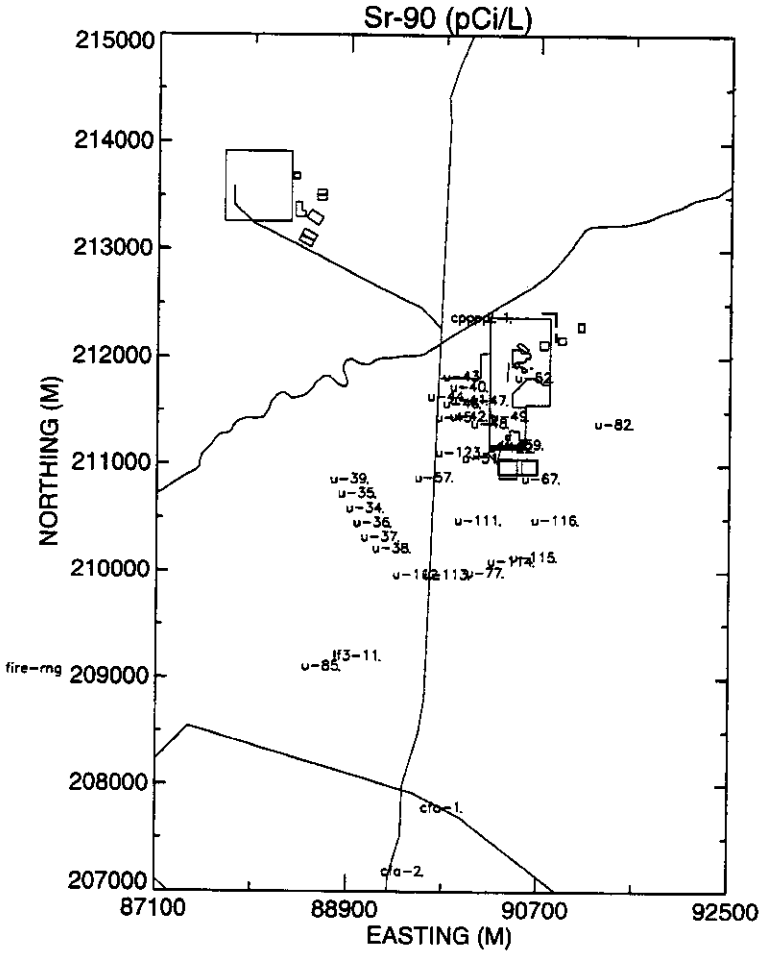

Figure 8-40 Well locations for the comparison of aquifer Sr-90 with a Kd=0 cm^3/g to field data.

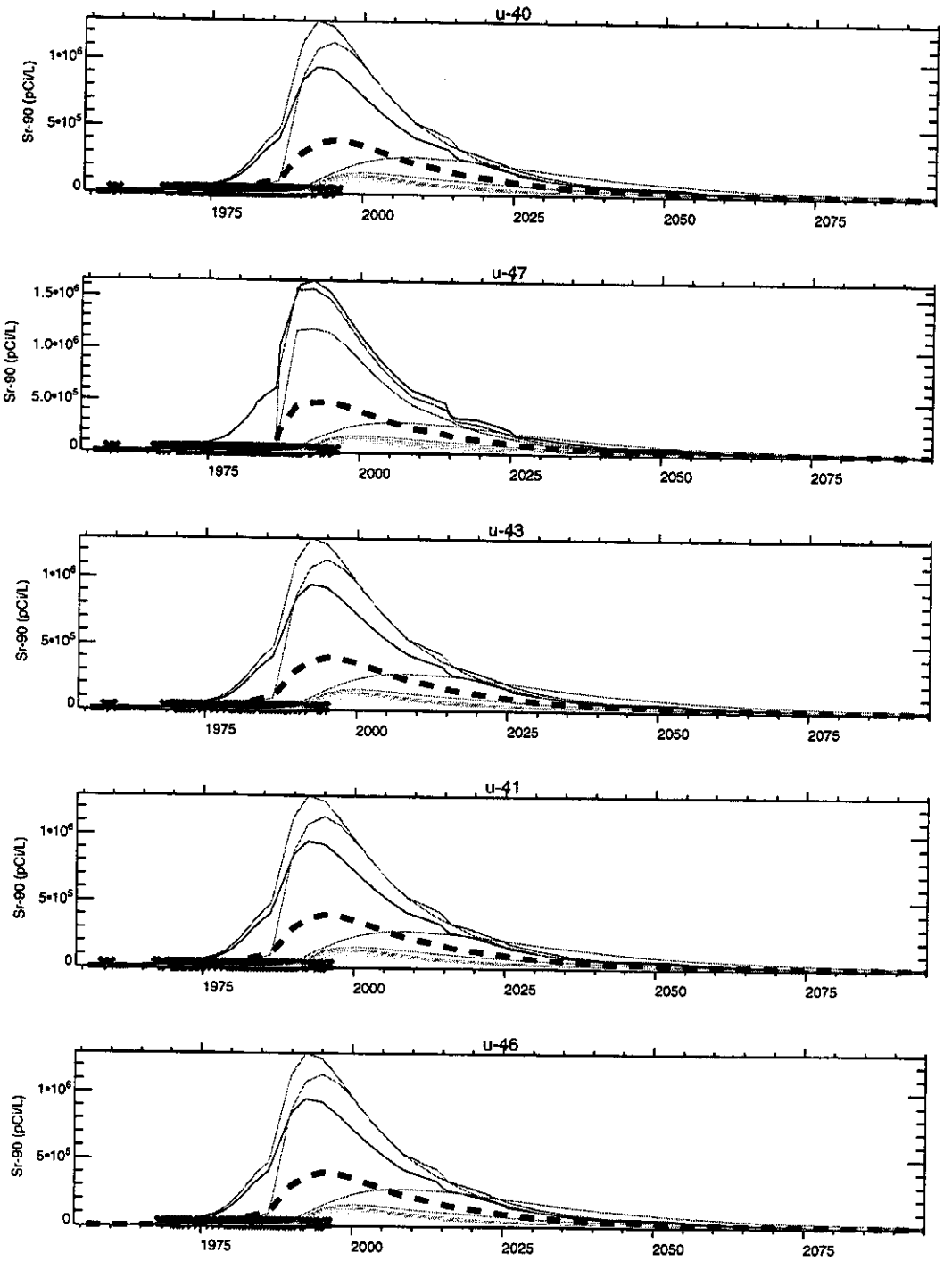

Figure 8-41 Comparison of aquifer Sr-90 with a Kd=0 cm^3/g to field data.

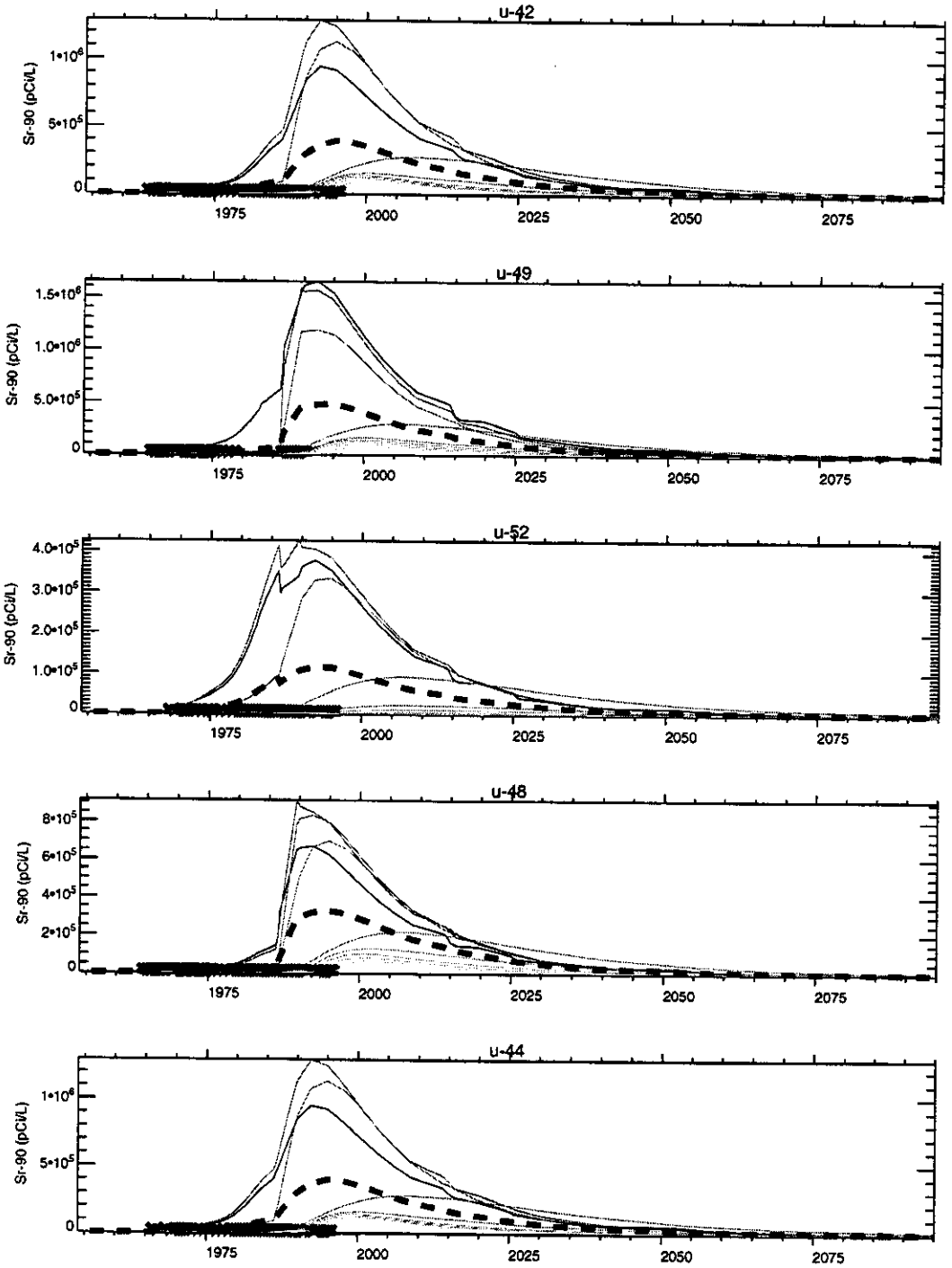

Figure 8-42 Comparison of aquifer Sr-90 with a Kd=0 cm^3/g to field data.

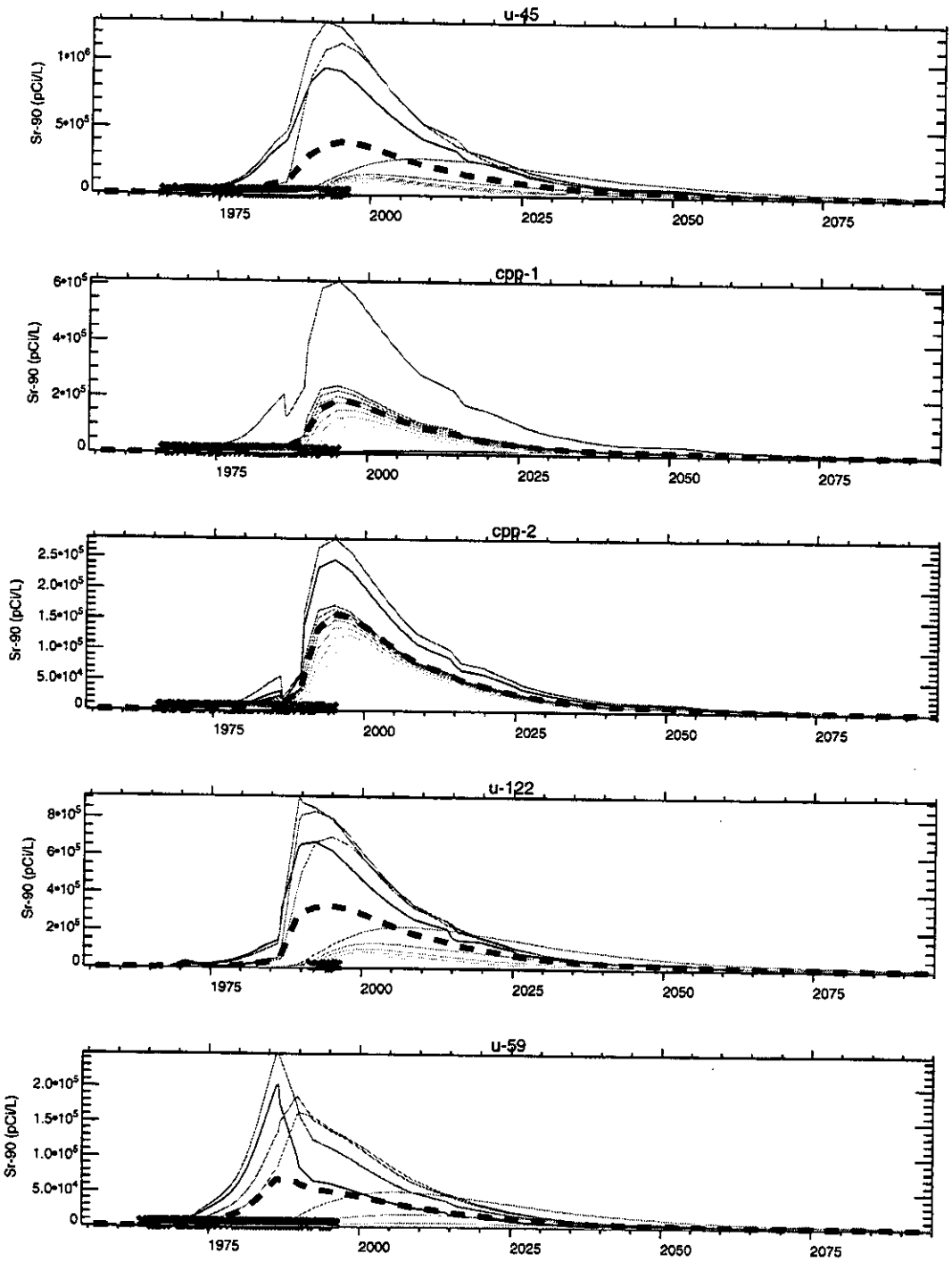

Figure 8-43 Comparison of aquifer Sr-90 with a Kd=0 cm^3/g to field data.

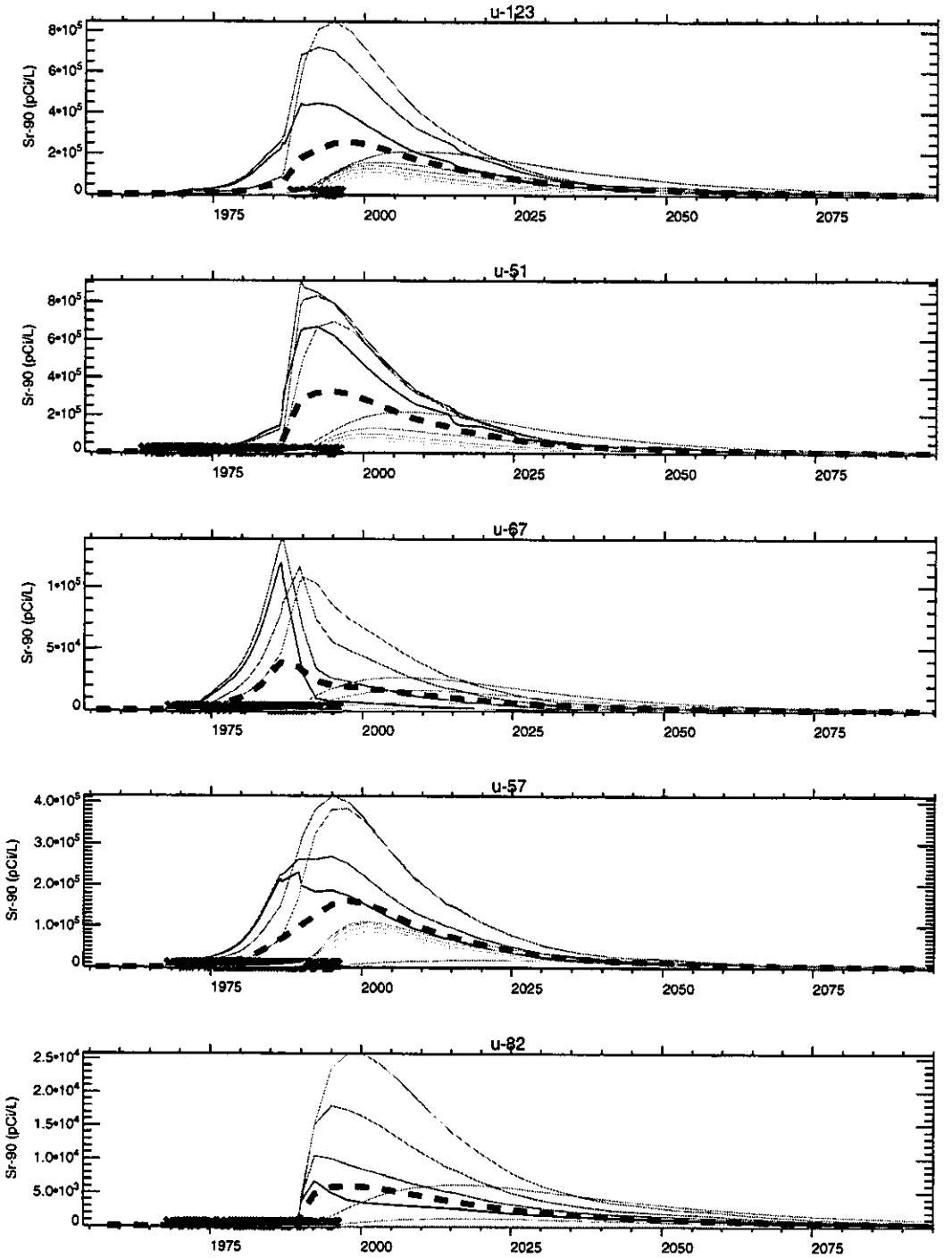

Figure 8-44 Comparison of aquifer Sr-90 with a Kd=0 cm^3/g to field data.

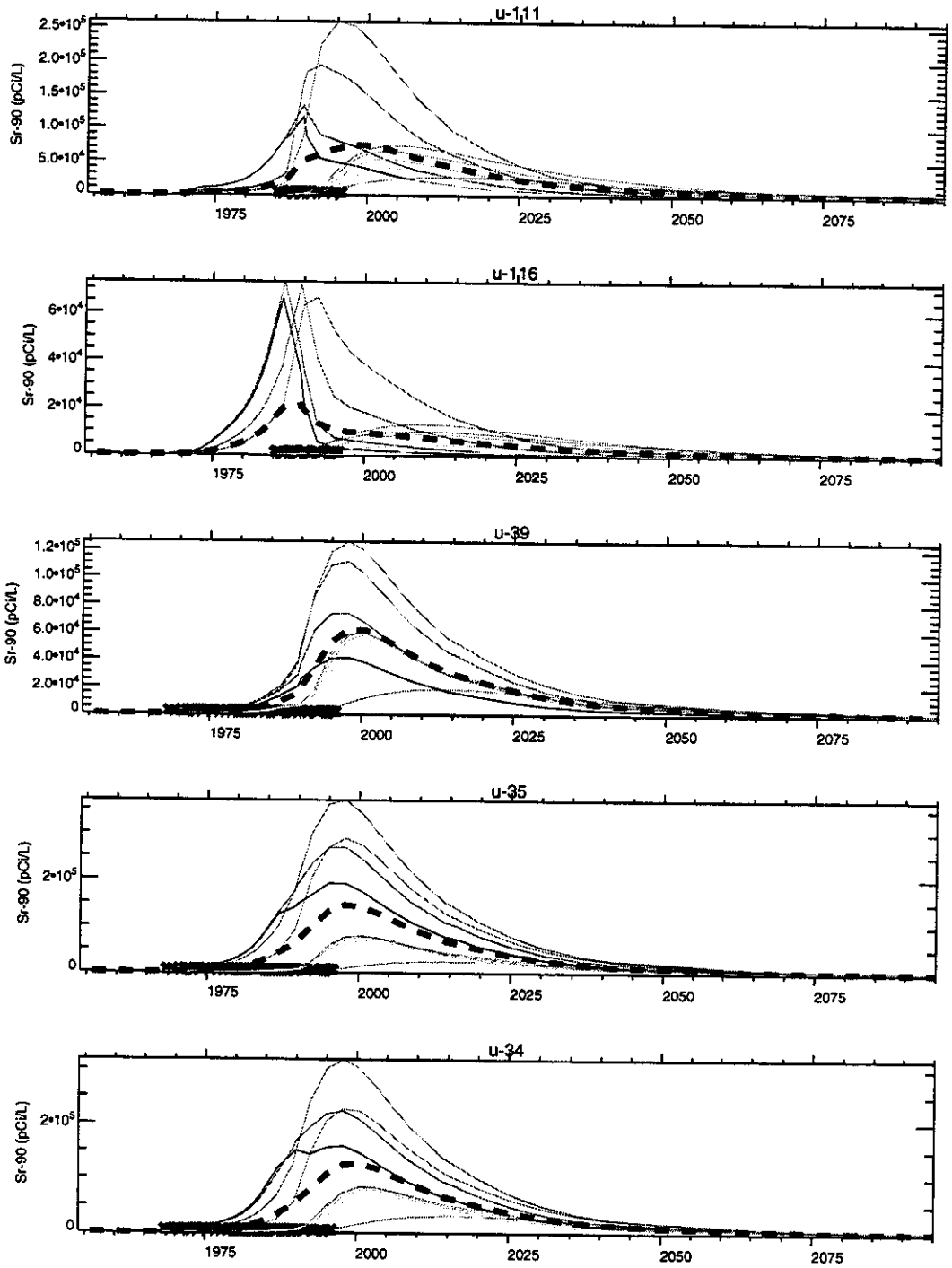

Figure 8-45 Comparison of aquifer Sr-90 with a Kd=0 cm^3/g to field data.

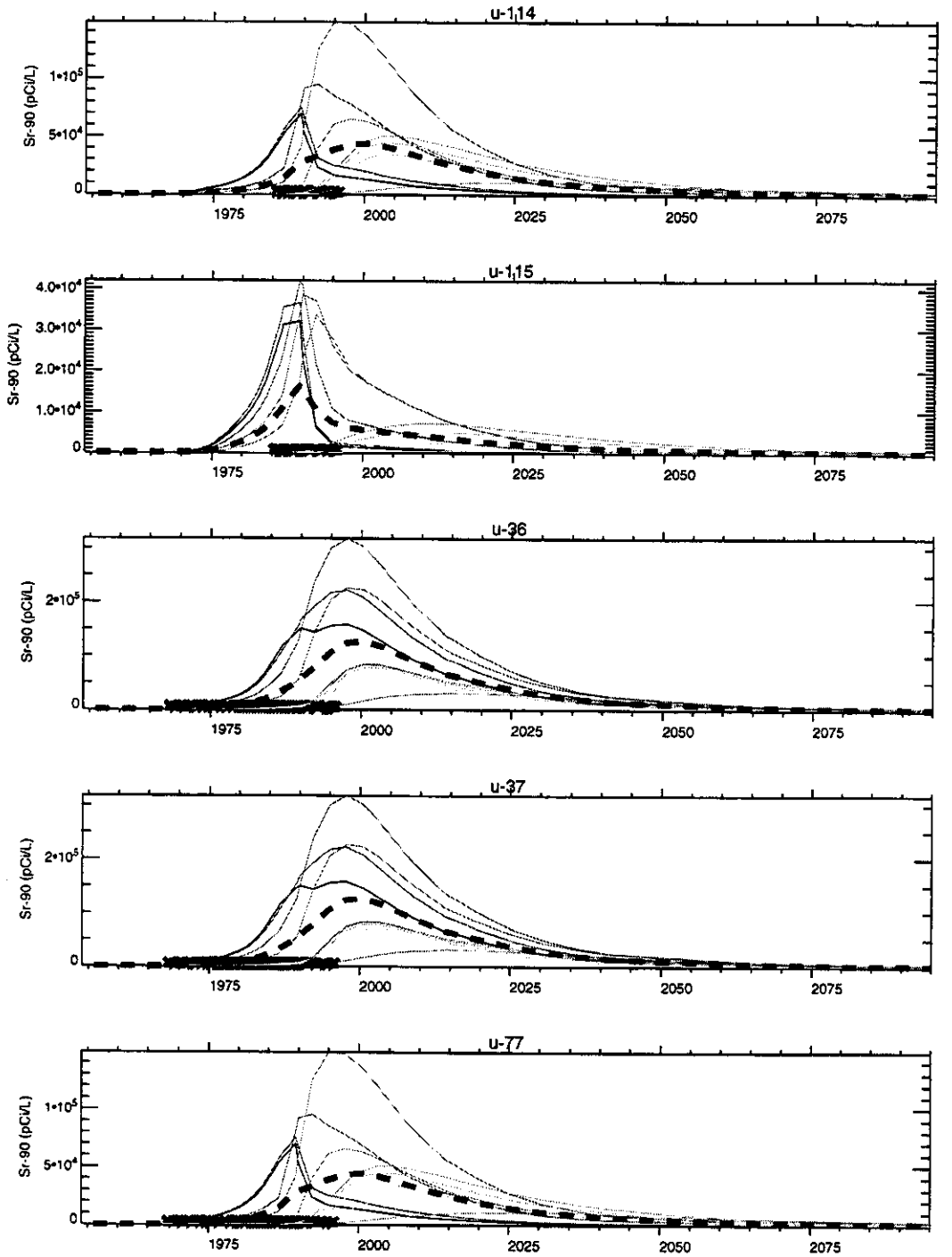

Figure 8-46 Comparison of aquifer Sr-90 with a Kd=0 cm^3/g to field data.

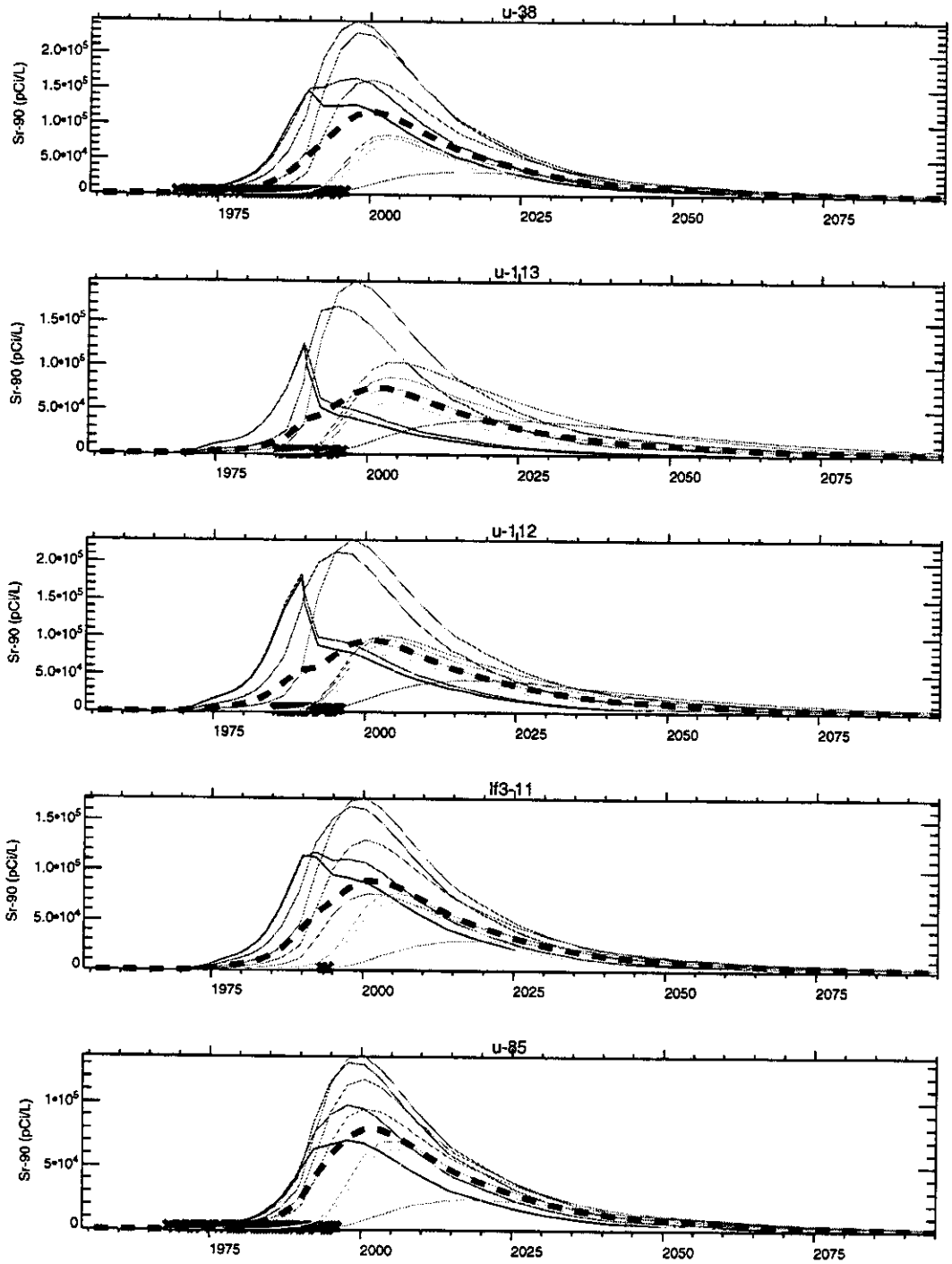

Figure 8-47 Comparison of aquifer Sr-90 with a Kd=0 cm^3/g to field data.

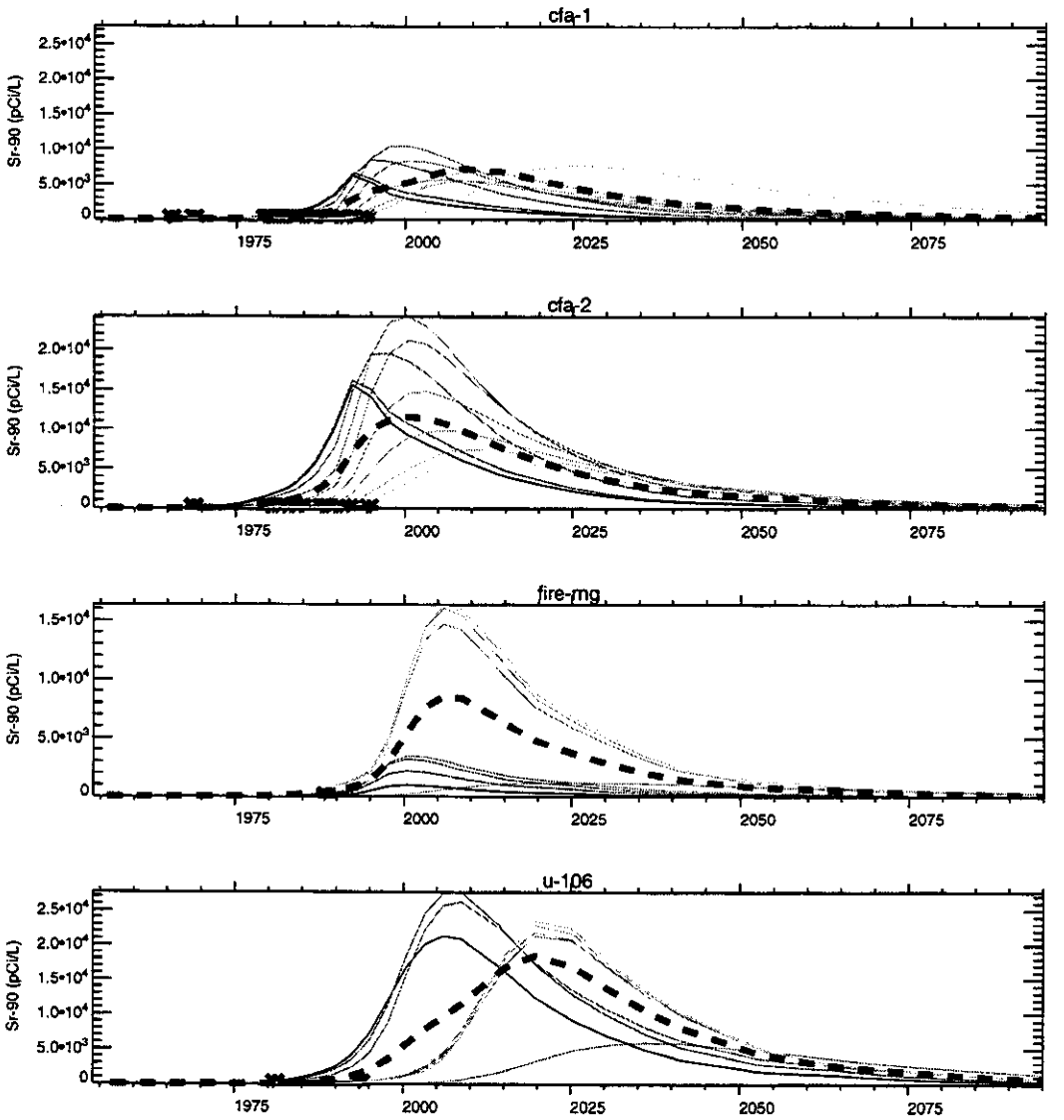

Figure 8-48 Comparison of aquifer Sr-90 with a Kd=0 cm^3/g to field data.

8.2 Sr-90 With Increased Tank Farm Source Mass

This simulation increases the contaminant sources for Sr-90 in the tank farm area by a multiplicative factor of 1.5. It assumes a Kd=24 cm^3/g so it is compared with the results from the first sensitivity simulations (Section 8.1.1). As a result, CPP-31, CPP-28, and CPP-86 masses increase such that the new relative contributions are: a) CPP-31 (61.79% up from 60.82%), b) CPP-28 (32.16% up from 31.66%), c) Soils (3.87% down from 5.71%), d) CPP-80 (1.92% up from 1.42%), e) CPP-02 (0.15% down from 0.17%), f) the injection well (0.08% down from 0.12%), and g) the '86 release (0.06% down from 0.09%). Transport through the vadose zone is represented in Figures 8-49 through 8-58 and Figures 8-59 through 8-72 present simulation results for the aquifer region. Contour levels for both the vadose zone and aquifer (Figures 8-49 through 8-52, 8-59, and 8-60) are given for $8x10^{-2}$, $8x10^{-1}$, 8 (the MCL), $8x10^{+1}$, $8x10^{+2}$, and $8x10^{+3}$ pCi/L. The corresponding risk contour maps for the aquifer simulation are given in Figures 8-61, and 8-62. Risk contours are plotted at the 10^{-7}, 10^{-6} (0.859 pCi/L), 10^{-5}, 10^{-4}, 10^{-3}, and 10^{-2} levels.

Unlike the previous sensitivity run, the aquifer calibration plots for this sensitivity run should be exactly like the Section 8.1.1 simulation because of the time frame necessary for the increase in tank farm source mass to reach the aquifer (after the year 2000). The best way to assess the relative differences between these simulation results and those for the Section 8.1.1 results are to compare Figure 8-6 to 8-54 and Figure 8-15 to 8-63. These figures correspond to the mass flux entering the aquifer from the vadose zone and the resultant peak aquifer concentration/risk respectively. To facilitate the comparison, the Section 8.1.1 mass flux has been plotted onto Figure 8-54 as the solid line, with the mass flux predicted using the increased tank farm mass fluxes given by the starred line. Given the peak mass flux to the aquifer, the relative difference between the two curves is small. This small increase in mass flux to the aquifer results in an equally small difference in peak aquifer concentration. Figure 8-63 also contains the Section 8.1.1 simulation results as the thin dotted line for concentration and thin solid line for risk for comparison to the thick dotted and solid lines representing concentration and risk for this simulation, respectively. This latter figure indicates that the time at which the peak aquifer concentration drops below the MCL and risk limits is virtually indistinguishable between the two simulations. The Sr-90 flux to the injection well is the major factor defining the predicted Sr-90 concentrations in the aquifer. The injection well flux is exactly the same for the base case and this sensitivity case.

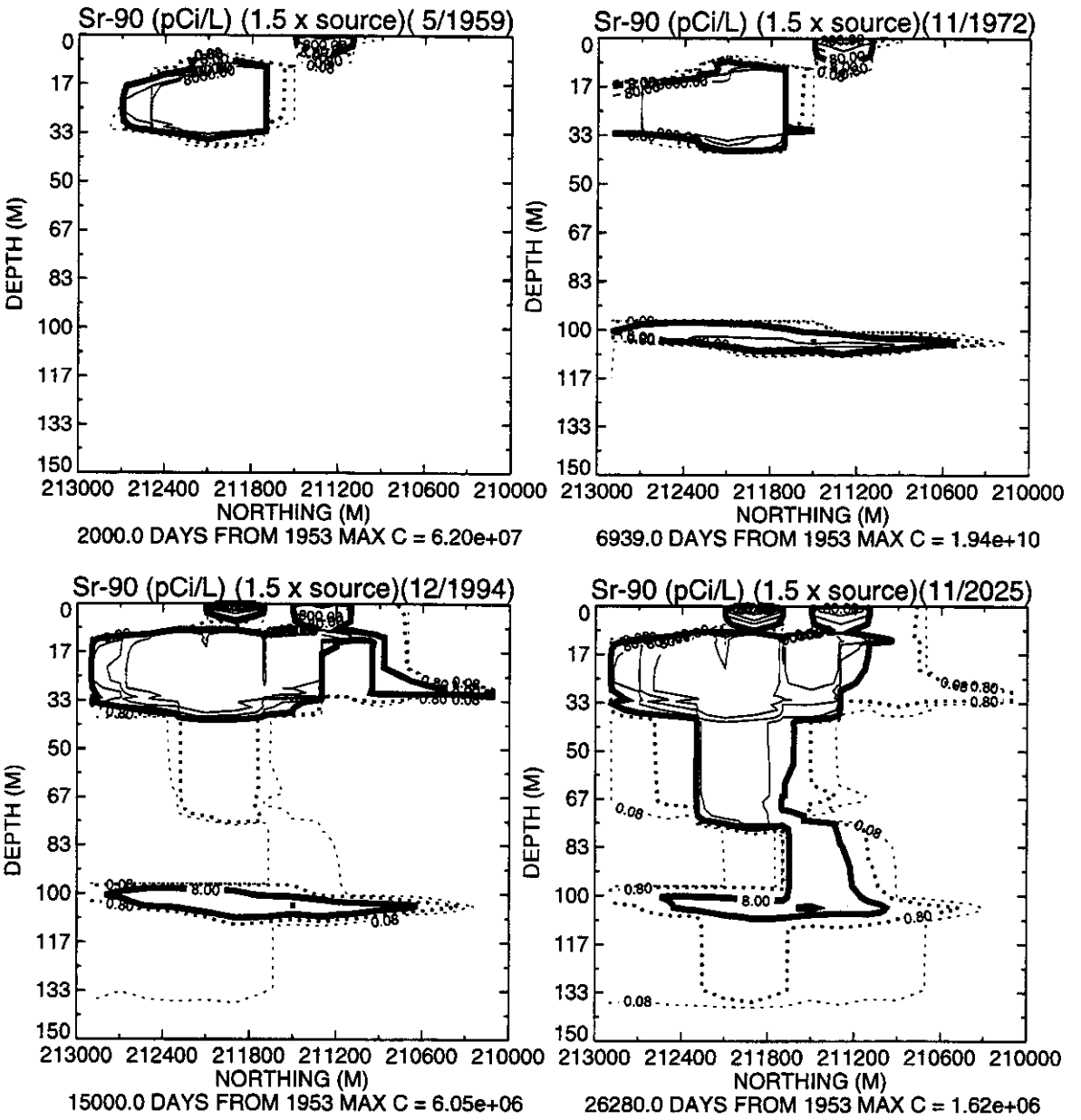

Figure 8-49 Vadose zone Sr-90 (increased tank farm mass) peak concentration contours.

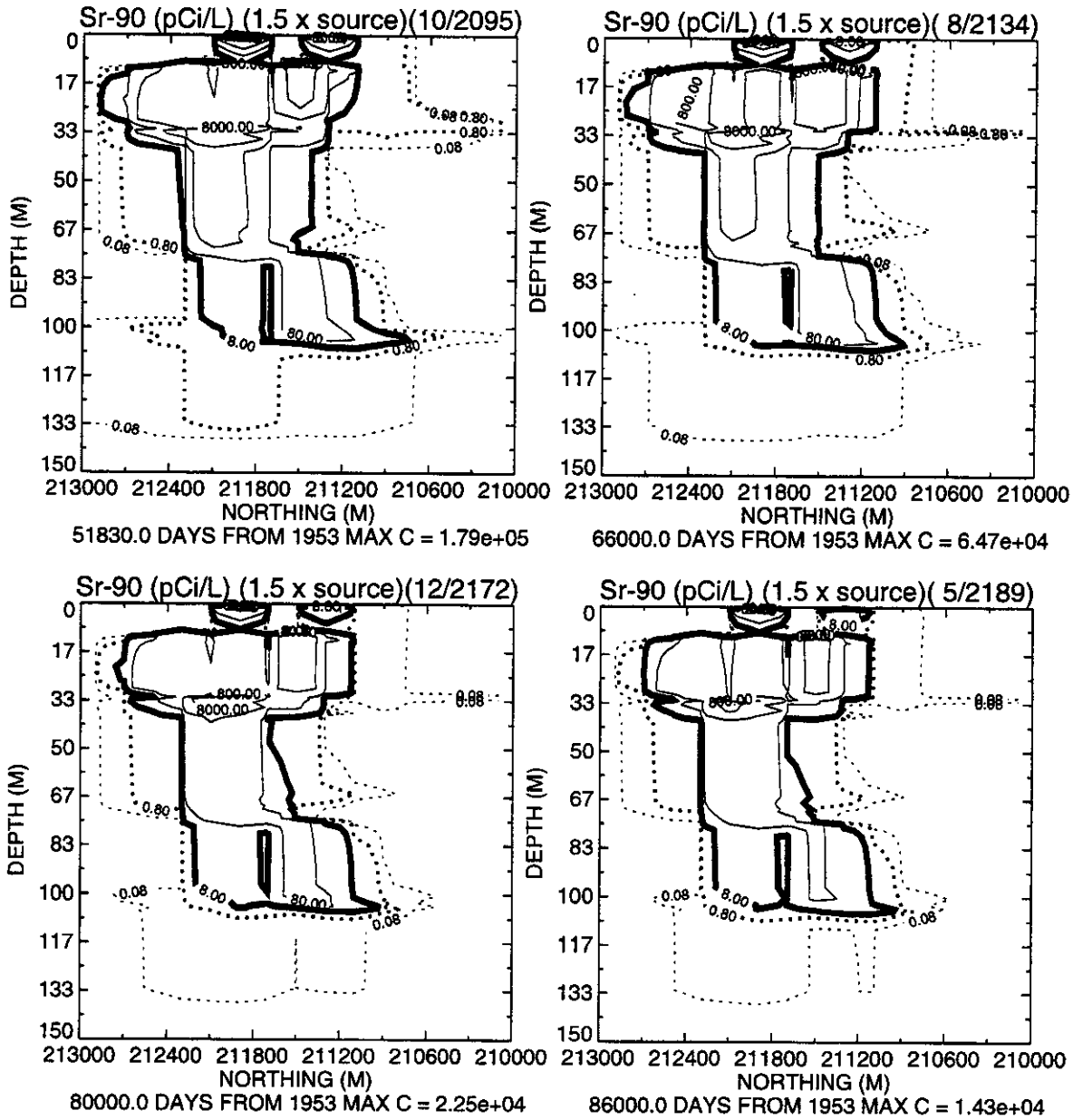

Figure 8-50 Vadose zone Sr-90 (increased tank farm mass) peak concentration contours.

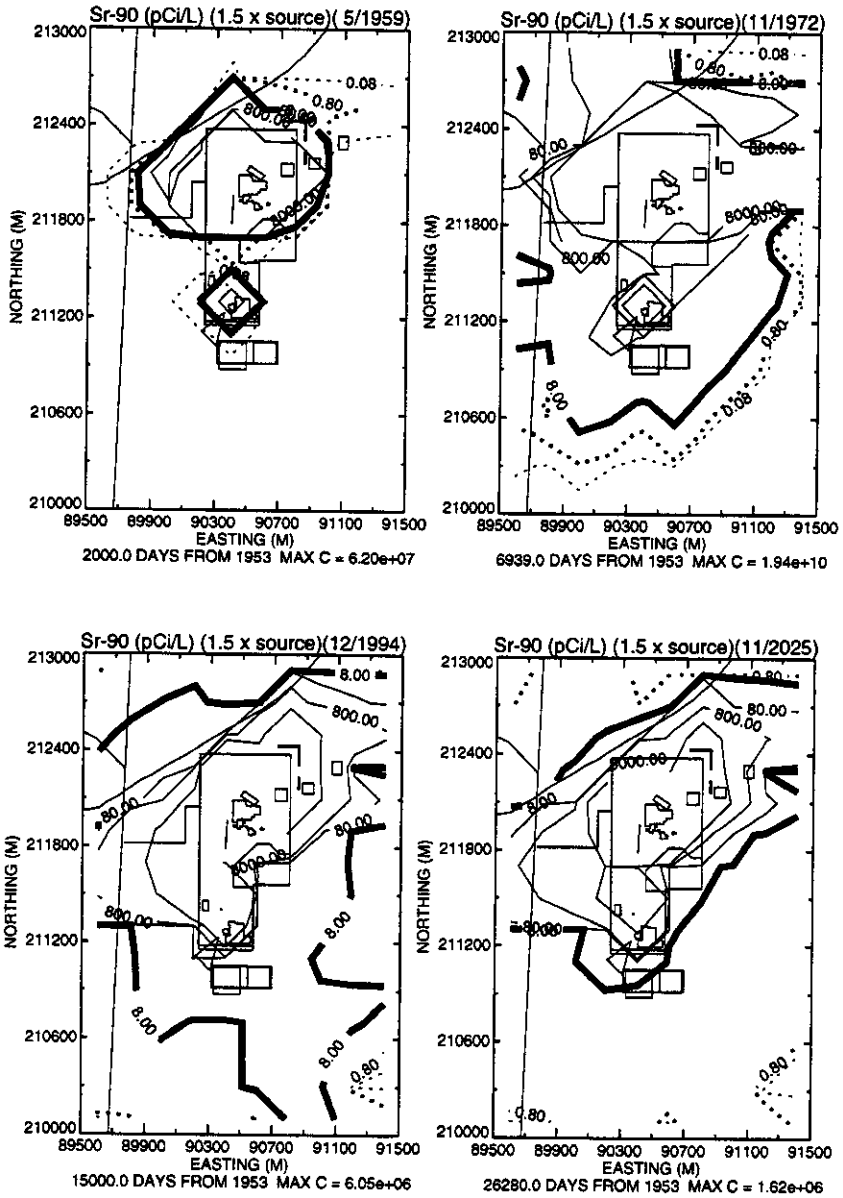

Figure 8-51 Vadose zone Sr-90 (increased tank farm mass) peak concentration contours.

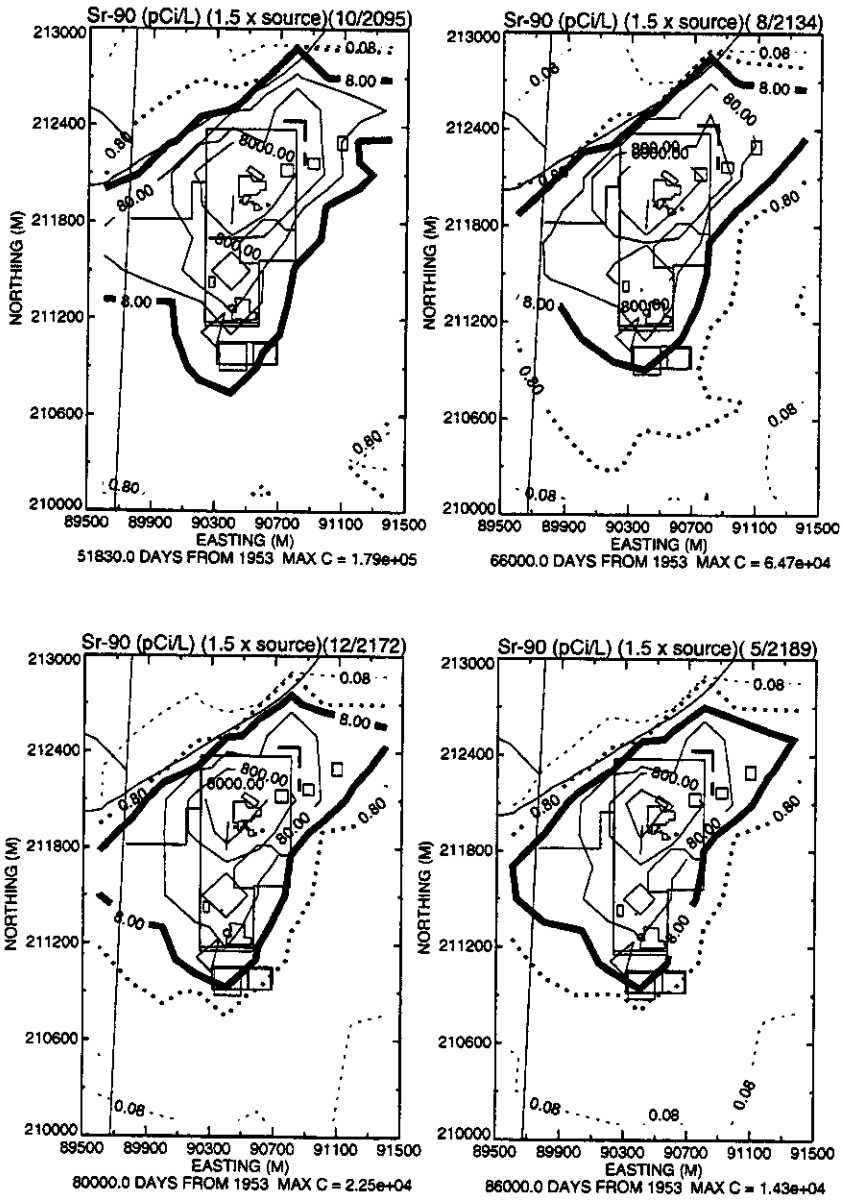

Figure 8-52 Vadose zone Sr-90 (increased tank farm mass) peak concentration contours.

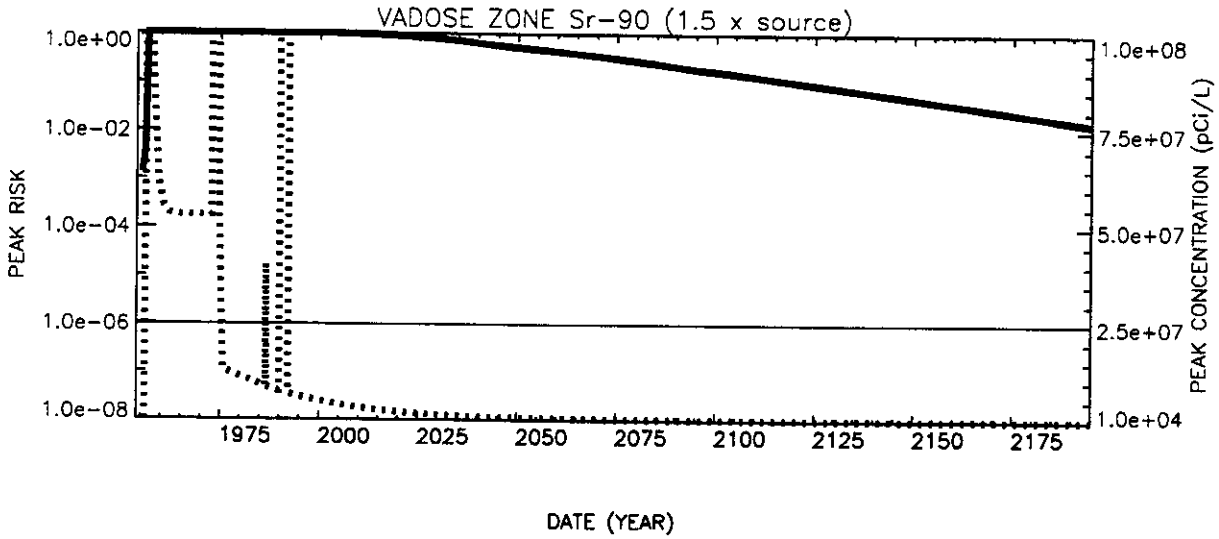

Figure 8-53 Peak vadose zone risk and concentration for Sr-90 (increased tank farm mass). Risk indicated by the thick line on the log scale with the 10^{-6} value shown as the solid line. The dotted line represents concentration given by the linear scale on the right axis.

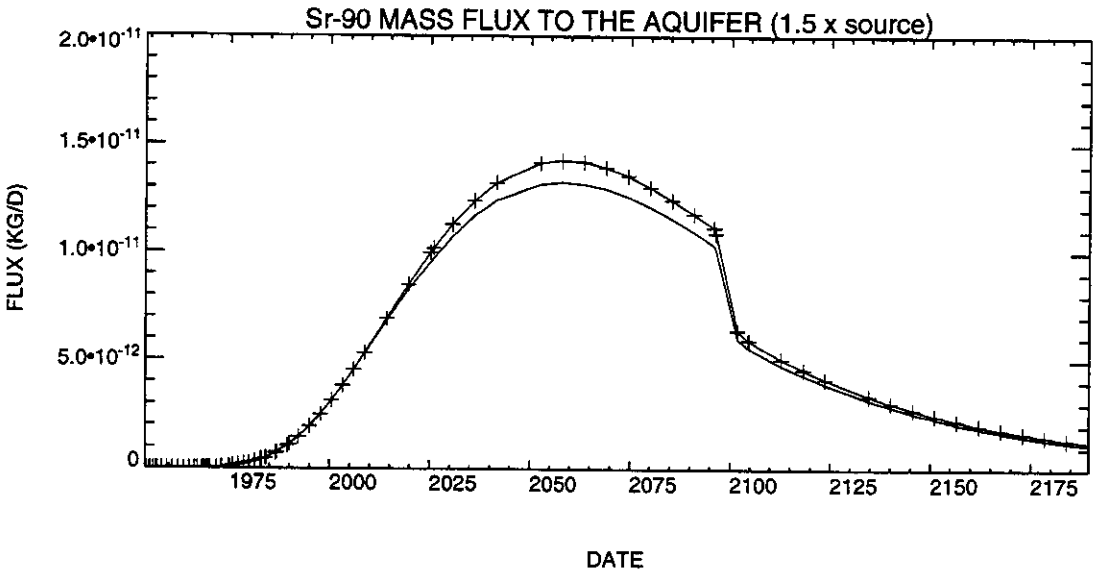

Figure 8-54 Mass flux of Sr-90 (increased tank farm mass) into the aquifer from the vadose zone.

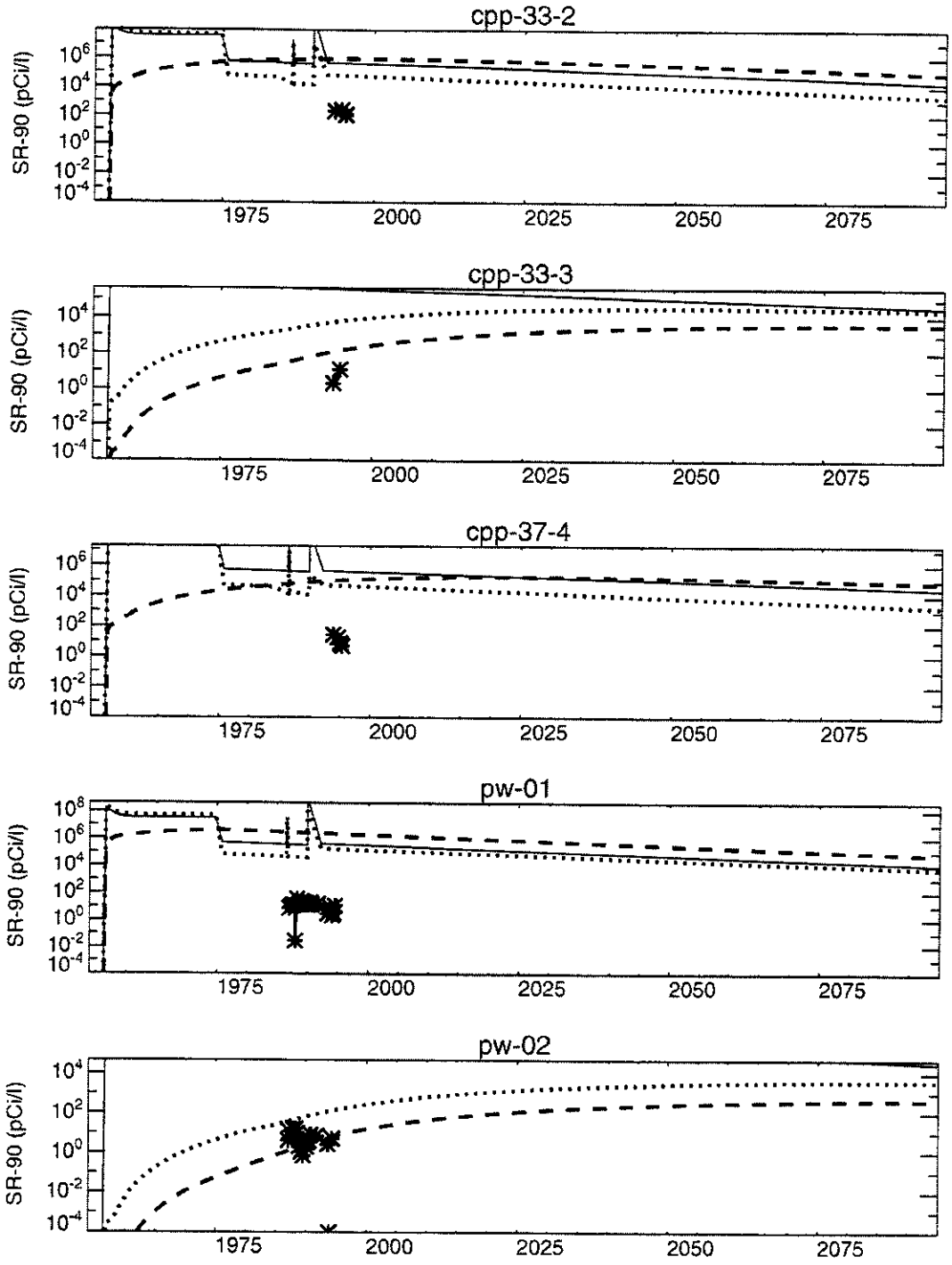

Figure 8-55 Comparison of vadose zone Sr-90 (increased tank farm mass) to field data.

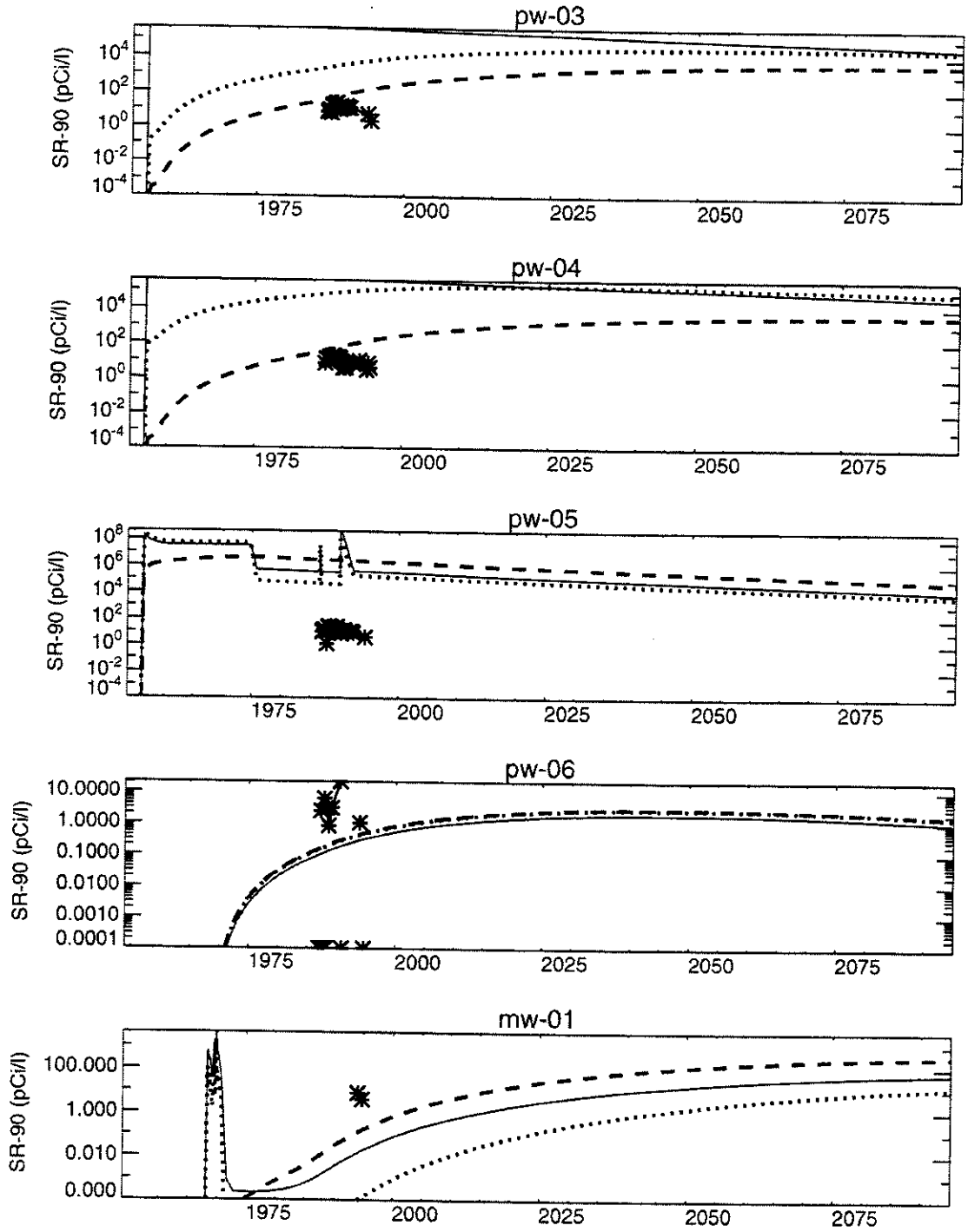

Figure 8-56 Comparison of vadose zone Sr-90 (increased tank farm mass) to field data.

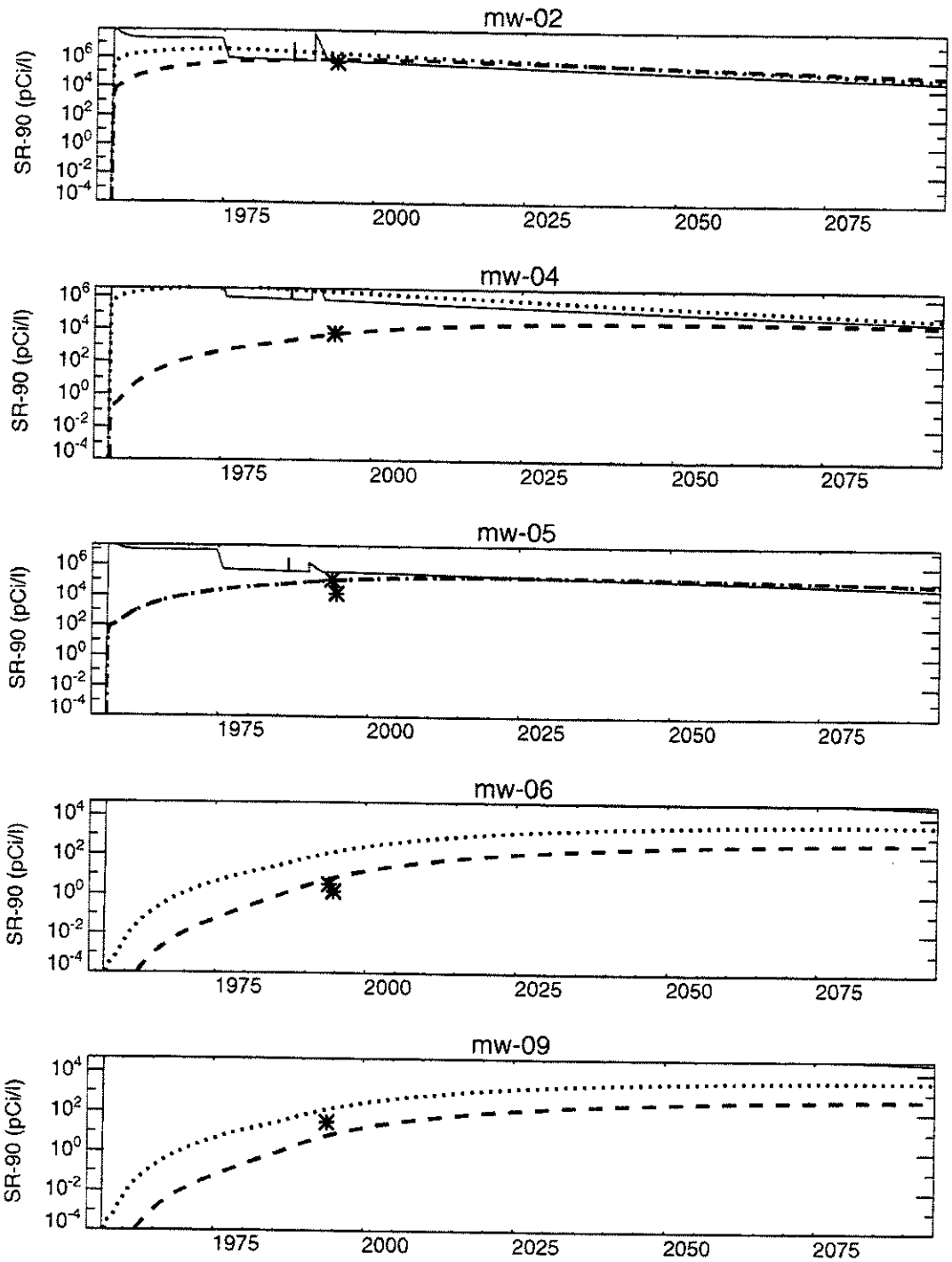

Figure 8-57 Comparison of vadose zone Sr-90 (increased tank farm mass) to field data.

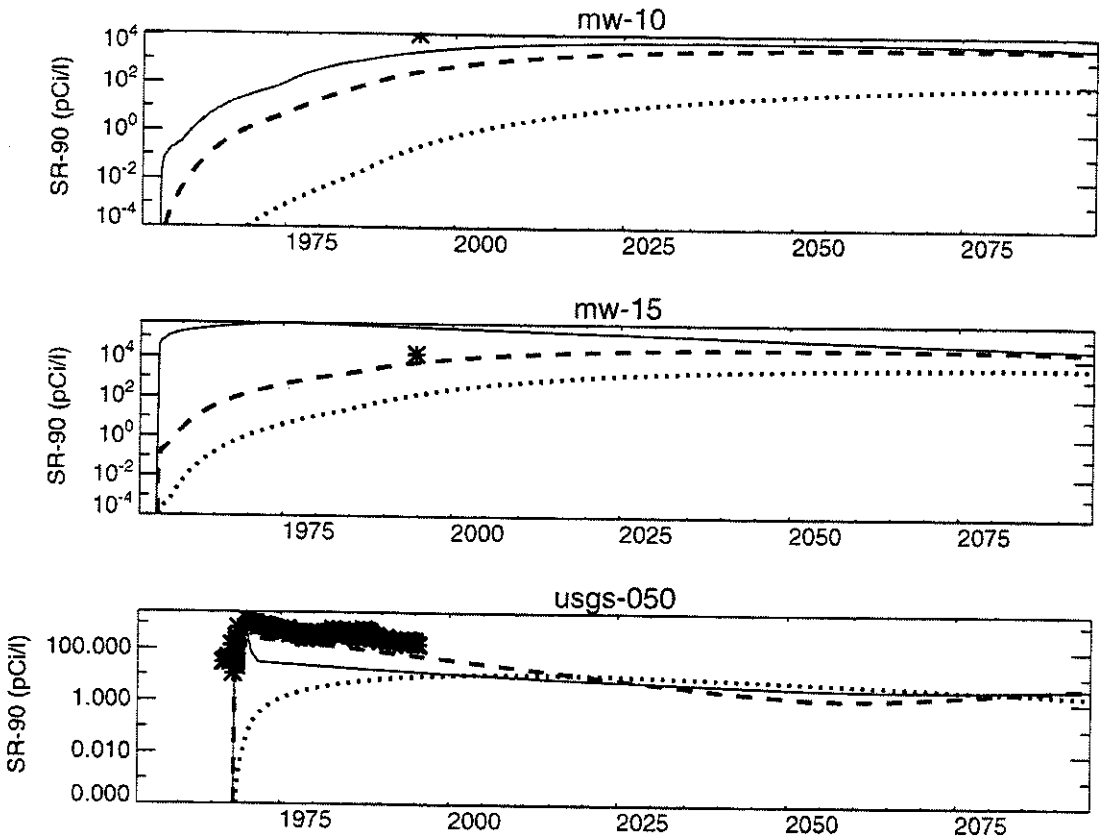

Figure 8-58 Comparison of vadose zone Sr-90 (increased tank farm mass) to field data.

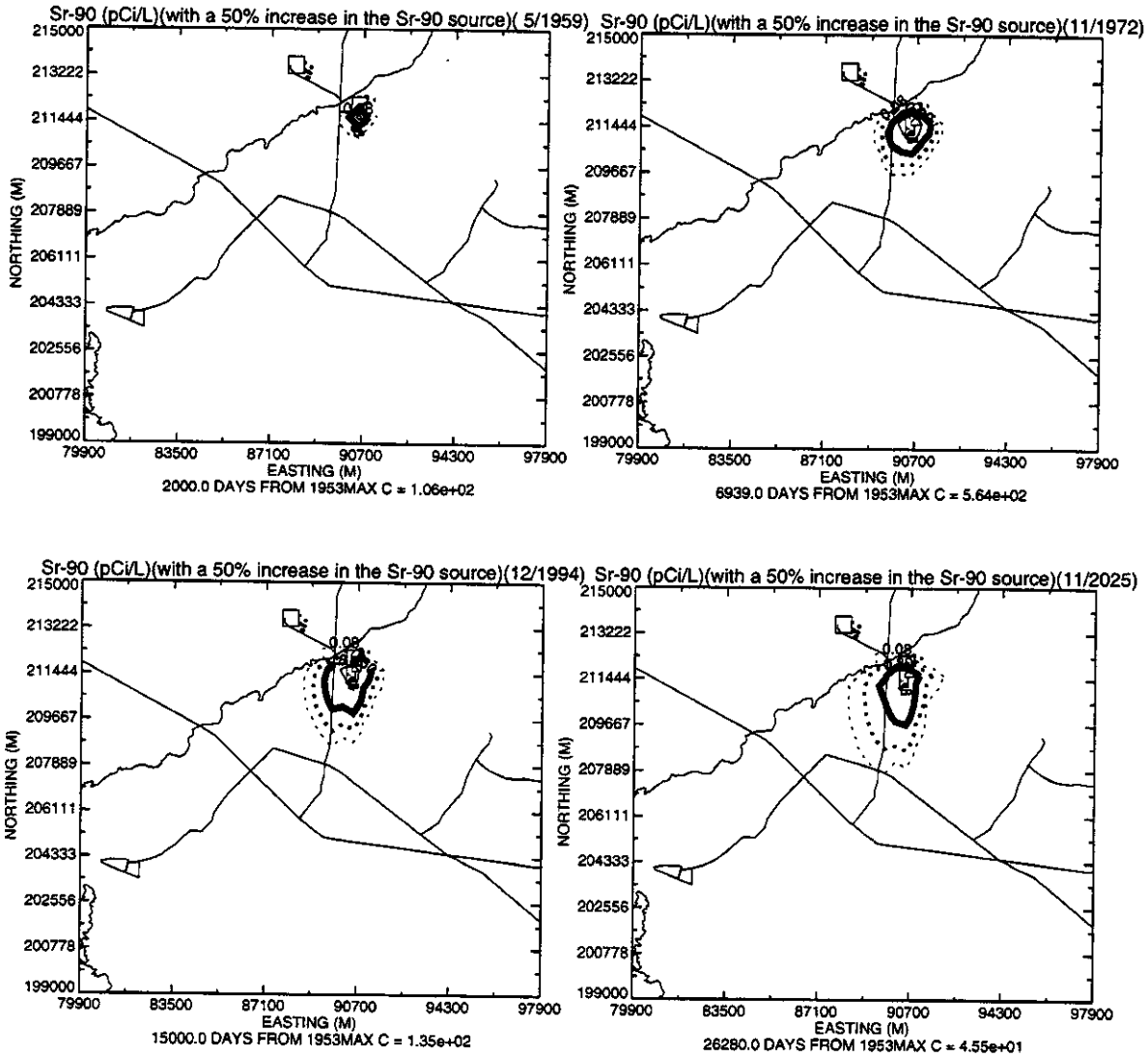

Figure 8-59 Aquifer Sr-90 (increased tank farm mass) peak concentration contours.

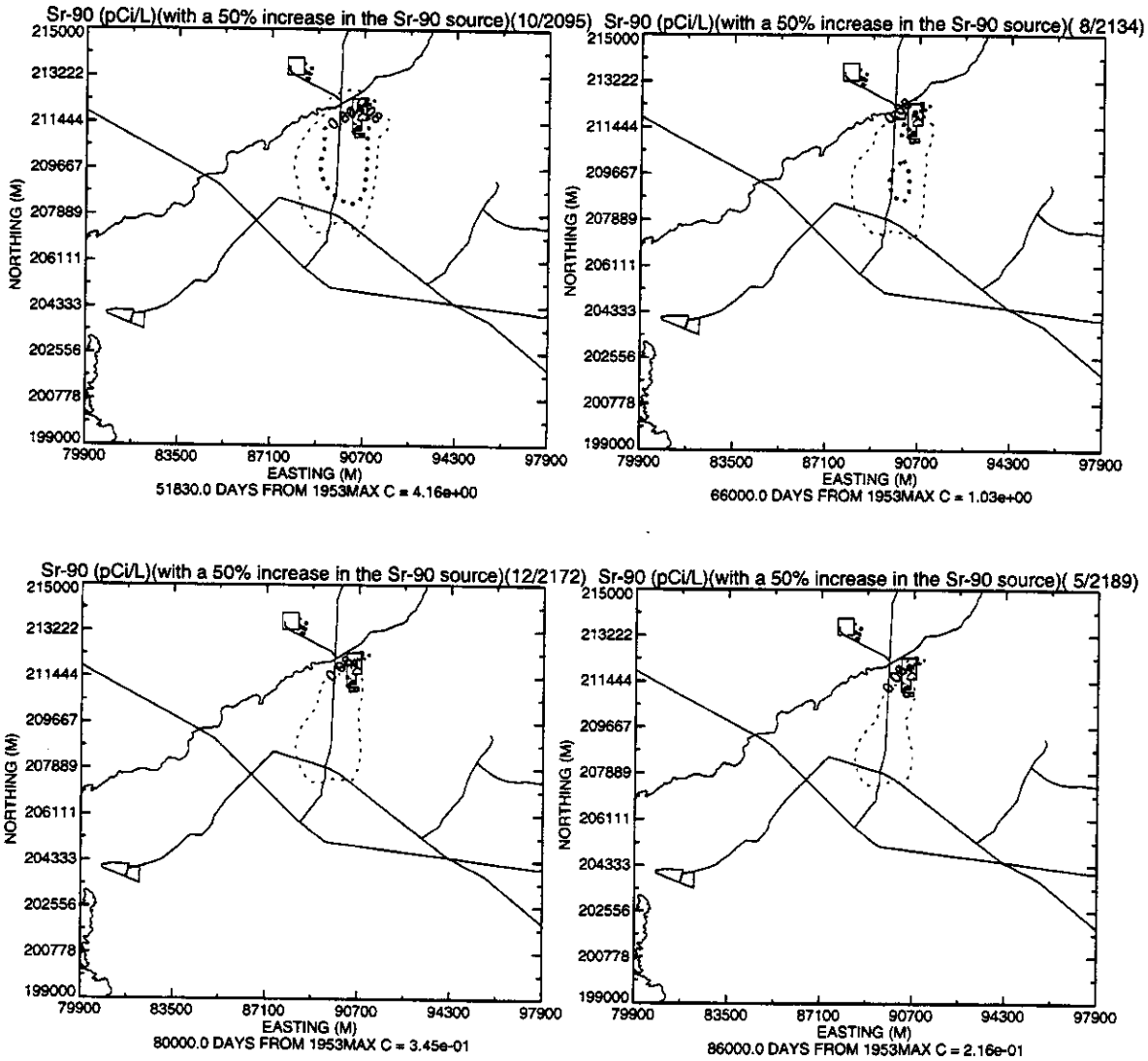

Figure 8-60 Aquifer Sr-90 (increased tank farm mass) peak concentration contours.

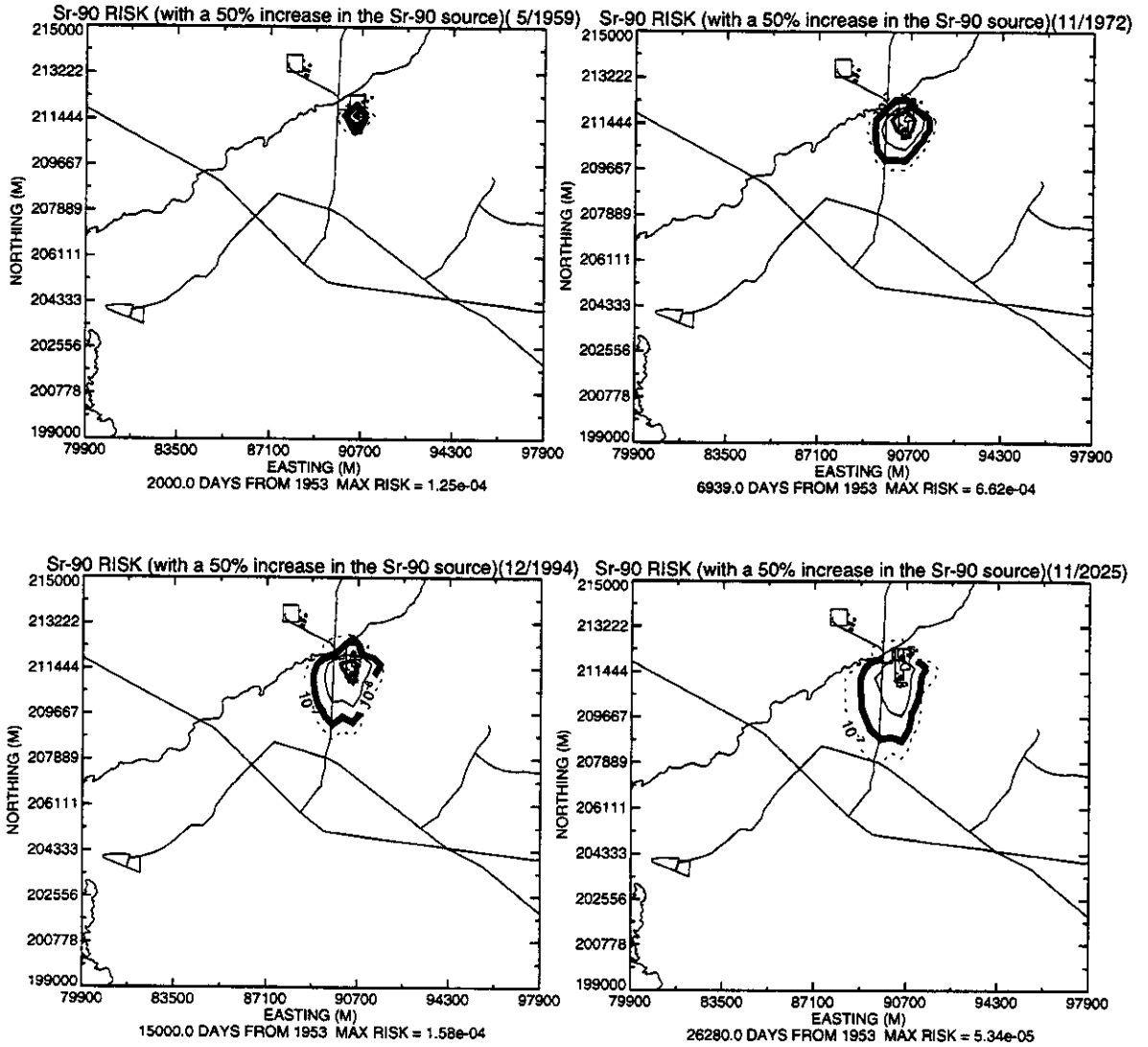

Figure 8-61 Aquifer Sr-90 (increased tank farm mass) peak risk contours.

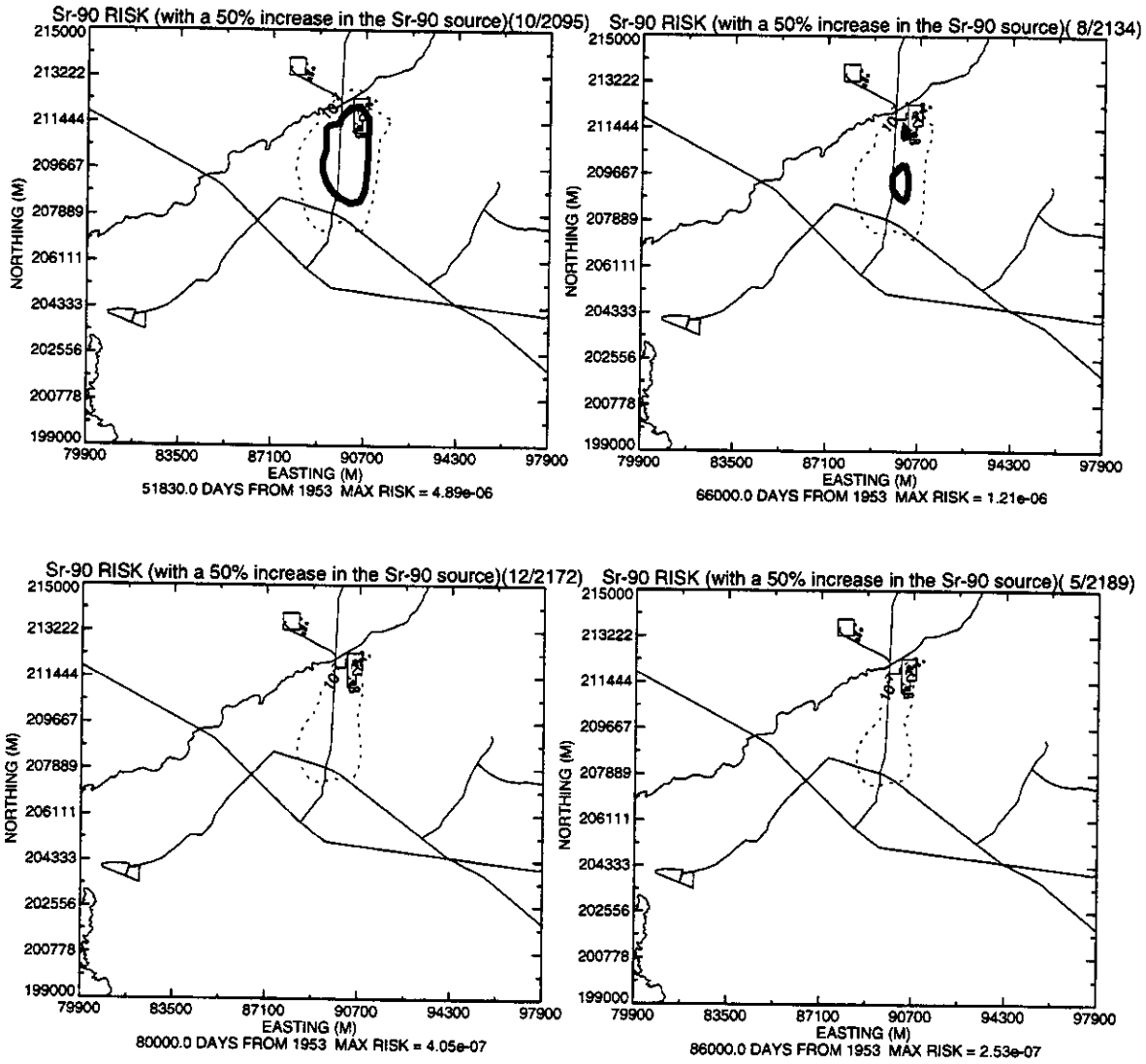

Figure 8-62 Aquifer Sr-90 (increased tank farm mass) peak risk contours.

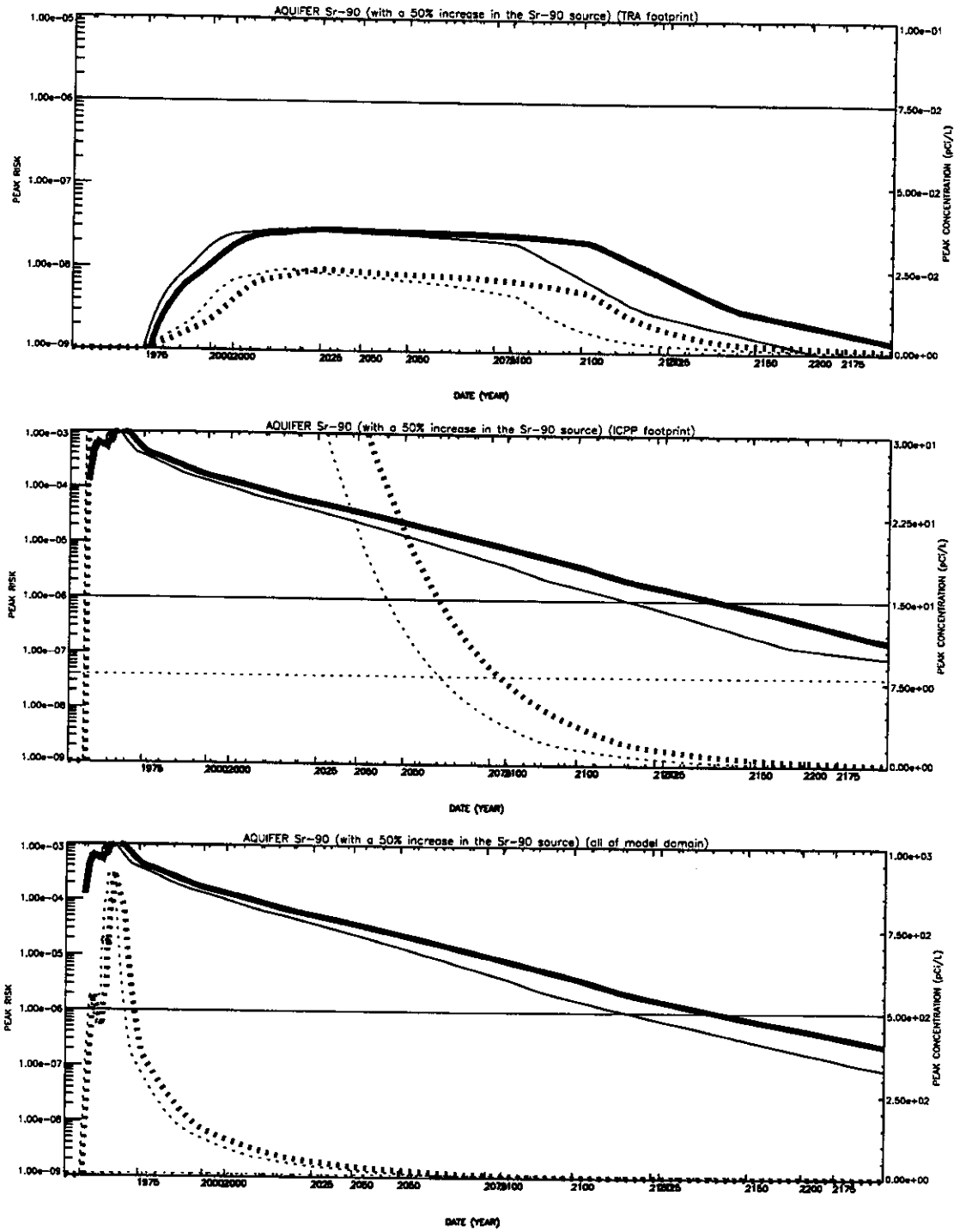

Figure 8-63 Peak aquifer concentration for Sr-90 (increased tank farm mass). Top figure: TRA foot print, Middle figure: ICPP footprint, Bottom Figure: entire aquifer domain. Thick line risk (left scale), dotted line concentration (right scale) solid line 10^{-6} risk (left scale).

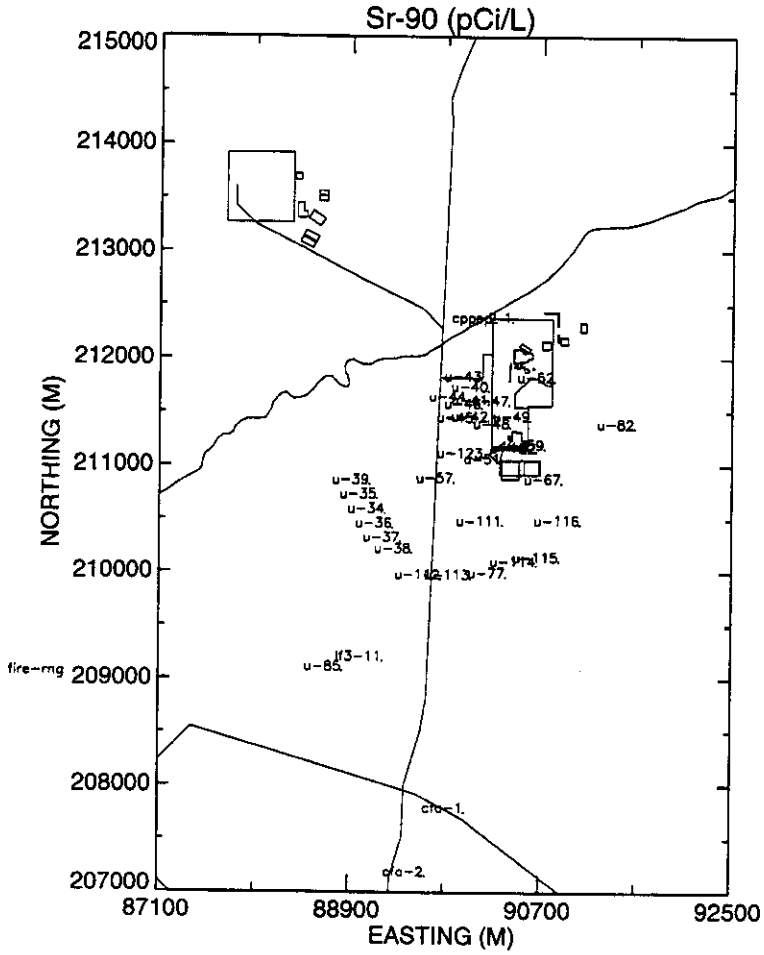

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Figure 8-64 Well locations for the comparison of aquifer Sr-90 (increased tank farm mass) to field data.

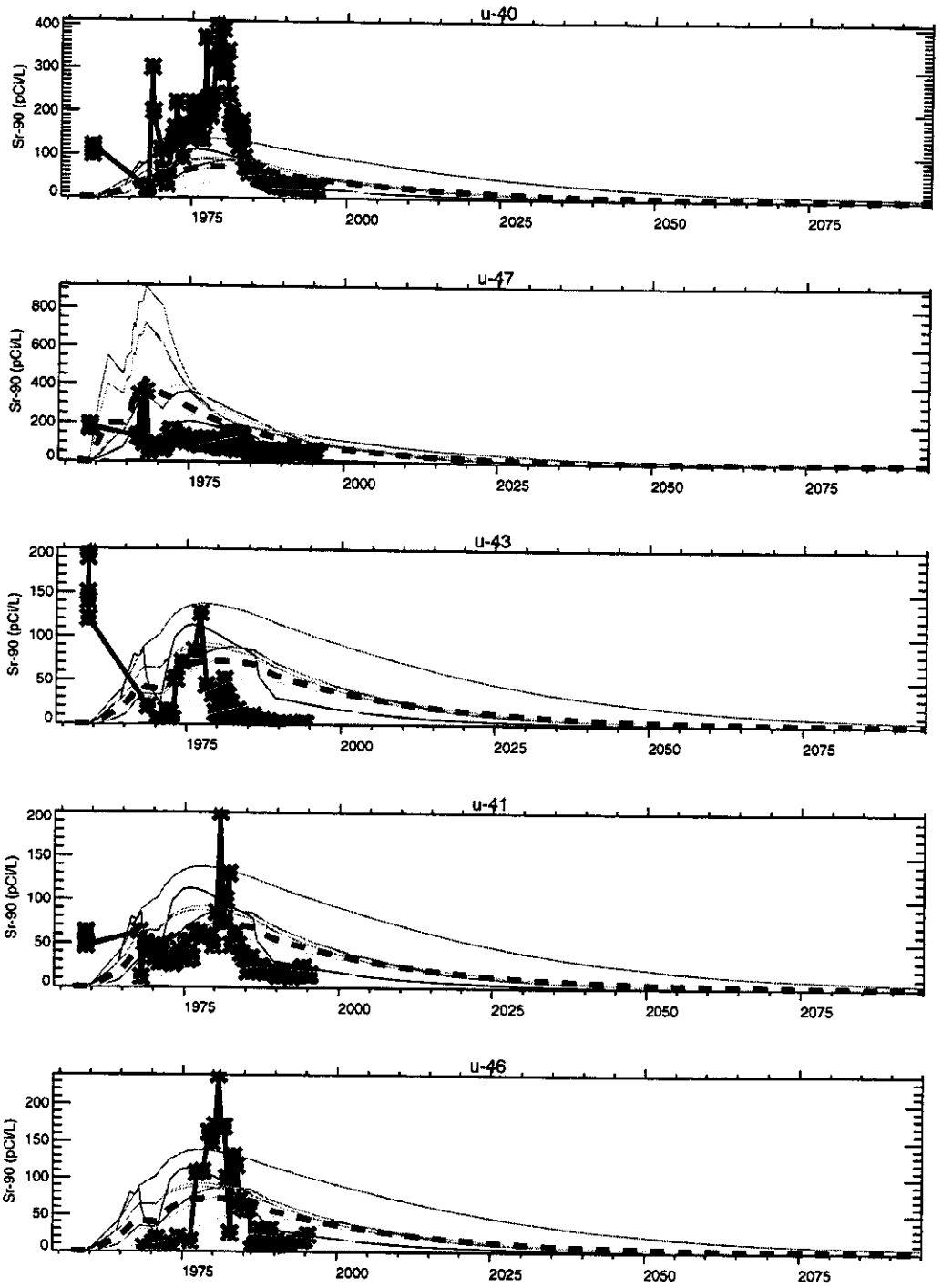

Figure 8-65 Comparison of aquifer Sr-90 (increased tank farm mass) to field data.

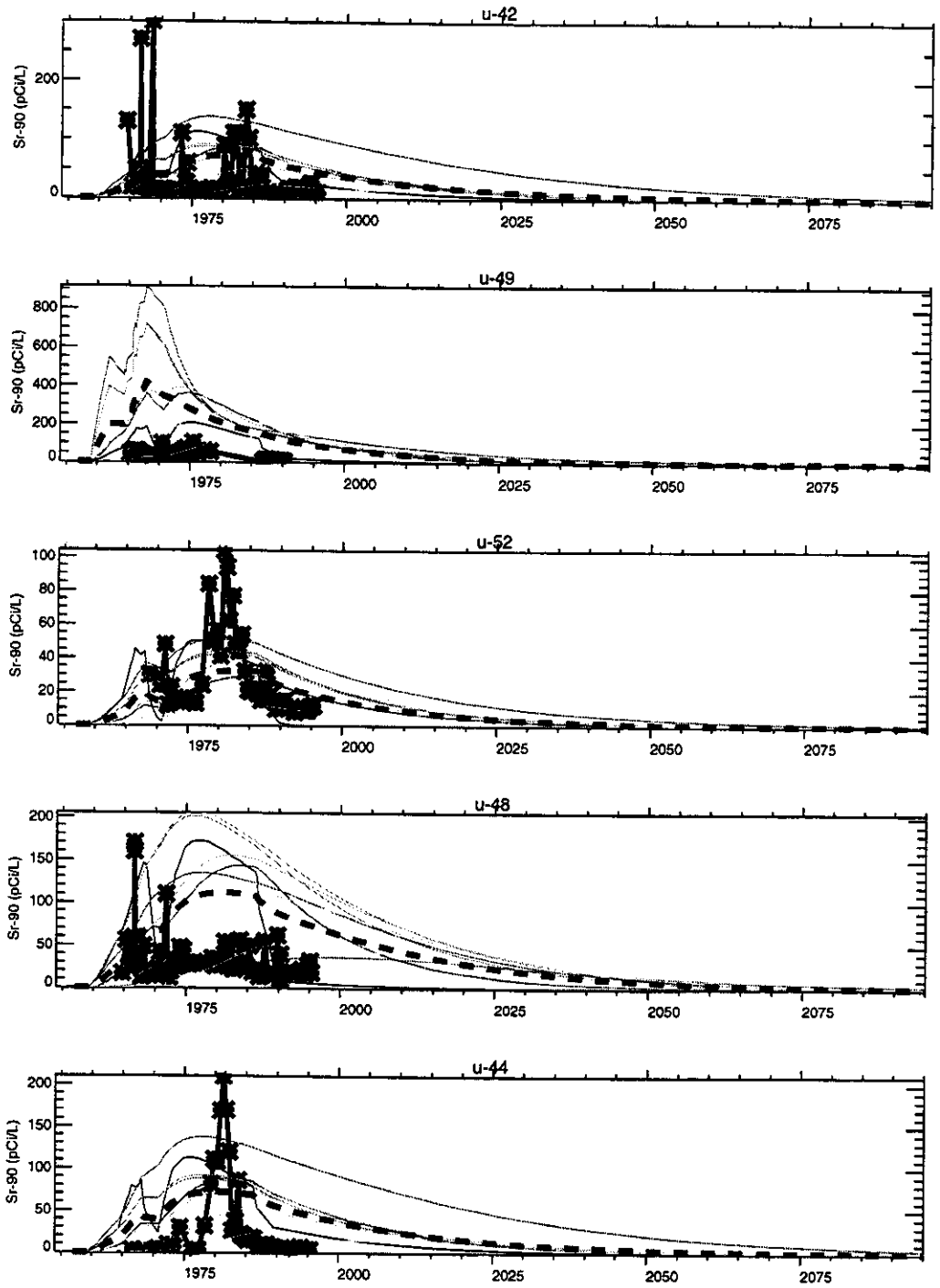

Figure 8-66 Comparison of aquifer Sr-90 (increased tank farm mass) to field data.

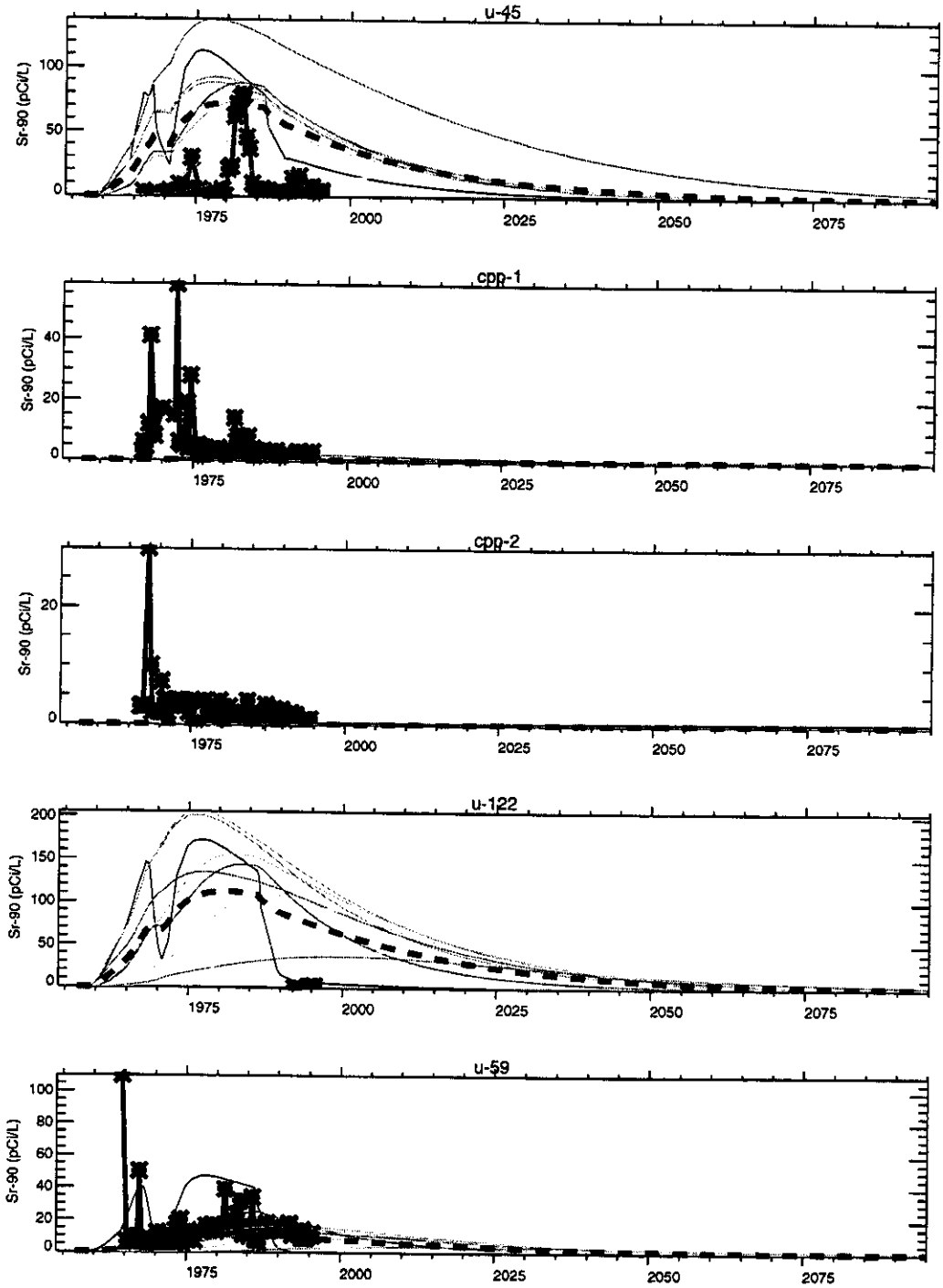

Figure 8-67 Comparison of aquifer Sr-90 (increased tank farm mass) to field data.

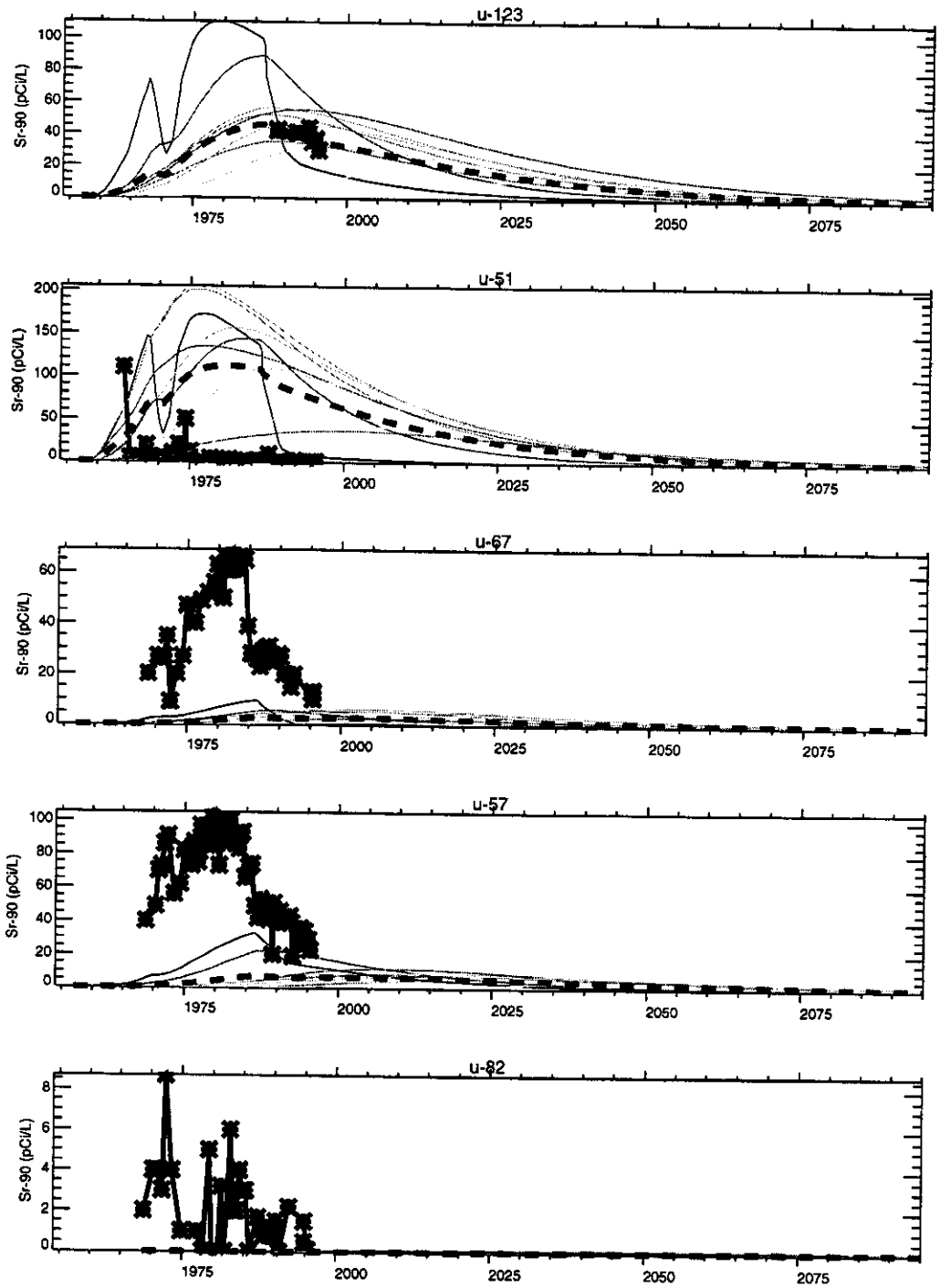

Figure 8-68 Comparison of aquifer Sr-90 (increased tank farm mass) to field data.

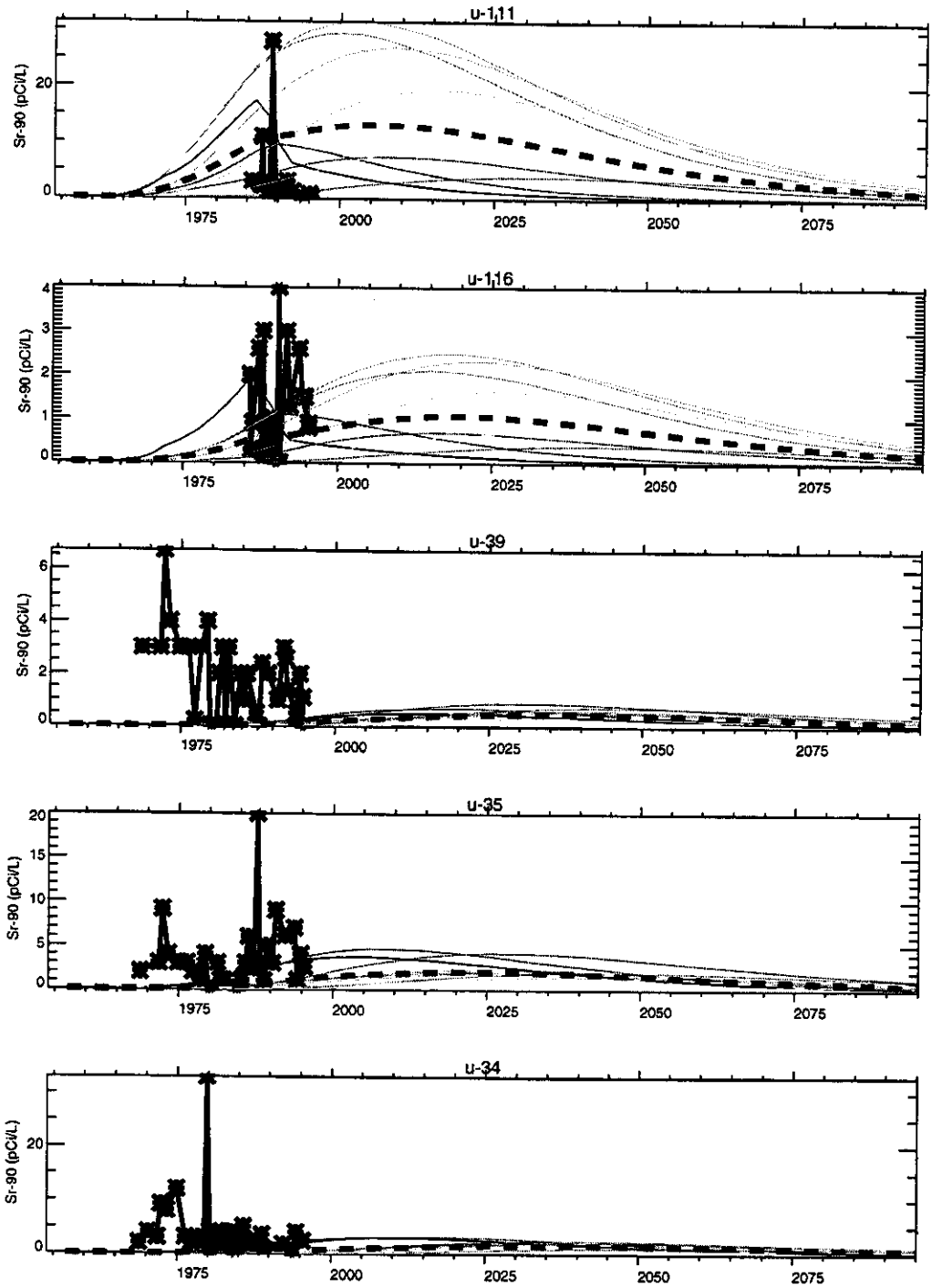

Figure 8-69 Comparison of aquifer Sr-90 (increased tank farm mass) to field data.

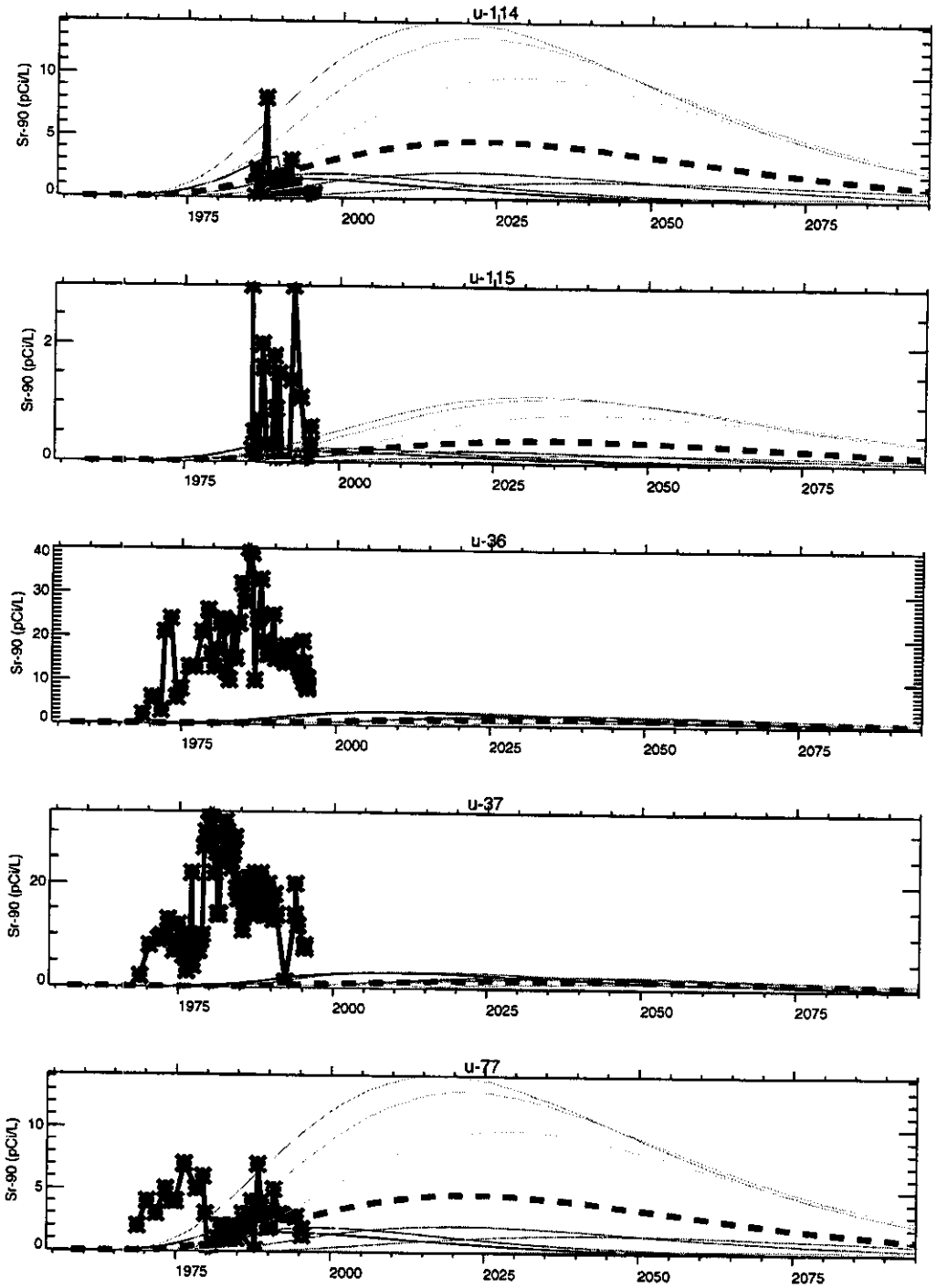

Figure 8-70 Comparison of aquifer Sr-90 (increased tank farm mass) to field data.

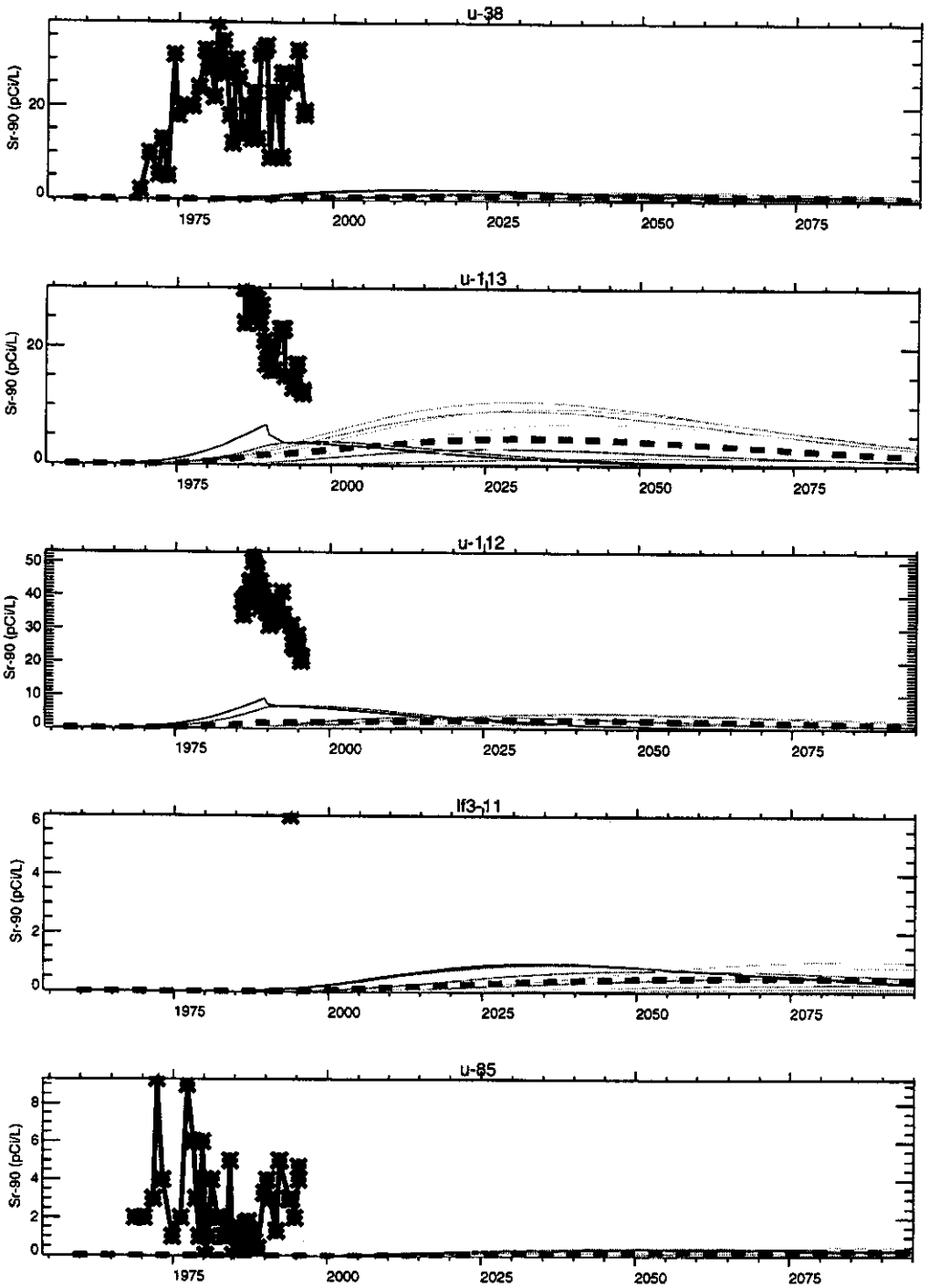

Figure 8-71 Comparison of aquifer Sr-90 (increased tank farm mass) to field data.

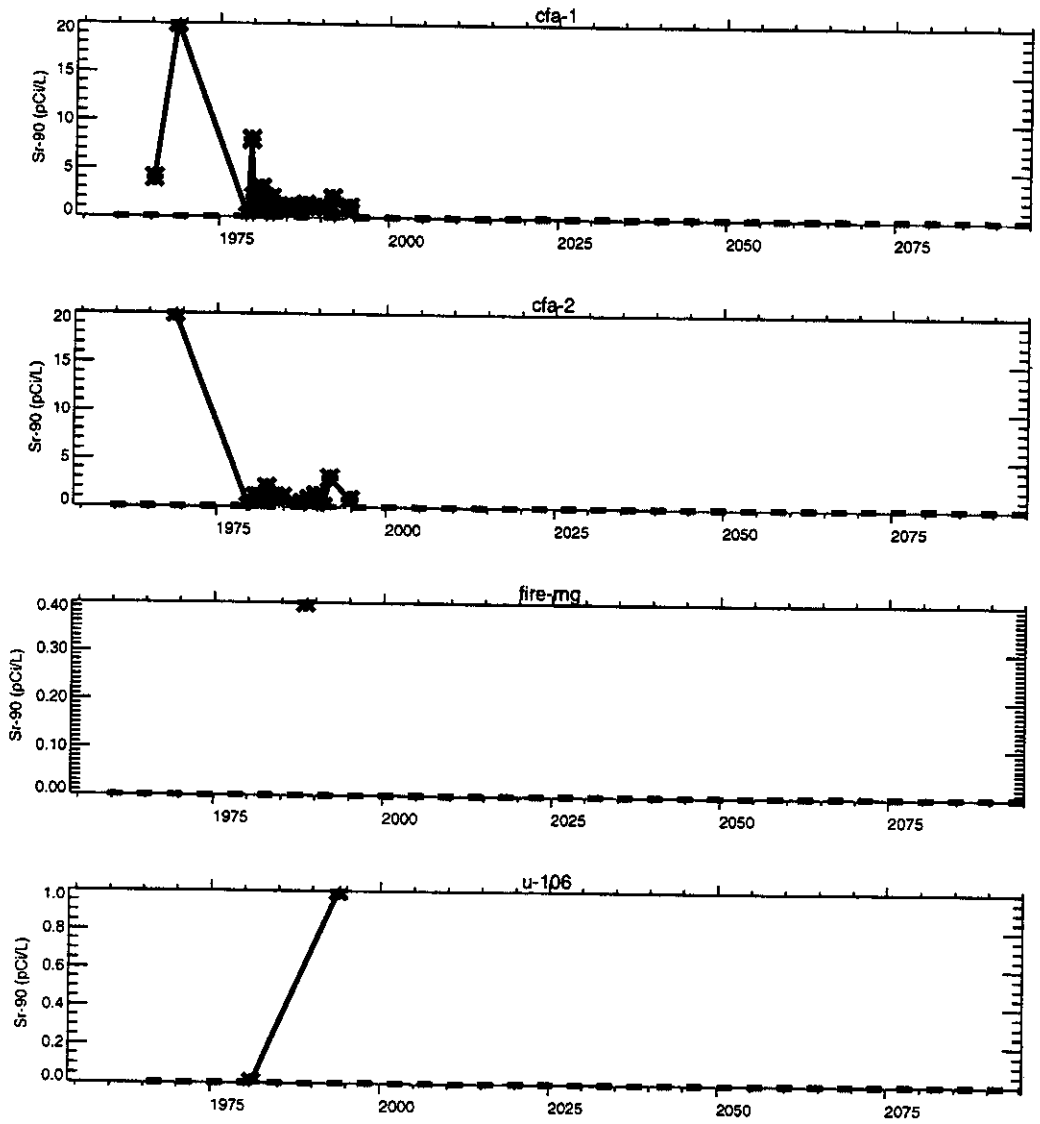

Figure 8-72 Comparison of aquifer Sr-90 (increased tank farm mass) to field data.

8.3 Sr-90 With Increased Fire Water Leakage

In this simulation, the water losses near the tank farm area are increased above the base case simulation by 50 Mgal/year to account for the measurement error in metering. The source masses remain the same as in the base case simulation and are by relative contribution: a) CPP-31 (60.82%), b) CPP-28 (31.66%), c) Soils (5.71%), d) CPP-80 (1.42%), e) CPP-02 (0.17%), f) the injection well (0.12%), and g) the '86 release (0.09%). Transport through the vadose zone is represented in Figures 8-73 through 8-82 and Figures 8-83 through 8-96 present simulation results for the aquifer region. Contour levels for both the vadose zone and aquifer (Figures 8-73 through 8-76, 8-83, and 8-84) are given for $8x10^{-2}$, $8x10^{-1}$, 8 (the MCL), $8x10^{+1}$, $8x10^{+2}$, and $8x10^{+3}$ pCi/L. The corresponding risk contour maps for the aquifer simulation are given in Figures 8-85, and 8-86. Risk contours are plotted at the 10^{-7}, 10^{-6} (0.859 pCi/L), 10^{-5}, 10^{-4}, 10^{-3}, and 10^{-2} levels.

This simulation is compared against the simulation presented in Section 8.1.1 because they both use a Kd=24 cm^3/g. Like the previous sensitivity run, the aquifer calibration plots for this simulation should be exactly like the Section 8.1.1 simulation because of the time frame necessary for the increase in tank farm source mass to reach the aquifer (after the year 2000). The best way to assess the relative differences between these simulation results and those for the base case are to compare Figure 8-6 to 8-78 and Figure 8-15 to 8-87. These figures correspond to the mass flux entering the aquifer from the vadose zone and the resultant peak aquifer concentration/risk respectively. To facilitate the comparison, the Section 8.1.1 mass flux has been plotted onto Figure 8-78 as the solid line, with the mass flux predicted using the increased tank farm water losses given by the starred line. Given the peak mass flux to the aquifer, the relative difference between the two curves is small. This small increase in mass flux to the aquifer results in an equally small difference in peak aquifer concentration. Figure 8-87 also contains the Section 8.1.1 simulation results as the thin dotted line for concentration and thin solid line for risk. The Section 8.1.1 values are presented for comparison to the thick dotted and solid lines representing concentration and risk for this simulation, respectively. This latter figure indicates that the time at which the peak aquifer concentration drops below the MCL and risk limits is virtually indistinguishable between the two simulations. The only measurable difference between this simulation and the Section 8.1.1 simulation occurs very late in the total simulation time as indicated by the divergence in the risk predictions for the two simulation cases.

This simulation indicates that a moderate increase in the infiltration rate has virtually no influence on the predicted concentrations of Sr-90 in the aquifer. Sr-90 has a relatively high Kd and a large increase in the infiltration rate would be needed to significantly change its travel time through the vadose zone to the aquifer. Although there was no detailed evaluation of the potential affects of flooding at the ICPP, assuming the flooding is intermittent, it would take many large floods to significantly influence the predicted Sr-90 concentrations in the aquifer.

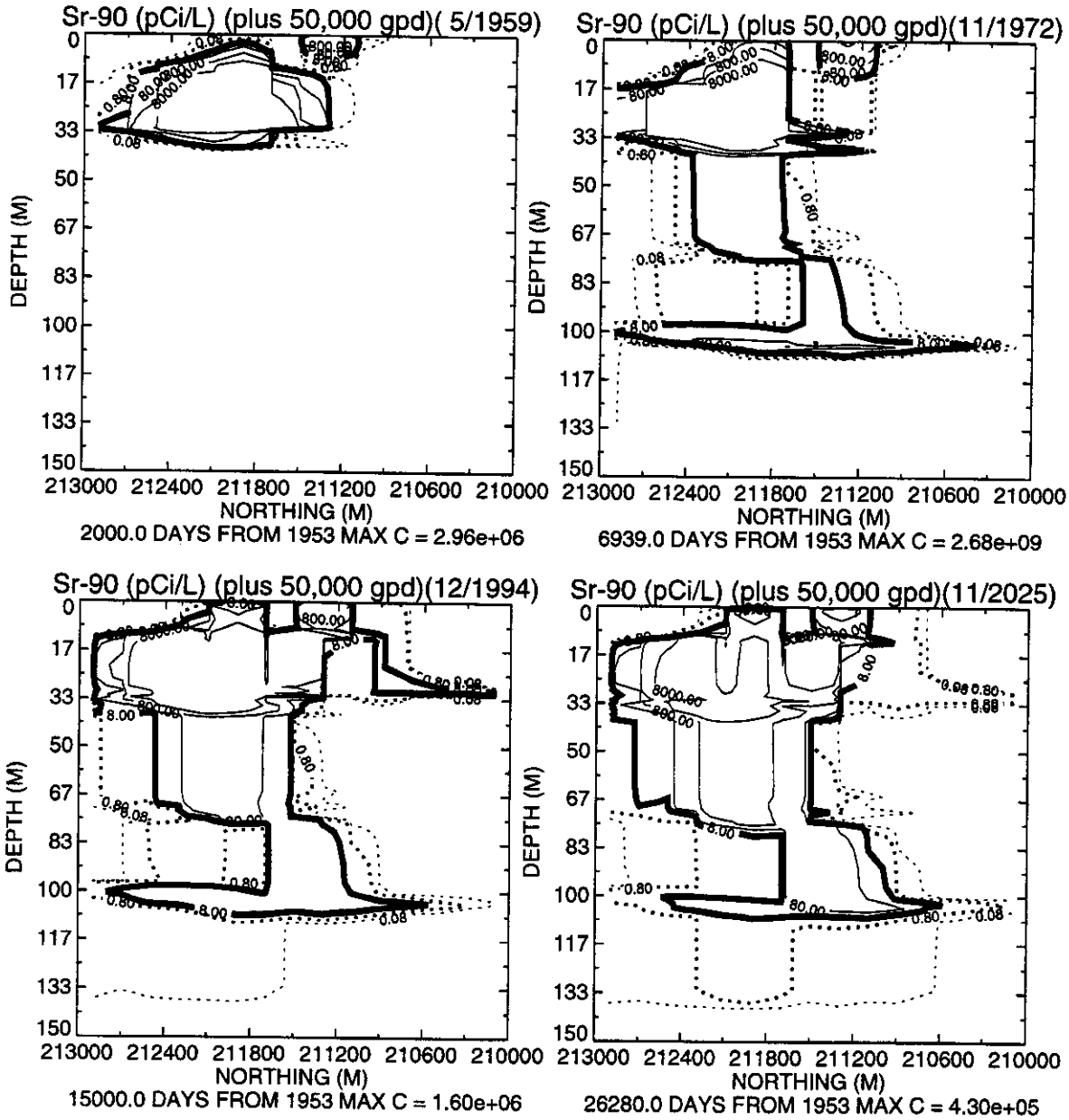

Figure 8-73 Vadose zone Sr-90 (increased water leakage) peak concentration contours.

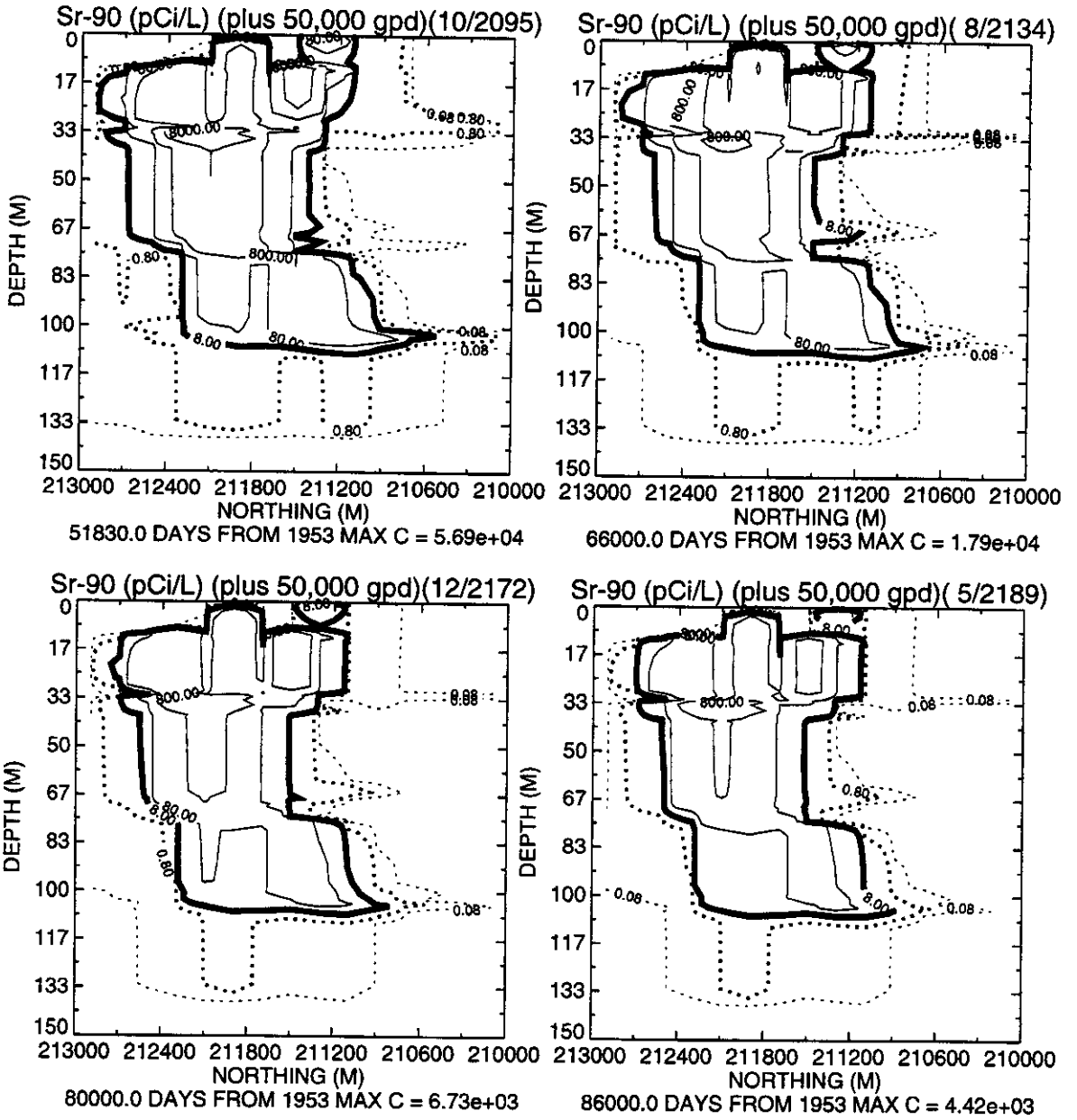

Figure 8-74 Vadose zone Sr-90 (increased water leakage) peak concentration contours.

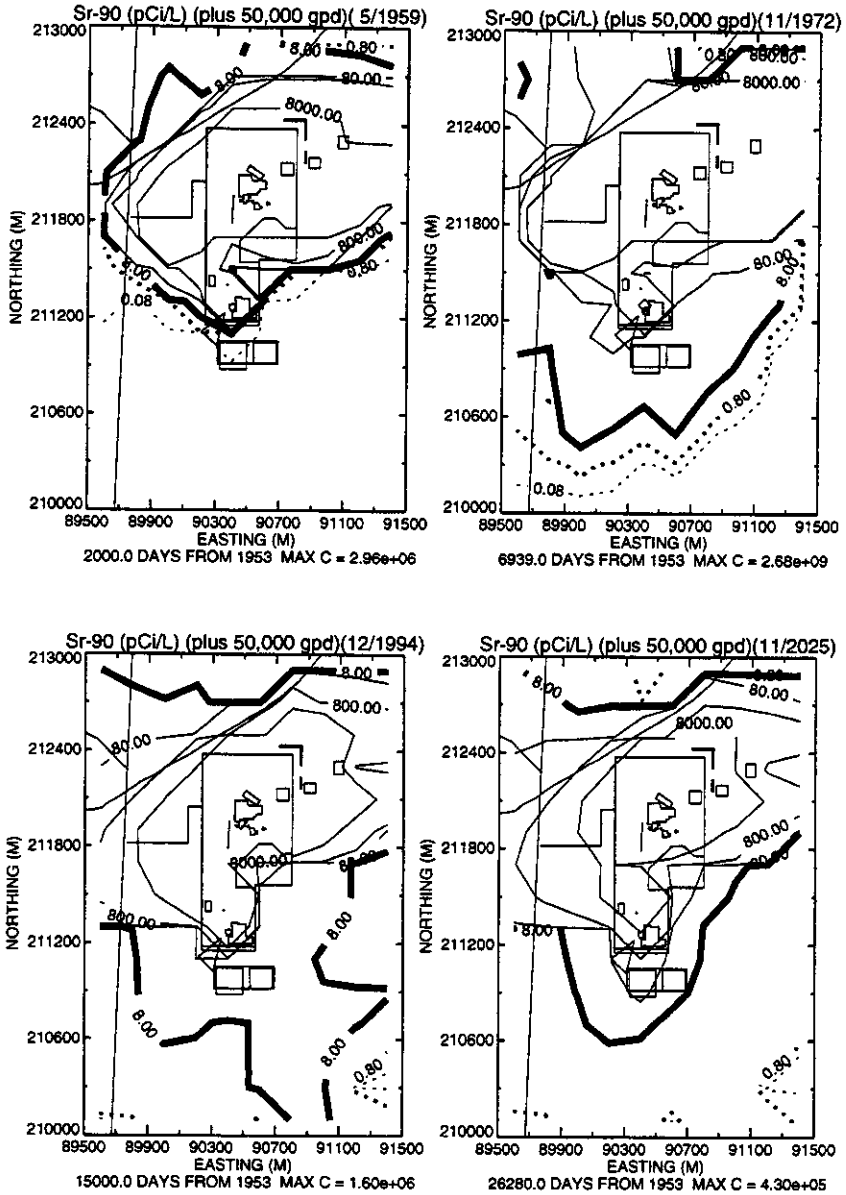

Figure 8-75 Vadose zone Sr-90 (increased water leakage) peak concentration contours.

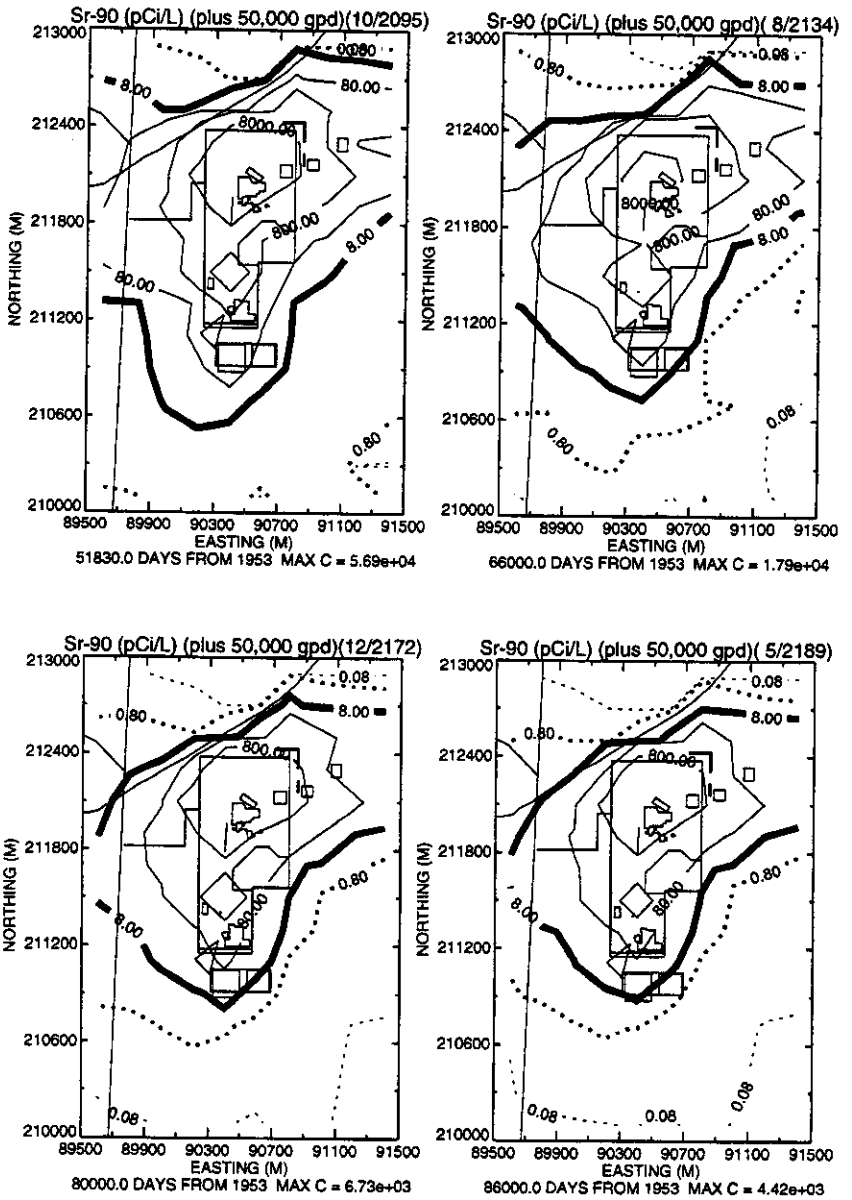

Figure 8-76 Vadose zone Sr-90 (increased water leakage) peak concentration contours.

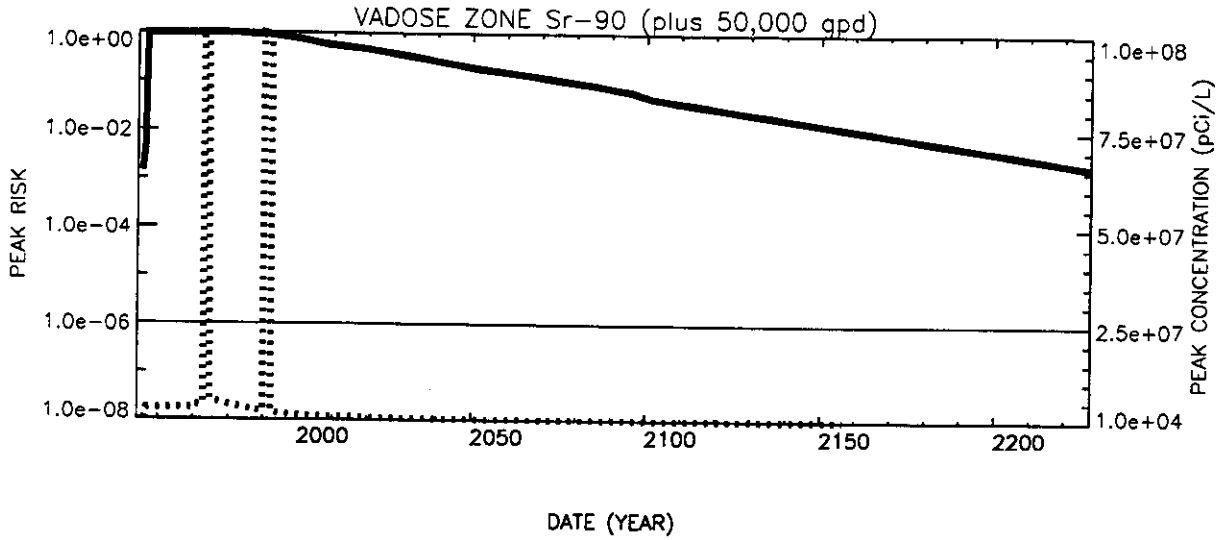

Figure 8-77 Peak vadose zone risk and concentration for Sr-90 (increased water leakage). Risk indicated by the thick line on the log scale with the 10^{-6} value shown as the solid line. The dotted line represents concentration given by the linear scale on the right axis.

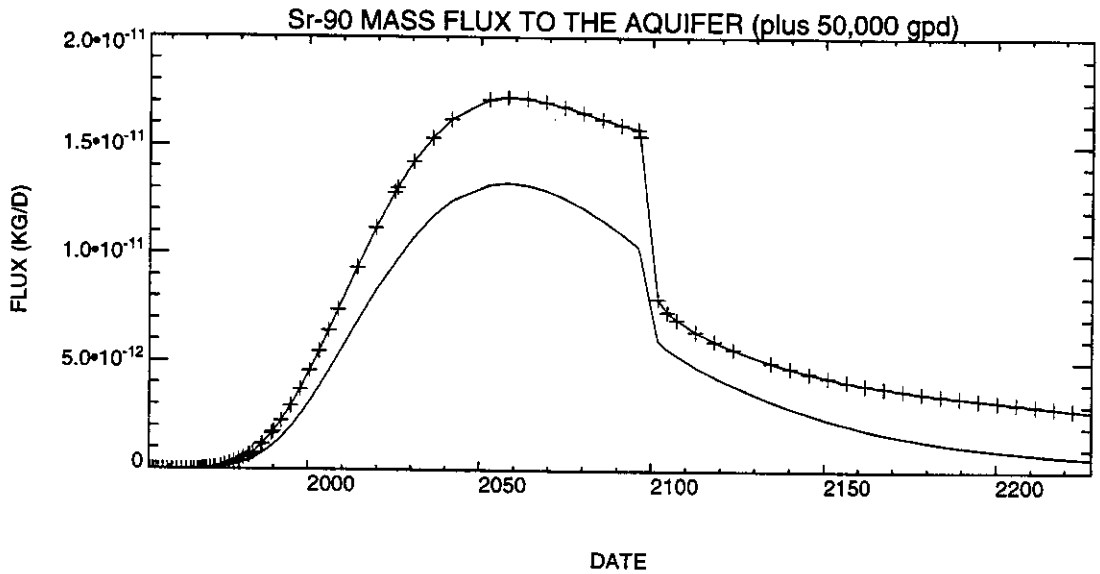

Figure 8-78 Mass flux of Sr-90 (increased water leakage) into the aquifer from the vadose

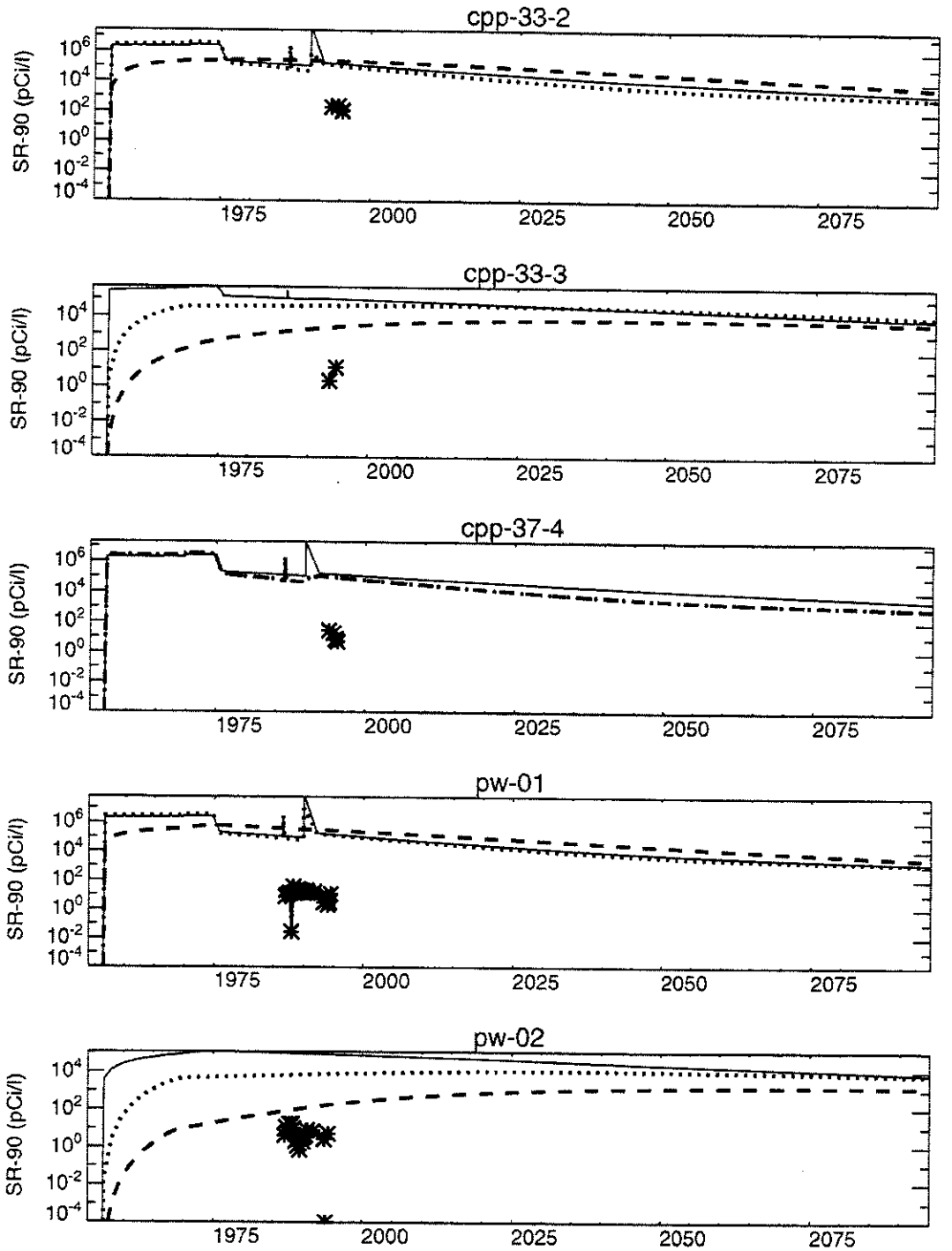

Figure 8-79 Comparison of vadose zone Sr-90 (increased water leakage) to field data.

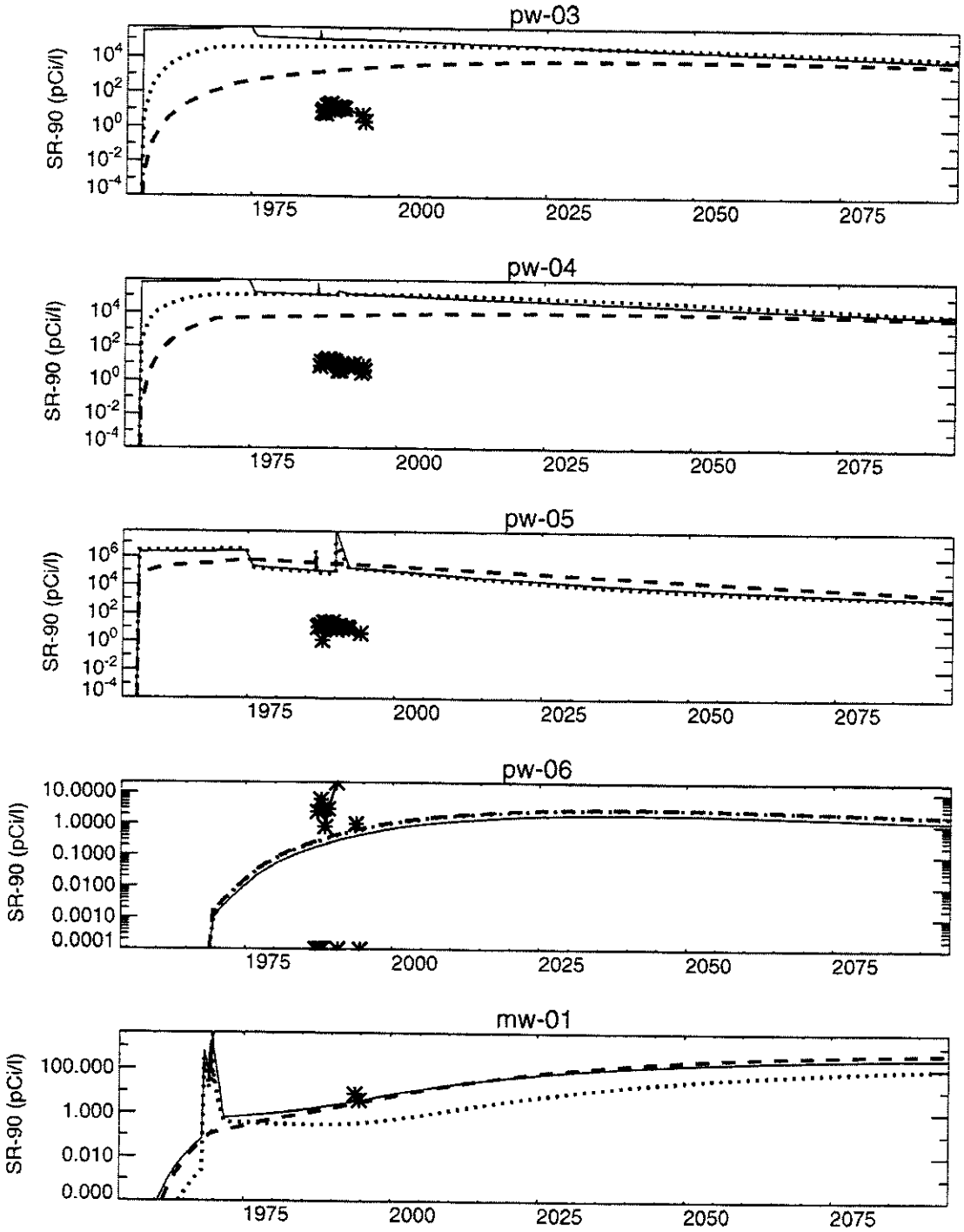

Figure 8-80 Comparison of vadose zone Sr-90 (increased water leakage) to field data.

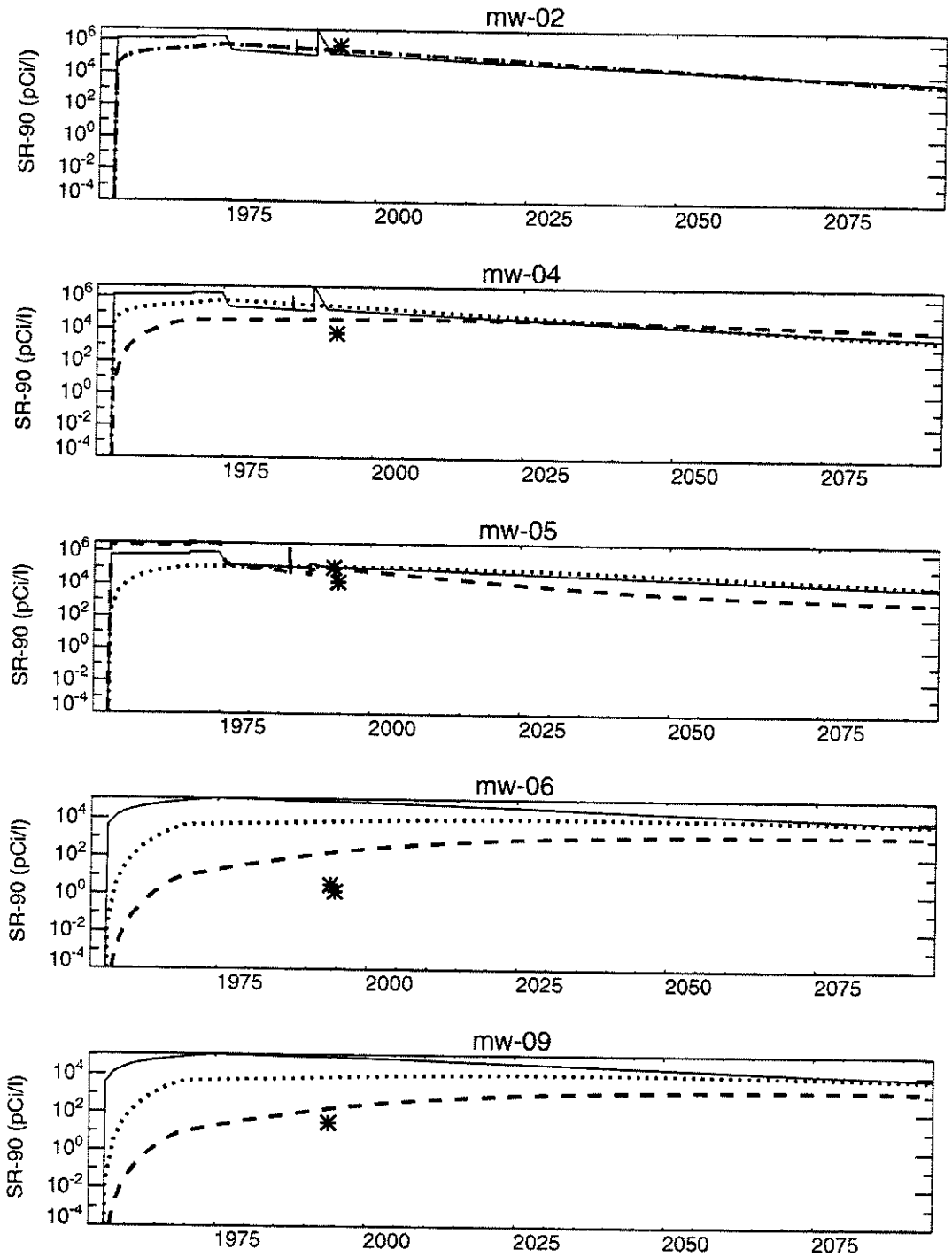

Figure 8-81 Comparison of vadose zone Sr-90 (increased water leakage) to field data.

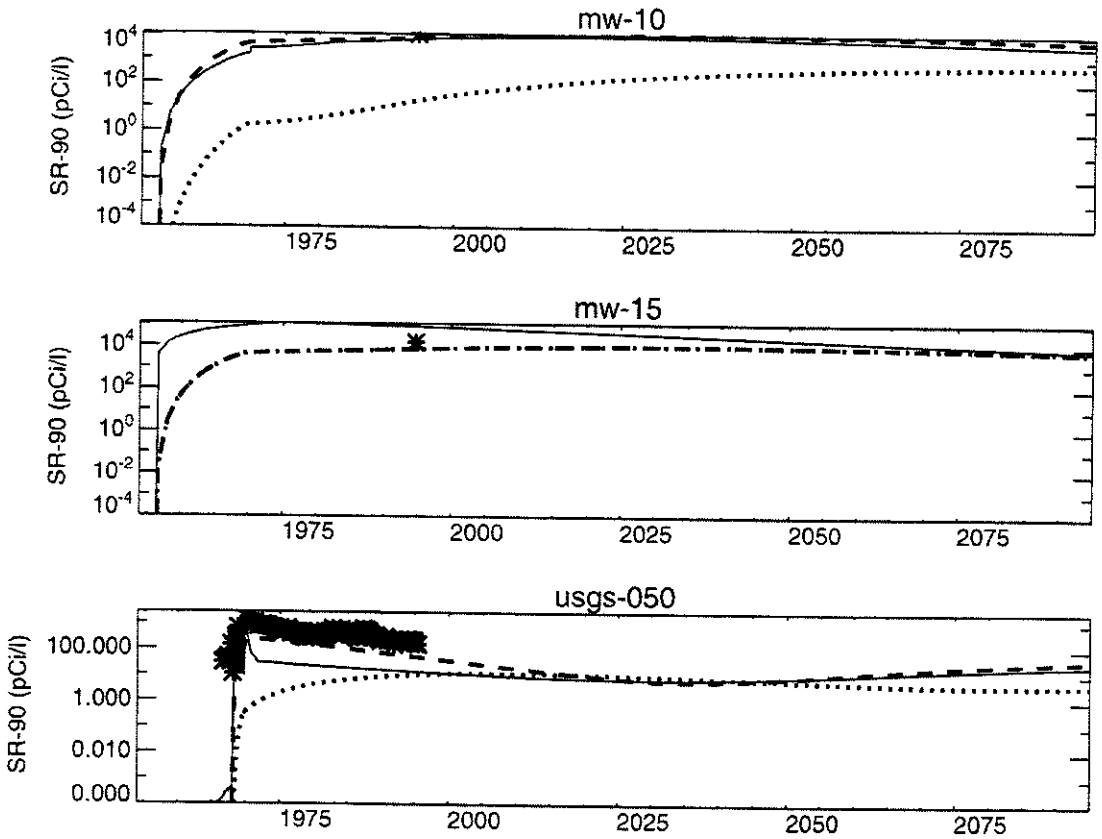

Figure 8-82 Comparison of vadose zone Sr-90 (increased water leakage) to field data.

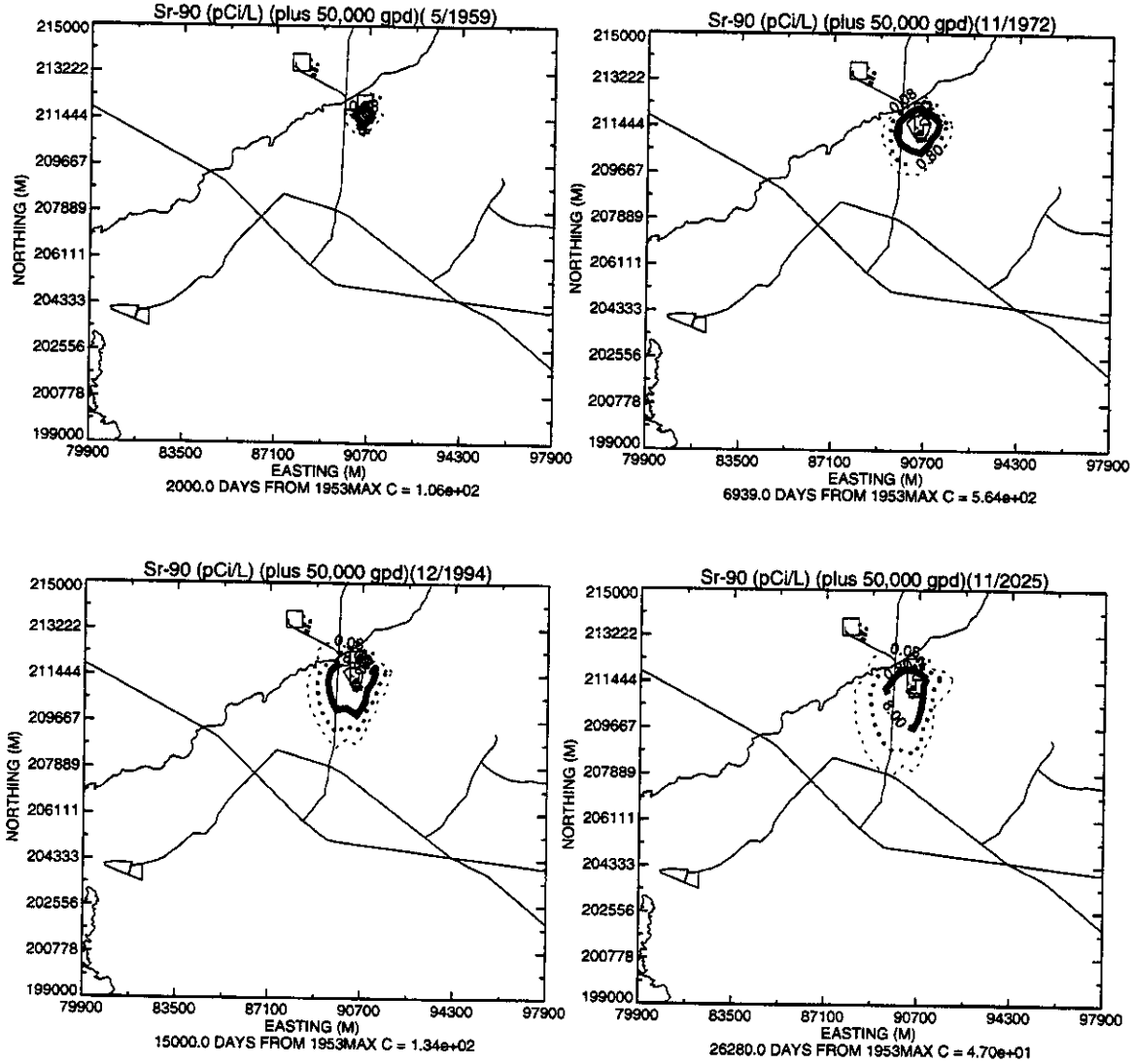

Figure 8-83 Aquifer Sr-90 (increased water leakage) peak concentration contours.

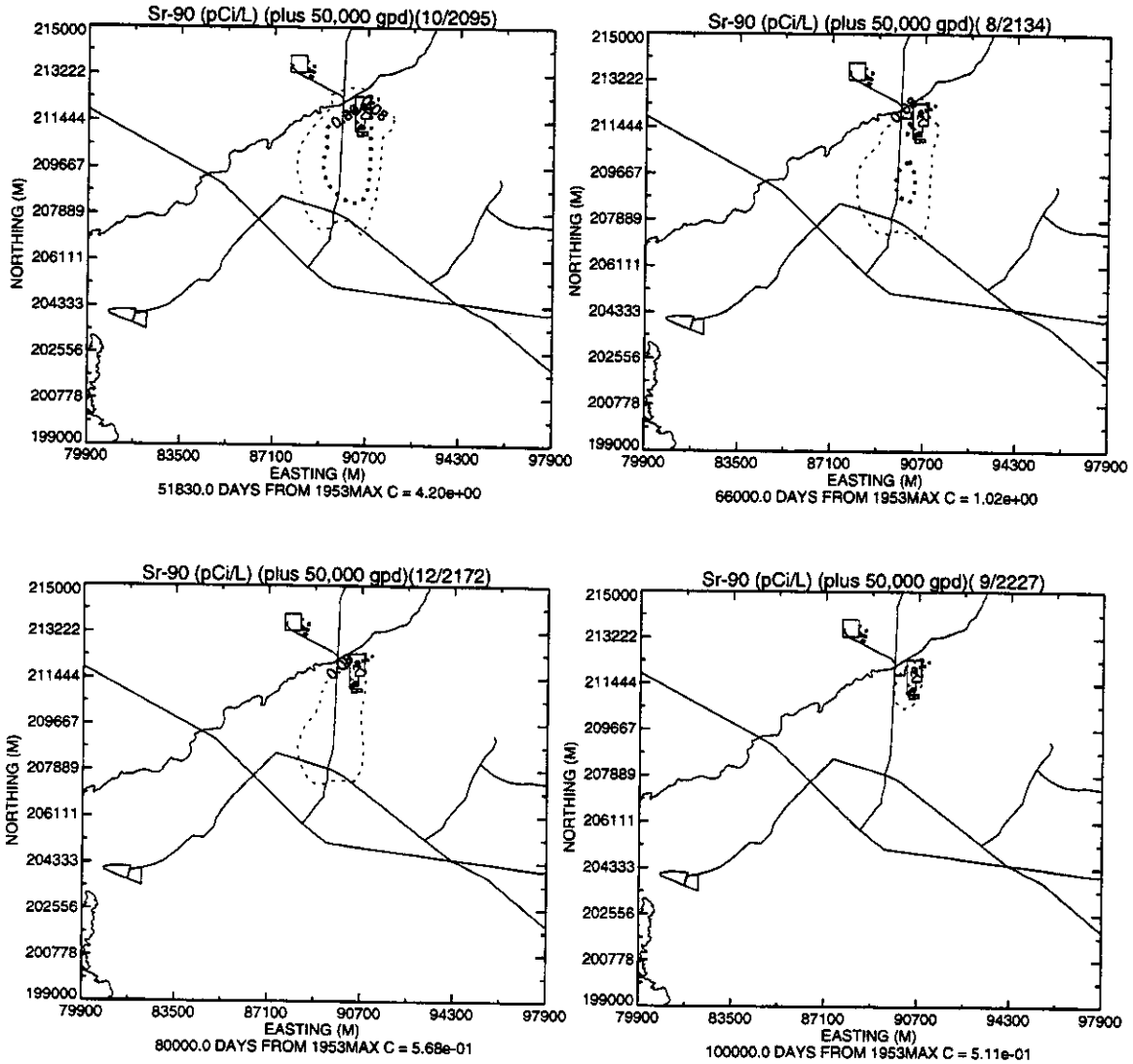

Figure 8-84 Aquifer Sr-90 (increased water leakage) peak concentration contours.

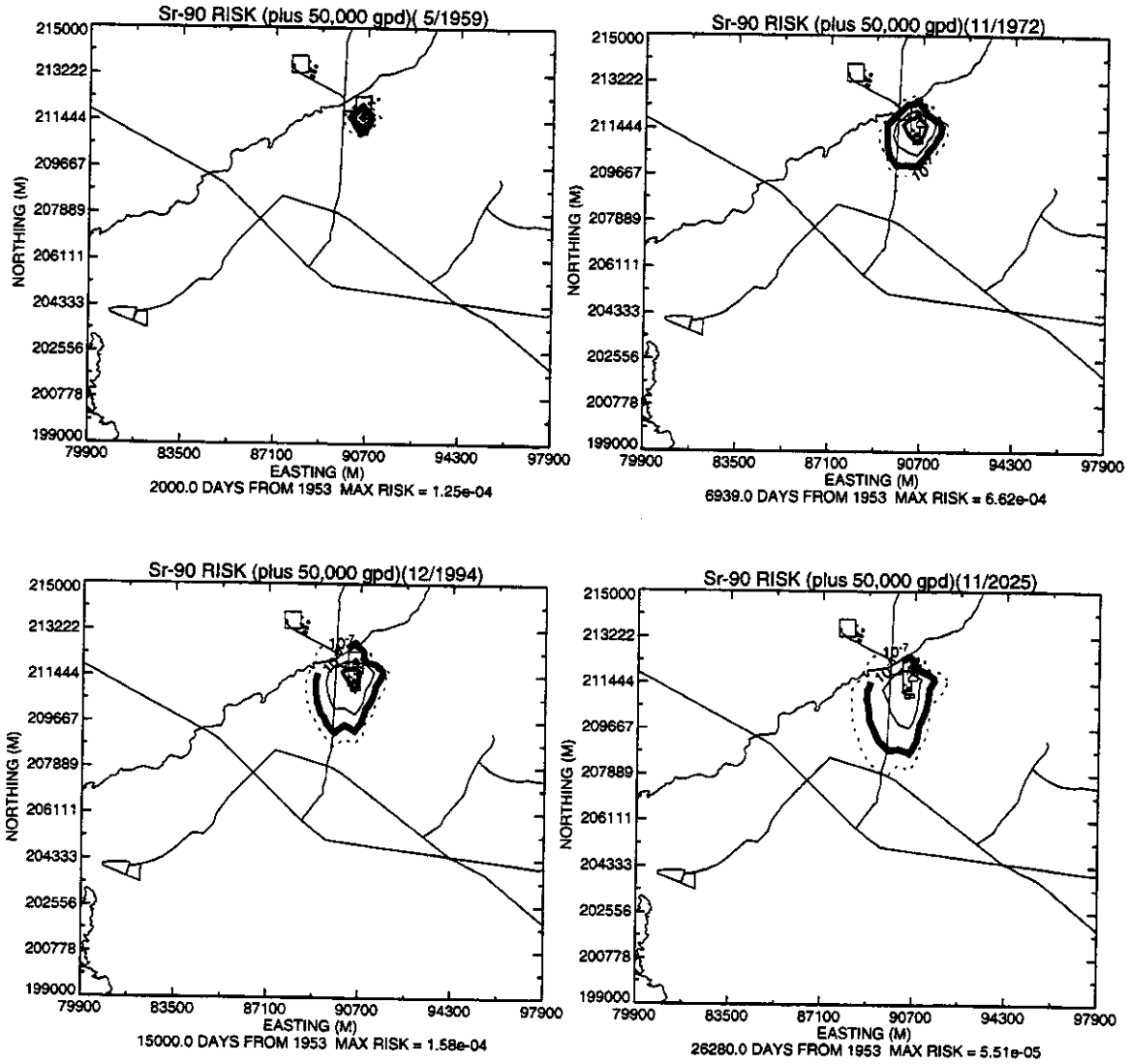

Figure 8-85 Aquifer Sr-90 (increased water leakage) peak risk contours.

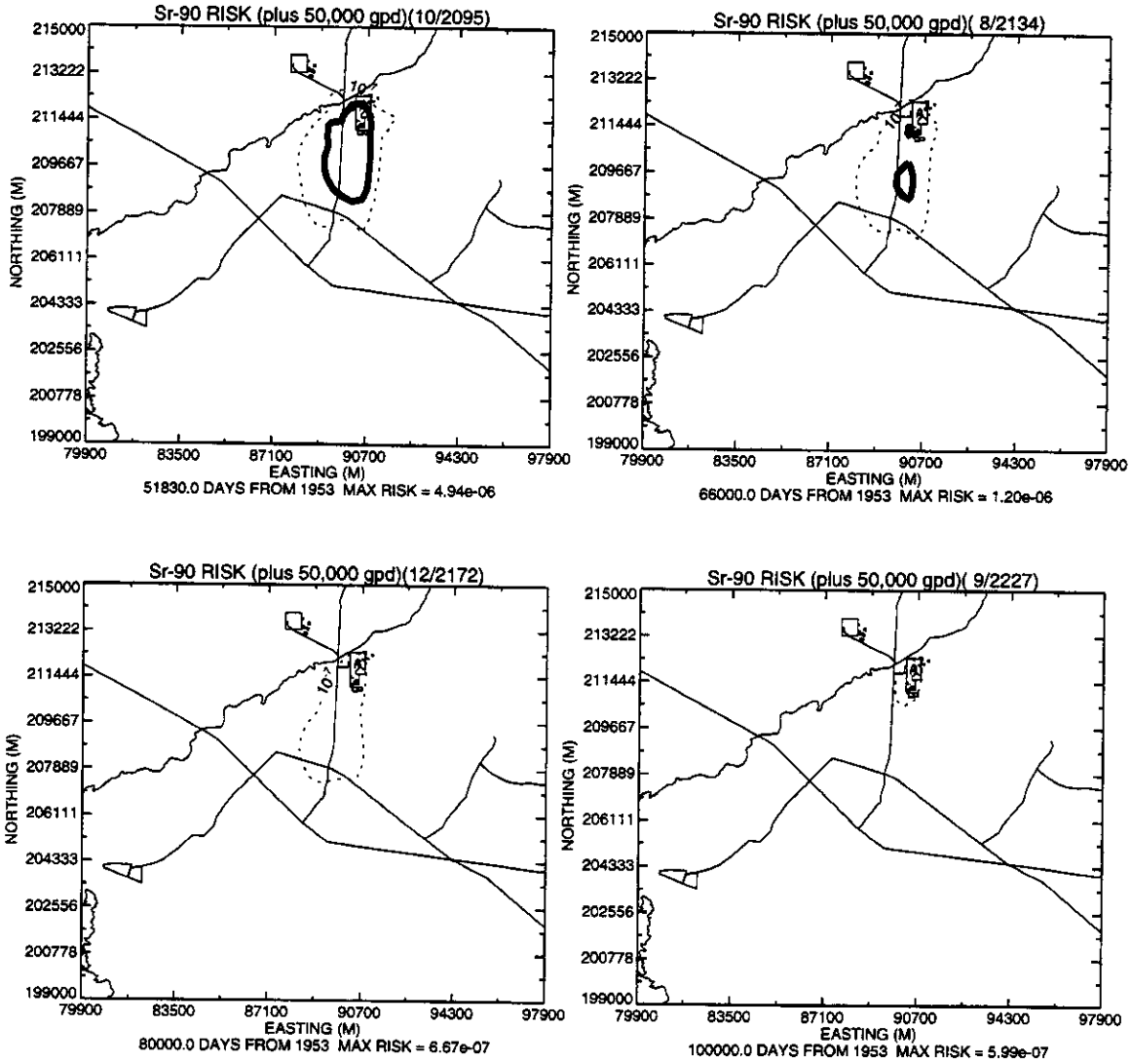

Figure 8-86 Aquifer Sr-90 (increased water leakage) peak risk contours.

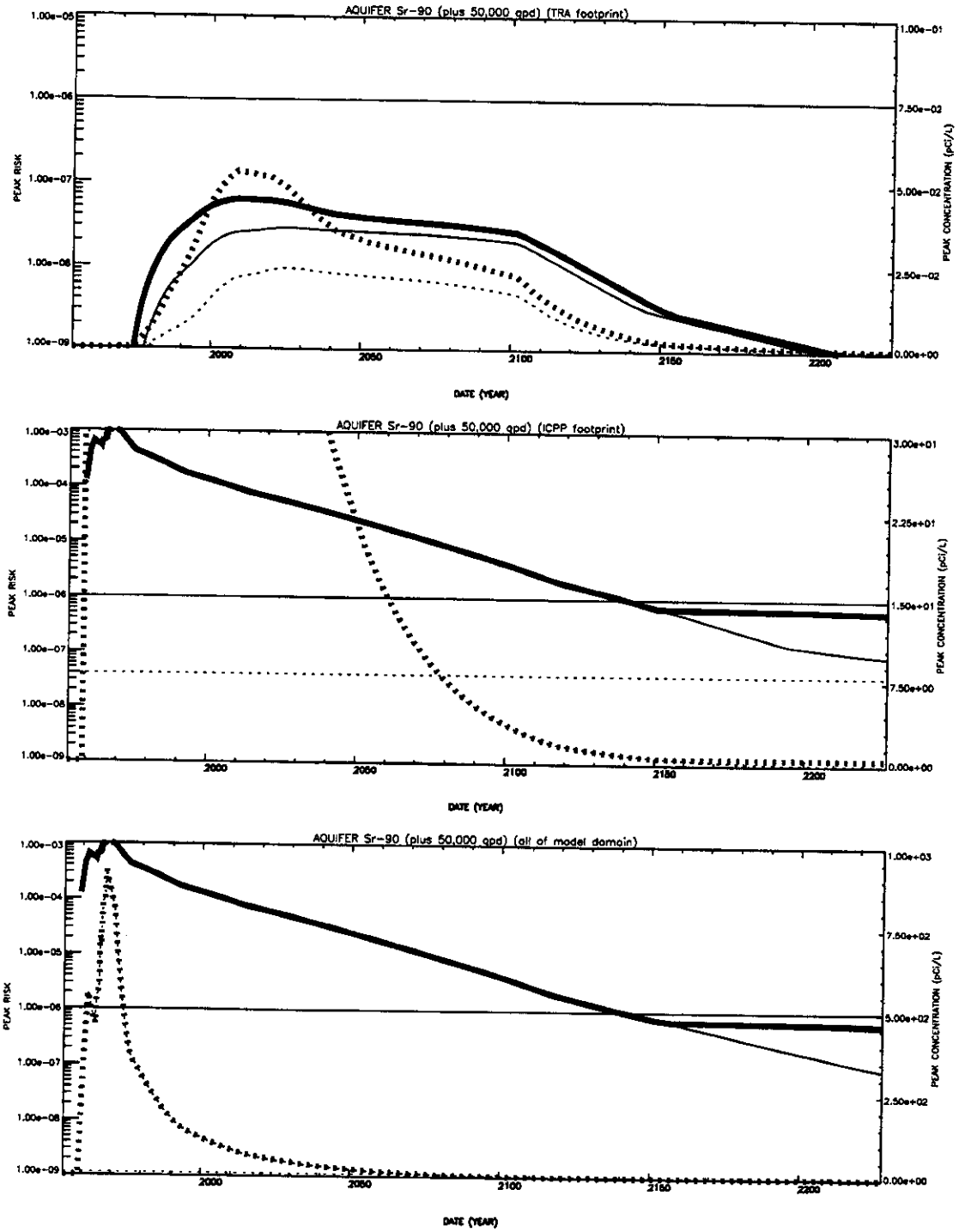

Figure 8-87 Peak aquifer concentration for Sr-90 (increased water leakage). Top figure: TRA foot print, Middle figure: ICPP footprint, Bottom Figure: entire aquifer domain. Thick line risk (left scale), dotted line concentration (right scale) solid line 10^{-6} risk (left scale).

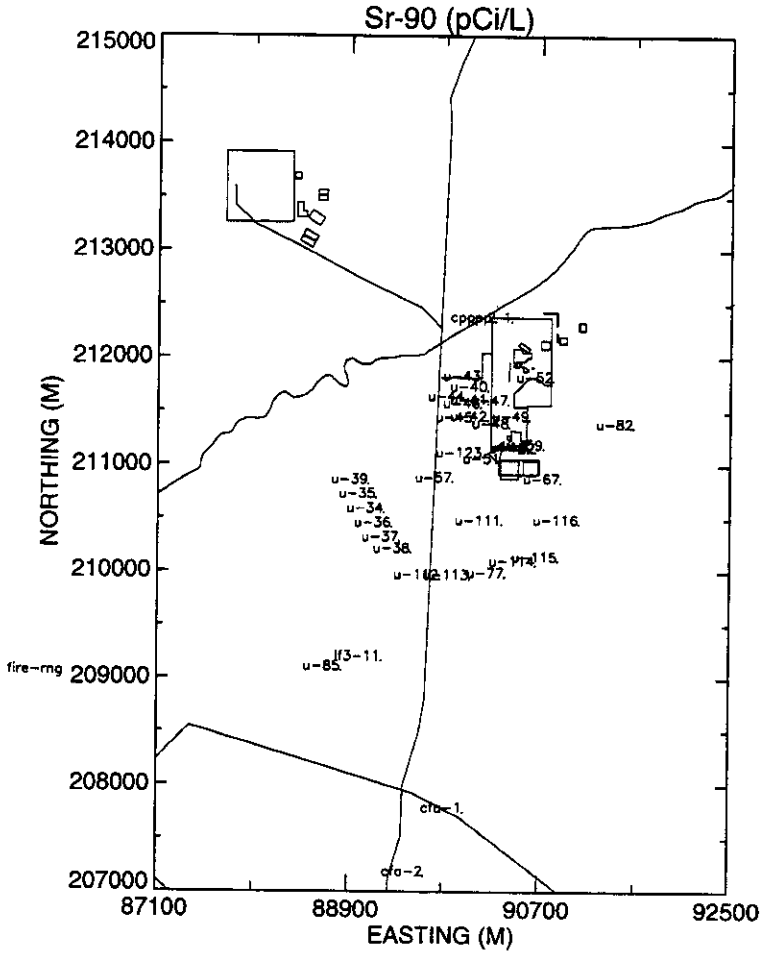

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Figure 8-88 Well locations for the comparison of aquifer Sr-90 (increased water leakage) to field data.

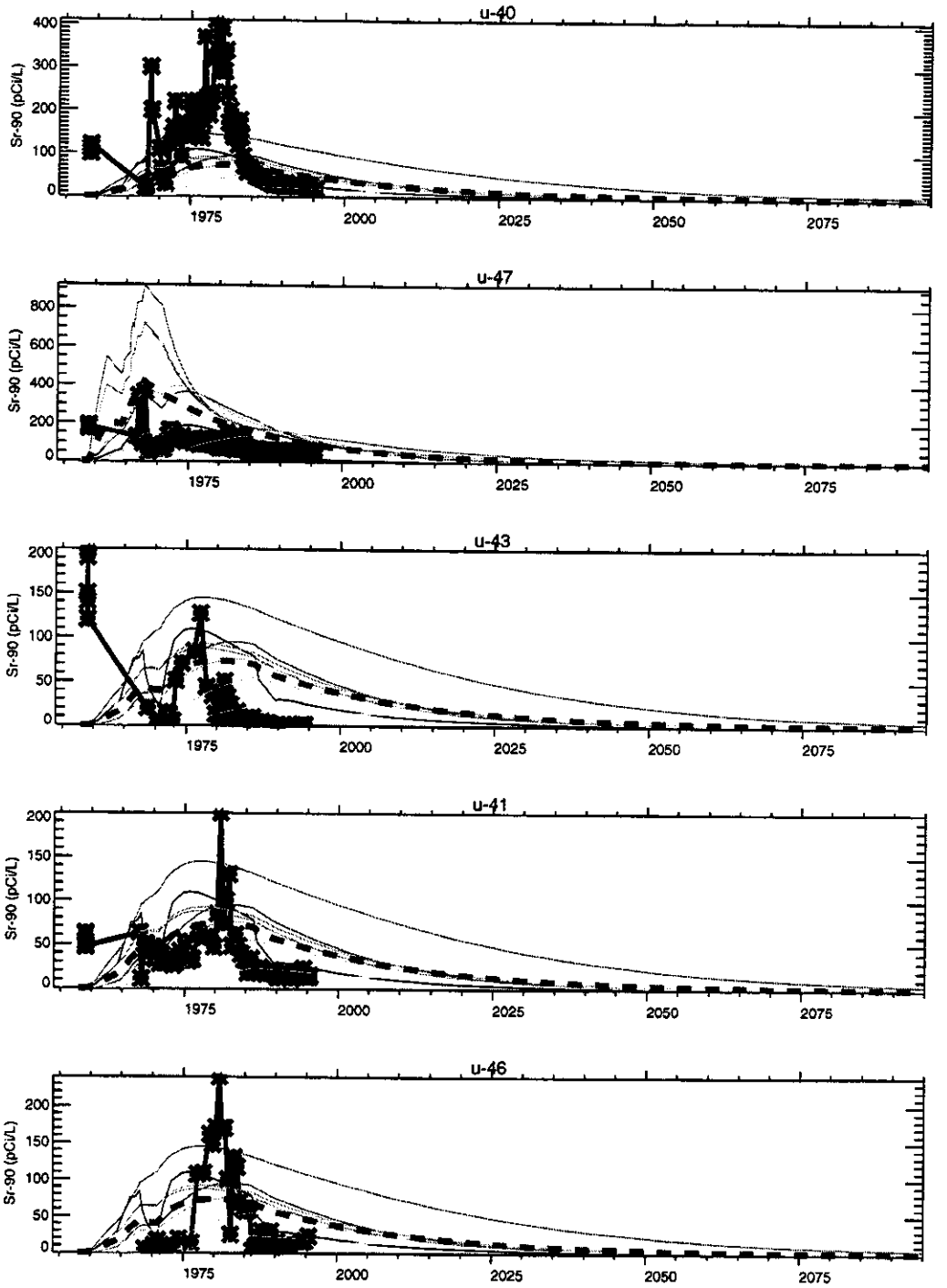

Figure 8-89 Comparison of aquifer Sr-90 (increased water leakage) to field data.

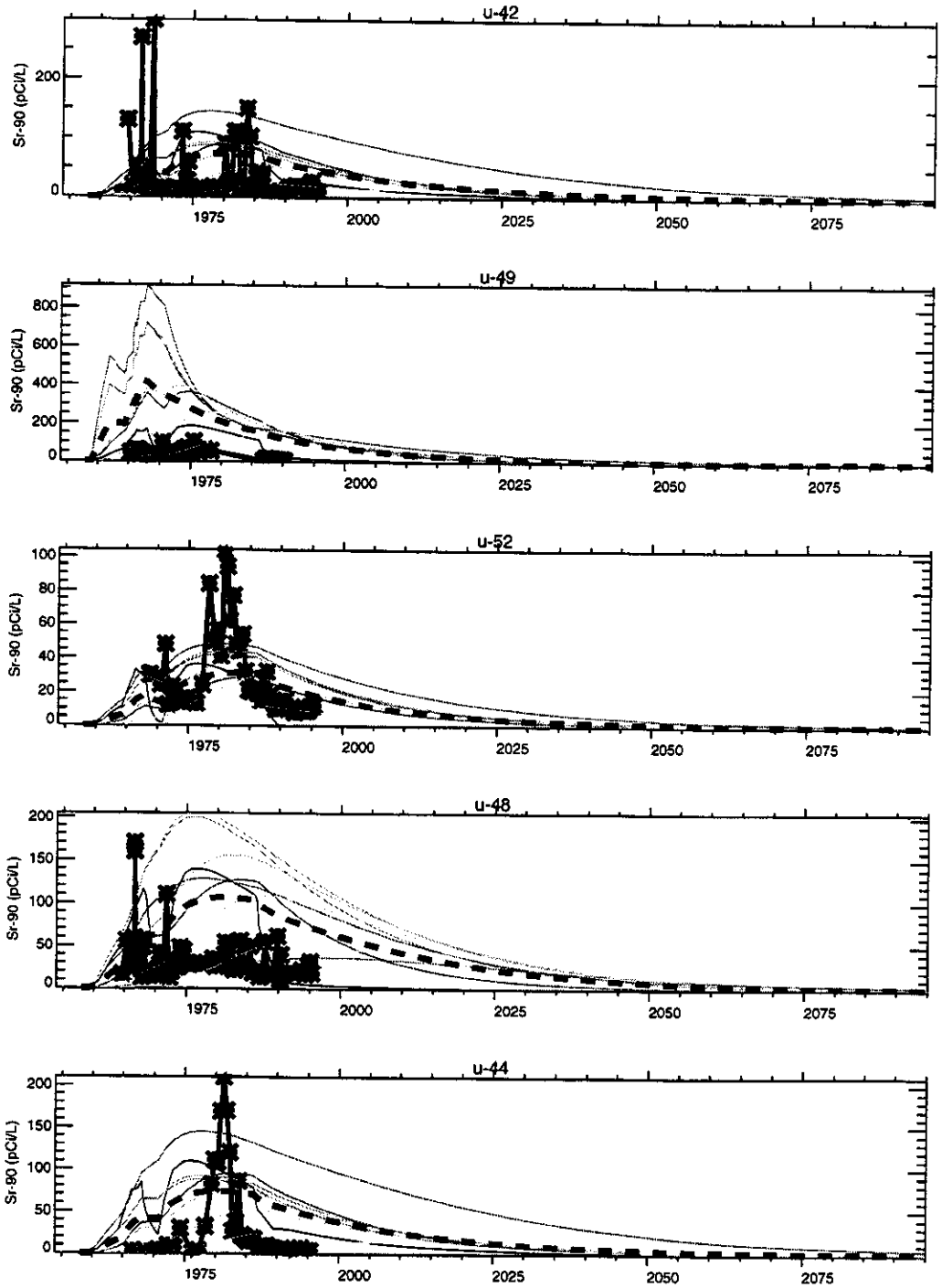

Figure 8-90 Comparison of aquifer Sr-90 (increased water leakage) to field data.

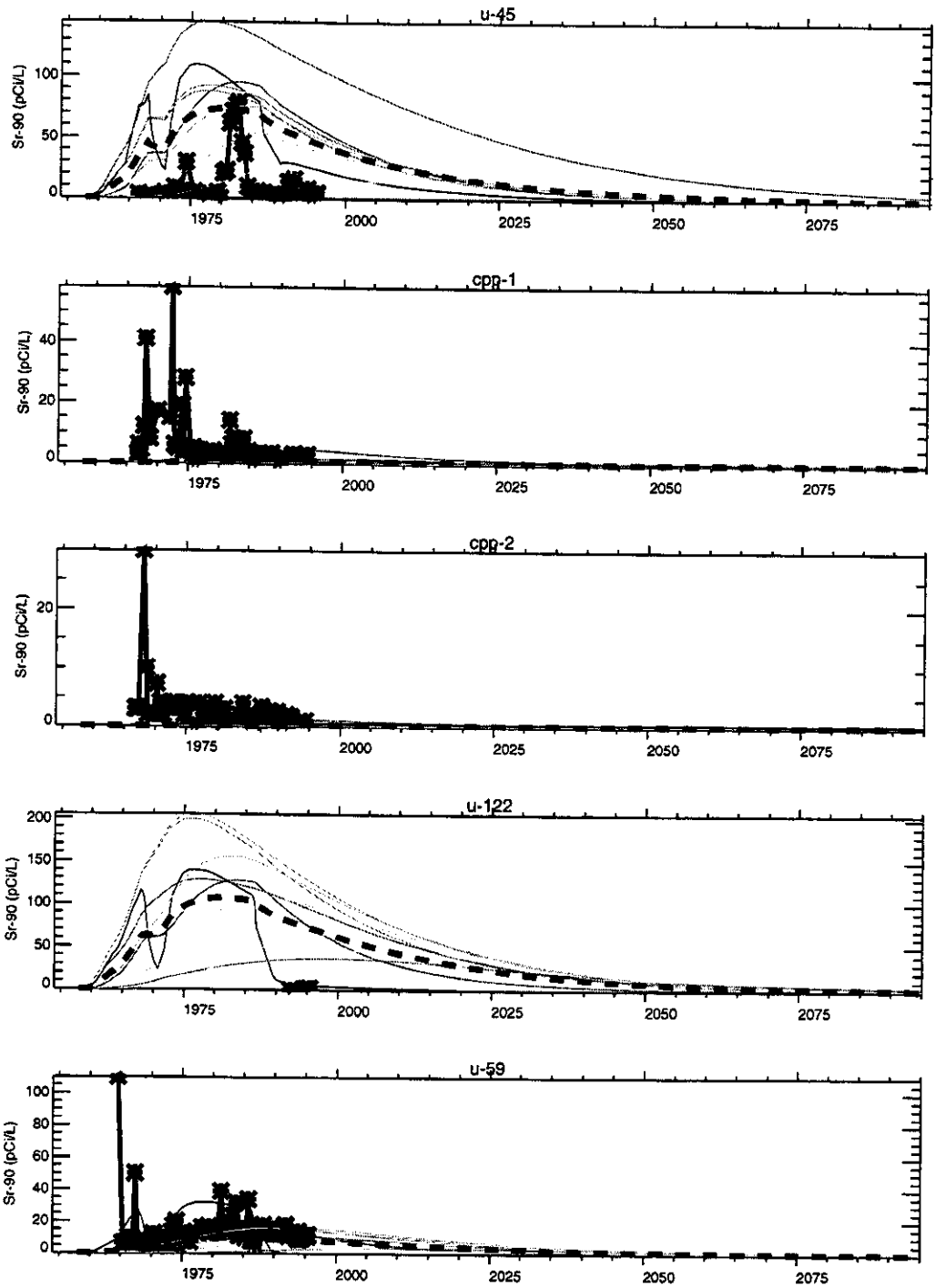

Figure 8-91 Comparison of aquifer Sr-90 (increased water leakage) to field data.

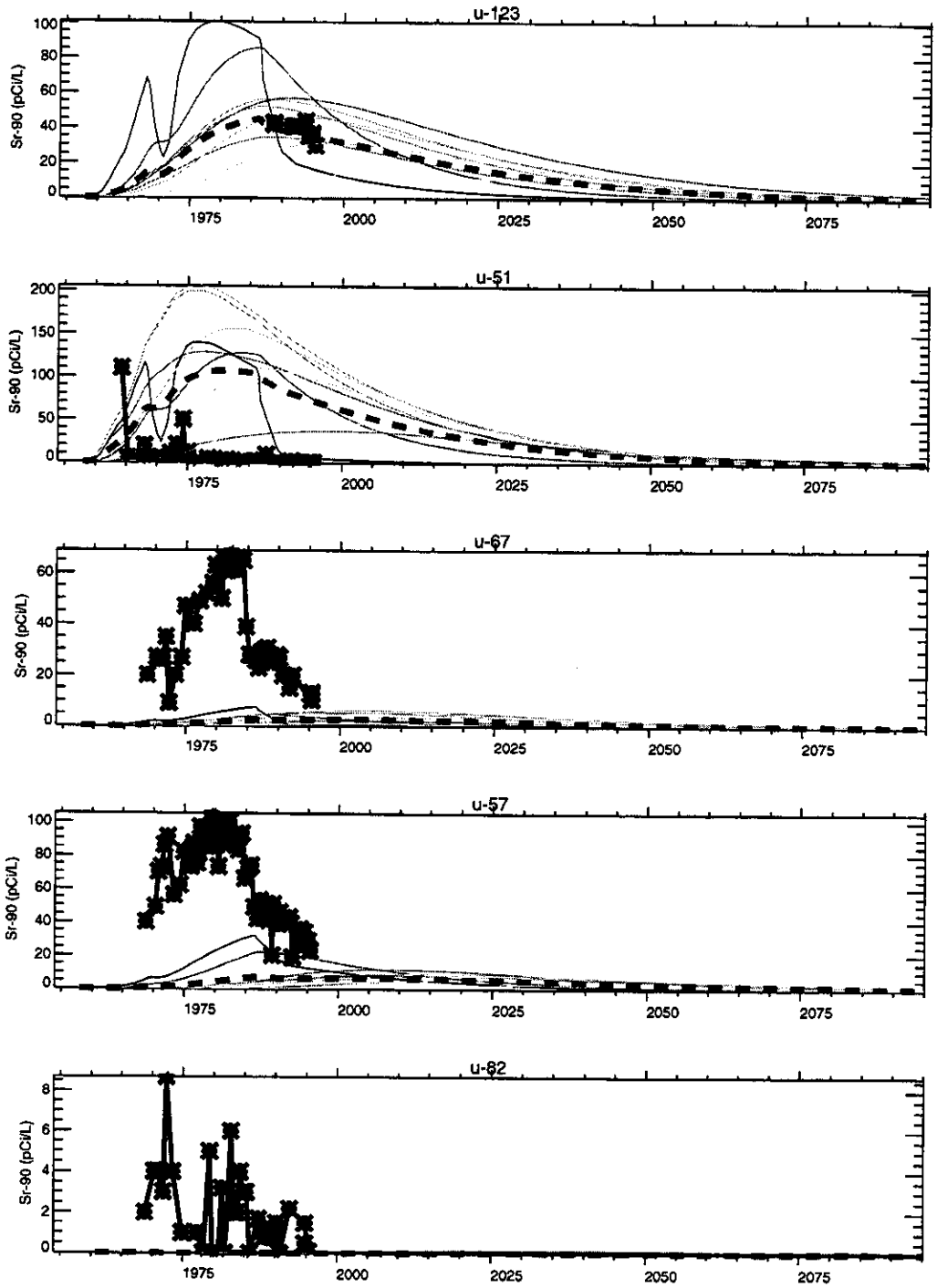

Figure 8-92 Comparison of aquifer Sr-90 (increased water leakage) to field data.

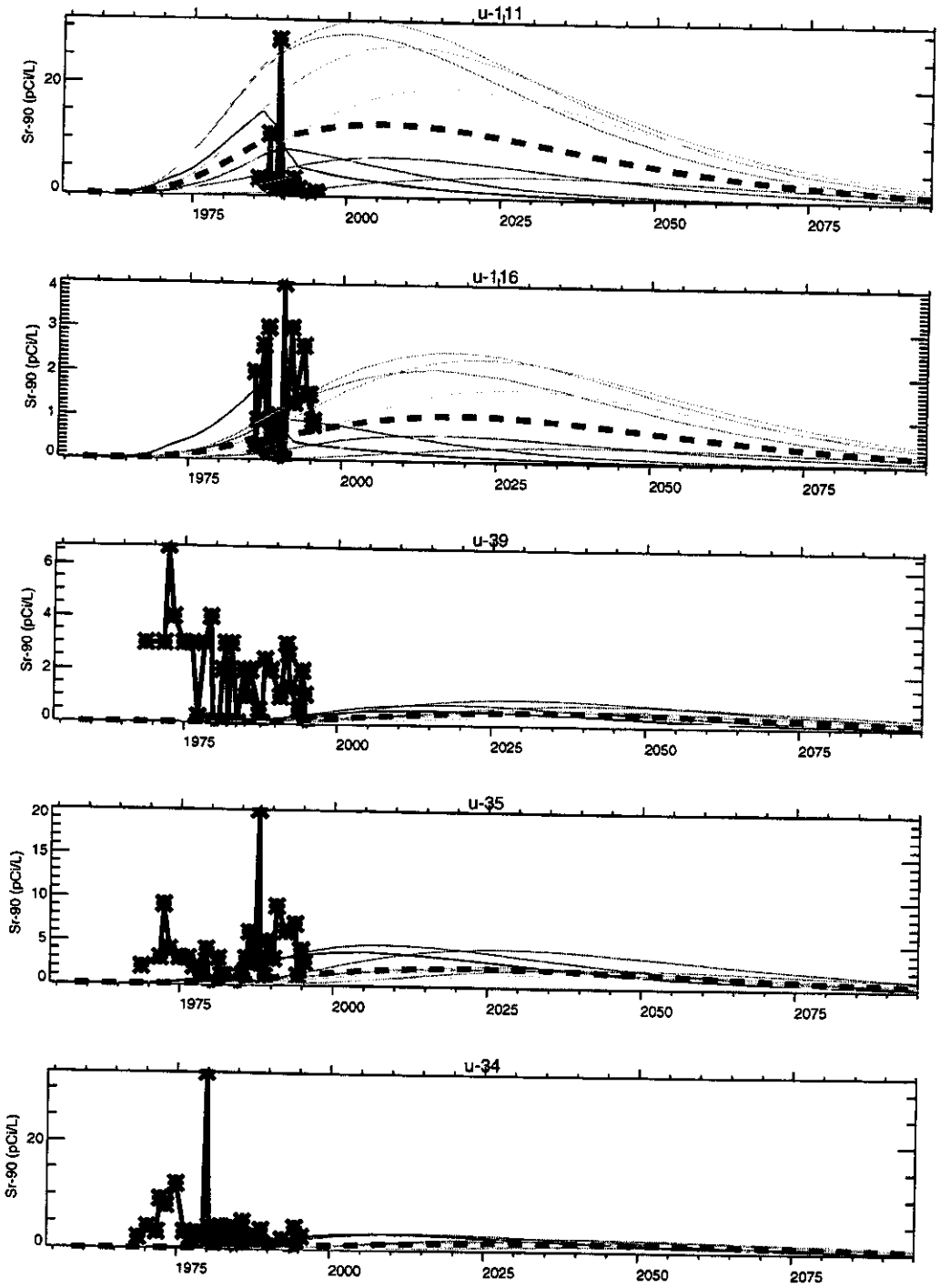

Figure 8-93 Comparison of aquifer Sr-90 (increased water leakage) to field data.

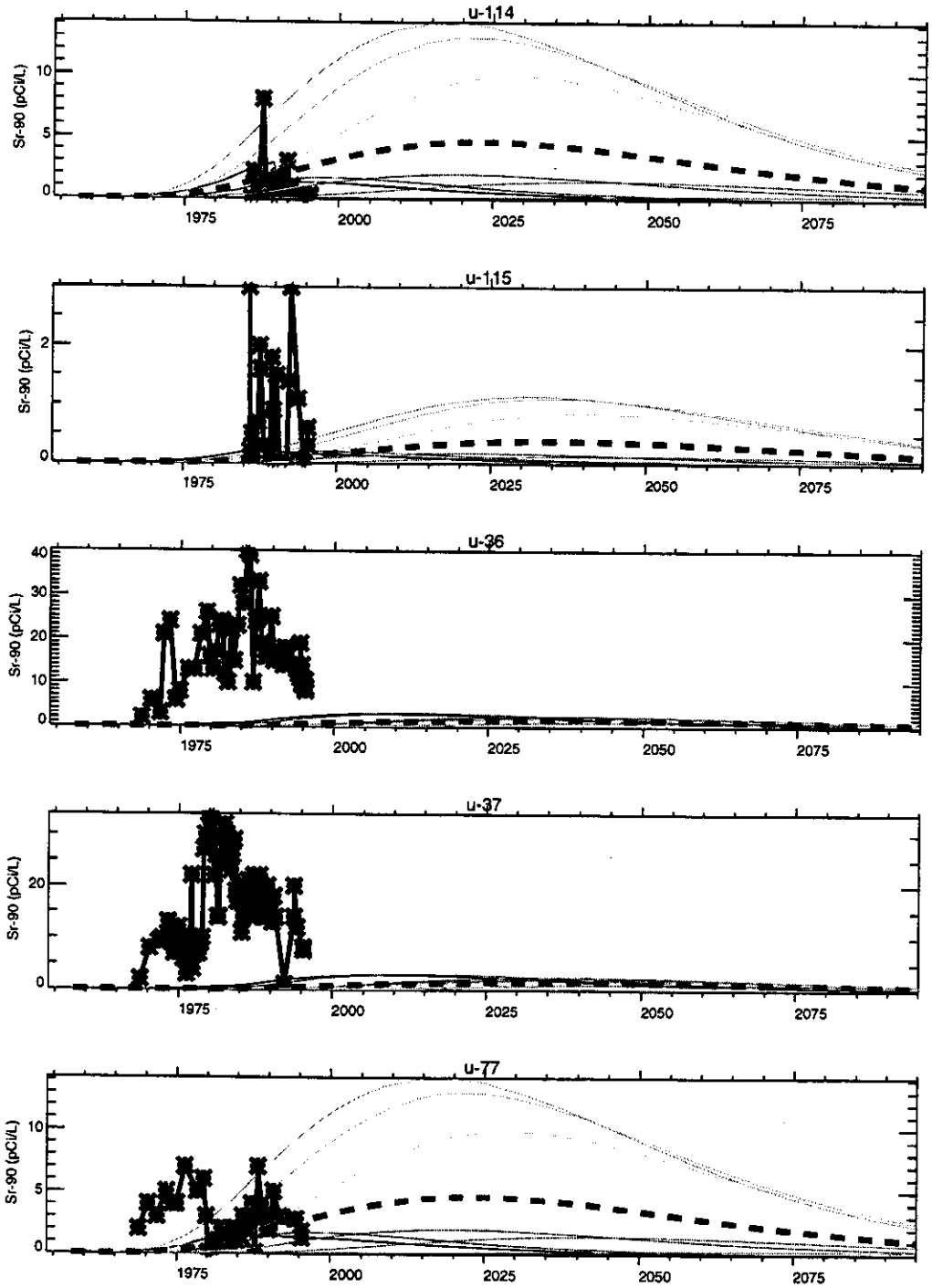

Figure 8-94 Comparison of aquifer Sr-90 (increased water leakage) to field data.

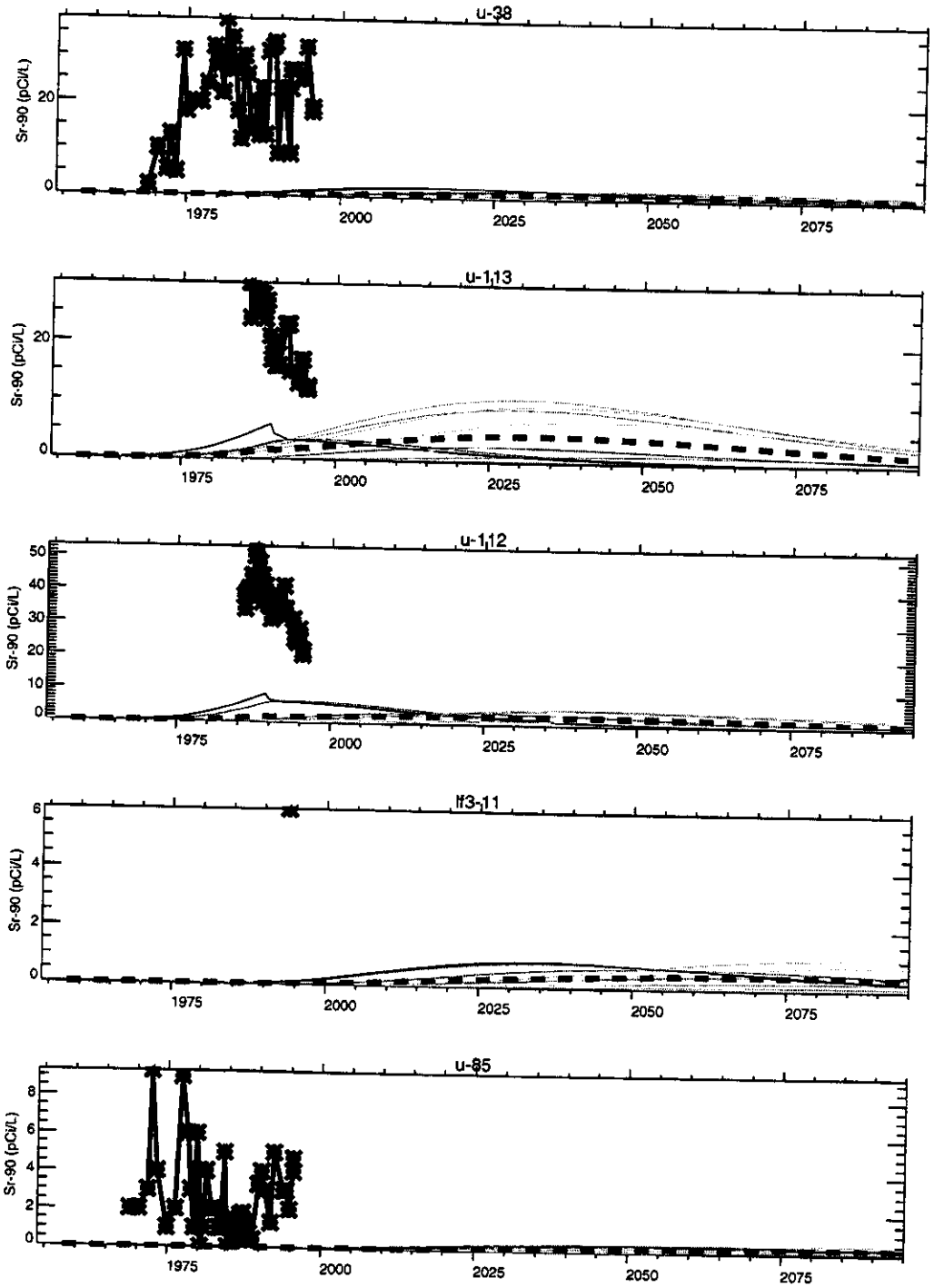

Figure 8-95 Comparison of aquifer Sr-90 (increased water leakage) to field data.

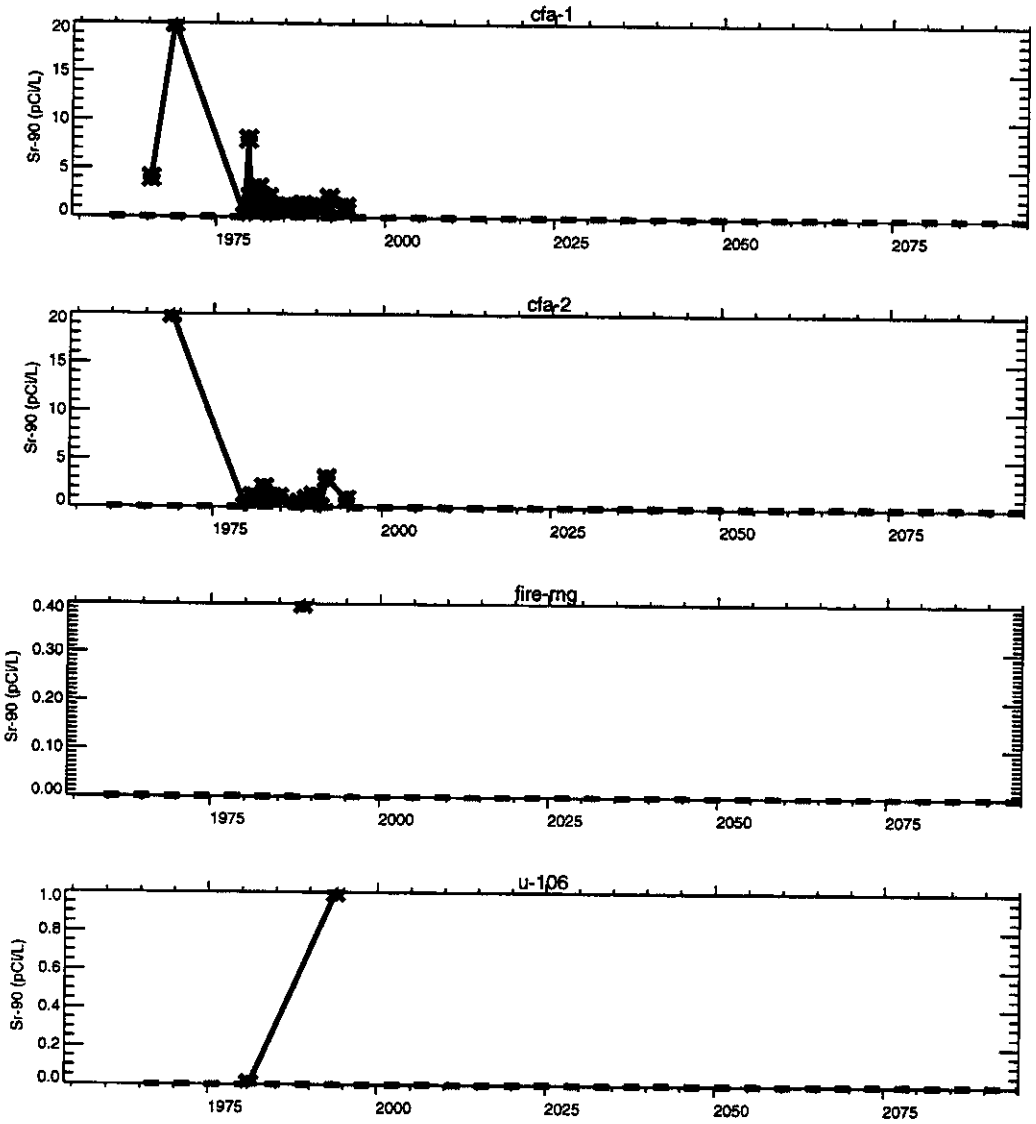

Figure 8-96 Comparison of aquifer Sr-90 (increased water leakage) to field data.

8.4 Sr-90 Leakage From The Upper Interbed

The base case and all previous sensitivity analysis simulations have assumed that the interbeds are essentially continuous and although they are very thin in places, they have no holes. The existence of holes would provide preferential pathways through which contaminants originating at the surface could pass on the way to the aquifer. Contaminants traversing the preferential pathways would not be subject to adsorption and thus would move faster through the vadose zone, arriving in higher than base case concentrations. Additional sources for preferential pathways are presented when monitoring, production, and injection wells are not completely sealed to the vadose zone or aquifer. In that case, contaminants originating at a higher elevation could flow down the sides of either the borehole or the casing. In order to evaluate the effective risk that would result from this type of leakage, three scenarios were simulated where it was assumed that the contaminants from the upper interbed region simply bypassed all other interbeds, and are injected directly into the aquifer. The results presented in Sections 8.4.1, 8.4.2, and 8.4.3 are for a 1, 5, and 10 gal/min leakage rates, respectively. These leakage rates were based on estimates of leakage in wells having similar completions as those at the ICPP. Because these simulations all assume a Kd=24 cm^3/g, they are compared against the results in Section 8.1.1.

In these simulations, the grid located in the upper interbed with the highest concentration during the 1975 through 2000 year time frame was found. This grid block was located slightly east and south of the CPP-31 source area and directly east of the CPP-28 source location. From that grid block, the time-history of concentration was extracted. The mass flux to the aquifer was calculated using the concentration history and the leakage rate specified in each Section below. This computed mass flux was applied to the aquifer grid block under the tank farm area. In addition to the leakage, these simulation uses the base contaminant sources for Sr-90 which included in order of decreasing contribution: a) CPP-31 (60.82%), b) CPP-28 (31.66%), c) soil (5.71%), d) CPP-80 (1.42%), e) CPP-02 (0.17%), f) the injection well (0.12%), and g) the '86 release (0.09%). Transport through the aquifer is represented as contours with levels specified at $8x10^{-2}$, $8x10^{-1}$, 8 (the MCL), $8x10^{+1}$, $8x10^{+2}$, and $8x10^{+3}$ pCi/L. The corresponding risk contour maps for the aquifer simulation are plotted at the 10^{-7}, 10^{-6} (0.859 pCi/L), 10^{-5}, 10^{-4}, 10^{-3}, and 10^{-2} levels.

8.4.1 Sr-90 With 1-GPM Leakage From The Upper Interbed

The most useful way of comparing the results of this sensitivity simulation is to look at the model comparison plots to field data for the Section 8.1.1 simulation (Figures 8-17 through 8-24 for the aquifer) and for this simulation (Figures 8-103 through 8-109). Examination of the aquifer comparison plots for wells near the injection well indicates that the 1 gal/min leakage mass flux assumed in this simulation probably does not occur. If it did occur, measured concentrations of Sr-90 would be much higher than currently observed. The comparison plots, in general, indicate that a small amount of leakage from the upper interbeds (where the concentrations are predicted to be fairly high) can have a large influence on aquifer concentrations near the point of application. On the other hand, the comparison wells also indicate that the increased concentrations due to leakage dissipate fairly rapidly as a result of combined adsorption and decay.

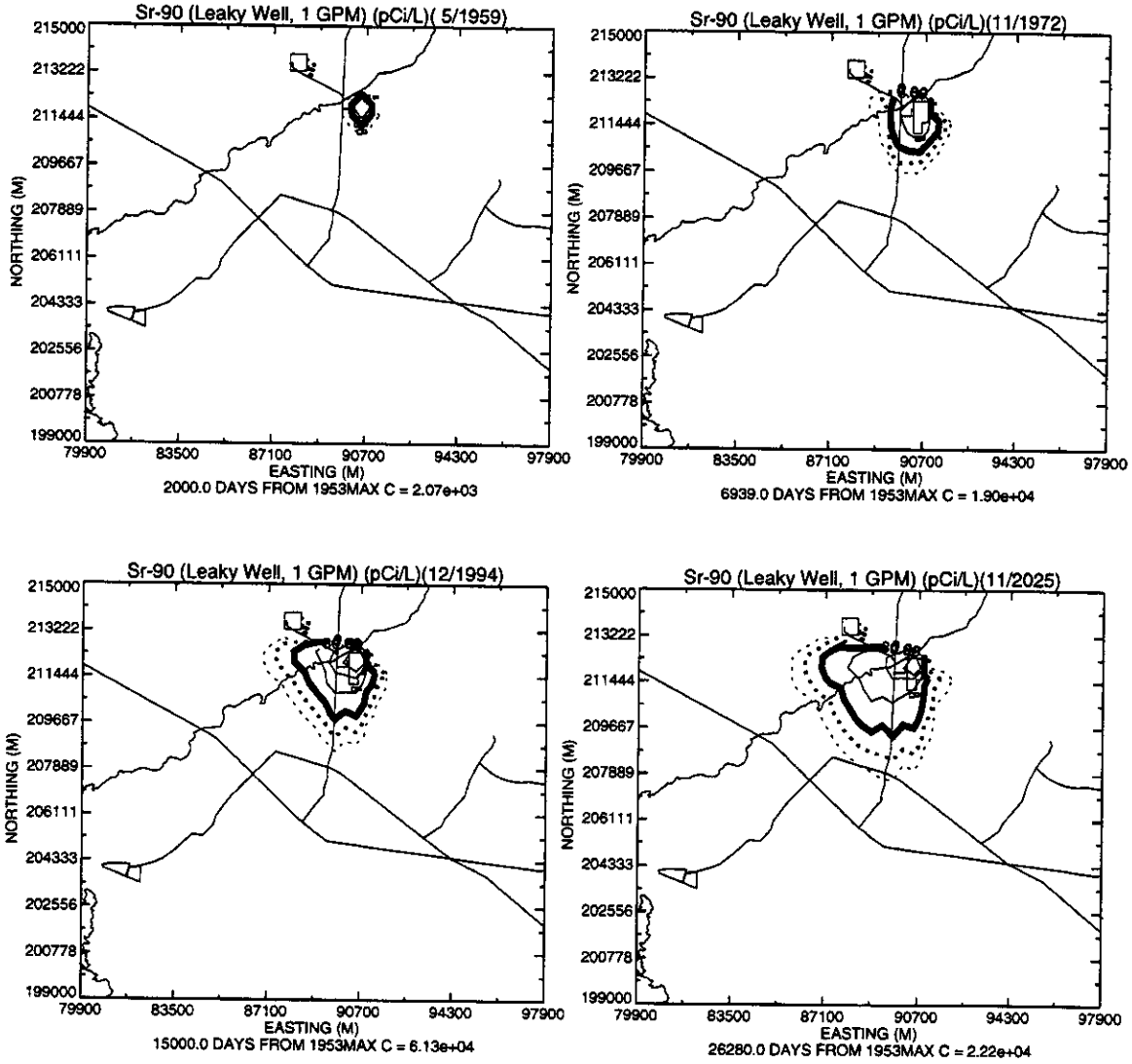

Figure 8-97 Aquifer Sr-90 (1 gpm interbed leakage) peak concentration contours.

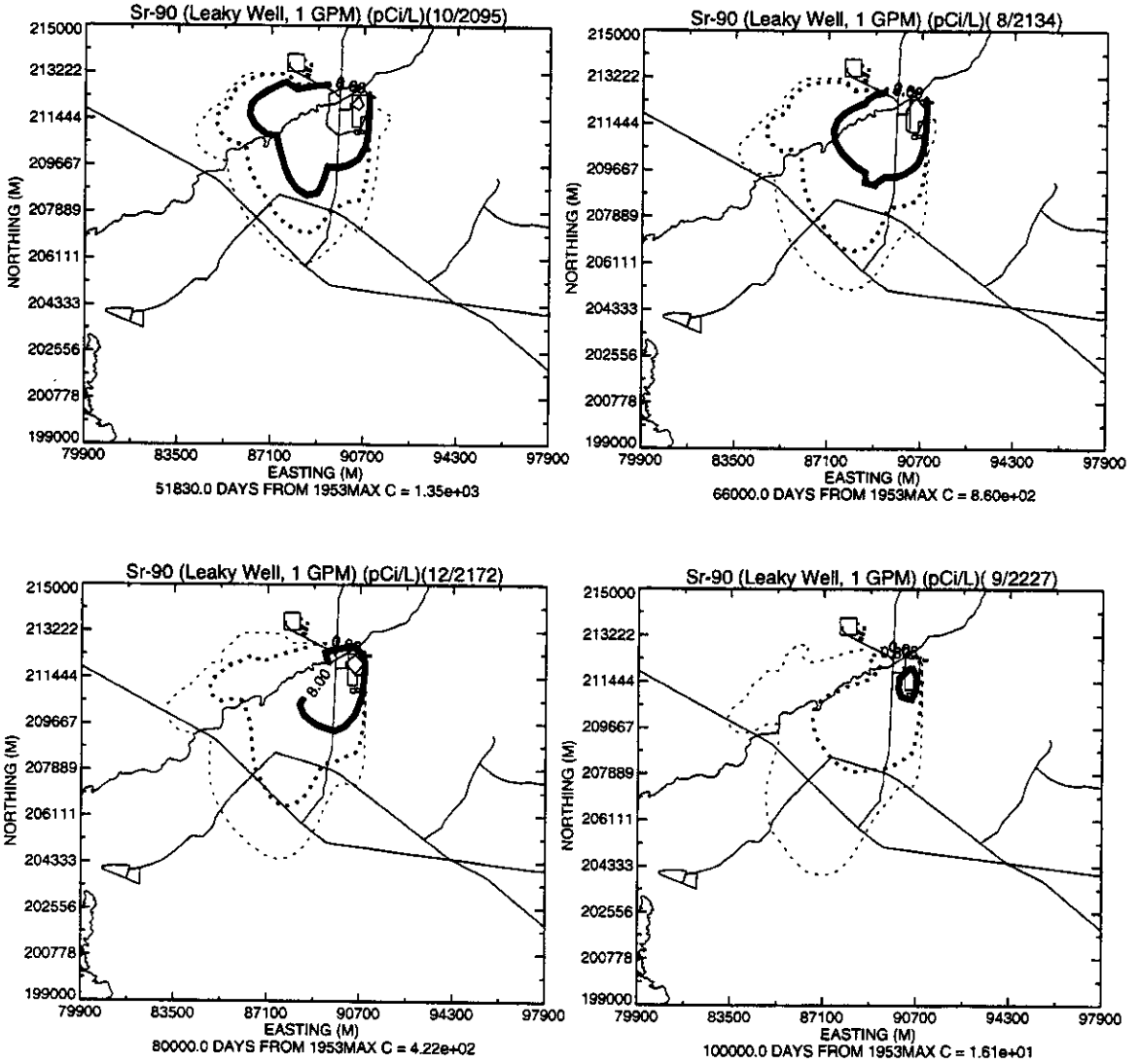

Figure 8-98 Aquifer Sr-90 (1 gpm interbed leakage) peak concentration contours.

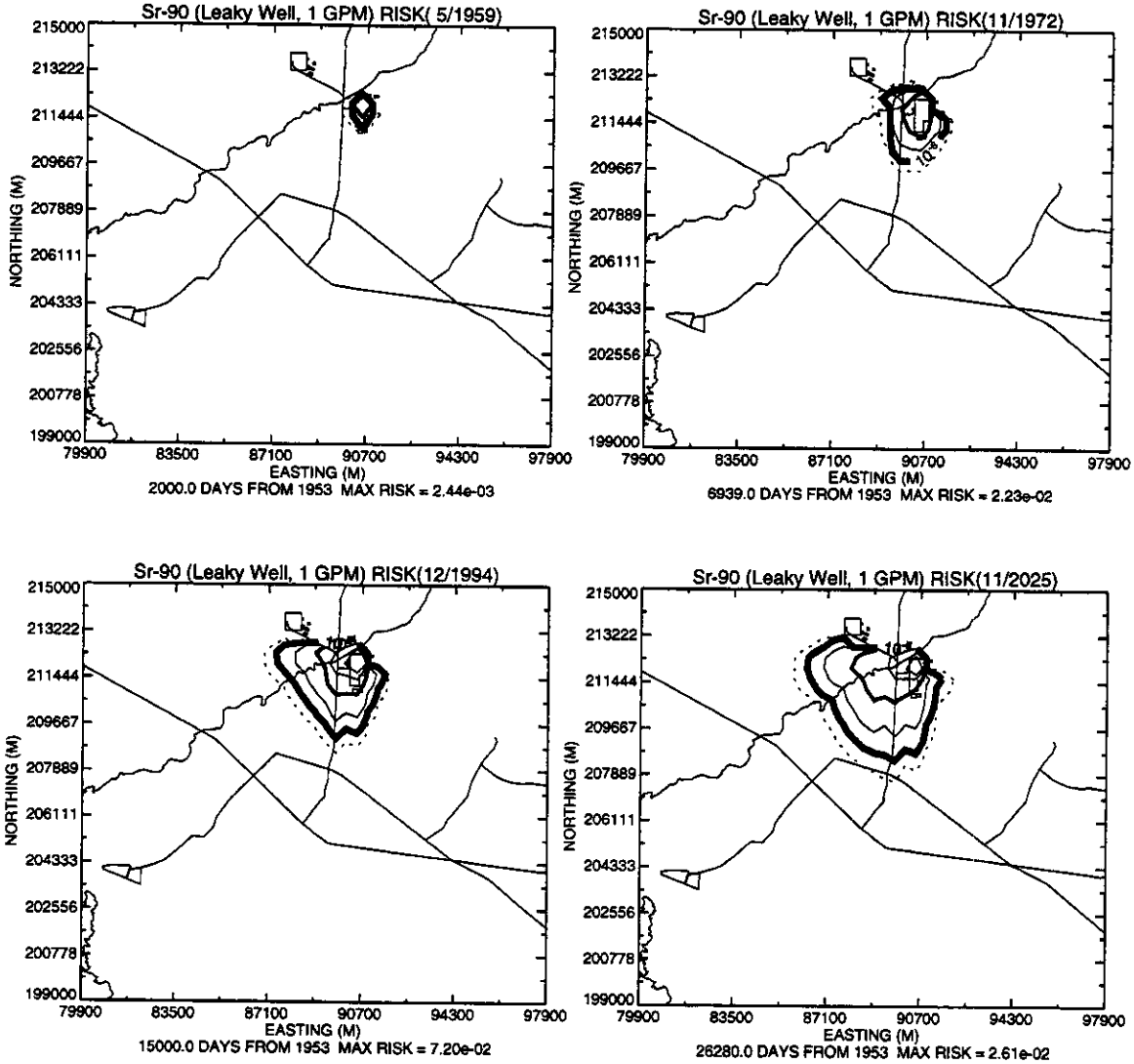

Figure 8-99 Aquifer Sr-90 (1 gpm interbed leakage) peak risk contours.

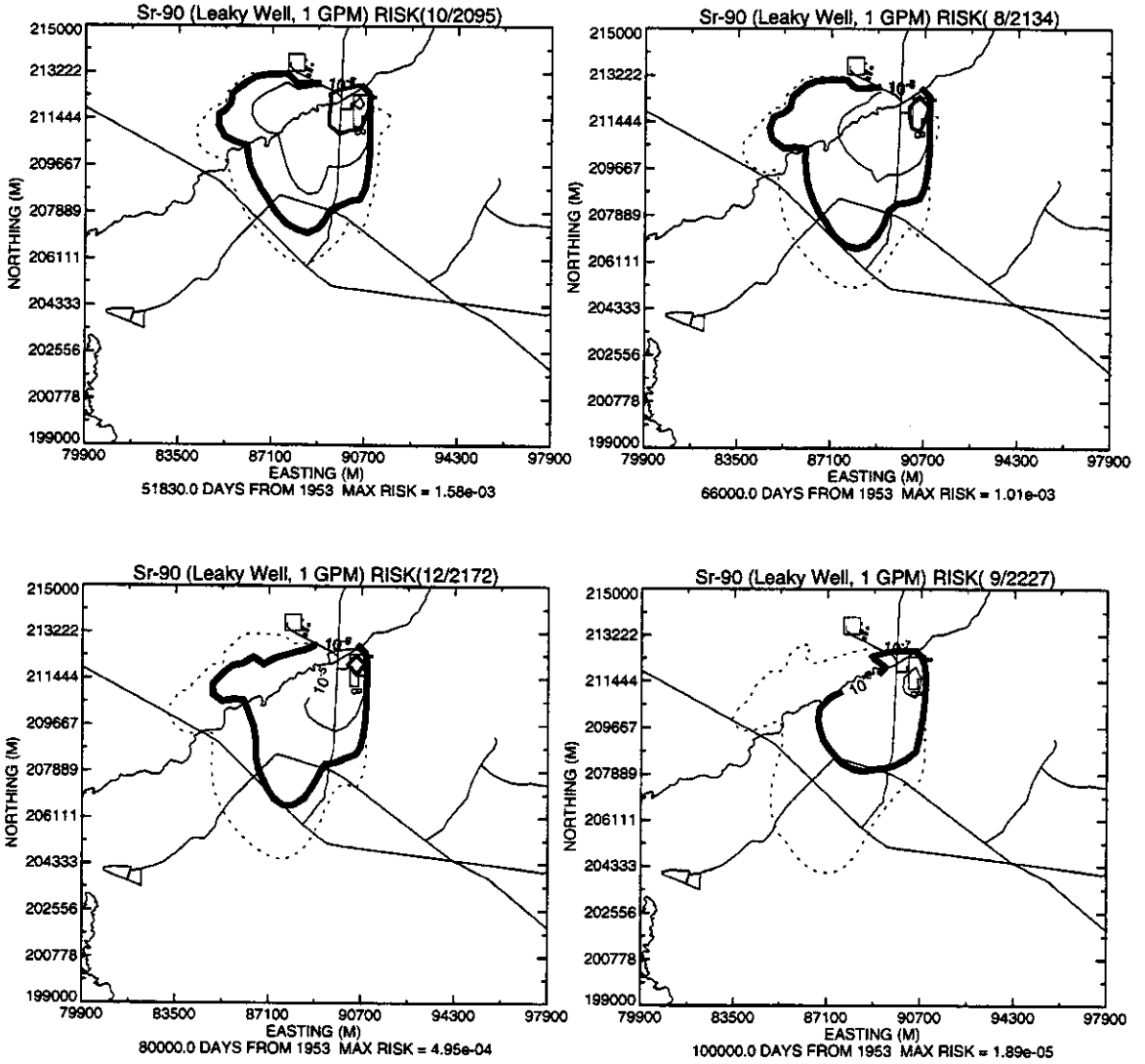

Figure 8-100 Aquifer Sr-90 (1 gpm interbed leakage) peak risk contours.

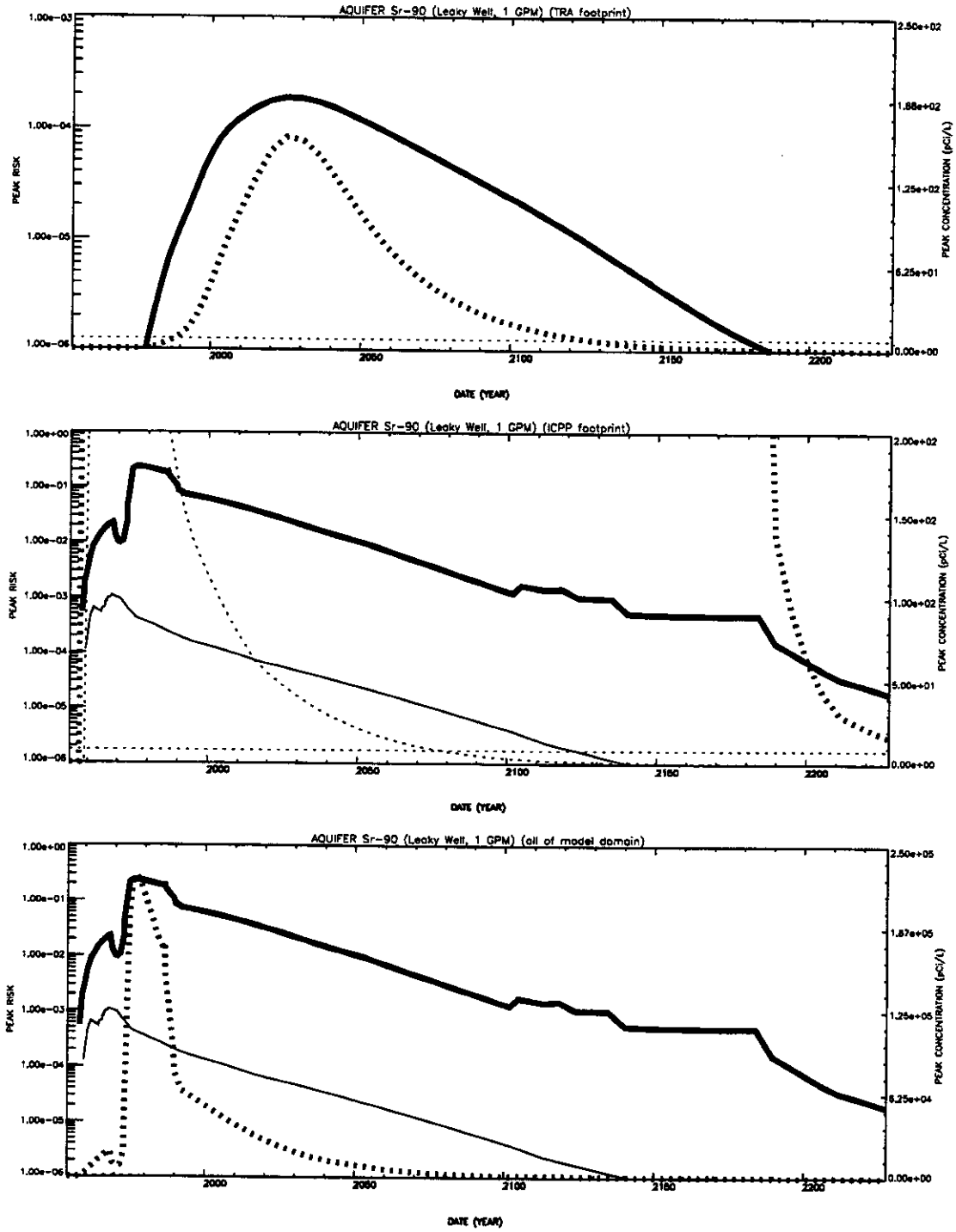

Figure 8-101 Peak aquifer concentration for Sr-90 (1 gpm interbed leakage). Top figure: TRA foot print, Middle figure: ICPP footprint, Bottom Figure: entire aquifer domain. Thick line risk (left scale), dotted line concentration (right scale) solid line 10^{-6} risk (left scale).

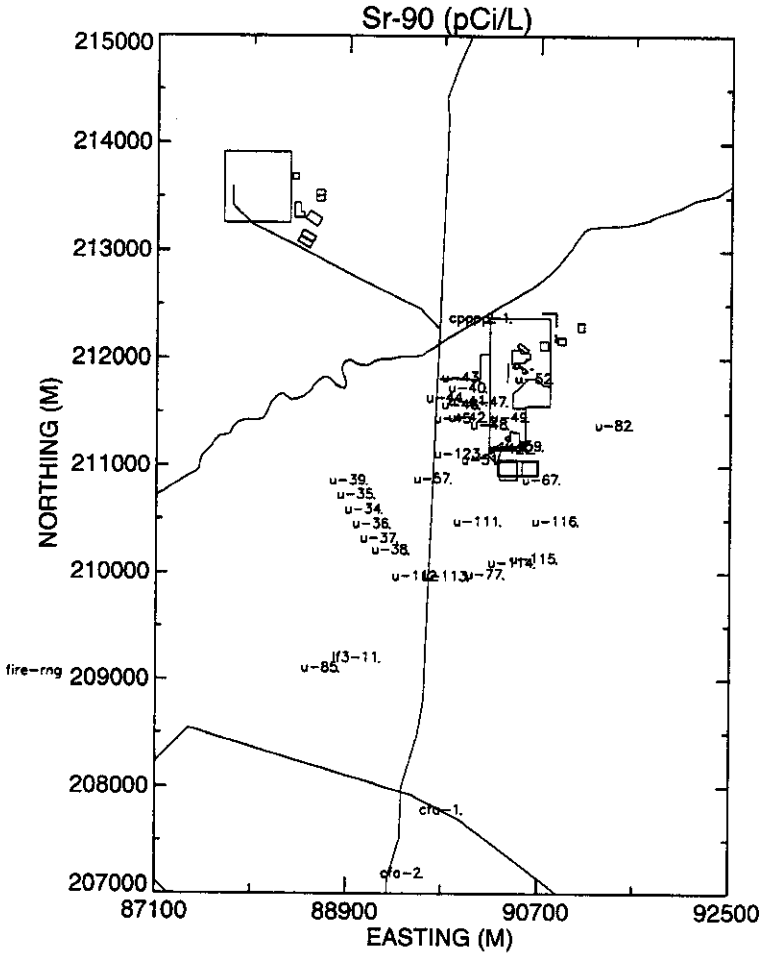

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Figure 8-102 Well locations for the comparison of aquifer Sr-90 (1 gpm interbed leakage) to field data.

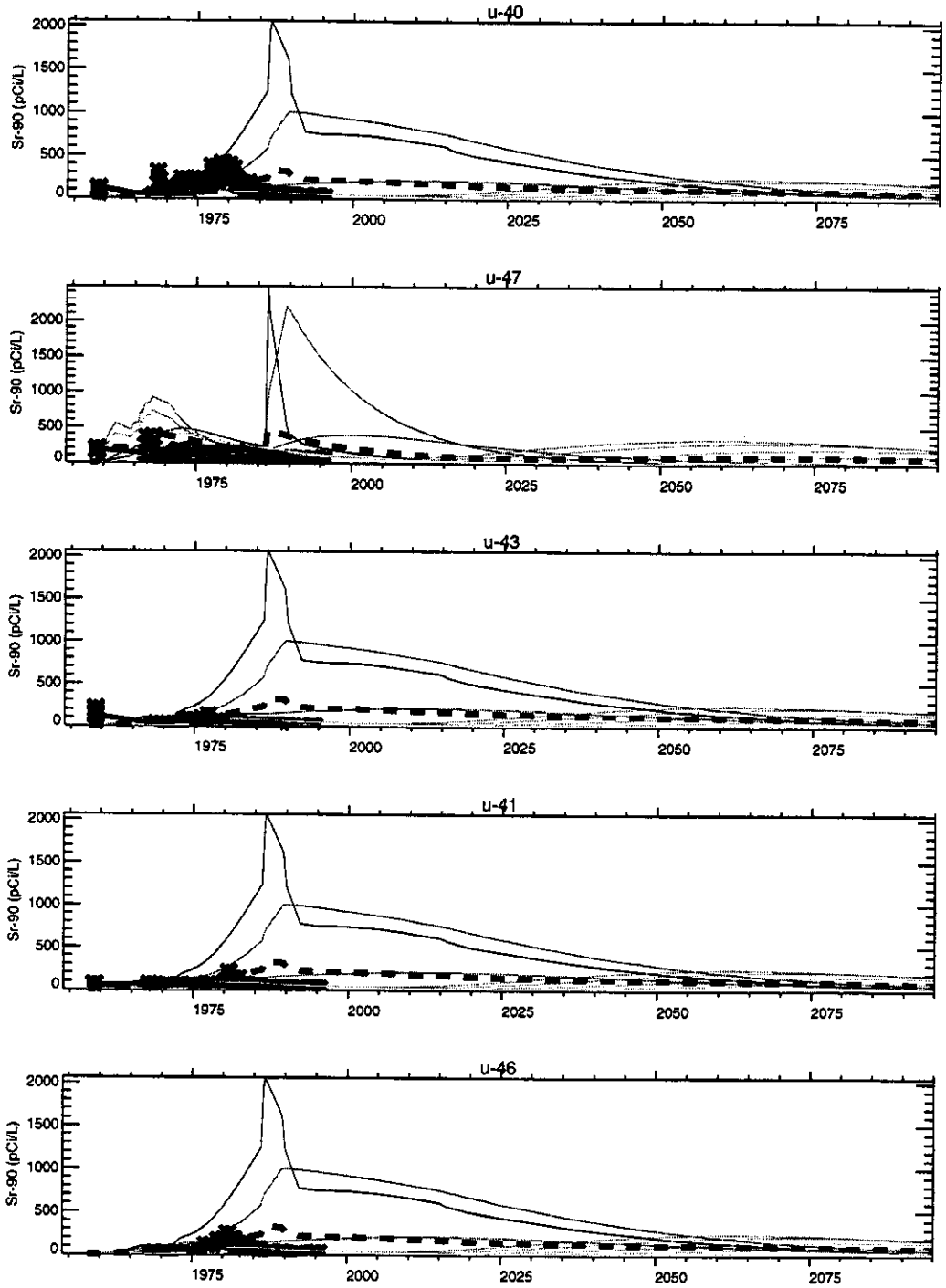

Figure 8-103 Comparison of aquifer Sr-90 (1 gpm interbed leakage) to field data.

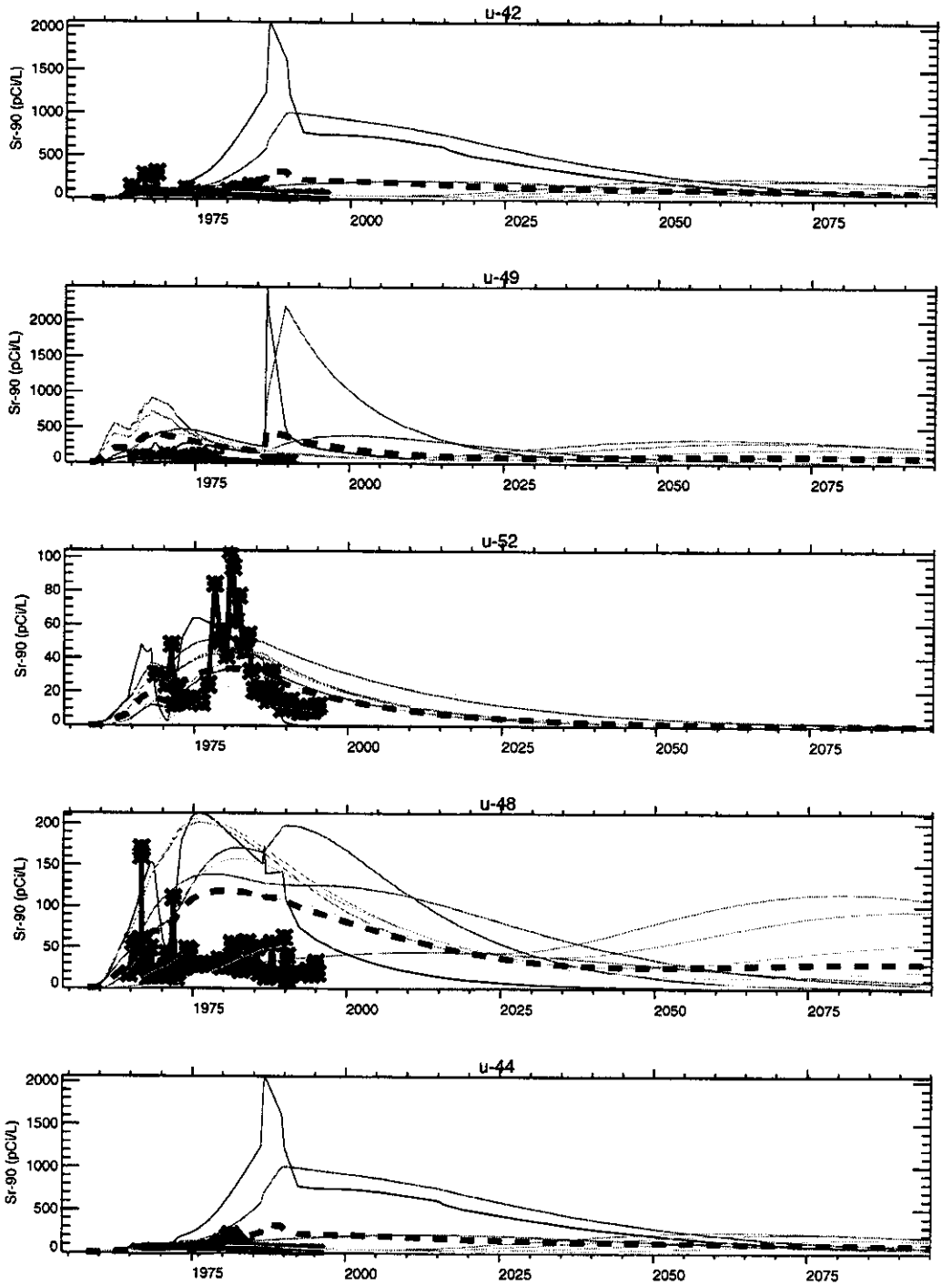

Figure 8-104 Comparison of aquifer Sr-90 (1 gpm interbed leakage) to field data.

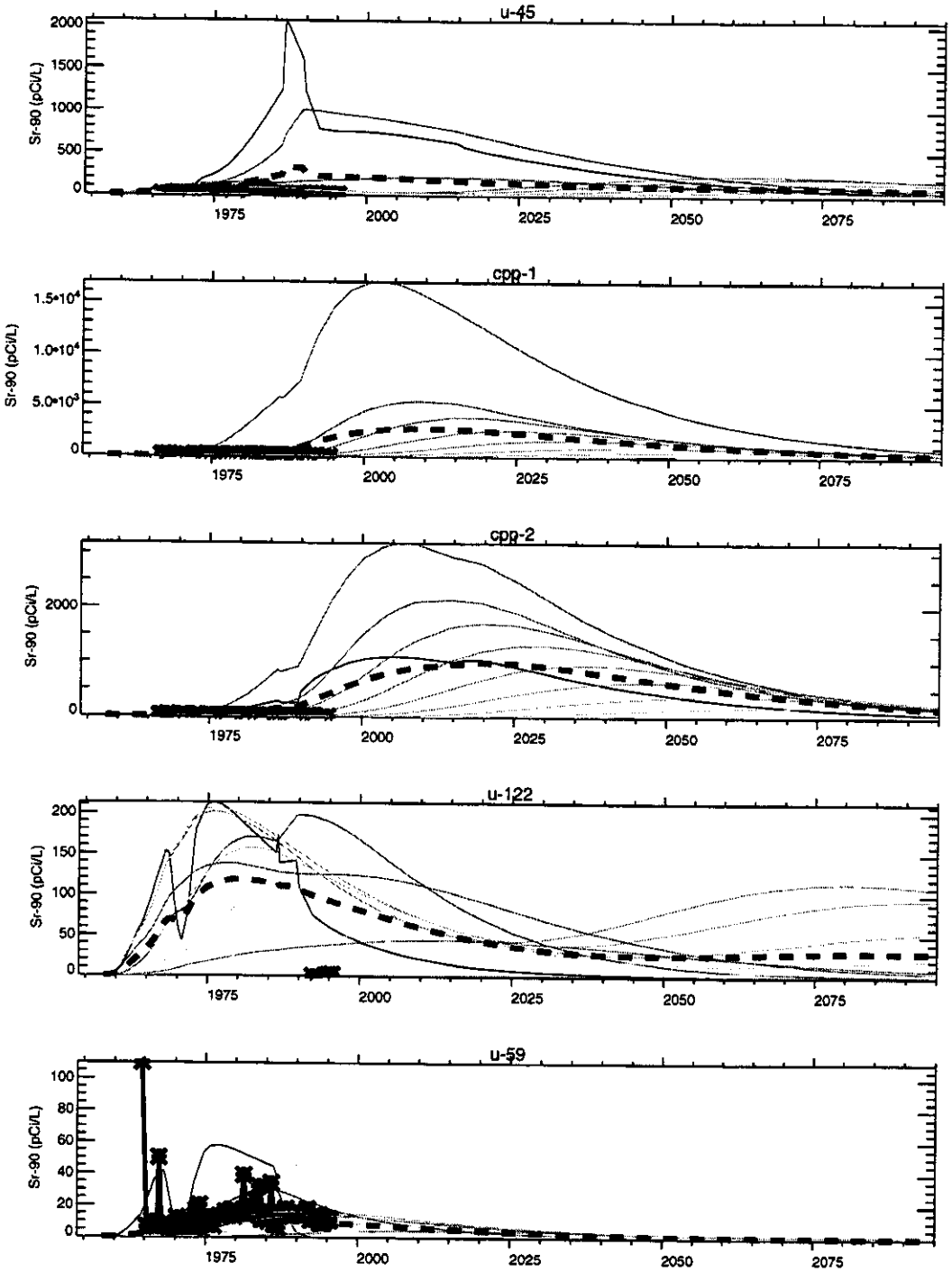

Figure 8-105 Comparison of aquifer Sr-90 (1 gpm interbed leakage) to field data.

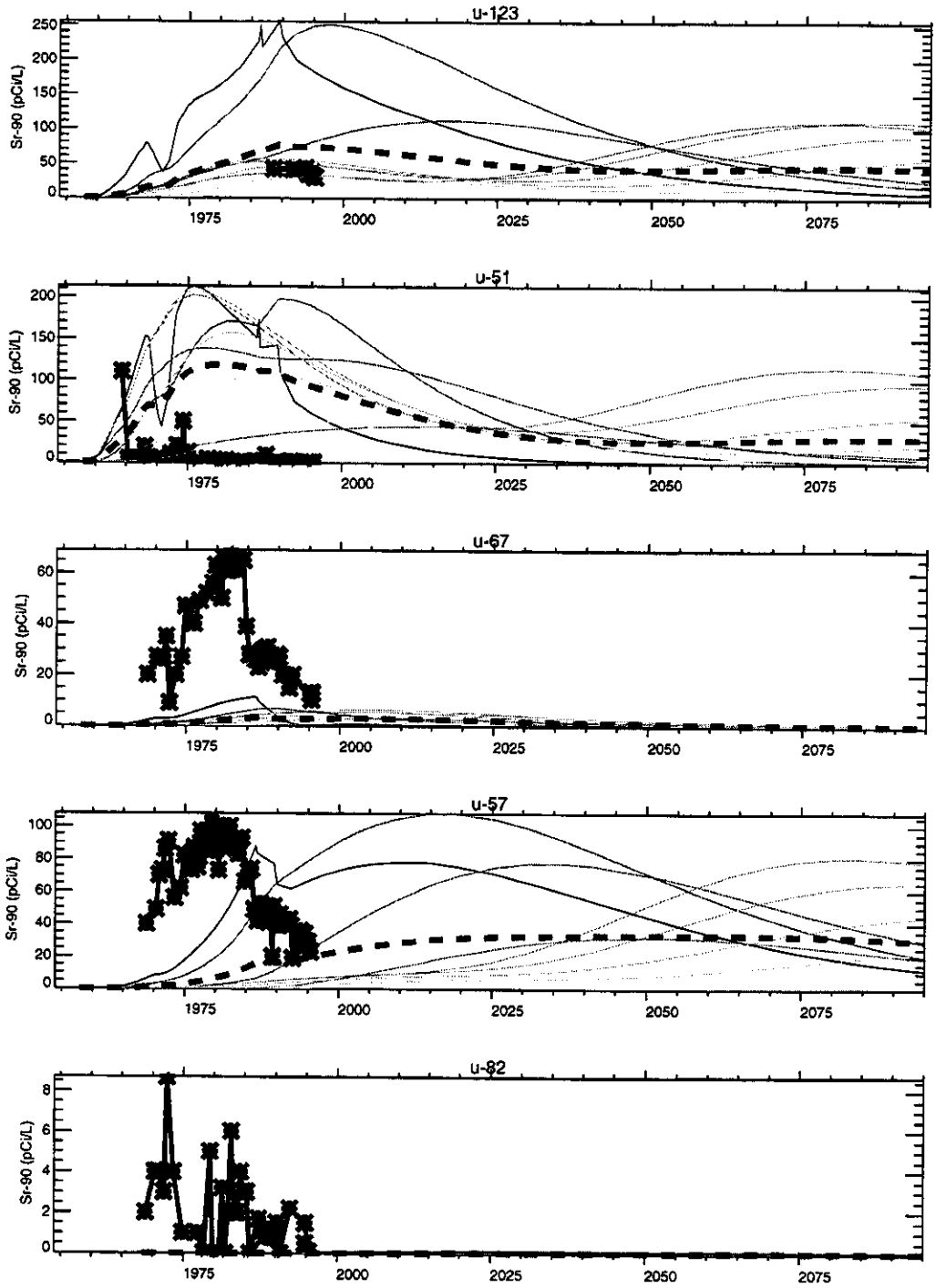

Figure 8-106 Comparison of aquifer Sr-90 (1 gpm interbed leakage) to field data.

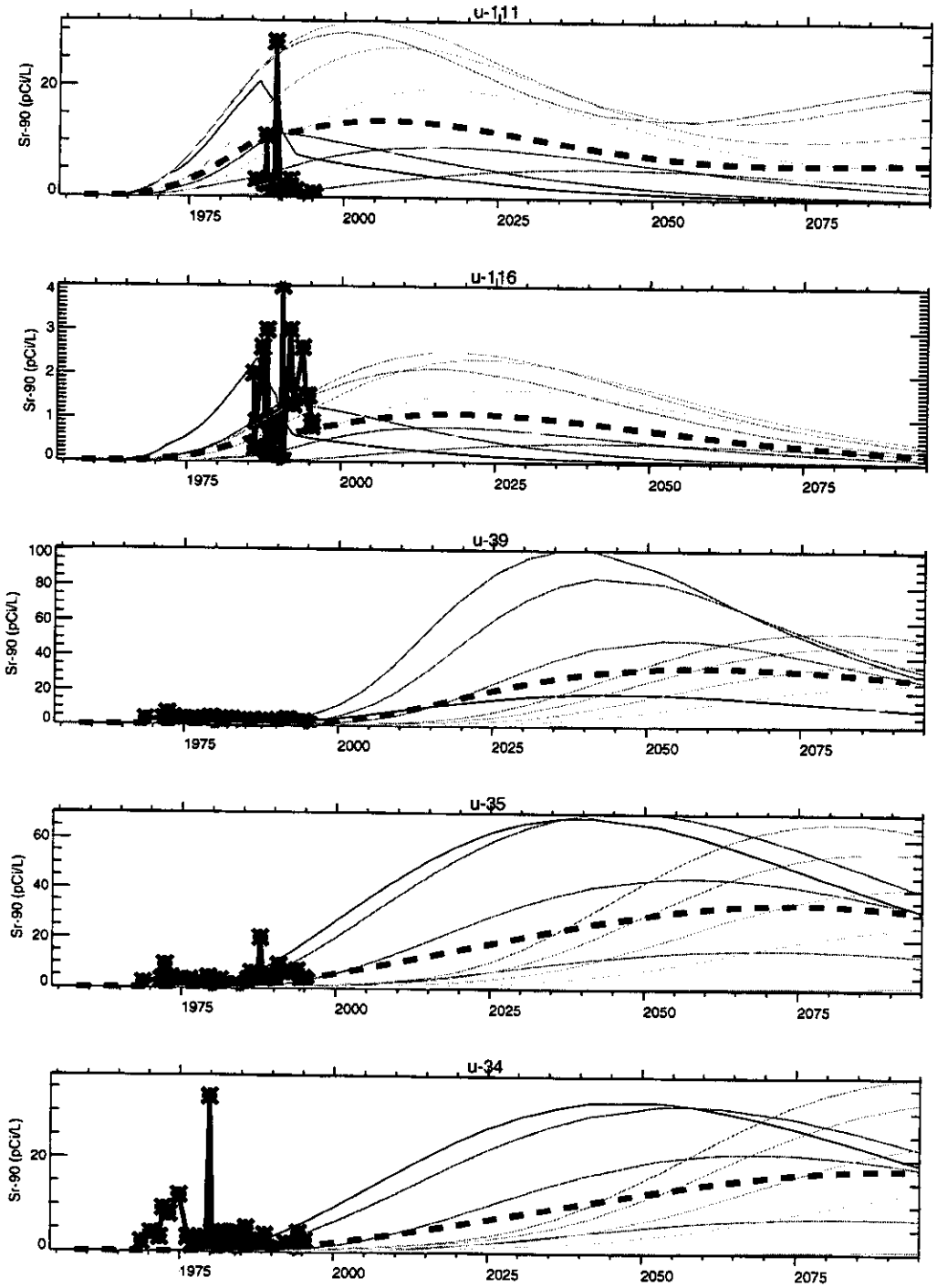

Figure 8-107 Comparison of aquifer Sr-90 (1 gpm interbed leakage) to field data.

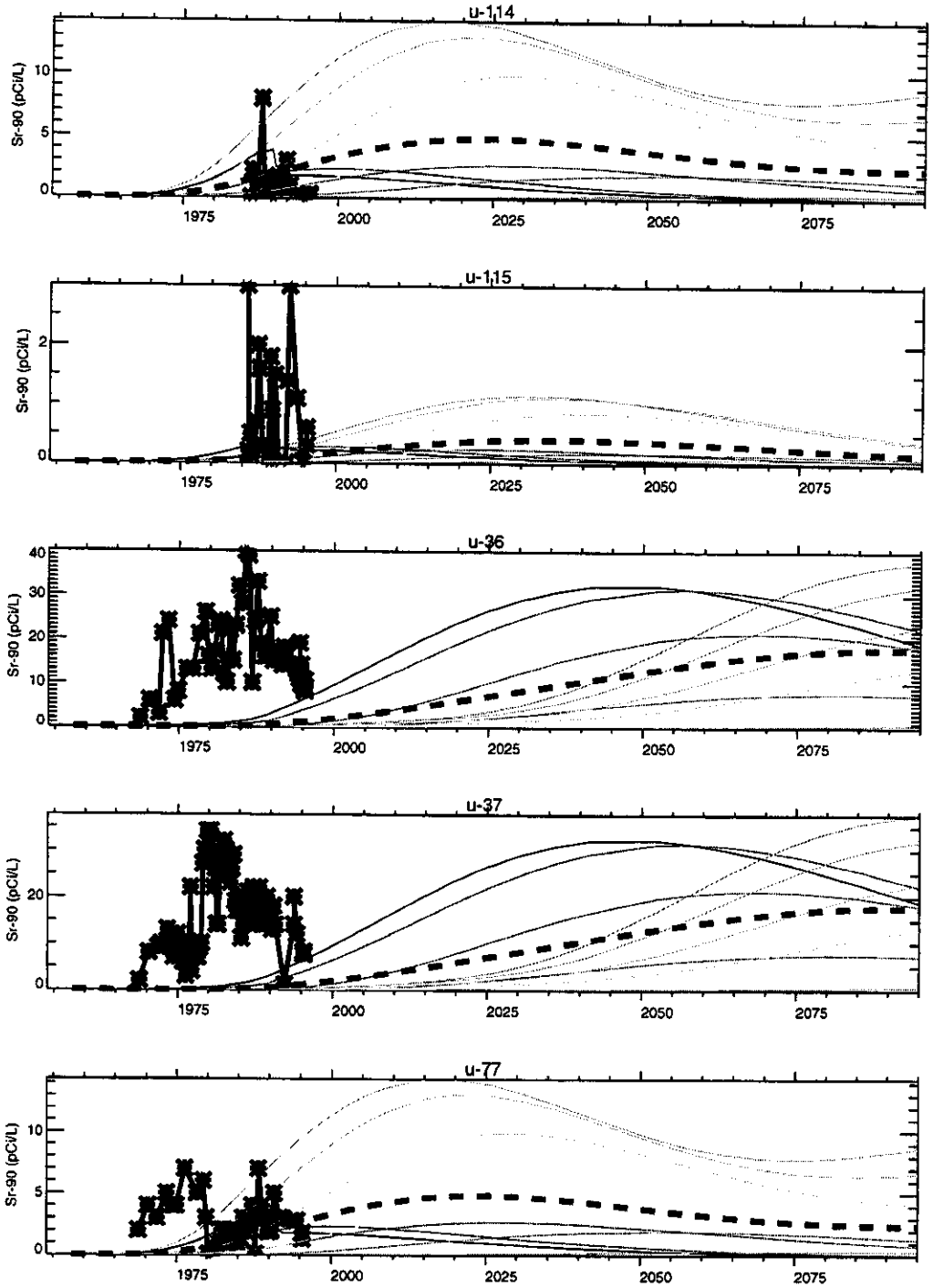

Figure 8-108 Comparison of aquifer Sr-90 (1 gpm interbed leakage) to field data.

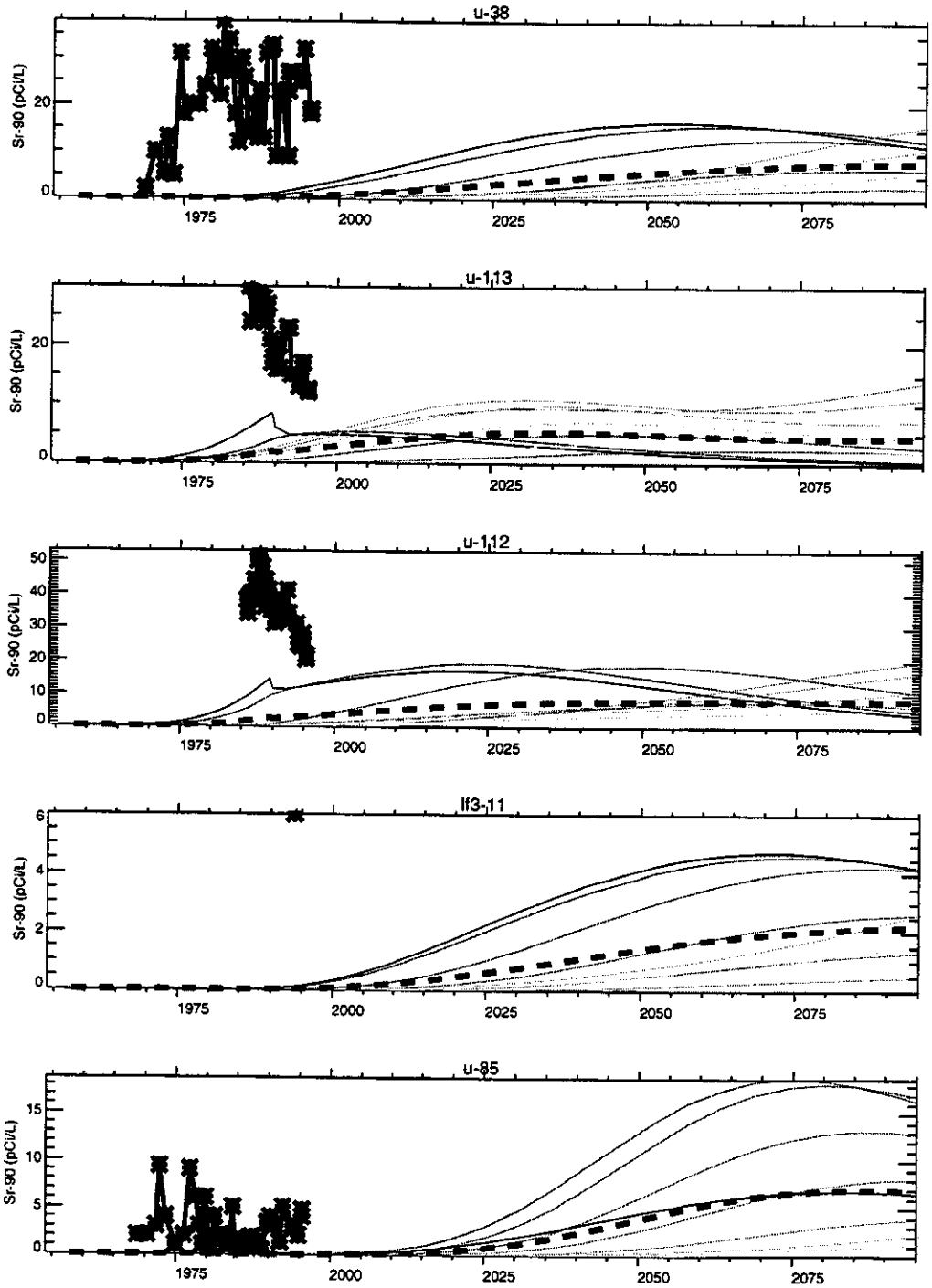

Figure 8-109 Comparison of aquifer Sr-90 (1 gpm interbed leakage) to field data.

8.4.2 Sr-90 With 5-GPM Leakage From The Upper Interbed

For this simulation it was assumed that the contaminants from the upper interbed region leaked directly into the aquifer at a rate of 5 gal/min based on estimates of leakage in wells having similar completions as those at the ICPP (as per personal communication with Scott Reno, 1996). As before, the most useful way of comparing the results of this sensitivity simulation is to look at the model comparison plots to field data for the base case simulation (Figures 8-17 through 8-24 for the aquifer) and for this simulation (Figures 8-116 through 8-122). Examination of the aquifer comparison plots for wells near the injection well indicates that the 5 gal/min leakage mass flux assumed in this simulation probably does not occur. If it did occur, measured concentrations of Sr-90 would be much higher than currently observed. The comparison plots, in general, indicate that a small amount of leakage from the upper interbeds (where the concentrations are predicted to be fairly high) can have a large influence on aquifer concentrations near the point of application. On the other hand, the comparison wells also indicate that the increased concentrations due to leakage dissipate fairly rapidly as a result of combined adsorption and decay.

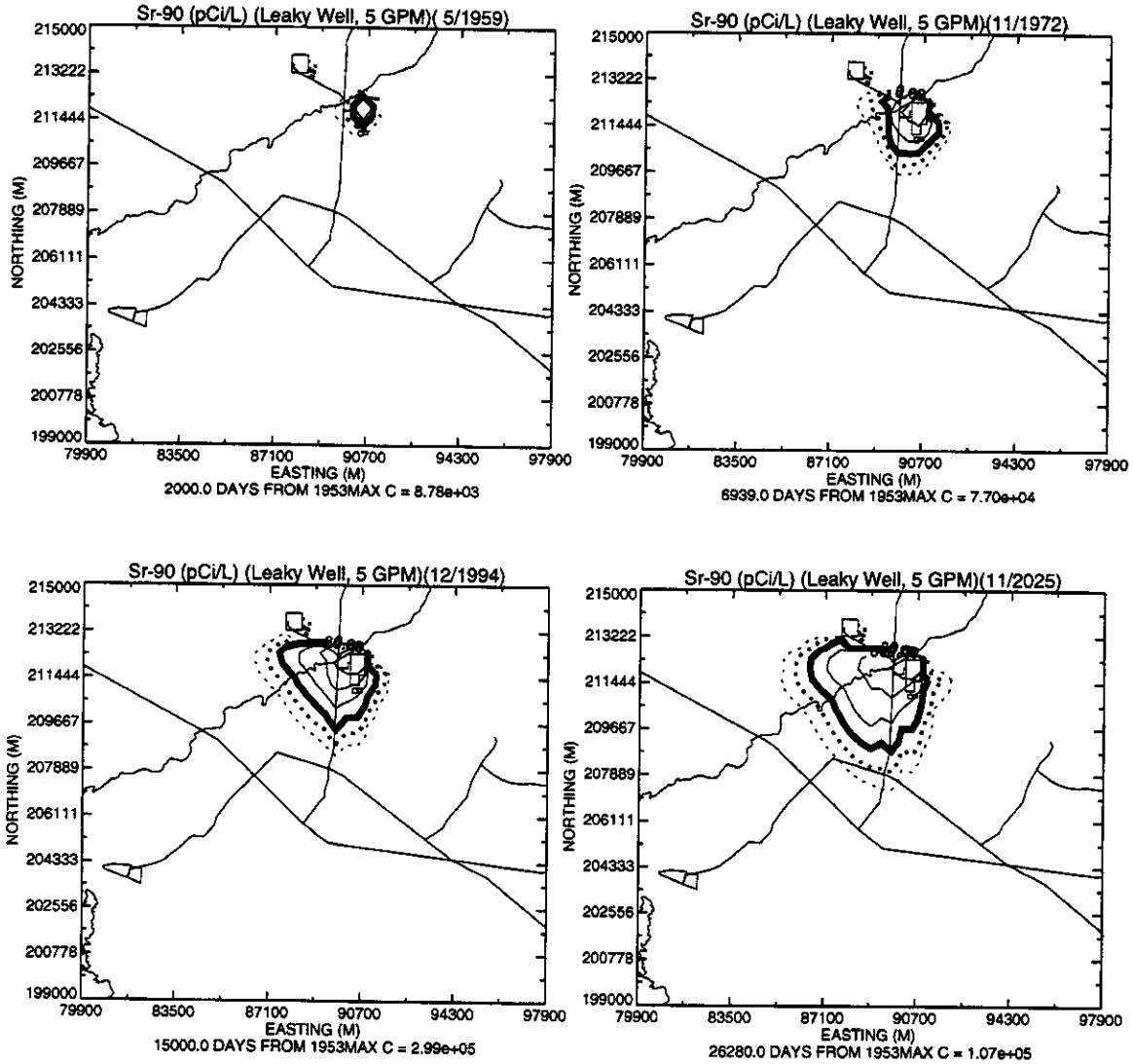

Figure 8-110 Aquifer Sr-90 (5 gpm interbed leakage) peak concentration contours.

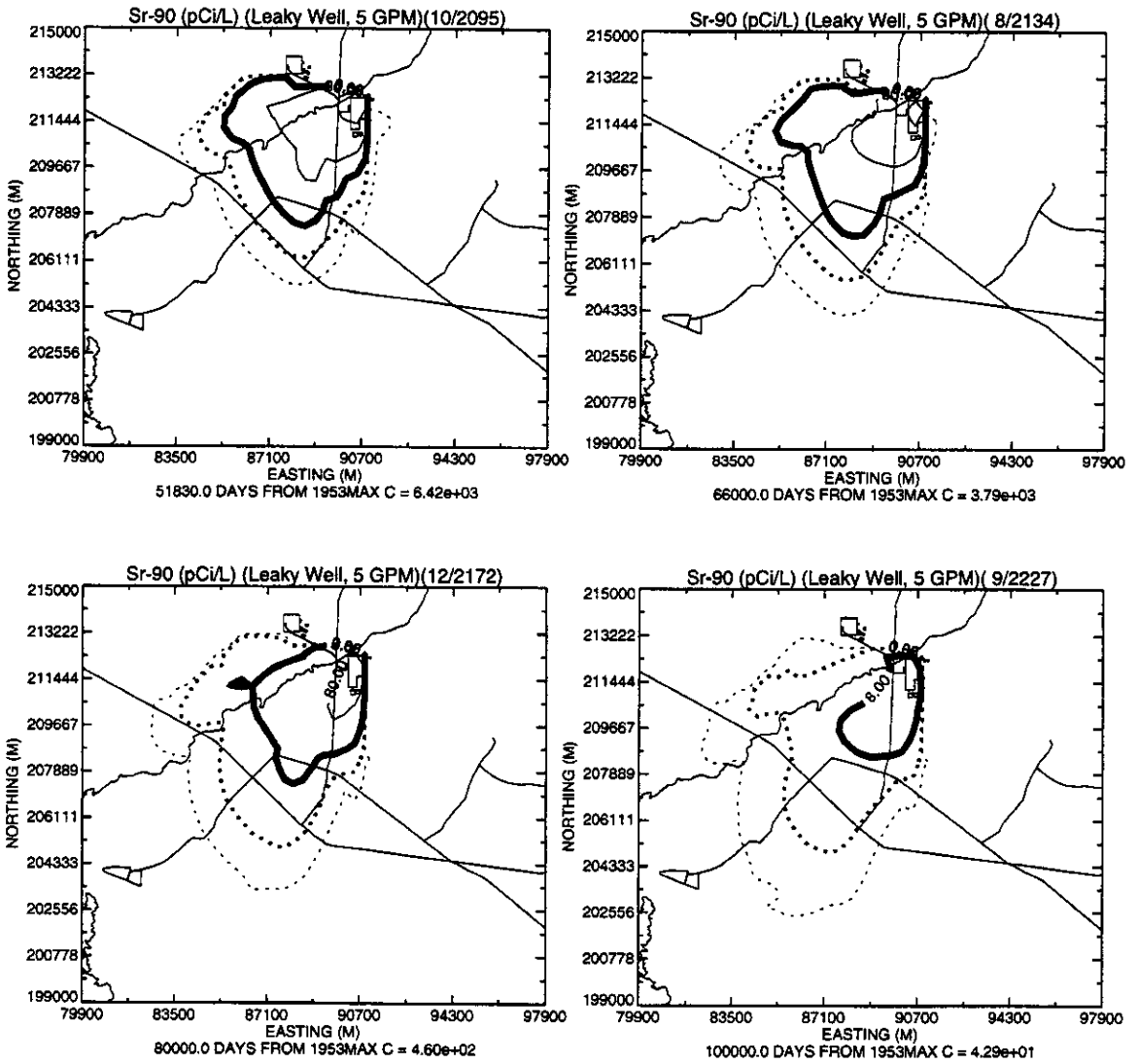

Figure 8-111 Aquifer Sr-90 (5 gpm interbed leakage) peak concentration contours.

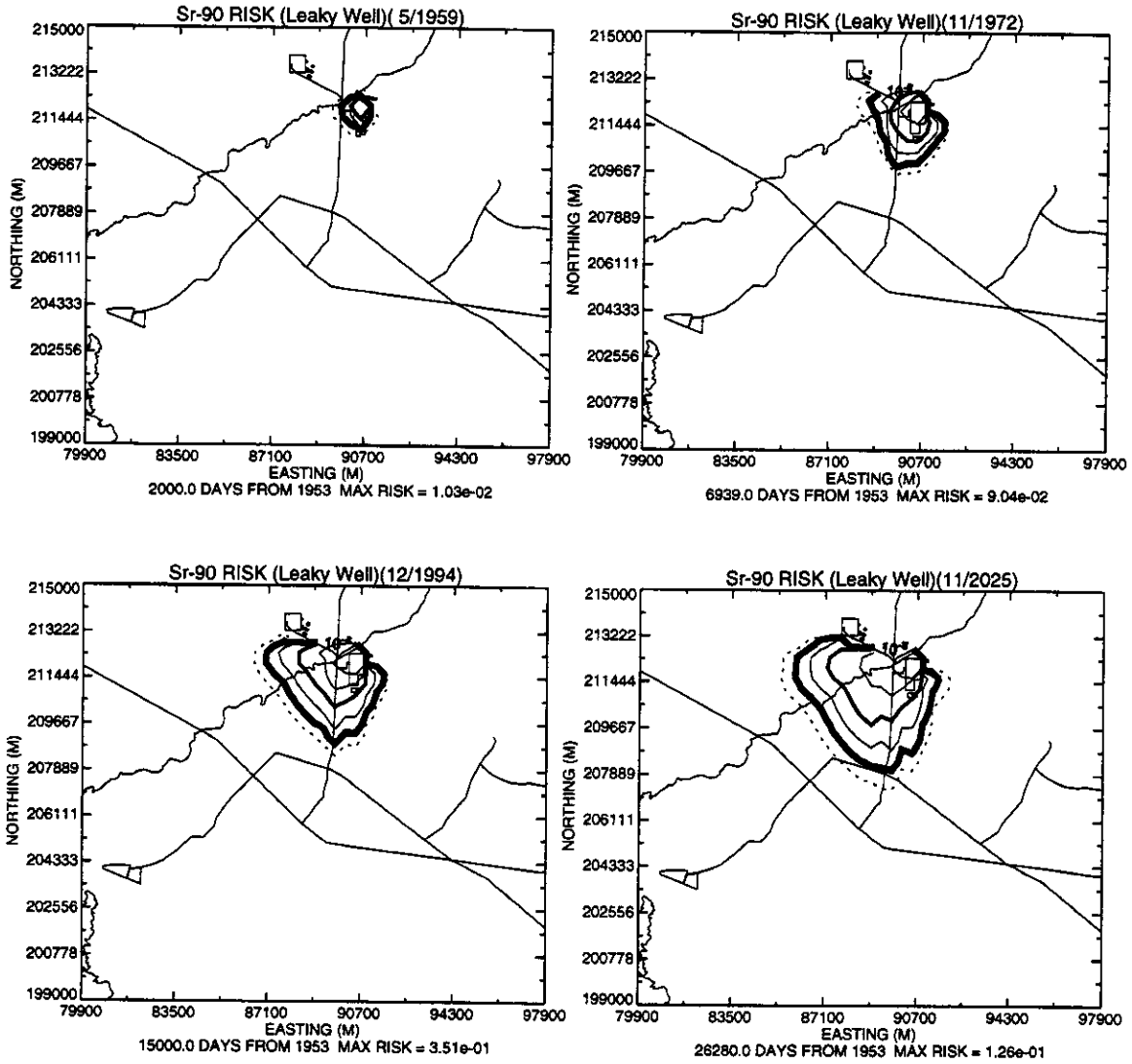

Figure 8-112 Aquifer Sr-90 (5 gpm interbed leakage) peak risk contours.

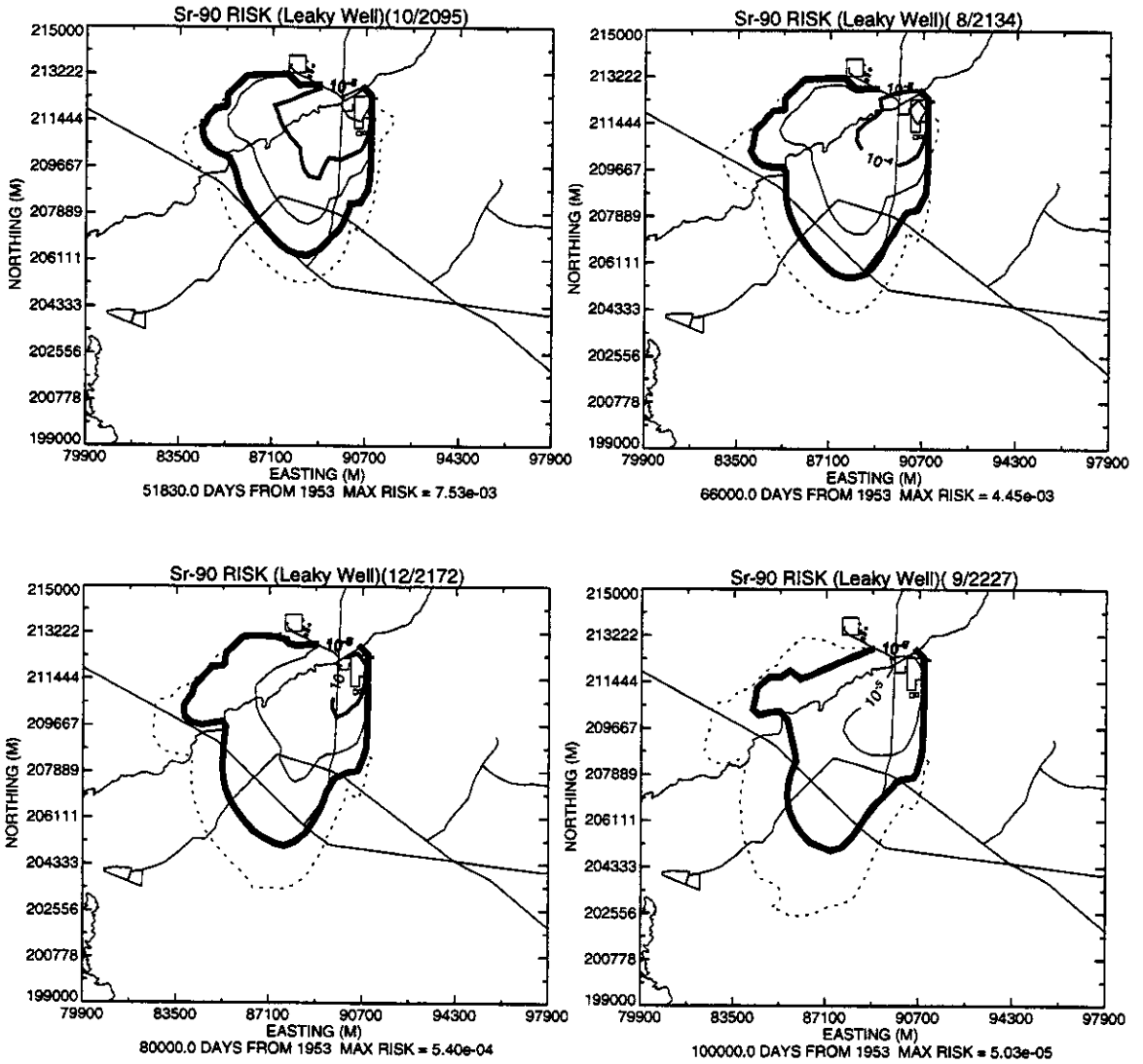

Figure 8-113 Aquifer Sr-90 (5 gpm interbed leakage) peak risk contours.

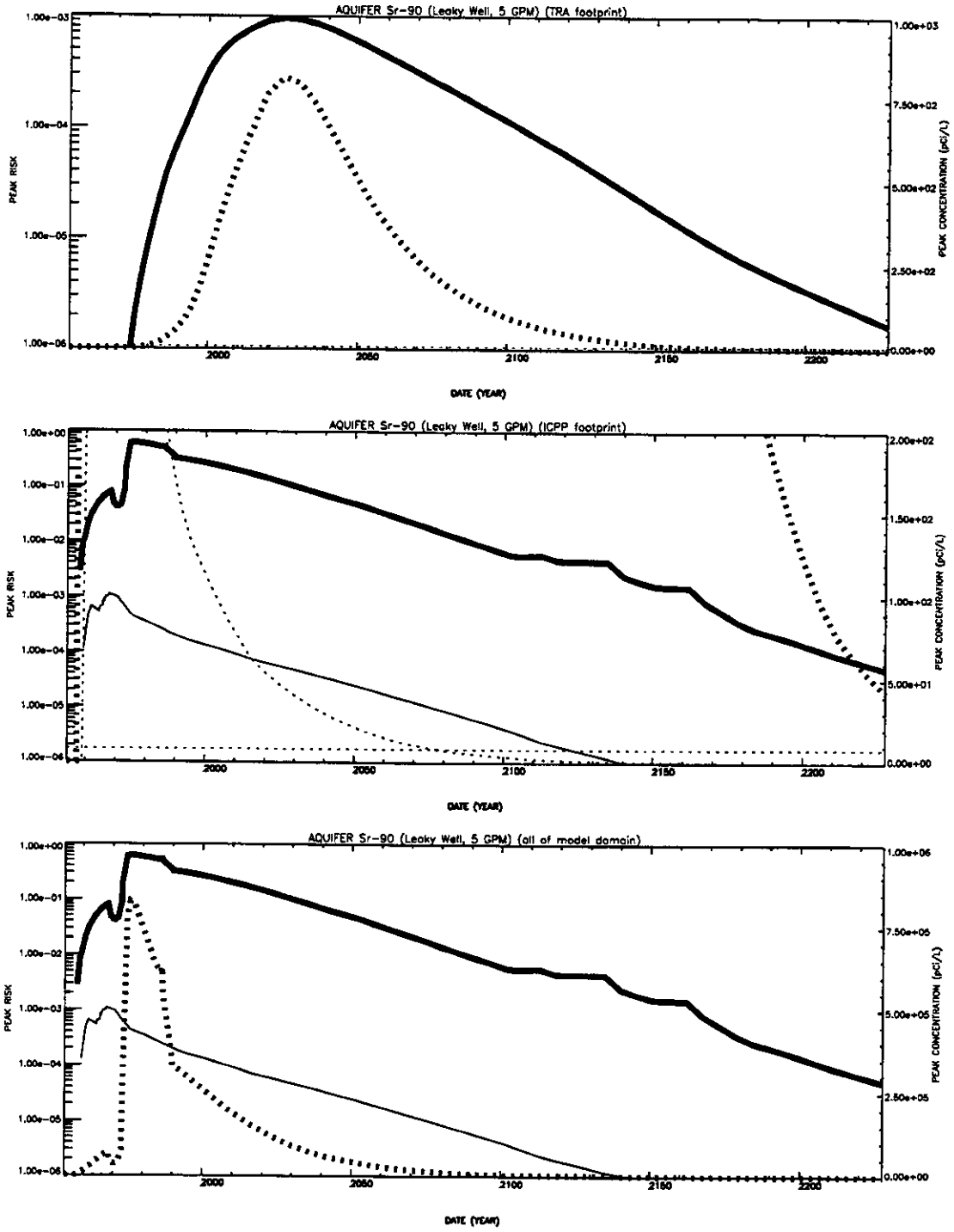

Figure 8-114 Peak aquifer concentration for Sr-90 (5 gpm interbed leakage). Top figure: TRA foot print, Middle figure: ICPP footprint, Bottom Figure: entire aquifer domain. Thick line risk (left scale), dotted line concentration (right scale) solid line 10^{-6} risk (left scale).

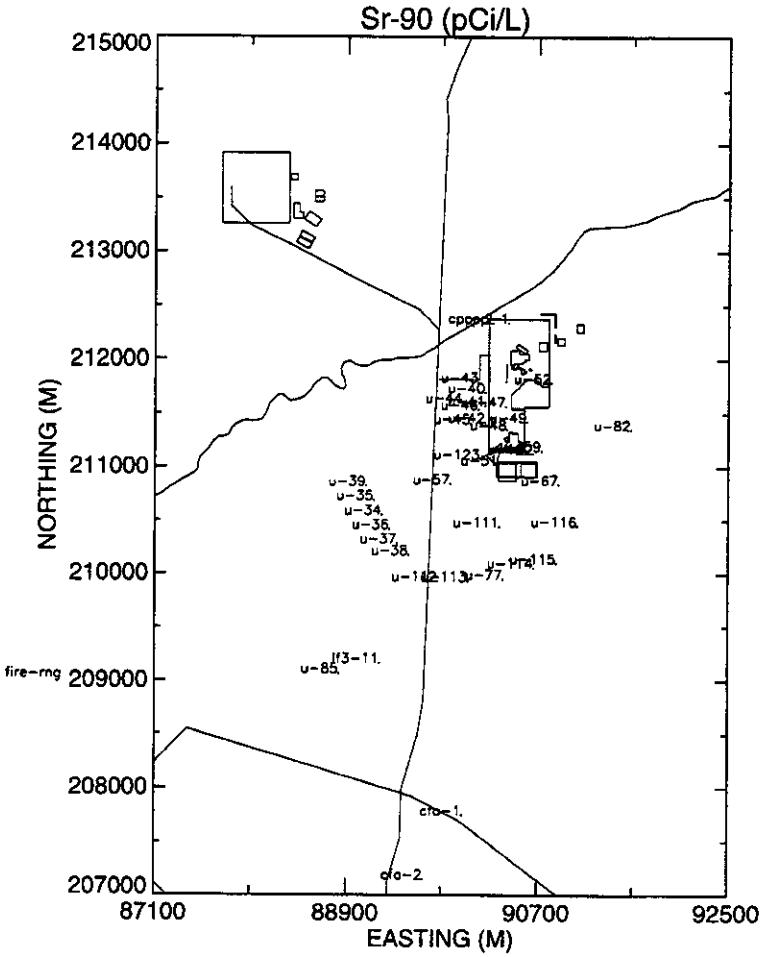

Figure 8-115 Well locations for the comparison of aquifer Sr-90 (5 gpm interbed leakage) to field data.

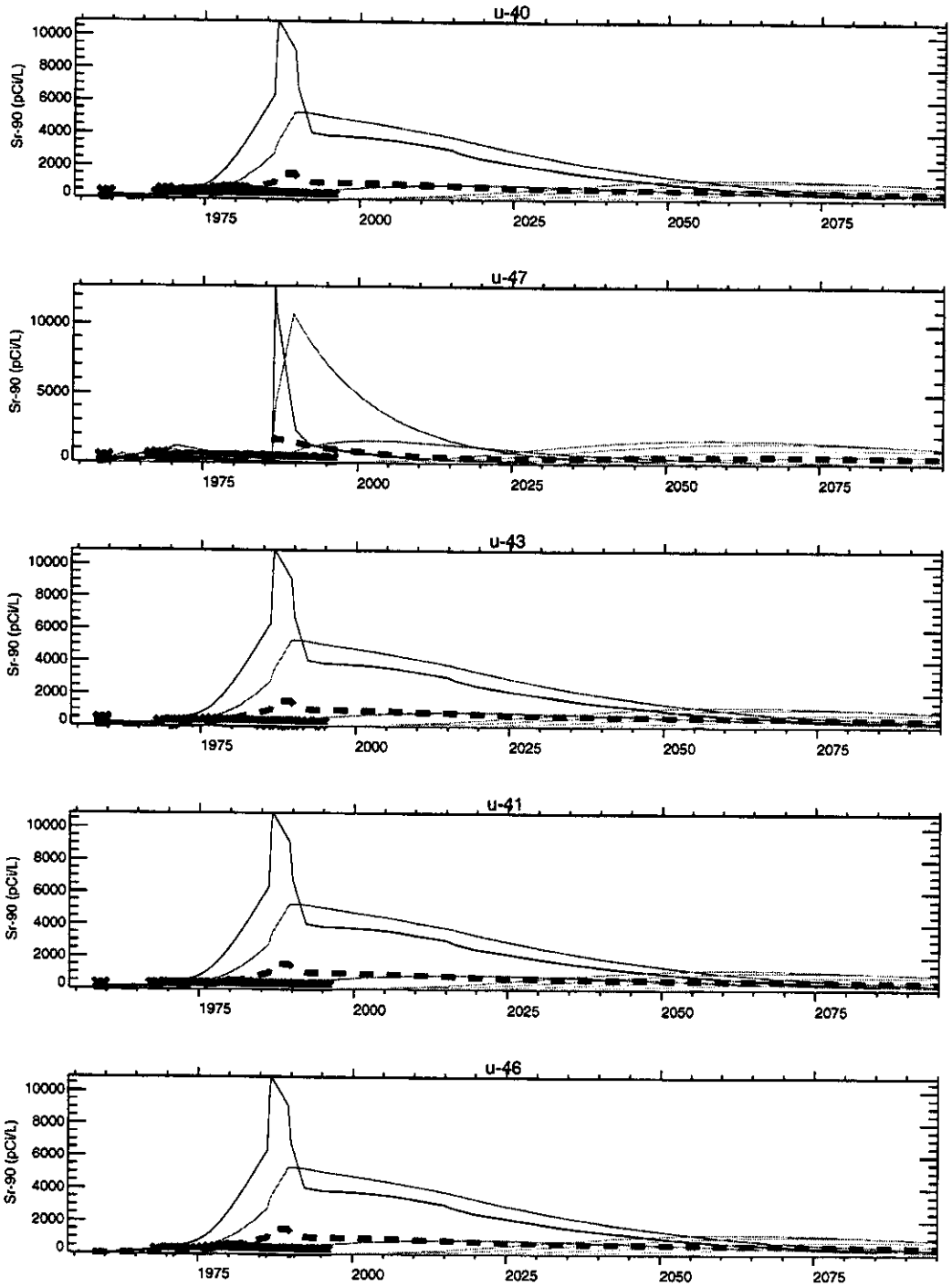

Figure 8-116 Comparison of aquifer Sr-90 (5 gpm interbed leakage) to field data.

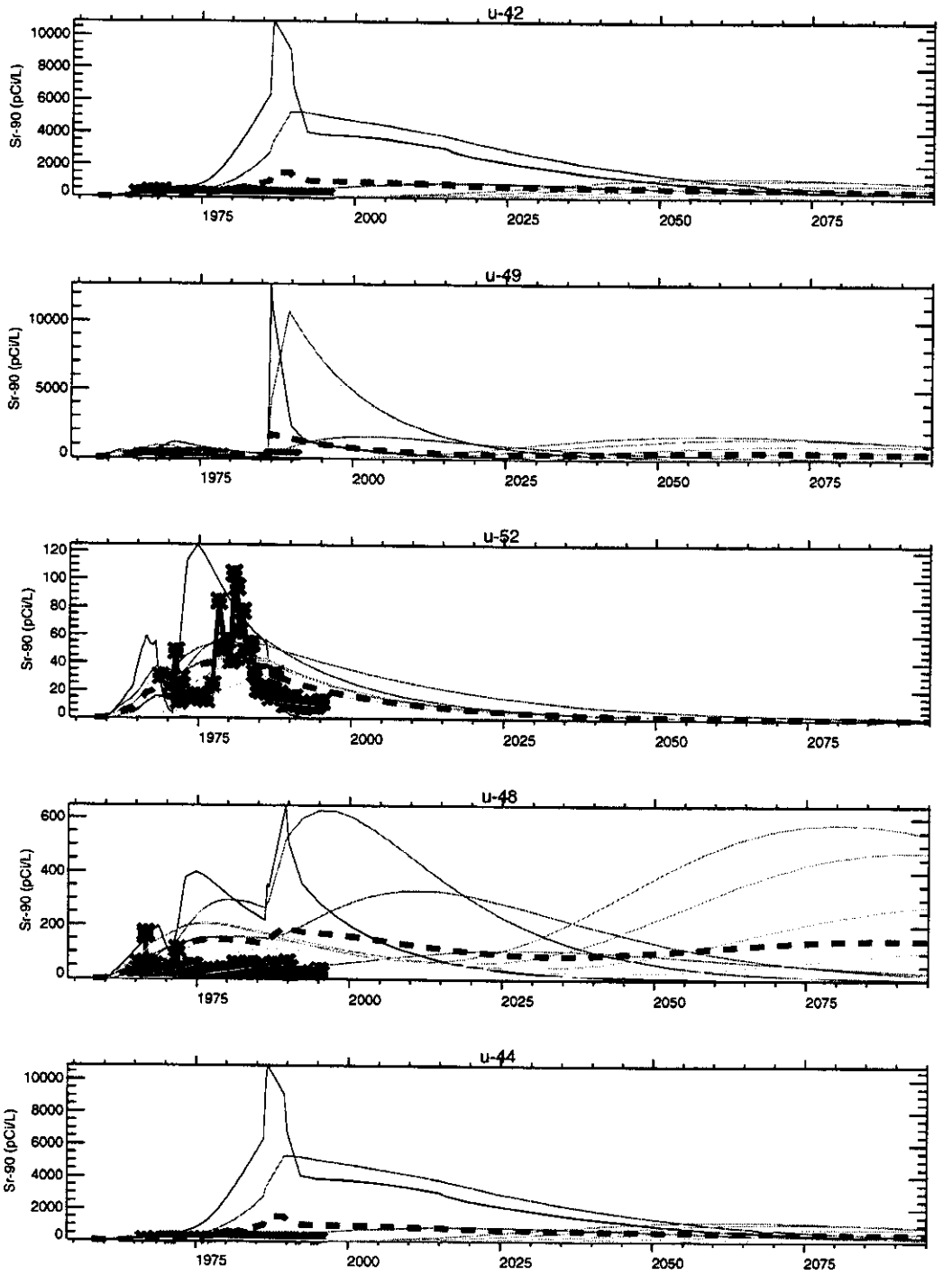

Figure 8-117 Comparison of aquifer Sr-90 (5 gpm interbed leakage) to field data.

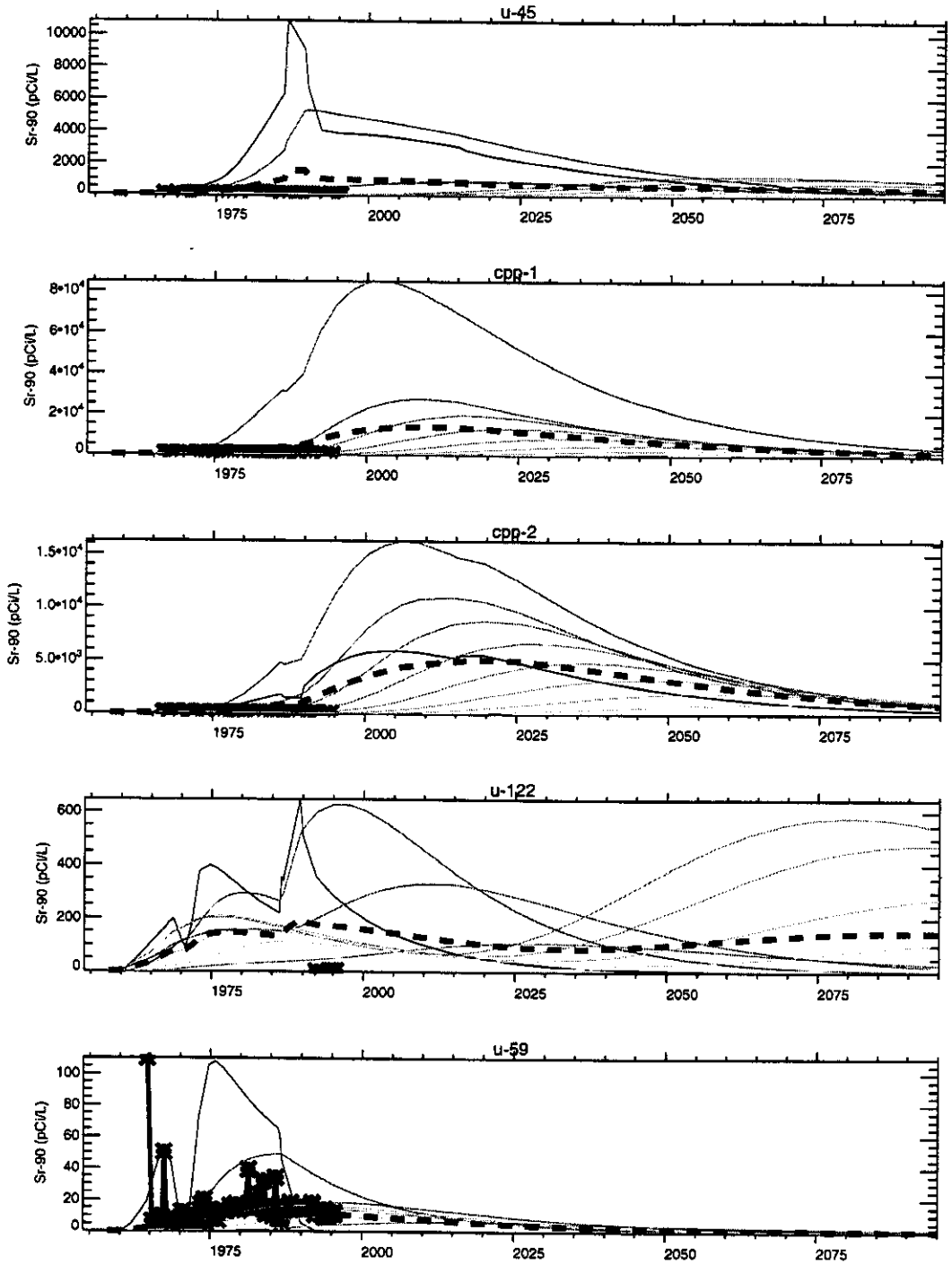

Figure 8-118 Comparison of aquifer Sr-90 (5 gpm interbed leakage) to field data.

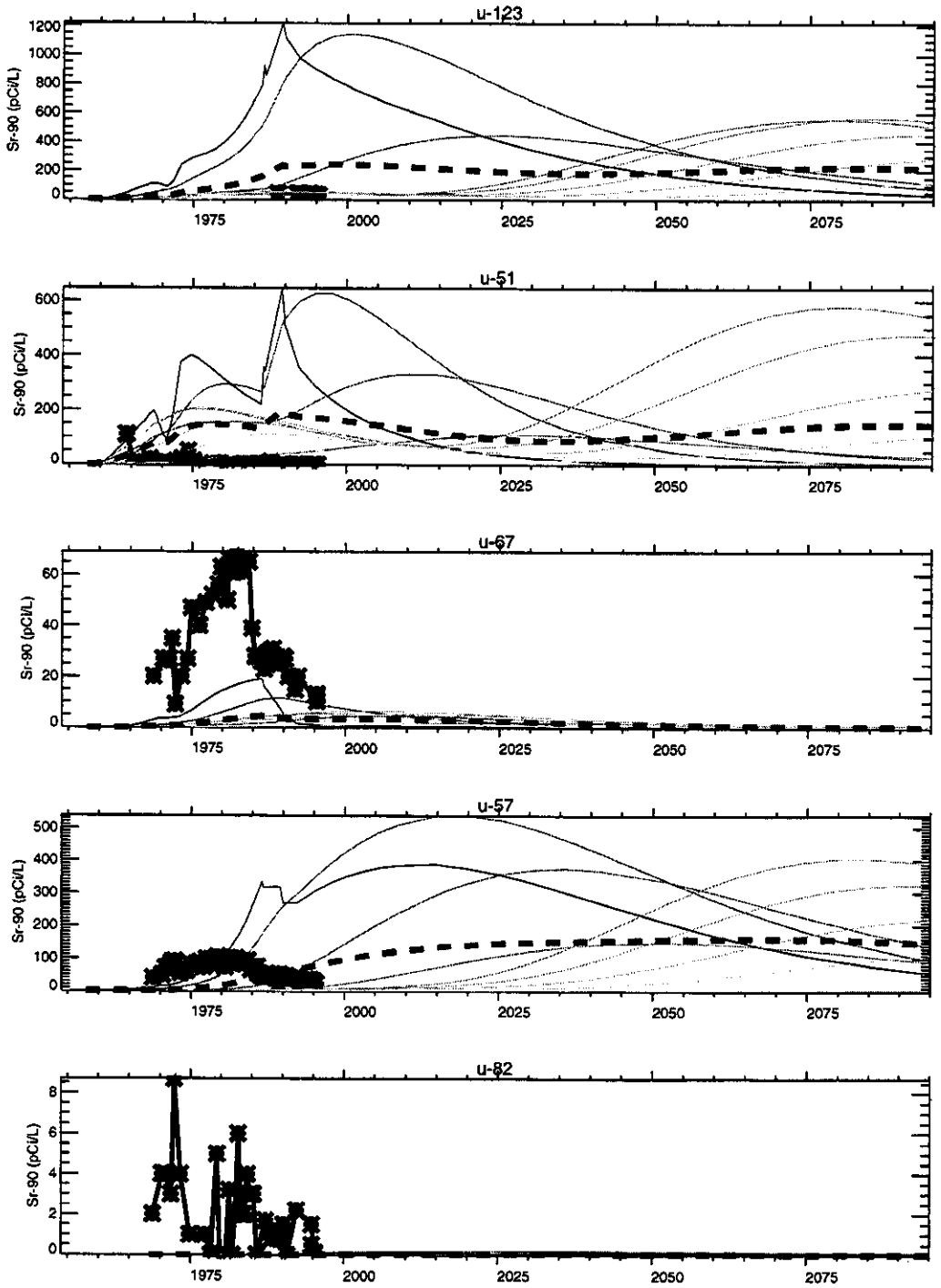

Figure 8-119 Comparison of aquifer Sr-90 (5 gpm interbed leakage) to field data.

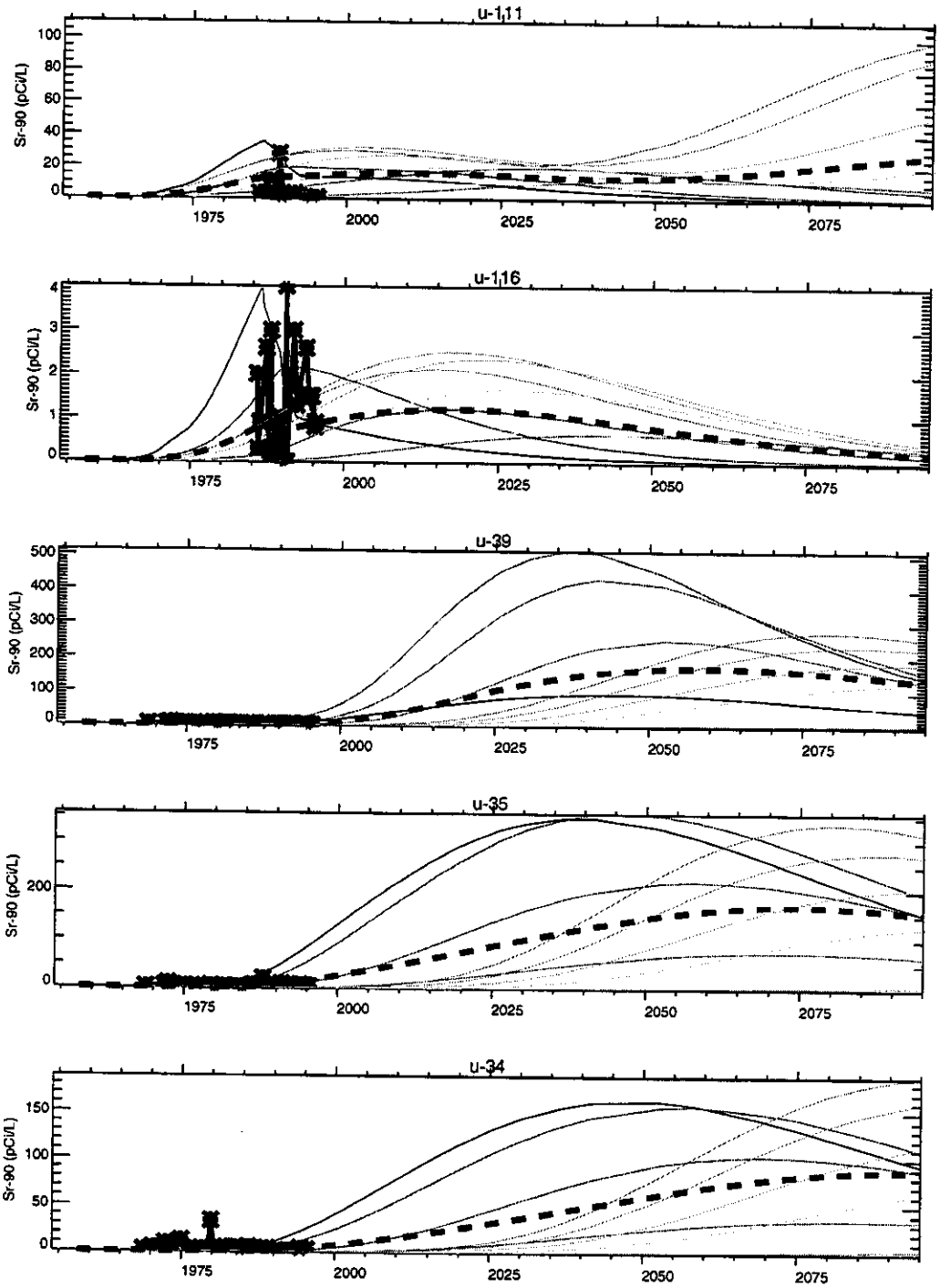

Figure 8-120 Comparison of aquifer Sr-90 (5 gpm interbed leakage) to field data.

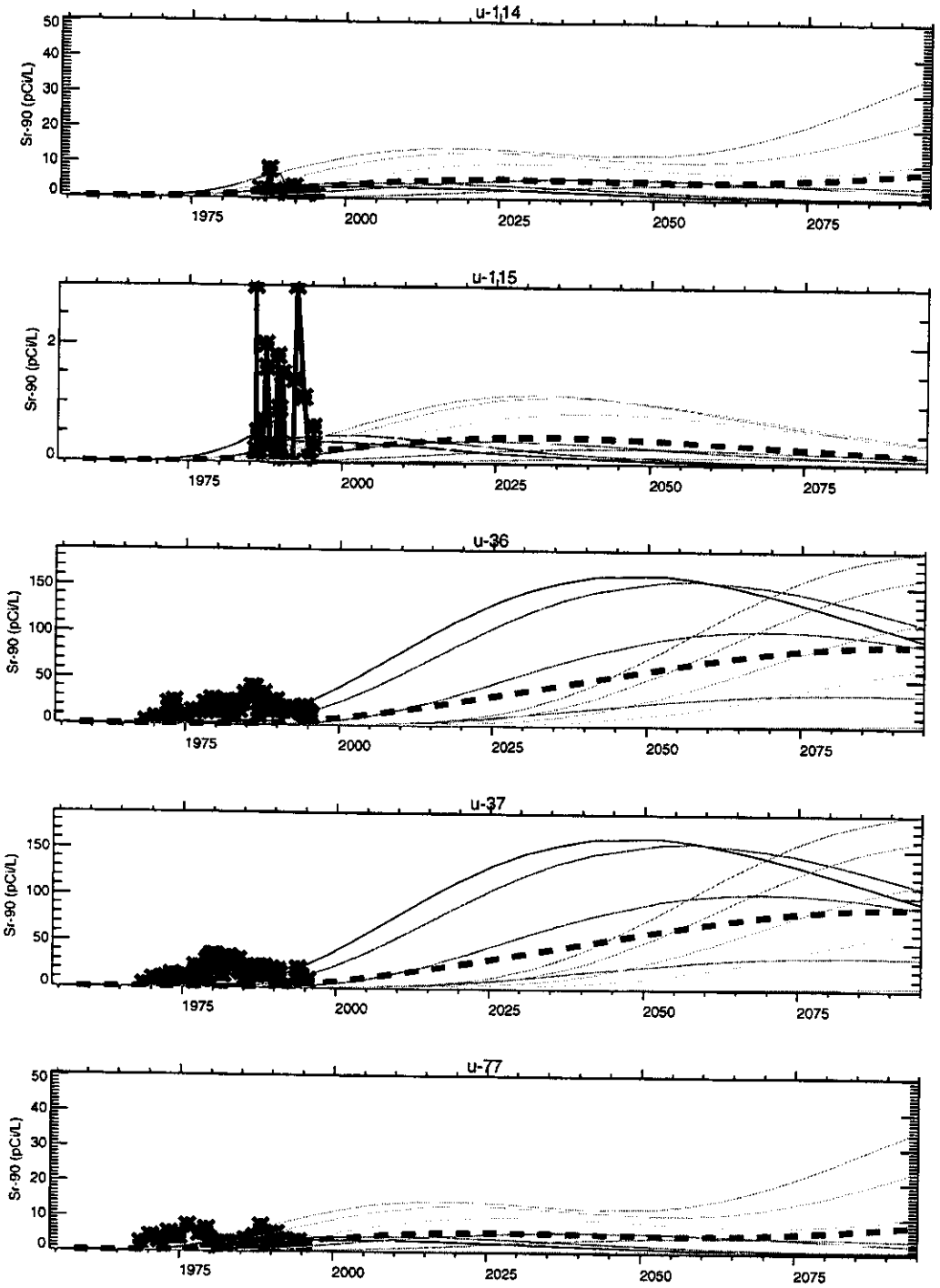

Figure 8-121 Comparison of aquifer Sr-90 (5 gpm interbed leakage) to field data.

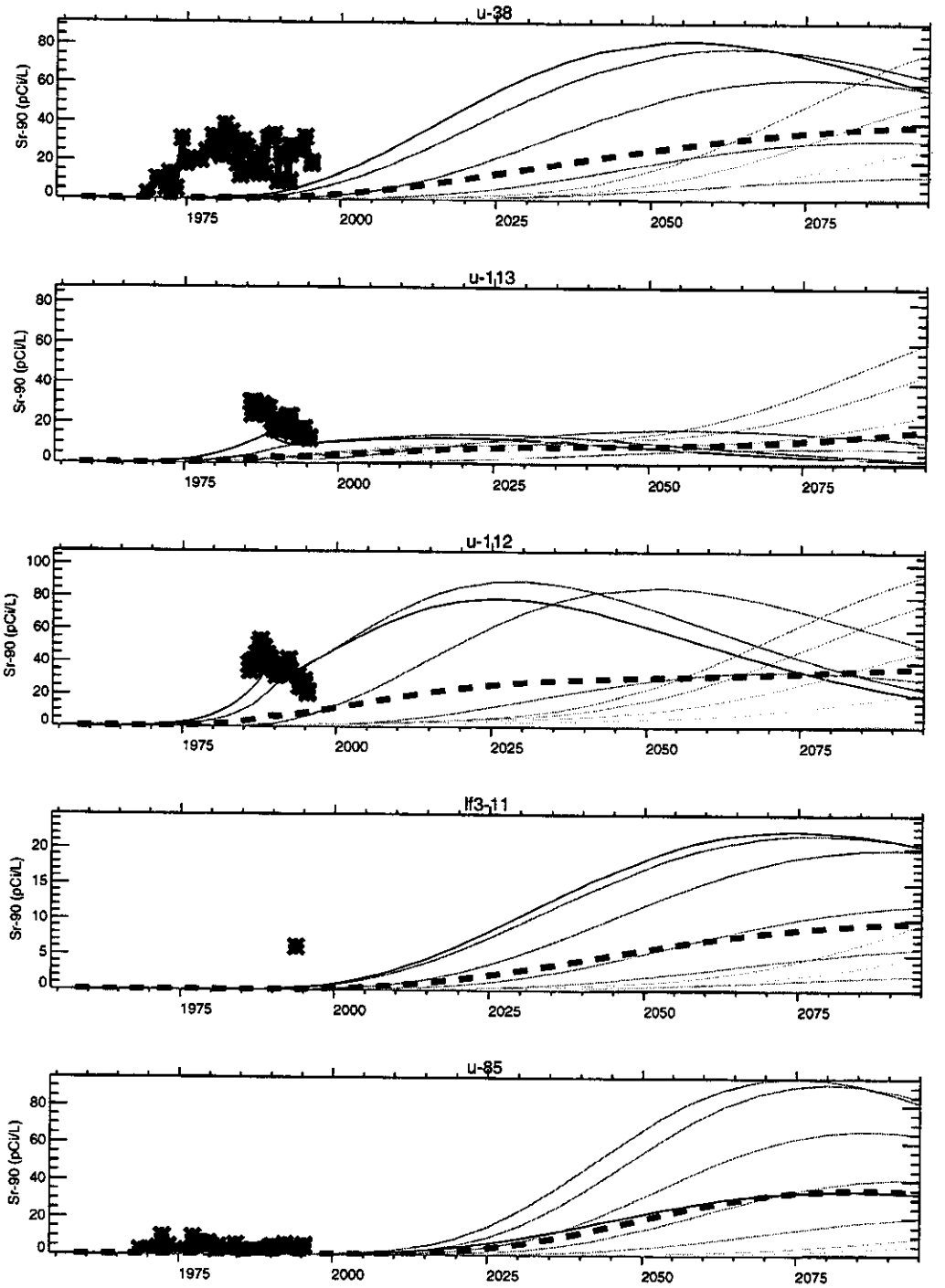

Figure 8-122 Comparison of aquifer Sr-90 (5 gpm interbed leakage) to field data.

8.4.3 Sr-90 With 10-GPM Leakage From The Upper Interbed

For this simulation it was assumed that the contaminants from the upper interbed region leaked directly into the aquifer at a rate of 10 gal/min. Transport through the aquifer is represented in Figures 8-123 through 8-127. Contour levels for the aquifer (Figures 8-123 and 8-124) are given for $8x10^{-2}$, $8x10^{-1}$, 8 (the MCL), $8x10^{+1}$, $8x10^{+2}$, and $8x10^{+3}$ pCi/L. The corresponding risk contour maps for the aquifer simulation are given in Figures 8-125, and 8-126. Risk contours are plotted at the 10^{-7}, 10^{-6} (0.859 pCi/L), 10^{-5}, 10^{-4}, 10^{-3}, and 10^{-2} levels. Because the peak concentrations are much higher than those shown for the slower leakage rate in Section 8.4.2, the comparison to field data plots are not included for this simulation.

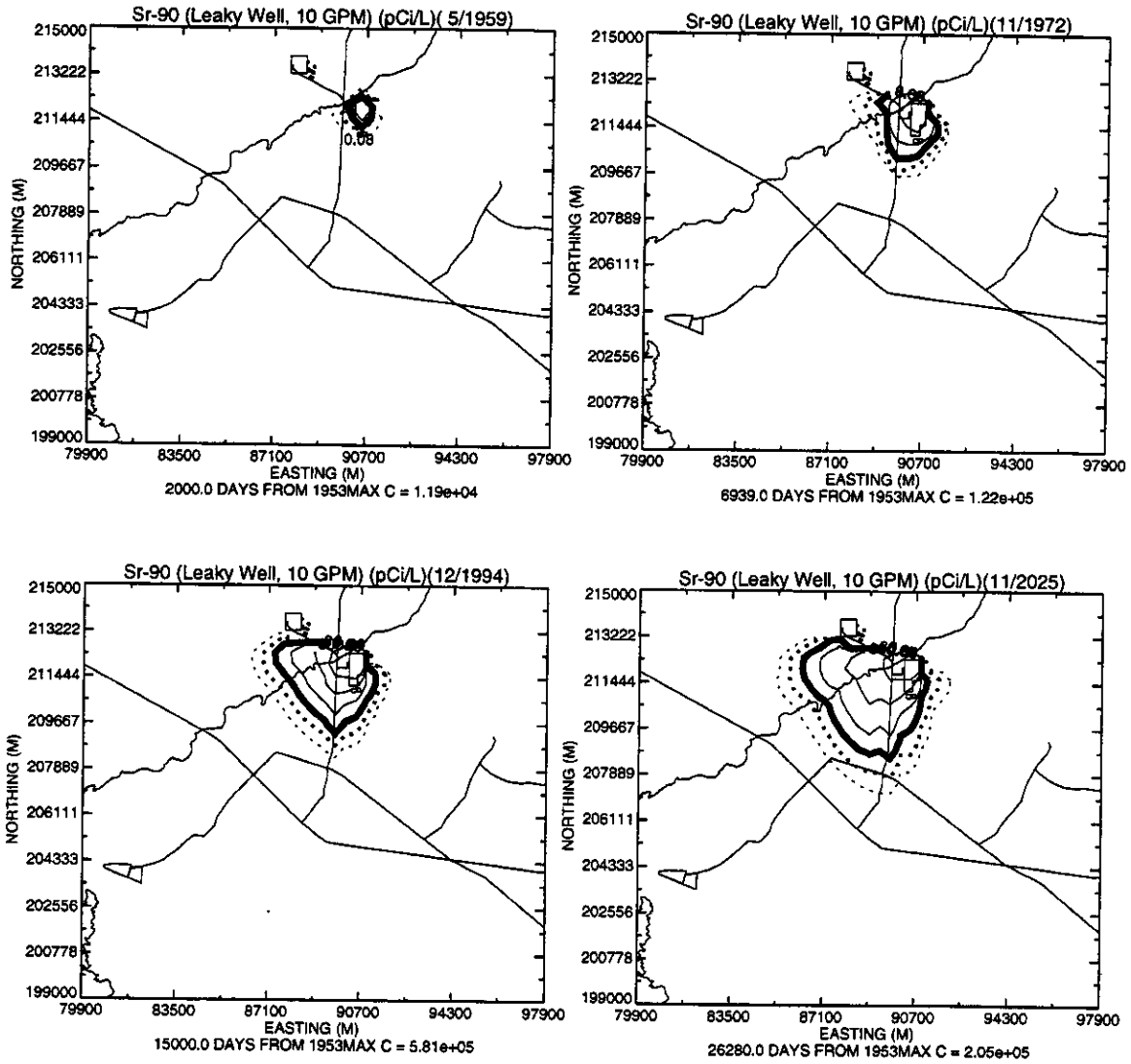

Figure 8-123 Aquifer Sr-90 (10 gpm interbed leakage) peak concentration contours.

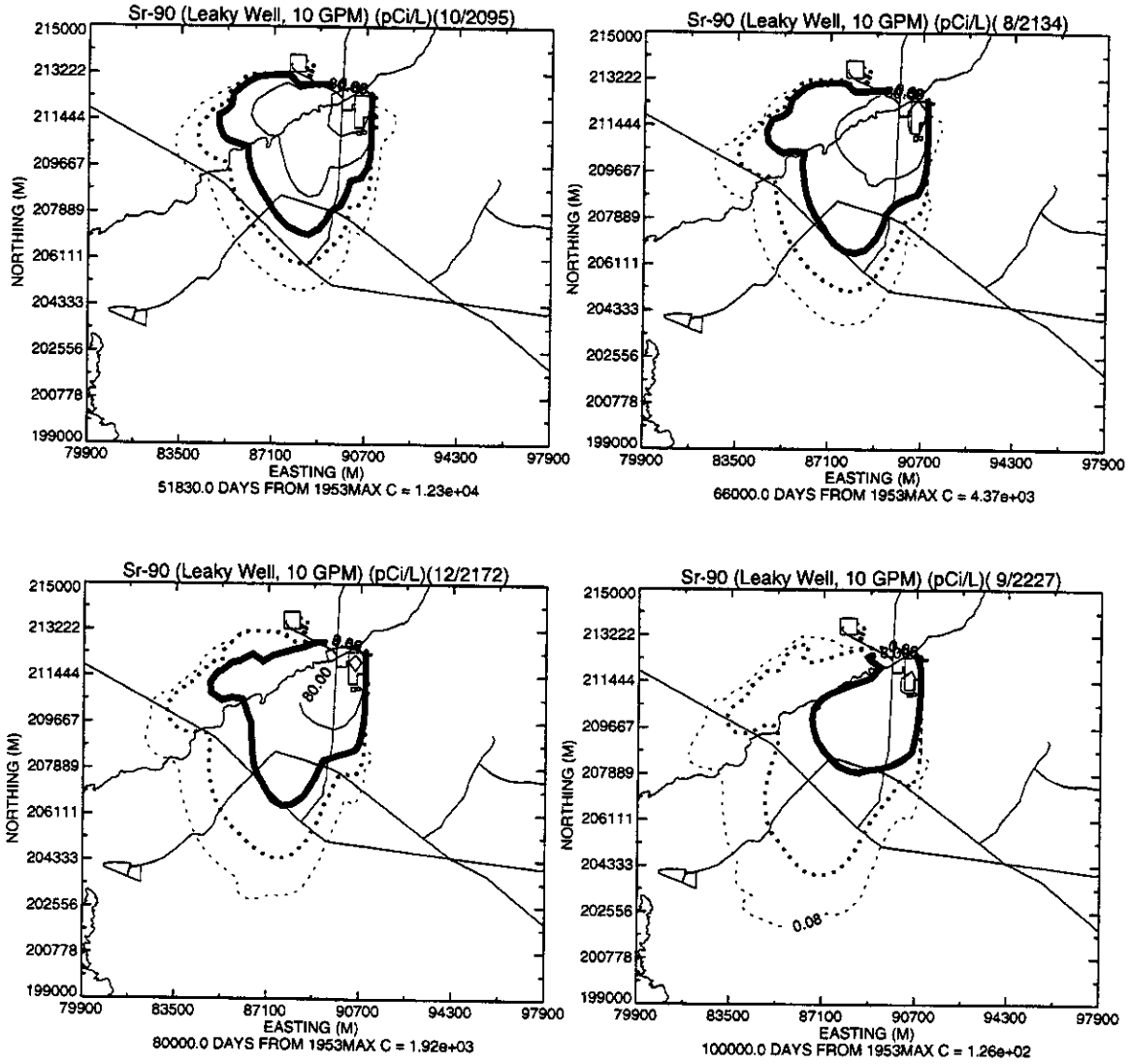

Figure 8-124 Aquifer Sr-90 (10 gpm interbed leakage) peak concentration contours.

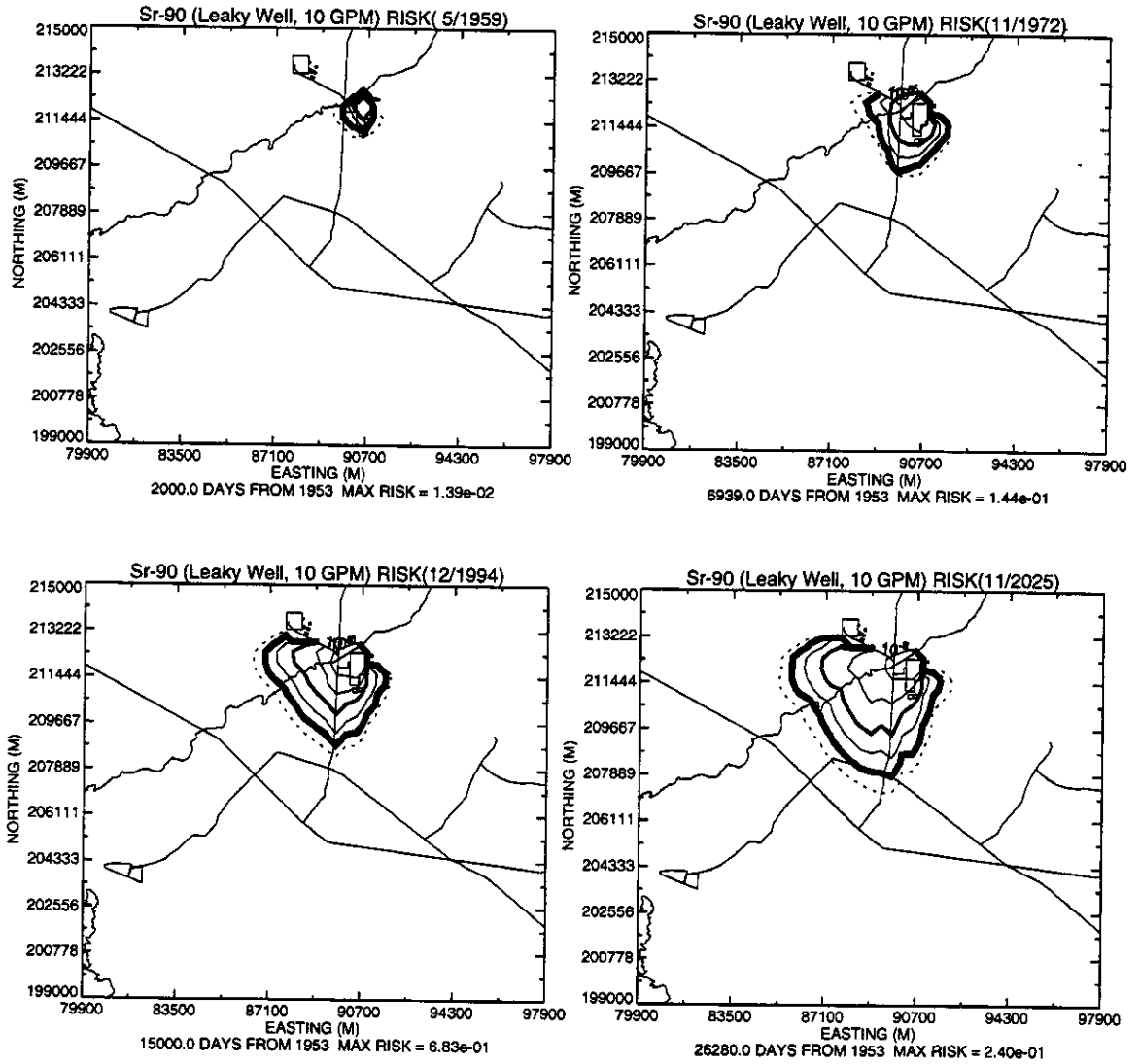

Figure 8-125 Aquifer Sr-90 (10 gpm interbed leakage) peak risk contours.

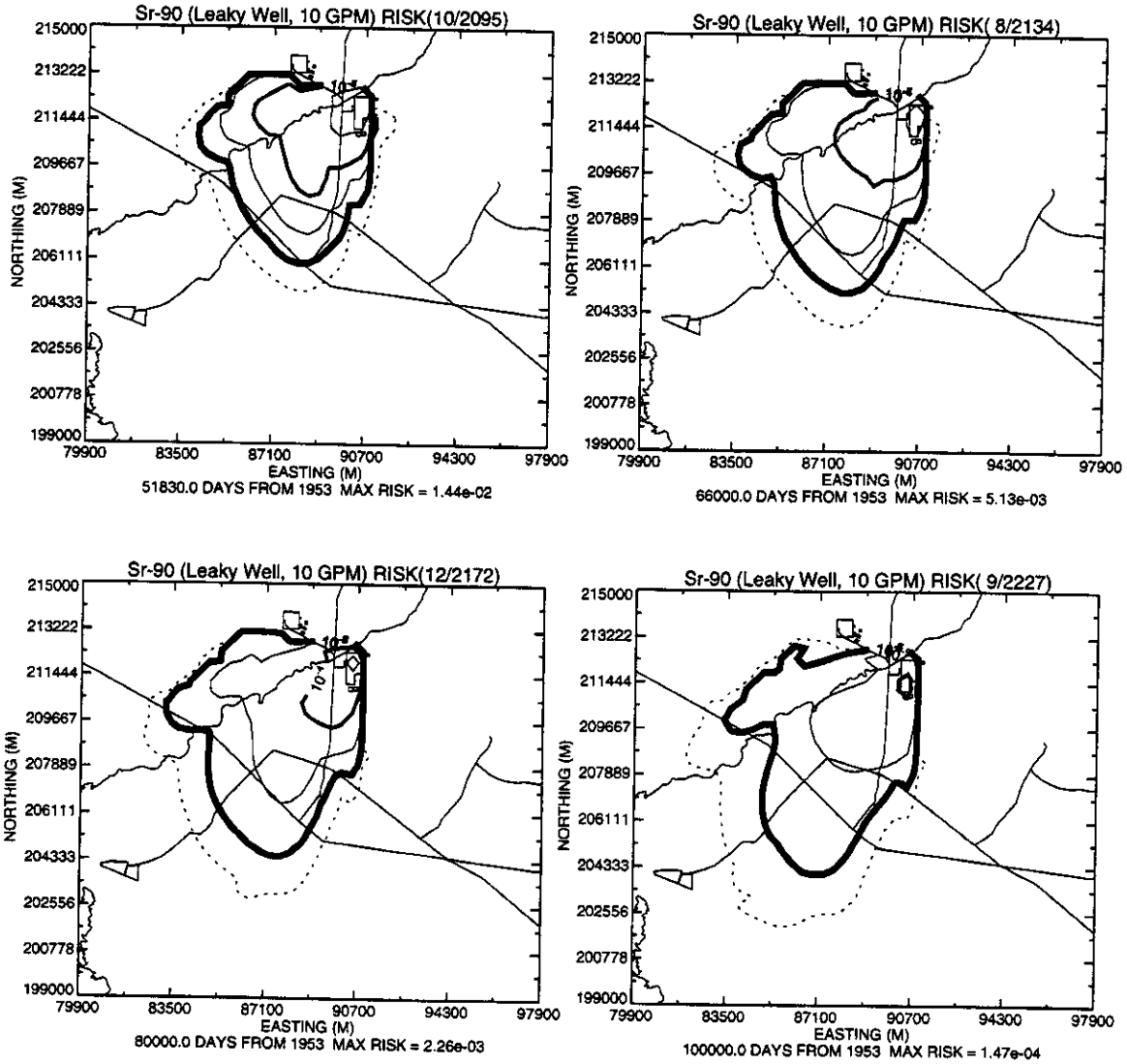

Figure 8-126 Aquifer Sr-90 (10 gpm interbed leakage) peak risk contours.

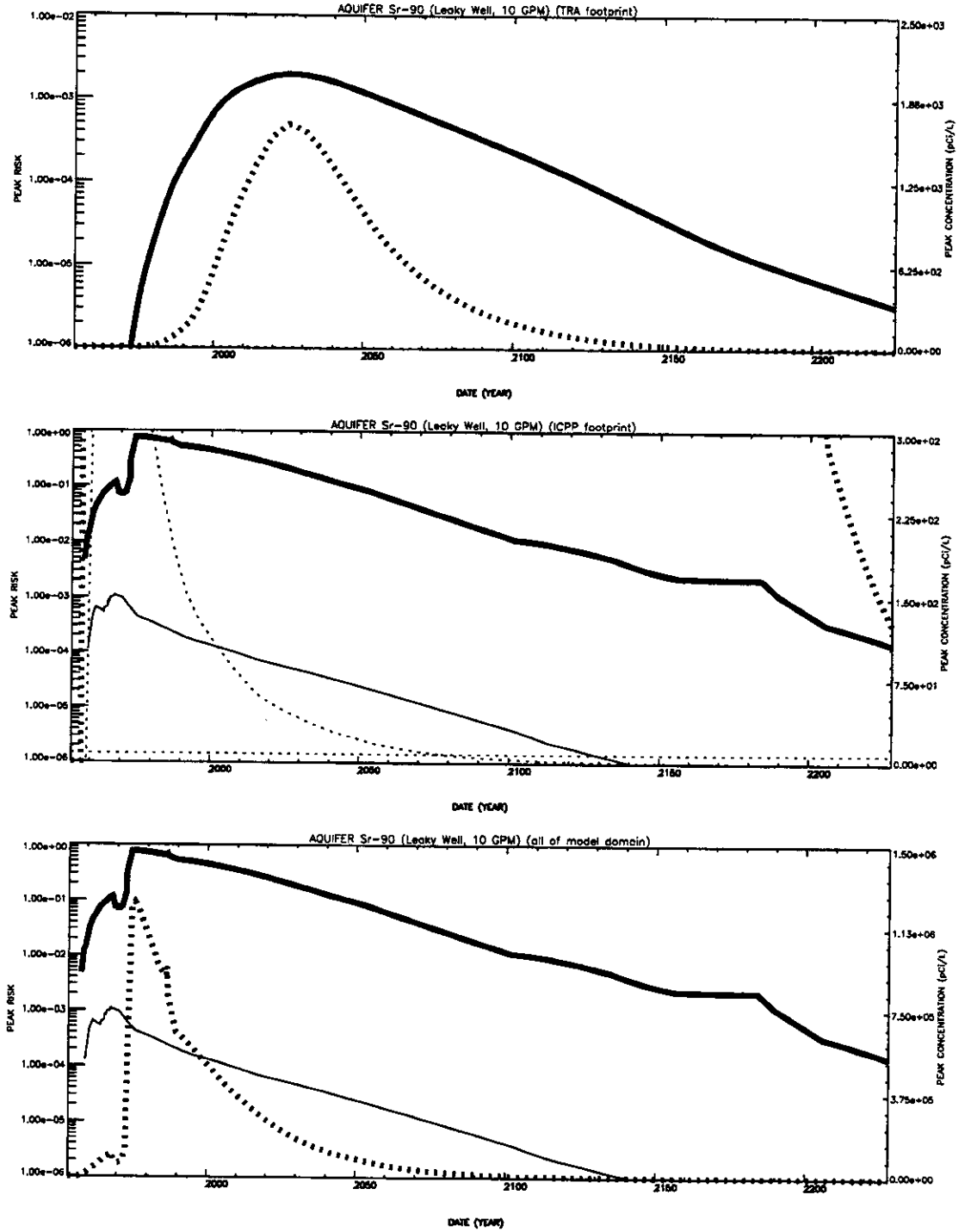

Figure 8-127 Peak aquifer concentration for Sr-90 (10 gpm interbed leakage). Top figure: TRA foot print, Middle figure: ICPP footprint, Bottom Figure: entire aquifer domain. Thick line risk (left scale), dotted line concentration (right scale) solid line 10^{-6} risk (left scale).

8.5 I-129 Sensitivity to Kd

As with Sr-90, the sensitivity to sorptive capacity of I-29 transport through the vadose zone is a non-linear function. The non-linearity is introduced as a complex function of travel time and radioactive decay. In addition, the transport is a function of the amount of basalt vs. sediment contacted by the I-129 as it is transported first through the sediments in the vadose zone, and then primarily through the basalts in the aquifer. The transport of I-129 differs from that of Sr-90 because the primary Sr-90 sources were at the surface, while the primary I-129 source is the injection well. To analyze the net effect of sediment vs. basalt contact area, and thus the effect of sediment vs. basalt Kds, the transport of I-129 was simulated using three different values of Kd. These include sediment, and basalt Kd pairs of: (0., 0.), (0.4, 0.016), and (0.4, 0.4) cm^3/g. Simulation results using a Kd=0 cm^3/g were presented as part of the base-case analysis in Section 7.7. Those results indicated that a slightly higher sorptive capacity is needed to delay arrival and reduced concentrations at many of the downgradient wells.

In all of the I-129 simulations, there are five sources for the I-129. Most of the I-129 contribution was from the injection well (91.21% from 1953 to 1986). There were minor contributions from the percolation ponds (5.38% from 1984-2095), the soils inventory (2.55%), and the Tank Farm (0.86%) releases. The vadose zone sources provide a minor contribution (< 9%) to the aquifer I-129 flux. In all I-129 simulations, the vadose zone and aquifer transport was completed through the years 2123 and 2961, respectively. Contour levels for both the vadose and aquifer are given for $1.x10^{-2}$, $1.x10^{-1}$, 1., $1.x10^{+1}$, $1.x10^{+2}$, and $1.x10^{+3}$ pCi/L, with concentrations equal to the MCL (1 pCi/L) represented by the dark solid line. The corresponding aquifer risk contour maps are given at the 10^{-7}, 10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}, and 10^{-2} levels. Contour levels above the 10^{-6} value (0.261 pCi/L) are indicated by the dark line.

8.5.1 I-129 With A Sediment Kd=0.4 cm^3/g, and Aquifer Basalt Kd=0.016 cm^3/g

Figures 8-128 through 8-136 present the simulation results for the transport of I-129 through the vadose zone, and Figures 8-137 through 8-149 present simulation results for the aquifer region. Differences in the SR-90 concentrations as a function of time were easily compared by looking at the simulation-field data comparison plots. However, the most useful way of comparing the results of this sensitivity simulation is not to look at the vadose zone and aquifer peak concentration plots or the model comparison plots of field data but by looking at the spatial distribution of the I-129 as given in the aquifer and vadose zone contour plots.

VADOSE ZONE: Examination of the vadose zone comparison plots to field data and for the comparison to the mass flux and peak concentration indicates that there is very little difference between these simulation results and those for the base case (non-sorptive) (Figures 7-131 through 7-133, Figures 8-128 through 8-134, and Figure 8-136). The most noticeable difference is in where the higher concentrations are distributed in the vadose zone as seen by comparing Figures 8-128 through 8-131 to Figures 7-125 through 7-128.

AQUIFER: Examination of the aquifer comparison plots indicates that there is also very little difference between these simulation results and those for the base case (non-sorptive) at the well locations. This is illustrated in Figures 7-144 through 7-150 compared to Figures 8-143 through 8-149. However, there is a substantial difference in the distribution of I-129 throughout the aquifer region as seen by comparing the contour plots of concentration (8-137 through 8-138 and 7-134 through 7-137). The similarity in the peak aquifer concentration is given in Figure 8-141.

As with the base case, the aquifer area with predicted peak concentrations greater than the MCL and 10^{-6} risk concentration is relatively large (as shown in Figures 8-137 through 8-140). The 2095 I-129 concentration is predicted to be 4.97 pCi/L. This concentration is greater than both the 10^{-6} risk concentration (0.261 pCi/L) and the MCL (1 pCi/L). The maximum aquifer concentration is predicted to exceed the 10^{-6} risk level until well beyond the year 2095 and to exceed the MCL until about the year 2125. The peak concentration was predicted to have been 86.4 pCi/L in 1986.

Locations for the wells used to compare the aquifer model predicted concentrations to the field data are given in Figure 8-142, and include near-, mid-, and far-field distances from the injection well. The injection well was used to dispose of most of the I-129 from 1953-1986. As a result, field measurements of I-129 should be a reflection of the mass disposed of to the injection well with little contribution from the vadose zone. Comparisons of aquifer model predicted concentrations to field data (Figures 8-143 through 8-149) show that predicted concentrations are, in general, reasonably close to the measured values. In fact, the predictions are almost identical to the predictions for I-129 with a Kd of 0 cm^3/g. This is because;

- 91.21% of the I-129 source is to the injection well,
- the aquifer basalt Kd of 0.016 cm^3/g is essentially 0, and
- there is very little sediment in the aquifer so that the aquifer sediment Kd of 0.4 cm^3/g has little effect on the solution.

Because the aquifer sediment Kd has very little influence on the simulation results, an additional sensitivity simulation was needed to evaluate the sensitivity of the aquifer concentration predictions to the aquifer basalt Kd. The next section presents the results of the simulation with a Kd of 0.4 cm^3/g in both the sediments and basalt in the aquifer.

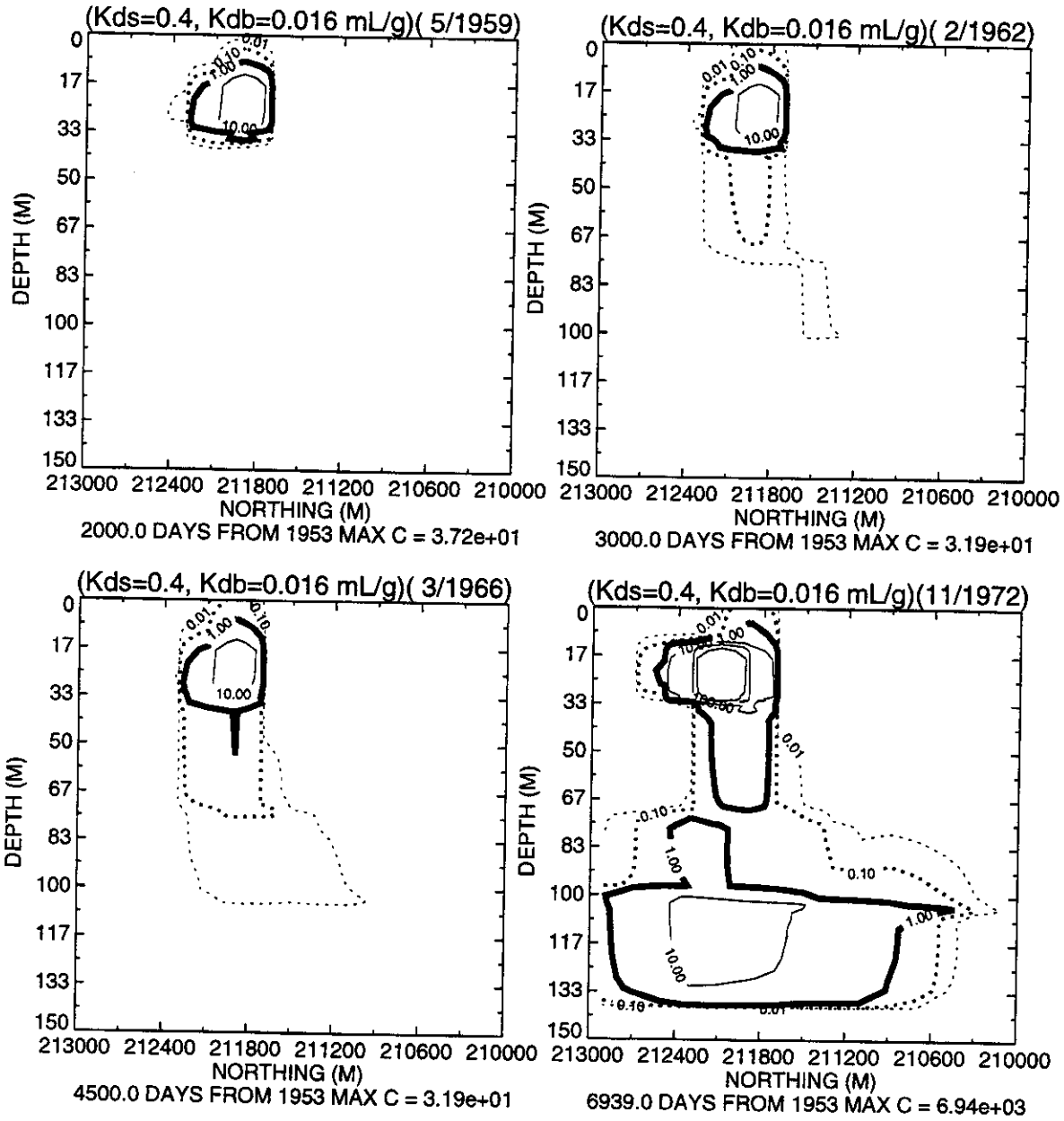

Figure 8-128 Vadose zone I-129 peak concentration contours.

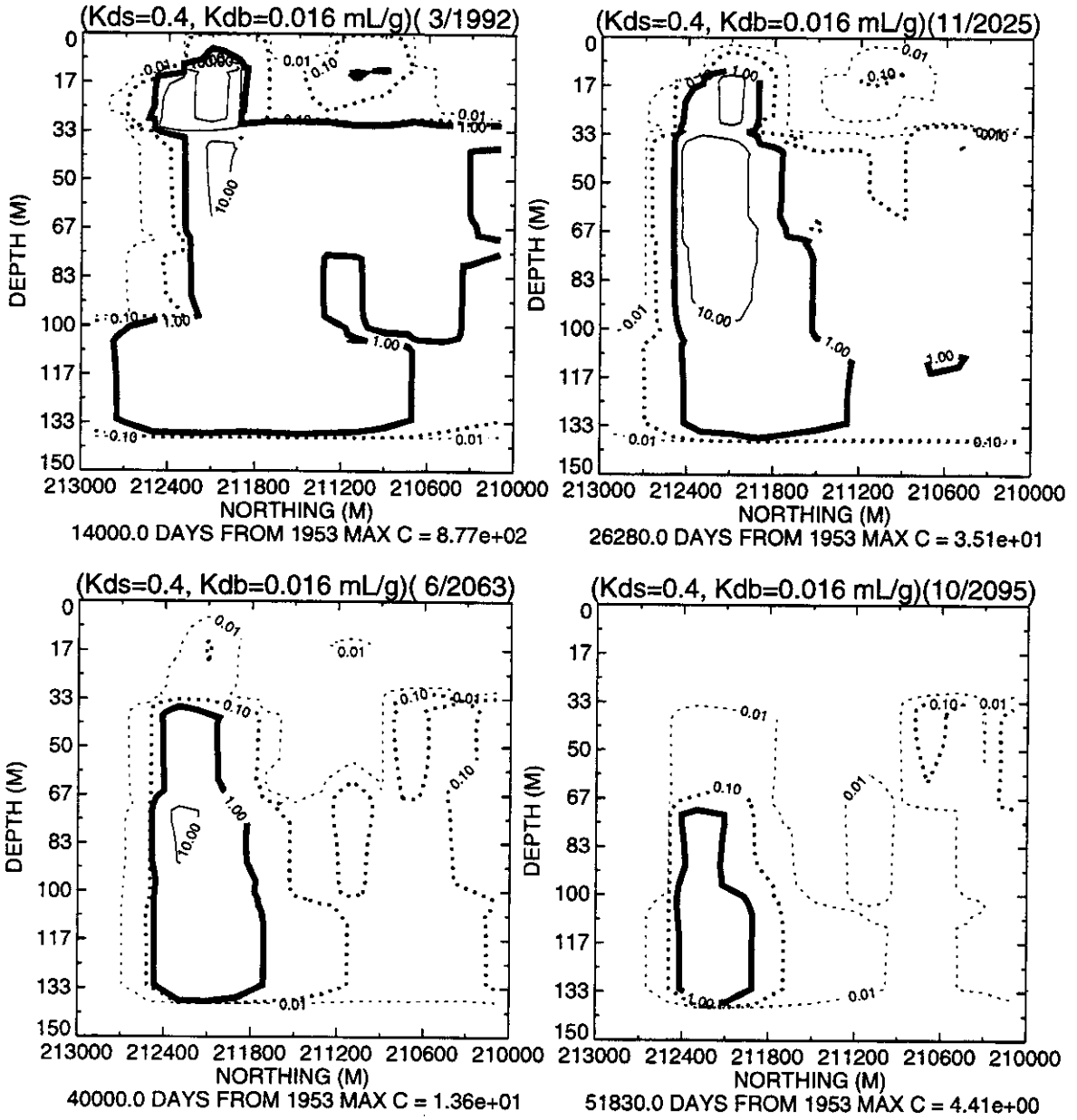

Figure 8-129 Vadose zone I-129 peak concentration contours.

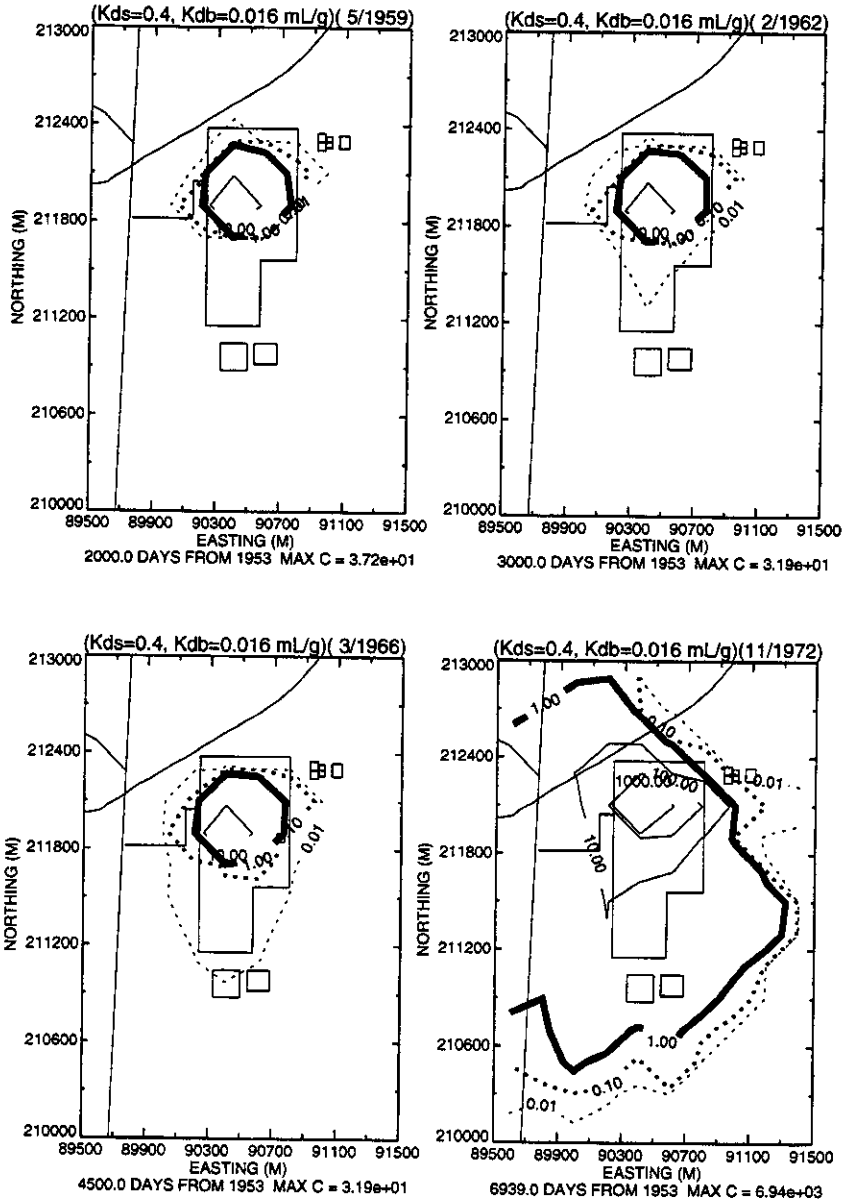

Figure 8-130 Vadose zone I-129 peak concentration contours.

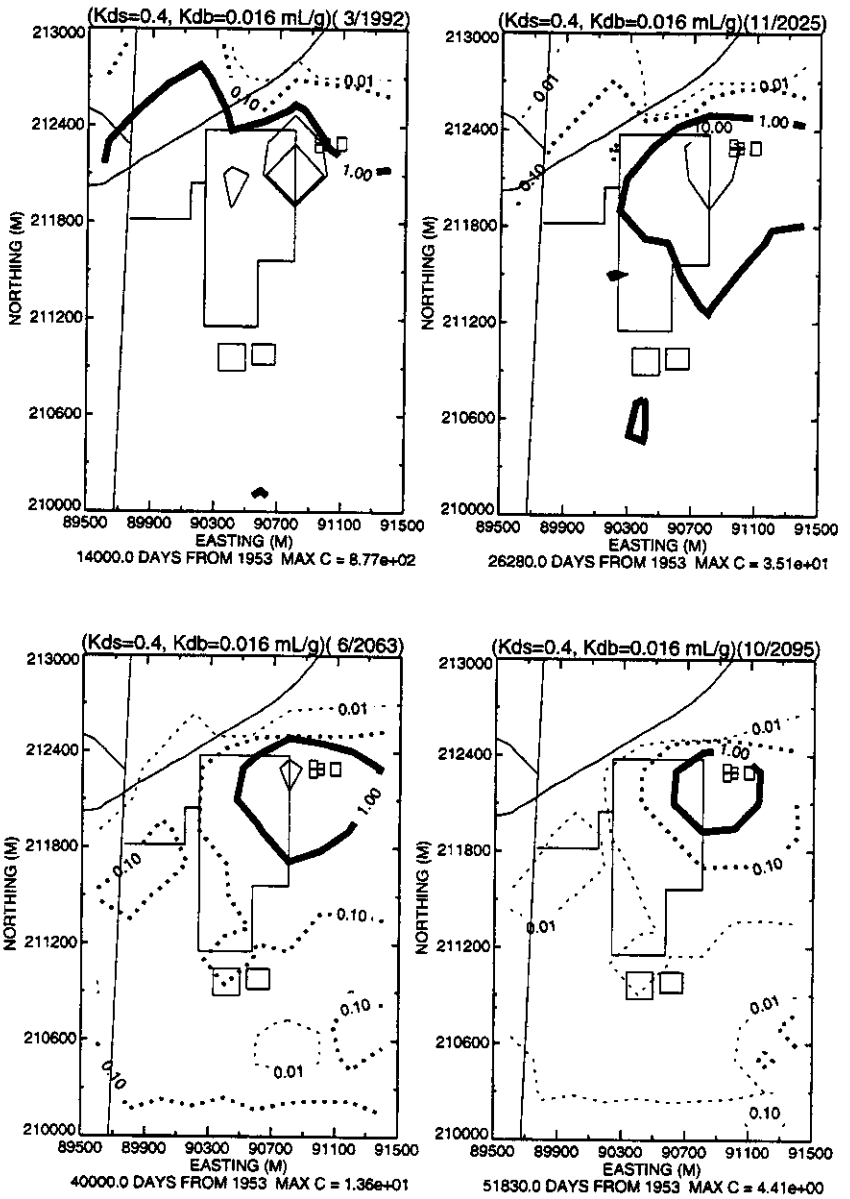

Figure 8-131 Vadose zone I-129 peak concentration contours.

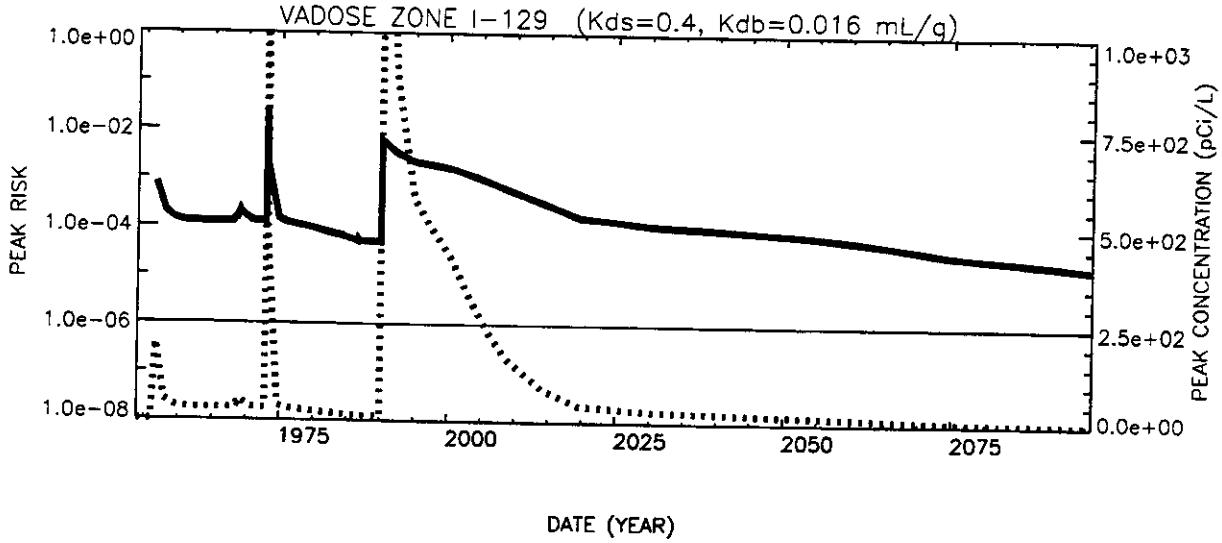

Figure 8-132 Peak vadose zone risk and concentration for I-129. Risk indicated by the thick line on the log scale with the 10^{-6} value shown as the solid line. The dotted line represents concentration given by the linear scale on the right axis with the MCL shown as the straight horizontal line.

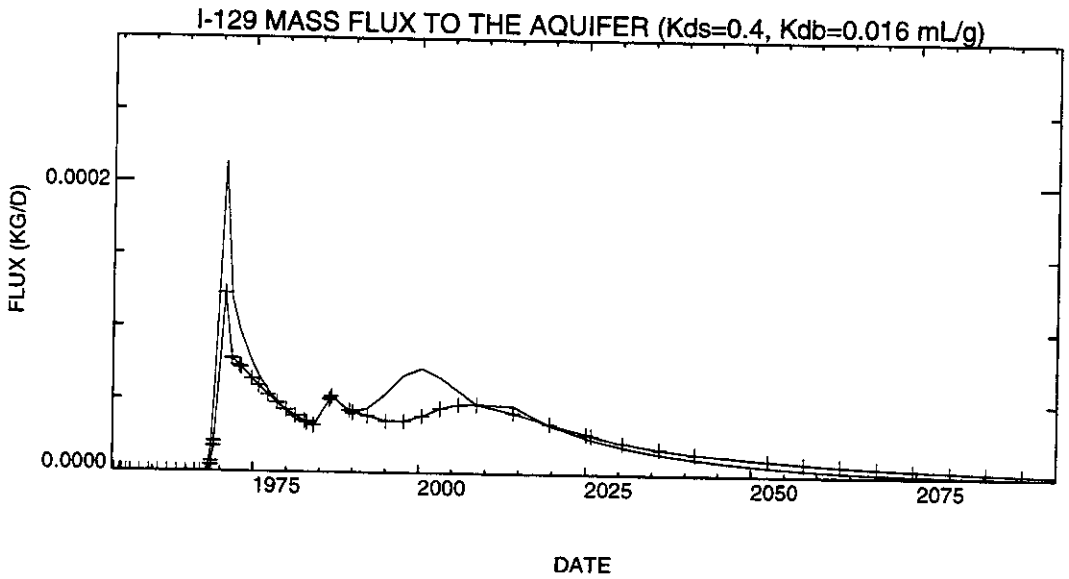

Figure 8-133 Mass flux of I-129 into the aquifer from the vadose zone.

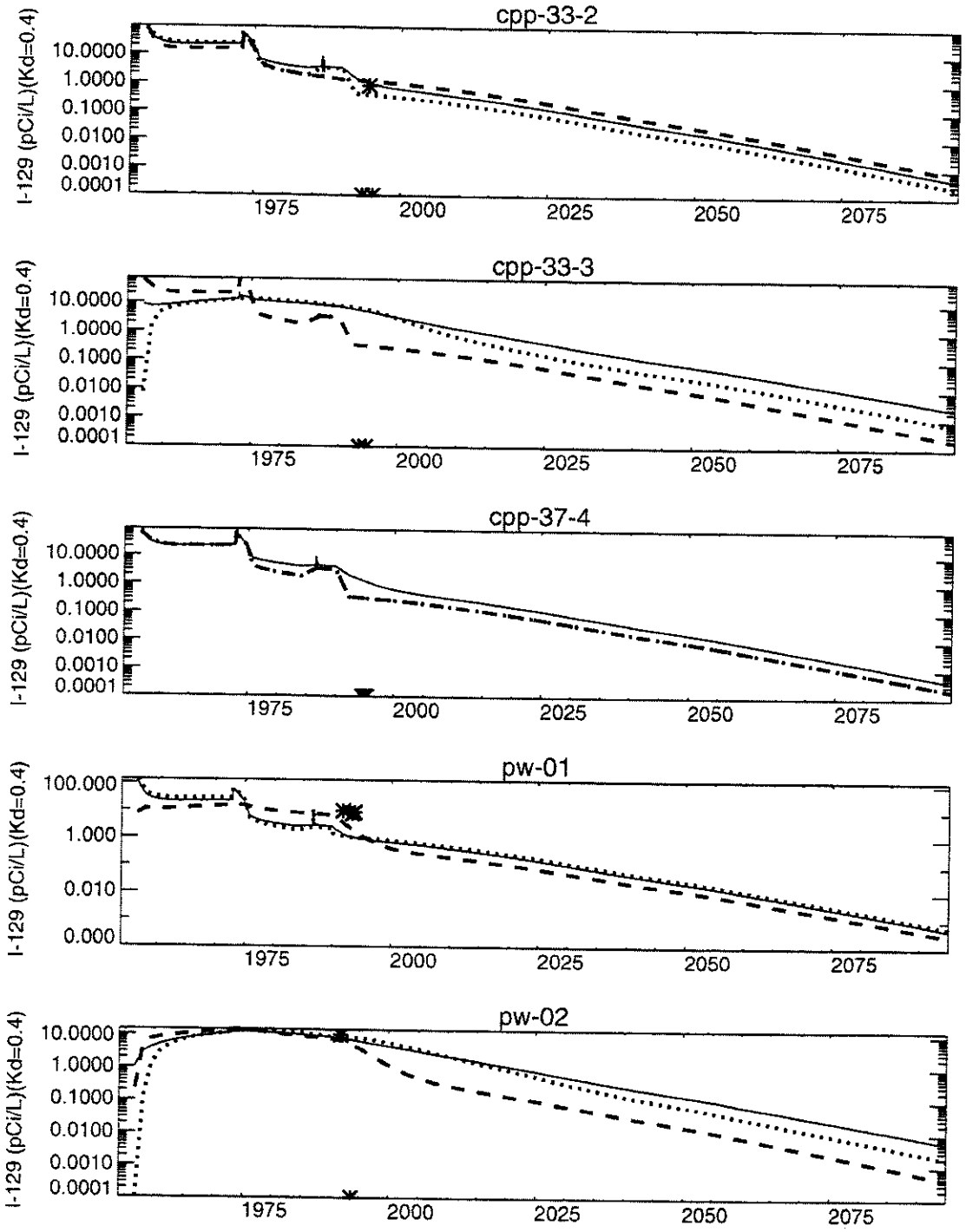

Figure 8-134 Comparison of vadose zone I-129 to field data.

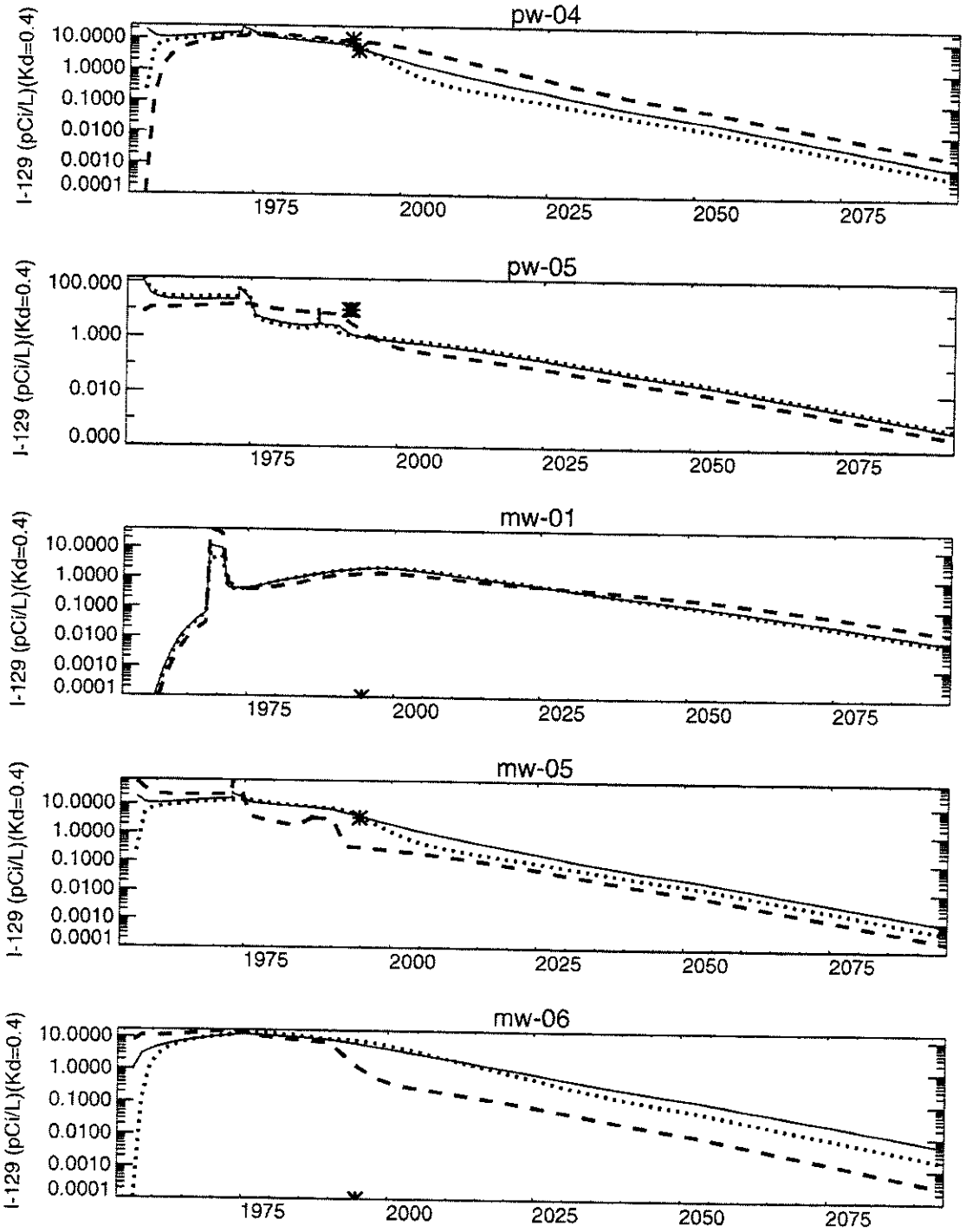

Figure 8-135 Comparison of vadose zone I-129 to field data.

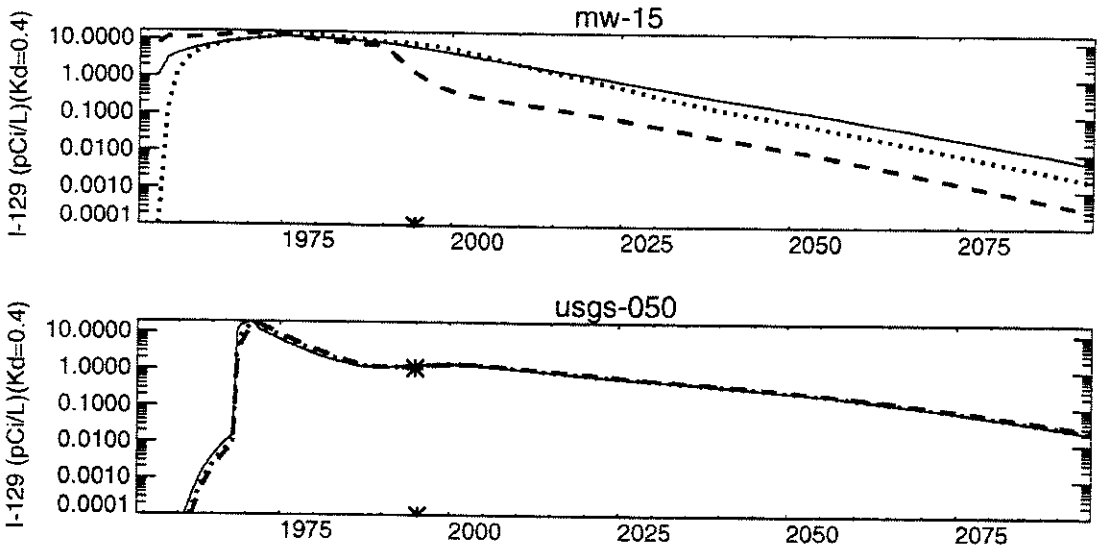

Figure 8-136 Comparison of vadose zone I-129 to field data.

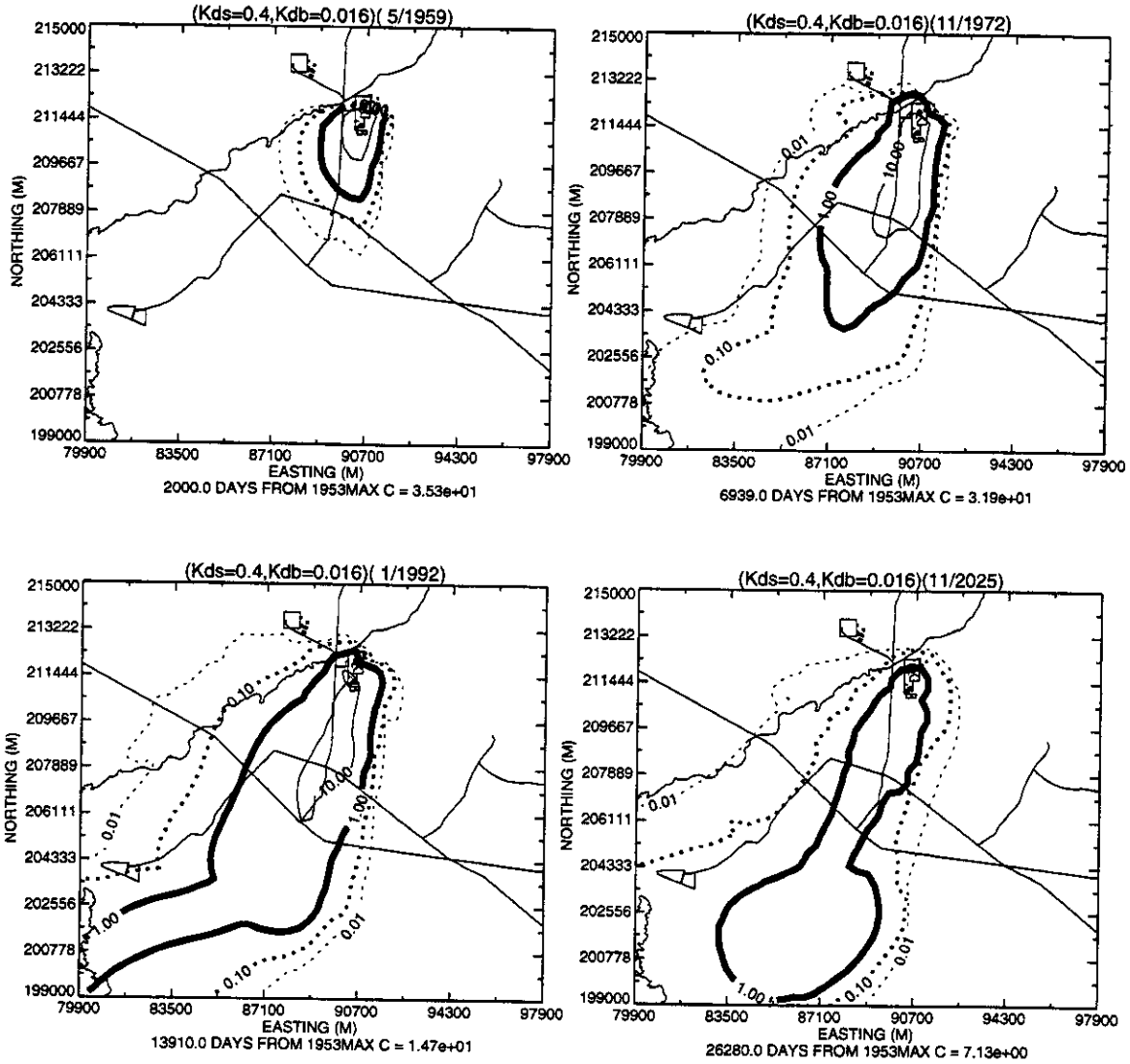

Figure 8-137 Aquifer I-129 peak concentration contours.

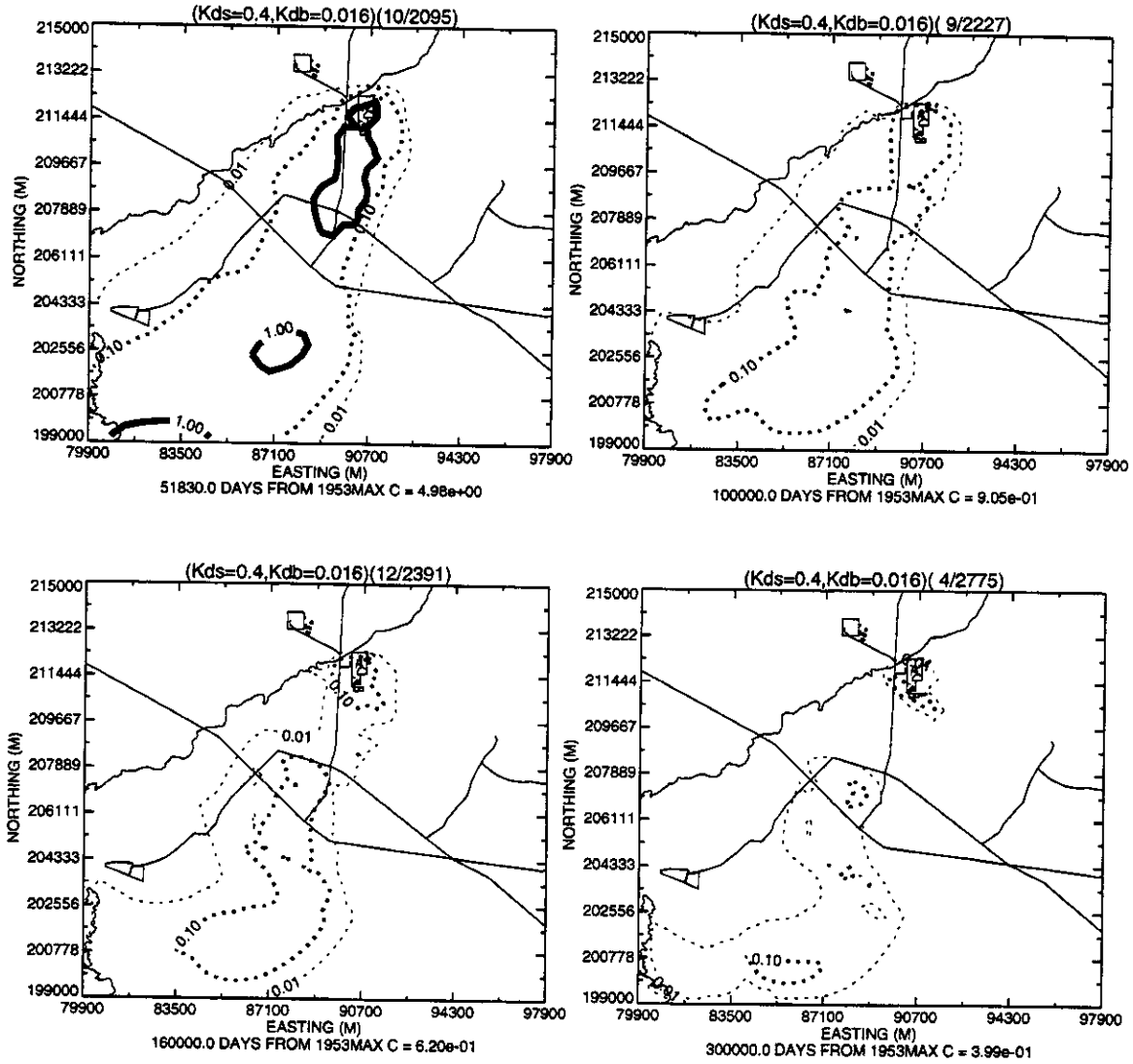

Figure 8-138 Aquifer I-129 peak concentration contours.

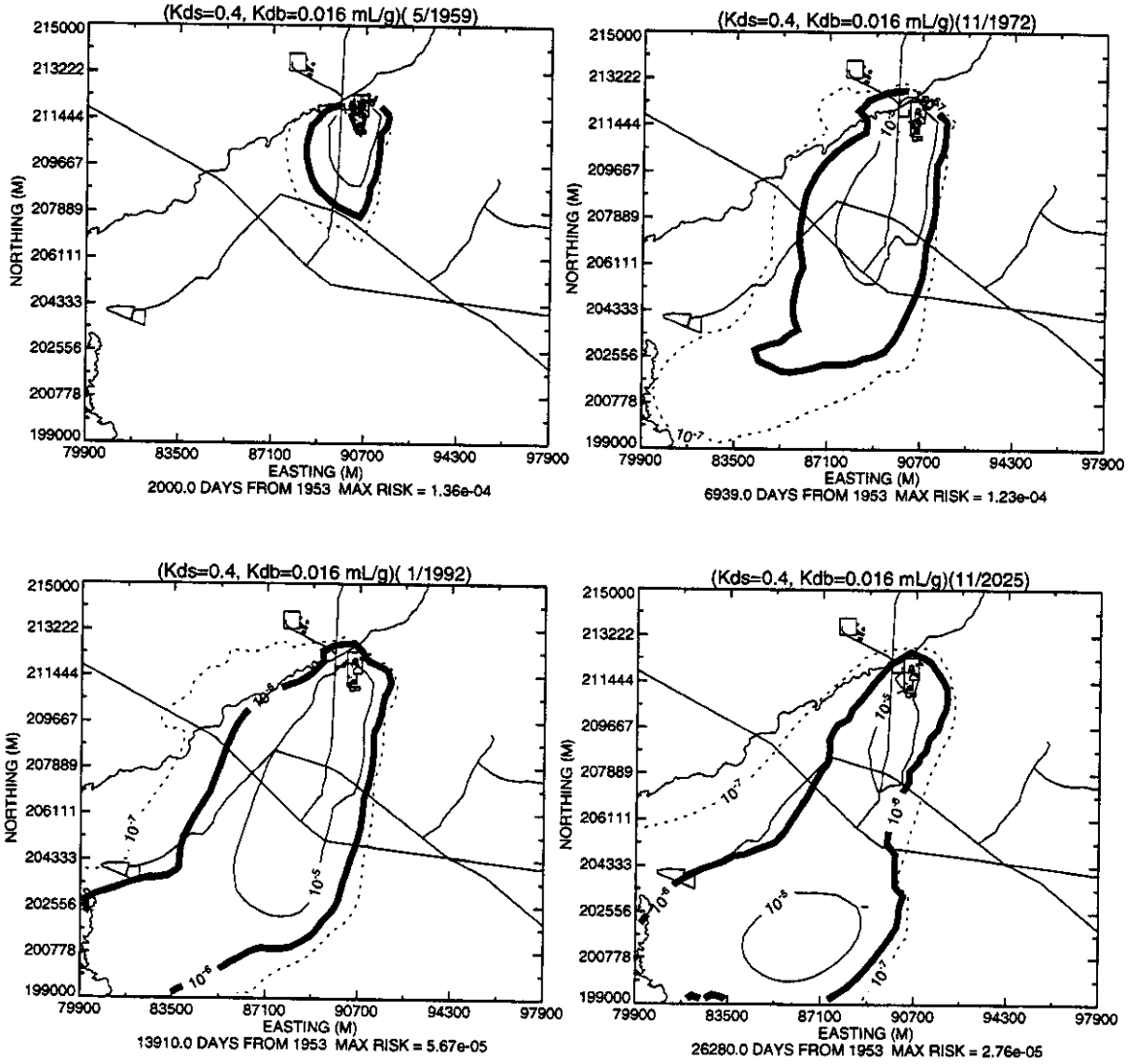

Figure 8-139 Aquifer I-129 peak risk contours.

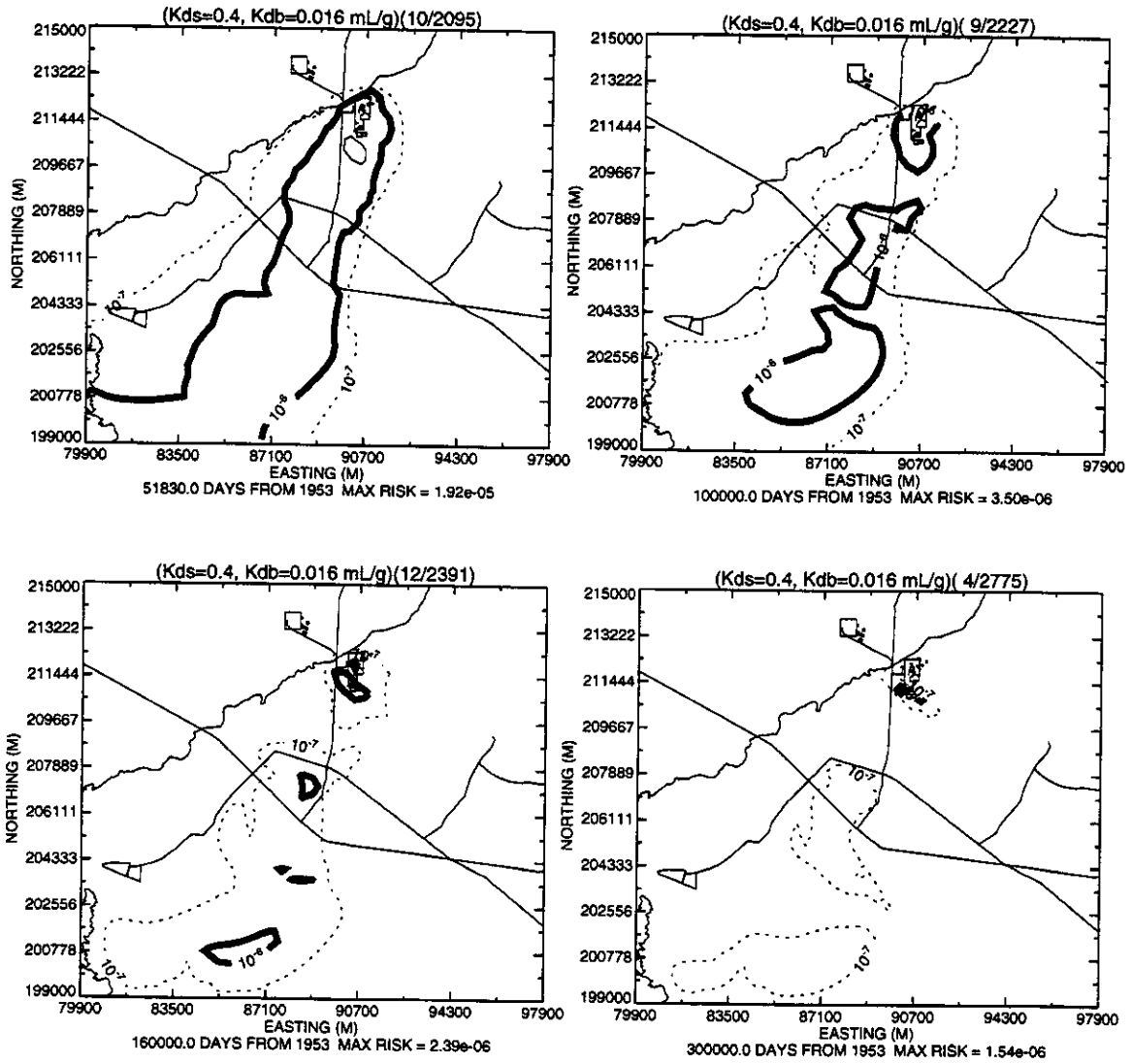

Figure 8-140 Aquifer I-129 peak risk contours.

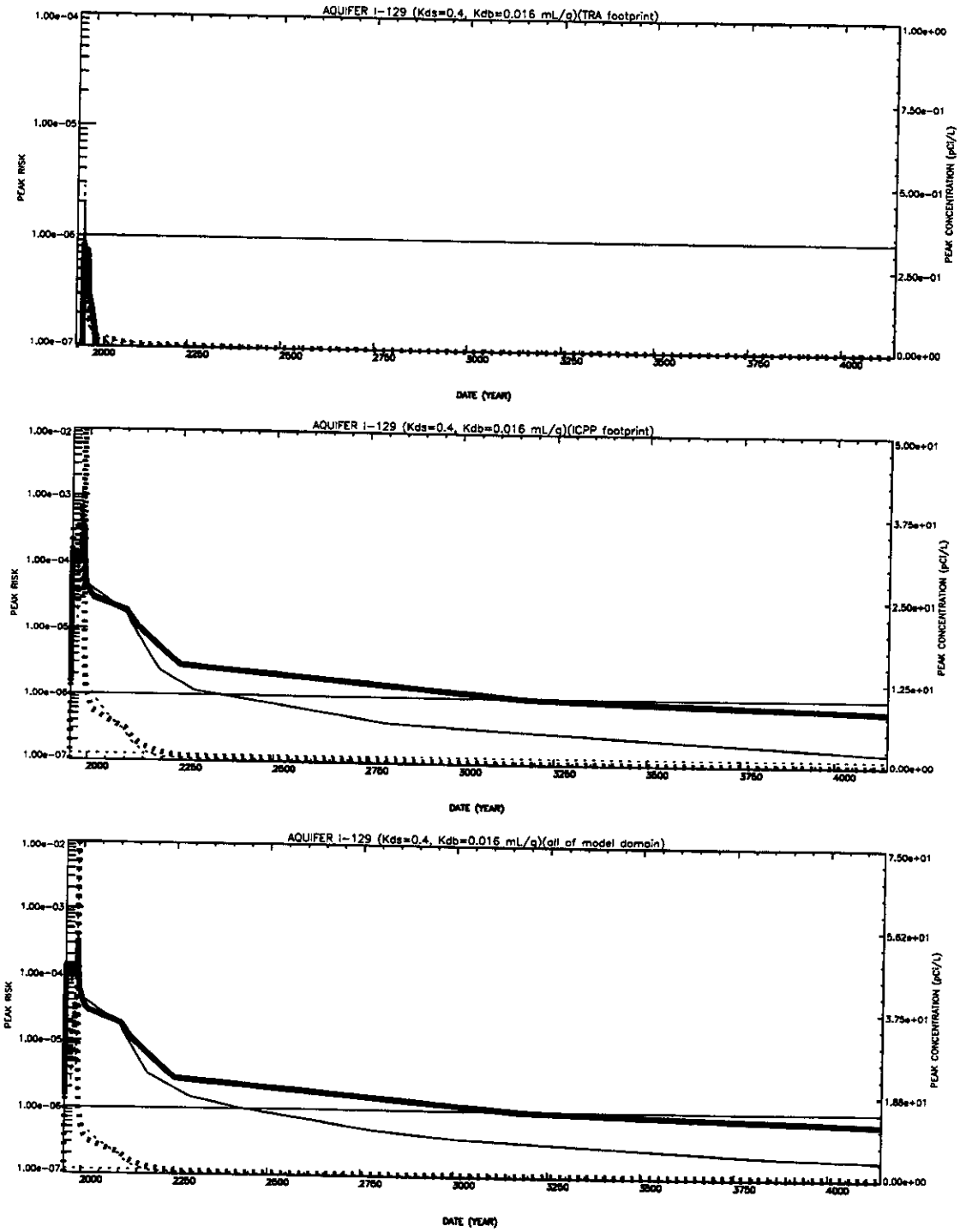

Figure 8-141 Peak aquifer concentration for I-129. Top figure: TRA foot print, Middle figure: ICPP footprint, Bottom Figure: entire aquifer domain. Thick line risk (left scale), dotted line concentration (right scale) solid line 10^{-6} risk (left scale).

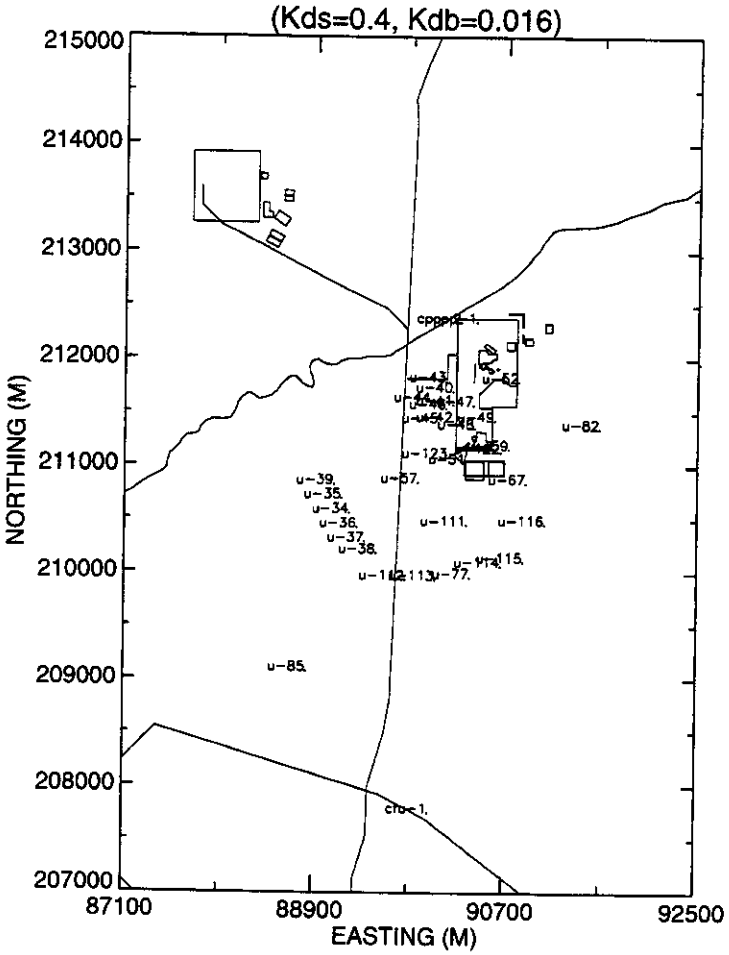

Figure 8-142 Well locations for the comparison of aquifer I-129 to field data.

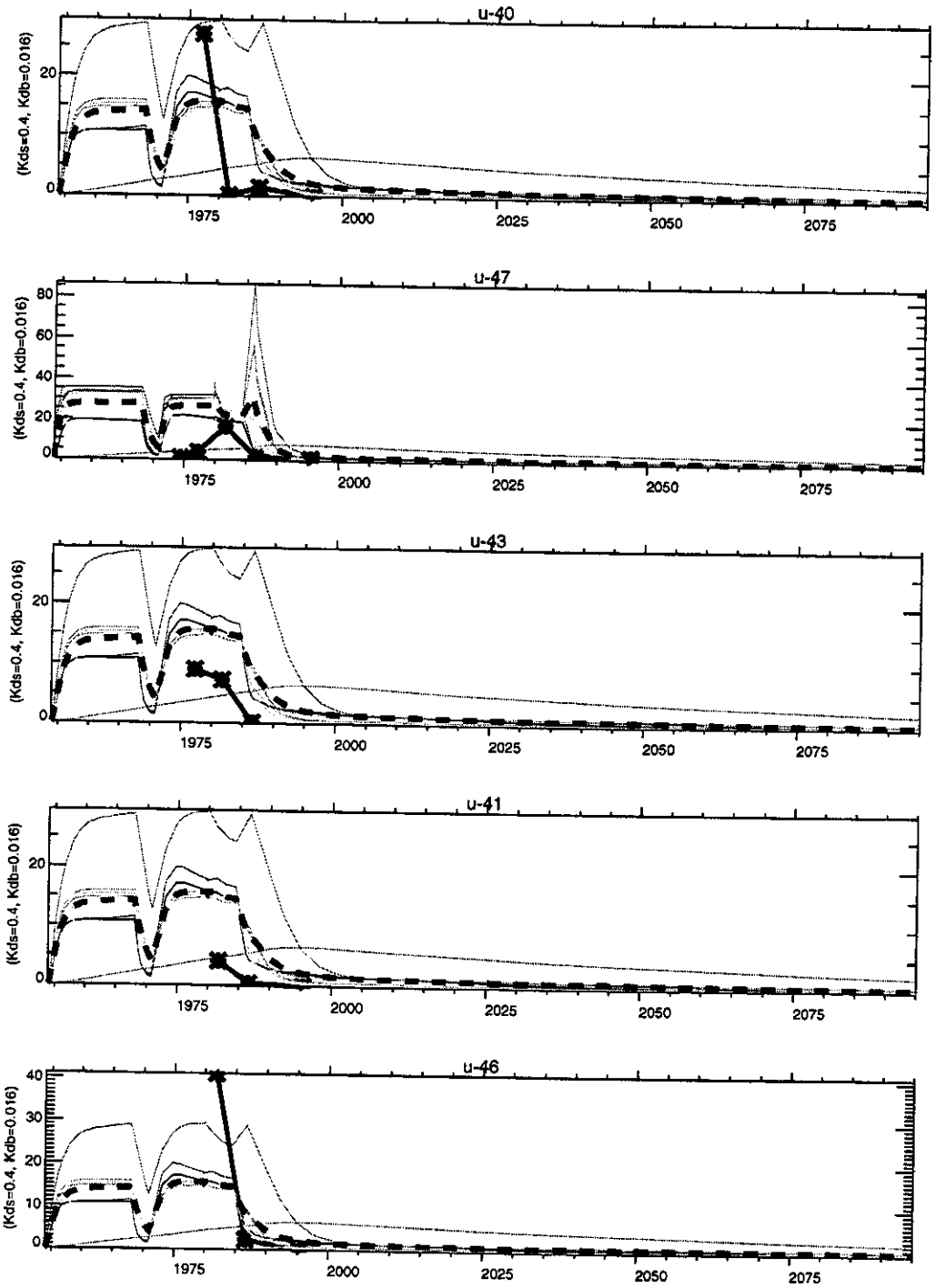

Figure 8-143 Comparison of aquifer I-129 to field data.

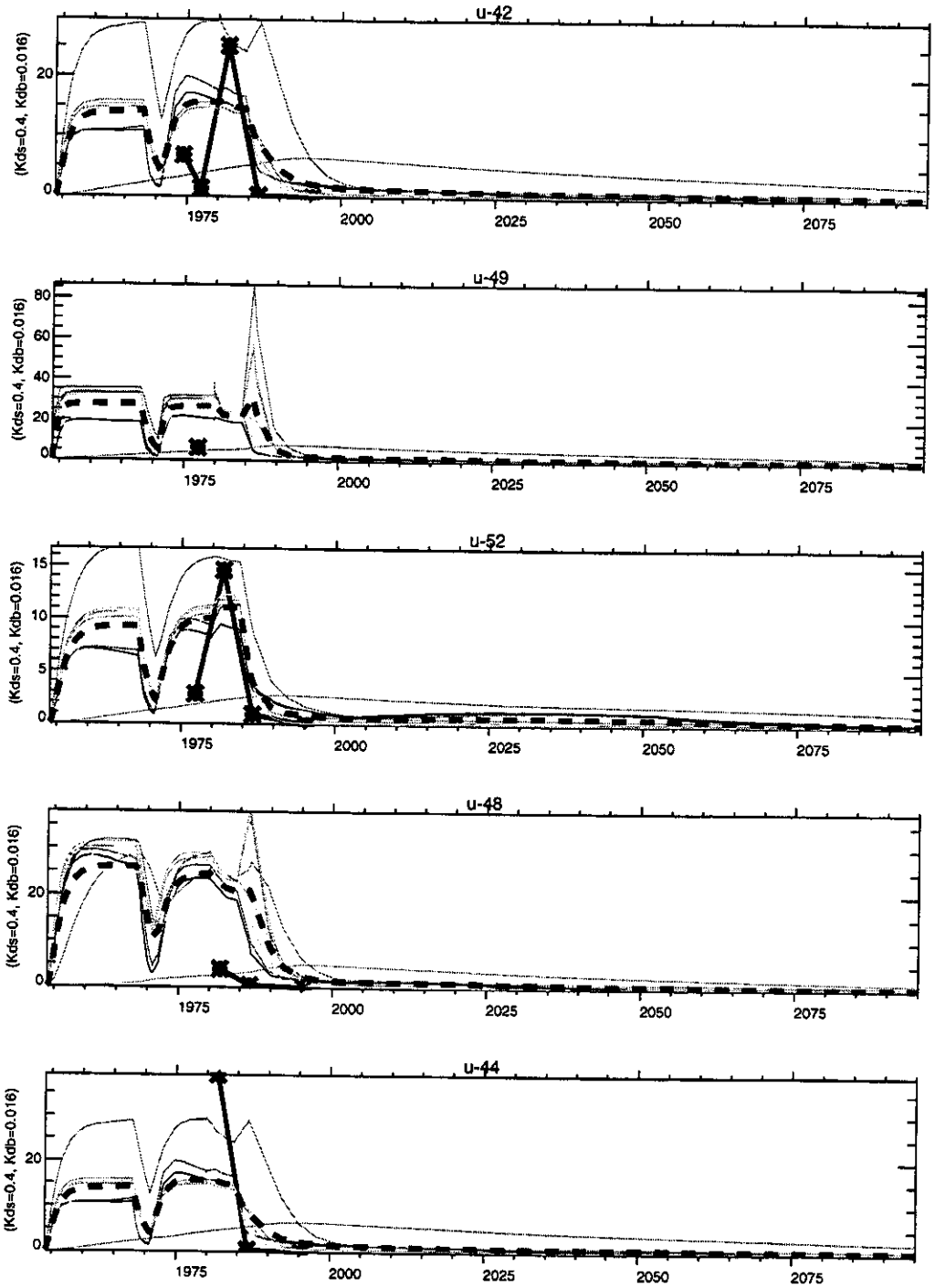

Figure 8-144 Comparison of aquifer I-129 to field data.

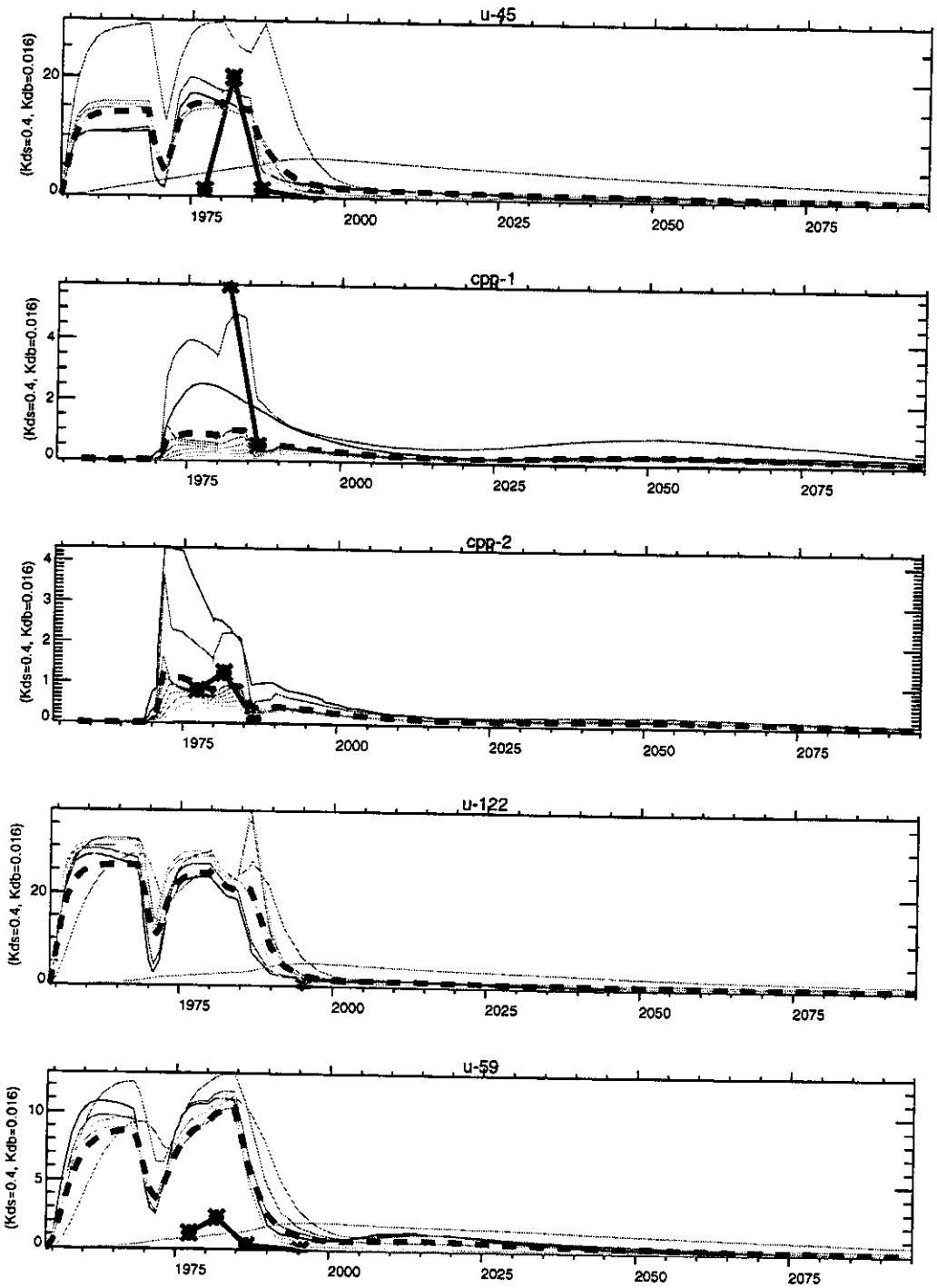

Figure 8-145 Comparison of aquifer I-129 to field data.

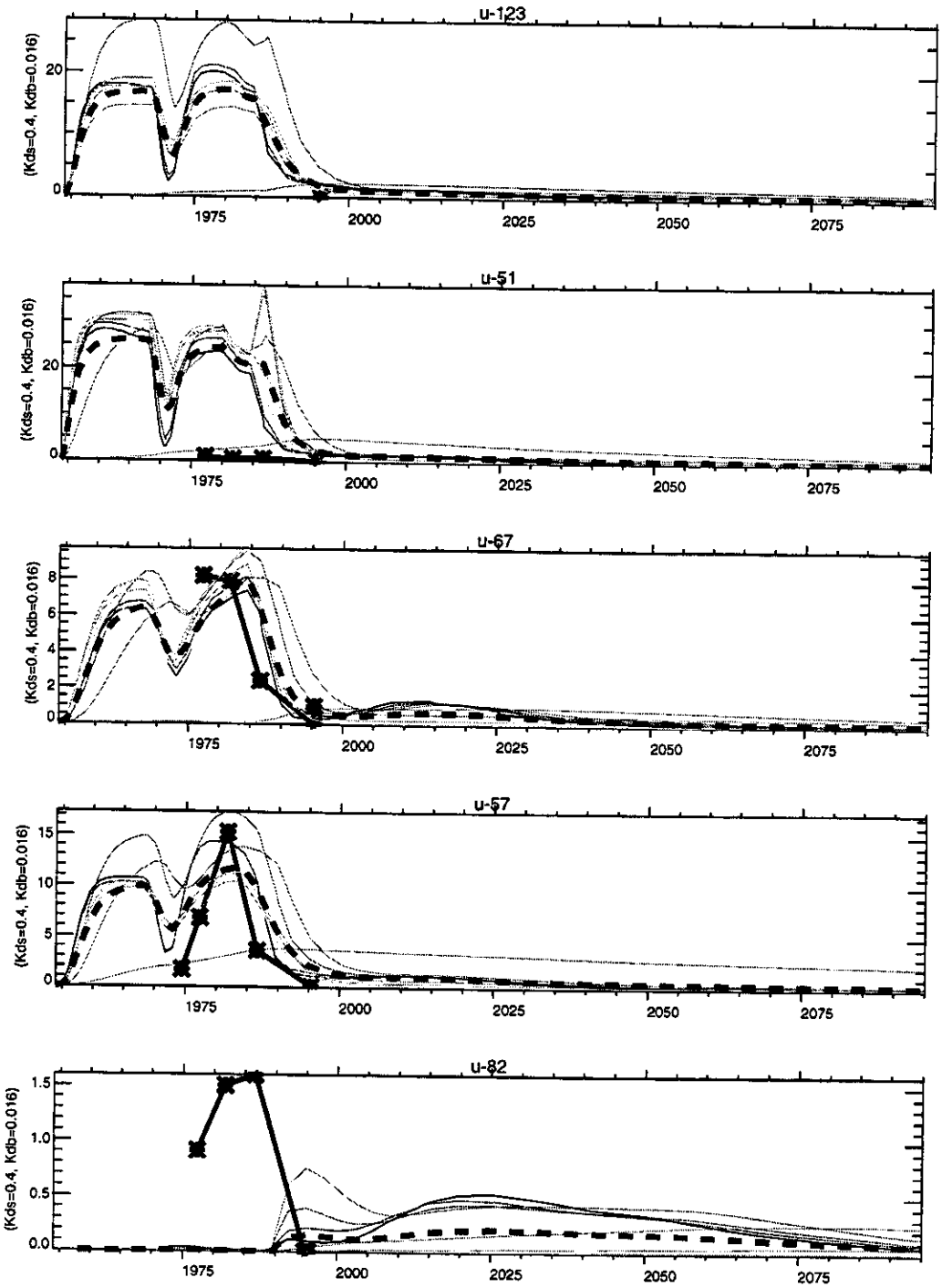

Figure 8-146 Comparison of aquifer I-129 to field data.

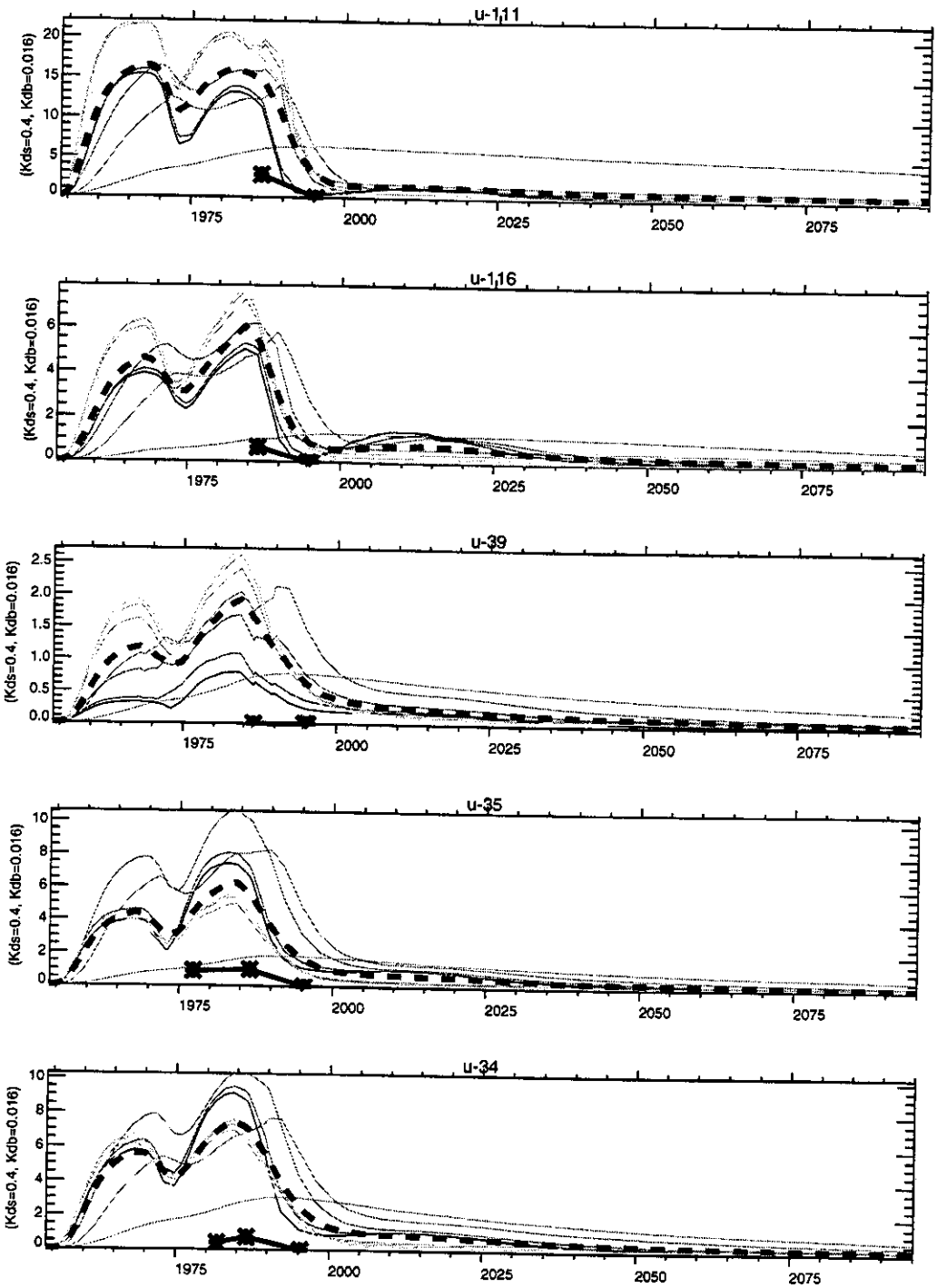

Figure 8-147 Comparison of aquifer I-129 to field data.

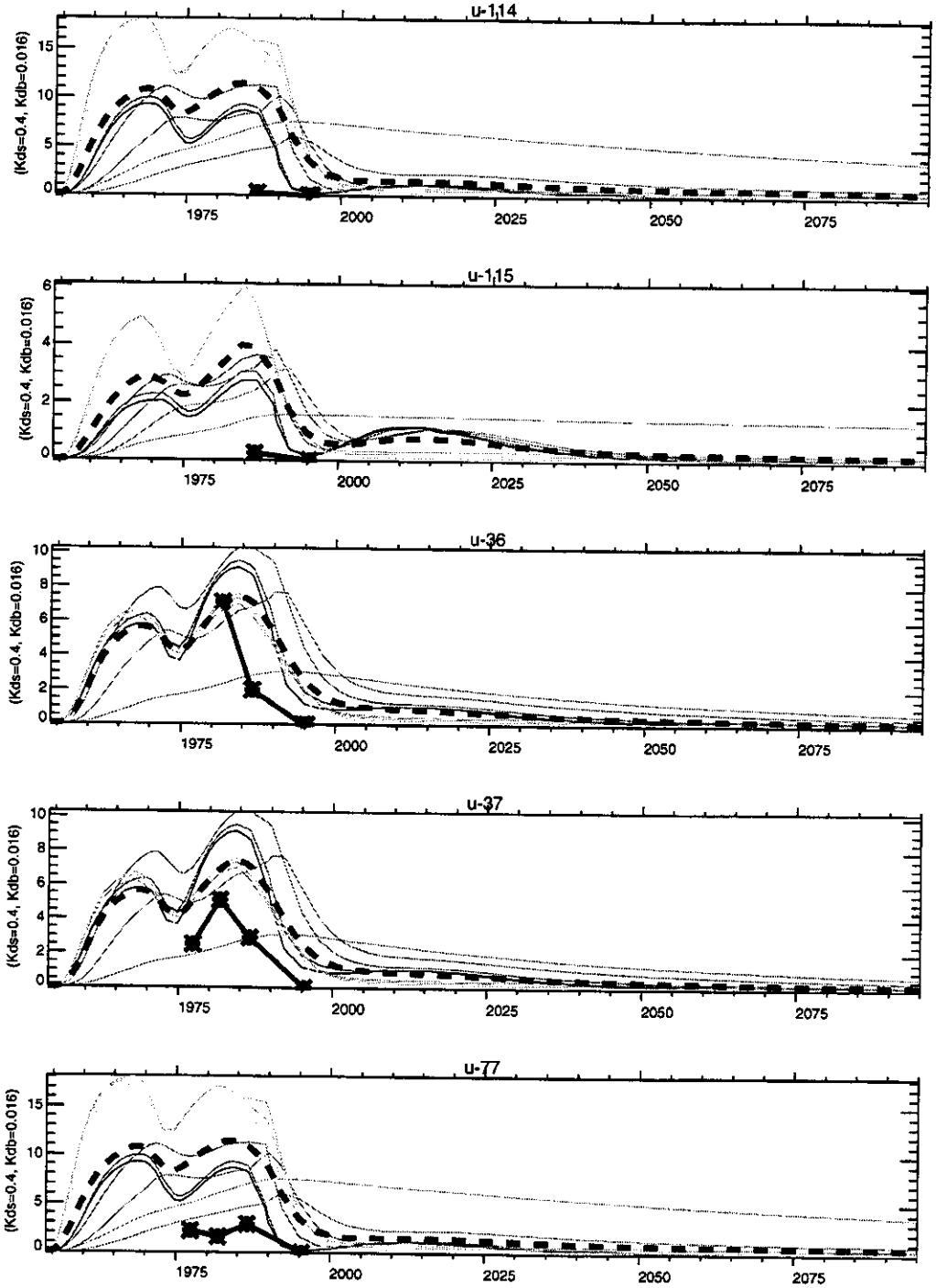

Figure 8-148 Comparison of aquifer I-129 to field data.

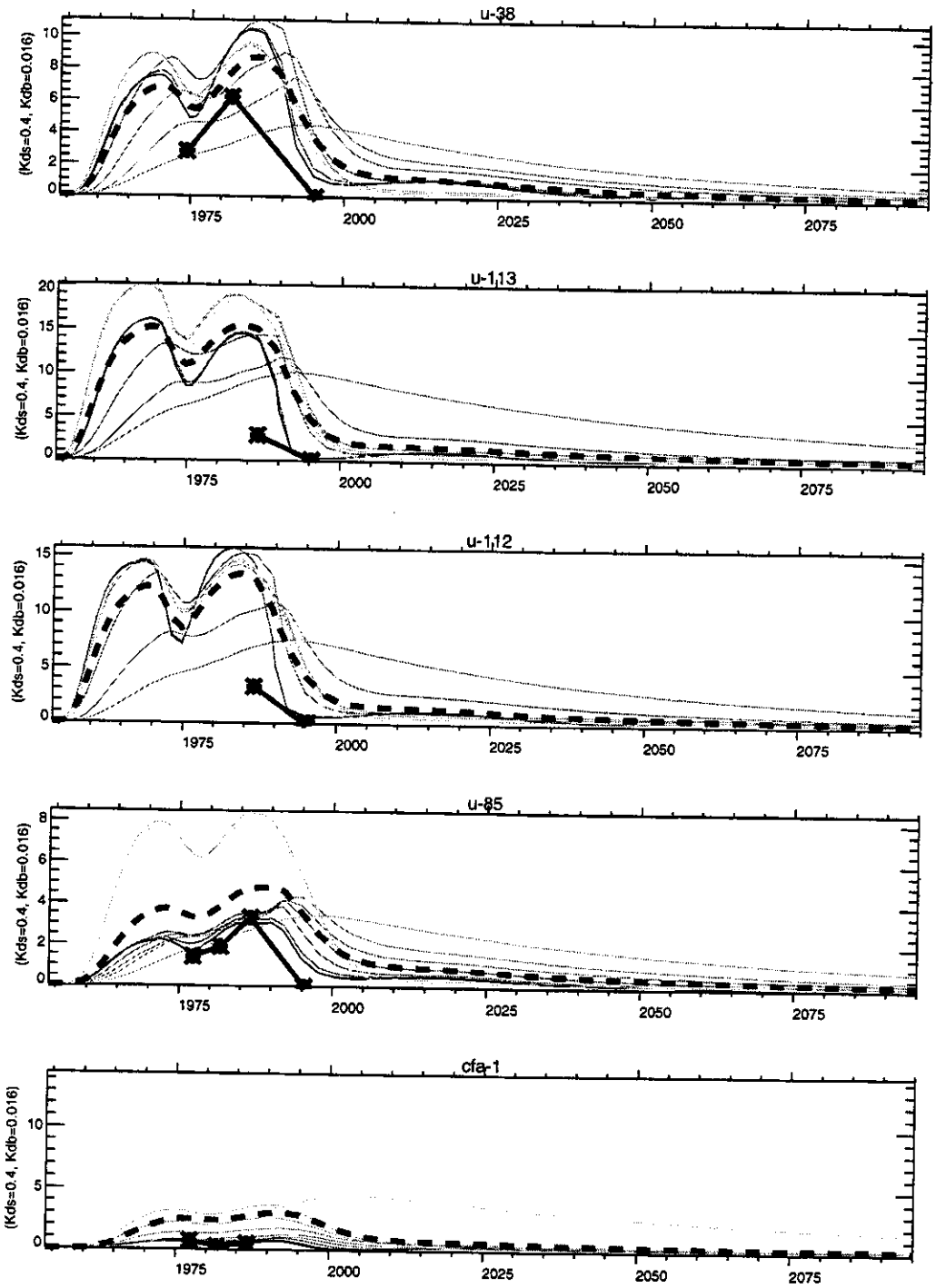

Figure 8-149 Comparison of aquifer I-129 to field data.

8.5.2 I-129 With A Sediment Kd=0.4 cm^3/g, and Aquifer Basalt Kd=0.4 cm^3/g

Using a sediment Kd of 0.4 cm^3/g in the previous simulation did not result in significantly different results than observed in the base case using a Kd of 0. cm^3/g. This is primarily because the bulk of the I-129 was disposed of directly to the injection well, and thus travels through primarily aquifer basalts. If the I-129 had been discharged into the vadose zone, the higher sediment Kd would have resulted in noticeable different results because the I-129 would have traversed large sections of vadose zone sediments as observed with the Kds used for Sr-90. In contrast, the only aquifer sediment exists in the form of the HI interbed and the bulk of the injected I-129 travels through basalt material. This sensitivity run is especially interesting because of the contrasts between the Sr-90 and I-129 sensitivity to sediment and aquifer Kd. Given the relatively insignificant difference between the base case and those for I-129 with a sediment Kd=0.4 and basalt Kd of 0.016 cm^3/g, the following simulation takes as input into the aquifer the vadose zone fluxes shown in Figure 8-133 of Section 8.5.1.

AQUIFER: As with the previous I-129 simulations, the aquifer area with predicted peak concentrations greater than the MCL and 10^{-6} risk concentration is relatively large (as shown in Figures 8-150 through 8-153). The 2095 I-129 concentration is predicted to be 4.67 pCi/L. This concentration is greater than both the 10^{-6} risk concentration (0.261 pCi/L) and the MCL (1 pCi/L). The predicted maximum aquifer concentration is predicted to exceed the 10-6 risk level until about the year 2535 and to exceed the MCL until about the year 2161. The peak concentration was predicted to have been 37.7 pCi/L in 1986,

The interesting thing about these simulation results compared to those for the base case is that although the peak concentration is less (as expected given an non-zero Kd), the time period over which the MCL and Risk based levels are exceeded are actually longer. This is because the dilution that occurs in the absence of retardation is not fully counter balanced by the reduction in concentration allowed by the very small Kd. This is apparent by looking at the peak concentration contours given in Figure 8-154.

In general, these simulation results tend to predict mass arriving later than observed in the field data, and in lower concentrations. This suggests that the base case results are probably more accurate even though they also tend to underpredict peak concentrations. It is suggests that the I-129 source term used in the model occurs over too long of a time period. If the time period were shorter, perhaps the peak values predicted by the model would be higher, the width of the pulse passing each well would be shorter, and maybe the predictions would more closely match observed field data. The real concern is that the field data completely missed the actual peak values, and that in fact the simulation results from each of these I-129 results are underpredicting that peak.

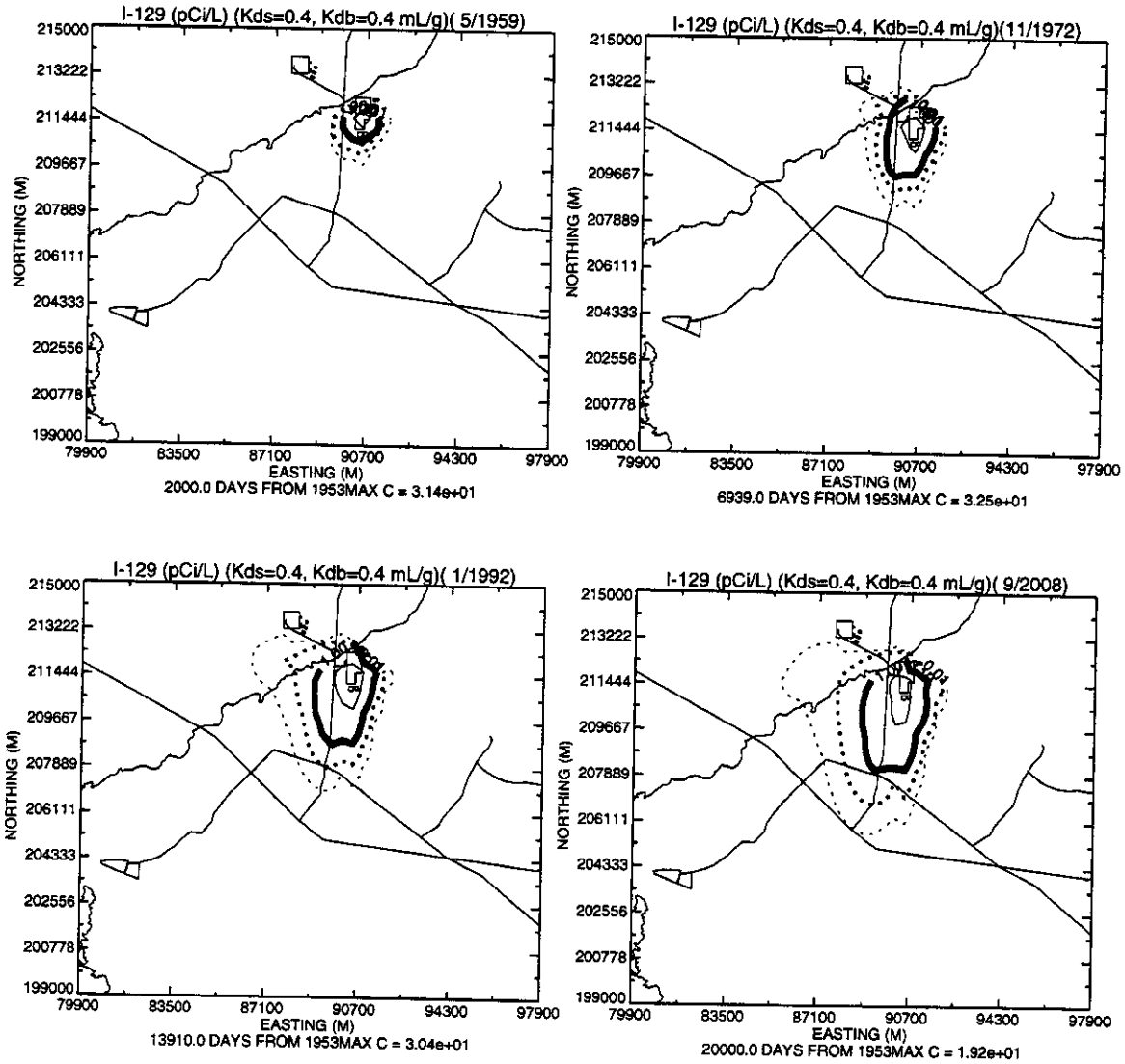

Figure 8-150 Aquifer I-129 peak concentration contours.

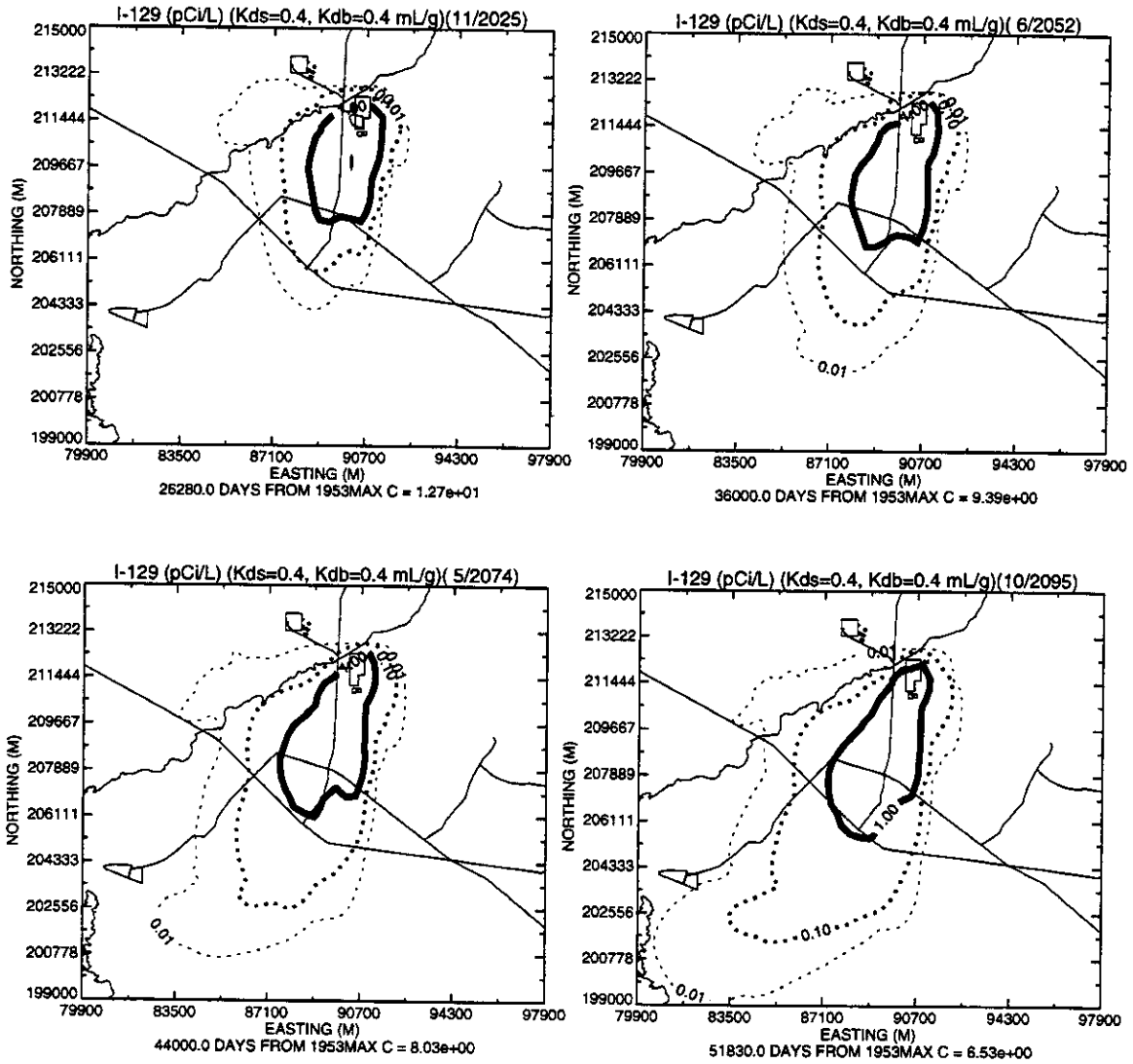

Figure 8-151 Aquifer I-129 peak concentration contours.

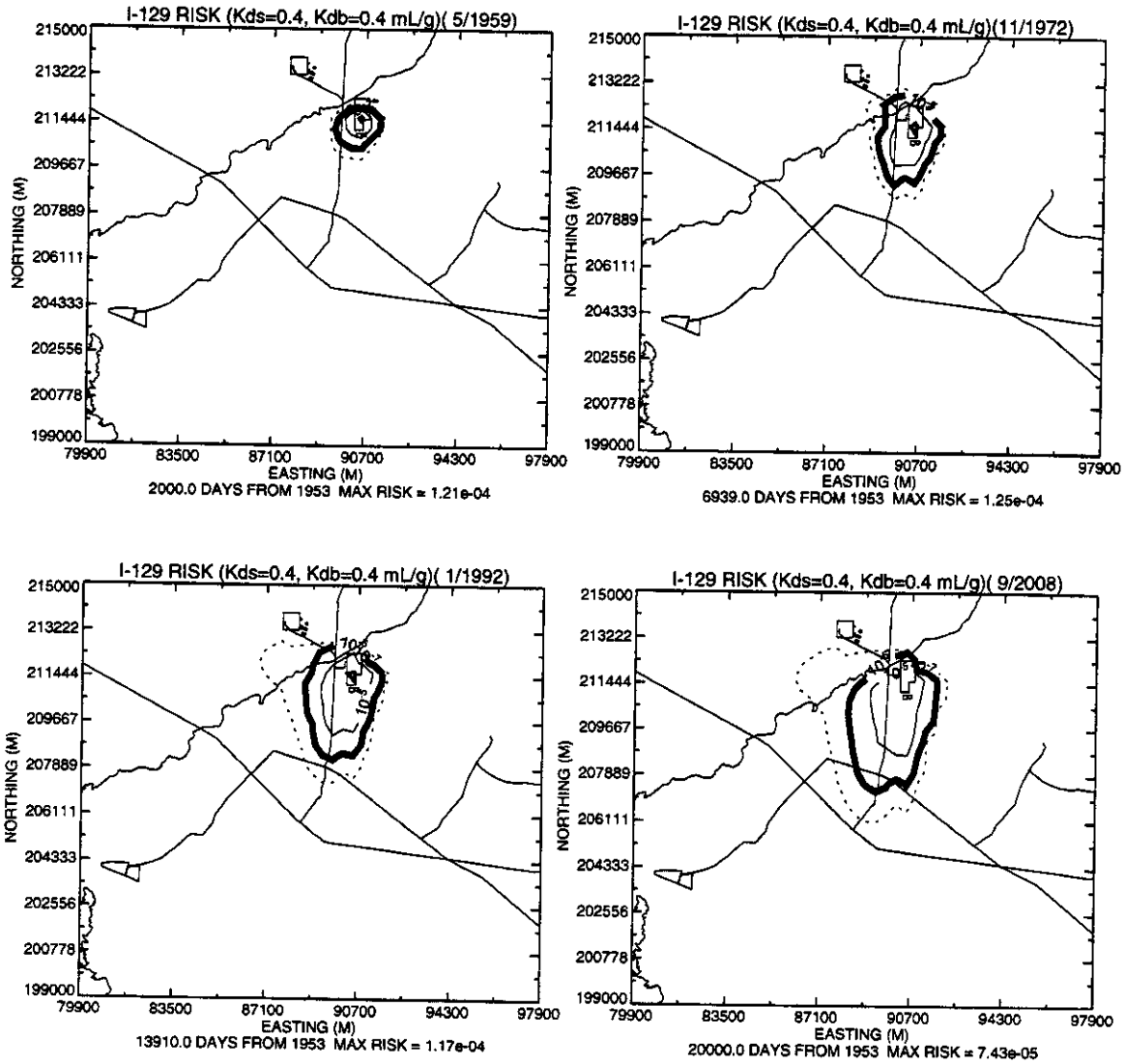

Figure 8-152 Aquifer I-129 peak risk contours.

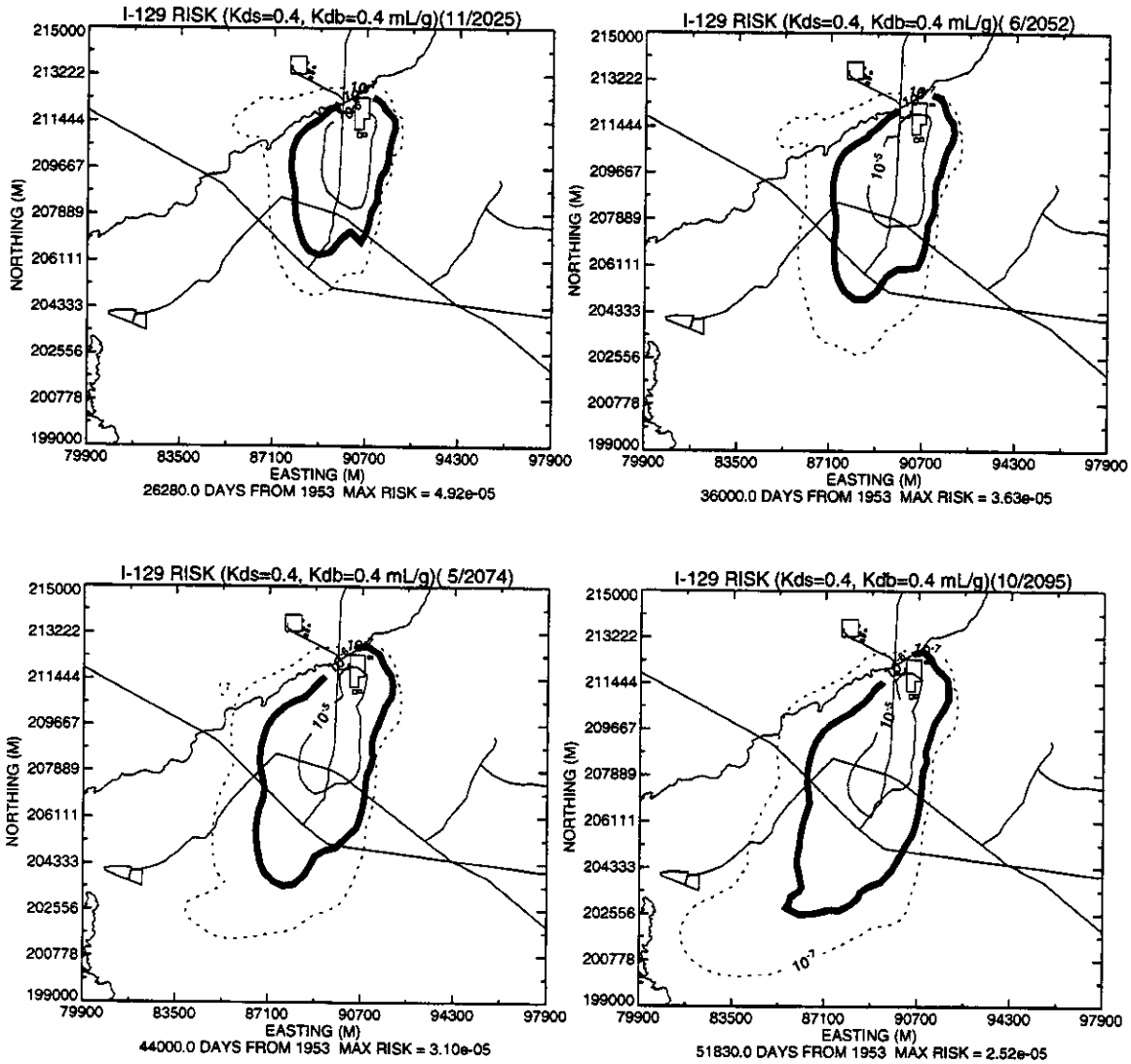

Figure 8-153 Aquifer I-129 peak risk contours.

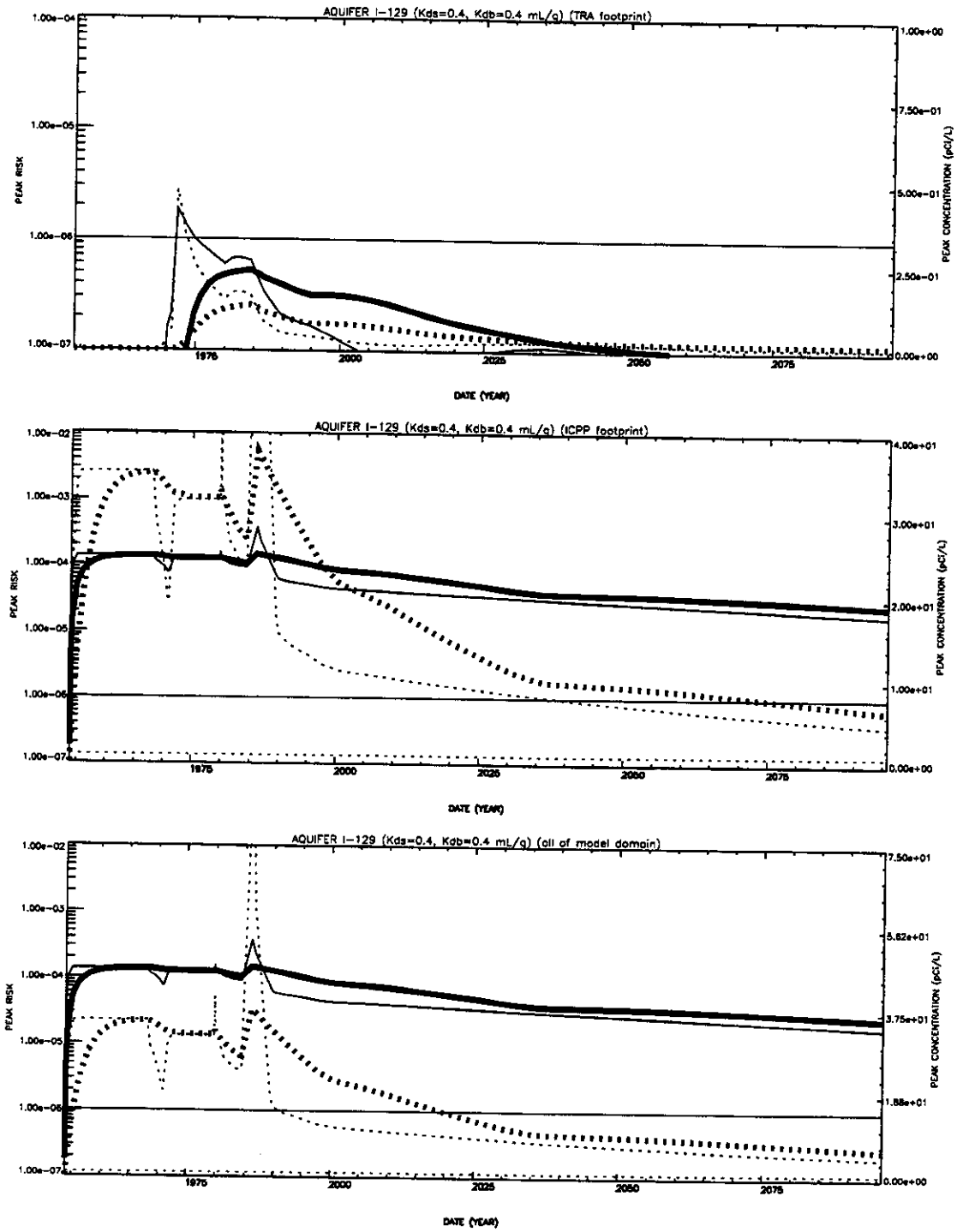

Figure 8-154 Peak aquifer concentration for I-129. Top figure: TRA foot print, Middle figure: ICPP footprint, Bottom Figure: entire aquifer domain. Thick line risk (left scale), dotted line concentration (right scale) solid line 10^{-6} risk (left scale).

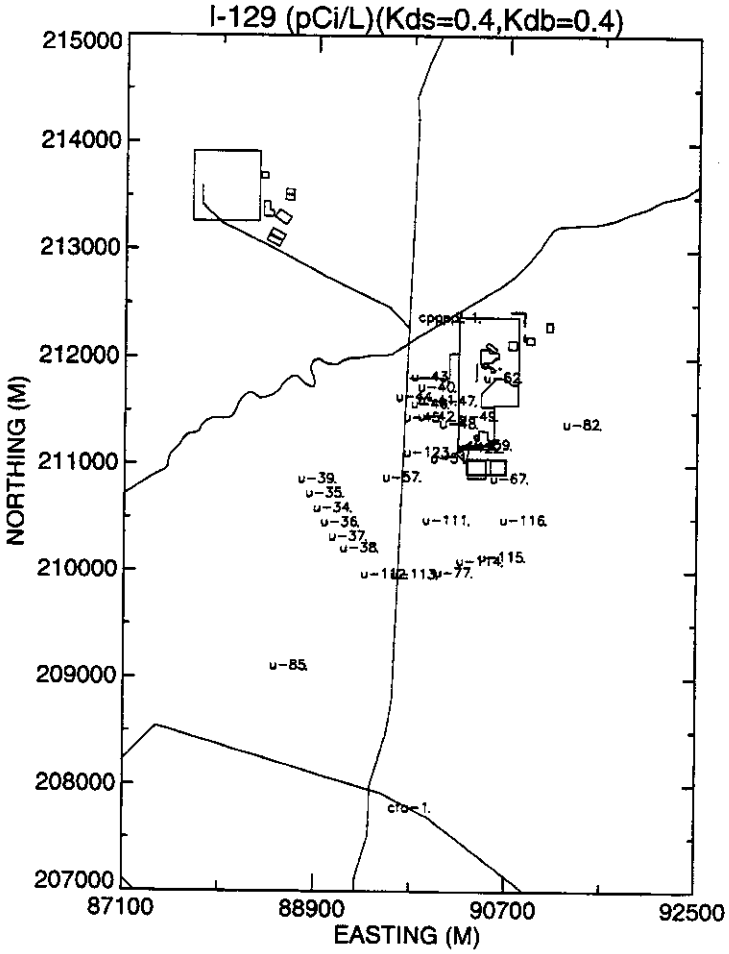

Figure 8-155 Well locations for the comparison of aquifer I-129 to field data.

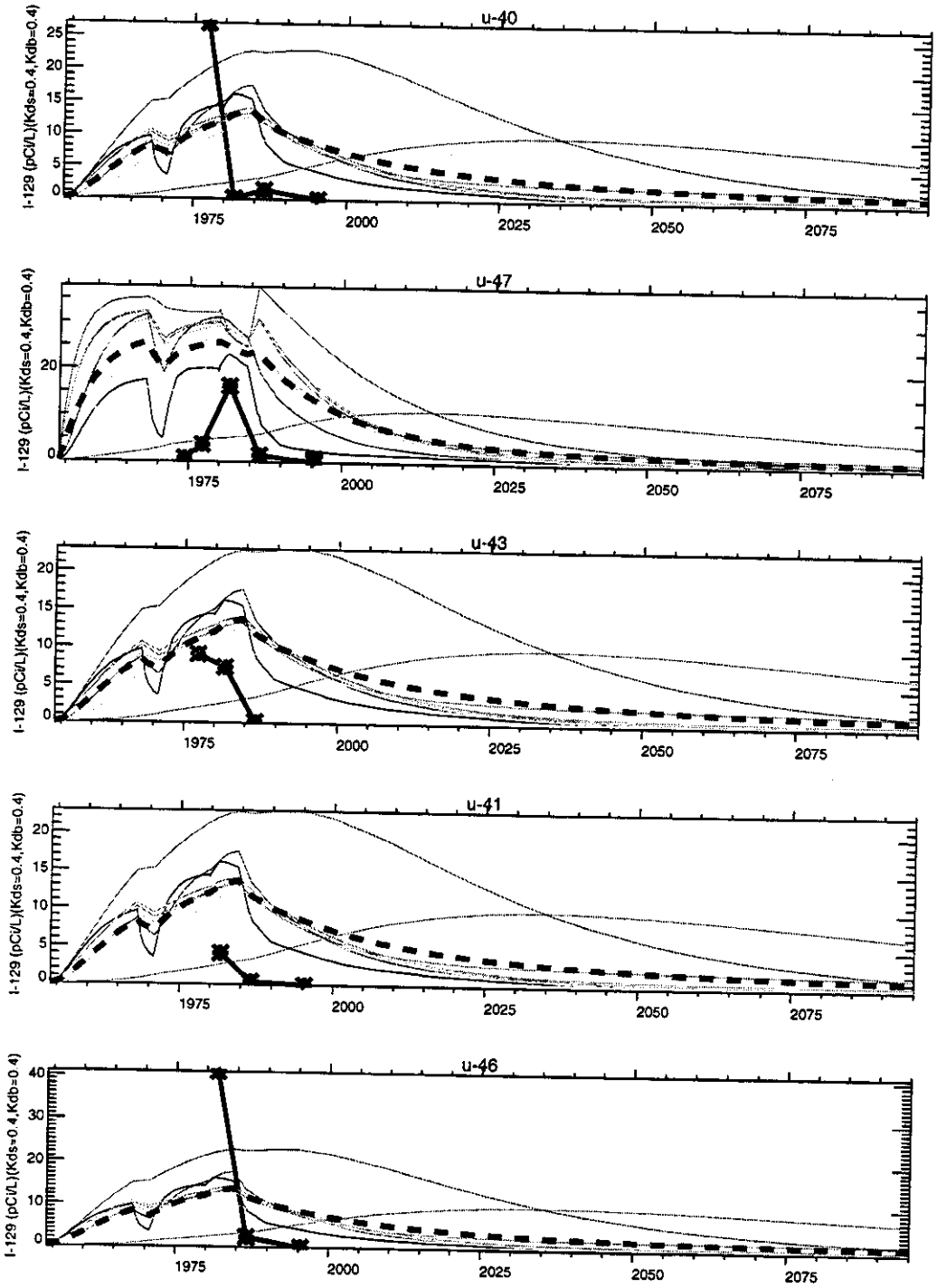

Figure 8-156 Comparison of aquifer I-129 to field data.

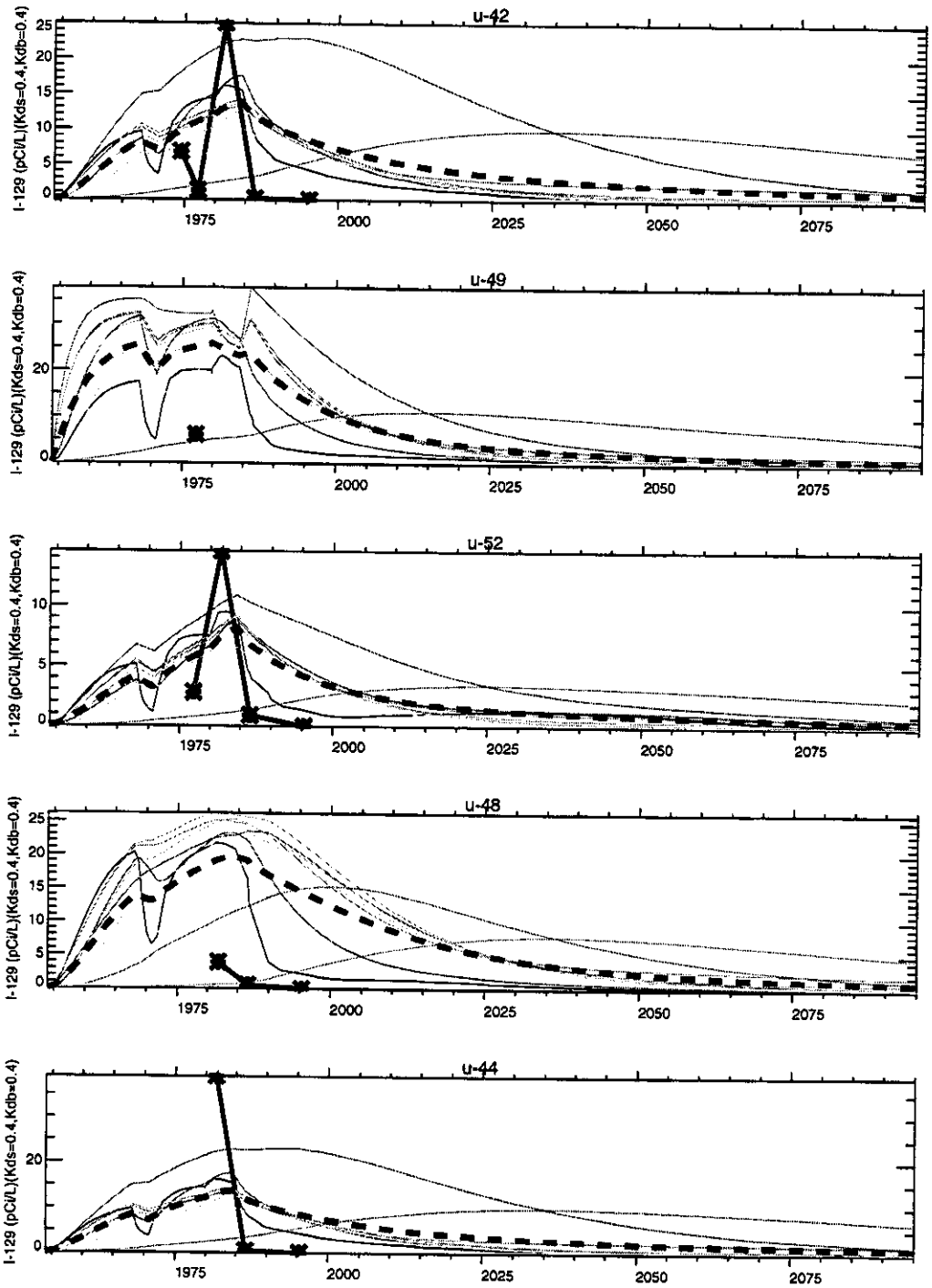

Figure 8-157 Comparison of aquifer I-129 to field data.

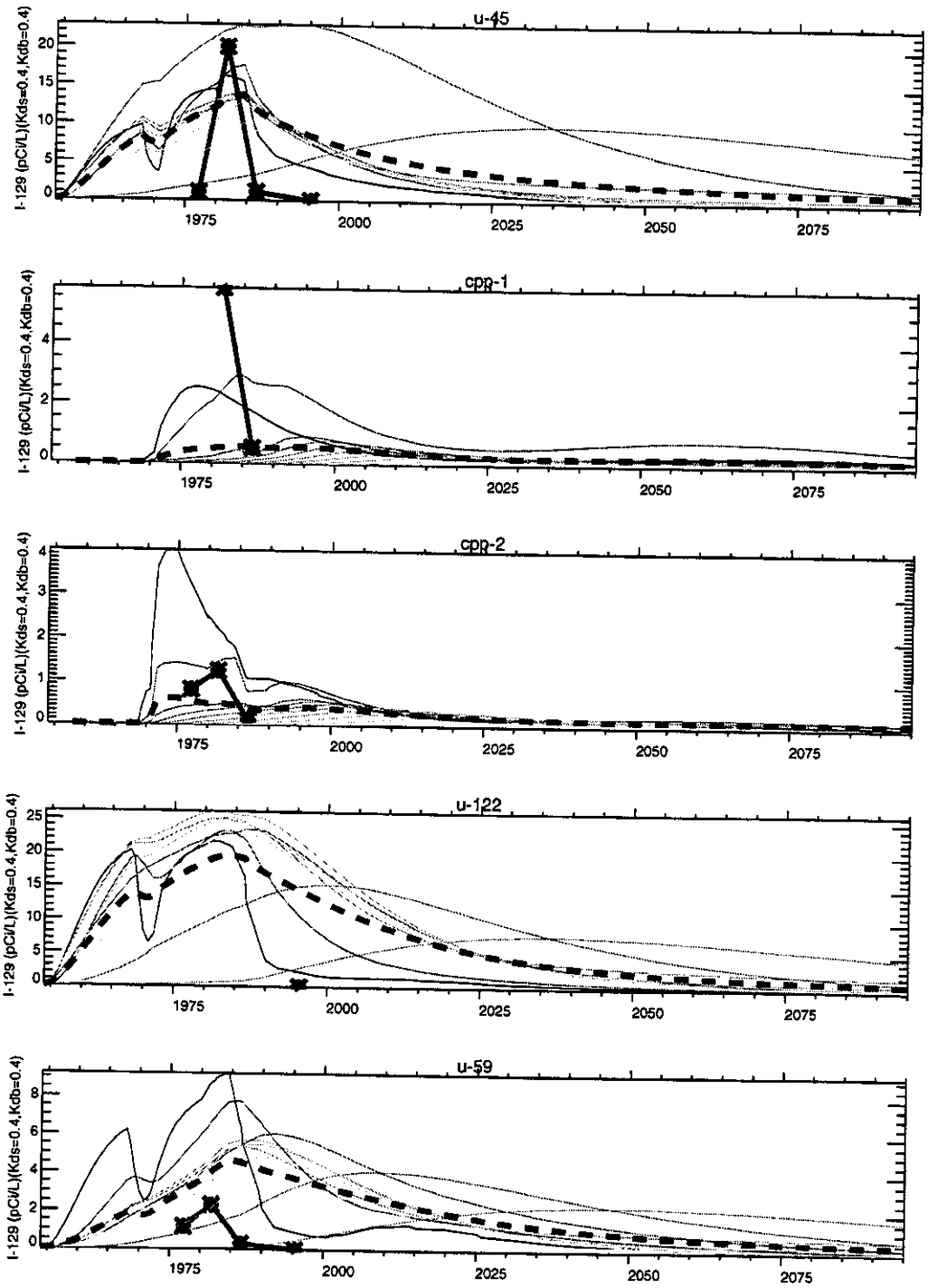

Figure 8-158 Comparison of aquifer I-129 to field data.

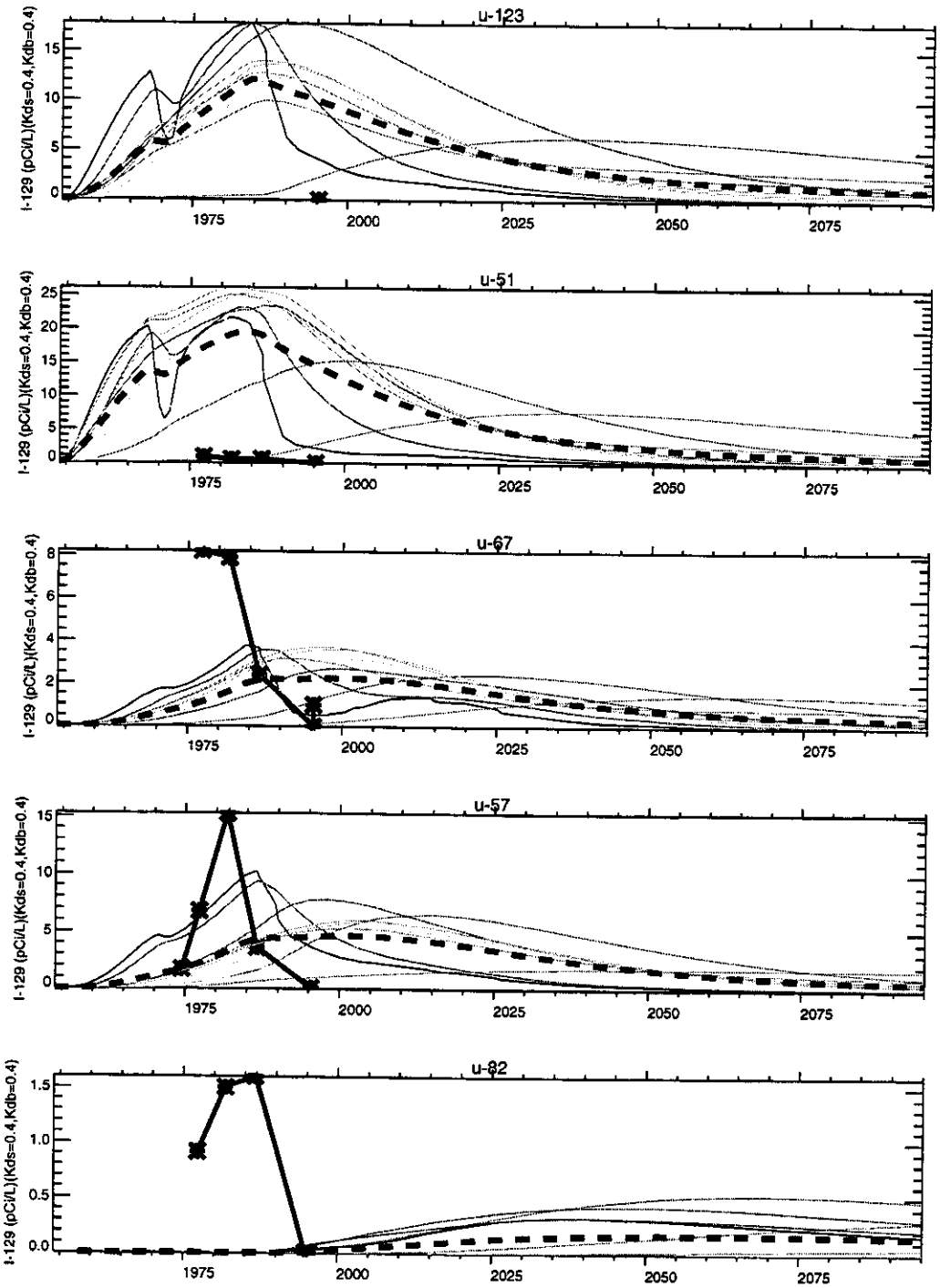

Figure 8-159 Comparison of aquifer I-129 to field data.

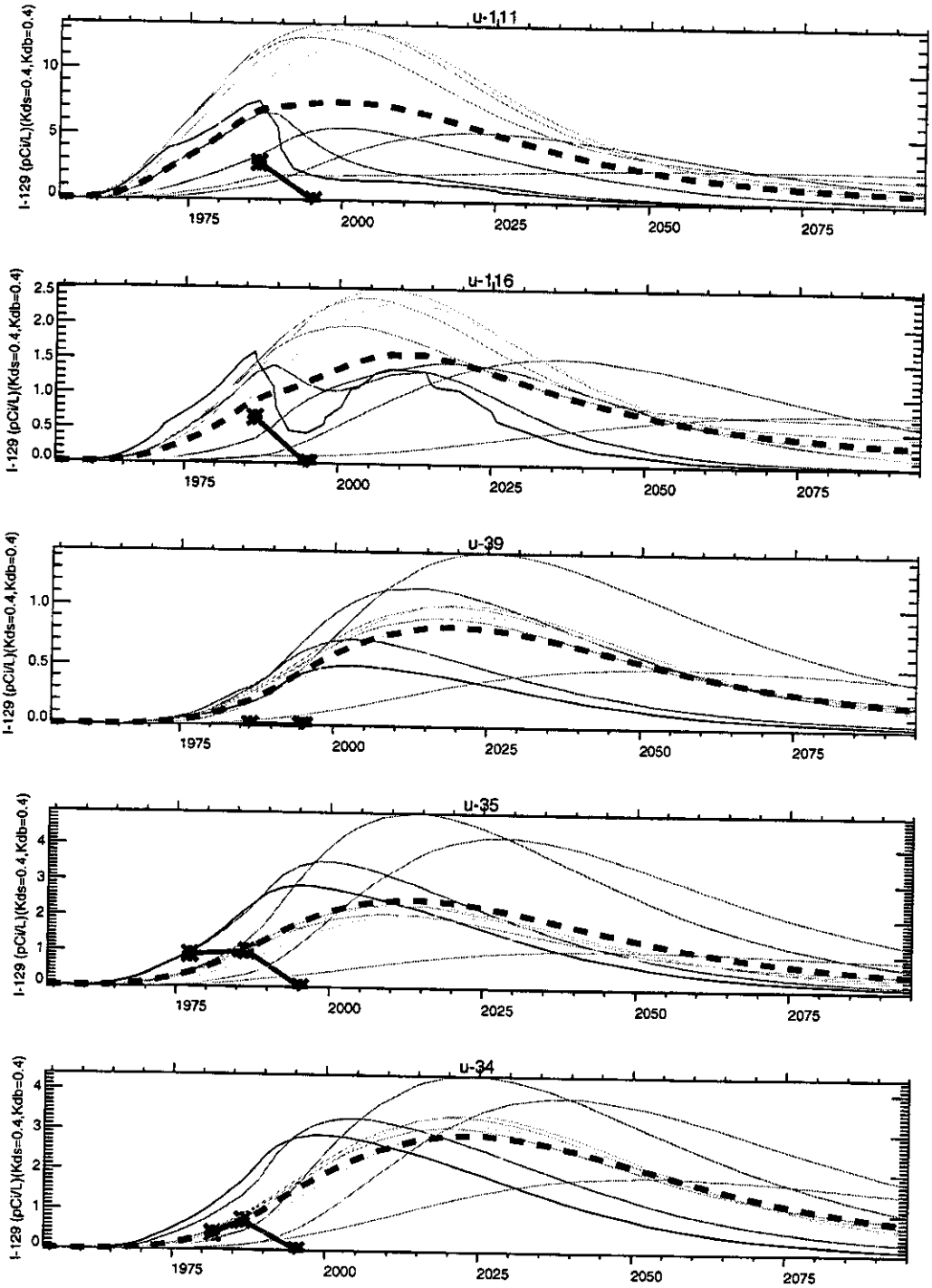

Figure 8-160 Comparison of aquifer I-129 to field data.

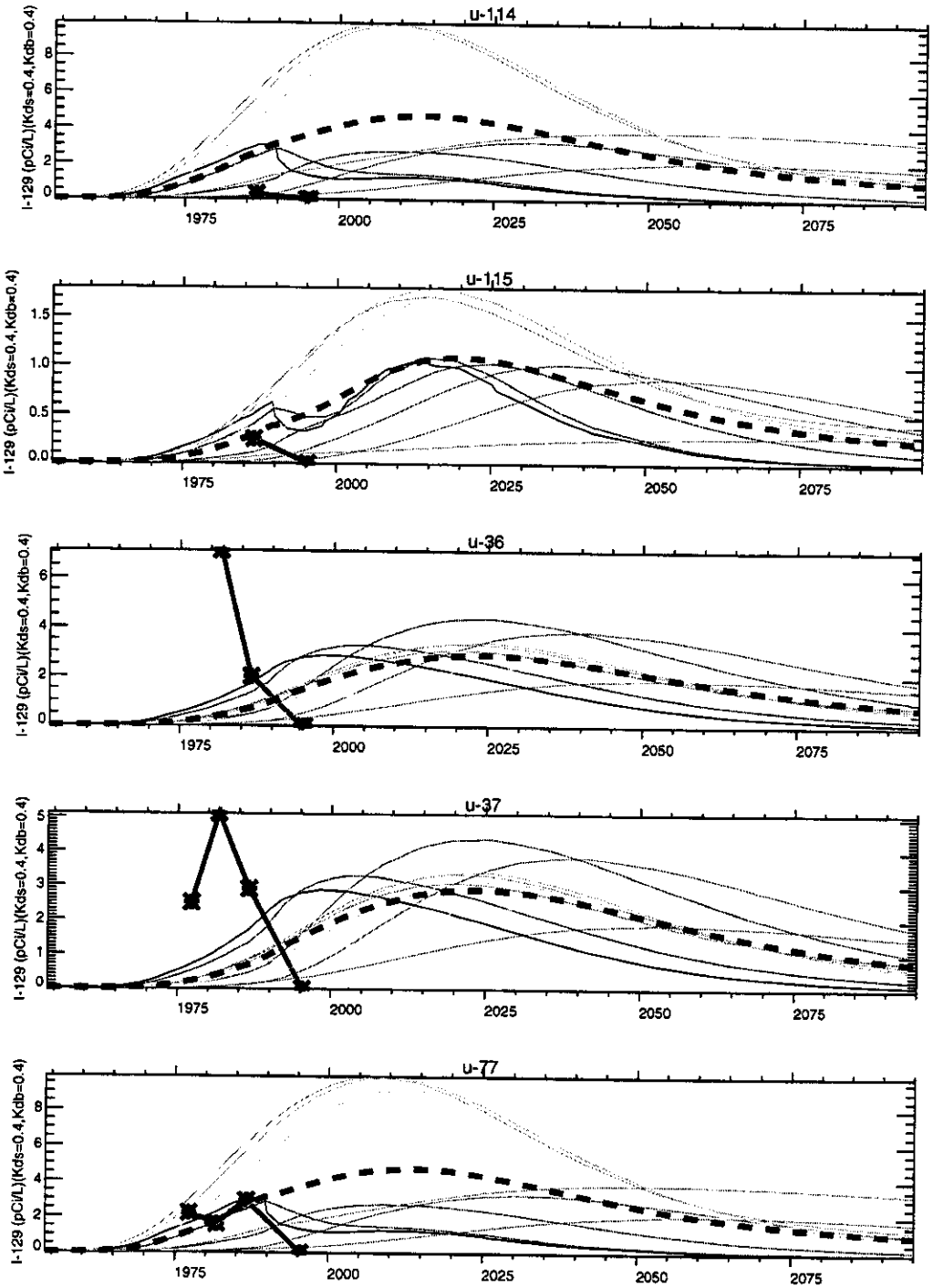

Figure 8-161 Comparison of aquifer I-129 to field data.

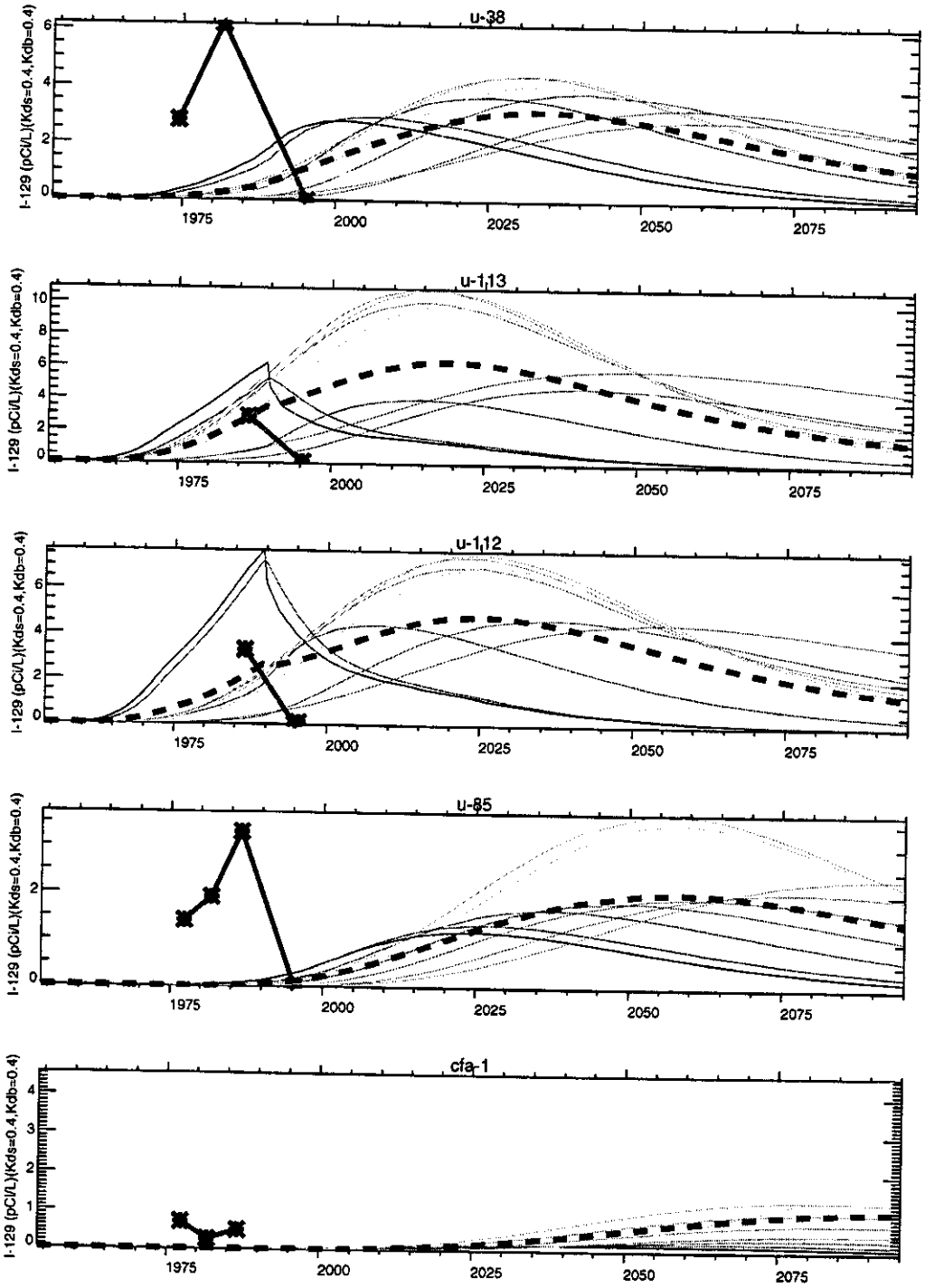

Figure 8-162 Comparison of aquifer I-129 to field data.

8.6 Np-237 Sensitivity to Kd

8.6.1 Np-237 With A Kd=0 cm^3/g

Dicke (1997) has suggested that Np-237 is a sorptive species, and should be modeled with a Kd=8 cm^3/g as opposed to being treated as a conservative species as is commonly done at earlier stages in the COPC identification process. To be complete, the following sensitivity simulation presents the conservative species simulation that reduces the retardation in the movement through the vadose zone and aquifer, resulting in higher predicted concentrations relative to the adsorptive species approach. The following simulation was done using sediment and basalt Kds=0 cm^3/g.

Np-237 was primarily introduced to the aquifer through the injection well (75.32% from 1953-1984) and into the vadose zone from the CPP-31 (15.23% in 1972), the CPP-28 (0.01% from 1956-1974) the '86 release (0.02%) and the soils inventory (9.41% in 1990). Some of the injection well disposal was during the period of time that the injection well was presumed to be backflowing into the vadose zone. As a result, there are two distinct break through curves from the vadose zone into the aquifer as the injection well source arrives before the surface sources are transported through the entire vadose zone depth. This is illustrated in Figures 8-163 through 8-170 for the transport of Np-237 through the vadose zone, and Figures 8-171 through 8-179 for the aquifer region. Contour levels for both the vadose zone and aquifer (Figures 8-163 through 8-166, 8-171, and 8-172) are given for $1.5x10^{-1}$, 1.5, $1.5x10^{+1}$, $1.5x10^{+2}$, $1.5x10^{+3}$, and $1.5x10^{+4}$ pCi/L, with concentrations equal to the cumulative alpha particle activity MCL (15 pCi/L) represented by the dark solid line. Contour maps representing the resultant risk are given in Figures 8-173, and 8-174 for the aquifer region. Risk contours are given for 10^{-7}, 10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}, and 10^{-2} levels with the 10^{-6} value (0.16 pCi/L) indicated by the dark solid line and the 10^{-4} level by the medium solid line.

VADOSE ZONE: The vadose zone and aquifer figures show that the Np-237 vadose zone and aquifer transport were simulated through the years 2123 and 2928, respectively. Like I-129, Np-237 is assumed not to adsorb to the sediments or basalt in this sensitivity simulation, and it has a relatively long half life. As a result, the Np-237 moves like a conservative tracer through the vadose zone and into the aquifer. The breakthrough of Np-237 into the aquifer from the vadose zone is given in Figure 8-168, with the peak vadose zone concentration given in Figure 8-167. These figures indicate that the predicted vadose zone concentration of Np-237 is predicted to be below the MCL in 2093, and that the peak aquifer concentrations should have been observed in 1989. Although still above the 10^{-6} risk level in 2123, the simulations were terminated because nearly 100% of the initial mass in place had passed through the vadose zone.

Comparisons of model predicted concentrations in the vadose zone to field data (Figures 8-169 through 8-170) are good for wells CPP-33-2 and C-33-3. Additional wells include CPP-33-4, MW-01, MW-05, MW-06, MW-15, and MW-050. In those wells, the predicted concentration is slightly high. There was no data available in the PW wells near the percolation ponds. The over prediction of Np-237 concentrations in the vadose zone implies that either the source term is overestimated or that Np-237 should be modeled as an adsorptive species.

AQUIFER: The predicted maximum Np-237 aquifer concentration is 4.82 pCi/L in the year 2095 (Figure 8-175) which exceeds the 10^{-6} risk concentration (0.16 pCi/L) but is less than the MCL (7.06 pCi/L). The predicted maximum aquifer concentration is predicted to exceed the 10^{-6} risk level until well beyond the year 2095 and to exceed the MCL until about the year 2041. Although still above the 10^{-6} risk level, the peak concentration in 2095 is declining from a maximum of 90.2 pCi/L in 1986. The aquifer area with concentrations greater than the MCL is limited to the area of the ICPP after the year 2025 (Figure 8-172), but the area above the 10^{-6} risk concentration is still very large after the year 2095 (Figure 8-174).

There are very little data available for use in comparing aquifer model predictions to measured concentrations for Np-237. In a majority of the wells sampled, data were collected only once in 1994. Using this limited information, comparisons of model predicted concentrations to field data are presented in Figures 8-177 through 8-179. Because there is very little time dependent information, it is difficult to evaluate

whether the comparison using Kd=0 cm^3/g is significantly better than the base case with Kd=8 cm^3/g presented in Section 7.8.

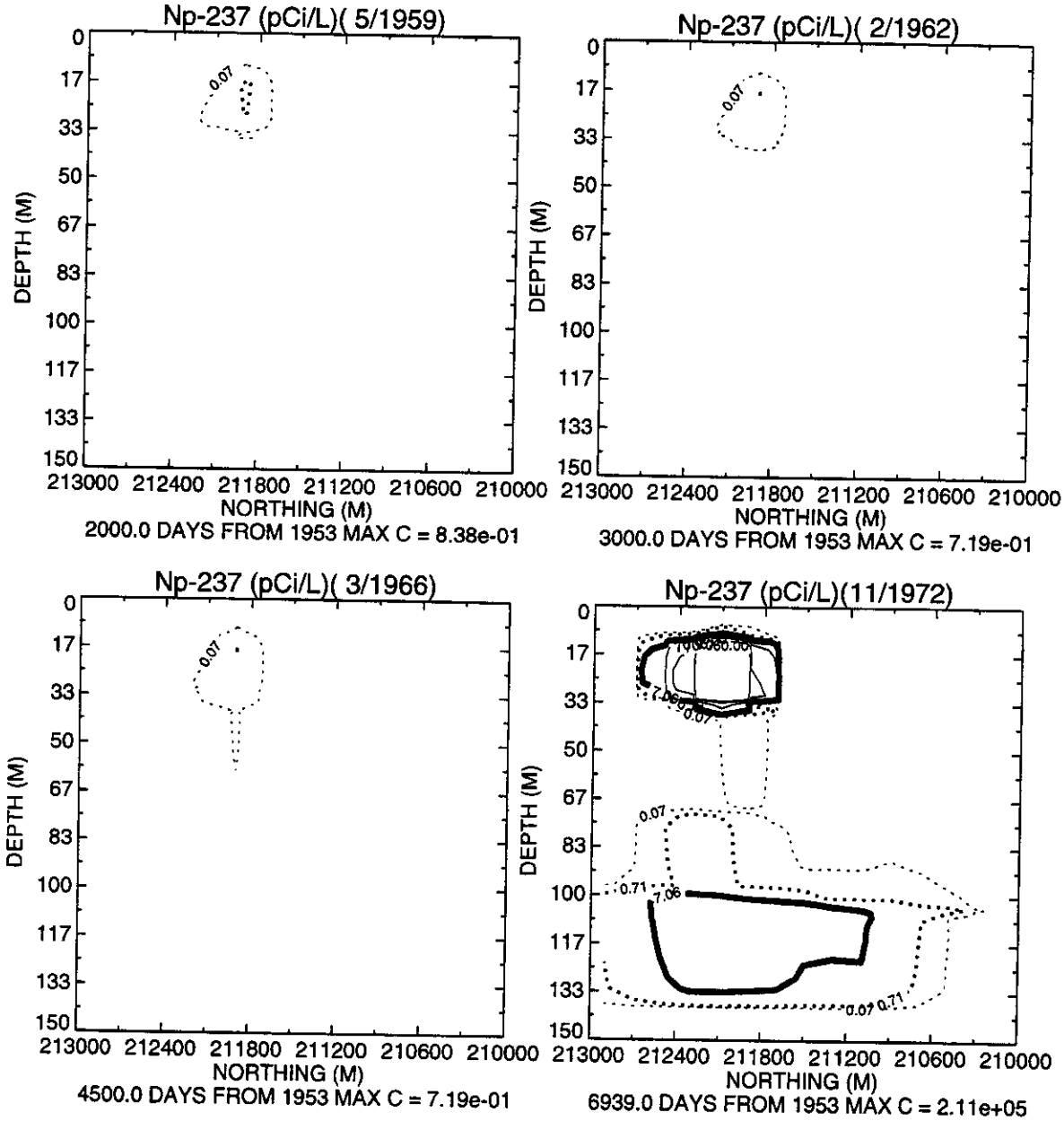

Figure 8-163 Vadose zone Np-237 peak concentration contours.

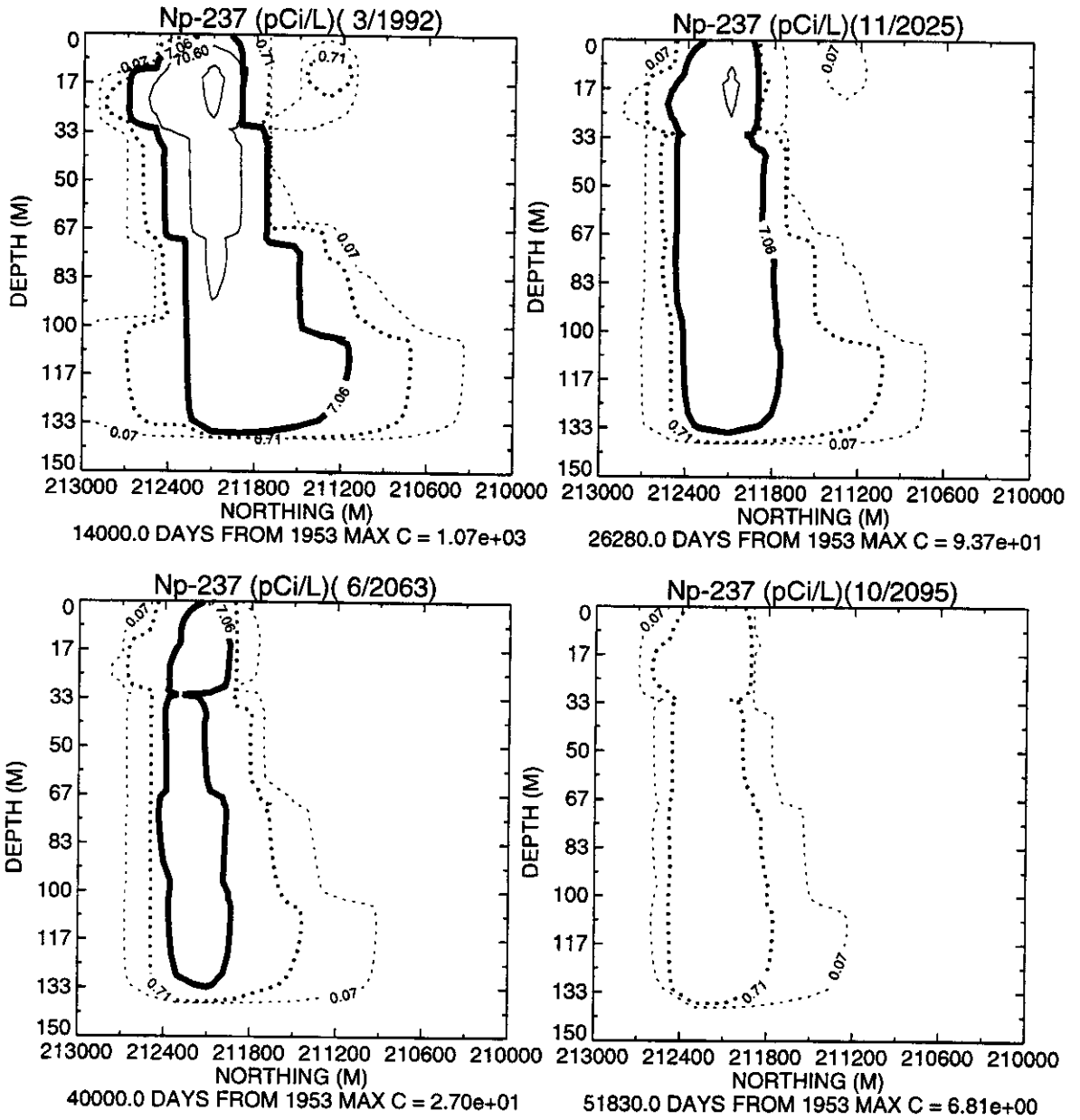

Figure 8-164 Vadose zone Np-237 peak concentration contours.

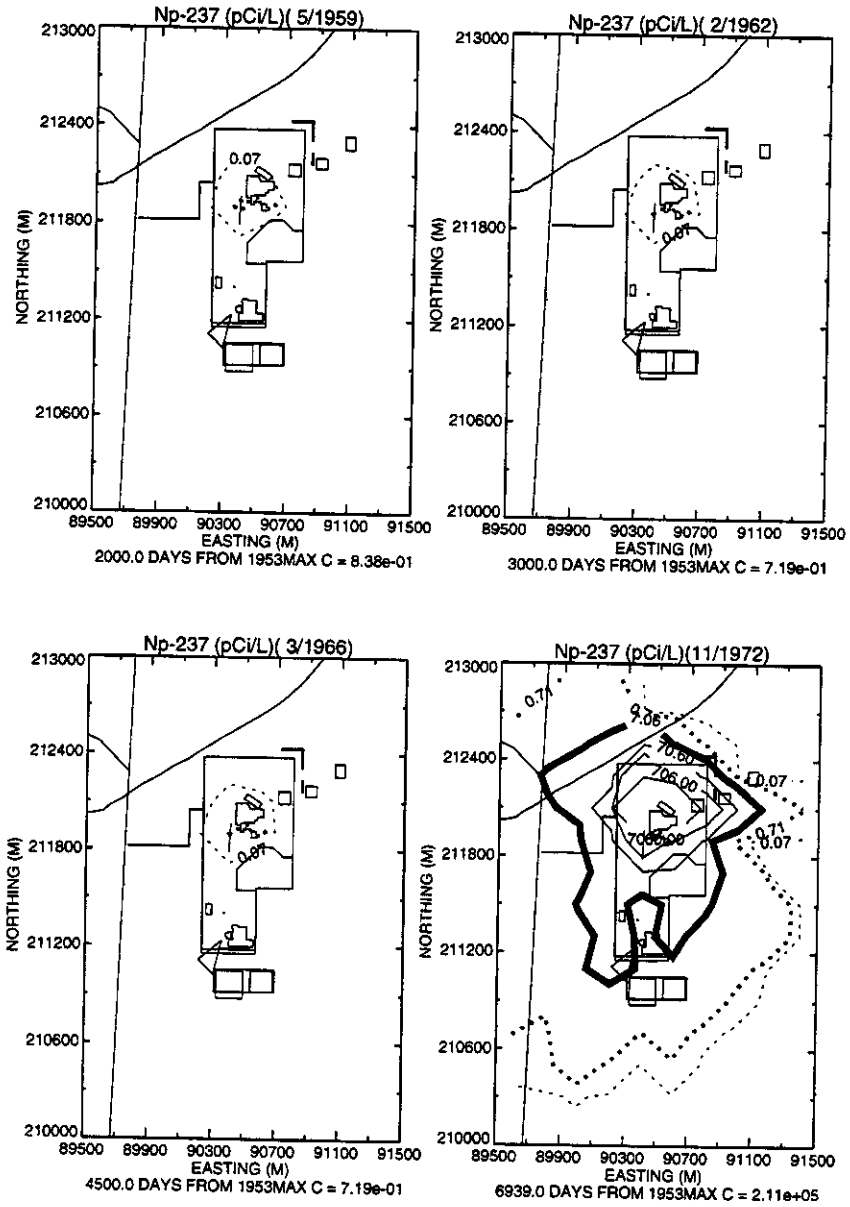

Figure 8-165 Vadose zone Np-237 peak concentration contours.

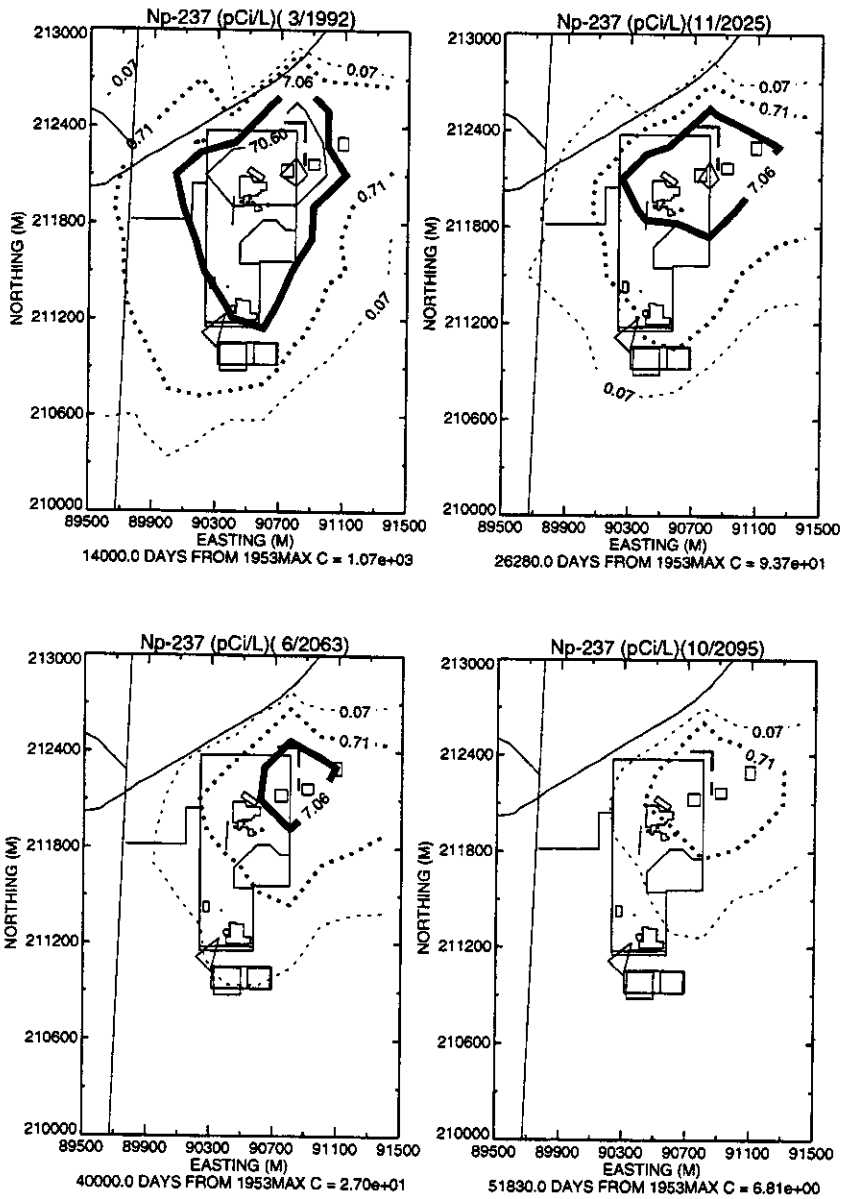

Figure 8-166 Vadose zone Np-237 peak concentration contours.

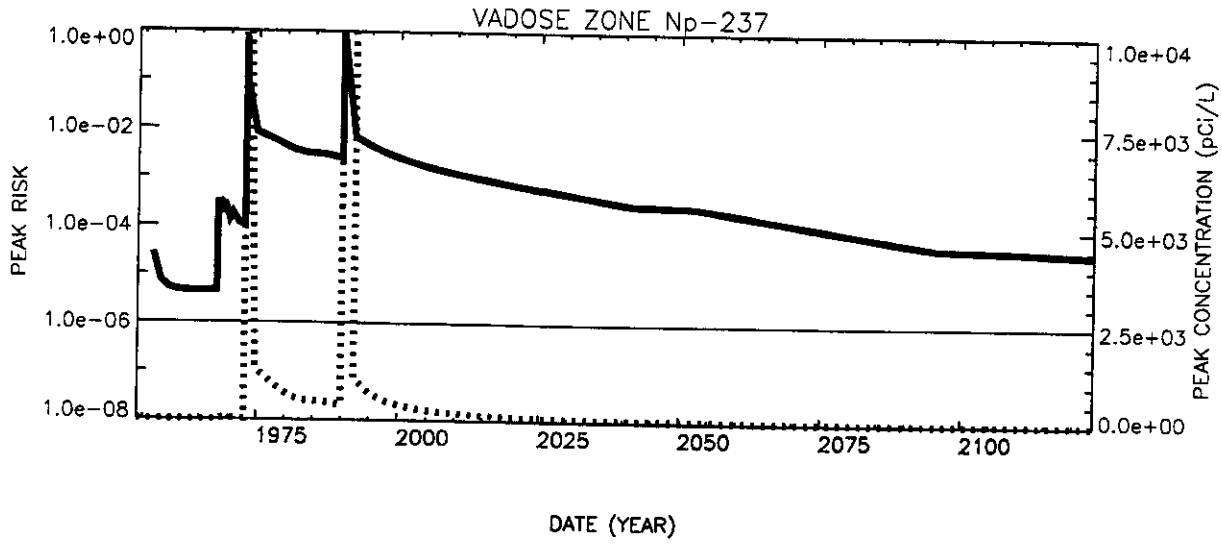

Figure 8-167 Peak vadose zone risk and concentration for Np-237. Risk indicated by the thick line on the log scale with the 10^{-6} value shown as the solid line. The dotted line represents concentration given by the linear scale on the right axis with the MCL shown as the straight horizontal line.

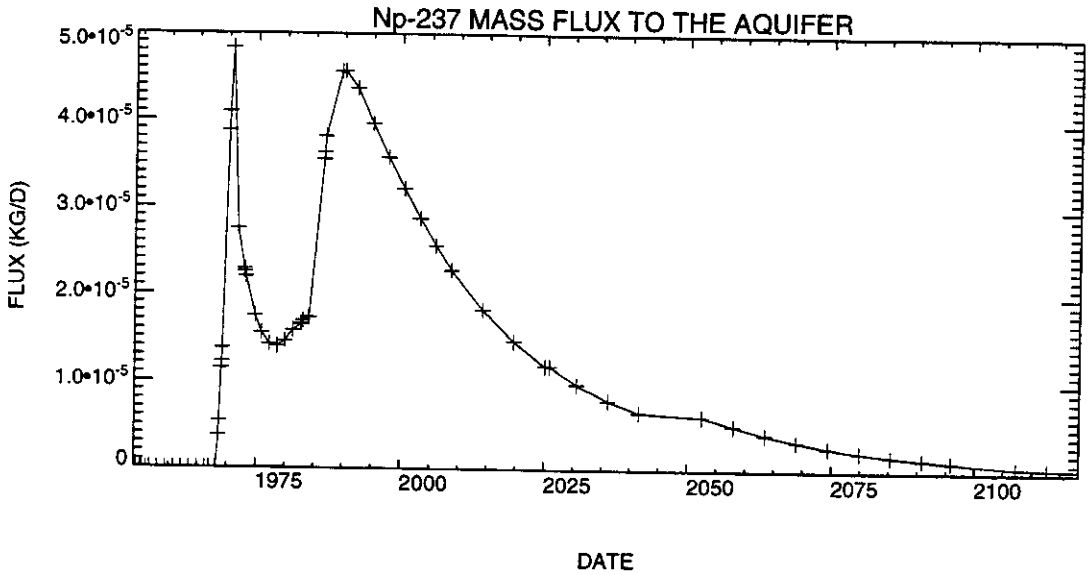

Figure 8-168 Mass flux of Np-237 into the aquifer from the vadose zone.

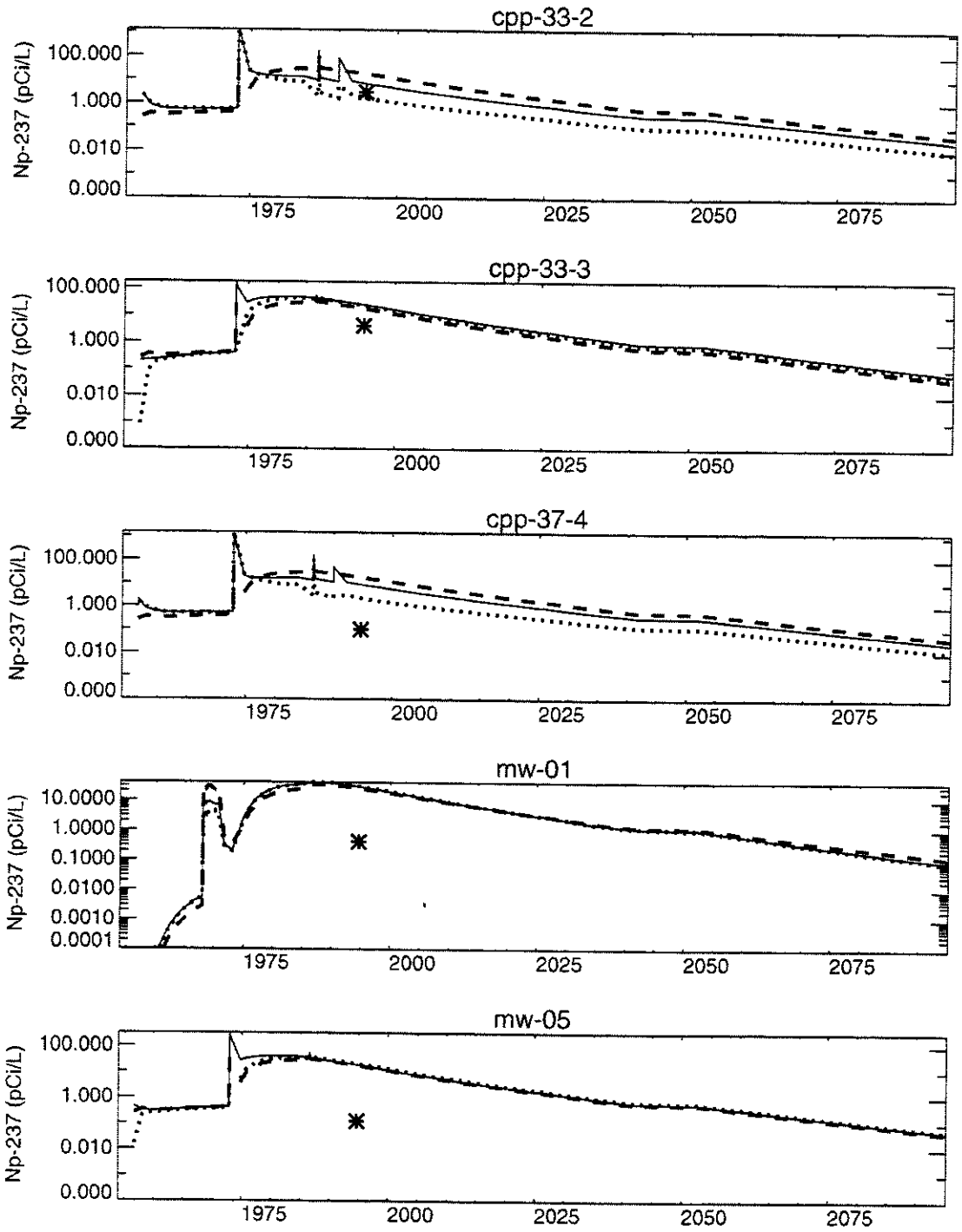

Figure 8-169 Comparison of vadose zone Np-237 to field data.

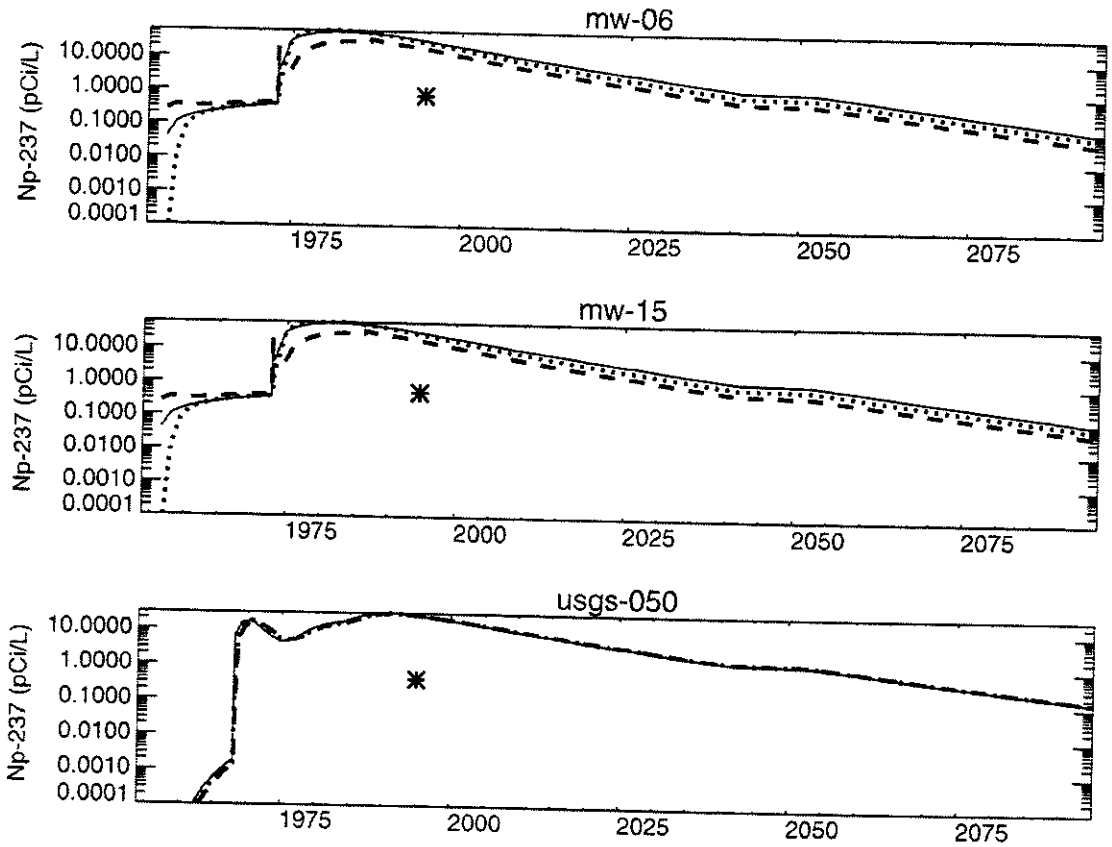

Figure 8-170 Comparison of vadose zone Np-237 to field data.

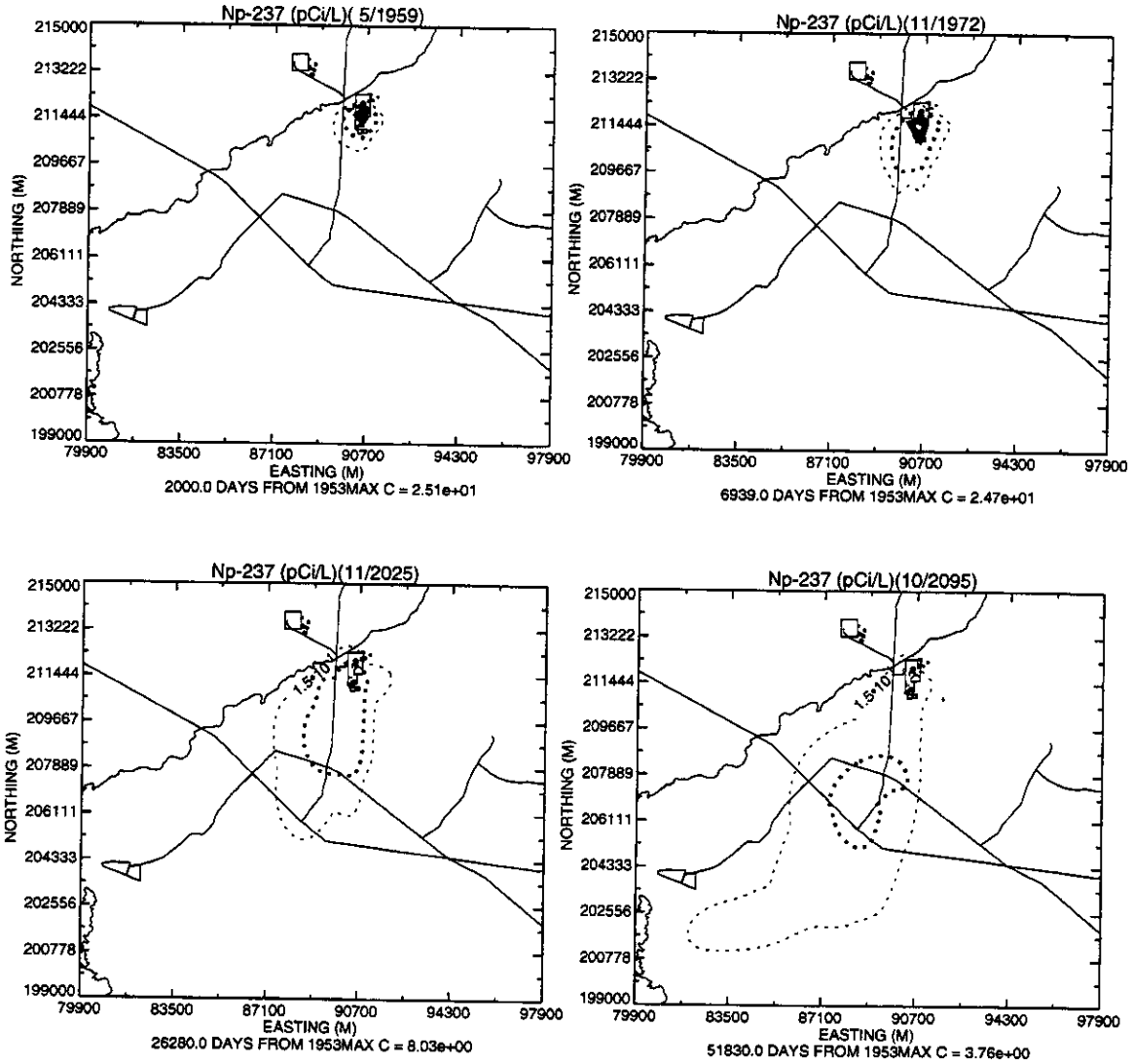

Figure 8-171 Aquifer Np-237 peak concentration contours.

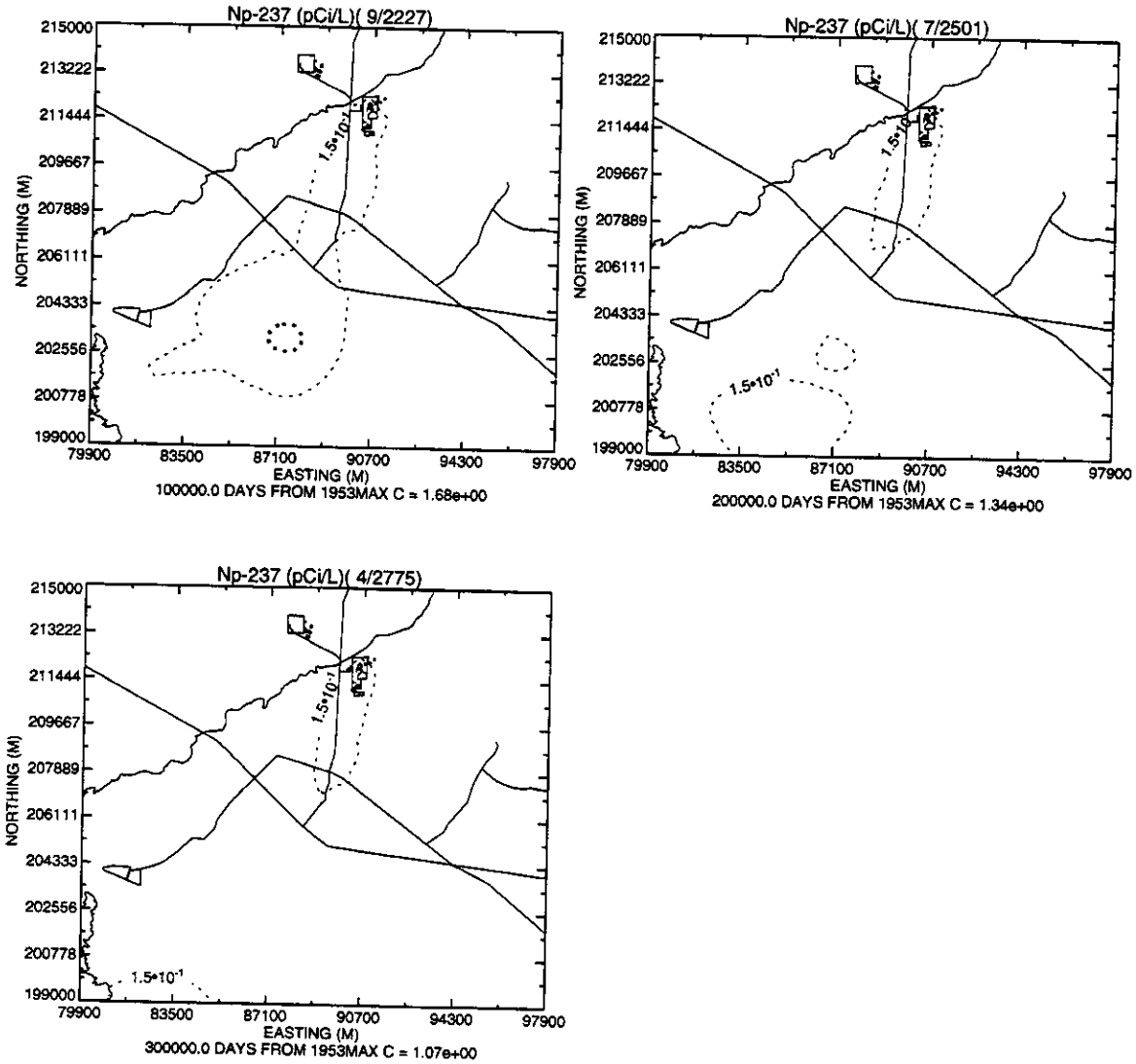

Figure 8-172 Aquifer Np-237 peak concentration contours.

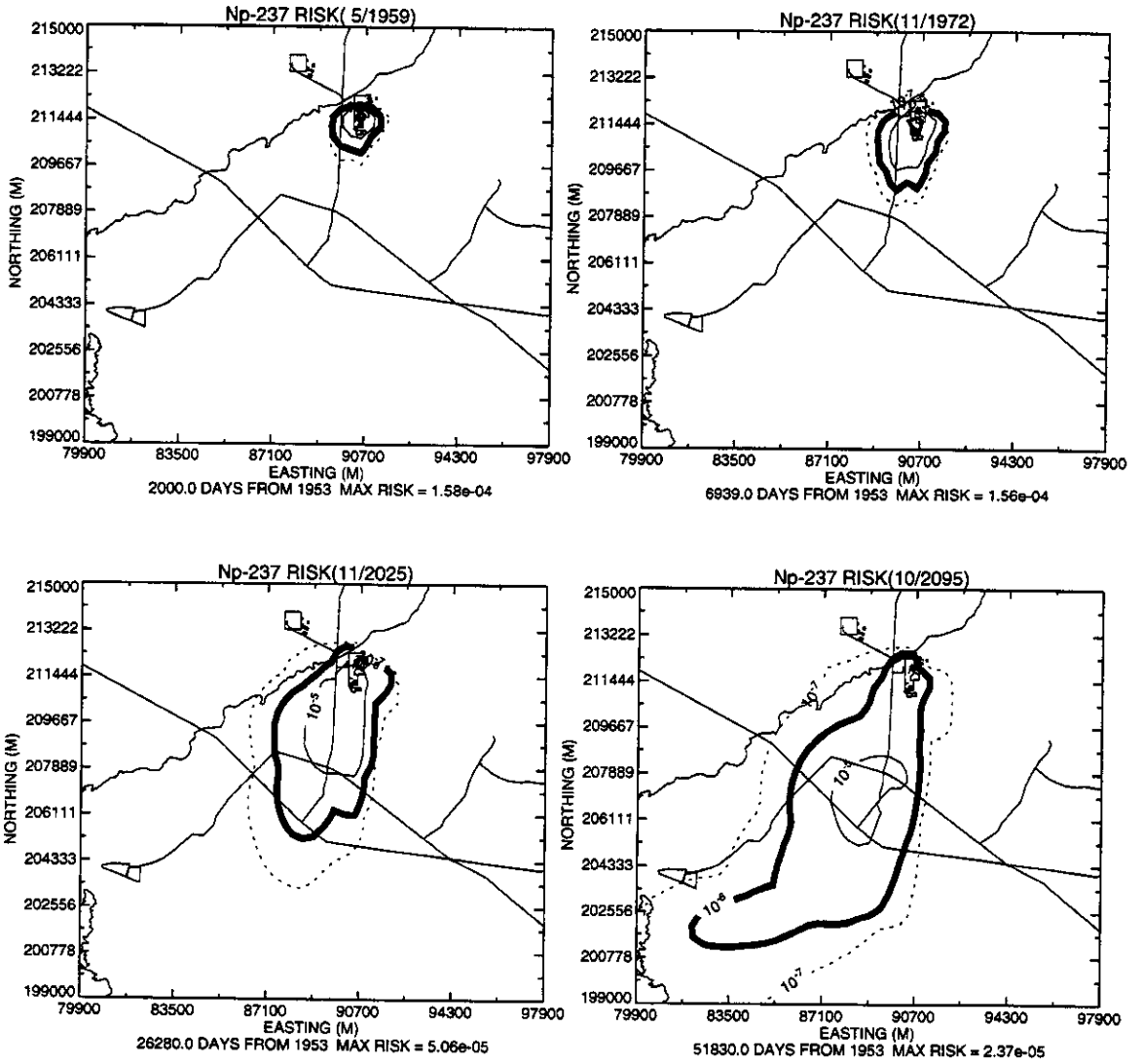

Figure 8-173 Aquifer Np-237 peak risk contours.

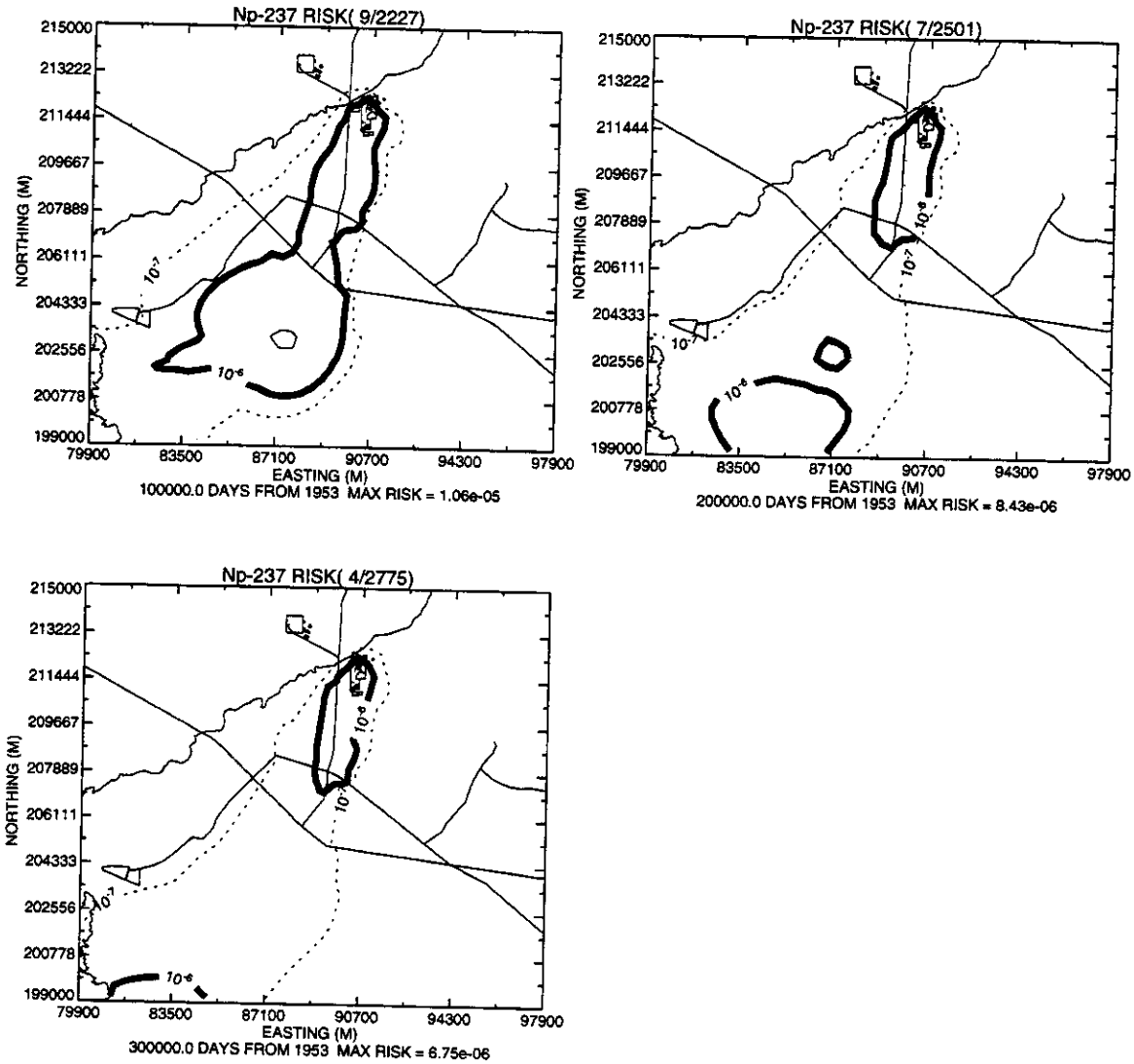

Figure 8-174 Aquifer Np-237 peak risk contours.

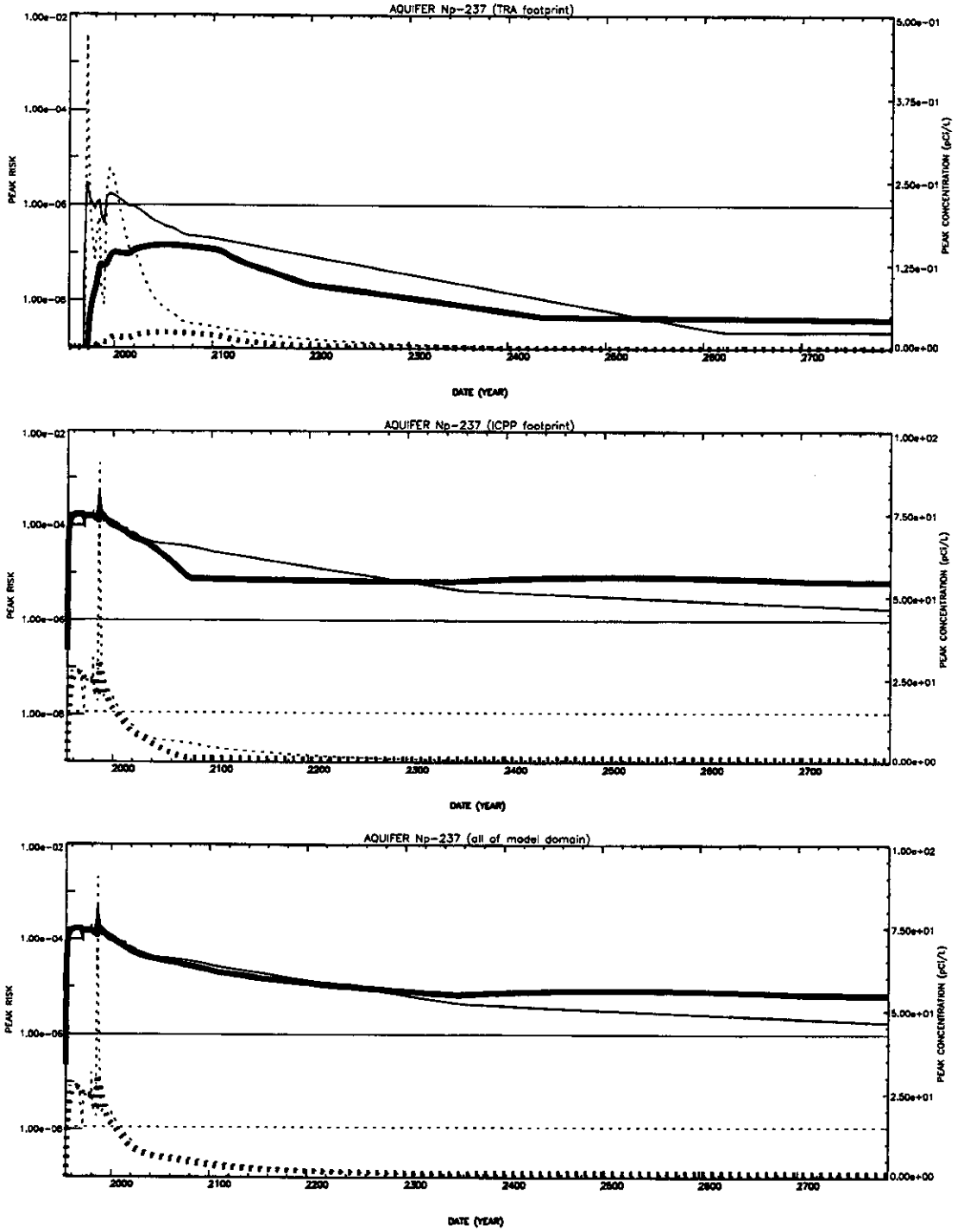

Figure 8-175 Peak aquifer concentration for Np-237. Top figure: TRA foot print, Middle figure: ICPP footprint, Bottom Figure: entire aquifer domain. Thick line risk (left scale), dotted line concentration (right scale) solid line 10^{-6} risk (left scale).

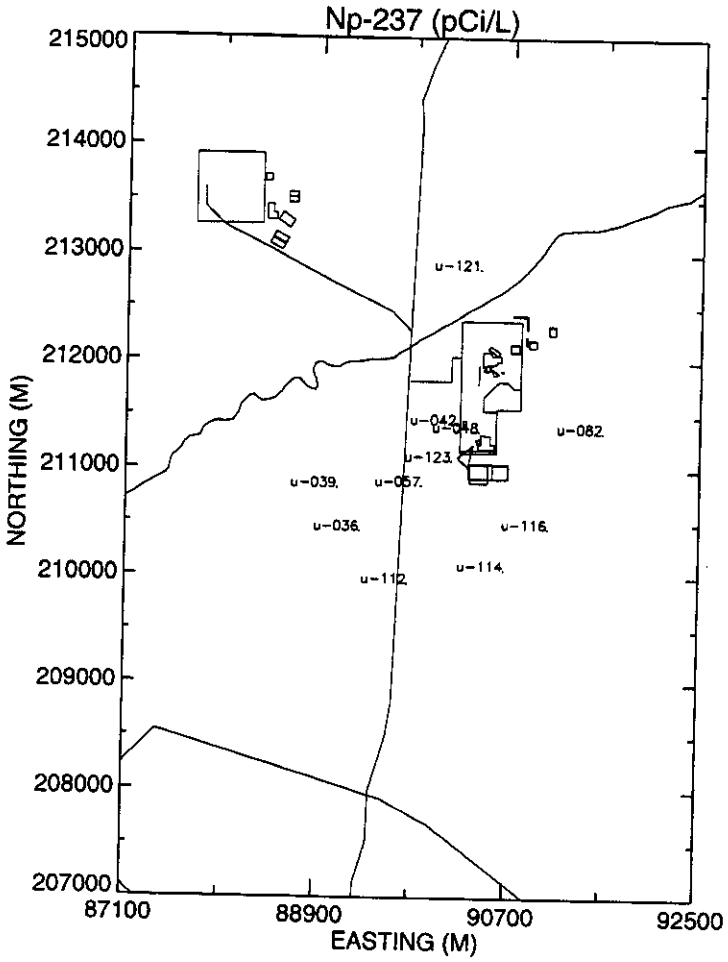

Figure 8-176 Well locations for the comparison of aquifer Np-237 to field data.

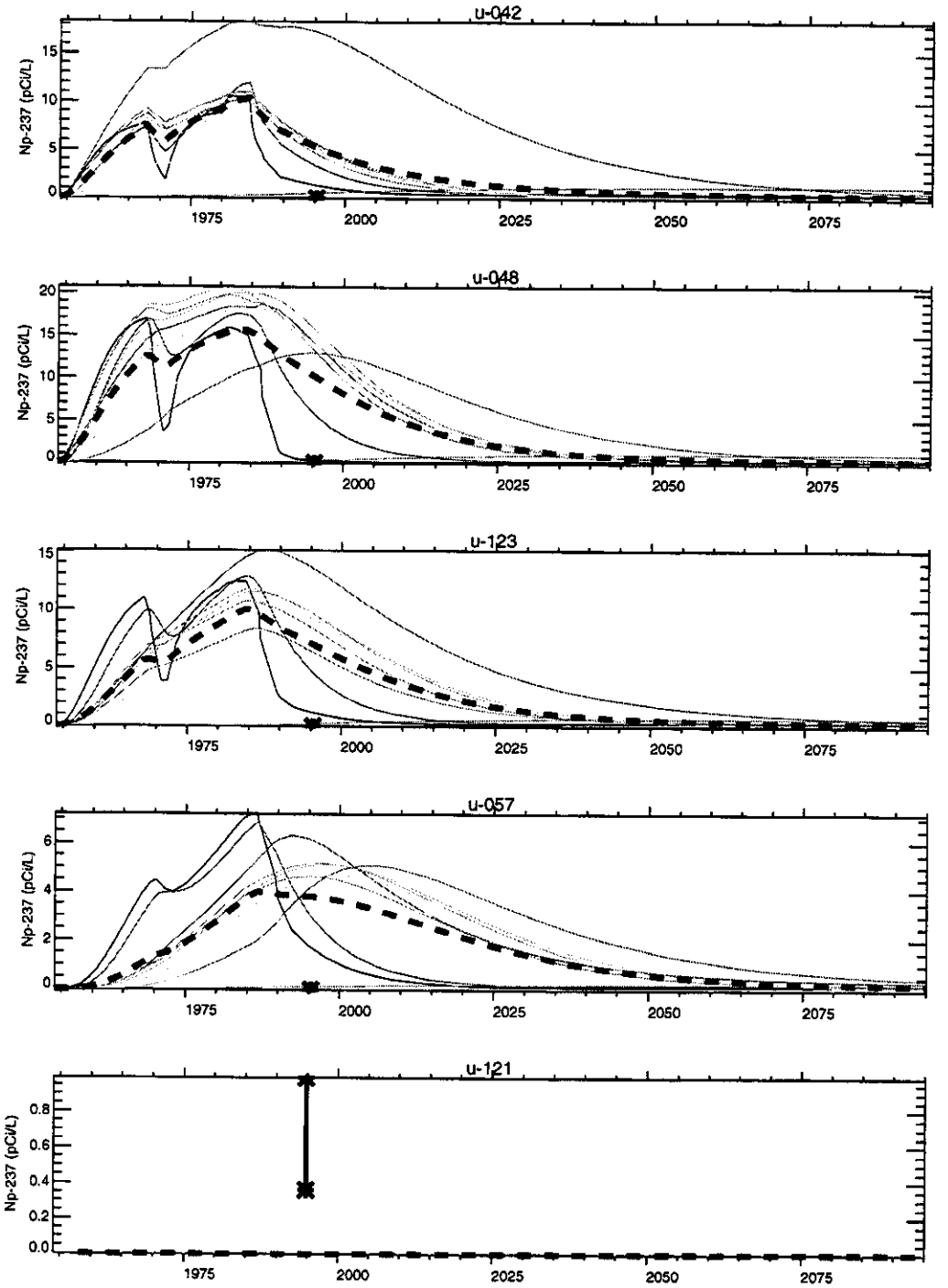

Figure 8-177 Comparison of aquifer Np-237 to field data.

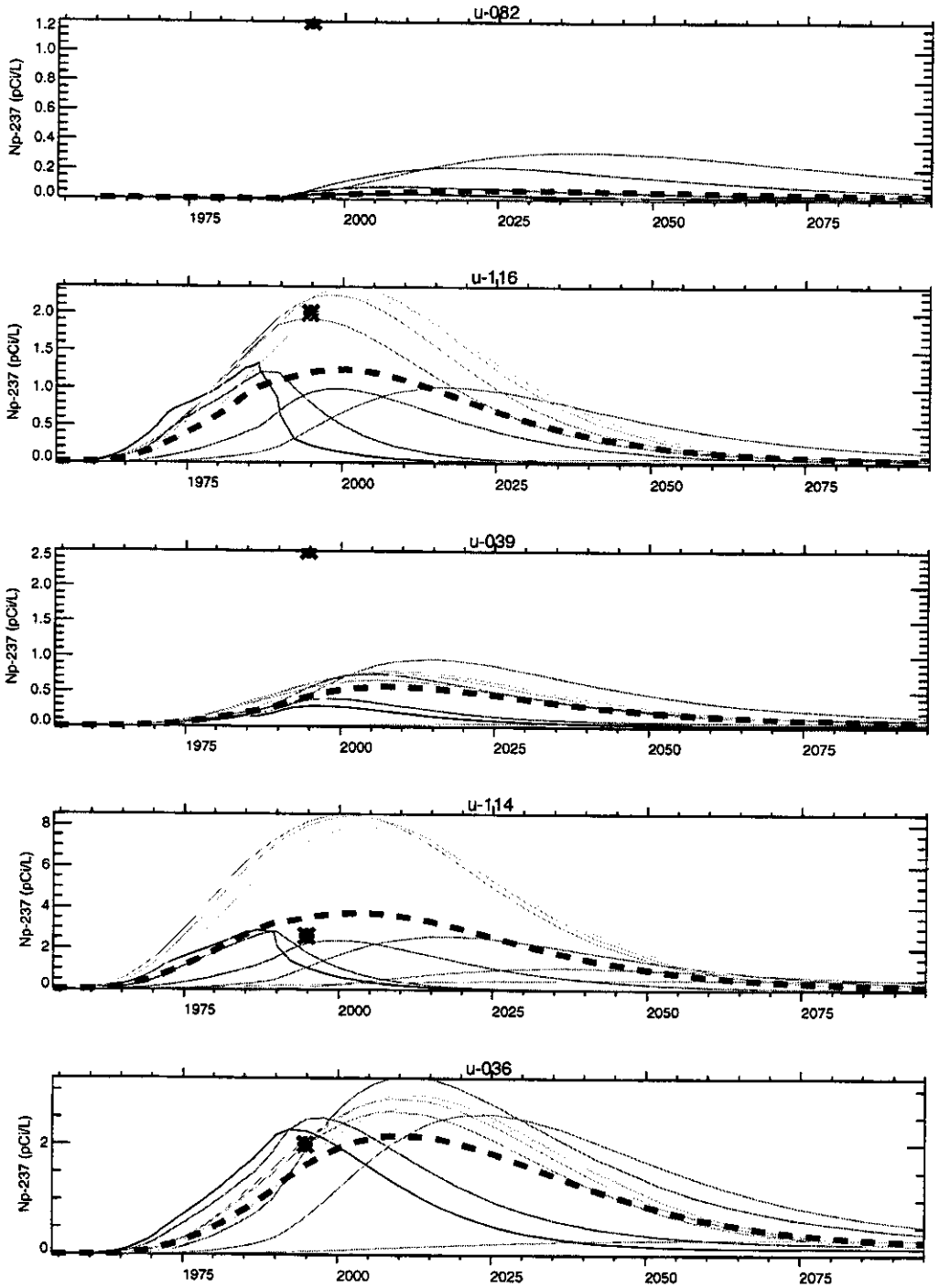

Figure 8-178 Comparison of aquifer Np-237 to field data.

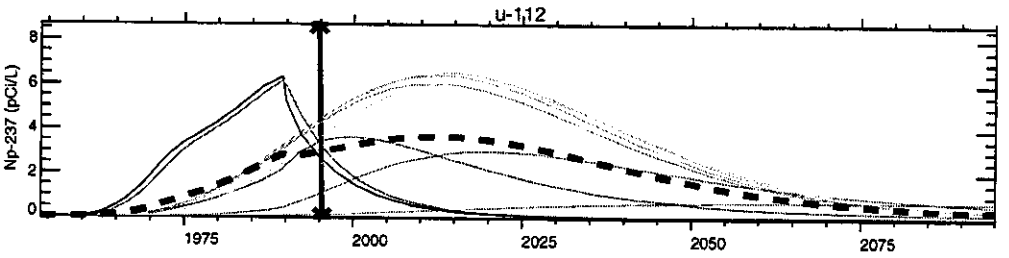

Figure 8-179 Comparison of aquifer Np-237 to field data.

8.7 Total Pu Sensitivity to Kd

A review of appropriate Kd values for the INEL (Dicke, 1997) indicates that the plutonium Kd values used for the ICPP analysis may be very conservative (0 in the vadose zone basalt, 22 cm^3/g in the vadose zone sediments, 0.88 cm^3/g in the aquifer basalts, and 22 cm^3/g in the aquifer sediments). The simulation results presented in the following section increases the Kd by a factor of 10 to show the sensitivity of the plutonium predictions to higher Kd values in the aquifer. With a sediment Kd of 220, the required vadose zone simulation time is over 19,000 years to capture the mass flux from the vadose zone to the aquifer. Using the TETRAD model used for the Section 7.9, this simulation would take almost one year of simulation time. After the artificial water sources are turned off in the year 2095 and the vadose zone drains out, the water movement in the vadose zone becomes steady state. After that time, the mass flux from the vadose zone was shown to be a linear function of the contaminant retardation. Therefore, the vadose zone simulation approach was changed to run the simulation with the appropriate Kd values for about 270 years until the water transport was steady state and then change the Kd values to zero and run until essentially all the Pu mass was out of the vadose zone. Then the portion of the mass flux curve from the simulation after 270 years was scaled using the retardation appropriate for a Kd of 220 mL/g. This mass flux information was used as the aquifer mass flux and the aquifer model was run with a Kd of 8.8 mL/g in the basalt and 220 mL/g in the sediment. Because of the use of this scaling approach in the vadose zone, only the aquifer results are presented.

Sources of Total Pu used in these simulations are the same as those used in the base case, and consist of the CPP-31 release in 1972 (80.66%), the CPP-28 release from 1956-1974 (11.04%), the soils inventory applied in 1990 (8.05%), the '86 release (0.12%), the percolation ponds where 0.01% was assumed to be discharged from 1984-2095, and a relatively small amount (0.12%) injected directly into the aquifer. The Total Pu was assumed to have a Kd of 220 cm^3/g, and a half life of 2.4×10^4 years, which means that it moves relatively slowly and within a 1000 year time frame makes little progress through the vadose zone and undergoes a small amount of decay. As a result, the scaled simulations were run for more than 19,000 years to allow the mass flux from the vadose zone to reach a maxima.

Contour levels Total Pu in the aquifer are given for the 1.5×10^{-1}, 1.5, $1.5 \times 10^{+1}$, $1.5 \times 10^{+2}$, $1.5 \times 10^{+3}$, and $1.5 \times 10^{+4}$ pCi/L levels with concentrations equal to 15 pCi/L represented by the dark solid line. This value is used to represent the maximum concentration allowed for total alpha radiation under the MCL guidance. Thus, the cumulative Total Pu and Total U alpha count can not exceed 15 pCi/L. Corresponding risk contour maps for the aquifer region are given at the 10^{-7}, 10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}, and 10^{-2} risk levels with the 10^{-6} value (0.15 pCi/L) indicated by the thick line, and the 10^{-4} level by the medium solid line.

Because the peak concentration is approximately in the year 18,500, Pu-239 is the only Pu isotope to exist in significant quantities at the time of the peak. Therefore, when transforming the Pu mass to activity, it should be assumed that all the Pu is Pu-239. In contrast, for the Section 7.9 calculations, the Pu isotopic distribution was assumed to have only 100 years of decay based on the assumptions presented in Section 6.2.1. As explained in Section 6.2.1, the Total Pu mass concentration is used to calculate the activity assuming that the Total Pu mass is composed of 83.3% Pu-239, 14.95% Pu-240, 0.02% Pu-241, and 1.74% Pu-242. This corresponds to a Total Pu activity distribution of 60.3% Pu-239, 30.0% Pu-240, 9.6% Pu-241, and 0.04% Pu-242. Therefore, for this simulation, the Pu distribution was assumed to be the same as that used in Section 7.9 so that the simulation results can easily be compared. The activity concentrations are overestimated by approximately a factor of two because of this assumption.

The risk is calculated assuming that all of the Pu isotopes have the same limiting 10^{-6} risk concentration of 0.15 pCi/L corresponding to Pu-239 through Pu-242 isotopes. The 10^{-6} risk limits for each of the isotopes was given in Table 5-2 where the risk limits are shown to deviate by less than 4% from 0.15 pCi/L.

In all of the Pu simulations, the absence of Pu-238 in the source inventory is a data gap. Pu-238 was reported in some contaminated soil but not in the major sources (the tank farm). The risk based limiting concentration for Pu-238 is essentially the same as the other plutonium isotopes. Qualitatively, the effects of neglecting Pu-238 on the risk assessment results is assessed in Sections 9 through 11.

8.7.1 Total Pu With the Sediment Kd=220 cm^3/g and Aquifer Basalt Kd=8.8 cm^3/g

Figures 8-180 through 8-184 present the simulation results for the transport of Pu through the aquifer region. Contour levels for both the vadose zone and aquifer concentrations are given in Figures 8-180 and 8-181. Corresponding risk contour maps for the aquifer region are given in Figures 8-182, and 8-183.

AQUIFER: The predicted maximum total Pu aquifer concentration is $2x10^{-4}$ pCi/L in the year 2095. This concentration is less than the 10^{-6} risk concentration (0.15 pCi/L) and the cumulative alpha particle activity MCL (15 pCi/L). The concentration in the aquifer resulting from vadose zone infiltration begins to increase about year 7,000 and continues to increase to a peak concentration of 2.25 pCi/L in the year 18,500 (if all the Pu is assumed to be Pu-239, the peak would be ~1.5 pCi/L). The peak concentration exceeds the 10^{-6} risk concentration and is less than the cumulative alpha particle activity MCL of 15 pCi/L. The aquifer area with predicted maximum concentrations greater than the 10^{-6} risk concentration is predicted to extend from the ICPP to near the CFA (Figure 8-183) in 15,000 years.

The use of a sediment Kd of 220 mL/g, vadose zone basalt Kd of 0 mL/g, and aquifer basalt Kd of 8.8 mL/g may still be conservative. Laboratory tests should be undertaken to identify an appropriate set of Pu Kd values for use at the ICPP. The use of an order of magnitude higher Kd would increase the time to the peak aquifer concentration from approximately 16,500 years to 165,000. The peak concentration in the aquifer would be expected to decrease by approximately one order of magnitude due to the increased Kd and approximately two orders of magnitude from radioactive decay.

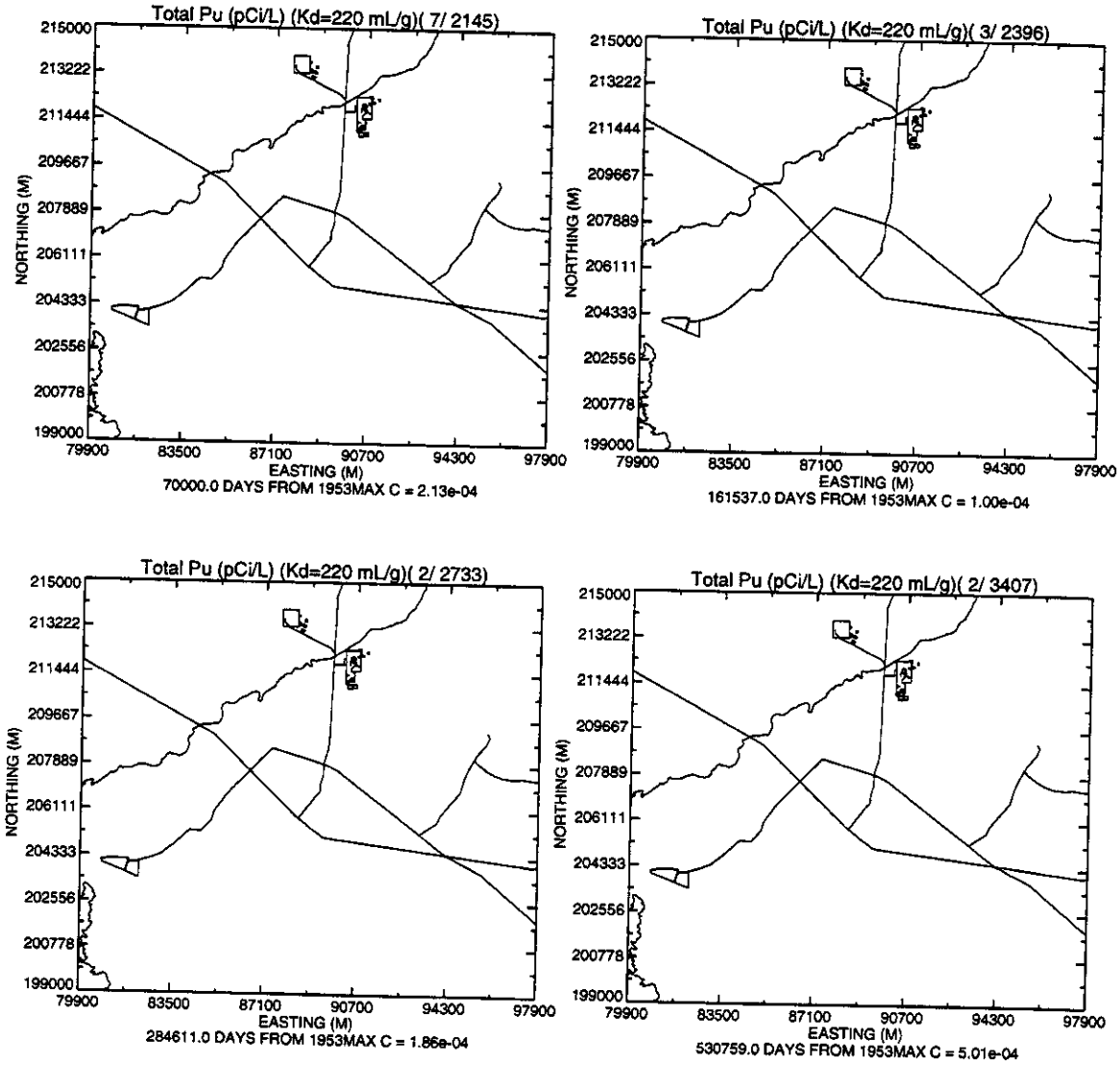

Figure 8-180 Aquifer Pu peak concentration contours.

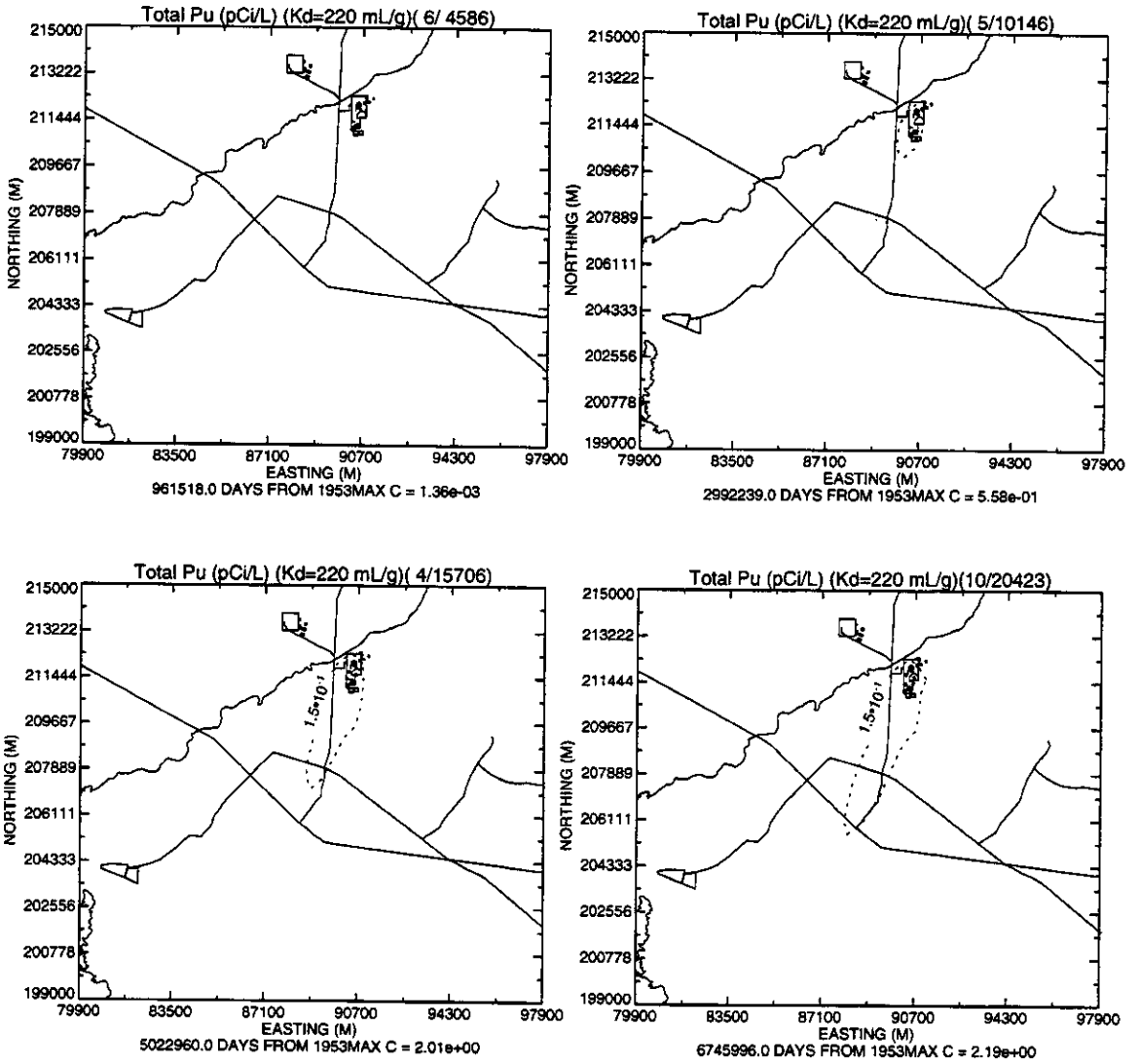

Figure 8-181 Aquifer Pu peak concentration contours.

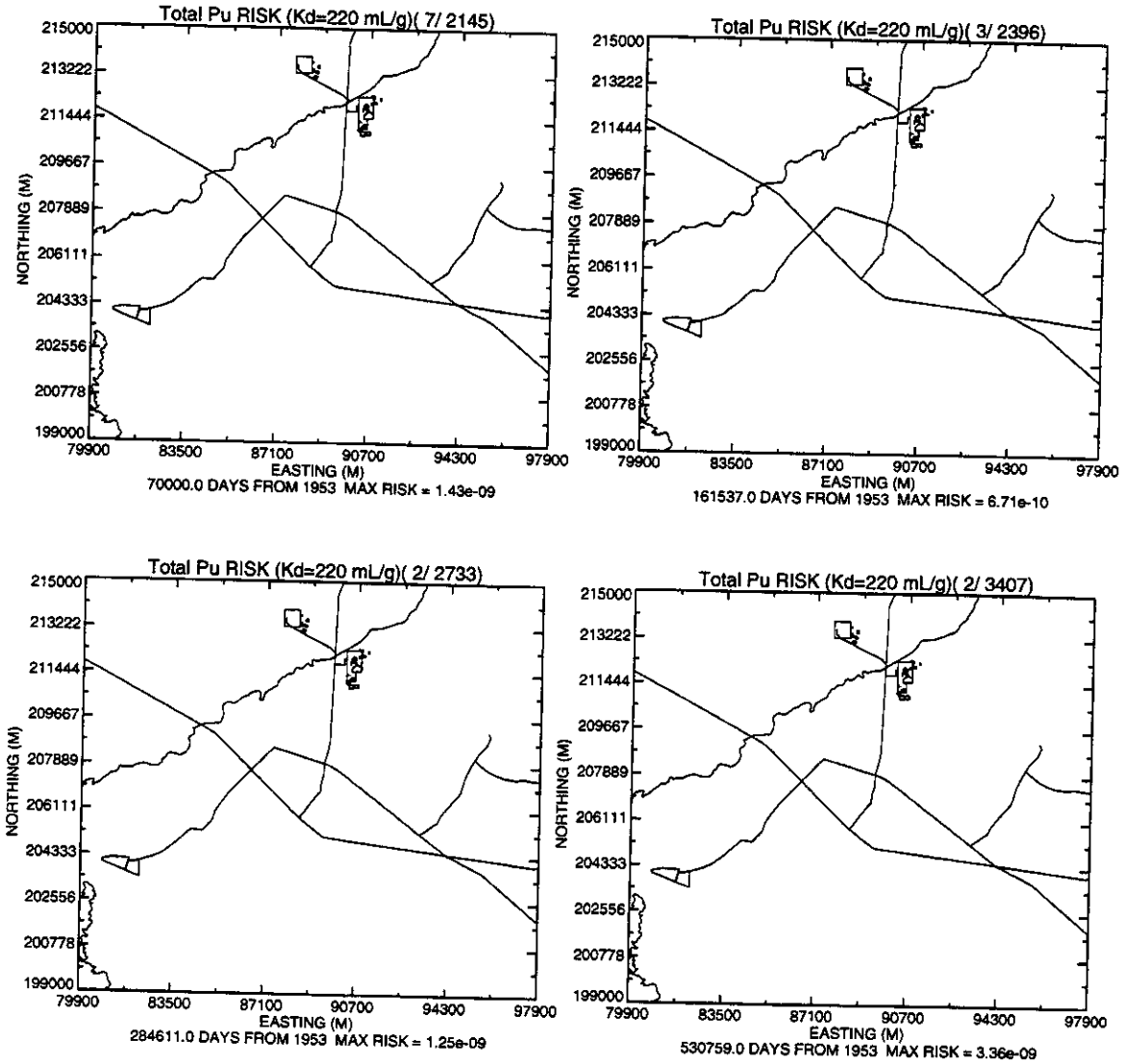

Figure 8-182 Aquifer Pu peak risk contours.

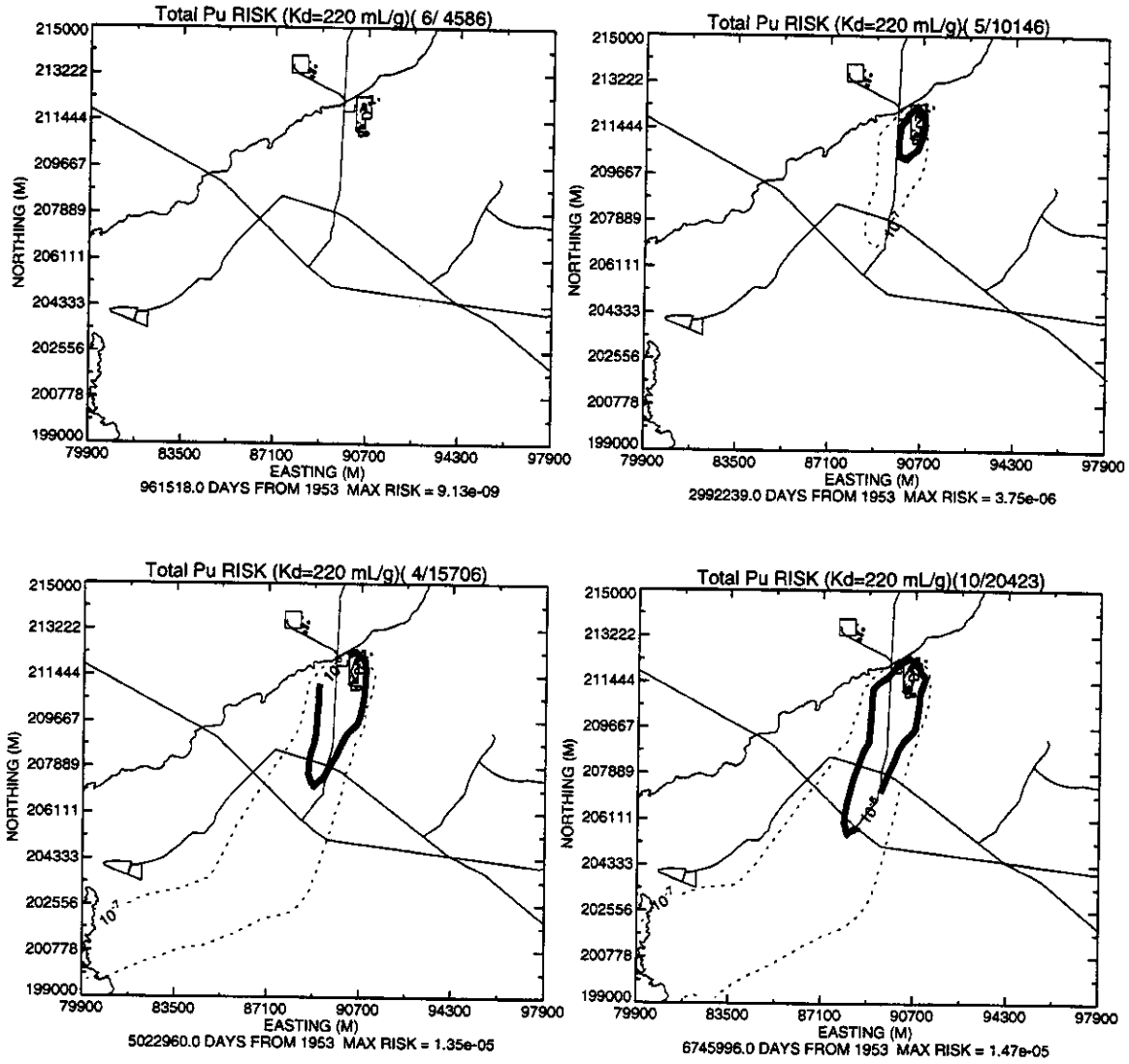

Figure 8-183 Aquifer Pu peak risk contours.

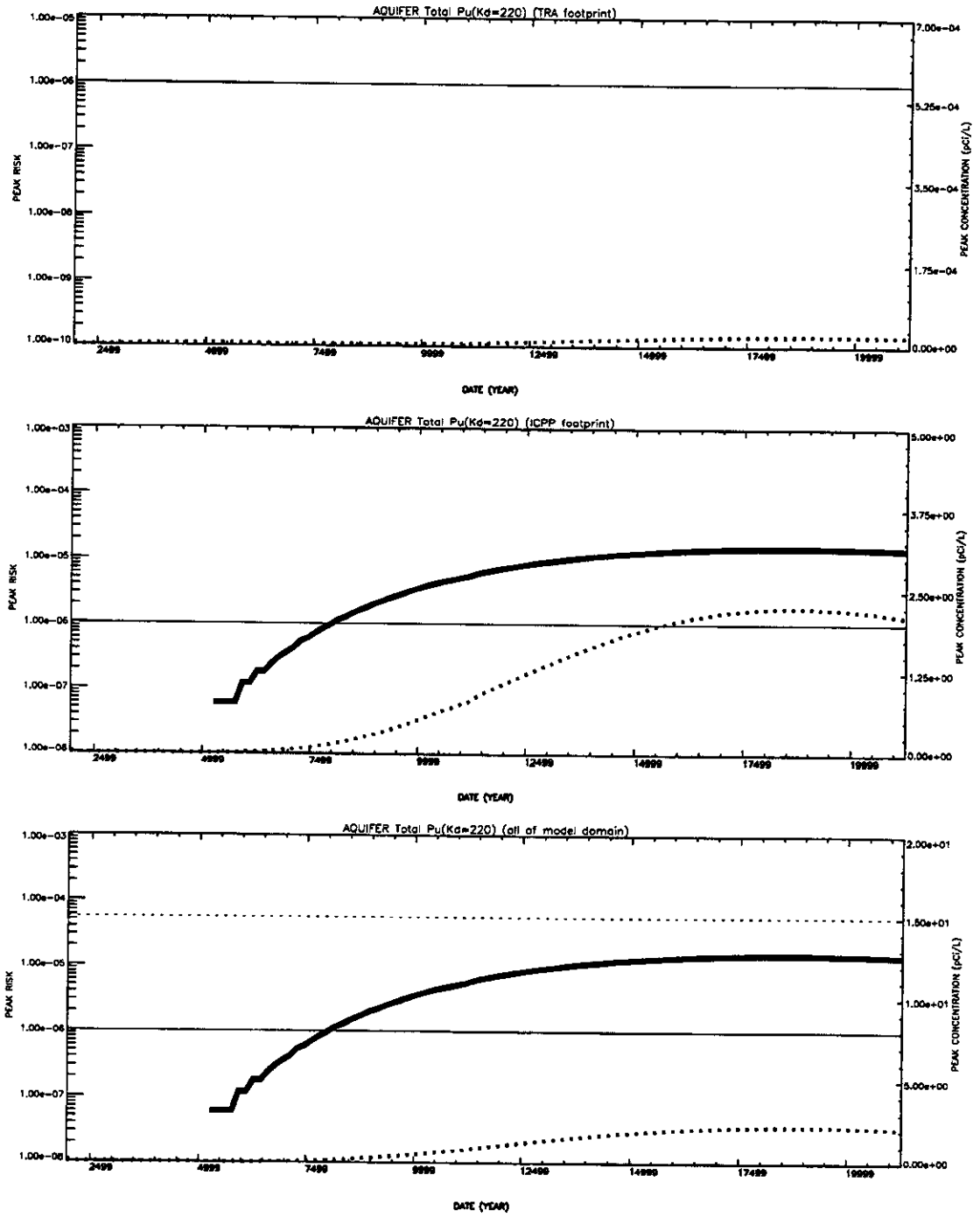

Figure 8-184 Peak aquifer concentration for Pu. Top figure: TRA foot print, Middle figure: ICPP footprint, Bottom Figure: entire aquifer domain. Thick line risk (left scale), dotted line concentration (right scale) solid line 10^{-6} risk (left scale).

8.8 SUMMARY OBSERVATIONS

Table 8-2 contains the predicted peak concentration in the vadose zone for a) the entire simulation time, b) the simulated time corresponding to 30 years from 1995, and c) the simulated time corresponding to 100 years from 1995. Tables 8-3 through 8-5 summarize the peak concentration information for the aquifer transport results. Columns 3 through 8 summarize the simulation results for transport in the vadose zone for the entire simulation period. Column 3 lists the year at the end of the simulation time, for each COPC. Column 4 gives the peak concentration predicted in the vadose zone throughout the entire simulation time for each COPC. Column 5 lists the time corresponding to the peak value, with Columns 6 through 8 indicating where the peak concentration was predicted to occur. The peak concentration 30 years from now is given in Column 9 and the predicted peak concentration 100 years in the future is given in Column 10.

Table 8-2 Vadose zone peak concentrations for the sensitivity analyses runs.

Section	Simulation	Simulation Results For The Period Spanning 1953 Through The Total Simulation Time						Simulation Results For The Year 2025	Simulation Results For The Year 2095
		Year at the End of Simulation Time	Peak Concentration pCi/L	Year of Peak	Easting (m)	Northing (m)	Depth From Surface (m)	Maximum Concentration in 2025 pCi/L	Maximum Concentration in 2095 pCi/L
	Sr-90 Sensitivity to Kd								
7.10	Sr-90 Base Case With A Kd=12 cm^3/g	2244	1.36E+10	1973	90400.	212100.	26.	1.38E+06	1.46E+05
8.1.1	Sr-90 Base case With A Kd=24 cm^3/g	2227	1.36E+10	1973	90400.	212100.	26.	1.13E+06	1.22E+05
8.1.2	Sr-90 With A Kd=0 cm3/g	2095	1.11E+10	1973	90400.	212100.	26.	1.62E+06	8.30E+04
	Sr-90 With Increased Tank Farm Source Mass								
8.2	Sr-90 With Increased Tank Farm Source Mass[a]	2194	1.94E+10	1973	90400.	212100.	26.	1.62E+06	1.79E+05
	Sr-90 With Increased Fire Water Leakage								
8.3	Sr-90 With Increased Fire Water Leakage[a]	2227	1.25E+10	1990	90400.	211500.	18.	4.30E+05	5.69E+04
	Sr-90 Leakage From The Upper Interbed								
8.4.1	Sr-90 With 1-GPM Leakage From The Upper Interbed[a]	----	---	----	---	----	---	----	---
8.4.2	Sr-90 With 5-GPM Leakage From The Upper Interbed[a]	----	---	----	---	----	---	----	---
8.4.3	Sr-90 With 10-GPM Leakage From The Upper Interbed[a]	----	---	----	---	----	---	----	---
	I-129 Sensitivity to Kd								
7.7	I-129 Base case with Kd=0 cm^3/g	2095	6.95E+03	1973	90400.	212100.	26.	3.94E+01	2.74E+00

a. compare these simulations with the Sr-90, Kd=24 cm^3/L simulation.
NA - These values are not available because the scaling used does not calculate concentrations throughout the vadose zone.

Table 8-2 Vadose zone peak concentrations for the sensitivity analyses runs.

Section	Simulation	Simulation Results For The Period Spanning 1953 Through The Total Simulation Time						Simulation Results For The Year 2025	Simulation Results For The Year 2095
		Year at the End of Simulation Time	Peak Concentration pCi/L	Year of Peak	Easting (m)	Northing (m)	Depth From Surface (m)	Maximum Concentration in 2025 pCi/L	Maximum Concentration in 2095 pCi/L
8.5.1	I-129 With A Sediment Kd=0.4 cm3/g, and Aquifer Basalt Kd=0.016 cm3/g	2095	6.94E+03	1973	90400.	212100.	26.	3.51E+01	4.41E+00
8.5.2	I-129 With A Sediment Kd=0.4 cm3/g, and Aquifer Basalt Kd=0.4 cm3/g	2095	6.94E+03	1973	90400.	212100.	26.	3.51E+01	4.41E+00
	Np-237 Sensitivity to Kd								
7.8	Np-237 Base case with Kd=8 cm^3/g	2797	2.15E+06	1990	90600.	212100.	20.	1.13E+02	7.33E+01
8.6.1	Np-237 With A Kd=0 cm3/g	2123	7.61E+05	1990	90600.	212100.	20.	9.37E+01	6.81E+00
	Total Pu Sensitivity to Kd								
7.9	Total Pu Base Case With the Sediment Kd=22 cm^3/g and the Aquifer Basalt Kd=1 cm^3/g	3815	2.66E+07	1990	90400.	211500.	18.	5.32E+03	3.08E+03
8.7.1	Total Pu With the Sediment Kd=220 cm3/g and Aquifer Basalt Kd=8.8 cm3/g	NA	NA	NA	NA	NA	NA	9.97E+02	8.91E+02

a. compare these simulations with the Sr-90, Kd=24 cm^3/L simulation.
NA - These values are not available because the scaling used does not calculate concentrations throughout the vadose zone.

Table 8-3 contains the predicted peak concentration in the entire aquifer simulation domain. Results are presented for a) the entire simulation time, b) 30 years from 1995, and c) 100 years from 1995. The third column of Table 8-3 lists the concentration corresponding to the MCL for each COPC given in Column 2. Column 4 gives the year at the end of the simulation time for transport through the aquifer for each COPC. Columns 5 through 10 summarize the simulation results for transport in the aquifer for the entire simulation period. Columns 5 and 6 give the peak concentration and corresponding risk predicted in the aquifer throughout the entire simulation time for each COPC. Column 7 lists the time corresponding to that value, with Columns 8 through 10 indicating where the peak concentration was predicted to occur. The maximum concentration and corresponding risk 30 years from now is given in Columns 11 and 12, while the predicted maximum concentration and corresponding risk 100 years in the future is given in Columns 13 and 14. The values given in the concentration columns can be compared against the MCL given in Column 3.

Table 8-3 Aquifer peak concentrations and risk for the entire aquifer domain for the sensitivity analyses runs.

Section	Simulation	MCL (pCi/L)	Simulation Results For The Period Spanning 1953 Through The Total Simulation Time							Simulation Results For The Year 2025		Simulation Results For The Year 2095	
			Year at the End of Simulation Time	Peak Concen. pCi/L	Peak Risk	Year of Peak	Easting (m)	Northing (m)	Depth Below Water Table (m)	Maximum Concen. pCi/L	Maximum Risk	Maximum Concen. pCi/L	Maximum Risk
Sr-90 Sensitivity to Kd													
7.10	Sr-90 Base case with A Kd=12 cm^3/g	8	2238	1.20E+03	1.41E-03	1967	90500.	211600.	19.	3.54E+01	4.15E-05	8.08E+00	9.48E-06
8.1.1	Sr-90 With A Kd=24 cm3/g	8	2227	9.20E+02	1.08E-03	1967	90500.	211600.	19.	4.56E+01	5.35E-05	4.12E+00	4.83E-06
8.1.2	Sr-90 With A Kd=0 cm3/g	8	2095	1.67E+06	8.58E-01	1994	90500.	212000.	4.	2.18E+05	2.26E-01	2.24E+04	2.59E-02
Sr-90 With Increased Tank Farm Source Mass													
8.2	Sr-90 With Increased Tank Farm Source Mass[a]	8	2189	9.17E+02	1.08E-03	1967	90500.	211600.	19.	4.55E+01	5.33E-05	4.16E+00	4.89E-06
Sr-90 With Increased Fire Water Leakage													
8.3	Sr-90 With Increased Fire Water Leakage[a]	8	2227	9.17E+02	1.08E-03	1967	90500.	211600.	19.	4.70E+01	5.51E-05	4.20E+00	4.95E-06
Sr-90 Leakage From The Upper Interbed													
8.4.1	Sr-90 With 1-GPM Leakage From The Upper Interbed[a]	8	2227	2.27E+05	2.34E-01	1977	90500.	212000.	4.	2.22E+04	2.58E-02	1.35E+03	1.58E-03
8.4.2	Sr-90 With 5-GPM Leakage From The Upper Interbed[a]	8	2227	8.26E+05	6.21E-01	1975	90500.	212000.	4.	1.07E+05	1.18E-01	6.42E+03	7.50E-03
8.4.3	Sr-90 With 10-GPM Leakage From The Upper Interbed[a]	8	2227	1.24E+06	7.67E-01	1975	90500.	212000.	4.	2.05E+05	2.14E-01	1.23E+04	1.43E-02
I-129 Sensitivity to Kd													
7.7	I-129 Base case with Kd=0.	1	4144	9.71E+01	3.75E-04	1986	90500.	211600.	19.	8.97E+00	3.46E-05	4.68E+00	1.81E-05
8.5.1	I-129 With A Sediment Kd=0.4 cm3/g, and Aquifer Basalt Kd=0.016 cm3/g	1	4144	8.65E+01	3.34E-04	1986	90500.	211600.	19.	7.13E+00	2.75E-05	4.98E+00	1.93E-05
8.5.2	I-129 With A Sediment Kd=0.4 cm3/g, and Aquifer Basalt Kd=0.4 cm3/g	1	2095	3.78E+01	1.46E-04	1986	90500.	211600.	19.	1.27E+01	4.92E-05	6.53E+00	2.52E-05

a. compare these simulations with Sr-90, Kd=24 cm^3/g simulation.

Table 8-3 Aquifer peak concentrations and risk for the entire aquifer domain for the sensitivity analyses runs.

Section	Simulation	MCL (pCi/L)	Simulation Results For The Period Spanning 1953 Through The Total Simulation Time							Simulation Results For The Year 2025		Simulation Results For The Year 2095	
			Year at the End of Simulation Time	Peak Concen. pCi/L	Peak Risk	Year of Peak	Easting (m)	Northing (m)	Depth Below Water Table (m)	Maximum Concen. pCi/L	Maximum Risk	Maximum Concen. pCi/L	Maximum Risk
						Np-237 Sensitivity to Kd							
7.8	Np-237 Base case with Kd=8 cm^3/g	<1.5E+01	2791	3.05E+01	1.92E-04	1986	90500.	211600.	19.	8.03E+00	5.06E-05	3.76E+00	2.37E-05
8.6.1	Np-237 With A Kd=0 cm3/g	<1.5E+01	2928	9.02E+01	5.68E-04	1986	90500.	211600.	19.	9.02E+00	5.68E-05	4.82E+00	3.03E-05
						Total Pu Sensitivity to Kd							
7.9	Total Pu Base Case With Sediment Kd=22 cm^3/g and Aquifer Basalt Kd=1 cm^3/g	<1.5E+01	3804	3.62E+01	2.43E-04	3585	90500.	211600.	4.	3.22E-01	2.15E-06	1.39E-01	9.54E-07
8.7.1	Total Pu With the Sediment Kd=220 cm3/g and Aquifer Basalt Kd=8.8 cm3/g	<1.5E+01	21266	2.25E+00	1.51E-05	18233	90500.	211600.	4.	2.68E-04	1.79E-09	2.41E-04	1.61E-09

a. compare these simulations with Sr-90, Kd=24 cm^3/g simulation.

As indicated in Section 5.2 the primary sources of chromium and H-3 resulted from disposal practices at TRA rather than those at the ICPP. To distinguish the aquifer contamination between the ICPP and TRA areas, Tables 8-4 and 8-5 below present the peak concentrations underlying those local facility areas.

Table 8-4 Aquifer peak concentrations and risk for the ICPP footprint area for the sensitivity analyses runs.

Section	Simulation	Simulation Results For The Period Spanning 1953 Through The Total Simulation Time		Simulation Results For The Year 2025		Simulation Results For The Year 2095	
		Peak Concen. pCi/L	Peak Risk	Maximum Concen. pCi/L	Maximum Risk	Maximum Concen. pCi/L	Maximum Risk
	Sr-90 Sensitivity to Kd						
7.10	Sr-90 Base case with A Kd=12 cm^3/g	1.20E+03	1.41E-03	3.54E+01	4.15E-05	8.08E+00	9.48E-06
8.1.1	Sr-90 Base case with A Kd=24 cm^3/g	9.20E+02	1.08E-03	4.56E+01	5.35E-05	4.12E+00	4.83E-06
8.1.2	Sr-90 With A Kd=0 cm3/g	1.67E+06	8.58E-01	2.18E+05	2.26E-01	2.24E+04	2.59E-02
	Sr-90 With Increased Tank Farm Source Mass						
8.2	Sr-90 With Increased Tank Farm Source Mass[a]	9.17E+02	1.08E-03	4.55E+01	5.33E-05	4.16E+00	4.89E-06
	Sr-90 With Increased Fire Water Leakage						
8.3	Sr-90 With Increased Fire Water Leakage[a]	9.17E+02	1.08E-03	4.70E+01	5.51E-05	4.20E+00	4.95E-06
	Sr-90 Leakage From The Upper Interbed						
8.4.1	Sr-90 With 1-GPM Leakage From The Upper Interbed[a]	2.27E+05	2.34E-01	2.22E+04	2.58E-02	1.35E+03	1.58E-03
8.4.2	Sr-90 With 5-GPM Leakage From The Upper Interbed[a]	8.26E+05	6.21E-01	1.07E+05	1.18E-01	6.42E+03	7.50E-03
8.4.3	Sr-90 With 10-GPM Leakage From The Upper Interbed[a]	1.24E+06	7.67E-01	2.05E+05	2.14E-01	1.23E+04	1.43E-02
	I-129 Sensitivity to Kd						
7.7	I-129 Base case with Kd=0 cm^3/g	9.71E+01	3.75E-04	8.97E+00	3.46E-05	4.68E+00	1.81E-05
8.5.1	I-129 With A Sediment Kd=0.4 cm3/g, and Aquifer Basalt Kd=0.016 cm3/g	8.65E+01	3.34E-04	7.13E+00	2.75E-05	4.98E+00	1.93E-05
8.5.2	I-129 With A Sediment Kd=0.4 cm3/g, and Aquifer Basalt Kd=0.4 cm3/g	3.78E+01	1.46E-04	1.27E+01	4.92E-05	6.53E+00	2.52E-05
	Np-237 Sensitivity to Kd						
7.8	Np-237 Base case with Kd=8 cm^3/g	3.05E+01	1.92E-04	8.03E+00	5.06E-05	1.20E+00	7.57E-06
8.6.1	Np-237 With A Kd=0 cm3/g	9.02E+01	5.68E-04	9.02E+00	5.68E-05	4.82E+00	3.03E-05
	Total Pu Sensitivity to Kd						

a. compare these simulations with the Sr-90, Kd=24 cm^3/g simulation.

Table 8-4 Aquifer peak concentrations and risk for the ICPP footprint area for the sensitivity analyses runs.

Section	Simulation	Simulation Results For The Period Spanning 1953 Through The Total Simulation Time		Simulation Results For The Year 2025		Simulation Results For The Year 2095	
		Peak Concen. pCi/L	Peak Risk	Maximum Concen. pCi/L	Maximum Risk	Maximum Concen. pCi/L	Maximum Risk
	Total Pu Sensitivity to Kd						
7.9	Total Pu Base Case With Sediment Kd=22 cm^3/g and Aquifer Basalt Kd=1 cm^3/g	3.62E+01	2.43E-04	3.22E-01	2.15E-06	1.39E-01	9.54E-07
8.7.1	Total Pu With the Sediment Kd=220 cm^3/g and Aquifer Basalt Kd=8.8 cm^3/g	2.25E+00	1.51E-05	2.68E-04	1.79E-09	2.41E-04	1.61E-09

a. compare these simulations with the Sr-90, Kd=24 cm^3/g simulation.

Table 8-5 Aquifer peak concentrations and risk for the TRA footprint area for the sensitivity analyses runs.

Section	Simulation	Simulation Results For The Period Spanning 1953 Through The Total Simulation Time		Simulation Results For The Year 2025		Simulation Results For The Year 2095	
		Peak Concentration pCi/L	Peak Risk	Maximum Concen. pCi/L	Maximum Risk	Maximum Concen. pCi/L	Maximum Risk
	Sr-90 Sensitivity to Kd						
7.10	Sr-90 Base case with A Kd=12 cm^3/g	1.56E-01	1.79E-07	1.39E-01	1.79E-07	9.65E-02	1.19E-07
8.1.1	Sr-90 With A Kd=24 cm^3/g	2.44E-02	2.87E-08	2.44E-02	2.87E-08	1.80E-02	2.12E-08
8.1.2	Sr-90 With A Kd=0 cm^3/g	1.88E+04	2.19E-02	4.03E+03	4.72E-03	1.67E+02	1.96E-04
	Sr-90 With Increased Tank Farm Source Mass						
8.2	Sr-90 With Increased Tank Farm Source Mass[a]	2.44E-02	2.87E-08	2.44E-02	2.87E-08	1.91E-02	2.22E-08
	Sr-90 With Increased Fire Water Leakage						
8.3	Sr-90 With Increased Fire Water Leakage[a]	5.32E-02	5.96E-08	4.79E-02	5.96E-08	2.39E-02	2.78E-08
	Sr-90 Leakage From The Upper Interbed						

a. compare these simulations with the Sr-90, Kd=24 cm^3/g simulation.

Table 8-5 Aquifer peak concentrations and risk for the TRA footprint area for the sensitivity analyses runs.

Section	Simulation	Simulation Results For The Period Spanning 1953 Through The Total Simulation Time		Simulation Results For The Year 2025		Simulation Results For The Year 2095	
		Peak Concentration pCi/L	Peak Risk	Maximum Concen. pCi/L	Maximum Risk	Maximum Concen. pCi/L	Maximum Risk
8.4.1	Sr-90 With 1-GPM Leakage From The Upper Interbed[a]	1.60E+02	1.87E-04	1.60E+02	1.87E-04	2.31E+01	2.71E-05
8.4.2	Sr-90 With 5-GPM Leakage From The Upper Interbed[a]	8.15E+02	9.56E-04	8.15E+02	9.56E-04	1.13E+02	1.33E-04
8.4.3	Sr-90 With 10-GPM Leakage From The Upper Interbed[a]	1.68E+03	1.97E-03	1.68E+03	1.97E-03	2.27E+02	2.66E-04
	I-129 Sensitivity to Kd						
7.7	I-129 Base case with Kd=0 cm^3/g	4.82E-01	1.85E-06	2.56E-02	1.19E-07	1.21E-02	5.96E-08
8.5.1	I-129 With A Sediment Kd=0.4 cm^3/g, and Aquifer Basalt Kd=0.016 cm^3/g	2.17E-01	8.34E-07	1.82E-02	5.96E-08	8.86E-03	4.36E-08
8.5.2	I-129 With A Sediment Kd=0.4 cm^3/g, and Aquifer Basalt Kd=0.4 cm^3/g	1.37E-01	5.36E-07	4.04E-02	1.79E-07	2.05E-02	1.01E-07
	Np-237 Sensitivity to Kd						
7.8	Np-237 Base case with Kd=8 cm^3/g	2.33E-02	1.19E-07	2.00E-02	1.19E-07	1.96E-02	1.19E-07
8.6.1	Np-237 With A Kd=0 cm^3/g	4.71E-01	2.98E-06	1.24E-01	7.75E-07	3.33E-02	2.38E-07
	Total Pu Sensitivity to Kd						
7.9	Total Pu Base Case With Sediment Kd=22 cm^3/g and Aquifer Basalt Kd=1 cm^3/g	2.91E-04	1.94E-09	1.54E-04	1.03E-09	1.37E-04	9.13E-10
8.7.1	Total Pu With the Sediment Kd=220 cm^3/g and Aquifer Basalt Kd=8.8 cm^3/g	2.35E-05	1.57E-10	1.59E-09	1.06E-14	1.24E-08	8.28E-14

a. compare these simulations with the Sr-90, Kd=24 cm^3/g simulation.

For the simulations in which Kd was varied (Sr-90, I-129 and Np-237), it is difficult to assess the relative impact by comparing the peak concentrations only. This section has provided the model to field data comparison figures for each variation, which allows assessment of the overall model performance. The results are only summarized in this section. The following summarizes the sensitivity of the modeling results to varying parameters, source estimates, and water leakage.

1. For Sr-90, a Kd of 0 cm^3/g was clearly shown to be unrealistic. However, it is very difficult to determine whether a Kd of 12 cm^3/g (base case) or 24 cm^3/g better predicts the historical data. Aquifer model predictions using both Kd values fit the field data fairly well but for different wells. The vadose zone comparison curves show that the model concentrations are slightly high in both cases. Based on a qualitative eval-

uation of the field data and predictions, the Kd in the alluvium and sediments was probably underestimated. As a result, the model predictions using a Kd of 12 cm^3/g fit the field data for the aquifer fairly well, while the vadose zone comparison curves show that the model concentrations are high. Because neither Kd=12 or 24 cm^3/g are clearly better than the other, Kd=12 cm^3/g was chosen to be conservative.

2. The simulation evaluating the effect of increased mass for Sr-90 shows that because of a relatively short half-life and adsorption occurring in the vadose zone, increasing the mass by a factor of 1.5 results in an insignificant increase in mass entering the aquifer. As a result, the risk associated with Sr-90, or any other adsorbing- short-lived radionuclide, will be insensitive to this magnitude of increase in the mass assumed at the tank farm.

3. Increasing the water losses near the tank farm within the uncertainty allowed by metering errors also results in relatively small changes in the risk in the aquifer for Sr-90.

4. Losses to the aquifer from the vadose zone as a result of potential leaks around well casings has a potentially large impact on the quality of water in the aquifer. A small assumed leakage rate in the highest concentration area of the sediment units in the vadose zone results in extremely high concentrations of Sr-90 in the aquifer. Apparently, this leakage does not occur based on measured field data. If in fact the wells leak in the vadose zone, either the leakage is trapped in a lower sediment unit while still in the vadose zone and allowed to decay, or the leakage rate is much smaller than that assumed in this sensitivity study. This sensitivity simulation placed the leakage directly into the aquifer rather than placing it in a lower vadose zone unit.

5. The Kd for the I-129 base case was 0 cm^3/g. Two larger Kd values were used to evaluate the simulation result's sensitivity to Kd (1. sediment Kd=0.4 cm^3/g and aquifer basalt Kd=0.016 cm^3/g, and 2. Kd=0.4 cm^3/g for both the sediment and aquifer basalt). The change in Kd did not result in significantly different predictions than observed in the base case using a Kd of 0 cm^3/g. This is primarily because the bulk of the I-129 was disposed of directly to the injection well, and thus travels through primarily aquifer basalts. If the I-129 had been discharged into the vadose zone, the higher sediment Kd would have resulted in noticeably different results because the I-129 would have traversed large sections of vadose zone sediments as observed with the Kds used for Sr-90. In contrast, the only aquifer sediment exists in the form of the HI interbed and the bulk of the injected I-129 travels through basalt material.

6. Comparisons of model predicted concentrations in the vadose zone to field data for Np-237 using a Kd of 8 cm^3/g (base case) were better than the results assuming a Kd=0 cm^3/g. The Kd=0 cm^3/g case overprediction of Np-237 concentrations in the vadose zone implied that either the source term was overestimated or that Np-237 should be modeled as an adsorptive species in INEL sediments. The assumed value used in the base case predicts vadose zone concentrations which are very close to the measured concentrations, indicating that a Kd of 8 cm^3/g is a reasonable estimate of the sediment Kd for Np-237. On the other hand, there was very little aquifer data available for use in comparing model predictions to measured concentrations (data were collected once in 1994). More Np-237 data is needed to evaluate the trends over time. Using this limited information, comparisons of aquifer model predicted concentrations to field data show that predicted concentrations are significantly high in wells very close to the injection well, are underpredicted in wells that are upgradient, but are very close for wells further down gradient from the injection well. As a result of limited data, it is difficult to evaluate whether the comparison using base case Kd=8 cm^3/g is significantly better than the Kd=0 cm^3/g case, for the aquifer basalts.

7. The sensitivity of the Total Pu concentrations was evaluated by increasing the Kd value an order of magnitude. The peak aquifer concentration after 2095 was decreased by slightly more than an order of magnitude (from 36.2 to 2.25 pCi/L) and the time to the peak concentration was increased an order of magnitude (from year 3585 to year 18233). The predictions could not be compared with historical data because past sampling efforts have not found Pu at concentrations greater than the uncertainty of the analytical methods used.

These sensitivity results illustrate that the model predictions are;

- relatively insensitive for short lived radionuclides when the Kd and water fluxes are the varied parameters,
- sensitive to the Pu Kd value, and
- very sensitive to the leakage of water from the upper interbed to the aquifer.

9 DISCUSSION OF PHYSICAL PARAMETER UNCERTAINTY

There were two major WAG-3 subsurface modeling objectives. The first was to estimate contaminant fate and transport in support of the WAG-3 OU-3-13 (ICPP) Baseline Risk Assessment, and the second was to develop a simulation tool to help evaluate the effectiveness of remedial action alternatives with respect to the groundwater pathway. In order to satisfy the first objective, two subsurface flow and transport conceptual models were devised and implemented. The first model was for the vadose zone, and the second model was for the aquifer. Numerical simulation results were obtained using TETRAD together with observed groundwater quality data to evaluate the risk from the predicted contaminant concentrations in the aquifer.

Numerical predictions of transport in the vadose zone and aquifer were based on a) an analysis of the hydrogeologic data forming the basis of the conceptual models for both the vadose zone and aquifer transport models, b) estimates of natural and anthropogenic recharge water sources, c) estimates of contaminant releases forming the source term information, and d) estimates of the contaminant-soil-basalt chemical interactions. As is always the case in subsurface modeling, the available hydrogeologic data were not used directly, but were subject to interpretation and simplified in order to cast the data into a modeling framework; direct measurements of all historical sources of recharge and contaminant were not available; and the availability of field data for the purposes of determining the soil-basalt-contaminant interactions was minimal. As a result, the ability of the simulation results presented in Section 7 to represent, or adequately predict, contaminant transport in the subsurface of the ICPP are inherently uncertain. The uncertainties associated with these predictions of transport are primarily functions of 1) the degree to which conceptual model represents unsaturated and saturated zone flow and transport processes at the ICPP, 2) the choice of the contaminant specific Kd values and ability to refine the Kd estimate based on field data, and 3) the accuracy of the estimated source term.

As discussed below, the uncertainty associated with the conceptual model and its parameterization can be, and has been, qualitatively assessed. This assessment was conducted independently from the influence of Kd, and based on relatively accurate source information. On the other hand, the uncertainty arising from estimating contaminant releases (volume and content) and of estimating the interaction of the contaminant with the soil and basalt (Kds) are virtually impossible to quantify independently, and are potentially orders of magnitude more significant. Jointly estimating the combined source term and Kd requires sufficient historical field data from which the insitu transport can be assessed. This estimation process requires that both temporally and spatially variable data exists. In the case of most of the COPCs disposed of at the ICPP, there is insufficient data available for this process. The conceptual model and Kd uncertainties are summarized in this section and the accuracy of the source term is addressed in Section 10.

9.1 CONCEPTUAL MODEL

The ability of the two conceptual models (vadose zone and aquifer) to represent hydraulic conditions and the transport of contaminants was illustrated in Sections 3 and 4. In those sections, the calibration results indicated that it was possible to parameterize the conceptual models in such a way to accurately represent hydraulic data and the transport of conservative tracers in the 1950-1995 time frame. Calibration to hydraulic data (head in the aquifer, and perched water elevations in the vadose zone) was obtained by adjusting the model equivalent of porosity, hydraulic conductivity, unsaturated permeability characteristics, and infiltration until the numerical predictions adequately reproduced field measurements of the target parameter.

Calibration to transport further refined the physical characteristics such that numerical predictions of chloride and H-3 migration matched observed field data over the time period for which data were available. At the INEEL, it is generally assumed that the adsorption of chloride and H-3 to basalt and sediment is negligible. Therefore, they were treated as conservative tracers and were useful for the purposes of calibration. The results of the calibration exercises indicated that obtaining acceptable agreement was possible between hydraulic head, perched water elevations, and transport in both the vadose and aquifer regions. Due to the complexity of the subsurface and sources of water and contaminants, the excellent matches obtained in the flow model and chloride and tritium transport simulations are believed to address and minimize the inherent uncertainty.

The sensitivity to boundary conditions used in the aquifer model were made apparent when some of the aquifer transport simulations were re-run using a larger aquifer modeling domain. This was done for H-3, I-129, and total Pu because the original transport predictions indicated that these contaminants will, at some point in the future, migrate beyond the original aquifer modeling domain at concentrations greater than the 10^{-6} risk based concentration. In order to perform these simulations, boundary conditions, and physical and hydrologic parameters had to be determined at the edges of the new simulation domain. For the boundary conditions and hydraulic conductivity, values were interpolated from the WAG-10 model as was done for the original aquifer model. In the extended domain, it was assumed that there was not an influence from the HI interbed or I basalt flow. These two geologic features were neglected in the parameterization of the extended domain. Within the original model domain extent, the parameters were identical to those used in the original model.

After parameterization, transport simulations were run for the 3 contaminants listed above, and the concentration as a function of time were compared to the original model results. In all cases, the difference between model predictions was less than 10%. That a difference would occur was predicted because of the change in model block size which alters the averaging area over which the pressure and concentration are predicted. In addition, moving the outflow boundary downgradient changes the local velocity at the original outflow boundary. The fact that the difference was as small as it was is an indication that the boundary conditions for the aquifer are fairly robust, and that the uncertainty in transport resulting from the outer boundary condition, based on this measure, is acceptable.

The model predictions can be very sensitive to the model dispersion in the vadose zone. Dispersion is an essential part of a subsurface transport model. It accounts for the natural spreading of a contaminant plume that cannot be simulated with a strictly advective (plug flow) model. Model dispersion comes both from numerical dispersion and dispersion purposely incorporated in the model. For contaminants with long decay half-lives, relative to their vadose zone travel time, the bulk of the mass will be advectively transported through the vadose zone. Dispersion will decrease the predicted peak concentration in the aquifer, but not affect the time to the peak mass flux to the aquifer. In general, for contaminants with short decay half-lives relative to the vadose zone travel time, the contaminant will decay in the vadose zone without any significant mass transfer to the aquifer. However, some mass will be transferred to the aquifer because of dispersive transport in the model. The dispersive transport will be significant if the initial mass of the contaminant is sufficiently large that even though the bulk of the contaminant decays in the vadose zone, a significant mass is transferred to the aquifer through dispersion. At the ICPP, this is the case for Sr-90. A large activity of Sr-90 was discharged at the tank farm. The advective transport time through the vadose zone is estimated to be approximately 800 years (with a Kd of 12 cm^3/g) which is 27 half lives. Virtually all of the Sr-90 will have decayed by that time. However, the model simulation results show a dispersive mass flux to the aquifer over the next 300 to 400 years that is sufficient to pose a Sr-90 risk to the aquifer. Sufficient field measurements are not available to calibrate Sr-90 transport through the vadose zone, as a result of this dispersive flux. Therefore, it is not possible to calculate the uncertainty associated with the Sr-90 predicted aquifer concentrations, from discharges at the tank farm.

9.2 Kd

There are many different views on obtaining representative Kds for INEEL sediments and basalts. Two of these approach the selection process from entirely different perspectives. The first treats the sorption coefficient as a purely geochemical phenomena that accounts for all processes that result in removal of a contaminant from the aqueous phase, and the second recognizes that, when used to simulate transport in complex heterogeneous media, the sorption coefficient is actually accounting for physical or hydrologic heterogeneity in addition to accounting for geochemical liquid-solid interactions. Numerical values of sorption coefficients obtained purely for the purposes of liquid-solid characterization will differ substantially from those derived for the purposes of transport simulation. Sections 9.2.2 and 9.2.1 below discuss how Kds are derived in support of each of these alternative view points, and Section 9.2.3 presents a brief discussion of the relative differences.

9.2.1 Geochemically Based Contaminant Distribution Coefficients

In a recent letter report, Dicke (1997) provided an explanation of INEEL site specific Kd's, how they were measured, and estimates for Kd's where INEEL site specific information was not available. The report discusses the fact that although some site-specific adsorption studies have been conducted for some contaminants of interest at the INEEL, many metals and radionuclides of interest at the Radioactive Waste Management Complex (RWMC) have no site-specific distribution coefficients available. In absence of site specific information, sediment and basalt sorption estimates for WAG-7 Environmental Restoration modeling efforts were estimated from literature values. The following text presents a summary of the information contained in that letter report with tables of the resultant Kds.

9.2.1.1 Distribution Coefficients and Sorption

Sorption describes all processes that result in removal of a contaminant from the aqueous phase. Adsorption refers to an actual chemical process that bonds contaminants to a solid. The distribution coefficient (K_d) used in transport modeling is a bulk term that encompasses all processes that remove a contaminant from the solution. This coefficient results from fitting a linear isotherm to experimental observations and neglects the actual mechanism or mechanisms responsible for the contaminant removal.

The distribution coefficient is the least complex numerical means of describing sorption and for this reason has been widely incorporated into transport codes. Distribution coefficients are determined by measuring the amount of a known contaminant that remains in solution after contact with a known mass of a solid (Equation 1).

$$K_d = \frac{S}{C} \tag{1}$$

where:

S = mass of contaminant adsorbed per unit mass of geologic material,

C = mass of contaminant in solution per unit volume of solute,

K_d = distribution coefficient.

An example of an adsorption isotherm is given in Figure 9-1 where C represents the concentration of the contaminant in moles/L and Γ is the site density in moles/mole. The gray zone represents the portion of the isotherm that can be described by a K_d (i.e., the relationship between C and Γ is linear). The line begins to flatten as the concentration of available adsorption sites become limited. Under some conditions, precipitation of the contaminant can occur after adsorption sites are completely occupied resulting in a second upward rise in the sorption curve (dashed line). If this occurs, the additional removal of contaminant is not typically incorporated in transport simulation unless it is shown that precipitation can occur in the natural system. The slope of the line indicates the type of isotherm used to describe the adsorption with a slope of 1 indicative of a

Langmuir isotherm and a slope less than 1 indicating a Freundlich isotherm. In systems where the pH varies, a series of isotherms are produced for different pH conditions.

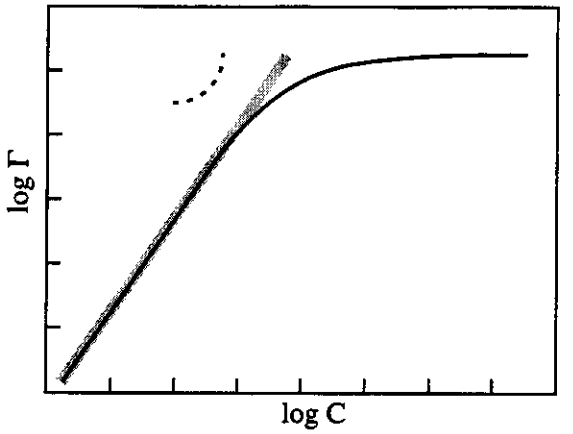

Figure 9-1 Characteristic adsorption isotherm. The linear portion of the plot can be described by a K_d. To capture the information in the remainder of the plot, another isotherm like the Langmuir isotherm is required.

The primary assumption when fitting a linear isotherm to sorption experiments is that K_d's partition the contaminant into the solid and liquid phases with no upper limit to the amount of contaminant that can be sorbed. This implies that there are an infinite number of adsorption sites in the soil or geologic material which is typically valid in dilute plumes. Values for distribution coefficient range from 0 mL/g, for conservative contaminants like tritium, to hundreds of thousands for reactive contaminants on high-surface-area materials (e.g., plutonium sorption on tuff). In addition, variations of several orders of magnitude have been measured for a given site-specific material with no insight into the reason for the variation (Kent et al., 1988).

9.2.1.2 Distribution Coefficient Measurement Methods

A variety of methods are used to determine the distribution coefficient for a specific contaminant, solution, and solid. Batch experiments are the most predominant method because results can be obtained relatively quickly at reasonable costs for most contaminants. Column experiments require more time to set up and can take extensive time periods to complete for reactive contaminants (i.e., achieve breakthrough of the tracer). Insitu studies are potentially the most useful, but are not often feasible due to costs and regulatory constraints. Estimating a K_d using existing values for non-site specific materials is the least favorable method, but is often the only alternative available.

The first requirement in conducting batch or column experiments is to determine the procedure to be used in the investigation. This entails determining the appropriate mineralogy, solution composition, solid/solution ratio (batch), contact time (batch) or flow velocity (column), particle size, temperature, and atmospheric conditions. The procedure for preparing the solid and solution includes determining the contaminant concentration to be used. Additionally, some basic modeling of the system should be performed to evaluate possible complicating factors in the experiment such as precipitation of the contaminant. When actinide or other elements that can be present in more than one oxidation state are the targeted contaminant, it is critical to prepare the contaminant correctly to ensure that oxidation states are maintained, and that they are representative of the site specific oxidation states.

- Batch experiments are conducted by contacting the solid phase of interest with a contaminant in the selected solution chemistry. The solid phase is ground or crushed if it is consolidated material, and the material is sieved to collect the size distribution of interest in the study. Typically, the fine-grained particles are removed from use in the batch experiments. The remaining

solid is then contacted with the water selected for use in the batch experiment to bring the freshly ground sample to equilibrium with the water composition. A split sample from the solid material is often used to equilibrate a water sample with the solid. Both types of samples are then centrifuged to separate the phases and the equilibrated water is also filtered to ensure that no fine materials are included in the water. The filtered water is then used to prepare the tracer solution for the batch experiment.

The prepared solid and tracer solutions are then mixed at the specified solid solution ratio. Solution volumes from 10 to 50 mL are often used in contact with 1 g of solid. Batch experiments are usually conducted in either polyethylene or polycarbonate tubes with sealed tops. The tube or group of tubes is placed on a shaker and agitated for the required contact time. The tubes are then centrifuged, the liquid is extracted, and the soluble contaminant concentration is determined. This procedure is followed for all solid/solution ratios and solution compositions of interest.

- Column experiments are particularly useful in determining retardation of contaminants that do not show appreciable sorption on a solid because the breakthrough of the contaminant can be monitored more precisely than can batch experiments. However, batch experiments are conducted prior to the column experiment to determine the time period required to conduct the experiment is reasonable (i.e., weeks or months and not years), and because highly sorptive materials and reactive contaminants will not show contaminant concentrations (i.e., breakthrough) for extensive periods of time and will indicate that column studies are not practical.

  The preparation for column experiments is similar to batch experiments. Unconsolidated material is sieved, and the grain size distribution of interest is collected and contacted with the solution water to bring the water and solid into equilibrium. Unconsolidated material is packed in the column in lifts at specified compaction pressures to obtain the hydraulic properties that are of interest. Core samples are also used in column experiments, but are typically restricted to relatively permeable materials in order to obtain results in a reasonable time frame. Consolidated materials are often ground or crushed and used in column experiments. In these experiments, the ground material is equilibrated with the solution composition prior to addition of the tracer.

  Column experiments begin by saturating the column with the water composition of interest, which is done by gradually pushing water up through the bottom of the column to reduce the potential of air pockets forming within the column. After the column is saturated, the flow field is established in the column and the contaminant is added after steady-state conditions have been achieved. The effluent water is sampled at prescribed intervals for contaminant analysis, and the resulting plot of time versus concentration will allow the distribution coefficient to be determined.

9.2.1.3 INEEL Distribution Coefficients

The most pertinent K_d's for the INEEL are those measured using INEEL sediments and basalt under expected solution conditions. Table 9-1 summarizes the available INEEL site-specific distribution coefficients obtained from a review of INEEL related reports. The lowest K_d's correspond to basalts as expected given that INEEL sediments have a greater amount of more reactive minerals (e.g., illite, smectite, kaolinite) than do the basalts. The interbed and surficial sediments do not display a definite pattern (i.e., interbeds more reactive than surficial sediments) for reactivity.

Table 9-1 K_d values for contaminants on INEEL materials.

Element	Surficial Sediments Kd (Range) (mL/g)	Interbeds Kd (Range) (mL/g)	Basalt Kd (Range) (mL/g)
Am		450 (450-1,100)[b]	70 (70-280)[b]
Co		1,148 (1148-3912)[b]	11 (11-54)[b]
Cs	950 (589-1,253)[a] (75-225)[c]	2,228 (2,228-3,255)[b]	39 (39-44)
Pu	7,800 (7,800-22,000)[b]	5,100 (5,100-7,900)[b]	70 (70-130)[b]
Sr	24 (23-26)[a] (8.3-16.6)[c] 50 (35-52)[d]	42 (42-63)[b] 155 (110-186)[d]	6 (6-13)[b] (1.1-2.7)[d]
Tc	0[d]	0[d]	0[d]
U		3.4 (3.4-9)[b]	0.2 (0.2-5.2)[b]
Hg	972 (236-1,912)[d]	176 (72-673)[d]	(9.2-87)[d]

a Schmalz (1972)
b Newman et al. (in Preparation)
c Hawkins and Short (1965)
d Del Debbio and Thomas (1989)

These basalt distribution coefficients were typically measured after crushing the basalt and are based on a specific size fraction. This has the potential to alter the resultant K_d by removing or reducing the oxidized mineral surfaces and secondary minerals produced by weathering of the basalt surfaces. Typically, the fines are not used in the sorption experiments, but in general, crushing the basalt increases the amount of fresh mineral surfaces to unnatural levels.

In order to address the mobility of the remaining contaminants in the RWMC RI/FS, a data base and literature review was conducted. The Nuclear Energy Agencies distribution coefficient data base (Ticknor and Ruegger, 1989) was used to provide the next level of K_d values. Experimental values were available for basalt, generic clays, specific clay minerals (e.g., smectite, kaolinite, illite), and sands. Experiments conducted under pH conditions outside the range (6.5 to 8.5) common to INEEL waters were removed from consideration for the sediment values. Many of the reported basalt experiments were conducted at higher pH but were not excluded from consideration because results do not differ significantly with changes in pH. The data were sorted by solid type and oxidizing conditions used in the experiments. The waters at the INEEL tend to be oxygen-rich, and experiments conducted under oxidizing conditions were selected for further consideration.

The values selected for use from the NEA data base were statistically analyzed to determine minimum, mean, median, and maximum values for each material type. Results of this data base search are given in Table 9-2. The median value is presented as the most reasonable estimate of the distribution coefficient and the range is represented by the minimum and maximum values. All of the contaminants with available NEA data were normalized to clay mineral concentrations found in RWMC sediments or direct sediment values if no clay mineral values are available. Basalt measurements under oxidizing conditions were taken directly from the data base.

Table 9-2 K_d estimates for interbeds and surficial sediments (oxidizing conditions).

Radionuclides	NEA Kd (range) (mL/g)	INEEL Kd (range) (mL/g)
C	2.3 (1.9-3.1)[d]	0.2(0.2-0.3)
Co	813 (1.2-75,000)[a]	80 (0.1-75,000)
Cs	10,000 (167-25,000)[b]	1,200 (20-3,000)
Eu	650 (60-1,600)[e]	13 (1.2-32)
I	1.75 (0.2-81.4)[c]	0.16(0.02-7.3)
Nb (anaerobic)	540 (100-1,140)[f]	500
Ni	365 (190-1,600)[f]	300
Np	64 (37-157)[b]	8 (4-19)
Pu	7,930 (2,262-700,000)[c]	700 (200-63,000)
Ra	6,400 (980-21,000)[c]	575 (88-1,890)
Sr	380 (266-1,078)[b]	46 (32-130)
Sb	7 (0.5-37.7)[f]	7 (0.5-37.7)
Tc	8 (0.8-453)[a]	0.96 (0.1-54)
Th		500 (75% of Pu)
U	147 (27-1,450)[b]	18 (3-174)

a Total clays
b Smectites (12% of sediment)
c Illite (9% of sediment)
d Sand and montmorillinite (10%)
e Kaolinite (2% of sediment)
f Sediments

Kds for contaminants missing site-specific or NEA sorption data were selected from several compendia of distribution coefficients from the literature (Sheppard and Thibault, 1990; Coughtrey et al., 1985; Ames and Rai, 1978; Isherwood, 1981). Of these sources, Sheppard and Thibault (1990) used soil grain-size classifications and organic content to further separate their K_d listing. This set of data is presented in Table 9-3, and should be conservative for most conditions.

Table 9-3 K_d determination for contaminants on sediments.

Element	Sand[a] K_d (range) (mL/g)	Loam[a] K_d (range) (mL/g)	Agricultural Soils[b] K_d (range) (mL/g)
Am	1,900 (8.2-300,000)	9,600 (400-48,309)	810 (1-47,230)
C	5 (1.7-7.1)	20 (CR)	
Cd	80 (2.7-625)	40 (7.0-962)	6.7 (1.26-26.8)
Cm	4,000 (780-22,970)	18,000 (7,666-44,260)	3,300 (93.3-51,900)
Co	60 (0.07-9,000)	1,300 (100-9,700)	55 (0.2-3,800)
Cs	280 (0.2-10,000)	4,600 (560 - 61,287)	1,100 (10-52,000)
Cr	70 (1.7-1,729)	30 (2.2-1,000)	37 (1.2-1,800)

a Sheppard and Thibault (1990)
b Baes and Sharp (1983)

Table 9-3 K_d determination for contaminants on sediments.

Element	Sand[a] K_d (range) (mL/g)	Loam[a] K_d (range) (mL/g)	Agricultural Soils[b] K_d (range) (mL/g)
H	0.06 (0.04-0.1)	20	
I	1.0 (0.04-81)	5 (0.1-43)	ND
Nb	160 (CR)	550 (CR)	
Ni	400 (60-3,600)	300 (CR)	ND
Np	5 (0.5-390)	25 (1.3-79)	11 (0.16-929)
Pu	550 (27-36,000)	1200 (100-5,933)	1,800 (11-300,000)
Ra	500 (57-21,000)	36,000 (1,262-530,000)	
Sr	15 (0.05-190)	20 (0.01-300)	27 (0.15-3,300)
Tc	0.1 (0.01-16)	0.1 (0.01-0.4)	0.033 (0.003-0.28)
Th	3200 (207-150,000)	3,300 (CR)	60,000 (2,000-510,000)
U	35 (0.03-2,200)	15 (0.2-4,500)	45 (10.5-4,400)
Ac	450 (CR)	1,500 (CR)	ND
Pb	270 (19 - 1,405)	16,000 (3500 - 59,000)	99 (4.5 - 7,640)
Pa	550 (CR)	1,800 (CR)	

a Sheppard and Thibault (1990)
b Baes and Sharp (1983)

Results of these searches have been compiled into Table 9-4 for all contaminants. When information was lacking for a particular contaminant from any of the aforementioned data sets, an appropriate analog was selected from the available list. Values for chloride, sodium, and tritium were assumed to be zero.

Table 9-4 K_d estimates for contaminants on INEEL materials.

Element	Sediments Kd (Range) (mL/g)	Basalt Kd (Range) (mL/g)
Am	450 (450-1100)[a]	70 (70-280)[a]
Be	250 (250-800)[d]	12 (12-40)[h]
C	5 (2-20)[e]	0
Cd	40 (7.0-962)[d]	2 (0.35-48)[h]
Cl	0	0
Cm	400 (400-1000)	70 (70-280)
Co	1,000 (50-4,000)[a,c]	11 (11-54)[a]
Cr	30 (2.2-1,000)	1.5 (0.11-50)[h]
Cs	1,000 (589-3,255)[a,c]	39 (39-44)[a]
Eu	400 (400-1000)	70 (70-280)
H	0	0
I	0.1 (0.02-5)	0
Na	0	0
Nb	500 (100-1,000)	8 (1.3-51)
Ni	300 (60-2,000)	10 (5-54)
NO_3	0	0

a Newman et al., (in preparation)
b Hawkins, 1964.
c Del Debbio and Thomas, 1989.
d Low end of Loam range (agrees with interbed experiments)
e range from NEA and Sheppard
f from NEA Database
g Kelmers, 1984
h 5% of sediment value

Table 9-4 K_d estimates for contaminants on INEEL materials.

Element	Sediments Kd (Range) (mL/g)	Basalt Kd (Range) (mL/g)
Np	8 (1-80)	8 (1.3-51)[f]
Pu	5,100 (5,100-22,000)[a]	100 (70-130)[a,g]
Ra	575 (88-1,890)	127 (127-186)[g]
Sb	7 (0.5-45)[e,f]	0.35 (0.025-2)[h]
Sr	60 (35-186)[a,c]	6 (1-13)[a,c]
Tc	0[c]	0[c]
Th	500 (200-3,000)	100 (70-130)
U	6 (3.4-9)[a]	3 (0.2-5.2)[a]
Ac	400 (400-1,000)	70 (70-280)
Gd	400 (400-1,000)	70 (70-280)
Pb	270 (30-1,000)	10 (5-50)
Pa	8 (1-80)	8 (1.3-51)
Hg	176 (72-1,912)[c]	9.2 (9.2-87)[c]

a Newman et al., (in preparation)
b Hawkins, 1964.
c Del Debbio and Thomas, 1989.
d Low end of Loam range (agrees with interbed experiments)
e range from NEA and Sheppard
f from NEA Database
g Kelmers, 1984
h 5% of sediment value

The source of each contaminant Kd estimate is summarized in Table 9-5.

Table 9-5 Summary of the sources for the distribution coefficient estimates

Element	Source
Americium:	Measured values from Newman et al. (in Preparation) for interbed sediments and basalt. The surficial sediment value was estimated from the interbed value.
Carbon:	These values are based on NEA data and literature values.
Chloride:	Anionic will not react with sediments.
Curium:	Analog of Am.
Cobalt:	Site-specific values.
Cesium:	Site-specific values.
Europium:	Analog of Am.
Tritium:	Non-reactive.
Iodine:	Combination of NEA and literature values.
Sodium:	Will not react significantly.
Niobium:	Combination of NEA and literature values.
Nickel:	Combination of NEA and literature values.
Neptunium:	Combination of NEA and literature values.
Plutonium:	Site-specific values.
Radium:	Combination of NEA and literature values
Strontium:	Site-specific values.
Technetium:	Site-specific values.
Thorium:	Plutonium analog.
Uranium:	Site-specific values.
Actinium:	Americium analog.
Gadolinium:	Americium analog.

Table 9-5 Summary of the sources for the distribution coefficient estimates

Element	Source
Lead:	Analogs and Sheppard and Thibault (1990).
Protactinium:	Neptunium analog.
Mercury:	Site-specific values.

After considering the values compiled for the contaminants, it was determined that the surficial and interbed sediment values were in agreement to allow grouping the distribution coefficients into a single sediment value. This can be seen in the site-specific values (Table 9-1) in which the K_d values tend to overlap, with the exception of cobalt. Also, the surficial sediments and interbeds have been shown to be very similar in composition and share a common source (Bartholomay, 1990).

9.2.2 Obtaining Kds From Transport Simulation

Contaminant mobility is generally incorporated into transport codes by means of the retardation factor (R_f). The retardation factor is used to approximate the movement of contaminants in groundwater (Equation 2), and is related to the sorption coefficient:

$$R_f = 1 + \frac{\rho_b}{\theta}\frac{S}{C} = 1 + \frac{\rho_b}{\theta}K_d \qquad (2)$$

where:

R_f = retardation factor

ρ_b = bulk density of geologic material

θ = aquifer porosity or vadose zone soil moisture content

S = mass of contaminant adsorbed per unit mass of geologic material

C = mass of contaminant in solution per unit volume of solute.

The average linear velocity of a contaminant is equal to the average linear groundwater velocity divided by the retardation factor (Equation 3):

$$V_c = \frac{V_w}{R_f} \qquad (3)$$

where:

V_c = average linear velocity of the contaminant (advective velocity)

V_w = Darcy velocity, or average linear velocity of the water

R_f = retardation factor.

and the Darcy velocity is obtained by solving the mass balance equations over the modeling domain. This process involves averaging processes over parameter spaces, resulting in a simplification of the actual transport path. In general, the actual transport path is much more complicated. During the modeling processes:

- a simple mathematical model is used to describe the interaction between contaminant, water, and porous media,
- the numerical implementation of the mathematical model incorporates a set of physical and chemical parameters, and
- the model calibration phase attempts to fit the model predictions to the historical observations by varying the values of the physical and chemical parameters.

In general, the physical and chemical parameters are not homogeneous in space, but vary in response to historical geologic processes. The spatial variability in permeability is incorporated through the mass balance equation (Darcy velocity), the variability in porosity can be handled explicitly as can the spatial variability in retardation. However, in many simulators, the input of spatially variable retardation factors is not a possibility or the system is not sufficiently characterized to define the heterogeneity. To deal with model inadequacy, the resultant model parameterization uses a combination of parameters to represent the unknown or unquantifiable influences of other parameters. The end result of the calibration phase should be a model that adequately represents the historical transport of contaminants. Clearly, uncertainty is introduced by the fact that if the physics (hydraulics) of the system change, the parameter values (permeability, Kd, porosity, moisture characteristic data, etc.) may change. The more complex the system, the greater the uncertainty. The alternative is to use the Kd to represent just the soil-contaminant-water chemical interaction, which would require that the spatial variability of Kd be known, and would also require tighter controls on the remaining hydrogeologic parameters.

9.2.3 Batch vs. Model Calibrated Kd's for Simulating Transport for WAG-3

Given sufficient disposal history and field data, K_ds (or R_fs) can be estimated through inverse or forward parameter estimation. In the case of most of the COPCs modeled during the WAG-3 RI, the source term was uncertain and field data were sparse. As a result, Kd values for the WAG-3 modeling were based on values previously used at the INEEL. Most of these values were not based on field calibrated modeling at other INEEL sites, but were values taken from literature or other sources. In addition, because of the extreme heterogeneity encountered in the subsurface of the ICPP, values were assumed for sediment as well as for basalt units. The Kd values presented in Section 5 were uniformly assigned to all of the interbed and alluvium units with the exception that the Kd in the alluvium underlying the Tank Farm was assumed to be zero because of the pH of the raw effluent. To be conservative, the Kd in the vadose zone basalts was assumed to be zero while the Kd in the aquifer basalts was assumed to be 1/25th the Kd applied to the interbeds (based on laboratory data presented in Del Debbio and Thomas (1989)).

Field data for contaminants with sufficient sampling information in the perched water and aquifer were compared to predicted concentrations in order to provide a measure of the accuracy of the predictions. On the basis of the comparison information, there may be enough vadose zone field data to further refine the original estimates of Kd through additional simulation for mercury, Sr-90, and Tc-99, and in the aquifer for Sr-90 and Tc-99. However, in this work, additional simulations to actually determine the COPC specific Kd were not performed. The sensitivity to the assumed Kds for Sr-90, I-129, total Pu and Np-237 were assessed in the sensitivity analysis.

The values used for the COPCs all fall within the range suggested by Dicke (1997) with the exception of the Kd used for Pu which was significantly lower than the recommended value. An interesting point that is apparent in making this comparison is the relatively large range in Kds that appear in the Dicke (1997) paper. This large range is one reason for using model calibrated values versus using literature or even site specific numbers. Unfortunately, there is insufficient Pu field data to determine the Kd through model calibration. In

general, the range reported by Dicke (1997) and the deviation between those values and the model calibrated values arise as a function of the following issues:

- the surface area contacted by transported contaminant species is directly proportional to the mass of sediment (or basalt). In the case of crushed basalt or consolidated sediments that have been unconsolidated, fresh mineral surfaces are exposed, and the recorded adsorption is in terms of mass of contaminant per mass of rock. In actuality, sorption is a function of the surface area and composition of the exposed mineral surface. In unsaturated flow, primary flow paths are established where the vast majority of the mineral surface is not contacted by the transported contaminant, or in the case of flow through fractured basalt, the primary flow path is in the fracture as opposed to being through freshly ground basalt. In these cases, the laboratory batch Kd will overestimate the sorptive capacity of the material by over estimating the ratio of surface area to bulk rock. Thus, laboratory measured Kds used in transport predictions will overestimate the time necessary for breakthrough and will underestimate the concentrations of the arriving contaminant.
- the type of surface exposed to the transported contaminant species after unconsolidating (or grinding) the sediment (or basalt) when measuring either column or batch Kds may not be representative of that encountered along the subsurface flow path.

In general, the batch Kds resulting from the experimental procedures as given are appropriate for loosely consolidated sediment and for rock surfaces that are not exposed to weathering. In the first case, fluid flows more or less uniformly through loosely consolidated sediments, and the mineral surfaces encountered by the transported contaminant are, on the average, similar to those found in the batch reactor. In the second case, it is assumed that the bulk of the fluid carries the transported species along flow paths that encounter unweathered surfaces, and that the surfaces are similar. Therefore, after unconsolidating the sediment and grinding the basalt, the fresh mineral surfaces are "representative", and the conditions after mixing the contaminant and sediment will be representative of those encountered by the transported contaminant. If the transported species contact more weathered surfaces than not, or the sediment is heterogeneous in composition, the laboratory measured values will not be representative of subsurface transport.

In addition, the Kds used in the WAG-3 model were uniform within the sediments and uniform within the basalts. Kds are not likely to be uniform in part because permeability is not uniform. But insufficient information is available to adjust Kd values in the basalt or sediment layers. Permeability is a function of the open and connected pore space in a porous media. It is along this open and connected pore space that contaminants travel. The INEEL basalts and sediments exhibit a large range in permeability, and would be expected to exhibit a large range in Kds for a given contaminant. Although TETRAD will allow heterogeneous parameterization of Kds (spatially variable Kds), there is a lack of spatially variable sorption data to match the spatially available permeability.

Most of these issues are directly related to scaling and spatial variability, and are problems that arise when applying an "average" modeling approach to fractured and/or heterogeneous media. They are compounded by the fact that every model parameterized for the purposes of transport simulation in the INEEL subsurface makes additional assumptions regarding the spatial continuity of sediment and basalt. For example, the vadose zone characterization of the ICPP vadose zone indicates over 13 different sediment units that can not be correlated over large distances. The modeling approach lumped these different known sediment units into 4 "effective interbeds". As a result, the model predicts that contaminants will pass through larger sediment thicknesses than will occur on the average in reality.

In general, it is felt that the model calibrated values make more sense from a transport prediction perspective although laboratory measured Kds may differ in numerical value. Because most of the transport results in this document reflect historical field data, it is felt that the overall model parameters work within this simulation context. Where there is a lack of field data for the purposes of calibration, as in the case of Total Pu, it might be beneficial to examine the scaling that occurs between laboratory values and calibration values for

all calibrated contaminants, and to use that scaling to adjust laboratory measured Kds. In the absence of field and laboratory data, literature values should be examined for scaling potential. This was not done for Total Pu or for Total U during the simulation of WAG-3 contaminants.

Based on field measurements, the Pu is moving much more slowly than the Sr-90 with either a Kd of 12 or 24 cm^3/g. However, at this time there are no ICPP specific laboratory information available with which to compare Sr and Pu laboratory Kd values for use in extrapolating to a field scale Kd for Pu.

9.3 Kd ISSUES SPECIFIC TO TOTAL Pu and Sr-90

There are issues remaining to be resolved regarding the conservative estimates of Kd used in this work for Pu. Specifically, the sediment Kd of 22 cm^3/g used here is actually the TRACK-2 proposed value for crushed basalt as opposed to being a number representative of INEEL sediments. As shown above, the range of sediment Kd's are typically 1-4 orders of magnitude (10-10000 times) larger. This means that the model predictions presented here are most likely overly conservative. If the Kd is one order of magnitude larger, the model predicts that Pu will not pose a threat to groundwater via ingestion. The implications here are profound because the follow up to this study is an evaluation of remedial alternatives. As it stands now, the simulation results presented here indicate that there are three primary risk drivers at the ICPP. The first is I-129 which has already reached the aquifer, the second is Sr-90 which is predicted to reach the aquifer during the next 300 years, and the last is Pu which is predicted to arrive in thousands of years from now. Because of the decades of difference in time frame for migration and the differences in decay rate for each of these COCs, the preferred alternatives and associated costs of dealing with each potential threat are very different.

This makes a very strong case for conducting a combination of field and laboratory measurements that can be used to develop site specific Kds for both Sr-90 and Pu. These experiments are difficult to design and interpret because they must address the following key issues:

- Pu typically adsorbs strongly to sediments (10^2 - 10^5 cm^3/g) and is much more mobile in basalts (10^{5+} cm^3/g).
- Not all of the Pu moves at the same rate. For the most part, Pu adsorbs strongly to sediments (99+%), with a smaller fraction being more mobile (<0.1-1.%).
- Pu can move with transported colloids in addition to being transported as a dissolved phase, and the transport of Pu is enhanced by the presence of organics.

Each of these issues could be taken into account from a modeling perspective, and would have the following implications:

- If the Kd for Pu in the sediments is only 10 times larger than the value used, Pu will not be a risk driver at the ICPP. Instead, the primary risk driver will be Sr-90. With this factor of 10 increase in Kd, the peak concentration of Pu is reduced from a predicted 36.2 pCi/L to 2.25 pCi/L.
- If the Kd for Pu is 220 cm^3/g, as much as 50% of the original mass could be mobile with a Kd of 22 cm^3/g before Pu would pose a threat to groundwater. This fraction is much higher than expected to be mobile (~1%). If the 1% mobility is correct, Pu would not be a risk driver.
- If Pu is transported with colloids, and the Kd is really 220 cm^3/g, as much as 50% of the original mass could be mobile with a Kd of 22 cm^3/g before Pu would pose a threat to groundwater. If colloidal transport occurs at a smaller Kd, there is less margin for error. If there are organics present, the margin for error is even further reduced.
- Alternatively, if Pu has a Kd of 220 cm^3/g and does not have a large mobile fraction, the estimate of original mass released could be off by as much as a factor of 6.7 before Pu would exceed 15 pCi/L (the MCL).

In light of these observations, it is recommended that additional data be collected for Kds at the ICPP.

10 UNCERTAINTY IN THE COPCs AND CONTAMINANT SOURCE ESTIMATES

The uncertainty in contaminant transport predictions presented in Section 7 are strongly dependent on the accuracy of the estimated contaminant sources. In this section, the uncertainty associated with the source estimate is presented. The section includes a quantitative evaluation of the CPP-31 source and a qualitative discussion of the other sources. The quantitative evaluation of CPP-31 is included because it is one of the primary sources, and one for which recent investigations have provided information that allows a more accurate source estimate calculation than was presented in Section 5.1. The availability of this new information allows for a comprehensive toxicity screening of all the radionuclides that were released at CPP-31 as opposed to the COPC identification based on environmental sampling presented in Section 5.1. The new information incorporates ICPP process knowledge to identify the COPCs. The more complete CPP-31 results are used to verify the list of COPCs identified in Section 5.1, and are used to reestimate the CPP-31 source inventory for comparison to the inventory calculated in Section 5.2.

Contributors to the source term uncertainty include the actual chemical composition of the spill, magnitude of each constituent, and the temporal discharge history. As indicated in the source estimate summary given in Table 5-43, Am-241, Cs-137, Total Pu, Sr-90, and Tc-99 primarily originated as Tank Farm releases. In addition, there was one primary source of H-3 (ICPP injection well), I-129 (ICPP injection well), arsenic (soils), chromium (TRA disposal). In contrast, a combination of locations contained mercury, Co-60, Np-237, and Total U. Of these release groupings, the injection well, tank farm, and contaminated soils comprise the most significant contributors to the total ICPP COPCs inventory. As discussed below, the injection well releases are fairly well known, while the remaining surface sources are more uncertain.

10.1 Injection Well Source Uncertainty

The injection well provided a direct source of contamination to the aquifer (except when the well failed, backflowing into the vadose zone, or when contaminants were discharged to USGS-50). The disposal history of H-3, Sr-90, and Cs-137 are assumed to be fairly accurate. These discharges were monitored regularly and a reasonably complete time history exists of discharged activity. On the other hand, there is relatively sparse information available for the injection well disposal of the other COPCs. Of most concern is the limited available disposal history for Am-241 and Np-237 and the complete lack of disposal history for Tc-99. Because of limited data availability, the direct discharge history was used to estimate a uniform annual disposal rate for all COPCs except H-3, Sr-90, and Cs-137. Of the other COPCs, I-129 has the most complete discharge history and therefore, the least uncertainty. COPCs affected most notably by a lack of information include Am-241, Np-237, and Tc-99 because the uncertainty of these estimated rates is unknown. Tc-99 was not reported as a source to the injection, therefore, no injection well discharge of Tc-99 was incorporated into the model. Given that Tc-99 appears in most of the other contaminant source locations, it is probable that Tc-99 was discharged in some quantity into the injection well. There are relatively few Tc-99 samples from the aquifer but the samples that have been collected indicate that the Tc-99 concentrations are significantly below a risk level and neglecting Tc-99 discharge to the aquifer has little effect on the predictions.

The effects of disposal to the injection well have been monitored over time by sampling wells completed in the aquifer. A comparison of the contaminant concentrations from aquifer predictions to field data provides a means of estimating the accuracy of the source terms used for the injection well. With the exception of arsenic, chromium, and Tc-99, there are records that indicate that all of the COPCs were discharged to the injection well. In theory, comparisons to field data for the other COPCs should provide a means of assessing the accuracy of both the source term and the Kds used in the aquifer model. In practice, field measurements over long periods of time do not exist for contaminants other than Sr-90, and H-3. For the remaining, COPCs, single, or closely spaced, data exists allowing estimation of either the source magnitude or Kd, but not both. As a result, the uncertainty for those contaminants is higher, and virtually impossible to quantify without more temporal data. The uncertainty is recognized in this report, but no information is available to quantify the uncertainty.

10.2 Uncertainty In Non-Tank Farm Surface Sources

Land surface contaminant sources include the tank farm inventory and contaminated soils. Of these, the primary sources are from the tank farm releases (see Table 5-44). Because the tank farm releases are the dominant influence on the model predictions, the surface source uncertainty evaluation focuses on the tank farm releases and neglects the contribution of the soil sources outside the tank farm.

10.3 Uncertainty Analysis Of The Tank Farm Source Estimates

As explained in Section 5.2.2, there were three tank farm releases used to originally define the tank farm source inventories. These correspond to the CPP-28/79, CPP-31, and 1986 releases. Actual liquid waste composition, volumes, and duration for these releases are unknown. As a result, estimates of volume and chemical composition were based on an assumed liquid waste inventory and on estimated waste stream composition as reported in Rhodes (1972) and Donovan (1989) (see Section 5.2.2.1). The Rhodes (1972) data was used to define the CPP-28/79 release using average concentrations of first cycle raffinate. Rhodes data are based on analytical evaluations of September, 1971 first cycle raffinate. The Donovan (1989) data was used to define the CPP-31 and 1986 releases using average concentrations for second cycle raffinate. The second cycle raffinate data were based on analytical evaluations of August 1989 fuel processing effluent. Average data was used because it was assumed that the releases contained waste from many different fuel compositions. The Rhodes (1972) and Donovan (1989) data was based on samples of tanks containing a cumulation of the effluent of many different fuel processing campaigns, yielding an average over many different fuel compositions. Thus, the averaging approach used in Section 5.2.2.1 was assumed to yield representative inventories for the tank farm releases. However, a primary disadvantage of the Rhodes (1972) and Donovan (1989) data exists because sampling was not done or reported specifically for the purposes of characterizing the tank farm releases. As a result, although the mass and activities of the reported contaminants are assumed to be representative of the inventory in the tank farm releases, particular contaminants that would be expected to be present in the final inventory are absent.

During subsequent investigation, it was discovered that the composition of the CPP-31 release could be defined more accurately than using the Donovan (1989) average second cycle raffinate concentration. It was found that the release resulted from a specific valve leak during the transfer of Tank WM-181 to WM-180 in November, 1972. From the historical records, it was possible to identify the type of fuel processed that contributed to the waste contained in Tank WM-181 during that time period. Based on the fuel types, a computer simulation code (ORIGEN2, Radiation Shielding Information Center, 1991) was used to develop a pseudo inventory of the radionuclides contained in Tank WM-181. The simulation was calibrated using analytical data from Tank WM-181 (from September, 1971) and soil samples taken at the release site in 1975. The ORIGEN2 simulation provides process knowledge by which the expected COPCs could be identified and the CPP-31 source inventory could be reestimated and compared with the source inventory estimates from Section 5.2.2, that were used in the modeling. Details of ORIGEN2, the calibration process, COPC identification, and subsequent analysis are presented in Appendix N. Comparison of the ORIGEN2 results to the COPC identification and implications for contaminant transport prediction are presented below for the CPP-31 release in Sections 10.3.3 and 10.3.4. For CPP-28/79 and 1986 Release, no additional information has been identified allowing improvement over the original source inventory estimates.

CPP-28/79: The history of the CPP-28/79 release is much more complex than that of the CPP-31 release. It is known to have been first cycle raffinate, and that it occurred from a small hole in a transfer line throughout the 1956 to 1974 time period. The volume released is unknown because the long term gradual release was not monitored. In addition, the release spanned many different fuel processing campaigns. As a result, analysis of the composition of a single waste tank would not provide reliable estimates of the relative contaminant concentrations. The source inventory estimate presented in Section 5.2.2 was based on average concentrations in the tanks in September 1971. The first cycle raffinate waste in these tanks represents an integration over the previous years spanning more than 80% of the time period during which the release occurred. In deriving the source term, it was assumed that this average composition provides an acceptable estimate of the radionuclide concentrations released at CPP-28/79. The release volume was calculated given

the physical characteristics of the piping and hole size. Based on limited soil characterization data, the estimated volume appears reasonable. However, further characterization of contaminated soil would be required to improve the CPP-28/79 estimate.

1986 Release: The 1986 Release was modeled as a second cycle raffinate released in the same vicinity (with respect to model discretization) as CPP-31. In terms of activity, the 1986 Release was much smaller than that of the CPP-31 release (estimated 44 Ci versus 28,900 Ci) making it a relatively insignificant contributor to the contaminant transport results. In addition, because this release occurred in 1986, the use of average second cycle raffinate composition based on the 1989 data are appropriate. Because of the time frame and relative volume, the 1986 Release uncertainty has not been quantified.

10.3.1 Summary of the CPP-31 Reestimated Source Results

There are three primary questions to be answered with the uncertainty analysis of the CPP-31 tank farm source estimates.

1. Were all of the significant COPCs identified in the Section 5.1?
2. Were the source inventories used to define CPP-31 conservative?
3. How much would the simulation results change based on the reestimated CPP-31 source estimates?

In order to answer these questions, the CPP-31 contaminant source estimates were reinvestigated and reestimated. The modeled contaminant source estimates (used in Section 5.2.2.1) are based on average 2nd cycle waste estimates from Donovan (1989). Several errors in the Donovan data (see footnotes in Table 5-20) lead the investigators to question its accuracy. In addition, because the data is from 17 years after the release, it may not be representative of the liquid waste being transferred during the CPP-31 release. The reinvestigation used historical process knowledge, analytical results from the liquid waste in tank WM-181 previous to the release, and analytical results from contaminated soil samples after the release, to simulate a pseudo source that uses all of the information available. The pseudo source was simulated using the ORIGEN2 computer code. Details of this analysis are presented in Appendix N of this RI report. As explained in Appendix N, the data available indicate an accuracy within a factor of 2 for the nuclides other than the activation products. The activation products were calibrated to Co-60 from soil samples from 1975 but there is no independent sample information with which to validate the Co-60 estimates.

The results of the ORIGEN2 simulation procedure for the CPP-31 release are presented in Table 10-1. In the first 2 columns are the radionuclide names identifying nuclides and nuclides with "Plus Daughter" (+D) slope factors (for use in risk assessment). In Column 1, parent radionuclides with progeny included in +D slope factors are indicated with a +D after the radionuclide name. For the risk assessment, the radionuclides in listed Column 2 are evaluated together with their parent radionuclide and should not be evaluated separately (as explained in EPA, 1995). Columns 3 and 4 contains the half-life and units for the half life for each radionuclide, respectively. Columns 5 through 12 give the calculated concentrations and the fraction of remaining activity, corresponding to November of 1972 (date of the CPP-31 release), and 100, 1,000, and 10,000 years after November 1972. For purposes of the following discussions, the 1972 and 2072 are referred to as "the near term" and 2972 and 11972 are referred to as "the far term". The concentration and activity fractions for the far term were included so that future COPCs were not inadvertently eliminated during near term screening. 10,000 years was arbitrarily chosen as the maximum time frame. There is very little confidence in any model predictions that far in the future.

Table 10-1 Calculated concentrations and normalized activities from the CPP-31 reevaluation.

Nuclide	Nuclides Incorporated into +D Slope Factors[1]	Half-Life	Half-Life Units	Calculated Nuclide Concentrations[2] (dps/mL)				Calculated Nuclide Fraction of the Total Activity[3]			
				Near Term Years		Far Term Years		Near Term Years		Far Term Years	
				1972	2072	2972	11972	1972	2072	2972	11972
ACTIVATION PRODUCTS											
Cl 36		3.01E+05	yr	5.6E-06	5.6E-06	5.6E-06	5.4E-06	1.5E-13	1.7E-12	9.6E-10	1.2E-09
Co 60		5.27E+00	yr	1.0E+04	1.9E-02			2.7E-04	5.8E-09		
Ni 63		1.00E+02	yr	5.1E-07	2.4E-07	2.8E-10		1.4E-14	7.2E-14	4.8E-14	
P 32		1.43E+01	d	2.1E-06	1.9E-06	7.1E-07	4.8E-11	5.6E-14	5.5E-13	1.2E-10	1.1E-14
Si 32		4.50E+02	yr	2.1E-06	1.9E-06	7.1E-07	4.8E-11	5.6E-14	5.5E-13	1.2E-10	1.1E-14
V 50		4.00E+16	yr	1.2E-13	1.2E-13	1.2E-13	1.2E-13	3.2E-21	3.5E-20	2.0E-17	2.7E-17
ACTINIDES+DAUGHTERS											
Ac227+D		2.18E+01	yr	2.8E-03	1.5E-02	3.1E-02	1.7E-01	7.5E-11	4.3E-09	5.4E-06	4.0E-05
	Th227	1.87E+01	d	2.7E-03	1.4E-02	3.1E-02	1.7E-01	7.4E-11	4.3E-09	5.3E-06	3.9E-05
	Fr223	2.18E+01	m	3.8E-05	2.0E-04	4.3E-04	2.4E-03	1.0E-12	6.0E-11	7.5E-08	5.5E-07
	Ra223	1.14E+01	d	2.8E-03	1.5E-02	3.1E-02	1.7E-01	7.5E-11	4.3E-09	5.4E-06	4.0E-05
	Rn219	3.96E+00	s	2.8E-03	1.5E-02	3.1E-02	1.7E-01	7.5E-11	4.3E-09	5.4E-06	4.0E-05
	Po215	1.78E-03	s	2.8E-03	1.5E-02	3.1E-02	1.7E-01	7.5E-11	4.3E-09	5.4E-06	4.0E-05
	Pb211	3.61E+01	m	2.8E-03	1.5E-02	3.1E-02	1.7E-01	7.5E-11	4.3E-09	5.4E-06	4.0E-05
	Bi211	2.13E+00	m	2.8E-03	1.5E-02	3.1E-02	1.7E-01	7.5E-11	4.3E-09	5.4E-06	4.0E-05
	Tl207	4.77E+00	m	2.8E-03	1.5E-02	3.1E-02	1.7E-01	7.5E-11	4.3E-09	5.4E-06	4.0E-05
	Po211	5.16E-01	s	7.7E-06	4.1E-05	8.7E-05	4.9E-04	2.1E-13	1.2E-11	1.5E-08	1.1E-07
Am241		4.32E+02	yr	1.1E+03	2.0E+03	4.7E+02	2.6E-04	2.9E-05	5.8E-04	8.1E-02	6.0E-08
Am242		1.60E+01	h	1.7E-02	1.1E-02	1.8E-04	2.6E-22	4.6E-10	3.2E-09	3.0E-08	
Am242M		1.52E+02	yr	1.7E-02	1.1E-02	1.8E-04	2.7E-22	4.6E-10	3.2E-09	3.1E-08	
Am243+D		7.38E+03	yr	1.2E-01	1.2E-01	1.1E-01	4.7E-02	3.2E-09	3.5E-08	1.9E-05	1.1E-05
	Np239	2.36E+00	d	1.2E-01	1.2E-01	1.1E-01	4.7E-02	3.2E-09	3.5E-08	1.9E-05	1.1E-05
Cf249		3.51E+02	yr	1.5E-13	1.2E-13	2.1E-14	3.9E-22	4.1E-21	3.6E-20	3.6E-18	
Cf250		1.31E+01	yr	1.2E-13	6.2E-16	2.7E-23	1.9E-23	3.4E-21	1.8E-22		
Cf251		9.00E+02	yr	3.5E-16	3.2E-16	1.6E-16	1.5E-19	9.4E-24	9.5E-23	2.8E-20	3.5E-23
CF252		2.64E+00	yr	1.0E-15	4.0E-27			2.8E-23			
Cm242		1.63E+02	d	1.4E-02	8.8E-03	1.5E-04	2.2E-22	3.9E-10	2.6E-09	2.5E-08	
Cm243		2.85E+01	yr	1.6E-03	1.4E-04	4.4E-14		4.3E-11	4.2E-11	7.6E-18	
Cm244		1.81E+01	yr	9.3E-01	2.0E-02	2.2E-17		2.5E-08	6.0E-09	3.8E-21	
Cm245		8.50E+03	yr	2.9E-05	2.8E-05	2.6E-05	1.3E-05	7.7E-13	8.4E-12	4.5E-09	2.9E-09
Cm246		4.75E+03	yr	6.4E-07	6.3E-07	5.5E-07	1.5E-07	1.7E-14	1.9E-13	9.5E-11	3.4E-11
Cm247		1.56E+07	yr	2.3E-13	2.3E-13	2.3E-13	2.3E-13	6.2E-21	6.8E-20	3.9E-17	5.2E-17
Cm248		3.39E+05	yr	7.0E-14	7.0E-14	7.0E-14	6.8E-14	1.9E-21	2.1E-20	1.2E-17	1.6E-17
Cm250		6.90E+03	yr	2.0E-22	2.0E-22	1.9E-22	1.3E-22	5.4E-30	5.9E-29	3.3E-26	3.1E-26
Np236		1.15E+05	yr	2.2E-05	2.2E-05	2.2E-05	2.1E-05	6.0E-13	6.6E-12	3.8E-09	4.8E-09

1. The "Nuclides Incorporated in the +D Slope Factors" do not include all of the progeny but only the progeny identified by the EPA to be evaluated together with their parent radionuclides, for purposes of risk assessment (EPA, 1995).
2. From Table 7 in Appendix N.
3. From Table 8 in Appendix N.

Table 10-1 Calculated concentrations and normalized activities from the CPP-31 reevaluation.

Nuclide	Nuclides Incorporated into +D Slope Factors[1]	Half-Life	Half-Life Units	Calculated Nuclide Concentrations[2] (dps/mL)				Calculated Nuclide Fraction of the Total Activity[3]			
				Near Term Years		Far Term Years		Near Term Years		Far Term Years	
				1972	2072	2972	11972	1972	2072	2972	11972
Np237+D		2.14E+06	yr	1.3E+01	1.4E+01	1.4E+01	1.4E+01	3.7E-07	4.0E-06	2.4E-03	3.2E-03
	Pa233	2.70E+01	d	1.3E+01	1.4E+01	1.4E+01	1.4E+01	3.7E-07	4.0E-06	2.4E-03	3.2E-03
Np238		2.12E+00	d	8.4E-05	5.3E-05	8.8E-07	1.3E-24	2.3E-12	1.6E-11	1.5E-10	
Pa231		3.73E+04	yr	1.4E-02	1.6E-02	3.1E-02	1.7E-01	3.7E-10	4.6E-09	5.4E-06	4.0E-05
Pb210+D		2.23E+01	yr	6.4E-05	4.8E-03	9.0E-02	1.8E+00	1.7E-12	1.4E-09	1.6E-05	4.0E-04
	Bi210	5.01E+00	d	6.4E-05	4.8E-03	9.0E-02	1.8E+00	1.7E-12	1.4E-09	1.6E-05	4.0E-04
	Po210	1.38E+02	d	5.7E-05	4.8E-03	9.0E-02	1.8E+00	1.5E-12	1.4E-09	1.6E-05	4.0E-04
Pu236		2.85E+00	yr	2.4E-02	2.0E-06	2.0E-06	1.9E-06	6.4E-10	5.9E-13	3.4E-10	4.3E-10
Pu238		8.78E+01	yr	4.1E+03	1.9E+03	1.5E+00	5.2E-22	1.1E-04	5.5E-04	2.6E-04	
Pu239		2.41E+04	yr	2.4E+03	2.4E+03	2.3E+03	1.8E+03	6.4E-05	7.0E-04	4.0E-01	4.1E-01
Pu240		6.57E+03	yr	5.3E+02	5.3E+02	4.8E+02	1.9E+02	1.5E-05	1.6E-04	8.3E-02	4.2E-02
Pu241		1.44E+01	yr	3.6E+04	2.9E+02	2.6E-05	1.3E-05	9.8E-04	8.7E-05	4.6E-09	2.9E-09
Pu242		3.76E+05	yr	8.6E-02	8.6E-02	8.6E-02	8.4E-02	2.3E-09	2.5E-08	1.5E-05	1.9E-05
Pu243		4.96E+00	h	2.3E-13	2.3E-13	2.3E-13	2.3E-13	6.2E-21	6.8E-20	3.9E-17	5.2E-17
Pu244+D		8.26E+07	yr	9.1E-09	9.1E-09	9.1E-09	9.0E-09	2.5E-16	2.7E-15	1.6E-12	2.1E-12
	U240	1.41E+01	h	1.6E-10	9.0E-09	9.0E-09	9.0E-09	4.4E-18	2.7E-15	1.6E-12	2.1E-12
	Np240M	7.40E+00	m	9.0E-09	9.0E-09	9.0E-09	9.0E-09	2.5E-16	2.7E-15	1.6E-12	2.1E-12
Ra226+D		1.60E+03	yr	4.4E-04	6.8E-03	9.0E-02	1.8E+00	1.2E-11	2.0E-09	1.6E-05	4.0E-04
	Rn222	3.82E+00	d	4.4E-04	6.8E-03	9.0E-02	1.8E+00	1.2E-11	2.0E-09	1.6E-05	4.0E-04
	Po218	3.05E+00	m	4.4E-04	6.8E-03	9.0E-02	1.8E+00	1.2E-11	2.0E-09	1.6E-05	4.0E-04
	Pb214	2.68E+01	m	4.4E-04	6.8E-03	9.0E-02	1.8E+00	1.2E-11	2.0E-09	1.6E-05	4.0E-04
	At218 [0.02%, none reported]										
	Bi214	1.99E+01	m	4.4E-04	6.8E-03	9.0E-02	1.8E+00	1.2E-11	2.0E-09	1.6E-05	4.0E-04
	Po214	1.64E-04	s	4.4E-04	6.8E-03	9.0E-02	1.8E+00	1.2E-11	2.0E-09	1.6E-05	4.0E-04
	Tl210 [0.02%, none reported]										
Ra228+D		5.75E+00	yr	2.0E-08	4.2E-08	4.8E-08	1.3E-07	5.3E-16	1.2E-14	8.3E-12	3.0E-11
	Ac228	6.13E+00	h	2.0E-08	4.2E-08	4.8E-08	1.3E-07	5.3E-16	1.2E-14	8.3E-12	3.0E-11
Th228+D		1.91E+00	yr	1.2E-01	1.2E-03	2.2E-06	2.0E-06	3.2E-09	3.6E-10	3.9E-10	4.6E-10
	Ra224	3.62E+00	d	1.2E-01	1.2E-03	2.2E-06	2.0E-06	3.2E-09	3.6E-10	3.9E-10	4.6E-10
	Rn220	5.56E+01	s	1.2E-01	1.2E-03	2.2E-06	2.0E-06	3.2E-09	3.6E-10	3.9E-10	4.6E-10
	Po216	1.46E-01	s	1.2E-01	1.2E-03	2.2E-06	2.0E-06	3.2E-09	3.6E-10	3.9E-10	4.6E-10
	Pb212	1.06E+01	h	1.2E-01	1.2E-03	2.2E-06	2.0E-06	3.2E-09	3.6E-10	3.9E-10	4.6E-10
	Bi212	6.06E+01	m	1.2E-01	1.2E-03	2.2E-06	2.0E-06	3.2E-09	3.6E-10	3.9E-10	4.6E-10
	PO212	3.00E-07	s	7.6E-02	7.7E-04	1.4E-06	1.3E-06	2.1E-09	2.3E-10	2.5E-10	2.9E-10
	Tl208	3.05E+00	m	4.2E-02	4.3E-04	8.1E-07	7.2E-07	1.2E-09	1.3E-10	1.4E-10	1.7E-10

1. The "Nuclides Incorporated in the +D Slope Factors" do not include all of the progeny but only the progeny identified by the EPA to be evaluated together with their parent radionuclides, for purposes of risk assessment (EPA, 1995).
2. From Table 7 in Appendix N.
3. From Table 8 in Appendix N.

Table 10-1 Calculated concentrations and normalized activities from the CPP-31 reevaluation.

Nuclide	Nuclides Incorporated into +D Slope Factors[1]	Half-Life	Half-Life Units	Calculated Nuclide Concentrations[2] (dps/mL)				Calculated Nuclide Fraction of the Total Activity[3]			
				Near Term Years		Far Term Years		Near Term Years		Far Term Years	
				1972	2072	2972	11972	1972	2072	2972	11972
Th229+D		7.34E+03	yr	6.6E-06	4.3E-05	2.8E-03	2.1E-01	1.8E-13	1.3E-11	4.9E-07	4.8E-05
	Ra225	1.48E+01	d	6.6E-06	4.3E-05	2.8E-03	2.1E-01	1.8E-13	1.3E-11	4.9E-07	4.8E-05
	Ac225	1.00E+01	d	6.6E-06	4.3E-05	2.8E-03	2.1E-01	1.8E-13	1.3E-11	4.9E-07	4.8E-05
	Fr221	4.80E+00	m	6.6E-06	4.3E-05	2.8E-03	2.1E-01	1.8E-13	1.3E-11	4.9E-07	4.8E-05
	At217	3.23E-02	s	6.6E-06	4.3E-05	2.8E-03	2.1E-01	1.8E-13	1.3E-11	4.9E-07	4.8E-05
	Bi213	4.57E+01	m	6.6E-06	4.3E-05	2.8E-03	2.1E-01	1.8E-13	1.3E-11	4.9E-07	4.8E-05
	Po213	4.20E-06	s	6.4E-06	4.3E-05	2.8E-03	2.1E-01	1.7E-13	1.3E-11	4.8E-07	4.7E-05
	Tl209	2.20E+00	m	1.4E-07	9.4E-07	6.1E-05	4.6E-03	3.9E-15	2.8E-13	1.1E-08	1.0E-06
	Pb209	3.25E+00	h	6.6E-06	4.3E-05	2.8E-03	2.1E-01	1.8E-13	1.3E-11	4.9E-07	4.8E-05
Th230		7.70E+04	yr	1.4E-01	1.6E-01	3.6E-01	2.2E+00	3.8E-09	4.8E-08	6.2E-05	5.1E-04
Th232		1.41E+10	yr	4.1E-08	4.2E-08	4.8E-08	1.3E-07	1.1E-15	1.2E-14	8.3E-12	3.0E-11
U232		7.20E+01	yr	2.1E-03	1.2E-03	2.2E-06	1.9E-06	5.7E-11	3.5E-10	3.8E-10	4.3E-10
U233		1.59E+05	yr	9.7E-04	6.9E-03	6.1E-02	6.0E-01	2.6E-11	2.0E-09	1.1E-05	1.4E-04
U234		2.45E+05	yr	2.3E+01	2.4E+01	2.5E+01	2.4E+01	6.3E-07	7.1E-06	4.2E-03	5.5E-03
U235+D		7.04E+08	yr	8.4E-01	8.4E-01	8.5E-01	8.6E-01	2.3E-08	2.5E-07	1.5E-04	2.0E-04
	Th231	2.55E+01	h	4.7E+01	8.4E-01	8.5E-01	8.6E-01	1.3E-06	2.5E-07	1.5E-04	2.0E-04
U236		2.34E+07	yr	1.2E-01	1.2E-01	1.4E-01	2.2E-01	3.3E-09	3.7E-08	2.4E-05	5.0E-05
U237		6.75E+00	d	1.6E-02	7.2E-03	6.5E-10	3.1E-10	4.3E-10	2.1E-09	1.1E-13	7.1E-14
U238+D		4.47E+09	yr	1.9E-01	1.9E-01	1.9E-01	1.9E-01	5.3E-09	5.7E-08	3.4E-05	4.4E-05
	Th234	2.41E+01	d	6.1E-01	1.9E-01	1.9E-01	1.9E-01	1.7E-08	5.7E-08	3.4E-05	4.4E-05
	Th234 decays almost immediately to U234 as part of the U238 decay chain										
	Pa234M	1.17E+00	m	6.1E-01	1.9E-01	1.9E-01	1.9E-01	1.7E-08	5.7E-08	3.4E-05	4.4E-05
	Pa234	6.70E+00	h	7.9E-04	2.5E-04	2.5E-04	2.5E-04	2.2E-11	7.5E-11	4.4E-08	5.8E-08
FISSION PRODUCTS											
Ag108M+D		1.27E+02	yr	1.4E-05	8.3E-06	6.1E-08	2.9E-29	3.9E-13	2.5E-12	1.1E-11	
	Ag108	2.37E+00	m	1.3E-06	7.4E-07	5.5E-09	2.5E-30	3.5E-14	2.2E-13	9.4E-13	
Be 10		1.60E+06	yr	3.4E-04	3.4E-04	3.4E-04	3.4E-04	9.2E-12	1.0E-10	5.8E-08	7.7E-08
C 14		5.73E+03	yr	1.4E-02	1.3E-02	1.2E-02	4.1E-03	3.7E-10	4.0E-09	2.1E-06	9.3E-07
Cd113M		1.36E+01	yr	8.1E+02	7.0E+00	1.9E-18		2.2E-05	2.1E-06	3.3E-22	
Ce142		1.05E+11	yr	3.4E-03	3.4E-03	3.4E-03	3.4E-03	9.2E-11	1.0E-09	5.8E-07	7.7E-07
Cs134		2.06E+00	yr	3.2E+04	7.9E-11			8.6E-04	2.4E-17		
Cs135		2.30E+06	yr	1.1E+01	1.1E+01	1.1E+01	1.1E+01	2.9E-07	3.1E-06	1.8E-03	2.4E-03
Cs137+D		3.00E+01	yr	9.0E+06	8.9E+05	8.3E-04		2.4E-01	2.6E-01	1.4E-07	
	Ba137M	2.55E+00	m	8.5E+06	8.4E+05	7.8E-04		2.3E-01	2.5E-01	1.4E-07	
Eu150		3.60E+01	yr	8.5E-05	1.2E-05	3.7E-13		2.3E-12	3.7E-12	6.4E-17	
Eu152		1.36E+01	yr	6.4E+01	3.9E-01	4.7E-21		1.7E-06	1.2E-07		
Eu154		8.60E+00	yr	3.8E+04	1.2E+01			1.0E-03	3.6E-06		
Eu155		4.96E+00	yr	4.5E+04	3.9E-02			1.2E-03	1.1E-08		
Gd152		1.08E+14	yr	7.2E-12	9.4E-12	9.4E-12	9.4E-12	2.0E-19	2.8E-18	1.6E-15	2.2E-15

1. The "Nuclides Incorporated in the +D Slope Factors" do not include all of the progeny but only the progeny identified by the EPA to be evaluated together with their parent radionuclides, for purposes of risk assessment (EPA, 1995).
2. From Table 7 in Appendix N.
3. From Table 8 in Appendix N.

Table 10-1 Calculated concentrations and normalized activities from the CPP-31 reevaluation.

Nuclide	Nuclides Incorporated into +D Slope Factors[1]	Half-Life	Half-Life Units	Calculated Nuclide Concentrations[2] (dps/mL)				Calculated Nuclide Fraction of the Total Activity[3]			
				Near Term Years		Far Term Years		Near Term Years		Far Term Years	
				1972	2072	2972	11972	1972	2072	2972	11972
H 3		1.23E+01	yr	2.5E+04	9.3E+01			6.9E-04	2.7E-05		
Ho166M		1.20E+03	yr	8.1E-04	7.7E-04	4.6E-04	2.5E-06	2.2E-11	2.3E-10	7.9E-08	5.7E-10
I129		1.57E+07	yr	2.7E+00	2.7E+00	2.7E+00	2.7E+00	7.4E-08	8.1E-07	4.7E-04	6.2E-04
In115		5.10E+15	yr	1.7E-09	1.7E-09	1.7E-09	1.7E-09	4.6E-17	5.1E-16	3.0E-13	3.9E-13
La138		1.35E+11	yr	2.5E-08	2.5E-08	2.5E-08	2.5E-08	6.7E-16	7.3E-15	4.2E-12	5.6E-12
Nb 93M		1.36E+01	yr	1.2E+02	2.4E+02	2.4E+02	2.4E+02	3.2E-06	7.1E-05	4.2E-02	5.5E-02
Nb 94		2.03E+04	yr	8.0E+01	8.0E+01	7.8E+01	5.7E+01	2.2E-06	2.4E-05	1.3E-02	1.3E-02
Nd144		2.10E+15	yr	1.6E-07	1.6E-07	1.6E-07	1.6E-07	4.3E-15	4.7E-14	2.7E-11	3.6E-11
Pd107		6.50E+06	yr	1.8E+00	1.8E+00	1.8E+00	1.8E+00	4.9E-08	5.4E-07	3.1E-04	4.1E-04
Pm146		2.02E+03	d	6.0E+00	2.0E-05			1.6E-07	6.0E-12		
Pm147		2.62E+00	yr	1.9E+06	6.5E-06			5.3E-02	1.9E-12		
Rb 87		4.73E+10	yr	3.3E-03	3.3E-03	3.3E-03	3.3E-03	8.9E-11	9.8E-10	5.7E-07	7.5E-07
Rh102		2.90E+00	yr	1.1E-01	4.6E-12			3.0E-09	1.4E-18		
Sb125+D		2.77E+00	yr	4.0E+04	5.4E-07			1.1E-03	1.6E-13		
	Te125M	5.80E+01	d	9.7E+03	1.3E-07			2.6E-04	3.9E-14		
Sb126		1.24E+01	d	6.1E+00	6.1E+00	6.1E+00	5.7E+00	1.7E-07	1.8E-06	1.0E-03	1.3E-03
Sb126M		1.90E+01	m	4.4E+01	4.4E+01	4.3E+01	4.1E+01	1.2E-06	1.3E-05	7.5E-03	9.3E-03
Se 79		6.50E+04	yr	4.9E+01	4.9E+01	4.8E+01	4.4E+01	1.3E-06	1.5E-05	8.4E-03	1.0E-02
Sm146		1.03E+08	yr	7.4E-07	9.1E-07	9.1E-07	9.1E-07	2.0E-14	2.7E-13	1.6E-10	2.1E-10
Sm147		1.07E+11	yr	1.2E-03	1.2E-03	1.2E-03	1.2E-03	3.1E-11	3.6E-10	2.1E-07	2.8E-07
Sm148		8.00E+15	yr	3.0E-10	3.0E-10	3.0E-10	3.0E-10	8.1E-18	8.8E-17	5.2E-14	6.8E-14
Sm149		1.00E+15	yr	1.5E-09	1.5E-09	1.5E-09	1.5E-09	4.1E-17	4.5E-16	2.6E-13	3.5E-13
Sm151		9.00E+01	yr	1.1E+05	5.0E+04	4.8E+01		2.9E-03	1.5E-02	8.4E-03	
Sn121M		5.00E+01	yr	8.8E+00	2.2E+00	8.3E-06		2.4E-07	6.5E-07	1.4E-09	
Sn126		1.00E+05	yr	4.4E+01	4.4E+01	4.3E+01	4.1E+01	1.2E-06	1.3E-05	7.5E-03	9.3E-03
Sr 90+D		2.91E+01	yr	8.6E+06	7.9E+05	3.9E-04		2.3E-01	2.3E-01	6.8E-08	
	Y 90	6.41E+01	h	8.6E+06	7.9E+05	3.9E-04		2.3E-01	2.3E-01	6.8E-08	
Tc 98		4.20E+06	yr	5.2E-05	5.2E-05	5.2E-05	5.2E-05	1.4E-12	1.5E-11	9.0E-09	1.2E-08
Tc 99		2.13E+05	yr	1.7E+03	1.7E+03	1.7E+03	1.6E+03	4.6E-05	5.0E-04	2.9E-01	3.8E-01
Te123		1.00E+13	yr	1.3E-12	1.3E-12	1.3E-12	1.3E-12	3.6E-20	4.0E-19	2.3E-16	3.1E-16
TM171		1.92E+00	yr	2.7E-08	5.7E-24			7.4E-16			
Zr 93		1.53E+06	yr	2.5E+02	2.5E+02	2.5E+02	2.5E+02	6.9E-06	7.5E-05	4.4E-02	5.8E-02
		Total		3.7E+07	3.4E+06	5.8E+03	4.4E+03	9.9E-01	9.9E-01	1.0E+00	1.0E+00

1. The "Nuclides Incorporated in the +D Slope Factors" do not include all of the progeny but only the progeny identified by the EPA to be evaluated together with their parent radionuclides, for purposes of risk assessment (EPA, 1995).
2. From Table 7 in Appendix N.
3. From Table 8 in Appendix N.

The purpose of this table is to list all of the radionuclides that are predicted to exist during the ORIGEN2 simulations. In the following sections, each of these radionuclides will be screened based on toxicity, slope factor, and travel time relative to the half-life.

10.3.2 Identification of COPCs Based on a Reevaluation of the CPP-31 Release

The primary objective of reevaluating the CPP-31 source term is to identify any COPCs that may have been overlooked based on the Donovan (1989) data as presented in Section 5.1. In order to identify COPCs from the full list of possible contaminants (presented in Section 10.3.1), a four step screening process was performed. These screening steps are:

1. All nuclides that are included in the +D slope factors of a parent radionuclide are incorporated into the risk assessment, together with their parent, by using the +D slope factors (EPA, 1995). The nuclides of interest have been separated in Column 2 of Table 10-1 for easy identification. The nuclides that are included in the +D slope factors will either be eliminated or retained together with their parent.
2. Based on a concentration-toxicity screen (EPA, 1989), eliminate all nuclides whose individual risk factor contributes less than 0.01% of the total risk factor in the near term and less than 1% in the far term. The reasons for choosing these screening levels are explained below.
3. A nuclide activity fraction screen was used to identify possible COPCs that do not have slope factors and can not be quantitatively screened with a toxicity screen. Retained contaminants are qualitatively evaluated based on an estimated concentration-toxicity.
4. Based on the estimated radionuclide travel time to the aquifer, eliminate all nuclides with travel times greater than 20 half-lives (a mass reduction factor of 10^6). The estimated travel time is based on the time to the leading edge of the mass flux curve from the vadose zone to the aquifer. This is approximately half as long as the time to the maximum mass flux from the vadose zone to the aquifer.

For the concentration-toxicity screen, individual risk factors are defined as the radionuclide concentration (from Table 10-1) times the ingestion slope factor. The sum of the individual risk factors is equal to the total risk factor, and the relative risk factor is equal to the individual risk factor divided by the total risk factor. This concentration-toxicity screen is based on the EPA (1989) guidance (Section 5.9.5). The EPA (1989) guidance recommends screening of all contaminants that initially contribute less than 1% to the total risk factor. This screening may not be sufficiently conservative for defining the groundwater COPCs from CPP-31. Two additional restrictions have been included in order to ensure an adequate COPC screen.

1. Because the groundwater risk occurs in the future, it is important to identify the future risk contributors. Therefore, in addition to screening based on the initial radionuclide inventory (1972), screening was performed based on the decayed inventories 10^2, 10^3, and 10^4 years later. These are included in order to identify the primary future risk contributors.
2. Because the majority of the activity released was Sr-90 and Cs-137, in the near term time frames, virtually all other radionuclides would be eliminated using a screening criteria equal to 1% of the total risk factor. Using this criteria, it is possible that the 1% limit could eliminate radionuclides that would pose a risk to the aquifer. Therefore, the risk factors for Sr-90 and Cs-137 were removed from the near term inventories in computing the total risk factor, and the screening criteria was modified to retain radionuclides contributing more than 1% of the adjusted total risk factor. Because Sr-90 and Cs-137 contribute approximately 99% of the activity, the new screening criterion is roughly 1% of the remaining 1% or about 0.01% of the original total risk factor.

The results of the first two screening steps are shown in Table 10-2. The radionuclides in the left hand and right hand columns are the retained radionuclides after Screens 1 and 2, respectfully.

Table 10-2 Results of the first and second COPC screens.

Retained Radionuclides After Screen 1	Slope Factor	Individual Risk Factor Fraction				Retained Nuclides After Screen 2
		Near Term Years		Far Term Years		
		1972	2072	2972	11972	
ACTIVATION PRODUCTS						
Cl36	2.23E-12	1.6E-14	1.7E-13	1.2E-11	1.9E-11	
Co60	1.89E-11	**2.4E-04**	4.8E-09	0.0E+00	0.0E+00	Co60
Ni63	5.50E-13	3.6E-16	1.8E-15	1.5E-16	0.0E+00	
P32	6.11E-12	1.7E-14	1.6E-13	4.2E-12	4.6E-16	
Si32	ND	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
V50	ND	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
ACTINIDES+DAUGHTERS						
Ac227+D	6.26E-10	2.3E-09	1.3E-07	1.9E-05	1.7E-04	
Am241	3.28E-10	**4.7E-04**	**8.8E-03**	**1.5E-01**	1.3E-07	Am241
Am242	1.47E-12	3.2E-11	2.2E-10	2.5E-10	6.0E-28	
Am242M	2.92E-10	6.4E-09	4.3E-08	5.0E-08	1.2E-25	
Am243+D	3.31E-10	5.1E-08	5.3E-07	3.5E-05	2.4E-05	
Cf249	ND	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Cf250	ND	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Cf251	ND	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Cf252	1.80E-10	2.3E-22	9.7E-33	0.0E+00	0.0E+00	
Cm242	3.83E-11	6.9E-10	4.5E-09	5.5E-09	1.3E-26	
Cm243	2.51E-10	5.2E-10	4.7E-10	1.1E-17	0.0E+00	
Cm244	2.11E-10	2.5E-07	5.7E-08	4.5E-21	0.0E+00	
Cm245	3.35E-10	1.3E-11	1.3E-10	8.4E-09	6.8E-09	
Cm246	3.32E-10	2.7E-13	2.8E-12	1.8E-10	7.8E-11	
Cm247	3.09E-10	9.2E-20	9.5E-19	6.8E-17	1.1E-16	
Cm248	1.31E-09	1.2E-19	1.2E-18	8.8E-17	1.4E-16	
Cm250	ND	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Np236	2.73E-11	7.8E-13	8.1E-12	5.8E-10	8.9E-10	
Np237+D	3.00E-10	5.0E-06	5.6E-05	4.0E-03	6.6E-03	
Np238	4.56E-12	5.0E-13	3.2E-12	3.8E-12	9.2E-30	
Pa231	1.49E-10	2.7E-09	3.2E-08	4.4E-06	4.0E-05	
Pb210+D	1.01E-09	8.4E-11	6.5E-08	8.7E-05	2.8E-03	
Pu236	7.68E-11	2.4E-09	2.1E-12	1.5E-10	2.3E-10	
Pu238	2.95E-10	**1.6E-03**	**7.5E-03**	4.2E-04	2.4E-25	Pu238
Pu239	3.16E-10	**9.8E-04**	**1.0E-02**	**7.0E-01**	**8.9E-01**	Pu239
Pu240	3.15E-10	**2.2E-04**	**2.2E-03**	**1.4E-01**	**9.3E-02**	Pu240
Pu241	5.20E-12	**2.4E-04**	2.0E-05	1.3E-10	1.1E-10	Pu241
Pu242	3.00E-10	3.3E-08	3.5E-07	2.5E-05	3.9E-05	
Pu243	3.69E-13	1.1E-22	1.1E-21	8.1E-20	1.3E-19	

ND - no slope factor available.

Table 10-2 Results of the first and second COPC screens.

Retained Radionuclides After Screen 1	Slope Factor	Individual Risk Factor Fraction				Retained Nuclides After Screen 2
		Near Term Years		Far Term Years		
		1972	2072	2972	11972	
Pu244+D	3.19E-10	3.8E-15	3.9E-14	2.8E-12	4.5E-12	
Ra226+D	2.96E-10	1.7E-10	2.7E-08	2.6E-05	8.3E-04	
Ra228+D	2.48E-10	6.4E-15	1.4E-13	1.1E-11	5.0E-11	
Th228+D	2.31E-10	3.6E-08	3.7E-09	4.9E-10	7.2E-10	
Th229+D	3.56E-10	3.0E-12	2.1E-10	9.6E-07	1.2E-04	
Th230	3.75E-11	6.8E-09	8.1E-08	1.3E-05	1.3E-04	
Th232	3.28E-11	1.7E-15	1.9E-14	1.5E-12	6.7E-12	
U232	8.12E-11	2.2E-10	1.3E-09	1.7E-10	2.4E-10	
U233	4.48E-11	5.6E-11	4.2E-09	2.6E-06	4.2E-05	
U234	4.44E-11	1.3E-06	1.4E-05	1.1E-03	1.7E-03	
U235+D	4.70E-11	5.1E-08	5.3E-07	3.8E-05	6.3E-05	
U236	4.21E-11	6.5E-09	6.8E-08	5.7E-06	1.4E-05	
U237	3.98E-12	8.2E-11	3.8E-10	2.5E-15	1.9E-15	
U238+D	6.20E-11	1.5E-08	1.6E-07	1.1E-05	1.8E-05	
FISSION PRODUCTS						
Ag108M+D	6.05E-12	1.1E-13	6.7E-13	3.5E-13	2.7E-34	
Be10	ND	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
C14	1.03E-12	1.9E-11	1.8E-10	1.2E-08	6.6E-09	
Cd113M	ND	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Ce142	ND	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Cs134	4.73E-11	**2.0E-03**	5.0E-17	0.0E+00	0.0E+00	Cs134
Cs135	4.53E-12	6.4E-08	6.7E-07	4.8E-05	7.8E-05	
Cs137+D	3.16E-11	**3.7E-01**	**3.8E-01**	2.5E-08	0.0E+00	Cs137+D
Eu150	ND	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Eu152	5.73E-12	4.7E-07	3.0E-08	2.6E-26	0.0E+00	
Eu154	9.37E-12	**4.6E-04**	1.5E-06	0.0E+00	0.0E+00	Eu154
Eu155	1.65E-12	9.6E-05	8.6E-10	0.0E+00	0.0E+00	
Gd152	ND	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
H3	7.15E-14	2.3E-06	8.9E-08	0.0E+00	0.0E+00	
Ho166M	ND	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
I129	1.84E-10	6.4E-07	6.7E-06	4.8E-04	7.7E-04	
In115	3.49E-11	7.7E-17	8.0E-16	5.7E-14	9.3E-14	
La138	ND	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Nb93M	6.64E-13	1.0E-07	2.1E-06	1.5E-04	2.5E-04	
Nb94	6.91E-12	7.2E-07	7.4E-06	5.2E-04	6.1E-04	
Nd144	ND	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Pd107	2.09E-13	4.9E-10	5.1E-09	3.6E-07	5.9E-07	
Pm146	ND	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Pm147	1.41E-12	**3.5E-03**	1.2E-13	0.0E+00	0.0E+00	Pm147
Rb87	3.68E-12	1.6E-11	1.6E-10	1.2E-08	1.9E-08	

ND - no slope factor available.

Table 10-2 Results of the first and second COPC screens.

Retained Radionuclides After Screen 1	Slope Factor	Individual Risk Factor Fraction				Retained Nuclides After Screen 2
		Near Term Years		Far Term Years		
		1972	2072	2972	11972	
Rh102	ND	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Sb125+D	3.54E-12	**1.8E-04**	2.6E-14	0.0E+00	0.0E+00	Sb125+D
Sb126	9.73E-12	7.7E-08	8.0E-07	5.7E-05	8.7E-05	
Sb126M	7.28E-14	4.1E-09	4.3E-08	3.0E-06	4.7E-06	
Se79	ND	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Sm146	ND	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Sm147	2.51E-11	3.9E-11	4.0E-10	2.9E-08	4.7E-08	
Sm148	ND	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Sm149	ND	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Sm151	4.60E-13	6.5E-05	**3.1E-04**	2.1E-05	0.0E+00	Sm151
Sn121M	2.00E-12	2.3E-08	5.9E-08	1.6E-11	0.0E+00	
Sn126	2.12E-11	1.2E-06	1.3E-05	8.7E-04	1.4E-03	
Sr90+D	5.59E-11	**6.2E-01**	**5.9E-01**	2.1E-08	0.0E+00	Sr90+D
Tc98	ND	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Tc99	1.40E-12	3.1E-06	3.2E-05	2.3E-03	3.5E-03	
Te123	ND	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Tm171	5.86E-13	2.0E-17	4.5E-32	0.0E+00	0.0E+00	
Zr93	5.21E-13	1.7E-07	1.7E-06	1.2E-04	2.0E-04	

ND - no slope factor available.

After the first two screening steps, of the radionuclides with slope factors, 13 were retained. The retained radionuclides and the time frames for which they are significant COPCs are summarized in Table 10-3. As shown in Table 10-3, all the COPCs for the far term time frames are identified as COPCs in the near term time frames. The plutonium isotopes become the major risk factor contributors in the far term.

Table 10-3 Summary of the retained radionuclides for CPP-31 after the first and second COPC screens.

Retained Radionuclides				
Near Term Year		Far Term Year		Complete List of Retained Radionuclides
1972	2072	2972	11972	
Co60				Co60
Am241	Am241	Am241		Am241
Pu238	Pu238			Pu238
Pu239	Pu239	Pu239	Pu239	Pu239
Pu240	Pu240	Pu240	Pu240	Pu240
Pu241				Pu241
Cs134				Cs134
Cs137	Cs137			Cs137
Eu154				Eu154
Pm147				Pm147
Sb125				Sb125

Table 10-3 Summary of the retained radionuclides for CPP-31 after the first and second COPC screens.

Retained Radionuclides				
Near Term Year		Far Term Year		Complete List of Retained Radionuclides
1972	2072	2972	11972	
	Sm151			Sm151
Sr90	Sr90			Sr90

Screen 3 is a nuclide activity fraction screen that is used to identify possible COPCs that do not have slope factors and can not be quantitatively screened with a toxicity screen. The radionuclides with no slope factors are listed in Table 10-4 along with their decay half-lives and maximum nuclide fraction from Table 10-1. The nuclide activity fraction screening level was defined as the minimum activity of the retained radionuclides in the toxicity screen (Table 10-2). The minimum activity was for Pu-240 which was 1.50×10^{-5}, in 1972.

Table 10-4 Nuclide activity fraction screen for the COPCs that do not have slope factors. Screen nuclides with maximum nuclide fractions less than 1.50×10^{-5}.

Radionuclides With No Slope Factor	Decay Half-Life	Half-Life Units	Nuclide Fraction of the Total Activity				Retained Nuclides After Screen 3
			Near Term Years		Far Term Years		
			1972	2072	2972	11972	
ACTIVATION PRODUCTS							
Si32	4.50E+02	yr	5.6E-14	5.5E-13	1.2E-10	1.1E-14	
V50	4.00E+16	yr	3.2E-21	3.5E-20	2.0E-17	2.7E-17	
ACTINIDES+DAUGHTERS							
Cf249	3.51E+02	yr	4.1E-21	3.6E-20	3.6E-18		
Cf250	1.31E+01	yr	3.4E-21	1.8E-22	0.0E+00		
Cf251	9.00E+02	yr	9.4E-24	9.5E-23	2.8E-20	3.5E-23	
Cm250	6.90E+03	yr	5.4E-30	5.9E-29	3.3E-26	3.1E-26	
FISSION PRODUCTS							
Be10	1.60E+06	yr	9.2E-12	1.0E-10	5.8E-08	7.7E-08	
Cd113M	1.36E+01	yr	2.2E-05	2.1E-06	3.3E-22		Cd113M
Ce142	1.05E+11	yr	9.2E-11	1.0E-09	5.8E-07	7.7E-07	
Eu150	3.60E+01	yr	2.3E-12	3.7E-12	6.4E-17		
Gd152	1.08E+14	yr	2.0E-19	2.8E-18	1.6E-15	2.2E-15	
Ho166M	1.20E+03	yr	2.2E-11	2.3E-10	7.9E-08	5.7E-10	
La138	1.35E+11	yr	6.7E-16	7.3E-15	4.2E-12	5.6E-12	
Nd144	2.10E+15	yr	4.3E-15	4.7E-14	2.7E-11	3.6E-11	
Pm146	2.02E+03	d	1.6E-07	6.0E-12			
Rh102	2.90E+00	yr	3.0E-09	1.4E-18			
Se79	6.50E+04	yr	1.3E-06	1.5E-05	8.4E-03	1.0E-02	Se79
Sm146	1.03E+08	yr	2.0E-14	2.7E-13	1.6E-10	2.1E-10	
Sm148	8.00E+15	yr	8.1E-18	8.8E-17	5.2E-14	6.8E-14	
Sm149	1.00E+15	yr	4.1E-17	4.5E-16	2.6E-13	3.5E-13	

Table 10-4 Nuclide activity fraction screen for the COPCs that do not have slope factors. Screen nuclides with maximum nuclide fractions less than 1.50×10^{-5}.

Radionuclides With No Slope Factor	Decay Half-Life	Half-Life Units	Nuclide Fraction of the Total Activity				Retained Nuclides After Screen 3
			Near Term Years		Far Term Years		
			1972	2072	2972	11972	
Tc98	4.20E+06	yr	1.4E-12	1.5E-11	9.0E-09	1.2E-08	
Te123	1.00E+13	yr	3.6E-20	4.0E-19	2.3E-16	3.1E-16	

As shown in Table 10-4, Cd-113M and Se-79 each have activity fractions larger than Pu-240 (1.50×10^{-5}). The largest Cd-113M fraction is for 1972 and drops an order of magnitude within 100 years (Table 10-1). The largest Se-79 activity fraction is for the year 11972 but the activity fraction is higher than the screening level in 2172 and 2972. Although there are no slope factors for Cd-113M and Se-79, there are dose-conversion factors (EPA, 1988, Table 2.2). Based on the dose-conversion factors, it was assumed that the slope factor for Cd-113M is similar to Sr-90 and Se-79 is similar to Se-75. Shown in Table 10-5 are the dose-conversion factors, slope factors, maximum individual risk factor fractions and year of this maximum. Based on the assumed slope factors, both Cd-113M and Se-79 would be eliminated in the toxicity screen. Therefore, all of the radionuclides without slope factors can be eliminated COPCs.

Table 10-5 Estimated maximum individual risk factor fractions for Cd-113M and Se-79.

Nuclide	Dose-Conversion Factor (Sv/Bq)	Slope Factor $(pCi)^{-1}$	Maximum Individual Risk Factor Fraction[1]	Year of Maximum
Sr-90	3.85E-08	4.09E-11[2]	4.6E-01	1972
Cd-113M	4.35E-08	~ 5.E-11	5.2E-05	1972
Se-75	2.60E-09	6.53E-12	Not calculated	Not calculated
Se-79	2.35E-09	~ 6.E-12	4.1E-04	11972

1. These were calculated by recalculating the values in Table 10-2 including Cd-113M and Se-79 with the assumed slope factors.
2. The slope factor is for Sr-90 rather than Sr-90+D. Therefore, this value is different than that used in Table 10-2.

The third screening step is a vadose zone travel time screen. Commonly, a travel time greater than 10 half-lives is considered to be a reasonable screening criteria. This corresponds to an activity reduction factor of approximately 1,000. However, because the known Sr-90 and Cs-137 activity released is extremely high, a conservative 20 half-lives (activity reduction factor of 10^6) was chosen for the screening criteria.

The vadose zone contaminant travel time has an advective and dispersive component. The advective arrival time of a pulse of contaminant is a function of the average linear velocity of the water and is independent of the dispersion. The addition of dispersion to the system spreads out the contaminant and results in an earlier arrival of the leading edge of the contaminant plume. Because dispersion results in earlier arrival of the plume, the use of an advective travel time for screening is not conservative and may screen contaminants that will pose a risk in the aquifer. Therefore, the numerical simulation results are needed to estimate the vadose zone travel time until a significant portion of the contaminant mass has move through the vadose zone to the aquifer. For purposes of this screening, a significant mass flux is not quantified but simply defined as the initial rise in the mass flux curve. The mass flux curve is scaled to the peak mass flux so that a visible rise in the mass flux curve is 1% to 5% of the peak mass flux.

The contaminant's vadose zone travel time in the area of CPP-31 is calculated based on the vadose zone travel time of a conservative tracer and the contaminant specific retardation, as follows.

$$TT_c = Rd \cdot TT_T \quad (1)$$

$$Rd = 1 + \frac{(\rho \cdot Kd)}{\theta} \quad (2)$$

where:

TT_c	contaminant travel time through the vadose zone from CPP-31 (years)
TT_T	conservative tracer travel time through the vadose zone from CPP-31 (7 years as explained below)
Rd	contaminant specific retardation coefficient (dimensionless)
ρ	soil bulk density (1.36 g/cm^3, as used in the model)
θ	soil moisture content (0.487, assumed equal to the sediment porosity use in the model)
Kd	contaminant specific equilibrium partition coefficient (ml/g)

In the sensitivity analysis, Np-237 with a Kd of 0 mL/g (Section 8.6) was used to estimate the vadose zone travel time of a conservative tracer, from CPP-31. This simulation run was chosen from all of the simulations presented in Sections 7 and 8 because Np-237 has a long half life and is assumed to have a Kd of 0 mL/g allowing it to move through the vadose zone with the water while undergoing essentially no decay. As incorporated in the model, there are two primary vadose zone sources of Np-237, 1) Np-237 that was discharged to the vadose zone when the injection well failed, and 2) Np-237 that was discharged during the CPP-31 release in November 1972. The mass flux shown in Figure 8-168 and repeated in Figure 10-1 represents these two Np-237 discharges. The first peak shown in the figure corresponds Np-237 mass from the failed injection well and the second peak corresponds to Np-237 that has traveled from CPP-31 through the vadose zone to the aquifer. Because of the Kd=0 assumption, the second peak is representative of the CPP-31 advective travel time through the vadose zone. Unfortunately, the Np-237 mass flux from the failed injection well is still entering the aquifer at the time of the initial mass flux from the surface (CPP-31 release). Therefore, Figure 10-1 does not show the initial rise of the mass flux curve for mass from the surface. The vadose zone travel time until the initial rise in the mass flux curve cannot be obtained directly from the mass flux curve but must be extrapolated using the mass flux curve later in time.

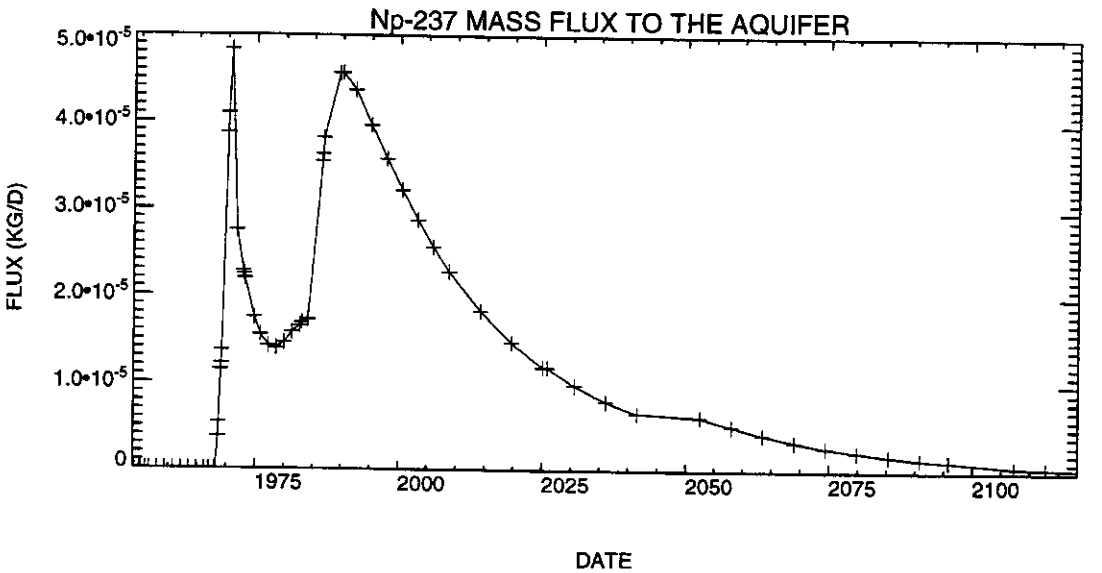

Figure 10-1 Mass flux of Np-237 into the aquifer from the vadose zone (Figure 8-168).

The advective water travel time from CPP-31 is approximately the time from November 1972 to the time of the maximum mass flux, (17 years based on the aquifer mass flux curve shown in Figure 10-1). Dispersion results in the arrival of contaminant mass at an earlier time. The aquifer mass flux curve shown in Figure 10-1 is used to approximate the model predicted time from the CPP-31 release in 1972 until the leading edge of the contaminant mass plume reached the aquifer. Extrapolating backwards from the time to the maximum aquifer mass flux (17 years) through the time required for half of the maximum mass flux to arrive (12 years), the vadose zone travel time to the leading edge of the aquifer mass flux curve is approximately 7 years. Therefore, 7 years was used for the time necessary for contaminants to move from CPP-31 through the vadose zone. This CPP-31 water travel time is representative of the time frame while the ICPP is an operating plant including water disposal to the percolation ponds. Because the ICPP is discharging water that infiltrates into the vadose zone, the predicted water travel times are shorter than those expected under natural conditions after closure of the ICPP facility. Therefore, the use of the calculated vadose zone travel time is conservative for relatively immobile radionuclides that will be transported primarily after the ICPP operations are finished and vadose zone water transport decreases.

In order to verify that the estimated vadose zone travel times are conservative, they were compared with the Pu mass flux results shown in Figure 7-177 and repeated in Figure 10-2. Assuming a Kd of 22 mL/g for Pu, the time required for the initial mass flux to arrive in the aquifer was estimated to be 437 years and the advective travel time would be 1060 years. Based on the Pu simulation results, the mass flux to the aquifer in 437 years is approximately 3% of the peak mass flux to the aquifer. The cumulative mass flux to the aquifer is less than 0.1% of the Total Pu mass. If 1% of the contaminant mass is considered a significant portion, then this is a conservative estimate of the time required for a significant mass flux to move from the vadose zone to the aquifer. Based on the Pu simulation results, the peak mass flux occurs in approximately 1620 years which is approximately 60% longer than the time predicted by extrapolation from the Np-237 simulations with Kd=0 mL/g. This difference occurs because the Np-237 moves through the vadose zone during the operating period of the ICPP when the water flux is artificially increased, in contrast to the movement of the Pu which

occurs primarily after the ICPP facilities are assumed to be non-operational and the vadose zone transport occurs under the influence of natural water sources.

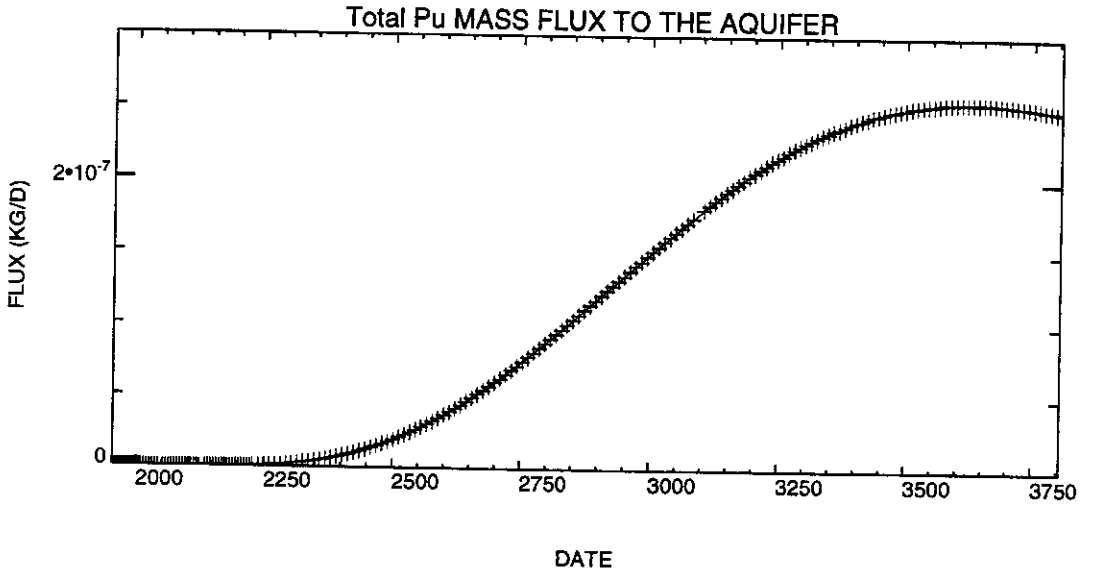

Figure 10-2 Mass flux of Pu into the aquifer from the vadose zone (Figure 7-177).

In Table 10-6 the radionuclide half-lives, soil water equilibrium partition coefficients (Kd), retardation coefficients (Rd), estimated vadose zone travel times, and number of half-lives expected during the vadose zone travel times are given. Of the 13 nuclides given in Table 10-3, Am-241, Pu-238, Pu-239, Pu-240, and Sr-90 each have vadose zone travel times less than 20 decay half-lives and are retained as CPP-31 COPCs. Of these radionuclides, Pu-238 has not previously been identified as a COPC. The sensitivity of the Total Pu simulation results to the addition of the Pu-238 as a COPC is discussed in Section 10.5.

Table 10-6 Results of the vadose zone travel time versus decay half-life screen.

Nuclide	Half-Life years	Kd mL/g	Rd	Vadose Zone Travel Time years	Travel Time / Half-Lives	Retained Nuclides
ACTIVATION PRODUCTS						
Co60	5.27	10	28.9	202	38.4	
ACTINIDES+DAUGHTERS						
Am241	432.2	340	950	6651	15.4	Am241
Pu238	87.75	22	62.4	437	4.98	Pu238
Pu239	24130	22	62.4	437	0.02	Pu239
Pu240	6569	22	62.4	437	0.07	Pu240
Pu241	14.4	22	62.4	437	30.3	

1 Assumed to have the same Kd as Am241 (Personal communication, Craig Dicke, 4/97)

Table 10-6 Results of the vadose zone travel time versus decay half-life screen.

Nuclide	Half-Life years	Kd mL/g	Rd	Vadose Zone Travel Time years	Travel Time / Half-Lives	Retained Nuclides
FISSION PRODUCTS						
Cs134	2.06	500	1397	9777	4742	
Cs137	30	500	1397	9777	326	
Eu154	8.6	340	950	6651	773	
Pm147[1]	2.62	340	950	6651	2536	
Sb125	2.77	50	141	984	355	
Sm151	90	340	950	6651	73.9	
Sr90	29.12	12	34	241	8.29	Sr90

1 Assumed to have the same Kd as Am241 (Personal communication, Craig Dicke, 4/97)

The results shown in Table 10-6 are strongly supported by the simulation results shown in Section 7. The estimated vadose zone travel times for Co-60 and Cs-137 are 38.4 and 326 half-lives, respectively. This corresponds to activity reduction factors of 3.6×10^{11} and 1×10^{98}, respectively. In Sections 7.4 and 7.5, Co-60 and Cs-137 were shown to decay without significant transport through the vadose zone. The estimated vadose zone travel times for Sr-90 and Am-241 are 8.3 and 15.4 half-lives, respectively. This corresponds to activity reduction factors of 3×10^{2} and 4×10^{4}, respectively. In Sections 7.10 and 7.13, the Sr-90 and Am-241 results showed a very small fraction of their total mass reaching the aquifer.

10.3.3 Reestimation of the CPP-31 Source Inventory

As explained in Section 5.2.2.1, the CPP-31 release was a November 1972 discharge of approximately 14,000 gallons (52,990 L) of liquid during a transfer of second cycle raffinate from tank WM-181 to WM-180. Using the reestimated activities given in Appendix N, the total CPP-31 inventory was calculated for each of the COPCs identified in Section 5.1. The reestimated CPP-31 activity concentrations and inventories released are summarized in Table 10-7 and compared with the inventories calculated in Section 5.2.

Table 10-7 Summary of the CPP-31 concentrations and inventories released.

Nuclide	Reestimated CPP-31 Source Concentrations		CPP-31 Source Inventory		Ratio of the Reestimated CPP-31 Releases to Those Estimated in Table 5-24
	dps/mL[1]	Ci/L	Reestimated Ci	Table 5-24 Ci	
ACTIVATION PRODUCTS					
Co60	1.0E+04	2.7E-04	1.4E+1	4.8E+1	3.0E-01
ACTINIDES+DAUGHTERS					
Am241	1.1E+03	3.0E-05	1.6E+0	1.1E+2	1.4E-02
Np237	1.3E+01	3.5E-07	1.9E-2	2.2E-1	8.6E-02
Pu238	4.1E+03	1.1E-04	5.9E+0	0.0E+0	NA
Pu239	2.4E+03	6.5E-05	3.4E+0	8.5E+0	4.1E-01
Pu240	5.3E+02	1.4E-05	7.6E-1	5.5E+0	1.4E-01
Pu241	3.6E+04	9.7E-04	5.2E+1	9.6E+2	5.4E-02

1. from Appendix N, Table 7. The values were modeled using ORIGEN2. The model was calibrated and validated using analytical data from tank wastes and soil samples as explained in Appendix N.
NA - Pu238 was not reported in the CPP-31 inventory estimate summarized in Table 5-24.

Table 10-7 Summary of the CPP-31 concentrations and inventories released.

Nuclide	Reestimated CPP-31 Source Concentrations		CPP-31 Source Inventory		Ratio of the Reestimated CPP-31 Releases to Those Estimated in Table 5-24
	dps/mL[1]	Ci/L	Reestimated Ci	Table 5-24 Ci	
Pu242	8.6E-02	2.3E-09	1.2E-4	1.1E-2	1.2E-02
U234	2.3E+01	6.2E-07	3.3E-2	6.7E-1	4.9E-02
U235	8.4E-01	2.3E-08	1.2E-3	1.1E-2	1.1E-01
U236	1.2E-01	3.2E-09	1.7E-4	2.5E-2	6.8E-03
U238	1.9E-01	5.1E-09	2.7E-4	1.8E-3	1.5E-01
FISSION PRODUCTS					
Cs137	9.0E+06	2.4E-01	1.3E+4	1.4E+4	9.1E-01
H3	2.5E+04	6.8E-04	3.6E+1	1.4E+1	2.5E+00
I129	2.7E+00	7.3E-08	3.9E-3	7.0E-3	5.5E-01
Sr90	8.6E+06	2.3E-01	1.2E+4	1.2E+4	1.0E+00
Tc99	1.7E+03	4.6E-05	2.4E+0	2.6E+0	9.4E-01

1. from Appendix N, Table 7. The values were modeled using ORIGEN2. The model was calibrated and validated using analytical data from tank wastes and soil samples as explained in Appendix N.
NA - Pu238 was not reported in the CPP-31 inventory estimate summarized in Table 5-24.

Based on the results shown in Table 10-7, the reestimated activation products and actinides and daughters are smaller than those presented in Table 5-24, with the exception of Pu-238 (which was not included in the modeled inventory). For the fission products, the reestimated Sr-90 is essentially the same as the estimates from Table 5-24, Cs-137 and Tc-99 are within 10% lower, I-129 is almost 50% lower, and H-3 is 2.5 times larger.

As discussed in Appendix N, the reestimated concentrations of the actinides, daughters, and fission products were calibrated to analytical samples taken from tank WM-181 in 1971 and validated using soil samples taken from the CPP-31 soils in 1975. The reestimated concentrations of the activation products were calibrated based on Co-60 concentrations using the 1975 CPP-31 soil samples but there is no independent data from which to validate the results. Based on the calibration (see Tables 1 and 2 in Appendix N), the reestimated concentrations are very accurate. Based on the validation (Tables 5 and 6 in Appendix N), the reestimated Eu-154 is high by 15%, and Sr-90, Cs-134 and Pu-239 are low by approximately 18%, 45%, and 39%, respectively.

Because the activation product estimates could not be verified with analytical results, the accuracy of this reestimate is questionable and the Co-60 CPP-31 inventory used for the simulations (from column 5 of Table 10-7) cannot necessarily be assumed to be conservative.

Pu-239 was the only actinide or daughter for which CPP-31 soil samples were analyzed in 1975 and could be used to validate the reestimated CPP-31 inventory. Based on these results, the reestimated Pu-239 concentrations may be low by approximately 39%. Assuming that the reestimated Pu-239 concentrations are low the reestimated CPP-31 Pu-239 inventory should be 5.6 Ci (3.4/0.61) or 66% of the 8.5 Ci inventory used for the simulations and presented in the 5th column of Table 10-7. Based on all available information, the CPP-31 Pu-239 inventory used for the simulations is only moderately conservative. Assuming the reestimated inventories for the other actinides and daughters are also low by approximately 39%, their CPP-31 inventories used for the simulations are still considered to be very conservative.

Cs-134, Eu-154, and Sr-90 were the fission products for which CPP-31 soil samples were analyzed in 1975 and could be used to validate the reestimated CPP-31 inventory. Based on these results, the reestimated

CPP-31 fission product inventories could be low by up to 45% or high by up to 15%. Because, with the exception of I-129, the reestimated fission product inventories are not significantly lower than the inventories used for the simulations and presented in the 5th column of Table 10-7 (and H-3 is higher) the CPP-31 inventories used for the simulations may not be conservative (overestimated). The Cs-137, H-3, Sr-90, and Tc-99 CPP-31 inventories presented in the 5th column of Table 10-7 may have been underestimated.

The Pu and U isotope activity estimates are different for the reestimated CPP-31 inventory compared to the modeled inventory. In all cases, the modeled inventory appears to have overestimated the CPP-31 Pu and U source. However, as discussed in Section 6.2, Total Pu and Total U were simulated rather than simulating each isotope of Pu and U. The transport simulations were for mass and the resulting mass concentrations were converted to activity concentrations using composite specific activities that were based on the assumed isotopic distributions. The isotope distributions were based on a combination of all of the contaminant sources at the ICPP, including CPP-31. As will be discussed in Section 10.5, both the inventory estimates and the assumed isotopic distributions affect the transport simulation results.

Because the Pu is modeled as Total Pu and the peak concentrations in the aquifer are approximately 1600 years in the future, the Pu-238 (87.7 year half-life) and the Pu-241 (14.4 year half-life) will decay away before they pose a significant risk to the aquifer. The affects of the Pu-238 and Pu-241 progeny are discussed in Section 10.3.4. The reestimated Pu-240 is present in relatively small concentrations compared to the Pu-239. Therefore, for the reestimated CPP-31 inventory, Pu-239 is the primary Pu risk component. When comparing the Pu differences between the reestimated and modeled Pu inventories, the transport simulation results will be primarily sensitive to the Pu-239 differences. As explained above, the reestimated Pu-239 inventory is approximately 41% of the modeled inventory estimates, however, based on the CPP-31 Pu soil samples, the Pu-239 inventory could be 39% low. Therefore, the Pu-239 inventory shown column 5 of Table 10-7 is assumed to be only slightly conservative. In addition Pu-238 was neglected in the CPP-31 inventory and must be added in. On the other hand, the reestimated Pu-240, 241, and 242 values are lower than the modeled inventory by 86%, 95%, and 99%. Of particular interest is the inventory differences for Pu-240 because it is predicted to by a major mass and activity contributor at the time of the predicted peak concentration in the aquifer (1600 years in the future). Therefore, based on the reestimated Pu-240 CPP-31 inventory, the simulated total Pu mass is probably conservative.

Each of the uranium isotopes have long half-lives relative to the vadose zone travel time. Therefore, the distribution of the uranium isotopes will be essentially unchanged over the modeling period of interest. Based on the results shown in Table 10-7 the modeled CPP-31 uranium inventory was over estimated. The chemical toxicity of uranium dominates the radiological toxicity. Therefore, U-235 and U-238 are the primary isotopes of interest because they contribute the majority of the mass (40.6% and 58.8%, respectively, see Table 10-8). Based on the reestimated CPP-31 inventories, the modeled U-235 and U-238 inventories were overestimated by factors of 9 and 6.7.

10.3.4 Effects of Progeny Ingrowth On The CPP-31 Estimated Inventory

The simulation results presented in Section 7 neglect the ingrowth of all progeny that are not included in the +D slope factors. These are progeny with relatively long half lives that are not necessarily in secular equilibrium with their parent radionuclide. They are produced by the parent radionuclide and then can travel through the environment completely separate from the parent. Table 10-8 summarizes the estimated total nuclide mass (parent and progeny) from CPP-31 that was present in 1972 and will be present 100, 1000, and 10,000 years afterwards. Based on this information the progeny production can be traced and the progeny significance estimated. Of the nuclide results shown in Table 10-8, Am-241 is the only identified COPC that will significantly increase its inventory over the next 10,000 years. Most of the Pu-241 mass will decay to Am-241 in the next 100 years.

Table 10-8 Summary of the near and far term CPP-31 mass for radionuclides and relatively long lived progeny.

Nuclide	Progeny	Nuclide Mass (g) Distribution Through Time For CPP-31 Release				Comments
		1972	2072	2972	11972	
Pu238		3.4E-01	1.6E-01	1.3E-04	4.4E-26	Use initial inventory. Minor contributor to U234 over the next 1,000 years.
	U234*	5.3E+00	5.5E+00	5.7E+00	5.5E+00	Use initial inventory
	Th230	9.9E-03	1.1E-02	2.6E-02	1.6E-01	Not identified as a COPC over the next 10,000 years.
	Ra226	6.4E-07	9.9E-06	1.3E-04	2.6E-03	Not identified as a COPC over the next 10,000 years.
	Pb210	1.2E-09	9.0E-08	1.7E-06	3.4E-05	Not identified as a COPC over the next 10,000 years.
Pu239		5.5E+01	5.5E+01	5.3E+01	4.2E+01	Use initial inventory. Minor contributor to U235 over the next 10,000 years.
	U235*	5.6E+02	5.6E+02	5.6E+02	5.7E+02	Use initial inventory
	Pa231	4.8E-04	5.5E-04	1.1E-03	5.9E-03	Not identified as a COPC over the next 10,000 years
	Ac227	5.5E-08	3.0E-07	6.1E-07	3.4E-06	Not identified as a COPC over the next 10,000 years
Pu240		3.3E+00	3.3E+00	3.0E+00	1.2E+00	Use initial inventory. Significant contributor to U236 over the next 1,000 to 10,000 years
	U236*	2.7E+00	2.7E+00	3.1E+00	4.9E+00	Use initial inventory because the mass contribution of U-236 is small. If the transport of U-236 was important, the Pu-240 contribution would have to be considered.
	Th232	5.4E-04	5.5E-04	6.3E-04	1.7E-03	Not identified as a COPC over the next 10,000 years
	Ra228	1.1E-13	2.2E-13	2.5E-13	6.8E-13	Not identified as a COPC over the next 10,000 years
	Th228	2.1E-07	2.1E-09	3.8E-12	3.5E-12	Not identified as a COPC over the next 10,000 years
Pu241		5.0E-01	4.0E-03	3.6E-10	1.8E-10	Use initial inventory. Decays to Am241. Increases Am-241 significantly in first 100 years
	Am241*	4.6E-01	8.3E-01	2.0E-01	1.1E-07	Increase initial inventory to include ingrowth. Insignificant (<2%) contributor to Np237
	Np237*	2.6E+01	2.8E+01	2.8E+01	2.8E+01	Use initial inventory
	U233	1.4E-04	1.0E-03	9.1E-03	8.9E-02	Not identified as a COPC over the next 10,000 years
	Th229	4.4E-08	2.9E-07	1.9E-05	1.4E-03	Not identified as a COPC over the next 10,000 years
Pu242		3.1E-02	3.1E-02	3.1E-02	3.1E-02	Use initial inventory. Insignificant contributor to U238 over the next 10,000 years
	U238*	8.1E+02	8.1E+02	8.1E+02	8.1E+02	Use initial inventory. Insignificant contributor to U234 over the next 10,000 years
	U234*	5.3E+00	5.5E+00	5.7E+00	5.5E+00	Use initial inventory
	Th230	9.9E-03	1.1E-02	2.6E-02	1.6E-01	Not identified as a COPC over the next 10,000 years
	Ra226	6.4E-07	9.9E-06	1.3E-04	2.6E-03	Not identified as a COPC over the next 10,000 years
	Pb210	1.2E-09	9.0E-08	1.7E-06	3.4E-05	Not identified as a COPC over the next 10,000 years

* Progeny nuclides that are also present in the initial inventory, in significant quantity.

10.4 Reestimation of the Tank Farm Source Inventory

The reestimated tank farm inventory is shown in Table 10-9. Because the CPP-28/79 and 1986 Releases were not modified, it only reflects the reestimated CPP-31 inventory on the overall tank farm inventory. The results shown in Table 10-9 indicate that the Am-241, Np-237, and the uranium inventory are significantly smaller for the reestimated CPP-31 inventory than the tank farm inventory calculated in

Section 5.2.2. The H-3 inventory is decreased by a factor of four. The Co-60, Total Pu, and I-129 inventory is decreased by a factor of two, and there is essentially no change in the Cs-137, Sr-90, and Tc-99 inventory.

Table 10-9 Summary of the reestimated tank farm release inventories.

Nuclide	CPP-31 Reestimate	CPP-31 Table 5-24	CPP-28/79 Table 5-19	1986 Release Table 5-25	Reestimated Tank Farm Release	Tank Farm Release From Section 5.2.2	Ratio of the Reestimated Tank Farm Releases to Those Estimated in Section 5.2.2
	Ci	Ci	Ci	Ci	Ci	Ci	
(Activation Products)							
Co60	1.4E+01	4.8E+01	2.0E+01	7.4E-02	3.5E+01	6.8E+01	5.1E-01
(Actinides and Daughters)							
Am241	1.6E+00	1.1E+02	NA	1.7E-01	1.7E+00	1.1E+02	1.6E-02
Np237+D	1.9E-02	2.2E-01	1.3E-04	3.3E-04	1.9E-02	2.2E-01	8.8E-02
Pu238	5.9E+00	0.0E+00	0.0E+00	0.0E+00	5.9E+00	0.0E+00	NA
Pu239	3.4E+00	8.5E+00	1.0E+00	1.3E-02	4.5E+00	9.5E+00	4.7E-01
Pu240	7.6E-01	5.5E+00	1.0E+00	8.4E-03	1.8E+00	6.5E+00	2.7E-01
Pu241	5.2E+01	9.6E+02	2.0E+02	1.5E+00	2.6E+02	1.2E+03	2.2E-01
Pu242	1.2E-04	1.1E-02	2.6E-03	1.6E-05	2.8E-03	1.3E-02	2.1E-01
Total Pu	6.2E+01	9.8E+02	2.0E+02	1.5E+00	2.7E+02	1.2E+03	2.3E-01
U234	3.3E-02	6.7E-01	3.6E-02	1.0E-03	7.0E-02	7.1E-01	9.9E-02
U235+D	1.2E-03	1.1E-02	7.4E-04	1.7E-05	2.0E-03	1.2E-02	1.7E-01
U236	1.7E-04	2.5E-02	1.9E-03	3.9E-05	2.1E-03	2.7E-02	7.8E-02
U238+D	2.7E-04	1.8E-03	3.5E-05	2.8E-06	3.1E-04	1.9E-03	1.7E-01
Total U	3.5E-02	7.1E-01	3.9E-02	1.1E-03	7.4E-02	7.5E-01	1.0E-01
(Fission Products)							
Cs137+D	1.3E+04	1.4E+04	1.3E+04	2.2E+01	2.6E+04	2.7E+04	9.5E-01
H3	3.6E+01	1.4E+01	4.4E+00	2.2E-02	4.0E+01	1.8E+01	2.2E+00
I129	3.9E-03	7.0E-03	0.0E+00	1.1E-05	3.9E-03	7.1E-03	5.5E-01
Sr90+D	1.2E+04	1.2E+04	6.2E+03	1.8E+01	1.8E+04	1.8E+04	1.0E+00
Tc99	2.4E+00	2.6E+00	0.0E+00	4.0E-03	2.4E+00	2.6E+00	9.4E-01

NA -Am-241 was not reported in the CPP-28/79 inventory in Table 5-19 and Pu238 was not reported in the CPP-31 inventory shown in Tables 5-24 and 5-25.

10.5 Uncertainty Affects on the Simulation Results

There is insignificant information available to quantitatively evaluate the uncertainty of the CPP-31 source estimates. However, there was sufficient information available to independently reevaluate estimates. Based on the differences in these two source term estimates, the uncertainty in the simulation results can be qualitatively evaluated.

For purposes of this uncertainty analysis, it is assumed that the difference between the modeled and reestimated CPP-31 source inventories provide a reasonable measure of the uncertainty in the CPP-31 source term. Uncertainty in the CPP-28/79 and 1986 Release source terms have not been quantified.

The radionuclides that are primary contributors to the total activity at the tank farm (see Table 5-43) are Am-241 (99%), Co-60 (39%), Cs-137 (90%), Np-237 (15%), Total Pu (99%), Sr-90 (93%), Tc-99 (96%), and Total U (37%). The change in the CPP-31 source inventory would result in the following effects on the transport simulations for the primary COPCs from the tank farm.

- **Am-241:** The reestimated CPP-31 inventory for Am-241 is 60 times smaller than the modeled inventory (Table 10-7) and 50 times smaller for the tank farm (Table 10-9). As explained in Section 5.2.2 and footnote a in Table 5-20, errors in the Donovan (1989) data account for a factor of 5 of the CPP-31 source overestimation. Am-241 was not included in the modeled CPP-28/79 inventory. Therefore, Am-241 source estimate at CPP-28/79 was underestimated with respect to that source. Comparing the CPP-28/79 and CPP-31 actinide inventories, indicates that the two sources are within one order of magnitude in all cases. Therefore, it can be assumed that a factor of 70 conservatism for CPP-31 is overly conservative to account for the neglected Am-241 at CPP-28/79. The vast majority of the Pu-241 will become Am-241 within 100 years (see Table 10-8). Therefore, because the Pu-241 to Am-241 decay chain was not simulated, the initial inventory of Am-241 should be assumed to include the initial inventory of Pu-241. The simulations presented in Section 7.13 used the modeled estimated Pu-241 mass which could include a potential overestimate of 38%. Because the Am-241 inventory was probably overestimated by an order of magnitude, minor inventory corrections based on Pu-241 decay would be negligible. The Am-241 simulation results appear to be conservative based on the assumptions of this uncertainty section. Based on the simulation results shown in Section 7.13, Am-241 did not pose a risk problem. Therefore, decreases in the Am-241 CPP-31 inventory would not move Am-241 from a COPC to a contaminant of concern (COC).
- **Co-60:** The reestimated CPP-31 inventory for Co-60 is one third the modeled inventory (Table 10-7) and half the total tank farm inventory (Table 10-9). Based on the simulation results shown in Section 7.4, the Co-60 decays away in place without posing a risk problem and a source uncertainty of 2 to 3 will have essentially no effect. Although the activation product source estimates could not be verified, based on the Co-60 half-life, a huge increase in Co-60 would be necessary in order for Co-60 to pose a risk to the aquifer.
- **Cs-137:** There is very little difference between the modeled and reestimated Cs-137 inventory from CPP-31. Therefore, there would be a negligible effect on the transport simulation results.
- **Np-237:** The reestimated CPP-31 inventory for Np-237 is 10 times smaller than the modeled inventory (Table 10-7) and 10 times smaller for the tank farm (Table 10-9). Based on the results shown in Table 10-8, decay of Am-241 will provide a negligible amount of mass to the Np-237 inventory over the next 100s to 1000s of years. Only 15% of the Np-237 released at the ICPP went to the tank farm while a conservatively estimated 75% went to the injection well. The results of reestimating the CPP-31 inventory would decrease the long term Np-237 aquifer concentrations by a factor of 10. Therefore, the Np-237 simulation results appear to be conservative based on the assumptions of this uncertainty section.
- **Total Pu:** As shown in Table 10-7 and explained in Section 10.3.3, in general the reestimated CPP-31 source inventory is has a much lower activity than was modeled. However, the majority of this discrepancy is from the activity of Pu-241 which will be gone in a relatively short time relative to the time of high Pu concentrations in the aquifer. At the time of the peak Pu concentrations in the aquifer (1600 years) the Total Pu inventory difference of concern for the groundwater pathway is limited to Pu-239 and Pu-240. The reestimated CPP-31 Pu-239 inventory is 41% of the modeled inventory and the reestimated tank farm inventory is 47% of the modeled inventory. The reestimated CPP-31 Pu-240 inventory is 14% of the modeled inventory and the reestimated tank farm inventory is 27% of the modeled inventory. However, the reestimated CPP-31 may be underestimated by 39% based on soil samples at CPP-31 in 1975. Therefore, based on the reestimated inventory and relative to the long term groundwater risk, the modeled Total Pu concentrations in the aquifer from the tank farm are probably overestimated by about 50%. The information available is not sufficient to bound the uncertainty exactly.

In addition, the composite specific activity used to convert the simulation mass to activity concentration assumes decay to the year 2095 (123 years from the release). The initial mass was assumed based on an average of 1st and 2nd cycle waste (Table 5-22). The initial mass and activity distributions as well as the distributions after 123 years are given in Table 6-2. A composite specific activity was calculated based on the isotope distribution and used to convert the mass concentrations to activity concentrations. Decaying 1600 years to the time of the Total Pu aquifer peak concentration provides a factor of about 25% decrease in the predicted peak Total Pu concentration in the aquifer because at that time Pu-241 and Pu-238 will no longer contribute to the specific activity. Between the conservative source and conservatively defined isotope distributions, the Total Pu concentration may be overestimated by approximately 75%. The Total Pu simulation results appear to be conservative based on the assumptions of this uncertainty section. From the results shown in Section 7.9, the Total Pu concentrations are approximately twice the MCL. Based on the reestimated CPP-31 source estimates and a composite specific activity after 1600 years, this concentration would be decreased but probably still be above the MCL.

- **Sr-90:** There is very little difference between the modeled and reestimated Sr-90 inventory from CPP-31 (approximately a 4% increase). However, analytical results from soil samples taken at CPP-31 in 1975 indicate that the Sr-90 may be underestimated (by 18%). The Sr-90 source inventory modeled for CPP-31 does not appear to be conservative but is relatively accurate.
- **Tc-99:** There is very little difference between the modeled and reestimated Tc-99 inventory from CPP-31. Therefore, the source uncertainty has little effect on the transport simulations.
- **Total U:** - The reestimated CPP-31 inventory indicates that the activity of the Total U isotopes are overestimated by about a factor of 10 for CPP-31 (Table 10-7) and for the tank farm (Table 10-9). The mass of the CPP-31 Total U isotopes is overestimated by a factor of 7 to 9. As explained in Section 10.3.3, the chemical toxicity of uranium dominates the radiological toxicity so that the primary risk drivers are the primary mass contributors (U-235 and U-238). U-234 and U-236 are minimal mass contributors and therefore negligible risk contributors. Decay ingrowth of U-234 provides a minimal uranium contribution based on the results shown in Table 10-8. Because the uranium toxicity is dominated by the chemical toxicity (not radiological toxicity), and the U-234 is a small fraction of the Total U mass, the ingrowth of U-234 has a negligible influence on the simulation results. The predicted long term Total U concentrations would decrease by approximately a factor of 6. The Total U simulation results appear to be conservative based on the assumptions of this uncertainty section.

Because the CPP-31 reestimation indicates a clear decrease in the CPP-31 inventory and the CPP-28/79 and 1986 releases are assumed to adequately describe the remaining soil contamination at the Tank Farm, the Section 7 simulation results should provide a conservative estimate of the future risk to the aquifer from the contaminants in the Tank Farm soils.

10.6 Summary of the Source Estimates Uncertainty Evaluation

Based on the assumptions and results of this uncertainty analysis, the COPCs identified in Section 5.1 included all of the significant COPCs from the CPP-31 release with the exception of Pu-238. Based on the reestimated CPP-31 inventory, the source inventory used for the simulations in Section 7 are conservative with the exception of Sr-90 which was increased by 4%. The aquifer predicted contaminant concentrations that result from tank farm sources would change in the following ways.

- There would be very little change in the simulated transport solutions for Co-60, Cs-137, Sr-90, and Tc-99.

- The Am-241 source term has significant uncertainty but an apparently conservative source term has been used resulting in extremely small predicted concentrations from the tank farm releases. Because the Am-241 decays away in the vadose zone, source uncertainty has little effect on the predictions.
- Based on the reestimated tank farm Np-237 inventory, the Np-237 concentrations from tank farm releases are overestimated by a factor of 10.
- Based on the reestimated tank farm Pu-239 inventory, and the Total Pu isotope distribution in the aquifer, the model predicted Total Pu concentrations from tank farm releases are overestimated by 75%.
- Based on the reestimated tank farm uranium inventory, the Total U concentrations from tank farm releases are overestimated by a factor of 6.

11 SUMMARY BY SPECIFIC CONTAMINANT OF UNCERTAINTY

Each COPC is subject to different levels of uncertainty. In addition, the relative importance of quantifying the uncertainty associated with each COPC varies depending on the ultimate prediction of risk. A summary of this information is presented in Table 11-1. Column 2 contains the base case soil Kd value. Columns 3 and 4 contain the source summary for each COPC. Column 5 is the year of the peak aquifer concentration, Column 6 is the overall maximum risk or HQ (for HQ values, a HQ is added in parenthesis), and Column 7 is the maximum risk or HQ in 2095 or beyond. If the risk or HQ value in Column 7 is for beyond the year 2095, the year of the peak is included in parenthesis.

Table 11-1 Summary of uncertainty information in the aquifer simulated predictions.

COPCs	Base Case Soil Kd Value (cm^3/g)	Source Summary		Year of Predicted Maximum Aquifer Concentration	Simulation Results		Comments
		Injection Well Activity(%)	Other Major Sources (%)		Overall Maximum Risk or HQ	Maximum Risk or HQ in 2095 or Beyond	
Arsenic	3.0	0%	soil (100%)	2479	3.42E-05	3.42E-05 (2479)	Measured concentrations are at essentially background levels.
Chromium	1.2	0%	TRA (99.4%)	1971	4.94 (HQ) (ICPP=0.013)	0.18 (HQ) (ICPP=0.012)	The primary source is at TRA. Concentrations in the ICPP area are low and reports indicate that there was very little chromium released from the ICPP, and the aquifer and vadose zone field data provide verification.
Co-60	10	0.7%	tank farm (39%) soil (60%)	1986	1.03E-05	0.00E+00	The peak risk was predicted to occur in 1986, implying that concentrations should be on the decline from now on. The short half life (~5 years) means that during the 100 years from 1995 until 2095, there are 20 half lives or approximately a factor of one million decay. There could be a large degree of uncertainty in both the Kd and source term before Co-60 will exceed risk based levels at any time beyond 2095.
Cs-137	500	0.1%	tank farm (90%) soil (9%)	1979	5.72E-05	3.92E-06	The peak risk was predicted to occur in 1979, implying that concentrations are declining. This is consistent with measured concentrations in the aquifer which have not exceeded the MCL since the early 1980s. The high Kd assumed for Cs-137 causes Cs-137 to be adsorbed in the vadose zone and aquifer sediments, and allows it to essentially decay in place. Comparison of model predictions to aquifer measurements indicate that the model is underpredicting the Cs-137 aquifer concentrations. Declining concentrations imply that the aquifer source is the injection well rather than the surface sources. Therefore, it is possible that the injection well Cs-137 source was underestimated in the model (or that the Kd was overestimated). Simulations were not performed to assess the impact of either source mass or Kd for Cs-137.
H-3	0	66%	TRA (29%)	1960	3.93E-03	1.34E-07	The peak risk was predicted to occur in 1960. In addition, most of the H-3 discharged near the ICPP was in the aquifer by the time the injection well was closed. H-3 undergoes dilution, dispersion, and decay relatively quickly because of a short half life and lack of adsorption. Because H-3 has been measured in the aquifer and because the aquifer model was calibrated using H-3, there is relatively little uncertainty in the predictions.

Table 11-1 Summary of uncertainty information in the aquifer simulated predictions.

COPCs	Base Case Soil Kd Value (cm^3/g)	Source Summary		Year of Predicted Maximum Aquifer Concentration	Simulation Results		Comments
		Injection Well Activity(%)	Other Major Sources (%)		Overall Maximum Risk or HQ	Maximum Risk or HQ in 2095 or Beyond	
I-129	0	91.6%	SWP (5.4%) Soil (2.6%)	1986	3.75E-04	1.81E-05	The peak risk was predicted to occur in 1986. The majority of the I-129 was put into the injection well and is currently moving through the aquifer. I-129 has a relatively long decay half-life so that no significant decay is expected in the aquifer, in the near future. The peak I-129 concentrations are predicted to remain above the MCL (1 pCi/L) until the year 2167 and fall below the 10^{-6} risk based concentration (0.26 pCi/L) in 2435. Because the I-129 has been measured over time in the aquifer at a number of wells and the model predictions are close to the field measurements, the predictions have a relatively high degree of certainty.
Mercury	100	39%	soil (58%)	1984	2.36	1.33 (HQ)	The peak risk was predicted to occur in 1984 as a result of the injection well source (extrapolated from the 1980-1983 disposal data) rather than the roughly equal soil source term. The soil source contributes very slowly to the aquifer because mercury has a very high Kd, implying that the migration of mercury occurs simply as a result of dispersion. As a result, the contaminated soils add little to the risk even after large time periods because the primary advective force will be removed with the percolation ponds. Because the mercury in the aquifer came from the injection well, the peak concentration will continue to decrease as it migrates very slowly down gradient. There are very few mercury measurements in the aquifer at greater than the estimated background concentration of 1×10^{-4} mg/L, however, there was one measurement of 3.2×10^{-4} mg/L at well USGS-47 in June of 1995. The predicted maximum concentration is approximately 20 times larger (in 1984) and the predicted concentration at USGS-47 in June of 1995 is approximately 10 times larger. Based on the aquifer measurements, the injection well source may be overestimated. Differences between measured and predicted concentrations could be due to the model predictions indicating that the mercury concentrations should decrease rapidly with distance from the injection well. As a result, the probability of sampling the maximum concentration using an existing well is very low.
Np-237	8	75%	tank farm (15%) soil (9%)	1986	1.92E-04	2.37E-05	The peak risk was predicted to occur in 1986 as a result of Np-237 discharged to the injection well. The source inventory was based on two reported Np-237 concentrations in the injection well discharge which were applied as a constant rate over a large period of time. This could have resulted in significantly overestimating the activity discharged into the injection well. The comparison with the aquifer data close to the injection well supports this. However, there are very few data points with which to make the comparison. Although the uncertainty in the Np-237 predictions cannot be quantified, because the predicted Np-237 concentrations are above a 10^{-6} risk based concentration, the existence of this uncertainty is potentially significant.

Table 11-1 Summary of uncertainty information in the aquifer simulated predictions.

COPCs	Base Case Soil Kd Value (cm^3/g)	Source Summary: Injection Well Activity(%)	Source Summary: Other Major Sources (%)	Year of Predicted Maximum Aquifer Concentration	Simulation Results: Overall Maximum Risk or HQ	Simulation Results: Maximum Risk or HQ in 2095 or Beyond	Comments
Total Pu	22	0.07%	tank farm (99%)	3585	2.43E-04	2.43E-04 (3585)	The peak concentration is predicted to occur in 3585 as the vast majority of the Pu migrates through the vadose zone from the tank farm. Because there is no Pu measured in the aquifer or perched water at above detection limits, the results could not be compared to measured values. Because the peak concentration is greater than the 10^{-4} risk based concentration, the lack of data is potentially significant. The Pu Kd used was 22 cm^3/g which is considered to be very conservative. Laboratory studies should be undertaken to improve this Kd estimate. By obtaining comparable laboratory Kd values for Sr-90 and Pu, and using field measurements to define Sr-90 transport, a field scale Pu Kd value could be estimated. An increase in the Kd of one order of magnitude would decrease the peak aquifer concentration more than an order of magnitude and increase the time to the peak an order of magnitude. There is considerable uncertainty in the overall tank farm release estimates; further increasing the impact of uncertain Kd values.
Sr-90	24	0.12%	tank farm (93%) soil (6%)	1967	1.41E-03	1.87E-05 (2172)	The peak concentration was predicted to occur in 1967. The majority of the Sr-90 source is attributed to the tank farm releases but the Sr-90 currently detected in the aquifer originated from the injection well. Because of its Kd value, Sr-90 is moving through the vadose zone slowly. The comparison of the predicted vadose zone and aquifer concentrations with measured concentrations shows that the model predictions are similar to the measured concentrations. In general, the vadose zone predictions overestimate the concentrations implying that the vadose zone model underestimates the travel time from the ground surface to the aquifer. Five different Sr-90 sensitivity runs were presented in Section 8. The sensitivity runs indicate that leakage from the upper perched water to the aquifer (down a well) could significantly affect the measured concentrations. A comparison of the fits of the predictions using Kd=12 (base case) or 24 cm^3/g (sensitivity case) to the historical data was not conclusive because the model differences are not sufficiently large to identify a best fit to the field data. A much more accurate source term and significantly more field data would be needed to discriminate between the two models. The peak aquifer concentrations after the year 2095 are primarily from releases from the tank farm. A very small amount of the Sr-90 reaches the aquifer because the Sr-90 moves slowly through the vadose zone, relative to its decay half-life. The mass that does reach the aquifer is the result of model dispersion which cannot be calibrated with the field data currently available. Therefore, the predicted future (after 2095) peak concentrations in the aquifer have a relatively large uncertainty. The uncertainty of the near term aquifer concentrations (Sr-90 disposed of to the injection well) is small. However, the uncertainty in the vadose zone concentrations is much larger. Based on the field data currently available, it appears that the simulation model provides conservative predictions as currently parameterized. However, future field data will be needed in order to understand the dispersive Sr-90 transport in the vadose zone, to accurately predict the future affect on aquifer concentrations.

Table 11-1 Summary of uncertainty information in the aquifer simulated predictions.

COPCs	Base Case Soil Kd Value (cm^3/g)	Source Summary: Injection Well Activity(%)	Source Summary: Other Major Sources (%)	Year of Predicted Maximum Aquifer Concentration	Simulation Results: Overall Maximum Risk or HQ	Simulation Results: Maximum Risk or HQ in 2095 or Beyond	Comments
Tc-99	0.2	0%	tank farm (96%) soil (4%)	1997	5.96E-06	7.03E-07	The peak concentration is predicted to occur in 1997 as a result of migration from the surface. The vast majority of the Tc-99 source was assumed to be from the tank farm and thus has a zero Kd under the primary source in the alluvium, and a small Kd in the other matrix materials. As a result of the small Kd, predicted aquifer concentrations for the 1990s are the result of Tc-99 moving through the vadose zone. However, it is impossible to determine if Tc-99 was actually discharged to the injection well. There are recent Tc-99 field data, but no historical data (in the 1950-1990 time period). In almost all of the perched water wells, the predicted concentrations were higher than observed values. This implies that the tank farm source is overestimated. However, predicted concentrations in the aquifer are fairly accurate for wells near the ICPP, indicating that the surface sources are fairly accurate. It is possible that Tc-99 could have been discharged to the injection well in the 1953-1986 time period and that it has moved downgradient from the ICPP.
Total U	6	13%	tank farm (37%) soil (46%)	1986	1.31E-05 0.13 (HQ)	7.30E-06 0.5 (HQ) (2468)	The peak concentration was predicted to occur in 1986, as a result of U discharged into the injection well. A second local maxima is predicted to occur in the concentration in approximately the year 2468 (at the $7x10^{-6}$ risk level) as a result of the downward migration from contaminated soils. Comparisons are not presented for total U because it was simulated as total U but field data exists for a) random numbers of the various isotopes at a given sample times; b) single isotopes at a given time; or c) total U at a given time. As a result of offset sampling intervals and the combination of isotopic and total data, direct comparison of the model predicted concentration to the field data would be at best subjective, and at the minimum very difficult to interpret. The source term uncertainty analysis indicates that the estimated CPP-31 inventory of Total U mass was overestimated by a factor or 7 to 8 which would decrease the overall tank farm inventory by a factor of 6 (Section 10.6). After year 2095 there is the predicted peak aquifer concentration greater than 10^{-6} risk based concentration, therefore, the uncertainties due to source term estimation, estimated Kd, and inadequate field data are potentially significant.
Am-241	340	0.1%	tank farm (99%)	1986	6.32E-06	4.35E-06	The peak concentration is predicted to have occurred in 1986 as a result of a relatively small injection well source. This source term was estimated based on a single reported Am-241 value and applied to a representative time period. As a result, the injection well source term is uncertain. In addition, the vast majority of the Am-241 source is attributed to the tank farm releases and should currently be moving very slowly through the vadose zone because of its high Kd. After 2095, when the ICPP water sources are assumed to stop, the Am-241 in the vadose zone will basically stop and the Am-241 will decay in place. There is very little evidence of Am-241 in the aquifer, and comparisons of predictions to measured concentrations are not very useful in assessing the accuracy of the estimated source term or the assumed Kd. The peak Am-241 concentration is predicted to remain above the 10^{-6} risk level until the year 2400. However, because of the high Kd, the area within the 10^{-6} risk based concentration plume will be relatively small.

Table 11-1 Summary of uncertainty information in the aquifer simulated predictions.

COPCs	Base Case Soil Kd Value (cm^3/g)	Source Summary		Year of Predicted Maximum Aquifer Concentration	Simulation Results		Comments
		Injection Well Activity(%)	Other Major Sources (%)		Overall Maximum Risk or HQ	Maximum Risk or HQ in 2095 or Beyond	
Total Am-241	340	0.1%	tank farm (99%)	NC	NC	6.00E-06	Pu-241 that has been discharged into the aquifer and vadose zone is and has been decaying into Am-241. This decay provides an additional source of Am-241 in the vadose zone and in the aquifer. The cumulative Am-241 from direct disposal and the decay of Pu-241 is referred to as Total Am-241 and is predicted to be above the 10^{-6} risk level until the year 2500. As with the directly disposed of Am-241, the area within the 10^{-6} risk based concentration plume will be relatively small. The sources of uncertainty for Total Am-241 include those for Pu-241 and those for directly disposed of Am-241.

NC - not calculated because the peak Am-241 is from the injection well before the Pu-241 decays to Am-241.

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