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October 25, 2001

164446.FR.11

Mark Purcell
U. S. Environmental Protection Agency
Mail Code 6SF-AP
1445 Ross Avenue
Suite 1200
Dallas, Texas 75202

40-8903

Subject: Homestake Mining Company Superfund Site
First Five-Year Review Report, September 2001

Dear Mr. Purcell:

Enclosed please find one unbound and two bound copies of the First Five-Year Review Report for the Homestake Mining Company Superfund Site, dated September 2001, and one copy on compact disc. This document represents the final signed version of the report.; the unbound version includes the original signature pages. Copies of the report are also being provided to Mr. Kenneth Hooks/US NRC and Ms. Karen Tomimatsu/EPA under cover of this letter, and under separate cover to the rest of the distribution list provided in the attached Table 1. Copies of the cover letters sent with the rest of the distribution list are attached for your information.

The compact disc includes electronic copies of the report to be placed on EPA's website. The three files that should be put on the website are found in the root directory of the CD, and are named as follows:

hmc_5yr_0108_readme.pdf < This is the file to be used as the main link to the report >
hmc_5yr_0108.pdf
hmc_5yr_0108_withoutphotographs.pdf

Please let me know if you have any questions. Thank you.

Sincerely,

CH2M HILL

Margaret O'Hare
Project Manager

Dallas\HMC_5Yr_0109_EPA_NRC_3copies.doc

Enclosures
C: Kenneth Hooks/ US NRC
Karen Tomimatsu/ US EPA

Five-Year Review Report

First Five-Year Review Report
for
Homestake Mining Company Superfund Site
Cibola County, New Mexico

September 2001

PREPARED BY:

CH2M HILL
Contract Number 68-W6-0036
Work Assignment Number 948-FRFE-06ZZ

PREPARED FOR:

Region 6
United States Environmental Protection Agency
Dallas, Texas

Five-Year Review Report

First Five-Year Review Report
for
Homestake Mining Company Superfund Site
Cibola County, New Mexico

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PREPARED BY:

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Dallas, Texas

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FIVE-YEAR REVIEW
Homestake Mining Company Superfund Site
EPA ID# NMD007860935
Cibola County, New Mexico

This memorandum documents the United States Environmental Protection Agency's (EPA's) performance, determinations, and approval of the Homestake Mining Company Superfund Site First Five-Year Review, provided in the attached First Five-Year Review Report prepared by CH2M Hill, Inc., on behalf of the EPA.

Summary of Five-Year Review Findings

The remedy being implemented at the Homestake Mining Company Superfund site (Site) is considered protective of human health and the environment in the short term; some further action is necessary to ensure continued protection of human health and the environment in the long term. Currently, exposure pathways that could result in unacceptable risk are being controlled. The reclamation and remediation activities performed to-date are restricting emissions of radioactive contaminants, and monitoring is in place to ensure NRC standards are being met during the ongoing tailings remediation. Ground water remediation is ongoing, and significant improvements have been made to the ground water restoration program since it was first implemented in 1977 to improve the rate and effectiveness of the remediation. The ground water collection and injection system appears to have effectively restricted further migration of contaminants and an alternate water supply has been provided to the residents of neighboring communities whose water wells are adversely impacted by the ground water contamination. The Site is well-maintained, and remedial actions performed at the Site have had a positive effect on the community and the environment. No deficiencies are noted that currently impact the protectiveness of the remedy. It is noted, however, that while the neighboring community is known to be hooked up to the municipal water supply for potable water, institutional controls are not in place to restrict ground water use, and unrestricted use may occur within the affected area for irrigation or other purposes. Also, the procedures to determine and verify that the ground water restoration objectives will be met within an expected time frame are not clearly defined and might benefit from a ground water modeling effort. Finally, the air monitoring data should be evaluated to confirm that the residual levels are sufficiently protective under CERCLA (they do currently meet the NRC's dose equivalent criterion).

Actions Needed

Implement institutional controls to restrict the domestic use of ground water by the local residents until the restoration objectives for ground water have been documented as being met. Establish procedures for determining and verifying that the ground water restoration objectives will be met under the current remedial approach within the expected time frame. Also, establish specific requirements for determining when the cleanup goals for ground water have been met. Implement post-closure monitoring requirements once the ground water remedy is complete, to verify that recontamination does not occur. Perform an evaluation of air monitoring data to confirm that emissions are within the risk range considered to be protective under CERCLA.

Determinations

I have determined that the remedy for the Homestake Mining Company Superfund site is protective of human health and the environment, and will remain so provided the action items identified in the Five-Year Review Report are addressed as described above.

Myron O. Knudson

9-27-01

Myron O. Knudson, P.E.
Director, Superfund Division
U.S. Environmental Protection Agency, Region 6

Date

CONCURRENCES

FIVE-YEAR REVIEW
Homestake Mining Company Superfund Site
EPA ID# NMD007860935

By: _____ Date: 09-25-01
Mark Purcell, U.S. EPA
Remedial Project Manager

By: _____ Date: 9/27/01
Donald Williams, U.S. EPA
Technical Support Team Leader

By: _____ Date: 9/25/01
Wren Stenger, U.S. EPA
Chief, Louisiana/New Mexico Branch

By: _____ Date: 9/26/01
Pamela J. Travis, U.S. EPA
Attorney, Office of Regional Counsel

By: _____ Date: 09/27/01
Mark Peycke, U.S. EPA
Chief, Office of Regional Counsel Superfund Branch

By: out on A/L _____ Date: _____
Pam Phillips, U.S. EPA
Deputy Director, Superfund Division

By: _____ Date: 9/26/01
June Buzzell, U.S. EPA
Writer Editor, Superfund Division

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Executive Summary

The first Five-Year Review of the Homestake Mining Company Superfund site (Site), located in Cibola County, New Mexico, was completed in September 2001. The results of this Five-Year Review indicate that the remedy being implemented is protective of human health and the environment in the short-term, and is expected to be protective in the long-term if certain followup actions are performed. Exposure pathways that could result in unacceptable risk are currently being controlled. Alternate water supplies are provided to residents in neighboring communities whose water wells are adversely impacted by ground water contamination. Additionally, the reclamation and remediation activities performed at the Site to date are restricting radioactive emissions. Overall, the remedial actions performed appear to be functioning as designed, and the Site has been maintained appropriately. Significant improvements have been made to the ground water restoration program since it was first implemented in 1977, including the installation of additional ground water collection and injection wells, construction of a reverse osmosis (RO) water treatment plant, and the addition of a second evaporation pond.

Five issues were noted during the Five-Year Review that do not directly impact the protectiveness of the remedy at this time. They are: (1) while an alternate drinking water supply has been provided for the community, there is a need to establish institutional controls restricting the potential use of contaminated ground water by local residents; (2) the ground water restoration that is ongoing downgradient of the mill site is not yet covered under the NRC's licensing agreement or the NMED discharge permits and needs to be so that specific objective/monitoring requirements can be established; (3) a background ground water study performed by Homestake indicates the background values originally assumed as cleanup levels may need to be reconsidered in an Alternate Concentration Limit application expected to be submitted by Homestake in the near future; (4) clear procedures for determining and verifying whether or not the current ground water restoration program is capable of achieving the cleanup standards within an expected time frame need to be established; and (5) the air monitoring data available for the Site should be evaluated to determine whether a Site-specific risk assessment is necessary to ensure the residual levels of radioactive constituents will meet the CERCLA standards for protectiveness.

The Site includes the Homestake Mining Company's (Homestake's) former uranium mill site and those portions of the underlying ground water aquifers that have been contaminated by seepage from waste byproduct materials (tailings) disposed at the mill site. The uranium mill ceased operating in 1990 and was decommissioned and demolished as part of the mill site reclamation work required under the U.S. Nuclear Regulatory Commission (NRC) Source Materials License No. SUA-1471 (License SUA-1471). The mill site is currently comprised of two former tailings impoundments, a ground water collection and injection system, the RO plant,

two collection ponds, two lined evaporation ponds, and associated equipment and structures. Seepage from the two tailings impoundments has resulted in the contamination of the underlying ground water aquifers with radioactive and non-radioactive contaminants and associated constituents, including uranium, thorium-230, radium-226 plus radium-228, selenium, vanadium, molybdenum, sulfate, chloride, nitrate and total dissolved solids (TDS).

The Site remediation activities have been divided into three distinct phases or operable units. The first operable unit (OU1) is the restoration of ground water that is contaminated by tailings seepage. The second operable unit (OU2) consists of the long-term stabilization of the tailings, surface reclamation, and the decommissioning and closure of the mill. The third and final operable unit (OU3) addresses indoor and outdoor radon concentrations in residential areas adjacent to the mill site.

Homestake commenced the OU1 remedial activities in 1977 by operating a state-approved ground water collection and injection system at the mill site. Fresh water is injected into three separate aquifers at wells located at or within the boundary of the mill site to reverse the natural flow of ground water back towards the collection wells. The collected ground water is then piped either to the RO plant for treatment and subsequent re-injection into the aquifer or to one of two lined evaporation ponds for disposal. This system has undergone several operating adjustments since it was first constructed, including the installation of additional ground water injection and collection wells and a series of toe drains within the large tailings impoundment to dewater the tailings. Over three billion gallons of contaminated ground water have been recovered by the collection wells, tailings wells and the toe drains since 1977.

This ground water restoration program is being implemented pursuant to requirements set forth in the NRC License SUA-1471 and a Ground Water Corrective Action Plan (CAP) incorporated therein, and the New Mexico Environment Department (NMED) ground water discharge plans (DP-200 and DP-725). The DP-200 includes the requirements for ground water corrective action, while the DP-725 is specifically for discharge of contaminated ground water to the evaporation ponds. Ground water cleanup standards are established by both the NRC, pursuant to License SUA-1471, and the NMED, pursuant to the DP-200.

Homestake is also implementing a secondary ground water collection and irrigation system to remediate those portions of the contaminant plumes which have migrated beyond the mill site. This secondary system is not currently a required part of the CAP or the DP-200. However, it is being incorporated by Homestake into a revised CAP to be submitted to the NRC for approval. It is also being incorporated into the DP-200 as part of a renewal process and is currently under review by the NMED.

In 1983, the United States Environmental Protection Agency (EPA) and Homestake signed an Agreement and Stipulation, which required Homestake to provide for the extension of the Village of Milan municipal water system to four residential subdivisions located south and southwest of the mill site (hereinafter the "Subdivisions") which were in the affected area of ground water contamination. The Agreement also required Homestake to pay for the residents' use of that water supply for a period of ten years. At that time, the EPA elected not to require any additional response actions to remediate the ground water since Homestake was already implementing the state-approved plan.

The connection of the Subdivisions' residences to the Village of Milan's water supply was completed in 1985 and Homestake paid for the residents' water use until 1995. The EPA has since released Homestake from its obligations under that Agreement. Although the residences have permanent hookups to alternate water supplies, there are currently no institutional controls in place to restrict the use of ground water by the local residents.

The OU2 remedial activities involve the stabilization of the tailings impoundments, surface reclamation, and decommissioning of the mill. The soil contaminated by windblown tailings was excavated and disposed in the large tailings impoundment. Beginning in 1993, the mill facility was decontaminated, demolished, and parts were either buried in place or placed in the large tailings impoundment. A radon barrier and erosion-protection cover were constructed on the sides of the large tailings impoundment, and an interim soil cover was constructed on its top and on the small tailings impoundment. A final radon barrier will be constructed on top of the large impoundment after the tailings are dewatered. This work is scheduled for completion in 2004. A final radon barrier will also be constructed on the small tailings impoundment once the ground water restoration is completed, and the remaining facilities are dismantled and disposed therein. Homestake estimates that the reclamation of the small tailings impoundment will be completed by 2010. The OU2 remedial activities are being implemented by Homestake under the direction of the NRC, pursuant to requirements set forth in License SUA-1471. After the reclamation and closure activities are completed at the mill site, the NRC will terminate License SUA-1471 and Homestake's property will be turned over to the U.S. Department of Energy (DOE) for long-term care in perpetuity. At that time, it is expected that all areas outside the portion of Homestake's property that will be deeded to the DOE will be released by the NRC for unrestricted use.

The OU3 remedial activities addressed indoor and outdoor radon concentrations in the Subdivisions adjacent to the mill site. This OU was addressed by a Record of Decision (ROD), signed in September 1989. The EPA's decision was to take no further action.

The OU3 ROD also stipulated that the NRC and the EPA would sign a formal agreement outlining each agency's regulatory responsibilities at the Site. In December 1993, a Memorandum of Understanding (MOU) was signed by the NRC and the EPA that designated the

NRC as the lead federal agency for all remedial and reclamation activities at the mill site (*i.e.*, within the License SUA-1471 boundary). The EPA would monitor all such activities and provide review and comment directly to the NRC. The EPA was responsible for assuring that the activities to be conducted under the NRC's regulatory authority would allow attainment of applicable or relevant and appropriate requirements (ARARs) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended, for the affected areas outside the mill site boundary.

The ground water restoration program is a long-term response action which has been ongoing since 1977, a period of about twenty-five (25) years. To date, Homestake has yet to attain the cleanup standards imposed by the NMED or the NRC for this Site. However, since ground water restoration began, monitoring results have shown that the concentrations of the contaminants have generally decreased over time in portions of the ground water aquifers. This decrease in concentrations demonstrates the effectiveness of the ground water collection/injection system in moving portions of the contaminant plumes back toward the collection wells and, hence, preventing the further migration of contamination off the mill site.

Based on analytical data from upgradient monitoring wells, Homestake currently believes that background concentrations for many of the Site contaminants generally exceed the ground water cleanup standards established by the NRC and/or the NMED and, therefore, present compliance issues. The original ground water cleanup standards established by the NMED in the DP-200 were set using average background concentrations. Homestake estimates that ground water restoration can be completed by 2008, but only if new background concentrations are accepted as alternate cleanup standards for the Site.

In 1999 Homestake submitted to the NRC and NMED a new background study which provides updated background concentrations (Background Study). The Background Study may provide for a more statistically valid representation of background concentrations than was originally calculated for the Site. The NMED and the NRC are currently reviewing the submittal. A determination by the NRC on the appropriateness of the proposed revision to the background concentrations is expected to be made as part of its review of an Alternative Concentration Limit (ACL) application to be submitted by Homestake. This ACL application will be part of the updated CAP which Homestake is planning to submit to the NRC. The NRC's review and approval process may, ultimately, result in an adjustment to the current ground water cleanup levels for those contaminants it regulates. However, any adjustment to the cleanup levels would still be based on the attainment of background levels. It is noted that EPA has not reviewed the Background Study and, therefore, makes no determination as to the appropriateness of the proposed revision to background concentrations, nor the methods by which they were calculated. Should Homestake submit the expected ACL application described above, the basis for revision of background concentrations will be reviewed by the EPA at that time.

Additionally, if Homestake is unable to reduce the levels of the contaminants in ground water to the current NMED-approved background concentrations, it may have to file a petition with the New Mexico Water Quality Control Commission (WQCC) for approval of alternative abatement standards (AASs). Under the WQCC Regulations, Homestake is not required to have an approved abatement plan for ground water remediation of non-radioactive constituents if abatement is conducted under EPA's authority, pursuant to CERCLA, or under another authority's approved discharge plan which is consistent with the WQCC Regulations. If the EPA deletes this Site from the NPL, and there is no alternate abatement plan which is consistent with the WQCC Regulations, this exemption would no longer be applicable.

If alternate cleanup standards are approved by the NRC and/or the WQCC, the EPA, under its statutory authority, may deem it appropriate to conduct a Site-specific assessment of those revised standards and, if necessary, establish alternate cleanup levels under CERCLA to ensure that the remedy is protective of human health and the environment.

Based on this Five-Year Review, it appears that the remedial actions originally set forth in the ROD and other decision documents for this Site are being implemented as planned, including the various modifications to the ground water restoration program. The remedy involving the reclamation of the mill site, including the decommissioning and dismantling of the mill, soil remediation, long-term stabilization of the tailings, and closure, is considered protective of human health and the environment in the short-term because the waste has been contained under the temporary radon barrier that limits emissions of radioactive constituents into ambient air and protects it from erosion. Followup action is necessary to monitor the continuing remediation of the tailings and installation of the final cover to ensure long-term protectiveness. In addition, followup action in the form of a risk evaluation is necessary to confirm the residual levels will be sufficiently protective under CERCLA (i.e., generally meet the 10^{-4} to 10^{-6} risk range and hazard index less than one). A preliminary evaluation should be done first using existing air monitoring data to determine whether a full risk assessment is necessary.

The remedy involving the ground water is also considered protective of human health and the environment in the short-term because an alternate water supply has been provided to residences located within the area of ground water contamination. In addition a ground water collection and injection system is in place which appears to have already been effective in preventing further migration of contaminants and in partially restoring portions of the affected aquifers. Followup actions in the form of institutional controls and the establishment of clear procedures for attaining and maintaining performance and compliance standards are necessary to ensure long-term protectiveness.

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List of Acronyms

AAS	Alternative Abatement Standards
ACL	Alternate Concentration Limit
ACM	Asbestos Containing Material
ARARs	Applicable or Relevant and Appropriate Requirements
bgs	below ground surface
CAA	Clean Air Act
CAP	Corrective Action Plan
CEDE	Committed Effective Dose Equivalent
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cm	centimeter
CWA	Clean Water Act
DOE	United States Department of Energy
EPA	United States Environmental Protection Agency
FR	Federal Register
ICRP	International Commission on Radiological Protection
MCL	Maximum Contaminant Level
MOU	Memorandum of Understanding
mg/l	milligrams per liter
mrem	millirems
mrem/qtr	millirems per quarter
mrem/yr	millirems per year
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NCRP	National Council on Radiation Protection
NESHAPs	National Emissions Standards for Hazardous Air Pollutants
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
NMEID	New Mexico Environment Improvement Division
NPL	National Priorities List
NRC	United States Nuclear Regulatory Commission
O&M	Operation and Maintenance
OUs	Operable Units
pCi/g	picoCuries per gram
pCi/l	picoCuries per liter
pCi/m^2s	picoCuries per square meter second
POC	Point-of-Compliance
Ra-226	Radium-226
Rn-222	Radon-222
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study

RO	Reverse Osmosis
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
TBCs	To Be Considered
TDS	Total Dissolved Solids
TEDE	Total Effective Dose Equivalent
Th-230	Thorium-230
tpd	tons per day
uCi/ml	microCuries per milliliter
UIC	Underground Injection Control
UMTRCA	Uranium Mill Tailings Remediation Control Act
U-nat	Natural Uranium
WQCC	New Mexico Water Quality Control Commission

Five-Year Review Summary Form

SITE IDENTIFICATION

Site name (from WasteLAN): Homestake Mining Company

EPA ID (from WasteLAN): NMD007860935

Region: EPA Region 6 | **State:** NM | **City/County:** Cibola County

SITE STATUS

NPL Status: ☒ Final ☐ Deleted ☐ Other (specify):

Remediation status (choose all that apply): ☐ Under Construction ☒ Operating ☐ Complete

Multiple OUs? ☒ Yes ☐ No | **Construction completion date:** NA

Has site been put into reuse? ☐ Yes ☒ No (Portions of the site)

REVIEW STATUS

Reviewing agency: ☒ EPA ☐ State ☐ Tribe ☐ Other Federal Agency:

Author: EPA Region 6, with support from RAC6 contractor CH2M HILL

Review period: 1977 through August 2001

Date(s) of site inspection: August 16, 2001

Type of review:
- ☐ Statutory
- ☒ Policy
  - ☐ Post-SARA ☐ Pre-SARA ☐ NPL-Removal only
  - ☐ Non-NPL Remedial Action Site ☐ NPL State/Tribe-lead
  - ☒ Regional Discretion

Review number: ☒ 1 (first) ☐ 2 (second) ☐ 3 (third) ☐ Other (specify):

Triggering action:
- ☐ Actual RA Onsite Construction ☐ Actual RA Start
- ☐ Construction Completion ☐ Recommendation of Previous
- ☒ Other (specify): Request from State Five-Year Review Report

Triggering action date (from WasteLAN): None.

Due date (five years after triggering action date): None.

Five-Year Review Summary Form

Deficiencies:

No deficiencies were noted that currently impact the protectiveness of the remedy. It was noted, however, that while the neighboring community is known to be hooked up to the municipal water supply for potable water, institutional controls have not been put in place to restrict ground water use, and unrestricted use may occur within the affected area for irrigation or other purposes. In addition, the procedures to determine and verify that the ground water restoration objectives will be met within an expected time frame do not appear to be clearly defined and might benefit from a ground water modeling effort. Finally, although the air monitoring data collected from the perimeter of the mill site indicates that radioactive constituents meet protective levels set forth by the U.S. NRC, it has not been confirmed whether those levels meet CERCLA standards for protectiveness (with the exception of radon). Therefore, an evaluation should be performed on those other radioactive constituents to verify the protectiveness of the remedy.

Recommendations and Follow-up Actions:

To ensure the continued protectiveness of the ongoing remedy, it is recommended that institutional controls be put in place to restrict the use of ground water by local residents or landowners in areas affected by ground water contamination. Also recommended is the development of clear requirements to determine when the cleanup goals for ground water have been met, and post-closure monitoring requirements to be implemented once the ground water remedy is complete, to verify that recontamination does not occur. The air monitoring data should be evaluated in accordance with the EPA guidance to confirm that the remedy meets the CERCLA standards for protectiveness as well as the NRC standards.

Protectiveness Statement(s):

The remedy involving the reclamation of the mill site, including the decommissioning and dismantling of the mill, soil remediation, long-term stabilization of the tailings, and closure, is considered protective of human health and the environment in the short-term because the waste has been contained under the temporary radon barrier that limits emissions of radioactive contaminants into ambient air and protects it from erosion. Followup action is necessary to monitor the continuing remediation of the tailings and installation of the final cover to ensure long-term protectiveness. In addition, followup action in the form of a risk evaluation is necessary to confirm the residual levels will be sufficiently protective under CERCLA (i.e., generally meet the 10^{-4} to 10^{-6} risk range and hazard index less than one). A preliminary evaluation should be done first using existing air monitoring data to determine whether a full risk assessment is necessary.

(Continued next page)

Protectiveness Statement(s), continued:
The remedy involving the ground water is also considered protective of human health and the environment in the short-term because an alternate water supply has been provided within the area of ground water contamination. In addition, a ground water collection and injection system is in place which appears to have already been effective in preventing further migration of contaminants and in partially restoring portions of the affected aquifers. Followup actions in the form of institutional controls and the establishment of clear procedures for attaining and maintaining performance and compliance standards are necessary to ensure long-term protectiveness.

Other Comments:
The site appears to be well-maintained, and the operators are effectively implementing and maintaining the system as designed and installed. The various parties involved with the site cleanup are the NRC, the NMED, Homestake and the EPA.

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First Five-Year Review Report
Homestake Mining Company

The United States Environmental Protection Agency (EPA) Region 6 has conducted a five-year review of the remedial actions implemented at the Homestake Mining Company Superfund Site (hereinafter the "Site"), located near the Village of Milan, Cibola County, New Mexico. The purpose of a five-year review is to determine whether the remedy at a site remains protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in Five-Year Review reports. In addition, Five-Year Review reports identify issues found during the review, if any, and recommendations to address them. This Five Year Review report (Report) documents the results of the review for this Site, conducted in accordance with EPA guidance on five-year reviews. EPA RAC6 contractor CH2M HILL provided support for conducting this review and the preparation of this Report.

Existing EPA guidance on five-year reviews includes the following:

- Office of Solid Waste and Emergency Response (OSWER) Directive 9355.7-02 (May 23, 1991), *Structure and Components of Five-Year Reviews* (introduced five-year review requirements).
- OSWER Directive 9355.7-02FS1 (August 1991), Fact sheet: *Structure and Components of Five-Year Reviews*.
- OSWER Directive 9355.7-02A (July 26, 1994), *Supplemental Five-Year Review Guidance* (introduced level of review considerations for sites where response is ongoing).
- OSWER Directive 9355.7-03A (December 21, 1995), *Second Supplemental Five-Year Review Guidance* (identified three purposes of five-year review and emphasized that reviews must include a signed protectiveness determination, along with recommendations to correct deficiencies).
- OSWER Directive 9355.7-03B-P (June, 2001b), *Comprehensive Five-Year Review Guidance* (replaced and superceded all previous guidance on conducting five-year reviews).

Guidance provided in these documents has been incorporated into the five-year review performed for this Site.

1.0 Introduction

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) call for five-year reviews of certain remedial actions. The EPA policy also calls for a five-year review of remedial actions in some other cases. The statutory requirement to conduct a five-year review was added to CERCLA as part of the Superfund Amendments and Reauthorization Act of 1986 (SARA). The EPA classifies each five-year review as either "statutory" or "policy" depending on whether it is being required by statute or is being conducted as a matter of policy. This five-year review for the Site is being conducted as a matter of policy.

A five-year review is conducted as a matter of policy for certain types of CERCLA sites. These types of sites include:

1. Sites where a remedial action will allow for unlimited use and unrestricted exposure upon completion, but requires five years or more to complete.

2. Sites where a remedial action selected prior to October 17, 1986 (called a pre-SARA remedial action) leaves hazardous substances, pollutants, or contaminants onsite above levels that allow for unlimited use and unrestricted exposure.

3. Removal-only sites on the National Priorities List (NPL) where the removal action leaves hazardous substances, pollutants, or contaminants onsite above levels that allow for unlimited use and unrestricted exposure and where no remedial action has or will take place.

This is the first five-year review for the Site. This review is being conducted as a matter of policy because contaminants remain onsite above levels that allow for unlimited use and unrestricted exposure (in the ground water and tailings impoundments), and because such a review was requested by the State of New Mexico (**NMED, 1999a**).

The United States Nuclear Regulatory Commission (NRC, formerly the Atomic Energy Commission) is the lead Federal agency regulating the remediation, reclamation, and closure

activities being performed at the Homestake Mining Company's (Homestake's) former uranium mill site, pursuant to Source Materials License No. SUA-1471 (License SUA-1471). Once those activities are completed and the NRC terminates License SUA-1471, the property will be released and turned over to the United States Department of Energy (DOE) for long-term monitoring and maintenance, in perpetuity (**EPA & NRC, 1993**).

Under a 1993 Memorandum of Understanding (MOU) between the EPA and the NRC, the EPA is responsible for assuring that all of the activities to be conducted under the NRC's regulatory authority would allow attainment of all applicable or relevant and appropriate requirements (ARARs) under CERCLA, as amended, for the areas outside of the byproduct materials disposal site (*i.e.*, former mill site).

2.0 Site Chronology

A chronology of significant Site events and dates is included in **Table 1**, provided at the end of the report text. Sources of this information are listed in **Attachment 1, Documents Reviewed.**

3.0 Background

This section describes the physical setting of the Site, including a description of the land use, resource use, and environmental setting. Finally, this section briefly describes the history of contamination associated with the Site, the initial response actions taken at the Site, and the basis for each action.

3.1 Physical Characteristics

The Site is located in Cibola County, New Mexico, approximately 5.5 miles north of the Village of Milan, at the intersection of Highway 605 and Country Road 63. A Site map is provided as **Figure 1**. The Site includes Homestake's uranium mill site. It also includes the contaminated

portions of the underlying ground water aquifers, known locally as the San Mateo alluvial aquifer and the Upper and Middle Chinle aquifers.

Homestake operated the uranium mill from 1958 until 1990. The mill was decommissioned and demolished from 1993 to 1995. The mill site is currently comprised of two former tailings impoundments (one large and one small impoundment), a ground water extraction and injection system, a reverse osmosis (RO) water treatment facility, two collection ponds, two lined evaporation ponds for disposal of contaminated ground water, associated equipment and structures, and an office building (**Figure 1**). The only current mill site operations are related to the operations and maintenance (O&M) of the continuing ground water remedy (**EPA, 2001a**).

The large tailings impoundment covers an area of about 170 acres and is approximately 85 - 100 feet high. It contains an estimated 21 million tons of tailings. The small tailings impoundment covers an area of about 40 acres and is 20 - 25 feet high. It contains approximately 1.2 million tons of tailings. Seepage from the two tailings impoundments has resulted in the contamination of the underlying ground water aquifers with radioactive and non-radioactive contaminants, including uranium, thorium-230, radium-226 and radium-228, selenium and molybdenum.

The Site is situated on alluvial soils (deposited by flowing rivers) within the San Mateo Creek drainage basin to depths of over 120 feet. The alluvial soils consist primarily of sandy silts that are covered by eolian (windblown) sands. Beneath the alluvium deposits is an 800-foot thick interval of interbedded sandstone and shale units comprising the Chinle Formation, which is in turn underlain by the San Andres Limestone. The Chinle sandstone and shale units are tilted or inclined and come into direct contact with (*i.e.*, subcrop with) the overlying alluvium deposits in certain areas of the Site (*see also* Geologic Cross-Section, **Figure 2**).

There are three primary aquifer systems beneath the Site. The upper aquifer system is the San Mateo alluvial aquifer, which is located within the alluvium deposits. Ground water flow in the

alluvial aquifer is generally from the northeast to the southwest. The next aquifer system is located within the Chinle Formation and consists of three separate aquifers within individual sandstone units: the Upper, Middle, and Lower Chinle aquifers. Each aquifer is separated by shale units. The subcrop of the Chinle sandstone units with the overlying alluvial soils results in the Upper and Middle Chinle aquifers being in direct contact with the San Mateo alluvial aquifer at the Site. This results in recharge, and potential recontamination, of the Upper and Middle Chinle aquifers from the overlying alluvial aquifer. The deepest aquifer at the Site is the San Andres aquifer. This aquifer is at a depth of approximately 1,000 feet bgs at the Site. The San Andres aquifer is the most important regional aquifer in this area (**Hydro-Engineering, 2001**).

The Site geology and hydrology are complicated by two faults in the Chinle Formation which trend northeast/southwest through the Site. They are identified in Site-related documents as the West Fault and East Fault. The West Fault extends under the Murray Acres subdivision and along the western perimeter of the large tailings impoundment. The East Fault extends under the Felice Acres and Broadview Acres subdivisions, the small tailings impoundment and the eastern perimeter of the large tailings impoundment. Ground water gradients and flow directions in the Chinle aquifers appear to be affected by the two faults and highly permeable zones associated with those faults (**Hydro-Engineering, 2001**).

3.2 Land and Resource Use

There are four residential subdivisions located south and southwest of the mill site: Felice Acres, Broadview Acres, Murray Acres, and Pleasant Valley Estates, along with a few residences located near Pleasant Valley Estates (hereinafter the "Subdivisions") (**Figure 1**). Within these Subdivisions, some of the land is also used for agricultural and livestock purposes. Further south and west of these Subdivisions, most of the land is used for agricultural and livestock purposes, with some isolated residences. Much of the land immediately surrounding the mill site to the north, east, and west, has been acquired over the years by Homestake, and this property has not been put into re-use. Homestake has also acquired some of the land south of the Subdivisions,

and some of this land has been put to use for agricultural purposes. The alluvial aquifer has been used in the past as a domestic water supply by the local residents (**Hydro-Engineering, 2001**).

3.3 History of Contamination

Operations at the Site began in 1958 under a license issued by the Atomic Energy Commission. Operations were originally conducted by two distinct partnerships, the Homestake-Sapin Partners (with a milling capacity of 1,750 tons per day [tpd]) and the Homestake-New Mexico Partners (with a milling capacity of 750 tpd). The Homestake-New Mexico Partnership dissolved in 1961, and the property was ultimately acquired by the Homestake-Sapin Partners. The milling operations were combined and expanded to bring the operating capacity to 3,400 tpd. The name of the partnership was changed in 1968 to United Nuclear-Homestake Partners. In 1981, Homestake purchased United Nuclear Corporation's interest, and the name changed to Homestake Mining Company - Grants.

Milling operations have involved an alkaline leach-caustic precipitation process to extract and concentrate uranium oxide from uranium ores. Waste byproducts from the milling operations were either disposed above ground in the two tailings impoundments or re-cycled back into the milling process. The tailings are composed of a uranium-depleted sand fraction and a fine fraction (slimes). The sand fraction was used for building the sides and internal dikes of the impoundment, while the slimes were allowed to collect in the center of the impoundment. To minimize wind and water erosion, the tailings were wetted with water and stabilized with solid objects (rocks), erosion blankets, and chemical agents that form a crust on the surface of the sands (**EPA, 1989**).

The contamination of ground water occurred as a result of the leaching or seepage of radioactive and non-radioactive contaminants and associated constituents from the tailings impoundments downward through the underlying soils and into the ground water. The primary contaminants and constituents of concern that are present in the ground water at the Site are uranium, selenium,

radium-226 + radium-228, thorium-230, molybdenum, vanadium, sulfate, chloride, nitrate, and total dissolved solids (TDS) (**Hydro-Engineering, 2001**).

The contamination of soil resulted from windblown tailings that were carried from the tailings impoundments and deposited, mostly in the prominent downwind direction, on the surface soil surrounding the mill site. Radium-226 was the primary contaminant of concern present in the soil. Soil cleanup of other radioactive constituents other than radium-226 was considered, but cleanup criteria were not proposed because levels of those constituents in excess of radium-226 were not anticipated from the alkaline process used at the mill. Some uranium measurements were performed, but most of the mill yard, where yellowcake spills were likely, was treated as a disposal area (**AKG, 1993**).

Much of the uranium mill's operating equipment and buildings were also contaminated as a result of the milling operations (**AKG, 1993**).

3.4 Initial Response

The State of New Mexico signed an agreement with the NRC in 1974 that granted the State of New Mexico the authority to regulate uranium milling activities (*i.e.*, became an "Agreement State"). The State of New Mexico then issued a radioactive materials license to Homestake for the uranium mill. In 1974 and 1975, the New Mexico Environment Improvement Division (NMEID, now the NMED) and the EPA conducted a survey of the impact of uranium mining and milling activities in the area on surface and ground water quality. As a result of this investigation, it was discovered that private water wells in two of the Subdivisions were contaminated with the heavy metal selenium (**EPA, 1989**).

Operable Unit No. 1. Based on the discovery of selenium in the ground water, NMEID and Homestake agreed to a ground water protection plan in 1976. Homestake began implementing this plan in 1977 through the installation and operation of a line of ground water injection wells

near the southern portion of the mill site boundary adjacent to the Subdivisions and a series of ground water collection wells close to the tailings impoundments and evaporation ponds (**NMEID, 1976,** and **Hydro-Engineering, 2001**). Beginning in 1975, Homestake also provided bottled water to residents of the Subdivision upon request.

Homestake was issued a state-required ground water discharge plan (DP-200) by the NMED in 1981, which modified and approved the original ground water protection plan (now named the ground water restoration program) in accordance with the requirements set forth in the New Mexico Water Quality Control Commission (WQCC) Regulations (**EPA, 1989**).

The Site was placed on the NPL in September 1983, primarily due to the ground water contamination found in residential wells. In December 1983 the EPA and Homestake entered into an Agreement and Stipulation (Agreement) requiring Homestake to secure alternate permanent water supplies for all existing and planned residents in the Subdivisions and to pay for the residents' water usage for ten years (**US Department of Justice [DOJ], 1983**). In complying with the Agreement, Homestake financed the extension of the Village of Milan's municipal water supply to the Subdivisions. The water connections were completed in 1985. Homestake made payments to the Village of Milan for the water used by the residents of the Subdivisions until 1995, a period of ten years (**EPA, 1989**).

At the time of the Agreement, the EPA elected not to require additional response actions under CERCLA to remediate ground water contamination at the Site since Homestake was already implementing the state-required program.

In 1986, the State of New Mexico, at the request of the Governor, returned regulatory authority of uranium milling operations to the NRC (*i.e.*, became a "Non-Agreement State"). Since that time, the ground water remedial activities have been regulated by the NMED, pursuant to DP-200, the NRC, pursuant to License SUA-1471, and by the EPA through the CERCLA process. In

1989, Homestake submitted a Corrective Action Plan (CAP) for ground water remediation to the NRC for incorporation into License SUA-1471, by amendment.

Operable Unit No. 2. Since 1989 Homestake's milling operation and disposal of solid waste byproducts (tailings) have been regulated by the NRC, pursuant to License SUA-1471. After milling operations ceased in 1990, the activities for mill decommissioning, surface reclamation and remediation, stabilization of the tailings impoundments, and site closure have been performed under the direction of the NRC.

Operable Unit No. 3. Homestake entered into an Administrative Order on Consent with the EPA in June 1987 to conduct a Remedial Investigation/Feasibility Study (RI/FS) to evaluate the extent of indoor and outdoor radon levels in the adjacent Subdivisions and determine whether such levels, if any, were attributable to Homestake's milling and tailings operations at the mill site. This became known as the Radon Operable Unit (OU). Homestake conducted the RI/FS from October 1987 to January 1989. Based on the results of the RI/FS, the EPA issued a ROD in September 1989 calling for no further action on the Radon OU. Although elevated indoor radon concentrations were discovered in a few houses in the Subdivisions, it was determined that there was no definitive correlation between the radon concentrations and the proximity of each of those homes to the mill site. The source of the elevated radon levels was determined by the EPA to be local soil (**EPA, 1989**).

The ROD also stipulated that the NRC and the EPA would sign a formal agreement outlining each agency's responsibilities at the Site. This resulted in the signing of the MOU in December 1993. The MOU stipulated that the NRC was the lead federal agency primarily responsible for oversight of the remedial and reclamation activities at the mill site. The EPA would monitor all such activities and provide review and comment directly to the NRC. The EPA was responsible for assuring that the activities to be conducted under the NRC's regulatory authority would allow

attainment of ARARs under CERCLA, as amended, for the areas outside of the mill site (**EPA and NRC, 1993**).

3.5 Basis for Taking Action

Initial response actions at the Site were taken to address exposure of residents in the Subdivisions to contaminated ground water. Other potential exposures at the Site included exposure to contaminated surface soil, buildings, equipment, and radon emissions from the tailings impoundments.

4.0 Remedial Actions

The remedial actions performed at the Site after it was placed on the NPL are addressed in this Five-Year Review. This section provides a description of the remedy objectives, selection, and implementation. It also describes the process through which modifications to the ground water remedy have been implemented, the ongoing O&M, and the overall progress made at the Site.

4.1 Remedy Objectives

Since the Radon OU ROD called for no further action, no remedial action objectives were set for this operable unit under CERCLA (**EPA, 1989**). The remedial action objectives for ground water restoration (OU1) are defined in the NRC License SUA-1471 and CAP, the NMED DP-200, and the 1983 Agreement between the EPA and Homestake. The remedial action objectives for decommissioning the mill, surface reclamation, long-term stabilization of the tailings and closure (OU2) are defined in the NRC License SUA-1471.

In general, the objectives of the remedial activities are to: (1) limit radon emissions from the tailings impoundments; (2) remediate contamination in soil that resulted from windblown tailings, remediate ground water to levels stipulated in the NRC License SUA-1471 and the NMED DP-200; (3) dewater the large tailings impoundment to remove this area as a continuing

source of ground water contamination; and (4) prevent the use of contaminated ground water by residents in the Subdivisions for domestic purposes.

For ground water, the NRC regulates the radioactive contaminants and some of the non-radioactive contaminants of concern at the mill site (*i.e.*, License SUA-1471 boundary). The NRC's CAP sets background values as the ground water cleanup standards to be achieved at certain point-of-compliance (POC) wells for those contaminants (**NRC, 1989, and NMED, 1996b**). The cleanup standards are as follows: uranium (0.04 mg/l); selenium (0.10 mg/l); molybdenum (0.03 mg/l); vanadium (0.02 mg/l); radium-226 + radium-228 (5.0 pCi/l); and thorium 230 (0.30 pCi/l). The designated POC wells are S4, D1, and X; they are located at the mill site, in close proximity to and downgradient from the tailings impoundments.

Currently, the NRC does not regulate these contaminants in areas beyond the mill site (*i.e.*, outside of the License SUA-1471 boundary). Additionally, the NRC does not regulate the following four non-radioactive constituents: sulfate, chloride, total dissolved solids (TDS), and nitrate. These constituents are regulated by the NMED over the entire Site, pursuant to DP-200. Homestake is currently revising the CAP to include all non-radioactive constituents addressed by DP-200, as well as the radioactive constituents, for NRC approval.

The NMED water-quality standards or approved background standards are as follows: uranium (5.0 mg/l); selenium (0.12 mg/l); molybdenum (1.0 mg/l), an irrigation standard; radium-226 + radium-228 (30.0 pCi/l); sulfate (976 mg/l); chloride (250 mg/l); TDS (1770 mg/l); and nitrate (12.4 mg/l). A comparison of the NMED's and NRC's ground water cleanup standards is presented in **Table 2** of this Report.

The NMED water-quality standards and other relevant requirements established for the protection of ground water are stated in the following WQCC Regulations at 20.6.2 NMAC: (1) Section 20.6.2.3101:

Section 3101 - states the purpose of the 3000-series is to control (contaminant) discharges to protect ground water for present and future domestic and agricultural uses;

Section 3103 - provides numerical standards for ground water with 10,000 mg/l TDS or less;

Section 3104 - states that all effluent or leachate discharges containing contaminants that may cause Section 3013 ground water standards to be exceeded must be conducted in accordance with a discharge plan approved by the NMED;

Section 4101 - states that the purpose of the 4000-series is to abate ground water pollution so that all ground water having a background concentration of 10,000 mg/l TDS or less is remediated for domestic and agricultural uses;

Section 4103 - provides abatement standards and requirements for ground water remediation efforts, and allows a responsible party to seek a variance or alternative abatement standards if it can demonstrate that compliance with this Section is technically infeasible;

Section 4104 - requires all responsible parties who are abating ground water pollution to do so under an approved abatement plan;

Section 4105 - provides exemptions from abatement plan requirements; Subsection A.6 states that an abatement plan is not required if the abatement activities are being conducted under an approved discharge plan and the abatement activities are consistent with standards and requirements of the WQCC Regulations (4000-series);

Section 4106 thru 4115 - communicate the requirements for investigation and abatement of impacted ground water.

Additionally, the National Primary Drinking Water Standards, established under the Safe Drinking Water Act at 40 CFR 141 include maximum contaminant levels (MCLs) for nitrate (10 mg/l), combined radium 226 + 228 (5 pCi/l), uranium (0.03 mg/l), and selenium (0.05 mg/l).

Other state regulations for the protection of ground water are established by the WQCC through a delegated Underground Injection Control (UIC) program and are stated at 20.6.2 New Mexico Administrative Code (NMAC). The injection activities at the Site are regulated under DP-200, and discharge from the two evaporation ponds are currently regulated under DP-725.

For the soil remediation, radon emissions, and management of uranium mill tailings, the cleanup standards are set forth in the NRC regulations at 10 CFR 40 Appendix A, I, the EPA regulations at 40 CFR 192, and the National Emissions Standards for Hazardous Air Pollutants (NESHAPs) regulations at 40 CFR 61. These regulations require that surface impoundments must conform to Resource Conservation and Recovery Act (RCRA) standards at 40 CFR 264.2211. Additionally, nonoperational mill tailings impoundments must have a radon barrier installed that limits emissions of radon to a level not exceeding 20 picoCuries/square meter second (pCi/m^2s). The soil cleanup standard for radium-226 is 5.0 picoCuries/gram (pCi/g) above background for the top 15 centimeters (cm) and 15 pCi/g above background for each subsequent 15 cm depth increment.

4.2 Remedy Selection

Remedy selection at the Site has been based on the procedures specified by the NMED, the NRC, and the 1983 Agreement between the EPA and Homestake. The DP-200 contains the NMED's ground water restoration plan for the Site. The CAP describes the remediation plan approved by the NRC for contaminated ground water at the mill site. It is noted that the NMED is in the process of renewing DP-200, and Homestake is planning on submitting a revised CAP to the NRC for review and approval. Also, the NRC License SUA-1471, as amended, defines the plans

for mill decommissioning, surface reclamation, long-term stabilization of the tailings impoundments and closure of the mill site.

In summary, the major components of the remedy employed at the Site include the following:

- Decontamination of the mill facilities and equipment.
- Demolition of the mill facilities and equipment.
- Burial of contaminated debris and asbestos containing materials (ACM) in the out slope of the large tailings impoundment.
- Burial of uncontaminated debris and equipment in pits on the mill site (**AKG, 1993**).
- Excavation of surface soil contaminated with windblown tailings and burial in the out slope of the large tailings impoundment (**AKG, 1993**).
- Construction of a final radon barrier on the two tailings impoundments to minimize radon emissions and reduce erosion (**NRC, 1995a**).
- Dewatering the large tailings impoundment to remove contaminated ground water and control the source area of the ground water contamination (**Hydro-Engineering, 2001**).
- Provision of an alternate and permanent water supply for residents of the Subdivisions and finance the cost of residents' water use for a period of ten years (**EPA, 1989**).
- Operation of a ground water collection and injection system at the mill site to reverse ground water flow back toward the collection wells adjacent to the tailings impoundments and to collect and treat the contaminated ground water at the RO plant for re-injection or dispose of it by evaporation (**NRC, 1989, and NMED, 1996a**).

In addition to the components of the remedy listed above, Homestake has been investigating options to optimize the operations and enhance the rate of ground water remediation at the Site. Homestake is testing bioremediation techniques to enhance the removal of contaminants from the large tailings impoundment, and it has plans to expand the treatment capacity of the RO plant.

Additionally, Homestake has put into operation a second ground water restoration system to restore affected ground water downgradient of the mill site, including the Subdivisions and those areas south and west of the Subdivisions. This second system is discussed in more detail below.

4.3 Remedy Implementation

This section describes remedy implementation for each of the two operable units requiring remediation.

Operable Unit No. 1 - Ground water Restoration. Homestake began implementing the state-approved ground water restoration program in 1977. The program consists of a ground water collection/injection system for the San Mateo alluvial aquifer and the Upper and Middle Chinle aquifers. Fresh water is injected into those aquifers at wells located along or near the south and southwest boundary of the mill site, between the Subdivisions and the tailings impoundments, to reverse the natural flow direction of the ground water away from the residences and back towards the tailings impoundments. Collection wells located adjacent to, and downgradient from, the impoundments collect the contaminated ground water for treatment. The collected ground water is pumped to either the RO plant for treatment and aquifer re-injection or to the two collection ponds. The water in the collection ponds is then piped to one of two lined evaporation ponds for disposal. Evaporation of water at the ponds is enhanced through spraying. Fresh water for injection is obtained from the San Andres Limestone aquifer and from product water that has been treated at the RO plant. Wastewater from the RO plant is treated in the evaporation ponds **(Hydro-Engineering, 2001)**.

Since 1977, Homestake has performed several operating modifications or adjustments to improve the ground water restoration system under the oversight of the NMED and the NRC. Injection wells have been periodically installed closer to the tailings impoundments as the ground water has been restored downgradient. The RO plant and Evaporation Pond No. 2 were constructed to increase the amount of contaminated water that could be recovered. Additional injection and

collection wells have been installed in the large tailings impoundment (tailings wells) and a series of toe drains constructed along the perimeter of the impoundment to aid in the dewatering of the tailings. Over three billion gallons of contaminated ground water have been recovered by the collection wells, tailings wells and the toe drains since 1977 (**Hydro-Engineering, 2001**).

Homestake is operating a second ground water restoration system comprised of thirteen (13) collection wells and two irrigation systems located south and southwest of the Subdivisions, on property owned by Homestake. The purpose of this second system is to remediate those portions of the ground water contaminant plumes which have migrated off the mill site and are beyond the influence of the primary ground water collection and injection system. The collection wells extract contaminated ground water by pumping, thereby gradually reducing the contaminant levels within the aquifer (this assumes that the upgradient source of the contamination, the tailings seepage, is being collected by the ground water collection/injection system at the mill site). The two irrigation systems consist of a spray irrigation system and a flood irrigation system which are used to grow alfalfa for feeding of livestock.

In February 1999, prior to implementing these irrigation systems, Homestake submitted a proposal to the NMED and the NRC for performing such activities, along with a radioactive dose assessment (health study) for approval. The proposed irrigation water concentrations were less than the New Mexico standards. Homestake received approval from the NMED to use the water for irrigation. The NRC informed Homestake that the proposed action was not subject to regulation by the NRC in conjunction with License SUA-1471 since it was not within the license boundary. However, the NRC also informed Homestake that it did review the health study and found it to be generally acceptable (**NRC, 1999a**). This secondary ground water system is not currently part of the CAP or the DP-200. The existing CAP is limited to those areas under the NRC regulatory authority (*i.e.*, the area within the license boundary or mill site). However, it is being incorporated by Homestake into a revised CAP to be submitted to the NRC for approval. It is also being incorporated into the renewal process for DP-200 and is currently under review by

the NMED. The second ground water restoration system will likely require additional monitoring requirements before being approved.

Pursuant to the 1983 Agreement between Homestake and the EPA, Homestake financed the extension of the Village of Milan's municipal water supply to the residences of the Subdivisions and made payments to the Village of Milan for the residents' water usage over a period of ten years. The extension of the water supply was completed in 1985 (**EPA, 1989**). The EPA released Homestake from the Agreement in 1995 (**EPA, 2001a**).

Operable Unit No. 2 - Mill Decommissioning, Surface Reclamation, Long-Term Stabilization of Tailings Impoundments and Closure. The decommissioning of the mill facilities and remediation of soil contaminated with windblown tailings occurred in two phases. The first phase involved the reclamation of all milling facilities and equipment not needed for the continued operation of the ground water restoration system. The first phase also included excavation of surface soil contaminated with windblown tailings and disposal on the mill site. The mill decommissioning and reclamation, as well as the cleanup of the contaminated soil, was conducted under the NRC-approved reclamation plan (**NRC, 1993a & 1993b, and AKG, 1993**).

These activities began in 1992 with the removal of ACM from the mill facilities. All ACM was assumed to be contaminated with radioactive constituents and was disposed of on the mill site. The ACM was placed on the toe of the original out slope of the large tailings impoundment and buried. After removal and disposal of the ACM, the mill components were tested for radioactive contamination prior to demolition. Highly-contaminated materials were dismantled and buried in the large tailings impoundment. Other components exhibiting lower levels of contamination were decontaminated, dismantled and/or broken down, and buried in pits within the mill area or on the east out slope of the large tailings impoundment. Mill structures were demolished, crushed to reduce volume and void space, and buried in pits within the mill area or in the small tailings impoundment. The burial pits were filled in five-feet lifts. Following placement of each

lift of material, the pits were filled with a sand-cement slurry grout up to the level of that lift to fill in the remaining void space. This process was then repeated up to four feet bgs. The remaining four feet were filled with soil to approximately the original grade. An average of two feet of contaminated soil were removed from the mill area and placed in the tailings impoundments. A few items exhibiting low levels of contamination were decontaminated to NRC standards and released from the mill site for reuse. This work occurred from November 1993 until March 1995 (**AKG, 1996**).

Homestake performed cleanup of radioactive contamination at the mill site from 1988 to 1995, including the cleanup of soil contaminated with radium-226 from windblown tailings. The cleanup criteria were based on the NRC requirements of 10 CFR 40, Appendix A, Criterion 6, which are equivalent to the EPA requirements specified in 40 CFR 192. These regulations include a cleanup standard for radium-226 in the top 15 centimeters (cm) of soil of 5 picoCuries/gram (pCi/g) above background and 15 pCi/g above background for each 15-cm depth increment below the top 15 cm. The background level for radium-226 at the mill site was established as 5.5 pCi/g. Therefore, the cleanup standards were 10.5 pCi/g for the top 15 cm of soil and 20.5 pCi/g for each succeeding 15-cm depth increment.

Soil contaminated with radium-226 above these levels was excavated and placed on the outslope of the large tailings impoundment prior to the placement of the final radon barrier on the perimeter of the impoundment and the interim soil cover on top of the impoundment. The depth of the soil excavation ranged between zero and up to about five feet. Confirmatory sampling showed that the cleanup standard for radium-226 in soil was achieved. Fill materials taken from other areas at or near the mill site were used as backfill. **Figure 3** shows the areas that were excavated (**ERG, 1995a**). The NRC approved the cleanup of the contaminated soil and the decommissioning of the mill in January 1999 (**NRC, 1999**).

Each tailings impoundment will be covered with a final radon barrier. Homestake submitted the final radon barrier designs to the NRC in June 1995, and the NRC approved the designs in October 1995. The final radon barrier designed for the large tailings impoundment will consist of a soil cover with a variable thickness between 3.8 feet and 8.5 comprised of clayey sand. The soil cover for the small tailings impoundment will be approximately fourteen (14) feet thick and comprised of similar materials. A rock cover will be placed on top of each radon barrier to protect against erosion. The rock covers will be approximately 6 - 9 inches thick (**NRC, 1995a**). The final barrier was placed on the out slopes of the large tailings impoundment after the first phase of reclamation was completed. A one-foot thick interim soil cover was also constructed on its top and on the small tailings impoundment to protect against erosion.

The second phase of reclamation will include the construction of the final radon barrier on the top of the large tailings impoundment and on the small tailings impoundment. The completion of the final radon barrier and all other reclamation activities to secure the large tailings impoundment is scheduled for September 2004, after the tailings are dewatered. The completion of the final radon barrier and all other reclamation activities for containment of the small tailings impoundment are scheduled for September 2013, following completion of the ground water restoration. Prior to barrier placement on the small tailings impoundment, the collection ponds and Evaporation Pond No. 2 will be dismantled, the liners decontaminated, and all materials placed in Evaporation Pond No.1 (*see also* **Figure 1**). All remaining soil contamination at the mill site will be excavated and placed in Evaporation Pond No. 1, along with any remaining site structures and equipment that will not be decontaminated for offsite use (**AKG, 1993**). The second phase is scheduled for completion once the ground water restoration program is completed in 2010.

4.4 Operations and Maintenance

Since the lead Federal agency is the NRC, the Site does not have an O&M Plan typically required under CERCLA. Required O&M activities at the Site are stipulated in the NRC license SUA-

1471 and the NMED discharge permits DP-200 and DP-725. O&M activities are also specified in a number of internal documents kept at the Site.

The O&M activities include:

- Operation, maintenance, and monitoring of the ground water injection and collection wells and associated piping.
- Maintenance of the final radon barrier and interim covers on the large and small tailings impoundments.
- Operation and maintenance of the RO plant, collection ponds, and evaporation ponds.
- Ground water sampling and monitoring.
- Air monitoring.
- Maintenance of air monitoring stations and ground water monitoring wells.
- Operation and maintenance of the spray irrigation and flood irrigation systems.

Homestake personnel are at the Site daily during the week performing O&M activities. Daily and weekly inspections are conducted to verify the condition of the components of the two ground water restoration systems, including the RO water treatment plant and the collection and evaporation ponds. The ground water restoration and treatment/disposal systems are also monitored by computer, and the systems are capable of calling Homestake personnel at home during non-working hours if a problem occurs.

The O&M costs are not stipulated in any of the decision documents for the Site. The NRC License SUA-1471 contains a condition requiring Homestake to provide a financial surety to cover the cost to implement the remaining reclamation and closure activities. During the Site inspection, a Homestake representative stated that it costs approximately $3 million to operate the facility annually. Given the fact that operations at the Site have varied from one year to the

next and that Homestake continues to investigate methods to enhance and accelerate the rate of ground water restoration, it is likely that annual O&M costs may vary.

5.0 Five-Year Review Process

This five-year review has been conducted in accordance with the EPA's Comprehensive Five-Year Review Guidance, dated June 2001 (**EPA, 2001b**). Interviews were conducted with relevant parties, a Site inspection was conducted, and a review of applicable data and documentation covering the period of the review was evaluated. The findings of the review are described in the following sections.

5.1 Administrative Components

The five-year review for this Site was initiated by the EPA in April 2001, when the EPA Contractor, CH2M HILL, was tasked by the EPA to perform the technical components of the review. The review was led by the EPA Remedial Project Manager for this Site, Mark Purcell, EPA Region 6. Agency representatives assisting the review team included: Mary Heather Noble, NMED Groundwater Quality Bureau, Mining and Environmental Compliance Section; Birgit Landin and Abbie Phillips, NMED Groundwater Quality Bureau, Superfund Oversight Section; and Kenneth Hooks, NRC, Fuels Cycle Licensing Branch, Division of Fuel Cycle Safety and Safeguards. Roy Cellan from Homestake and his staff also supported the review team, providing information related to the Site and assistance during the Site inspection. The components of the review included Community Involvement, Document Review, Data Review, Site Inspection, Interviews, and development of the Five-Year Review Report (Report), as described below.

5.2 Community Involvement

Upon completion of the five-year review, the Report will be placed in the information repository maintained for this Site at the New Mexico State University Grants Library, located at 1500 Third Street in Grants, New Mexico, and at the EPA Region 6 office in Dallas, Texas, and a

public notice will be issued announcing completion of the five-year review and the availability of the Report in the information repositories.

5.3 Document Review

This five-year review included a review of relevant documents, including ground water and soil cleanup plans, reclamation plans, verification reports, the NMED discharge plans, the NRC License SUA-1471 and amendments, and related monitoring data. Documents that were reviewed are listed in **Attachment 1**.

5.4 Data Review

Various types of data have been collected since cleanup activities began at the Site in 1977. These types of data have included ground water quality data, ground water levels, and the amount of ground water injected, collected, and treated with respect to the ground water restoration program. In addition, there are settlement monitoring data for the large tailings impoundment, weather monitoring data, air monitoring data, and leak-detection monitoring data for the evaporation ponds. For purposes of this Five-Year Review, ground water quality data, ground water level data and air monitoring data were reviewed. The soil cleanup and mill reclamation activities were completed in 1995 and approved by the NRC in 1999. The cleanup levels associated with these actions were approved as meeting applicable regulatory requirements, and Homestake documented achievement of these cleanup levels during the cleanup activities (**NRC, 1999, AKG, 1996, and ERG, 1995a**). Discussed below are the data associated with ongoing remedial activities, including the ground water monitoring data, the water level data, and the air monitoring data.

Ground Water Monitoring. Ground water monitoring at the Site began in 1977. Since that time, over 600 wells have been installed at the Site for ground water injection, collection, and/or monitoring purposes. These wells are completed within the San Mateo alluvial aquifer, the Upper, Middle, and Lower Chinle aquifers, or the San Andres aquifer. The NMED DP-200 sets

cleanup levels at average background concentrations documented in the San Mateo alluvium for TDS (1770 mg/l), sulfate (976 mg/l), selenium (0.12 mg/l), and nitrate (12.4 mg/l). These constituents were the only constituents having background concentrations that exceeded water-quality standards set forth in the WQCC Regulations (**NMED, 1996a**). Other water-quality standards of the WQCC regulations include uranium (5.0 mg/l), molybdenum, as an irrigation standard (1.0), combined radium-226 + radium-228 (30 pCi/l), and chloride (250 mg/l). In addition, the NRC CAP establishes water-quality standards for chromium (0.06 mg/l), molybdenum (0.03 mg/l), selenium (0.10 mg/l), vanadium (0.02 mg/l), uranium (0.04 mg/l), thorium-230 (0.03 pCi/l), and combined radium-226 + radium-228 (5.0 pCi/l). A comparison of the Site standards are presented in **Table 2**. These standards are based on average background concentrations measured from upgradient wells at the Site. The NMED standards are based on concentrations from Wells P, Q, and R, while the NRC standards are based on concentrations from Well P only.

Homestake submitted a report to the NRC and NMED in 1999 documenting a background water-quality study they completed for the San Mateo alluvium aquifer (Background Study). The Background Study calculated background concentrations for Site contaminants based on the 95th percentile of the upper tolerance limit in a non-parametric data set (*i.e.*, 95 percent of the data points in the data set are less than or equal to the proposed background value) using wells DD, P, Q, R, and ND (**Hydro-Engineering, 2001**). These background concentrations are presented along with the original NMED DP-200 background concentrations (cleanup levels) and CAP cleanup levels in **Table 2**. Most of the newly-calculated background concentrations are higher than the previously-calculated background, the most significant being uranium, with a value (0.15 mg/l) nearly four times the current NRC standard of 0.04 mg/l. The Background Study is currently under review by the NRC and the NMED.

Homestake is currently revising the CAP for submittal to the NRC; this revision may include a request for Alternate Concentration Limits (ACLs) based on the 95% upper tolerance limit for

background concentrations calculated in the Background Study. Also, Homestake has applied for renewal of discharge plan DP-200. This application is currently in review at NMED and NRC. The existing requirements of DP-200 remain in effect pending approval of the renewal application. It is noted that EPA has not reviewed the Background Study and, therefore, makes no determination as to the appropriateness of the proposed revision to background concentrations, nor the methods by which they were calculated. Should Homestake submit the expected ACL application described above, the basis for revision of background concentrations (and cleanup levels) will be reviewed by EPA at that time.

Uranium and selenium are the most widespread contaminants present at the Site, and their distributions are very similar. Therefore, for purposes of discussing the ground water monitoring data, uranium concentrations and distributions will be discussed and presented in this Report. For more information, refer to Homestake's annual report entitled "Ground-Water Monitoring and Performance Review for Homestake's Grant Project, NRC License SUA-1471 and Discharge Plan DP-200, 2000," dated March 2001 (2001 Annual Report). The ground water monitoring data indicate that only the San Mateo alluvial aquifer and the Upper and Middle Chinle aquifers are impacted by contamination from tailings seepage at the mill site (**Hydro-Engineering, 2001**).

It is noted that uranium and selenium are also the only contaminants that are still present in the ground water off the mill site at levels above the background concentrations being proposed by Homestake. The more recently-calculated background concentrations are 0.15 mg/l for uranium and 0.27 mg/l for selenium. The current standards are 0.04 mg/l for uranium and 0.12 mg/l for selenium.

Figure 4 shows the locations of monitoring wells in the San Mateo alluvial aquifer used for documenting ground water quality in the 2001 Annual Report. It also depicts the grouping of wells used for plotting trends in contaminant concentrations over time, beginning in 1977 (water-

quality plots). **Figure 5** is a contour map of uranium concentrations in the San Mateo alluvial aquifer. The map shows that the areas of highest uranium concentrations (exceeding 50 mg/l) are beneath or near the tailings impoundments. Uranium concentrations exceeding the NRC standard of 0.04 mg/l generally extend from the tailings impoundments to the west and south as two separate, narrow, and elongated plumes. The uranium plume to the west of the impoundments extends beneath the northern portion of Pleasant Valley Estates subdivision, past Valle Verde, and joins with uranium concentrations in the Rio San Jose alluvial system before turning southward. Uranium concentrations within this plume range up to 0.9 mg/l. The southward-extending uranium plume appears to originate beneath the east perimeter of the small tailings impoundment and extends under Highway 605, the Broadview Acres and Felice Acres subdivisions, and beyond Felice Acres to the southwest, along a separate and constrictive zone of the aquifer. Maximum uranium concentrations in this plume exceed 2.0 mg/l near the southwest corner of Felice Acres. There are also isolated areas where the uranium levels exceed 0.04 mg/l along the mill site boundary and in Murray Acres subdivision. These areas may represent pockets of residual concentrations remaining in the portion of the aquifer flushed by the fresh-water injection wells.

Figures 6, 7, 8, 9, 10, and **11** are the water-quality plots showing the change in uranium concentrations over time in various groups of alluvium wells, beginning around 1977. **Figures 6, 7**, and **8** contain data for the POC wells, S4, D1, and X. **Figures 9, 10**, and **11** show trends in the uranium concentration for wells within the Subdivisions. The uranium concentration has decreased over time at all three POC wells. Some of the wells near the tailings impoundments show increasing concentrations over time. This is most likely due to their locations relative to the ground water collection wells. Except for monitoring wells 802 and 496, the uranium concentrations in the wells within the Subdivisions have generally been decreasing with time (from near 10 mg/l to less than 1 mg/l). Additionally, uranium levels in some wells within the Subdivisions have actually decreased to below the current NRC standard of 0.04 mg/l (**Hydro-Engineering, 2001**).

Uranium concentrations in well 802, which is located in the northeast corner of the Murray Acres subdivision, have increased over the last seven years from background levels to near 1.5 mg/l. The cause of this increase is unknown. However, since uranium concentrations in this area of the alluvial aquifer are relatively low, they are expected to gradually decrease at well 802 with time. Well 496 is located at the southeast corner of Felice Acres subdivision. It is positioned along the axis of the narrow aquifer zone where the higher concentrations of the southward-trending uranium plume are present (**Hydro-Engineering, 2001**). The concentration of uranium in well 496 has not decreased during the four years it has been monitored.

Overall, the decrease in concentrations in most of the wells located in areas of fresh-water injection demonstrate the effectiveness of the collection/injection system in (1) moving those portions of the contaminant plumes under the mill site back toward the collection wells, and (2) preventing the further migration of contamination off the mill site and toward the Subdivisions.

Figure 12 shows the locations of wells in the Upper Chinle sandstone aquifer and the boundary of the aquifer where it subcrops against the overlying San Mateo alluvium deposits. It also shows the location of the East Fault and West Fault. The Upper Chinle aquifer is present under the eastern portion of the mill site, the eastern portion of Murray Acres subdivision, and most of Broadview Acres and Felice Acres subdivisions. **Figure 13** is a contour map of uranium concentrations present in the Upper Chinle aquifer. The map depicts two areas of uranium concentrations above the current standard of 0.04 mg/l. The first area covers a portion of the mill site, including the large tailings impoundment and the collection ponds, and the northeast corner of Murray Acres subdivision. The maximum concentration of uranium detected is 1.54 mg/l. The second area covers Broadview Acres subdivision, the northern two-thirds of Felice Acres subdivision, and a small area across Highway 605. The maximum concentration of uranium detected is 0.27 mg/l.

Figure 14 is a water-quality plot showing trends in the uranium concentration over time for several of the Upper Chinle aquifer wells, beginning in 1981. In general, the uranium concentrations have decreased with time in most of the wells. Uranium concentrations in well CW3, which is upgradient from the tailings impoundments, have remained stable over time and below the cleanup standard of 0.04 mg/l. Uranium concentrations in well 494, located in the middle of Felice Acres subdivision, has decreased from about 1.0 mg/l in 1983 to 0.27 mg/l in 2000. However, the rate of decrease appears to have leveled off over the last few years. The most concentrated portion of the plume is centered near collection well CE2, located near the tailings impoundments (**Hydro-Engineering, 2001**).

Figure 15 is a contour map of the uranium concentrations in the Middle Chinle sandstone aquifer. The map also depicts the boundary of the aquifer where it subcrops against the overlying San Mateo alluvium deposits and the positions of the East Fault and West Fault. There appears to be significant displacement of Middle Chinle sandstone across the West Fault. The map shows generally two areas where the uranium concentrations are currently above the cleanup standard of 0.04 mg/l. The largest of the two areas is centered over Felice Acres and Broadview Acres subdivisions, and areas southwest of those subdivisions, were the Middle Chinle aquifer subcrops against the overlying San Mateo alluvial aquifer. The maximum uranium concentration detected is 1.78 mg/l. The second area of uranium concentrations that exceed the cleanup standard is located northwest of the large tailings impoundment, across County Road 63. The maximum concentration of uranium detected is 0.17 mg/l.

Figure 16 is a water-quality plot showing the uranium concentration trends over time for wells in the Middle Chinle aquifer, beginning in 1980. For those wells that are not located within the uranium plumes depicted on **Figure 15**, the concentrations of uranium have remained stable or increased slightly over time and are at or near the cleanup standard. For the one well currently located within the area of highest uranium concentrations, CW44, the concentration has slightly decreased (**Hydro-Engineering, 2001**).

Ground Water Water Level Data. The primary aquifer of concern is the San Mateo alluvial aquifer. This is the aquifer that is most contaminated and was previously used by residents in the Subdivisions for potable water. However, contamination is also present in the Upper and Middle Chinle aquifers at the Site. One of the objectives of the ground water restoration program is to reverse the natural ground water gradients at the site to move contamination away from the Subdivisions and towards the collection wells. Fresh water is injected into the San Mateo alluvial aquifer and the Upper and Middle Chinle aquifers. Contaminated ground water is collected from the San Mateo alluvial aquifer and the Upper Chinle aquifer.

Figure 17 is a contour map of the water elevations for the San Mateo alluvial aquifer. Also shown are areas where the San Mateo alluvium is not saturated. The map shows the effect of ground water collection and injection on the hydraulic gradients and flow directions within the alluvium beneath the mill site. The natural southwest ground water flow direction has been reversed in an area between the tailings impoundments and the northern edge of the Subdivisions, thereby creating a capture zone for recovering contaminated ground water and preventing the further migration of contaminants off the mill site (**Hydro-Engineering, 2001**).

Figure 18 shows the water levels, ground water gradient, and ground water flow directions for the Upper Chinle aquifer. This figure also shows where the Upper Chinle aquifer is in direct contact with the overlying San Mateo alluvium. Ground water flows away from the three injection wells and towards the single collection well (**Hydro-Engineering, 2001**).

Figure 19 shows the water levels, ground water gradient, and ground water flow directions for the Middle Chinle aquifer. The figure also shows where the Middle Chinle aquifer is in direct contact with the San Mateo alluvium. Ground water, in general, is flowing towards the northeast, except near injection well CW14. Ground water is flowing radially away from injection well CW14 (**Hydro-Engineering, 2001**).

The water level data demonstrate that the ground water restoration program appears to have effectively reversed the ground water flow back towards the mill site. Also, the data demonstrate that the San Mateo alluvial aquifer and the Upper Chinle aquifer collection systems are capturing the contaminated ground water for treatment.

Air Monitoring Data. Homestake submits a semi-annual environmental monitoring report to the NRC and the NMED. Homestake currently monitors ambient air quality along the perimeter of the mill site for natural uranium (U-nat), radium-226 (Ra-226), thorium-230 (Th-230), radon-222 (Rn-222), and gamma exposure rate. **Figure 20** shows where each air monitoring station is located. The second report for each year contains a summary of the annual effective dose equivalent for inhalation at those monitoring stations. This summary compares the data from the background sample location to the data from the sample location nearest the Subdivisions that contained the highest levels of each constituent. The report for the year 2000 was available for this five-year review. The report contains a total-effective- dose-equivalent (TEDE) assessment based on the sum of the committed effective dose equivalent (CEDE) for inhalation of radionuclides, CEDE for exposure to Rn-222, and the dose equivalent for exposure to direct radiation. All units are in millirems per year (mrem/yr). The values at the background location have been subtracted out to obtain the TEDE. **Table 3** presents each of these parameters for air monitoring station HMC #4 in 2000.

Table 4 presents the gamma exposure rate and Rn-222 air monitoring data for 2000 at all monitoring points, and **Table 5** presents the air monitoring data for U-nat, Ra-226, and Th-230 for 2000 at all monitoring points. These monitoring data were used to calculate the TEDE in **Table 3.**

The air monitoring data show that no radon emissions are above 1.0 pCi/l above background, there are no radon concentrations detected above the EPA indoor air standard of 4.0 pCi/l, and

the TEDE is below the NRC criterion (with exemption) of 100 mrem/year (see Section 6.2 for a discussion of this standard).

5.5 Site Inspection

A Site inspection was conducted on August 16, 2001 by the EPA RAC6 contractor, CH2M HILL. The Site-inspection checklist is included as **Attachment 3**, and photographs taken during the Site inspection are included as **Attachment 4**. The purpose of the inspection was to assess current Site conditions as they relate to the protectiveness of the remedy.

No significant issues were noted during the Site inspection. The Site appeared to be well maintained and operated. The Site is surrounded by barbed-wire fencing, and the Site office is surrounded by chain-link fencing. Entry to the Site was made at the Homestake office located on the northeast corner of the mill site (**Photographs 1, 2, 39, 40, 48**, and **50**).

The radon barrier and protective rock cover on the large tailings impoundment appeared in good condition. There were no signs of bulging, cracking, slumping, or erosion (**Photographs 17, 18, 23**, and **43-45**). There are large pipes running down the side to channel runoff from the top of the tailings impoundment to the bottom (**Photographs 26, 27, 44**, and **46**). Homestake personnel stated that these pipes would be removed once the final barrier on the top of the impoundment was completed. Numerous injection and collection wells were present on top of the large tailings impoundment, and additional wells were being installed during the inspection (**Photographs 3, 4, 6, 24**, and **25**). Due to the large number of wells present on site, not every well was directly inspected. However, the wells that were inspected appeared in good condition and were functioning (**Photograph 6**).

The area where ACM was disposed in the out slope of the large tailings impoundment was clearly marked (**Photographs 43-45**). Evaporation Pond No. 1 and the RO plant were operating

at the time of the inspection (**Photographs 15** and **16**). The RO plant appeared well maintained and in good condition (**Photographs 28-37**). One air monitoring station (Station No. 5), located north of the Murray Acres subdivision, was directly inspected, and all components were functioning and appeared in good condition (**Photograph 41**). It was observed that native vegetation had been restored to all the areas that had been excavated at the mill site, making these areas indistinguishable from undisturbed areas (**Photographs 17, 18, 28, 42**, and **48**).

It was stated by Homestake representatives during the Site inspection that some residents within the Subdivisions use their wells for irrigation and livestock watering. Also, it was stated that at least one additional resident outside of the Subdivisions was using a well in an area near the known location of the contaminant plume. Homestake does sample this well, and concentrations do not exceeded background levels.

5.6 Interviews

Interviews for this five-year review were conducted with representatives from the NMED, the NRC, Homestake, and the Village of Milan. Interview Record Forms are provided in **Attachment 2**. **Mr. Roy Cellan/Homestake Mining Company** was interviewed during the Site inspection on August 16, 2001, at the Site. **Ms. Mary Heather Noble/NMED Groundwater Quality Bureau, Mining and Environmental Compliance Section**, was interviewed by telephone and electronic mail on August 21, 2001. **Ms. Birgit Landin/NMED Groundwater Quality Bureau, Superfund Oversight Section**, was interviewed by telephone on August 31, 2001. **Mr. Kenneth Hooks/NRC Fuels Cycle Licensing Branch, Division of Fuel Cycle Safety and Safeguards**, was interviewed by telephone on August 30, 3001.

Overall, the responses generated during the interview were very positive. All involved parties indicated that Homestake has been proactive in addressing the contamination issues at the Site, and communicative and supportive of the NRC, the NMED, and the EPA requests and

requirements. The NMED representatives indicated they would like to see more definitive projections on the expected achievement of cleanup standards, and clear monitoring requirements established for determining when cleanup standards are met and for demonstrating continued compliance after active remediation is discontinued. See **Attachment 2** for the interview records.

6.0 Technical Assessment

The five-year review must determine whether the remedy at a site is protective of human health and the environment. The EPA guidance describes three questions used to provide a framework for organizing and evaluating data and information and to ensure all relevant issues are considered when determining the protectiveness of a remedy. These questions are assessed for the Site in the following paragraphs. At the end of the section is a summary of the technical assessment.

6.1 Question A: Is the Remedy Functioning as Intended by the Decision Documents?

The primary documents that detail the remedial decisions for the Site are the ROD, the NRC License SUA-1471, the NRC-approved Reclamation Plan, the NRC-approved CAP, and the NMED-approved discharge plans DP-200 and DP-725. The ROD recommended that no further action be taken to address radon gas emissions in the Subdivisions. The remedy for soil contamination and mill reclamation described by the Reclamation Plan have been implemented for the most part. The remaining reclamation work includes the dewatering of the large tailings impoundment and capping of both impoundments with a final radon barrier cover and erosion-protection layer. This reclamation work will be completed once ground water restoration is complete. The ground water contamination is being addressed as required by the CAP and DP-200. Homestake's schedule is to have all portions of the remedy, reclamation and decommissioning completed by 2013, when the facility is expected to be turned over to the DOE.

The review of all pertinent documents indicate that the various components of the remedy appear to have been implemented as intended and are functioning as intended. The mill reclamation and soil cleanup were documented to attain the levels required by the ARARs for the Site. The CAP requires that ground water be restored to the NRC's water-quality standards or approved background standards before the NRC will terminate License SUA-1471 and release the property to the DOE for long-term care, in perpetuity.

The operation of the ground water collection/injection system has been partially successful at restoring ground water to the approved standards. Monitoring data show that the flow of ground water has been reversed, as intended, from the injection wells located at the mill site boundary back toward the collection wells. However, although contaminant levels have generally decreased over time, they still exceed the Site cleanup standards at the POC wells and in some portions of the aquifers. Ground water monitoring shows that there are two separate contaminant plumes which have migrated beyond the influence of the existing collection/injection system. The first plume is generally located beneath the southern portion of Felice Acres and extends approximately one mile to the southwest. The second plume is located under the northern portion of Pleasant Valley Estates subdivision and extends approximately 2.5 miles to the west. Although these plumes have low levels of contamination, they are above current cleanup standards.

The NMED and the NRC are concerned that Homestake will not be able to attain the current cleanup standards by the estimated completion date of 2008 with the existing ground water collection/injection system. Homestake believes that the current background levels are too low and, reportedly, is in the process of updating the CAP to reflect what it believes are more statistically-valid background concentrations (*see also* Issue on Alternate Cleanup Levels in Section 7.0, below). At this time, there do not appear to be specific procedures to determine and verify whether or not the existing ground water restoration program is capable of achieving the ground water cleanup standards within an expected time frame.

Homestake has actively sought ways to optimize and enhance the operation of the ground water restoration program. Evaporation Pond No. 2 was installed in an attempt to increase the amount of contaminated water that could be treated. A turbo sprayer and misting system were also added to enhance evaporation. The location of Pond No. 2 and local weather conditions limited the evaporation potential from the pond. As a result, Homestake installed a weather monitoring station to gauge when optimal conditions are present that would allow for use of Pond No. 2.

Homestake also constructed the RO Plant to increase the amount of contaminated water that can be treated and re-injected back into the aquifer. The treatment rate increased from 300 gallons per minute (gpm) to 600 gpm and the injection increased from approximately 250 to 500 gpm. The product water from this plant is used for injection, while the wastewater from the plant is pumped into the evaporation ponds for treatment. Homestake has plans to expand the capacity of the RO plant.

According to Homestake, a field study has been initiated to determine if bioremediation could be enhanced in the large tailings impoundment to reduce contaminant levels. No report has been submitted on the design of this study or any results obtained therefrom. Pilot studies are being conducted at the Site to determine if bioremediation within the large tailings impoundment can reduce contaminant levels. A toe drain was constructed along the perimeter of the large tailings impoundment in 1992 to enhance dewatering of the large tailings impoundment. To date, almost 120 million gallons of leachate have been collected from the drain. Also, collection and injection wells (tailings wells) were installed on the large tailings impoundment to further enhance the dewatering process, and additional tailings wells were being installed at the time of the Site inspection. To date, nearly 50 million gallons of leachate have been collected by the tailings wells. Homestake has recently installed the ground water collection/irrigation system to address those portions of the ground water contaminant plumes which have migrated off the mill site to the west and south and are outside the influence of the primary ground water collection/injection system. That ground water contamination had not previously been addressed.

The 1983 Agreement between the EPA and Homestake addressed the residential use of the contaminated ground water. A review of the Village of Milan's records indicates that all the residents in the subdivisions are currently using the municipal water supply. Based on discussions with the Offices of the State and County Engineers, it was learned that there are currently no restrictions or conditions (*i.e.*, institutional controls) imposed to limit the use of ground water by local residents or landowners.

Homestake's property will be turned over to the DOE for long-term care once the NRC license is terminated. At that time, it is expected that all areas outside the portion of Homestake's property that will be deeded to the DOE will be released by the NRC for unrestricted use.

6.2 Question B: Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives (RAOs) Used at the Time of the Remedy Selection Still Valid?

This section addresses changes in ARARs and To-Be-Considereds, and changes in exposure pathways, toxicity, and other contaminant characteristics.

Changes in ARARs and To Be Considereds (TBCs). Several ARARs for the Radon OU were identified in the ROD dated September 27, 1989. This five-year review included identification of and evaluation of changes in these ARARs to determine whether such changes may affect the protectiveness of the selected remedy. In addition, several ARARs and guidance or policy requirements that are TBCs were identified for the other operable units of the Site. Differences in the type of contamination and degree of exposure at the various operable units indicate that different standards could apply to different operable units.

The ROD identified the following ARARs as having an impact on the proposed remedy:

1. Standards for protection against radiation, as regulated at 10 CFR 20. These regulations are promulgated and enforced by the NRC, and the regulations create standards for protection

against radiation exposure. The ROD specifically states that the permissible limit for radon emissions at the facility boundary, which is 1 pCi/l above background, is considered a relevant and appropriate requirement.

2. Criteria relating to the operation of uranium mills and the disposition of tailings of wastes produced by the extraction or concentration of source material from ores processed primarily for their source material content, as regulated at 10 CFR 40 Appendix A. These regulations govern the operation and decommissioning of licensed uranium mills.

3. Health and environmental protection standards for uranium and thorium mill tailings, as regulated at 40 CFR 192. These regulations establish standards for the cleanup of land and buildings at uranium and thorium mill sites.

4. The ROD considered the EPA-recommended indoor exposure level for radon of 4 pCi/l an ARAR at this Site.

The only ARAR that has not been changed to some extent since the ROD was signed is the EPA guideline of 4 pCi/l as the indoor exposure level for radon. This guideline is not a regulatory requirement, and as such, would be a TBC for this Site. Other potential ARARs and TBCs have been identified for this Site, and a discussion of each is provided below.

The Uranium Mill Tailings Radiation Control Act (UMTRCA) established two programs to protect the public health, safety, and the environment from uranium mill tailings. The second program, established under Title II, deals with active facilities that are licensed by the NRC. The Homestake uranium mill site is a Title II site. Title II regulates uranium byproduct materials, such as mill tailings. It establishes requirements for final disposal of the mill tailings, control of effluents into ground water, and radon emissions during and after operations. The requirements

of UMTRCA resulted in the EPA promulgating the regulations at 40 CFR 192 and the NRC promulgated the regulations at 10 CFR 40 Appendix A.

The regulations at 40 CFR 192 that apply to Title II UMTRCA sites are contained in subparts D and E. Subpart D establishes standards for the management of uranium byproduct material. It includes the requirements that surface impoundments must conform to Resource Conservation and Recovery Act (RCRA) standards at 40 CFR 264.221. It states that the RCRA ground water protection standards at 40 CFR 264.92 must be achieved, and adds uranium and molybdenum to the list of hazardous constituents. Nonoperational mill tailings pile and impoundments must have a radon barrier installed that limits releases of radon-222 to a level not exceeding 20 pCi/m^2-s. Soil clean-up levels for radium-226 are established at 5 pCi/g above background, averaged over the upper 15 cm of soil, and 15 pCi/g above background, averaged over each succeeding 15 cm layer below the top 15 cm. It also indicates that while radioactive hazards should be controlled for 1,000 years to the extent reasonably achievable, the hazards must be controlled for at least 200 years at a minimum. Subpart E extends most of the Subpart D requirements to thorium byproduct materials. It also adds the requirement that operations be conducted in a manner that restricts exposures below the annual dose equivalent of 25 millirems (mrem) to the whole body, 75 mrem to the thyroid, and 25 mrem to any other organ (radon-220 and its daughter products excepted).

The NRC wrote the requirements at 10 CFR 40 Appendix A to conform to the EPA requirements at 40 CFR 192. The only significant changes to 10 CFR 40 Appendix A is to Criterion 6(6) (69 FR 17506 to 17510), which amended the use of the existing soil radium standard to derive a benchmark dose criterion. This benchmark dose would then apply to the sum of all radionuclides present in an area. The requirement is to remediate a site such that remaining residual radionuclides would not result in a dose greater than the radium soil standard. This change was promulgated in 1999, after Site soil remediation and mill decommissioning activities were completed.

Other ARARs not listed in the ROD that should be applied to this Site are the National Primary Drinking Water Standards, established under the Safe Drinking Water Act (SDWA), and expressed as maximum contaminant levels (MCLs). The MCLs are promulgated at 40 CFR 141. New MCLs for Beta/photon emitters, Alpha emitters, combined radium-226 and radium-228, and uranium were promulgated on December 7, 2000 (65 FR 76745). The new MCL for Beta/photon emitters is 4 mrem/yr. For Alpha emitters, the MCL is 15 pCi/l. The MCL is 5 pCi/l for combined radium, and the MCL is 0.03 mg/l for uranium.

The SDWA also establishes ground water protection requirements through the Underground Injection Control (UIC) program. The UIC regulations are contained at 40 CFR 144-149. The State of New Mexico is authorized to administer the UIC program. State regulations are established by the WQCC and are stated at 20.6.2 New Mexico Administrative Code (NMAC). Injection activities at the Site are regulated under the state-issued discharge plan, DP-200, and discharges from the evaporation ponds are currently regulated under DP-725. The NMED and Homestake are currently in the process of renewing DP-200. The WQCC Regulations also set limits on contaminants present in ground water to protect the use of this resource. These WQCC Regulations are stated at 20.6.2 NMAC Section 3103. The contaminants present in ground water above these standards are regulated under DP-200. DP-200 also sets monitoring, reporting, and abatement requirements for these contaminants at the site. **Table 2** lists the standards set for the site for by the NMED for those contaminants exceeding WQCC regulatory limits. The WQCC Regulations in Section 4101 state that contaminated ground water with a TDS of 10,000 mg/l or less must be remediated and that surface waters must be remediated/protected for their intended use. It further states that if background concentrations are greater than the standard, then contamination shall be abated to background concentrations. Section 4103 states that the vadose zone shall be abated so that contamination cannot migrate to ground water or surface water. The section also states that toxic pollutants shall not be present. These WQCC Regulations would also be an ARAR for this Site.

The Clean Air Act (CAA) also establishes standards for emissions of radionuclides to ambient air. The CAA requirement that applies to the Site are established under the National Emissions Standards for Hazardous Air Pollutants (NESHAP) regulations at 40 CFR 61. The NESHAP regulation that applies to the remedy at the Site is the requirement that radon-222 emissions to the ambient air from uranium mill tailings units that are no longer operational not exceed 20 $pCi/m^2/s$.

The NRC promulgated changes to the requirements at 10 CFR 20 establishing new radioactive criteria for license termination in 1997 (62 FR 39058). The new criteria established cleanup level criteria of 25 mrem/yr EDE as the primary standard, with exemptions that could allow cleanup levels as high as 100 mrem/yr EDE (this 100 mrem/yr criterion is the value to which Homestake compares their TEDE in their annual report). The EPA determined that these levels were equivalent to approximately 5×10^{-4} and 2×10^{-3} lifetime cancer risk respectively. EPA guidance is to conduct site-specific dose and risk assessments to determine if cleanup values obtained using the new criteria will be protective. According to the EPA guidance, the decision to conduct a risk assessment/dose assessment should be made on a site- specific basis. Also, the EPA has determined that the maximum dose limit under CERCLA is 15 mrem/yr EDE for establishing preliminary remediation goals. The EPA determined that this dose limit corresponds to a risk level of 3×10^{-4}, which was determined to be, in effect, equivalent to the upper risk range of 1×10^{-4} (**EPA, 2000a**). This EPA guidance should be a TBC for this Site. The EPA guidance recommends that the levels at 10 CFR 20 not be used to establish cleanup levels under CERCLA. This guidance also states that NRC decommissioning should be evaluated by determining if the planned or actual cleanup levels (not the dose limits) will achieve the accepted risk range (10^{-4} to 10^{-6}) under CERCLA for the reasonably anticipated land use. The guidance also states that NRC decommissioning does not have to be evaluated using all the procedures that would be used under CERCLA (**EPA, 1997**). This guidance would be a TBC for this Site.

Changes in Exposure Pathways, Toxicity, and Other Contaminant Characteristics. The remediation conducted for this Site has been determined based on limits established by ARARs for soil contamination and the mill facility and by background ground water quality for ground water contamination. A risk assessment was not conducted at this Site to establish cleanup values. No changes have occurred in the assumptions used to establish the ARARs applicable to UMTRCA Title II sites, and no new exposure pathways have been identified as a result of this five-year review. The ground water restoration program is progressing, and Homestake has estimated that the entire remediation at the Site will be completed in 2009 or 2010. Once the remedial activities at the mill site are completed, the Site will be turned over to the DOE. Homestake expects that the mill site will be turned over to the DOE in 2013. These deadlines are tentative dates established by Homestake. Remediation work will continue until the cleanup standards at the mill site and in the underlying ground water aquifers have been met.

6.3 Question C: Has any Other Information Come to Light that Could Call into Question the Protectiveness of the Remedy

There was no other information identified that would call into question the effectiveness of the remedy.

6.4 Technical Assessment Summary

According to the data review, Site inspection, and interviews, the remedial actions selected for this Site appear to have been implemented and continue to function as intended by the decision documents. There have been no changes in the physical Site conditions that would call into question the protectiveness of the remedy. The mill decommissioning and cleanup of windblown tailings-contaminated soil complied with the ARARs, and the objective of the ground water restoration program is to achieve background concentration levels for all contaminants at the POC wells. Although the ground water restoration program has been in operation for almost 25 years, the cleanup standards for ground water have not yet been achieved at the POC wells. The data indicate that a significant portion of the contaminant plume in the alluvial aquifer beneath

the mill site has been successfully moved back to near the collection wells, leaving that portion of the aquifer restored, or partially restored. Furthermore, water-quality data show that concentrations of contaminants are generally decreasing over time in many of the Subdivision monitoring wells.

There are two separate contaminant plumes in the alluvial aquifer which extend beyond the mill site and are outside of the influence (*i.e.*, capture zone) of the ground water collection/injection system. Homestake is operating a secondary ground water collection and irrigation system to restore those affected areas. Specific requirements for abating such contamination are expected to be incorporated into the revised CAP and the DP-200, upon renewal.

The Village of Milan provided information indicating that all residences in the Subdivisions are currently connected to its municipal water supply.

The air monitoring data indicates that the ARARs are being met, including the requirement mentioned in the ROD that radon emissions be below 1 pCi/l above background at the site boundary. Also, the TEDE meets the requirements established by the NRC (100 mrem/year with an exemption). The TEDE calculated by Homestake in its latest monitoring report was 87 mrem/year, including radon. If radon is excluded from the calculation, the TEDE is 16.2 mrem/year. This TEDE is slightly above the dose limit that EPA generally considers minimally acceptable under CERCLA (**EPA, 2000a**) (radon is excluded because it decays rapidly and may overestimate the risk if included in the calculation). This is discussed in EPA Directive No. 9200.4-35P (**EPA, 2000a**), which states "EPA has previously determined that dose limits greater than 15 mrem/year generally will not provide a protective basis for establishing preliminary remediation goals under CERCLA." As stated above, Homestake's value of 16.2 mrem/year is slightly above the 15 mrem/year referenced in the EPA directive, although it should be noted that the 15 mrem/year value is not a standard, and is not a presumptive cleanup level under CERCLA. The directive states that a site-specific risk assessment must generally be conducted to confirm

that the residual levels allowed to meet the compliance dose evaluation are sufficiently protective to be used as cleanup levels under CERCLA (i.e., generally meets a 10-4 to 10-6 risk range and hazard index less than 1).

7.0 Issues

Several issues are identified for this site, as described in the following paragraphs.

Institutional Controls for Restricting Use of Ground Water. One issue at this Site is the potential for use of the contaminated ground water by local residents or landowners. Although residents of the Subdivisions currently use the municipal water supplied by the Village of Milan, and the background concentrations documented for the San Mateo alluvial aquifer are above that which would normally be desirable for drinking water, the San Mateo alluvial aquifer has been used as a potable water supply in the past. Furthermore, institutional controls have never been put in place by either the State of New Mexico or the County of Cibola, New Mexico to restrict such use at this Site. The lack of institutional controls mean that there are no restrictions on the uses of the ground water in those areas.

It was stated by Homestake representatives during the Site inspection that some of the people still use their wells for irrigation and/or livestock watering. Also, it is not known how many people may be using water from the San Mateo alluvium in areas affected south and west of the Subdivisions, where alternate water supplies have not been provided. Homestake representatives are aware of at least one additional well being used in an area near known ground water contamination. However, Homestake samples this well periodically, and concentrations do not exceed background levels. The Homestake representatives also believe that there may be at least one other potentially-affected well located downgradient of the Subdivisions, and this well is not sampled. They are unaware of any other potentially-affected wells in areas affected by ground water contamination.

The NMED, as well as the NRC and the EPA, are concerned about the potential for local residents and landowners to use ground water in the affected areas of contamination. However, institutional controls are difficult to enforce in New Mexico and, until recently, the NMED has generally not used them to protect the public. Furthermore, the NMED believes that any effort to impose institutional controls at the Site, in addition to the provision of alternate water supplies to local residences, should not be the sole justification for approving alternate cleanup standards for ground water (*see also* Alternate Cleanup Standards for Ground Water, below).

Requirements for Ground Water Restoration Beyond the Mill Site. In 2000, Homestake began operating a second ground water restoration system to abate contamination which has migrated beyond the boundary of the mill site. This contamination is outside of the hydraulic influence (*i.e.*, capture zone) of the primary ground water collection/injection system. The second system is comprised of thirteen (13) collection wells and two irrigation systems (spray and flooding systems). The irrigation systems are used for growing alfalfa for feeding livestock. This second system is not required as part of the NRC's CAP or the NMED's DP-200. However, Homestake is incorporating this system into a revised CAP which will be submitted to the NRC for approval. It will also be incorporated into the NMED's DP-200 through the permit renewal process. The NMED is currently reviewing Homestake's application for renewal. The updated CAP and renewed DP-200 will likely specify additional performance and monitoring requirements before that system is approved.

It is noted that although the ground water collection and irrigation system is not currently incorporated into the CAP or DP-200, Homestake did submit a proposal to the NMED and the NRC for utilizing irrigation as a means for disposal of collected water in February 1999. The proposal included a radioactive dose assessment (health study). The proposed irrigation water concentrations included 0.44 mg/l for uranium and 0.10 for selenium. The proposed levels were below the ground water standards set in DP-200 for uranium (5.0 mg/l) and selenium (0.12 mg/l). Additionally, the proposed levels met the NRC's selenium standard specified in the CAP and the

current uranium standard set forth in 10 CFR 20 for radiation exposure levels. The NMED notified Homestake that a discharge plan was not required to use the groundwater for irrigation. The NRC notified Homestake that the proposed action was not subject to regulation by the NRC in conjunction with License SUA-1471 since it was not within the license boundary. However, the NRC also informed Homestake that it did review the health study and found it to be generally acceptable.

Under the WQCC Regulations at 20.6.2 NMAC, Section 3103, the irrigation standards for New Mexico generally are the same as the human health standards. Therefore, the ground water standards the NMED has established in DP-200 for the Site would also apply to irrigation. The highest uranium concentration detected in the wells in that area is 2.09 mg/l, which is below the 5.0 mg/l level set in DP-200. The highest selenium concentration detected in those wells is 0.39 mg/l, which is above the 0.12 mg/l level set in DP-200. It is noted that Section 3105 of the WQCC Regulations does not require a discharge plan to perform irrigation for agricultural purposes.

In light of the above, any additional performance or monitoring requirements established by the NMED in issuing the renewed DP-200 or the NRC in approving the updated CAP should include requirements for irrigation.

Alternate Cleanup Standards for Ground Water. The ground water restoration program is a long-term response action which has been ongoing since 1977, a period of about twenty-five (25) years. To date, Homestake has yet to attain the cleanup standards imposed by the NMED or the NRC for this Site. The NMED and the NRC are concerned that the current ground water cleanup standards will not be attained within the time frame estimated by Homestake for completion of this restoration program (currently 2008). Although contaminant concentrations have generally decreased with time in those wells located within the influence of the ground water collection/injection system, there are still a few wells which do not show such decreases. They

may indicate the presence of isolated pockets of residual contamination. The monitoring data also show that there are two separate and narrow plumes of contaminants within the San Mateo alluvial aquifer which have migrated beyond the influence of the ground water collection/injection system to the south and west of the Subdivisions. The contaminant concentrations are low, but they do exceed the cleanup standards. Some wells located within those plumes have not consistently shown a decreasing trend in concentrations from year to year.

Based on analytical data from upgradient monitoring wells, Homestake believes that background concentrations for many of the Site contaminants generally exceed the ground water cleanup standards established by the NRC and/or the NMED and, therefore, present compliance issues. The original ground water cleanup standards established by the NMED in the DP-200 were set using average background concentrations. Homestake estimates that ground water restoration can be completed by 2008, but only if new background concentrations are accepted at alternate cleanup levels for the Site.

In 1999 Homestake submitted to the NRC and NMED the Background Study and proposal for revised background concentrations as alternate cleanup levels at the Site. The Background Study may provide for a more statistically valid representation of background concentrations than was originally calculated for the Site. The NMED and the NRC are currently reviewing that submittal. The proposed background concentrations exceed most of the current Site standards, including uranium (0.15 mg/l proposed for San Mateo alluvial aquifer). A determination by the NRC on the appropriateness of the proposed background concentrations is expected to be made as part of its review of an Alternative Concentration Limit (ACL) application to be submitted by Homestake. This ACL application will be part of the updated CAP which Homestake is planning to submit to the NRC. The NRC's review and approval process may, ultimately, result in an adjustment to the current ground water cleanup levels for those contaminants it regulates. However, any adjustment to the cleanup levels would still be based on the attainment of background levels.

Furthermore, if Homestake is unable to reduce the levels of the contaminants in ground water to the current NMED-approved background concentrations, it may have to file a petition with the WQCC for approval of alternative abatement standards (AASs). Currently, pursuant to the WQCC Regulations, Homestake is not required to have an approved abatement plan for ground water remediation of non-radioactive constituents if abatement is conducted under EPA's authority, pursuant to CERCLA, or under another authority's approved discharge plan which is consistent with the WQCC Regulations. If the EPA deletes this Site from the NPL, and there is no approved abatement plan which is consistent with the WQCC Regulations, the WQCC exemption from addressing non-radioactive constituents is no longer applicable.

If alternate cleanup standards are approved by the NRC and/or the NMED, the EPA, under its statutory authority, may deem it appropriate to conduct a Site-specific assessment of those standards and, if appropriate, establish alternate cleanup levels under CERCLA to ensure that the remedy is protective of human health and the environment.

Ground Water Monitoring Requirements. At this time, there does not appear to be clear procedures to determine and verify whether or not the existing ground water restoration program is capable of achieving the ground water cleanup standards within an expected time frame. Also, there are no specific requirements for establishing the number of monitoring events which are necessary to determine that concentrations at the POC wells are, in fact, at background concentrations. Further, there are no POC locations designated by the NRC for those portions of the contaminated ground water aquifers located downgradient of the mill site. This is because the NRC has yet to extend its regulatory authority to those affected portions of the aquifers and, therefore, does not currently regulate the radioactive contaminants which have migrated off the mill site. Once the NRC approves the revised CAP, requirements for abating and monitoring the radioactive contaminants in the downgradient portions of the aquifers will need to be established, including the designation of downgradient POC wells. To document the completion of the ground water restoration program, ground water quality must be shown to meet background

concentrations at the POC wells located both on the mill site and in previously affected areas downgradient of the mill site. Finally, no detection monitoring program is currently required to verify that recontamination does not occur once the ground water restoration program is terminated.

EPA Air Quality Standards. The TEDE meets the requirements established by the NRC (100 mrem/year with exemption), but is slightly above the dose limit that EPA generally considers minimally acceptable under CERCLA (**EPA, 2000a**). This is discussed in EPA Directive No. 9200.4-35P (**EPA, 2000a**), which states "EPA has previously determined that dose limits greater than 15 mrem/year generally will not provide a protective basis for establishing preliminary remediation goals under CERCLA." The TEDE calculated by Homestake in its latest monitoring report was 87 mrem/year, including radon. If radon is excluded from the calculation, the TEDE is 16.2 mrem/year (radon is excluded because it decays rapidly and may overestimate the risk if included in the calculation). As stated above, this value of 16.2 mrem/year is slightly above the 15 mrem/year referenced in the EPA directive, although it should be noted that the 15 mrem/year value is not a standard, and is not a presumptive cleanup level under CERCLA. The directive states that a site-specific risk assessment must generally be conducted to confirm that the residual levels allowed to meet the compliance dose evaluation are sufficiently protective to be used as cleanup levels under CERCLA (i.e., generally meets a 10-4 to 10-6 risk range and hazard index less than 1). The directive goes on to state that a risk assessment is recommended for two reasons; first, because the benchmark dose concept in Criterion 6(6) was developed using the ICRP/NCRP (International Commission on Radiological Protection/National Council on Radiation Protection) regulatory approach, which assumes that doses less than 100 mrem/yr are protective, rather than the risk range used to determine protectiveness under CERCLA, and second, because there is no basis for demonstrating that even compliance doses below 15 mrem/year will be protective for the radionuclides that may be addressed by the 6(6) rule.

8.0 Recommendations and Follow-up Actions

Based on the Five-Year Review, it appears the remedial actions for the Site originally set forth in the ROD and other decision documents have been implemented as planned, including the various updates to the ground water restoration system, and the remedy appears to continue to be protective of human health and the environment. To ensure the continued protectiveness of the ongoing remedy, it is recommended that institutional controls be put in place to restrict the use of ground water by local residents and landowners in those areas affected by ground water contamination. Also recommended is the development of clear requirements for determining when the cleanup goals for ground water have been met and the development of post-closure monitoring requirements to be implemented once the ground water remedy is complete, to verify that recontamination does not occur. In addition, the air monitoring data should be evaluated to confirm that in addition to meeting NRC criterion, the residual levels are sufficiently protective under CERCLA (i.e., within the 10^{-4} to 10^{-6} risk range generally used to determine protectiveness under CERCLA).

9.0 Protectiveness Statement

The remedy involving the reclamation of the mill site, including the decommissioning and dismantling of the mill, soil remediation, long-term stabilization of the tailings, and closure, is considered protective of human health and the environment in the short-term because the waste has been contained under the temporary radon barrier that limits emissions of radioactive constituents into ambient air and protects it from erosion. Followup action is necessary to monitor the continuing remediation of the tailings and installation of the final cover to ensure long-term protectiveness. In addition, followup action in the form of a risk evaluation is necessary to confirm the residual levels will be sufficiently protective under CERCLA (i.e., generally meet the 10^{-4} to 10^{-6} risk range and hazard index less than one). A preliminary evaluation should first be done using existing air monitoring data to determine whether a full risk assessment is necessary.

The remedy involving the ground water is also considered protective of human health and the environment in the short-term because an alternate water supply has been provided to residences located within the area of ground water contamination. In addition, a ground water collection and injection system is in place which appears to have already been effective in preventing further migration of contaminants and in partially restoring portions of the affected aquifers. Followup actions in the form of institutional controls and the establishment of clear procedures for attaining and maintaining performance and compliance standards are necessary to ensure long-term protectiveness.

The recommended follow-up actions described in Section 8.0 are necessary to ensure the continued protectiveness of the remedial actions, and if implemented, will ensure that the remedial actions performed remain protective of human health and the environment in the future.

10.0 Next Review

The next Five-Year Review, the second for the Site, should be completed on or before December 2005. This review should occur whether or not, in the interim, the Site has been deleted from the NPL. It is the EPA's policy that the Five-Year Review requirement is independent of and unaffected by the process by which sites are deleted from the NPL. If the Site has been deleted or is in the process of being deleted at the time of the next Five-Year Review, the Five-Year Review report should address the status of the deletion action. Five-year reviews will continue as necessary after deletion, based on the recommendation of the next Five-Year Review.

The EPA will continue to monitor this Site to determine whether to delete the Site from the NPL, to defer additional CERCLA response action until the NRC and the NMED actions are completed, or seek further response actions under CERCLA to protect human health and the environment.

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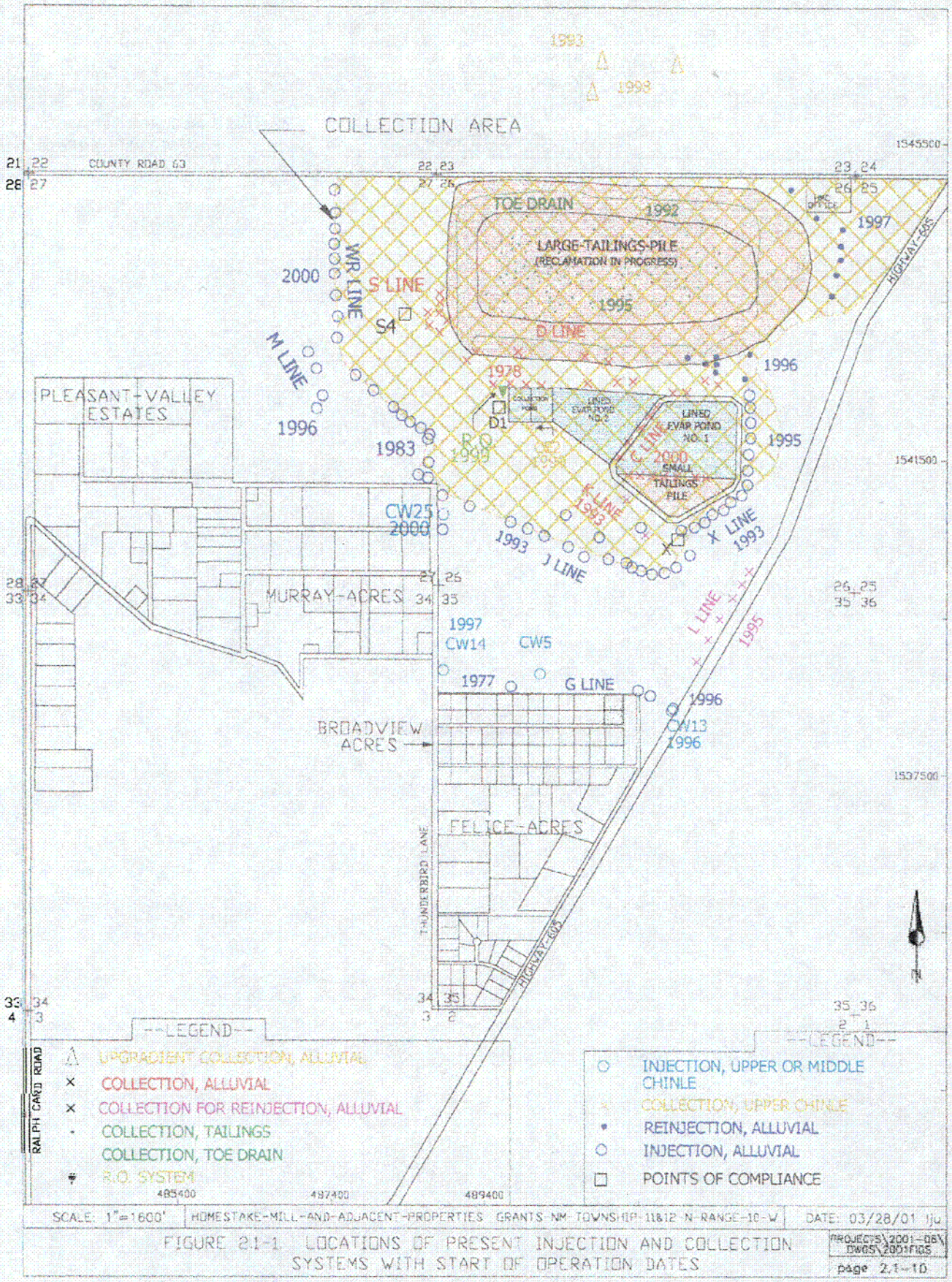

Figure 1
Site Map
First Five-Year Review
Homestake Mining Company Superfund Site
Cibola County, New Mexico
[reproduced from HydroEngineering, 2001]

C01

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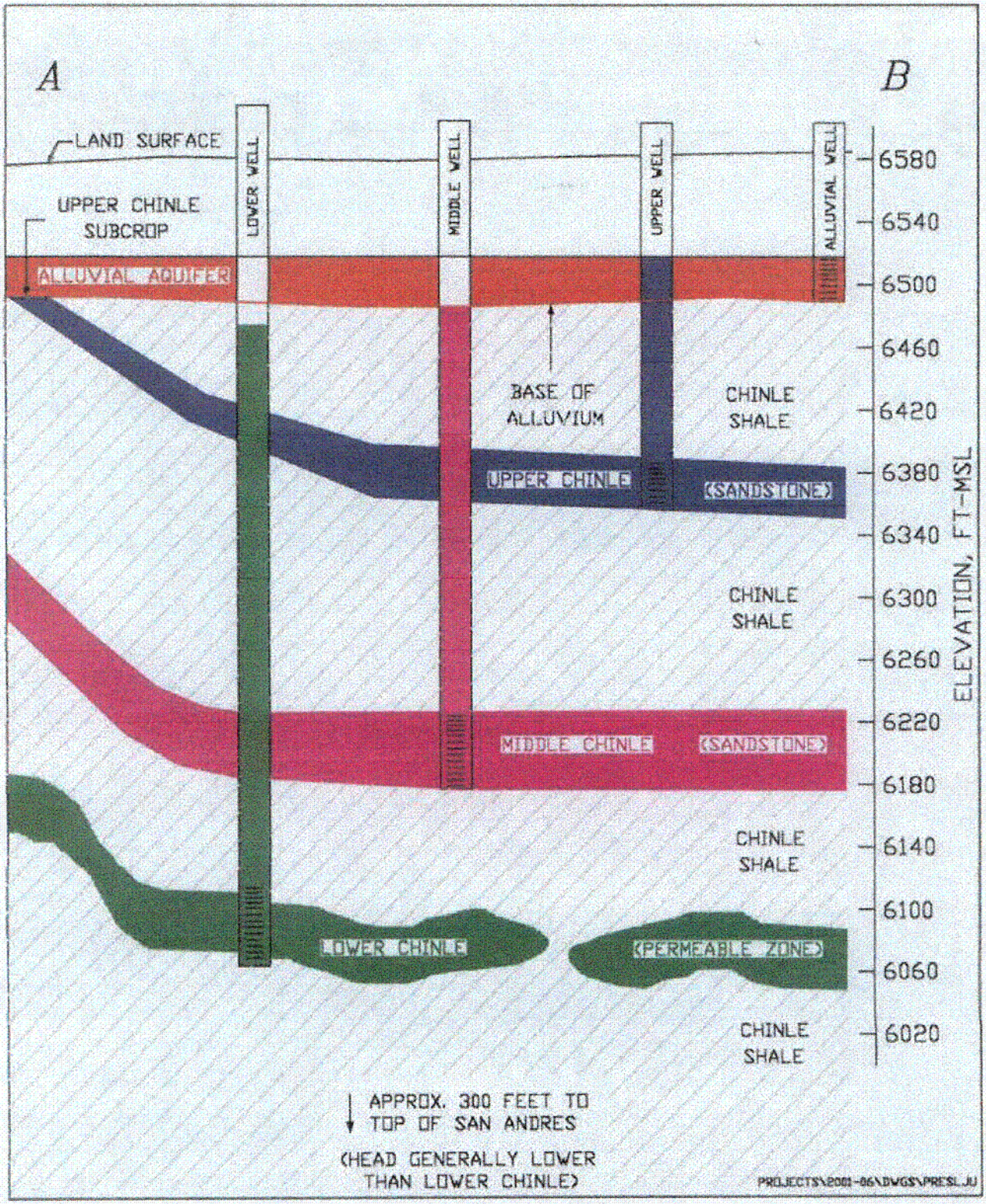

FIGURE 5.1-3. TYPICAL GEOLOGIC CROSS SECTION.

Figure 2
Geologic Cross-Section
Homestake Mining Company Superfund Site - First Five-Year Review
Cibola County, New Mexico
[reproduced from HydroEngineering, 2001]

C02

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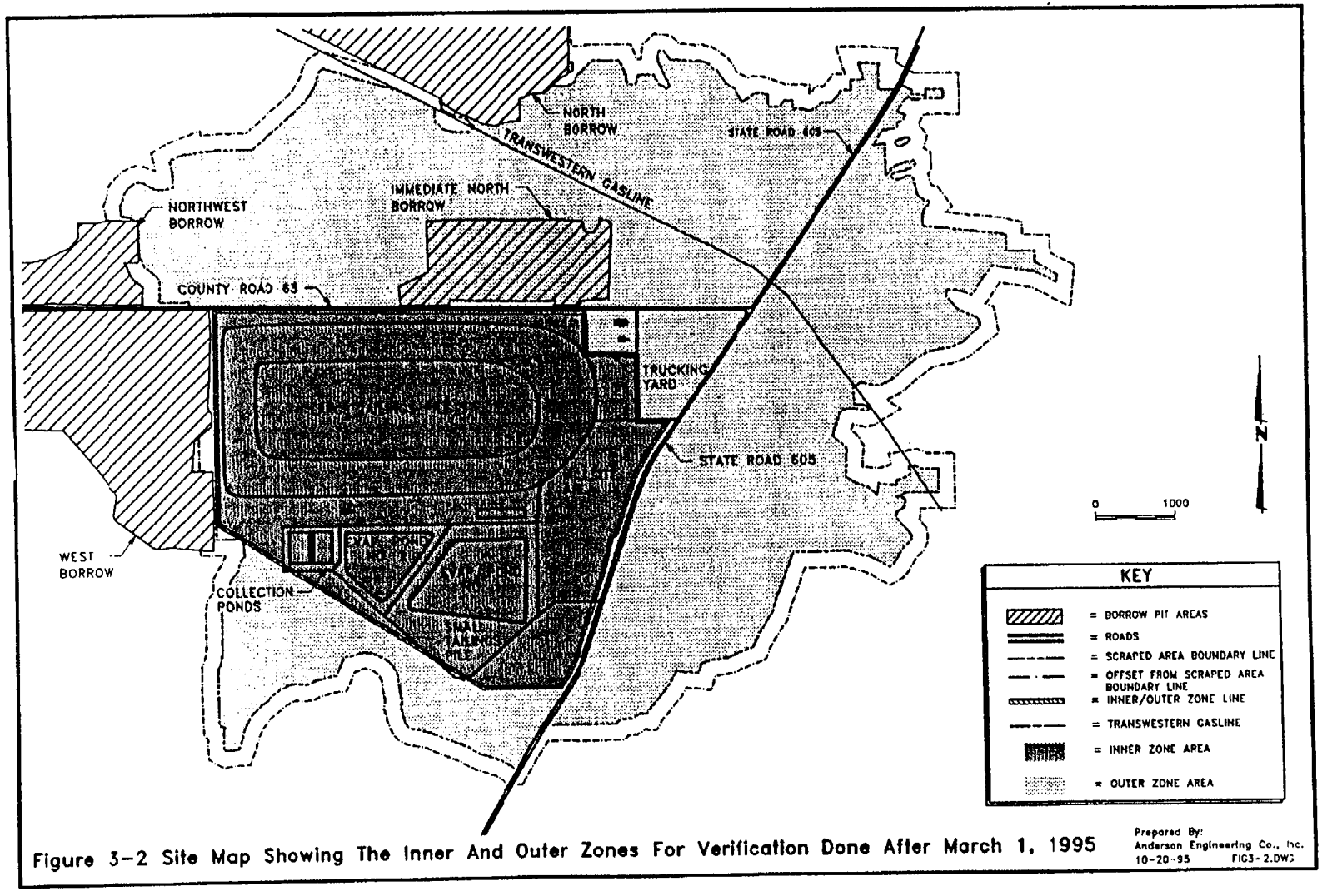

Figure 3-2 Site Map Showing The Inner And Outer Zones For Verification Done After March 1, 1995

Figure 3
Areas of Soil Excavation
Homestake Mining Company Superfund Site - Five-Year Review
Cibola County, New Mexico
[reproduced from ERG, 1995a]

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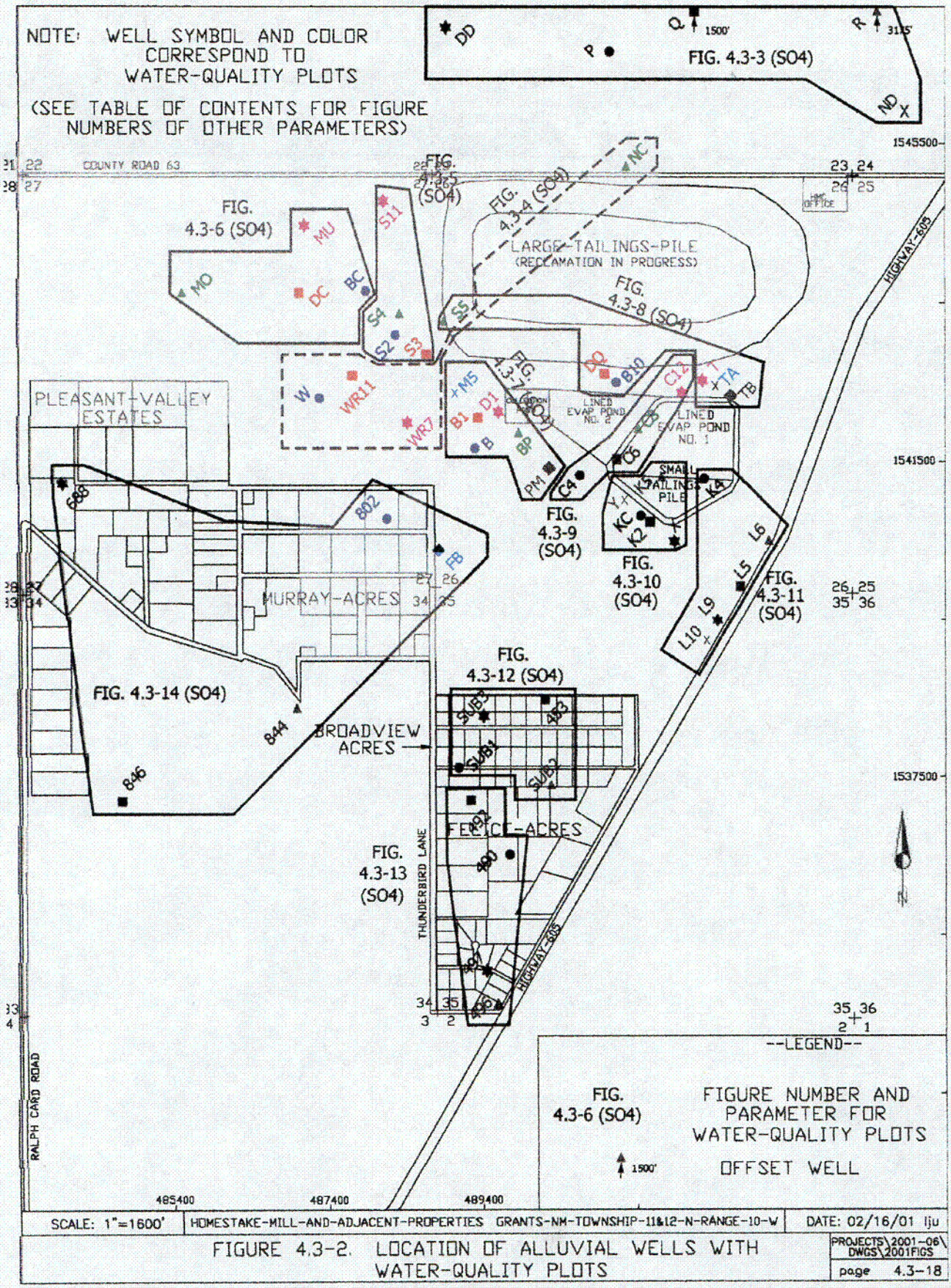

Figure 4
San Mateo Alluvium Monitor Well Locations
Homestake Mining Company Superfund Site - First Five-Year Review
Cibola County, New Mexico
[reproduced from HydroEngineering, 2001]

C03

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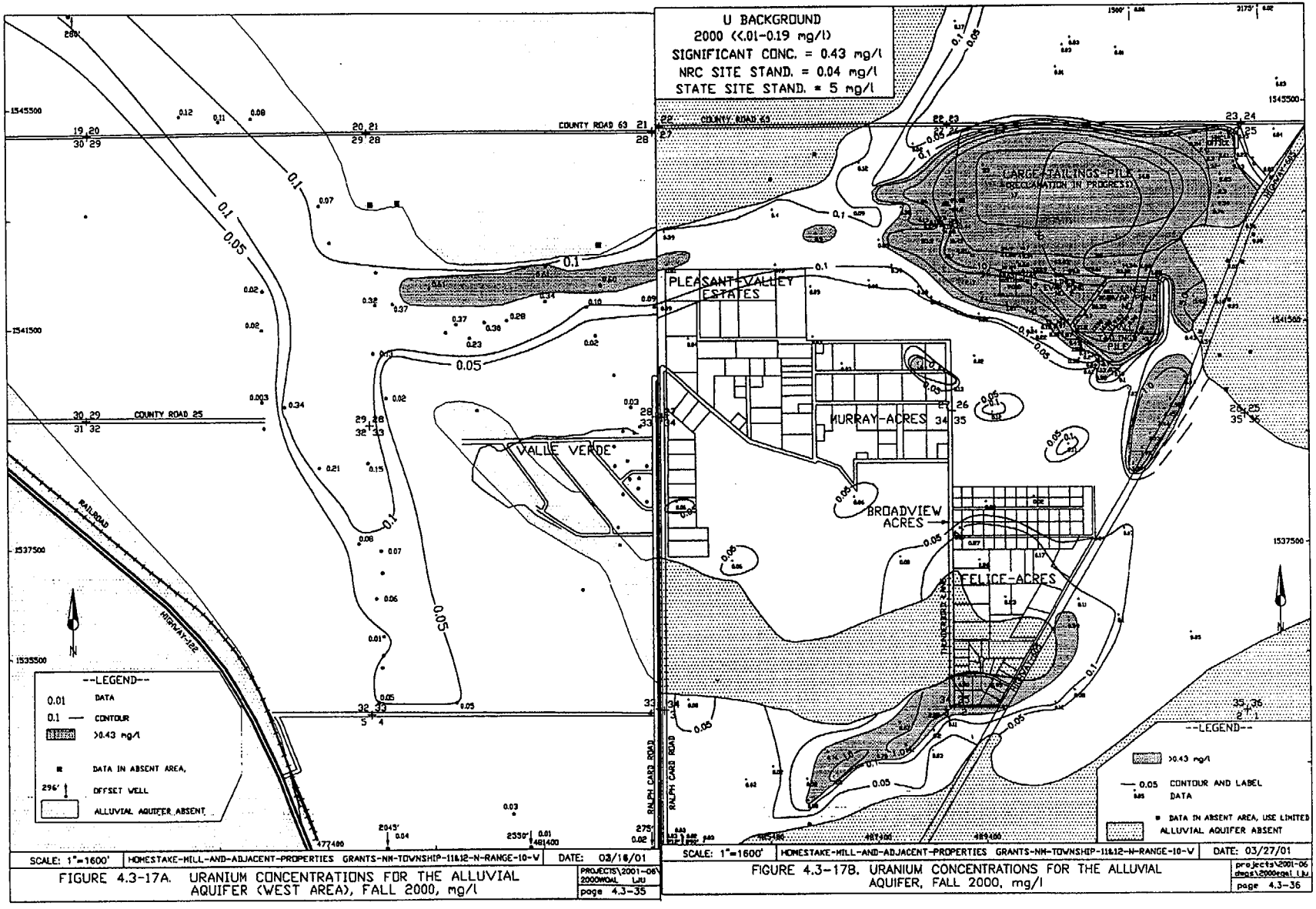

FIGURE 4.3-17A. URANIUM CONCENTRATIONS FOR THE ALLUVIAL AQUIFER (WEST AREA), FALL 2000, mg/l

PROJECTS\2001-06\2000WQAL LJU

page 4.3-35

FIGURE 4.3-17B. URANIUM CONCENTRATIONS FOR THE ALLUVIAL AQUIFER, FALL 2000, mg/l

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page 4.3-36

Figure 5
Uranium Concentrations in the San Mateo Alluvium
Homestake Mining Company Superfund Site - First Five-Year Review
Cibola County, New Mexico
[reproduced from HydroEngineering, 2001]

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Figure 6
Uranium Concentrations in San Mateo Alluvium Wells S2, S3, S4, and S11
Homestake Mining Company Superfund Site - First Five-Year Review
Cibola County, New Mexico
[reproduced from HydroEngineering, 2001]

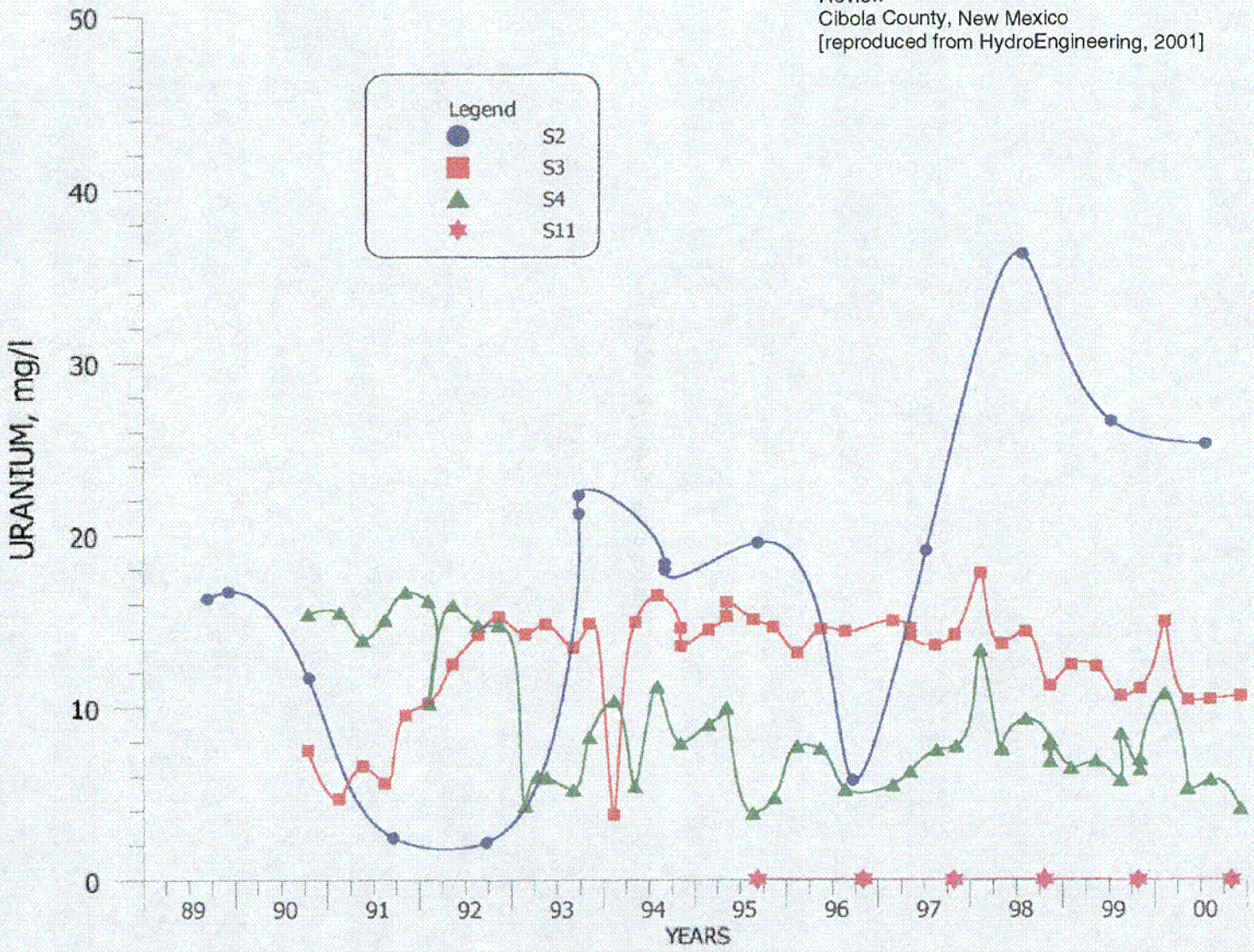

FIGURE 4.3 20 URANIUM CONCENTRATIONS FOR WELLS S2, S3 S4 AND S11

4.3-39

C04

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Figure 7
Uranium Concentrations in San Mateo Alluvium Wells B, B1, BP, D1, M5, and PM
Homestake Mining Company Superfund Site - First Five-Year Review
Cibola County, New Mexico
[reproduced from HydroEngineering, 2001]

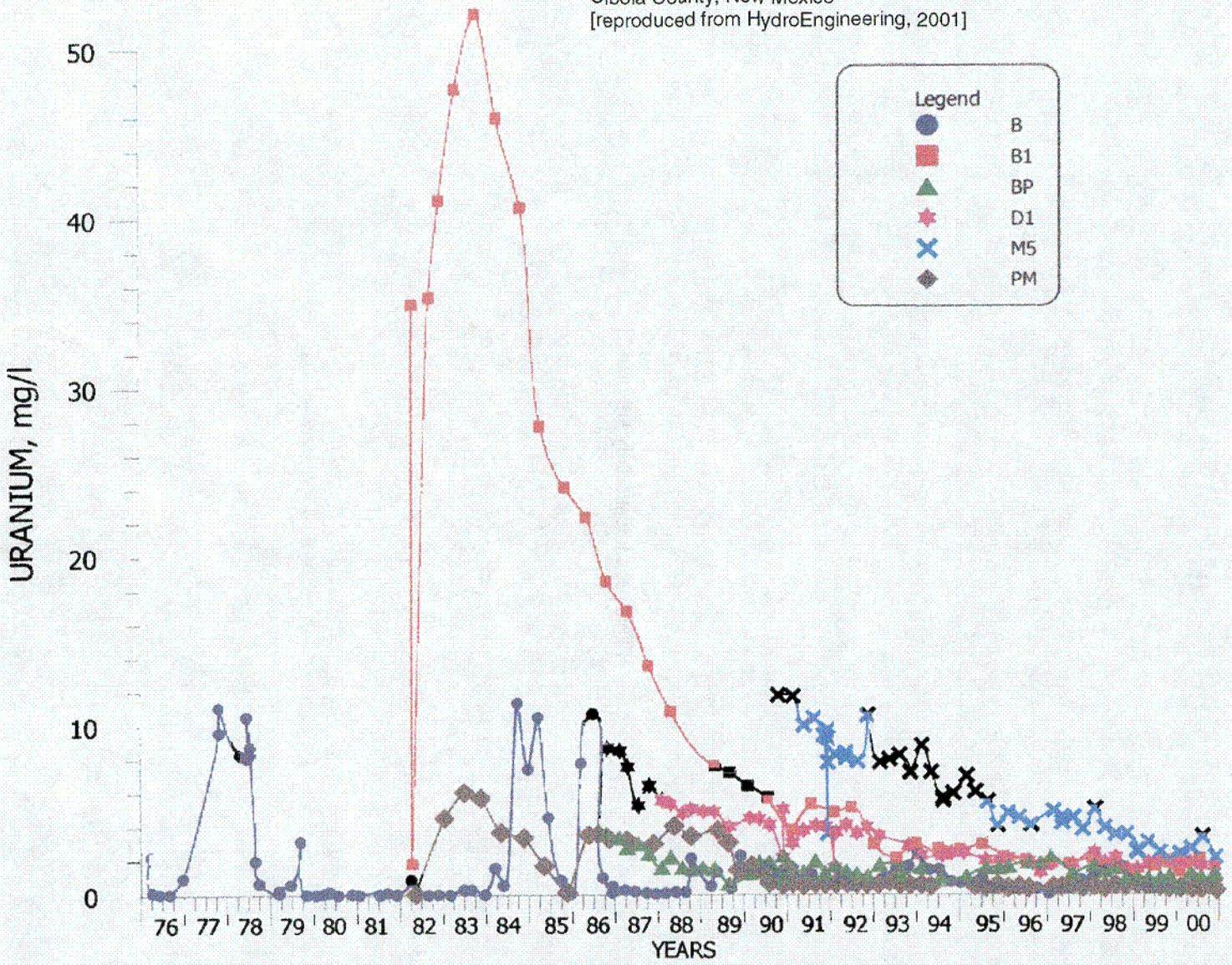

FIGURE 4.3-22. URANIUM CONCENTRATIONS FOR WELLS B, B1, BP, D1, M5 AND PM.

C05

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Figure 8
Uranium Concentrations in San Mateo Alluvium Wells KC, K2, K5, X, and Y
Homestake Mining Company Superfund Site - First Five-Year Review
Cibola County, New Mexico
[reproduced from HydroEngineering, 2001]

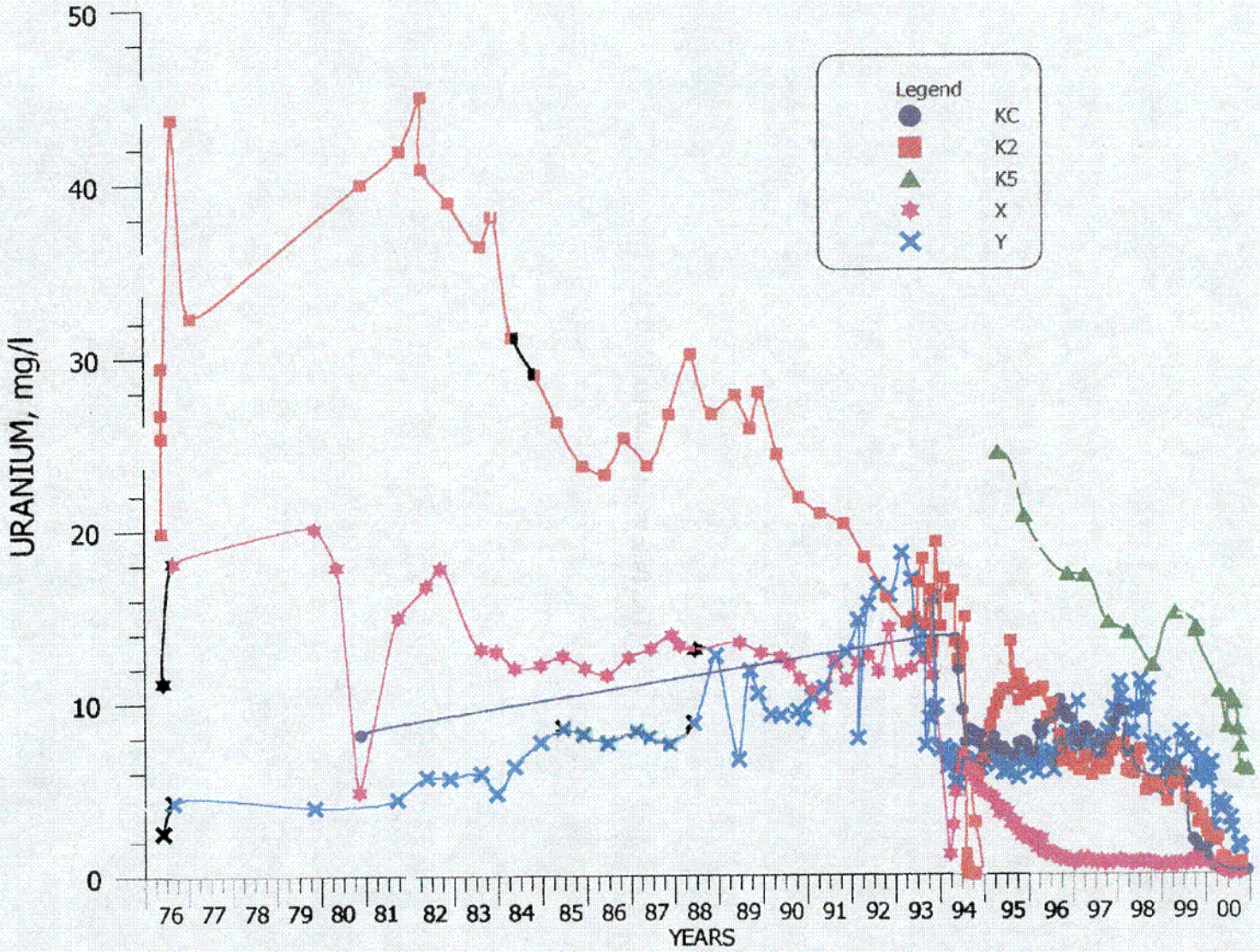

FIGURE 4.3-25. URANIUM CONCENTRATIONS FOR WELLS KC, K2, K5, X AND Y.

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Figure 9
Uranium Concentrations in San Mateo Alluvium Wells SUB1, 453, SUB2, and SUB3
Homestake Mining Company Superfund Site - First Five-Year Review
Cibola County, New Mexico
[reproduced from HydroEngineering, 2001]

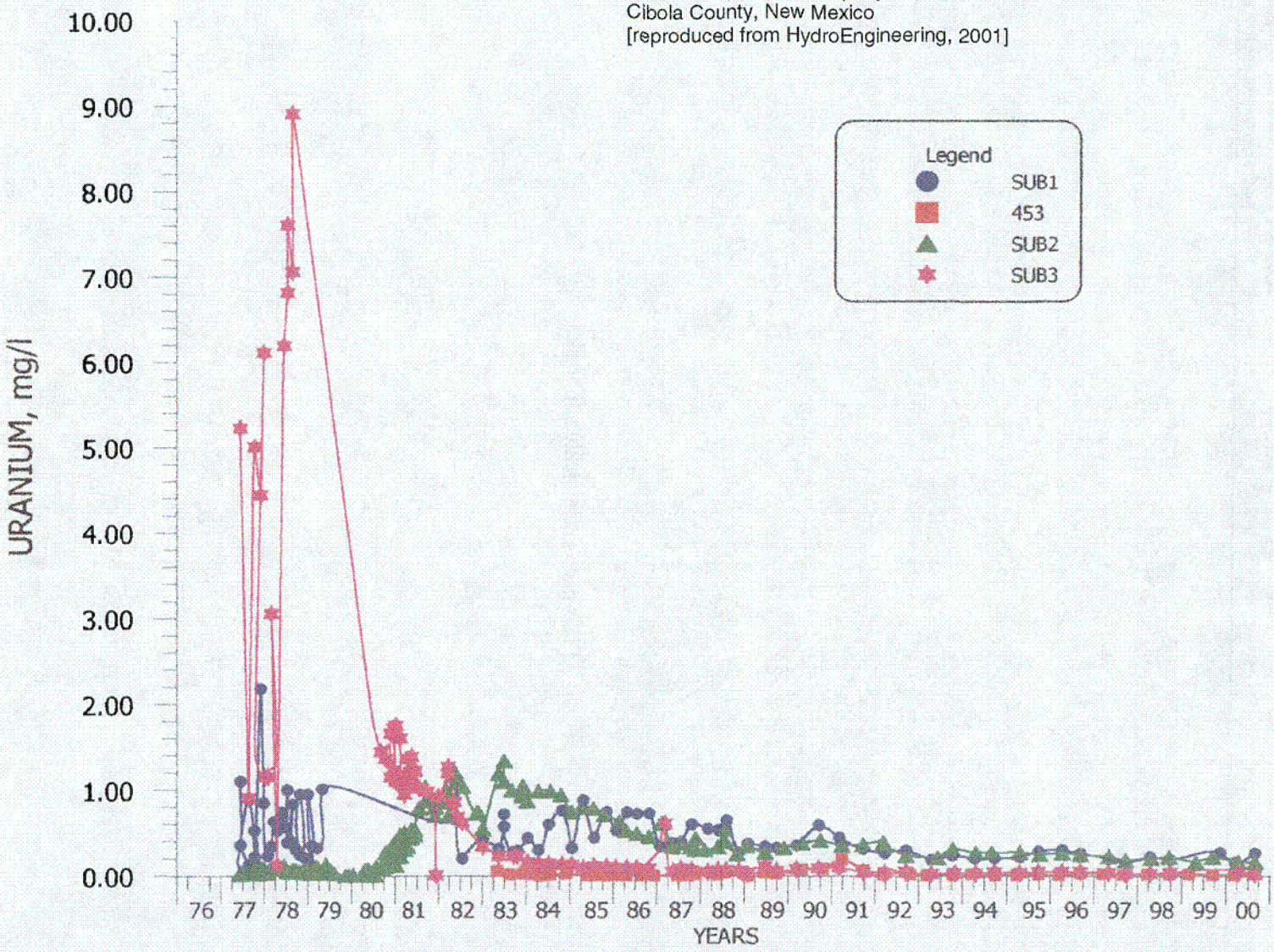

FIGURE 4.3-27. URANIUM CONCENTRATIONS FOR WELLS SUB1, 453, SUB2 AND SUB3.

C07

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Uranium Concentrations in San Mateo Alluvium Wells 490, 492, 496, and 497
Homestake Mining Company Superfund Site - First Five-Year Review
Cibola County, New Mexico
[reproduced from HydroEngineering, 2001]

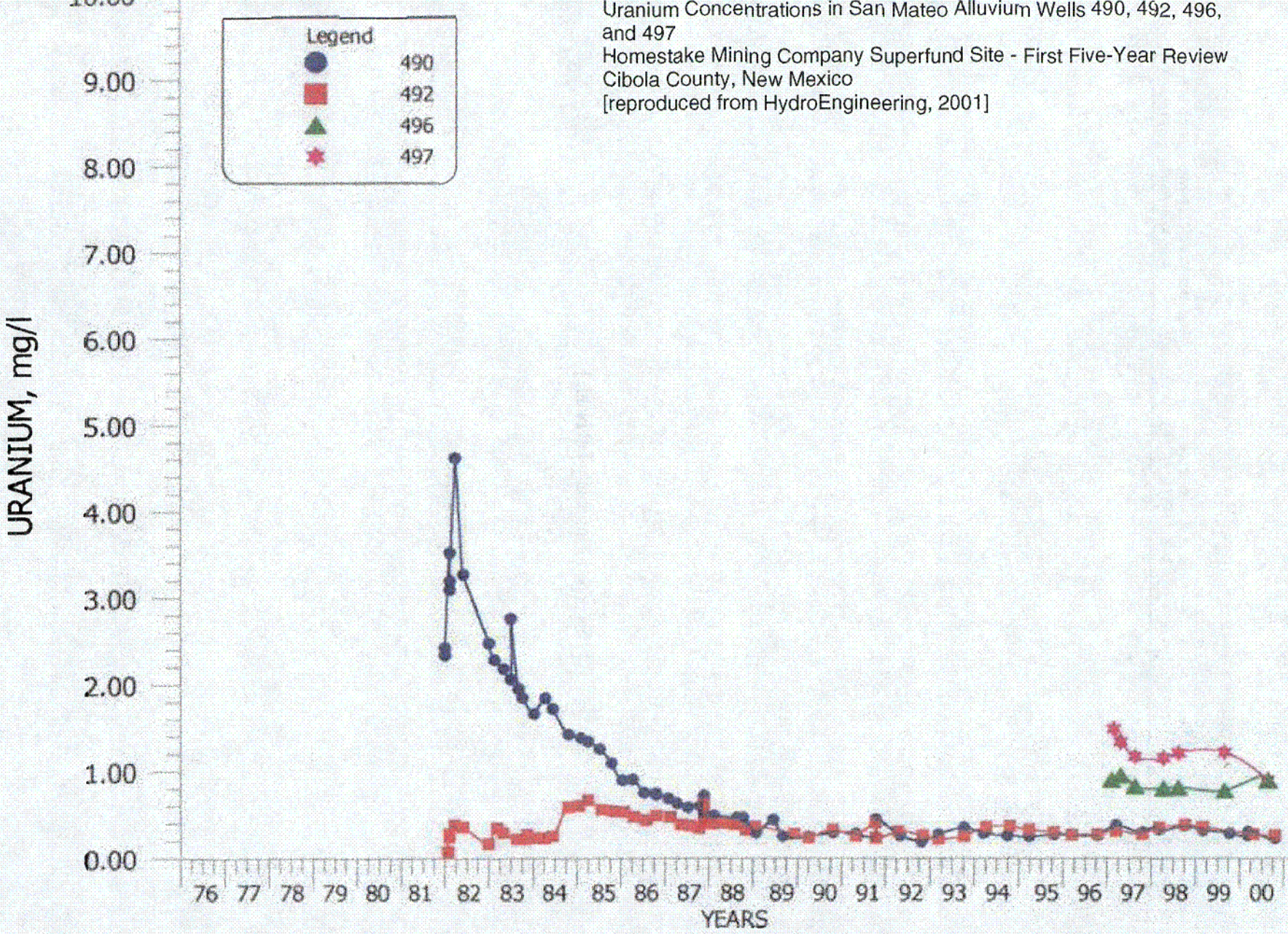

FIGURE 4.3-28. URANIUM CONCENTRATIONS FOR WELLS 490, 492, 496 AND 497.

C08

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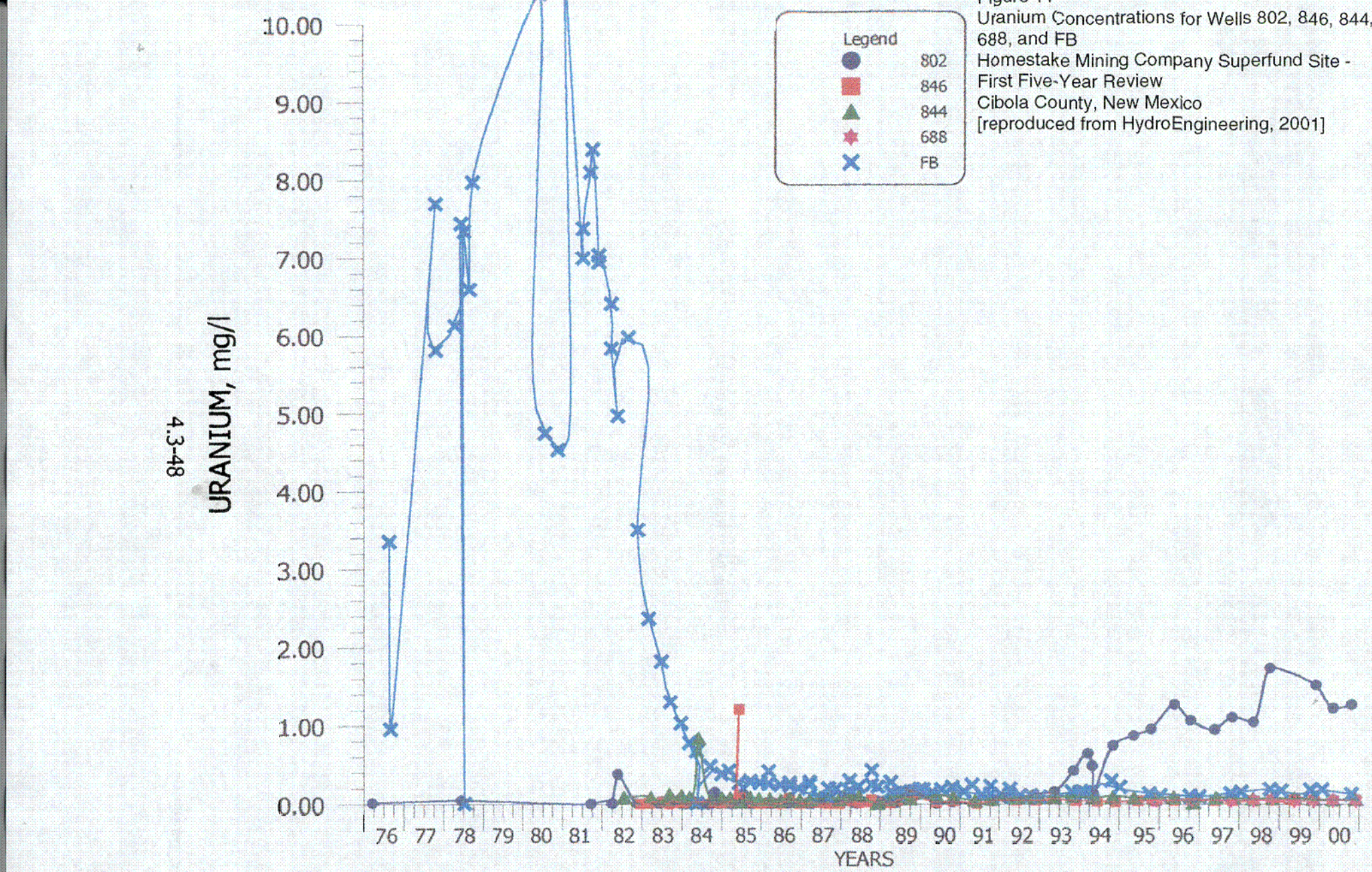

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FIGURE 4.3-29. URANIUM CONCENTRATIONS FOR WELLS 802, 846, 844, 688 AND FB.

C09

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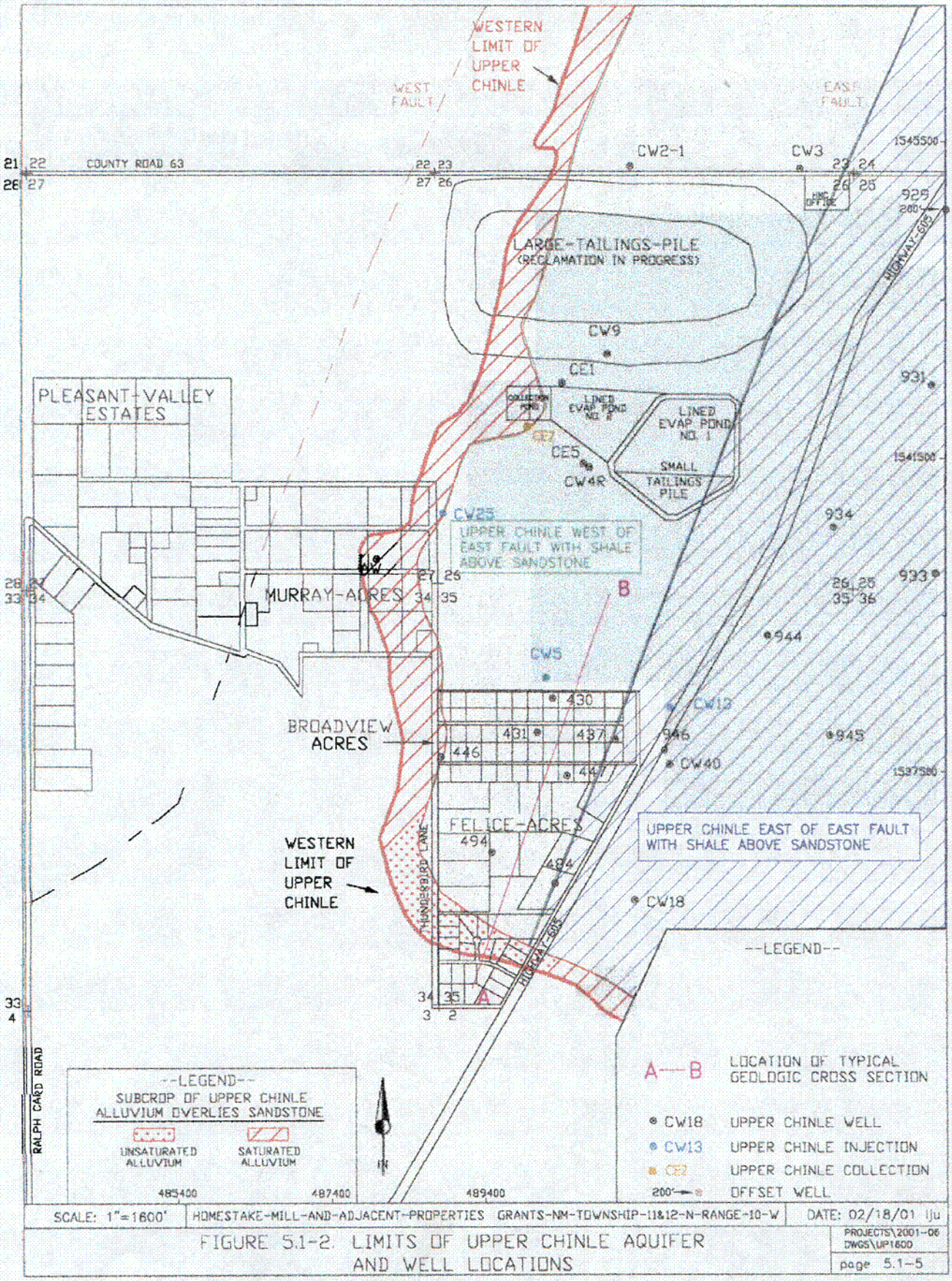

Figure 12
Upper Chinle Aquifer Monitor Well Locations
Homestake Mining Company Superfund Site
First Five-Year Review
Cibola County, New Mexico
[reproduced from HydroEngineering, 2001]

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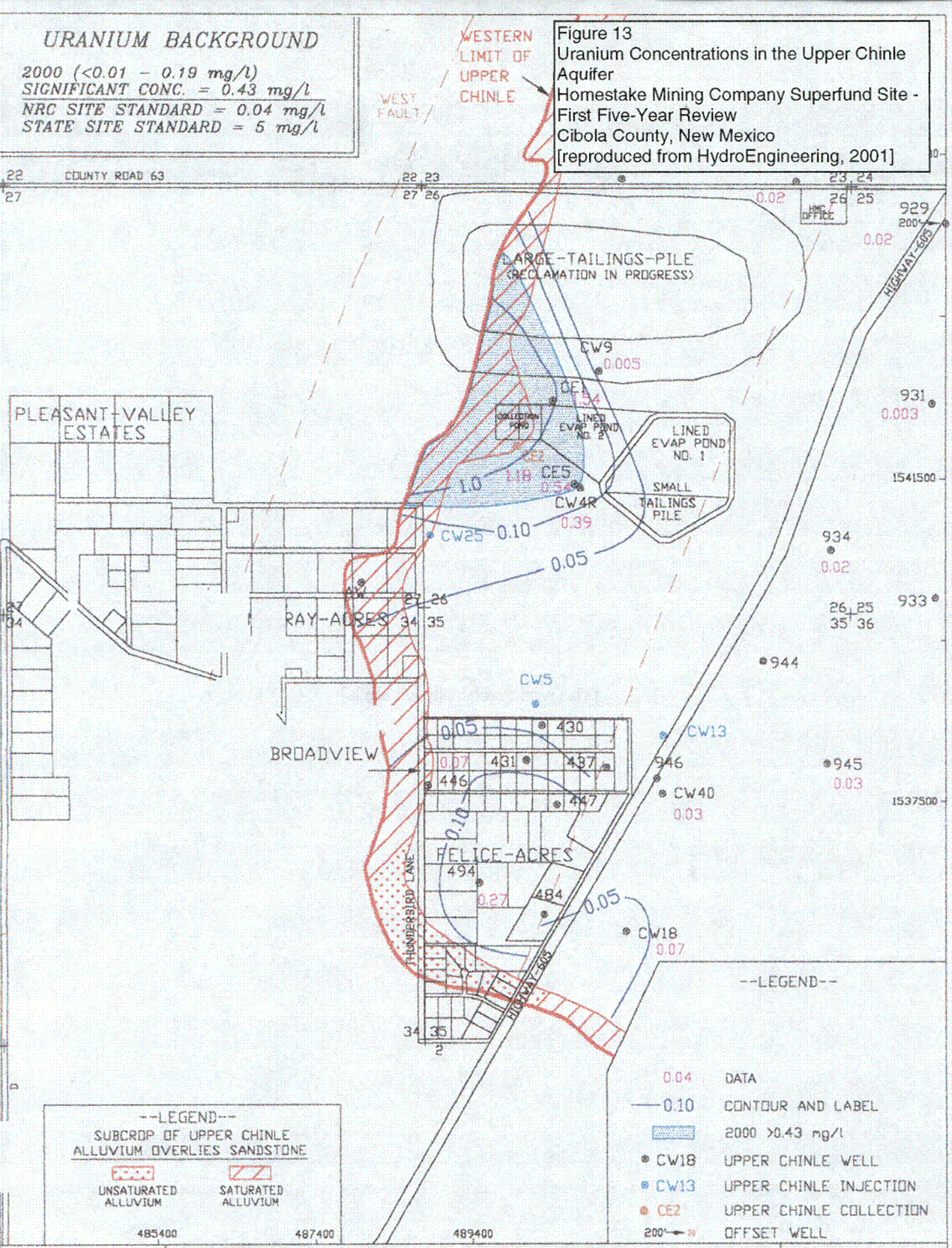

Figure 13
Uranium Concentrations in the Upper Chinle Aquifer
Homestake Mining Company Superfund Site - First Five-Year Review
Cibola County, New Mexico
[reproduced from HydroEngineering, 2001]

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Figure 14
Uranium Concentrations in Upper Chinle Wells CW3, CW4R, CE2, 446, and 494
Homestake Mining Company Superfund Site - First Five-Year Review
Cibola County, New Mexico
[reproduced from HydroEngineering, 2001]

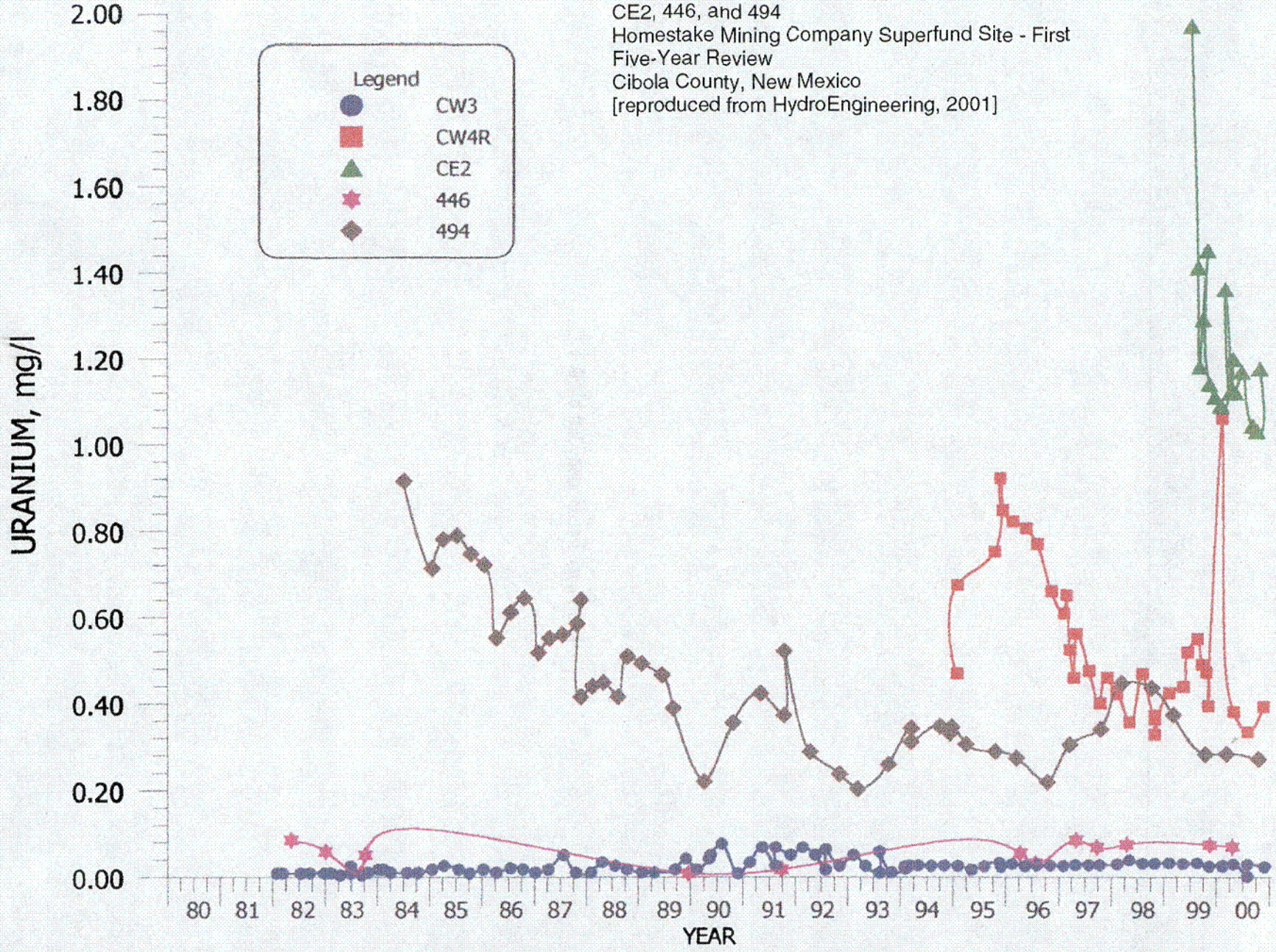

FIGURE 5.3-8. URANIUM CONCENTRATIONS FOR WELLS CW3, CW4R, CE2, 446 AND 494.

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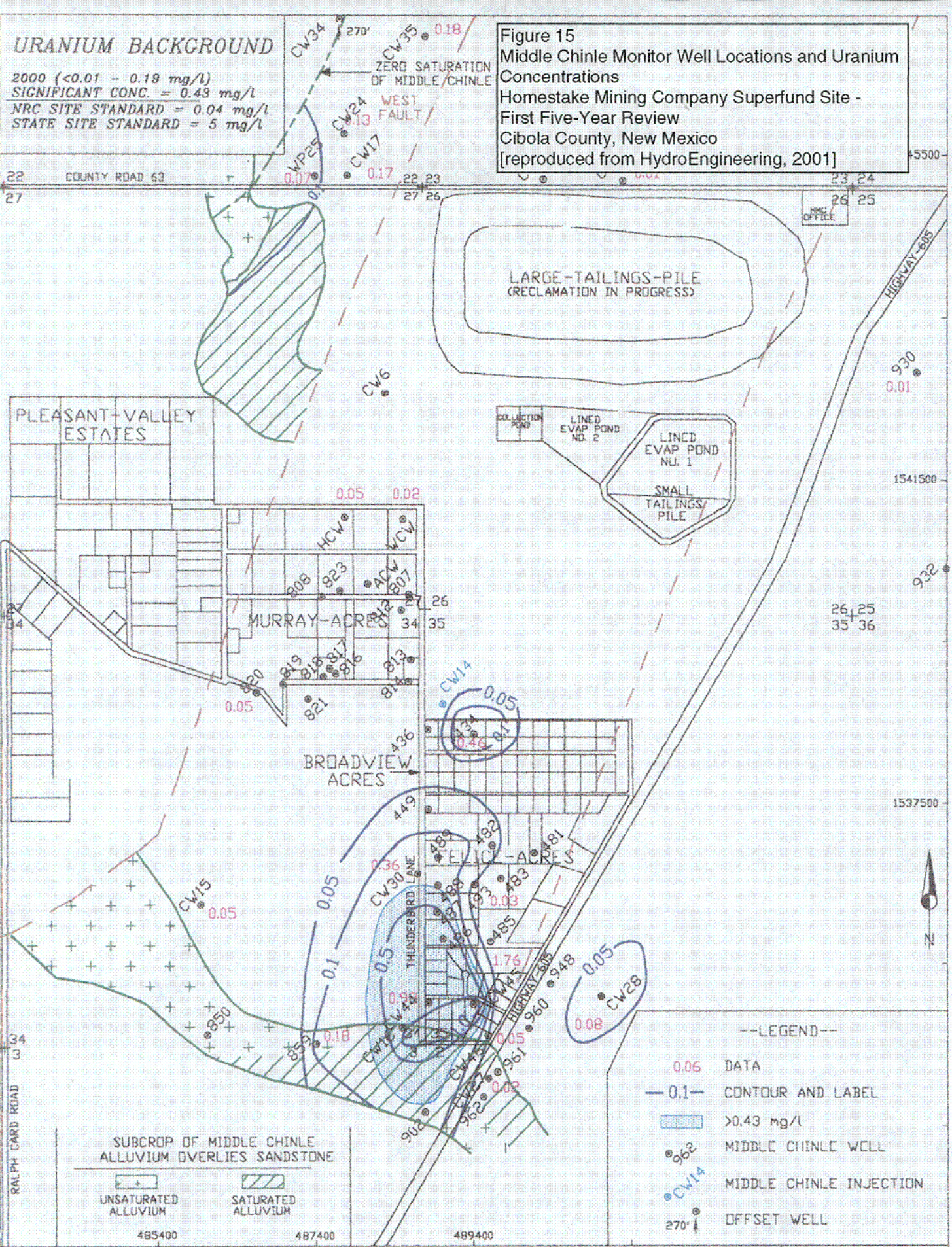

Figure 15
Middle Chinle Monitor Well Locations and Uranium Concentrations
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Cibola County, New Mexico
[reproduced from HydroEngineering, 2001]

FIGURE 6.3-7. URANIUM CONCENTRATIONS FOR THE MIDDLE CHINLE AQUIFER, FALL 2000, mg/l

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Uranium Concentrations in Middle Chinle Wells CW2, CW15, CW28, CW44, WCW, and 493
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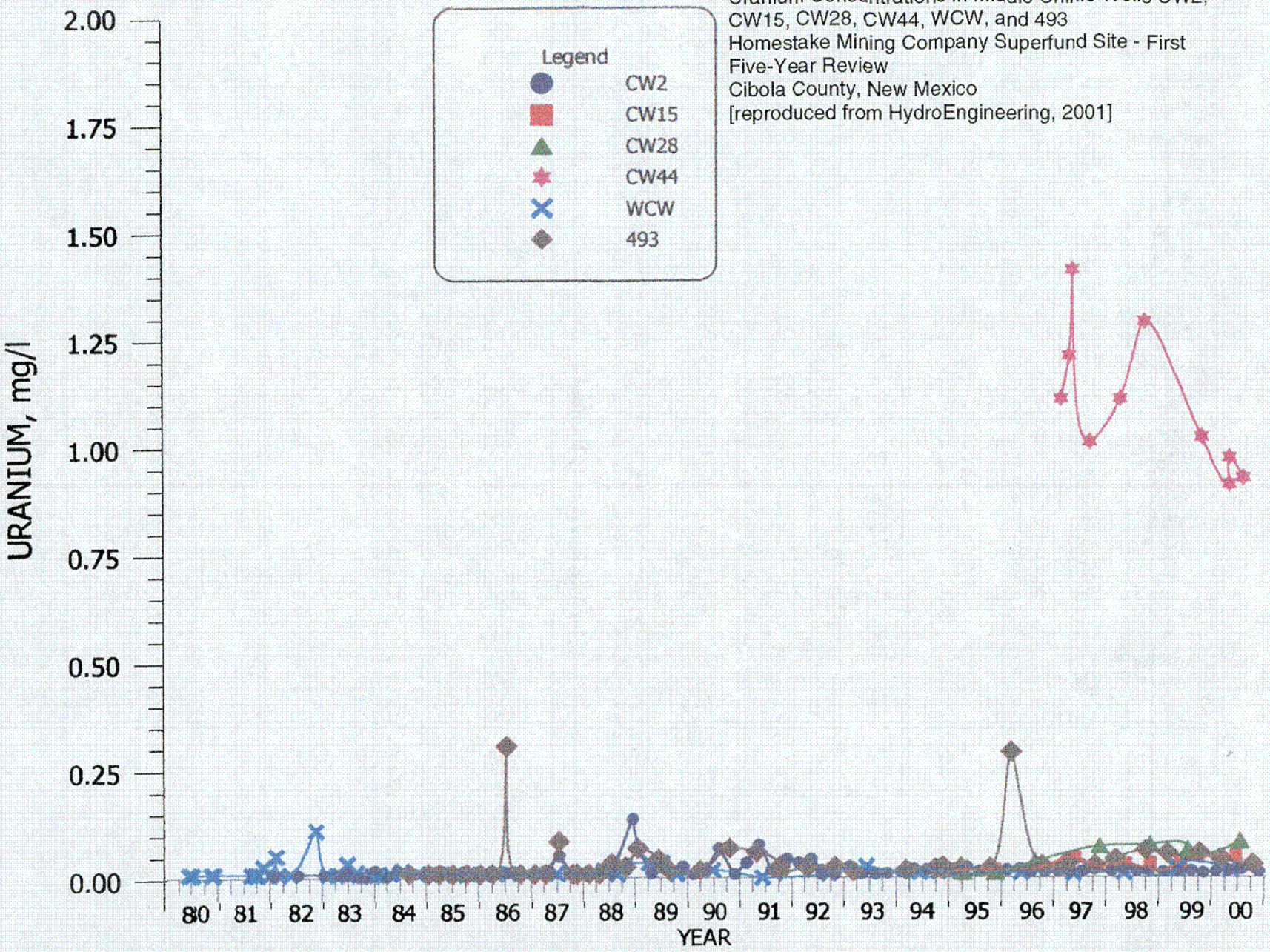
Cibola County, New Mexico
[reproduced from HydroEngineering, 2001]



6.3-14

FIGURE 6.3-8. URANIUM CONCENTRATIONS FOR WELLS CW2, CW15, CW28, CW44, WCW AND 493.

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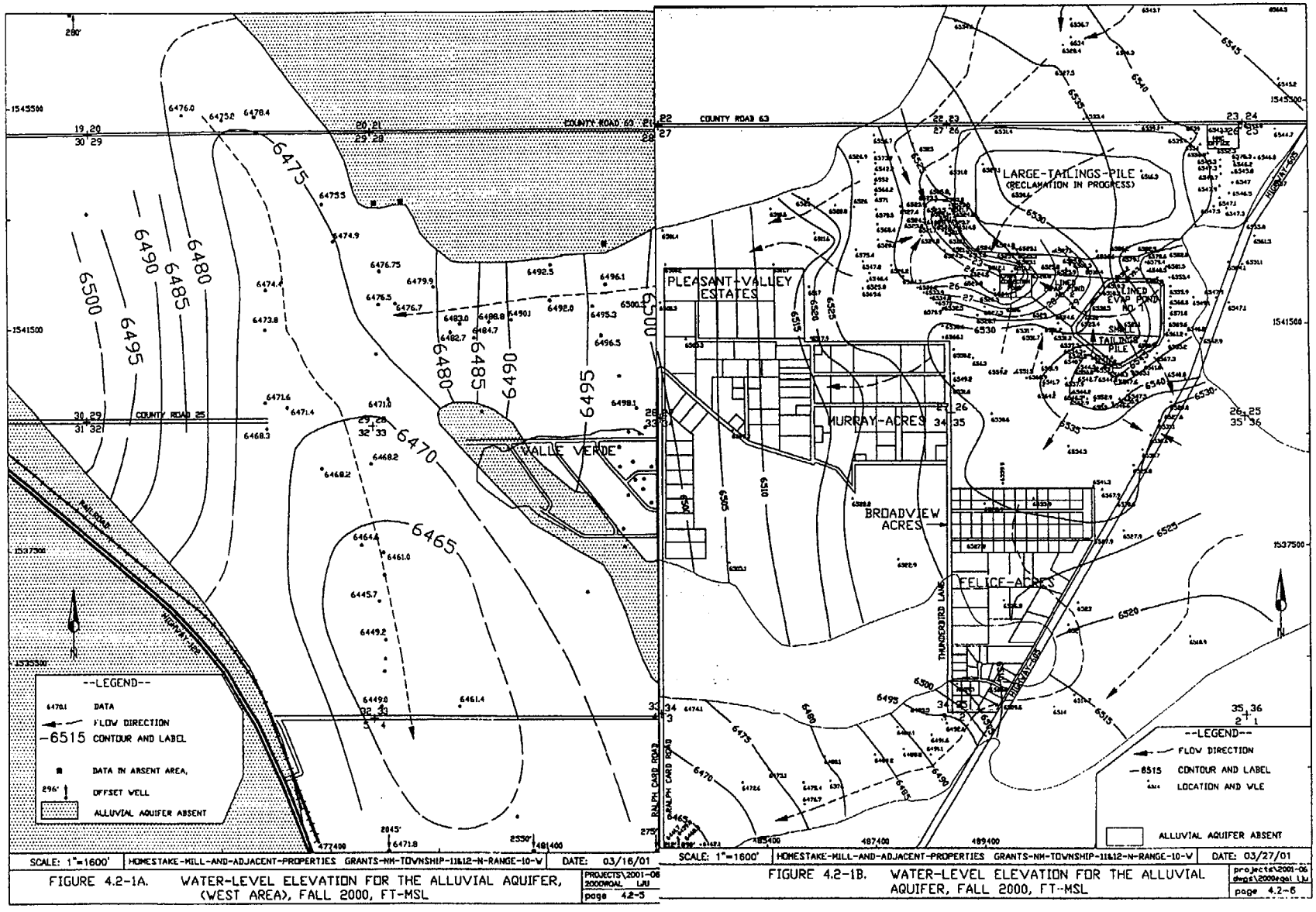

Figure 17
Water Levels and Groundwater Flow Directions in the San Mateo Alluvium
Homestake Mining Company Superfund Site - First Five-Year Review
Cibola County, New Mexico
[reproduced from HydroEngineering, 2001]

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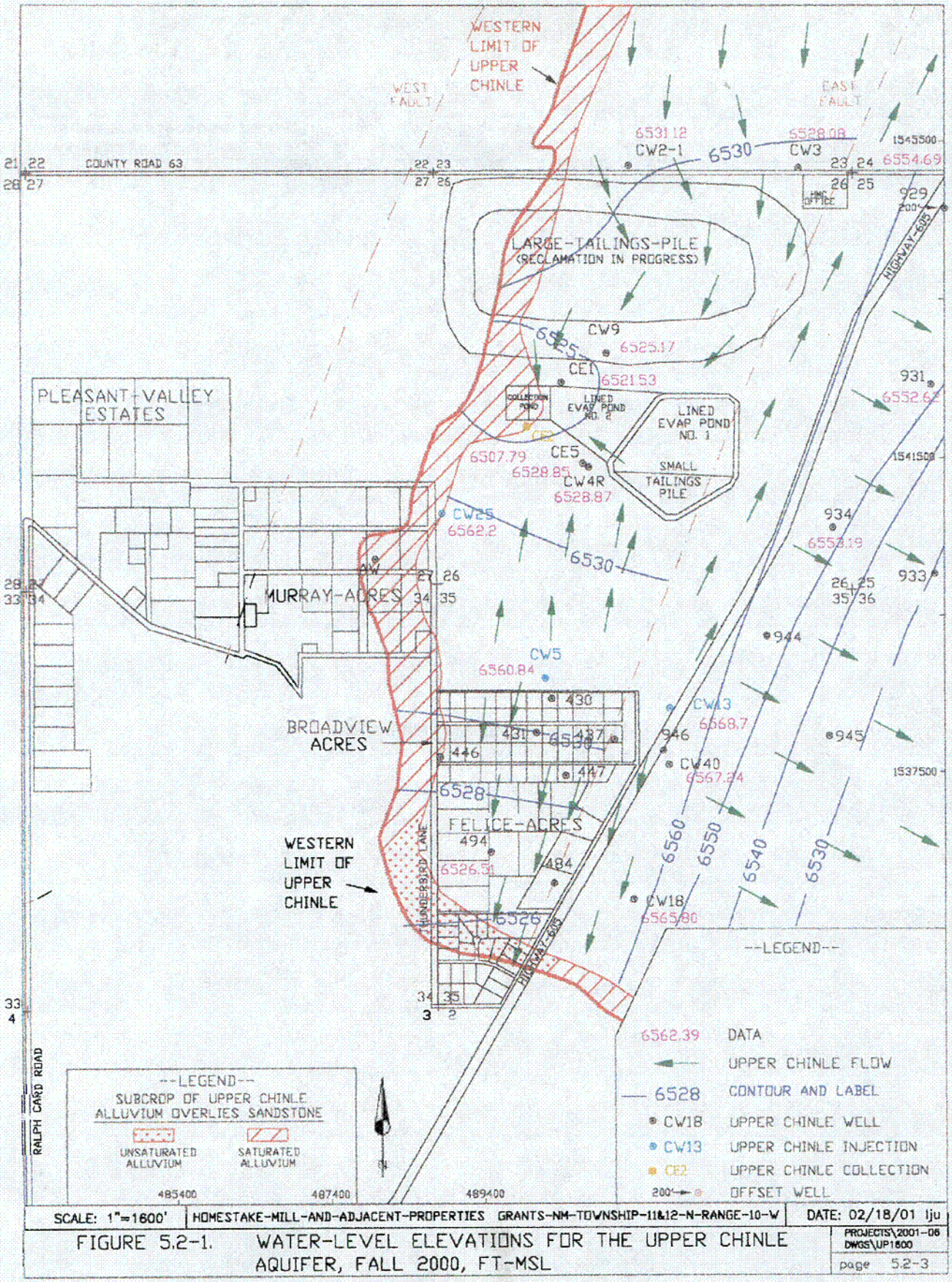

Figure 18
Upper Chinle Water Levels and Groundwater Flow Directions
Homestake Mining Company Superfund Site - First Five-Year Review
Cibola County, New Mexico
[reproduced from HydroEngineering, 2001]

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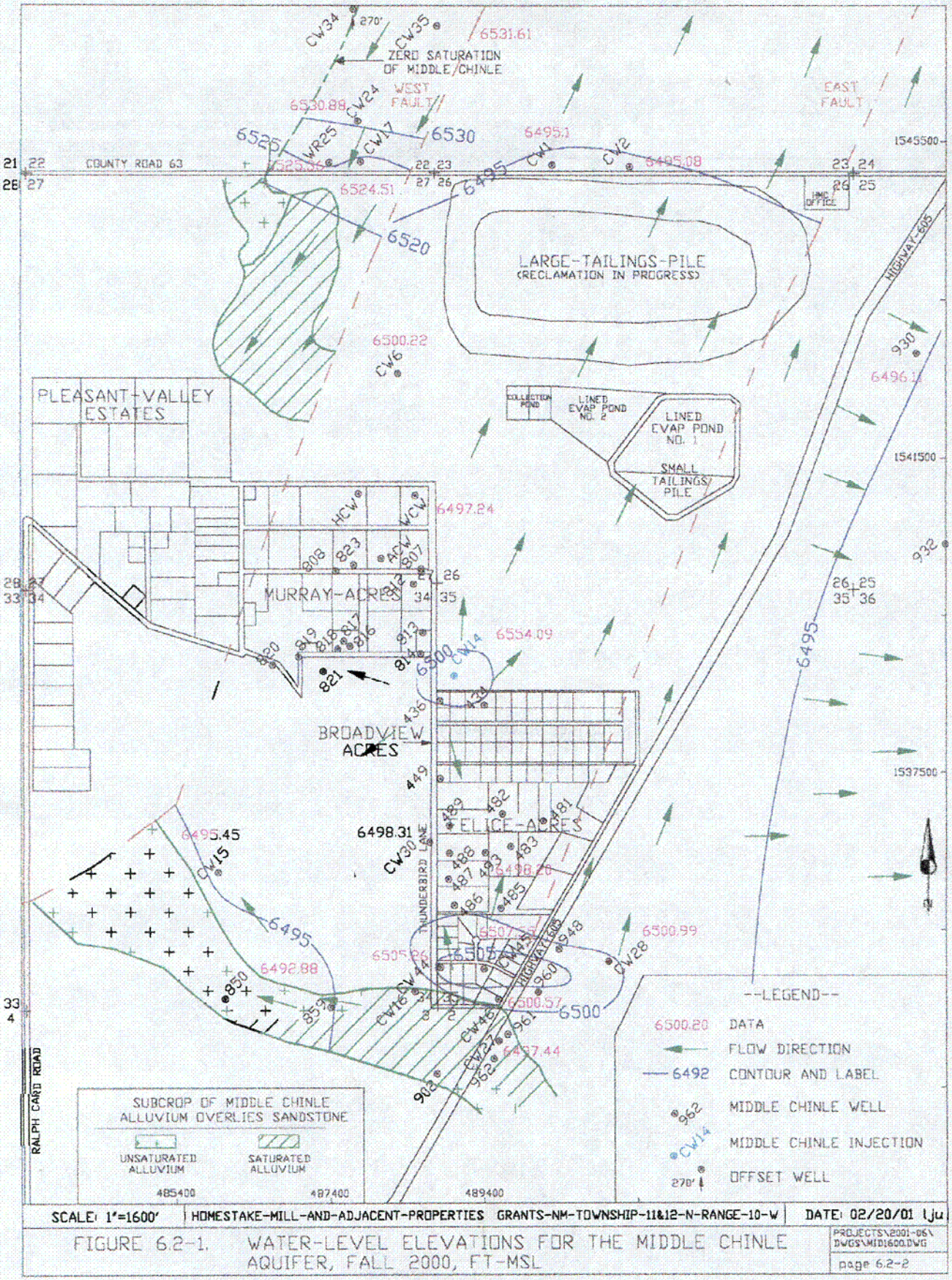

Figure 19
Middle Chinle Water Levels and Groundwater Flow Directions
Homestake Mining Company Superfund Site - First Five-Year Review
Cibola County, New Mexico
[reproduced from HydroEngineering, 2001]

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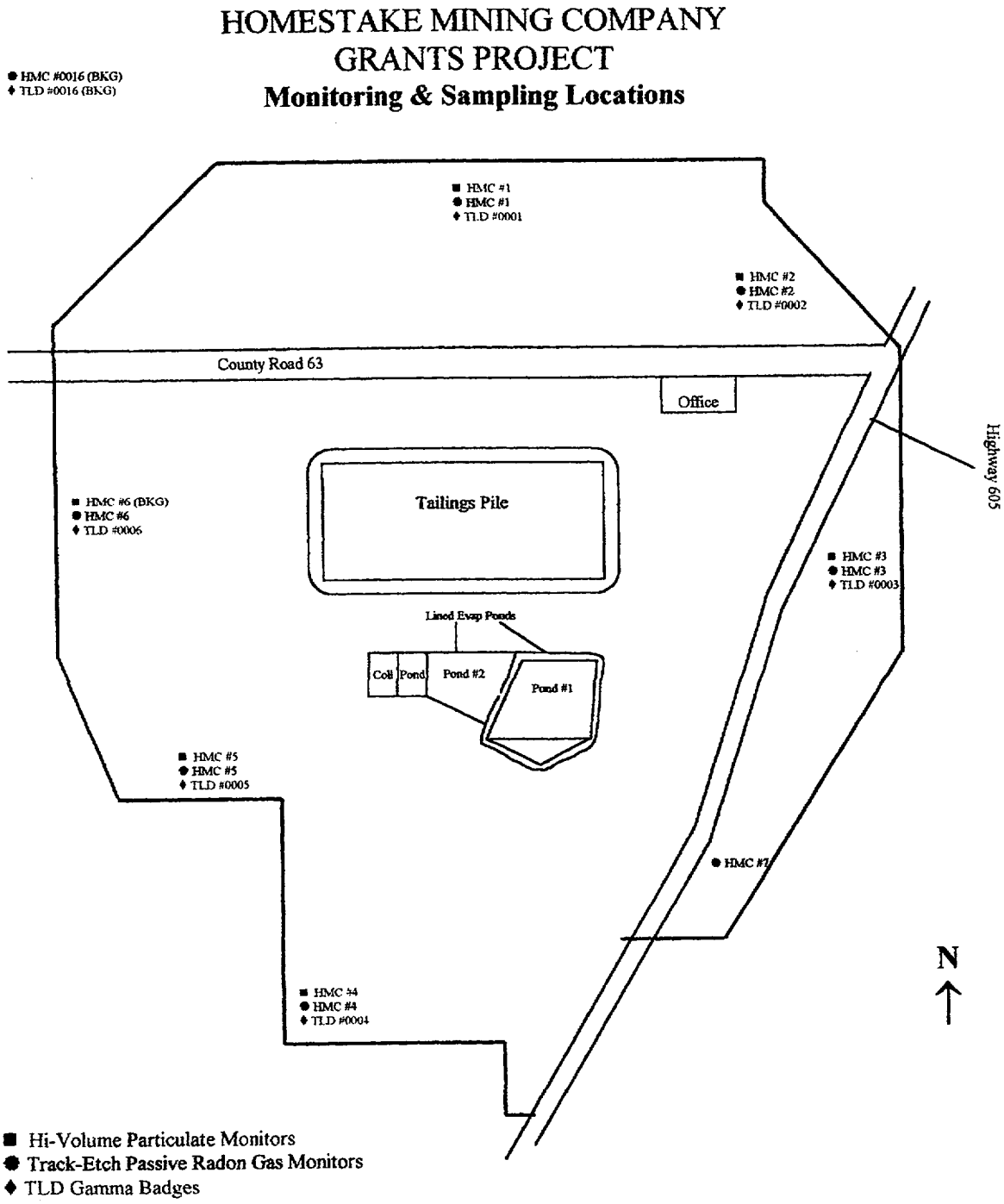

FIGURE 1

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Figure 20
Air Monitoring Locations
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Cibola County, New Mexico
[reproduced from HMC, 2001c]

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