DOE/EIS-0096-D

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Draft Environmental Impact Statement

Remedial Actions at the Former Vitro Rare Metals Plant Site Canonsburg, Washington County Pennsylvania

U.S. Department of Energy

October 1982

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Draft Environmental Impact Statement

Remedial Actions at the

Former Vitro Rare Metals Plant Site

Canonsburg, Washington County,

Pennsylvania

(a) Lead Agency: U.S. Department of Energy (DOE)
Cooperating Agency: U.S. Nuclear Regulatory Commission (NRC)

(b) Proposed Action: Cleanup of the radioactively-contaminated material at a site in Canonsburg, Pennsylvania, designated by the Uranium Mill Tailings Radiation Control Act of 1978.

(c) For Further Information Contact: (1) Mr. Richard H. Campbell, Manager, Uranium Mill Tailings Remedial Action Project, U.S. Department of Energy, Albuquerque Operations Office, 5301 Central Avenue, N.E., Suite 1700, Albuquerque, New Mexico 87108, Ph: (505) 844-3941; (2) Dr. Robert J. Stern, Director, Office of Environmental Compliance, U.S. Department of Energy, Office of the Assistant Secretary for Environmental Protection, Safety, and Emergency Preparedness, Room 4G-064, Forrestal Building, 1000 Independence Avenue, S.W., Washington, D.C. 20585, Ph: (202) 252-4600.

<u>For Copies of the DEIS, Contact</u>: Mr. Campbell at the above address.

(d) Designation: Draft EIS (DEIS).

(e) Abstract: This statement evaluates the environmental impacts associated with the cleanup of those residues remaining at the abandoned uranium-mill-tailings site located in Canonsburg, Pennsylvania. This site is a 30-acre property part of which was formerly owned by the Vitro Rare Metals Company that operated a processing plant under contract to the U.S. Atomic Energy Commission to extract uranium and other rare metals. In addition to storing the residues of this process at Canonsburg, approximately 12,000 tons of contaminated residues were transferred to an abandoned railroad landfill in Burrell Township, Indiana County, Pennsylvania. This EIS evaluates five alternatives for removing the public health hazard associated with the contaminated material. In addition to "no action," these alternatives involve various combinations of stabilization of the material in place or decontamination of the site. In addition to the two sites mentioned, a third site located in Hanover Township, Washington County, Pennsylvania has been considered as a repository to which contaminated material at either of the other two sites might be moved.

The five alternatives are: (1) no action; (2) decontamination of Burrell, transfer of the Burrell material to Canonsburg, and stabilization of both the Canonsburg and Burrell materials at Canonsburg; (3) stabilization of the Burrell material at Burrell and the Canonsburg material at Canonsburg; (4) decontamination of both Burrell and Canonsburg and disposal of all of the contaminated material at Hanover; and (5) stabilization of the Burrell material at Burrell and decontamination of Canonsburg and disposal of its material at Hanover.

Impacts associated with the proposed cleanup were assessed in terms of radiation, air quality, surface- and ground-water quality, soils, geology, mineral resources, aquatic and terrestrial ecology, noise, land use, socioeconomics, demography, and transportation networks. Under Alternative 1 the present situation would remain. The main impact of this alternative is the 5.4 additional lung cancer deaths predicted for the total population living within 2 kilometers (1.24 miles) of the Canonsburg and Burrell sites. After any of the other alternatives are completed, the chance for someone living within 2 kilometers of any of the three sites dying from lung cancer arising from the mill tailings is 1 in 50,000,000. This is extremely small when compared with the normally expected cancer death rate of 16 in 100 people. Aside from the radiological impacts, the impacts arising from the transportation of the contaminated material and clean fill are potentially serious. If Alternative 3 is selected as the recommended action, the majority of the hauling will be for clean fill. This material will come from borrow pits located near each site. The use of 20-ton dump trucks to haul this material will create traffic, noise, and road decay problems, particularly on the narrow streets giving access to the Canonsburg site. The timing of the trips will be such that peak traffic hours and heavily traveled routes will be used as little as possible.

Other impacts that cannot be avoided include the possible violation of the suspended particulate and nitrogen-oxide air-quality standards, the disruption of the terrestrial ecosystems at each site, the disruption of local businesses, the inconvenience of the local residents through noise, travel, and aesthetic problems, and the potential loss of land for future development. If Alternative 2 or 3 is chosen, there would be the loss of seven residences currently located adjacent to the Canonsburg site on Wilson Avenue and George Street. These people, and the businesses within the Canon Industrial Park will receive location assistance from the U.S. Department of Energy.

Local businesses and local government agencies could receive additional revenues from supplying the goods and services needed by the workers conducting the remedial action.

Several mitigation measures have been identified which, if implemented, will reduce or eliminate any remaining impacts. These measures include emission controls on vehicles, stoppage of work during adverse weather conditions, covering all exposed piles at the end of each day, placement of erosion-control berms, use of protective equipment, treatment of all water, decontamination of all empty vehicles leaving the site, and personnel radiation protection measures. A monitoring program will be implemented during the remedial action to ensure that no significant releases of radiation, dust, soil, or other pollutants occur. After the project is completed, monitoring will be continued to further ensure that the program accomplished its primary goal, i.e., removing the public health hazard associated with the radioactively contaminated material.

(f) Comments on this DEIS should be addressed to Mr. Campbell at the address given previously. To be considered in the preparation of the final EIS (FEIS), all comments should be submitted no later than _____________.

DOE/EIS-0096-D

Draft Environmental Impact Statement

Remedial Actions at the Former Vitro Rare Metals Plant Site Canonsburg, Washington County Pennsylvania

U.S. Department of Energy

October 1982

Prepared by
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Contract No. 74-2738
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1 SUMMARY

Within the past several years there has been a growing concern on the part of the public and the government over the possible public health hazards associated with exposure to abandoned dumps, hazardous waste areas, and inactive uranium-mill-tailings sites. In response to this concern, on November 8, 1978, Public Law 95-604, the Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA) was enacted. In UMTRCA, the Congress acknowledged the potential health hazards associated with uranium-mill tailings. Title I of UMTRCA authorizes the U.S. Department of Energy (DOE) to enter into cooperative agreements with affected states and Indian tribes to clean up those sites contaminated with uranium-mill tailings and the U.S. Environmental Protection Agency (EPA) to promulgate standards for these sites. The EPA has published interim cleanup standards (45 FR 27366-27368, April 22, 1980) and proposed disposal standards (46 FR 2556-2563, January 9, 1981). All remedial actions are to be performed with the concurrence of the U.S. Nuclear Regulatory Commission (NRC), which will issue a license for the maintenance and monitoring of the site after the cleanup work is complete. For the purposes of this environmental impact statement (EIS), the proposed EPA standards were used. The final EPA standards may be different, which could affect the design of the disposal site. When the final engineering design is prepared, there may be modifications to it. The EPA standards will be met regardless of the details of the final design.

The UMTRCA requires the Secretary of the DOE to designate high priority cleanup sites. The Canonsburg, Pennsylvania site (Figure 1-1) was given this designation by the Secretary on November 9, 1979. The DOE and the Commonwealth of Pennsylvania entered into a cooperative agreement effective September 5, 1980, to perform remedial work at this site. The program described and evaluated in this EIS is being conducted to accomplish one major goal: remove a public health hazard, i.e., that hazard associated with uncontrolled radioactively-contaminated material. The steps taken to conduct this program are basically the following:

1. Project background.
2. Data collection.
3. Design of alternatives.
4. Characterization of the affected environment.
5. Evaluation of environmental impacts.
6. Cleanup.
7. Maintenance and monitoring.

Each of the steps is discussed in the subsections that follow.

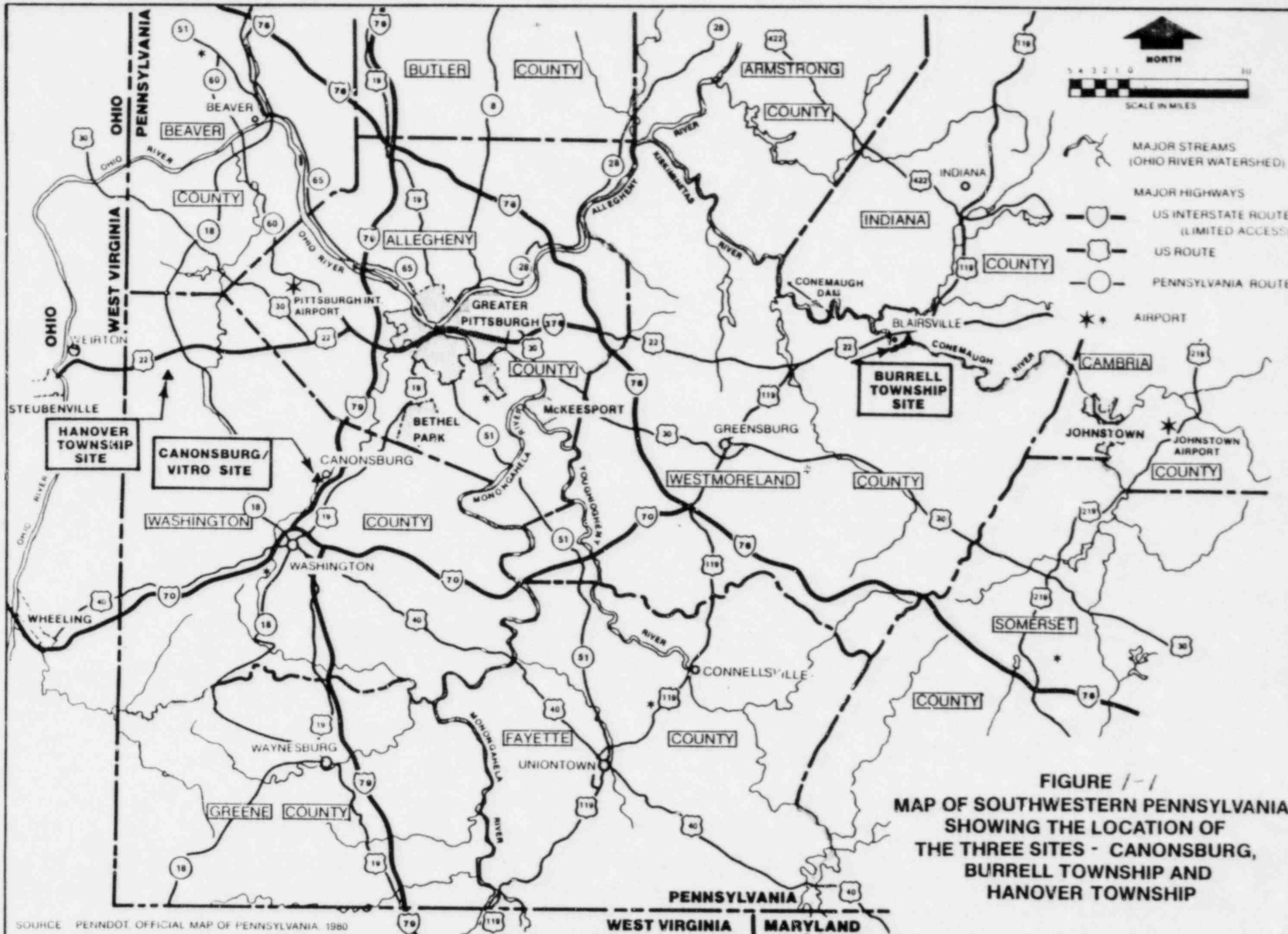


FIGURE 1-1
MAP OF SOUTHWESTERN PENNSYLVANIA SHOWING THE LOCATION OF THE THREE SITES - CANONSBURG, BURRELL TOWNSHIP AND HANOVER TOWNSHIP

1.1 PROJECT BACKGROUND

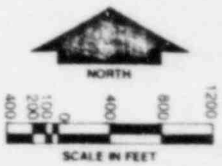
The Canonsburg site is located within the Borough of Canonsburg, Washington County, in southwestern Pennsylvania. It lies approximately 20 miles southwest of downtown Pittsburgh (Figure 1-1). The site is bounded by Chartiers Creek to the north, west, and east and by the ConRail right-of-way to the south (Figure 1-2). The site consists of these basic areas: the former Vitro Rare Metals Plant (18 acres), the former Georges Pottery property (6 acres), and several residences (6 acres) (Figure 1-3). The Vitro property is the area designated by the UMTRCA as containing the radioactively-contaminated material and is the area implied in most instances in this EIS when discussing the Canonsburg site. The other areas of the site are needed for the various remedial-action alternatives. The Vitro property is further divided by Strabane Avenue and Ward Street into three separate areas: A, B, and C. Area A is the only developed area and contains all of the buildings. Areas B and C are open areas along Chartiers Creek.

From 1942 through 1957 the Vitro Manufacturing Company (Vitro) processed uranium at the Canonsburg site under contract to the U.S. Atomic Energy Commission (AEC) (Leggett et al., 1978). During this time various ores, concentrates, and scrap materials were brought from different AEC installations to the Canonsburg site for uranium recovery. All solid process wastes were stored on the site. Liquid wastes were discharged into a swamp in Area C, which drained into Chartiers Creek. This swamp no longer exists.

In late 1956 to early 1957 about 11,600 tons of wet material containing approximately 6 tons of uranium oxide were taken to the Burrell site, a Pennsylvania Railroad landfill in Burrell Township, Indiana County, about 51 miles east of Canonsburg (Leggett el al., 1979) (Figure 1-1). The Burrell site covers approximately 50 acres; it is an undeveloped plateau along a bend of the Conemaugh River at the southern boundary of Indiana County in southwestern Pennsylvania (Figure 1-4). Its only significant surface features are three steep-banked ponds in the western area, remnants of an old disposal pit (Figure 1-5). Disposal of the 11,600 tons of material removed from the Canonsburg site took place within a 9-acre section in the western portion of the Burrell site. The residues were brought in by railcar, dumped into the disposal pit, and covered with an uneven layer of uncontaminated material.

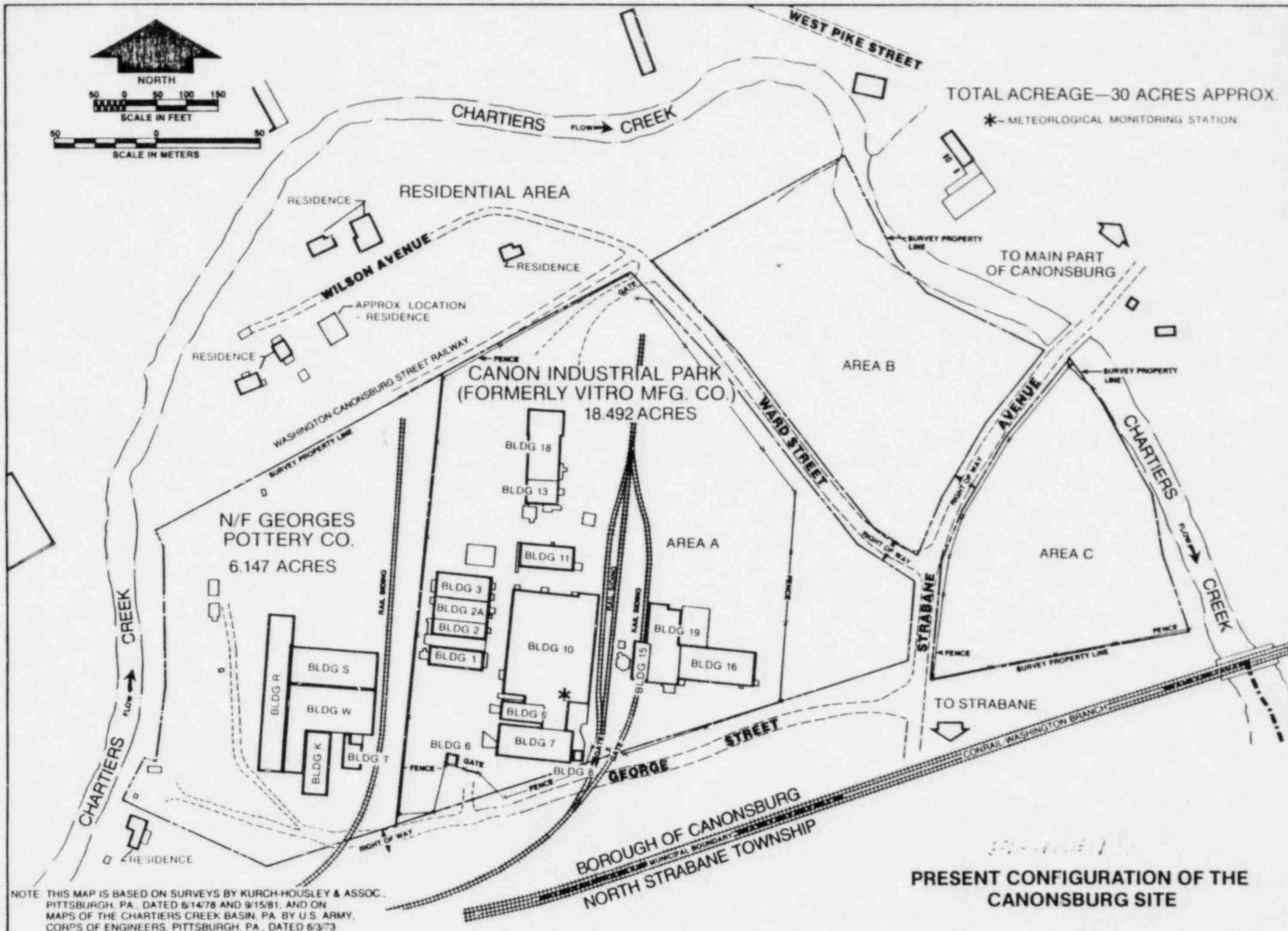
In 1962 Vitro's real property was sold to developers, with Vitro retaining title to the remaining radioactive material. In an effort to decontaminate the immediate plant area, in 1964 all the materials then considered contaminated were consolidated into one pile in Area A. This pile was eventually moved to Area C in 1965 and buried beneath a relatively impermeable layer of steel-mill slag (red dog). Vitro's source-material license was then terminated, and the Vitro property was developed into its present use as the Canon Industrial Park.

In 1980 representatives of the Commonwealth of Pennsylvania conducted a study (Pennsylvania, 1981) of potential areas in Washington County where the Canonsburg material could be taken if the site was to be decontaminated. Using a preliminary draft of 10 CFR Part 61, Licensing Requirements for Land Disposal of Radioactive Waste (46 FR 38081ff; July 24, 1981), they performed field investigations and examined existing reports, maps, files, data, and

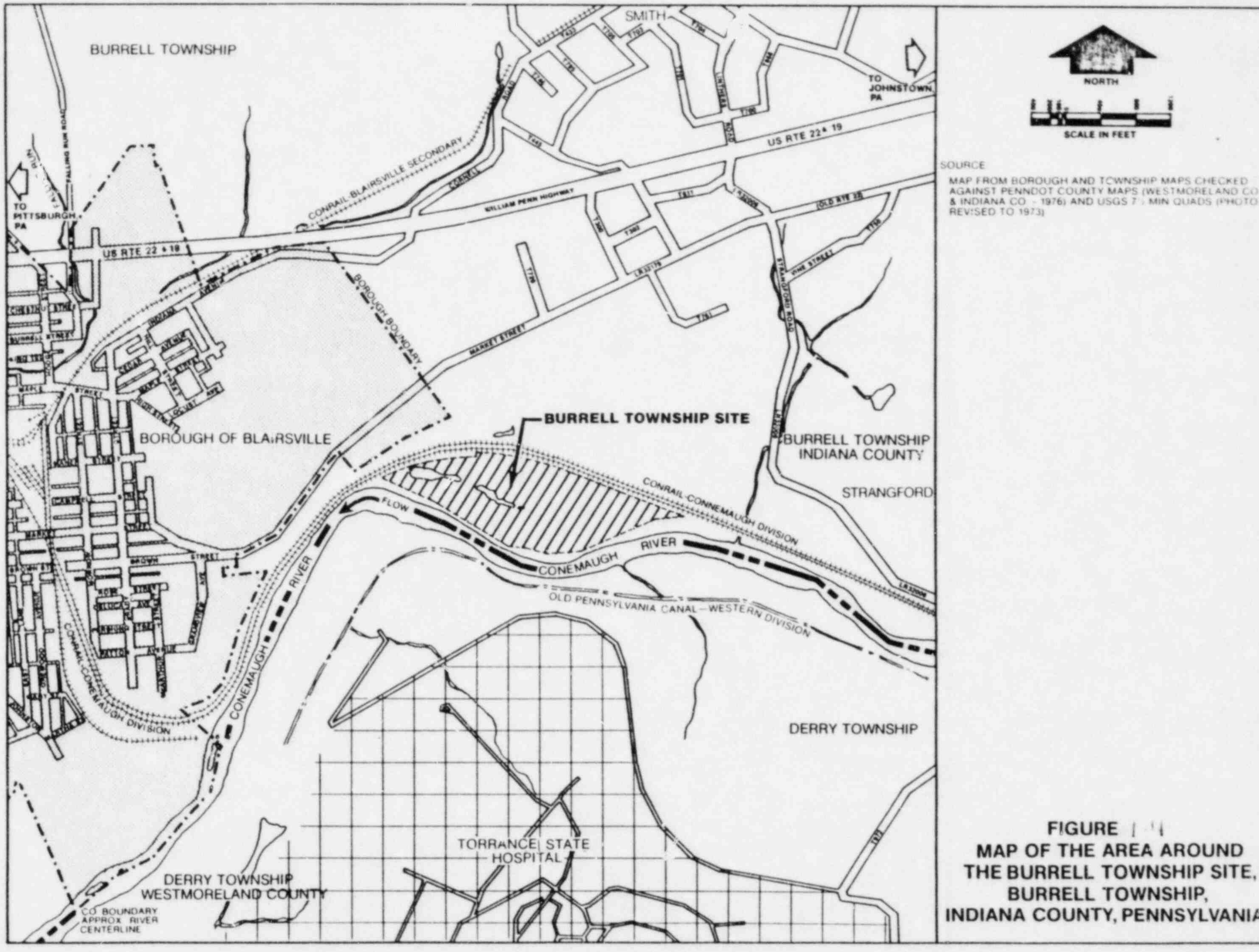


SOURCE
MAP FROM BOROUGH AND TOWNSHIP MAPS CHECKED AGAINST PENNDOT COUNTY MAP (WASHINGTON CO 1976) AND USGS 7½ MIN QUADS (PHOTOREVISED TO 1969)

FIGURE 1
MAP OF THE AREA AROUND THE CANONSBURG SITE, BOROUGH OF CANONSBURG, WASHINGTON COUNTY, PENNSYLVANIA



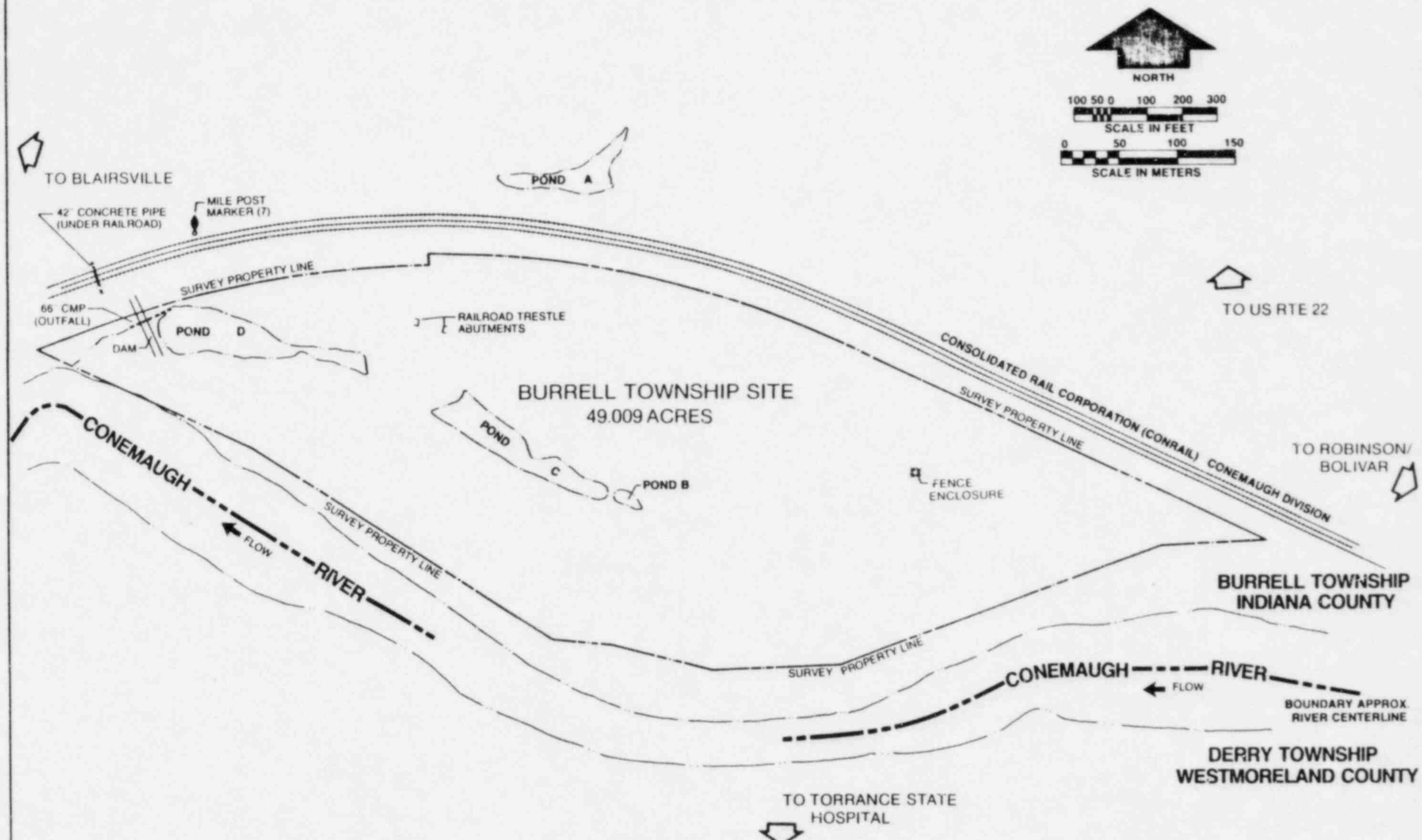
PRESENT CONFIGURATION OF THE CANONSBURG SITE



SOURCE

MAP FROM BOROUGH AND TOWNSHIP MAPS CHECKED AGAINST PENNDOT COUNTY MAPS (WESTMORELAND CO & INDIANA CO - 1976) AND USGS 7½ MIN QUADS (PHOTO REVISED TO 1973)

FIGURE 1-4
MAP OF THE AREA AROUND THE BURRELL TOWNSHIP SITE, BURRELL TOWNSHIP, INDIANA COUNTY, PENNSYLVANIA



PRESENT CONFIGURATION OF THE BURRELL TOWNSHIP SITE

NOTE: 1. PROPERTY LINE DATA FROM PLAN OF PROPERTY, FOR UNION CARBIDE CORP., BY RICHARD G. BACH & ASSOC. ZELIENOPIA, PA - NOVEMBER 16, 1977 aerial photographs. As a result of this investigation, the Commonwealth identified seven areas in which disposal sites might potentially be located; these areas are numbered 1 through 7 on Figure 1-6. The Burrell site was not included in the sites that were investigated.

In providing the results of the disposal site study to the DOE, the Commonwealth's representatives stated that Areas 6 and 7 appeared to be better suited as potential disposal sites than the other five. Further study by the DOE has confirmed this evaluation (Weston, 1981a). Within or near Areas 6 and 7, seven promising sites, identified as Sites A through G on Figure 1-7, have been investigated further (Weston, 1981b). Of these seven sites, only Sites B and C have been judged acceptable. Site B, located in Hanover Township, ranks appreciably above Site C and will be considered in detail in this EIS as the prime alternative disposal site (Figures 1-8 and 1-9).

1.2 DATA COLLECTION

After establishing the location of the three sites to be considered, it was necessary to assemble the data on each of the sites. This included reviewing existing data and collecting new information. Compilation of the existing data was accomplished by researching government, public, and private sources.

The literature review led directly to the planning and initiation of field and laboratory programs to gather the necessary additional data. These programs required personnel to be both on the site and within the surrounding area to collect information. The types of data coll[illegible] ranged from the number of people living in nearby houses to the concentrations of contaminated materials in ground water. The appendices accompanying this EIS present the detailed programs used by each of the technical disciplines to conduct these studies: i.e., engineering, air quality, soils, geology, hydrology, ecology, radiology, socioeconomics, noise, and transportation.

1.3 DESIGN OF ALTERNATIVES

After the information was collected, engineering studies were conducted to determine the feasibility of various solutions to the problem. All of the alternatives strived for the same basic goal: removing a public health hazard, i.e., cleaning up the radioactively-contaminated material at the Canonsburg and Burrell sites (U.S. DOE, 1982).

Five alternatives have been developed for the remedial work at the Canonsburg and Burrell sites. They are as follows:

1. No action.

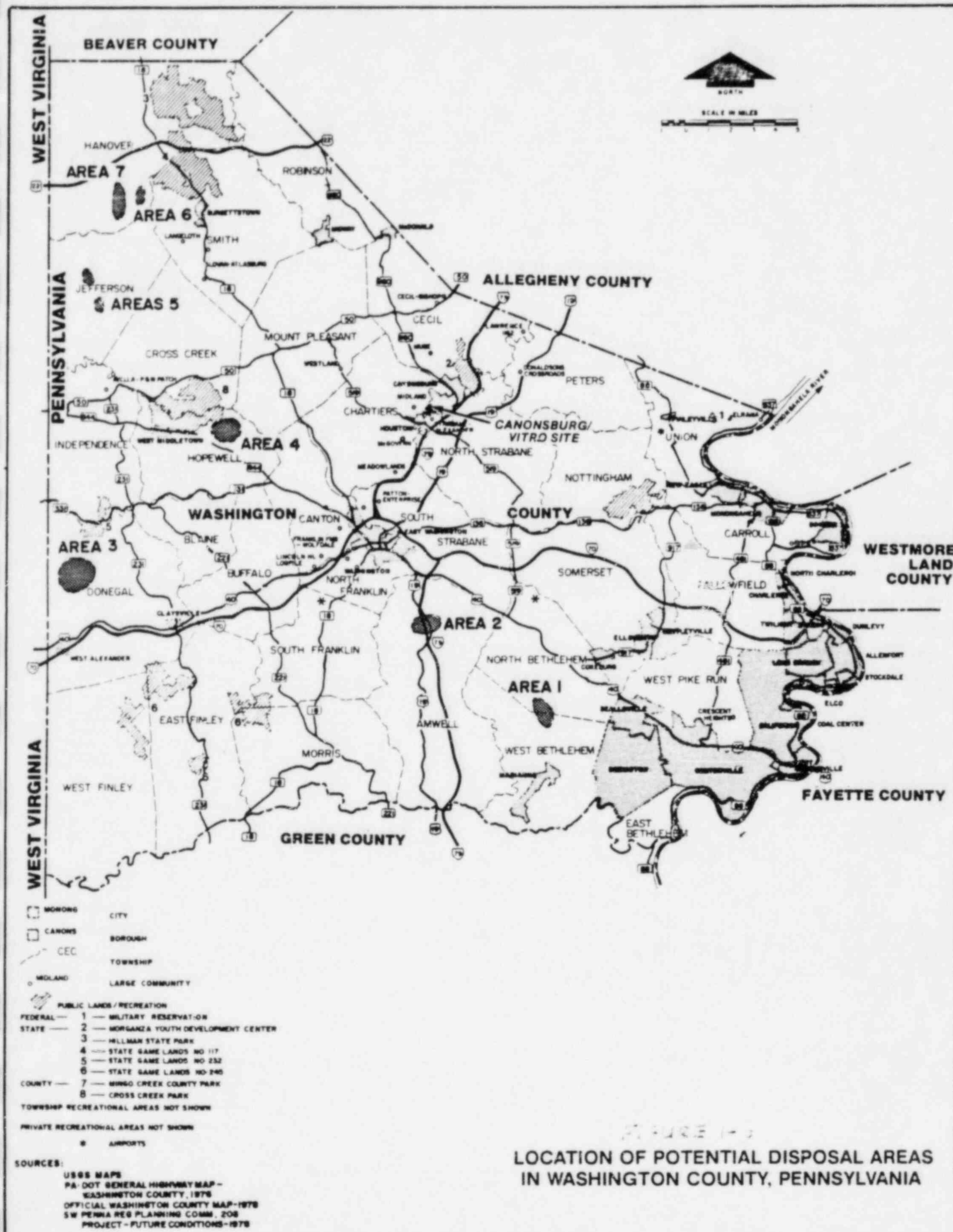
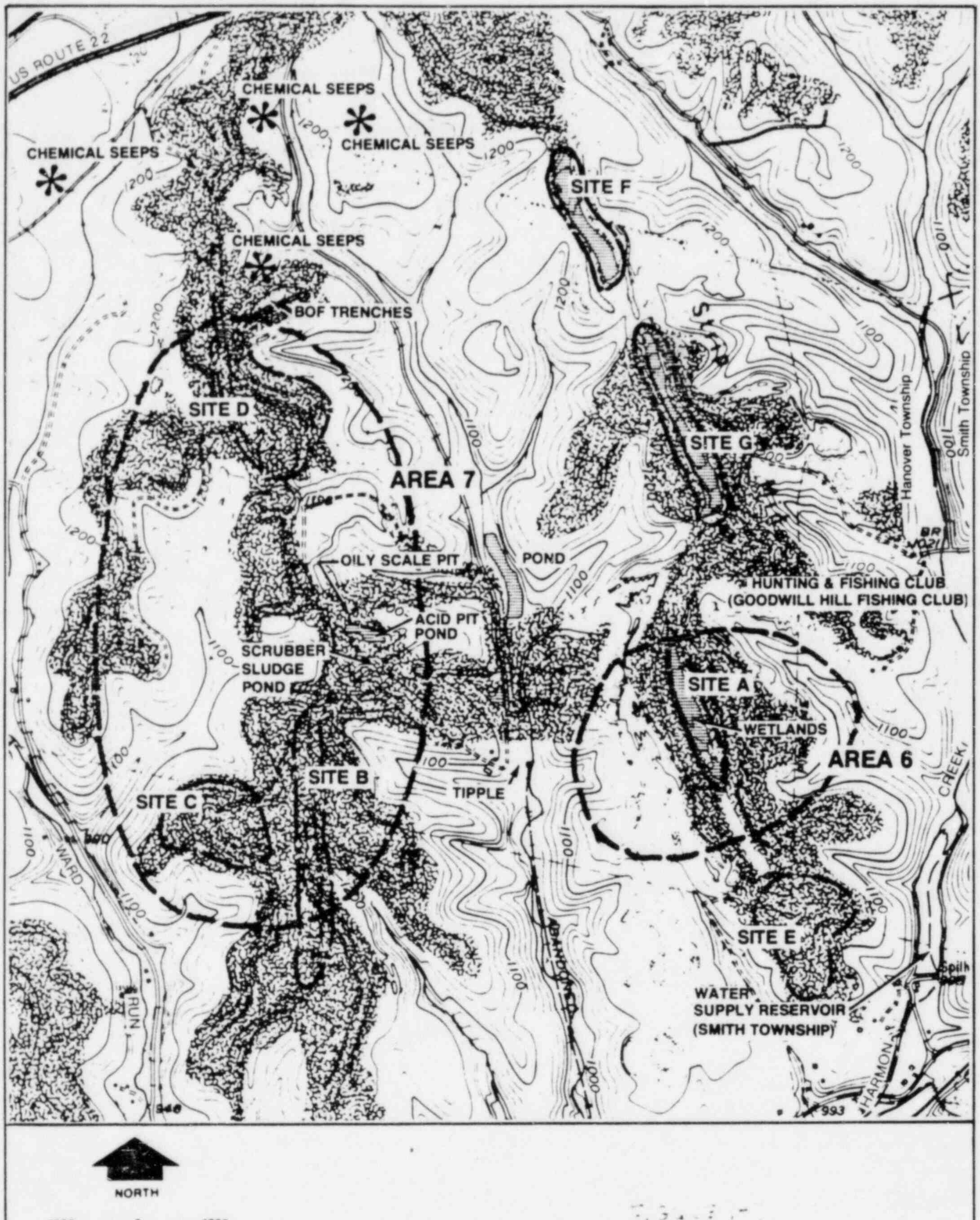


FIGURE 1-3

LOCATION OF POTENTIAL DISPOSAL AREAS IN WASHINGTON COUNTY, PENNSYLVANIA



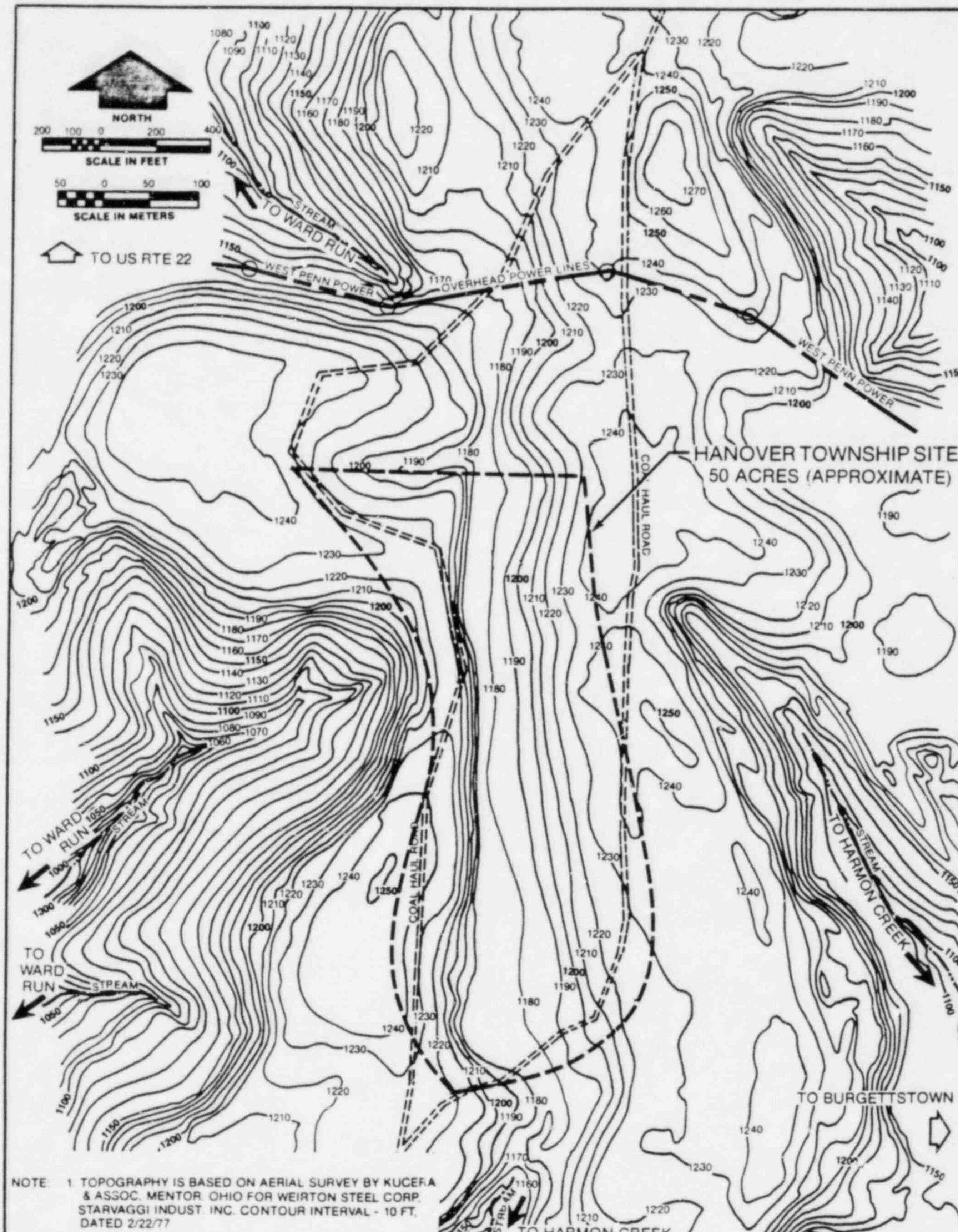
SOURCE:
USGS. BURGETTSTOWN QUAD. 7½ MIN., PR. 1979

LOCATION OF POTENTIAL DISPOSAL SITES IN HANOVER TOWNSHIP, WASHINGTON COUNTY PENNSYLVANIA

SOURCE

MAP FROM TOWNSHIP MAPS CHECKED AGAINST PENNDOT COUNTY MAP (WASHINGTON CO - 1976) AND USGS 7 MIN QUADS (PHOTOREVISED TO 1979)

FIGURE 1-
MAP OF THE AREA AROUND THE HANOVER TOWNSHIP SITE, HANOVER TOWNSHIP, WASHINGTON COUNTY, PENNSYLVANIA



PRESENT CONFIGURATION OF THE HANOVER TOWNSHIP SITE

2. Decontamination of Burrell, transfer of the Burrell material to Canonsburg, and stabilization of both the Canonsburg and Burrell materials at Canonsburg.

3. Stabilization of the Canonsburg material at Canonsburg and the Burrell material at Burrell.

4. Decontamination of both Canonsburg and Burrell, and disposal of all of the contaminated material at Hanover.

5. Decontamination of Canonsburg, disposal of its contaminated material at Hanover, and stabilization of the Burrell material at Burrell.

The specific actions associated with each alternative are given in Table 1-1. The volumes of material, resource commitments, staffing, and duration of each alternative are given in Table 1-2.

The primary difference between decontaminating and stabilizing a radioactively-contaminated site is that a decontaminated site will contain no radioactively-contaminated material at levels above the EPA standards and may later be available for unrestricted use. A stabilized site will meet the EPA disposal standards, but it will still retain its radioactive material and therefore must remain undisturbed to protect the containment. Thus, its future use is permanently restricted.

None of these alternatives includes reprocessing the tailings. Pursuant to Public Law 95-604, the DOE solicited expressions of interest in reprocessing from the current owner of each abandoned uranium-mill-tailings site (by individual letter) and from the general public (by notices in the Federal Register and press releases). For the Canonsburg site there has been no response to these requests, probably because the small amount of reprocessible material and the long distance to established reprocessing plants make this alternative uneconomical. For this reason, reprocessing is not included in any of the five alternatives being considered.

Those properties contaminated with material from the Canonsburg site that have been designated vicinity properties have been addressed as a separate segment of the Canonsburg remedial-action program (Weston, 1982). The material removed from these properties will be temporarily stored on the Canonsburg site until remedial action on the site begins. The DOE made a "finding of no significant impact" (FONSI) for this segment of the work on July 16, 1982 (47 FR 31061-31062, July 16, 1982). The Burrell site is a vicinity property not covered in the FONSI. A brief description of each alternative follows.

1.3.1 Alternative 1: no action

This alternative consists of performing no remedial action, thereby allowing the present situation at the site to continue.

Table 1-1. Summary of remedial-action activities

Project activities	Alternative 1		Alternative 2		Alternative 3		Alternative 4			Alternative 5		
	Canonsburg	Burrell	Canonsburg	Burrell	Canonsburg	Burrell	Canonsburg	Burrell	Hanover	Canonsburg	Burrell	Hanover
1. Roadway construction	---	---	X	X	X	X	X	X	X	X	X	X
2. Temporary roadway closing	---	---	X	---	X	---	X	---	---	X	---	---
3. Permanent roadway closing	---	---	X	---	X	---	---	---	---	---	---	---
4. Onsite building demolition	---	---	X	---	X	---	X	---	---	X	---	---
5. Temporary interruption of vicinity property use	---	---	---	---	---	---	X	---	---	X	---	---
6. Permanent elimination of vicinity property	---	---	X	---	X	---	---	---	---	---	---	---
7. Excavation of site's radioactive material	---	---	X	X	X	---	X	X	---	X	---	---
8. Export of site's radioactive material	---	---	---	X	---	---	X	X	---	X	---	---
9. Import of radioactive materials from other places	---	---	X	---	X	---	X	---	X	X	---	X
10. Encapsulation of radioactive material	---	---	X	---	X	---	---	---	X	---	---	X
11. Covering of radioactive material areas	---	---	X	---	X	X	---	---	X	---	X	X
12. Temporary lowering of water table	---	---	X	---	X	---	X	---	X	X	---	X
13. Use of truck-wash station	---	---	X	X	X	---	X	X	X	X	---	X
14. Use of onsite waste-water-treatment facilities	---	---	X	X	X	---	X	X	X	X	---	X

Table 1-2. Approximate volumes of materials, resource commitments, staffing, and project duration required for each alternative

	Alternative 1		Alternative 2		Alternative 3		Alternative 4			Alternative 5		
	Canonsburg	Burrell	Canonsburg	Burrell	Canonsburg	Burrell	Canonsburg	Burrell	Hanover	Canonsburg	Burrell	Hanover
Volume of contaminated material excavated (cubic yards)	0	0	40,000	80,000	40,000	0	250,000	80,000	N/A	250,000	0	N/A
Volume of contaminated material exported from the site (cubic yards)	0	0	0	80,000	0	0	250,000	80,000	N/A	250,000	0	N/A
Volume of contaminated material imported to the site (cubic yards)	0	0	80,000	0	0	0	0	0	330,000	0	0	250,000
Volume of fill and construction materials imported (cubic yards)	0	0	250,000	16,000	250,000	70,000	250,000	16,000	200,000	250,000	70,000	170,000
Electricity requirement (kWh)	0	0	222,000	140,000	222,000	8,500	270,000	140,000	280,000	270,000	8,500	280,000
Engine fuels (gallons)	0	0	232,000	127,000	228,000	82,000	640,000	127,000	503,000	640,000	82,000	383,000
Concrete (cubic yards)	0	0	5,000	1,260	5,260	---	7,760	1,260	4,510	7,760	---	3,510
Water (gallons)	0	0	2,120,900	185,000	2,120,000	125,000	5,350,000	185,000	4,000,000	5,350,000	125,000	4,000,000
Average/maximum site staffing (persons)	0	0	28/55	19/35	28/41	15/29	28/49	19/35	28/48	28/49	15/29	29/47
Project duration (weeks)	0	0	96	81	86	32	104	81	120	104	32	120

1.3.2 Alternative 2: decontamination of Burrell, transfer of the Burrell material to Canonsburg, and stabilization of both the Canonsburg and Burrell materials at Canonsburg

All material contaminated with radionuclides at the Burrell and Canonsburg sites would be stabilized at the Canonsburg site. The site buildings would be demolished, and the contaminated portions of them would be buried with the other radioactive residues. Seven nearby houses (six on Wilson Avenue and one on George Street) and the Georges Pottery buildings would also be demolished. The EPA standards would be met by moving from Burrell all material with radium-226 concentrations above 5 picocuries per gram and by encapsulating this material with the more highly contaminated portion of the Canonsburg residues (radium-226 concentrations above 100 picocuries per gram) at the Canonsburg site. The encapsulation would consist of placing the contaminated material in a repository that would be lined -- top, sides, and bottom -- with a relatively-impermeable material, such as clay. The remainder of the Canonsburg contaminated material, including those areas with radium-226 concentrations less than 100 picocuries per gram and those areas with radium-226 concentrations greater than 100 picocuries per gram, but buried deeper than 6 feet, would be stabilized in place by covering the entire site with a layer of uncontaminated fill up to 6 feet thick.

Transport by truck or rail of all the materials associated with this and the other alternatives is discussed in this EIS. Following completion of the project, ownership of the Canonsburg site would be transferred from the Commonwealth to the Federal government. The Commonwealth is currently in the process of acquiring the site pursuant to the DOE and Commonwealth of Pennsylvania cooperative agreement. The NRC would issue a license for long-term maintenance and monitoring of the site to the DOE or any other Federal agency charged with custody of the site. The Burrell site would be released for use and development in accordance with its land-use controls.

1.3.3 Alternative 3: stabilization of the Canonsburg material at Canonsburg and the Burrell material at Burrell

This alternative differs from Alternative 2 in that the Burrell material would not be removed from that site. All of the contaminated material at Canonsburg would be disposed of as under Alternative 2. At Burrell, the EPA disposal standards would be met by covering the site with a layer of uncontaminated soil up to 3 feet deep. Recent studies have indicated that only small amounts of contaminated material remain at Burrell. The Canonsburg site would then be transferred to the DOE and its future use restricted as specified in the NRC license.

1.3.4 Alternative 4: decontamination of both Canonsburg and Burrell, and disposal of all of the contaminated material at Hanover

All materials with radium-226 concentrations above 5 picocuries per gram would be removed from the Canonsburg and Burrell sites. Work at Burrell would be the same as under Alternative 2. At Canonsburg, however, a greater amount of material would have to be excavated and handled than during in-situ stabilization because stabilization in place does not require that all of the contaminated material be dug up.

The radioactively-contaminated material would be encapsulated at Hanover by methods similar to those described for Canonsburg under Alternatives 2 and 3.

The Burrell and Canonsburg sites would be available for unrestricted use, while ownership of the Hanover site would be transferred to the DOE and its future use restricted according to the license issued by the NRC.

1.3.5 Alternative 5: decontamination of Canonsburg, disposal of its contaminated material at Hanover, and stabilization of the Burrell material at Burrell

This alternative would be the same as Alternative 4 for Canonsburg and Hanover, and Alternative 3 for Burrell.

1.4 CHARACTERIZATION OF THE AFFECTED ENVIRONMENT

In order to predict the potential impacts of the remedial action, the baseline data were analyzed to determine each site's major physical, biological, and sociological characteristics.

The Canonsburg, Burrell, and Hanover sites are within 70 miles of each other in southwestern Pennsylvania. This is an area of rugged topographic features, many forests, and rich coal, oil, and gas resources. The land use and economic character of the area have been strongly influenced by these features. The pattern of land use shows distinct communities set in a region dominated by rural and open spaces. Air quality in the region meets all the National Ambient Air Quality Standards (NAAQS), except for ozone, which exceeds the statewide standards, and all of the Pennsylvania air-quality standards. Several major industrial and manufacturing centers, particularly the City of Pittsburgh, are located along the Ohio River system and the interstate highways.

1.4.1 Canonsburg site

The Canonsburg site is a 30-acre parcel situated in a densely-populated part of a residential section of the Borough of Canonsburg. The site itself, which is currently zoned for industrial use, consists of developed areas occupied by buildings and houses, and undeveloped areas covered by weeds and medium-sized trees. Larger trees grow along the banks of Chartiers Creek.

The site's location in the humid continental climate region of southwestern Pennsylvania results in temperatures ranging from 99°F in the summer to -18°F in the winter. Annual precipitation at Canonsburg averages 37 inches, with winds coming mainly from the west at moderate speeds.

The topography of the Canonsburg site has been altered by past earth-moving and landfilling activities. The elevation of much of the site has been raised above natural levels, resulting in 30 feet of relief over the site. The lower portions of the site are included in the 100-year flood plain of Chartiers Creek.

Chartiers Creek in the vicinity of the Canonsburg site is polluted by acid mine drainage and by industrial and municipal discharges. Public water supplies for Canonsburg come from protected surface waters upstream of the site. There are two ground-water systems at the site; one in the unconsolidated fill and one in the bedrock. The shallower system recharges the deeper one and both flow toward Chartiers Creek. The ground water contains elevated levels of both sulfates, derived from the natural substrate material in the area, and radium-226 and total uranium levels in excess of the EPA standards (Leggett et al., 1978). The area has been extensively mined for coal, but the Pittsburgh coal seam does not occur on the site.

In addition to the radiological contamination in the ground water the site contains a heterogeneous mixture of contaminated soils. It contains unprocessed ores, contaminated soils, waste sludges and fines, and building materials. These are distributed at depths of up to 16 feet. Area A contains radium-bearing wastes in its top few feet of soil, as well as beneath its buildings, with virtually all of its surface soils exceeding the EPA radium-226 standard of 5 picocuries per gram. Area B contains a 2- to 6-foot thick layer of material contaminated with radium above the EPA standard, situated beneath 8 to 9 feet of clean fill. Area C contains contamination above the EPA standard from the surface to a depth of 16 feet.

1.4.2 Burrell site

In contrast to the Canonsburg site, the Burrell site is a 50-acre open, unpopulated area. There are two small housing communities within 1 mile of the site, and the Town of Blairsville is 1 mile to the west. The Burrell site is a low-lying plateau situated along the Conemaugh River with only 10 feet of topographic relief. It contains two steep-banked ponds.

The level of the Conemaugh River at the Burrell site is regulated by a U.S. Army Corps of Engineers dam about 10 miles downstream of the site. At the maximum elevation of the flood pool, approximately 15 percent of the site would be inundated; however, recorded river levels have always been below this maximum. The river is polluted by the same factors as Chartiers Creek at Canonsburg; similar to Canonsburg, public-water supplies come from protected surface waters.

There are two ground-water systems at the Burrell site, one in the fill and one in the bedrock. Unlike Canonsburg, the shallow system does not recharge the deeper system at Burrell. Instead, both systems flow separately toward the river. The ground water is high in naturally derived sulfates, but does not contain radioactively-contaminated material above the EPA standards (Leggett et al., 1979).

Analyses of the soils at Burrell have produced contrasting levels of radioactive contamination. In 1977, surveys (Leggett et al., 1979) revealed that soils as deep as 36 feet contained contamination at levels well above the EPA standards. In 1981 and 1982 similar surveys (Rarrick, 1982) indicated that the site contained much less contaminated material and that this material was at shallower depths than seemed to be the case in 1977.

1.4.3 Hanover site

The Hanover site is in an unpopulated area. The site occupies 50 acres along a ridgetop created by strip mining. The site lies within the watershed of Harmon Creek, a small severely polluted stream.

Ground water at the site is contained in two systems, a shallow system in the fill and a deeper one in bedrock, but the site is not a ground-water recharge area. The water does not meet Federal drinking-water standards; however, it does not contain any detectable amounts of radioactive material.

Of the three sites, Hanover has the most pronounced topographic relief. The site is being considered as a new disposal site, and currently contains no radioactive material from activities at the Canonsburg site or elsewhere.

1.5 EVALUATION OF ENVIRONMENTAL IMPACTS

The impacts of the five alternatives are summarized and compared in Table 1-3. It is helpful to separate these potential impacts into those directly associated with the radioactive material and those that are not. Among the nonradiological impacts, one kind stands out. This is the transportation impacts associated with moving radioactive material and fill dirt into and out of the sites. This means that large numbers of trucks will be moving on the poor, narrow residential roads leading to the Canonsburg site. Also, at Canonsburg Strabane Avenue will have to be closed for the duration of the project, approximately 2 years.

Both Ward Street and Wilson Avenue will also be closed; permanently under Alternatives 2 and 3, and temporarily under Alternatives 4 and 5. Also, the seven residences located on Wilson Avenue and George Street will be either demolished (Alternatives 2 and 3) or closed for 2 years (Alternatives 4 and 5).

In addition to transportation impacts, there is the direct impact of several people losing their homes and several industries that will have to be relocated. These situations will be handled as easily as possible; the DOE will assist the homeowners in finding temporary housing under Alternatives 4 and 5, and will reimburse them for their properties under Alternatives 2 and 3. The industries will receive relocation assistance and compensation for their losses.

The remainder of the nonradiological impacts will be small. There will be normal construction noises and dust, people will be temporarily inconvenienced at certain times, and there may be some localized siltation of Chartiers Creek, but these impacts will be no greater than those experienced from construction projects such as building a new highway or erecting a new shopping center. All of these impacts are manageable and proper measures such as dust suppression, vehicle mufflers, work scheduling, waste-water treatment, and erosion control will be taken to mitigate their severity.

The remaining area of potential concern is radioactivity. The people living near the sites, particularly Canonsburg, are afraid that they have been and will continue to be exposed to radioactivity that will impair their health and shorten their lifespans.

Calculations show that this radioactive material may be causing an excess lung cancer mortality rate of 5.4 deaths per generation among people living near the Canonsburg and Burrell sites. Because there are about 14,000 people in these areas (total) and the normal lung cancer mortality rate is 1 in 33, this means an expected lung cancer mortality rate of 425 deaths per generation. An individual in this population has an increased chance of 1.3 percent of dying of lung cancer because of the presence of these sites as they are now.

Preliminary results from two recent studies (Lane, 1982; and Talbot, 1982), show that the cases of lung and thyroid cancer among people living near the Canonsburg site are not statistically different from those for the general public not living nearby. However, these preliminary results are not very pertinent because the lung cancer study was based on a very small sample and thyroid cancer is not the expected consequence of exposure to radon and its daughters (lung cancer is expected).

Table 1-3. Comparison of potential impacts at each site for each remedial-action alternative

	Alternative 1		Alternative 2		Alternative 3		Alternative 4			Alternative 5			Reference
	Canonsburg	Burrell	Canonsburg	Burrell	Canonsburg	Burrell	Canonsburg	Burrell	Hanover	Canonsburg	Burrell	Hanover	
Radiological													
Annual external dose (man-rem) to population[a]													
Short-term[b]		4.3		6.4		6.2		10			10		
Long-term[c]		4.3		0.01		0.01		0.01			0.01		Table 5-3
Annual bronchial dose (man-rem) to population													
Short-term		8,300		12,900		12,800		11,500			11,500		
Long-term		8,100		13		13		13			13		Table 5-3
Excess lung cancer deaths from long-term exposure		5.4		0.008		0.008		0.008			0.008		Table 5-3
Air quality													
Short term													
Annual TSP (g/cu m)			15.2	5.8	11.5	7.0	22.2	5.8	53.4	22.2	7.0	48.9	
Annual SO_2 (g/cu m)			7.2	4.3	6.5	4.6	9.1	4.3	5.4	9.1	4.6	5.3	
1-hour CO (g/cu m)	No impact	No impact	2,447	3,499	2,495	2,417	2,781	3,499	2,904	2,781	2,417	2,908	
Annual NO_x (g/cu m)			77.7	44.0	72.4	48.1	94.9	44.0	56.5	94.9	48.1	53.4	Table 5-6
3-hour HC (g/cu m)			64.8	58.9	35.0	26.4	61.7	58.9	155.	61.7	26.4	155.	
Settleable particulates (tons/sq mi-month)			5.8	2.2	4.4	2.3	8.4	2.2	20.3	8.4	2.7	18.5	
Long term	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	
Soils													
Short term	Minimal impact	Minimal impact	No removal of soils. Import approximately 250,000 cubic yards of natural material. Import 80,000 cubic yards of Burrell residues and fill material.	Removal of 80,000 cubic yards of residues and fill material. Import 18,000 cubic yards of fill material.	No removal of soils. Import approximately 250,000 cubic yards of natural material.	No removal of soils. Import 70,000 cubic yards of natural material.	Removal of 252,000 cubic yards of residues and fill. Import 250,000 cubic yards of natural material.	Same as Alternative 2.	No soil removal. Import 130,000 cubic yards of residues and fill. Import 200,000 cubic yards of natural material.	Same as Alternative 4.	Same as Alternative 3.	No soil removal. Import 250,000 cubic yards of residues and fill. Import 170,000 cubic yards of natural material.	Subsections 3.1.1 to 3.1.5, 5.4.2
Long term	Minimal impact	Minimal impact	Soil stabilization	Soil stabilization	Soil stabilization	Soil stabilization	Soil stabilization	Soil stabilization	Soil stabilization	Soil stabilization	Soil stabilization	Soil stabilization	Subsections 3.1.1 to 3.1.5, 5.4.2
Mineral Resources													
Short and long term	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	Section 5.5
Topography													
Short term	No impact	No impact	Raise elevation of encapsulation area.	Lower elevation of excavated area.	Same as Alternative 2.	Raise elevation of stabilized area.	No new topographic highs or lows.	Same as Alternative 2.	Raise elevation in section of trench.	Same as Alternative 4.	Same as Alternative 3.	Same as Alternative 4.	Subsection 5.4.1
Long term	No impact	No impact	Overall site grading to even slopes.	Grade surrounding area to slope evenly past excavated area.	Same as Alternative 2.	Grade surrounding area to slope evenly past stabilized area.	Overall site grading to even slopes.	Same as Alternative 2.	Overall site grading to even slopes.	Same as Alternative 4.	Same as Alternative 3.	Same as Alternative 4.	Subsection 5.4.1
Surface Waters													
Short term	Erosion Contaminant discharge Possibility of washing contaminants into Chartiers Creek during flooding.	No erosion or runoff into river. Indirect discharge into river. No major potential for contaminant load during flooding.	Possibility of erosion of sediments and contaminants into creek during project controlled by erosion and sedimentation controls. Discharge from WWTP[d] controlled under NPDES[e] permit. No change in water quantity; water supplied from local supply; discharge from WWTP < 1 CFS.	Use of erosion and sediment controls during project. Discharge from WWTP controlled under NPDES permit. No change in water quantity; water supplied from well; discharge from WWTP <1 CFS.	Same as Alternative 2.	Use of erosion and sediment controls Minimal possibility for impact because of no excavation or exposure of contaminated material.	Same as Alternative 2.	Same as Alternative 2.	Possibility for erosion of sediment and contaminants into Hermon Creek during project controlled by erosion and sedimentation controls. Discharge from WWTP controlled under NPDES permit. No change in water quantity: water supplied from well; discharge from WWTP <1 CFS.	Same as Alternative 2.	Same as Alternative 3.	Same as Alternative 4.	Subsection 5.6.1
Long term	Same as short term	Same as short term	Reduced input of contaminants into creek. Improved site drainage.	Reduced potential for contaminants entering river.	Same as Alternative 2.	Minimal possibility of impact.	Same as Alternative 2.	Same as Alternative 2.	No input of radiological contaminants into the creek. Improved site drainage.	Same as Alternative 2.	Same as Alternative 3.	Same as Alternative 4.	Subsection 5.6.1

Table 1-3. (continued)

	Alternative 1		Alternative 2		Alternative 3		Alternative 4			Alternative 5			Reference
	Canonsburg	Burrell	Canonsburg	Burrell	Canonsburg	Burrell	Canonsburg	Burrell	Hanover	Canonsburg	Burrell	Hanover	
Ground water													
Short term	Continued leaching of radiological contaminants into ground water.	Minimal movement of radiological contaminants into ground water.	Reduce leaching of contaminants into ground water. Temporary lowering of water table in Area C.	Stop leaching of contaminants into ground water.	Same as Alternative 2.	Reduce leaching of contaminants into ground water.	Stop leaching of contaminants into ground water.	Same as Alternative 2.	Reduce leaching of contaminants into ground water.	Same as Alternative 4.	Same as Alternative 3.	Same as Alternative 4.	Subsection 5.4.2
Long term	Same as short term	Same as short term	Reduce leaching of contaminants into ground water.	Same as short term	Same as Alternative 2.	Same as short term	Same as short term	Same as Alternative 2.	Same as short term	Same as Alternative 4.	Same as Alternative 3.	Same as Alternative 4.	Subsection 5.4.2
Biology													
Terrestrial													
Short term	No impact	No impact	Temporary disruption and loss of habitat during project.	Temporary disruption and loss of habitat during project.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Temporary disruption and loss of habitat during project.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 4.	Subsection 5.7.1
Long term	No impact	No impact	Habitat will be reestablished after project.	Habitat will be reestablished after project.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Habitat will be reestablished after project.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 4.	Subsection 5.7.1
Aquatic													
Short term	Minimal impact	Minimal impact	Potential for temporary habitat alteration and biological impact from accidental contaminant discharge.	Minimal impact	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Potential for temporary habitat alteration and biological impact from accidental contaminant discharge.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 4.	Subsection 5.7.2
Long term	Minimal impact	Minimal impact	Return to preproject conditions after project.	Minimal impact	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Return to preproject conditions after project.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 4.	Subsection 5.7.2
Socioeconomics													
Land use													
Short term	No impact	No impact	Temporary closing of site for several years.	Minimal impact	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Minimal impact	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 4.	Section 5.8
Long term	No impact	No impact	Permanent commitment of site as disposal area.	Availability of site for development and use in accordance with land-use controls.	Same as Alternative 2.	Permanent commitment of site as vicinity property.	Availability of site for development and use in accordance with land-use controls.	Same as Alternative 2.	Permanent commitment of site as disposal area.	Same as Alternative 4.	Same as Alternative 3.	Same as Alternative 2.	Section 5.8
Truck traffic													
Short term	No impact	No impact	<90 trucks per day over 32 weeks for construction materials. <40 truck trips per day over 20 weeks for Burrell material.	<40 truck trips per day over 8 weeks for construction materials. <40 truck trips per day over 20 weeks for material removal.	<90 trucks per day over 32 weeks for construction materials.	<60 truck trips per day over 15 weeks for construction materials.	<90 truck trips per day over 32 weeks for construction materials. <70 truck trips per day over 46 weeks, for material removal.	Same as Alternative 2.	Low rate of import of construction materials over 52 weeks. <70 truck trips per day over 46 weeks for Canonsburg material. <40 truck trips per day over 20 weeks for Burrell material.	Same as Alternative 4.	Same as Alternative 3.	Low rate of import of construction materials over 52 weeks. <70 truck trips per day over 46 weeks for Canonsburg material.	Section 3.2
Long term	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	

Table 1-3. (continued)

	Alternative 1		Alternative 2		Alternative 3		Alternative 4			Alternative 5			Reference
	Canonsburg	Burrell	Canonsburg	Burrell	Canonsburg	Burrell	Canonsburg	Burrell	Hanover	Canonsburg	Burrell	Hanover	
Socio-economics (cont.)													
Population[a]													
Short term	No impact	No impact	Increase in local population of a maximum of 55 remedial-action workers.	Increase in local population of a maximum of 35 remedial-action workers.	Increase in local population of a maximum of 41 remedial-action workers.	Increase in local population of a maximum of 29 remedial-action workers.	Increase in local population of a maximum of 49 remedial-action workers.	Increase in local population of a maximum of 31 remedial-action workers.	Increase in local population of a maximum of 47 remedial-action workers.	Same as Alternative 4.	Same as Alternative 3.	Same as Alternative 4.	Table 5-10
Long term	No impact	No impact	Decrease in vicinity population by 7 families.	No impact	Decrease in vicinity population by 7 families.	No impact	Temporary relocation of 7 families.	No impact	No impact	No impact	No impact	No impact	Section 5.8
Housing requirements													
Short term													
Partial project duration	0	5	44	26	32	29	43	26	17	43	29	26	
Most of project duration	0	0	7	5	7	0	6	5	31	6	6	31	Table 5-11
Long term	0	0	0	0	0	0	0	0	0	0	0	0	
Noise													
Short term	No impact	No impact	Minimal impact	Minimal impact	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Minimal impact	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 4.	Section 5.9
Long term	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	
Transportation													
Short term	No impact	No impact	Temporary closing of Strabane and Wilson Aves. and and Ward and George Sts.	Impact on local roads	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Impact on local roads	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 4.	Section 5.14
Long term	No impact	No impact	Permanent closing of Wilson Ave., Ward and George Sts.	No impact	Same as Alternative 2.	No impact	No impact	No impact	No impact	No impact	No impact	No impact	Section 5.14
Project Requirements													
Manpower -- average/maximum			28/55	19/35	28/41	15/35	28/49	19/25	28/47	28/49	15/29	28/47	Section 3.1
Short term	0	0	6	0	0	0	0	0	0	0	0	0	
Long term	0	0	9	0	0	0	0	0	0	0	0	0	
Financial[f]	No cost		$14,202,000		$13,842,000			$14,205,000			$24,514,000		Table A.4-1

[a] Population = persons living within 1.24 miles of the site.
[b] Short term = existing for the period of project activity.
[c] Long term = existing for significant period of time following project completion.
[d] WWTP = waste-water treatment plant.
[e] NPDES = National Pollutant Discharge Elimination System.
[f] Excluding the cost of decontaminating the vicinity properties.

Each of the alternatives, except for Alternative 1, will reduce the already small increase in lung cancer deaths. The remedial action will decrease the excess lung cancer death rate to people near the Canonsburg site to about 0.0003, or a 1 in 50,000,000 increased chance of any one person dying from lung cancer. In reality this means that there is a very small probability that a lung cancer death will result directly from exposure to the contaminated material in Canonsburg. The chances of cancer deaths are similarly small at Burrell and Hanover. Both of these areas are more isolated than Canonsburg and are not subject to the same frequency of activity as in Canonsburg. Chapter 5 discusses these impacts in greater detail.

The DOE will clean up the site to the point that the EPA standards are met, so that there will be no significant impacts once the remedial-action activities are finished. The public health hazard will be eliminated and the site will be removed from the list of those areas that could harm the public health.

1.6 CLEANUP

The actual work will be done on the sites during this phase of the program. The DOE's remedial-action contractor (RAC) will handle all of this work. The RAC will contract with several local firms for the building-demolition, earth-moving, and material-handling activities required at each site. The construction will follow a predetermined schedule in which major activities have been planned and a time period for each step developed. Table 1-2 indicates the basic engineering-related requirements for each alternative.

During the construction period a set of safety and contamination controls will be followed to ensure that no workers are exposed beyond acceptable limits, and that no significant amounts of radioactive material escape into the surrounding area.

1.7 MAINTENANCE AND MONITORING

After all of the cleanup work is finished, the DOE, or another Federal agency charged with custody of the site, will continue to monitor the final disposal site to ascertain whether the remedial-action program continues to comply with the EPA standards. This will include measurements of parameters such as air and water contaminant levels as specified by the NRC in its license and maintenance of the site as required. All EPA standards will have to be met before the remedial action is considered officially completed.

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2 PURPOSE AND NEED

The remedial actions (except no action) presented in this EIS are possible strategies for reducing the radioactivity levels at the Canonsburg and Burrell sites to the EPA standards. The purpose of these standards is to protect the public health and safety and the environment from radiological and nonradiological hazards associated with radioactive materials at the sites. The remedial-action program will remove a public health hazard, i.e., that hazard associated with uncontrolled radioactively-contaminated material.

In 1978, Congress passed Public Law 95-604, the Uranium Mill Tailings Radiation Control Act, expressly finding that uranium-mill tailings located at inactive (and active) mill sites may pose a health hazard to the public. UMTRCA charges the EPA with the responsibility for promulgating radiological and nonradiological standards for inactive mill sites. Under UMTRCA the DOE is authorized to enter into cooperative agreements with affected states or Indian tribal governments to perform remedial actions to bring the radiation levels at the sites in their jurisdictions within the EPA standards. The DOE will fund 90 percent of the remedial-action-cleanup costs (except on Indian land where DOE will fund 100 percent); the affected state will provide the remaining 10 percent. All remedial actions must be performed with the concurrence of the NRC, which will issue a license for long-term maintenance and monitoring of the disposal site.

Title I to the UMTRCA identified 22 sites to be designated by the DOE for remedial action. On November 9, 1979, the DOE designated those 22 sites and an additional three sites; Canonsburg was one of the designated sites. (One site, in Baggs, Wyoming, was later removed from the list because it was under Federal ownership, thus ineligible for remedial action under the provisions of Title I of the UMTRCA.) As a result, the DOE and the Commonwealth of Pennsylvania entered into a cooperative agreement effective September 5, 1980, for remedial action at the Canonsburg and Burrell sites.

2.1 HISTORY AND PRESENT STATUS

From 1942 through 1957, Vitro conducted uranium-processing operations under contract to the AEC at an 18.5-acre site in Canonsburg, Washington County, Pennsylvania (Figures 1-1 and 1-3). Process wastes from this operation and other AEC contract work were stored here during this period. From 1956 to 1957, with the approval of the AEC and the Pennsylvania Railroad, approximately 11,600 tons of radioactively-contaminated residues were moved from the Vitro property to a railroad landfill located in Burrell Township, Indiana County, Pennsylvania (Figure 1-1). The Vitro property was sold in 1966 and developed as the Canon Industrial Park. At various times contaminated soils and building materials were removed from the Vitro property and used in local construction projects. It is estimated that 100 properties in the vicinity of the Canonsburg site have been affected by these construction activities.

The Canonsburg and Burrell sites require cleanup to reduce their radioactivity levels. Radiological surveys made of the Canonsburg site in 1977 (Leggett et al., 1978) indicate that significant amounts of contaminated material remain on the site and that the radiation levels in the buildings, soils, and ground water exceed EPA standards. The contaminated material at the Canonsburg site is heterogeneously distributed; it consists of unprocessed ores, contaminated soils, waste sludges and fines, and building materials.

Contaminated material at the Burrell site (Figure 1-4) is mixed with a large amount of debris, especially railroad ties (Leggett et al., 1979). The Hanover site (Figure 1-8), proposed as a possible alternative repository for the wastes, currently contains no radioactive residues. It is located in an abandoned strip-mine area and is surrounded by land contaminated by chemical and industrial wastes.

As required by the National Environmental Policy Act of 1969 (NEPA, PL 91-190) this EIS has been prepared to provide environmental information before decisions are made and before action is taken. It predicts and analyzes the effects on the environment from performing each alternative. It also incorporates the major areas of public concern expressed during scoping meetings.

2.2 EPA STANDARDS

Under Public Law 95-604, no remedial action may begin until final cleanup standards have been promulgated. The final EPA standards have not yet been issued. However, in order to permit remedial action to begin at the radioactively-contaminated vicinity properties, the EPA has issued interim standards (45 FR 27366-27368, April 22, 1980) for the cleanup of open lands and occupied or occupiable buildings in which elevated radiation levels occur because of the presence of residual radioactive materials from a designated inactive processing site (Table 2-1).

The EPA has also proposed standards governing the disposal of residual radioactive materials from inactive uranium-processing sites (46 FR 2556-2563, January 9, 1981). These standards (Table 2-2) place limits on the amounts of certain elements and substances that may be released from the final disposal site. In addition, the disposal of the radioactive material must be done in such a manner that there is a reasonable expectation that the limits in the proposed standards will be maintained for at least 1000 years. The standards impose the following limits:

1. The average annual release of radon-222 at the surface of the site is limited to values less than or equal to 2 picocuries per square meter per second plus the radon emission expected from the material covering the tailings.

Table 2-1. EPA interim standards for remedial-action cleanup of open lands and structures

Type of radiation	Remedial-action (RA) standard[a]
External gamma radiation (EGR) in dwellings	RA required if EGR greater than 0.02 mR/hr above background
Radon-daughter concentration (RDC) in dwellings	RA required if RDC greater than 0.015 WL including background (annual average)
Ra-226 concentration on open lands	RA required if Ra-226 greater than 5 pCi/g (excluding background)

[a]Abbreviations

mR/hr = milliroentgen per hour
WL = working level, or RDC per liter of air that results in eventual emission of 1.3×10^5 MeV of alpha energy
pCi/g = picocuries per gram

Source: 45 FR 27366-27368, April 22, 1980

Table 2-2. EPA proposed standards for tailings disposal

ELEMENT CONCENTRATION IN SOURCE OF UNDERGROUND DRINKING WATER

Element	Maximum permissible concentration in ground water[a]	
Arsenic	0.05	mg/l
Barium	1.0	mg/l
Cadmium	0.01	mg/l
Chromium	0.05	mg/l
Lead	0.05	mg/l
Mercury	0.002	mg/l
Molybdenum	0.05	mg/l
Nitrate nitrogen	10.0	mg/l
Selenium	0.01	mg/l
Silver	0.05	mg/l
Combined radium-226 and radium-228	5.0	pCi/l
Gross alpha particle activity (including radium-226 but excluding radon and uranium)	15.0	pCi/l
Uranium	10.0	pCi/l
RADON FLUX LIMIT FROM DISPOSAL SITE[a]		
Maximum permissible radon flux emitted from residual radioactive materials at the disposal site	2	pCi/m^2-second (annual average)

[a]Abbreviations

mg = milligram
pCi = picocurie
m^2 = square meter
l = liter

Source: 46 FR 2556-2563, January 9, 1981

2. Concentrations of the elements listed in Table 2-2 in sources of underground drinking water are limited. Material released from a disposal site is neither to cause the concentrations of the specified elements in underground drinking water to exceed the levels nor to result in any increase in their concentrations in water that exceeded those levels before the remedial actions for causes other than residual radioactive material. These limitations apply to underground drinking water beyond 1.0 kilometer (0.624 mile) from a disposal site that was a processing site and beyond 0.1 kilometer (330 feet) from a new disposal site.

3. Materials released from disposal sites should not cause an increase in the concentration of any toxic substance in any surface waters. In general, "surface waters" means any bodies of water on the earth's surface that the public may traverse or enter, or from which food may be taken.

2.3 NRC LICENSING

The NRC has not issued and does not intend to issue regulations that apply to the cleanup and disposal of residual radioactive materials at inactive uranium-processing sites. In conformance with UMTRCA, NRC concurrence in proposed remedial actions and determinations as to the licensability of disposal sites for such materials will be to ensure compliance with the EPA final standards. The NRC has issued regulations governing the disposal of tailings from active uranium milling operations. These regulations (45 FR 65533-65536, October 3, 1980) are not applicable to UMTRAP remedial actions, but do contain technical criteria, primarily in the form of performance objectives, for the disposal of uranium-mill tailings. Though they will not be applied by the NRC to the inactive sites, the NRC technical criteria embody considerations that are relevant to the evaluation of remedial-action alternatives for an UMTRCA Title I inactive site.

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3 ALTERNATIVES INCLUDING THE PROPOSED ACTION

3.1 DESCRIPTION OF THE ALTERNATIVES

Five alternative actions have been developed for dealing with the contaminated material at the Canonsburg and Burrell sites. In all the alternatives except no action, the effort would begin by decontaminating the local vicinity properties now contaminated with tailings. Material removed from these properties would be consolidated at the Canonsburg site after that property is acquired by the Commonwealth of Pennsylvania. The vicinity properties include all open lands, homes, businesses, and other places at or near Canonsburg where radiation levels are higher than the EPA standards because of the presence of tailings or other radioactive materials from the processing site. The remedial-action alternatives for the Canonsburg and Burrell sites, described in detail in this subsection, are the following:

- Alternative 1 -- No action
- Alternative 2 -- Decontamination of Burrell and stabilization of both the Canonsburg and Burrell materials at Canonsburg.
- Alternative 3 -- Stabilization of the Canonsburg material at Canonsburg and the Burrell material at Burrell.
- Alternative 4 -- Decontamination of both Canonsburg and Burrell, and disposal of the contaminated material at Hanover.
- Alternative 5 -- Decontamination of Canonsburg, and disposal of the contaminated material at Hanover, and stabilization of the Burrell material at Burrell.

The primary difference between decontaminating and stabilizing a radioactively-contaminated site is that a decontaminated site will contain no material at levels above the EPA standards and may later be available for unrestricted use. A stabilized site will meet the EPA disposal standards, but it will still retain its radioactive material and therefore must remain undisturbed to protect the containment. Thus, its future use is permanently restricted.

The basic strategies considered for carrying out the remedial actions are to stabilize the tailings at their present locations or to transport the tailings to a new disposal site (U.S. DOE, 1982). Tables 3-1 through 3-3 summarize the basic methods to be used in actually performing each of the alternatives.

Table 3-1. Summary of possible environmental controls and engineering features for in-situ stabilization of the Canonsburg site[a]

Environmental issues and requirements	Engineering features
1. Control of radon-emanation rate	a. Encapsulation of highly contaminated materials from Areas A and C. b. Decontamination of buildings in Area A. c. Use of multilayer cover system (clay and soil, gravel and stone, and soil layers) for radon-222 attenuation in encapsulation area. d. Use of soil cover for balance of site.
2. Surface-radiation levels	a. Encapsulation of highly-contaminated materials. b. Soil cover over balance of site depending on radiation levels. c. Stabilization and vegetation of site.
3. Subsurface-water quality	a. Removal of highly-contaminated materials from saturated zone in Area C. b. Dewatering of Area C and treatment of recovered water. c. Encapsulation of highly-contaminated material. d. Use of multilayer cover system to minimize the potential for leachate generation in encapsulation cell. e. Use of clay and soil liner for waste containment, and attenuation of leachate contaminants. f. Reduction of infiltration throughout the site using cover, drainage, and stabilization of surface. g. Placement of in-situ ion-exchange filter (only if needed).
4. Surface-water quality	a. Removal of highly-contaminated materials from flood plain (Area C). b. Construction of flood-control berm around the excavated areas. c. Improving drainage and control of runoff. d. Collection and treatment of contaminated water and waste water during construction period.

[a]See Appendix A.1 and Weston (1982a) for additional information.

Table 3-1. Summary of possible environmental controls and engineering features for in-situ stabilization of the Canonsburg site[a] (continued)

Environmental issues and requirements	Engineering features
5. Soil-contamination levels	a. Removal of highly-contaminated materials from Areas A and C. b. Encapsulation of highly-contaminated material. c. Soil cover over mildly-contaminated areas. d. Building decontamination and demolition. e. Stabilization of site surface using soil cover and revegetation.
6. Long-term stability	a. Use of natural material for liner and cover construction. b. Use of passive control techniques. c. Physical and structural stabilization of highly-contaminated material prior to encapsulation.
7. Radiation protection (public and construction personnel)	a. Control of site access (fence, gates, signs, etc.) during remedial-action program. b. Establishment of employee health and support facilities (showers, protective clothing, dosimeters, etc.). c. Radiation monitoring and surveillance. d. Quality control and assurance.

[a]See Appendix A.1 and Weston (1982a) for additional information.

Table 3-2. Summary of possible environmental controls and engineering features for in-situ stabilization of the Burrell site[b]

Environmental issues and requirements	Engineering features
1. Control of radon-emanation rate	a. Stone and soil cover over localized high radiation spots.
2. Surface radiation	a. Multilayer cover system (stone and soil) over localized high radiation spots. b. Stabilization and revegetation of the contaminated areas of the site.
3. Subsurface-water quality	a. Two-layer cover system to reduce excessive infiltration through contaminants.
4. Surface-water quality	a. Covering localized high radiation spots. b. Improving runoff and drainage patterns. c. Site stabilization and revegetation of areas prone to erosion.
5. Soil-contamination levels	a. Covering localized high radiation spots. b. Site stabilization and revegetation.
6. Long-term stability	a. Use of natural earth and durable material (stone, soil, slag, and clay) for site stabilization and cover. b. Design of cover to accommodate projected subsidence of waste material. c. Use of passive control techniques.
7. Radiation protection (public and construction personnel)	a. Control of site access (fence, gates, signs, etc.) during remedial-action program. b. Establishment of employee health and support facilities(showers, protective clothing, dosimeters, etc.) . c. Radiation monitoring and surveillance. d. Quality control and assurance.

[b]See Appendix A.2 and Weston (1982b) for additional information.

Table 3-3. Summary of possible environmental controls and engineering features for stabilization at the Hanover site

Environmental issues and requirements	Engineering features
1. Control of radon-emanation rate	a. Encapsulation of waste and contaminated material and use of multilayer cover consisting of clay cap, stone, and soil layers.
2. Surface radiation	a. Use of adequate cover material and thickness. b. Stabilization and revegetation of the site.
3. Subsurface-water quality	a. Locating encapsulation cells above ground-water table. b. Control of ground-water levels using drainage devices. c. Use of multilayer cover system to minimize the potential for leachate generation in encapsulation cells. d. Use of clay and soil liner for waste containment and attenuation of leachate contaminants.
4. Surface-water quality	a. Construction of runoff, drainage, and erosion-control devices. b. Stabilization and revegetation of site surfaces. c. Collection and treatment of contaminated runoff and leachate during construction and waste placement periods.
5. Soil-contamination levels	a. All waste and contaminated material and soils will be placed in the encapsulation cell between clay liners and multilayer cover system.
6. Long-term stability	a. Use of natural material for liner and cover material. b. Use of passive control techniques. c. Optimum compaction of waste and contaminated material during placement in encapsulation cells. d. Design and construction of cover system that could accommodate some degree of settlement and subsidence.

Table 3-3. Summary of possible environmental controls and engineering features for stabilization at the Hanover site (continued)

Environmental issues and requirements	Engineering features
7. Radiation protection (public and construction personnel)	a. Control of site access (fence, gates, signs, etc.) during remedial-action program. b. Establishing employee health and support facilities (showers, protective clothing, dosimeters, etc.). c. Radiation monitoring and surveillance. d. Quality control and assurance.

A number of site activities are a part of every alternative except no action. They include the following:

1. Surveying the site and placing benchmarks at specific work locations.

2. Installing site security barriers and developing the road network that is required on the site, including both constructing new roads and closing or rearranging existing roads.

3. Setting up personnel trailers and decontamination facilities and establishing areas for stockpiling materials.

4. Developing and installing a waste-water collection and treatment system for those alternatives involving handling contaminated materials. Earthen berms will be constructed around all work areas and adjacent to waterways to collect storm water and transfer it to the waste-water-treatment plant. All process waste waters will also be collected and sent to the treatment plant. In addition to storm water, the process waste waters will include equipment-washing wastes, ground water pumped to temporarily lower the water table during excavation (at Canonsburg and Hanover), and waste water from building steam-cleaning (at Canonsburg). The waste-water-treatment plants have been designed to treat 120,000, 60,000 and 60,000 gallons per day at the Canonsburg, Burrell, and Hanover sites, respectively. At the end of the remedial action these facilities will be disassembled and deposited along with the contaminated material. The collected solids will be mixed with concrete and also disposed of with the contaminated material. Each plant will include the following:

    a. A lined sedimentation pond for surge amounts of waste water collected in excess of the continuous treatment capacity.

    b. Multi-media pressure filters for suspended-solids control.

    c. Mixed-resin ion-exchange beds for dissolved-solids control.

    d. pH adjusters.

5. Transferring approximately 10,000 cubic yards of contaminated material from the vicinity properties near the Canonsburg site onto the Canonsburg site.

None of these alternatives includes the reprocessing of the tailings. Pursuant to Public Law 95-604, the DOE solicited expressions of interest in reprocessing from the owners of each uranium-mill-tailings pile (by individual letter) and from the general public (by notices in the Federal Register and press releases). For the Canonsburg site there has been no response to these requests, probably because the small amount of reprocessible material and the long distance to established reprocessing plants make reprocessing uneconomical. For this reason, reprocessing is not included in any of the five alternatives being considered.

3.1.1 Alternative 1 -- no action

This alternative entails leaving the sites in their present condition.

3.1.2 Alternative 2

In this alternative all tailings and contaminated materials, including those at Burrell and at the local vicinity properties, will be placed at Canonsburg.

The Burrell site will be decontaminated and the Canonsburg and Burrell residues stabilized at Canonsburg. The major stabilization activities at Canonsburg fall into three categories: structure demolition, excavation, and burial of contaminated material. The decontamination activities at Burrell include excavating and removing the contaminated material, and filling and grading the site.

Structures that will be demolished at Canonsburg include the industrial park buildings, the railroad spur, the Georges Pottery buildings, and the Wilson Avenue and the George Street residences. (These are shown on Figure 1-3.) Since the latter two structural groups are uncontaminated, their rubble will be dropped into their respective basements without prior cleaning or treatment. The industrial park buildings, however, are contaminated and will be steam cleaned before demolition to remove surface contamination. Their rubble will be stockpiled until it can be buried on the site. The building foundations will be sprayed with an asphalt coating. The railroad spur material is also contaminated and will eventually be buried on the site. Steel will be salvaged from the industrial park and Georges Pottery buildings and transported off the site after being decontaminated, if necessary, to the levels specified in NRC Regulatory Guide 1.86.

The excavation activities at Canonsburg will occur in stages (see Appendix A.1 and Weston, 1982a). The initial stage includes excavating the boundaries of an encapsulation-cell. Figure A-2 shows the encapsulation cell to be constructed in Areas A and B. It may be moved onto the high ground in Area A, and may be broader and flatter than shown, and can be built entirely on grade.

The second stage of excavation at Canonsburg will entail unearthing all of the material in Areas A and C with radium-226 concentrations greater than 100 picocuries per gram. This will result in spot removals in Area A and excavation of a major portion of Area C. The water table in Area C is relatively high, often within 4 feet of the surface. Therefore this area must be dewatered during the entire excavation period. It has been estimated that 300,000 gallons per day must be pumped out initially to depress the water table and 20,000 gallons per day thereafter to maintain a depressed level. These estimates are based on assumed aquifer characteristics. The rate of delivery of this water to the treatment plant can be controlled in order to ensure adequate treatment capacity. This water will be routed through a holding pond and an onsite waste-water-treatment plant before discharge into Chartiers Creek. Discharged water will meet the Federal drinking water standards for radioactive contamination. Since all of the material in Area B with radium-226 concentrations greater than 100 picocuries per gram is deeper than 6 feet, no excavation will take place in this area.

The encapsulation cell to be used at Canonsburg includes a multilayer cover and a low-permeability liner. The cover is designed to limit the radon-222 emanation from the encapsulated materials to 2 picocuries per square meter per second and to limit the water infiltration to as low as 1 percent of the annual-average precipitation. The liner serves the dual purpose of minimizing water movement and passively treating any water that does move through. The cover and liner will be constructed of natural materials brought onto the site from local sources, augmented by admixing with imported bentonite clay to meet permeability and ion-exchange criteria. The permeability will be no more than 10^{-7} centimeters per second. The ion-exchange capacity will be such as to restrict breakthrough to less than 1 percent after 1000 years. The liner consists of a 3-foot layer of compacted clay. The cover will be up to 10 feet thick, consisting of a 3-foot compacted-clay layer above the contaminated material, a 1-foot gravel layer, and up to 6 feet of soil on top. The gravel layer serves as a drain layer; with an adequate final surface slope it will reduce infiltration. Vegetation will be established to reduce erosion and thus to enhance the longevity of the cover.

Burial of the contaminated material at Canonsburg has been scheduled to minimize stockpiling. As soon as a portion of the encapsulation cell is complete, the initial material excavated from Area A will be emplaced. If rail transportation is not used to bring in contaminated material from Burrell, the contaminated material resulting from dismantling the railroad spur into Area A will also be emplaced there. If rail transportation is used, the spur will be revitalized. As an alternative, the imported material could be off-loaded alongside the main railroad line and moved by conveyor onto the site. The Burrell residues will be brought onto the site and deposited directly into the cell. Similarly, the bulk materials from Areas A and C will be deposited in the encapsulation cell as they are excavated. The residues from Area C will be wet and will be mixed with the dry residues from Area A. At the close of each working day the exposed material in the cell will be treated to prevent wind erosion either by spraying with water or by covering with a tarpaulin. If contaminated organic materials are found during waste removal, they will be either shredded and spread over Area A outside the encapsulation cell or containerized in steel drums or other types of approved containers and shipped to an approved low-level commercial waste disposal site. Organic materials in the site buildings may also be contaminated; they will be decontaminated prior to burial at the Canonsburg site. The decontamination process will involve steam washing and wet sand splashing of bulky objects or contaminated wood structures prior to burial.

Approximately 10,000 cubic yards of contaminated material that had previously been brought onto the site from cleaning the vicinity properties will either be encapsulated or spread over Area A and covered with up to 6 feet of soil, depending on its radiation levels.

All of the excavated holes will be backfilled and graded to natural contours. The entire site will be covered with up to 6 feet of cover soil, topsoil, and seeded.

The excavation work at Burrell will entail removing surface-contamination hot spots and other material with a radium-226 concentration greater than 5 picocuries per gram and transporting them to the Canonsburg site. This work will include the original tailings, as well as other material that has become contaminated. Following contaminated-material excavation, the Burrell site will be filled, regraded, and reseeded. Only a minimum amount of fill material will be used.

The major material-handling activities at Canonsburg during Alternative 2 are importing and burying the contaminated Burrell residues, excavating and burying the Canonsburg contaminated material, and importing fill and construction material. The Burrell residues (up to 80,000 cubic yards) can be brought onto the Canonsburg site by 20-ton dump trucks at a rate of 40 trips per day over a 20-week period or by rail in 70-ton side dumping railroad cars in two or three trains per week in approximately the same time.

The contaminated material from the Canonsburg site consists of the following:

Area A preliminary excavation	5,000 cubic yards
Railroad spur material	3,000 cubic yards
Major Area A excavation	10,000 cubic yards
Area C excavation	12,000 cubic yards
Stockpiled vicinity properties materials	10,000 cubic yards
Total	40,000 cubic yards

Miscellaneous contaminated organic material (e.g., wood) would be segregated for shredding and disposal on the site or for shipment to an approved low-level waste site, such as Hanford or Beatty.

With the exception of the Area A rail spur, contaminated organics, and vicinity-properties material, the contaminated material from Canonsburg will be placed in the encapsulation area as it is excavated.

Fill and construction materials for the Canonsburg site will consist of 5,000 cubic yards of crushed stone, 33,000 cubic yards of clay, 18,000 cubic yards of topsoil, and up to 194,000 cubic yards of fill and cover material. It should be emphasized, however, that the estimate of 194,000 cubic yards for cover is an extremely conservative estimate to meet the currently proposed radon emanation standard of 2 picocuries per square meter per second and the assumption that the onsite soils may not be suitable for use as cover material. Relaxation of the standard or use of onsite soils may reduce the amount of soil required to be imported and consequently the rail or truck traffic. These materials will be brought to the site by 20-ton trucks over approximately a 32-week period. Daily truck trips should not exceed 90. The quantities of clay and fill needed could also be delivered by rail. The limiting factor would be the ability to adequately load and unload the cars. The construction materials will be stockpiled on the site and used as needed.

Material handling at Burrell will consist of exporting the contaminated material and importing clean fill. It is estimated that 16,000 cubic yards of clean fill will be required. This will be brought to the site at a rate of 40 truck trips per day over a 4-week period and stockpiled until needed. If trains are used to haul the clean fill, the delivery period would be about the same.

The decontamination of the Burrell site will occur over an 81-week period, while the stabilization of the Canonsburg site will require 96 weeks. (The duration of the four alternatives discussed in this section represents all activity from the first day of site mobilization through the last day of site demobilization. Radioactive-material handling will not necessarily occur over this entire span.) The stabilization of Canonsburg and the decontamination of Burrell are both scheduled to start at the same time. The Canonsburg staffing levels average 28 site workers, with 55 persons during the peak activity. Staffing levels at Burrell will average 19 persons on the site at any one time, with a maximum of 35. Typical construction and earth-moving equipment will be used at both sites. After all remedial action is completed, the stabilized site will be fenced and both sites monitored to ensure the integrity of the work.

3.1.3 Alternative 3 -- the proposed action

This alternative will result in onsite stabilization of the radioactive material at Canonsburg and Burrell separately. The activity at Canonsburg will be identical to that described for Alternative 2, except that there will be no inflow of material from Burrell. This will result in a slightly smaller encapsulation cell at Canonsburg.

The Burrell site will be stabilized in place without excavation. The following description discusses the maximum amount of remedial action that would be necessary at the Burrell site, i.e., the upper-bound (see Appendix A.2 and Weston, 1982b). Based on recent surveys (Rarrick, 1982) there is the distinct possibility that much less work will be required. The most recent solution under study is to remove only the small "hot spots" (about 5000 cubic yards), and simply cover the remainder of the site with soil. For these reasons, the DOE has officially designated the Burrell site as a vicinity property and not a waste repository. Three ponds south of the area containing contaminated material will be converted into a drainage swale (Figure 3-1). The contaminated area will be graded to encourage the runoff of precipitation, and covered with several feet of stone and soil to decrease percolation downward and to prevent excessive erosion.

The remedial action will proceed in several stages. Initially the ponds will be drained and the existing sediment removed to ensure a high-permeability contact with the underlying porous strata. The soil removed will be put on the surface of the contaminated area as an adjunct to rough grading. Several feet of gravel, pea gravel, and soil will serve as a filter over the subdrain.

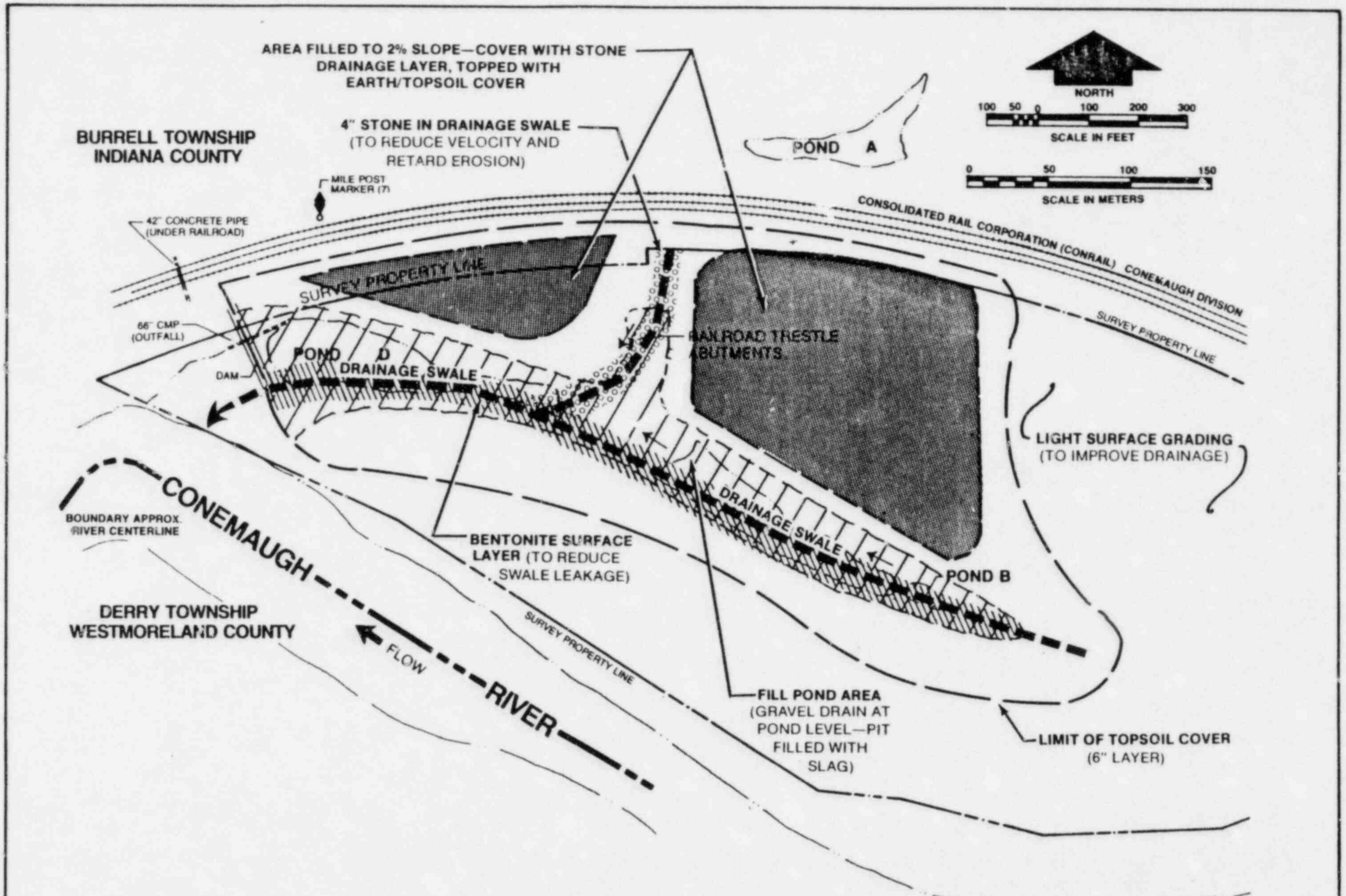

FIGURE
SCHEMATIC PLAN OF SITE STABILIZATION AND CLOSURE —ALTERNATIVE 1
WESTERN PART— BURRELL TOWNSHIP SITE

NOTE: 1. PROPERTY LINE DATA FROM PLAN OF PROPERTY FOR UNION CARBIDE CORP. BY RICHARD G. BACH & ASSOC., ZELIENOPLE, PA-DATED 11/16/77

The surface of the contaminated area will be graded to a 2-percent slope and covered with a stone-drainage blanket consisting of 8 inches of large stone, 4 inches of gravel, and a single thickness of geotextile. Over this will be placed 18 inches of clean soil and 6 inches of topsoil for a total final soil cover of 2 feet. The whole area will be seeded to hasten revegetation.

The slopes of the drainage swale will be kept to no more than 12 percent; where this is not possible, as in the side drainage area shown on Figure 3-1, the channel and part of its side slopes will be covered with coarse stone. A cross-section of the finished stabilized site is shown on Figure B-4. Contours of the final graded site are shown on Figure B-5.

Analysis of this cover configuration indicates that of the approximately 40 inches of rain that falls on the Burrell site, about 7.8 inches will penetrate the underlying contaminated zone. Thus, the surface improvements will mean a reduction in percolation by a factor of four. This reduction should be considered temporary in that decomposition and consolidation of the biodegradable fraction of the fill could cause settlement that may reestablish surface depressions. The extent of consolidation and settlement is impossible to predict with the available data, but it is estimated that the grades proposed are enough to keep infiltration under reasonable control for perhaps 50 years, after which more filling and grading may be necessary.

Material handling at Canonsburg during Alternative 3 entails excavating and burying the contaminated material on the site and importing fill and construction materials. These activities will be performed in the same way as described for Alternative 2.

Material handling at Burrell is limited to importing construction and fill materials. These will consist of 35,000 cubic yards of soil, 15,000 cubic yards of clay, and 20,000 cubic yards of other cap material. These materials will be brought to the site in 20-ton trucks over a 15-week period at a rate of less than 60 truck trips per day. Another method of transportation is by rail using the railroad spur on the site. The material could be delivered in 70-ton freight cars in about the same time period. The construction and fill materials will be stockpiled on the site and used as needed.

The stabilization of the Canonsburg site will require 86 weeks, 10 fewer than for Alternative 2. The staffing levels will average 28 onsite workers, peaking to a maximum of 41.

The stabilization of the Burrell site will occur over a 32-week period, less than half the time required for Alternative 2. The staffing levels will average 15 persons on the site with a maximum of 29.

3.1.4 Alternative 4

Under this alternative all materials with radium-226 concentrations greater than 5 picocuries per gram will be excavated from the Canonsburg and Burrell sites and disposed of at the Hanover site.

The activities at Canonsburg will consist primarily of demolishing buildings, excavating and removing contaminated material, and subsequently filling the excavated holes. The demolition of buildings and the railroad spur will be performed as discussed for Alternative 2, with the exception of the Wilson Avenue residences. These will remain standing, and Ward Street will be returned to public use following the remedial work. The contaminated rubble from the industrial park buildings and the railroad spur (totaling 7000 cubic yards) will also be transported to the Hanover site for disposal.

Significantly greater amounts of contaminated materials will be excavated during this alternative than in Alternative 2, because of the requirement for removing radium contamination rather than simply reducing surface radon flux. Approximately 250,000 cubic yards of material must be excavated at Canonsburg. This amounts to 140,000, 34,000, and 76,000 cubic yards from Areas A, B, and C, respectively. (The stockpiled vicinity-property material will add another 10,000 cubic yards.)

The excavation of Area A will cover a larger general area in comparison to the spot removals during Alternative 2. The excavation of Area C, although involving a greater volume, will be performed as described for Alternative 2, complete with lowering the water table and mixing wet residues with dry Area A material. Unlike the stabilization alternatives, radioactively contaminated material will also be excavated and removed from Area B.

The radioactively-contaminated material will be exported from Canonsburg as it is excavated, with very little stockpiling, over a 46-week period using 20-ton trucks at a rate of less than 70 truck trips per day. Rail transportation may be a feasible alternative to truck use, but it would be necessary to rehabilitate a considerable length of abandoned spur in the Hanover area.

The fill and construction materials used at Canonsburg for this alternative consist of 32,000 cubic yards of road and berm materials, 200,000 cubic yards of clean fill, and 18,000 cubic yards of topsoil. These materials will be brought on the site over a 32-week period at a daily rate of less than 90 truck trips; an alternative transportation method would again be rail. The materials will be stockpiled on the site until used.

The decontamination of the Burrell site will be performed as described for Alternative 2, with the same volume of material, and number of trips. The only difference will be the transportation route for the contaminated material.

Moving the contaminated material from Canonsburg and Burrell will require approximately 46 weeks, at an average daily rate of less than 90 truck trips or with railroad cars.

The construction and fill materials (approximately 200,000 cubic yards total of crushed stone, fill, clay, and topsoil) will be brought to the Hanover site by 20-ton dump trucks over a 52-week period or can be delivered by rail and stockpiled if the spur is rehabilitated.

The decontamination of the Canonsburg site will take place over a 104-week period. There will be an average of 28 persons working on the site at any time. The maximum staff will be 49 persons during the height of the excavation and transporting activities.

The decontamination of the Burrell site will occur over an 81-week period. The staff levels will average 19 persons and peak to 35.

The Canonsburg and Burrell materials will be stabilized at the Hanover site in an encapsulation cell. This repository will be constructed in the same design as that constructed at the Canonsburg site under Alternatives 2 and 3. A leachate-collection system will be installed at the low point in the encapsulation-cell excavation. This system will be in operation during project activities to collect storm water and transport it to the waste-water-treatment plant. Once burial is complete, the collection system will be abandoned.

A temporary water-supply well and pond will be constructed on the site to provide a source of wash water for equipment decontamination. Once a portion of the liner is complete at Hanover, the contaminated Burrell and Canonsburg materials will be brought in. These materials will be placed in the encapsulation cell as they arrive.

The stabilization activities at the Hanover site will require 120 weeks to complete. The onsite staff will average 29 persons, with a maximum of 47.

3.1.5 Alternative 5

This alternative entails decontaminating the Canonsburg site and disposing of the material at the Hanover site, while the Burrell material is stabilized in place.

The activities that will be performed at Canonsburg are identical to those presented for Alternative 4. Excavating and removing the material to Hanover will be conducted in the same way as for Alternative 4. This alternative will require the same length of time and staffing levels.

The Burrell site will be stabilized as discussed for Alternative 3. The same activities, material-handling volumes, transporting rates, staffing, and scheduling will be involved as for Alternative 3.

The stabilization activities at the Hanover site will be generally the same as presented for Alternative 4. The primary difference between these sites will be in the project duration and volume of material to be disposed of. The 80,000 cubic yards of Burrell material will not be brought to the site. The activity at Hanover will take place over 120 weeks. The manpower requirements average 29 people, with a maximum of 47.

3.1.6 Alternatives eliminated from further consideration

Three additional remedial-action alternatives were identified but eliminated from further consideration either for sociopolitical reasons or because they were contrary to the state-proposed guidelines. These alternatives and the reasons for their elimination are discussed in the subsections that follow.

3.1.6.1 Decontaminate the Canonsburg site and stabilize the Canonsburg and Burrell residues at the Burrell site

This alternative would involve transporting the greater bulk of radioactive material over 50 miles from Washington County to Indiana County. This violates one of the guidelines for disposal-site selection imposed by the Commonwealth of Pennsylvania, the one that calls for keeping the tailings within the county they are now in. The people in the vicinity of the Burrell site have expressed the desire to leave the existing tailings in place and stabilize them with minimal disruption; they are also against bringing more contaminated material to the Burrell site. Most important, this alternative requires the construction of a disposal facility that would probably be larger than the Burrell site can handle.

3.1.6.2 Stabilize the Canonsburg site, decontaminate the Burrell site, and dispose of the Burrell residues at the Hanover site

This alternative would also require transporting large quantities of contaminated material across county borders and through metropolitan Pittsburgh. It goes directly against the desire of the people in Burrell Township who want to leave the tailings in place. The costs of this alternative in terms of finances, level of effort, and risks significantly outweigh the benefits; in effect, it would require the same magnitude of costs as Alternatives 2 and 4. Most important, if the Canonsburg site is suitable for stabilization of its tailings in place, it can also take care of the additional volume of Burrell tailings and thus not require two final disposal sites.

3.1.6.3 Decontaminate the Canonsburg and Burrell sites and dispose of the contaminated material in above-ground containment structures

There is no historical experience that demonstrates the ability of any type of above-ground structure to provide long-term isolation with minimal maintenance. The climate of Pennsylvania complicates the problem because it would subject the containment structure to alternating environmental conditions.

The isolation of 330,000 cubic yards of radioactively-contaminated material would require an extremely large structure. In addition to the engineering difficulties associated with this endeavor, serious aesthetic and social problems would occur. The prominence of the above-ground structure would serve as a constant reminder of the presence of the radioactive material.

3.2 ENVIRONMENTAL IMPACTS

3.2.1 Comparison of impacts

The major differences among the remedial-action alternatives (2 through 5) are compared in this section. Chapter 5 contains a complete description of all of the environmental impacts associated with the remedial-action alternatives, and Table 1-3 summarizes these impacts.

One of the two major areas of concern in comparing the alternatives is their radiological impacts. Under the no action alternative, people living near the Canonsburg and Burrell sites will continue to receive radiation doses. The 14,000 people living within 1.24 miles of the Canonsburg and Burrell sites will receive a bronchial dose of 8300 man-rems per year, which could cause 5.4 lung cancer deaths per generation.

Each of the remedial-action alternatives will have about the same short- and long-term effects on population exposure. Exposure during project implementation will be similar to the present level, while after completion, the exposures will be reduced by a factor of 700 from the present level. This will result in an expected increase of 0.0008 lung cancer death per generation among these people. Each of these actions would meet the EPA standards for radioactively-contaminated material disposal. The main difference between the remedial-action alternatives is that, unlike Alternatives 2 and 3, Alternatives 4 and 5 would involve a site presently not radioactively-contaminated.

The alternative actions involve various degrees of excavation and burial of radioactively-contaminated material at the three sites. Alternative 3 would involve the smallest amount of earth-moving activity. The Burrell radioactively-contaminated material would be stabilized in place with no excavation. At Canonsburg, only material with radium-226 concentrations above 100 picocuries per gram and buried less than 6 feet deep would be excavated for encapsulation. The remainder would be stabilized in place by adding a soil cover. The largest amount of excavation and contaminated-material handling would occur during Alternative 4. Under this alternative all of the Burrell and Canonsburg material with radium-226 concentrations greater than 5 picocuries per gram would be moved to Hanover. This would involve a large amount of earth-moving work associated with the installation of the encapsulation area at Hanover.

The second major area of concern is the transportation impacts of the alternatives. Each of the remedial-action alternatives will require extensive handling of both radioactively- and nonradioactively-contaminated materials. Since borrow pits are available near the sites but not near rail lines (Appendix A.6), and the use of railroads would require revitalizing several track sections, rail transport was determined to be not economically viable (Appendix I). Access to each site is by minor roadways. The Canonsburg area will be the most sensitive because the trucks must use narrow, congested roads through residential areas. Alternatives 2 and 3 would entail the least amount of truck traffic into the Canonsburg site. Alternatives 4 and 5 would each require 25,000 total truck trips to the Canonsburg site. Each remedial action will also affect traffic patterns in the vicinity of the Canonsburg site. The temporary closing of Strabane Avenue, a major connecting route between the Borough of Canonsburg and the Village of Strabane, will require motorists to travel over one-half mile to the east or west to cross Chartiers Creek. This could lead to traffic congestion in these two areas.

The remedial-action alternatives will differ in their short-term air-quality impacts. Since the total suspended particulate background level already exceeds the NAAQS secondary standard, Canonsburg and Hanover exceed the annual total suspended particulate primary standard in all of the alternatives. Hanover also exceeds this standard in Alternatives 4 and 5. In addition, the NAAQS for nitrogen oxide at the Canonsburg site, and hydrocarbons at the Hanover site may be exceeded.

Socioeconomic [illegible] at the sites will differ depending on the alternative considered. Stabilized sites (Canonsburg under Alternatives 2 and 3, Burrell under 3 and 5, and Hanover under 4 and 5) will be permanently committed as disposal sites and will not be available for future development. All alternatives will create offsite land-use impacts at the Canonsburg site. Under Alternatives 2 and 3, seven houses adjacent to the site will be permanently closed. Under Alternatives 4 and 5 these houses will be closed for two or three years. Strabane Avenue in Canonsburg will be closed for several years during all four remedial-action alternatives; Wilson Avenue and Ward Street will be closed permanently under Alternatives 2 and 3, and closed temporarily under Alternatives 4 and 5.

None of the alternatives will cause large-scale population changes. There will be a permanent relocation of the persons occupying the seven houses on Wilson Avenue and George Street under Alternatives 2 and 3, and a temporary relocation of them during Alternatives 4 and 5. There will also be a slight difference in staffing requirements. Because most of the remedial-action workers will be from within the Pittsburgh area, there will be only a slight, short-term population shift. None of these levels is high enough to have a serious effect on local housing or community services.

Each of the alternatives will have a small economic impact in the project areas. Closing the Canon Industrial Park (Alternatives 2 through 5), and closing the seven houses at Canonsburg (temporarily during Alternatives 4 and 5, and permanently during Alternatives 2 and 3) will eliminate the tax revenues collected from these land uses. Because the workers will not be permanent residents of the local area, only a portion of their income will flow into the local economy. Material and supply purchases will be the major portion of project funds injected into the local economy.

3.2.2 Mitigating measures

Each remedial-action alternative (2 through 5) will include the same types of mitigation controls to prevent or lessen, potential environmental impacts during project implementation.

Radiation releases and human exposure will be controlled by a combination of physical and management techniques to reduce wind and water erosion and to minimize direct human contact with the contaminated material. Contaminated material will be covered each evening with tarps or water, if needed. Under high-wind conditions no contaminated material would be handled. The offsite transport of dust would be controlled by washing trucks before they leave the site and by containing their loads with tight-fitting covers and tailgates.

Water erosion of contaminated materials is a possibility for all actions except stabilization at Burrell, since that alternative would not expose radioactive material. Erosion control berms will be installed at each site around all areas where radioactively-contaminated material is exposed. There will also be a berm built along the entire length of Chartiers Creek at Canonsburg for all remedial actions and along the bank of the Conemaugh River under Alternatives 2 and 4. These structures will keep water from flowing into the contaminated areas, and will collect all precipitation falling into these zones. All collected water will be routed to the waste-water treatment plant before being disposed of in the creek or river. The waste-water-treatment plant will treat precipitation, runoff, process waste-water, and pumped ground water to meet the NPDES standards. Direct human contact with radioactive materials will be minimized by restricting access to the project sites. Protective equipment will be provided to the remedial-action workers, as needed.

Nonradiological air-quality impacts will be reduced by the use of exhaust controls on equipment and vehicles, and by dust control in work areas. Fugitive dust will be controlled by the same measures used to prevent wind erosion of the radioactive dust.

The noise generated by equipment and vehicles will be reduced by the use of mufflers. In addition, noise levels experienced off the site will be lessened by scheduling activities during daylight hours only.

Mitigation of transportation-related impacts will rely largely on route selection and scheduling. Traffic routes will be selected and hauling activities scheduled to avoid the most sensitive areas and times, i.e., school zones during school hours.

Following project completion, a monitoring and maintenance program will be conducted for the final stabilized disposal site as required under the terms of the license issued by the NRC. This program will include measures for protecting structure integrity, such as restricting tree growth over the stabilized area and establishing a complete site security system. Studies to monitor the effectiveness of the stabilization will be conducted with emphasis on possible air and ground-water contamination.

3.2.3 Summary of impacts

There are three major issues to be faced in comparing impacts. They are radiological isues, transportation issues, and costs.

Alternatives 2 through 5 will all met the EPA standards. Alternative 1 will not, and is therefore unacceptable.

The remedial-action alternatives (2 through 5) will all reduce the residual population doses from the contaminated material nearly to background levels. However, there are minor differences in levels of population exposure during the remedial action, as well as differences in who will be affected; i.e., people near the Canonsburg and Burrell sites under all of the alternatives, and people near the Hanover site under Alternatives 4 and 5.

This EIS assumes that the considerations detailed in Appendix I will dictate the use of trucks rather than rail transportation to bring in fill dirt and to move out contaminated material. Fill dirt is needed at the Canonsburg and Burrell sites in all of the remedial-action alternatives, and at the Hanover site for Alternatives 4 and 5. No contaminated material must be moved from Canonsburg under Alternatives 2 and 3, or from Burrell under Alternatives 3 and 5. This material will be taken to Hanover under Alternatives 4 and 5. This movement involves not only the use of large trucks on minor roads, but also public concern about radiation exposure.

The costs associated with the alternatives are summarized in subsection 5.13.2. They differ by a factor of three, in the following order: Alternative 3 ($13.7 million), Alternative 2 ($24.2 million), Alternative 5 ($34.5 million), and Alternative 4 ($44.5 million).

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4 AFFECTED ENVIRONMENT

4.1 A BRIEF DESCRIPTION OF THE REGION AND THE AFFECTED AREA

4.1.1 Regional characteristics

The Canonsburg, Burrell, and Hanover Township sites are located within 70 miles of each other in southwestern Pennsylvania (see Figure 1-1). They are situated south, east, and west, respectively, of the City of Pittsburgh, which is the major industrial and population center of the region. Secondary economic centers include the City of Johnstown to the east and the Cities of Steubenville, Ohio, and Weirton, West Virginia to the west.

Economic growth and development in southwestern Pennsylvania is heavily influenced by its geologic features. This region lies within the Appalachian Mountain system and contains rich coal seams and numerous natural gas and oil deposits. Coal, oil, and gas are the major natural resources of the region. Washington County, which includes the Canonsburg and Hanover sites, and Indiana County, which includes the Burrell site, are the leading coal-producing counties in Pennsylvania, ranking first and second, respectively.

These geologic resources are also responsible for shaping the industrial character of this area. Electricity-generating facilities are primarily coal-fired. Industrial activities are dominated by steel and primary-metals production, while the major manufacturing activities are centered around machinery production, including mining equipment, glass products, and electrical equipment.

The major renewable resource in southwestern Pennsylvania is forest land. In several counties, forests account for the greatest land use, making this area a leading producer of forest products. Agricultural production is the second largest user of land in this area. Much of the farmland is dedicated to dairy and livestock production because the rugged topography often limits field-crop production. The forests in southwestern Pennsylvania support a significant wildlife population, and hunting is a popular recreational activity.

The overall pattern of land-use development in southwestern Pennsylvania is one of distinct communities set in a region dominated by rural areas and open space. Coal mines and oil and gas fields occur throughout the region, while manufacturing activities generally occur in association with the larger communities.

Southwestern Pennsylvania is connected to the greater regional area by a well-developed transportation network. The Greater Pittsburgh International Airport, the Ohio River, and various rail lines and interstate highways, such as I-79 running north and south and I-70 running east and west, provide interstate service. Population and industrial centers within the region are interconnected by numerous highways and rail lines. The layout of the local highway system is typically influenced by the topography. As a result, the roads are often narrow with steep slopes, abrupt curves, and poor surfaces.

The region contains an extensive surface-water network that eventually drains into the Ohio River system. The most notable surface-water feature of this area is the confluence of the Allegheny and Monongahela Rivers in Pittsburgh, forming the Ohio River. The headwaters of the area's streams generally have good water quality and support healthy fisheries. However, much of the downstream water quality is adversely affected by acid drainage from mining activities. As a result, many streams are characterized by a low pH and are high in iron, sulfates, and total dissolved solids.

The air quality in southwestern Pennsylvania is classified as attainment for the National Ambient Air Quality Standards (NAAQS) for all criteria pollutants except photochemical oxidants. (Ozone is a regional problem, with the entire state of Pennsylvania classified as a nonattainment area.) However, the potential exists for temporary poor air-quality conditions locally. The rugged terrain tends to decrease wind speeds, which increases the potential for a buildup of high concentrations of airborne pollutants. Manufacturing activity is mainly concentrated in valley areas such as the Ohio, Allegheny, and Monongahela River valleys and, in conjunction with coal-mining operations and coal-fired power plants, is capable of generating significant air impacts. During temperature inversions, when air masses remain in a confined area, contaminants can reach unhealthy levels.

4.1.2 Canonsburg site

The Canonsburg site is located in the Borough of Canonsburg, in northern Washington County, approximately 20 miles southwest of downtown Pittsburgh (Figure 1-1). It is situated at the intersection of George Street and Strabane Avenue (Figure 1-2). It is bounded by Chartiers Creek on the east, north, and west, and the ConRail right-of-way on the south. The site is located within a densely developed urban area. Residences are as close as 250 feet to the site.

The site consists of three basic areas: the former Vitro Rare Metals Plant (18.5 acres), the former Georges Pottery property (6 acres), and several nearby residences (6 acres) (Figure 1-3). The area designated by the UMTRCA is the Vitro property; the other areas are needed in the various remedial-action alternatives. The Vitro property contains the radioactively-contaminated material. The Vitro property is divided into three separate areas: A, B, and C. Area A covers 11 acres and is bounded by Ward Street, Strabane Avenue, George Street, and the former W. S. Georges Pottery Company. All of the buildings on the Canonsburg site are situated in Area A. Area B covers approximately 4.5 acres and is vacant. It is bounded by Chartiers Creek, Strabane Avenue, Ward Street, and the no-longer-operating Washington-Canonsburg Street Railway right-of-way. Area C covers 3 acres and is also vacant. It is bounded by Chartiers Creek, Strabane Avenue, and the ConRail right-of-way.

The former Vitro property is owned by the Canon Development Company which has operated it as the Canon Industrial Park since 1962, but it is in the process of being condemned by the Commonwealth of Pennsylvania in accordance with the provisions of the DOE-Pennsylvania cooperative agreement, entered into under PL 95-604, Section 104. As of December 1981 there were three firms, employing a total of 25 persons, located on the site.

4.1.3 Burrell site

The Burrell site is located in Burrell Township along the southern border of Indiana County (Figure 1-1). It lies approximately 40 miles east of Pittsburgh, and 1-mile east of the Town of Blairsville. It is situated about 50 miles in a straight line from the Canonsburg site. The Burrell site lies within a bend of the Conemaugh River along its northern bank (Figure 1-4). The ConRail main line passes along the northern boundary of the site (Figure 1-5). The Burrell site consists of 50 acres, which is a portion of a larger tract presently owned by the James Burrows Company. There are no structures on the property, and except for the ConRail right-of-way along the northern boundary, there are no public thoroughfares. The most outstanding surface features of the site are two steep-banked ponds (three at low water) located within the western sector. These correspond to ponds B, C, and D on Figure 1-5. Pond A is included on the figure only for completeness; it is not contained on the site. The general area of the Burrell site is sparsely developed; the nearest residence is 500 feet away.

4.1.4 Hanover site

The Hanover site is located in southwestern Pennsylvania in Hanover Township, Washington County (Figure 1-1). It is approximately 25 miles from downtown Pittsburgh and 16 miles from the Canonsburg site. The nearest community is Burgettstown, which lies 3 miles to the east of the site. Steubenville, Ohio and Weirton, West Virginia are 10 and 6 miles to the west, respectively. The area considered in Hanover Township covers about 50 acres of a much larger parcel of land owned by Starvaggi Industries (Figure 1-8). The Hanover site consists of a long dry trench that was formed as a result of strip-mining activities (Figure 1-9). There are no structures on the site, and the only access is by unimproved gravel-access roads along its eastern and western boundaries. The Hanover site is surrounded by a large amount of uninhabited land. There are only a few residences within the general area; and the nearest home is over 2000 feet away from the site.

4.2 DESCRIPTION OF THE CANONSBURG AND BURRELL SITE RESIDUES

4.2.1 Canonsburg site

The Standard Chemical Company was the initial operator of the Canonsburg reprocessing facilities from 1911 to 1922, engaged in extracting radium from carnotite ore. Operations ceased from 1922 until 1930 when the Vitro Manufacturing Company (Vitro) acquired the plant. Vitro extracted radium and uranium salts from onsite residues and carnotite ore from 1930 to 1942. After 1942, the plant was operated under Federal government contracts to recover uranium from various ores, concentrates, and scrap materials. Vitro records show that in October 1948, approximately 15 tons of uranium oxide (U_3O_8) were being extracted per month from 150 tons of waste received from different AEC installations.

Under the AEC contract requirements, Vitro retained its process wastes on the site. These were maintained as open piles in various site areas. Liquid wastes were discharged into the former swamp in Area C through a drainage system beneath Strabane Avenue. The swamp was connected by a drainage ditch to Chartiers Creek. (This swamp is no longer in existence.)

In 1955 Vitro's responsibility to store its wastes on the site expired. The AEC's Oak Ridge Operations Office approved the transfer of 11,600 tons of radioactively-contaminated material to the Burrell site. This material, estimated as containing approximately 6 tons of uranium oxide, was transported to the Burrell site from late 1956 to early 1957.

Recovery operations at the Vitro plant ceased in 1957. The remaining unprocessed residues and contaminated processing wastes remained stored on the site under an AEC "storage only" license. The real property was sold in 1962 to developers, while Vitro retained title to the uranium-containing materials. Before 1964, an effort was made to decontaminate the immediate plant area, and all contaminated materials were moved to a main stockpile of uranium ores, located in Area A. In 1965, this pile was moved to the swamp in Area C, buried beneath a relatively impermeable layer of "red dog" (a steel-milling slag), and covered by clean fill material. Following this action, the company's source-material license was terminated. The Vitro property was then developed into its present use as the Canon Industrial Park.

Radiological surveys were made of the former Vitro property in 1977 under the Atomic Energy Commission's 1974 "Formerly Utilized MED/AEC Sites Remedial Action Program" (Leggett et al., 1978). It was determined that significant amounts of contaminated material remained on the site and that the radiation levels measured in the buildings, soils, and ground water exceeded the current as well as present EPA and NRC standards and guidelines (10 CFR 20, Regulatory Guide 1.86, 40 CFR 192 (proposed)).

The former Vitro property exhibits a widely distributed, heterogeneous pattern of radioactive contamination in each of its three areas: A, B, and C. This material consists of unprocessed ores, contaminated soils, waste sludges and fines, and building materials. These materials are distributed from the surface to a depth of 16 feet. Decontamination of the Canonsburg site to a radium-226 (Ra-226) concentration of 5 picocuries per gram would require removing approximately 250,000 cubic yards of material.

Surveys of Area A indicate that radium-bearing residues are present in soil beneath and adjacent to many of the buildings as well as in the top few feet of soil over much of the area. Virtually all of the surface soils in Area A exceed the EPA radium-226 soil-concentration standard (40 CFR 192 (proposed)). Alpha-contamination levels, beta-gamma dose rates, and external gamma-radiation levels in some areas of the buildings and outdoors in Area A are above NRC standards (10 CFR 20). Radon, radon-daughter products, and thorium-230 levels in building air are also above NRC standards (10 CFR 20) in many places. The ground water in Area A contains concentrations of radium and uranium above the NRC standards. Subsurface contamination in this area occurs within 8 feet of the surface, mostly at depths of 0 to 4 feet.

Area B is also above EPA and NRC standards (10 CFR 20, 40 CFR 192 (proposed)) for radioactivity, although with lower contamination levels than Area A. Beta-gamma dose rates, external gamma-radiation levels, radium in soil, and uranium and radium in ground water are all above the applicable NRC and EPA standards (10 CFR 20, 40 CFR 192 (proposed)). The 2- to 6-foot layer of contaminated soil on this area appears to be under approximately 8 to 9 feet of clean fill, which has held surface radiation levels in this area below those of Area A.

Area C, a former lagoon area, was used as a depository for liquid wastes during uranium- and radium-recovery operations. The surface and subsurface soils are more contaminated than Areas A and B. A mucky material remains beneath the surface, with concentrations of uranium and radium well above the NRC standards. Federal standards (40 CFR 192 (proposed), 10 CFR 20) for soil radioactivity, ground-water radioactivity, and dose rates are exceeded in this area. Surveys indicate that this area is contaminated to a depth of approximately 16 feet.

4.2.2 Burrell site

The Burrell site was never operated under an AEC license. The radiological contamination is the result of a one-time disposal operation. From October 1956 through January 1957, Vitro, with the approval of the AEC and the Pennsylvania Railroad, disposed of approximately 11,600 tons of residues from its Canonsburg facility at the Burrell site. This amount included 6000 cubic yards of radioactive residues, 4000 tons of water, and 1600 tons of possibly noncontaminated material. This material reportedly contained carbonate cake, pitchblende, calcium fluoride, and magnesium fluoride (Leggett et al., 1979).

These materials were further described as containing an average of 0.097 percent uranium oxide by weight (or about 6 cubic yards of uranium oxide), which corresponds to approximately 1.5 curies of uranium-238. The Canonsburg residues were transported by rail to the site and stockpiled in a relatively small section between a railroad spur and the disposal area in the western portion of the site. From there they were pushed by bulldozer into the disposal area. This type of disposal did not allow the residues to mix uniformly with uncontaminated material and resulted in virtually all of the Vitro material being located in a small section of the disposal area. The residues were covered with an uneven layer of uncontaminated material.

The contaminated material is located in a 9-acre area in the vicinity of the ponds in the western portion of the site (Leggett et al., 1979). The radioactive material occurs from the surface to a depth of 36 feet. Field surveys by ORNL (Leggett et al., 1979) indicated that more than 75 percent of the material was located at least 10 feet below the surface. It was estimated that the total radium-226 and uranium-238 activity in this material is 4 curies and 1.3 curies, respectively. This would include the Vitro residues and any other material that has become contaminated. Recent surveys (Rarrick, 1982), conducted by Roy F. Weston, Inc. and Bendix Field Engineering Corporation have indicated that there may be significantly less contaminated material remaining on the site. This, in turn, implies that a much smaller remedial-action plan is necessary. The Burrell site has been declared a vicinity property, and remedial action may consist of removing a minimum (5000 cubic yards) of contaminated material and covering the rest of the site with a minimum soil cover.

4.3 WEATHER

Weather data for the Canonsburg site were collected from a meteorological monitoring station operated at the site (Figure 1-3) (Appendix B.1), which measured wind speed, wind direction, and temperature from 1979 through 1981. An identical system was installed at the Burrell site; however, within a month it was vandalized. Based on the one month's worth of simultaneous monitoring (Appendix B.1), wind estimates for the Burrell site for 1979 through 1981 were derived by altering Canonsburg values to reflect Burrell's topographic conditions. This was done by making a 30-degree clockwise shift in the recorded Canonsburg wind directions. Average temperature and precipitation information for the Burrell site were obtained from the Indiana Airport, approximately 15 miles to the north.

The Hanover site meteorological data were obtained from measurements made at the Pittsburgh International Airport for the 1979 through 1981 period. The airport is located 13 miles east of the site and has a similar topographic setting.

4.3.1 Weather patterns

The Canonsburg, Burrell, and Hanover sites are located in the humid continental climatic region. This region experiences distinct seasons with seasonal variations slightly moderated by the nearness of the Great Lakes and the Atlantic seaboard.

The regional climate is dominated by a succession of low- and high-pressure centers and fronts that migrate through the area during the year. The constant movement of these weather systems from west to east and the sites' proximity to moisture sources (i.e., the Great Lakes) provide a generally uniform distribution of precipitation and winds in the areas of relatively flat, open terrain.

The summer season is generally mild but frequently humid because of invasions of tropical air from the Gulf of Mexico. The winter months are brisk with occasional periods of extreme cold. Cloud cover is persistent during the winter because of the frequent passage of moisture-laden air masses from the Great Lakes and the region's location in the path of west-to-east migratory storms. Spring and fall are transitional seasons with moderate-to-cool temperatures. Rapid and wide variations in day-to-day weather conditions are common during the spring and fall.

4.3.2 Temperature

Temperatures for this region from 1979 through 1981 ranged from 99°F in the summer to -18°F in the winter (Table B.1-2). July and August are typically the warmest months of the year, while December, January, and February are the coldest. During the winter it is not uncommon for subfreezing temperatures to persist for 1 to 2 weeks.

The average annual temperature in the region is approximately 50°F as reported for all three sites. Average winter temperatures range between 28°F at Canonsburg to 32°F at Hanover, while summer temperatures average between 68°F at Burrell to 70°F at Hanover and Canonsburg.

4.3.3 Precipitation and floods

Precipitation in this climatic region primarily results from cyclonic storms in winter, spring, and fall; from thunderstorms in the summer; and infrequently, from remnants of hurricanes and tropical storms in late summer and fall. The annual precipitation in this area is fairly evenly distributed throughout the year.

Precipitation in the Canonsburg-Hanover vicinity averages 37.0 inches per year. March and June are the wettest months, averaging 3.8 inches each, while February and November are the driest, averaging 2.4 inches each. The average annual snowfall in the Canonsburg-Hanover area is 45.3 inches, and has varied from 16.6 inches to 82.0 inches. The snow season typically occurs from October to May with the heaviest fall in January.

The average annual precipitation in the Burrell vicinity is 44.4 inches. The highest monthly precipitation occurs in June and July, and the lowest occurs in December. The snowfall values for the Canonsburg-Hanover vicinity are also representative of Burrell.

Canonsburg and Hanover precipitation events are based on data from the Pittsburgh International Airport for the period from 1941 to 1980. Precipitation for Burrell is from the Indiana Airport. No data are available on extreme events for Burrell; however, information for extreme events from Pittsburgh would be representative because these events generally occur as a result of large-scale systems that affect the entire three-site area.

Although thunderstorms are common in the vicinity of the Canonsburg, Burrell, and Hanover sites during the spring and summer months, hurricanes or low-pressure-tropical systems rarely affect the region. Approximately 36 thunderstorms occur annually, most frequently in summer (June, July, and August). Tornados are rare, but can occur during the summer.

Since 1931 an average of only two hurricanes reach the United States coast each year. Significantly fewer storms will actually affect the study area. Based on data collected since 1953 only 1.2 tornadoes occur in Pennsylvania each year. Only 8 tornadoes were reported in the three-site area between 1916 and 1950, which translates into an average of 0.25 tornadoes per year.

A portion of the Canonsburg site is located in the flood plain of Chartiers Creek (Figure D.1-1), which has a history of flooding. The most significant flooding occurred in 1912. Other major floods occurred in August 1956, April 1961, March 1963, and February 1966 (Federal Emergency Management Agency, 1979).

Although the Burrell site is within the maximum flood pool of the Conemaugh River (Figure D.1-3), the potential for flooding at this site is believed to be minimal since even Hurricane Agnes in 1972, considered to be a 1000-year storm, did not create a flood pool high enough to inundate the site. During that storm the two onsite ponds did not completely fill.

The Hanover site is located on a plateau and therefore is not subject to flooding.

Preliminary conversations have been held with the U.S. Army Corps of Engineers, which has jurisdiction over Federal projects in flood plains and wetlands, pursuant to Executive Orders 11988 and 11990. The Corps has indicated that probably no permit will be required to do the work needed at Canonsburg under any of the proposed alternatives. The Burrell site is subject to a perpetual easement for flood control, and the terms of that easement will have to be modified to be consistent with whatever remedial action is carried out there.

4.3.4 Winds

The Canonsburg site is situated in the east-to-west-oriented Chartiers Creek valley, which channels wind flows. As a result, the predominant wind direction (occurring over 50 percent of the time) is from the west-to-northwest sector (Figure B.1-1). Cross-valley flows (north and south) are limited to periods of relatively high wind speeds. These typically occur in the winter as northerly winds. The average annual wind speed as measured from 1979 to 1980 at the Canonsburg site is 4.7 miles per hour. Over 90 percent of the recorded wind speeds were less than 11.2 miles per hour, and none exceeded 22.4 miles per hour. Calm periods (wind speeds less than 0.7 miles per hour) occurred less than 2 percent of the time.

The Canonsburg site is strongly affected by the topography of the surrounding area. The relatively high hills south and north of the site tend to shield the area from high-speed winds in these quadrants. The elevated terrain induces a drag on the wind causing a decrease in speed and a corresponding change in direction. The lower wind-speed conditions reduce the potential for significant transport of pollutants from the site and increase the potential for relatively high localized-pollutant concentrations. The low wind-speed conditions, which are generally associated with either very unstable or very stable conditions, will contribute to higher localized pollutant concentrations. The low wind-speed conditions, in conjunction with the high frequency of up-valley winds, will further enhance the potential for the high pollutant concentrations.

The predominant wind direction at the Burrell site is from the west and northwest sectors (Figure B.1-2). The wind distribution reflects the strong topographic influence on local wind conditions. The wind-speed distribution at Burrell is very similar to that at Canonsburg.

The Burrell site is also strongly influenced by local topography. High hills to the north and east of the site tend to shield this area from the winds in these quadrants. Similar reductions in speed and corresponding changes in direction will occur at this site because of the effects of the hills. The reduction in wind speed will reduce the potential for transport of pollutants off the site, but will increase the potential for locally high pollutant concentrations. Stability, dispersion, and mixing are likely to occur similarly at Burrell, as for Canonsburg.

The wind distribution at the Hanover site is generally uniform, indicating that winds here are not strongly influenced by the topography (Figure B.1-3). Although the predominant wind direction is westerly, a southerly flow is common during the warmer months. The average annual wind speed at Hanover is 9.4 miles per hour, with more than 80 percent less than 11.2 miles per hour. Calm periods exist only 9 percent of the time, while wind speeds greater than 22.4 miles per hour occur less than 2 percent of the time.

The strong similarity between the two-year (1979 to 1980) average wind-direction data for the Hanover site and the ten-year average wind-flow data suggest that the two-year data used at the other sites are also representative of longer-term wind conditions.

The Hanover site is located on a plateau that is at least as high as the surrounding hills, making it unlikely that winds would be affected by the terrain. The potential for offsite transport and dispersion of pollutants at Hanover is greater than for the other two sites, resulting in a lower potential for a local buildup of pollutants.

4.4 AIR QUALITY

The Canonsburg, Burrell, and Hanover sites are all located in the southwest Pennsylvania Interstate Air Quality Control Region (AQCR). None of the sites are located in an air basin designated by the Pennsylvania Department of Environmental Resources (PA DER). Air-quality standards adopted by the PA DER include the National Ambient Air Quality Standards (NAAQS) and Pennsylvania standards (Table B.2-1). These standards cover the following pollutants:

1. National Ambient Air Quality Standards.
   a. Carbon monoxide (CO).
   b. Nonmethane hydrocarbons (included for completeness. This standard is currently not being enforced by the EPA).
   c. Nitrogen dioxide (NO_2).
   d. Ozone (O_3).
   e. Total suspended particulates (TSP).
   f. Sulfur dioxide (SO_2).
   g. Lead (Pb).

2. Pennsylvania standards.
    a. Settleable particulates.
    b. Beryllium.
    c. Sulfates.
    d. Fluorides.
    e. Hydrogen sulfides.

The region is classified as attainment for all criteria pollutants except photochemical oxidants (ozone). The entire state of Pennsylvania has been designated as nonattainment for ozone. Based on measurements at Johnstown, Pennsylvania and for the Lower Beaver Valley Air Basin, the average annual concentration is approximately 0.020 parts per million. This is a reasonable estimate of the background ozone concentrations for the three sites because ozone is a regional pollutant, meaning that the levels reported in nearby basins should be similar. The only air-quality data that are collected in this area that are representative of conditions at Canonsburg, Burrell, and Hanover are total suspended particulates and sulfur dioxide (Osmon, 1982). Total suspended particulates are routinely measured in the City of Washington, approximately 8 miles southwest of Canonsburg. Sulfur dioxide is measured in the City of Florence, in northern Washington County at the intersection of Routes 22 and 18, about 18 miles northeast of Canonsburg. The monitors at Washington and Florence are the only ones near the sites that are not significantly impacted by nearby sources. The Pennsylvania DER confirmed these sites as being the most representative for the Canonsburg-Burrell-Hanover area.

The total suspended-particulate data collected in 1981 indicate that the annual geometric-mean concentration was 67 micrograms per cubic meter, which is 80 percent of the primary standard and 112 percent of the secondary standard. The maximum 24-hour concentration measured during 1981 was 194 micrograms per cubic meter, and the second highest value was 119 micrograms per cubic meter. The second highest value was 46 percent of the primary standard and 79 percent of the secondary standard.

Sulfur-dioxide data collected in 1981 indicated a mean annual concentration of 0.018 parts per million (60 percent of the primary standard). The maximum 3-hour concentration measured was 0.204 parts per million (61 percent of the primary standard), and the maximum 24-hour concentration was 0.065 parts per million (46 percent of the primary standard).

4.5 SURFACE AND SUBSURFACE FEATURES

4.5.1 Topography

4.5.1.1 Canonsburg site

The topography of the Canonsburg site, originally a low-lying flood plain, has been altered through filling and earth-moving activities (Figure C.1-1). The site's general slope is from the southwest corner of Area A toward Chartiers Creek, with a total relief of 30 feet. Area A, which contains buildings and a railroad spur, exhibits the greatest relief. Area B is a plateau that is elevated 7.5 feet above its perimeter; it was created through the disposal of dredged material from Chartiers Creek. Area C is the lowest portion of the site and is relatively flat. Georges Pottery and the Wilson Avenue residences also exhibit minimal relief except where the site drops off sharply to the creek along the northern and western sides.

The natural soil structure of the Canonsburg site has been disturbed by site use. The soil materials exhibit a wide variation in characteristics (Table C.1-2). The soils range from sandy loams to silty clay loams (Table C.1-1). Coarser materials (sandy loams) are found in Area B as a result of the disposal of dredged materials. The finer materials represent the site's natural flood-plain soils. The soil pH ranges from a low of 2.8 in Area C where the steel-mill waste (red dog) was placed, to a high of 7.5 in association with the natural alluvium along Chartiers Creek.

The organic content of the soils ranges from 0.10 percent in the natural soil to 11.09 percent in the dredge fill. The cation-exchange capacity follows a similar trend of 9.4 milliequivalent per 100 grams in the natural soils to 31.7 milliequivalent per 100 grams in the dredged material (due to the high organic content).

Soil-infiltration rates (the rate at which water enters the soil surface), range from 5.5×10^{-6} to 3.9×10^{-3} inches per second (Table C.1-3). The slowest rates are found in the undisturbed soil profile in Area A at a depth of 24 inches, while the rate for the dredged material and flood-plain soils ranges from 7.0×10^{-4} to 3.9×10^{-3} inches per second.

Soil-percolation or permeability rates (the rate at which water moves through the soil in all directions) ranges from 1.7×10^{-4} to 1.6×10^{-3} inches per second in the natural soils and from 1.1×10^{-5} to 2.2×10^{-4} inches per second in the disturbed and dredged soils.

4.5.1.2 Burrell site

The Burrell site is a plateau formed by landfilling. Its major topographic feature is an east-to-west trending valley about 40 feet deep that occupies approximately 25 percent of the site area (Figure C.1-2). This valley remains from the previous site-filling operations. The valley contains two ponds. The remainder of the site varies in elevation between 970 and 980 feet from the north to the south across a 1300-foot horizontal distance. There is a 50-foot drop from the edge of the plateau to the river.

Soils at the Burrell site have also been disturbed by excavating and landfilling operations. No original soils were encountered in the study areas; instead, fill material was found to depths of 50 to 60 feet. The fill consists of gravelly loam and sandy loam mixed with ashes, cinders, gravel, railroad ties, bricks, boards, and sandstone fragments (Table C.1-4). There are numerous voids throughout the fill due to its random placement and settling. Soil percolation rates range from 6.7×10^{-4} to 2.8×10^{-3} inches per second. Soil infiltration rates range from 1.7×10^{-4} to 6.2×10^{-3} inches per second (Table C.1-5).

The fill material at the Burrell site, which includes railroad ties and bulky debris with very little natural soil, is not conducive to determining soil characteristics such as percent organic matter and cation exchange capacity. This material could not be sampled or analyzed as soil. The site is presently fully covered with herbaceous and woody plants, and its soil-like material is stabilized to the same degree that it would be following remedial action. Thus, the present soil loss is virtually the same as that estimated after remedial work; i.e., less than 5 tons per year for the entire site (Table A.5-2), a negligible amount.

4.5.1.3 Hanover site

The Hanover site is located in a broad trench on a ridge top formed during strip-mine reclamation (Figure C.1-3). The trench walls are composed of mine rubble and reach elevations of 1250 feet. The trench floor slopes gently from north to south, from elevations of 1180 to 1170 feet.

Soils at the Hanover site have been disturbed during strip-mining operations; therefore, at present they do not exist as a stratified unit. The soil material at the site is a composite of medium-textured loams, sandy loams, and silty loams. The soil is mixed with numerous sandstone, shale, and coal fragments ranging in size from small gravel to boulders over 2 feet in diameter (Table C.1-6). Percolation tests revealed rates from 5.5×10^{-5} to 1.2×10^{-3} inches per second (Table C.1-7). This range indicates that once precipitation enters the unsaturated fill, it moves through the material at a moderately rapid rate. Like the Burrell site, the Hanover site is composed of disturbed and fill material; therefore, it is extremely difficult to determine the soil characteristics. The steep slopes (7 to 8 percent) over most of the site, poor soil management, and the shale-sandstone composition of the overburden contribute to soil loss. However, because of the unevenness of the terrain, the runoff is detained during a rainfall, providing time for solids to settle out of solution. The total suspended solids in runoff recorded during a sampling program were low, averaging 1.1×10^{-4} pounds per gallon (Table D.1-12).

4.5.2 Rock structure

4.5.2.1 Canonsburg site

The Canonsburg site is underlain by fill, alluvium, and bedrock (Figure C.2-1). The thickness of the fill on the site ranges from 8.9 feet to less than 1 foot. The most common component of the fill in Areas A and C is cinders mixed with soil, gravel, and building rubble. Area B has been filled with dredged material from Chartiers Creek; this gray sandy silt ranges from 3.9 feet to 19.7 feet thick. Alluvial material deposited during flood stages of Chartiers Creek is found on the edge of the site.

Bedrock under the entire site is a part of the Conemaugh Formation of Pennsylvanian age. The rock types are gray limestone with shale partings and limey shale. The shale near the bedrock surface is weathered to thin brittle plates 0.3 to 0.5 inch thick. There is approximately 36.5 feet of relief on the bedrock surface beneath the site. The general trend of the bedrock topography is toward the northeast and Chartiers Creek. The exposure of the Conemaugh Formation at the surface in the creek is apparently the result of erosion by Chartiers Creek. There are no bedrock exposures on the site. Off the site south of George Street, the Monongahela Formation overlies the Conemaugh Formation. The lowest unit of the Monongahela Formation is the Pittsburgh coal that is mined extensively in the area.

4.5.2.2 Burrell site

Subsurface conditions at the Burrell site are the result of former site uses (Figure C.2-2). The site is underlain by three separate materials: fill, unconsolidated sediments, and sedimentary rocks (Figure C.2-3). The fill material consists of railroad ties, ashes, rubble, coal, and scrap metal. The thickness of the fill varies; the maximum thickness is approximately 56 feet. Unconsolidated sediments underlie the fill and include both colluvium (or talus) and alluvium. The colluvium is composed of unweathered, broken rocks that vary widely in size. These rocks have been eroded from the steep bluff face north of the site. The maximum thickness of the colluvium at the site is approximately 20 feet near the bluff. The alluvium is fine- to coarse-grained silty sand deposited by the Conemaugh River; its maximum thickness on the site is approximately 11.5 feet. The bedrock at the site is composed of alternating layers of shale, limestone, sandstone, siltstone, coal, coal underclays, and claystone. These rocks belong to the Casselman Formation of Pennsylvania age, a member of the Conemaugh Group of coal-bearing formations. The bedrock is well defined, with most units ranging from 1 foot to 5.7 feet thick. Structurally, the local bedrock lies in a gently-folded northeast-trending anticline.

4.5.2.3 Hanover site

At the Hanover site the near-surface geology has been disturbed by strip mining the Pittsburgh coal. Before mining operations were started, the area was underlain by shale and sandstone of the Monongahela Formation. When the site was strip mined, the shales and sandstones were removed to expose the underlying coal. After the coal was removed, the overburden was replaced as the site was reclaimed. The site is now underlain by mine rubble that is composed of shale and sandstone boulders, pebbles, and soil (Figure C.2-4). The fill material is 5 to 10 feet thick on the trench floor. On the upland portions of the site mine rubble is approximately 85 to 98 feet thick. Below the mine rubble is an undisturbed underclay layer that was directly beneath the Pittsburgh coal. Where the underclay is present it is 5.7 feet thick. The clay was not encountered in all borings in the center of the valley floor (presumably portions of the clay were removed during strip-mining operations). The underclay is the lowest unit of the Monongahela Formation. Below the underclay is the Casselman Formation, the upper unit of the Conemaugh Group. At the Hanover site this unit is fractured shale with minor interbedded sandstone. It was common practice in the area to blast the bottoms of mine pits to increase drainage. It is possible that there was fracturing at Hanover caused by this type of blasting during the strip-mining operations; however, there are no records of this practice at the site.

4.5.3 Mineral resources

4.5.3.1 Canonsburg site

The primary mineral resources in Washington County are coal, oil, and gas. The most significant source of coal in the Canonsburg area is the Pittsburgh coal seam. Recent production rates in Washington County have been approximately 20 million tons per year. However, the U.S. Geological Survey (Cortis et al., 1975) has indicated that, as of 1971, most of the coal in the Canonsburg, Houston, and Strabane areas had been mined. Pittsburgh coal does not occur on the Canonsburg site.

Although oil-producing zones do occur in the Conemaugh Group that underlies the Canonsburg site, there are no available records that indicate that there is a potential producing zone beneath the site. In the oil field closest to the site, the shallowest producing zone is the Gordon sand, which is approximately 2510 feet below the surface. The Canonsburg site has not been included on any maps of oil or gas fields in Washington County.

4.5.3.2 Burrell site

The only mineable coal resources in the vicinity of the Burrell site occur in the Lower Freeport unit that subcrops approximately 2 miles from the site. No major gas or oil fields have been mapped for this area. (Lytle and Balogh, 1977).

4.5.3.3 Hanover site

The Hanover site has been strip mined to remove the Pittsburgh coal seam; the strip pits were 41 to 115 feet deep, depending on the location. In 1970-1971 the site was reclaimed by backfilling with overburden (sandstone, slate, and shale). The coal seam below the Pittsburgh coal is the Upper Freeport unit that is approximately 1000 feet below the surface. The seam is not currently mineable in the area of the site.

Within 1.24 miles of the Hanover site are two shallow gas fields, several small, shallow oil fields, and a gas-storage field (Lytle and Balogh, 1977).

If significant mineral resources are found under either site, the Secretary of the Interior, with NRC concurrence, could sell or lease the subsurface mineral rights (as specified in PL 95-604, Section 104(h)).

4.5.4 Seismicity

The Canonsburg, Burrell, and Hanover sites are located in seismic risk zone 1, according to the seismic risk map of the United States. This map is based on the known distribution of damaging earthquakes and the intensities associated with them, as well as evidence of strain release, and consideration of major geologic structures and provinces believed to be associated with earthquake activity. The probable frequency of damaging earthquakes was not considered in assigning ratings to the various zones. Four zones were developed by Algermissen (Coffman and von Hake, 1973), as follows:

Zone 0 -- no damage.

Zone 1 -- minor damage.

Zone 2 -- moderate damage.

Zone 3 -- major damage.

In zone 1, distant earthquakes may cause damage to structures with fundamental periods greater than 1.0 seconds. This corresponds to intensities V and VI on the Modified Mercalli Scale of 1931 (Figure C.2-5).

4.6 WATER

4.6.1 Surface water

4.6.1.1 Canonsburg site

The Canonsburg site lies in the Chartiers Creek basin along the creek's southern bank, approximately 15 miles upstream of its confluence with the Ohio River. In the Canonsburg area Chartiers Creek is a meandering stream with a channel width varying from 75 to 100 feet and a channel depth of about 10 feet. The actual water levels in the creek are usually much less than these values. It drains approximately 265 square miles, of which about 80 square miles are upstream of the site. The average flow past the site ranges from 90 to 130 cubic feet per second. Past floods from the creek have had no serious impacts on the Canonsburg site (Figure D.1-1, Table D.1-1).

The surface topography divides the Canonsburg site into four distinct subbasins (Figure D.1-2). Runoff from three of the basins flows directly into Chartiers Creek, while the fourth discharges first to George Street and then to the creek. The berm created by the ConRail trackbed along George Street isolates the site from upland runoff from Strabane (Table D.1-2).

Chartiers Creek is polluted by acid mine drainage and industrial and municipal discharges (Table D.1-3). The state water-quality limits (Table D.1-4) have previously been exceeded for iron, sulfates, manganese, dissolved solids, and fecal coliforms. The high levels of sulfates and iron are a result of acid drainage from mines operating in the creek basin. The mines, as well as other dischargers into the stream, are still active and the water quality is not expected to improve.

The water running off the Canonsburg site, determined from samples taken during a storm, was high (many above state water-quality limits) in iron, lead, sulfates, and arsenic (Tables D.1-5 and D.1-6). The results of this survey indicated that the site contributes to the TOC and boron loading of Chartiers Creek; however, the contribution is minimal.

The public water used in the area is generally supplied by reservoirs on tributaries to Chartiers Creek. Although the creek is not used as a public-water-supply source, it is a tributary of the Ohio River, which supplies drinking water to several communities in Ohio. The impact of current pollution from the site to these communities is minimal because water from Chartiers Creek is diluted a thousand fold after mixing with the Ohio River.

4.6.1.2 Burrell site

The Burrell site lies in the Conemaugh River basin, along its northern bank, directly upstream of Blairsville Borough. The river drains an area of about 1750 square miles. The site is located approximately 10 miles upstream from the Conemaugh River Dam, which is used to store up to 273,600 acre-feet of water for flood control. Downstream of the dam, the Conemaugh River combines with the Loyalhanna to become the Kiskiminetas River, a tributary of the Allegheny River which in turn joins the Monongahela River to form the Ohio River at Pittsburgh. Other important tributaries of the Conemaugh River are Two Lick, Black Lick, and Yellow Creeks, which join the river between the site and the downstream dam. During a storm, flood waters could be retained behind the dam to form a flood pool having a maximum elevation of 975.0 feet, at which point the flood pool would extend 13 miles upstream of the dam and would inundate the site to the elevation of 975 feet above mean sea level (Figure D.1-3).

River stages past the site for actual storms during recent years have been less than the maximum as follows:

Date	Pool elevation (feet above mean sea level)
June 1972	969.45
March 1964	968.23
April 1960	959.90
March 1967	959.59
July 1977	958.00

The June 1972 storm (Hurricane Agnes) is considered a 1000-year storm, and the elevation of 969.45 recorded at the site at that time is probably the highest that will be realized.

Rainfall draining off the site discharges either directly into the river or into one of two onsite ponds before overflowing a dam at the west end of the property. Of the 49 acres that make up the site, 16.4 acres drain directly to the river and 32.6 acres drain to the ponds. The soil at the site is mostly manmade fill that is porous and interspersed with openings and underground voids; runoff from the 32.6 acres infiltrates ground-water supplies before reaching the ponds. The result is that runoff percolates through the soil and becomes ground water; a portion subsequently discharges to the ponds (see subsection 4.6.2). The total amount of runoff available for direct discharge to the river and for ground-water recharge was computed for several storm events (Table D.1-4). The site is isolated from runoff from the adjacent area north of the site by the berm created by the ConRail tracks.

The reach of the Conemaugh River adjacent to the site is severely polluted by acid drainage from active and abandoned mines, and by industrial and municipal waste-water discharges (Table D.1-8). Concentration limits for fecal coliforms, iron, sulfates, and manganese in the river have been exceeded on a regular basis both up- and downstream of the site. The pH measurements indicate that river water conditions are more acidic at local recording stations than is permissible. This is due to the acid mine drainage and is responsible for iron, manganese, and sulfates leaching above permissible limits. Elevated levels of fecal coliforms are a result of the discharge of untreated or partially treated industrial and municipal waste water into the river. In the Conemaugh Basin some improvement in waste-water treatment is projected (U.S.EPA, 1979). There are no statewide plans to alleviate acid drainage from abandoned mines, which is the most significant source of pollution.

Currently, 98 percent of the area's public-water use is supplied from protected surface waters, usually from reservoirs on tributaries to the Conemaugh River. Only after the waters of the Conemaugh reach the Ohio River do they become a direct source of drinking water for some localities. Water-year flows in the Ohio River average over 12 times the flow estimated past the Burrell site, an indication of the dilution rate before use.

The Burrell site's pond waters are characterized by sulfate-ion concentrations above drinking water standards (Table D.1-9). All other nonradiological parameters tested were generally within drinking water limits, except lead. No lead was detected; however, the detection limit was greater than the drinking water standard.

4.6.1.3 Hanover site

The Hanover site lies in the Harmon Creek Basin, which drains an area of approximately 33 square miles in Pennsylvania and Ohio before discharging into the Ohio River, about 7 miles west of the site. Approximately 5 square miles of this area is upstream of the site. The site is located on the top of a ridge north of Harmon Creek that divides two subbasins of the creek; i.e., Ward Run on the west and an unnamed tributary of Harmon Creek on the east. The area of these subbasins that is directly affected by surface-water runoff is approximately 425 acres. In the absence of USGS water-data-collection stations, it is estimated that the average flow in Harmon Creek to the Ohio River is 68 cubic feet per second, but only an average of 10 cubic feet per second at the site. Because of the topography of the Hanover site, it is unlikely that it will be susceptible to flooding. The 1000-year storm event that occurred in 1972 did not cause any areas of the site to be inundated.

Rain falling on the site runs off in three directions; to Harmon Creek to the south, to an unnamed tributary to the east, and to Ward Run to the west. Runoff volumes for the entire subbasin for several storms were computed (Table D.1-10).

Onsite inspections conducted by the EPA (Downie and Petrone, 1980) in May 1980 during a surface-water sampling program concluded that both Ward Run and the unnamed tributary to Harmon Creek that lies east of the site are polluted with acid mine drainage (Table D.1-11). Analyses of the runoff in the vicinity of the chemical seep on the site revealed toxic conditions and a severely depressed pH of 3.2. A sampling program conducted by the owners of the site during the course of a landfill permit application process showed high concentrations of iron and dissolved solids, and a higher chemical oxygen demand, as well as depressed pH levels at various locations on the property (Figure D.1-4, Table D.1-12).

Because the chemical quality of Ward Run and Harmon Creek is poor, aquatic life is not present and public or industrial uses are either nonexistent (Depmer, 1968) or limited to tributaries isolated from the main stream of Harmon Creek by dams. One such dam (spillway elevation 998) is located upstream of the site on Harmon Creek, and forms a water-supply reservoir for Smith Township. The watershed is independent of site-drainage patterns. The only downstream uses identified are from the Ohio River. As is true for the water from the Canonsburg and Burrell sites, the impact of pollution from the Hanover site on communities using Ohio River water is minimal. The average annual flow in the Ohio River at the closest station to the inflow of Harmon Creek is 32,000 cubic feet per second, indicating a dilution factor of at least 1000.

4.6.2 Ground water

4.6.2.1 Canonsburg site

Ground-water characteristics of the Canonsburg site were determined through the field measurement program described in Appendix D.2. Ground water at the Canonsburg site occurs both in the unconsolidated fill and in the bedrock. Ground-water flow patterns in the fill show a high at the center of Area A and flow towards Chartiers Creek across Areas B and C and Georges Pottery (Figures D.2-1 through D.2-7). Not all of the 1979 wells were used in the 1982 studies because some wells had been plugged or vandalized and were no longer considered reliable. Water levels in the unconsolidated material vary through the period of record; the variation of most of the wells is 5 feet or less. The curves resulting from plotting changes in ground-water elevations are, with only a few exceptions, remarkably similar. The shallowest (closest to the surface) water levels occurred on May 21, 1979, August 27, 1979, October 11, 1979, and November 20, 1979. The shallow water levels correlate well with periods of high creek levels and are of significantly shorter duration than the periods of deeper water levels. Flow in the bedrock system is from southwest to northeast across the site.

Pump testing was not performed at the Canonsburg site because this type of test would bring contaminated water to the surface and there was no acceptable means of disposing of this water at Canonsburg. Slug tests were performed instead, since these tests reveal the same information without bringing water to the surface (Appendix D.2). The results of the slug tests at Canonsburg were extremely variable because of the variability in the site's subsurface materials. Since the ground-water testing was unreliable, observations of well conditions were used to determine whether the site is a recharge area.

Elevation differences in the paired shallow and deep wells over Areas A, B, and C (with only a few exceptions) indicate that although most of the shallow ground water flows laterally into Chartiers Creek, some of the ground water in the unconsolidated fill recharges the bedrock.

Ground-water quality at the Canonsburg site was determined by analyses of selected well samples during April 1979 to March 1980 (Table D.2-1). Of the nonradiological parameters analyzed, sulfate had the highest concentration, ranging from 54 parts per million in well 5 to 1940 parts per million in well 24A. Sulfate levels in this region are typically high because of the underlying coal-bearing rocks. All other parameters were below Pennsylvania water-quality criteria (Table D.1-4).

The major water-supply source in Washington County is surface water, not ground water. Over 80 percent of the county is served by public facilities that obtain 94 percent of their water from surface supplies. Data on local ground-water use were collected during the September 1979 socioeconomic survey (Appendix G). This survey sampled 15.2 percent of the households within a one-mile radius, concentrating on the Village of Strabane. Of the 302 questionnaires completed, 13 respondents indicated that they had wells on their property (Table D.2-2). This method of data collection was used because there are virtually no records available regarding wells installed before 1965. None of the respondents to the survey reported that the water was used for drinking purposes. Newport (1975) lists 176 wells located in Washington County, but does not include any wells within a 1-mile radius of the site.

4.6.2.2 Burrell site

The hydrologic regime at the Burrell site is directly related to the site's historic use (Figure C.2-2). Before 1949 the site was established as a borrow pit for alluvial and colluvial sand and gravel deposits. During the borrow operations a berm of alluvium was retained along the river's edge (the site's southern boundary). The area between this berm and the railroad right-of-way was then excavated to river bed elevation. When the property was obtained by the Pennsylvania Railroad in the 1950's, the land was filled inward from the elevated edges. This resulted in the site's present subsurface bowl-like configuration, with the railroad and industrial debris as well as the Canonsburg residues contained within a hollow lined with alluvial and colluvial material.

Information on the Burrell site's current hydrologic regime was obtained through a ground-water-monitoring program that involved installation of 6 wells into bedrock and 22 into the fill or alluvium and colluvium (Figure D.2-8). The site is a discharge area, with the ground water flowing into two discharge zones: the onsite ponds and the river bank. The majority of the site has a gentle ground-water gradient except for two relatively steep areas along the river edge and along the northern perimeter adjacent to the bluff.

The transmissivities of the fill and of the alluvium and colluvium were determined to be 36,490 and 264 gallons per day per foot of drawndown, respectively. The permeabilities of the fill and the alluvium and colluvium were determined to be 1840 and 9.6 gallons per day per square foot of cross-sectional area, respectively. The difference of permeability between the fill and bedrock indicates that there is no recharge of ground water from the fill into the bedrock. It is estimated that 556 gallons per minute flow through the site with 200 gallons per minute discharging into the ponds and 356 gallons per minute discharging into the river (Table D.2-3). The fill's porosity and depth and the rate of ground-water flow through the site suggest that 2.9×10^8 gallons of water pass through the site annually. It takes 3 years for ground water to completely pass through the site, which means that since the 1957 disposal, the ground water at the site has been replaced eight times.

The ground-water-flow patterns at Burrell are based on a complex interaction between ground-water springs and storm-water runoff flowing from the bluff onto the site, precipitation falling on the site, and the site's fill material (Figure D.2-9). The water from the bluff (north of the site) is characterized by a very acid pH (Figure D.2-10), with a high concentration of dissolved sulfate ions (Figure D.2-11), a high oxidation-reduction potential (ORP), a low concentration of dissolved chloride ions, and a low to nondetectable radionuclide concentration. The ground water at the Burrell site is a pH-buffered water in the mildly alkaline range, with a mildly reduced ORP, low concentrations of soluble chloride and sulfate ions, and very low concentrations of radionuclides (Table D.2-4).

The ground water at Burrell is only mildly degraded. Sulfate-ion concentrations exceed Federal drinking-water standards, but this is a natural condition of the regional geologic makeup. The chloride-ion concentrations are well within the Federal drinking-water standards. The water pH is generally within the same standards. The areas of low pH are most likely a result of the coal-containing bedrock. All other dissolved nonradiological species analyzed were within the Federal drinking-water standards, except for lead and iron. No lead was actually detected; however, the detection limit was greater than the Federal drinking-water standard. The Federal drinking-water standard for iron was exceeded in three of the samples, but this is a natural condition for this region.

4.6.2.3 Hanover site

Ground-water hydrology of the Hanover site is closely tied to its topography (Figure C.1-3). Depth to ground water varies over the site in relation to topographic differences (Figure D.2-12). In the trench bottom the depth to ground water is less than 10 feet, while alongside it can be as much as 70 feet below the surface. There is 5 feet of relief on the piezometric surface area over a distance of 4000 feet (Figure D.2-13).

The major component of ground-water flow at the Hanover site is from north to south along the disposal trench's length. Flow into the site is primarily from the uplands along the north and east. Based on topography and the location of the streams (Figure 1-9), there is apparently a ground-water divide along the western side of the trench so that the major ground-water flow there is away from the site.

During drilling, water was encountered at or near the interface between the mine-rubble fill and the bedrock surface, and the mine rubble at the southern site edge was saturated. Ground water in the bedrock occurs in fractures in the rock. Transmissivity in the bedrock was determined to be 3693 gallons per day per foot. The site is not a recharge area as evidenced by the increased heads with depth displayed in most of the site wells.

Ground-water quality at the Hanover site is not within Federal drinking-water standards (Table D.2-5). This is partially attributable to past activities in the vicinity and to the high concentration of some pollutants that would be expected in a coal strip mine (Figures D.2-14 through D.2-16). The presence and distribution of excessive concentrations of some pollutants indicates that there is a source of contamination south of the site, in addition to the most obvious disposal area north of the site. Sulfate-ion concentrations are well above the EPA drinking-water standard of 250 milligrams per liter for all wells, with a high of 3030 milligrams per liter. Analysis for priority pollutants in one of the site's wells showed three contaminants above detection limits:

Butyl benzyl phthalate	- 61.2 micrograms per liter
Methylene chloride	- 23.5 micrograms per liter
4, 4' DDT	- 21.6 micrograms per liter

4.7 ECOSYSTEMS

4.7.1 Terrestrial vegetation

4.7.1.1 Canonsburg site

Site-survey information and a vegetation map of the Canonsburg site are presented in Appendix E.1 and on Figure E.1-1. Mature trees line both the banks of Chartiers Creek along Areas B and C, and between the rail line and George Street south of Area A. These strip woodlands consist mainly of elm, box elder, cherry, hickory, and willows characteristic of the region (Kuchler, 1964; Bailey, 1976, 1980). Common early successional tree species such as quaking aspen, black locust, sumac, and cherry are found along the edge of these woodlands, along fences within the site areas, and scattered throughout the site (Table E.1-1).

Areas B and C contain successional old fields. Grasses, mosses, and wildflowers are the dominant ground cover of all three site areas. Within the fenced part of Area A, broomsedge sparsely covers the tile field (the area north of Building 18), and another thick clump of grass is found along the fence.

The flat top of the dredge fill part of Area B is sparsely covered with various tall grasses and dense patches of clover, while the perimeter slopes of Area B are thickly covered with bunch grass and dense tangles of brambles. Bulrushes also occur in water lenses on top of the dredge fill area and seeps on the slopes. Runoff ditches along the roadways contain small stands of cattail and bulrush.

Area C has a sparse cover of grasses and wildflowers. An examination of soil test pits in the area indicates that grass roots do not penetrate through this red-dog layer. There are places in Area C that are entirely devoid of vegetation. These vegetation patterns may be the result of variable species growth on the red-dog fill, fill placement, former maintenance of this area as a ballfield, or geological or radiological survey efforts.

4.7.1.2 Burrell site

Most of the Burrell site is vegetated (Appendix E.1, Figure E.1-2). The vegetation consists primarily of grasses and other herbaceous species. Wood growth is limited to a fringe of intermediate-sized trees along the river bank and along the bluff to the north of the rail lines. Individual trees, approximately 15 years old, are also located randomly over the plateau area. The ravines containing the ponds are largely brush-covered, and reed grass occurs in the wetter ravine areas and along the river bank.

The Burrell site is an old-field habitat. The herbaceous vegetation includes teasel, burdock, goldenrod, common mullein, and Queen Anne's lace, in addition to numerous grasses (Table E.1-1). Raspberries and other brambles are also present. The trees on the site are typically early-colonizing species such as sumac, birch, quaking aspen, hawthorn, and black locust. Taller trees include maples, oaks, hickories, and sycamores.

Although many of the trees occurring at Burrell typically grow in dense groupings, there are no well-defined stands on the flat areas. This may be a result of the scarcity of soils.

4.7.1.3 Hanover site

The Hanover site is typical of a recently-reclaimed strip mine. Its substrate is primarily shale fragments and other rocky rubble. Some areas of the site, particularly on the steeper slopes, have no vegetation, thereby exposing bare rocky material. The vegetation over most of the site is limited to low-growing perennial species, mainly clover and grasses (Table E.1-1). There are also cattails growing in areas of standing water in low-lying sections of the site.

There are no trees within the site area. Early successional species such as sumac and birch occur immediately outside the site boundaries, and stands of trees typical of the region (oaks, maples, hickories, aspens, and conifers) are located in nearby areas that have not been strip mined.

4.7.2 Terrestrial wildlife

4.7.2.1 Canonsburg site

The primary habitat type at the Canonsburg site is old field. This habitat exists in most of Areas B and C and the undeveloped portion of Area A. A narrow strip, no more than 20 feet wide, of riparian habitat stretches along Chartiers Creek for the entire length of Areas B and C.

The site's open fields are primarily inhabited by mice, voles, and shrews (Table E.1-2). The field's surfaces are honeycombed with tunnels, runways, and nests. Edge areas surrounding the fields (usually associated with site fences, drainage ditches, and sloped surfaces) provide habitat for rabbits, groundhogs, and opossums whose burrows can be observed along undisturbed areas. Wooded areas on the site provide suitable habitat for passerine birds, while older trees along the creek are used as den trees for raccoons and squirrels. Kestrels have been observed successfully hunting at the site, and it is likely that other carnivores such as screech owls and redtail hawks hunt in this area.

Muskrats are commonly associated with Chartiers Creek and its tributaries in this area. Migrating waterfowl, such as mallards and wood ducks, also use the creek to a minor extent during spring and fall.

The riparian woodland has the greatest value for wildlife because it represents an undisturbed area in an urban setting. The reach of Chartiers Creek along the site is the one of the few creek segments in the area that has not been channelized for flood control.

4.7.2.2 Burrell site

The Burrell site is used as a feeding and nesting area for a variety of wildlife. The irregular substrate is well suited for burrow- and den-dwelling animals, as evidenced by the numerous den openings and well-worn runs traversing the site (Appendix E.1). Typical site animals include rabbits, opossum, mice, voles, shrews, groundhogs, and possibly fox. A variety of songbirds also inhabit the site (Table E.1-2).

Some forest animals include the site as part of their range. There is evidence (tracks, droppings, and paths) that deer regularly traverse the area. Kestrels have been observed hunting at the Burrell site, and it is likely that other hawks, as well as owls, also hunt there. Waterfowl may make some use of the Burrell site during spring and fall. Mallards have been seen on the site.

4.7.2.3 Hanover site

The Hanover site is inhabited by a variety of field-dwelling, burrowing animals such as mice, voles, shrews, groundhogs, and rabbits (Table E.1-2). There is insufficient cover at the site to provide nesting or bedding areas for passerine birds or larger animals. Nevertheless, the Hanover site is used as a feeding area by deer and a number of bird species from nearby wooded areas.

4.7.3 Aquatic biota

4.7.3.1 Canonsburg site

Chartiers Creek is a moderately low-flowing (90 to 130 cubic feet per second) tributary of the Ohio River. Its natural substrate consists primarily of a thin layer of rubble and silt overlying shale bedrock, and its banks are muddy with some bedrock outcroppings. A relatively steep gradient (10 to 20 feet per mile) in the area creates swift currents and numerous riffles. At the Canonsburg site, the stream is tree-lined and shady, and undercut banks are common.

The physical setting of Chartiers Creek along the Canonsburg site provides adequate habitat to support a variety of aquatic organisms (Table E.2-2). The water quality in this reach, however, is poor as a result of upstream discharges from strip- and deep-coal mines, and by sewage and industrial waste waters that contribute high concentrations of iron, sulfates, dissolved solids, and fecal-coliform bacteria. The iron and sulfates and the sewage discharges (organic matter and bacteria) lead to conditions of low pH and low dissolved oxygen, respectively, in the creek, thereby reducing its usefulness as an aquatic habitat.

Biological surveys of Chartiers Creek (Appendix E.2) verified the stream's low habitat potential. No fish were observed near the site; however, carp and white suckers are known to be present (Table E.2-3). The benthic macroinvertebrate community was dominated by oligochaetes (segmented worms), chironomid (midge) larvae, nematodes (thread worms), and physid snails. These species are all tolerant of low pH and low oxygen conditions.

The aquatic vegetation of Chartiers Creek in the site area consists primarily of mats of filamentous algae (green algae), diatoms, and sewage fungi (green and blue-green algae). Like the animals surveyed, these algae are also typical of streams with degraded water quality.

Chartiers Creek is presently classified by the Pennsylvania Fish Commission as a cold water fishery (Weirich, 1982). This is strictly a designation, based mainly on the stream's thermal conditions. Because of its poor water quality, Chartiers Creek in the Canonsburg site vicinity is not stocked with trout or managed as a fishery.

The lack of adequate sewage treatment, and the numerous discharges from abandoned coal mines in its watershed, are the major deterrents to upgrading water quality in this area. Eliminating mine discharges, especially from deep mines, will require complex, expensive restoration. Although the State Bureau of Mines (within the Pennsylvania Department of Environmental Resources) has implemented programs to control discharges from active mining, the contamination from abandoned mines will be a long-term problem in this area.

4.7.3.2 Burrell site

The Conemaugh River is the major surface-water feature near the Burrell site. There are three ponds, within 25- to 30-foot-deep ravines, in the western part of the site, and a shallower pond is located north of the rail lines against the bluff, outside the site boundaries.

Although the Pennsylvania Fish Commission has classified the Conemaugh River as a warm-water fishery (Weirich, 1982), the segment of the river at the site is severely polluted by acid-mine drainage, as well as industrial and municipal discharges. The levels of pH, iron, manganese, fecal coliforms, and occasionally sulfates, seriously violate state water-quality standards for this area. Because of the poor water quality, biological productivity and diversity in this segment of the Conemaugh River are very low.

Acid-mine drainage is a prevalent problem in western Pennsylvania. Although new management practices and environmental controls are being implemented at active mine sites, inactive (abandoned) deep-mine discharges are difficult to correct, both from a technical, as well as financial, standpoint. Therefore, it is not expected that contaminant levels in the Conemaugh River resulting from mine drainage will change significantly in the near future.

The site ponds have not been surveyed for aquatic biology. No visible signs of aquatic life were noted during the site visits.

4.7.3.3 Hanover site

The Hanover site does not contain any creeks within its defined boundaries. There are two areas of standing water, one in the northern part of the site and one in the southern part. These are formed as the result of the collection of runoff from the low areas, and support no aquatic ecosystems. These areas eventually drain northward into a tributary of Ward Run (which drains into Harmon Creek) or southward to a tributary of Harmon Creek.

The entire area within a 1-1/2-mile radius of the site has been heavily strip mined. As a result, all of the local waterways are highly contaminated by acid-mine drainage. In addition, leachate from industrial wastes dumped within this area contributes to the pollution of this part of the Harmon Creek network. Water-quality samples taken in the vicinity of the Hanover site are high in chlorides, iron, and dissolved solids, with generally low pH values.

Observations of the Harmon Creek tributaries revealed few aquatic animals. Snapping turtles and frogs were the only organisms observed. Much of the drainage water on the site was dark red, indicating the presence of iron oxides. No recreationally important fish species (trout, bass, etc.) are known to be in the extremely poor-quality waters in the Harmon Creek system near the site.

4.7.4 Endangered species

No evidence of state or Federal endangered or threatened species (45 FR 33768-33781, May 20, 1980) was found during the survey of the three sites. The Pennsylvania Fish Commission and the Pennsylvania Game Commission were contacted regarding threatened or endangered animal species, and the Pennsylvania Bureau of Forestry was contacted and Wiegman (1979) reviewed in regard to endangered plant species. Appendix E.3 contains letters from these agencies verifying the absence of such species from the three site areas. The U.S. Fish and Wildlife Service must yet be contacted on this subject.

4.8 RADIATION

Radiological surveys of the Canonsburg and Burrell sites were performed by the ORNL (Leggett et al., 1978, 1979), Weston, and Bendix Field Engineering Corporation (Rarrick, 1982). These surveys analyzed air, water, soil, and other materials for the levels of radioactivity present. The radiological units used to express concentrations are microcuries (μCi) and picocuries (pCi) per gram or liter and disintegrations per minute (dpm) per area for radionuclide concentrations. The units used to express the radiological dose rates are microroentgens (μR) and milliroentgens (mR), microrads (μr) and millirads (mr), and microrems (μrem) and millirems (mrem). For the purposes of this EIS these units are equivalent. The pertinent regulatory guidelines and standards referred to in this subsection are found in Table F.1-1. This table also lists the maximum values found at the Canonsburg and Burrell sites.

The approximate normal or naturally occurring background radiation levels at the Canonsburg, Burrell, and Hanover sites are as follows:

1. 10 microrems per hour for external gamma radiation at 1 meter above the ground.

2. 0.01 to 0.02 millirad per hour for beta-gamma dose rates at 1 centimeter above the ground.

3. 0.03 picocurie per liter for radon-222 (Rn-222) in air.

4. 1 to 2 picocuries per gram in soil for uranium-238 (U-238), radium-226 (Ra-226), thorium-230 (Th-230), and lead-210 (Pb-210).

5. 0.9 to 2 picocuries per liter of water for uranium-238, radium-226, thorium-230, and lead-210.

4.8.1 Canonsburg site

Surveys at the Canonsburg site indicate that within Area A large quantities of the radioactive wastes generated during the radium- and uranium-recovery operations still remain on the site. Radium-bearing wastes are present in the soil beneath and adjacent to many of the buildings, as well as in the top few feet of soil over much of the area. Alpha-contamination levels, beta-gamma dose rates, and external-gamma radiation levels in some areas of the buildings and outdoors in Area A are above NRC standards (10 CFR 20). Radon, radon-daughter products, and thorium-230 levels in building air are also above these NRC standards. The ground-water concentrations of radium and uranium in Area A are also above the EPA and NRC standards (40 CFR 192 (proposed), 10 CFR 20).

Area B is also above current NRC standards for radioactivity, although with lower surface-contamination levels than Area A. Beta-gamma dose rates, external-gamma radiation levels, radium in soil, and uranium and radium in ground water are all above the NRC standards. There appears to be a 2- to 6-foot layer of contaminated soil under approximately 8 to 9 feet of clean fill in this area, a condition that has led to lower radiation levels in this area than in Area A.

Area C, the former swamp area, was used as a depository for liquid wastes during the uranium- and radium-recovery operations. The surface and subsurface soils are more contaminated than those in Areas A and B. A semi-fluid material remains beneath the surface, with concentrations of uranium and radium well above the EPA and NRC standards. Current NRC and EPA standards for soil radioactivity, ground-water radioactivity, and dose rates are exceeded in this area.

Radon-222 concentrations have been measured off the site at levels in excess of NRC standards. In 1977, the ORNL (Leggett et al., 1978), measured these concentrations at four locations off the site. At the closest of these to the site, just across the ConRail tracks to the south of the site, 72 measurements averaged 8.6 picocuries per liter of radon-222. The other three locations had averages below the maximum permissible concentration for radon-222 in air in unrestricted areas (pertaining to unrestricted access and use) of 3 picocuries per liter. This value was exceeded, however, in all of the onsite buildings. Daytime average radon-222 concentrations ranged from 2.6 to 106.5 picocuries per liter, while maximum radon-222 concentrations ranged from 6.5 to 300 picocuries per liter. Measurements of radon daughters in all but one of the buildings also exceeded the appropriate EPA standard (0.015 working level), with an average daytime concentration from 0.02 to 0.51 working level.

Building 7 had the highest average external-gamma-radiation value, based on a one-time series of measurements, of 80 microroentgens per hour. The maximum value, found at one spot in Building 10, was 310 microroentgens per hour. These values could result in an individual receiving a radiation dose of 160 millirems per year and 620 millirems per year, respectively, assuming a 2000-hour work year. The latter exceeds the NRC standard of 500 millirems per year for nonoccupationally exposed individuals. Since the Canonsburg site is an unrestricted property in private use, this standard applies to the onsite workers.

All onsite buildings have extensive areas with gross-alpha, gross-beta-gamma, and transferable-alpha and beta contamination and external dose rates exceeding the NRC standards and guidelines.

Results of radon-222 measurements outdoors in Area A at several locations ranged from 0.80 to 2.7 picocuries per liter. At one location, the measurements ranged from 2.5 to 10 picocuries per liter. At another location, the average was 17 picocuries per liter with a maximum of 69 picocuries per liter.

Over 90 percent of the maximum beta-gamma dose-rate measurements at a 1-centimeter height in Area A exceeds the NRC standard of 0.2 millirad per hour, with some as high as 25 millirads per hour. Virtually all external-gamma levels measured at 1 meter in Area A were greater than 100 microroentgens per hour. Values along the eastern portion of Area A ranged from 300 to 500 microroentgens per hour, with a maximum of 1600 microroentgens per hour. Values for beta-gamma and external-gamma radiation also exceeded the NRC standards at many locations in Areas B and C.

Concentrations of radium-226 and uranium-238 in surface- and subsurface-soil samples from all three areas were found to be significantly greater than allowed under the NRC and EPA standards (Table F.1-2). Radium-226 values ranged up to 21,800 picocuries per gram with over half the samples exceeding 5 picocuries per gram. Concentrations of uranium-238 were usually greater than 10 picocuries per gram, with values as high as 51,000 picocuries per gram.

Radiological water quality was assessed at onsite wells by ORNL and Weston (Figure F.1-1). With the exception of one extremely high radium-226 concentration of 4500 picocuries per liter (it is suspected that this well, well 5, was drilled into the drain system of an old building), the highest radium-226 concentrations were found in the southeast corner of Area A (up to 390 picocuries per liter) (Table F.1-3). The lowest radium-226 concentration in any onsite well was less than 1 picocurie per liter. The majority of the results were above the NRC standard of 30 picocuries per liter and the EPA standard of 5 picocuries per liter. All of the analysis results for uranium-238 were below the NRC standard of 40,000 picocuries per liter for this radionuclide; however, the majority of the results exceeded the EPA standard of 10 picocuries per liter of total uranium. Other radionuclides were found at above background levels, but with the exception of well 5, the results were below the current NRC standards.

Radiological analyses of ground water from the Georges Pottery property found total uranium levels for all samples below the NRC standard, but above the EPA standard for five of the eight samples taken (Table F.1-3). Radium-226 was above the EPA standard but below the NRC standard for one sample. All other results were below the applicable NRC standards.

Samples were taken of Chartiers Creek water and streambed sediments at locations near the site (Leggett et al., 1978). All water samples showed very low concentrations of radium-226; the highest level reported was 4 picocuries per liter. The highest sediment sample reported measured 36 picocuries per gram of radium-226. All other samples measured 5 picocuries per gram or lower. The 36 picocuries per gram value was at the downstream corner of Area C, the farthest downstream of any of the sampling locations.

4.8.2 Burrell site

Radioactive residues containing an estimated 6 tons of uranium oxide (approximately 1.5 curies of uranium-238) were transferred from the Canonsburg site and dumped at the Burrell site. Analyses by the ORNL (Leggett et al., 1979) of subsurface-soil samples from 76 holes drilled on this site to depths of up to 50 feet revealed the general location of residues containing an estimated above-background total uranium-238 activity of 1.3 curies, and an estimated total radium-226 activity of 4 curies. It appeared at that time that more than 75 percent of the residues lay at least 10 feet beneath the surface. Some radioactive residues were also scattered on the surface. At some points the following values were measured in the surface soils:

1. Radium-226 concentrations of several thousand picocuries per gram.

2. Uranium-238 concentrations of 360 picocuries per gram.

3. External-gamma radiation levels at 1 meter above the surface in excess of 600 microroentgens per hour.

4. Beta-gamma dose rates at 1 centimeter above the surface in excess of 5 millirads per hour.

These measurements were not representative of the entire area; at most sampling points radionuclide concentrations in the surface soils and radiation levels at the surface and at 1 meter above the surface were less than ten times background levels.

Grid-point measurements of gamma-radiation levels at 1 meter above the surface indicated a maximum gamma-radiation level of 630 microroentgens per hour. Several external gamma measurements exceeding 300 microroentgens per hour were observed in the western portion of the site. However, many measurements, particularly in the western portion of the site, were at background levels. The maximum beta-gamma dose rate at 1 centimeter from the surface on this site was 5.4 millirads per hour. The majority of the beta-gamma dose-rate measurements were at background levels.

Concentrations of radium-226 and uranium-238 in surface-soil samples were as high as 5000 picocuries per gram and 360 picocuries per gram, respectively. Radium-226 concentrations in the area that showed general surface contamination averaged 10 picocuries per gram; the EPA standards allow 5 picocuries per gram. The average uranium-238 concentration in this same area was 3.9 picocuries per gram.

Subsurface-soil contamination was determined by drilling holes to depths of up to 50 feet, measuring in-situ radiation levels with a gamma probe, and analyzing soil samples. The radioactive residues were widely scattered and were found at depths ranging from the surface to 36 feet deep. No meaningful estimates of maximum or average radium-226 or uranium-238 concentrations could be made because of the sampling method and the heterogeneity of the results. However, this technique did permit an estimation of the total amount of radioactivity present above background levels. It was estimated that 4 curies of radium-226 and 1.3 curies of uranium-238 are buried at this site. According to historical records, approximately 1.5 curies of uranium-238 were transported to the Burrell site for disposal. This agreement indicated that nearly all of the residues were dumped in the region surveyed.

Analyses of sediments filtered from some of the water samples taken in drainage areas on and near the site revealed elevated concentrations of lead-210, and in some samples, thorium-230. However, in all water samples taken on and near the site, concentrations of radium-226, thorium-230, uranium-238, and lead-210 were below the NRC standards, but radium-226 and uranium-238 concentrations were above the EPA standards.

Concentrations of radium-226, thorium-230, and uranium-238 were determined in ground water taken from the drill holes. The maximum values found were 370 picocuries per liter for thorium-230, 10 picocuries per liter for radium-226, and 403 picocuries per liter for uranium-238. These results are below the NRC standards; however, one radium value and the majority of the uranium results were above the EPA standards. Analyses of water samples taken from drainage ditches to the Conemaugh River noted lead-210, thorium-230, radium-226, and uranium-238 concentrations below the NRC and EPA standards; however, the results for lead-210 and uranium-238 were slightly above background levels. Analyses of sediments from these water samples showed similar results.

Average radon-222 levels in air at the Burrell site were at background levels with one exception. The one elevated reading of 1.82 picocuries per liter was below the NRC standard of 3 picocuries per liter. The radon-daughter-product levels in air were all at background levels. It appeared from these data that there is no significant ground-water or atmospheric transport of radioactivity from the site.

Subsequent to the surveys just reported, Weston made additional surveys of the Burrell site in 1981 and 1982, including measurements of uranium-238 and radium-226 in ground water at 26 wells and gamma-radiation levels at various depths in 28 deeper holes drilled on the site (Figure F.1-2).

The highest ground water uranium-238 concentrations were about 12 picocuries per liter in two wells; one in the known dump area and the other 1500 feet east of the dump area (Table F.1-5). Resampling and analysis of ground water from these wells several months later found uranium-238 activities below 10 picocuries per liter, with the majority of the results at background levels. Radium concentrations were at background levels for all wells tested.

Gamma-radiation levels in 28 boreholes found above-background activity in seven instances. One borehole was contaminated at a depth of 21 feet, another was contaminated at a depth of 11 feet, and the remaining five boreholes were contaminated at depths of less than 7 feet.

The results found by Weston were confirmed in a separate survey by Bendix in 1982 (Rarrick, 1982). The Bendix surveys consisted of gamma logs in 22 boreholes and estimations of radium concentrations in the soil around these boreholes by gamma-spectral analysis. Above-background radioactivity was found in eight boreholes, at a depth of 12 feet in one and at depths less than 8 feet in the remaining 7 boreholes. Estimates of the radium content ranged from less than 1 picocurie per gram up to 800 picocuries per gram. The average radium-226 concentration was less than 5 picocuries per gram across the site.

A comparison of the results of the ORNL, Weston, and Bendix surveys indicates that a change in the radiological quality of the site occurred between 1977 and 1981. This change has resulted in the site now apparently meeting the EPA standards for radionuclides in ground water and radon emission rates. A good deal less material seems now to be present than was inferred from the 1977 data.

4.9 LAND USE

4.9.1 Canonsburg site

In 1979 a complete socioeconomic survey was made of the Canonsburg site area (Appendix G, subsection G.2). This survey consisted of an interview program conducted within a 1-mile radius of the site. Surveys were also performed in the Burrell and Hanover site areas in January 1982, but because of their more open settings, these surveys relied on drive-throughs of their respective 1-mile radius areas, and extensive agency contacts.

The area within a 1-mile radius of the Canonsburg site includes portions of four municipalities: Canonsburg and Houston Boroughs, and Chartiers and North Strabane Townships. Residential use covers nearly 27 percent of this area, and is concentrated primarily in Canonsburg and Houston Boroughs and in the Village of Strabane (a residential development of North Strabane Township). The 1-mile-radius area also includes the commercial centers of Canonsburg and Houston, and a number of industrial establishments (Figure G-1, Table G-1).

The Canonsburg site is located in the light-industrial zoning district of the Borough of Canonsburg. Other zoning designations for that part of the Borough within a 1-mile radius of the site include the following:

1. High-density residential in the eastern portion of the Borough.

2. Light-industrial, general commercial, and low-density residential in the northern and northwestern portions.

The sections of the Borough of Houston and North Strabane Township located within a 1-mile radius of the site are zoned primarily for residential use, while the portion of Chartiers Township included in that area is zoned for medium-density residential use, but currently is open space (Figure G-2). The composite land-use plan (Figure G-3) for these boroughs and townships specifies development generally in accordance with local zoning designations (Kendree and Shepard Planning Consultants, 1970; Canonsburg Borough Planning Commission, 1971; Selck Minnerly Group, 1974; Houston Borough Zoning Board, 1982).

4.9.2 Burrell site

The area within a 1-mile radius of the Burrell site includes portions of Burrell Township and Blairsville Borough in Indiana County, and Derry Township in Westmoreland County. The major land use in this 1-mile radius area is open space (agriculture, woods, flood plains, and miscellaneous uses such as the Burrell site). Residential areas are primarily in Blairsville Borough and along major highways in Burrell Township; however, there are residential uses close to the site such as the community of Strangeford 1 mile east of the site, and a small development along the northern edge of the site on old Route 22 (Figure G-4, Table G-2).

Burrell Township has no land-use plans, zoning ordinances, or subdivision regulations. The Indiana County Comprehensive Plan places the site vicinity within the multiple-use flood-control district (Bellante and Clauss, Inc., 1967). The Derry Township section within the 1-mile radius of the Burrell site is dedicated to public or semi-public use; primarily the Torrance State Hospital. Blairsville Borough has a zoning ordinance; however, the details of the ordinance are unavailable. Development within the 1-mile radius area in Indiana County is controlled by the County's Special Recreation and Conservation Ordinance (1973).

4.9.3 Hanover site

The entire 1-mile radius area of the Hanover site is within Hanover Township, except for a very small section of Jefferson Township (Figure G-5). Most of this area is in industrial land use, mainly mining activity. The site area is currently zoned (Hanover Township, 1970) for rural-residential use (Table G-3), which allows the following:

1. Agriculture.
2. Residences.
3. Community services.
4. Recreation.
5. Planned-residential developments.
6. Mineral extraction.
7. Community facilities and accessory uses.

There are no future-land-use plans for Hanover Township.

4.10 NOISE

4.10.1 Canonsburg site

An acoustical survey conducted in 1979 by the Franklin Research Center (Hargens, 1979) (Appendix H) revealed that the Canonsburg site and the surrounding community are generally quiet. Nearly all sounds are steady and have very little diurnal variation. The immediate site area has only a few outstanding sound sources, since most of the industrial activities on the site have been shut down. Except for passing aircraft and land vehicles, the background sound levels around the site perimeter range from 45 to 57 dBA. Sounds emanating from Areas B and C are natural in origin, primarily insect and water sounds. Area A has irregular manufacturing sound pulses from the remaining site industrial activities.

Sound sources off the site that contribute to background levels on the site include nearby roadways and residences. West Pike Street runs roughly parallel to the site's northern boundary. This roadway connects the boroughs of Houston and Canonsburg and carries heavy traffic. Residences directly across the ConRail tracks in the Village of Strabane and along Chartiers Creek on Wilson Avenue are as close as 250 feet to the site, and may make minor occasional contributions to sound levels.

4.10.2 Burrell site

The Burrell site is in an open area and is very quiet. Background-sound sources are primarily natural, with irregular rail traffic and aircraft overflights.

4.10.3 Hanover site

The Hanover site is also an open, quiet area. It is 2 miles away from any developed area and transportation routes.

4.11 SCENIC, HISTORICAL, AND CULTURAL RESOURCES

4.11.1 General appearance

The Canonsburg site is located within the general Canonsburg community. The immediate vicinity is largely developed and contains no significant features to distinguish it from other small western Pennsylvania towns. Although the Burrell and Hanover sites are located in more open areas, they exhibit no significant scenic or aesthetic features. Much of the open area surrounding the Burrell site is a wooded flood plain, while the site itself is a former industrial landfill. The Hanover site, like much of its surroundings, is a former strip-mining area.

4.11.2 History

Western Pennsylvania supported numerous American Indian tribes before settlement by Europeans. The movement of settlers into this area was limited until secure passes through the Appalachian ridges were established. As a result traffic was channeled along a limited number of westward routes, and communities subsequently developed along these routes.

The major impetus to the development of western Pennsylvania came with the demand for coal during the industrial age. The availability of coal and other mineral resources attracted industrial development. Industry was also supported by the connection of the Ohio River system with the Mississippi River, allowing products and supplies to be transported and distributed over a much wider area. The Pennsylvania Canal System was developed to provide a waterway connection between the Ohio River and eastern river systems such as the Susquehanna and the Delaware. This system was initially designed to operate in conjunction with some rail lines; however, it was eventually replaced by a complete cross-state rail system connecting Philadelphia, Harrisburg, and Pittsburgh. (The western division of the canal system passed within one mile of the Burrell site.)

The industrial development of western Pennsylvania created an extensive demand for labor. This demand coincided with the periods of heavy immigration from eastern Europe, and many of the immigrants settled in western Pennsylvania.

4.11.3 Places of archaeological, historical, or cultural interest

Many of the significant archaeological resources near the three sites have been disrupted by mining and other development activity. No places of special interest are known to be in the immediate site vicinity, although several are reported within a 1-mile radius of this and the Burrell and Hanover sites. (Washington County Planning Commission, 1979; Philpott, 1980; Kent, 1982)

Within a 1-mile radius of the Canonsburg area are two places that are listed in the National Register: Dr. McMillan's Log School, and the Robert's House, a half Georgian house built in 1805. Other structures of historical interest and significance include several houses and churches (Table G-4).

In addition to Indian sites, the remnants of the western division canal are a significant historical feature of the Burrell area. The Hanover area includes several covered bridges, such as the remnants of the Doc Hanlin Covered Bridge, which is listed in the National Register, and several other structures of historical significance (Table G-4).

4.12 SOCIOECONOMIC CHARACTERISTICS

Information for subsections 4.12.1 through 4.12.7 was obtained from the 1979 socioeconomic survey of the Canonsburg site area and the 1982 socioeconomic surveys of the Burrell and Hanover site areas. Detailed data from these surveys are contained in Appendix G.

4.12.1 Population

The Canonsburg site is situated within a densely populated area. Both the Burrell and Hanover sites are situated in rural areas. The population of Canonsburg within a 1-mile radius of the site was 7938 in 1980 (Figure G-6, Table G-5). This total is broken down by age and sex on Table G-6. Historical and projected population distributions among municipalities within 1 mile of the Canonsburg site are given in Table G-7. Using the percent share of the 1980 population within the four area municipalities and the area's development potential, it is estimated that the 1-mile radius area population will decrease slightly to 7929 by the year 2000 (Table G-8). There were only 2312 persons living within 1 mile of the Burrell site in 1980 (Figure G-7, Table G-9). The majority of these people live in Blairsville, west of the site. An increase of 338 people within 1 mile of the Burrell site over the 1980 population is expected by the year 2000. Hanover Township had 78 people living within 1 mile of the site in 1980 (Table G-11), and this number is expected to increase by only 2 people by the year 2000. (Increases for the Burrell and Hanover site areas were projected in the same way as for the Canonsburg site area.)

4.12.2 Social structure

The communities within southwestern Pennsylvania have rich ethnic traditions and are bound together by tight family structures. The population centers are old and stable with a small number of transients. There are many civic, social, and religious organizations that serve the population. There are a number of cultural organizations within the Canonsburg site vicinity that serve the Lithuanian community in the area; no dominant ethnic culture is present in either the Burrell or Hanover site vicinities.

4.12.3 Economic structure

The mining industry is a strong economic force in southwestern Pennsylvania (Appendix G, subsection G.3). Washington and Indiana Counties are the two largest coal-producing areas in the region. In addition to the mining industry, the manufacture of primary metals, glass-producing machinery, electrical machinery, and food preparation and distribution equipment plays an important role in the regional and local economies. Agriculture provides another major source of income for the region. Dairy products, poultry, meat, field crops, and maple syrup make up the bulk of the agricultural production. The forestry industry provides an additional source of income in the more rural areas.

The economic structure of the Hanover site is influenced by its proximity to the steel and titanium industries in West Virginia and Ohio.

4.12.4 Work force

The December 1981 statistics show a high unemployment rate of approximately 8-1/2 percent in both Washington and Indiana Counties (Appendix G, subsections G.4.1 and G.4.2). The major losses of employment were in the primary metals, fabricated metals, machinery, and transportation-related industries. Total employment in December 1981 was 87,700 and 32,200 persons in Washington and Indiana Counties, respectively. Approximately one-half of all employed persons who reside within the 1-mile radius area of the Canonsburg site work within 2 miles of their homes. Employed persons living within the 1-mile radius areas of the Burrell and Hanover sites work at greater distances from their homes, with some Hanover residents working in Weirton, West Virginia.

4.12.5 Housing

The Canonsburg site is situated within an area of dense residential development. The closest houses include those on the site -- the six on Wilson Avenue and one on George Street, and the Village of Strabane immediately across the railroad to the south, with some as near as 250 feet. The Burrell site has fewer houses in its immediate area, with the closest homes being situated along the ridge to the north of the site (over 500 feet away). The Hanover site is situated in an area with very few houses; the nearest one is about 2000 feet away.

The houses in the Canonsburg area are relatively old but in good condition. Most of the houses are owner-occupied with infrequent turnover. There are only a few rental units available within a 1-mile radius of the Canonsburg site, located mostly in Canonsburg. Historical data on housing stock in the area municipalities are given in Table G-19. Newer housing units are located in the northwestern section of Canonsburg and the Oak Spring Cemetery section of Chartiers Township. Based on a 2 percent vacancy rate, approximately 210 single-family houses are available in the site vicinity. Multifamily housing is limited in the area.

Current property assessments for developed properties near the Canonsburg site range from $1,927 to $6,392 per property; their total represents about 9 percent of the actual property value. The 1981 assessed value of the properties composing the Canon Industrial Park was $54,698, meaning a market value of about $608,000. The newer homes in the Canonsburg site vicinity have an average assessed value of $5,000 (assessed at 9 percent of market value). The asking prices of some houses in the site area, as obtained from local realtors, are presented in Table G-20.

Housing activity in the Burrell site area, and particularly in Burrell and Derry Townships, has expanded rapidly in recent years, particularly in new subdivisions (Table G-19). There is a total of nine houses located within one-quarter mile of the site, with the nearest one 500 feet from the site. Approximately 550 houses of the 1980 housing stock of the area municipalities are currently vacant, based on the vacancy rates in Indiana and Westmoreland Counties. The cost of vacant land in the vicinity of the site ranges from $300 to $400 per acre. Average home prices are in the $40,000 to $45,000 range.

There are only 26 houses within the 1-mile radius area of the Hanover site (Figure G-11), with the nearest house about 2000 feet from the site. Over the last decade, the number of houses in the area municipalities (Hanover, Burgettstown, Jefferson, and Smith Townships) has increased by 13 percent. At a 2-percent vacancy rate, there are about 85 vacant houses in these municipalities. The cost of vacant land in Hanover Township ranges from $300 per acre for deep-stripped-mined land with only minimal use, to as much as $10,000 per acre for lands suitable for occupational development (accessible and favorable for sewers) and for development as landfills (mined areas with deep-cut walls).

4.12.6 Tax and assessment structure

Canonsburg is the largest borough in Washington County in terms of population, ranking only behind Monongahela and Washington, both third-class cities. The revenue of Canonsburg and its surrounding communities was more than $3.5 million in 1978 (Table G-21). The majority of the revenue came from real-estate and Act 511 taxes, with lesser amounts coming from Federal and state grants, state highway taxes, and sanitary sewer charges. The revenue was used primarily to provide local services and was approximately 15 percent of the County's government-service outlays. Washington County was reassessed in 1980; the current tax rate is 25 mills. The current property assessment is 9 percent of the market value. Current assessed values, market values, and tax rates for the area municipalities are given in Table G-22.

Revenues for 1978 for both Burrell Township and the Borough of Blairsville, Indiana County, totalled more than $1 million (Table G-23). The 1980 and 1981 tax rates for these municipalities are given in Table G-24.

Based on its 1978 population, Hanover Township represented an average second-class township, while its fiscal statistics (Table G-25) for that year were substantially less than average for its size. The rural character of this township accounts for its small-scale revenue needs and expenditures.

4.12.7 Community structure

Community services such as schools, hospitals, fire and police protection, public utilities, and recreational facilities within the site area municipalities are described in Appendix G, section G.4. A school is located within one-quarter mile of the Canonsburg site. No schools are near the Burrell site, and the school closest to the Hanover site is over 2 miles away.

Canonsburg also has the closest hospitals and recreational facilities. Burrell and Hanover Townships rely on regional facilities, parks, and open areas for recreation. This trend affects all of the community services offered at each site; i.e., the services provided by Canonsburg are closer and more comprehensive than those in Burrell or Hanover.

4.12.8 Transportation network

A transportation survey of the three site areas was performed to assess the various alternative routes (Transportation and Distribution Associates, Inc. 1982). This survey is presented as Appendix I.

Interstate Highways 70 and 79 are the major highways in the vicinity of the Canonsburg site (Figure 1-1). The principal arterial roads near the Canonsburg site are U.S. Routes 19 and 40 and State Routes (SR) 980, 519, 50, 18, and 88. The main access road to the site is Strabane Avenue. This street becomes Chartiers Street south of the site and joins Pike Street north of the site. Other major roads near the site include North Main Street and Oak Spring Road in Chartiers Township and Boone Avenue and SR 519 in North Strabane Township. The most recent traffic counts on these roads are given in Table G-28. Most of the local streets are narrow, poorly paved, and congested. No major improvements are planned for any of the routes. There are four major railroads serving Canonsburg: the ConRail, the Montour, the Baltimore and Ohio, and the Norfolk and Western.

The major roads in Burrell Township are U.S. 22 and 119, SR 217, and several legislative roads (LR). The 1980 traffic counts on the major roads in this area are given in Table G-28. There is currently no major access road to the Burrell site. The only available public road that could be used to connect the site with the major arterial roads in the region is LR 32006 (Strangford Road; see Figure 1-4). It presently has a 15-ton load limit and is 12 to 15 feet wide. The other closest road is LR 32179, which intersects LR 32006 nearly 3000 feet northeast of the site. A ConRail route runs along the northern edge of the site.

Major highways near the Hanover site include old U.S. 22, new U.S. 22, SR 18, and LRs 62017 and 62122. Access to the site is through LR 62017 either from old U.S. 22 or from SR 18 and LR 62122. Traffic counts (1980) on these routes are presented in Table G-28.

The Canonsburg and Burrell sites are accessible by railroad mainly through the ConRail lines connecting these two sites via Pittsburgh. From Canonsburg one route travels north to Carnegie and Pittsburgh, northeast to Kiski Junction and to the southeast through Vandergrift, Saltsburg, and Blairsville to the Burrell site. This route is a designated ConRail Hazardous Material (HAZMAT) route. Another route travels from Canonsburg north to Pittsburgh, then basically south and east through Greensburg, Latrobe, and Blairsville to the Burrell site. The Canonsburg-Burrell routes pass through a number of urban centers including about 2.5 miles through the City of Pittsburgh. The Canonsburg-Burrell routes pass through Indiana, Westmoreland, Armstrong, Allegheny, and Washington Counties.

There is no direct railroad line to the Hanover site. A siding to the site could be provided from the ConRail line south of the site running between Carnegie, Pennsylvania, and Weirton, West Virginia. This line is also part of the ConRail HAZMAT route. However, ConRail may be abandoning this section by 1983 in the interest of cost control. This route passes through mostly rural communities.

4.12.9 Public reactions to the remedial-action project

Many of the people living in the vicinity of the Canonsburg site have expressed a strong desire to have the potential health impacts of the radioactive material eliminated. They are concerned with the continuing effects of this material on their lives and property and have been led to expect this remedial action for several years. The public is now demanding immediate action, and the determination to see this problem resolved is being expressed in public meetings, newspaper articles, letters to government officials, and recently filed lawsuits.

During the September 1979 socioeconomic door-to-door survey of the Canonsburg site vicinity (in which over ten percent of the households within a 1-mile radius of the site were surveyed) a number of persons interviewed expressed a desire to have more information on the plans to clean up the site, while many others were ignorant of the ongoing activities. Less than 5 percent of the households approached responded with an "I am not interested" attitude. It was later learned from neighbors that these noninterested families had some former association with the Vitro operations, e.g., employment or possession of materials from the old facility.

One of the concerns expressed by a number of families living in the older homes within a half mile radius of the site was the fear of losing their homes as part of the cleanup effort. Some of them expressed concern that their homes were along the prevailing wind direction from the Canonsburg site. However, there has not been any odus of people from the Canonsburg area because of fear of radiation exposure. None of the people surveyed (some of whom have lived in the Village of Strabane for the past 25 to 35 years and some of whom used to work at the Vitro plant) said they had plans to leave the area.

The Burrell site vicinity is much different from that of Canonsburg. There are no homes in the immediate vicinity of the site, and the site itself is an unusable open space. The general consensus of the nearby community, as expressed by the Burrell Township Supervisors, is that the site is not apt to cause any alarm, but that moving the material from the site to another location may stir up public objections because of the potential increases in traffic, noise, and dust.

Information on the reactions of the residents of Hanover Township was mostly obtained from the public meetings held in that area in June 1981. The residents are strongly opposed to the disposal of radioactively-contaminated material at the Hanover site.

Major public involvement in the remedial action plans at the Canonsburg and Burrell sites began during the identification of potential disposal sites for the radioactively-contaminated material (Weston, 1981a, b). After two possible disposal areas in Hanover Township, Washington County, were selected, a remedial-action-concept paper (RACP) was written in April 1981. This paper was published and widely distributed in the project area to inform participating agencies and the public of the tentative project plans. The Burgettstown Enterprise printed the entire RACP in its April 22, 1981 issue. (A later version of the RACP has since been published by the DOE (U.S. DOE, 1982).) Preliminary public meetings on the tentative plans were held in Canonsburg Borough and Hanover Township in April 1981 and in Burrell Township in May 1981.

The notice of intent to prepare an EIS and hold public scoping meetings was published in the Federal Register (46 FR 26807-26810, May 15, 1980). This notice was also given wide publicity by the DOE and appeared in numerous local papers such as the Washington, Pennsylvania Observer Reporter on May 26, 1981, and in television and radio announcements.

Scoping meetings were held as follows:

1. June 3, 1981 at 10:00 a.m. at Black Lick in Burrell Township (30 people attended).

2. June 3, 1981 at 7:00 p.m. in Canonsburg (55 people attended).

3. June 4, 1981 from 3:00 to 5:00 p.m. and 7:00 to 10:00 p.m. in Hanover Township (300 people attended).

At these meetings the public was given an opportunity to express any concerns about the tentative project plans. The DOE also requested that those persons wishing to submit written comments do so by June 30, 1981.

The types of concerns expressed by the public include the following:

1. What is the extent of the exposure to radiation that the public and the project workers will receive from the project activities? What levels are expected and what are their health effects? What protective measures and monitoring will be performed and by whom?

2. What is the extent of the exposure to radiation from possible accidents? Who will clean up an accident, and how? What are the possible radiation doses and the subsequent health impacts that could result?

3. What changes in air quality will occur because of dust and other airborne pollutants during the project activities?

4. What will be the effects of the project on the soils and mineral resources in Hanover Township? The soils at this site may be too porous, and the bedrock may be fractured or weakened by mining activities. Disposal of contaminated materials in Hanover Township may eliminate the future use of geologic resources in the immediate vicinity of the site.

5. What will be the effects on surface and ground water? Radioactive contaminants may enter water supplies at the Canonsburg and Burrell sites and at the disposal site. The volumes of runoff from the disposal site(s) will be increased because of the impermeable cover.

6. What will be the effects on plants and animals? The ecological resources of Hanover Township are already seriously degraded from mining and industrial activities.

7. What will be the changes in land use? The disposal of radioactive material at a site will eliminate any future use of that site and make the surrounding area unattractive for further development. Property values will also decrease. Disposal at a site may interfere with the use of nearby institutions (schools, medical facilities), as well as community services.

8. How much will noise levels increase during the project activities?

9. How will the transportation networks be affected? Local roadways and railways may not be able to handle all of the traffic associated with moving the contaminated materials. Transporting the radioactive and construction materials will seriously increase local traffic volumes.

10. What will be the effect of storms during the project activities?

11. What impact will the proposed disposal site at Hanover have on a nearby hunting and fishing area?

12. Will the chemicals associated with the radioactive residues or sulfur and mine acids adversely affect the liners used for the disposal area(s)?

13. What is the possibility of unearthing toxic chemicals at the former Canonsburg lagoon (Area C)?

14. Can the Canonsburg residues be disposed of in shielded containers above ground so that they can be inspected for leakage?

15. Can the residues at the three sites be stabilized in place?

The following questions were also asked during the public meetings:

1. Would other radioactive wastes, such as from Three Mile Island, also be disposed of in Hanover Township? Answer: no.

2. In light of the general antagonism toward the nuclear industry, will stopping this project be seen as an attempt to halt nuclear arms production? Answer: no.

3. Will this project halt the current illegal dumping of chemical wastes at the Hanover site? Answer: no.

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5 ENVIRONMENTAL CONSEQUENCES

5.1 INTRODUCTION

In assessing the impacts of each alternative, the following principles are basic to all alternatives except Alternative 1:

1. All of the alternatives will limit the release of radioactive material off the site to within the EPA standards.

2. All of the alternatives will effectively isolate the radioactively-contaminated material over the long term.

3. All of the alternatives will improve the existing situation at both Canonsburg and Burrell. The existing health hazard that is a result of the present configuration of the radioactive material will be eliminated.

4. This study addressed the maximum impacts; it is expected that the actual impacts will be much less severe. This is especially true at Burrell, which has been officially declared a vicinity property. This decision is based, in part, on recent field data that indicate that the amount of radioactively-contaminated material currently at Burrell is significantly less than indicated in tests conducted in 1977. Since the remedial actions presented in this EIS are based on the 1977 data, they are in greater scope and detail than will actually be needed at Burrell. They represent the maximum impacts expected from the project.

5.2 IMPACTS OF RELEASES OF RADIATION

This section assesses the radiological impacts resulting from each of the alternatives. The methods used to perform the assessments are given in Appendices F.2 and F.3. The data used to perform these impact assessments were collected by ORNL in 1977 (Leggett et al., 1978, 1979), by Weston in 1981, and Bendix in 1982 (Rarrick, 1982). This data base is not complete and additional data are currently being collected. As such, the impact assessment presented in this chapter is an interim estimate that will be revised for the final EIS. This interim estimate does, however, represent an upper bound on the predicted impact. The impact assessment includes estimates of the resulting organ-specific radiation doses and health effects on both the general population within 1.24 miles (2 kilometers) of the Canonsburg, Burrell, and Hanover sites and the remedial-action workers assigned to each site. Radiation doses and health effects resulting from transporting contaminated material under Alternatives 2, 4, and 5 are also estimated for the general population. In performing the dose and health effects calculations as described in Appendix F.3, no credit was taken for any of the mitigating measures to be employed. Thus, the doses and effects presented are worst-case or upper-bound limits.

5.2.1 Impacts of remedial actions

The dose commitments for the general population and remedial-action workers under each of the alternatives are presented in Tables 5-1 and 5-2. The estimated health effects among the population of 14,222 people living within 1.24 miles (2 kilometers) of the Canonsburg, Burrell, and Hanover sites and among the 43 to 75 remedial-action workers (depending on the alternative), are presented in Tables 5-3 and 5-4. The single most important exposure pathway to the general public and the remedial-action workers is the inhalation of radon-daughter products and the subsequent irradiation of the tracheobronchial systems. In addition, the remedial-action workers have an important secondary pathway through working in close association with the residues, direct external exposure of the whole body. In order to put these results in perspective, Table 5-5 presents the estimated background-radiation doses, the EPA standards, and the normal cancer-death expectations for the exposed populations.

The population dose calculations indicate that the closest resident in the predominant downwind direction from the Canonsburg site (south-southeast) is currently receiving an excess bronchial dose of about 22 rems per year. This is equivalent to a 14 in 1000 chance of dying from lung cancer because of exposure to radon-222 from the residues at the Canonsburg site. Any of the remedial-action alternatives (2 through 5) will reduce this exposure by a factor of approximately 700. The normal expectation of dying from lung cancer is approximately a 30 in 1000 chance (National Academy of Sciences, 1980).

At Burrell, the most exposed persons are across the river to the southwest. They currently receive an excess bronchial dose of 130 millirems per year, which will be reduced to 3 millirems per year by the remedial action. The former dose implies a chance of 8 in 100,000 of dying from lung cancer because of exposure to radon-222 from the residues at the Burrell site.

At Hanover, there is no present exposure to radioactive tailings or their effluents. If either Alternative 4 or 5 is carried out, the most exposed person will be in a house about one-half mile to the northeast. That person would receive an excess bronchial dose of 0.14 millirem per year, implying a chance of 9 in 100,000,000 of dying from lung cancer.

Under Alternative 1, the no-action alternative, radiation doses to the bronchial epithelium of the general population will average 52 percent of background levels, and 14 percent of the EPA standard on an annual basis. This can result in 5.4 additional lung cancer deaths, an increase of 1.3 percent above normal to the 14,108 people living within 1.24 miles of the Canonsburg and Burrell sites. During any of the proposed remedial actions (Alternatives 2 through 5), the population dose commitments for the estimated 96-week exposure period are similar and little more than the annual doses in Alternative 1. These doses range from 11,500 to 12,900 man-rems to the bronchial epithelium and from 6.2 to 10 man-rems for whole body irradiation during the 96-week remedial-action alternatives. These doses are due to radon and its daughters; other particulate activity accounts for less than 1 percent of the total dose. On an annual basis, these doses range from 6200 to 7000

Table 5-1. Excess population dose commitments to the general public within 1.24 miles of the Canonsburg, Burrell, and Hanover sites

Alternative	Dose delivery period	Population size affected (persons)[a]	Man-rems: Whole body[b]	Bone[b]	Lung[b]	Liver[b]	Kidney[b]	Tracheobronchial system[c]
1	Annually	14,108	4.3	4.4	4.3	4.3	4.3	8,300
During remedial action								
2	96 weeks	14,108	6.4	6.6	7.5	6.4	6.4	12,900
3	96 weeks	14,108	6.2	6.4	7.1	6.2	6.3	12,800
4	96 weeks	14,222	10	13	43	9.8	10	11,500
5	96 weeks	14,222	10	13	43	9.8	10	11,500
After remedial action								
	Annualy	14,108 to 14,222	0.01	0.01	0.01	0.01	0.01	13

[a]Canonsburg - 9562 people, Burrell = 4546 people, and Hanover = 114 people.

[b]Mainly exposure to gamma radiation.

[c]Mainly exposure to radon-daughter products.

Table 5-2. Excess dose commitments during remedial action to the onsite workers

Alternative	Dose-delivery period	Number of workers	Man-rems: Whole body[a]	Bone[a]	Lung[a]	Liver[a]	Kidney[a]	Tracheobronchial system[b]
2	96 weeks	47	14	14	14	14	14	300
3	96 weeks	43	12	12	12	12	12	300
4	96 weeks	75	21	21	21	21	21	220
5	96 weeks	72	19	19	19	19	19	210

[a]Mainly exposure to gamma radiation.

[b]Mainly exposure to radon-daughter products.

Table 5-3. Excess cancer deaths for the general public within 1.24 miles of the Canonsburg, Burrell, and Hanover sites due to radiation from the residues at the Canonsburg and Burrell sites

Alternative	External dose (man-rems)[a]	Bronchial dose (man-rems)[b]	Lung cancer deaths[b]	All other cancer deaths[a]	Total deaths
1	4.3 per year	8,300 per year	5.4	0.02	5.4
During remedial action					
2[c]	6.4	12,900	0.26	0.0008	0.26
3[c]	6.2	12,800	0.26	0.0008	0.26
4[c]	10	11,500	0.23	0.0001	0.23
5[c]	10	11,500	0.23	0.0001	0.23
After remedial action					
	0.01 per year	13 per year	0.008	0.00003	0.008

[a]Mainly whole body exposure to gamma radiation.

[b]Mainly exposure to radon-daughter products.

[c]Exposure for 96 weeks only.

Table 5-4. Excess cancer deaths among the remedial-action workers due to radiation from the residues at the Canonsburg and Burrell sites[a]

Alternative	External dose (man-rems)[a]	Bronchial dose (man-rems)[b]	Lung cancer deaths[b]	All other cancer deaths[a]	Total deaths
2	14	300	0.006	0.002	0.008
3	12	300	0.006	0.001	0.007
4	21	220	0.004	0.002	0.006
5	19	210	0.004	0.002	0.006

[a]Mainly whole body exposure to gamma radiation.

[b]Mainly exposure to radon-daughter products.

Table 5-5. General radiological parameters

Parameter	Value: General public[a]	Value: Remedial-action workers[b]
Background external whole body dose -- man-rems per year[c]	1,250	3.8-6.6
Background bronchial dose -- man-rems per year[d]	16,000	48-85
EPA standard for whole body dose -- man-rems per year[e]	3,750	---
EPA standard for bronchial dose -- man-rems per year[f]	64,500	---
Normal expectation of lung cancer deaths -- 3 percent	430	1-2
Normal expectation of total cancer deaths -- 16 percent	2,330	7-12

[a]The general public is the 14,222 people living within 1.24 miles of the three sites. Canonsburg = 9,562 people; Burrell = 4,546 people; and Hanover = 114 people.

[b]43 to 75 in number.

[c]Resulting from a gamma background of 88 mrem/year.

[d]Resulting from the gamma background plus a radon-daughter background of 0.004 WL.

[e]Resulting from a limit of 20 μR/hr plus a background of 10 μR/hr.

[f]Resulting from the gamma limit plus a radon-daughter limit of 0.015 WL.

man-rems to the bronchial epithelium and 3.4 to 5.4 man-rems for whole body irradiation. These doses imply an additional 0.23 to 0.26 cancer deaths in the exposed populations due to radioactivity released during the remedial action. The radiological impacts under each alternative and similar, the there is no reason from a radiological health effects point-of-view, to prefer a specific alternative.

Health impacts and doses decrease significantly once any of the remedial actions are completed. At that time, the bronchial epithelium doses will become 0.08 percent of background levels, and 0.02 percent of the EPA standard on an annual basis. This may result in a total increased cancer death rate of approximately 0.002 percent or 0.008 additional lung cancer deaths in the exposed populations. After any remedial-action alternative, the health effects on the exposed populations will be reduced by a factor of about 700. Thus, a significant decrease in potential cancer deaths should occur after remedial action is completed.

Impacts on the remedial-action workers are essentially the same under each alternative, but would be higher, on an individual basis, than impacts on the general population. The incremental radiation doses will be 3 to 6 times higher than background levels with approximately 5 percent of the airborne dose due to fugitive dust, and thus will increase the health risk by 0.05 to 0.1 percent of the expected cancer-death rate. These estimates are based on not using radiological-protection procedures for the workers during the remedial-action activities; however, comprehensive radiation-protection practices will be used during any remedial-action activities. These practices will include training programs, contamination-control procedures, personnel-monitoring procedures, and, as necessary, respiratory-protective devices and protective clothing. Thus, the actual impacts on the workers and the general public will be lower than has been calculated.

Impacts on the general public and remedial-action workers from transporting the residues off the site will occur under Alternatives 2, 4, and 5. It has been estimated that 9200 loaded miles will be traveled in relocating the residues from Canonsburg to Hanover. The radiation dose commitment due to residue transportation under these alternatives is 0.0001 man-rem to the general public and 0.2 man-rem to the truck drivers. These doses are small compared to background and present no serious impacts on either the general public or the remedial-action workers.

5.2.2 Radiological impacts of transportation accidents

The worst-case credible accident, which has a probability of 1 in 200 of happening during the transportation of contaminated materials from Canonsburg to Hanover, based on an accident rate of 0.000000052 accident per loaded ton-mile, would occur if a truck overturned and spilled its contents onto the street (U.S. DOT, 1977; U.S. NRC, 1972). (The capacity of the trucks is 10 tons.)

This type of accident could expose nearby people to low levels of gamma radiation, radon gas, and radon daughters associated with these materials for a short time. This exposure rate, however, would not exceed that delivered to nearby people during the remedial action because simple steps, taken immediately, would effectively reduce the exposure. Ribbons, flags, and radiation signs would be used at the accident scene to control people. The remedial-action crews would stop their activities, go to the accident scene, and reload the spilled material. The final cleanup would consist of sweeping, and possibly vacuuming, any residue, with guidance from the safety team who would locate contaminated materials with their instruments. If the accident occurred during rainy weather, the cleanup work would probably be more difficult because the contaminated material might be washed away by runoff. The cleanup procedure would be the same, however, and the risk of public exposure would be minor.

This type of accident would take a few hours at most to clean up. The dose to the cleanup crew and the public would be insignificant. A person standing 1 meter from the spill for 15 minutes would receive a dose of 0.06 millirem. Workers cleaning up this spill would be irradiated at 0.2 millirem per hour; in a 2-hour cleanup a worker's total dose would be 0.4 millirem.

5.2.3 Comparison of radon-222 emissions with the EPA standards

The UMTRCA directs the EPA to issue standards to be met in remedial actions such as those proposed at the Canonsburg and Burrell sites. One such standard is a limit on the radon flux from the surface of the stabilized disposal site. The proposed limit is a flux of 2 picocuries per square meter per second.

Radon is a gas; its daughter products are all solids. As a gas it will diffuse upward through the cover material, decaying en route with a half life of 3.8 days. The solid daughter products do not diffuse upward. Effectively, then, the radon flux decreases exponentially according to the formula (U.S. NRC, 1979, Appendix P):

$$F = F_o \exp\left(-\sum_{i=1}^{n} X_i(P_i/D_i)^{1/2}\right)$$

Where

F = Radon flux from the surface after attenuation with various cover materials (picocuries per square meter per second).

F_o = Radon flux at the base surface of the contaminated material (picocuries per square meter per second).

λ = Decay constant for radon-222 ($2.1 \times 10^{-6}\ s^{-1}$).

s = Seconds.

P_i = Porosity or void fraction of the ith layer of the cover (dimensionless).

D_i = Effective diffusion constant for radon in the ith layer (square centimeters per second).

X_i = Thickness of the ith layer (centimeters).

Analyses were made of the effects of various cover configurations on radon-flux rates using a computer model developed by Rogers et al. (1981). These analyses showed that a base radon flux of 1000 picocuries per square meter per second would be cut to 0.8 picocuries per square meter per second by the preferred cover configuration (3 feet of clay, 1 foot of gravel, 6 feet of soil) (Weston, 1982a).

Similar calculations have shown that at the Canonsburg site the material not encapsulated (i.e., the material either contaminated to levels no greater than 100 picocuries per gram or contaminated to levels above 100 picocuries per gram and buried greater than 6 feet deep) can be controlled to the EPA standard with 6 feet of cover material.

The EPA also has a longevity requirement; i.e., that there is a reasonable expectation that the disposal configuration used will meet the standards for 1000 years. At the Canonsburg site this longevity is ensured by two cover characteristics. First, the clay component of the layered cover will stay wet and therefore not crack because it is in a wet environment and the overlying soil and gravel will smooth out seasonal changes in rainfall. Second, the 6 to 10 feet of cover will be revegetated at the beginning by reseeding and later by natural successional processes; it will thus resist erosion.

The amount of erosion lost can be estimated by using the Universal Soil Loss Equation. This equation predicts an annual loss of soil of 12.75 tons per acre (Table A.5-1), or at a density of 100 pounds per cubic foot, 0.006 foot per year, during construction activities when no soil stabilization techniques can be employed. Appendix A.5 also presents estimates of potential soil losses from each site following stabilization with vegetation. These show that at Canonsburg the soil lost over 1000 years will be about 0.12 inch (Table A.5-2).

At the Burrell site, the radon flux is already less than 2 picocuries per square meter per second; therefore no additional measures are required under Alternative 3 or 5 to meet this standard. The grading and cover proposed will keep the thickness of soil removed by erosion down to 0.56 inch in 1000 years (Table A.5-2).

If the Hanover site is to be used (Alternative 4 or 5), a burial plan equivalent to the one just analyzed for the Canonsburg site would ensure adherence to the EPA radon-flux standard. In this case the potential erosion loss during 1000 years is about 1 inch (Table A.5-2).

5.3 IMPACTS ON AIR QUALITY

Each of Alternatives 2 through 5 will generate the following nonradiological pollutants:

1. Suspended particulates.

2. Nitrogen oxides (NO_x).

3. Sulfur oxides (SO_2).

4. Carbon monoxide (CO).

5. Hydrocarbons (HC). (Although this is not an EPA-enforced standard, it is included for completeness.)

Gaseous pollutants (NO_x, SO_2, CO, HC) will be generated by tailpipe emissions from the construction vehicles and equipment on the site and from the trucks used to haul fill and radioactive material on and off the site. Total suspended-particulate emissions will be generated by a variety of activities, including the following:

1. General construction activities (demolition and earth moving).
2. Storage-pile stacking.
3. Wind erosion from storage piles.
4. Fugitive roadway emissions from hauling.
5. Exhaust emissions from construction vehicles and trucks.

The emissions from all of these activities have been included in calculations of the emission rate for each period, alternative, and site. Appendix B.2 describes the methods used to calculate these emission rates and to estimate the maximum emission rate for each pollutant. Because a conservative worst-case approach was used to calculate their emission rates, the results presented in Appendix B.2 are the potential emission rates that the proposed remedial-action activities could produce. For gaseous pollutants, no mitigation procedures were assumed. For particulate emissions the following mitigation measures were assumed:

1. All unpaved roadways will be sprayed at least four times per year during the remedial action with a surfactant or water (Cowherd et al., 1979).

2. All storage piles will be sprayed with water during dry periods.

3. Construction areas will be sprayed with water during dry periods (defined as any 7-day period when precipitation is less than 0.02 inch for all one-hour intervals within the 7 days).

Another assumption, based on an evaluation of fugitive emissions by the EPA (Cowherd et al., 1979), is that the recommended mitigation measures will reduce total suspended-particulate emissions by 95 percent.

The controlled emission rates were used to calculate the ambient air-quality impacts of the alternatives. The first step in modeling the dispersion used an EPA-approved area-source-screening model, the Climatological Dispersion Model, to calculate the maximum potential offsite impact of the activities in each alternative. This analysis indicated that for some alternatives at some sites, a potentially-significant offsite impact would occur. Therefore, a more refined modeling approach was used to better quantify the impacts. The EPA-approved Industrial Source Complex Model (Bowers et al., 1979), was used to predict the 1-hour, 3-hour, 8-hour, 24-hour, and annual impacts of the proposed actions. For the short-term impacts, it was assumed that the winds were constant and from the same 10-degree sector for 24 hours and that the atmosphere was slightly stable. For the annual average concentration, the measured meteorological conditions for 1979-1980 were used in the model.

For Canonsburg, meteorological data collected on the site were used for the analysis. The Canonsburg data were corrected for the local topography at Burrell, and were used for the Burrell analysis. Pittsburgh International Airport data were used for the Hanover site. The details of the modeling analysis are found in Appendix B.2. The predicted concentrations are the maximum potential ambient concentrations; they are summarized in Table 5-6. Also included in the table are measured background concentrations for each pollutant and the National and State Ambient Air Quality Standards.

Alternative 3, stabilization in place at both Canonsburg and Burrell, should result in the minimum incremental air-quality impact in the Canonsburg area. Alternative 2, stabilization of all materials at Canonsburg, should result in a slightly higher incremental air-quality impact than Alternative 3. Except for total suspended particulates, the total ambient air-pollutant concentration (incremental plus background) for both sites under either alternative is predicted to be below the National Ambient Air Quality Standards. The conservative (worst case) modeling analysis, including mitigative measures for the control of total suspended particulates, suggests that a violation of the annual total suspended particulate standards could occur. Additional mitigative measures may be required.

Table 5-6. Maximum predicted ambient air-quality impacts due to remedial action, national primary and secondary standards, and Pennsylvania standards[a]

Alternative	Site	TSP[b] ($\mu g/m^3$) Annual[c]	TSP[b] ($\mu g/m^3$) 24-hour	SO_2 ($\mu g/m^3$) Annual[c]	SO_2 ($\mu g/m^3$) 3-hour	SO_2 ($\mu g/m^3$) 24-hour	CO ($\mu g/m^3$) 1-hour	CO ($\mu g/m^3$) 8-hour	NO_x ($\mu g/m^3$) Annual	HC ($\mu g/m^3$) 3-hour	Settleable particulates[d] (tons/sq mi-month)
2	Canonsburg	15.2[f]	156[e]	7.2	162	53.6	2,447	2,422	77.7	64.8	5.8
	Burrell	5.8[e]	75	4.3	122	40.6	3,499	3,488	44.0	58.9	2.2
3	Canonsburg	11.5[f]	153[e]	6.5	125	41.2	2,495	2,469	72.4	35.0	4.4
	Burrell	7.0[e]	51	4.6	82.6	27.4	2,417	2,410	48.3	26.4	2.7
4	Canonsburg	22.2[f]	211[e]	9.1	166	54.6	2,781	2,751	94.9[f]	61.7	8.4
	Burrell	5.8[e]	75	4.3	122	40.6	3,499	3,488	44.0	58.9	2.2
	Hanover	53.4[f]	691[f]	5.4	273	272	2,904	2,467	56.5	155	20.3
5	Canonsburg	22.2[f]	211[e]	9.1	166	54.6	2,781	2,751	94.9[f]	61.7	8.4
	Burrell	7.0[e]	51	4.6	82.6	27.4	2,417	2,410	48.3	26.4	2.7
	Hanover	48.8[f]	725[f]	5.3	273	272	2,904	2,467	55.4	155	18.5
Background concentration		67[g]		47[g]			1,142[h]		20		18[g]
National primary standard		75	260	80		365	40,000	10,000	100	160	
National secondary standard		60	150		1,300		40,000	10,000	100		
Pennsylvania standards (same as National Primary and Secondary Ambient Air Quality Standards)											43

[a]Incremental levels must be added to background to determine violations of standards.

[b]Assumes reduction of TSP by 95 percent due to mitigation measures.

[c]Assumes an 8-hour per day, 5-day per week, 50-week per year work schedule.

[d]Settleable-particulate rate = 0.38 x annual mean TSP concentration.

[e]Secondary-standard violation.

[f]Primary-standard violation.

[g]Measured background; TSP and settleable particulates from 1981 data collected at Washington, Pennsylvania; SO_2 from 1981 data collected at Florence, Pennsylvania.

[h]Estimated background based on suggested rural background concentrations (U.S. EPA, 1978).

In both Alternatives 4 and 5 and at both Canonsburg and Hanover, the predicted peak 24-hour incremental total suspended-particulate-concentrations are significantly greater than at least the secondary standards. The ambient total annual nitrogen-oxide concentrations predicted in the Canonsburg area may exceed the ambient air standard. In addition, the 3-hour hydrocarbon standard may be exceeded at Hanover based on the incremental impact due to the remedial action plus background. (Although no background hydrocarbon value is available, it is likely to be greater than 5 micrograms per cubic meter, which would result in a violation at Hanover.)

This evaluation did not include ozone because ozone modeling has not been developed for this type of project. It is not possible at this time to address ozone concentrations quantitatively. The effect of the remedial-action alternatives on ozone levels is not expected to be significant because the nitrogen oxide and hydrocarbon emissions are not great.

The potential health effects of air emissions from material movement will be primarily related to the pollutants that exceed the standards. Effects on transportation routes will not be significant because the high total suspended-particulate concentrations are only associated with onsite construction and transportation activities. Only nitrogen-oxide emissions will occur along paved roadways. Fugitive-dust emissions are caused by reentrainment of dust deposited on roadways during hauling activities. Covering the trucks will prevent large amounts of dust from reaching the roadways, thereby minimizing the generation of fugitive dust.

Material movement during any of the remedial-action alternatives will have negligible offsite visibility impacts. Most of the particles generated by the activities will be very large and they will settle out quickly. The fugitive particles will be larger than the most effective light-scattering diameter; therefore, while there will be a high concentration of particles in the immediate site construction area, but any effects on visibility should not extend off the site.

Because both nitrogen oxides and hydrocarbons for all remedial-action alternatives are below, or close to, the standards, and because the period of activity will be short (1 to 3 years), it is not likely that they will have a significant impact on air quality.

The duration of air-quality impacts experienced at each site will be equal to the period of construction and earth-moving, as follows:

Alternative	Site	Impact duration (months)
2	Canonsburg	23
	Burrell	21
3	Canonsburg	22
	Burrell	7
4	Canonsburg	25
	Burrell	21
	Hanover	30
5	Canonsburg	25
	Burrell	7
	Hanover	26

It should also be noted that the air emissions will not be constant during these periods. The concentrations of airborne materials will be reduced at the close of workdays, and during those days when no work is in progress. Because the impacts on air quality would be caused by earth-moving and equipment operation, only the time intervals during which these activities will occur are considered the impact duration (i.e., the actual time frame for air emissions from the sites will be shorter than the entire project duration).

5.4 IMPACTS ON TOPOGRAPHY AND SOILS

5.4.1 Impacts on topography

The no-action alternative will not alter the topography at any of the three sites.

Alternative 2 will affect both the Burrell and Canonsburg sites. The removal of 80,000 cubic yards of contaminated material from the Burrell site and its subsequent replacement with 16,000 cubic yards of fill will lower the overall elevation of the project area. Depending on the final grading plan, to be specified in the final design, the reduction in elevation may increase the extent and frequency of flooding in areas below the maximum flood-pool elevation. However, the site will have been decontaminated and no radioactive material can mix with the flood waters to be carried off the site.

Alternative 2 activities at the Canonsburg site will raise the elevation of Areas A and B. To minimize elevation changes, Area C will be filled with the same amount of material that is excavated. The elevation of Area A will be raised 10 to 20 feet to a maximum of 1006 feet above mean sea level, and the topography of Area B will be changed similarly. The low area along Ward Street between Areas A and B will be eliminated. The final grade will be a smooth slope from Area A and the encapsulation area that will fill Ward Street. Since those residences situated along Wilson Avenue will be demolished, the filling of Ward Street will be economical, and the resultant grade will minimize runoff.

Alternative 3 will have much the same impact as Alternative 2 at the Canonsburg site. At the Burrell site the major change from the present topography will be grading the cover material and smoothing out the present irregular surface.

Alternative 4 will affect all three sites. The impact of this alternative on the Burrell site will be the same as for Alternative 2. The material removed from the Canonsburg site will be replaced by approximately the same amount of fill to pre-project elevations. The impact of Alternative 4 will be significant at the Hanover site. The southern half of the trench along the ridge top will be filled to slightly above the existing trench walls. The northern half of the trench will be untouched; the northern wall of the fill will slope toward the trench floor. Therefore, the northern half of the trench will become a semi-enclosed depression.

The impacts of Alternative 5 at the Canonsburg and Hanover sites will be the same as for Alternative 4. At the Burrell site the impacts will be the same as for Alternative 3.

5.4.2 Impacts on soils

In all of the alternatives but the no-action alternative, soils will be imported from local commercial sources and stockpiled for construction and stabilization. The stockpiles will be surrounded by collection trenches to eliminate soil loss. The amount of materials to be imported are given in Table 5-7. All of the in-situ soil at the Canonsburg and Burrell sites with radium-226 concentrations of less than 100 picocuries per gram will remain on the sites under stabilization. Because of the presence of large amounts of fill material at all three sites, the soils are not considered productive. The materials needed for covers are readily available, except in the area of the Burrell site (Appendix A.6). The project will not affect the local availability or supplies of these materials.

Table 5-7. Materials that must be imported during the remedial-action alternatives

Alternative/site	Quantity
Alternative 1	None
Alternative 2	
Canonsburg	250,000 cubic yards of crushed stone, fill, cover, and clay.
Burrell	16,000 cubic yards of clean fill.
Alternative 3	
Canonsburg	250,000 cubic yards of crushed stone, fill, cover, and clay.
Burrell	70,000 cubic yards of fill, clay, and cover.
Alternative 4	
Canonsburg	250,000 cubic yards of road and berm materials, clean fill, and topsoil.
Burrell	16,000 cubic yards of clean fill.
Hanover	200,000 cubic yards of crushed stone, fill, clay, and topsoil.
Alternative 5	
Canonsburg	250,000 cubic yards of road and berm materials, clean fill, and topsoil.
Burrell	70,000 cubic yards of fill, clay, and cover.
Hanover	170,000 cubic yards of crushed stone, fill, clay, and topsoil.

5.5 IMPACTS ON MINERAL RESOURCES

The Pittsburgh coal seam does not occur at the Canonsburg site because of past geological action. It is also absent from the Burrell site, and it has been removed from the Hanover site by strip mining. No deeper layers are thick enough to be mined economically with present mining methods. Thus, there is no impact on coal, oil, or gas resources at any of the three sites.

5.6 IMPACTS ON WATER

5.6.1 Impacts on surface water

The no-action alternative will have little effect on surface-water quantities or use in the systems associated with the Canonsburg, Burrell, or Hanover sites. Chartiers Creek will continue to receive sediment and ground-water discharges from the Canonsburg site. The discharge of ground water has had no detectable effect on surface-water quality to date (see subsection 5.6.2), and would not be expected to have a detectable effect in the future if the current rate and quality of discharge continues. The discharge of contaminated soil to the creek as sediment resulting from scouring in Area C would be expected during a 500-year flood event. In addition, continued erosion of Area C during lesser storm events would contribute contaminated sediment in runoff because of elevated levels of radioactivity in the soil on and near the surface of Area C.

The Burrell site would continue to discharge ground water and sediment to the Conemaugh River. The quality of the soil and ground water at the site is mildly degraded; however, this discharge would have no detectable effect on the river because of the existing poor quality of the river water.

Under Alternative 2 waste waters generated by construction activities will be treated and discharged into Chartiers Creek and the Conemaugh River at Canonsburg and Burrell, respectively. These wastes include process wastes, as well as precipitation collected in and around the work areas. Before discharge, these waste waters will be treated by temporary facilities located at the two sites. Both facilities will be operated under National Pollutant Discharge Elimination System (NPDES) permits, and the discharges would meet all applicable water-quality criteria. Further water-quality protection at both sites will be provided by the installation of erosion-control measures including dikes around work areas and along the length of Chartiers Creek at the Canonsburg site. Erosion during normal rains (nonflooding) is not a concern at Burrell because the extremely high permeability of the landfill material minimizes any runoff or erosion from the site.

The Canonsburg site is partially contained within the 100-and 500-year flood plains of Chartiers Creek. During excavation and construction activities, in Area C in particular and in Area B to a lesser degree, some contaminated soil and fill may be discharged into the creek during flooding or heavy rains. In order to prevent such discharges from occurring, erosion control and flood protection must be provided during the earth-moving activities.

Remedial activities at the Canonsburg and Burrell sites will have no effect on surface-water quantities at either site. The consumptive water use is expected to be less than 20 gallons per minute for any of the remedial actions at any site. An average family uses 3 to 5 gallons per minute. Therefore, this will not place a heavy demand on local water systems. Process water will not be taken from surface-water systems, but will be supplied from the local water system. Discharges at each site will be less than 1 cubic foot per second, which is insignificant in comparison to flows in either Chartiers Creek or the Conemaugh River.

Over the long term, Alternative 2 would have beneficial impacts on surface-water conditions at the Canonsburg site. The current erosion from the site and associated sediment and contaminant loading of Chartiers Creek will be reduced by stabilization of the site and the improved site drainage. Installation of the encapsulation cell and final site grading will divert precipitation from the contaminated material and will prevent this material from getting into suspension.

There will be no changes in the overall site-drainage patterns at Burrell following Alternative 2. Precipitation falling onto the site will continue to percolate into the ground. Any runoff from the filled excavation area will infiltrate the surrounding landfill area. Removing the radioactively-contaminated material from the Burrell site will eliminate any indirect contaminant loading caused by leaching water through the remaining residues. Alternative 2 will not cause any changes in the water uses of Chartiers Creek or the Conemaugh River.

Alternative 3 will have the same short- and long-term effects on the Canonsburg site's surface waters as Alternative 2. The potential for short-term water-quality impacts at Burrell would be significantly less in Alternative 3 than in Alternative 2 because there will be no excavation or exposure of radioactively-contaminated material. As a result, stabilization of the Burrell site will not require a waste-water treatment facility, nor will there be any water discharge to the Conemaugh River. Standard erosion-control measures will be used to prevent the erosion of stockpiled construction materials during heavy rains.

Alternative 3 may result in an increase in runoff from the stabilized area at Burrell due to the cover. As at Canonsburg, final site grading will be designed to divert runoff. The permeability of the rest of the landfill materials will allow infiltration of this water. The stabilization of the small amount of radioactively-contaminated material remaining on the site will have a beneficial impact on the area's surface-water system because the cover will reduce the amount of water infiltrating the residues and leaching the contaminants. This alternative will have no effect on long-term surface-water usage at either site.

Alternative 4 will have the same short-term surface-water impacts at Canonsburg as Alternatives 2 and 3, and will include the same protective measures. After this alternative is completed, the residues will be eliminated as a possible source of surface-water contamination. As in the other alternatives, the site will be graded to provide improved site drainage and flood protection.

Both the short- and the long-term surface-water impacts at Burrell will be the same as for Alternative 2.

The potential for degrading surface-water quality at Hanover during construction activities will be offset by the same kind of protective provisions employed during stabilization at Canonsburg. An onsite waste-water treatment facility will be operated under an NPDES permit during the project activities. Unlike the other two sites, the Hanover site is not subject to flooding. Protection against erosion from storm-water runoff, including dikes around work areas, will still be used. There will be no changes in surface-water quantities at the Hanover site during project activities. Water will not be supplied from surface-water systems, and the waste-water treatment facility will discharge less than 1 cubic foot per second.

The remedial actions at the Hanover site will have a long-term beneficial impact on the surface-water system. The final site grading will be a major improvement in site drainage, thereby reducing erosion and contaminant loading into the local watershed. The radioactively-contaminated residues will be hydrologically isolated by the encapsulation cell and will not be subject to leaching. The semi-enclosed depression that would be created at the north end of the site would drain to an adjacent unnamed tributary to Harmon Creek outside the west side of the site.

Overall, this alternative will have no long-term effect on surface-water use at any of the three sites.

Short- and long-term surface-water impacts at the Canonsburg and Hanover sites under Alternative 5 will be the same as for Alternative 4, while at Burrell they will be the same as for Alternative 3.

Thus, in all of the remedial-action alternatives, little, if any, of their radioactive or toxic constituents will enter the surface-water systems because rain and flood water will be prevented from entering the contaminated materials. The EPA standards for prevention of further degradation of surface-water quality will be met in any of the alternatives, including the no-action alternative.

5.6.2 Impacts on ground water

The types of ground-water impacts to be considered include changes in quantity and quality. The quantity reductions associated with all of the remedial-action alternatives are minimal at all of the sites. Although precipitation will run off the cover, most of it will infiltrate around the covered area, resulting in a minimal net loss of water. The only induced change will be a temporary lowering of the water table in Area C at Canonsburg during Alternatives 2 through 5. Initially, 300,000 gallons of water per day will be pumped out; then 20,000 gallons will be pumped per day to maintain the depressed level. The pumping will cease when excavation is complete. It may also be necessary to temporarily pump some ground water to lower the water table at the Hanover site during excavation of the encapsulation area. Although quantities have not yet been estimated, this would only be a minor, temporary impact.

None of the alternatives affect ground-water use since there is no significant ground-water use in the areas around the three sites, and their ground-water systems are not tied into major regional aquifers.

Under Alternative 1 the hydrogeological regimes at the Burrell and Canonsburg sites would remain unaltered. At Burrell, only two ground-water samples had radiation levels in excess of the EPA standards (Table F.1-1) (one for radium-226 and one for gross alpha), and three were questionable for gross alpha because the detection limit was higher than the standard. All of the wells were within the EPA uranium-238 standard. Most of the ground water passing through the Burrell site exits the subsurface system as discharge into the onsite ponds and the Conemaugh River. Therefore, because of dilution it is probable that under Alternative 1 the Burrell site will meet the ground-water radiation levels set for existing uranium-mill-tailings sites greater than 0.62 mile (1 kilometer) from the site. The information to date gives no indication that the site's ground water will be further degraded if the tailings are left in place.

The ground water of the former Vitro property site exceeds the Federal drinking-water standards for several radiological parameters. Ground water at the adjacent Georges Pottery property also exhibits ground-water-radiation levels in excess of these standards. Since the ground-water discharge from the site is primarily to Chartiers Creek, and because the creek shows no radiological contamination at the site, it is assumed that the radiological contamination is not reaching 0.62 mile (1 kilometer) downstream.

Under Alternative 2, the removal of residues from the Burrell site will have a negligible impact on the site's ground-water quality since the ground water is generally already within the standards for existing sites under the present conditions. The Burrell material will not act as an additional source of contamination at Canonsburg.

Although none of the alternatives will affect the contaminants presently in the ground water, stabilization of the Canonsburg site will have a beneficial long-term effect on the site's ground-water quality. Encapsulation of the site's radioactive material will eliminate this material as a source of long-term contamination by preventing further movement of radioactive contaminants into the ground water. Regrading the Canonsburg site, adding a low-permeability cover material, and placing the encapsulated area over Ward Street will have an effect on local ground-water-flow patterns. The present ground-water mounds in Areas A and B will be reduced since these mounds are largely the result of direct infiltration of precipitation. The low-permeability cover over the whole site and the construction of the encapsulated area in Areas A and B will reduce the infiltration of precipitation, and therefore, reduce these mounds, the hydraulic gradients, and the amount of outflow. The effect of such local changes will not be detectable at the site boundary, and will not have a negative effect within the site. The bottom of the encapsulation cell will be located so that it is not resting in ground water. The final cell placement will ensure that there is no direct contact between the encapsulated material and the ground water.

The ground-water impacts under Alternative 3 will be similar to those for Alternative 2 for Canonsburg and Alternative 1 for Burrell.

The ground-water impacts under Alternative 4 at Burrell will be similar to Alternative 2. At Canonsburg the removal of the contaminant source will have a long-term beneficial effect on water quality. Contamination of the ground water at Hanover should not occur because the material disposed of at Hanover will be encapsulated.

The ground-water impacts under Alternative 5 will be similar to those under Alternative 4 for Canonsburg and Hanover and Alternative 3 for Burrell.

The preferred alternative, with respect to ground-water quality and quantity, is Alternative 3 for the following reasons:

1. The major sources of contamination at Canonsburg would be removed and encapsulated.

2. Additional contaminated material would not be disposed of at the Burrell site. It would be extremely difficult to ensure the integrity of an encapsulation cell at this site unless the fill were removed. At present the ground water at the Burrell site is only slightly contaminated.

3. Contaminated material will not be disposed of at a currently-uncontaminated site.

5.6.3 Comparison of ground-water quality changes with the EPA standards

The UMTRCA directs the EPA to issue standards to be met by remedial actions such as those proposed at the Canonsburg and Burrell sites. One such EPA standard is a limit to the concentrations of radium and a number of nonradioactive elements, mostly heavy metals, that can be found in nearby ground and surface water. Because Chartiers Creek and the Conemaugh River are already badly polluted, the requirement means that there should be no increase in pollution due to a stabilized disposal site nearby.

The concentrations of pollutants in the ground water at the Burrell site are already below the EPA standards, and any release to the Conemaugh River further dilutes them.

The ground water at the Canonsburg site is contaminated well above the EPA standards. It has not been possible to estimate the rate at which this ground water enters Chartiers Creek because of inherent uncertainties in ground-water flow rates. Nevertheless, actual measurements of the water quality in that creek show that the releases that do occur are so slow that there is no detectable difference in concentrations of radium and other metals above and below the site. The reduction in ground-water access to the contamination and the reduction of hydraulic gradients that would occur after the remedial action can only slow these releases over the long term. The currently available data indicate that the EPA water-quality standards are already met at the Canonsburg site.

To further substantiate this conclusion for Canonsburg, a ground-water testing program has been developed. Wells will be drilled both on and off the site along Chartiers Creek. Samples taken from both the shallow and deep ground-water aquifers will be tested for their radiological content. The results of the program will help to further define the ground-water-flow rates and pattern, and determine to what extent radiological material is currently leaving the site in the water.

5.7 IMPACTS ON PLANTS AND ANIMALS

5.7.1 Impacts on terrestrial biota

Under the no-action alternative all of the Burrell and Hanover sites, and the majority of the Canonsburg site, would remain in open use. Since the succession of these sites to wooded areas appears to have been arrested by their substrate conditions, these sites would probably remain as old field habitats.

Alternatives 2 through 5 would have the same short-term impacts on the terrestrial biota at all sites. Both stabilization and decontamination will disrupt terrestrial habitat to the same degree because of the earth-moving activities. The major difference between these alternatives will be the length of time that the sites are disrupted and the number of sites involved. Over the short-term nearly all of the terrestrial vegetation and associated habitat would be disrupted at the project sites.

All three sites are inhabited primarily by old-field animals (small mammals and some passerine birds). Individual animals may be lost either through road kills or competition when they try to relocate in other areas. The mortality of these individuals will not threaten the continued survival of any species, since all of the site inhabitants are common throughout the region. Larger animals that feed at the Burrell and Hanover sites will avoid these areas until the construction is completed.

Long-term impacts will not be different for any of sites following any of the alternatives. Stabilization at Canonsburg, Burrell, or Hanover would mean that the sites would become perpetual old field habitats since tree growth would be prevented. Once the vegetation has been stabilized, small animals would move back into the sites from the surrounding areas.

Decontamination of the Burrell and Canonsburg sites would also leave portions of these sites in open space because of Burrell's land-use controls and because a portion of the Canonsburg site is within the flood plain of Chartiers Creek. These undeveloped areas could eventually become wooded habitats.

5.7.2 Impacts on aquatic biota

The potential short-term impacts (those occurring during project implementation) on aquatic biota at any site would be the same during all of the alternatives since each would involve similar earth-moving activities. The only differences between the alternatives would be in the length of time over which the short-term impacts could arise, and the number of sites involved.

All of the alternatives (i.e., all but stabilization at Burrell) involve the discharge of process waste waters into nearby watercourses. These discharges will be treated by onsite facilities to meet NPDES requirements before discharge. The average quantity of discharge will be less than 1 cubic foot per second, which will not alter natural flow conditions.

Unplanned releases of material into any of the three surface-water systems could arise from flooding of disturbed areas at the Canonsburg or Burrell sites, or from large-scale runoff from any of the three sites during a high-intensity rainfall. To reduce the possibility of contaminated material eroding from the sites during these situations, flood and erosion-control structures are planned to isolate disturbed areas from surface-water systems. The primary result of an unplanned discharge be an increase in turbidity. Increases in turbidity are commonly experienced during high-water situations; however, disturbed sites contribute greater than normal quantities of material. Because the surface-water systems associated with the sites are not closed systems (i.e., they are free-flowing), the suspended soil material will not remain in one place for a long time; it will settle in areas of lower water velocity.

The erosion of disturbed material from the sites could also carry both radiological and nonradiological contaminants into the watercourses. The contaminated material would remain temporarily suspended in the water column with some possible uptake by aquatic plants and animals. It would eventually settle in the stream beds over a wide area. The contaminants could become incorporated into the substrate, become resuspended and transported downstream, or be assimilated into organisms.

Alternatives 2 through 5 are designed for long-term isolation of contaminated materials from surface-water systems. There will be no discharges of contaminants into any of the sites' associated aquatic ecosystems. Particularly at Canonsburg and Hanover, the remedial actions will increase soil-material stabilization and decrease erosion. The sediment and contaminant loadings from these two sites will be reduced from present levels.

5.7.3 Impacts on endangered species

As discussed in subsection 4.7.4, there are no known endangered or threatened species or critical habitats located near the three sites (Appendix E.3).

5.8 IMPACTS ON LAND USE

The long-term direct impacts of Alternatives 2 through 5 on the existing and future uses of the three sites are summarized in Table 5-8. The major change in land use at the Canonsburg site under Alternatives 2 and 3 will be the conversion of the 18.5-acre Canon Industrial Park site to controlled (limited use or unusable) open space. Alternatives 2 and 3 will also eliminate the residential use of the six houses on Wilson Avenue and one house on George Street and the use of the Georges Pottery property since these properties will be included in the restricted area because of their proximity to the former Vitro property. Under Alternatives 4 and 5, depending on the degree of decontamination, the Canonsburg site would either be converted to controlled open space or be made available for use in accordance with the Borough's land-use controls. Alternative 1 will leave the site in its present condition with its future use questionable because its few remaining businesses have been requested by the state to vacate. The economic impacts of moving the Canonsburg site businesses under all alternatives will be minimal because they are entitled to relocation assistance.

The Burrell site is currently a 50-acre limited-use open space, and will remain that way under Alternative 1. Under Alternatives 3 and 5 it would be unusable or limited-use open space. Under Alternatives 2 and 4, after the decontamination process is completed, the site will be usable as open space or for any other use permitted within the multiple-use flood control district of Indiana County.

The Hanover site is affected only by Alternatives 4 and 5, in which contaminated material from the Canonsburg and Burrell sites is brought to and stabilized at Hanover. The site is part of a large stretch of strip-mine area south of U.S. Route 22. Under Alternatives 4 and 5, this 50-acre portion of the worked-out strip mine will be separated and controlled as unusable or limited-use open space.

All of the remedial actions except Alternative 1 will have direct short-term impacts on land uses in the immediate vicinity of the Canonsburg site. The families on Wilson Avenue and George Street will be relocated

Table 5-8. Long-term land-use changes associated with the alternatives

Location	Changes in land use: From (existing use)	Changes in land use: To (use after remedial action)
Canonsburg (30 acres)		
Alternative 1	Industrial[a]	Industrial
Alternative 2	Industrial[a]	Unusable or limited-use open space
Alternative 3	Industrial[a]	Unusable or limited-use open space
Alternative 4	Industrial[a]	Usable open space [b]
Alternative 5	Industrial[a]	Usable open space [b]
Burrell (50 acres)[c]		
Alternative 1	Unusable open space[b]	Limited-use open space
Alternative 2	Unusable open space[b]	Usable open space[b]
Alternative 3	Unusable open space[b]	Unusable or limited-use open space
Alternative 4	Unusable open space[b]	Usable open space[b]
Alternative 5	Unusable open space[b]	Unusable or limited-use open space
Hanover (50 acres)		
Alternative 1	Strip mine (industrial)	Strip mine (industrial)
Alternative 2	Strip mine (industrial)	Strip mine (industrial)
Alternative 3	Strip mine (industrial)	Strip mine (industrial)
Alternative 4	Strip mine (industrial)	Unusable or limited-use open space
Alternative 5	Strip mine (industrial)	Unusable or limited-use open space

[a]The industrial use is being phased out.

[b]Under Alternatives 4 and 5 for the Canonsburg site, and Alternatives 2 and 4 for the Burrell site, after the decontamination process is completed, the sites would be released for any use allowed by the local planning and zoning regulations.

[c]The use of the site is affected by a combination of factors: a portion of the site is subject to a perpetual easement from the Corps of Engineers because it is situated in the full flood pool of the Conemaugh River Dam. This and the site's inaccessibility limit its possible use and development.

during all of the remedial activities. Under Alternatives 2 and 3 these families will be relocated permanently. Other local residents will experience the effects of earth-moving operations, such as increased noise and activity. Users of local streets will be inconvenienced by the temporary closing of Strabane Avenue during all of the alternatives, and Wilson Avenue, George Street, and Ward Street during Alternatives 4 and 5. Ward Street, Wilson Avenue, and George Street will be closed permanently under Alternatives 2 and 3. The temporary closing of Strabane Avenue will necessitate rerouting school buses for the Canon-McMillan School District, thus increasing travel times. Although this closure will not eliminate the accessibility of any area residence or business, it will make travel between Canonsburg and the Village of Strabane more difficult.

The Burrell site is separated from the closest developed land use (residential) by more than 500 feet. Any remedial action at the site will only have a minor impact on the surrounding land uses. The short-term adverse impact on land uses from Alternatives 2 through 5 will be limited to the inconvenience created by heavy equipment and trucks moving along local streets.

Alternatives 4 and 5 will only have a minor impact on the surrounding land uses at the Hanover site. The few homes along the probable access road (old U.S. 22) to the site will be inconvenienced by the movement of heavy equipment and trucks for the duration of the project.

Once the remedial work under Alternative 4 or 5 is complete, the Canonsburg site could be developed for use in accordance with the Borough's ordinance and future land-use plan. Under Alternative 1, no action, the site would remain in its present condition with its future use questionable. Alternatives 2 and 3 dictate that the site must remain as a controlled open space, which is not in conformance with the Borough's current land-use controls for the site area.

The future uses of the Burrell site under Alternatives 2 and 4 would conform to the Comprehensive Plan of Indiana County. Under Alternative 1, the site would remain as limited-use open space, mainly because of its physical instability (from the previous landfill operations) and its poor accessibility. Alternatives 3 and 5 would also leave the site as unusable or limited-use open space because of the restrictions imposed by the presence of stabilized radioactive materials.

Alternatives 4 and 5 are the only ones affecting the Hanover site. As a disposal location, this site would remain unusable or limited use open space, which is not in accordance with its current rural residential zoning designation.

5.9 IMPACTS ON NOISE LEVELS

The performance of any of the remedial-action alternatives will result in noise from the construction equipment and from the trucks transporting excavated and fill materials. All of the alternatives will require roughly the same types of equipment.

The sound levels at 50 feet for the equipment types used for remedial action range from 65 to 116 dBA (Table 5-9). The operation of several pieces of equipment at one time can increase these noise levels.

The Canonsburg site will be very sensitive to increased noise levels. Residences are within 300 feet of the site, and truck traffic into and out of the site will have to pass through densely populated residential areas. It has been estimated (Appendix H) that nearby residences could experience occasional noise levels of 60 to 84 dBA indoors. This is in excess of acceptable levels in residences. The Burrell and Hanover sites are less sensitive since both are located in less densely developed areas with the closest residences at least 500 and 2000 feet from the site, respectively. Also, the associated truck traffic will not pass through an area as heavily developed as Canonsburg.

Alternative 3 will generate the minimum noise impacts. At Burrell the stabilization alternative will involve short-term activities with minimal equipment use. In-situ stabilization of the Canonsburg material will have only minimum impacts since this alternative requires the least amount of truck traffic to and from the site.

Equipment noise levels will be controlled by the use of mufflers and by scheduling activities for daytime work hours only. Through the use of these control measures, the increased noise levels, particularly in the vicinity of the Canonsburg site, should be less of a problem, and public annoyance should be minimal.

The local municipalities in the vicinity of the Canonsburg site do not have ordinances on noise levels; however, sections of their zoning ordinances include noise as one of the considerations in land development. For example, the Zoning Ordinance for Chartiers Township, Section 805.1, contains performance standards for commercial districts where sound pressure in excess of 60 decibels is considered as noise and this level is not to be exceeded for a sustained time. This level could be exceeded for short periods, but not in a manner that is different from other construction sites. There are no ordinances on noise levels for either Burrell or Hanover Township.

Table 5-9. Noise levels of typical construction equipment

Equipment	Noise level (dBA) at 50 feet
Pneumatic tools	86
Trucks	91
Pile drivers	101
Bulldozers	80
Cranes with wrecking balls-	
derrick	88
mobile	83
Mobile cranes without wrecking balls	83
Power saws	78
Wood chipping equipment	88
Scrapers	88
Wagon drills	98
Jackhammers	88
Graders	85
Rollers	74
Compactors	116
Power shovels	82
Backhoes	85
Gradalls	85
Concrete mixers	
mixer	85
pump	82
vibrator	76
Paving machine	89
Trench diggers	89
Post hole digger	79
Post driver	79
Snow plow and sander	79
Sandblasting	81
Air compressors	81
Small airplane	90
Mowers	65

Source: U.S. Environmental Protection Agency, 1971a, b.

5.10 IMPACTS ON SCENIC, HISTORICAL, AND CULTURAL RESOURCES

The Division of Planning and Protection, Bureau for Historic Preservation of the Pennsylvania Historical and Museum Commission has reviewed the proposed project at the Canonsburg, Burrell, and Hanover sites in accordance with Section 106 of the National Historic Preservation Act of 1966, Executive Order 11593, and the regulations of the Advisory Council on Historic Preservation (36 CFR 800) (Appendix G). The Bureau has concluded that "there are no eligible or listed historic or archeological properties in the area(s) of this proposed project and therefore, this project should have no effect upon such resources."

5.11 IMPACTS ON POPULATION AND WORK FORCE

The remedial-action alternatives will have no major impact on existing or projected populations in the vicinity of the three sites. The only appreciable effect on population will be the temporary relocation of the families occupying the six houses on Wilson Avenue and the one house on George Street at the Canonsburg site during Alternatives 4 and 5, and the permanent relocation of these families under Alternatives 2 and 3.

The peak employment at each site during any of the alternatives will not exceed 55 workers at one time, as shown in Table 5-10.

Table 5-10. Peak staffing requirements (number of persons)

Alternative	Canonsburg	Burrell	Hanover
1	0	0	0
2	55	35	0
3	41	29	0
4	49	31	47
5	49	29	47

Although several of the alternatives could require 26 to 30 months for completion, only the supervisory and administrative staff and environmental engineering and safety personnel will be expected to be on the site for this length of time. The requirements for other staff members will be shorter, ranging from two months to one year.

It is expected that all of the professional and skilled labor needs will be provided by specialized contractors from outside the site areas. The DOE's Remedial Action Contractor (RAC) will be responsible for the overall project coordination. The RAC will use either competitively bid, fixed-price construction contracts to the maximum extent possible, or his own work force to handle the stabilization work and transfer of the contaminated materials. The contractor could come from the Pittsburgh area, but the use of firms from other areas is possible. At present, levels of unemployment in western Pennsylvania are high. Based on the low staffing requirements for each alternative, and the need for specialized contractors, the remedial actions will have only a minimal beneficial impact on the local work force. An effort will be made to hire local workers. In the event additional skills are required, these services can probably be obtained from local labor markets, including mining, the construction trades, and related fields. Because of the short-term nature of the remedial-action alternatives (about 2 years), this can be considered only a temporary benefit.

Based on the estimated work-force requirements, the remedial-action alternatives will not have a significant impact on the local population in terms of people moving into the area or of the subsequent need for additional housing, school capacity, and utilities.

5.12 IMPACTS ON HOUSING, SOCIAL STRUCTURE, AND COMMUNITY SERVICES

Housing, social-structure, and community-service impacts could result directly from long-term (greater than one year) immigration of an outside work force, as well as from the indirect expansion of supporting services. Long-term involvement will be required of supervisory and administrative personnel, and environmental control and waste-water treatment specialists. Workers who will be employed at the sites for less than 1 year and live outside commuting distance, will require short-term housing accommodations. These requirements will be met by the rental of apartments and trailers. Outside workers brought to the project sites for periods greater than 1 year will exert long-term housing requirements, which will probably be provided through leasing arrangements.

The peak housing accommodations for long- and short-term employees associated with the alternatives are presented in Table 5-11. These accommodations are based on the worst-case scenario with employees brought to the site areas by contracting firms. Although this is unlikely and some employment (possibly all) will come from the Pittsburgh Standard Metropolitan Statistical Area (SMSA) and the Indiana County labor pool and commute to each site, there is the possibility that the engineering contractor will be required to employ specially-trained staff (trained to handle radioactive material and avoid safety risks) in the hazardous waste disposal. This restriction on the use of the local work force may also be directed by the liability insurance of the contractors.

Table 5-11. Peak housing requirements at project sites for each option

Alternative	Number of housing units required					
	Canonsburg		Burrell		Hanover	
	Long term	Short term	Long term	Short term	Long term	Short term
1	0	0	0	0	0	0
2	7	48	5	26	0	0
3	7	32	0	29	0	0
4	6	43	5	26	31	17
5	6	43	0	29	31	16

In Canonsburg, the implementation of Alternative 2 would require the maximum housing requirements. Under this alternative, 7 long-term and 48 short-term accommodations could be required. In Burrell, 5 long-term housing accommodations would be needed under Alternative 2, and Alternative 3 would require the largest number of short-term accommodations (29). In Hanover Township, Alternative 4 would require the most long-term (31), and short-term (17) accommodations.

Over 10,500 housing units were reported in the Canonsburg area in 1980. With an estimated 2 percent vacancy, sufficient housing (210 units) is available in the current housing stock. These units will provide the accommodations for the peak housing needs of Alternative 2. In 1980 the housing stock in the Burrell area was estimated at over 8700 units, with an estimated 6.3 percent vacancy (550 units). This vacancy level will adequately accommodate the peak needs in Alternatives 2 and 4. There were over 4200 housing units in the Hanover area in 1980. Based on the estimated 2 percent vacancy in the area, 85 units will be available to provide accommodations for the peak long- and short-term workers needed in Alternative 4.

The influx of a few worker families in the general area of the three sites will have no adverse effect on the social structure of the communities in the vicinity of these sites. There are a number of ethnic and social groups in the general area of the Canonsburg site. The few worker families moving into the site area may join some of these groups.

In the vicinity of the Burrell site there are no ethnic or social groups that dominate the cultural and social aspects of the general area. Since the site is not close to the area's major residential sections, there will be no direct impact on the community structure from the project activities.

There are no identifiable cultural or ethnic groups living within a 1-mile radius of the Hanover site. Therefore, no impact on the social structure of the area is anticipated by implementing either Alternative 4 or 5.

The only noticeable impact of the alternatives (except Alternative 1) on community services in the Canonsburg site vicinity would be traffic-related impacts on the SNPJ Hall and Bowling Alley on Latimer Avenue because of the movement of heavy equipment and trucks along local streets. This community facility caters to the cultural and recreational needs of the major ethnic group in the Village of Strabane, the Slovenian community. The Alexander Cooperative Store on Latimer Avenue will be directly affected by the activities at the site, especially by closing Strabane Avenue during the remedial action. This store is owned and operated by the local community, and serves a large number of the households in Strabane as well as the Boroughs of Canonsburg and Houston.

There are no community facilities located near the Burrell or Hanover sites that would be disturbed by the proposed alternatives. The few homes on these routes would be affected by noise, dust, and congestion.

5.13 IMPACTS ON ECONOMIC STRUCTURE

The money inflow into the project areas will be primarily from salaries, work-force-related living expenditures, and for purchases of materials and supplies. Since the majority of the firms that will be involved in the remedial action are not located in the immediate project areas and are expected to already possess the required equipment, only a small amount of money from operational expenses will filter into the area. The overall flow of money from the project will vary with each remedial action, because of staffing levels and the project duration.

Estimates of the maximum total project-related wages and salaries for each alternative (Table 5-12) are based on the 1981 wages in the construction industry and the oil- and coal-products sectors of the Pittsburgh SMSA (between $1,600 and $2,300 per month). The maximum infusion of income, based on a monthly salary of $2,300, is estimated at $2.2 million for Alternative 4.

Table 5-12. Estimated 1981 average annual wages and salaries paid in each alternative

Alternative	Canonsburg	Burrell	Hanover	Total
1	$ 0	$ 0	$ 0	
2	$750,000	$490,000	$ 0	$1,240,000
3	$778,000	$246,000	$ 0	$1,024,000
4	$783,000	$490,000	$894,000	$2,167,000
5	$783,000	$246,000	$809,000	$1,838,000

Source: Washington County Board of County Commissioners (1980) for data on wages and salaries. These data were applied to the scheduling and staffing estimates for the various alternatives.

It is assumed that all project workers will be living in Washington and Indiana Counties during their employment. When these income totals are compared with the annual economic activity for the two counties, the differences are insignificant. (For example, the average payrolls for deep- and strip-mining alone were over $80 million for 1976.) The actual inflow of the project-related wages and salaries into the economy of the two counties will be lessened by those employees who maintain permanent residences outside Washington and Indiana Counties.

The indirect impacts of the wages and salaries generated by the project will be an increase in local business transactions of various types, such as for motor fuel, vehicle services, and restaurant, laundry, and other services. Since the period of employment for these individuals is estimated at only 2 years, it is unlikely that the imported workers will be making appreciable investments or durable goods purchases. Since the project-related personal income levels are insignificant in comparison with the total income levels in the site region, the indirect impacts of this income on local economies will be minimal. In general, each of the remedial-action alternatives (Alternatives 2, 3, 4, and 5) will have a slightly beneficial short-term indirect impact on local economies. Also, Alternatives 4 and 5 would open the Canonsburg site for development, which can be considered a long-term beneficial impact.

Material purchases and supplies are the other major sources of project funds that would be put into the local economy (Table 5-13). At a maximum, the material purchases are at $1 to $1.2 million (Alternatives 4 and 5). Although these material purchases may have a significant impact on individual firms, their impact on the local economy will be minimal.

Table 5-13. Estimated material purchases[a] (fill, crushed stone, clay, and topsoil) -- 1982 dollars

Alternative	Canonsburg	Burrell	Hanover	Total
1	$ 0	$ 0	$ 0	
2	$508,000	$ 32,000	$ 0	$ 540,000
3	$508,000	$138,000	$ 0	$ 646,000
4	$508,000	$ 32,000	$556,000	$1,096,000
5	$508,000	$138,000	$556,000	$1,202,000

[a]WESTON engineering estimates. Estimates of supplies (i.e., concrete, steel, etc.) are not available for costing under each alternative.

5.13.1 Government structure

In 1978 Canonsburg collected a total of $729,923 in taxes from real estate ($469,873) and Act 511 ($260,050) sources. All of the alternatives except Alternative 1 will reduce the amount of property taxes collected by closing the Canon Industrial Park (Alternatives 2 through 5), the seven residences (Alternatives 2 and 3), and the Georges Pottery property (Alternatives 2 and 3).

The taxes lost will be dependent on the assessed value of the properties at the time of closure. In 1981 the assessed value of the industrial park was $55,698, and $2,300 in taxes was collected by the Borough. Seventeen nearby properties were assessed at an average value of $2,839, for a total assessed value of $48,269. Under Alternatives 2 and 3, it is assumed that nine properties will be removed as Borough tax sources, without relocation within the Borough. At a tax rate of 41.25 mills, these properties contributed $937 in taxes. This results in a tax loss of $2,300 for Alternatives 4 and 5 and $3,237 for Alternatives 2 and 3. Taxes under Act 511 that will be affected at the local, county, and state level include the following:

1. School-district tax of 99 mills ($99.00 per $1,000 assessed valuation).

2. County tax of 25 mills.

3. Earned-income tax (0.5 percent each for the borough and school district) from project-related incomes.

4. Revenues from the privilege tax of $5.00 each to the Borough and school district.

5. Canonsburg mercantile tax of 1 percent.

6. Pennsylvania state income tax of 2.2 percent.

7. Pennsylvania state sales tax of 6 percent.

The project impacts on these taxes are minor. The possible increases in income- and sales-related taxes are probably offset by the decline in taxes from the loss of employment associated with the Canon Industrial Park (the 1978 level of employment was about 200 employees; the current level is 25). The Borough's involvement in traffic management may also have an impact on its finances. However, following Alternative 4 or 5, the possible development of the Canonsburg site may generate revenue for the Borough in terms of wages, sales, or property taxes.

In 1978 Burrell Township collected a total of $108,238 in local taxes. Real-estate taxes accounted for over $21,000, and the remaining $86,000 was obtained under Act 511. Alternative remedial actions will have little or no impact on property taxes because of the location of the disposal site.

Based on the estimated average annual wages and salaries for the Burrell area, which, at a maximum, would be $0.5 million, the associated income and other taxes at the local, county, and state levels are also expected to be minimal.

The total taxes collected in Hanover Township in 1978 were $85,963. Real-estate taxes accounted for $202, and Act 511 taxes were the remaining $85,761. Based on the current idle use of the proposed disposal site and the current 8-mill property tax, the loss in property taxes, if any, will be minor.

Based on the potential average annual wages and salaries (as much as $800,000) that could be produced by project personnel, Act 511 taxes in the Hanover Township area may be improved. Earned-income taxes would increase. The revenue from the tax imposed on mechanical devices (each) by the Township could also increase. The total change in the tax structure in Hanover Township would be insignificant, however.

5.13.2 Costs

The net costs for the several alternatives have been estimated (Table 5-14). These costs include excavation of the contaminated material, transporting it to its final disposal site, preparation of that site, cover and closure of that site, reclamation of that site, and reclamation of the decontaminated site, including the importation of clean fill. They also include the costs of acquiring the needed land. They do not include the cost of cleaning up the Canonsburg vicinity properties other than the Burrell site. The individual cost estimates upon which this summary is based are presented in Appendix A.4.

Cost estimates were prepared on a feasibility level of engineering assumptions of quantities, distances, and characteristics. These costs have an internal contingency of 15 percent on quantities, and an external contingency of 15 percent on the total construction cost. The unit costs used in these estimates are given in Appendix A.4. Since a conceptual design study has not been performed, an additional "uncertainty factor" of plus or minus 25 to 30 percent should be applied to the net costs, as shown in Table 5-14.

The cost of transporting clean fill will be directly affected by its availability and proximity to the sites. As indicated in Appendix A, there are several existing clean fill sites within the Canonsburg area. Several contractors have also indicated that clean fill will be available when it is needed (i.e., give someone the contract and they will obtain the fill).

Table 5-14. Order-of-magnitude costs of the remedial-action alternatives

Alternative	Net cost[a]
Alternative 1	0
Alternative 2	$24.2 million
Alternative 3	$13.7 million
Alternative 4	$44.5 million
Alternative 5	$34.5 million

[a]Costs in millions of 1982 dollars.

5.14 IMPACTS ON TRANSPORTATION NETWORKS

A study has been conducted to compare rail versus truck hauling of the contaminated and clean fill materials (Appendix I). The results indicate that trucks are the preferred method from the economic and engineering standpoints.

Except for the no-action alternative, all of the proposed project alternatives will have direct adverse impacts on the transportation networks in the vicinity of the Canonsburg and Burrell sites. The major impacts will come from the movement of heavy equipment and vehicles associated with stabilizing the material at each of the sites, transporting the materials from the sites to the disposal site, and importing new fill material. The approximate total truck trips required for each alternative at the three sites are given in Table 5-15. A major impact under all alternatives will be caused by the importation of large amounts of clean fill or cover material. The quantity of fill material required at the three sites is given in Chapter 3, with the descriptions of the alternatives. The effort to locate active borrow pits (Appendix A.6) resulted in several pits near Canonsburg, but none near Burrell. When the fill material is actually needed, adequate areas (former agricultural fields) will probably be available.

Table 5-15. Approximate total truck trips required at each site for transporting fill and contaminated materials

Site	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Canonsburg	16,500	12,500	25,000	25,000
Burrell	4,800	3,500	4,800	3,500
Hanover	0	0	26,500	21,000

The roadways leading to the three sites and the regional routes connecting the sites have been evaluated in terms of their physical and structural settings, current speed limits, use limitations, and capacity to handle project-related truck trips. The results of this study are given in Appendix I.

At the Canonsburg site the existing traffic patterns will be affected by closing Strabane Avenue under Alternatives 2 through 5 during the construction period. The closing of Strabane Avenue under all of these alternative routes will have little or no impact on the economic activities in the immediate vicinity of the project site. The impacts on the local residents from the truck-traffic generated by these alternatives will be from nuisance, noise, dust, and travel safety. Ward Street, Wilson Avenue, and George Street will be permanently closed under Alternatives 2 and 3. Most of the local streets that are currently congested because of their narrow width, will experience more congestion from the projected increase in truck traffic under Alternatives 2 through 5. In addition to disrupting the cross-traffic between Canonsburg and the Village of Strabane, the closing of Strabane Avenue will require traffic to be detoured to the Jefferson or Central Avenue crossings of Chartiers Creek, about 3/4-mile downstream from Strabane Avenue, or to the Main Street crossing about 4/5-mile upstream (Figure 1-2).

The route via Strabane Avenue and West Pike Sheet, PA 519 to I-79, is capable of supporting the projected truck traffic of 14,000 round-trips spread over 75 weeks, with minor improvements along the route for safe turning of trucks. On completion of the project, portions of the route will require resurfacing. However, since this route does not involve any municipal roads, the costs associated with the resurfacing work will not affect local municipalities fiscally.

Other alternative routes considered to avoid the truck traffic along West Pike Street are as follows (see Figure 1-2):

1. Via Strabane Avenue south to Latimer Avenue and west to PA 519.

2. Strabane Avenue, south to Boone Avenue, and then west to PA 519.

3. An access road to be constructed south of and adjacent to the ConRail Line from Strabane Avenue to PA 519.

Except for the third route, where the construction of a new approach road is involved, these routes will have lesser impacts on community services and the local traffic than the route through West Pike Street.

The feasibility studies (Weston, 1982a, b) upon which the costs given were based considered the possibility of modifications to the implementation plans that would lower the expected costs. Since these modifications can be evaluated only during further stages of the work, the base case for costs should remain, at this time, the in-situ stabilization alternatives as described for Canonsburg and Burrell.

Access to the Burrell site from nearby Strangford Road (L.R. 32006; see Figure 1-4) could be provided by the following:

1. Construction of a 1350-foot two-lane gravel and dirt road from the site proper to the ConRail right-of-way.

2. Rehabilitation of a two-lane private gravel grade crossing over the ConRail three-track mainline.

3. Rehabilitation of a two-lane 2800-foot cinder road adjacent to the ConRail tracks to a point of intersection with Strangford Road.

Strangford Road is currently inadequate to handle the volume of truck trips generated by the project, at a rate of 4.6 trucks in each direction per hour for an 8-hour day, 5-days per week for 24 weeks, under Alternatives 2 and 4. Also, Strangford Road with its 12- to 15-foot wide asphalt paving, inadequate shoulders, and horizontal curves is not suited for moving heavy equipment and vehicles.

The impacts of the project under Alternatives 4 and 5 on the transportation network in the vicinity of the Hanover site is mainly from the congestion on the access route, LR 62017 (Figure 1-8). The use of LR 62122 that parallels the ConRail mainline and Harmon Creek westward from PA 18 will have minimum impact, except while passing through Burgettstown. The direct impacts on the few residences along this route will be from congestion, inconvenience, noise, and dust.

Alternatives 2, 4, and 5 also require transporting the materials through regional arterial routes.

Under Alternative 2, the material from the Burrell site will be transported to Canonsburg for stabilization at the Canonsburg site. The possible routes are as follows:

1. U.S. 22/119, U.S. 22 via Pittsburgh to I-376/U.S. 22, I-279/U.S. 22, and south on I-79 to Canonsburg.

2. U.S. 22/119, U.S. 119 via Greensburg, I-70 to Washington, and north on I-79 to Canonsburg.

In addition to the impacts on local residents in the vicinities of the Burrell and Canonsburg sites, the truck traffic along either alternative route will pass through very high density population centers, such as Pittsburgh or Greensburg and Washington. Using alternative route 1, trucks will have to pass through two tunnels, thereby possibly creating a potentially hazardous situation if the trucks are involved in an accident.

The residents along the routes could be subjected to health hazards if a loaded truck overturned and spilled its contents. Alternative route 2 also encounters a number of communities along its 77.5-mile stretch through hilly and winding sections of the arterial routes. The traffic is very heavy (4?,200 average daily traffic count in 1980) near the I-79 interchange of I-70, and the truck activity during the project will create some additional congestion at this interchange.

For Alternative 4, the trucks originating at the Burrell site will follow alternative route 1 to I-79, and then continue on U.S. 22 to Florence. The trucks originating at Canonsburg will use either I-79 north to U.S. 22 west to Florence, or a very congested route via PA 519, PA 50, PA 18 passing through Houston, Westland, Hickory, and Atlasburg, or via I-79 south, I-70 west to PA 18 north through builtup areas like downtown Washington, Pennsylvania (Figure 1-1).

Transporting the material to Hanover by truck will interfere with regional and community traffic patterns, and create congestion and potential hazards to other road users and the residents of communities along the routes.

The impacts of Alternative 5, which requires transporting the Canonsburg material to Hanover, will be the same as those under Alternative 4; i.e., creating additional traffic on I-79, U.S. 22, and other state and local routes.

Alternatives 2, 4, and 5 require trucking the contaminated material between sites, and thus will impact the regional and local traffic by the additional truck trips, and may create health hazards from overturned trucks and resulting spillage. Fiscal impacts on local municipalities along the regional routes will only be minimal; the restoration of road surfaces after the completion of the project will not be the responsibility of these municipalities since the transportation routes do not include any municipal roads. However, additional road-crossing guards may be required in communities along these routes where the route is near a school.

Alternative 3 will have the least adverse impact on the communities and the local and regional traffic network from the truck transportation perspective.

As addressed in Appendix I from both transportation, engineering, and cost standpoints, the use of trucks is the preferred mode of transportation when compared with railroad use. Adequate truck fleets are available in the region to handle the quantities of material invoved, and the regional road network could connect the three sites with only a minimum capital investment. Conversely, for the use of the rail system, elaborate additions, and rehabilitation of existing railways are needed, requiring additional costs and time.

5.15 USE OF ENERGY AND OTHER RESOURCES

Each of the remedial-action alternatives will require the use of electricity, fuel, water, manpower, and construction materials such as soil and concrete (Table 5-16).

Electricity is required for personnel services, site lighting, and operation of the waste-water treatment facility. Fuel is required for the earth-moving equipment and the construction machinery. Concrete will be needed on a long-term basis for constructing the waste-water treatment facility, the truck-washing stations, and the encapsulation basins for sludge from the waste-water treatment facility.

Each of these resources, as well as soil, water, and manpower, are readily available in the area around the three sites.

Table 5-16. Energy and other resource requirements[a]

Alternative/ location	Electricity (kWh)	Engine fuel[b] (gal)	Concrete (cu yds)	Manpower (avg. man-weeks)	Soil and construction materials (cubic yards)	Water (gallons)
Alternative 2						
Canonsburg	222,000	232,000	5,000	2,688	250,000	2,120,000
Burrell	140,000	127,000	1,260	1,539	16,000	185,000
Total	362,000	359,000	6,260	4,227	266,000	2,305,000
Alternative 3						
Canonsburg	222,000	228,000	5,260	2,408	250,000	2,120,000
Burrell	8,500	82,000	0	480	70,000	125,000
Total	230,500	310,000	5,260	2,888	320,000	2,245,000
Alternative 4						
Canonsburg	270,000	640,000	7,760	2,912	250,000	5,350,000
Burrell	140,000	127,000	1,260	1,539	16,000	185,000
Hanover	280,000	503,000	4,510	3,360	200,000	4,000,000
Total	690,000	1,270,000	13,530	7,811	466,000	9,535,000
Alternative 5						
Canonsburg	270,000	640,000	7,760	2,912	250,000	5,350,000
Burrell	8,500	82,000	0	480	70,000	125,000
Hanover	280,000	383,000	3,510	1,363	170,000	4,000,000
Total	558,500	1,105,000	11,270	4,755	490,000	9,475,000

[a]The calculations used to derive these estimates are given in Appendix A.3.

[b]Gasoline and diesel.

5.16 ACCIDENTAL IMPACTS NOT ARISING FROM RELEASES OF RADIATION

Onsite accident possibilities include those typically associated with construction sites, such as falling into excavated areas. Of particular concern is the control of these situations during nonworking hours. Therefore, in addition to work place safety controls, off-hours protection will be provided, including restricted site access enforced by site security.

The major potential for offsite accidents is the movement of trucks over local roadways. This potential will be reduced by careful scheduling to minimize truck traffic during school and rush hours.

The Canonsburg site will require special precautions during the building demolition activities. These precautions will include isolating the area from the public and disconnecting all utility service lines to the buildings. It will be particularly important to monitor the utility service lines during all site activities to prevent accidents such as exposing live electric wires or rupturing gas lines.

At the Burrell site trucks will have to cross three rail lines. Since these lines are minor rail-traffic routes, safe crossings can be ensured by proper scheduling and the use of a railroad flagman.

Unlike the Canonsburg and Burrell sites, the Hanover site is situated in a remote area. The major offsite safety concern is the condition of the local roadways. Proper road maintenance and careful routing will be necessary to minimize the possibility of trucks overturning.

None of the transportation activities will significantly impact traffic patterns and therefore accident rates on the major arterial routes between the sites. There is concern over transporting the Canonsburg and Burrell materials through Pittsburgh and other urban communities. However, the volume of traffic generated by the remedial-action alternatives represents only a small portion of the total traffic on the roadways in question.

Alternative 3 presents the least potential for accidents since it entails activity at only two sites and excavation at only one. It also involves the least amount of truck traffic through residential areas. Alternative 4 has the greatest potential for both onsite and transportation-related accidents because it entails excavation at three sites and material removal from two sites.

5.17 RELATIONSHIPS TO LAND-USE PLANS, POLICIES, AND CONTROLS

Currently the Canonsburg, Burrell, and Hanover sites are being used in accordance with their respective land-use plans and controls (see Section 4.9). Implementation of the stabilization or decontamination alternatives will interfere with current site uses and, at Canonsburg, will interrupt some land uses in the vicinity of the site.

Stabilization of the Canonsburg site (Alternatives 2 and 3) will permanently exclude 30 acres from industrial development and residential use, and it will close Strabane Avenue as a major connecting link between Canonsburg and the Village of Strabane for the duration of the work.

Decontamination of the Canonsburg site (Alternatives 4 and 5) will temporarily disrupt its use, including the use of the Wilson Avenue and George Street residences and the use of Strabane Avenue will also be temporarily prohibited.

Stabilization of the material at the Burrell site (Alternatives 3 and 5) will exclude the site from any future major development. This does not represent a significant loss of usable open space since its development is already restricted by the flood-plain easement and its present unstable composition.

Decontamination of the Burrell site (Alternatives 2 and 4) could release the site for as much development as the easement will allow.

The disposal of contaminated material at the Hanover site (Alternatives 4 and 5) will eliminate the site from future use in accordance with its current zoning designation. This will not affect land-use plans or controls in the vicinity of the site.

5.18 UNAVOIDABLE ADVERSE IMPACTS

This section presents only those adverse impacts that cannot be offset by implementing the appropriate project controls (i.e., mitigating measures). The magnitude of the adverse impacts discussed in this section represent an upper bound (i.e., the worst-case situation).

5.18.1 Radiation

Under Alternative 1, 5.4 additional lung-cancer deaths above normal are predicted for the total population living within 2 kilometers (1.24 miles) of the Canonsburg and Burrell sites. During implementation of any of Alternatives 2 through 5 this population will receive approximately the same radiation exposure as during Alternative 1.

After the remedial action is completed, the local populations will be subject to very low levels of radiation exposure under Alternatives 2 and 3 at Canonsburg, Alternatives 3 and 5 at Burrell, and Alternatives 4 and 5 at Hanover. These exposures will result in approximately a 1 in 50,000 chance of a lung cancer death above normal in the 14,222 people living within 1.24 miles of the Canonsburg, Burrell, and Hanover sites.

The overall radiological impacts on remedial-action workers would be the same for Alternatives 2 through 5; however, the radiation doses to an individual worker will be greater than for the local populace during the short-term exposure. The workers' exposures will be three to six times greater than that for the local residents, and the workers' chances of cancer deaths will be increased by 0.05 to 0.1 percent above the normal.

5.18.2 Air quality

The implementation of Alternatives 2 through 5 will produce air contaminants, which are released during the operation of construction equipment. The concentrations of two pollutants (suspended particulates and nitrogen oxides) will probably exceed the NAAQS. In the case of suspended particulates, the background value already exceeds the national secondary standard and is close to the primary standard. Therefore, any additional contribution will cause a violation. The amounts predicted for the alternatives are based on a given set of engineering assumptions. It is possible to change these assumptions and perhaps lower the particulate emissions even further, but obviously not below the secondary standard. The standard for nitrogen oxides will probably be exceeded under Alternatives 4 and 5 at Canonsburg. Changes in the engineering assumptions may also reduce these emissions to below the standards, but the possible solutions for this pollutant are less viable.

5.18.3 Ecology

The implementation of Alternatives 2 through 5 will result in the temporary loss of most of the involved sites' terrestrial habitat. None of these losses will affect any endangered or threatened species, or jeopardize the survival of any species in the site areas. After the project is completed, all sites will be revegetated.

5.18.4 Land use

Alternatives 2 through 5 will have virtually the same short-term effects on land use at each site. At Canonsburg, under Alternatives 4 and 5, the use of the Canon Industrial Park, Georges Pottery property, and the seven residences will be temporarily discontinued.

Under Alternatives 2 and 3 the long-term adverse impacts to land use in the Canonsburg site area would occur from the demolition of the seven adjacent residences and the loss of the Georges Pottery and Canon Industrial Park properties. Stabilization at Burrell (Alternatives 3 and 5) and stabilization at Hanover (Alternatives 4 and 5) would eliminate these sites from future development.

5.18.5 Noise

All remedial-action alternatives, except Alternative 1, will raise noise levels in the project site areas. The greatest noise impact would be at the Canonsburg site because of its proximity to nearby residences. Noise generation may, at times, reach annoyance levels.

5.18.6 Transportation networks

All of the remedial-actions (Alternatives 2 through 5) will adversely affect local transportation systems during project implementation. The Canonsburg site area is the most sensitive of the three sites since it is the most densely developed area. The movement of large dump trucks into and out of the site will create traffic and noise-related problems, increase safety concerns along the route through Canonsburg, and make accessibility to local residences more difficult. The greatest impact would be from Alternatives 4 and 5 since these will involve the heaviest volume of material transportation. Ward Street, Wilson Avenue, George Street, and Strabane Avenue will be closed during the implementation of all of the alternatives. Under Alternatives 2 and 3 all of these roads, except Strabane Avenue, will be closed permanently. Strabane Avenue is a major connecting artery between the Borough of Canonsburg and the Village of Strabane.

The Burrell and Hanover site areas will also have increased traffic congestion and noise levels. However, these sites will not be as sensitive as the Canonsburg site area because of their more open settings.

5.19 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

All of the remedial-action alternatives (except Alternative 1) will require the same types of resource inputs. These include electricity, engine fuel, concrete, fill material, manpower, water, and land. Table 5-16 presents the resource requirements for these alternatives. The use of land is not a completely permanent commitment, since there is the slight possibility that the materials may be moved in the future, thus releasing the disposal sites for other uses. The encapsulation and fill materials could potentially be salvaged if this did occur.

5.20 RELATIONSHIP BETWEEN THE SHORT-TERM USE OF THE ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

Under Alternative 1, no action, there will be no short-term or long-term changes in the environment. The existing contaminated materials will remain at both the Canonsburg and the Burrell sites, thereby continuing the present low productivity of both sites. The Canon Industrial Park is in the process of being condemned, so it is not currently available for any use. Development of the Burrell site is restricted by a combination of factors; its land-use controls, the presence of radioactive material, and its unstable substrate.

All of the other alternatives have impacts that will result in some long-term changes in productivity. These are summarized in Table 5-17.

Under Alternative 2 the Canonsburg and Burrell site areas will experience short-term impacts. During project implementation, the two sites, including the Georges Pottery property and the seven residences in Canonsburg, will be unavailable for any use. The access roads, Wilson Avenue, Ward and George Streets, along with Strabane Avenue, will be closed to public use. Earth-moving activities will affect other local roadways in both site areas by increasing truck traffic and causing detours in travel between Canonsburg and the Village of Strabane. Terrestrial habitats will also be disrupted.

Following the completion of Alternative 2, the future development and use of the Canonsburg site will be limited. Wilson Avenue, George Street, and Ward Street will remain closed, but Strabane Avenue will be reopened. Radiological emissions from the Canonsburg site will be reduced from current levels to meet the EPA standards.

The long-term productivity and stability of the Burrell site will be enhanced by removing the radioactively-contaminated material and replacing the railroad ties with soil. The future development of the site will still be restricted by local land-use controls.

Under Alternative 3 the short- and long-term conditions at Canonsburg will be identical to Alternative 2, except that the project length and the traffic impacts will be less because the Burrell material will not be moved to Canonsburg.

Table 5-17. Short-term uses and long-term productivity

Location	Alternative 1	2	3	4	5
Short term					
Canonsburg	NC	D	D	D	D
Burrell	NC	D	D	D	D
Hanover	NC	NC	NC	D	D
Long term					
Canonsburg	NC	S	S	R	R
Burrell	NC	R	S	R	S
Hanover	NC	NC	NC	C	C

NC = No change.
D = Short-term description with increased air emissions, noise, and traffic.
R = Improved by removal of contaminated material.
S = Improved by stabilization of contaminated material.
C = Contamination of new area.

The short-term impacts at the Burrell site will be significantly less than for Alternative 2 because the contaminated material will not be excavated. Thus, air emissions, will be insignificant and there will be very little truck traffic.

The long-term conditions of the Burrell site will be enhanced by stabilization of its radioactive material. There will be no major change in the site's ecological productivity or substrate stability compared to preproject levels.

The short-term impacts at the Canonsburg site during Alternative 4 will be similar to Alternatives 2 and 3, but will be of a greater magnitude because of the increased amount of material handling and the longer period of activity required.

The long-term productivity potential of the Canonsburg site will be enhanced as a result of removing the site's radioactively-contaminated material. This will release the property for unrestricted use and development. In addition, Wilson Avenue, George Street, and Ward Street, and the adjacent residences will be returned to their preproject uses. All of the offsite impacts will cease at the project's completion.

All short- and long-term impacts at the Burrell site under Alternative 4 will be identical to those for Alternative 2.

Under Alternative 4 the Hanover site will experience the same types of short-term impacts as during the stabilization activity at Canonsburg. There will be increased truck traffic, noise levels, and air emissions, and a disruption of terrestrial habitats.

The Hanover site will remain in restricted open use. This does not represent a significant change from the existing conditions, since the site's rocky substrate limits its future development.

Alternative 5 will create the same short- and long-term conditions for Canonsburg and Burrell as Alternatives 4 and 3, respectively. The situation at the Hanover site will be approximately the same as for Alternative 4.

Over the long term, the decontaminated sites will experience a greater potential for human use than the stabilized sites. Environmental productivity will be enhanced approximately the same, since both types of remedial action would eliminate the uncontrolled release of radiation and will meet all EPA standards.

An additional consideration is that Alternatives 4 and 5 would involve a previously nonradioactively contaminated property, and commit it as a waste repository. This commitment would be counterbalanced by the accompanying release of the formerly contaminated sites for general use.

5.21 MITIGATION MEASURES DURING THE REMEDIAL ACTION

The DOE, with the concurrence of the NRC, will establish and operate a monitoring program throughout the remedial-action project. This will consist of routine field sampling and laboratory analysis, and comparison of the resulting data with both the rates predicted in the EIS and the levels specified in the EPA standards and NRC regulations and guidelines. If any significant deviation is recorded, immediate action will be taken to eliminate the problem.

5.12.1 Mitigation of impacts from the release of radiation

The release of contaminated particulates will be reduced by dampening contaminated material when it is uncovered, by covering it with tarps or plastic sheeting when feasible, by stopping contaminated material-handling operations during adverse weather conditions, and by using trucks with tight-fitting tailgates and covers when the material is moved off the site.

The offsite transportation of radioactively-contaminated material will be controlled by the use of decontamination facilities (e.g., truck wash stations) to clean trucks and vehicles before they leave the site. All waste-water streams will be treated before disposal, and all disturbed areas will be isolated from surface-water systems by the erosion-control methods described in subsection 5.21.3.

Human exposure to radioactive material will be reduced by relocating, either temporarily or permanently, the residents of the seven houses within the Canonsburg site, by restricting access to the project sites, and by providing the protective equipment necessary for use by the remedial-action workers.

5.21.2 Mitigation of impacts from air emissions

The exhausts resulting from the combustion of fuels in equipment and vehicles will be treated using approved methods such as catalytic converters to minimize unburned hydrocarbons, and the engines will be tuned to reduce other emissions to a practical minimum so that the exhausts will meet EPA emission standards.

Construction areas will be sprayed as needed to control fugitive dust, and roads will be sprayed during the remedial-action period with a dust suppressant. All materials, both contaminated and uncontaminated, will be transported in covered trucks. No material will be disrupted during adverse weather conditions.

5.21.3 Mitigation of impacts from water contamination

To prevent possible flooding of the sites during excavation and handling of the contaminated material, protective dikes isolating the disturbed material from surface-water systems will be installed. The construction of a collecting and settling pond and an associated waste-water-treatment plant at all of the sites will permit the collection and treatment of waste water resulting from washing vehicles and equipment, and will permit the treatment of contaminated storm water that might collect in excavations or as runoff from the contaminated areas. In addition, ground water pumped from Area C in Canonsburg will also be routed through this facility before it is discharged to the creek. The effluent water will be treated to meet NPDES water-quality criteria before being discharged to surface-water systems. The sediment from the collecting ponds and the resins and residues from the waste-water-treatment plants will be solidified with concrete and disposed of on the site.

5.21.4 Mitigation of impacts of noise

The impacts of noise will be reduced by using mufflers on vehicles and equipment, and by scheduling the remedial action for daytime hours only.

5.21.5 Mitigation of impacts on transportation networks

Whenever feasible, the high-capacity, primary road networks will be used to minimize the possibility of damage to the transportation network and to avoid congestion that could be a nuisance to the local populace. Truck traffic through Canonsburg will be scheduled to avoid school zones during school activity times, and congested areas during peak use times. Based on the transportation engineering study (Appendix I), material transportation between the three sites by rail is not an economical or viable engineering alternative.

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ABBREVIATIONS AND ACRONYMS

ADT	Average daily traffic
AEC	U.S. Atomic Energy Commission
AQCR	Air Quality Control Region
BEIR	Advisory Committee on the Biological Effects of Ionizing Radiation of the National Academy of Sciences (also their report)
Bendix	Bendix Field Engineering Corporation, Grand Junction, Colorado
BOD	Biological oxygen demand
CDM	Climatological dispersion model
CFR	Code of Federal Regulations
CO	Carbon monoxide
COD	Chemical oxygen demand
dBA	Decibels on the A scale; a logarithmically based unit of sound intensity
DOE	U.S. Department of Energy
dpm	Disintegrations per minute
EA	Environmental assessment
EGR	External gamma radiation
EIS	Environmental impact statement
EPA	U.S. Environmental Protection Agency
FR	Federal Register
FUSRAP	Formerly Utilized MED/AEC Sites Remedial Action Program
g	Grams; a unit of weight = 0.035 ounce
HC	Hydrocarbon
ISC	Industrial Source Complex
kWh	Kilowatt hours
l	Liter; a unit of volume = 1.057 quarts
LC_{50}	Concentration at which 50 percent of the organisms are killed in 96 hours
LR	Pennsylvania state traffic (legislative) route
m	Meter; a unit of length = 3.28 feet; also milli, a prefix meaning one-thousandth (10^{-3})
MED	U.S. Army Corps of Engineers, Manhattan Engineering District
MeV	Million electron volts
mg	Milligrams; a thousandth of a gram
mgd	Million gallons per day
MILDOS	A computer code used to calculate both the spread of radon and particulates in the atmosphere and the consequent radiation doses

MPC	Maximum permissible concentration
MPN	Most probable number
mr/hr	Milliroentgens per hour
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act of 1969 (PL 91-190)
NO_2	Nitrogen dioxide
NO_x	Nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
O_3	Ozone
ORNL	Oak Ridge National Laboratory, Oak Ridge, Tennessee
ORO	Oak Ridge, Tennessee office of the DOE
ORP	Oxidation-reduction potential; the same as redox potential or Eh
p	Pico, a prefix meaning one-trillionth (10^{-12})
PA DER	Pennsylvania Department of Environmental Resources
Pb	Lead
pCi/g	Picocuries per gram
pCi/l	Picocuries per liter
PE	Thornwaite Precipitation-Evaporation Index
pH	A logarithmic scale of hydrogen-ion concentration, and hence, an indication of acidity or alkalinity: pH = 7 is neutral; pH less than 7 is acidic; pH greater than 7 is alkaline
RA	Remedial action
Ra-226	Radium-226
RAC	Remedial-action contractor
RACP	Remedial-Action Concept Paper
RDC	Radon-daughter concentration
Rn-222	Radon-222
Sandia	Sandia National Laboratories, Albuquerque, New Mexico
SIC	Standard Industrial Classification
SMSA	Standard Metropolitan Statistical Area
SO_2	Sulfur dioxide
SR	Pennsylvania state traffic route
SU	Standard unit; used in this report to indicate a pH change of one
TOC	Total organic carbon
TSP	Total suspended particulates
TSS	Total suspended solids

U-234	Uranium-234
U-235	Uranium-235
U-238	Uranium-238
U_3O_8	Uranium oxide; also called yellow cake
UMTRAP	Uranium Mill Tailings Remedial Action Project
UMTRCA	Uranium Mill Tailings Radiation Control Act of 1978 (PL 95-604)
USGS	U.S. Geological Survey
Vitro	Vitro Manufacturing Company, Canonsburg, Pennsylvania
Weston	Roy F. Weston, Inc., West Chester, Pennsylvania
WL	Working level (a measure of radon-daughter-product concentration)
WLM	Working-level month (exposure to 1 WL for 170 hours)
WWTP	Waste-water treatment plant
$\bar{X}$	Mean (average) value of the variable
μ	Micro; a prefix meaning one-millionth (10^{-6})

GLOSSARY

absorbed dose, radiological	Radiation energy absorbed per unit mass, usually given in units of rads.
acid mine drainage	Water that has come in contact with iron disulfide in rock strata and coal seams in the presence of oxygen. This causes the formation of sulfuric acid and ferrous sulfate and lowers the pH of the water.
Act 511 of 1965	"The Local Tax Enabling Act of Pennsylvania," i.e., the authority under which municipalities levy a number of taxes other than real estate and occupation taxes that were previously levied under Act 481 of 1947. These taxes may include per capita, earned income, trailer, mechanical devices, and mercantile taxes.
alluvium	Sediment deposited by a flowing river.
alpha particle	A positively charged particle emitted from certain radionuclides. It is composed of two protons and two neutrons, and is identical to the helium nucleus.
anticline	A fold in the underground rock structure that is convex upward. Its core contains the stratigraphically older rocks.
aquifer	A subsurface formation containing sufficiently saturated permeable material to yield significant quantities of water.
aquitard	A confining bed that retards but does not prevent the flow of water to or from an aquifer.
atom	A unit of matter; the smallest unit of an element consisting of a dense, central, positively charged nucleus surrounded by a system of electrons, equal in number to the number of nuclear protons and characteristically remaining undivided in chemical reactions except for limited removal, transfer, or exchange of certain electrons.
A-weighted sound levels	A method of measuring sound intensity that simulates an individual's sound perception
background radiation	Radiation arising from radioactive material other than that under consideration. Background radiation due to cosmic rays and natural radioactivity is always present, and there is always background radiation due to the presence of radioactive substances in building materials, etc.
beta particle	Charged particle emitted from the nucleus of an atom, with mass and charge equal to those of an electron.

borough — A political subdivision of a county with a defined boundary over which a municipal administration has been established to provide local government functions and facilities. In Pennsylvania, a borough is a minor civil division within a county with similar administrative and political functions as a city or a township.

colluvium — Rock fragments, sand, and soil that accumulate on steep slopes or at the foot of hills.

confined aquifer — An aquifer bounded above and below by relatively impermeable beds.

contamination — In this report, the presence of radioactive material in undesirable concentrations.

daughter product(s) — A nuclide resulting from radioactive disintegration of a radionuclide, formed either directly or as a result of successive transformations in a radioactive series; it may be either radioactive or stable.

decay, radioactive — Disintegration of the nucleus of an unstable nuclide by spontaneous emission of charged particles, photons, or both.

decibel — A unit expressing relative sound levels.

decontamination — The reduction of radioactive contamination from an area to a predetermined level set by a standards-setting body such as the EPA by removing the contaminated material.

disintegrations per minute or second — The number of radioactive decay events occurring per minute or second.

disposal — The planned safe permanent placement of radioactive waste.

dose — A general term denoting the quantity of radiation or energy absorbed; for special purposes, it must be qualified; if unqualified, it refers to absorbed dose.

dose, absorbed — The amount of energy imparted to matter by ionizing radiation per unit mass of irradiated material at the point of interest; given in units of rads.

dose commitment — The cumulative dose equivalent that results and will result from exposure to radioactive materials over a discrete time period; given in units of rems.

dose equivalent — The quantity that expresses all kinds of radiation on a common scale for calculating the effective absorbed dose; defined as the product of the absorbed dose in rads and modifying factors, especially the qualifying factor; given in terms of rems. Often abbreviated "dose."

electron	A negatively charged particle found either free or surrounding the nucleus of an atom.
equipotential lines	Lines of equal pressure within an aquifer.
excess lifetime cancer deaths	The number of cancer deaths occurring in the lifetime of a particular population that is in excess of the number normally expected.
exposure	The presence of radiation that may deposit energy in an individual; given in units of roentgens.
external dose	The absorbed dose or dose commitment that is due to a radioactive source external to the individual as opposed to radiation emitted by inhaled or ingested sources.
fault	A surface or zone of rock fracture along which there has been movement.
fecal coliforms	Bacteria indicative of human waste.
flood plain	Lowland or relatively flat areas that are subject to a 1 percent or greater probability of flooding in any given year (i.e., a 100 year or more common flood).
flux, radon	The emission of radon gas from the earth or other material, usually measured in units of picocuries per square meter per second.
gamma dose	Radiation dose caused by gamma radiation.
gamma logging (or logs)	A technique for determining gamma radiation levels at various depths in a bore hole.
gamma ray or radiation	High energy electromagnetic radiation emitted from some radionuclides. The energy levels are specific for different radionuclides.
gamma spectral analysis (gamma spectroscopy)	An analytical technique for identifying radionuclides based on their different gamma energy levels.
ground water	Water below the land surface, generally in a zone of saturation.
half life	The time it takes for 50 percent of the quantity of a radionuclide to decay into its daughters.
in situ	In the natural or original position.

internal dose	The absorbed dose or dose commitment resulting from inhaled or ingested radioactivity.
isotopes	Nuclides having the same number of protons in their nuclei, but differing in the number of neutrons: the chemical properties of isotopes of a particular element are almost identical.
legislative route	A state-maintained roadway serving less than an arterial capacity.
licensing	In this report, the process by which the NRC will, after the remedial actions are completed, approve the final disposition and controls over a disposal site. It will include a finding that the site does not and will not constitute a danger to the public health and safety.
lineament	Any line on the ground or on an aerial photograph, that is structurally controlled.
man-rem	Unit of population exposure obtained by summing individual dose-equivalent values for all people in the population. Thus, the number of man-rems attributed to 1 person exposed to 100 rems is equal to that attributed to 100 people each exposed to 1 rem.
micro	A prefix meaning one millionth (x 1/1,000,000 or 10^{-6}).
milli	A prefix meaning one thousandth (x 1/1000 or 10^{-3}).
Modified Mercalli (scale)	A standard scale for the evaluation of the local intensity of earthquakes based on observed phenomena such as the resulting level of damage. Not to be confused with magnitude, such as measured by the Richter scale, which is a measure of the comparative strength of earthquakes at their sources.
municipality	General term for a city, town, borough, village, or other district incorporated for self-government.
neutron	An electrically neutral particle found in or emitted from the nucleus of an atom.
nucleus	The positively charged center of an atom.
nuclide	A kind of atom characterized by the constitution of its nucleus. It is specified by the number of protons and the number of neutrons in the nucleus.
passerine	Birds in the order Passeriformes, which includes perching birds and all song birds.

permeability	The ease with which liquids or gases penetrate or pass through a layer of soil. Technically, it is the volume of fluid that will flow through a unit area under a unit hydraulic gradient, measured in centimeters per second or equivalent units.
permissible dose	That dose of ionizing radiation that is considered acceptable by standards-setting bodies such as the EPA. Also, the dose of radiation that may be received by an individual within a specified period with the expectation of no substantially harmful result.
person-rem	Same as man-rem.
pico	A prefix meaning one trillionth (x 1/1,000,000,000,000 or 10^{-12}).
picocurie	A unit of radioactivity defined as 0.037 disintegrations per second.
piezometric surface	The potentiometric surface of an aquifer. This represents the pressure exerted on a confined aquifer, or the water table in an unconfined aquifer.
population dose (exposure)	The sum of individual radiation doses received by all of those exposed to the source of interest.
priority pollutant	One of 65 toxic substances officially recognized by the EPA and declared toxic under Section 307(a) of the Clean Water Act of 1977 by the U.S. Congress. The EPA has promulgated guidelines for the analytical methods to be used for testing for these pollutants.
proton	An electrically positive elementary particle found in the nucleus of an atom. Also, the nucleus of a hydrogen atom.
quality factor (QF)	The principal modifying factor by which absorbed doses are multiplied to obtain dose equivalents for radiation-protection purposes and thus express the effectiveness of absorbed doses on a common scale for all kinds of ionizing radiation. The quality factor depends on the type and the energy of the radiation being considered.
rad	A unit of measure for the absorbed dose of radiation. It is equivalent to 100 ergs per gram of material.
radioactivity (radioactive decay)	The property of some nuclides of spontaneously emitting particles or gamma radiation or of spontaneous fission.
radioisotope	A radioactive isotope of an element with which it shares almost identical chemical properties.

radionuclide	A radioactive nuclide.
radium-226	A radioactive daughter product of uranium-238. Radium is present in all uranium-bearing ores; it has a half life of 1620 years.
radon-222	The gaseous radioactive daughter product of radium-226; it has a half life of 3.8 days.
radon-daughter product	One of several short-lived radioactive daughter products of radon-222. All are solids.
red dog	A reddish-brown slag produced by steel mills.
rem	A unit of dose equivalent equal to the absorbed dose in rads times quality factor times any other necessary modifying factor. It represents the quantity of radiation that is equivalent in biological damage to 1 rad of x-rays.
riparian	Pertaining to a river bank.
roentgen	A unit of measure of ionizing radiation in air; 1 roentgen in air is approximately equal to 1 rad and 1 rem in tissue.
sands	In this report, relatively coarse-grained waste products of uranium-ore processing.
slimes	In this report, fine-grained waste materials from uranium-ore processing that are mixed with small amounts of water.
soil infiltration rate	The rate at which water enters the soil surface and moves vertically.
soil percolation rate	The rate at which water moves through soil in all directions.
specific conductance	A measure of the electrical conductivity of a solution, expressed in mhos per centimeter. It is an indicator of the presence of free ions (cations and anions) in the solution.
stabilization	The reduction of radioactive contamination in an area to a predetermined level by a standards-setting board such as the EPA, by encapsulating or covering the contaminated material.
state route	A Pennsylvania traffic route. It is a state-maintained arterial road.
syncline	A fold in the rock structure that is concave upward.

tailings, uranium-mill	The wastes remaining after most of the uranium has been extracted from uranium ore.
thorium-230	A radioactive-daughter product of uranium-238; it has a half life of 80,000 years and is the parent of radium-226.
transmissivity, hydraulic	A measure of the ability of an aquifer to transmit water equal to the product of the permeability and the thickness of the aquifer, expressed in gallons per day per foot of drawdown.
unconfined aquifer	An aquifer that is not confined by impermeable beds. The upper surface is called the water table.
uranium-238	A naturally occurring radioisotope with a half life of 4.5 billion years; it is the parent of uranium-234, thorium-230, radium-226, radon-222, and others.
water table	The level from which water can be drawn from a well.
working level (WL)	A measure of radon-daughter-product concentrations. Technically, it is any combination of short-lived radon decay products in 1 liter of air that will result in the ultimate emission of alpha particles with a total energy of 130,000 MeV.
working-level month (WLM)	Exposure to a worker resulting from inhalation of air with a concentration of 1 WL of radon daughters for 170 working hours. Continuous exposure of a member of the general public to 1 WL for one year results in approximately 27 WLM of exposure after allowing for lighter breathing rates during nonworking hours; 1 WLM is approximately equal to 5 rem.

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INDEX
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Appendix A

ENGINEERING INFORMATION

Appendix A.1

EXECUTIVE SUMMARY FROM "ENGINEERING FEASIBILITY ANALYSIS FOR IN-SITU STABILIZATION OF CANONSBURG RESIDUES," UMTRA-DOE/ALO-170, JANUARY 1982

UMTRA-DOE/ALO

Unlimited Release

ENGINEERING FEASIBILITY ANALYSIS FOR IN-SITU STABILIZATION OF CANONSBURG RESIDUES

January 1982

Prepared by
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under contract
to
Sandia National Laboratories
Contract No. 74-2738
for the
UMTRA Project Office
Albuquerque Operations Office
Department of Energy

Appendix A.1

A.1 INTRODUCTION

The U.S. Department of Energy is considering several methods for carrying out remedial actions in Canonsburg, Pennsylvania, at the site of an inactive uranium-processing mill. The main objective of this study is to determine the feasibility of in-situ stabilization as the remedial action. In-situ stabilization is an alternative to site decontamination and offsite disposal. The problems associated with offsite hauling of large quantities of contaminated material and with the location and development of a new disposal site could be avoided by the implementation of an in-situ stabilization concept. In addition, the in-situ approach would be more cost-effective than offsite disposal. This study will establish that a technically feasible and implementable in-situ stabilization concept can be developed that meets regulatory requirements and is cost effective. This study in no way commits the DOE to implement any specific actions described herein.

A.2 BACKGROUND

The Canonsburg site (Canon Industrial Park) is located in southwestern Pennsylvania, in northern Washington County, approximately 20 miles from downtown Pittsburgh. It is entirely contained within the urbanized Borough of Canonsburg.

If the stabilization-in-place option were to be implemented at the Canonsburg site, severe difficulties would be encountered in maintaining access to the residences on Wilson Avenue, the Georges Pottery property, and the residence at the end of George Street, both during and after remedial-action operations. For this reason and for other cogent health and safety concerns, this study is based on the premise that those properties would probably be acquired and would be incorporated into the disposal site.

The feasibility study area therefore covers a 30-acre area including 18.6 acres of the Canon Industrial Park (the original Canonsburg site), 6.1 acres of the Georges Pottery property, and 5.3 acres of residential property. It is bounded on the north, east, and west by Chartiers Creek, and on the south by the Conrail Washington Branch railroad. Two roadways (Strabane Avenue and Ward Street) traverse the industrial park, dividing it into three parcels, designated Areas A, B, and C. Areas B and C are undeveloped and relatively open, while Area A contains approximately ten structures. George Street borders the Georges Pottery area, which contains one large building and part of the residential area (one home), while six homes are located on Wilson Avenue.

Currently, portions of the site are being operated as an industrial park. There are 15 firms located on the site. These firms include a truck freight terminal, metal-work operations, machine shops, laundry operations, and various warehouses.

A.2.1 Radiation levels

Radiological surveys were made of the Canonsburg site in 1977 under the Atomic Energy Commission's 1974 "Formerly Utilized MED/AEC Sites Remedial Action Program." It was determined that significant amounts of contaminated material remain on the site and that the radiation levels measured in the buildings, soils, and ground water exceeded the proposed DOE guidelines for remedial action. Consequently, environmental and engineering analyses were made with respect to remedial action. The Canonsburg site was specifically identified in the 1978 Uranium Mill Tailings Radiation Control Act for remedial action consideration. The work at Canonsburg is a part of the Uranium Mill Tailings Remedial Action Program of the U.S. Department of Energy.

Radiological surveys of the Canonsburg site have been performed by several organizations, including the Oak Ridge National Laboratory (ORNL) and the Environmental Measurements Laboratory (EML). Concentrations of radium-226 and uranium-238 in surface soil samples from all three areas were found to be significantly greater than average natural background concentrations (1.2 and 1.3 picocuries per gram, respectively). Radium-226 values ranged up to 4200 picocuries per gram with over three-quarters of the samples exceeding 5 picocuries per gram. Concentrations of uranium-238 in some samples were greater than 172 picocuries per gram (the equivalent of source material), with values as high as 51,000 picocuries per gram. Measurements of the site's buildings show that all onsite buildings have extensive areas with gross alpha, gross beta-gamma, external gamma, and transferable alpha and beta contamination that exceed the appropriate limit.

Radiological ground-water quality was assessed at 40 of the onsite wells. With the exception of one extremely high radium-226 concentration of 4500 picocuries per liter in the western portion of Area A, the highest radium-226 concentration was found in the southeast corner of Area A (390 picocuries per liter). The lowest radium-226 concentration in any onsite well was 34 picocuries per liter. These results are above the existing standard of 30 picocuries per liter set by the U.S. Nuclear Regulatory Commission (NRC) and the proposed U.S. Environmental Protection Agency (EPA) standard of 5 picocuries per liter. All but two of the analysis results for uranium-238 were below the NRC standard of 40 picocuries per liter for this radionuclide; however, the majority of the results exceeded the EPA proposed standard of 10 picocuries per liter of total uranium.

In summary, surveys within Area A indicate that large quantities of the radioactive residue still remain on the site. Radium-bearing residues are present in soil beneath and adjacent to many of the buildings, as well as in the top few feet of soil over much of the area. Alpha contamination levels, beta-gamma dose rates, and external gamma radiation levels in some areas of the buildings and outdoors in Area A are above current Federal guidelines. Radon, radon daughter products, and thorium-230 levels in building air are also above current Federal guidelines in many instances. The ground water in Area A is also well above the current maximum permissible concentrations for radium and uranium.

Area B, although with lower contamination levels than Area A, is also above current Federal guidelines for radioactivity. Beta-gamma dose rates, external gamma radiation levels, radium in soil, and uranium and radium in ground water were all above the applicable guidelines. The 2- to 6-foot layer of contaminated soil on this area appears to be under approximately 8 to 9 feet of clean fill, which held surface contamination levels in this area lower than those of Area A.

Area C, a former lagoon area, was used as a depository for liquid wastes during uranium and radium recovery operations. The surface and subsurface soils are more contaminated than Areas A and B. A mucky material remains beneath the surface, with high concentrations of uranium and radium. Current Federal guidelines for soil radioactivity, ground-water radioactivity, and dose rates are exceeded in this area.

Radon and radon daughter products have been measured off the site at levels possibly in excess of current Federal guidelines.

A.2.2 Standards governing remedial action

The U.S. Environmental Protection Agency (EPA) has the primary responsibility for developing environmental standards for the disposal of wastes. In 1980, the EPA proposed standards for inactive uranium-processing sites under the Uranium Mill Tailings Radiation Control Act of 1978. These proposed standards are currently being revised, and may be made less stringent. For the sake of feasibility, however, the proposed remedial action has been designed to satisfy the proposed standards.

The EPA-proposed standards limit the annual average release of radon gas to the air from dispersed tailings to 2 picocuries per square meter per second, which is about twice the average for normal soils.

The performance standard for ground-water protection provides that selected contaminants from disposed tailings piles into ground water will not exceed specified levels. The contaminants specified are the same as those in the National Interim Primary Drinking Water Regulations. The only exception is the fluoride limitation. The EPA has omitted fluorides from the proposed standards because they are not important constituents in uranium mill tailings. If upstream ground-water levels exceed the specified concentration levels, then no further degradation is allowed. For existing sites, the EPA is proposing that the ground-water protection standards be applied starting 1.0 kilometer from the site.

The existing site conditions at Canonsburg and the proposed regulatory requirements for the safe disposal of wastes from inactive uranium processing sites define a unique set of considerations for onsite disposal.

A.2.3 Considerations for remedial action

With the radon and ground-water standards proposed by EPA, the 1000-year containment standard, and the long-term management objectives of NRC, the study of in-situ stabilization of the Canonsburg residues must deal with the following issues:

1. Heterogeneity -- Can a differentiation be made between various types and degrees of contamination, and can a spectrum of control strategies be developed to deal with them?

2. Excavation -- Is excavation (either partial or complete) a necessary part of the in-situ stabilization scenario? What is the extent of excavation required? If no excavation is required, can the areas of highest contamination levels be isolated to prevent public-health and environmental problems?

3. Area C materials -- Is it feasible to dispose of Area C materials on the site? How can this be accomplished?

4. Buildings -- What control measures are required to deal with the on-site buildings? If demolition is required, can the demolition rubble be disposed of on the site? Can any of the material be salvaged?

5. Multiple protection goals -- Can the contaminated material be isolated from storm-water infiltration while the radon flux rate from it is simultaneously held below regulatory levels?

6. Ground-water protection -- Can the ground-water flow regime and contaminant-leaching mechanisms be accurately established and control strategies developed to deal with the conditions? If these phenomena cannot be completely determined, can flexible strategies be developed to deal with the spectrum of uncertain conditions?

7. Newly generated wastes -- What management activities will be required for wastes created as a result of remedial-action activities (i.e., waste waters, dust, etc.)?

8. Flooding -- What flood protection measures might be required during and after construction?

9. Expected life -- Can an engineering design be developed for which the reasonably expected life is 1000 years? What historical or experimental basis is there for predicting the 1000-year life?

10. Cost -- Is there a cost-effective approach to in-situ stabilization at the Canonsburg site? Would there be a significant cost savings as a result of in-situ stabilization instead of decontamination and off-site disposal?

There are uncertainties in existing conditions such as the following:

1. Amount of contaminated materials.

2. Characteristics of contaminated materials.

3. Ground-water flow regime and potential for leaching of contaminants.

However, by using reasonable assumptions based on existing data and developing a flexible in-situ stabilization scenario, these uncertainties can be taken into consideration.

A.2.4 Conceptual approach for remedial action

This scenario is based on a conceptual approach that is conclusive in terms of feasibility and flexible enough to accommodate both the previously described uncertainties and the variations in regulatory requirements. The approach is modular, allowing various parts of the study called modules to be added or deleted depending on the results of further field study, changes in regulatory posture, or other design requirements.

The essential modules to be considered for in-situ stabilization at Canonsburg include the following:

1. Contaminated material handling.

2. Encapsulation of contaminated material.

3. Additional site work.

4. Environmental management.

A.3 CONTAMINATED-MATERIAL HANDLING

The contaminated-material module is required for assessing amounts and levels of contamination and sources and types of contaminated material. This is especially necessary at Canonsburg because of the heterogeneity of the contamination. This module covers the classification of contaminated material and the handling methods in terms of removal, excavation, decontamination, disposal, etc.

The existing data on surface and subsurface contamination at the site and knowledge of previous operating procedures indicate a large area of subsurface contamination in the lagoon portion of Area C, and a scattering of "hot spots" (contamination at levels of hundreds to thousands of picocuries per gram of radium-226) in Areas A and B. The hot spots in Area A are relatively close to the surface (0 to 8 feet), but in Area B they are deeper (8 to 14 feet).

The buildings in Area A have floors of contaminated soils or cracked concrete; these floors release radon gas and particulate daughter products.

Insufficient data exist to properly characterize the contaminated materials in Area C. Conflicting reports have been made concerning the characteristics of these materials, particularly pH and their potential for contaminant leaching. The uncertain chemical nature of the contaminated materials does not prevent the selection of a feasible in-situ stabilization concept as long as the construction materials used are resistant to wide variations in pH.

There are two basic conceptual approaches for in-situ stabilization. The first is to excavate and dispose of all contaminated materials in a specially designed repository. The second involves a judicious selection of some of the contaminated materials for excavation and disposal in this manner; the remainder would be stabilized in place, without excavation.

The problems with excavation of the entire site are many:

1. There is a logistics problem of secure handling and storage of large quantities of contaminated materials after they have been excavated.

2. Increased construction costs are involved in large excavations adjacent to Chartiers Creek.

3. Construction-worker exposure is increased.

4. Massive construction efforts will increase the time required for construction which may delay the remedial-action schedule.

After consideration of the distribution of contaminated materials and their varying degrees of contamination and heterogeneity, it appears that the most feasible in-situ stabilization would involve a judicious selection of only some of the materials for excavation and disposal. The remaining materials would be stabilized in place using cover systems. This concept requires that all onsite buildings be decontaminated and demolished and that the more contaminated soils in Areas A and C be excavated. The building debris would be disposed of in the excavated portion of Area C, as well as other excavations, if possible. The more contaminated soils excavated from Areas A and C would be disposed of by placement in a specially designed cell which would totally encapsulate the material with a liner and a cover. Contaminated soils in Area B, located well below the surface, would receive additional soil cover (cap) over the entire area, as would areas surrounding the encapsulation structure.

Figure A-1 shows the areas of excavation required to remove soils contaminated with radium-226 at concentrations of greater than 100 picocuries per gram in Areas A and C. Little excavation should be needed in Area B since the contamination is so deeply buried that the existing overburden, plus an additional soil cover, will be sufficient to control radon emanation and infiltration.

The physical and chemical properties of the Area C material have not been accurately quantified as yet. It has been described as "soup" or "yogurt" with pH values reportedly ranging from as low as 2 to as high as 13. In consideration of these uncertainties, it was decided to assume a worst-case condition of excavation by dragline to demonstrate the feasibility of the project concept. A sampling and analysis program to more fully characterize the Area C material is recommended before any excavation activity.

In some sections of Area C ground water is only 4 feet below the surface. Even during dry-weather periods, the ground water may only be 8 feet below the surface in Area C. Therefore, it may be necessary to dewater the area to facilitate excavation of contaminated material. Dewatering would simplify handling of the material after excavation as well.

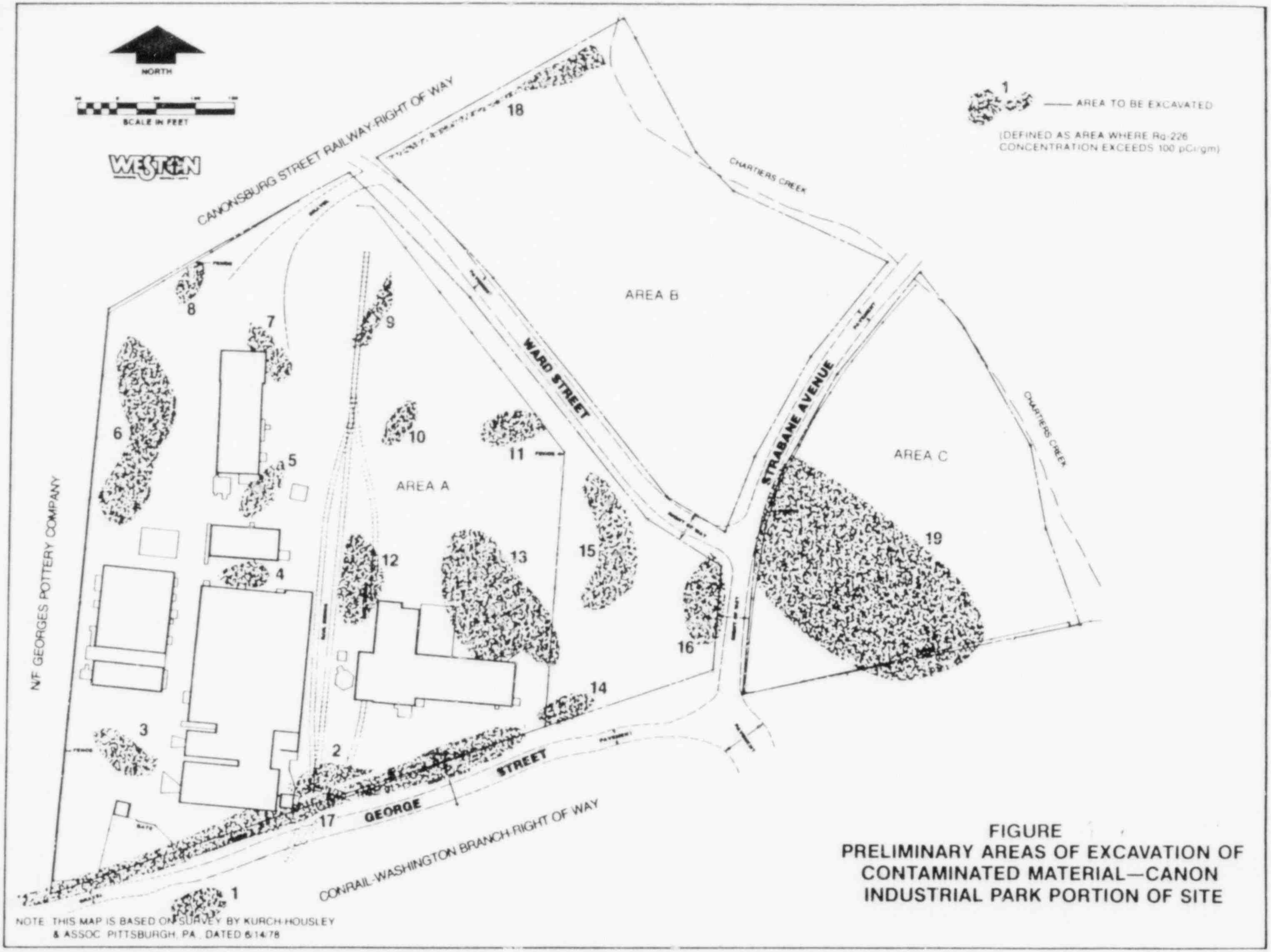


FIGURE
PRELIMINARY AREAS OF EXCAVATION OF CONTAMINATED MATERIAL—CANON INDUSTRIAL PARK PORTION OF SITE

NOTE: THIS MAP IS BASED ON SURVEY BY KURCH-HOUSLEY & ASSOC. PITTSBURGH, PA., DATED 6/14/78

A.4 ENCAPSULATION OF CONTAMINATED MATERIAL

The encapsulation-cell module is required for developing handling strategies for the most highly contaminated materials at the site. The source and character of these materials is developed in the contaminated-material module. The encapsulation-cell module addresses the evaluation, selection, and interaction of cover and liner materials and the conditioning and handling of these materials. The proposed location of the encapsulation cell is shown on Figure A-2. The cover and liner configuration recommended for use is shown on Figure A-3.

The encapsulation area is designed to contain the excavated more contaminated soils. It consists of a multilayer cover and a low-permeability liner. The cover is designed to limit radon flux from the encapsulated materials to 2 picocuries per square meter per second and to limit infiltration to as low as 1 percent of the annual average precipitation. The design of this cover represents a new approach in landfill design. Traditional designs allow water to penetrate the fill material and provide for long-term collection and possible treatment of leachate as it is generated. In the type of design proposed, the liner is essentially impermeable to ensure that no significant leachate escapes the cell. The multilayer cover is designed to minimize infiltration so that little leachate is generated. The liner then serves as a backup system to the cover. This type of design is essentially maintenance-free in application. The cover system should be constructed of entirely natural materials. The use of these materials is the best assurance of extended life because of their inherent structural stability and high resistance to biochemical degradation.

A.4.1 Multilayer cover system

A primary purpose of the cover system described in this subsection is to reduce radon fluxes at the surface of the covered Canonsburg disposal site to 2 picocuries per square meter per second or less. It is necessary to design the cover to accommodate the highest radon flux anticipated from the encapsulation area. The site characterization indicates that the highest radon flux could be 1000 to 1500 picocuries per square meter per second from the encapsulated material and up to several hundred picocuries per square meter per second from the remainder of the site.

Analyses of the effects of various cover configurations on radon flux rates were conducted using a computer model developed by Rogers Associates Engineering Corporation (RAECO, March 1981). The flux rate of 1000 to 1500 picocuries per square meter per second from the encapsulation area can be controlled to the specified regulatory level of 2 picocuries per square meter per second with the use of a 10-foot multilayer cover system (3 feet of clay, 1 foot of gravel, 6 feet of soil). The flux rate of several hundred picocuries per square meter per second flux from the remaining soils can be controlled to the specified level with the use of a 6-foot soil cover. Since contamination at several hundred picocuries per square meter per second and less can be adequately controlled by the 6-foot soil cover, it was determined that the excavation of soils contaminated with radium-226 at these lower concentrations would not be necessary.

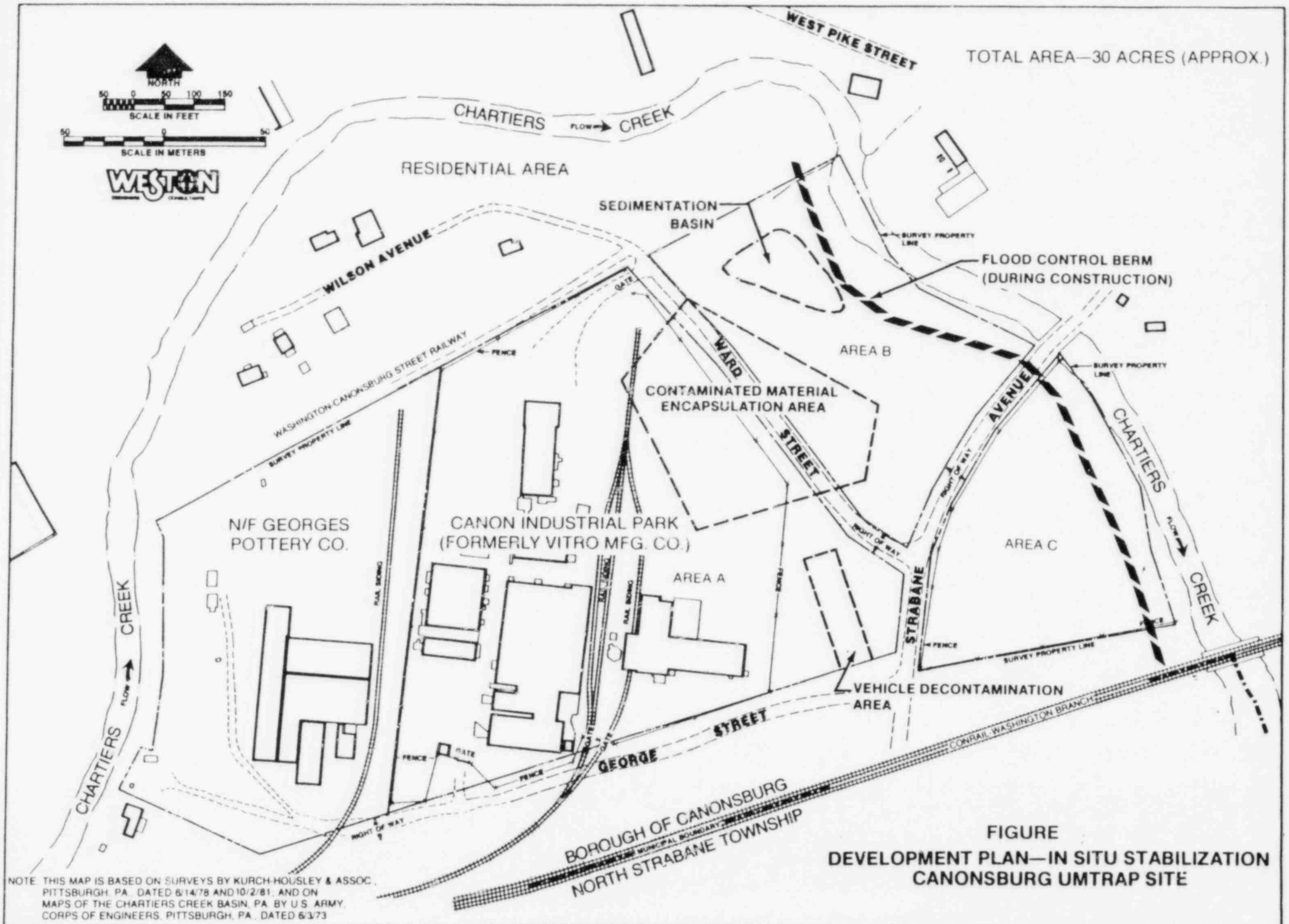


FIGURE
DEVELOPMENT PLAN—IN SITU STABILIZATION
CANONSBURG UMTRAP SITE

NOTE: THIS MAP IS BASED ON SURVEYS BY KURCH-HOUSLEY & ASSOC., PITTSBURGH, PA., DATED 6/14/78 AND 10/2/81; AND ON MAPS OF THE CHARTIERS CREEK BASIN, PA. BY U.S. ARMY, CORPS OF ENGINEERS, PITTSBURGH, PA., DATED 6/3/73

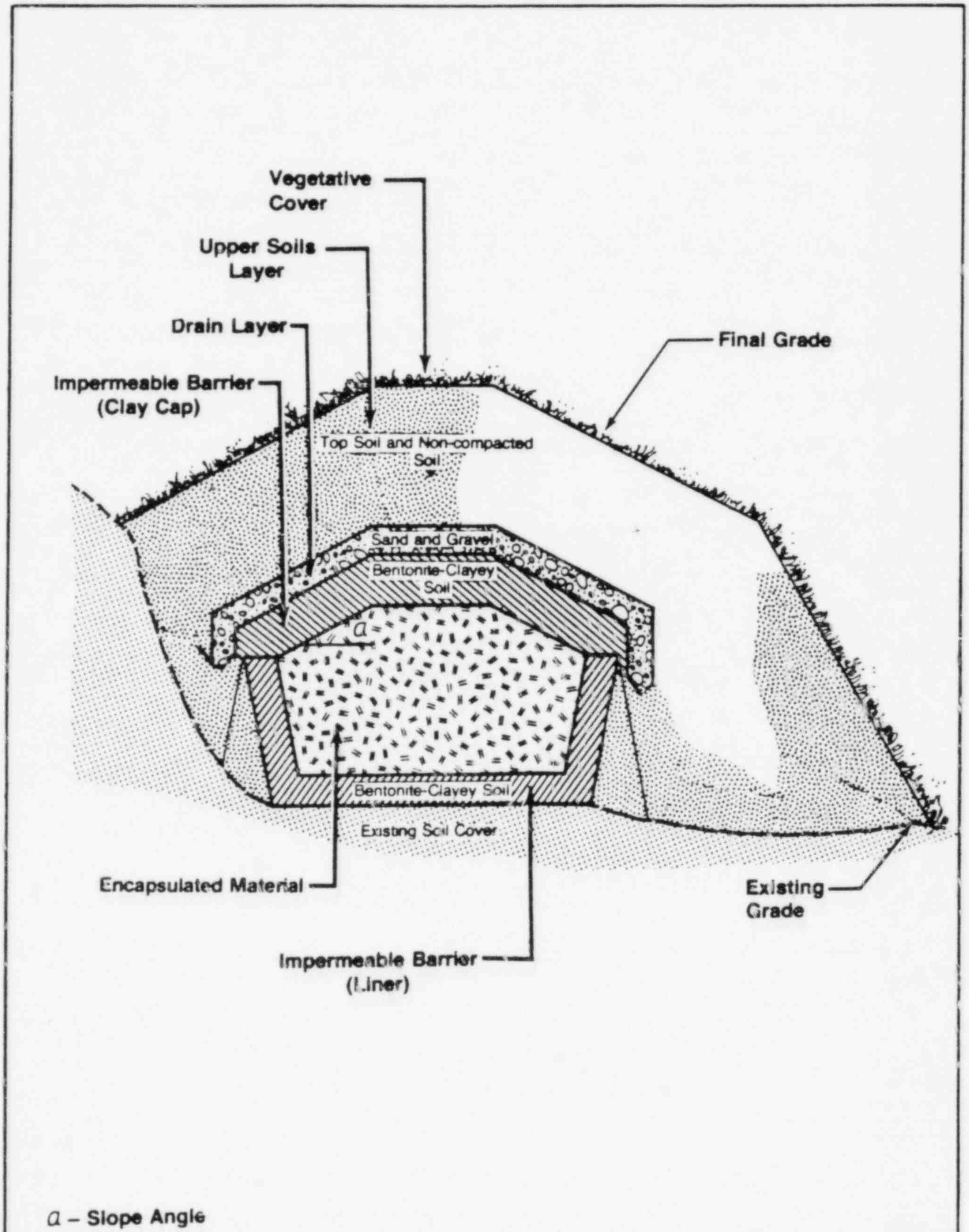


FIGURE PROFILE OF RECOMMENDED ENCAPSULATION AND COVER CONFIGURATION—CANONSBURG UMTRAP SITE

A 6-foot multilayered cover system (3 feet of clay, 1 foot of gravel, 2 feet of soil) was considered an optional design for the encapsulation area due to the uncertain status of the EPA criteria. If the radon flux criterion was increased to 50 picocuries per square meter per second, this cover system would provide adequate radon control at a lower cost than the 10-foot-thick design. Similarly, the use of several thicknesses of soil was considered for cover for the remainder of the site in the event that the radon flux criteria become less stringent.

A.4.2 Liner system

The primary purpose and function of a liner system is to retard the physical movement of water into the natural environment. An optimal liner design would address the dual function of minimizing water (leachate) movement while passively treating any leachate that does migrate through the liner.

Upon reviewing the performance evaluation of various liner materials, it was determined that low-permeability native soils, admixtures of soil and bentonite, and bentonite itself are most suited to this application. The specific liner material, however, can only be selected once the readily available native soils are tested for permeability and cationic exchange capacity and the need for bentonite is established. The liner has been designed to be only as effective as the multilayered cover in terms of water control. Therefore, there should be no leachate or water buildup and no long-term maintenance requirements for leachate collection. Any water percolating through the liner will undergo ion-exchange attenuation through the clay.

A.4.3 Ion exchange

An ion-exchange barrier may be considered a means of controlling, if necessary, the migration of radionuclides in or into ground water. This type of system could be constructed as follows:

1. A curtain or barrier designed to intercept the flow of ground water around the periphery of the site.

2. A liner placed under the encapsulation cell designed to intercept any leachate that may be generated.

Ion-exchange material may be composed of the following:

1. Natural soils (clays generally have a high cation-exchange capacity).

2. Synthetic resins (zeolites, macroreticular polymers, gels, etc.).

The selection of the type of ion-exchange material will generally depend on the following factors:

1. Characteristics of the water or leachate that will be handled.
2. Presence and concentration of other ionic species.
3. Type of ionic species that must be removed.
4. Economic considerations.
5. Effective life.
6. Construction feasibility.

In addition, the ion-exchange function of a barrier or liner must be compatible with the other desired functions. For example, a primary purpose and function of a liner system is to retard the physical movement of water through the liner.

A.4.4 Waste conditioning

Waste conditioning is generally performed to meet one of the following three objectives:

1. To improve the handling and physical characteristics of the waste.

2. To decrease the surface area across which transfer and loss of contained contaminants can occur.

3. To limit the solubility of various contaminants within the waste.

Objectives 1 and 3 could be important at the Canonsburg site.

A number of fixation and conditioning methods were considered for application including the following:

1. Cement-based techniques.
2. Lime-based techniques.
3. Thermoplastic techniques.
4. Thermosetting resins.
5. Encapsulation techniques.
6. Glass and ceramic fixation techniques.
7. Thermal stabilization.
8. Acid extraction of contaminants.

They may be used in the event material excavated from Area C is found to have a low pH, which could damage a liner or cap made of bentonite clay and soil. Of the conditioning techniques considered, the lime-based techniques are the most applicable to the Area C material. Fixation techniques using lime-type products usually depend on the reaction of lime with a pozzolanic* material, water, and the waste to produce a concrete-type material. The most common pozzolanic materials used in waste fixation are cement-kiln dust, fly ash, and pulverized slag. These materials are readily available in the Pittsburgh area. The effectiveness of chemical fixation using this technique must also be demonstrated through bench-scale tests that simulate the actual process.

A.5 ADDITIONAL SITE WORK

The additional-site-work module is required for addressing those parts of the site other than the encapsulation cell. This module includes general site preparation such as flood control, dust control, and vehicle and worker decontamination, as well as handling strategies for contaminated materials other than those addressed in the encapsulation-cell module.

Additional site requirements which have been addressed as part of the in-situ-stabilization concept include the following:

1. Flood control and storm-water management, both during and after construction.

2. Site-access control and security.

3. Vehicle decontamination.

4. Fugitive-dust control.

5. Worker decontamination and health considerations.

6. Materials handling.

In addition, the areas of the site not included in the encapsulation cell must be addressed. They should be covered with a maximum of 5-1/2 feet of noncompacted fill and 6 inches of topsoil to support vegetation. Utilization of materials from the Burrell landfill site and from the vicinity proper as fill or cover materials is also feasible. Computer simulation efforts have shown that this should be sufficient to control radon flux to regulatory levels and to significantly reduce infiltration.

*The term pozzolanic applies to silicate-type material.

A.6 ENVIRONMENTAL MANAGEMENT

The environmental-management module is required for considering the environmental effects of construction activities. This module addresses environmental monitoring during construction, ground-water, surface-water, and waste-water management both during and after construction.

The cleanup strategy proposed for Area C could require initial dewatering of the soils in the area before excavation and the maintenance of a low ground-water table by continued pumping of the wells during the excavation. The waste waters, along with those generated during building decontamination and daily vehicle and worker decontamination, may require treatment for the removal of radioactive species before discharge to Chartiers Creek.

Storm runoff into the open excavation pits during construction should be collected and may require treatment before discharge. The waste-water treatment would include a sedimentation-and-surge basin followed by multimedia pressure filters for the treatment of suspended material. These could be followed by cation- and anion-exchange beds for the control of dissolved species, if necessary. Water softening may also be used in order to reduce the need for resin regeneration in the ion-exchange beds. Effluent quality should be monitored before discharge. The final design of waste-water treatment facilities would be determined by further characterization of the waste waters to be generated.

To control contamination in ground water, interim measures may be needed until complete natural renovation of the area is accomplished. Existing data on ground-water quality and the flow regime are not sufficient to precisely determine requirements and design parameters for such an interim measure. Offsite migration of ground-water contamination has not been identified yet. However, in order to establish the feasibility of the remedial-action concept a subsurface ion-exchange barrier was evaluated for application. If further confirmation studies establish the need for interim means of protecting the ground-water quality, this barrier, composed of a mixture of sand and natural zeolite, could provide a means of passive treatment for contaminated ground water flowing through the upper layer of unconsolidated material on the site. Within five to ten years the ion-exchange capability of the bed will be exceeded, but, by then, the effects of remedial action will have eliminated further contamination of the ground water. A water budget analysis of the proposed cover systems shows that 1 percent or less of the water impinging on the site will percolate through the waste.

A.7 APPROXIMATE COST ESTIMATE

An approximate cost estimate for in-situ stabilization of the Canonsburg site is given in Table A-1. The costs are presented in a modular format to allow each element of the control concept (e.g., cover by itself, etc.) to be reviewed. It should be noted that this "approximate cost" is based on conservative assumptions. A preliminary cost estimate should be prepared as part of the detailed engineering phase of this project.

It should be noted that this cost estimate does not include site acquisition, cleaning offsite properties, and preparation of the Environmental Impact Statement (EIS). A significant reduction of the project cost could be realized by reducing the areas to be covered, reducing cover thickness, and verifying water quality conditions, to redefine the need for the ion-exchange barrier and portions of the waste-water treatment plant.

A.8 CONCLUSIONS

The study of the Canonsburg site was initiated to ascertain the feasibility of onsite stabilization of all the radioactive contamination. Upon completion of this study, the following can be concluded:

1. An innovative remedial-action plan for in-situ stabilization has been developed that is both cost effective and feasible. Preliminary estimates are for a total cost of approximately $10 million.

2. A multilayered cover system has been developed. It is 10 feet thick, consisting of 3 feet of clay, 1 foot of gravel, and 6 feet of soil. It restricts water infiltration to 1 percent and controls radon flux rates to the regulatory levels of 2 picocuries per square meter per second.

3. All of the more contaminated materials (23,700 cubic yards of soil and 14,000 cubic yards of demolition rubble) on the site can be handled using demonstrated technologies.

4. The 80,000 cubic yards of material on the Burrell landfill site and the 5700 cubic yards of material on the vicinity properties can also be incorporated into this design.

5. These disposal technologies will satisfy proposed EPA and current NRC criteria for remedial action, and are flexible enough to handle a variety of future regulatory postures.

6. This plan will minimize impact to the public during construction (a period of approximately 18 months), and its implementation will ensure long-term stability.

Table A-1. Approximate cost[a]

Item	Approximate cost		
Encapsulation area (3 acres)			
Liner	$ 720,000		
Material filling	80,000		
Multilayer cover with vegetation	935,000		
Subtotal		$1,735,000	
Remainder of site (27 acres) 6-foot cover with vegetation		$1,790,000	
Contaminated soil excavation (23,985 cubic yards)			
Dewater Area C	60,000		
Excavation and material handling	215,000		
Subtotal		$275,000	
Building decontamination and demolition			
Building decontamination	200,000		
Salvageable-steel decontamination (4,700 tons)	30,000		
Building demolition	575,000		
Demolition-debris handling (18,000 cubic yards)	120,000		
Subtotal		$925,000	
Waste-water treatment		510,000	
Ion-exchange barrier (48,000 square feet)		500,000	
General site preparation			
Flood-control berm (2,400 feet)	240,000		
Fencing (7,000 feet)	100,000		
Remove railroad embankment and track (1,900 feet)	40,000		
Vehicle decontamination	30,000		
Worker facility	30,000		
Demobilization and cleanup	25,000		
Subtotal		$465,000	
Construction cost			$6,200,000
Contingency (15 percent)			930,000
Standby equipment and crew[b] (100 days at $5000 per day)			500,000
Engineering			713,000
Construction and environmental management			$1,500,000
TOTAL			$9,843,000

[a]Based on Engineering News Record cost index 3560; all individual cost items include 15 percent contingency for quantities, labor rate, etc.

[b]Cost of idle time for inspections, construction quality control, monitoring, and inclement weather.

Appendix A.2

EXECUTIVE SUMMARY FROM "ENGINEERING FEASIBILITY ANALYSIS FOR IN-SITU STABILIZATION OF BURRELL RESIDUES," UMTRA-DOE/ALO-187, SEPTEMBER 1982

UMTRA-DOE/ALO-187
Unlimited Release

ENGINEERING FEASIBILITY ANALYSIS

FOR IN-SITU STABILIZATION OF

BURRELL RESIDUES

September 1982

Prepared by
Roy F. Weston, Inc.
under contract
to
Sandia National Laboratories
Contract No. 74-2738
for the
U.S. Department of Energy
UMTRA Project Office
Albuquerque Operations Office

1 EXECUTIVE SUMMARY

1.1 SCOPE AND OBJECTIVES

The Burrell Township site, located in western Pennsylvania, received approximately 11,600 tons of radioactively-contaminated material in late 1956 and early 1957 from the Vitro Manufacturing Company's operations in Canonsburg, Pennsylvania. WESTON was requested to conduct an engineering study to determine the feasibility of stabilizing the site in accordance with the U.S. Environmental Protection Agency's (EPA) interim standards (45 FR 27366-27368, April 22, 1980, and 46 FR 2556-2563, January 9, 1981). The scope of this study is limited to those alternatives that can be implemented on the site and will not require removal and offsite disposal of radioactively-contaminated material.

Four alternatives for control of the radioactive material at the Burrell site were considered and evaluated, as follows:

1. Site stabilization and closure.
2. Site control and containment.
3. Waste excavation and encapsulation.
4. Waste excavation, incineration, and encapsulation.

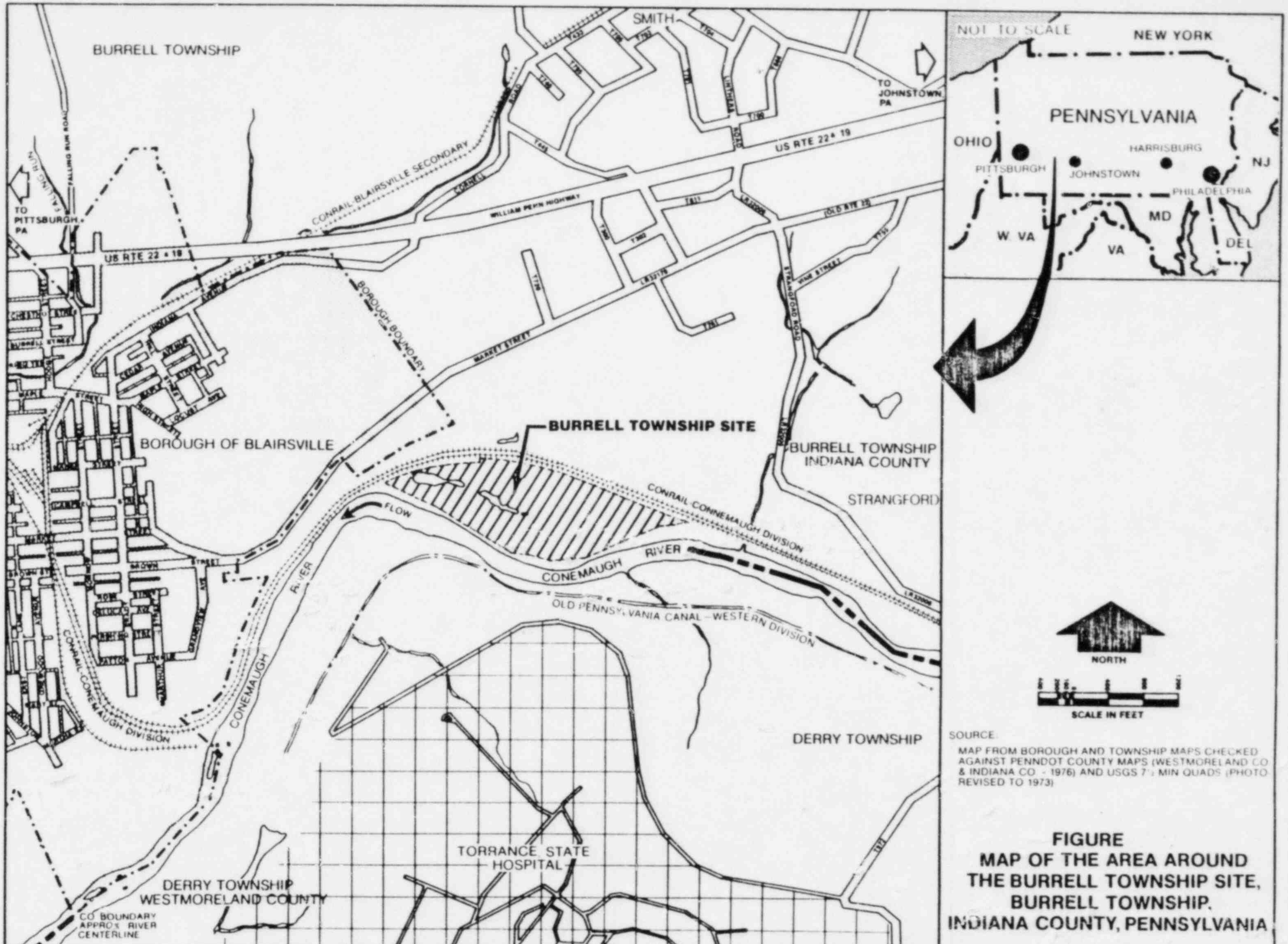
1.2 SITE CHARACTERIZATION

1.2.1 Introduction

The current conditions at the Burrell site have been characterized using published information and detailed field investigations to determine the site's radiological, hydrogeological and water-quality conditions.

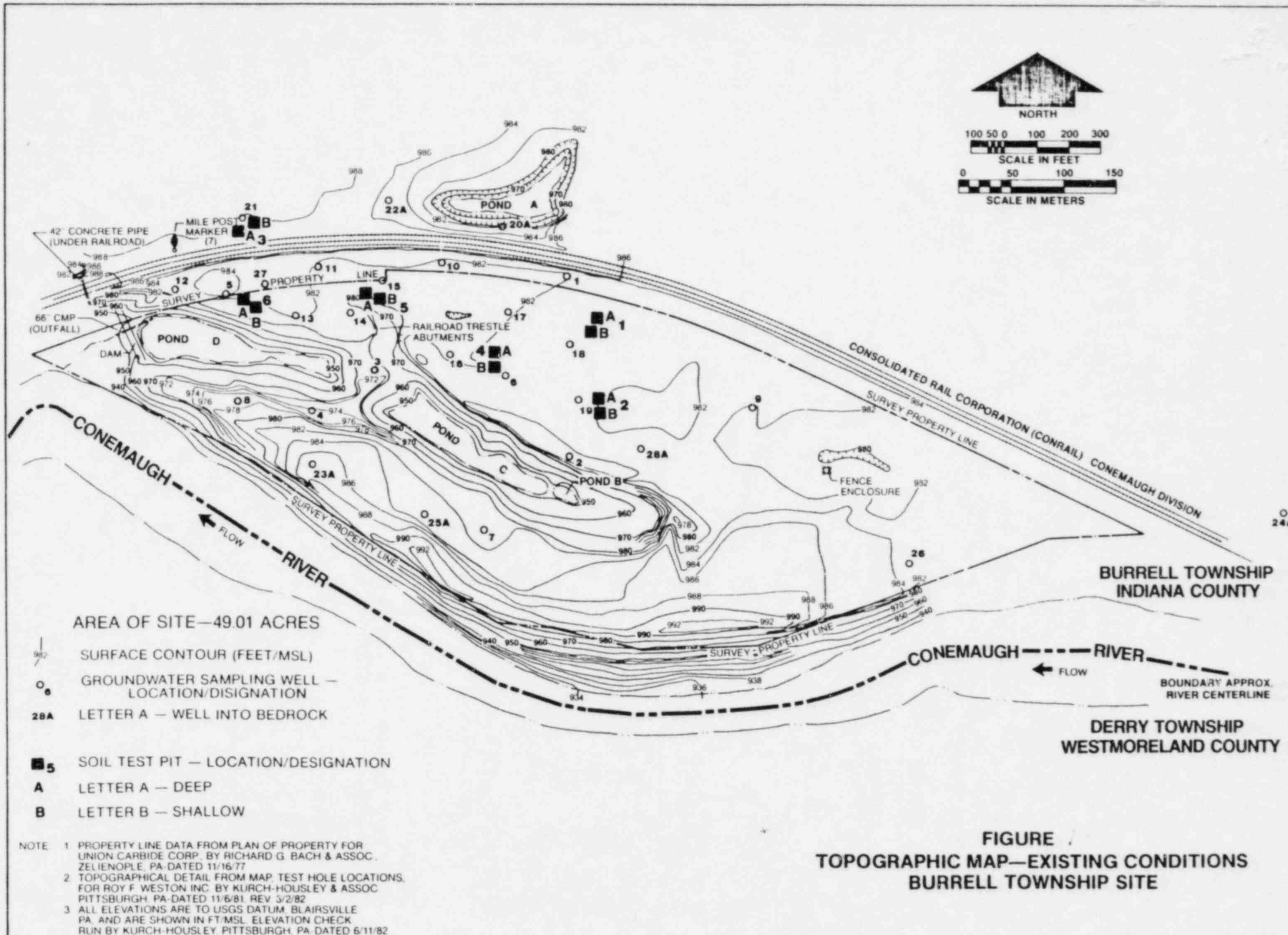
1.2.2 Site history

The Burrell site is located in western Pennsylvania approximately 40 miles east of Pittsburgh (Figure 1-1). The 50-acre site is situated within a bend of the Conemaugh River (Figure 1-2). During the 1950's, the Pennsylvania Railroad operated the site as a dump for a variety of wastes, including railroad ties. Radiological contamination of the site resulted from the disposal of 11,600 cubic yards of residues during one time period, i.e., October 1956 to January 1957, from the Vitro Manufacturing Company operations in Canonsburg, Pennsylvania. The waste residues were generated under Atomic Energy Commission (AEC) contract AT-(30-1)-1683, and were reported to consist of pitchblende, carbonate cake, calcium fluoride, and magnesium fluoride (Leggett et al., 1979). These residues contained approximately 6000 cubic yards (dry volume) of waste residues containing an average of 0.097 percent uranium oxide by weight.



SOURCE:
MAP FROM BOROUGH AND TOWNSHIP MAPS CHECKED AGAINST PENNDOT COUNTY MAPS (WESTMORELAND CO. & INDIANA CO. - 1976) AND USGS 7½ MIN QUADS (PHOTO REVISED TO 1973)

FIGURE
MAP OF THE AREA AROUND THE BURRELL TOWNSHIP SITE, BURRELL TOWNSHIP, INDIANA COUNTY, PENNSYLVANIA



FIGURE

TOPOGRAPHIC MAP—EXISTING CONDITIONS BURRELL TOWNSHIP SITE

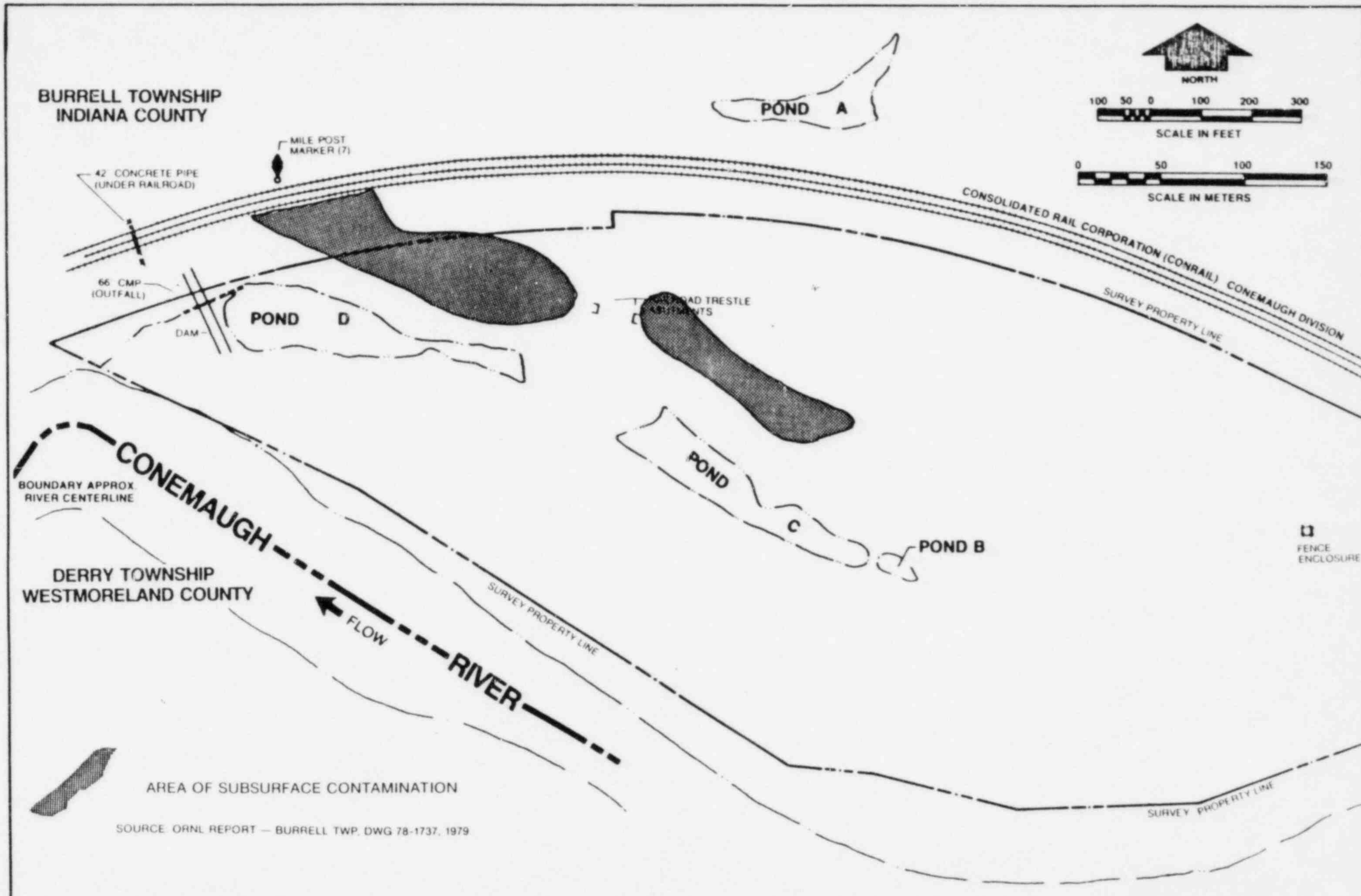
The uranium (approximately 6 cubic yards of uranium oxide) was classified as "unrecoverable material-measured." The wet volume of the residues was estimated to be 10,000 cubic yards, and since the material was shipped wet, it appears that approximately 1600 cubic yards of possibly nonradioactive materials were mixed with the radioactive materials during loading.

1.2.3 Radiological characteristics of the site

A radiological survey of the Burrell site was conducted by Oak Ridge National Laboratory in late 1977 (Leggett el al., 1979). During this survey, measurements were taken of the following:

1. Beta-gamma dose rates.
2. Concentrations of radium-226 (Ra-226) and uranium-238 (U-238) in soils and subsurface water.
3. Gamma-radiation levels as a means of estimating radium-226 concentrations in bore holes.
4. Concentrations of radon-222 (Rn-222) and its daughters in ambient air.

These surveys indicated that radioactive residues containing an estimated 5.8 tons of 0.097-percent uranium oxide (approximately 1.5 curies of uranium-238) were transferred from the Canonsburg site and dumped at the Burrell site. Analyses of subsurface-soil samples for 76 holes augered on this site to depths of 50 feet revealed the general location of residues containing an estimated above-background total uranium-238 activity of 1.3 curies, and an estimated total radium-226 activity of 4 curies. It appeared that more than 75 percent of these residues were at least 10 feet beneath the surface (Figure 1-3). Radioactive residues were also scattered on the surface. At some points the surface soils showed radium-226 concentrations of several thousand picocuries per gram, uranium-238 soil concentrations of 360 picocuries per gram, and external-gamma-radiation levels at 1 meter in excess of 600 microroentgens per hour, and beta-gamma dose rates at 1 centimeter from the surface in excess of 5 millirads per hour. Such measurements were not, however, representative of the entire area; at most sampling points radionuclide concentrations in surface soils and radiation levels at the surface and at 1 meter above the surface were less than 10 times background levels. Figure 1-4 depicts the surface radiation levels found at the site. The maximum concentrations of radioisotopes in onsite ground-water samples were 370 picocuries per liter for thorium-230, 10 picocuries per liter for radium-226, and 403 picocuries per liter for uranium-238. Analyses of water and sediment from drainage pathways from the site to the Conemaugh River indicated that these radionuclides were at or only slightly above background levels in these pathways off the site. Atmospheric radon levels were, with one exception, at background levels; radon-daughter-product concentrations were also at background levels.



SOURCE ORNL REPORT — BURRELL TWP. DWG 78-1737, 1979

FIGURE .
AREAS OF SUBSURFACE CONTAMINATION
BURRELL TOWNSHIP SITE

NOTE 1 PROPERTY LINE DATA FROM PLAN OF PROPERTY FOR UNION CARBIDE CORP. BY RICHARD G. BACH & ASSOC., ZELIENOPLE, PA-DATED 11/16/77

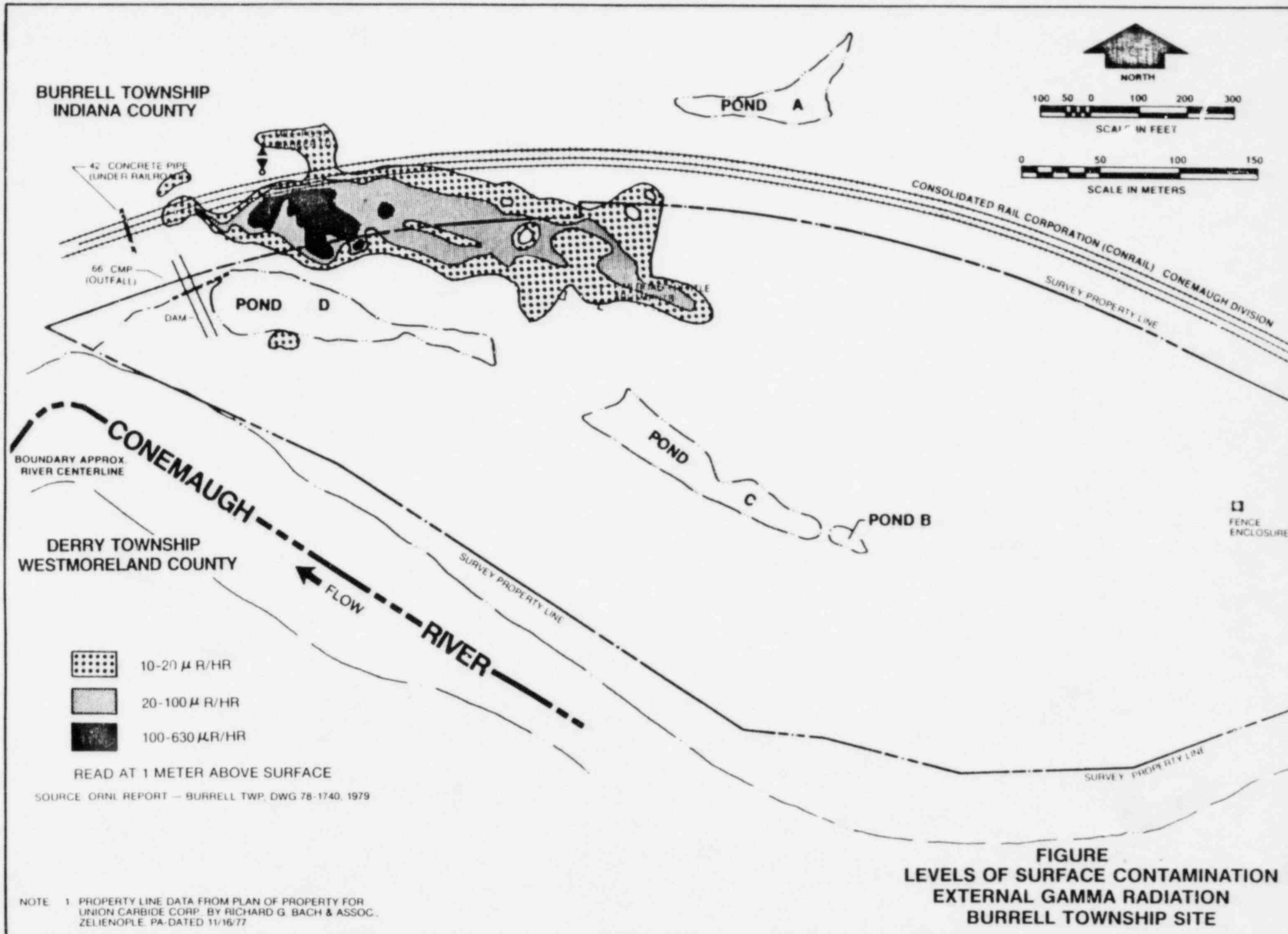


FIGURE
LEVELS OF SURFACE CONTAMINATION
EXTERNAL GAMMA RADIATION
BURRELL TOWNSHIP SITE

During July 1981 and January and February 1982, WESTON conducted a limited radiological survey that included measurements of uranium-234, -235, and -238, and radium-226 in ground water and gamma-radiation levels at various depths in augered bore holes (Figure 1-5). This survey found very little radiation at the site. The external gamma-dose rates were essentially at the background level, and the radium and uranium levels in ground water were at or slightly above background. Very little radioactivity was present in soils near or below the surface. The highest uranium concentrations found in the ground water were 6.6 picocuries per liter of uranium-234, 0.22 picocuries per liter of uranium-235, and 5.3 picocuries per liter of uranium-238. The total uranium concentrations for wells in the known dump area ranged up to 12 picocuries per liter. The radium-226 levels in the ground water from all wells tested were found to be at background level. In 7 out of 28 bore holes gamma-radiation levels were found to be above background level, with most of the activity in these holes at depths less than 7 feet.

In March and April of 1982, Bendix Field Engineering Corporation performed a confirmatory survey of the Burrell site, including gamma-radiation levels and estimates of radium-226, magnetic susceptibilities, potassium, thorium, and total potassium-uranium-thorium in the bore holes. In 9 out of 28 bore holes the gamma-radiation levels were above background level, with most of the activity at depths less than 8 feet. The estimates of radium-226 concentrations in subsurface soils ranged from less than 1 picocurie per gram to 800 picocuries per gram. Only seven observations were documented in which radium activity was greater than 10 picocuries per gram.

In general, the Bendix survey results confirmed WESTON's conclusion that the levels of radioactivity in the contaminated zone at the site have declined since the 1977 survey by ORNL. This reduction is evidenced in Table 1-1 where the average radium-226 concentration in ground water decreased by a factor of approximately 3, and for uranium-238, by a factor of approximately 24.

The reduction of these radioactivity levels at the site may be due to the radionuclides leaching and migrating through various pathways, or the redistribution of activity throughout larger portions of the site. Regardless of the mechanism, it is clear that radioactivity at the site is currently at a very low level and does not warrant any extensive remedial action.

Table 1-1. Comparison of ground-water radioactivity (picocuries per liter)

Nuclide	1977 ORNL data		1981-1982 WESTON data		Proposed EPA standard
	Range	Average	Range	Average	
Ra-226	0.5 - 10	3.6	1.0 - 2.02	1.06	5[a]
U-238	2.1 - 403	31.8	0.10 - 5.73	1.33	10[b]

[a]Includes Ra-226 and Ra-228.

[b]Total uranium.

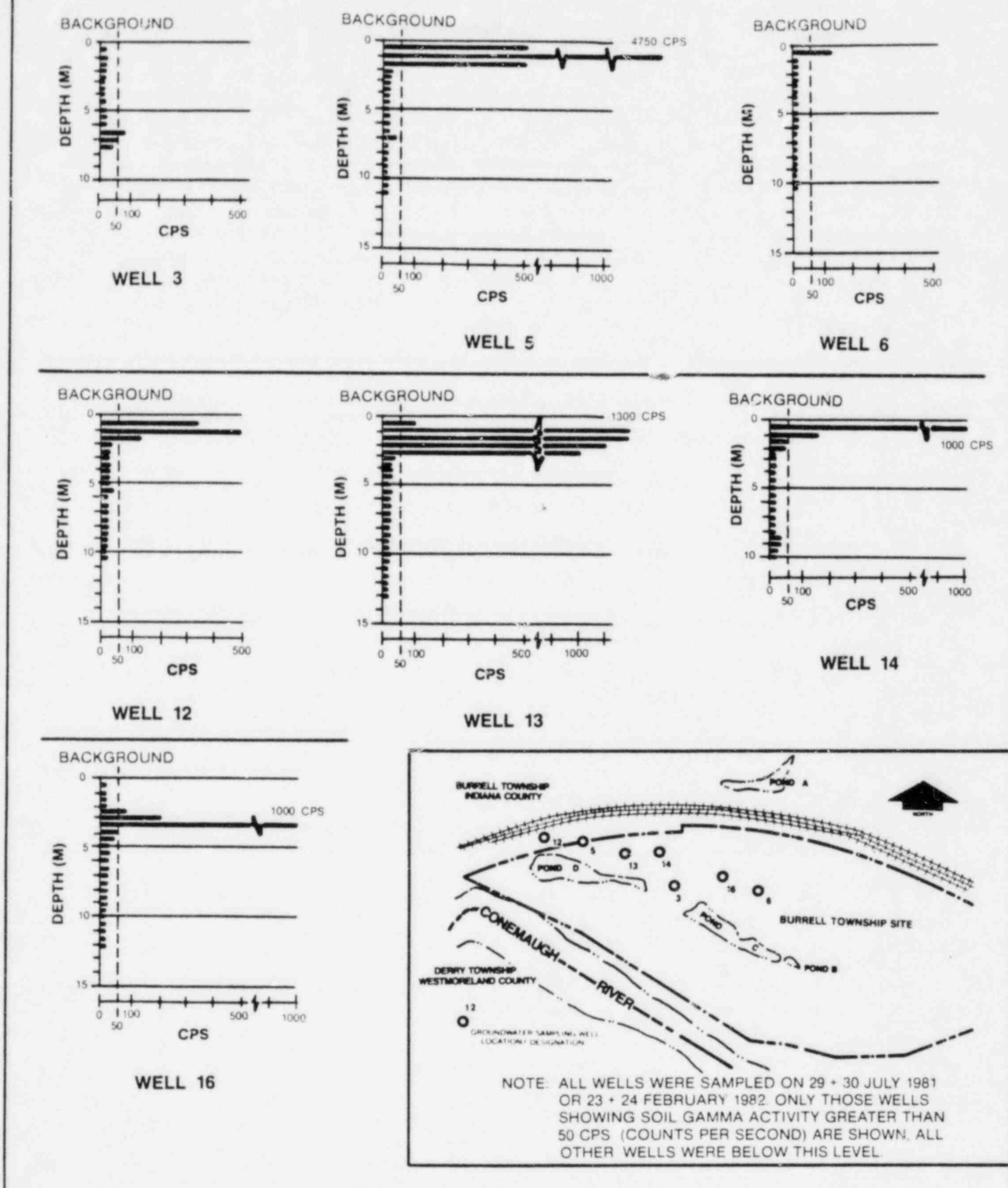


FIGURE
SOIL GAMMA ACTIVITY AS DETERMINED BY NATURAL GAMMA LOGGING JULY 1981 —BURRELL TOWNSHIP SITE

1.2.4 Hydrogeological characteristics

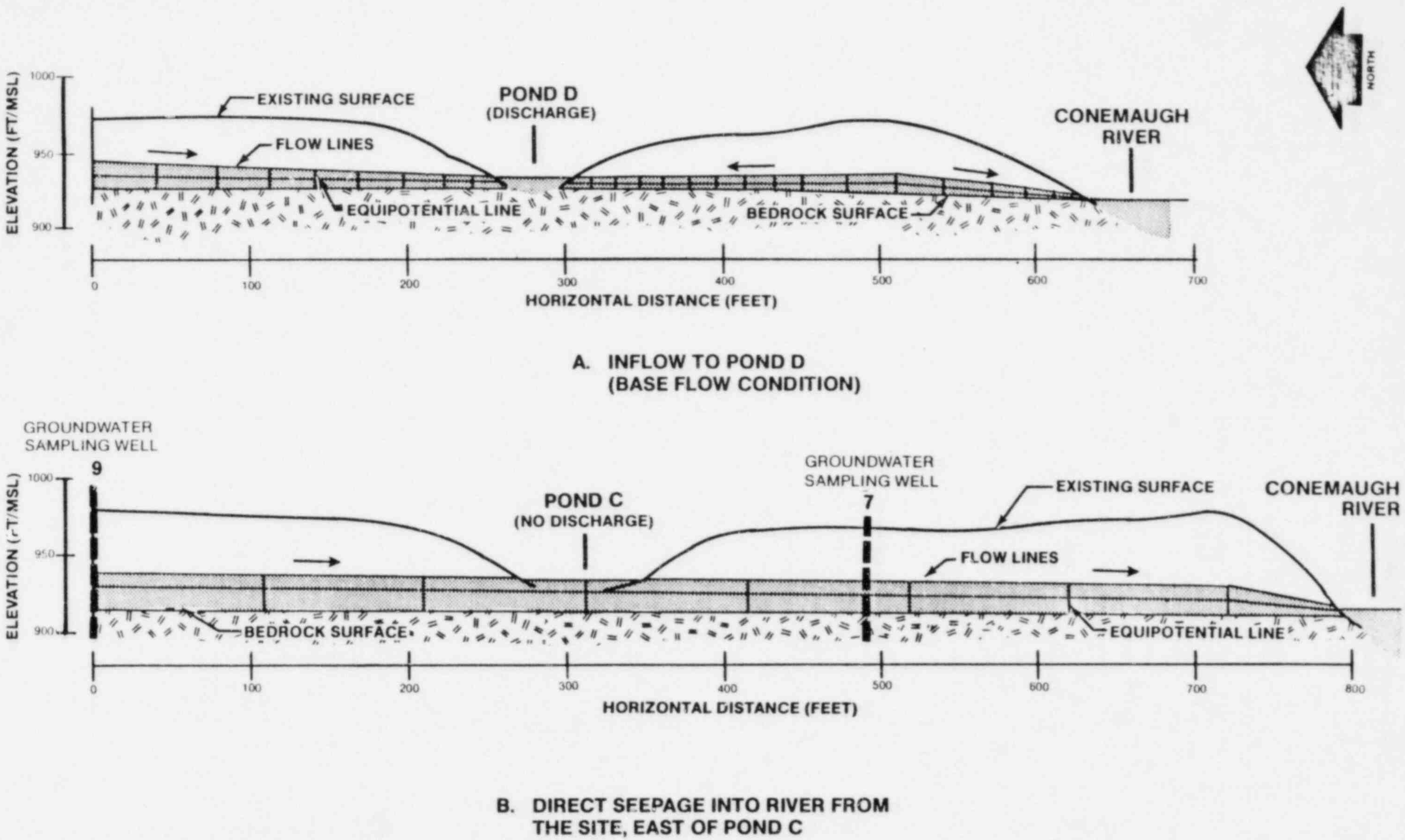
The present hydrogeological environment at the Burrell site has been substantially affected by past site use as a borrow area (documented in 1949 air photographs). (The hydrogeological features and the water budget for the Burrell site are shown on Figure 1-6, and tabulated in Table 1-2.) The excavation of materials left a bowl-shaped pit with steep sides in the unconsolidated colluvium and alluvium. This bowl was subsequently filled with a variety of materials, including railroad ties, rubble, and low-level radioactive waste. The result is a high-permeability fill overlying low-permeability colluvium, alluvium, and bedrock. Ground-water pump-test data on the fill indicated a transmissivity of 36,490 gallons per day per foot of drawdown, and a permeability of 1840 gallons per day per foot of cross-sectional area. In the alluvium and colluvium the transmissivity was 264, and the permeability was 9.6. The large permeability differential between the two materials indicates that ground water in the fill is not the principal source of recharge for the bedrock, therefore, the ground water from the fill exits the site directly and not by way of the bedrock. Ground water exits the site as effluent to both the ponds and the river.

The ground-water quality at the site is only slightly affected by the waste material as compared to background conditions. Even though sulfate was found to be above Federal drinking-water standards in all samples, this and all other nonradiological above-standard values were within the range expected in the coal-containing bedrock underlying the site. The radiological water quality was within Federal drinking-water standards for most samples.

1.2.5 Remedial-action requirements

The latest radiological survey of the Burrell site, conducted in March and April 1982 by the Bendix Corporation, concluded that the current levels of radiation do not warrant extensive remedial action. However, because of the uncertainty about the final EPA standards (yet to be published), a conservative approach has been taken. The remedial action discussed in this report is based on current (stringent) EPA proposed requirements for cleanup of inactive uranium-mill-tailings sites and designated properties. Such standards would require removing the contaminated material that exceeds, on the average, 5 picocuries of radium-226 per gram, or stabilizing and containing the site to prohibit the release of radionuclides in various pathways into the environment for at least 1000 years.

Since the scope of this study is to investigate only the feasibility of onsite remedial-action alternatives, only those alternatives that do not require offsite disposal of contaminated material have been developed and evaluated.



TONED AREAS INDICATE SATURATED ZONE
-UNCONSOLIDATED MATERIAL

← GROUNDWATER FLOW DIRECTION

50 0 50

SCALE IN FEET

(NO VERTICAL
EXAGGERATION)

NOTE: SEE TABLE FOR FLOW NET CALCULATIONS

FIGURE
FLOW NET ANALYSIS OF SHALLOW GROUNDWATER FLOW
BURRELL TOWNSHIP SITE

Table 1-2. Flow-net calculations

Flow through unit cross-section:

$$q = K\Delta h \frac{N_f}{N_d} \cdot \frac{a}{b}$$

Where:

K = Hydraulic conductivity.

N_f = Number of flow channels.

a/b = Ratio of spacing of equipotential lines (a) to flow lines (b).

Δh = Change in potential (head) between two equipotential liras (b_1-h_2).

n_d = Equipotential units between h_1 and h_2.

Refer to Figure 1-6 (a).

Δh = Drop in head between W19 and W7.

K = 0.16 ft/min.

n_f = 2.

a/b = 0.1.

$$q = (0.16 \text{ ft/min.})(942.2' - 937.9') \cdot \frac{2}{4.7} (0.1)$$

q = 0.029 ft^3/min.

Total flow across 2000 ft. cross-section Q:

Q = 58 ft^3/min. = 452 gpm.

Refer to Figure 1-6 (b).

Δh = Drop in head between edge of site and Pond D.

K = 0.16 ft/min.

n_f = 2.

a/b = 0.19.

$$q = K\Delta h \frac{n_f}{n_d} \cdot \frac{a}{b}$$

$$q = (0.16 \text{ ft/min.})(950 - 937) \cdot \frac{2}{9} (0.19)$$

q = 0.089 ft/min.

Total flow across 950 ft. cross-section:

Q = 39.1 ft^3/min. = 305 gpm

Outflow from Pond D = 200 gpm (field estimate).

305
-200
105 gpm -- direct seepage to river

Total direct seepage to river:

452
+105
557 gpm

1.3 REMEDIAL-ACTION ALTERNATIVES

1.3.1 Control requirements

Radiological monitoring and exploration at the site indicated only a few localized soil areas with radionuclide levels exceeding the EPA proposed standards and requiring some remedial action, with minimal radioactive contamination of ground water, and with a probable annual average radon flux, based on soil radium-226 content, which was essentially at background levels. However, the characteristics of the site create some uncertainty about future increases in radionuclide losses through any of several mechanisms. These characteristics include the following:

1. Pond topography -- As constituted, the ponds have side slopes of greater than a 1:1 slope. Erosion of the slopes on the north side could produce erosion channels potentially extending into the contaminated zone and thus might allow the direct release of radionuclides into runoff.

2. Surface permeability -- The materials currently on the surface of the filled area are quite porous; infiltration has been estimated as high as 85 percent. The leaching of radioisotopes has probably occurred in the past, but might increase from present levels if decomposition releases more soluble materials.

3. Landfill stability -- The fill material has substantial quantities of decomposable materials. As this material continues to degrade, subsidence in the ground surface will occur over an extended period of time. The resulting surface cracking may increase infiltration and leaching, and expose shallow radioactive zones.

4. Shallow burial -- Because of shallow burial of the material, the contaminated zone is sufficiently near the surface that penetration by burrowing animals or vegetative roots may expose contaminated buried material or damage a final cover system.

A series of alternatives for site remedial action were investigated. The overall objective for developing the remedial-action alternatives was to produce a range of alternatives from which an optimum plan could be formulated. The essential features of the four remedial-action alternatives are summarized in Table 1-3. The alternatives are the following:

1. Site stabilization and closure.
2. Site control and containment.
3. Waste excavation and encapsulation.
4. Waste excavation, incineration, and encapsulation of residues.

Table 1-3. Common features of onsite remedial-action alternatives

Alternative	Ground-water stabilization	Pond slopes	Surface permeability	Decomposition settlement	Roots and burrowing animals
1. Site stabilization and closure	Gravel underdrain at pond elevation.	Fill ponds	Fill contaminated area to obtain 2 percent slope.	Slope only.	Stone layer.
2. Site control and containment	Gravel underdrain at pond elevation.	Fill ponds	Fill to obtain 4 percent slope plus clay cap.	Increased slope only.	Stone layer.
3. Waste excavation and encapsulation	Gravel underdrain at pond elevation.	Fill ponds[a]	Clay cap and liner.	Slope only.	Stone layer.
4. Waste excavation, incineration, and encapsulation	Gravel underdrain at pond elevation.	Fill ponds[a]	Clay cap and liner.	Burn decomposible materials.	Stone layer.

[a]Encapsulation areas are partially located over the existing ponds.

The main factors addressed in all of these alternatives include the following:

1. Stabilization of contaminated material and control of ground water.
2. Reduction of slopes surrounding the ponds to minimize erosion.
3. Reduction of surface permeability to reduce infiltration.
4. Reduction of the consequences of decomposition and settlement.
5. Reduction of the potential for root and animal penetration.

The four alternatives are evaluated in subsection 1.3.6, relative to the following set of criteria:

1. General suitability -- The approach should be consistent with the problems identified, and should avoid overly complex remedial actions that are not clearly justified by site conditions.

2. Environmental effectiveness -- The plan should address the site characteristics in a direct manner and without the creation of secondary environmental and exposure impacts. The selected alternative should ensure continued compliance with all environmental standards pertaining to air, water, and soil quality.

3. Technical feasibility -- The recommended plan should incorporate proven technology and should be within the capabilities of conventional construction contractors.

4. Cost-effectiveness -- Increased levels of expenditure should produce recognizable gains in environmental protection appropriate to the level of expenditure.

1.3.2 Alternative 1: site stabilization and closure

The main features of this alternative (conceptually presented on Figure 1-7) include the following:

1. Reduction of infiltration (to approximately 20 percent of total annual precipitation) through the contaminated zone by placement of a two-layer surface-cover system consisting of the following:

   a. A 12-inch stone and gravel layer covered by a geotextile layer.
   b. An 18-inch soil layer covered by 6 inches of topsoil.

2. Reduction in the potential for animal and root penetration, as well as potential radon emanation, by placement of the two-layer cover components.

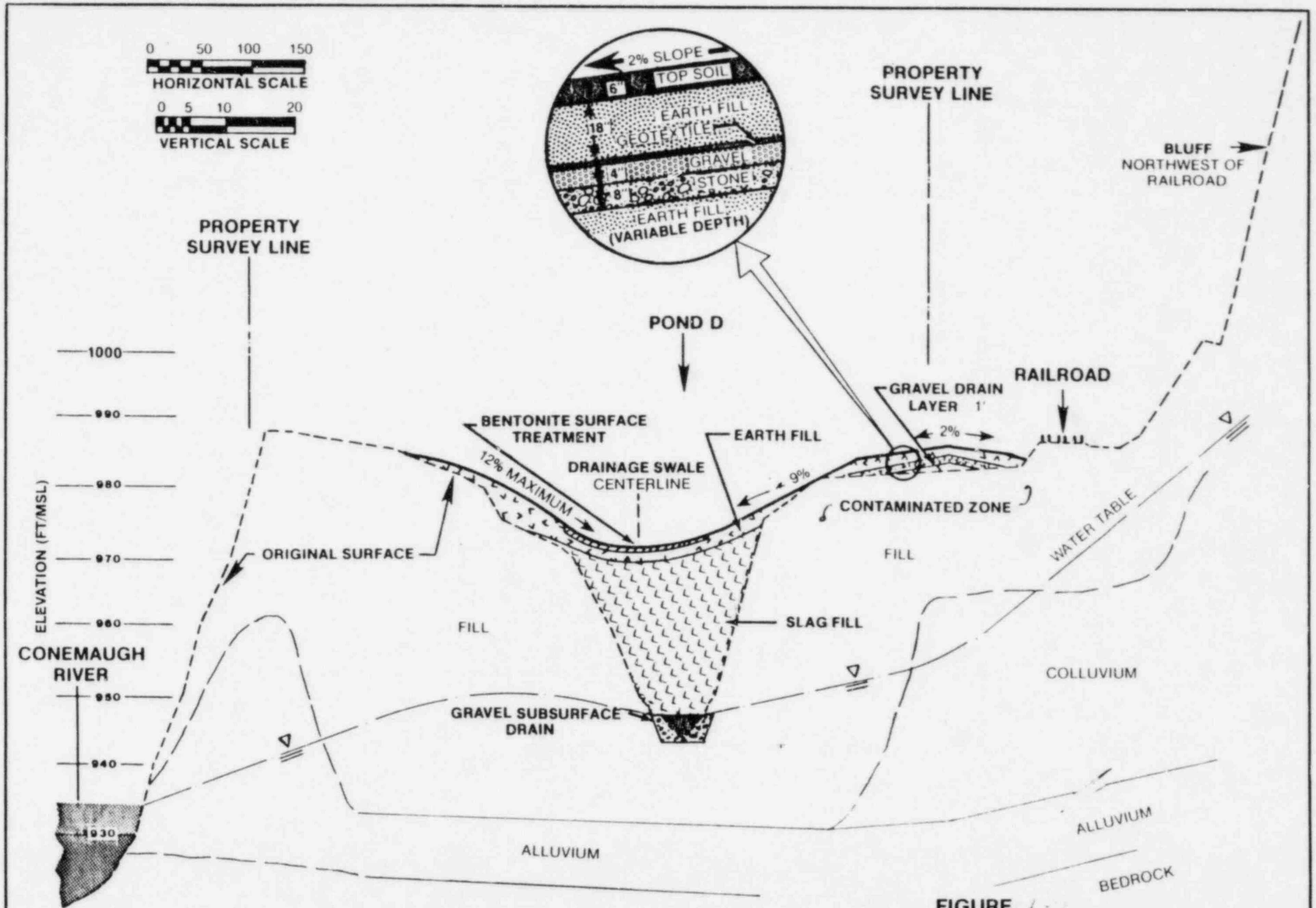


FIGURE /
TYPICAL SECTION—SITE STABILIZATION AND CLOSURE
ALTERNATIVE 1– BURRELL TOWNSHIP SITE

3. Reduction of surface erosion by establishing a vegetation cover, improving the drainage pattern for the site by constructing swales and sedimentation ponds for storm-water control.

4. Stabilization of the side slopes in the contaminated zone by backfilling ponds B, C, and D.

5. Control of the ground-water elevation in the area of the contaminated zone by placing a gravel subdrain at the lower portion of ponds B, C, and D (as shown on Figure 1-5) to reduce the potential for water to rise into the waste materials.

6. Overall site management and improvement to prevent excessive erosion and potential exposure of contaminated material through environmental pathways.

The preliminary cost estimates for the major components of this site stabilization and closure alternative are summarized as follows:

Landfill surface cover and stabilization	$ 597,000
Installation of subdrain, pond filling, and rehabilitation	$ 1,134,000
Overall site management and improvements	$ 349,000
Contingency, engineering, and management	$ 700,000
Total	$ 2,780,000 (Approximately $2.8 million)

It should be noted that these estimates are very conservative and are based on the stabilization and closure of large portions of the disposal site. It is probable that the appropriate level of remedial action may only require implementation of part of the site stabilization and closure plan. This would reduce the cost to below $1 million.

1.3.3 Alternative 2: site control and containment

The main features of this concept are very similar to those described for Alternative 1, with the exception of the following:

1. Substantial reduction in the infiltration through the contaminated zone (to less than 1 percent of the total annual precipitation) by installing a multilayer cover system consisting of the following:

   a. Earth fill to establish a 4-percent grade, with the addition of bentonite clay admixture in the top 6 inches of this layer.

b. A 12-inch stone and gravel layer covered by a geotextile layer.

c. An 18-inch layer of soil covered by an 8-inch layer of topsoil.

2. Incorporation of an ion-exchange medium in the subdrain layer in the lower portion of ponds B, C, and D.

The preliminary construction cost estimates for the site control and containment alternative are as follows:

Multilayer cover and stabilization	$ 1,517,000
Installation of subdrain and ion-exchange medium, pond filling, and rehabilitation	$ 1,644,000
Overall site management and improvements	$ 349,000
Contingency, engineering, and management	$ 1,230,000
Total	$ 4,740,000 (Approximately $4.8 million)

1.3.4 Alternative 3: waste excavation and encapsulation

The main features of this concept consist of the following:

1. Excavating the waste material (approximately 213,000 cubic yards) from the contaminated zone and removing it to a staging area.

2. Placing a clay and soil liner in the excavation area after preparing the subgrade.

3. Installing a gravel subdrain, and backfilling and rehabilitating ponds C, and D (as described in Alternative 1).

4. Transferring the excavated material from the staging area, and placing and compacting the excavated waste and contaminated material in the lined area.

5. Placing a multilayer cover system (similar to the cover for Alternative 2) over the lined area to encapsulate the excavated waste.

6. Overall site management and improvements (similar to those discussed for Alternative 1).

The preliminary construction cost estimates for the major components of the waste excavation and encapsulation alternative are summarized as follows:

Installation of subdrain, pond filling, and rehabilitation	\$ 845,000
Material excavation and staging	\$ 1,705,000
Installation of clay liner, material placement, and encapsulation with a multilayer cover system	\$ 2,555,000
Overall site management and improvements	\$ 1,051,000
Contingency, engineering, and management	\$ 2,159,000
Total	\$ 8,315,000 (Approximately \$8.3 million)

1.3.5 Alternative 4: waste excavation, incineration, and encapsulation

The main features of this concept are similar to those described for Alternative 3 with the following steps added between the waste removal and encapsulation activities:

1. Staging and sorting the excavated material followed by shredding the bulky combustible material (e.g., railroad ties) for size reduction.

2. Incineration of the combustible fraction of the excavated waste materials in two parallel rotary-kiln incineration lines.

3. Conditioning and cleaning flue gas from the incineration units using cooling chambers, a roughing filter, and high-efficiency particulate air filters.

4. Burial of the incinerator residues in the encapsulation area along with the other noncombustible waste materials.

The preliminary cost estimates for the major components of this alternative are summarized as follows:

Installation of subdrain, pond filling, and rehabilitation	$ 845,000
Material excavation, staging, and sorting	$ 1,705,000
Shredding and incineration of the combustible fraction	$22,160,000
Installation of clay liner and encapsulation of waste and incinerator residues	$ 1,500,000
Site management and improvements	$ 1,051,000
Contingency, engineering, and management	$10,920,000
Total	$38,181,000 (Approximately $38 million)

1.3.6 Evaluation of alternatives

A qualitative evaluation of the four onsite remediation alternatives has been performed. A summary of this analysis is presented in Table 1-4. It should be noted that each alternative can meet regulatory and environmental requirements. However, the selection of an optimum level of control is also a function of technical feasibility and cost-effectiveness.

Alternative 1, site stabilization and closure, meets all the environmental objectives and the technical feasibility and implementation requirements. This concept, in comparison to the other three approaches, ranks highest in terms of cost-effectiveness. The other alternatives do not substantially add to the environmental effectiveness, technical feasibility, or implementation of the remedial-action program in comparison with the additional construction costs associated with these alternatives.

Alternative 2, site control and containment, represents added control of infiltration through the contaminated zone. However, this reduction does not correspond to any additional environmental benefits, since even with the current levels of infiltration, the radiological limits of the Federal primary drinking water standards are not exceeded. Moreover, the complex multilayer cover system will complicate the implementation of the remedial action while raising questions about the effects of waste degradation and subsidence on long-term integrity. Similar concerns can also be raised about the need for and the cost-effectiveness of the ion-exchange barrier to be incorporated in the subdrain. Therefore, this concept is not recommended.

Table 1-4. Evaluation of remedial-action alternatives

Evaluation criteria	1 Site stabilization and closure	2 Site control and containment	3 Waste excavation and encapsulation	4 Waste excavation, incineration, and encapsulation
<u>Environmental criteria</u>				
Air-quality impacts	Good	Good	Fair	Poor
Surface-water impacts	Fair	Fair	Fair	Fair
Ground-water impacts	Fair	Fair	Good	Good
Secondary impacts	Good	Good	Poor	Poor
Future land use	Poor	Poor	Poor	Fair
<u>Technical criteria</u>				
Technical feasibility	Good	Fair	Poor	Poor
Long-term stability	Fair	Fair	Good	Good
Implementation features	Good	Fair	Poor	Poor
<u>Economic criteria</u>				
Cost-effectiveness	Good ($2.9 million)	Fair ($4.8 million)	Poor ($8.3 million)	Poor ($38 million)
Impact on future UMTRA sites	Good	Fair	Poor	Poor

Alternative 3, waste excavation and encapsulation, is not recommended for the Burrell site because of its questionable technical feasibility and implementation, and the possible secondary environmental and exposure impacts from waste excavation and handling, and its poor cost-effectiveness.

Alternative 4, excavation, incineration, and encapsulation of residuals, is not recommended because of its questionable technical feasibility and implementation, and because of the possibility of secondary impacts from disturbing, handling, and incinerating the wastes. This concept is also not feasible because of its prohibitive cost (an order of magnitude higher than Alternative 1).

The conclusion drawn from this analysis is that Alternative 1 meets all of the environmental, technical, and cost-effectiveness criteria. Therefore, it is recommended that the feasibility of onsite remedial action be based on this approach (site stabilization and closure). Furthermore, this level of control should be considered an upper limit for the Burrell site, since recent radiological surveys suggest that the contamination level has declined. Partial implementation of the Alternative 1 control elements may reduce the cost of remedial action below $1 million.

1.4 FEASIBILITY OF THE RECOMMENDED ACTION

1.4.1 Feasibility analysis

Ten criteria were established to evaluate the feasibility of the recommended engineering concept. These criteria are discussed in the paragraphs that follow.

1. Meeting regulatory requirements -- It is anticipated that the recommended concept will meet the proposed requirements for air and water quality; however, it is difficult to predict long-term compliance with extended life criteria (e.g., 1000 years) because of the anticipated differential subsidence of the waste material in the fill. The recommended concept should not, however, result in significant releases of radionuclides even if subsidence and settlement continue for the foreseeable future.

2. Environmental effectiveness -- The recommended concept will provide adequate protection of air, water, and land quality.

3. Cost-effectiveness -- The site stabilization and closure concept, Alternative 1, could cost as much as $2.8 million. Partial stabilization and closure (e.g., not filling the ponds) could reduce the cost below $1.0 million. Although Alternative 1 is less costly than other onsite or offsite alternatives, it is equally effective and superior in technical feasibility and implementation.

4. Use of demonstrated technology -- The recommended concept utilizes proven and demonstrated construction techniques and materials such as soil, gravel, and clay. The overall approach is very similar to rehabilitation and closure of inactive municipal, commercial, and industrial land-disposal sites.

5. Long-term stability -- The materials selected for site stabilization and closure are natural and durable materials that should maintain the integrity of the site for a long time. Because of the organic nature of the existing landfill materials, some level of long-term maintenance is required to prevent land subsidence and disruption of the closure integrity as the landfill materials continue to decompose.

6. Public acceptance -- During the scoping meeting held 3 July 1981 at Black Lick, the DOE received a petition favoring in-situ stabilization over other concepts that require excavating, removing, reprocessing, and hauling the waste materials because of secondary impacts and exposure that could occur.

7. Conductibility and schedule -- The site stabilization and closure activities can be achieved in approximately one year using conventional earthmoving equipment and will not require highly specialized construction equipment or skilled personnel.

8. Implementation and practicability -- The recommended concept can be implemented and is practical. However, detailed engineering analysis and design tasks must be performed before starting construction.

9. Flexibility of control elements -- The recommended concept is flexible and could be implemented partially or in phases for improved cost-effectiveness.

10. Impact on the UMTRA Project -- The Burrell site, a vicinity property, should be viewed, from a radiation point of view, as a lower priority property. Complete site stabilization and closure should be considered as an upper limit (cost $2.8 million). Other means of cost reduction should be pursued further.

1.4.2 Implementation guidelines

The guidelines for implementing the recommended alternative are presented in the paragraphs that follow.

1. Final engineering design -- The recommended design for the site stabilization and closure alternative for the Burrell site (shown on Figure 1-8) is based on the following:

   a. Using a two-layer cover system over the contaminated landfill zone.

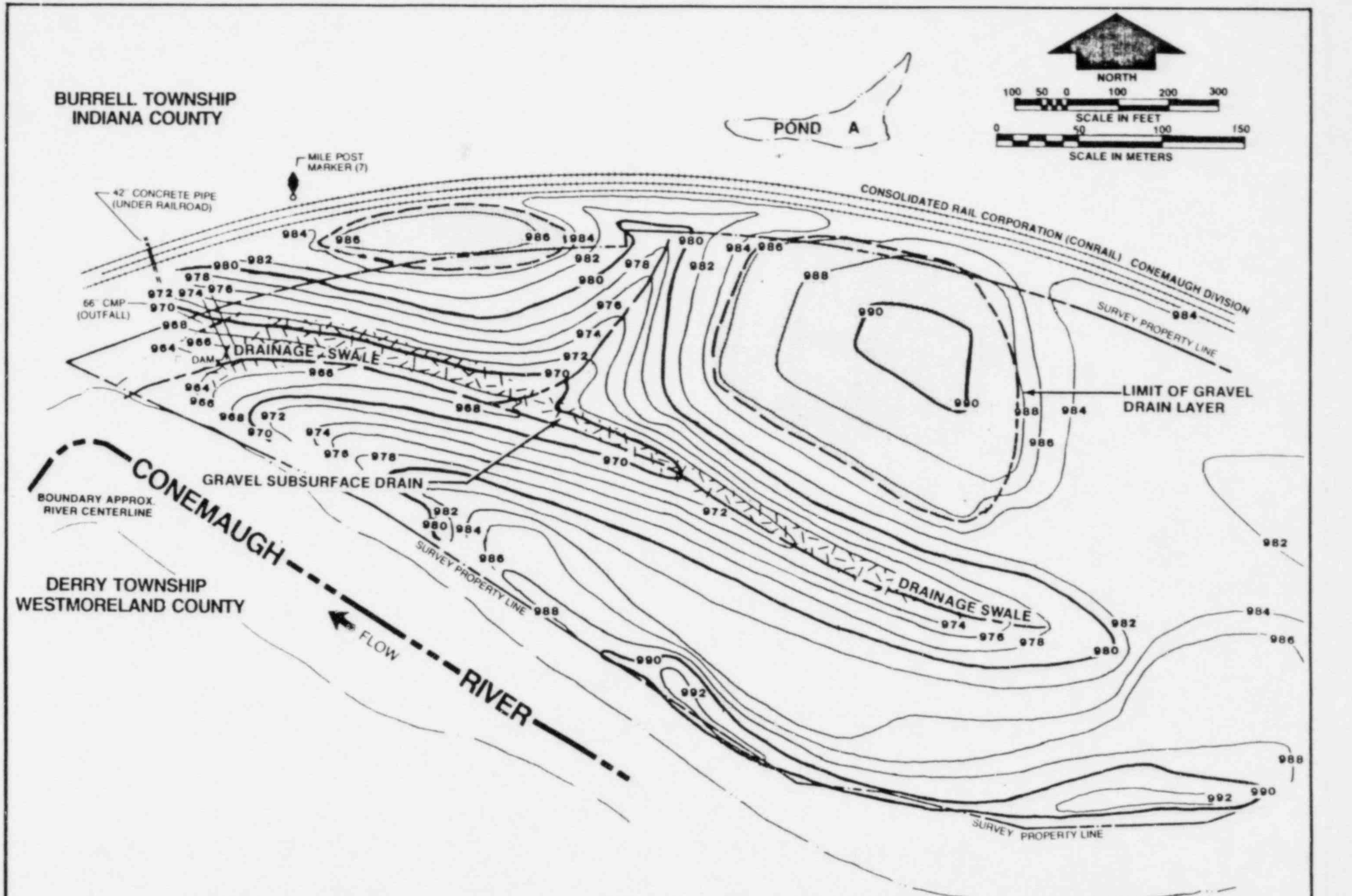


FIGURE
FINAL GRADING PLAN—SITE STABILIZATION AND CLOSURE
ALTERNATIVE 1- WESTERN PART- BURRELL TOWNSHIP SITE

NOTE 1 PROPERTY LINE DATA FROM PLAN OF PROPERTY FOR UNION CARBIDE CORP. BY RICHARD G. BACH & ASSOC., ZELIENOPLE, PA-DATED 11/16/77

b. Installing a subdrain and backfilling the pond areas contiguous to the contaminated zone.

c. Overall site management to improve drainage and reduce infiltration.

Before the work can begin, a detailed engineering evaluation and design will be required to develop the following:

a. Optimum level of remedial action and the need for cover and pond stabilization.

b. Swale elevation and pond-filling details.

c. Type and quantity of materials required for filling the ponds.

d. Provisions for draining pond A to lower the water table in the area (north of the railroad tracks).

2. Construction sequence -- The site stabilization and closure effort will require approximately one year to stabilize the ponds, cover the contaminated zone, and complete overall site improvements, as required. Before the construction activities, however, the access road and rail crossing must be improved to receive the construction materials (soil, gravel, clay, etc.).

3. Material availability -- The construction materials required for full implementation will consist of large quantities of soil, gravel or stone, and clay (up to 250,000 cubic yards). These materials should be available close to the site. A smaller quantity of bentonite clay (500 tons) will be required for stabilizing the pond and may have to be imported from a considerable distance (e.g., Wyoming).

4. Traffic patterns and control -- The access road to the site must be improved before construction activities begin. In addition, a rail-unloading facility will be required if it is feasible to transport the construction materials by rail. Traffic and rail-crossing controls will be required during the entire construction period.

5. Environmental monitoring during construction -- A moderate level of radiation monitoring during construction is recommended to record the contamination levels at the site and to protect the health of the construction workers.

1.5 CONCLUSIONS AND RECOMMENDATIONS

1.5.1 Conclusions

The conclusions reached from this project are as follows:

1. Radiological surveys performed by Oak Ridge National Laboratory, WESTON, and Bendix Corporation have shown the following:

   a. Concentrations of airborne and ground-water radionuclides, for the most part, are below current and proposed Federal guidelines.

   b. There is no significant measurable transport of radioactivity off the site.

   c. Soil radiation levels are, on the average, below the EPA proposed standards; however, such limits are exceeded in a few localized areas.

2. Hydrogeological investigations indicate that the site has high transmissivity and permeability. This appears to have caused a redistribution or reduction of site radiation levels between the 1977 and 1982 radiological surveys. The ground water currently contains radiation levels below the Federal primary drinking-water standards. This decline in radionuclide concentrations is expected to continue.

3. An analysis of the site's radiological and hydrogeological conditions indicates that the Burrell site requires only a minimal level of remedial action.

4. Of the four alternatives for onsite remedial action evaluated, only one, site stabilization and closure, is technically and environmentally justified, and then only as an upper limit.

5. Partial implementation of the stabilization and closure alternative could alleviate the potential radioactivity problem based on the extent of the current site radiological conditions. This could reduce the remediation cost from $2.9 million to less than $1 million, particularly if selective site covering and/or nonfilling of the ponds is possible.

6. The base concept, site stabilization and closure, when implemented in full or in part, would meet the feasibility criteria set for this project (i.e., regulatory requirements, environmental protection, cost-effectiveness, technical feasibility, etc.).

1.5.2 Recommendations

The following are the recommendations concerning the feasibility of a program for onsite stabilization of the Burrell site:

1. The UMTRA project office and the Technical Assistance Contractor (TAC) should continue following the status of regulatory requirements issued by the EPA for inactive uranium-mill-tailings sites and vicinity properties. The current level of radiological contamination should be checked against the final standards when they become available.

2. If the radiological-contamination levels in soils, air, and water at the site are below or close to the levels requiring remedial action, as indicated by the final EPA standards (to be promulgated in late 1982), the UMTRA and TAC project teams may elect to investigate the feasibility of requesting an exemption for the site based on the current insignificant radiation levels and resultant minimal potential environmental impacts. The Burrell site could be exempted as a vicinity property, thereby reducing or eliminating the remedial action effort and costs. It is also possible that the DOE could acquire the site, conduct minimal remedial action, and permanently restrict access to the site.

3. If remedial action is required, the site stabilization and closure alternative should be considered the proposed action for establishing the feasibility of an onsite remedial-action program. This alternative should be viewed as an upper limit since the existing radiological conditions of the site may preclude the necessity for remedial action under the EPA standards. If remedial action is required for the Burrell site, the means of reducing costs over the basic alternative should be investigated. This may include:

   a. Selective site improvements, partial cover, and closure.
   b. Stabilization of specific contaminated areas.
   c. Use of onsite materials for stabilizing the adjacent ponds.

4. After confirming the level of remedial action at the Burrell site that will be required to meet the regulatory and programmatic standards, the TAC should confirm the site conditions, establish the design requirements and parameters, and finish the preliminary design in preparation for detailed design and construction by the Remedial Action Contractor (RAC).

Appendix A.3

ENERGY AND OTHER RESOURCES CALCULATIONS

The values given in the tables in this appendix are estimates of the amounts of energy and materials necessary for the entire project.

Table A.3-1. Electrical power use by alternative (kilowatt hours)

Alternative	Base	Contingency (25%)	Total
Alternative 2			
Canonsburg			
Storage trailers (2)	112,000		
Shower/lockerroom trailer	30,250		
Hot water	3,000		
Waste-water treatment plant	7,800		
Yard lighting	24,650		
Subtotal	177,700	44,300	222,000
Burrell			
Storage trailer	45,300		
Shower/lockerroom trailer	42,300		
Hot water	2,500		
Waste-water treatment plant	2,600		
Yard lighting	20,300		
Subtotal	113,000	27,000	140,000
Total	290,700	71,300	362,000
Alternative 3			
Canonsburg	177,700	44,300	222,000
Burrell			
Storage trailer	5,100		
Hot water	800		
Yard lighting	900		
Subtotal	6,800	1,700	8,500
Total	184,500	46,000	230,500

Table A.3-1. Electrical power use by alternative (kilowatt hours) (continued)

Alternative	Base	Contingency (25%)	Total
Alternative 4			
Canonsburg			
Storage trailers (2)	112,000		
Shower/lockerroom trailer	60,500		
Hot water	3,600		
Waste-water treatment plant	12,000		
Yard lighting	27,000		
Subtotal	215,100	54,900	270,000
Burrell	113,000	27,000	140,000
Hanover			
Storage trailers(s)	115,000		
Shower/lockerroom trailer	64,500		
Hot water	3,900		
Waste-water treatment plant	10,900		
Yard lighting	28,000		
Subtotal	222,300	57,700	280,000
Total	550,400	139,600	690,000
Alternative 5			
Canonsburg	215,100	54,900	270,000
Burrell	6,800	1,700	8,500
Hanover	222,300	57,700	280,000
Total	444,200	114,300	558,500

Table A.3-2. Fuel use by alternative (gallons)

Alternative	Base		Utilization factor	Total
<u>Alternative 2</u>				
Diesel fuel				
Canonsburg	250,668	x	0.80	200,000
Burrell	108,605	x	0.80	87,000
Subtotal				287,000
Gasoline				
Canonsburg	40,300	x	0.80	32,000
Burrell	48,680	x	0.80	40,000
Subtotal				72,000
Total				359,000
<u>Alternative 3</u>				
Diesel fuel				
Canonsburg	228,468	x	0.85	195,000
Burrell	90,232	x	0.85	77,000
Subtotal				272,000
Gasoline				
Canonsburg	39,160	x	0.85	33,000
Burrell	6,120	x	0.85	5,000
Subtotal				38,000
Total				310,000

Table A.3-2. Fuel use by alternative (gallons) (continued)

Alternative	Base		Utilization factor	Total
Alternative 4				
Diesel fuel				
Canonsburg	663,430	x	0.90	600,000
Burrell	108,605	x	0.80	87,000
Hanover	607,317	x	0.80	485,000
Subtotal				1,172,000
Gasoline				
Canonsburg	48,400	x	0.80	40,000
Burrell	48,400	x	0.80	40,000
Hanover	21,840	x	0.80	18,000
Subtotal				98,000
Total				1,270,000
Alternative 5				
Diesel fuel				
Canonsburg	663,430	x	0.90	600,000
Burrell	90,232	x	0.85	77,000
Hanover	431,795	x	0.85	367,000
Subtotal				1,044,000
Gasoline				
Canonsburg	48,400	x	0.80	40,000
Burrell	6,120	x	0.85	5,000
Hanover	20,080	x	0.80	16,000
Subtotal				61,000
Total				1,105,000

Table A.3-3. Concrete use by alternative (cubic yards)

Alternative		Waste-water treatment plants	Pads for truck wash	Stabilization of filter sludge	Total
Alternative 2					
Canonsburg		70	190	4,850	5,000
Burrell		70	190	1,000	1,260
	Total	140	380	5,850	6,260
Alternative 3					
Canonsburg		70	190	5,000	5,260
	Total	70	190	5,000	5,260
Alternative 4					
Canonsburg		70	190	7,500	7,760
Burrell		70	190	1,000	1,260
Hanover		70	190	4,250	4,510
	Total	210	570	12,750	13,530
Alternative 5					
Canonsburg		70	190	7,500	7,760
Hanover		70	190	3,250	3,510
	Total	140	380	10,750	11,270

Table A.3-4. Water use by alternative (gallons)

Alternative	Dust control	Truck cleaning	Steam cleaning	Total
Alternative 2				
Canonsburg	150,000	1,320,000	650,000	2,120,000
Burrell	125,000	60,000	---	185,000
Total	275,000	1,380,000	650,000	2,305,000
Alternative 3				
Canonsburg	150,000	1,320,000	650,000	2,120,000
Burrell	125,000	---	---	125,000
Total	275,000	1,320,000	650,000	2,245,000
Alternative 4				
Canonsburg	1,000,000	3,700,000	650,000	5,350,000
Burrell	125,000	60,000	---	185,000
Hanover	1,600,000	2,400,000	---	4,000,000
Total	2,725,000	6,160,000	650,000	9,535,000
Alternative 5				
Canonsburg	1,000,000	3,700,000	650,000	5,350,000
Burrell	125,000	---	---	125,000
Hanover	1,600,000	2,400,000	---	4,000,000
Total	2,725,000	6,100,000	650,000	9,475,000

Appendix A.4

ORDER-OF-MAGNITUDE COST ESTIMATES FOR PERFORMING REMEDIAL ACTION AT THE ALTERNATIVE SITES

Table A.4-1. Summary of cost estimates

Item	Canonsburg	Burrell	Hanover	Total
Alternative 2				
General site preparation	$ 465,000[a]	$ 670,000[b]	---	---
Contaminated soil excavation	275,000[a]	3,200,000[b]	---	---
Building decontamination and demolition	925,000[a]	---	---	---
Waste-water treatment plant	512,000[a]	380,000[b]	---	---
Encapsulation	1,735,000[a]	2,800,000[b]	---	---
Fill importation	1,790,000[a]	1,010,000[b]	---	---
Standby equipment and crew[c]	500,000[a]	500,000[b]		
Subtotal	$6,200,000	$8,560,000		$14,760,000
Contingency (15 percent)[d]				$ 2,214,000
Monitoring and radiation management (15 percent)				2,214,000
Engineering and construction management (15 percent)				2,214,000
Legal, administration, and site acquisition				2,800,000
Total[e,f]				$24,202,000
Alternative 3				
General site preparation	$ 465,000[a]	$ 349,000[g]	---	---
Contaminated soil excavation	275,000[a]	---	---	---
Building decontamination and demolition	925,000[a]	---	---	---
Waste-water treatment plant	510,000[a]	---	---	---
Encapsulation	1,735,000[a]	---	---	---
Fill importation	1,790,000[a]	---	---	---
Standby equipment and crew[c]	500,000[a]	---	---	---
Landfill surface stabilization -- contaminated area	---	597,000[g]	---	---
Pond rehabilitation	---	1,134,000[g]	---	
Subtotal	$6,200,000	$2,080,000	---	$ 8,280,000
Contingency (15 percent)[d]				$ 1,242,000
Monitoring and radiation management (15 percent)				1,242,000
Engineering and construction management (15 percent)				1,242,000
Legal, administration, and site acquisition				1,656,000
Total[e,f]				$13,662,000

Table A.4-1. Summary of cost estimates (continued)

Item	Canonsburg	Burrell	Hanover	Total
Alternative 4				
General site preparation	$ 465,000[h]	$ 670,000[b]	$1,500,000[b,h]	---
Contaminated soil excavation	5,560,000[h]	3,200,000[b]	---	---
Building decontamination and and demolition	925,000[h]	---	---	---
Waste-water treatment plant	510,000[h]	380,000[b]	380,000[b,h]	---
Encapsulation	8,500,000[h]	2,800,000[b]	---	---
Fill importation	1,500,000[h]	1,010,000[b]	---	---
Standby equipment and crew[c]	1,000,000[h]	500,000[b]	---	---
Subtotal	$18,460,000	$8,560,000	$1,880,000	$28,900,000
Contingency (15 percent)[d]				$ 4,335,000
Monitoring and radiation management (15 percent)				4,335,000
Engineering and construction management (15 percent)				4,335,000
Legal, administration, and site acquisition				3,300,000
Total[e,f]				$45,205,000
Alternative 5				
General site preparation	$ 465,000[h]	$ 349,000[g]	$1,000,000[h]	---
Contaminated soil excavation	5,560,000[h]	---	---	---
Building decontamination and demolition	925,000[h]	---	---	---
Waste-water treatment plant	510,000[h]	---	380,000[h]	---
Encapsulation	8,500,000[h]	---	---	---
Fill importation	1,500,000[h]	---	---	---
Standby equipment and crew[c]	1,000,000[h]	---	---	---
Landfill surface stabilization -- contaminated area	---	597,000[g]	---	---
Pond rehabilitation	---	1,134,000[g]		---
Subtotal	$18,460,000	$2,080,000	$1,380,000	$21,920,000
Contingency (15 percent)[d]				$ 3,288,000
Monitoring and radiation management (15 percent)				3,288,000
Engineering and construction management (15 percent)				3,288,000
Legal, administration, and site acquisition				2,730,000
Total[e,f]				$34,514,000

[a]See Table A.4-2.

[b]See Table A.4-3.

[c]Cost of idle time for inspections, construction quality control, monitoring, and inclement weather.

[d]Based on Engineering News Record Cost Index 3560.

[e]An ion-exchange barrier may be considered a means of controlling the migration of radionuclides in or into the ground water. The approximate cost of $500,000 is not included in the total.

[f]Total does not include the cost of transporting the degradable organics (i.e., wood products) to a controlled low-level waste landfill (Harford, Washington, or Beatty, Nevada).

[g]See Table A.4-4.

[h]See Table A.5-5.

Table A.4-2. Order-of-magnitude cost estimate for Canonsburg site -- Alternatives 2 and 3

Item	Approximate cost
General site preparation	
Flood-control berm (2,400 feet)	$ 240,000
Fencing (7,000 feet)	100,000
Remove railroad embankment and track (1,900 feet)	40,000
Vehicle decontamination	30,000
Worker facility	30,000
Demobilization and cleanup	25,000
Subtotal	$ 465,000
Contaminated soil excavation (23,985 cubic yards)	
Dewater Area C	60,000
Excavation and material handling	215,000
Subtotal	$ 275,000
Building decontamination and demolition	
Building decontamination	200,000
Salvageable-steel decontamination (4,700 tons)	30,000
Building demolition	575,000
Demolition-debris handling (18,000 cubic yards)	120,000
Subtotal	$ 925,000
Waste-water treatment plant -- Subtotal	$ 510,000
Encapsulation area (3 acres)	
Liner	720,000
Material filling	80,000
Multilayer cover with vegetation	935,000
Subtotal	$1,735,000
Fill importation (27 acres)	
6-foot cover with vegetation -- Subtotal	$1,790,000
Standby equipment and crew (100 days at $5000 per day) -- Subtotal	$ 500,000
Total	$6,200,000

Table A.4-3. Order-of-magnitude cost estimate for Burrell site -- Alternatives 2 and 4

Item	Approximate cost
General site preparation -- Subtotal	$ 670,000
Contaminated soil excavation	
Excavation (80,000 cubic yards at $10 per cubic yard)	800,000
Staging and loading (80,000 cubic yards at $4 per cubic yard)	320,000
Material hauling (80,000 cubic yards x 65 miles at $0.40 per cubic yard mile)	2,080,000
Subtotal	$3,200,000
Waste-water treatment plant	
Burrell	380,000
Hanover	380,000
Subtotal	$ 760,000
Encapsulation area (5 acres)	
Liner at $200,000 per acre	1,000,000
Material filling	800,000
Multilayer cover	1,000,000
Subtotal	$2,800,000
Earth work soil importation and backfilling (16,000 cubic yards at $10 per cubic yard)	160,000
Backfilling adjacent ponds	850,000
Subtotal	$1,010,000
Preparation of new site (Hanover) (50 acres at $10,000)-- Subtotal	$ 500,000
Standby equipment and crew (100 days at $5,000 per day) -- Subtotal	$ 500,000
Total	$9,440,000

Table A.4-4. Order-of-magnitude cost estimate for Burrell site -- Alternatives 3 and 5

Item	Approximate cost
General site preparation	
Lightly grade 8 acres and add fill	$ 40,000
Apply topsoil on 10 acres and seed	80,000
Construct sedimentation basin and drainage	34,000
Construct access roads and install fencing	150,000
Worker facilities	20,000
Demobilize and clean up	25,000
Subtotal	$ 349,000
Landfill surface stabilization -- contaminated area	
Construct earth fill for surface slope	180,000
Place stone-drainage blanket	81,000
Install geotextile	70,000
Install 18-inch earth cover	186,000
Apply topsoil and seed	80,000
Subtotal	$ 597,000
Pond rehabilitation	
Grade and install subdrain	183,000
Place fill material in pond area	435,000
Install 2-foot cover over fill material	146,000
Place bentonite in earth cover under swales	290,000
Apply topsoil and seed	80,000
Subtotal	$1,134,000
Total	$2,080,000

Table A.4-5. Order-of-magnitude cost estimate for Canonsburg site -- Alternatives 4 and 5

Item	Approximate cost
General site preparation	
Canonsburg (see Table A.4-2)	$ 465,000
Hanover (100 acres at $10,000 per acre)	1,000,000
Subtotal	$ 1,465,000
Contaminated soil excavation	
Areas A, B, and C (250,000 cubic yards at $10 per cubic yard)	2,500,000
Dewater Area C	60,000
Excavation (250,000 cubic yards at $4 per cubic yard)	1,000,000
Material hauling (250,000 cubic yards x 20 miles at $0.50 per mile-yard)	2,000,000
Subtotal	$ 5,560,000
Building decontamination and demolition (see Table A.4-2)	
Subtotal	$ 925,000
Waste-water treatment plant	
Canonsburg	510,000
Hanover	380,000
Subtotal	$ 890,000
Encapsulation area (15 acres)	
Liner at $250,100 per acre	3,000,000
Material filling at $10 per cubic yard	2,500,000
Multilayer cover at $200,000 per acre	3,000,000
Subtotal	$ 8,500,000
Soil importation and backfilling (150,000 cubic yards at $10 per cubic yard) -- Subtotal	$ 1,500,000
Standby equipment and crew (200 days at $5,000 per day) -- Subtotal	$ 1,000,000
Total	$19,840,000

Table A.4-6. Unit costs, including material, labor, and equipment

Item	Cost
Fill -- select	$ 7.65 per cubic yard
Fill -- placement	2.75 per cubic yard
Borrow and haul	5.10 per cubic yard
Clay fill -- borrow	11.17 per cubic yard
-- place	3.00 per cubic yard
Bentonite	543.00 per ton
Fill and compact (general site)	3.90 per cubic yard
Sand fill	7.15 per cubic yard
Gravel fill	6.90 per cubic yard
Clean fill	5.00 per cubic yard
Topsoil	9.40 per cubic yard
Vegetation	0.60 per square yard
Grading -- rough	2.10 per cubic yard
-- finish	0.60 per square yard
Riprap	18.25 per square yard
Basin excavation	3.10 per cubic yard
2 inches asphalt	4.50 per square yard
Concrete -- pads, etc.	275.00 per cubic yard
Fencing -- 8-foot chain link	12.00 per linear foot
-- gates	51.70 per linear foot
-- posts	131.00 each
Grading	22.50 per square foot
Dewatering	3100.00 each

Appendix A.5

ESTIMATES OF SOIL LOSSES

The following calculations indicate the amounts of soil that are expected to be removed from the sites through erosion and runoff during the various phases of the project.

Table A.5-1. Estimates of soil loss off the sites during construction

Symbol	Description	Value			Basis
		Canonsburg	Burrell	Hanover	
R	Rainfall and runoff erosivity index	150	140	150	Local conditions
K	Soil-erodibility factor	0.25	0.25	0.33	--[a]
L_s	Topographic factor	0.34	1.9	2.35	--[b]
C	Cover	1.0	1.0	1.0	--[c]
P	Supporting practices	1.0	1.0	1.0	--[d]
A	Annual soil loss (tons per acre per year)	12.75	66.5	116	--[e]

[a]50 percent silt at Canonsburg and Burrell, 55 percent at Hanover. 20 percent sand at all sites. 2 percent organic material at Canonsburg and Burrell, 1 percent at Hanover.

[b]Slopes of length 600 feet, 800 feet, and 800 feet; 2-, 6-, 7-percent grade, at Canonsburg, Burrell, and Hanover, respectively.

[c]Assumes no ground cover.

[d]Not applicable -- applies only to intensive farming practices.

[e]Using the Universal Soil Loss Equation (U.S. EPA, 1975):

$$A = R \times K \times L_s \times C \times P.$$

	Canonsburg	Burrell	Hanover
Acreage	30	50	50
SDR[f]	0.50	0.46	0.46
Total annual soil loss (tons per year)[g]	191.25	1529.50	2668.00

[f]SDR (sediment delivery ratio) -- Obtained from SCS National Engineering Handbook, Section 3, "Sedimentation," Chapter 6, "Sediment Sources, Yields, Delivery Ratios," Figure 6-2.

[g]$A = R \times K \times L_s \times C \times P \times$ total acreage $\times$ SDR

Table A.5-2. Estimates of soil loss off the sites after remedial action

Symbol	Description	Value			Basis
		Canonsburg	Burrell	Hanover	
R	Rainfall and runoff erosivity index	150	140	150	Local conditions
K	Soil-erodibility factor	0.25	0.25	0.33	--[a]
L_s	Topographic factor	0.34	1.9	2.35	--[b]
C	Cover factor	0.003	0.003	0.003	--[c]
P	Supporting practices	1.0	1.0	1.0	--[d]
A	Annual soil loss (tons per acre per year)	0.038	0.199	0.349	--[e]
	Acreage	30	50	50	--
SDR	Sediment delivery ratio	0.50	0.46	0.46	--[f]
Total annual soil loss (tons per year)		0.57	4.60	8.00	--[g]

[a]50 percent silt at Canonsburg and Burrell, 55 percent at Hanover. 20 percent sand at all sites. 2 percent organic material at Canonsburg and Burrell, 1 percent at Hanover.

[b]Slopes of length 600 feet, 800 feet, and 800 feet; 2-, 6-, 7-percent grade, at Canonsburg, Burrell, and Hanover, respectively.

[c]Assumes 95 to 100 percent ground cover with herbaceous plants and decaying duff or litter at least 2 inches deep, and 25 percent canopy cover with shrubs and small trees.

[d]Not applicable -- applies only to intensive farming practices.

[e]Using the Universal Soil Loss Equation (U.S. EPA, 1975):

$$A = R \times K \times L_s \times C \times P$$

[f]SDR (sediment delivery ratio) -- Obtained from SCS National Engineering Handbook, Section 3, "Sedimentation," Chapter 6, "Sediment Sources, Yields, Delivery Ratios," Figure 6-2.

[g]$A = R \times K \times L_s \times C \times P \times \text{total acreage} \times SDR$

Table A.5-3. Estimates of soil loss for 1000 years[a]

Canonsburg	Burrell	Hanover
0.12 inch	0.56 inch	0.98 inch

[a]Based on the following:

$$\text{1,000-yr soil loss in in.} = \frac{\text{Annual soil loss after remedial action}\ \frac{\text{tons}}{\text{yr}} \times 2{,}000\ \frac{\text{lbs}}{\text{ton}} \times 1{,}000\ \text{yrs} \times 12\ \frac{\text{in.}}{\text{ft}}}{\text{Area (acres)} \times 43{,}560\ \frac{\text{sq ft}}{\text{acre}} \times 90\ \frac{\text{lbs}}{\text{cu ft}}}$$

$$= 6.12\ \frac{\text{Annual soil loss}\ \frac{\text{tons}}{\text{yr}}}{\text{Area (acres)}}$$

Appendix A.6

BORROW PITS

Appendix A.6

BORROW PITS

Local contractors in the Canonsburg and Hanover Township areas have borrow pits with the necessary quantities of soil for rehabilitation of either site. The approximate locations and distances to several sites are shown in Table A.6-1. At the present time there are no known active borrow pits in the area around Burrell Township.

It should be pointed out that between now and the actual initiation of cleanup activities these borrow pits may become unavailable, or possibly new, closer sites will be developed. It has been our experience that once a project is slated for startup many contractors and landowners will have the quantity and type of fill required. It is important that prior to beginning any construction activities all necessary soil testing be completed to ensure receiving suitable soil.

Table A.6-1. Borrow pit locations

Site	Location	Distance to Hanover (miles)	Distance to Canonsburg (miles)
Houston	Pike Street	10	2
Hickory, PA	Route 50	10	10
Bavington	Route 22	10	17
M&M site	Route 18	3	24

Source: Batty, 1982; Orient, 1982.

REFERENCES FOR APPENDIX A

Batty, F., 1982. Batty Excavating, Washington, Pennsylvania, Telephone conversation with Dr. M. V. Mellinger, Roy F. Weston, Inc., West Chester, Pennsylvania on September 10, 1982.

Orient, D., 1982. M&M Equipment Company, Florence, Pennsylvania, Telephone conversation with Dr. M. V. Mellinger, Roy F. Weston, Inc., West Chester, Pennsylvania on September 8, 1982.

U.S. EPA (Environmental Protection Agency), 1975. Control of Water Pollution from Cropland, Volume I, EP-600/2-75-026a.

Appendix B

METEOROLOGY AND AIR-QUALITY INFORMATION

Appendix B.1

METEOROLCGICAL MONITORING PROGRAMS

Appendix B.1

METEOROLOGICAL MONITORING PROGRAMS

The meteorological monitoring system employed at the Canonsburg site is the Climatronics Electronic Weather Station (EWS). The electronic weather station is composed of six individual meteorological sensors and a recording device. It continually monitors and records specific meteorological parameters. By using alternating and direct current operation the electronic weather station can operate unattended for as long as 31 days using 115-volts alternating current line power or two standard 6-volt lantern batteries. The recorder and batteries are solid state, and are housed in a weatherproof fiberglass enclosure. The sensors may be located as far as 1000 feet from the recorder without a loss of accuracy.

The meteorological parameters monitored at Canonsburg are wind speed, wind direction, relative humidity, temperature, integrated solar radiation, and precipitation. Wind speed is sensed by a photochopper using a solid-state light source. Wind direction is sensed by a precision potentiometer with 540-degrees output (eliminating the problem of crossover). The relative humidity sensor enables full range measurement (0 to 100 percent) between -30°C and +50°C. The temperature sensor utilizes a precision thermistor with 0.5°C accuracy. Solar radiation is measured by a photovoltaic sensor. Precipitation is measured by a tipping rain and snow gauge with 0.01-inch resolution. The specifications for the individual sensors and for the recorder are contained in Table B.1-1.

The recorder prints through the impinging action of its two styluses driven by the chopper bar against the pressure-sensitive chart paper. Its presentation is a series of dots appearing as a continuous line. The recorder contains a multiplexer that allows the six meteorological parameters to be recorded on the chart paper simultaneously. The recorder operates by swinging each stylus to three separate zones on each half of the chart paper.

Recording on the chord of the stylus arch by the edge of the chopper bar is possible because the styluses are able to write along their length rather than at their points. This results in chart paper printed with straight lines and rectilinear recordings.

The standard electronic weather station chart operates at 1 inch per hour. Therefore, 24 hours of operation are recorded over 24 inches of chart paper. The entire length of the paper roll is printed with hours (1 to 12) along the left margin and horizontal lines marking each 15 minutes (1/4 inch) interval. The electronic weather station recorder contains an internal timing mark which provides a check of the drive mechanism. All sensors come to rest for 5 minutes every 24 hours, which results in a zero printout on the chart paper.

Table B.1-1. Specifications of the Climatronics Electronic Weather Station

Sensor	Accuracy	Range	Distance or time constant	Threshold	Damping ratio
Sensor specifications (metric)					
Wind speed	0.011 m/sec or 1.5 percent	0 to 50 m/sec	2.4 m	0.33 m/sec	
Wind direction	±1.5 percent	0 to 360° mechanical 0 to 540° electronic	2.4 m	0.33 m/sec	0.4 to 0.6
Relative humidity	±2 percent 0 to 100 percent	0 to 100 percent	10 sec		
Temperature	±0.55°C	-30° to +50°C	10 sec		
Integrated solar radiation	±3 percent	0 to infinity, in 2 Langley steps and 20 Langley cycles			
Precipitation	±1 percent	0 to infinity, in 0.0254-cm and 0.254-cm cycles			

Sensor	Range	Chart resolution
Electronic weather station recorder specifications (metric)		
Wind speed	0 to 25 m/sec 0 to 50 m/sec	0.22 m/sec
Wind direction	0 to 540°C	±5°
Relative humidity	0 to 100 percent	±2 percent
Temperature	-30°C to +20°C 0°C to +50°C	0.55°C
Integrated solar radiation	0 to ∞ Langleys	2 Langleys/division
Precipitation	0 to ∞ cm (0.0254-cm events)	0.0254 cm

Source: Climatronics service manual.

The electronic weather station includes a method for site calibration during use. Each parameter is calibrated against a precision internal reference source. The procedure is accomplished by adjusting specific potentiometers contained on an extender board within the recorder. Calibration of the electronic weather station at the Canonsburg site is performed once a month in conjunction with changing the chart paper rolls and batteries.

The Canonsburg meteorological monitor was installed in April 1979, and has been operating continuously since then. The sensors are situated at the top of a 33-foot tower on the highest level of Building 10 (Figure 1-3). This configuration represents the optimum location within the site confines, minimizing the effects of site structures on wind conditions.

An identical station was installed at the Burrell site in May 1981. The system was located in the open area in the western portion of the site, with the sensors placed on the top of a 33-foot tower which was cemented into the ground. In an effort to prevent vandalism, a cyclone fence with three strands of barbed wire on top was erected around the unit. Within one month, however, the sensors were shot off the tower and the tower stolen from the site. Because of the expense of the system and the inability to provide complete security, the unit was not replaced.

Just under one-month's data was recovered from the Burrell unit. Because of their similar settings (within valleys) and relative closeness (50 miles) these data were compared with data recorded at Canonsburg during the same time period. This comparison revealed that the Canonsburg wind data could be applied to the Burrell site if an adjustment was made in wind direction values to reflect the difference in valley orientation. The wind speeds did not require any adjustments.

The Hanover site is similar to Burrell in that it is an open, easily-accessible property. Therefore, although site-recorded meteorological data would be desirable, it was ruled out. This site is fairly close to the Pittsburgh International Airport (13 miles) and has a similar topographic setting (i.e., both are located on ridge tops). Thus, the airport data were determined to be applicable to the Hanover site.

The results of the temperature data available to date are given in Table B.1-2, and the wind data are depicted on Figures B.1-1, B.1-2, and B.1-3.

Table B.1-2. Temperatures

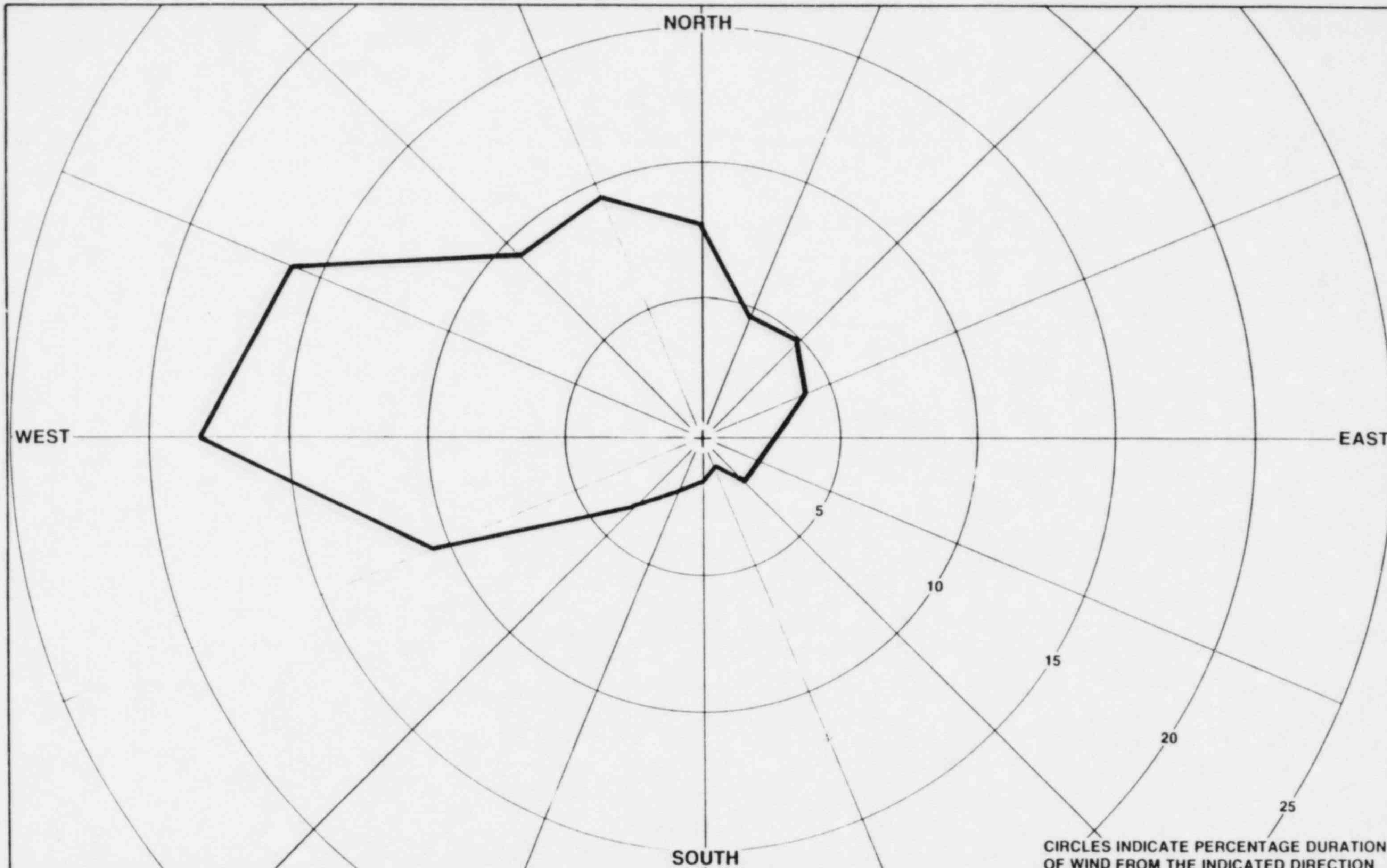
Temperature	Site Canonsburg[a]	Burrell[b]	Hanover[c]
	(Temperature, °F)		
Average annual	50	50	50
Maximum[d] winter	63		39
Average winter	28	30	32
Minimum[d] winter	-6		-18
Maximum[d] spring	82		87
Average spring	50	49	51
Minimum[d] spring	30		15
Maximum[d] summer	95		99
Average summer	70	68	73
Minimum[d] summer	36		34
Maximum[d] fall	88		97
Average fall	50	52	52
Minimum[d] fall	10		-1

[a]Based on onsite data collected from 1979 to 1981.

[b]Based on data collected at the Indiana Airport, Indiana, Pennsylvania from 1967 to 1981. Maximum and minimum temperatures are not available for Burrell.

[c]Based on data collected at the Greater Pittsburgh International Airport from 1953 to 1981.

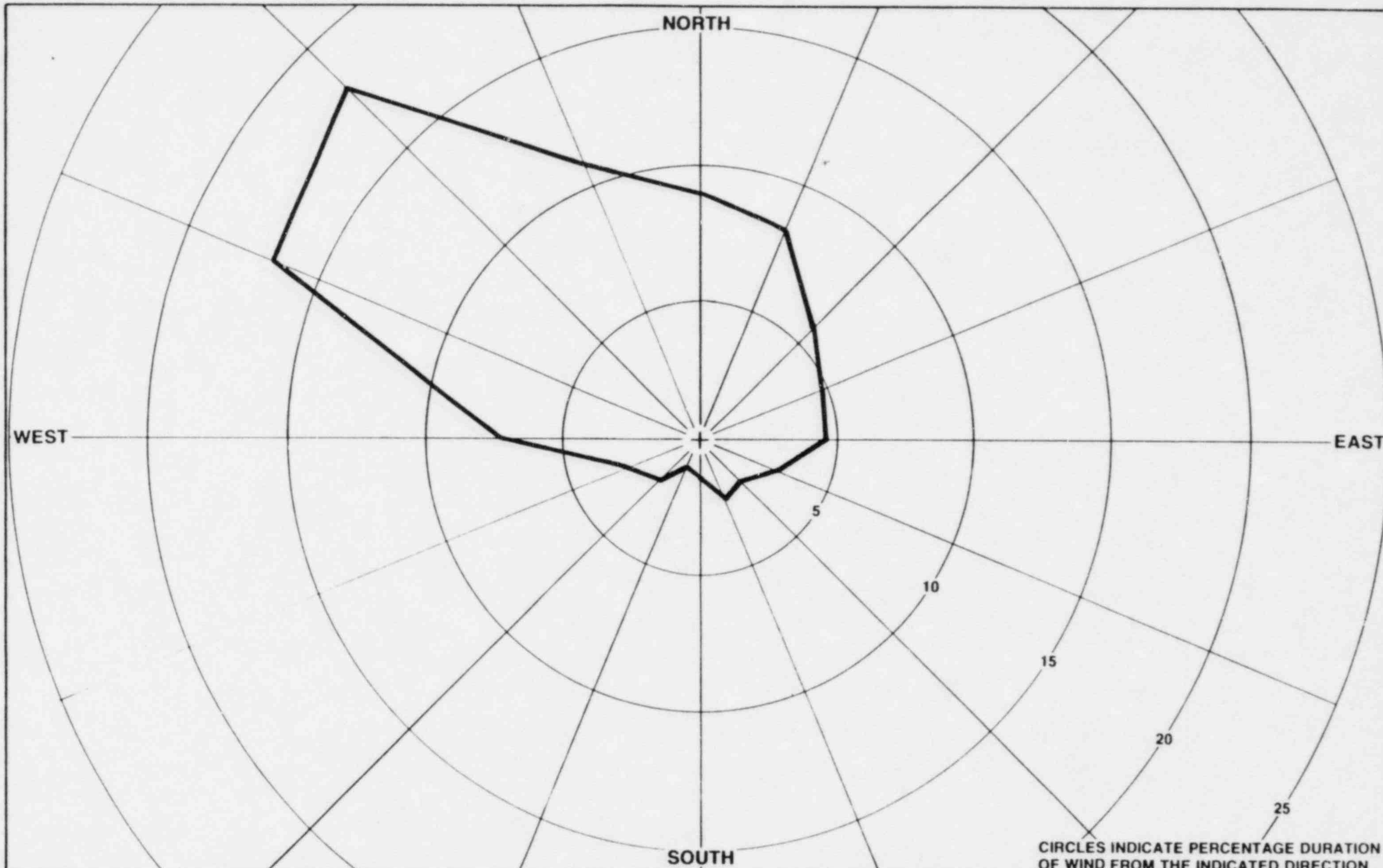
[d]The highest and lowest temperatures recorded during the period of record.



—— CANONSBURG SITE (FOR THE PERIOD MAY 1979 TO APRIL 1980)

SOURCE: DATA FROM METEORLOGICAL TOWER-ON SITE
CANONSBURG SITE

FIGURE
ANNUAL AVERAGE WIND FREQUENCY POLYGON
FOR THE VICINITY OF THE CANONSBURG SITE

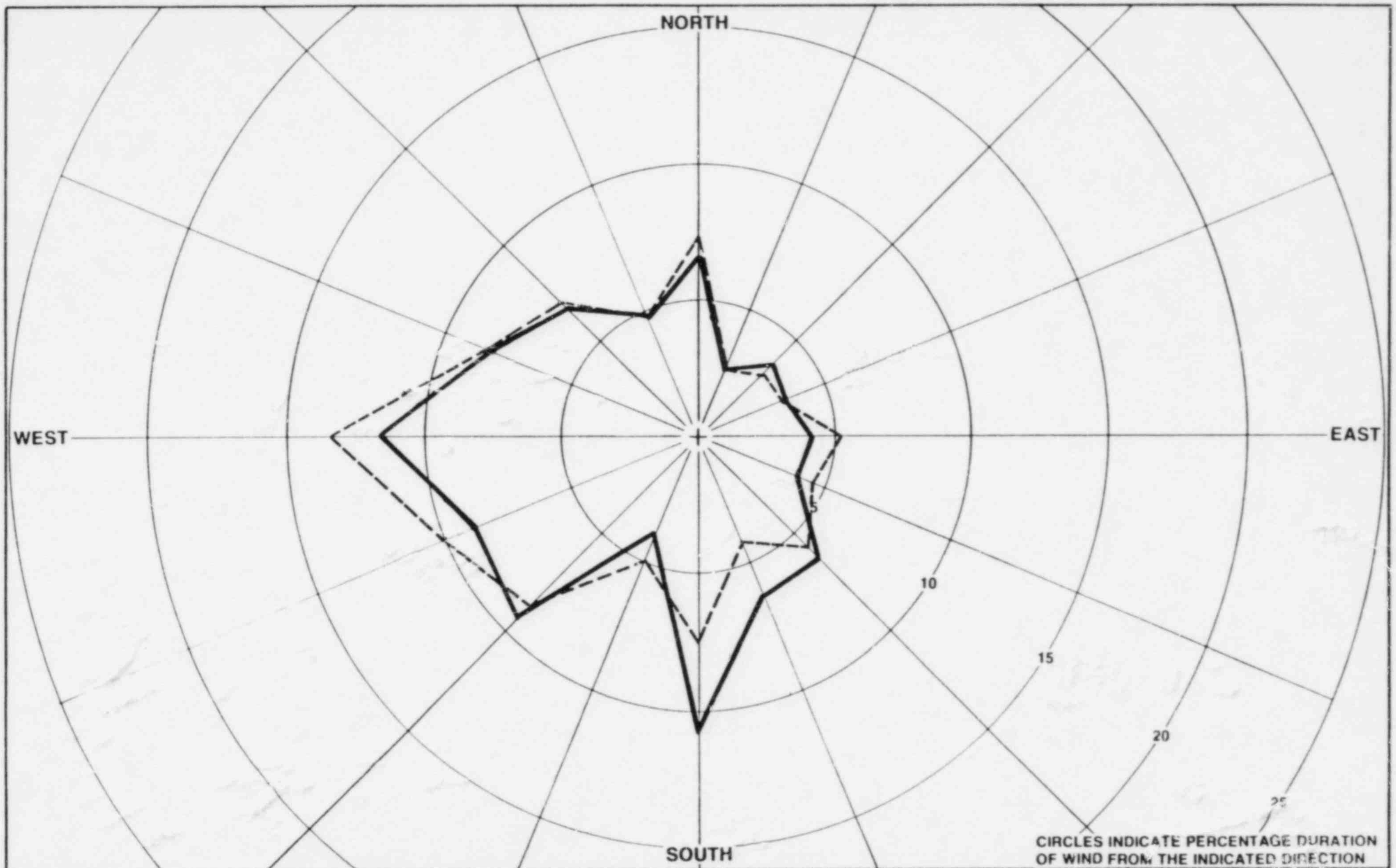


BURRELL TOWNSHIP SITE (FOR THE PERIOD MAY 1979 TO APRIL 1980)

SOURCE: CANONSBURG DATA ADJUSTED FOR TOPOGRAPHY IN THE VICINITY OF THE BURRELL TOWNSHIP SITE

FIGURE

ANNUAL AVERAGE WIND FREQUENCY POLYGON FOR THE VICINITY OF THE BURRELL TOWNSHIP SITE



ANNUAL AVERAGE (FOR THE PERIOD MAY 1979 TO APRIL 1980)

10 YEAR ANNUAL AVERAGE (FOR THE PERIOD 1967 TO 1976)

GREATER PITTSBURGH INTERNATIONAL AIRPORT DATA
(APPROX. 12 MILES TO N.E. OF HANOVER TWP. SITE)

FIGURE
ANNUAL AVERAGE WIND FREQUENCY POLYGON FOR THE VICINITY OF THE HANOVER TOWNSHIP SITE

Appendix B.2

NONRADIOLOGICAL AIR-QUALITY INFORMATION

Appendix B.2

NONRADIOLOGICAL AIR-QUALITY INFORMATION

B.2.1 Background

The proposed activities for each alternative will result in the emission of criteria pollutants at each of the sites. The following pollutants could potentially be emitted:

1. Total suspended-particulates (TSP).
2. Carbon monoxide (CO).
3. Nitrogen oxides (NO_x).
4. Sulfur dioxide (SO_2).
5. Hydrocarbons (HC). (Although this is not a regulated standard, it is included for completeness.)

These pollutants can be emitted in a variety of activities. Gaseous pollutants (CO, NO_x, SO_2, HC), can be generated by construction vehicles on the site, as well as by trucks bringing clay and fill material onto the site and removing radioactive wastes. Total suspended-particulate emissions can be generated by the following:

1. General construction activities: demolition and earth-moving.
2. Truck traffic on unpaved roads.
3. Storage-pile stacking.
4. Wind erosion from storage piles.
5. Exhaust emissions from construction vehicles and trucks.

The emissions from these activities were calculated for each site and alternative based on the following engineering information:

1. Number and type of construction vehicles on the site for each period and alternative.

2. Number of truck-hauling trips per day for each period and alternative.

3. Amount of fill, clay, and demolition material stacked during each period and the size of the piles.

4. Size of the active construction area at each site.

The first step required to determine the ambient air-quality impacts of any of the proposed remedial actions is to determine the emission rate for the vehicles used in the remedial actions for each criteria pollutant. Subsequent subsections of this appendix include a description of the methods used to calculate the emission rates. All emission rates were calculated using EPA-approved emission factors such as those contained in the AP-42 publication (U.S. EPA, 1977), which was used to calculate the vehicle-exhaust-emission rates.

The second step in the analysis is to use an air-pollution dispersion model to estimate the maximum potential offsite ambient air quality impacts of each alternative. The models used for this determination are part of the EPA-approved UNAMAP Version 4 series, and include the climatological air screening model (Climatological Dispersion Model) and the more sophisticated dispersion model (Industrial Source Complex) both the short- and long-term versions. The modeling assumptions used for calculating both short-term (1-hour, 3-hour, 8-hour, 24-hour) and long-term (annual) ambient air-quality impacts for each alternative and site are described in subsequent subsections of this appendix.

The final step in the analysis involves combining the model predicted incremental concentrations, and the background concentrations, and comparing the result to national and state ambient air-quality standards (Table B.2-1) in order to determine whether any of the remedial-action alternatives will result in significant offsite concentration levels and thereby exceed the applicable standards.

B.2.2 Vehicle exhaust emission rate calculations

The exhaust emission rate for all criteria pollutants emitted by the construction and hauling vehicles (trucks, bulldozers, scrapers, rollers, etc.) used on the site were computed using AP-42 (U.S. EPA, 1977) emission factors. The emission factors for both heavy-duty diesel and gasoline-powered construction vehicles were used to calculate the emission rates of these pollutants (Table B.2-2). The maximum emission rate was calculated as follows:

$$\text{Emission rate (grams per second)} = \frac{\text{(Vehicle emission factor in grams per hour)} \times \text{(\% used)}}{3600 \ \frac{\text{seconds}}{\text{hour}}}$$

Table B.2-1. Air quality standards

National Ambient Air-Quality Standards (NAAQS)

Pollutants	Averaging times 1 hour	3 hours	8 hours	24 hours	1 quarter	1 year
Carbon monoxide (ppm)	35		9			
Nonmethane hydrocarbons (ppm)		0.24	(6:00 a.m. - 9:00 p.m.)			
Nitrogen dioxide (ppm)						0.05
Ozone	0.12					
Total-suspended particulates ($\mu g/m^3$)				260 (150)[a]		75 (60)[a]
Sulfur dioxide (ppm)		(0.5)[a]		0.14		0.03
Lead ($\mu g/m^3$)					1.5	

Pennsylvania Ambient Air-Quality Standards

Pollutant	Averaging times 1 hour	24 hours	30 days	1 year
Settleable particulates (tons/square mile/month)			43	23
Beryllium ($\mu g/m^3$)			0.01	
Sulfates ($\mu g/m^3$)		30	10	
Fluorides ($\mu g/m^3$) (total soluble as hydrogen fluoride)		5		
Hydrogen sulfide (ppm)	0.1	0.005		

[a]Values in parentheses represent secondary standards.

Table B.2-2. AP-42 (U.S. EPA, 1977) emission factors for diesel- and gasoline-powered construction vehicles

Vehicle	Fuel	Emission factor (g/hr) TSP	CO	NO_x	SO_2	HC	Percent used[a]
Wheeled tractor	Diesel	61.5	973	451	40.9	68.4	100
Wheeled dozer	Diesel	75	335	2290	158	104	80
Scraper	Diesel	184	660	2820	210	284	80
Motor grader	Diesel	27.7	97.7	478	39.0	25.2	80
Wheeled loader	Diesel	77.9	251	1090	82.5	86.4	90
Off-highway truck	Diesel	116	610	3460	206	198	80
Roller	Diesel	22.7	83.5	474	30.5	25.2	100
Miscellaneous	Diesel	63.2	188	1030	64.7	72.0	60
Wheeled loader	Gas	13.5	7060	235	10.6	86.4	50
Miscellaneous	Gas	11.7	7720	187	10.6	255	100

[a]Percent used reflects the percentage of the time in an 8-hour work day that the equipment is used on the site.

The emission rate for each vehicle, alternative, and site was calculated for the total time required to perform each remedial action and the total per-period-emission rate for each pollutant for each site and alternative was computed by summing the emissions for each pollutant from all vehicles used in each period for each alternative and site. The annual average emission rate of exhaust pollutants for each site and alternative was calculated by averaging the per-period emission rates. The annual average gram per second emission rates were converted to a gram per area-second emission rate (used in the area-source dispersion model) by dividing by the active area of the site (Table B.2-3).

The maximum 1-hour, 3-hour, or 8-hour exhaust emission rates were determined by using the maximum emission rate in any period for each site. The maximum 24-hour emission rate was determined by dividing the value in Table B.2-3 by 3. This represents the proportion of the day that the activities are generating emissions (assuming an 8-hour work day). The gram per second emission rate was converted to a gram per area per second emission rate by dividing by the active area of the site (Table B.2-4).

B.2.3 Construction activity emission-rate calculation

Construction emissions due to demolition and earth-moving activities on the site were calculated using AP-42 (U.S. EPA, 1977) emission factors. The emission-rate calculation using this approach is based on the following assumptions:

1. The quantity of dust generated is proportional to the amount of activity and the area being worked.

2. The emission rate only includes particles less than 30 micrometers.

3. The silt content of the material being moved is 30 percent.

4. A conservative Thornwaite Precipitation-Evaporation Index (PE) value of 50 (i.e., a semi-arid climate) is assumed.

Using these conservative assumptions, the maximum per acre emission rate for particulates is 1.2 tons per acre per month of activity, or an average of 0.42 gram per acre per second. The maximum potential-emission rate was scaled on the basis of the level of construction activity for each period. During the most active construction period (based on the number of construction vehicles and trucks working at the site) the emission rate was assumed to be equal to the rates just given. The emission rates for other periods of activity were reduced to reflect the level of activity; i.e.,

$$\text{Emission rate for period (g/area-sec)} = \frac{\text{Vehicles in period}}{\text{Maximum number of vehicles in any period for the site}} \times \text{Maximum emission rate}$$

Table B.2-3. Annual average exhaust emission rate of construction vehicles and trucks for criteria pollutants

Alternative	Site	Emission rate ($\mu g/m^2$-sec) TSP	CO	NO_x	SO_2	HC
2	Canonsburg	0.7	44.5	20.4	1.9	0.7
	Burrell	0.6	37.9	12.4	1.2	0.6
3	Canonsburg	0.7	23.9	19.0	1.7	0.5
	Burrell	0.4	38.7	13.6	1.3	0.4
4	Canonsburg	0.8	39.8	24.9	2.4	0.7
	Burrell	0.6	37.9	12.4	1.2	0.6
	Hanover	1.8	52.1	52.3	5.0	2.1
5	Canonsburg	0.8	39.8	24.9	2.4	0.7
	Burrell	0.4	38.7	13.6	1.3	0.4
	Hanover	1.9	45.1	51.3	4.9	2.2

Site averages used:

Canonsburg - 20.0 acres
Burrell - 18.0 acres
Hanover - 10.0 acres

Table B.2-4. Maximum exhaust emission rates of construction vehicles and trucks for criteria pollutants[a]

Alternative	Site	Emission rate (μg/sq m-sec)				
		TSP	CO	NO_x	SO_2	HC
2	Canonsburg	4.6	234.5	169.2	15.6	6.3
	Burrell	5.1	343.2	129.9	12.0	5.8
3	Canonsburg	4.6	238.8	126.9	12.0	3.4
	Burrell	2.8	237.0	88.8	8.1	2.6
4	Canonsburg	5.5	266.1	166.2	15.9	6.0
	Burrell	5.1	343.1	129.9	12.0	5.8
	Hanover	7.9	491.4	504.0	54.3	30.9
5	Canonsburg	5.5	266.1	166.2	15.9	6.0
	Burrell	2.8	237.0	88.8	8.1	2.6
	Hanover	16.5	491.4	504.0	54.3	30.9

[a]These values were used to calculate the 1-hour, 3-hour, 8-hour, and 24-hour exhaust emission rates. The maximum 24-hour exhaust emission rates can be determined by dividing these values by 3.

B.2.4 Fugitive emissions from roadways

The per-vehicle emission rate for particulates generated by vehicular activity on unpaved roadways was calculated using the approach suggested by Cowherd et al. (1979). Based on empirical data, the roadway emissions can be calculated using the following formula:

$$\text{Emission rate (lbs/vehicle-mile)} = 5.9 \left(\frac{s}{12}\right) \left(\frac{S}{30}\right) \left(\frac{W}{3}\right)^{0.7} \left(\frac{w}{4}\right)^{0.5} \left(\frac{d}{365}\right)$$

Where:

- s = Percent silt content of roadway dust.
- S = Average vehicle speed (mph).
- W = Vehicle weight (tons).
- w = Average number of wheels per vehicle.
- d = Dry days per year (precipitation $<$0.01 inch).

For each site the values for each of these parameters and the miles of roadway traveled on the site per hour and the per-vehicle-emission rate in grams per second are shown in Table B.2-5. These values were used in conjunction with the number of truck trips per hour at each site for each period and alternative to calculate the gram per second emission rate associated with fugitive-roadway emissions. Thus, the emission rate is given by:

$$\text{Emission rate (g/sec)} = \frac{\text{Emission rate (g/vehicle-mile)} \times \text{Vehicle miles/hour}}{(3600 \text{ sec/hr})}$$

The gram per second emission rate was converted to a gram per area per second emission rate by dividing by the active area of the site.

Table B.2-5. Fugitive roadway-emission-parameter values

Silt content of roadway dust	Vehicle speed	Number of wheels/vehicle	Vehicle weight	Dry days
20%	20 mph	16	40 tons	212

	Miles of roadway[a]/hr	Emission rate (g/sec-vehicle)
Canonsburg	0.57	3.36
Burrell	0.57	3.36
Hanover	5.0	29.4

[a]Miles of roadway estimated in engineering design.

B.2.5 Storage-pile-stacking emissions

The emissions associated with stacking fill, clay, and potentially radioactive materials from truck-loading and dumping activities were calculated. The formula (Cowherd et al., 1979) used to make this calculation is as follows:

$$\text{Emission rate (lbs/ton stacked)} = \frac{(0.0018)\ (\frac{S}{5})\ (\frac{U}{5})\ (\frac{H}{10})}{(\frac{M}{2})}$$

Where:

S = Silt content of materials (20 percent, based on information given in Cowherd et al., 1979).
U = Annual average wind speed (miles per hour). (Canonsburg 4.7, Burrell 4.7, Hanover 9.4.)
H = Drop height (10 feet).
M = Moisture content of materials (2 percent).

The emission rates calculated for each site using these values are as follows:

Canonsburg	3.07 g/ton stacked
Burrell	3.07 g/ton stacked
Hanover	6.14 g/ton stacked

Each of these emission rates was multiplied by the number of tons stacked per day for each period divided by the 28,800 seconds in an 8-hour day in order to calculate the maximum per-period emission rate in grams per second. The gram per second emission rates were converted to grams per area per second emission rates by dividing by the active area of the site.

B.2.6 Wind erosion from storage piles

The emissions associated with wind erosion from storage piles were calculated using the emission-rate formula contained in Cowherd et al. (1979). The formula used to calculate the emission rate is:

$$\text{Emission rate (lbs/ton)} = 0.05\ (\frac{S}{1.5})\ (\frac{d}{235})\ (\frac{f}{15})\ (\frac{D}{90})$$

Where:

S = Silt content of material (20 percent).
d = Number of dry days (precipitation less than or equal to 0.01 inch) (212 days).
f = Percent of time wind speed is greater than 12 miles per hour (Canonsburg 6.3, Burrell 6.3, Hanover 18.8).
D = Duration of material storage (90 days).

The percentages for wind speed greater than 12 miles per hour were obtained from meteorological measurements for 1979-1980. The duration of the 90-day storage cycle is conservative in that it is likely that most materials will be stored less than 90 days. Using this formula and the values just listed, the pound per ton emission rate for each site is as follows:

Canonsburg	0.25 lb/ton	or	113 g/ton
Burrell	0.25 lb/ton	or	113 g/ton
Hanover	0.75 lb/ton	or	340 g/ton

For each period, the amount of material stored (in tons) was multiplied by the emission rate just given, and divided by the total number of seconds in the month to determine the gram per second emission rate for each period. The gram per second emission rate was converted to a gram per area per second emission rate by dividing by the active area of the site.

B.2.7 Mitigative measures for control of fugitive particulates

The fugitive-emission rate for total suspended particulates due to the remedial-action alternatives may cause violations of the total suspended particulate standards at some sites for some of the alternatives. In order to reduce the emissions, the following mitigative measures were assumed:

1. All roadways for truck-hauling operations will be sprayed with a dust suppressant (e.g., surfactants) at least four times per year in order to reduce fugitive roadway emissions.

2. All storage piles will be sprayed with water or other dust suppressants during dry periods to reduce fugitive wind-blown emissions.

3. Construction areas will be sprayed with water or other dust suppressants during dry periods to reduce fugitive construction emissions.

It is anticipated that these recommended measures can reduce fugitive emissions by 95 percent, based on data referenced in Cowherd et al. (1979). If additional total suspended-particulate-emission reductions are required, other mitigative measures, such as those listed in Table B.2-6, could be employed.

Table B.2-6. Example of reasonable precautions for prevention and control of fugitive dust

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1. For land clearing, excavating, grading, earthmoving, dredging, or demolition:

    a. Wetting down, including prewatering.
    b. Stabilizing with chemicals.
    c. Applying dust palliatives.
    d. Disturbing less topsoil per unit of time, and reclaiming disturbed areas as quickly as possible.
    e. Restricting the speed of vehicles traversing the area.

2. For constructing, using, altering, or repairing private roads or parking facilities:

    a. Watering, paving, or chemically stabilizing routinely used haul roads.
    b. Restricting the speed of vehicles.
    c. Watering down or chemically stabilizing roadway shoulders.
    d. Enclosing or covering open-bodied trucks.
    e. Switching from moving materials by vehicle to moving them by conveyance systems.
    f. Covering, shielding, or enclosing the area.
    g. Preventing and/or promptly removing dirt and mud deposits on paved roads.
    h. Cleaning paved roads frequently.

3. For exposure of land or materials subject to wind erosion:

    a. Landscaping and replanting exposed areas with native vegetation.
    b. Installing wind screens or equivalent wind-speed reduction devices.
    c. Stabilizing the land with chemicals.
    d. Physically stabilizing the land by covering with a nonerodible material such as gravel.
    e. Enclosing aggregate storage piles.

B.2.8 Total criteria pollutant maximum emission rates

The total criteria-pollutant maximum emission rates were determined by summing the emissions from all sources. The total suspended-particulate-emission rates reflect a 95 percent reduction in fugitive emissions by the recommended mitigative measures.

Table B.2-7 includes the maximum 24-hour emission rate for particulates. The annual average total suspended-particulate emissions shown in Table B.2-8 reflect the average emission rate during the entire remedial-action program for each site and alternative.

The values shown in Tables B.2-2, B.2-3 and B.2-4 for gaseous pollutants and in Tables B.2-7 and B.2-8 for total suspended-particulate pollutants were used in the modeling analyses to predict the maximum ambient air-quality impacts attributable to each of the remedial-action alternatives under consideration at each site.

B.2.9 Ambient air-quality impacts

The maximum potential ambient air-quality impacts for each of the pollutants emitted during the proposed remedial actions were calculated using the EPA-approved area-source emissions model (Industrial Source Complex). This model has an area source option that is the appropriate dispersion modeling tool for this study. The Industrial Source Complex model has been used for a variety of area source problems and is the EPA-recommended model for such studies.

The 1-hour, 3-hour, 8-hour, and 24-hour ambient concentrations were calculated using the short-term version of the model, while the annual average-ambient concentrations were calculated using the long-term version. The emission rates for criteria pollutants reported previously were used as input to the model.

The short-term impacts of the remedial-action program were estimated on the basis of assumed worst-case meteorological conditions. These included the following:

1. Wind direction was constrained to be within a 10-degree sector for 24 hours.

2. Wind speed was assumed to be 2 meters per second.

3. Mixing height was assumed to be 500 meters.

4. Stability was category 5 -- slightly stable.

Using these assumptions and the maximum emission rate for each pollutant, alternative, and site, the maximum potential offsite 3-hour, 8-hour, and 24-hour ambient-pollutant concentrations were predicted (Table B.2-9). It should be emphasized that these concentrations represent the maximum potential short-term ambient concentration for each alternative. It is unlikely that these concentrations would occur for any prolonged period.

Table B.2-7. Maximum 24-hour total suspended-particulate-emission rates with mitigation measures used

Alternative	Site	Emission rate (μg/m²-sec)					
		Vehicle exhaust	Construction activities[a]	Wind erosion[a]	Roadway emissions[a]	Pile stacking[a]	Total
2	Canonsburg	1.52	1.30	6.45	5.87	0.01	15.15
	Burrell	1.69	0.70	3.1	1.93	---	7.42
3	Canonsburg	1.52	1.10	8.8	3.40	0.02	14.8[illegible]
	Burrell	0.90	1.30	0.9	1.93	---	5.03
4	Canonsburg	1.85	1.00	10.7	6.90	---	20.45
	Burrell	1.69	0.70	3.1	1.93	---	7.42
	Hanover	2.03	0.90	13.2	121.9	---	137.73
5	Canonsburg	1.85	1.00	10.7	6.90	---	20.45
	Burrell	0.90	1.30	0.9	1.93	---	5.03
	Hanover	5.50	1.27	10.3	127.3	0.02	144.39

[a]Assumes mitigation measures that reduce emissions by 95 percent.

Table B.2-8. Annual average total suspended-particulate emission rates with mitigation measures used

Alternative	Site	Emission rate ($\mu g/m^2$-sec) Vehicle exhaust	Construction activities[a]	Wind erosion[a]	Roadway emissions[a]	Pile stacking[a]	Total
2	Canonsburg	0.7	0.50	0.73	2.04	0.01	3.98
	Burrell	0.6	0.38	0.15	0.53	0.01	1.63
3	Canonsburg	0.7	0.48	0.76	1.07	0.01	3.02
	Burrell	0.4	0.56	0.18	0.81	0.03	1.98
4	Canonsburg	0.8	0.50	1.51	2.97	0.04	5.82
	Burrell	0.6	0.38	0.15	0.53	0.01	1.63
	Hanover	1.8	0.46	1.90	45.27	0.04	49.47
5	Canonsburg	0.8	0.50	1.51	2.97	0.04	5.82
	Burrell	0.4	0.56	0.18	0.81	0.03	1.98
	Hanover	1.9	0.43	2.11	40.65	0.06	45.15

[a]Assumes mitigation measures that reduce emissions by 95 percent.

Table B.2-9. Maximum predicted ambient air-quality impacts due to remedial action, national primary and secondary standards, and Pennsylvania standards[a]

Alternative	Site	TSP[b] ($\mu g/m^3$)		SO_2 ($\mu g/m^3$)			CO ($\mu g/m^3$)		NO_x ($\mu g/m^3$)	HC ($\mu g/m^3$)	Settleable particulates[d] (tons/sq mi-month)
		Annual[c]	24-hour	Annual[c]	3-hour	24-hour	1-hour	8-hour	Annual	3-hour	
2	Canonsburg	15.2	156[e]	7.2	162	53.6	2,447	2,422	77.7	64.8	5.8
	Burrell	5.8	75	4.3	122	40.6	3,499	3,488	44.0	58.9	2.2
3	Canonsburg	11.5	153[e]	6.5	125	41.2	2,495	2,469	72.4	35.0	4.4
	Burrell	7.0	51	4.6	82.6	27.4	2,417	2,410	48.3	26.4	2.7
4	Canonsburg	22.2	211[e]	9.1	166	54.6	2,781	2,751	94.9[f]	61.7	8.4
	Burrell	5.8	75	4.3	122	40.6	3,499	3,488	44.0	58.9	2.2
	Hanover	53.4	691[f]	5.4	273	272	2,904	2,467	56.5	155	20.3
5	Canonsburg	22.2	211[e]	9.1	166	54.6	2,781	2,751	94.9[f]	61.7	8.4
	Burrell	7.0	51	4.6	82.6	27.4	2,417	2,410	48.3	26.4	2.7
	Hanover	48.8	725[f]	5.3	273	272	2,904	2,467	55.4	155	18.5
Background concentration		67[g]		47[g]			1,142[h]		20[h]		18[g]
National primary		75	260	80		365	40,000	10,000	100	160	
National secondary		60	150		1,300		40,000	10,000	100		
Pennsylvania standards (same as National Primary and Secondary Ambient Air Quality Standards)											43

[a]Incremental levels must be added to background to determine violations of standards.

[b]Assumes reduction of TSP by 95 percent due to mitigation mearures.

[c]Assumes an 8-hour per day, 5-day per week, 50-week per year work schedule.

[d]Settleable-particulate rate = 0.38 x annual mean TSP concentration.

[e]Secondary-standard violation.

[f]Primary-standard violation.

[g]Measured background; TSP and settleable particulates from 1981 data collected at Washington, Pennsylvania; SO_2 from 1981 data collected at Florence, Pennsylvania.

[h]Estimated background based on PSD guideline document (1980) suggested rural background concentrations.

The annual average ambient-pollutant concentration for the peak offsite receptor was predicted using the ISC long-term model in conjunction with the emission rates reported previously, and the 1979 meteorological data for each site. For Canonsburg onsite meteorological data were available and used. These data were adjusted for the topographical differences between Burrell and Canonsburg, and the modified data were used as input for the Burrell analysis. Meteorological data collected at the Pittsburgh airport were used for the Hanover model. The airport data are directly applicable to the Hanover site because of its proximity to the site (13 miles), and its similar topographic setting. The annual average calculated concentrations and the approximate criteria pollutant National and State Ambient Air Quality Standards for all criteria pollutants are shown in Table B.2-9.

B.2.10 Impacts of settleable-particulate matter

The amount of settleable-particulate matter potentially generated at each site under each alternative was calculated using the model-predicted maximum annual-ambient concentration and data collected from DER TSP Hi-Volume samplers. Information on the annual geometric mean total suspended-particulate concentration at rural sites along with annual average settleable-particulate rates were used to determine the relationship between total suspended-particulate concentrations and settled particles. (Rural values were used because the three sites are situated primarily in rural settings, and the particle-size distribution, which is the primary factor affecting particle settling rates, is very similar.) Table B.2-10 presents the annual geometric mean total suspended-particulate concentration and the annual average settleable-particle rate for six rural sites. Also shown is the ratio of annual average settleable-particle rates to the annual geometric-mean total suspended-particulate concentration. The largest ratio (0.38) was calculated for the Perry County monitor, which is the state-designated rural background site. Since the particles generated by the remedial activities at the sites are likely to have a size distribution similar to the rural background particle-size distribution (both are primarily wind-generated-fugitive emissions), this ratio was used to calculate the maximum annual settleable-particulate rate. The model-predicted maximum annual average total suspended-particulate concentration at each site for each alternative was multiplied by the 0.38 ratio from Perry County to make a conservative estimate of the incremental settleable-particulate rate due to the remedial-action activities. The incremental increases in settleable particulates from the remedial-action alternatives at each site are shown in Table B.2-9.

Table B.2-10. Annual rural background total suspended-particulate geometric-mean concentration and tons per square mile of settled particles

Rural background site	Annual geometric mean -- 1980 ($\mu g/m^3$)	Annual average tons/sq mile -- 1980	Ratio
Perry County (state background site)	34	13	0.38
Quakertown	49	7[a]	0.14
Chambersburg	55	8	0.15
Lebanon	53	11	0.21
East Hempfield	60	13	0.22
Manheim Township	57	10	0.18

[a]Not a full year of data, because their entire year is unavailable.

Appendix C

SOILS AND GEOLOGY INFORMATION

Appendix C.1

SOILS INVESTIGATIONS

Appendix C.1

SOILS INVESTIGATIONS

C.1.1 Canonsburg site

C.1.1.1 Background

A detailed soils investigation of the 18.5-acre former Vitro plant site was conducted in April 1979, A total of 14 test pits were excavated (Figure C.1-1) and described. The test pit descriptions are given in Table C.1-1.

Area A of the former Vitro site consists of buildings, parking lots, a railroad line, and lawns. The soils identified in Area A were classified as made-land or urban land. The original soil profiles in Area A have been disturbed or completely destroyed with the construction of buildings, parking lots, and a railroad line. A total of four test pits were excavated in Area A (test pits 7, 8, 13, and 14). Test pit 7 was excavated in a lawn area adjacent to Strabane Avenue. The soil consisted of a surface layer of grey-black, heavy silt loam underlain by a mottled and gleyed yellowish-brown, silty clay loam subsoil. Moderately-weathered shale bedrock was encountered at 75 inches. In the area of test pit 8, fill material covered the surface. The subsoil described was a mottled and gleyed yellowish-brown silty clay loam. An abandoned waste disposal line was encountered at 36 inches. Test pits 13 and 14 in Area A were similar to the other test pits. In Area A water was encountered in only one of the test pits--at about 8 feet in test pit 13 along the northern property line.

Area B of the Canonsburg site was initially mapped by the Soil Conservation Service as a flood plain of Chartiers Creek. A major portion (estimate 85 percent) of Area B has since been filled with about 8 feet of dredged material. The unfilled area is still in the flood plain of Chartiers Creek and is subject to flooding. A total of six test pits were excavated in Area B. Test pits 1, 2, 3, and 4 were excavated in the filled area. The test pits showed that 51 to 109 inches of fill material overlie the original soil material. The fill material consisted of cinders, wood, metal, bricks, and silty clay to sandy soil material. In test pit 1 the fill was underlain by sandy soil material, while test pits 2, 3, and 4 were underlain by a silty clay loam. Water was encountered in all three test pits. Test pits 5 and 6 were dug along the present flood plain of Chartiers Creek. The soil profiles were typical flood-plain soil profiles, showing deposition and stratification. The soil encountered fit the Soil Conservation Service description for Melvin silt loam.

Four test pits were excavated in Area C. The surface of the area is covered with 6 to 14 inches of red dog. (Red dog is burned overburden from coal mines.) The underlying material was dredged-soil material from Chartiers Creek. The dredged fill consisted of cinders, sediment, bricks, coal, wood, and other debris. Underlying the dredged-fill material was old flood-plain soil of Chartiers Creek. Water was encountered in all four of the test pits from a shallow depth of 37 inches in test pit 12, to 75 inches in test pit 11.

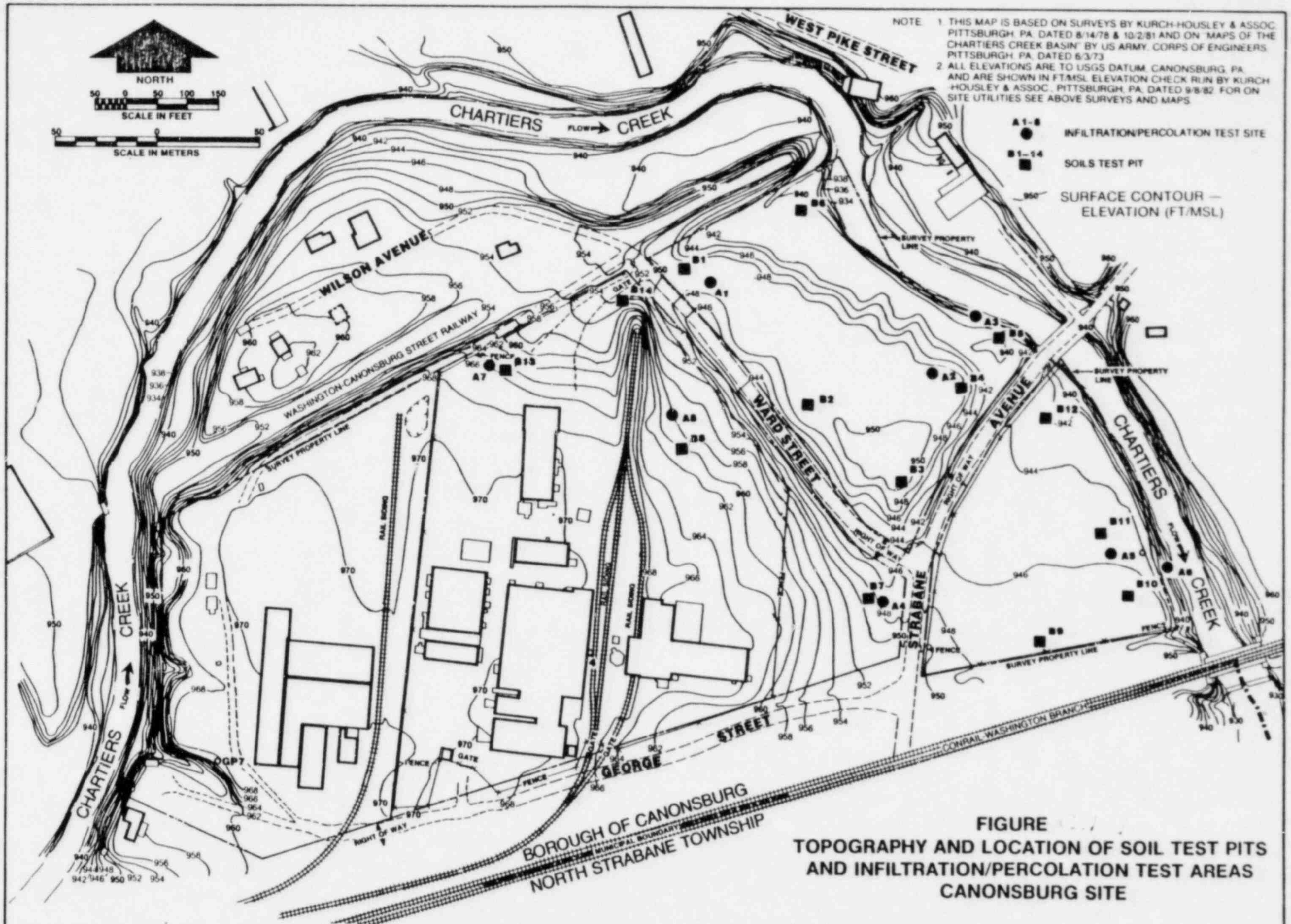


FIGURE
TOPOGRAPHY AND LOCATION OF SOIL TEST PITS AND INFILTRATION/PERCOLATION TEST AREAS CANONSBURG SITE

Table C.1-1. Test pit descriptions[a] -- Canonsburg site

Test pit	Description
Test pit 1	
0 - 8 inches	Channery silt loam -- very dark gray; friable.
8 - 84 inches	Variable fill material -- cinders, oily roots to 8 inches only, bricks, sandy loam to silty clay loam soil material, wood, friable to firm; black, variegated in color.
84 - 98 inches	Fine sandy loam -- black.
98+ inches	Sand -- gray; stratified.
Test pit 2	
0 - 6 inches	Silt loam fill and rock -- varigated.
6 - 51 inches	Rock fill with some wood and metal.
51 - 108 inches	Silty clay loam -- dark gray brown.
Water perched on top of clay -- 51 inches. Test pit filled up -- water rushed in through the stone fill.	
Test pit 3	
0 - 7 inches	Silt loam -- gray; 15 percent coarse fragment.
7 - 78 inches	Fill material -- variegated in nature, ranging from brown to gray, black in color; stumps.
108+ inches	Silty clay loam -- brown and gray.
Water seeping in at 64 inches.	
Test pit 4	
0 - 6 inches	Channery silty clay loam -- gray.
6 - 40	Silty clay loam -- variegated brown.
40 - 96 inches	Silty clay loam -- gray; wood, metal in fill.
Test pit caved in.	

[a]Test pit locations are shown on Figure C.1-1.

Source: Weston (1979) field data.

Table C.1-1. Test pit descriptions[a] -- Canonsburg site (continued)

Test pit	Description
<u>Test pit 5</u>	
0 - 8 inches	Silty clay loam -- gray.
8 - 12 inches	Silty clay loam -- gray brown.
12 - 47 inches	Silty clay loam -- brown.
47 - 55 inches	Silty clay loam -- dark gray.
55 - 96+ inches	Silty clay loam -- brown.
Water at 40 inches.	
<u>Test pit 6</u>	
0 - 7 inches	Heavy silt loam -- dark brown.
7 - 49 inches	Silty clay loam -- brown mottled.
49 - 69 inches	Heavy silt loam -- grayish brown, gleyed.
69+ inches	Silty clay loam -- dark gray, gleyed
Water seeping in at 60 inches.	
<u>Test pit 7</u>	
0 - 8 inches	Heavy silt loam -- gray black.
8 - 30 inches	Silty clay loam -- yellow brown.
30 - 49 inches	Silty clay loam -- yellow brown, mottled, manganese stains.
49 - 75 inches	Silty clay loam -- gleyed, manganese stains.
75+ inches	Moderately weathered shale.
No water detected.	
<u>Test pit 8</u>	
0 - 11 inches	Fill materials, cinders, block.
11 - 16 inches	Layered silty clay loam -- yellow and brown.
16 - 40 inches	Silty clay loam -- yellow brown.
40+ inches	Mottled silty clay -- gray.
Sewerage stone at 36 inches.	
<u>Test pit 9</u>	
0 - 14 inches	Fill -- cinders, coal, wood, loamy; gray black, firm.
14 - 69 inches	Fill, loam -- dredged material, red bricks.
Water at 65 inches.	

[a]Test pit locations are shown on Figure C.1-1.

Source: Weston (1979) field data.

C.1.1.2 Soil analysis

Soil samples were collected from the test pits and analyzed for particle size, soil pH, percent organic matter, and cation exchange capacity. The results of the analyses are shown in Table C.1-2.

A wide range can be seen for each parameter analyzed. Soil pH within the dredged material varied from a low of 2.8 to a high of 7.2. The low pH was only found in Area C where the strip-mine (red dog) material was placed on the surface. In Areas A and B, the soil pH ranged from 4.9 for the original soil material, to a high of 7.5 for the alluvium along Chartiers Creek.

The percent organic matter varied from a low of 0.10 percent for natural soil material, to a high of 11.09 percent for the dredged fill material. The cation exchange capacity also followed the same trend with a low of 9.4 milliequivalent per 100 grams of soil for original soil material, to a high of 31.7 milliequivalent for the dredged fill. The high cation exchange capacity of 31.7 for the dredged fill was due to the high organic matter content of the sample and not due to a high clay content.

The particle size analysis showed a range of sandy loams to silty clay loams. The coarser materials (sandy loams) were found in the dredged material, and the finer silty and clayey soils were found in the flood-plain soil materials and in the original and disturbed in-situ soil material.

C.1.1.3 Soil permeability and soil infiltration tests

The permeability and infiltration rates of the soils were determined by onsite testing. The permeability of the soils was determined by the standard percolation method. Soil infiltration rates were determined by the single-ring method. The tests were run at the ground surface and at depths of 12 and 24 inches. The results of the permeability and infiltration tests are shown in Table C.1-3. The locations of the tests are shown on Figure C.1-1.

The percolation rate ranged from 1.1×10^{-5} inches per second to 1.6×10^{-3} inches per second, depending on the type of soil. The natural in-situ soils, both alluvial and residual, showed permeabilities of 1.7×10^{-4} to 5.9×10^{-4} inches per second. These permeabilities are consistent with the publicized U.S. Soil Conservation Service permeabilities for these upland and flood-plain soil series.

The permeability of the dredged fill areas (Areas B and C) ranged from 1.1×10^{-5} to 2.2×10^{-4} inches per second. The slower permeabilities are due to the particle size of the dredged material. The material, since it is an alluvial deposit, will vary considerably in texture. The permeabilities found are typical for fine-textured alluvial deposits.

Table C.1-2. Soil analysis results -- Canonsburg site

Sample location[a] (test pit no.)	Sample depth (in.)	Percent <2 mm	Percent ≥2 mm	Particle size hydrometer fractionation: 3 min.	10 min.	30 min.	90 min.	270 min.	720 min.	Soil pH	Organic matter (%)	Cation exchange capacity (meq/100 g)
1	Fill	50.8	49.2	0.076	0.141	0.247	0.435	0.762	1.245	7.4	2.85	22.8
4	7-40	51.8	48.2	0.071	0.133	0.237	0.419	0.743	1.229	7.2	1.71	12.9
4	40+	44.3	55.7	0.072	0.135	0.239	0.425	0.744	1.229	7.4	3.01	12.0
6	7-49	27.7	72.3	0.068	0.130	0.234	0.417	0.738	1.216	7.5	1.09	13.3
6	49-69	4.2	95.8	0.073	0.135	0.240	0.422	0.744	1.229	7.2	1.70	16.3
7	8-30	30.6	69.4	0.065	0.125	0.225	0.403	0.718	1.202	5.2	0.12	14.7
7	30-60	47.0	53.0	0.065	0.123	0.221	0.400	0.718	1.199	4.9	0.10	15.4
9	12-36	48.8	51.2	0.069	0.129	0.231	0.412	0.735	1.216	3.1	6.31	11.9
11	0-9	60.3	39.7	0.072	0.134	0.238	0.427	0.750	1.240	3.5	3.48	13.4
11	9-37	45.5	55.5	0.069	0.128	0.277	0.409	0.731	1.216	2.8	11.09	31.7
11	37-69	37.5	62.5	0.071	0.134	0.238	0.419	0.743	1.232	4.3	1.52	14.6
13	18-23	39.6	60.4	0.069	0.131	0.237	0.422	0.748	1.250	6.5	0.91	10.0
13	23-39	28.4	71.6	0.069	0.130	0.235	0.417	0.735	1.208	6.2	0.10	9.4
13	39+	37.8	62.2	0.075	0.138	0.241	0.424	0.738	1.208	4.9	0.11	11.0

[a]Test pits shown on Figure C.1-1.

Source: Weston (1979) field data.

Table C.1-3. Percolation and infiltration rates -- Canonsburg site

Test pit[a]	Percolation rate (in./sec)	Percolation depth (in.)	Infiltration[b] rate (in./sec)
1	1.9×10^{-5}	0	1.3×10^{-3}
2	1.1×10^{-5}	0	---
3	1.6×10^{-4}	12	7.0×10^{-4}
4	1.7×10^{-4}	24	$<5.5 \times 10^{-6}$
5	6.2×10^{-5}	12	3.1×10^{-3}
6	5.9×10^{-4}	0	9.4×10^{-4}
7	2.2×10^{-4}	0	3.9×10^{-3}
8	1.6×10^{-3}	0	2.9×10^{-3}
$\overline{X}$[c]	3.5×10^{-4}	6	2.2×10^{-3}

[a]Test pit locations are shown on Figure C.1-1.

[b]Infiltration tests were performed in the top 4 inches of soil.

[c]$\overline{X}$ = average.

Source: Weston (1979) field data.

C.1.2 Burrell site

Twelve test pits were excavated to examine the soils at the Pennsylvania Railroad landfill site in Burrell Township, Pennsylvania. Soil profile descriptions were completed at each test pit and are presented in Table C.1-4. Each test pit consisted of various fill materials, such as wooden planks, metal strips, slag, gravel, and bottles. The test pits contained very little profile development as evidenced by the lack of horizonation. The few layers occurring in the profiles were caused by the different fill materials being deposited at various times. The U.S. Department of Agriculture (USDA), in conjunction with the Soil Conservation Service (SCS), have classified these soils as "made land." According to the USDA-SCS, made land is defined as a miscellaneous land type that consists of areas where the soil material has been covered, moved, or graded by man. In some areas the original soil has been covered or destroyed by earth-moving operations.

Table C.1-4. Test pit descriptions[a] -- Burrell site

Test pit	Description
Test pit 1A	
Total depth -- 6 feet Percolation hole depth -- 7 feet	
0-12 inches	N2/0. Very abrupt boundary, probably plowed when cover was planted, friable, massive structure.
12-24 inches	10YR5/3. Massive structure, friable, contains metal strips around 24 inches long, a few snail shells (land snails), very moist conditions, gravelly sandy loam.
36 inches	Olive green/gray silty clay, mixed with gravelly sandy loam, massive to weak subangular, blocky structure, friable.
48 inches	Very wet layer, silty clay and loam textures, massive structure, friable.

Additional notes:

The test pit contained bricks, boulders (chunks of fine-grained sandstone), and a few pieces of wood. This pit was not as gravelly as 2A, but had more gravel than the other pits. There seemed to be more natural soil than fill material. This pit looked the least like fill of all of the pits. The vegetation was a cover of grasses and broadleaves (100 percent cover). Samples were taken at depths of 6, 24, 36, and 48 inches.

Test pit	Description
Test pit 1B	
Total depth -- 2 feet 4 inches Percolation-hole depth -- 3 feet 4 inches	Horizonation was similar to test pit 1A. However, at 24 inches there was a gravelly clay loam. All layers were firm and very moist with fine gravels.

Additional notes:

The test pit contained a few land snails, a lot of bricks, but no pieces of wood, and a few metal pieces. This pit was a cross between test pits 1A and 2A, but was most like test pit 1A. The vegetative cover (100 percent) consisted of grasses, sweet clover, and broadleaf weeds. Samples were taken at 6 inches.

[a]Test pit locations are shown on Figure C.1-2.

Source: Weston (1982) field data.

Table C.1-4. Test pit descriptions[a] -- Burrell site (continued)

Test pit	Description
Test pit 2A	
Total depth -- 5 feet Percolation hole depth -- 6 feet	
0-6 inches	Contains 85 percent gravel chips, no structure, looks like gravel from a railroad bed.
6-15 inches	Firm to very firm, compacted by some type of machinery, massive structure, no other apparent horizonation.
Additional notes:	
This test pit contained a lot of smaller gravels and large cobbles, coal slag, bricks, wood, excess metal, twisted metal rods, and rubber hoses. The pit also contained many firm zones and oily or shiny spots in some areas. The color was primarily N2/0 (very black). Some chemical odors were also noted, possibly diesel fuel. The ground cover contained crown vetch, sweet clover, weeds, and grasses (covering approximately 90 percent). This pit contained the most gravel of all of the test pits (approximately 60 percent of the pit was gravel). Samples were taken at 4 inches and 24 inches.	
Test pit 2B	
Total depth -- 24 inches	This test pit was flooded to within 3 inches of the surface. It was similar to test pit 2A.
Test pit 3A	
Total depth -- 4 1/2 feet Percolation hole depth -- 5 1/2 feet	
0-8 inches	Friable, weak granular structure, contains fine gravels.
8-18 inches	Brittle but very firm layer, massive structure.
18-24 inches	A white and orange conglomerate (chemical by-product ?), very firm, massive.

[a]Test pit locations are shown on Figure C.1-2.

Source: Weston (1982) field data.

Table C.1-4. Test pit descriptions[a] -- Burrell site (continued)

Test pit	Description
Test pit 3A (continued)	
24-38 inches	Red-brown sandy loam, massive structure.
38-50 inches	Black and dark gold loose material, massive fill.

Additional notes:

This material looked like natural material but was fill. There were rounded cobble-size material scattered throughout the soil profile. Some metal pieces, wood, and bricks were present, but were few in number. The vegetative cover (80 percent) consisted of crown vetch and foxtail. Samples were taken at 20, 30, and 40 inches.

Test pit 3B

Total depth -- 2 feet
Percolation hole depth -- 32 inches

Similiar to test pit 3A with some concrete pieces also present.

Test pit 4A

Total depth -- 4 feet
Percolation hole depth -- 56 inches

0-24 inches	Very moist, water trickling in, fine gravels, sandy loam, 10YR3/2, faint mottling, very friable. At 20 inches very firm, compacted coal-mine waste, fine coal pieces mixed with red slag layer.
24-28 inches	Red slag, very firm, clayey, pieces of coal.
36 inches	Concrete pieces, tie rods (metal), smaller gravels than test pits 5 and 6.
48 inches	Very firm, compacted, wire boxes, bricks, weathered rock, very sandy, possibly boiler waste, very lightweight, massive.

[a]Test pit locations are shown on Figure C.1-2.

Source: Weston (1982) field data.

Table C.1-4. Test pit descriptions[a] -- Burrell site (continued)

Test pit	Description
Test pit 4A (continued)	
Additional notes:	
This test pit was located in a swampy area with 80-percent vegetative cover consisting of low grasses and broadleaves. There was slag or rocks at the bottom of the percolation hole that covered the entire bottom of the pit. There was slight unpleasant chemical odor coming from the pit. Samples were collected at 10, 24, and 40 inches.	
Test pit 4B	
Total depth -- 2 1/2 feet	
0-10 inches	Loose, fine gravels, sandy loam, very wet.
18 inches	Red layer similar to that in test pit 4A.
Additional notes:	
The test pit flooded to within 1 foot of the surface, therefore, no percolation test was run. A few pieces of wood and bricks were noted in the pit. The vegetation consisted of grasses and tall broadleaves (80 percent cover). No samples were collected.	
Test pit 5A	
Total depth -- 4 1/2 feet Percolation hole depth -- 5 1/2 feet	
0-6 inches	Friable, weak subangular blocky structure, small amounts of gravel.
6-10 inches	Red crumbled brick layer, firm, discontinuous.
24 inches	Firm, very dark, coal fragments, moist, cobble-size material, structure is weak, subangular and blocky due to compaction.

[a]Test pit locations are shown on Figure C.1-2.

Source: Weston (1982) field data.

Table C.1-4. Test pit descriptions[a] -- Burrell site (continued)

Test pit	Description
Test pit 5A (continued)	
30 inches	Yellowish gray sandy clay loam, waste product, white porcelain or glass pieces mixed in, possibly insulators from electric lines.
48 inches	Olive green to gray silty clay, plastic, sticky, friable.

Additional notes:

There were more color variations (bricks) and different layers of fill in this pit. There was virtually no wood or was it as gravelly as test pit 6A. There were bricks and metal bars at a depth of 36 inches. The vegetation consisted of grasses and broadleaf weeds (100 percent cover). Samples were collected at 6, 10, 30, and 48 inches.

Test pit 5B

Total depth -- 3 feet
Percolation hole depth -- 4 feet

0-10 inches	Loose, cobbles, no structure.
30 inches	Band of weathered blue gray shale, very firm.
35-37 inches	Small, discontinuous band of weathered sandstone or ironstone, loamy sand, dark rusty color, single grain.
18 and 42 inches	Pockets of crumbled red brick.

Additional notes:

This test pit contained many wooden boards and metal cable pieces. The vegetation consisted of grasses as well as broadleaf weeds with some moss. Samples were collected at 6 inches and 30 inches.

[a]Test pit locations are shown on Figure C.1-2.

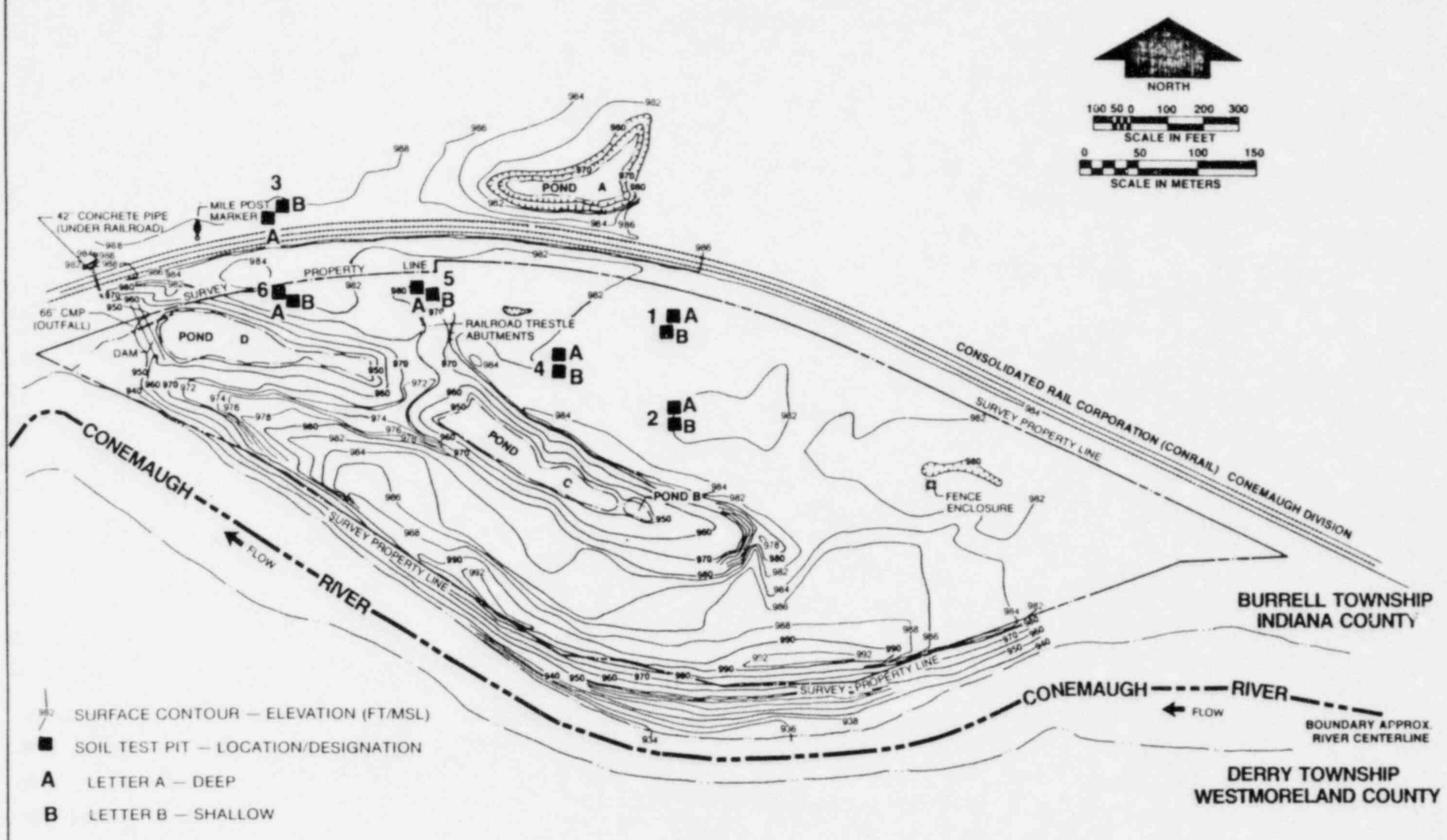
Source: Weston (1982) field data.

Table C.1-4. Test pit descriptions[a] -- Burrell site (continued)

Test pit	Description
Test pit 6A	
Total depth -- 4 feet Percolation hole depth -- 5 feet	
0-6 inches	Weak, friable, massive structure.
15 inches	Very firm slag material.
6-30 inches	Firm, metal strips and bars, dark color (N2/0), massive structure.
30 inches	Small clay layer.
48 inches	Friable, massive, interbedded white chemical by-product.
Additional notes:	
This test pit contained iron strips, electrical lines, railroad ties, bottles, bricks, rounded gravel, coal slag, and sandstone. The cover vegetation (approximately 70 percent) consisted of mosses, low-lying broadleaf cover, and tall grasses. Samples were taken at 15, 30, and 48 inches.	
Test pit 6B	
Total depth -- 3 feet Percolation hole depth -- 4 feet	
10 inches	Gravelly, black (N3/0), very coarse material, compacted layer (roadbed gravel?).
30 inches	Mottled, gray brown, loam, higher clay content, massive structure, firm.
Additional notes:	
This test pit contained many wooden boards, railroad ties, bricks, cement chunks, metal trash, and pieces of rubber. The ground cover (70 percent) consisted of broadleaf cover and grasses. Samples were collected at depths of 10 and 30 inches.	

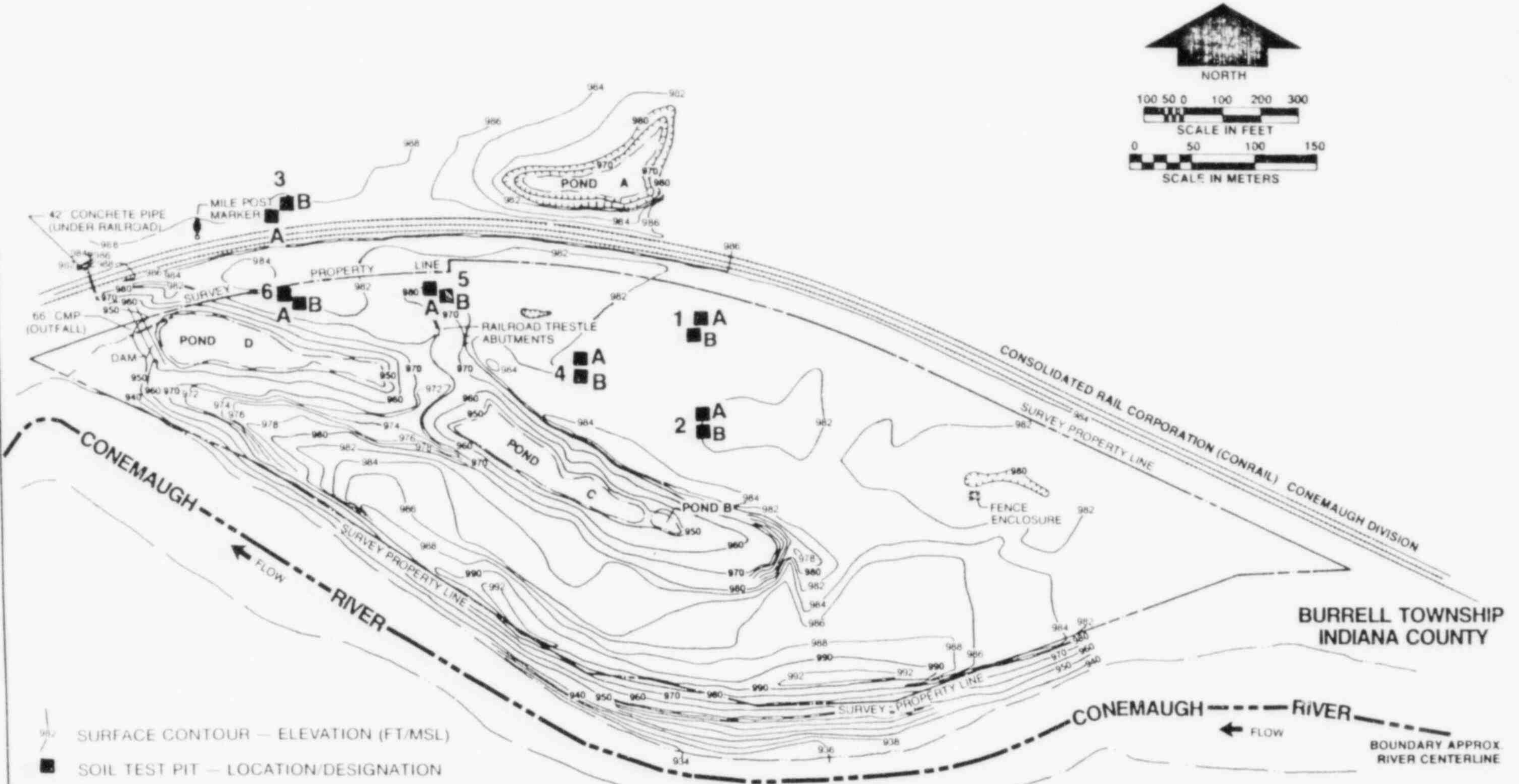
aTest pit locations are shown on Figure C.1-2.

Source: Weston (1982) field data.



NOTE: 1. PROPERTY LINE DATA FROM PLAN OF PROPERTY FOR UNION CARBIDE CORP. BY RICHARD G. BACH & ASSOC., ZELIENOPLE, PA-DATED 11/16/77
2. TOPOGRAPHICAL DETAIL FROM MAP, TEST HOLE LOCATIONS, FOR ROY F. WESTON INC. BY KURCH-HOUSLEY & ASSOC. PITTSBURGH, PA-DATED 11/6/81, REV. 3/2/82
3. ALL ELEVATIONS ARE TO USGS DATUM, BLAIRSVILLE PA, AND ARE SHOWN IN FT/MSL. ELEVATION CHECK RUN BY KURCH-HOUSLEY, PITTSBURGH, PA-DATED 6/11/82

FIGURE
TOPOGRAPHY AND LOCATION OF SOIL TEST PITS
BURRELL TOWNSHIP SITE



982 SURFACE CONTOUR — ELEVATION (FT/MSL)

■ SOIL TEST PIT — LOCATION/DESIGNATION

A LETTER A — DEEP

B LETTER B — SHALLOW

NOTE
1. PROPERTY LINE DATA FROM PLAN OF PROPERTY FOR UNION CARBIDE CORP. BY RICHARD G. BACH & ASSOC. ZELIENOPLE, PA-DATED 11/16/77.
2. TOPOGRAPHICAL DETAIL FROM MAP. TEST HOLE LOCATIONS FOR ROY F. WESTON INC. BY KURCH-HOUSLEY & ASSOC. PITTSBURGH, PA-DATED 11/6/81, REV. 3/2/82.
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FIGURE
TOPOGRAPHY AND LOCATION OF SOIL TEST PITS
BURRELL TOWNSHIP SITE

Table C.1-5. Percolation and infiltration rates -- Burrell site

Test pit[a]	Percolation rate (in./sec)	Test depth (in.)	Infiltration rate (in./sec)
1A	2.6×10^{-3}	84	2.2×10^{-3}
1B	9.2×10^{-4}	40	8.3×10^{-4}
2A	2.4×10^{-3}	72	2.0×10^{-3}
2B	Flooded	--	7.3×10^{-3}
3A	6.7×10^{-4}	66	6.2×10^{-3}
3B	2.8×10^{-3}	32	9.7×10^{-3}
4A	1.2×10^{-3}	56	6.7×10^{-4}
4B	Flooded	--	2.2×10^{-3}
5A	8.3×10^{-3}	--	1.7×10^{-4}
5B	1.4×10^{-3}	48	1.5×10^{-3}
6A	1.2×10^{-3}	60	1.7×10^{-3}
6B	7.8×10^{-4}	48	9.2×10^{-3}
$\bar{X}$[b]	1.5×10^{-3}	57.2	3.6×10^{-3}

[a]Test pit locations are shown on Figure C.1-2.
[b]$\bar{X}$ = average.

Source: Weston (1982) field data.

C.1.3 Hanover site

Twelve test pits were excavated to examine the soils at the Hanover site. Soil profile descriptions were completed for each test pit and are presented in Table C.1-6. Each test pit contained mostly rock fragments with only a small amount of fines present. Very little soil profile development (verified by the absence of horizons or layers) was observed at each pit.

U.S. Soil Conservation Service Bulletin No. N32-9-4 (published in 1979) outlines an interim classification system that attempts to provide a basis for uniformly identifying soils developed in mine spoil. Under this system, all of the soils at the Hanover site would be classified as Udorthents, sandstone, and shale. The classification of these soils means that they are young in age, contain mostly sandstone and shale boulders, and are found in a humid moisture regime.

Table C.1-6. Test pit descriptions -- Hanover site

Test pit	Description
<u>Test pit 1A</u>	
90 percent coarse fragments	
0-12 inches	Loam, 10YR5/4, granular, friable, heaviest growth of roots
	Yellow orange, coarse sandstone, gravelly loamy sand, 10YR6/8.
	Gray-white coarse sandstone, gravelly loamy sand, 10YR5/4, predominant unit.
	Very soft black fractured shale, pockets of heavy silt loam, 10YR3/1.
	Highly weathered dark brown sandstone, loamy coarse sand, 5YR3/2
<u>Test pit 2</u>	
90 percent coarse fragments	
0-8 inches	Sandy loam to loam, variegated colors, main root zone.
	Micaceous gray shale, gravelly silt loam, 10YR5/3, friable.
	Gray-white coarse sandstone, loamy coarse sand, 10YR6/3, predominant unit.
	Yellow-orange coarse sandstone, gravelly loamy sand, 10YR6/8.
<u>Test pit 3</u>	
90 percent coarse fragments	
0-9 inches	Sandy loam to loam to silt loam, 10YR4/3, granular, weak, friable, main root zone.
	Gray-white sandstone, loamy coarse sand, predominant rock unit.

Table C.1-6. Test pit descriptions -- Hanover site (continued)

Test pit	Description
Test pit 3 (continued)	
	Brown sandstone, sandy loam, 10YR4/3 predominant soil color.
	Black shale, pockets of silt loam.
Test pit 4	
90 percent coarse fragments	
0-24 inches	Sandy loam and loam, 10YR4/3, predominant soil color, main root zone.
	Light gray shale, siltstone, and very fine-grained sandstone.
	Coarse gray sandstone, coarse sandy loam predominant unit.
	Brown coarse sandstone with pockets of hard coal.
Test pit 5	
90 percent coarse fragments	
0-15 inches	Loamy coarse sand, 10YR4/3, main root zone.
	Coarse brown sandstone, predominant unit, several tree branches and pieces of wood present.
	Yellow-orange sandstone, loamy sand.
	Light gray shale, silt loam.
Test pit 6	
80 percent coarse fragments	
0-28 inches	Loamy sand, 10YR4/3, main root zone.
	Gray-white sandstone, sandy loam.

Table C.1-6. Test pit descriptions -- Hanover site (continued)

Test pit	Description
Test pit 6 (continued)	
	Yellow-orange sandstone, sandy loam.
	Light gray fine siltstone, loam to silt loam, pockets of lignite.
Test pit 7	
98 percent coarse fragments	
	Sandy loam, 10YR4/3, main root zone, granular, weak, friable.
	Alternating bands of loamy sand, yellow orange and silt loam, black-gray lignite, subangular blocky, weak, friable.
Test pit 8	
70 percent coarse fragments	
0-10 inches	Main root zone, silt loam, 10YR4/3.
	Gray-white sandstone, gravelly coarse sandy loam, 10YR4/3.
	Black shale and lignite pockets, gravelly loam to silt loam.
Test pit 9	
90 percent coarse fragments	
0-11 inches	Gravelly sandy loam, 10YR4/3, main root zone.
	Gray-white coarse sandstone, gravelly coarse sandy loam.
	Yellow-orange coarse sandstone, coarse sandy loam, lignite and coal pockets.

Table C.1-6. Test pit descriptions -- Hanover site (continued)

Test pit	Description
<u>Test pit 10</u>	
90 percent coarse fragments	
0-22 inches	Gravelly loam, 10YR4/3, granular, weak, main root zone.
	Gray-white sandstone, gravelly coarse sandy loam, subangular, blocky, weak.
	Fine-grained black siltstone, loam to silt loam.
	Yellow-orange sandstone, sandy loam.
	Limestone, light gray, gravelly silt loam.
<u>Test pit 11</u>	
90 percent coarse fragments	
0-9 inches	Gravelly loam, 10YR5/2, main root zone.
	Gray-white sandstone, gravelly loam.
	Yellow-orange sandstone, gravelly loam.
	Gray shale, loam.
<u>Test pit 12</u>	
90 percent coarse fragments	
0-12 inches	Sandy loam, 10YR4/3, granular, very weak, friable, main root zone.
	Gray-white sandstone, sandy loam, large pockets of lignite.
	Coarse brown sandstone, sandy loam.
	Yellow-orange sandstone, sandy loam.

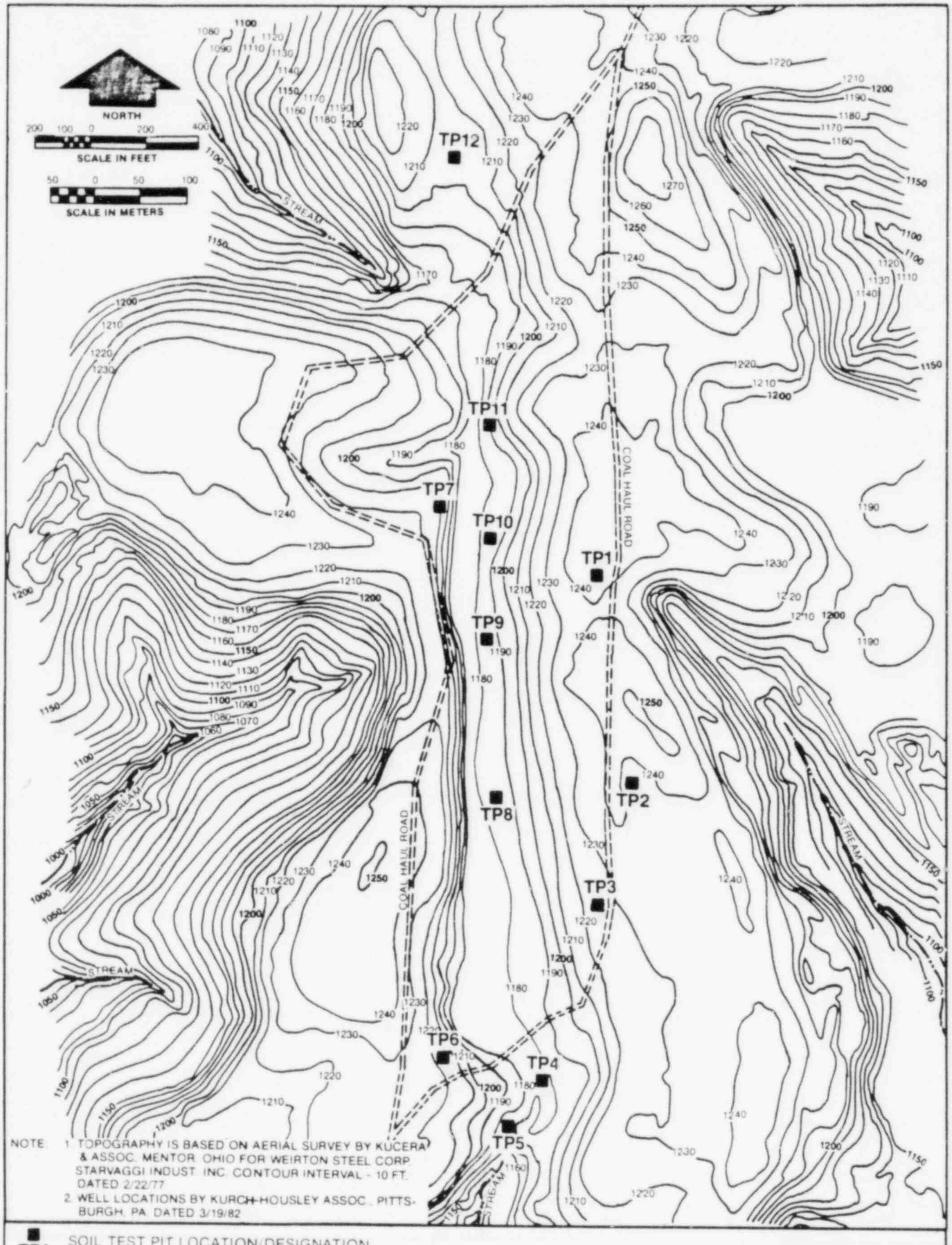


FIGURE
TOPOGRAPHY AND LOCATION
OF SOIL TEST PITS
HANOVER TOWNSHIP SITE

Table C.1-17. Percolation rates -- Hanover site

Test pit[a]	Percolation rate (in./sec)	Percolation depth (in.)
1A	5.5×10^{-5}	73
2A	1.1×10^{-4}	69
2B	1.2×10^{-3}	41
3A	1.4×10^{-4}	75
3B	3.3×10^{-4}	45
6	1.1×10^{-4}	69
7B	3.9×10^{-4}	45
8A	No movement	72
8B	1.1×10^{-4}	45
10A	3.3×10^{-4}	72
10B	2.8×10^{-4}	44
$\bar{x}$[b]	3.0×10^{-4}	59

[a]Test pit locations are shown on Figure C.1-3.
[b]$\bar{x}$ = average.

Source: Weston (1982) field data.

Appendix C.2

GEOLOGICAL INFORMATION

Appendix C.2

GEOLOGICAL INFORMATION

Geological investigations were conducted at the Canonsburg, Burrell, and Hanover sites to determine the following:

1. Site stratigraphy.
2. Depth to bedrock.
3. Regional setting.
4. Geological structure.
5. Mineral resources.

At each site the investigations utilized the extensive regional data in the literature. The regional data were augmented and verified during the site-specific drilling programs conducted for hydrogeological analysis. These drilling programs are described in Appendix D.2.

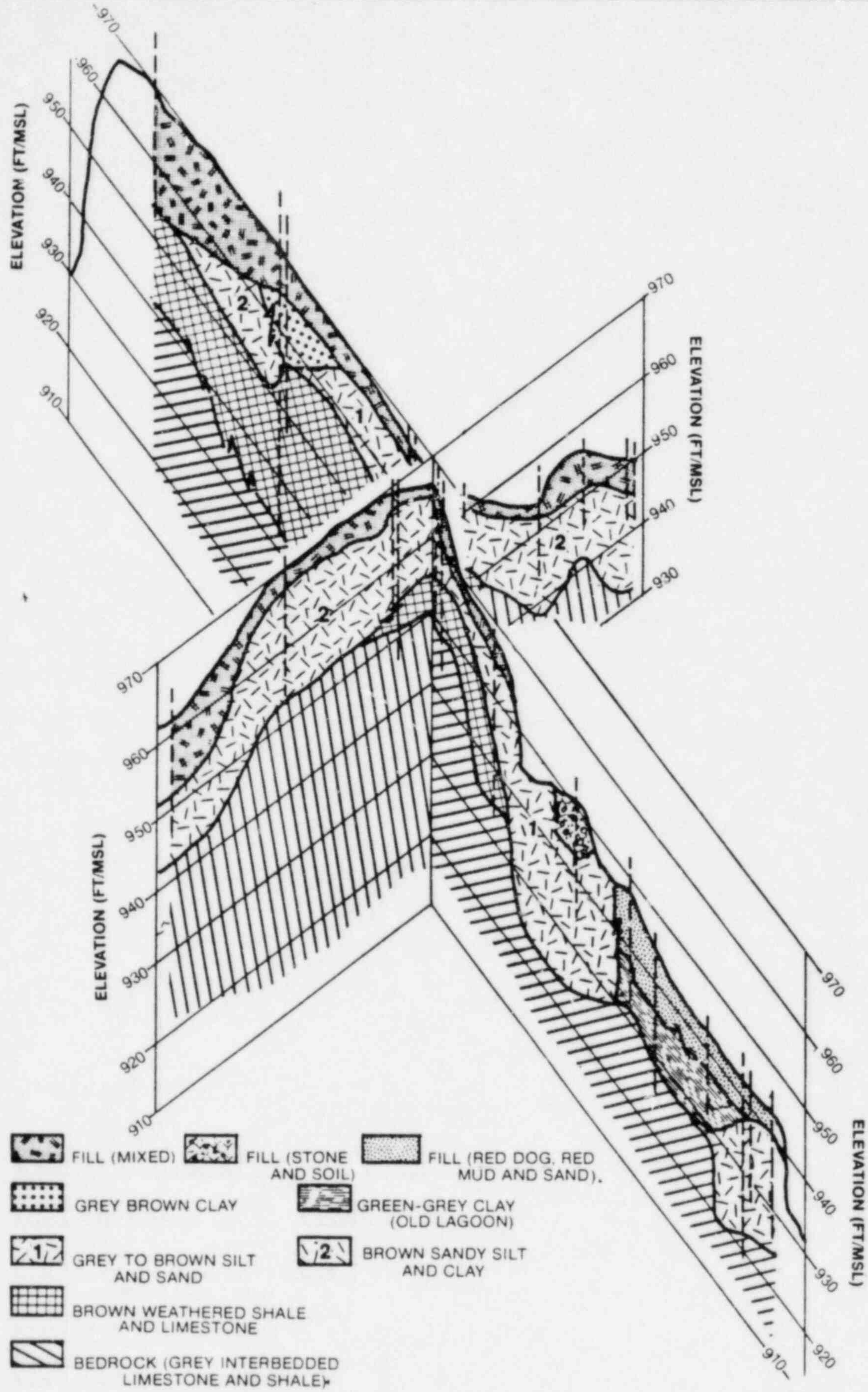
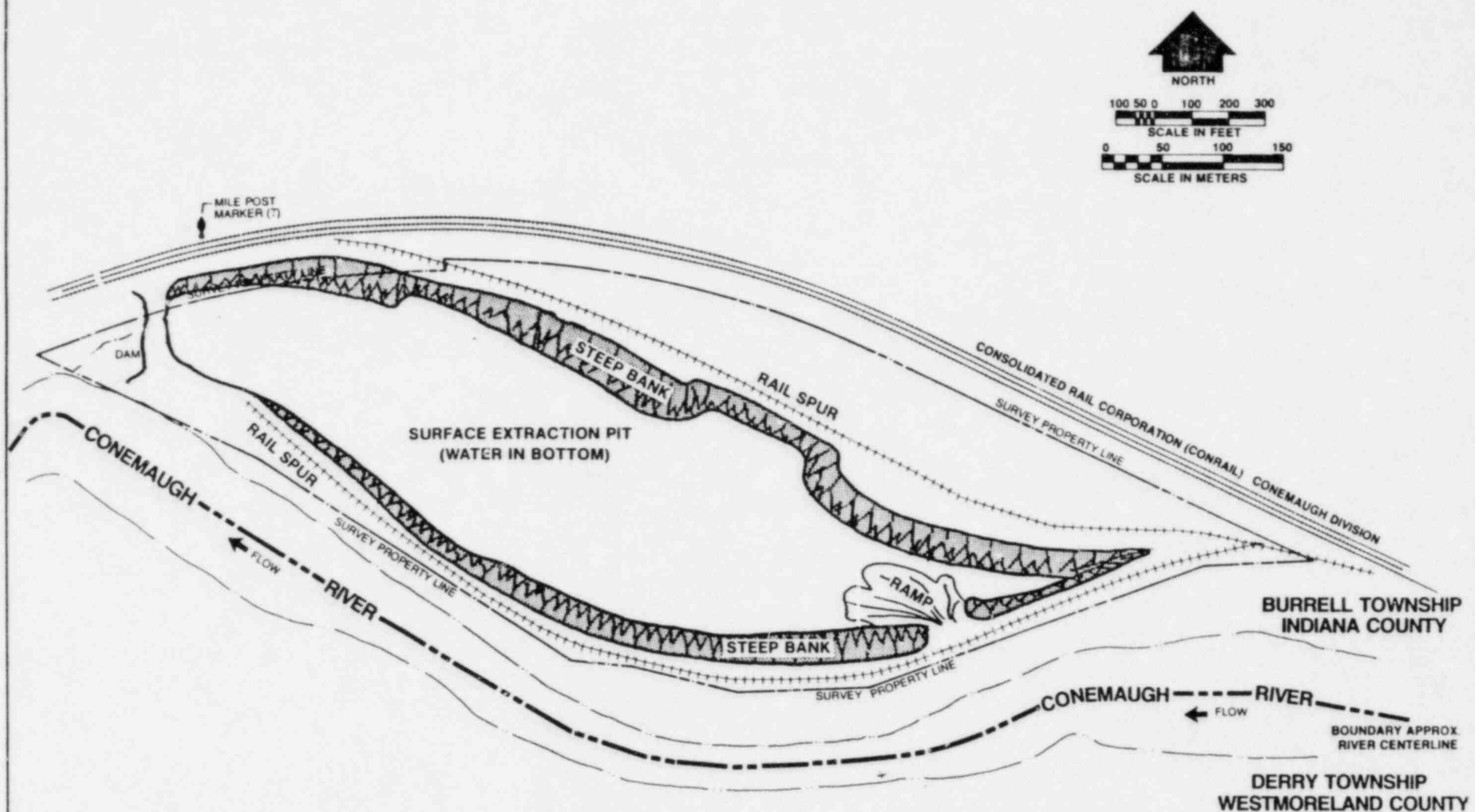


FIGURE
GEOLOGIC CROSS-SECTION
CANONSBURG SITE



FROM HISTORICAL AERIAL PHOTOGRAPHY, USDA,
DATE: 10/13/49

SITE CONFIGURATION — 1949
BURRELL TOWNSHIP SITE

NOTE 1 PROPERTY LINE DATA FROM PLAN OF PROPERTY FOR UNION CARBIDE CORP. BY RICHARD G. BACH & ASSOC. ZELIENOPLE, PA-DATED 11/16/77

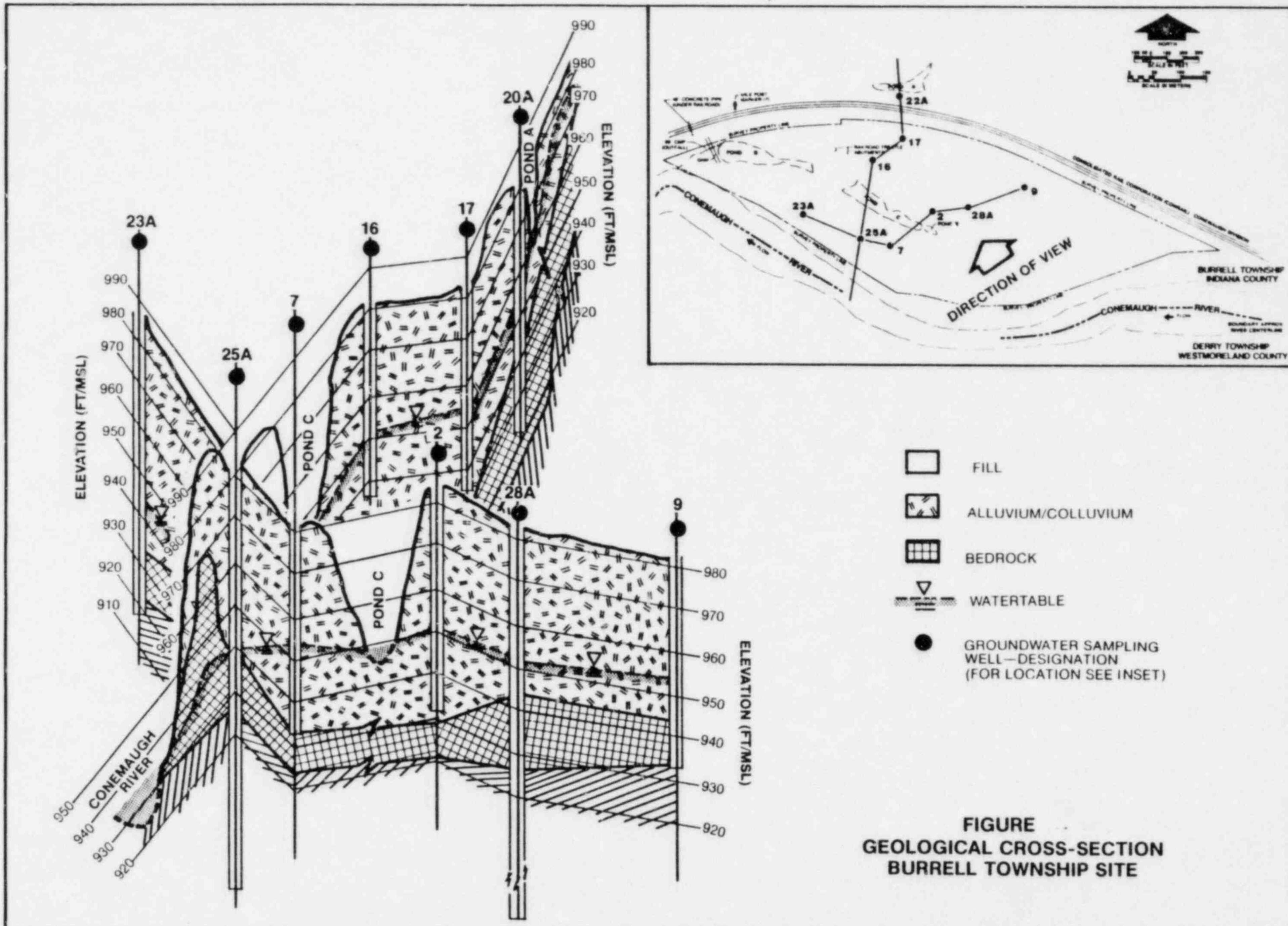


FIGURE
GEOLOGICAL CROSS-SECTION BURRELL TOWNSHIP SITE

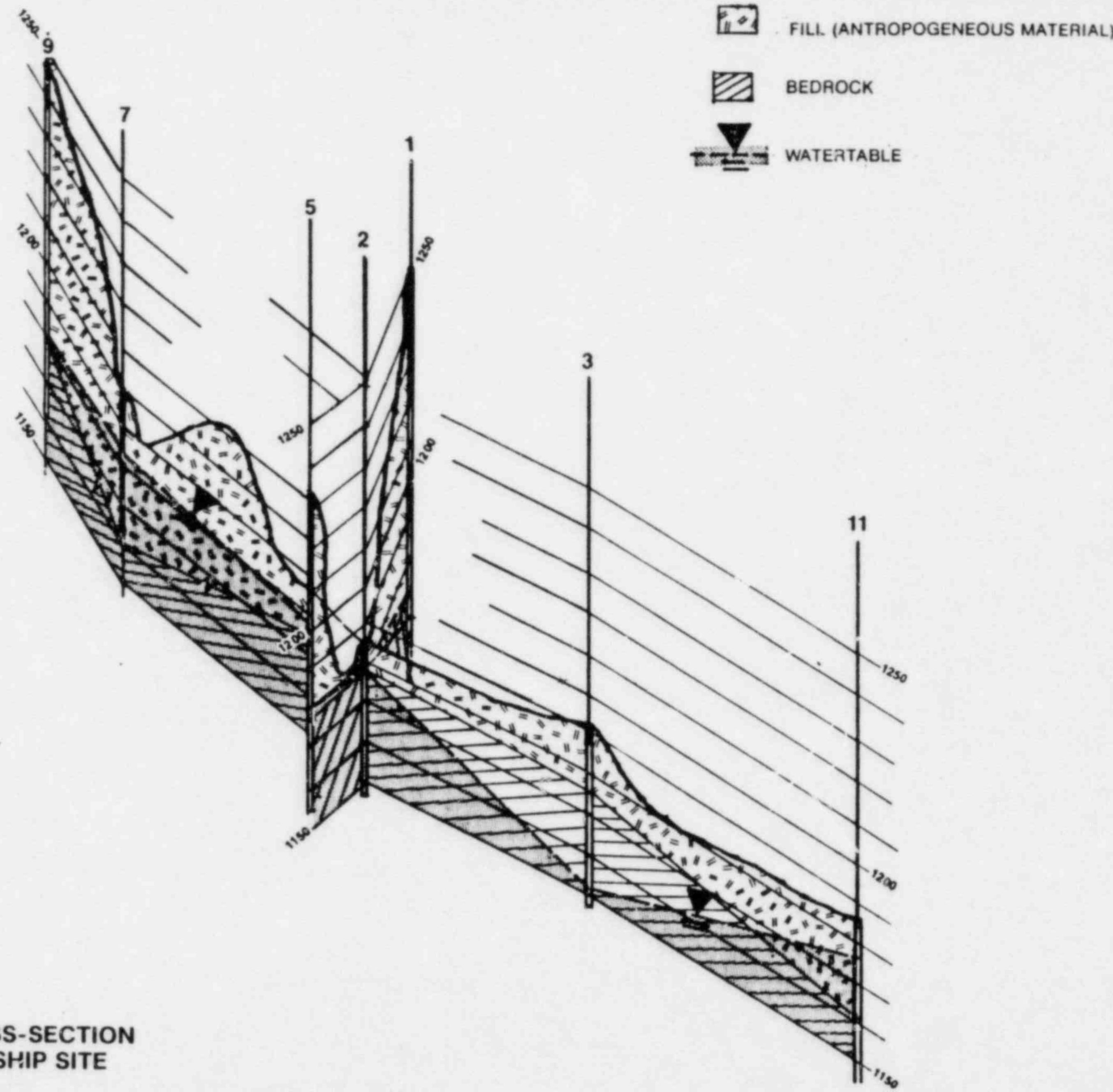


FIGURE
GEOLOGICAL CROSS-SECTION
HANOVER TOWNSHIP SITE

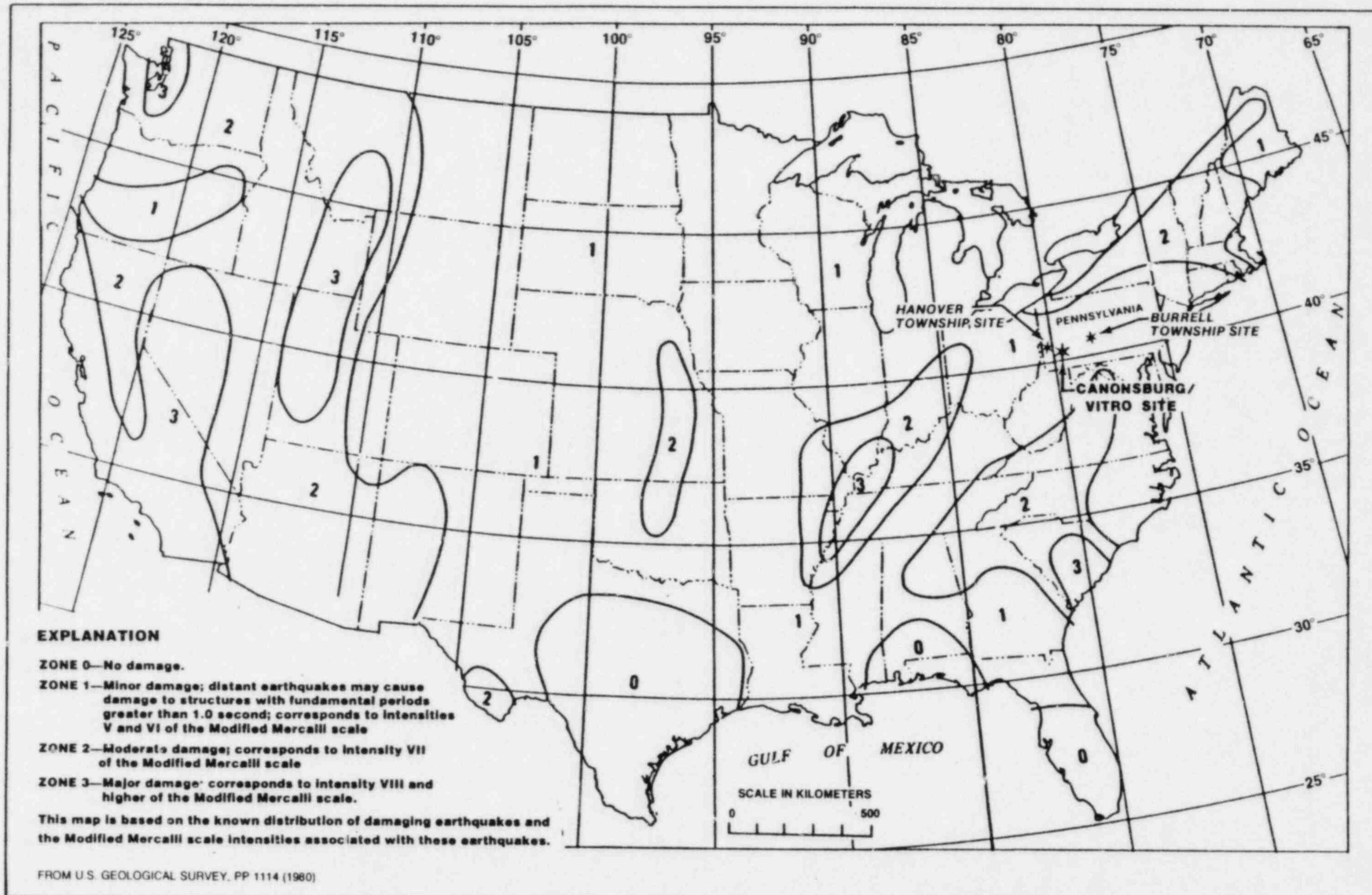


FIGURE [illegible] UNITED STATES SEISMIC RISK ZONES-1979
(FROM ALGERMISSEN, 1969)

Appendix D

WATER RESOURCES INFORMATION

Appendix D.1

SURFACE-WATER INFORMATION

Appendix D.1

SURFACE WATERS

Information on existing water quality and flow conditions in Chartiers Creek and the Conemaugh River was obtained from the Pennsylvania DER's STORET system. In addition, Weston performed a surface-water sampling effort at the Canonsburg site (the methods used are described in Table D.1-5, and the results are given in Table D.1-6) to determine the nonradiological-contaminant loading of Chartiers Creek from the site, and to compare it to input from other local sources.

An EPA-water quality study was performed on the surface waters in the vicinity of the Hanover site, as part of a permit application by the site's owner (Starvaggi Industries) to construct an industrial landfill. The results of this study, along with the results from an owner-performed water-quality testing program, were used to characterize the waters in the Hanover site area.

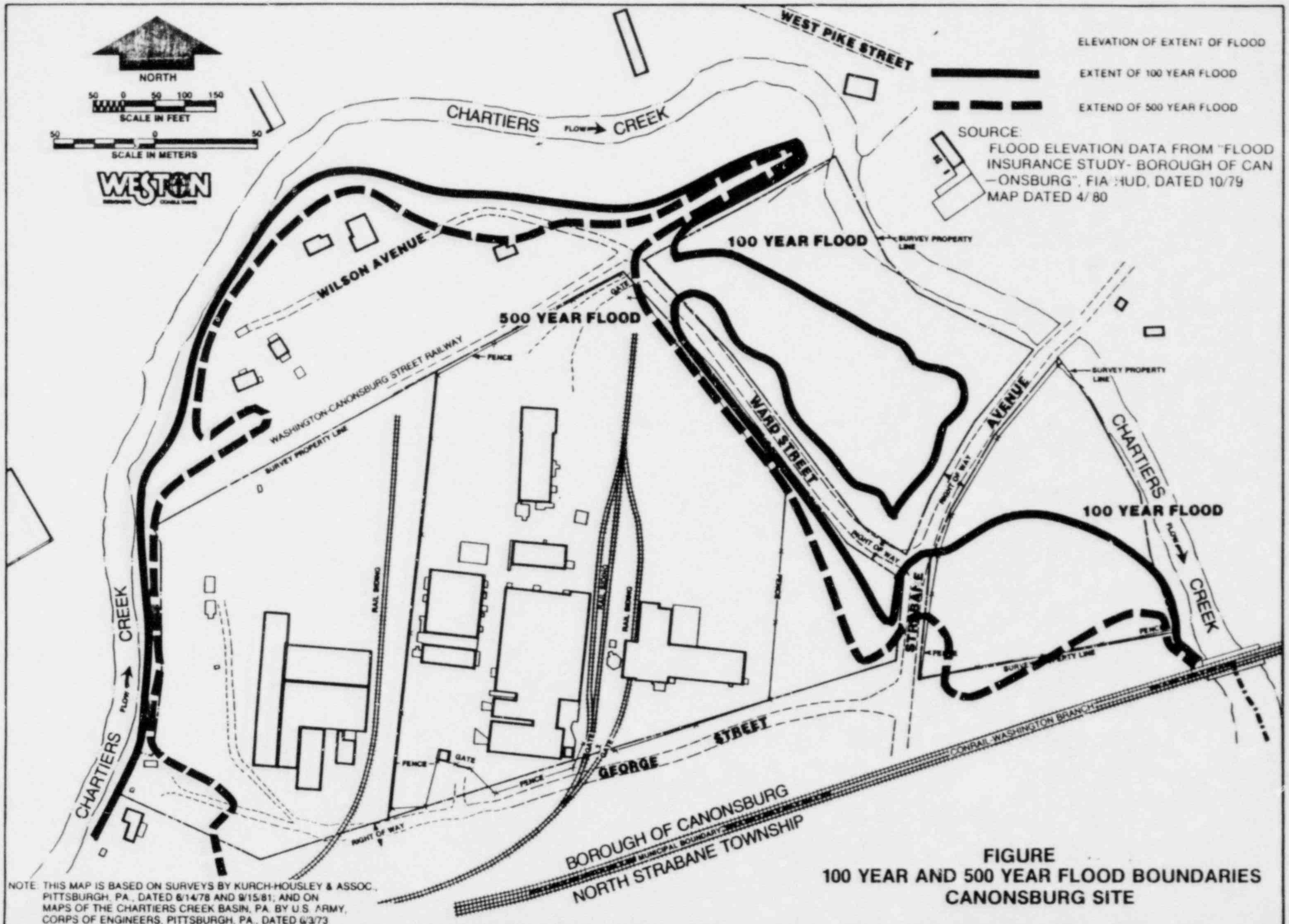


FIGURE
100 YEAR AND 500 YEAR FLOOD BOUNDARIES
CANONSBURG SITE

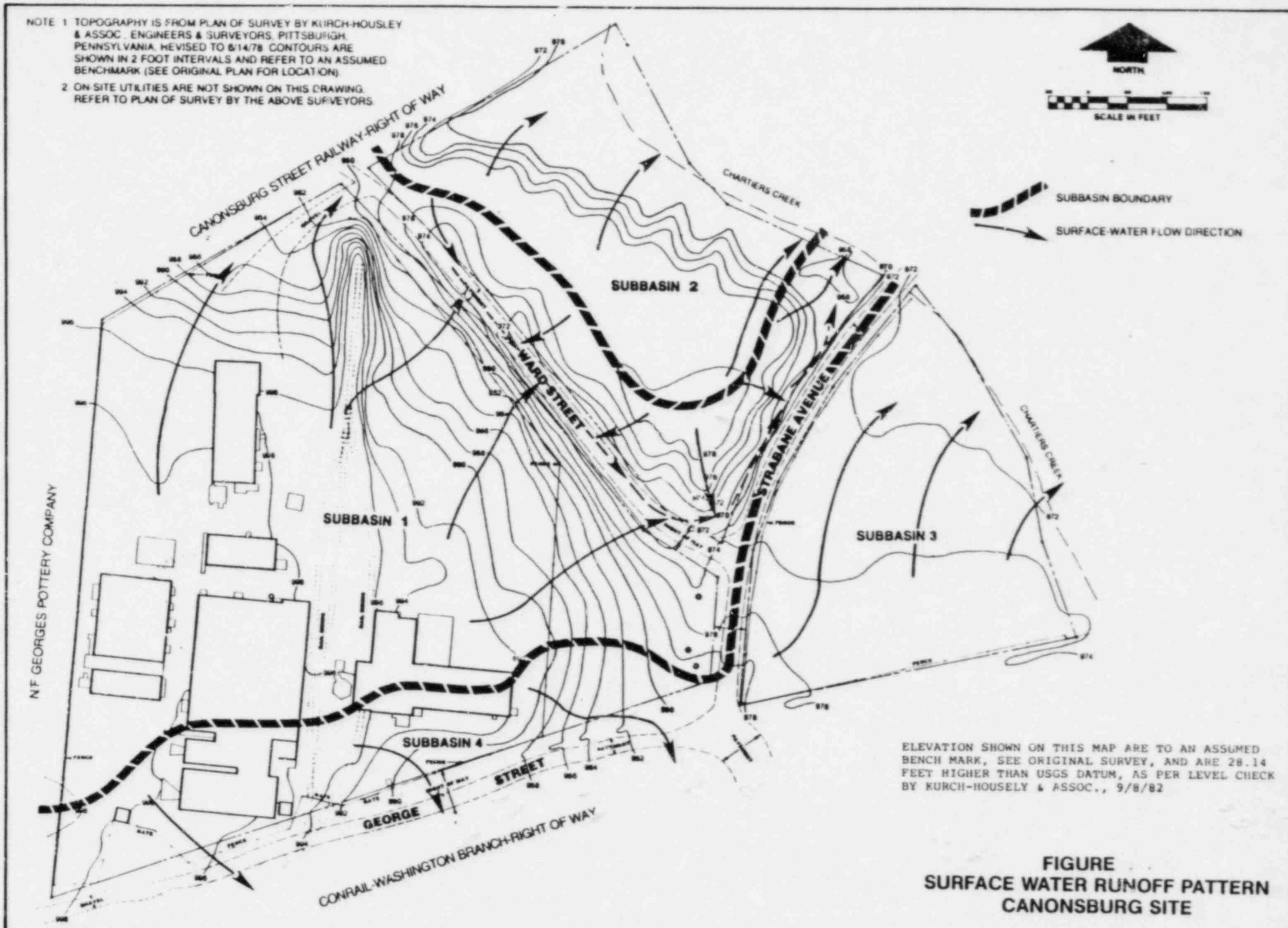


FIGURE
SURFACE WATER RUNOFF PATTERN
CANONSBURG SITE

Table D.1-1. Flood elevations and discharges on Chartiers Creek adjacent to the Canonsburg site

Stream location	Flood elevations (USGS data) (mean sea level) 10 yr	50 yr	100 yr	500 yr
ConRail railroad bridge	938	941.5	942.5	944
Strabane Ave. bridge	940	943.5	945.5	949.3
Just upstream of site	945.5	949.5	951.5	954.1
	Stream discharge (cfs)			
Near site	5,600	10,100	12,600	19,400

Source: U.S. Department of Housing and Urban Development (1979).

<u>Notes</u>: Flood elevations reflect the completion of a portion of the ongoing channelization project in the Canonsburg-Houston area. The channel-improvement project has been completed from the North Central Avenue bridge crossing upstream to the ConRail bridge crossing, just downstream of the site. As channel improvements continue, flood elevatio'ns will be reduced.

Refer to the U.S. Army Corps of Engineers (1975).

Flooding patterns are shown on Figure D.1-1.

Table D.1-2. Estimated runoff volume (acre-feet) from the Canonsburg site

Return period (yrs)	Duration (hrs)	Intensity[a] (in./hr)	Subbasin 1[b] Area (acres)	Subbasin 1[b] Runoff coeffi- cient	Subbasin 1[b] Runoff volume (acre-ft)	Subbasin 2[b] Area (acres)	Subbasin 2[b] Runoff coeffi- cient	Subbasin 2[b] Runoff volume (acre-ft)	Subbasin 3[b] Area (acres)	Subbasin 3[b] Runoff coeffi- cient	Subbasin 3[b] Runoff volume (acre-ft)	Total runoff volume (acre-ft)
2	0.25	2.5	10.4	0.29	0.16	2.56	0.12	0.016	3.61	0.07	0.013	0.19
2	1	1.1	10.4	0.29	0.28	2.56	0.12	0.028	3.61	0.07	0.023	0.33
2	6	0.27	10.4	0.29	0.41	2.56	0.12	0.041	3.61	0.07	0.034	0.48
2	12	0.15	10.4	0.29	0.45	2.56	0.12	0.046	3.61	0.07	0.038	0.53
10	0.25	3.3	10.4	0.29	0.21	2.56	0.12	0.021	3.61	0.07	0.017	0.25
10	1	1.5	10.4	0.29	0.38	2.56	0.12	0.038	3.61	0.07	0.031	0.45
10	6	0.4	10.4	0.29	0.60	2.56	0.12	0.061	3.61	0.07	0.051	0.71
10	12	0.22	10.4	0.29	0.66	2.56	0.12	0.067	3.61	0.07	0.056	0.78
50	0.25	4.00	10.4	0.32	0.27	2.56	0.13	0.028	3.61	0.08	0.023	0.32
50	1	2.00	10.4	0.32	0.55	2.56	0.13	0.056	3.61	0.08	0.046	0.65
50	6	0.50	10.4	0.32	0.83	2.56	0.13	0.084	3.61	0.08	0.069	0.98
50	12	0.28	10.4	0.32	0.93	2.56	0.13	0.095	3.61	0.08	0.078	1.10
100	0.25	4.50	10.4	0.32	0.31	2.56	0.13	0.031	3.61	0.08	0.026	0.37
100	1	2.20	10.4	0.32	0.61	2.56	0.13	0.062	3.61	0.08	0.051	0.72
100	6	0.55	10.4	0.32	0.91	2.56	0.13	0.093	3.61	0.08	0.076	1.08
100	12	0.30	10.4	0.32	1.00	2.56	0.13	0.101	3.61	0.08	0.083	1.18

[a]Rainfall intensity -- U.S. Department of Commerce (1955)

[b]Runoff patterns are shown on Figure D.1-2.

Methodology: Modified rational formula, V = CiA

Where: V = Runoff volume (acre-feet).

C = Runoff coefficient.

i = Total inches of rainfall divided by 12.

A = Drainage area (acres).

Table D.1-3. Water-quality data for Chartiers Creek -- Canonsburg site

Parameter	Water-quality[a] criteria	Canonsburg, 1978[b]		Carnegie, 1978[c]	
		Average (mg/l)	Extreme (mg/l)	Average (mg/l)	Extreme (mg/l)
Fecal coliforms	5/1 through 9/30 -- ≤200/100 ml 10/1 through 4/30 -- ≤2000/100 ml	14,760	20,000	2,300	6,000
Total dissolved solids	Monthly average ≤500 mg/l ≤750 mg/l at all times	696	1,180	853	1,340
Total iron	≤1.5 mg/l	1.38	3.25	6.09	10.0
Dissolved sulfate	≤250 mg/l	299	630	276	405
Dissolved oxygen	≥5.0 mg/l	11.2	7.0 (low)	9.4	9.4
pH	6.0 - 9.0	6.99	8.2	6.95	6.8
Manganese	≤1.0 mg/l	0.6	0.6	3.0	3.0
Alkalinity	≥20 mg/l as $CaCO_3$	136	108 (low)	100	74 (low)
NO_2 and NO_3	≤10 mg/l as nitrogen	2.8	4.0	2.5	4.0

[a]Anonymous (1979).

[b]Pennsylvania Department of Natural Resources, STORET retrieval, Water Quality No. 0916.

[c]Pennsylvania Department of Natural Resources, STORET retrieval, Water Quality No. 0914.

Table D.1-4. Water-quality criteria -- Pennsylvania

Parameter	Symbol	Criteria
Alkalinity	Alk_1	Equal to or greater than 20 mg/l as $CaCO_3$, except where natural conditions are less. Where discharges are to waters with 20 mg/l or less alkalinity, the discharge should not further reduce the alkalinity of the receiving waters.
Ammonia nitrogen	Am_2	Not more than 1.5 mg/l.
Arsenic	As	Not to exceed 0.05 mg/l.
Bacteria	Bac_1	During the swimming season (May 1 through September 30), the fecal-coliform level shall not exceed a geometric mean of 200 per 100 milliliters (ml) based on five consecutive samples, each sample collected on different days. For the remainder of the year, the fecal-coliform level shall not exceed a geometric mean of 2000 per 100 milliliters (ml) based on five consecutive samples collected on different days.
Chromium	Cr	Not to exceed 0.05 mg/l as hexavalent chromium.
Dissolved oxygen	DO_2	Minimum daily average 5.0 mg/l; no value less than 4.0 mg/l.
Dissolved sulfate	SO_4	Not to exceed 250 mg/l.
Iron	Fe	Not to exceed 1.5 mg/l as total iron; not to exceed 0.3 mg/l as dissolved iron.
Lead	Pb	Not to exceed the smaller of 0.05 mg/l or 0.01 mg/l of the 96-hour LC_{50} for representative important species as determined through substantial available literature data or bioassay tests tailored to the ambient quality of the receiving waters.
Manganese	Mn	Not to exceed 1.0 mg/l.
Nickel	Ni	Not to exceed 0.01 mg/l of the 96-hour LC_{50} for representative important species as determined through substantial available literature data or bioassay tests tailored to the ambient quality of the receiving waters.
Nitrite plus nitrate	N	Not to exceed 10 mg/l as nitrogen.
pH	pH_1	Not less than 6.0 and not more than 9.0.
Temperature	$Temp_2$	No rise when ambient temperature is 87°F or above; not more than 5°F rise above the ambient temperature until stream temperature reaches 87°F. Not to be changed by more than 2°F during any one-hour period.
Total dissolved solids	TDS_1	Not more than 500 mg/l as a monthly average value; not more than 750 mg/l at any time.

Source: Anonymous (1979).

Table D.1-5. Sampling of surface runoff entering Chartiers Creek from the Canonsburg site, July 22 and 26, 1979

	Method
Sampling Locations	
Upstream	To determine the water quality of Chartiers Creek upstream of the site, samples of water were taken for both storms at a point roughly 1000 feet downstream from the South Main Street bridge (in Houston).
Downstream	These samples were taken from the creek 50 feet downstream of the Strabane Avenue bridge.
Ditch No. 3	Two grab samples were taken on the night of July 22 from the ditch that runs north of Strabane Avenue between Ward Street and Chartiers Creek, at a point at the intersection of Strabane Avenue and Ward Street. One sample was taken an hour into the storm, and the second sample was taken two hours after the storm.
Ditch No. 4	One grab sample was obtained during the July 26 storm in the drainage ditch about 15 feet from the junction of Chartiers Creek and Strabane Avenue.

Results

The results of the water-quality analysis are presented in Table D.1-6. The samples from ditch No. 3 were combined, analyzed, and found to be high in iron (22.2 mg/l), lead (0.44 mg/l), and arsenic (0.182 mg/l) with respect to water-quality standards. The elevated values of total organic carbon (TOC) downstream of the site in Chartiers Creek appear to be caused by runoff from the site. The increase in concentration of boron from upstream to downstream may be attributed to other offsite-runoff sources. Both iron and sulfates were high in Chartiers Creek during this storm.

The sample from ditch No. 4 was analyzed and again found to be high in iron (8.8 mg/l), lead (0.06 mg/l), and arsenic (0.96 mg/l). Both iron and sulfate concentrations were high in Chartiers Creek during this storm (July 26, 1979).

The estimated annual pollutant load to Chartiers Creek from subbasin 1 was developed from data obtained during the July 22, 1979 storm. During this storm, approximately 0.57 inch of rain fell on the site. The runoff volume from this storm was estimated at 0.14 acre-feet based on a runoff coefficient of 0.29 and drainage area of 10.4 acres. The annual pollutant loads given in the table were based on the following assumptions:

Table D.1-4. Water-quality criteria -- Pennsylvania

Parameter	Symbol	Criteria
Alkalinity	Alk_1	Equal to or greater than 20 mg/l as $CaCO_3$, except where natural conditions are less. Where discharges are to waters with 20 mg/l or less alkalinity, the discharge should not further reduce the alkalinity of the receiving waters.
Ammonia nitrogen	Am_2	Not more than 1.5 mg/l.
Arsenic	As	Not to exceed 0.05 mg/l.
Bacteria	Bac_1	During the swimming season (May 1 through September 30), the fecal-coliform level shall not exceed a geometric mean of 200 per 100 milliliters (ml) based on five consecutive samples, each sample collected on different days. For the remainder of the year, the fecal-coliform level shall not exceed a geometric mean of 2000 per 100 milliliters (ml) based on five consecutive samples collected on different days.
Chromium	Cr	Not to exceed 0.05 mg/l as hexavalent chromium.
Dissolved oxygen	DO_2	Minimum daily average 5.0 mg/l; no value less than 4.0 mg/l.
Dissolved sulfate	SO_4	Not to exceed 250 mg/l.
Iron	Fe	Not to exceed 1.5 mg/l as total iron; not to exceed 0.3 mg/l as dissolved iron.
Lead	Pb	Not to exceed the smaller of 0.05 mg/l or 0.01 mg/l of the 96-hour LC_{50} for representative important species as determined through substantial available literature data or bioassay tests tailored to the ambient quality of the receiving waters.
Manganese	Mn	Not to exceed 1.0 mg/l.
Nickel	Ni	Not to exceed 0.01 mg/l of the 96-hour LC_{50} for representative important species as determined through substantial available literature data or bioassay tests tailored to the ambient quality of the receiving waters.
Nitrite plus nitrate	N	Not to exceed 10 mg/l as nitrogen.
pH	pH_1	Not less than 6.0 and not more than 9.0.
Temperature	$Temp_2$	No rise when ambient temperature is 87°F or above; not more than 5°F rise above the ambient temperature until stream temperature reaches 87°F. Not to be changed by more than 2°F during any one-hour period.
Total dissolved solids	TDS_1	Not more than 500 mg/l as a monthly average value; not more than 750 mg/l at any time.

Source: Anonymous (1979).

Table D.1-5. Sampling of surface runoff entering Chartiers Creek from the Canonsburg site, July 22 and 26, 1979

	Method
Sampling Locations	
Upstream	To determine the water quality of Chartiers Creek upstream of the site, samples of water were taken for both storms at a point roughly 1000 feet downstream from the South Main Street bridge (in Houston).
Downstream	These samples were taken from the creek 50 feet downstream of the Strabane Avenue bridge.
Ditch No. 3	Two grab samples were taken on the night of July 22 from the ditch that runs north of Strabane Avenue between Ward Street and Chartiers Creek, at a point at the intersection of Strabane Avenue and Ward Street. One sample was taken an hour into the storm, and the second sample was taken two hours after the storm.
Ditch No. 4	One grab sample was obtained during the July 26 storm in the drainage ditch about 15 feet from the junction of Chartiers Creek and Strabane Avenue.

Results

The results of the water-quality analysis are presented in Table D.1-6. The samples from ditch No. 3 were combined, analyzed, and found to be high in iron (22.2 mg/l), lead (0.44 mg/l), and arsenic (0.182 mg/l) with respect to water-quality standards. The elevated values of total organic carbon (TOC) downstream of the site in Chartiers Creek appear to be caused by runoff from the site. The increase in concentration of boron from upstream to downstream may be attributed to other offsite-runoff sources. Both iron and sulfates were high in Chartiers Creek during this storm.

The sample from ditch No. 4 was analyzed and again found to be high in iron (8.8 mg/l), lead (0.06 mg/l), and arsenic (0.96 mg/l). Both iron and sulfate concentrations were high in Chartiers Creek during this storm (July 26, 1979).

The estimated annual pollutant load to Chartiers Creek from subbasin 1 was developed from data obtained during the July 22, 1979 storm. During this storm, approximately 0.57 inch of rain fell on the site. The runoff volume from this storm was estimated at 0.14 acre-feet based on a runoff coefficient of 0.29 and drainage area of 10.4 acres. The annual pollutant loads given in the table were based on the following assumptions:

Table D.1-5. Sampling of surface runoff entering Chartiers Creek from the Canonsburg site, July 22 and 26, 1979 (continued)

Method

Results (continued)

1. Pollutant concentrations (Table D.1-6) measured during the July 22 storm are average storm-runoff values.

2. Annual pollutant loads are directly related to precipitation, thus allowing the pollutant loads measured during the July 22 storm to be scaled up to an annual estimate using the annual inches of precipitation (36.9) for the area.

Summary

The site contributes high levels of pollutant loads, particularly iron and sulfate, to Chartiers Creek. However, with the possible exception of total organic carbon, these pollutant loads do not contribute to further degradation of water quality in the creek, because the pollutant loads coming off the site are smaller than those from other industrial sites for the parameters shown in Table D.1-6.

Source: Weston (1979) field data.

Table D.1-6. Results of the Chartiers Creek surface-water sampling program

Parameter	Analysis results (mg/l unless noted): Sampling date -- July 22, 1979: Chartiers Creek -- upstream[b]	Ditch corner of Strabane Ave. and Ward St.	Chartiers Creek -- downstream[c]	Sampling date -- July 26, 1979: Chartiers Creek -- upstream[b]	Ditch -- Strabane Ave. near Chartier Creek	Chartiers Creek -- downstream[c]	State water quality limits (mg/l)[d]	Estimated annual pollutant load[a]: lbs/yr	lbs/acre-in.	Comparable pollutant load[e]
BOD_5	2	5	1	---	2	2	---	126	0.005	0.35
Suspended solids	42	753	15	---	253	39	---	19,000	0.76	2.0
NH_3-N	0.4	<0.14[f]	<0.14	---	0.8	0.8	---	<3.5	<0.00014	---
NO_3-N	6.7	1.5	2.9	---	0.76	2.9	≤10	38	0.0015	---
Silicon	7.3	4.9	7.2	---	10.4	8.6	---	124	0.005	---
Total phosphorus	1.21	0.61	1.08	---	0.96	0.65	---	15	0.0006	0.007
TOC	5	13	12	---	---	6	---	328	0.013	---
Silver	<0.02	<0.02	<0.02	---	<0.02	<0.02	---	<0.5	<0.00002	---
Arsenic	0.018	0.182	0.014	---	0.096	0.015	0.05	4.6	0.00018	---
Selenium	0.045	0.047	0.044	---	0.025	0.049	---	1.2	0.000047	---
Iron	3.21	22.2	1.05	---	8.8	1.51	≤1.5	560	0.022	---
Nickel	<0.02	<0.2	<0.02	---	<0.02	<0.02	≤0.01	<0.5	<0.00002	0.064
Lead	0.02	0.44	0.02	---	0.06	0.02	≤0.05	11	0.00044	0.01
Chromium	<0.02	0.03	<0.02	---	<0.02	<0.02	≤0.05[g]	0.75	0.00003	0.105
Barium	<0.2	<0.2	<0.2	---	<0.2	<0.2	---	<5.0	<0.0002	---
Mercury	<0.2	<0.2	<0.2	---	<0.2	<0.2	---	<5.0	<0.0002	---
Cadmium	<0.02	<0.02	<0.02	---	<0.02	<0.02	---	<0.5	<0.00002	---
Boron	0.12	0.11	0.16	---	0.12	0.15	---	2.8	0.00011	---
Sulfate	335	126	322	---	155	262	250	3,180	0.13	---
Turbidity (JTU)	17.5	860	13	---	400	22	---	---	---	---

[a]In combination with NO_2-N concentrations.

[b]Approximately 4700 feet upstream from the Strabane Avenue bridge.

[c]Approximately 50 feet downstream from the Strabane Avenue bridge.

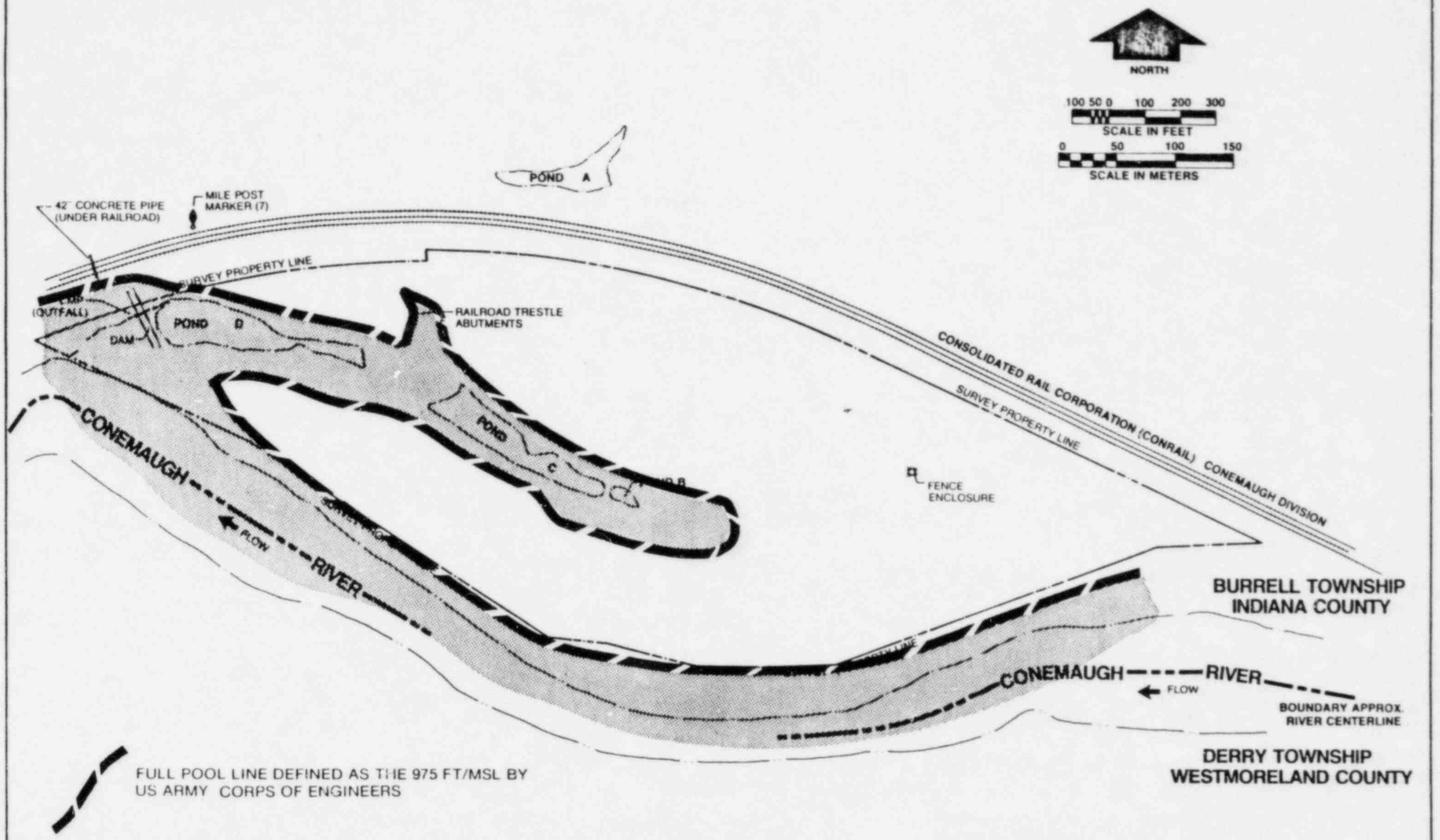
[d]PA DER (1979)

[e]Heartland Industrial Park, Long Island, New York.

[f]< Implies a detection limit; actual concentrations may actually be lower.

[g]Hexavalent chromium only.

Source: Weston (1979) field data.



NOTE 1 PROPERTY LINE DATA FROM PLAN OF PROPERTY FOR UNION CARBIDE CORP. BY RICHARD G. BACH & ASSOC., ZELIENOPLE, PA-DATED 11/16/77

FIGURE
"FULL POOL" BOUNDARY
BURRELL TOWNSHIP SITE

Table D.1-7. Estimated runoff volume (acre-feet) from the Burrell site

Return period (yrs)	Duration (hrs)	Intensity[a] (in./hr)	Subbasins -- Groundwater recharge and discharge ponds[b]			Subbasins -- Direct river discharge			Total runoff volume (acre-ft)
			Area (acres)	Runoff coefficient	Runoff volume (acre-ft)	Area (acres)	Runoff coefficient	Runoff volume (acre-ft)	
2	0.5	1.9	32.6	0.35	0.90	16.4	0.35	0.45	1.35
2	1	1.17	32.6	0.35	1.11	16.4	0.35	0.56	1.67
2	6	0.32	32.6	0.35	1.83	16.4	0.35	0.92	2.75
2	12	0.2	32.6	0.35	2.28	16.4	0.35	1.15	3.43
10	0.5	2.9	32.6	0.35	1.38	16.4	0.35	0.69	2.07
10	1	1.8	32.6	0.35	1.72	16.4	0.35	0.86	2.58
10	6	0.48	32.6	0.35	2.74	16.4	0.35	1.38	4.12
10	12	0.28	32.6	0.35	3.19	16.4	0.35	1.61	4.80
50	0.5	3.7	32.6	0.39	1.96	16.4	0.39	0.99	2.95
50	1	2.35	32.6	0.39	2.49	16.4	0.39	1.25	3.74
50	6	0.63	32.6	0.39	4.00	16.4	0.39	2.01	6.01
50	12	0.37	32.6	0.39	4.70	16.4	0.39	2.36	7.06
100	0.5	4.2	32.6	0.39	2.22	16.4	0.39	1.12	3.34
100	1	2.6	32.6	0.39	2.75	16.4	0.39	1.39	4.14
100	6	0.67	32.6	0.39	4.26	16.4	0.39	2.14	6.40
100	12	0.41	32.6	0.39	5.21	16.4	0.39	2.62	7.83

[a]Rainfall intensity -- U.S. Department of Commerce (1955).

[b]See subsection 4.6.2.2.

Methodology: Modified rational formula, V = CiA

Where: V = Runoff volume (acre-feet).

C = Runoff coefficient.

i = Total inches of rainfall divided by 12.

A = Drainage area (acres).

Table D.1-8. Water-quality data for the Conemaugh River -- Burrell site

Parameter	Water-quality criteria[a]	Water-quality data (mg/l)[b]							
		Seward, 1977		Vandergrift, 1979		Tunnelton, 1970-1979		Josephine, 1977	
		Average	Extreme	Average	Extreme	Average	Extreme	Average	Extreme
Fecal coliforms	5/1 through 9/30 -- 200/100 ml 10/1 through 4/30 -- 2000/100 ml	13,500	25,000	18,000	25,000	---	---	---	---
Suspended solids	---	303	56[illegible]	---	---	---	---	506	1,246
Total iron	≤1.5 mg/l	5.0	9.5	2.9	5.5	5.5	17.7	12.0	21.0
Dissolved sulfate (SO_4)	≤250 mg/l	221	360	144	270	144	144	262	820
Dissolved oxygen	≥5.0 mg/l	10.0	7.5	11.5	10.0	10.0	13.0	9.8	7.0
pH	6.0 - 9.0	4.7	4.2	5.1	4.7	4.6	3.4	4.3	3.3
Manganese	≤1.0 mg/l	1.5	3.2	0.9	1.6	1.6	5.0	1.0	1.8
Total dissolved solids	Monthly -- ≤500 mg/l Per sample -- ≤750 mg/l	257	257	402	322	538	538	---	---
Alkalinity as $CaCO_3$	≥20 mg/l	3.2	0	1.2	0	8	8	0.3	0
Ammonia nitrogen	≤1.5 mg/l	1.02	2.7	0.4	1.0	0.5	0.5	0.52	2.5
Temperature °F	See Table D.1-4	55.1	32/81	46.8	32/66	45	---	48.0	32/81
Location from site downstream		15 miles upstream		30 miles downstream		10 miles downstream		7 miles (on Black Lick Creek)	

[a]Anonymous (1979).

[b]U.S. Geological Survey (1977).

Table D.1-9. Pond surface-water quality -- Burrell site

Pond[a]	pH	Specific conductance (μmhos/cm)	Cl^- (mg/l)	SO_4 (mg/l)	NO_3N (mg/l)	Fe (mg/l)	Pb (mg/l)	Ba (mg/l)	B (mg/l)
Pond A	7.0	1250	19.7	420	ND[b]	ND	ND	0.02	0.76
Pond B	6.9	1200	20.2	290	ND	ND	ND	0.03	0.41
Pond C	5.7	12	22.3	440	0.72	ND	ND	ND	0.07
Standard[c]							0.05	1.0	
EPA	5-9								
PA	6-9			250	10	1.5	0.05		

[a]Pond locations given on Figure 1-5.
[b]ND = None detectable.
[c]See Tables 3-2 and D.1-4.

Source: Weston (1982) field data.

Table D.1-10. Estimated runoff volume (acre-feet) from Hanover site

Return period (yrs)	Duration (hrs)	Intensity[a] (in./hr)	To Harmon Creek: Area (acres)	To Harmon Creek: Runoff coefficient	To Harmon Creek: Runoff volume (acre-ft)	To unnamed tributary: Area (acres)	To unnamed tributary: Runoff coefficient	To unnamed tributary: Runoff volume (acre-ft)	To Ward Run: Area (acres)	To Ward Run: Runoff coefficient	To Ward Run: Runoff volume (acre-ft)	Total runoff volume (acre-ft)
2	0.25	2.5	201	0.35	3.66	90	0.35	1.64	136	0.35	2.48	9.7
2	1	1.1	201	0.35	6.45	90	0.35	2.89	136	0.35	4.36	13.7
2	6	0.3	201	0.35	10.55	90	0.35	4.73	136	0.35	7.14	22.4
2	12	0.2	201	0.35	14.07	90	0.35	6.30	136	0.35	9.52	29.9
10	0.25	3.3	201	0.35	4.84	90	0.35	2.17	136	0.35	3.27	10.3
10	1	1.5	201	0.35	8.79	90	0.35	3.94	136	0.35	5.95	18.7
10	6	0.4	201	0.35	14.07	90	0.35	6.30	136	0.35	9.52	29.9
10	12	0.2	201	0.35	14.07	90	0.35	6.30	136	0.35	9.52	29.9
50	0.25	4.0	201	0.39	6.5	90	0.39	2.92	136	0.39	4.42	13.9
50	1	2.0	201	0.39	13.06	90	0.39	5.85	136	0.39	8.84	27.8
50	6	0.5	201	0.39	19.60	90	0.39	8.78	136	0.39	13.26	41.6
50	12	0.3	201	0.39	23.52	90	0.39	10.53	136	0.39	15.91	50.0
100	0.25	4.5	201	0.39	7.35	90	0.39	3.29	136	0.39	4.97	15.6
100	1	2.2	201	0.39	14.37	90	0.39	6.43	136	0.39	9.72	30.5
100	6	0.6	201	0.39	23.52	90	0.39	10.53	136	0.39	15.91	50.0
100	12	0.3	201	0.39	23.52	90	0.39	10.53	136	0.39	15.91	50.0

[a]Rainfall intensity - U.S. Department of Commerce (1955).

Methodology: Modified rational formula, V = CiA

Where: V = Runoff volume (acre-feet).

C = Runoff coefficient.

i = Total inches of rainfall divided by 12.

A = Drainage area (acres).

Table D.1-11. Results of EPA surface-water analysis -- Hanover site, May 7, 1980

Parameter	Sample location: At chemical seep on the site	Upstream -- unnamed tributary	Downstream -- unnamed tributary
Sample type	Grab	Grab	Grab
Temperature (water), °C	13	14	14
pH	3.2	6.1	6.1
COD (mg/l)	40	15	20
Total arsenic (μg/l)	28	2.6	4
Total cadmium (μg/l)	25	3	5
Total lead (μg/l)	11	38	28
Total mercury (μg/l)	0.4	0.6	0.4
Toxicity	Very toxic	---	---
Volatile organics	Not detectable	Not detectable	Not detectable

Source: Downie and Petrone (1980).

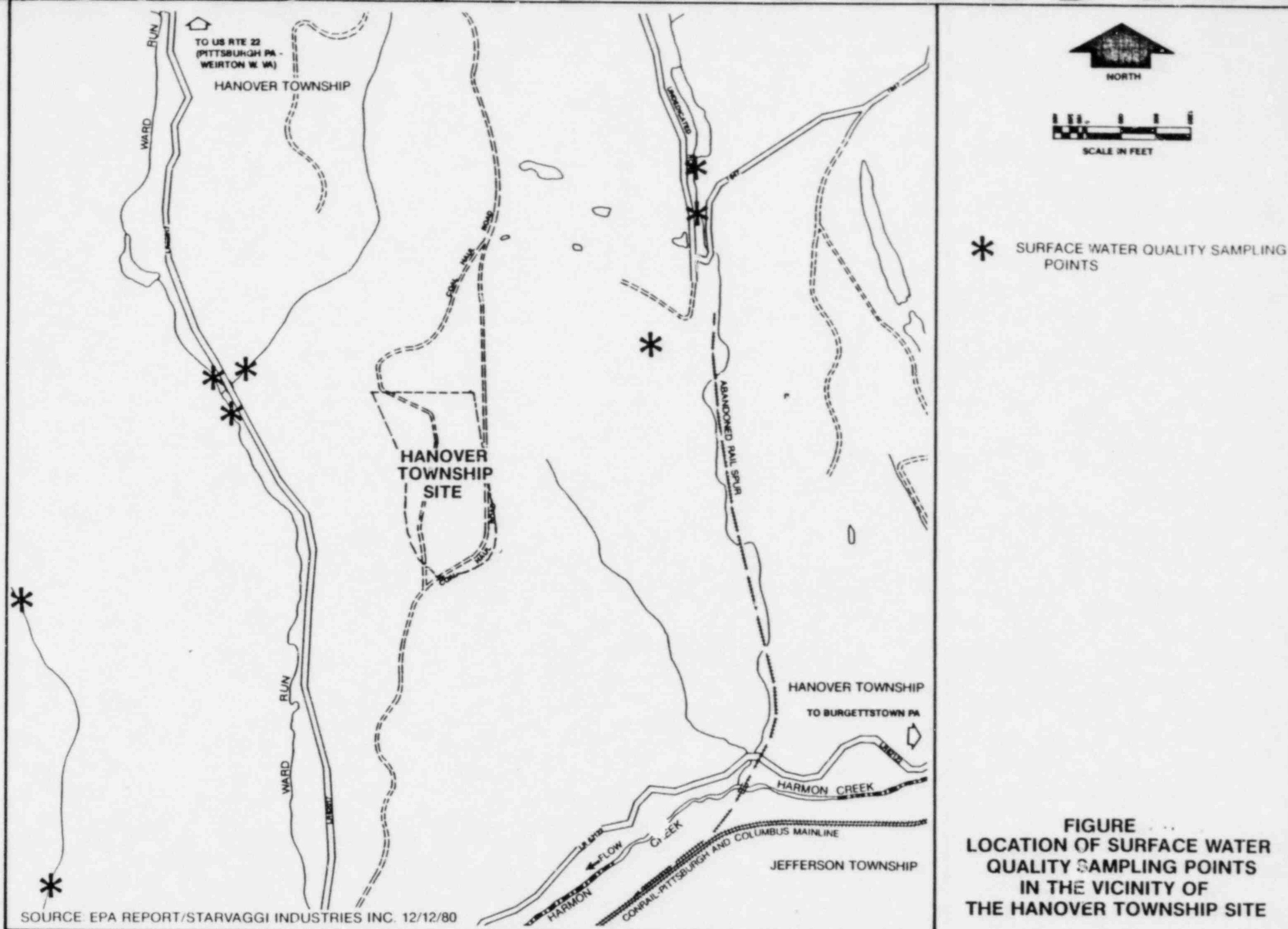


FIGURE
LOCATION OF SURFACE WATER QUALITY SAMPLING POINTS IN THE VICINITY OF THE HANOVER TOWNSHIP SITE

Table D.1-12. Results of surface-water sampling program, Starvaggi Industries landfill, Hanover Township

Sample location[a]	TOC (mg/l)	COD (mg/l)	BOD (mg/l)	Chloride (mg/l)	Oil and grease (mg/l)	Phenol (mg/l)	Cyanide (mg/l)	Alkalinity (mg/l)	pH (SU)	Ammonia (mg/l)
S-1	5	784	4	4	1.7	0.001	0.005	2	5.2	0.15
S-2	3	792	2	23	0.4	0.001	0.004	92	7.9	0.13
S-3	3	878	4	4	0.4	0.002	0.006	34	7.6	0.12
S-4	6	893	2	20	0.4	0.001	0.004	24	7.2	0.125
S-5	8	901	5	104	0.6	0.001	0.008	2	5.0	0.16
S-6	8	945	3	42	0.2	0.004	0.004	10	6.[illegible]	0.11
S-7	7	890	3	9	0.2	0.001	0.004	26	7.0	0.175
S-8	10	941	2	5	0.4	0.001	0.006	56	7.1	0.16
S-9	8	956	2	7	0.8	0.000	0.004	24	6.9	0.14
S-10	7	439	2	814	1.6	0.000	0.003	4	5.0	0.15
S-11	52	461	25	12,922	0.8	0.013	0.003	6	5.2	1.95
S-12	15	358	11	1,436	0.8	0.000	0.005	4	5.1	0.19

Sample location[a]	TSS (mg/l)	Dissolved solids (mg/l)	Zinc (mg/l)	Lead (mg/l)	Nickel (mg/l)	Magnesium (mg/l)	Cadmium (mg/l)	Chromium (mg/l)	Iron (mg/l)	Aluminum (mg/l)
S-1	6	3,187	0.70	0.002	0.63	90	0.01	0.02	0.02	4.4
S-2	0.1	1,363	0.01	0.002	0.04	20	<0.002	0.01	0.20	0.3
S-3	7	1,626	0.02	0.003	0.05	32	0.002	0.01	0.13	0.3
S-4	0.5	1,608	0.04	0.002	0.08	34	0.002	0.01	0.20	0.1
S-5	19	2,518	0.40	0.001	0.34	68	0.006	0.02	2.32	10.0
S-6	13	1,883	0.14	0.001	0.15	44	0.002	0.02	0.76	28.6
S-7	22	1,607	0.36	0.002	0.21	100	0.002	0.01	5.34	3.8
S-8	16	3,087	0.11	0.001	0.22	116	0.002	0.02	6.80	2.4
S-9	7	2,774	0.11	0.002	0.14	102	0.004	0.02	3.52	0.7
S-10	5	3,370	0.15	0.002	0.20	78	0.004	0.02	0.57	5.0
S-11	15	30,171	0.40	0.008	1.50	175	0.052	0.11	7.02	4.6
S-12	47	4,365	0.34	0.002	0.36	84	0.008	0.02	4.62	16.0

[a]Sample locations are shown on Figure D.1-4.

Appendix D.2

GROUND-WATER INFORMATION

Appendix D.2

GROUND-WATER INFORMATION

D.2.1 Description of hydrogeological data collection program

D.2.1.1 Canonsburg site

The collection of hydrogeological data began in the spring of 1979 with the installation of shallow and deep ground-water wells on the Canon Industrial Park site. At this time the following constraints were placed on the data collection program:

1. Wells could not be drilled off the Canon Industrial Park property.

2. Wells could only be drilled on the periphery of Area C because of the suspected high levels of contamination in the area.

3. Pump tests were not permitted because there was no available treatment facility for the ground water that was withdrawn.

In an attempt to obtain data on aquifer characteristics of the site, slug tests were conducted on a number of wells. The slug tests were performed by instantaneously injecting a known volume of water into a well after measuring the well's static water level. The rate at which the water level returned to the static level was determined by measuring the water levels at preselected time intervals. The success of slug tests can be affected by the nature of subsurface materials, and, at Canonsburg, the highly-variable nature of the onsite materials led to widely-varying measurements. Because of this situation, the data from the slug tests were not considered reliable. Therefore, other measurements of the ground-water well levels had to be used in determining the site's aquifer characteristics.

Ground-water elevations in the wells were determined approximately once a month. In addition, one well was fitted with a continuous water-level recorder. These data were reduced and plotted.

Based on the initial data, it appeared that a ground-water high existed in Area A, suggesting that radioactively-contaminated water was flowing into the Georges Pottery property. Permission was requested, and granted, to drill wells on that site. This program, conducted in 1980, confirmed this suspicion.

In 1982 permission was obtained to drill in Area C to further characterize the ground-water regime and to obtain data on radiological contamination in the subsurface materials.

Since 1979, a number of wells on the site have been vandalized or covered, thus preventing further data collection. In April 1982 a round of water-level measurements was taken on all of the remaining wells. The loss of some wells did not appear to affect the validity of these measurements in the Canon Industrial Park since the flow patterns established before the loss of the wells were upheld.

The purpose of the data collection program at the Canonsburg site was to define the levels of contamination and identify the receiving water bodies.

D.2.1.2 Burrell site

The data collection program at the Burrell site began with the installation of four ground-water wells in 1980. These wells were installed to determine the current levels of contamination. From the analysis results, it was determined that additional data were required. Therefore, additional wells were drilled to more completely define the contaminant levels, and define the relationship between ground water in the fill, alluvium and colluvium, and bedrock.

Because the contaminant levels in the ground water at Burrell were negligible, pump tests were conducted on selected wells in unconsolidated material and bedrock. These data, in conjunction with water-level measurements, were used to construct a flow net and develop a ground-water budget for the site.

D.2.1.3 Hanover site

The purpose of hydrogeological data collection at the Hanover site was to provide sufficient baseline data to determine whether it is feasible to use the site as a disposal area, and to project the impacts of using the site.

Wells were constructed in both bedrock and the overlying mine rubble on the upper slopes of the site. A limited amount of aquifer data were collected during pump tests on selected wells. These data were used to determine flow patterns in the site and its immediate vicinity. Samples were collected and analyzed to determine the baseline water quality.

D.2.2 Well-sampling procedure

Selected wells at each of the three sites were sampled for ground-water quality analyses. Samples were obtained from the wells by pumping and bailing.

Before sampling, the static water level in the well was measured using a Soiltest water-level indicator (Model DR-762A). The volume of standing water in the well was calculated. A standard (one-half horsepower) submersible pump was placed in the well, and five times the volume of standing water was removed from the casing. Samples were then obtained from the discharge line of the pump. In cases where the well would not sustain pumping, a hand bailer was used to remove five volumes of water from the casing. The well was allowed to recover and samples were taken with the bailer. Between wells, the pump and bailer were rinsed with deionized water to prevent cross contamination. The sampling was conducted in accordance with Weston's Standard Operating Procedure No. 2.1, as follows:

1. Measure the depth from the top of the casing to the top of the water. Record the depth for future use in the development of the ground-water contour map. All measuring devices used in the well must be thoroughly rinsed with distilled water prior to use.

2. Measure the depth from the top of the casing to the bottom of the well casing (total depth of cased hole) for initial sampling of a new well or use the previously-recorded depth for resampling an established well.

3. Subtract the depth to the top of the water from the depth to the bottom of the casing to determine the height of standing water in the casing.

4. Remove a quantity of water from the well equal to five times the calculated volume of water in the well.

5. If the well goes dry during pumping or bailing, allow the well to recover and again empty the well.

6. Obtain a sample for chemical analysis immediately after pumping or bailing is completed. In case a well is pumped or bailed dry, obtain a ground-water sample as soon as possible while the well is recovering.

7. The sampling bailer or pump should be flushed with distilled water after sampling to prevent cross contamination between sampling wells. Materials incidental to sampling, such as bailer ropes and tubing, must also be flushed with distilled water. Sampling equipment must be protected from the ground surface by clean plastic sheeting. No sampling should be accomplished when windblown particles may contaminate the sample or sampling equipment.

8. All samples for organic chemical analysis should be placed in specially-cleaned amber glass bottles with Teflon-lined lids. Samples for inorganic chemical analysis should be placed in polyethylene bottles. The sample bottle should be partially filled, and the contents should be agitated and discarded. The cap should be rinsed with the water to be sampled. The bottle should be filled to the top and capped securely. The sample bottle should be placed in a temperature-controlled (4°C) chest immediately after sampling and delivered to the laboratory as soon as possible.

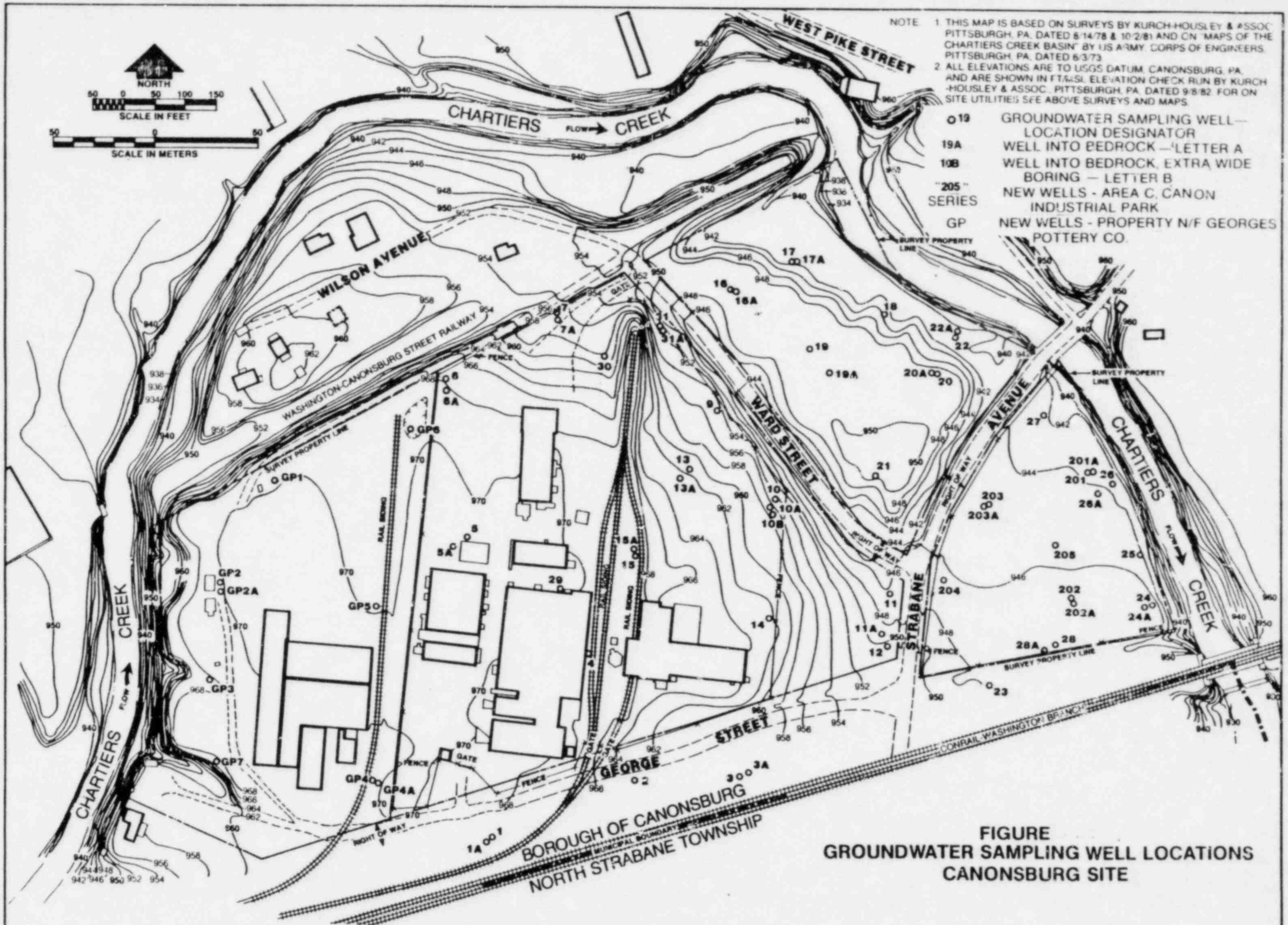


FIGURE
GROUNDWATER SAMPLING WELL LOCATIONS
CANONSBURG SITE

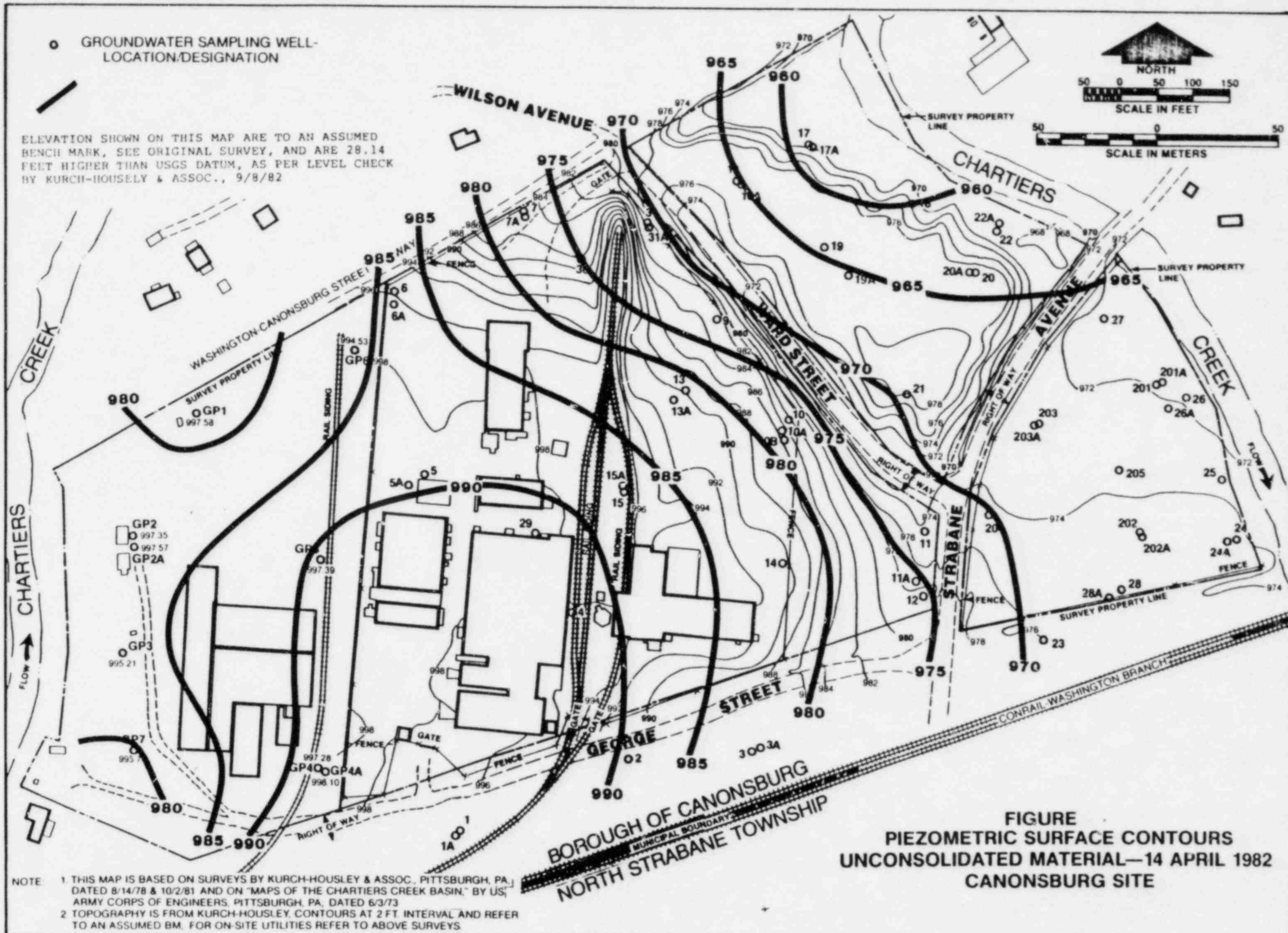


FIGURE
PIEZOMETRIC SURFACE CONTOURS
UNCONSOLIDATED MATERIAL—14 APRIL 1982
CANONSBURG SITE

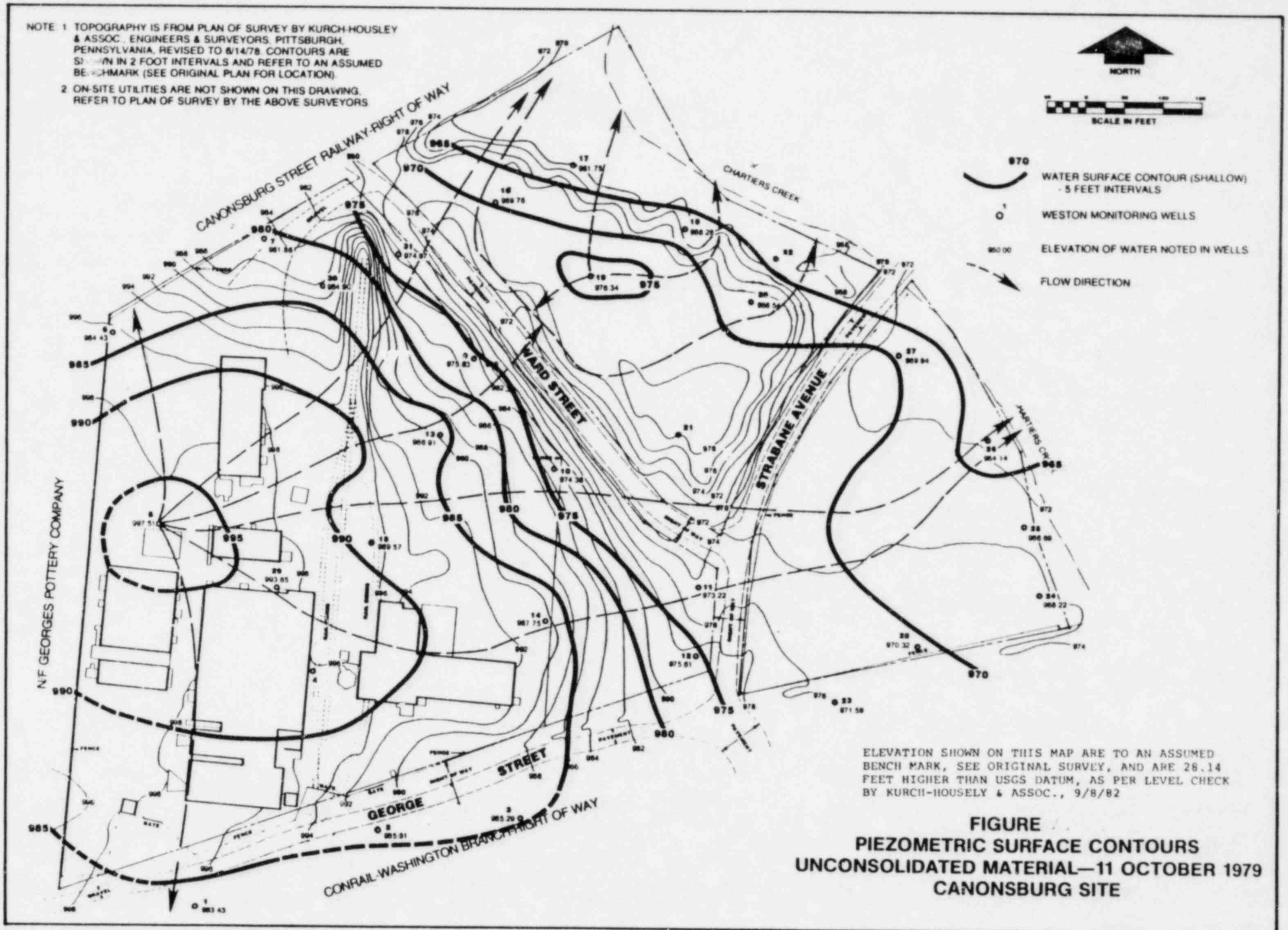


FIGURE
PIEZOMETRIC SURFACE CONTOURS
UNCONSOLIDATED MATERIAL—11 OCTOBER 1979
CANONSBURG SITE

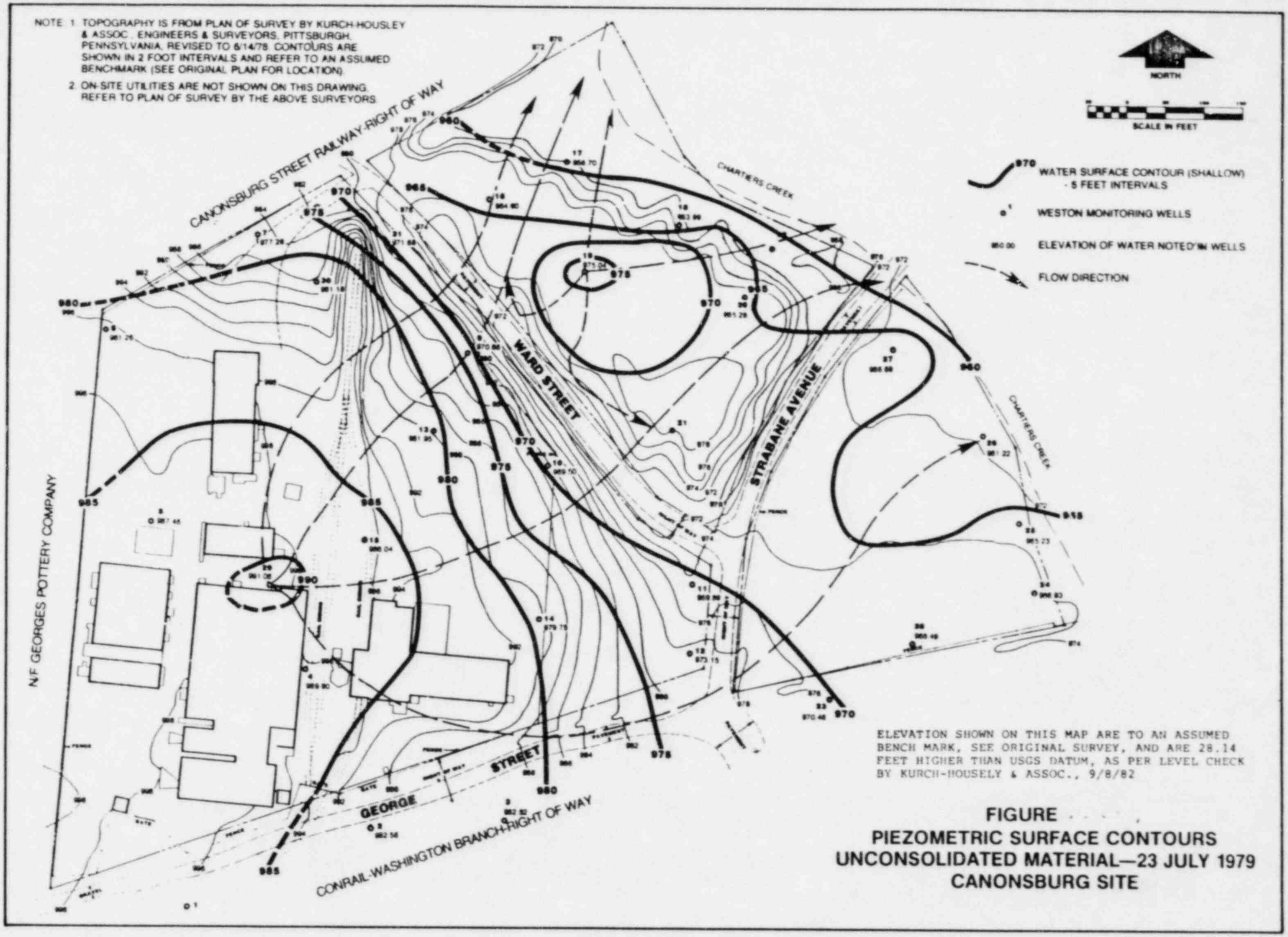


FIGURE
PIEZOMETRIC SURFACE CONTOURS
UNCONSOLIDATED MATERIAL—23 JULY 1979
CANONSBURG SITE

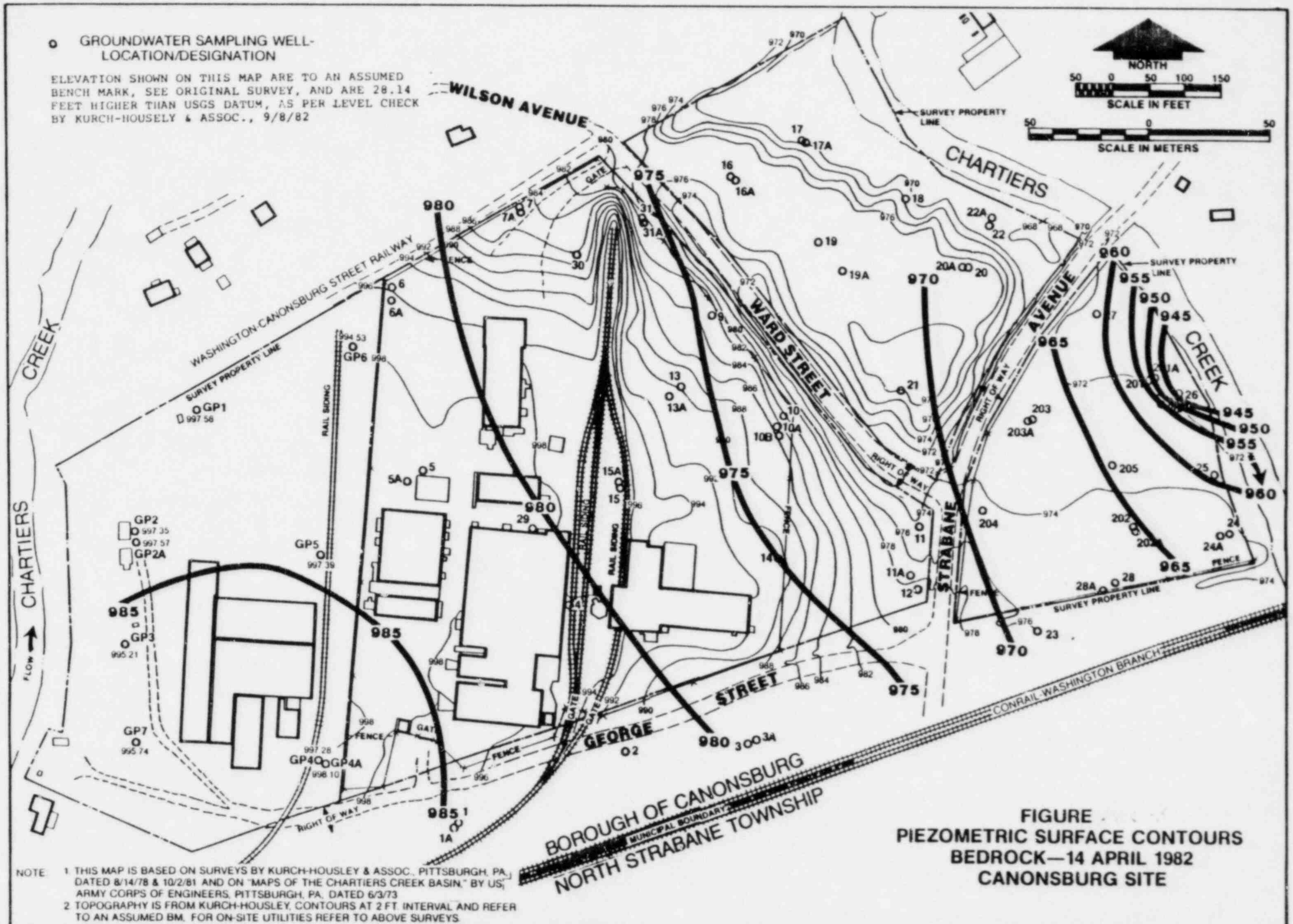


FIGURE
PIEZOMETRIC SURFACE CONTOURS
BEDROCK—14 APRIL 1982
CANONSBURG SITE

NOTE:
1. THIS MAP IS BASED ON SURVEYS BY KURCH-HOUSLEY & ASSOC., PITTSBURGH, PA. DATED 8/14/78 & 10/2/81 AND ON "MAPS OF THE CHARTIERS CREEK BASIN," BY US ARMY CORPS OF ENGINEERS, PITTSBURGH, PA, DATED 6/3/73
2. TOPOGRAPHY IS FROM KURCH-HOUSLEY, CONTOURS AT 2 FT. INTERVAL AND REFER TO AN ASSUMED BM. FOR ON-SITE UTILITIES REFER TO ABOVE SURVEYS.

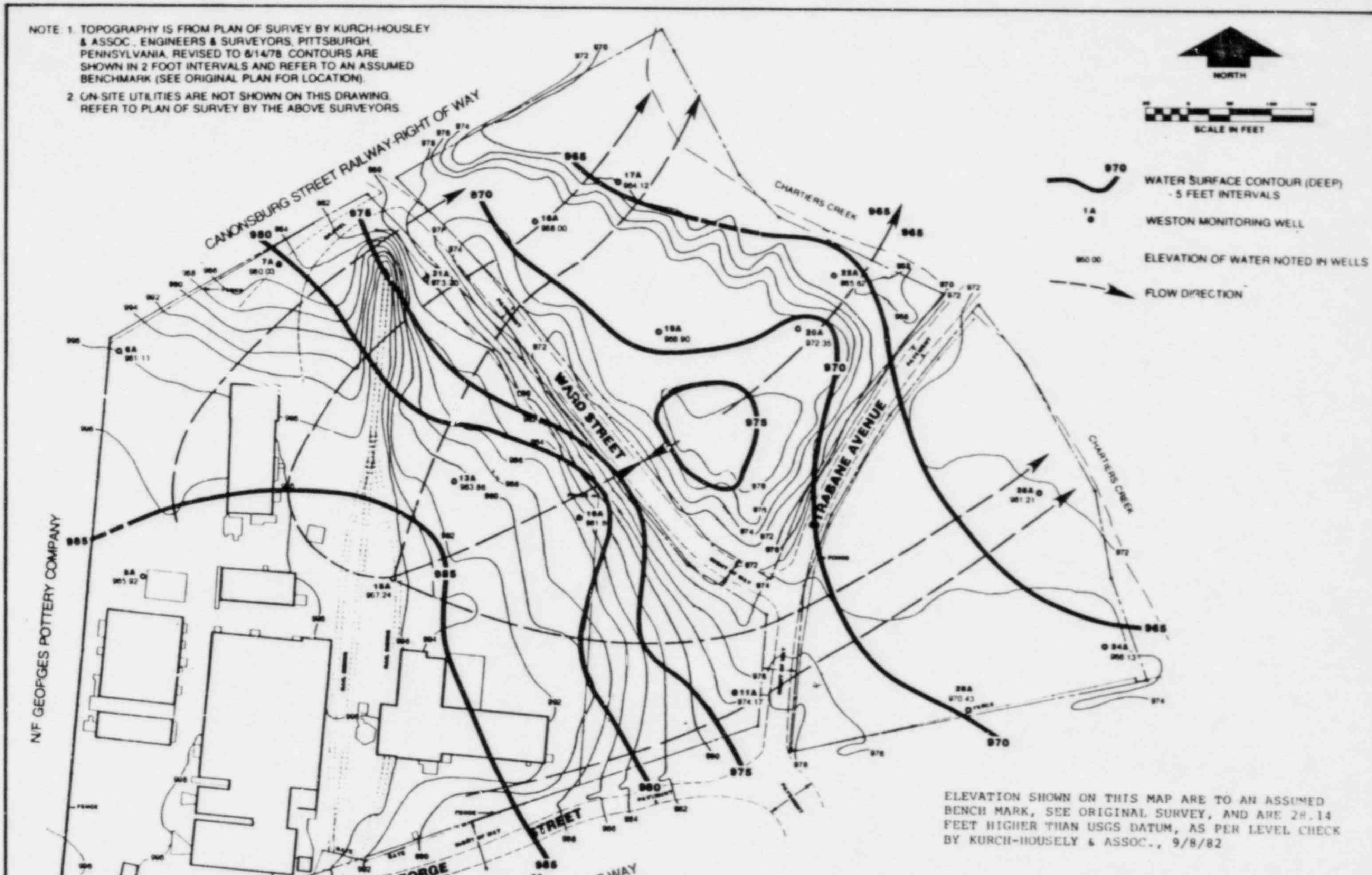
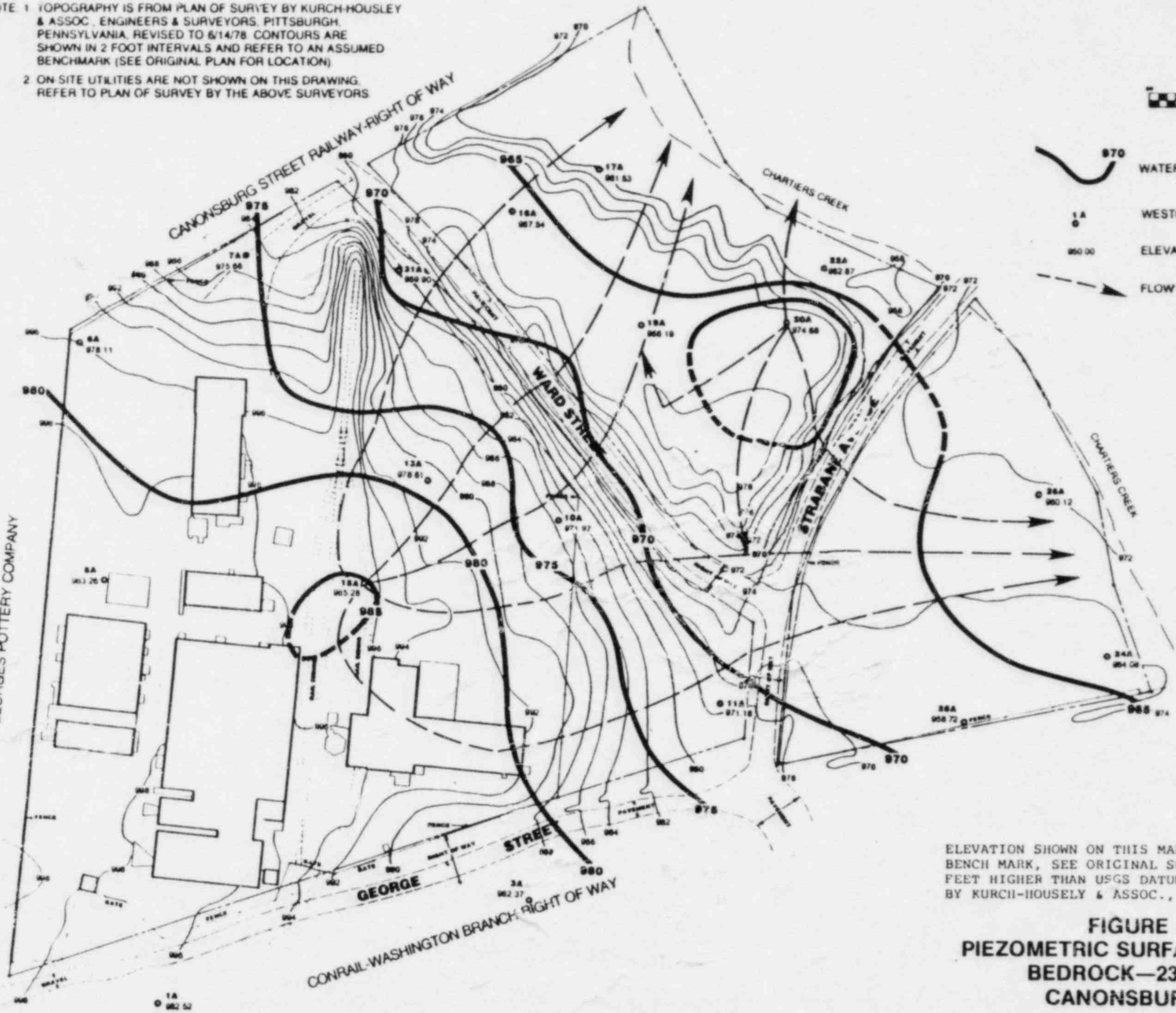


FIGURE
PIEZOMETRIC SURFACE CONTOURS
BEDROCK—11 OCTOBER 1979
CANONSBURG SITE

NOTE 1 TOPOGRAPHY IS FROM PLAN OF SURVEY BY KURCH-HOUSLEY & ASSOC., ENGINEERS & SURVEYORS, PITTSBURGH, PENNSYLVANIA, REVISED TO 6/14/78. CONTOURS ARE SHOWN IN 2 FOOT INTERVALS AND REFER TO AN ASSUMED BENCHMARK (SEE ORIGINAL PLAN FOR LOCATION)

2 ON-SITE UTILITIES ARE NOT SHOWN ON THIS DRAWING. REFER TO PLAN OF SURVEY BY THE ABOVE SURVEYORS



970 WATER SURFACE CONTOUR (DEEP) 5 FEET INTERVALS

1A WESTON MONITORING WELLS

950.00 ELEVATION OF WATER NOTED IN WELLS

FLOW DIRECTION

ELEVATION SHOWN ON THIS MAP ARE TO AN ASSUMED BENCH MARK, SEE ORIGINAL SURVEY, AND ARE 28.14 FEET HIGHER THAN USGS DATUM, AS PER LEVEL CHECK BY KURCH-HOUSELY & ASSOC., 9/8/82

FIGURE
PIEZOMETRIC SURFACE CONTOURS
BEDROCK—23 JULY 1979
CANONSBURG SITE

Table D.2-1. Ground-water quality data -- Canonsburg site

Well[b] number	Number of samples	Arsenic (mg/l)	Boron (mg/l)	Barium (mg/l)	Cadmium (mg/l)	Chloride (mg/l)	Chromium (mg/l)	Iron (mg/l)	Lead (mg/l)	Nickel (mg/l)	Nitrate (mg/l)	pH	Selenium (mg/l)	Silicon (mg/l)	Silver (mg/l)	Sulfate (mg/l)
		Parameter[a]														
1	1	<0.002[c]	0.16	<0.2	<0.02		<0.02	<0.02	<0.02	<0.02	0.02		0.004	9.4	<0.2	256
1A	1	<0.002	0.05	<0.2	<0.02		<0.02	<0.02	<0.02	<0.02	0.07		0.003	9.8	<0.2	162
5	6		0.19					11.0					0.009	12.7		66
5A	8		0.08					4.3					0.008	4.8		282
6	8		0.18					17.0					0.012	7.3		809
6A	8		0.11					2.3					0.010	8.8		522
10	1	<0.02	0.10	<0.2	<0.02		<0.02	<0.02	<0.02	<0.02	1.91		0.003	11.2	<0.2	140
17	8		0.28					1.4					0.016	13.2		845
17A	8		0.005					28.0					0.014	10.9		751
22	8		0.15					61.0					0.011	9.7		305
22A	7							5.9					0.010	8.2		364
24	1	0.043	0.17	<0.2	<0.02		<0.02	0.16	<0.02	<0.02	4.13		0.017	52.5	<0.2	730
24A	1	0.051	0.06	<0.2	<0.02		<0.02	12.9	<0.02	<0.02	0.16		0.086	14.4	<0.2	1940
201	1					14.2		ND	ND		ND	7.5				995
201A	1					493		ND	ND		ND	8.2				306
201A	1					397		ND	ND		ND	8.3				278
202	1					16.3		ND	ND		1.4	6.5				2070
202A	1					214		ND	ND		ND	7.6				555
203	1					48.9		ND	ND		ND	11.5				1010
203A	1					723		ND	ND		ND	7.8				220
204	1					124		ND	ND		ND	7.4				1810
205	1					10.6		ND	ND		ND	7.8				1430
<u>Standard</u>[c]																
EPA		0.05		1.0	0.01	250	0.05		0.05		10.0	5-9	0.01		0.05	250
PA		0.05						1.5	0.05		0.01	6-9				

[a]In mg/l.

[b]Well locations shown on Figure D.2-1.

[c]"<" indicates a detection limit; actual concentrations may be lower.

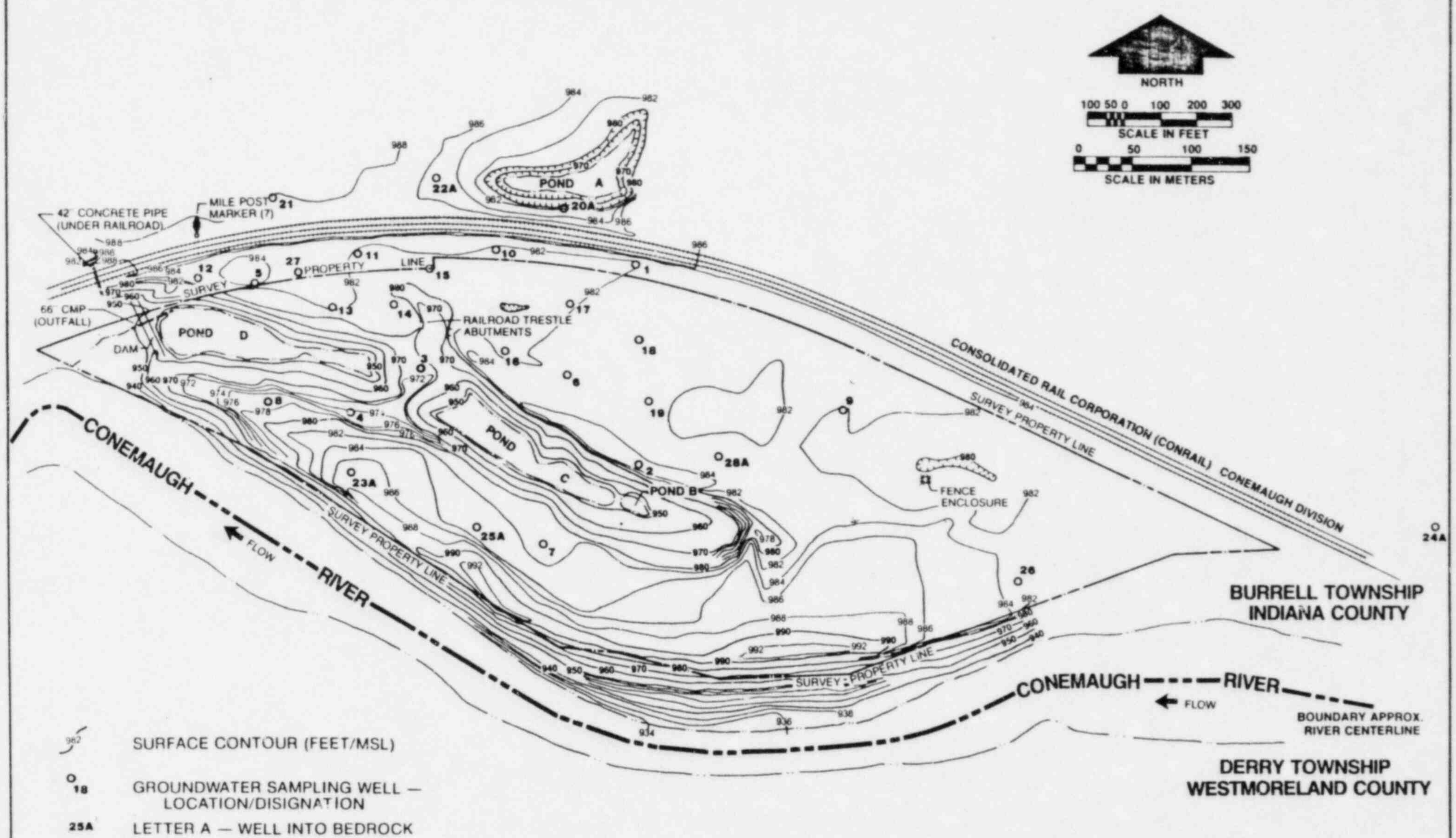
[d]See Tables 2-2 and D.1-4.

Source: Weston (1982) field data.

Table D.2-2. Wells within a 1-mile radius of the Canonsburg site

Address	Use
322 Spruce Street	To water garden
351 Bluff Street	Abandoned
402 Ridge Avenue	Not in use
32 West Pitt Street	Abandoned
154 E. College Street	Never used
15 Latimar Avenue	
302 W. Grant Avenue	Abandoned
109 N. Main Street	
202 W. Grant Street	
115 McNutt Street	
213 Reed street	Not in use
223 W. Pike Street	Used to pump water
126 W. Pike Street	Not in use

Source: Weston (1979) socioeconomic survey.



NOTE
1. PROPERTY LINE DATA FROM PLAN OF PROPERTY FOR UNION CARBIDE CORP. BY RICHARD G. BACH & ASSOC., ZELIENOPLE, PA-DATED 11/16/77
2. TOPOGRAPHICAL DETAIL FROM MAP, TEST HOLE LOCATIONS FOR ROY F. WESTON INC. BY KURCH-HOUSLEY & ASSOC. PITTSBURGH, PA-DATED 11/6/81, REV. 3/2/82
3. ALL ELEVATIONS ARE TO USGS DATUM, BLAIRSVILLE PA. AND ARE SHOWN IN FT/MSL. ELEVATION CHECK RUN BY KURCH-HOUSLEY, PITTSBURGH, PA-DATED 6/11/82

FIGURE
GROUNDWATER SAMPLING WELL LOCATIONS
BURRELL TOWNSHIP SITE

Flow through unit cross-section:

$$q = K\Delta h \frac{N_f}{N_d} \cdot \frac{a}{b}$$

Where:

K = Hydraulic conductivity.

N_f = Number of flow channels.

a/b = Ratio of spacing of equipotential lines (a) to flow lines (b).

Δh = Change in potential (head) between two equipotential lines (b_1-h_2).

n_d = Equipotential units between h_1 and h_2.

Refer to Appendix A.2, Figure 1-6(a).

Δh = Drop in head between W19 and W7.

K = 0.16 ft/min.

n_f = 2.

a/b = 0.1.

$$q = (0.16 \text{ ft/min.})(942.2' - 937.9') \cdot \frac{2}{4.7} (0.1)$$

q = 0.029 ft^3/min.

Total flow across 2000 ft. cross-section Q:

Q = 58 ft^3/min. = 452 gpm.

Refer to Appendix A.2, Figure 1-6(b).

Δh = Drop in head between edge of site and Pond D.

K = 0.16 ft/min.

n_f = 2.

a/b = 0.19.

$$q = K\Delta h \frac{n_f}{n_d} \cdot \frac{a}{b}$$

$$q = (0.16 \text{ ft/min.})(950 - 937) \cdot \frac{2}{9} (0.19)$$

q = 0.089 ft/min.

Total flow across 950 ft. cross-section:

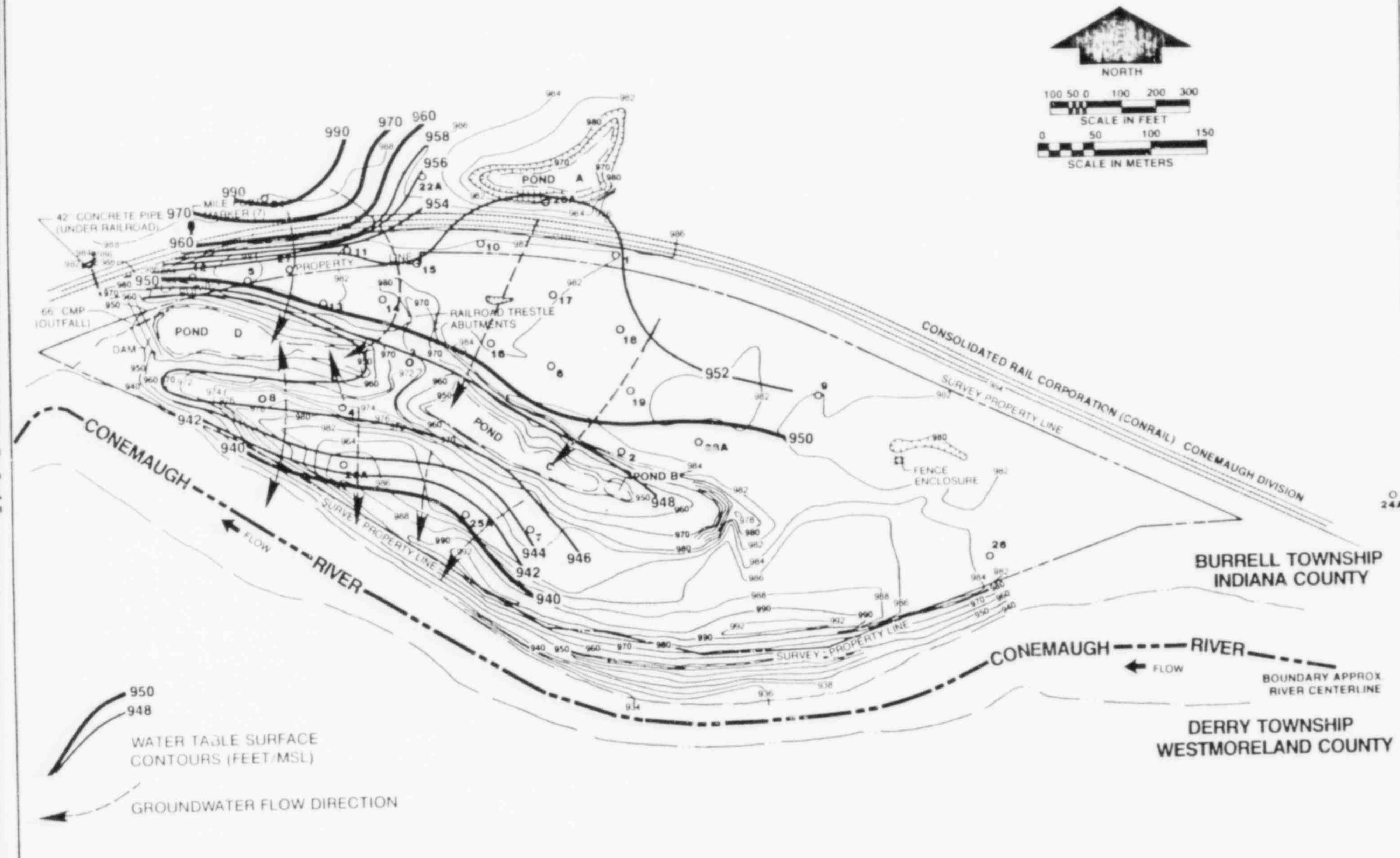
Q = 39.1 ft^3/min. = 305 gpm

Outflow from Pond D = 200 gpm (field estimate).

305
-200
105 gpm -- direct seepage to river

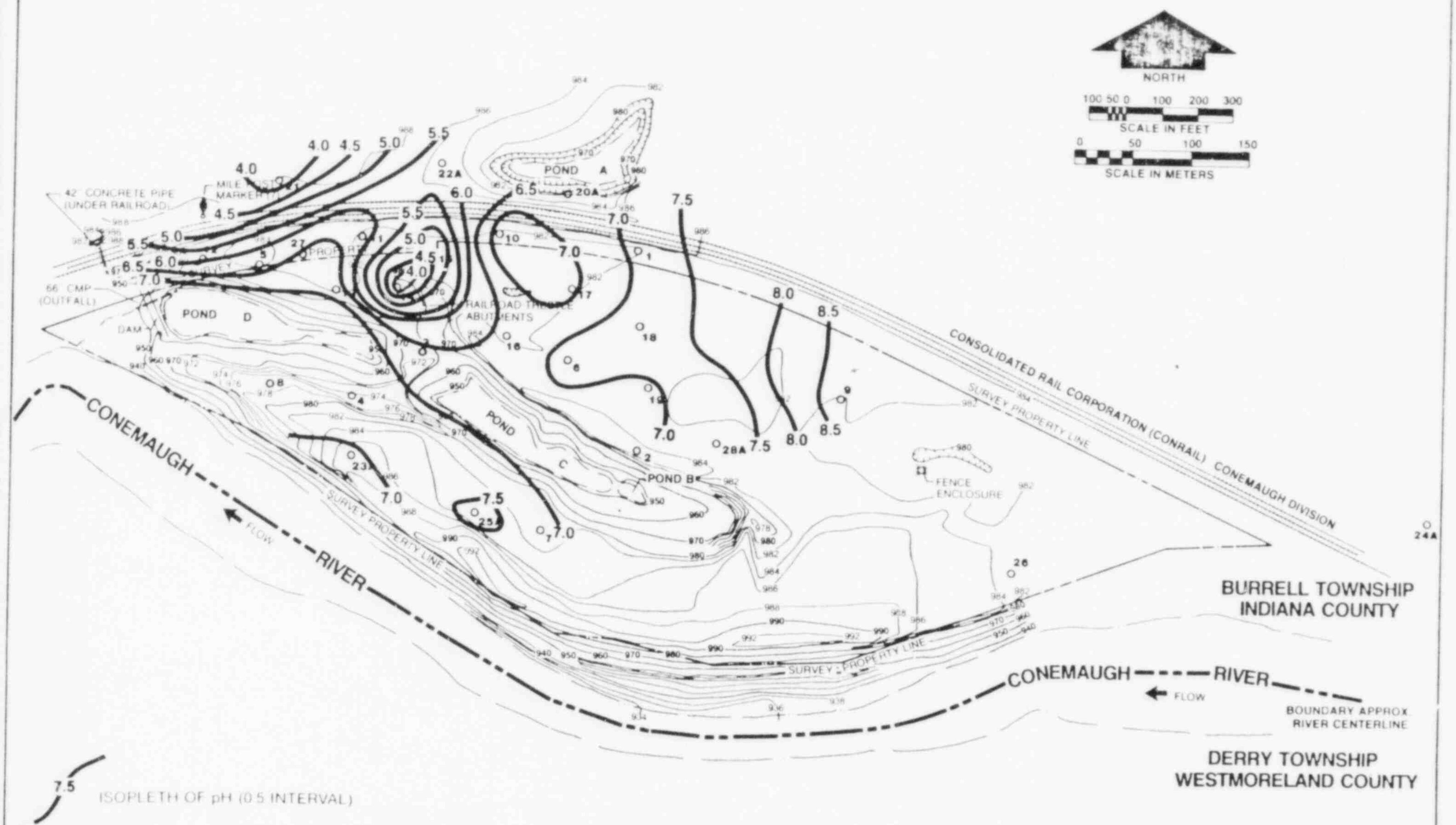
Total direct seepage to river:

452
+105
557 gpm



NOTE
1. PROPERTY LINE DATA FROM PLAN OF PROPERTY FOR UNION CARBIDE CORP. BY RICHARD G. BACH & ASSOC. ZELIENOPLE, PA DATED 11/16/77
2. TOPOGRAPHICAL DETAIL FROM MAP TEST HOLE LOCATIONS FOR ROY F. WESTON INC. BY KURCH-HOUSLEY & ASSOC. PITTSBURGH, PA DATED 12/6/81 REV. 3/2/82
3. ALL ELEVATIONS ARE TO USGS DATUM, BLAIRSVILLE, PA AND ARE SHOWN IN FT/MSL. ELEVATION CHECK RUN BY KURCH-HOUSLEY, PITTSBURGH, PA DATED 6/11/82

FIGURE
WATER TABLE MAP — 19 JANUARY 1982
BURRELL TOWNSHIP SITE



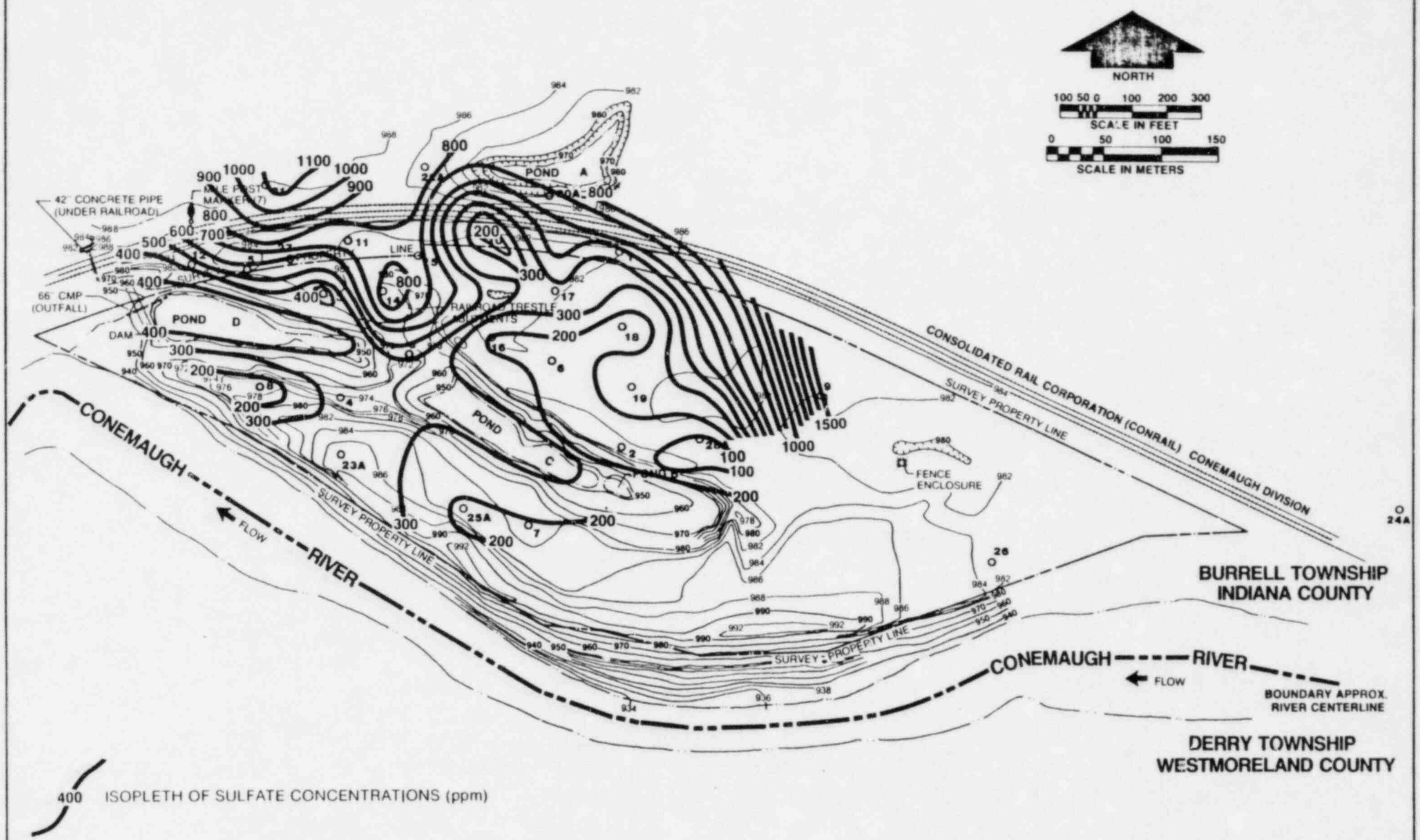
NOTE 1. PROPERTY LINE DATA FROM PLAN OF PROPERTY FOR UNION CARBIDE CORP. BY RICHARD G. BACH & ASSOC. ZELIENOPLE, PA. DATED 11/16/77

2. TOPOGRAPHICAL DETAIL FROM MAP: TEST HOLE LOCATIONS FOR ROY F. WESTON INC. BY KURCH-HOUSLEY & ASSOC. PITTSBURGH, PA. DATED 11/6/81, REV. 3/2/82

3. ALL ELEVATIONS ARE TO USGS DATUM, BLAIRSVILLE PA. AND ARE SHOWN IN FT. MSL. ELEVATION CHECK RUN BY KURCH-HOUSLEY, PITTSBURGH, PA. DATED 6/11/82

FIGURE

ISOPLETH MAP OF GROUNDWATER pH
BURRELL TOWNSHIP SITE



NOTE

1. PROPERTY LINE DATA FROM PLAN OF PROPERTY FOR UNION CARBIDE CORP., BY RICHARD G. BACH & ASSOC., ZELIENOPLE, PA-DATED 11/16/77
2. TOPOGRAPHICAL DETAIL FROM MAP, TEST HOLE LOCATIONS FOR ROY F. WESTON INC. BY KURCH-HOUSLEY & ASSOC. PITTSBURGH, PA-DATED 11/6/81, REV. 3/2/82
3. ALL ELEVATIONS ARE TO USGS DATUM, BLAIRSVILLE PA, AND ARE SHOWN IN FT/MSL. ELEVATION CHECK RUN BY KURCH-HOUSLEY, PITTSBURGH, PA-DATED 6/11/82

FIGURE [illegible]
ISOPLETH MAP OF GROUNDWATER SULFATE CONCENTRATION BURRELL TOWNSHIP SITE

Table D.2-4. Ground-water quality -- Burrell site

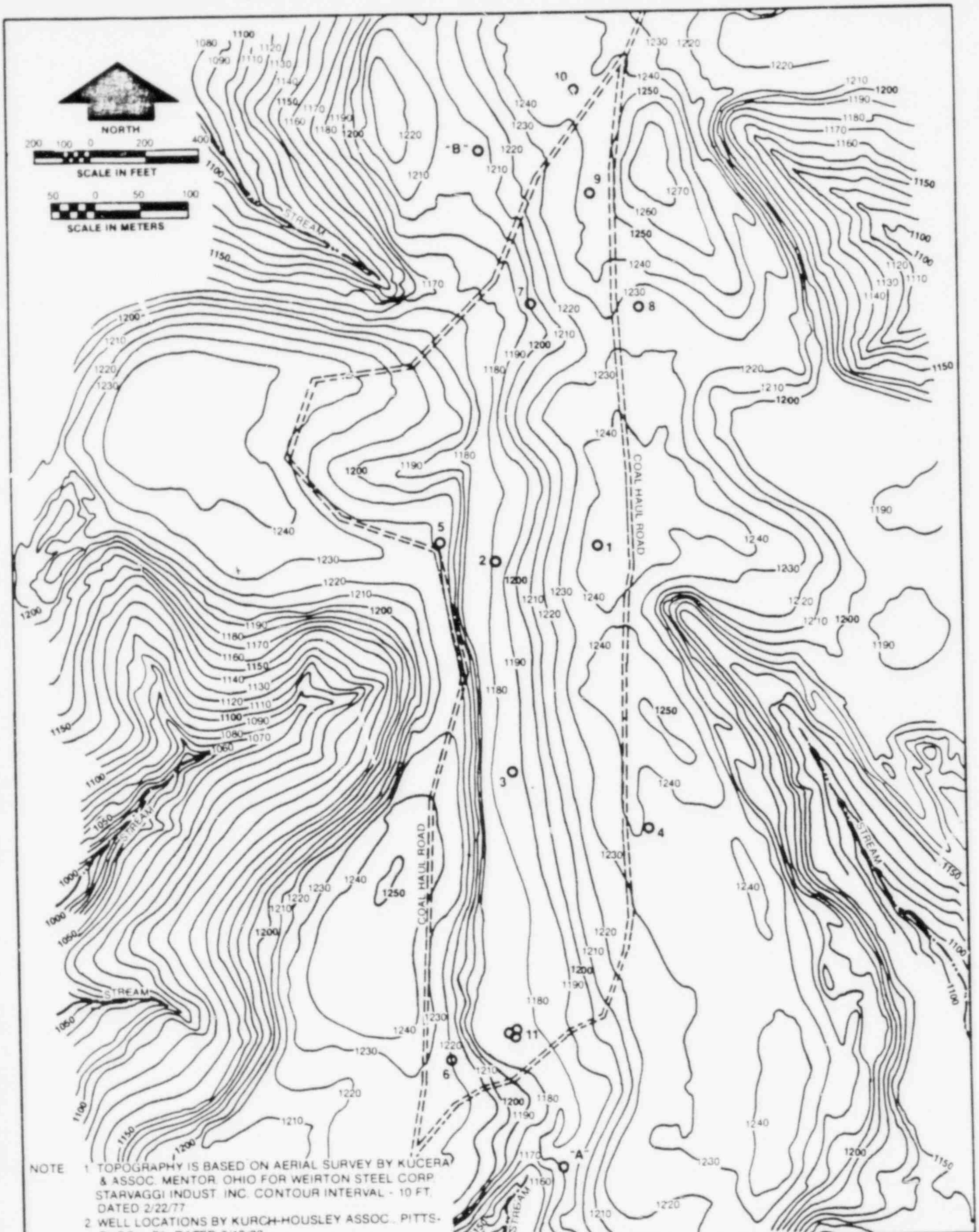
Well[a] number	Date sampled	pH	Specific conductance (mhos/cm)	Chloride (mg/l)	Sulfate (mg/l)	Nitrate (mg/l)	Iron (mg/l)	Lead (mg/l)	Barium (mg/l)	Boron (mg/l)
1	Dry									
2	1-29-82	6.8	1100	29.8	91	NF	0.06	NF	0.07	0.63
3	1-29-82	6.9	1175	14	348	NF	0.22	NF	0.02	0.40
4	Dry									
5	Blocked									
6	2-4-82	7.2	1200	35.2	170	NF	0.10	NF	0.11	0.45
7	1-29-82	7.7	1300	59.8	200	NF	NF	NF	0.10	1.13
8	1-29-82	7.4	900	9.3	131	NF	NF	NF	0.04	0.59
9	1-29-82	8.8	4900	106	1590	6.5	142	NF	0.41	1.70
10	2-4-82	7.3	900	21.2	108	NF	0.07	NF	0.02	0.18
11	1-29-82	7.1	2000	795	NF	NF	NF	NF	NF	0.20
12	1-29-82	5.8	750	8.3	720	0.34	3.84	NF	NF	0.27
13	1-29-82	7.2	1975	24.3	300	NF	NF	NF	0.07	0.24
14	1-29-82	3.5	1825	23.4	880	1.62	50.1	0.52	NF	0.07
15	1-29-82	4.6	1250	17.8	680	0.33	0.40	NF	NF	0.06
16	2-4-82	6.7	1550	16.8	198	NF	0.06	NF	NF	0.22
17	2-4-82	6.8	1100	19.1	380	NF	NF	NF	0.02	0.24
18	2-2-82	7.0	570	9.1	112	0.23	1.62	NF	NF	0.17
19	1-29-82	6.9	1500	15.5	266	NF	0.07	NF	NF	0.94
20	2-4-82	6.6	1300	20.4	665	I	NF	NF	0.03	0.07
21	1-29-82	3.7	---	5.6	891	0.32	0.72	NF	NF	NF
	2-2-82	3.3	1850	8.8	1120	0.73	3.7	NF	NF	0.10
22	2-4-82	5.2	1500	18	845	NF	NF	NF	NF	NF
23	2-2-82	6.9	1425	51.8	390	NF	NF	NF	NF	0.43
24	2-2-82	7.8	325	4.2	34.8	NF	0.49	NF	0.10	0.15
25	2-2-82	7.6	1200	24	169	NF	NF	NF	0.09	0.50
26	2-2-82	7.0	700	18.3	79	NF	0.14	NF	0.03	0.16
27	2-4-82	6.6	---	11	895	NF	13	NF	NF	0.12
28	2-4-82	7.5	350	7.0	9.6	NF	NF	NF	0.72	0.08
Pond A	2-4-82	7.0	1250	19.7	420	NF	NF	NF	0.02	0.76
Pond B	2-4-82	6.9	1200	20.2	290	NF	NF	NF	0.03	0.41
Pond C	2-4-82	5.7	12	22.3	440	0.72	NF	NF	NF	0.07
Standards[b]										
EPA					250			0.05	1.0	
PA		6-9				10	1.5	0.05		

[a]Well locations shown on Figure D.2-8.

[b]See Tables 2-2, and D.1-4.

NF = Not found; I = Interference

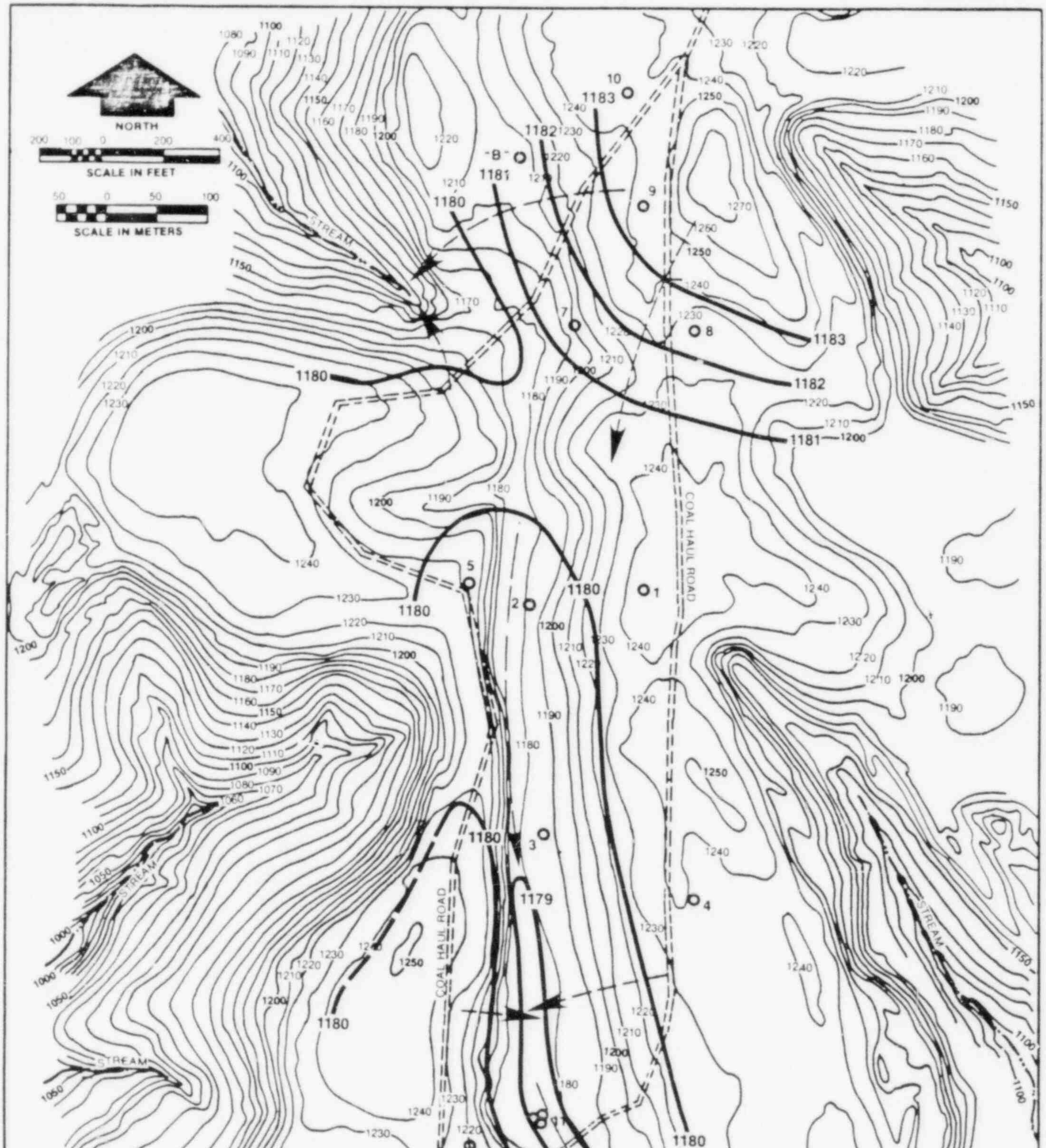
Source: Weston (1982) field data.



NOTE 1. TOPOGRAPHY IS BASED ON AERIAL SURVEY BY KUCERA & ASSOC. MENTOR, OHIO FOR WEIRTON STEEL CORP. STARVAGGI INDUST. INC. CONTOUR INTERVAL - 10 FT. DATED 2/22/77
2. WELL LOCATIONS BY KURCH-HOUSLEY ASSOC., PITTSBURGH, PA. DATED 3/19/82

3 O GROUNDWATER SAMPLING WELL-LOCATION/DESIGNATION

FIGURE
GROUNDWATER SAMPLING WELL LOCATIONS
HANOVER TOWNSHIP SITE



O GROUNDWATER SAMPLING WELL-LOCATION/DESIGNATION

1179 WATERTABLE SURFACE CONTOURS (FT/MSL)

GROUNDWATER FLOW DIRECTION

FIGURE

WATER TABLE MAP—12 MARCH 1982
HANOVER TOWNSHIP SITE

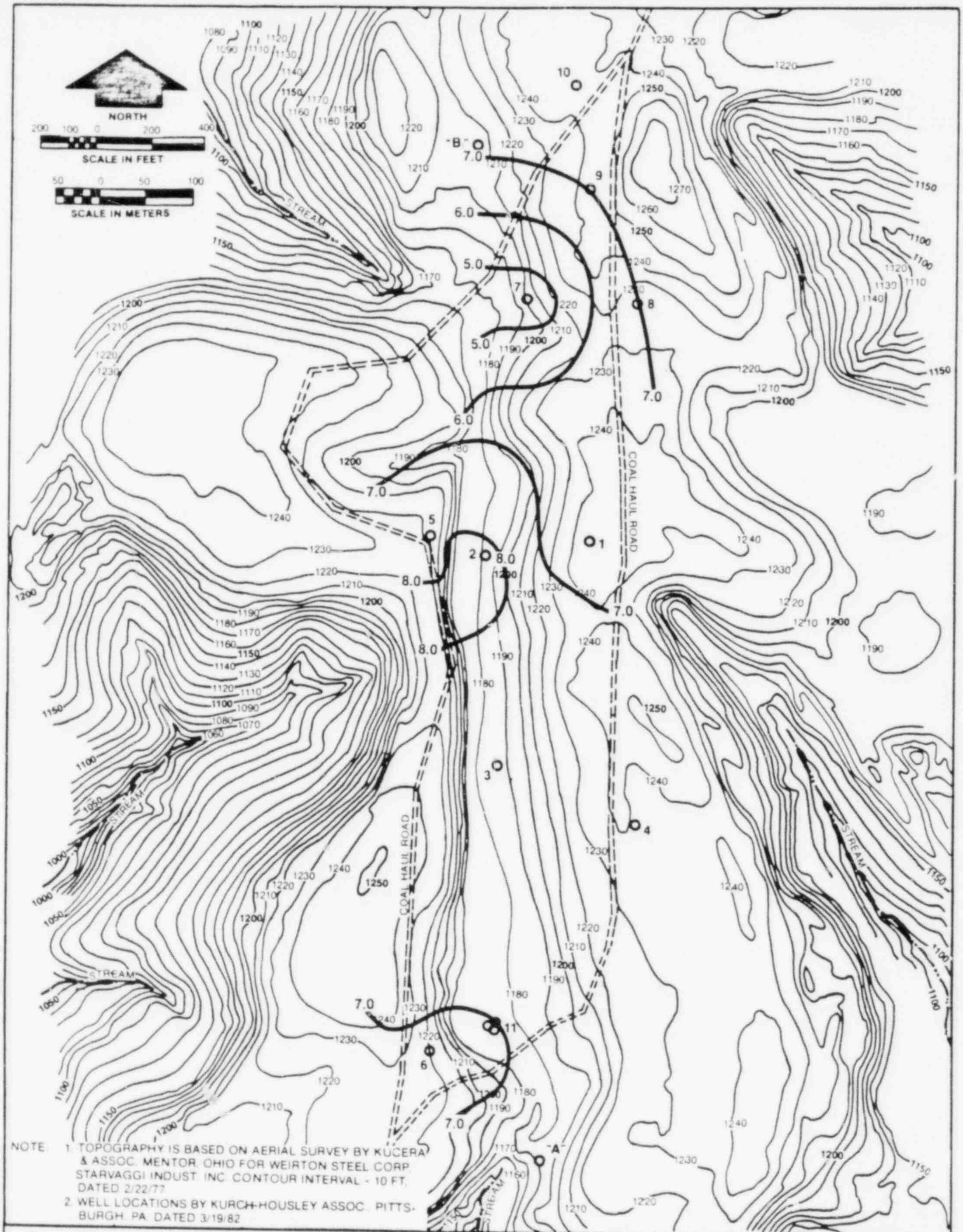
Table D.2-5. Ground-water quality -- Hanover site

Well number[a]	Iron (mg/l)	Lead (mg/l)	Nitrate (mg/l)	Sulfate (mg/l)	Total cyanide (mg/l)	Total organic carbon (mg/l)	Specific conductance (mmhos)	pH	Total dissolved solids (mg/l)
1	ND	ND	0.94	1660	0.03	50.5	3100	6.3	4792
2	ND	ND	0.2	910	0.02	26.0	2200	8.2	1706
5	ND	ND	0.2	1250	0.03	16.0	1500	7.7	2004
6	0.07	ND	3.75	2500	0.03	11.0	2300	6.8	3918
7	0.27	ND	0.33	3030	0.03	6.5	3000	4.4	4884
8	ND	ND	0.2	2840	0.03	22.5	2200	6.9	4724
9	ND	ND	0.2	2240	0.03	16.5	2400	7.0	2874
11	0.14	ND	0.2	2320	0.03	5.5	2300	7.3	3196
"A"	ND	ND	0.64	1910	0.03	5.5	2500	7.3	3196
"B"	0.06	ND	0.2	1860	0.03	6.0	2700	7.0	[illegible]30
Creek	ND	ND	0.21	1550	0.02	1.5	2100	6.3	2690
Standards[b]									
EPA		0.05	10	250					
PA	1.5	0.05	10					6-9	750

ND - Not detectable.

[a]Well locations are shown on Figure D.2-12.
[b]See Tables 2-2 and D.1-4.

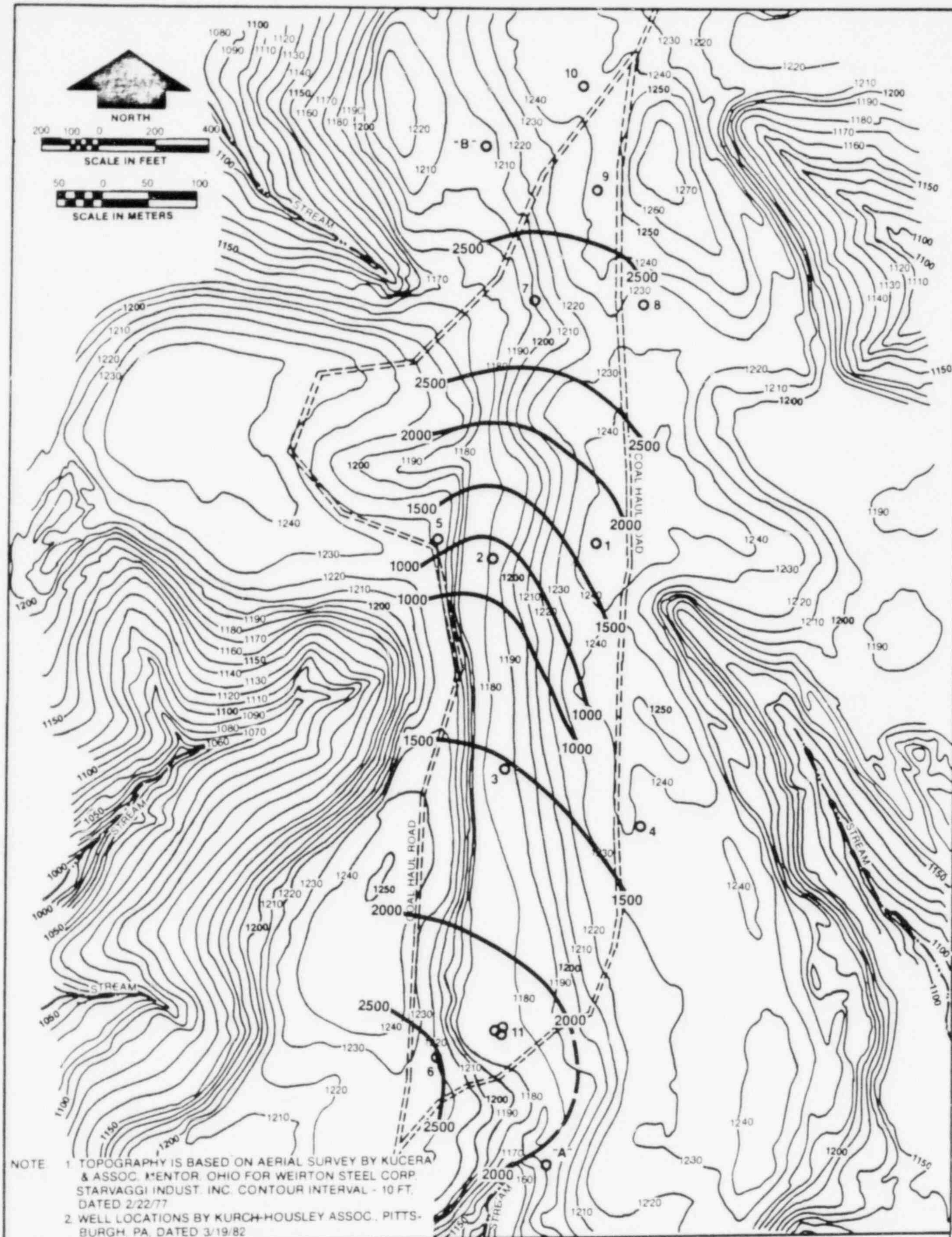
Source: Weston (1982) field data.



○ GROUNDWATER SAMPLING WELL-LOCATION/DESIGNATION

6.0 ISOPLETH OF pH (1 UNIT INTERVAL)

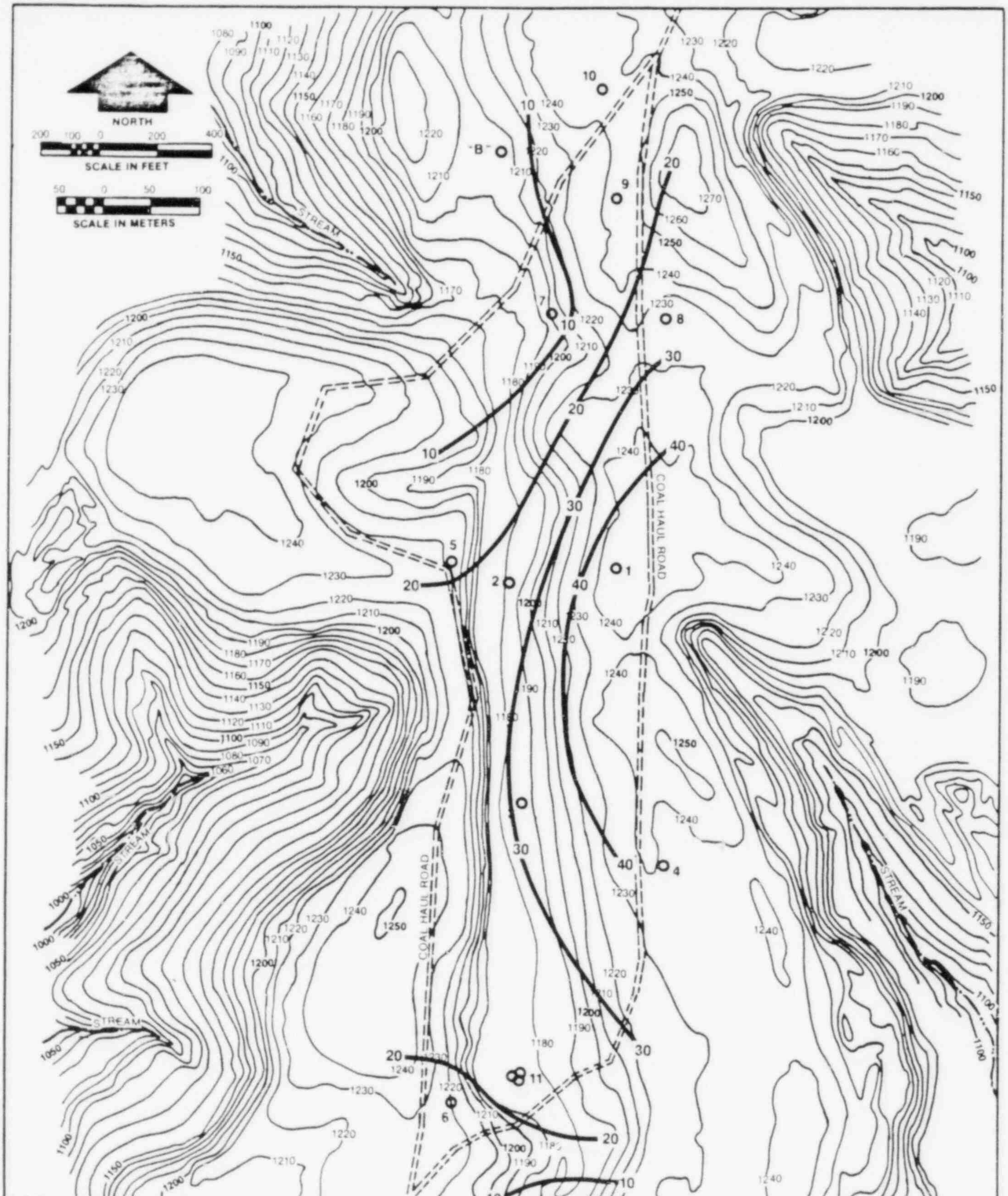
FIGURE
ISOPLETH MAP OF GROUNDWATER pH
HANOVER TOWNSHIP SITE



○ GROUNDWATER SAMPLING WELL-LOCATION/DESIGNATION

1500 ISOPLETH OF SULFATE CONCENTRATIONS (ppm)

FIGURE
ISOPLETH MAP OF GROUNDWATER SULPHATE CONCENTRATIONS HANOVER TOWNSHIP SITE



NOTE: 1. TOPOGRAPHY IS BASED ON AERIAL SURVEY BY KUCERA & ASSOC. MENTOR, OHIO FOR WEIRTON STEEL CORP, STARVAGGI INDUST. INC. CONTOUR INTERVAL - 10 FT, DATED 2/22/77

2. WELL LOCATIONS BY KURCH-HOUSLEY ASSOC., PITTSBURGH, PA. DATED 3/19/82

O GROUNDWATER SAMPLING WELL-LOCATION/DESIGNATION

30 ISOPLETH OF TOTAL ORGANIC CARBON CONCENTRATIONS (mg/l)

FIGURE
ISOPLETH MAP OF GROUNDWATER TOTAL ORGANIC CARBON CONCENTRATIONS HANOVER TOWNSHIP SITE

REFERENCES FOR APPENDIX D

Anonymous, 1979. "Water Quality Criteria for Pennsylvania," Pennsylvania Bulletin, 9(36), Section 93.7(e), September 8, 1979.

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Appendix E

BIOLOGICAL INFORMATION

Appendix E.1

TERRESTRIAL ECOLOGY SURVEYS

Appendix E.1

TERRESTRIAL ECOLOGY SURVEYS

E.1.1 Overview

The purpose of the terrestrial ecology surveys conducted at the Canonsburg, Burrell, and Hanover sites was to perform qualitative observations for use in developing a general description of their ecological resources. Observations were to be made for the following reasons:

1. To determine the site habitats and their associated wildlife.

2. To identify any unique ecological features of the site (as a whole, or in part) with respect to the surrounding area.

3. To provide input to determining the need for further quantitative ecological studies.

Because of its small size, the entire 18.5-acre Canon Industrial Park was traversed during the site survey. The Burrell and Hanover sites, being larger (about 50 acres each), were surveyed by selecting key areas and representative zones for study.

An overview of the Burrell site and its surrounding area was made from a chartered airplane on February 11, 1980. This reconnaissance provided an overall comparison between the site and its surroundings. It was also used to delineate major vegetation zones on the Burrell site, and to choose areas for ground-level investigation. The 1980 ground survey was performed by walking through representative transects of the site. A segment of the river bank and the complete pond perimeters were also traversed.

The Hanover site is an open property lacking the variation in features of the other sites. Therefore, the ecological survey was based on a walk-through of random sectors.

These surveys concentrated on the following activities:

1. Identifying tree species.

2. Identifying the major herbaceous and brush species.

3. Estimating the vegetative zones over the site--their relative size and location.

4. Identifying any unique or unusual vegetation with respect to the general area.

5. Determining the habitat types on the site and identifying the animals associated with them.

All of the major vegetation types encountered during the walk-throughs were identified in the field, and their relative abundance and location were noted. (Numerous photographs were also taken to document site conditions.) In addition, physical conditions were noted which might affect the site's ecology.

Wildlife information was also obtained through careful site observation. The major impetus was placed on noting the indirect signs of habitation (e.g., tracks, droppings, burrows, nests, trails, runways, etc.). During the checks of the Canonsburg and Burrell sites, key areas were traversed to verify the earlier observations and note any changes.

E.1.2 Observations

E.1.2.1 Canonsburg site

Mature woodland trees line the bank of Chartiers Creek along Areas B and C and occur in the area between the rail line and George Street. These strip woodlands consist mainly of elm, box elder, cherry, hickory, and occasional willows. Common colonizing or early successional tree species such as quaking aspen, black locust, sumac, and cherry are found along the edge of these woodlands and along fences, with scattered individuals within the site.

Grasses and mosses are the dominant ground covers in Areas A, B, and C. Within the fenced section of Area A, broomsedge sparsely covers the tile field (to the north of Building 18), and another thick bunch grass is found along the fence. Outside the fence is a mowed lawn of crabgrass and native fescue.

The flat central potion of Area B (the dredge fill) is sparsely covered with various tall grasses and dense patches of clover, while its slopes are thickly covered with bunchgrass. (Bulrush also occurs in water lenses on top of the dredge fill area and seeps on the side slopes.) Runoff ditches along the roadways (mainly along the perimeters of Areas A and B) are choked with cattail and bulrush, where water stands and sediment from the building area is accumulating.

The ballfield, Area C, has a sparse cover of grasses, asters, and goldenrod. The availability of soil moisture appears to be very low in the foot-deep surface layer of red dog which covers the entire ballfield. An examination of soil test pits in the area indicate that grass roots do not penetrate this red-dog layer. Premature wilting and burning was observed throughout the field, particularly in the old "infield" in early summer (presumably from a moisture deficit). A pervasive layer of mosses may provide the major moisture retention in this area.

Although the ballfield (in Area C) has been inactive for some time, striking patterns remain in the ground cover. Round bare areas of red dog occur in the infield and a distinct area of short grasses extends from the fence gate opening into the field and curves toward left field. A bare strip of red dog nearly devoid of vegetation extends from home plate along the third base line into left field. This strip, from 3 to 8 feet wide, has radioactivity levels consistently above background, with one of the highest surface levels of activity within the study area (>15,000 cps) occurring on third base. The vegetation patterns may well be a result of various species' success on variable depths and consistencies of the red-dog fill. These patterns may also be remnants of fill placement, research investigations, or ballfield maintenance activities. (A map of the site's vegetation zones is shown on Figure E.1-1. Table E.1-1 gives a listing of the plant species growing on the site.)

Although all three site areas have relatively sparse vegetative cover because of poor growth on cinders, dredge spoils, and red dog, each area is ringed by a less-disturbed fringe area of good vegetative cover along fence lines, ditches, and spoil area slopes. Overall these areas provide suitable habitat for significant small mammal populations. Runways were observed in all areas, particularly along fringe sectors. Kestrels were observed successfully hunting in all three areas.

More heavily vegetated fringe or edge areas surrounding the field areas provide habitat for rabbits and groundhogs whose burrows were only observed along the relatively undisturbed slopes of the creek, the intermittent stream (B4), and the fence line of Area A. Rabbit trails and feeding areas were common throughout all areas.

Edge areas and woodlands provide suitable habitat for a variety of passerine birds. In addition to kestrels already mentioned, screech owls and redtail hawks probably hunt in the site area at times. A few old trees along the creek may even be used for nesting, as well as for raccoon and squirrel dens.

According to the local game warden, muskrats are commonly associated with Chartiers Creek and its tributaries. Migrating waterfowl utilize Chartiers Creek to a minor extent during spring and fall. Mallards and wood ducks were observed on the creek immediately upstream of the site in the fall. Green herons were occasionally observed along the creek in the area, and it is likely that great blue herons also use the creek near the site.

A general list of wildlife common to the Canonsburg site region is given in Table E.1-2.

All areas of natural vegetation have some value as wildlife habitat. Chartiers Creek and its riparian woodlands have the greatest value for wildlife of the site's habitats, mainly due to their unique nature in an urban setting. Although every small habitat area which contributes to the support of wildlife has some value, perhaps the greatest value of site habitats may be seen in their use as undeveloped or potential urban parkland. If the well-worn trails along the creek and through field areas are any indication, the area is heavily visited by local residents. However, no organized hunting or other recreational activity is known to occur in or near the site area.

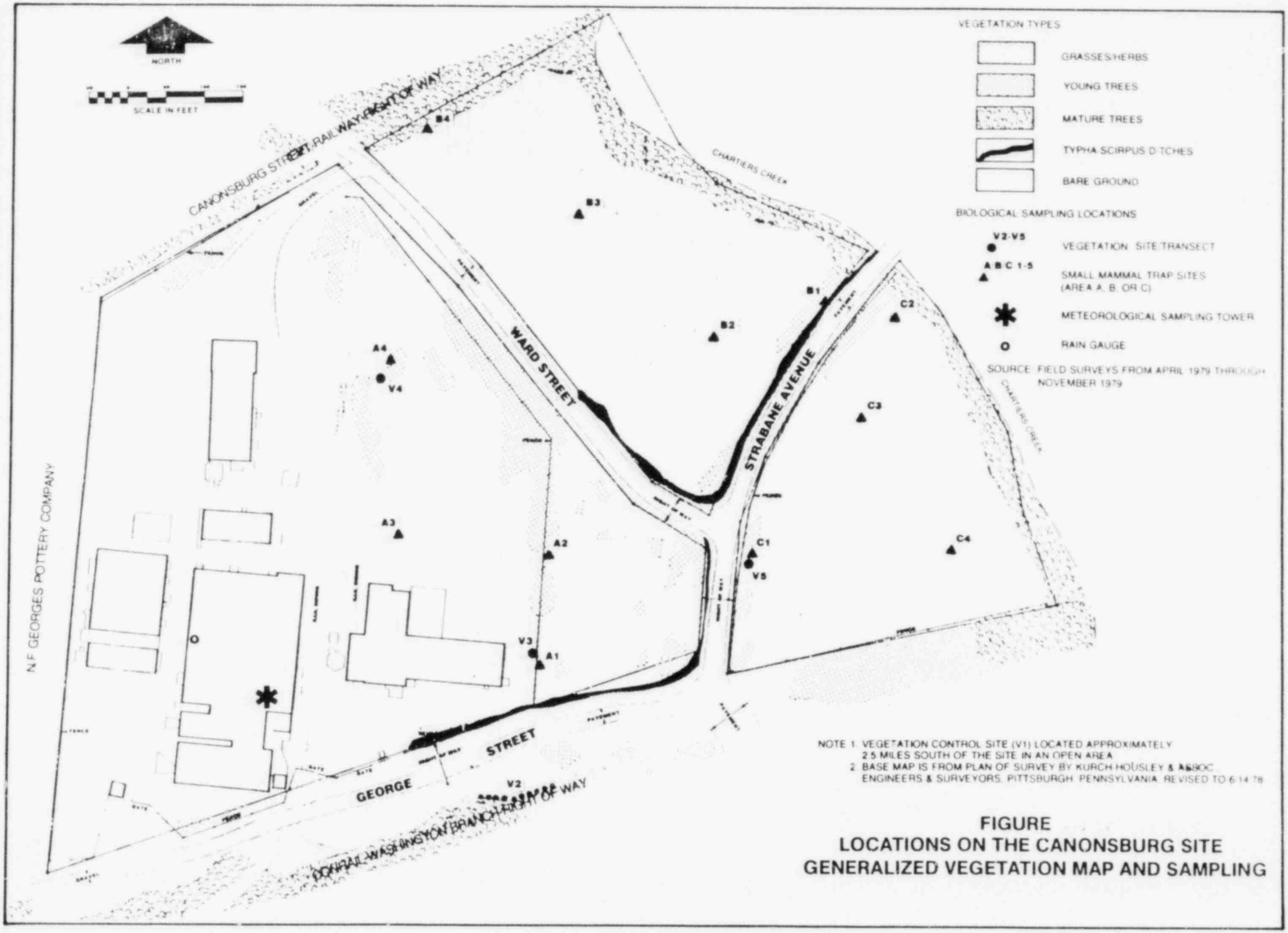


FIGURE
LOCATIONS ON THE CANONSBURG SITE
GENERALIZED VEGETATION MAP AND SAMPLING

Table E.1-1. Plants of the three project sites

Scientific Name	Common name
Canonsburg	
Almus americana	American elm
Prunus sp	Cherry
Acer negundo	Box elder
Carya sp	Hickory
Salix sp	Willow
Populus tremuloides	Quaking aspen
Robina pseudoacacia	Black locust
Rhus sp	Sumac
Typha latifolia	Cattail
Scirpus validus	Bulrush
Andropogon virginicus	Broomsedge
Trifolium sp	Clover
Aster sp	Aster
Solidago sp	Goldenrod
Dipsacus sylvestris	Teasel
	Grasses
Burrell	
Platanus occidentalis	Sycamore
Populus tremuloides	Quaking aspen
Betula sp	Birches
Robina pseudoacacia	Black locust
Crataegus	Hawthorne
Quercus sp	Oaks
Carya sp	Hickory
Rhus sp	Sumac
Dipsacus sylvestris	Teasel
Arctium minus	Burdock
Verbascum thapsus	Common mullein
Phragmites communis	Reed grass
Daucus carota	Queen Anne's lace
	Grasses
Hanover	
Trifolium sp	Clover
	Grasses
	(Near the site proper)
Quercus sp	Oaks
Coniferae	Conifers
Populus sp	Aspen
Carya sp	Hickory
Acer sp	Maple
Rhus sp	Sumac
Betula sp	Birch

Table E.1-2. Wildlife common to the region of the three sites

Scientific Name	Common name
Mammals	
Didelphis marsupialis	Opossum
Blarina brevicauda	Shorttail shrew
Scalopus aquaticus	Eastern mole
Peromyscus leucopus	White-footed mouse
Microtus Pennsylvanicus	Meadow vole
Procyon lotor	Raccoon
Mustela rixosa	Least weasel
Mustela frenata	Longtail weasel
Mustela vison	Mink
Mephitis mephitis	Striped skunk
Vulpes fulva	Red fox
Urocyon cinereoargenteus	Gray fox
Marmota monax	Woodchuck
Tamias striatus	Chipmunk
Sciurus carolinensis	Eastern gray squirrel
Sciurus niger	Eastern fox squirrel
Ondatra zibethica	Muskrat
Sylvilagus floridanus	Eastern cottontail
Odocoileus virginianus	Whitetail deer
Waterfowl	
Gavia immer	Common loon
Podilymbus podiceps	Pied-billed grebe
Olor columbianus	Whistling swan
Branta canadensis	Canada goose
Anas platyrhynchos	Mallard
Aix sponsa	Wood duck
Lophodytes cucullatus	Hooded merganser
Ardea herodias	Great blue heron
Butorides striatus	Green heron
Raptors	
Accipiter gentilis	Goshawk
Accipiter cooperii	Cooper's hawk
Buteo jamaicensis	Red-tailed hawk
Falco sparverius	American kestrel
Otus asio	Screech owl
Bubo virginianus	Great horned owl
Tyto alba	Barn owl

E.1.2.2 Burrell site

From the air the Burrell site appeared to be a flat, grassy plateau with a thin fringe of intermediate-sized trees along its perimeters. The river bend containing the Burrell site resembled the other river bends in the area, and was distinguishable only by the presence of the steep-banked ponds in its western region.

At ground-level, the site's substrate is clearly its most outstanding feature. Apparently the entire site is a plateau of railroad ties. The presence of exposed ties along the steep river and pond banks suggests that they may be present to a considerable depth. Many stretches of the site consist solely of ties with little to no soil material present. There are also small irregular subsidence areas where the ties appear to have settled.

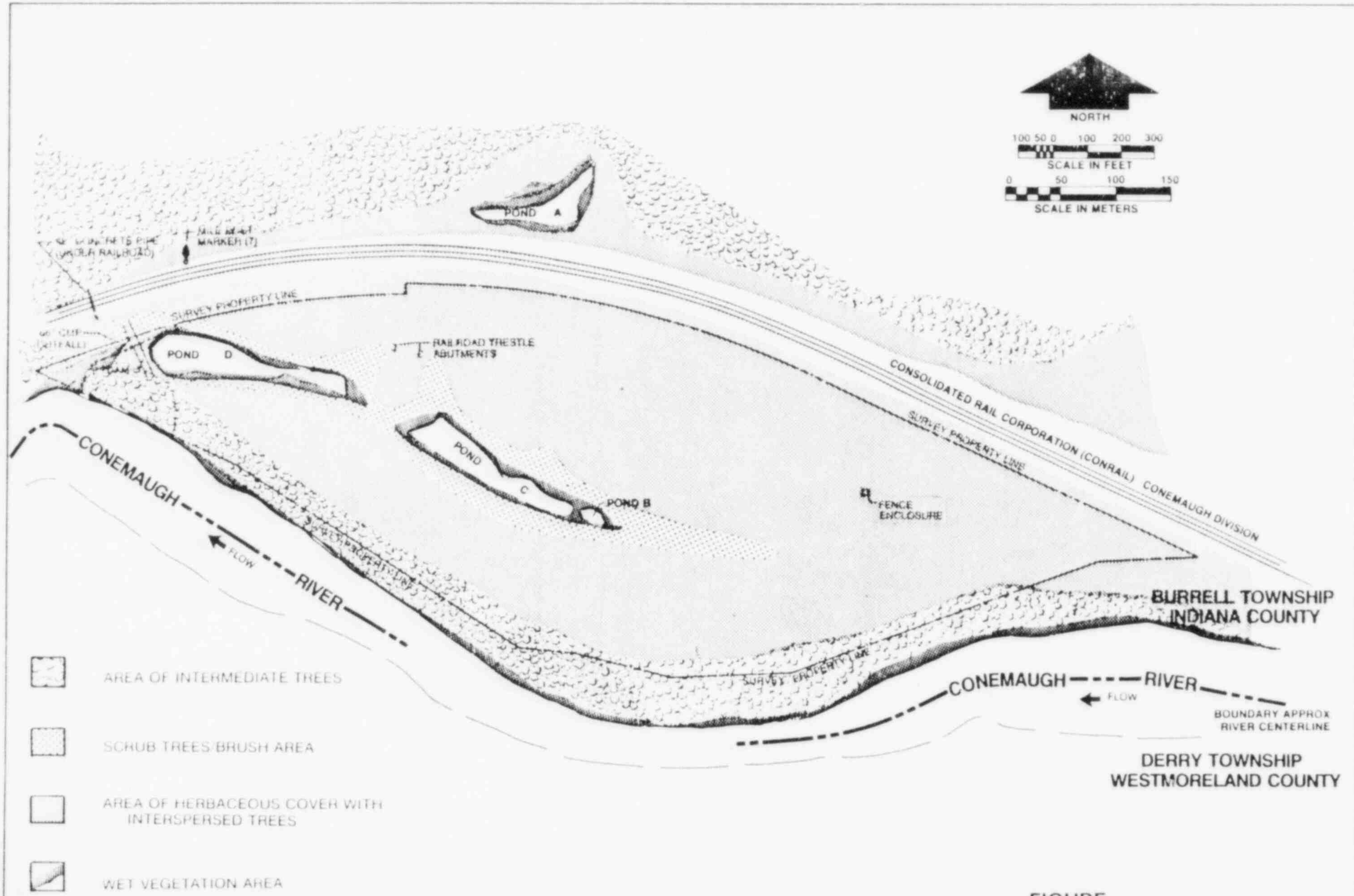
Except for the rail corridor running along its northern perimeter, the entire site is vegetated (see Figure E.1-2). The majority of its cover consists of grasses and other herbaceous plants, such as: teasel, burdock, goldenrod, common mullein, multiflora, raspberry, and Queen Anne's lace (Table E.1-1). Trees present at the site are generally early-successional types: sycamore, hawthorn, birches, maples, quaking aspen, locust, and sumacs. The only stands of trees occur along the river bank and along the bluff to the north of the raillines, forming a fringe along the perimeters. Taller trees in the bluff area also include some oaks and hickories.

The steep-banked pond areas contain often dense patches of brushy vegetation (mainly sumacs and multiflora and hawthorn); however it is questionable whether the bank area could support significant tree growth because of its loose railroad tie composition. Individual trees, roughly 15 years old, occur irregularly throughout the site. The age of these trees, and the fact that they are early colonizing species that typically grow in stands, suggests that vegetative succession is being inhibited at the site. It may be that tree growth over the majority of the site area is being limited by the presence of the railroad ties and the subsequent lack of a stable soil substrate. Wet areas in the vicinity of the ponds and along the river bank also contain stands of reed grass.

The overall site is best characterized as an old field habitat. It is too open, even along the river bank, to support true forest dwellers. The dominant wildlife supported at the Burrell site appears to be burrowing and den-dwelling animals. The irregularity of the landfill material is well suited for this use, as evidenced by many den openings and well-worn runs and paths traversing the site. Signs (droppings and tracks) of rabbits, opossum, mice, voles, shrews, and woodchucks were observed during the surveys. The carcass of a red fox was also encountered in February 1980.

Areas of loose landfill material (especially piles of railroad ties, rocks, and scrap metal) also provide suitable habitat for snakes. Black rat snakes and several types of garter snakes were observed at the Burrell site.

The Burrell site serves as a hunting area for a variety of carnivorous animals such as foxes and kestrels, which have been observed at the site.



SOURCE: FIELD SURVEY 2/21/80 AND AERIAL PHOTOGRAPHS

NOTE: 1. PROPERTY LINE DATA FROM PLAN OF PROPERTY FOR UNION CARBIDE CORP. BY RICHARD G. BACH & ASSOC. ZELIENOPLE, PA DATED 11/16/77

FIGURE
GENERALIZED VEGETATION TYPE MAP
BURRELL TOWNSHIP SITE

Although the site trees do not appear to be well-suited for nesting raptors, many are used as nest sites for a variety of passerines typical of old-field habitats. Sparrows, finches, blackbirds, cardinals, and woodpeckers were observed at the site during the surveys. During the February survey, the presence of a large number of their nests was noted.

Although the Burrell site does not support forest dwellers, there is evidence, in the form of droppings and worn paths, that deer regularly pass through the site.

The only standing water occurs in the three steep-banked ponds. These were not sampled during any of the ecology surveys. The pond north of the raillines contains a large amount of roofing shingles and automobile tires, and the western-most pond is covered with an oily sheen and contains red staining on the bottom. Based on the observed conditions of these ponds, their value as aquatic habitat is questionable.

The river valley in this area is in open use, much of it being wooded. The Burrell site's open condition is not unusual for the area, and its plant and animal species are common to the area. No unusual species or habitats were encountered that would necessitate further quantitative study. The site region supports the same type of animal species as the Canonsburg site (Table E.1-2).

E.1.2.3 Hanover site

The most outstanding feature of the Hanover site is its rocky substrate. This appears to have limited vegetative growth over the entire site area, while some of the steeper slopes have bare rocky areas. Outside the site there are steep hill areas that have not been strip-mined like the site. These areas contain wooded growth that includes oaks, conifers, hickories, maples, and aspen, with sumacs and birches along their perimeters (Table E.1-1). The Hanover site does not contain any trees. Its major vegetation consists of clover and bunch grasses. Dense stands of cattails grow within the wet drainage areas.

This site represents an old field habitat. It supports a variety of small mammals, such as mice, voles, shrews, and rabbits. Since there are no trees on the site, den- or tree-nesting animals were not observed at the site. The Hanover site is included in the range of larger, woodland-dwelling animals. Deer were observed on the site and it is likely that raptors and other carnivores hunt on the site. The Hanover site is contained within the same regional area as the Canonsburg site. Therefore, the general area contains similar animal species.

Appendix E.2

AQUATIC BIOLOGY SURVEY OF CHARTIERS CREEK

Appendix E.2

AQUATIC BIOLOGY SURVEY OF CHARTIERS CREEK

E.2.1 Purpose

Two surveys were conducted to assess the general condition of the biota in Chartiers Creek near the Canon Industrial Park. The purpose of the surveys was to describe the biota of the creek in order to predict what effects remedial actions at the site would have on stream life. The first survey was conducted on April 3, 1979, and the second on July 25, 1979.

E.2.2 Methods

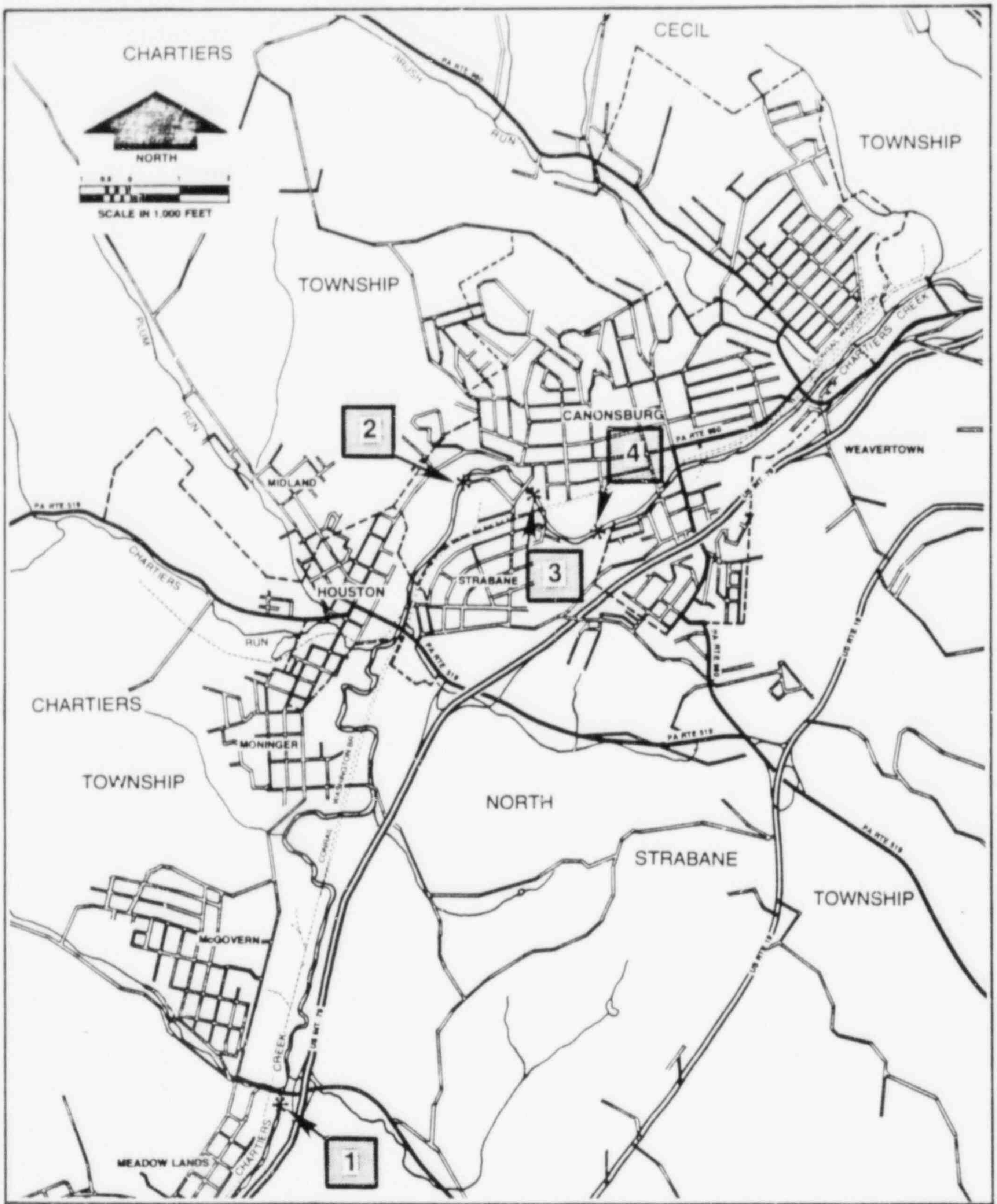
Four sampling stations were established (Figure E.2-1) in Chartiers Creek. Station 1 was located well upstream of the site, and was designed to serve as a reference. Stations 2 and 3 were located along the Canonsburg site, above and below the small ditch draining the site. This ditch empties into Chartiers Creek at the Strabane Avenue bridge. Station 4 was located in the channelized portion of Chartiers Creek, approximately 400 meters downstream from the railroad bridge.

A Smith-Root Type VII backpack electroshocker, and a beach seine were used for fish sampling, while macrofauna were sampled by kicknet. The suitability of the electroshocker for stream conditions was determined by performing preliminary water-quality measurements. These water conditions are given in Table E.2-1. The conductivities measured in April were 420 to 440 micromhos, using the equipment's optimum range (20 to 1000 micromhos). The measurements in July (1080-1200 micromhos), although high, can still be expected to provide accurate results.

E.2.3 Physical conditions

Table E.2-2 presents a description of the physical nature of each station. In general, Chartiers Creek flows over shale bedrock overlain by a thin layer of rubble and silt, and is characterized by a steep gradient. This gradient results in swift currents and numerous riffles. Undercut banks and snags are common. The banks tend to be muddy, but the mud extends less than 1 meter into the stream, where it is replaced by the rocky substratum.

Station 1 yielded large numbers of oligochaetes and chironomids in April, but no other species. In July, the kicknet samples contained numerous oligochaetes and nematodes, as well as a snail. Few chironomids were noted, probably reflecting adult emergence between April and July. Extensive growths of aquatic vegetation contained large numbers of snails. No fish were captured by either seining or electrofishing, although local inhabitants claimed that carp are occasionally caught near Station 1.



AQUATIC BIOLOGY SAMPLING SITES

FIGURE
LOCATION OF THE AQUATIC BIOLOGY SURVEY SAMPLING SITES ON CHARTIERS CREEK IN THE VICINITY OF THE CANONSBURG SITE

Table E.2-1. Water-quality parameters in Chartiers Creek associated with the biological sampling efforts (1979)

Station	Temperature (°C)		Specific conductance (micromhos)		pH (units)		Dissolved oxygen (mg/l)	
	April	July	April	July	April	July	April	July
1	4.7	21.8	420	1200	7.6	---	---	3.9
2	4.6	22.7	420	1080	7.8	---	---	4.5
3	4.7	22.8	420	1100	7.8	---	---	4.6
4	4.9	23.5	440	1160	7.5	---	---	7.4

Station 2 was dominated by oligochaetes and chironomids in April, with a few leeches. In July, the chironomids were uncommon, leeches and snails were dominant, and oligochaetes were subdominant. The kicknet samples in July also contained a small dead crayfish, a dead isopod, and a water beetle. Numerous crayfish holes were present in the bank. No fish were captured in an electrofishing effort, which extended from Station 2 to the waterfall at the railroad bridge.

Station 3 was characterized by numerous leeches and chironomids in April. Oligochaetes were rare. One physid snail and one juvenile crayfish were noted. In July, oligochaetes were common, as were leeches and snails. Chironomid larvae were rarely observed, but pupae were observed. One crayfish (2.5 cm long) was captured.

In April, the fauna at Station 4 consisted of chironomids and oligochaetes with occasional leeches, and appeared to be sparse in numbers. In July, however, the samples contained numerous snails, oligochaetes and chironomid larvae and pupae. Leeches and an isopod were also present, as well as a dead crayfish.

These results suggest that the stream reach under study is in a zone of recovery from the input of sewage. Dissolved oxygen and species diversity both increase in a downstream direction, indicating a gradual improvement in conditions. Although no fish were captured during this study, their presence was evident, and local fishermen are known to have caught carp in the study reach. The physical nature of the habitat is good; it is likely that the very poor water quality is the principal limiting factor to fish.

E.2.4 Additional aquatic information

As an additional source of aquatic information on Chartiers Creek, Weston drew upon a field study performed by Gary Kreamer (1978).

"Between sites 9 and 10 (Figure E.2-2), Chartiers Creek flows through light residential and commercial areas and receives iodide compounds, oil, fluoride, and acid rinse water in effluents from local industries. Oily films, milky-colored films, and brownish scums are extensive on the water surface. A wide, rapid riffle, bottomed with boulders, and rubble, grades upstream to a shallower riffle of moderate current and a rubble-gravel substrate. Above the riffles, a long pool section of mostly bedrock overlain with some rubble, gravel and silt (especially at the sides), follows a short pool section of silted flat rubble and gravel. Pools are mostly of moderate flow, and uniform in depth with some small eddies, and shelter in the form of debris and overhanging vegetation. The shade is fair in the riffles, which are banked by fairly steep, wooded hills. The pool areas sampled (except below a bridge), were more exposed to the sun with low and grassy banks. No fish were collected at site 10 (Table E.2-3).

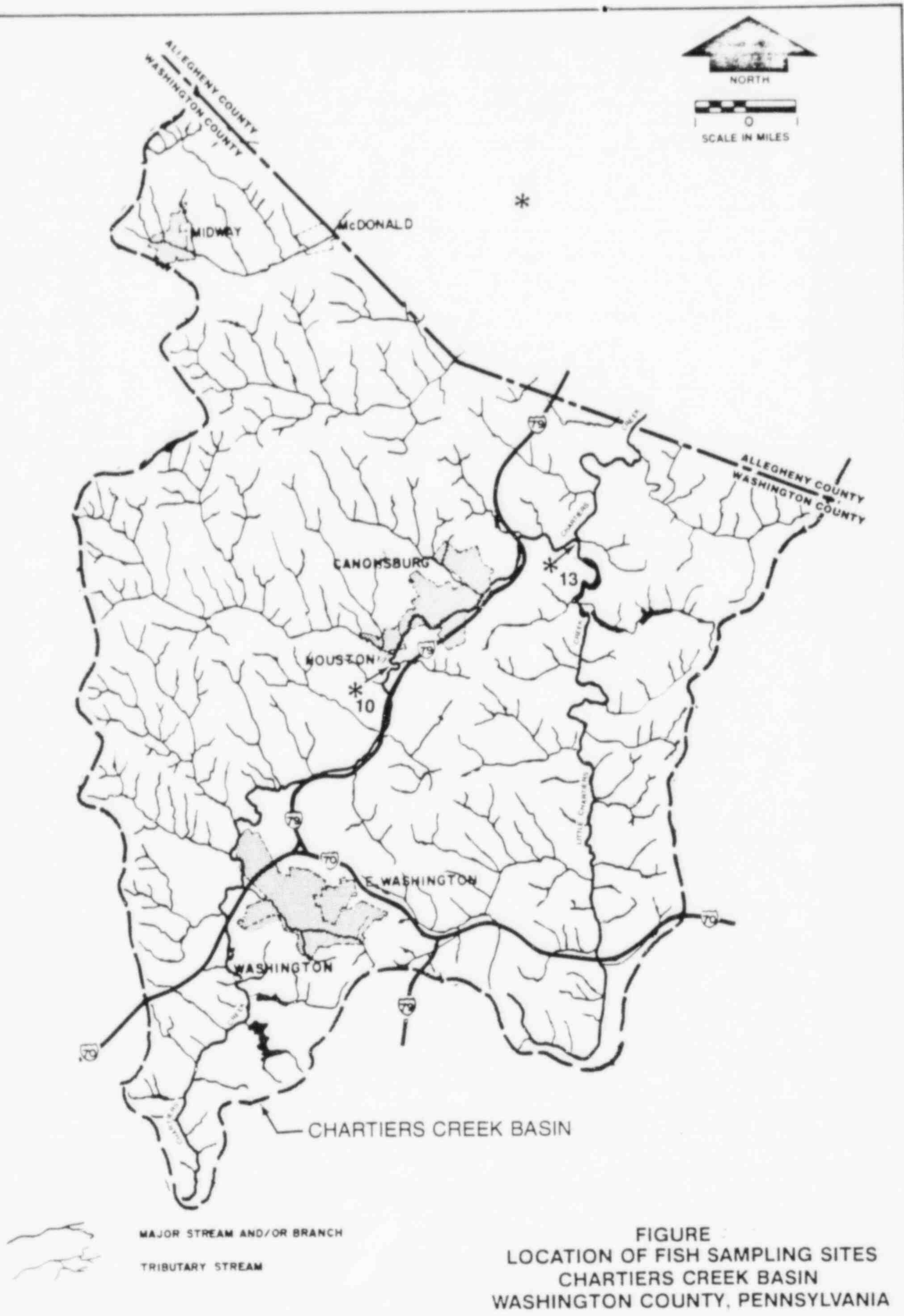


FIGURE
LOCATION OF FISH SAMPLING SITES
CHARTIERS CREEK BASIN
WASHINGTON COUNTY, PENNSYLVANIA

Table E.2-2. Physical conditions at aquatic sampling stations (April and July 1979)

Station	Substratum	Banks	Shade	Aquatic vegetation
1	Shale bedrock covered with periphyton and cobbles; silt in the interstices.	Muddy and low.	None--banks covered with grass and bushes.	Numerous attached green algae and *Sphaerotilus* in April; abundant algae in July.
2	Boulders and cobbles covered with periphyton; silt in interstices.	Steep, undercut; trash dumped along banks.	Moderately shaded by trees.	Sparse attached green algae and *Sphaerotilus* in April; abundant algae in July.
3	Shale bedrock covered with cobbles; periphyton abundant; silt in interstices.	Steep, undercut.	Well shaded by trees.	Sparse attached green algae in April; moderately-abundant in July.
4	Shale bedrock; areas of cobbles and gravel; periphyton abundant.	Steep, riprapped.	None.	Very sparse--attached green algae in April; abundant algae in July.

Source: Weston (1979).

Table E.2-3. Fish collected at sites on Chartiers Creek

Scientific name	Common name	Stream order 4 / Site number 10	Stream order 4 / Site number 13
Semotilus atromaculatus	Creek chub	0	1
Catostomus commersoni	White sucker	0	17
Notropis chrysocephalus	Striped shiner	0	
Cyprinus carpio	Carp	0	6
Total individuals		0	24
Total species		0	3
Diversity		0	1.04

Source: Kreamer (1978).

"Site 13 is the farthest downstream on Chartiers Creek. Between sites 10 and 13 the waters of Chartiers Creek have been greatly altered by channelization as the stream passes through the highly developed towns of Houston and Canonsburg. Within this section, Chartiers Creek receives substantial amounts of mine drainage, particularly from Chartiers Run, and a large outflow from an inactive deep mine near the Fort Pitt Bridge Works in Canonsburg (Table E.2-4). Numerous industrial discharges also enter the stream in this area, containing crude oil, brine, cooling water, clays, silage wastes, and potato wastes (WCPC, 1973). Within the 7-mile reach separating sites 10 and 13, the waters of Chartiers Creek become very turbid, in addition to increasing substantially in flow.

"Site 13 is located about 100-yards downstream from the Hahn Portal of Montour Mine No. 4, and about a half-mile downstream from a primary sewage treatment plant that services the Canonsburg area. Decomposing organic matter is quite evident on the surface of the extemely turbid water. The stream is mostly moderately flowing, with wide (65 feet) pools of fairly uniform depth (16 to 34 inches). Substratum in the pools is mostly rubble and gravel with some exposed bedrock. Still eddies to the sides of the pool areas, laden with organic-rich sediments, reach a depth of 2 feet and contain some logs and debris. Shelter, however, is generally poor, and deep lurking areas are scarce. A wide riffle flows rapidly over bedrock, boulders, and rubble within the study area. Stream banks are well vegetated with deciduous trees and brush. Fish were collected in the waters of Chartiers Creek at site 13, including several large carp in the moderate pools and young white suckers and creek chubs that inhabited only the still organic-rich eddies at the pool margins."

Table E.2-4. Physical/chemical data for sites on Chartiers Creek

Parameter	Site number 10	Site number 13
Nitrates (ppm)	53	48
Sulfates (ppm)	195	260
Iron (ppm)	0.8	4.0
Chlorides (ppm)	87	81
Specific conductance (mhos/cm)	835	750
pH	7.6	7.4
M.O. (alkalinity) (ppm)	171	188
Hardness (ppm)	325	325
Flow volume (cfs)	78	137
Stream gradient (feet/mile)	13	6
Substrate composition (%)		
Bedrock	40	5
Boulders	10	15
Rubble	25	45
Gravel	15	15
Sand	0	5
Silt	10	10
Clay	0	0
Muck	0	0
Pool-riffle ratio	3	2
Riffle habitats		
Maximum width (ft)	55	65
Average depth (in.)	9	14
Maximum depth (in.)	14	20
Maximum length (ft)	60	80
Siltation	1	1
Pool habitats		
Maximum width (ft)	50	65
Average depth (in.)	20	18
Maximum depth (in.)	33	34
Maximum length (ft)	100	100
Siltation	2	2
Flow rate (%)		
Rapid	25	20
Moderate--riffle	20	30
Moderate-- pool	50	40
Sluggish	5	10

Appendix E.3

CORRESPONDENCE ON THREATENED OR ENDANGERED SPECIES

Appendix E.3

ENDANGERED SPECIES

Both state and Federal agencies were asked to review the three site areas for the presence of endangered or threatened species, unusual habitats or areas of special concern. In each case, none of these species or habitats were discovered. The accompanying letters document the agencies' findings.

COMMONWEALTH OF PENNSYLVANIA

PENNSYLVANIA GAME COMMISSION

P. O. BOX 1567
HARRISBURG, PENNSYLVANIA 17120

ADMINISTRATIVE DIVISIONS

ACCOUNTING	787 - 4492
ADMINISTRATION	787 - 5670
LICENSE SECTION	787 - 2084
PERSONNEL	787 - 7836
GAME MANAGEMENT	787 - 5529
	787 - 6711
INFORMATION & EDUCATION	787 - 6286
LAW ENFORCEMENT	787 - 5743
LAND MANAGEMENT	787 - 6818
REAL ESTATE	787 - 6568

August 11, 1982

Mr. Michael V. Mellinger, PhD
Project Manager
Weston Consultants
Weston Way
West Chester, PA 19380

In re: Borough of Canonsburg,
Cleanup of Landfill Site

Dear Mr. Mellinger:

Thank you for forwarding the above referenced information to our office for review and comment.

We have made a determination that this project will not affect the habitat of any Federally listed threatened or endangered wildlife species under our jurisdiction.

We appreciate the opportunity to comment on proposed projects during the developmental stages, and to provide technical assistance as available.

If we can be of further assistance, please contact this office.

Very truly yours,

Jacob I. Sitlinger, Chief
Division of Land Management

An Equal Opportunity Employer

COMMONWEALTH OF PENNSYLVANIA

PENNSYLVANIA GAME COMMISSION

P. O. BOX 1567
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	787 - 6711
INFORMATION & EDUCATION	787 - 6286
LAW ENFORCEMENT	787 - 5743
LAND MANAGEMENT	787 - 6818
REAL ESTATE	787 - 6568

July 21, 1982

Mr. Michael V. Mellinger, PhD
Project Manager
Weston Consultants
Weston Way
West Chester, PA 19380

In re: Proposed Sites - Hanover Township, Washington County, Burrell Township, Indiana County

Dear Mr. Mellinger:

This is in response to your above referenced requests for information.

A field assessment team from our Southwest Division office has recently reviewed this project and made a determination that the proposed project would not affect any Federally listed, endangered or threatened wildlife species under our jurisdiction. A determination was also made that this project would not affect any critical or unique habitat of special concern to the Pennsylvania Game Commission.

If you have any further questions, please contact this office.

Very truly yours,

Jacob I. Sitlinger, Chief
Division of Land Management

An Equal Opportunity Employer

COMMONWEALTH OF PENNSYLVANIA
PENNSYLVANIA FISH COMMISSION
Bureau of Fisheries and Engineering
Robinson Lane
Bellefonte, PA 16823
814-359-2754

August 10, 1982

Mr. Michael V. Mellinger
Roy F. Weston, Inc.
Weston Way
West Chester, PA 19380

Dear Mr. Mellinger:

I have examined the maps depicting the uranium mill tailings site in Canonsburg, Washington County, and the two proposed disposal sites in Hanover Township, Washington County, and Burrell Township, Indiana County.

None of the fishes, amphibians or reptiles listed by us as endangered or threatened are presently known to occur at or in the vicinity of these sites. The only federally listed fish, amphibian or reptile species recorded from Pennsylvania are the shortnose sturgeon (Delaware River only), blue pike, and longjaw cisco. The latter two species were listed for the Great Lakes only, and have been proposed for deregulation by the Fish and Wildlife Service due to probable extinction (F.R. Vol 47, No. 101, May 25, 1982).

If you require additional information about endangered or threatened species under our jurisdiction, please do not hesitate to contact this office.

Sincerely,

Clark N. Shiffer

Clark N. Shiffer
Herpetology and Endangered
Species Coordinator

jb
Enclosure
cc: R. Snyder

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES

Post Office Box 1467
Harrisburg, Pennsylvania 17120

August 25, 1982

(717) 787-3444

In reply refer to
RM-F FAS
Bureau of Forestry

Michael V. Mellinger, Ph.D.
Project Manager
Weston Consultants
Weston Way
West Chester, PA 19380

Dear Dr. Mellinger:

The Bureau of Forestry knows of no endangered plant species at, or near, the proposed disposal areas at Canonsburg, Hanover Township and Burrell Township. There is no State Forest Land near these areas.

You should contact the Pennsylvania Game Commission concerning endangered mammals and birds and the proximity of Stat[illegible]e Lands to these sites. Contact the Pennsylvania Fish Commission concerning endangered fish where the site is near water.

Sincerely,

Malcolm D. Waskiewicz

MALCOLM D. WASKIEWICZ
Assistant forest Resource Planner

Appendix F

RADIOLOGICAL INFORMATION

Appendix F.1

BASELINE RADIOLOGICAL INFORMATION

Table F.1-1. Comparison of radiological observations at the Canonsburg and Burrell sites with pertinent regulatory guidelines and standards

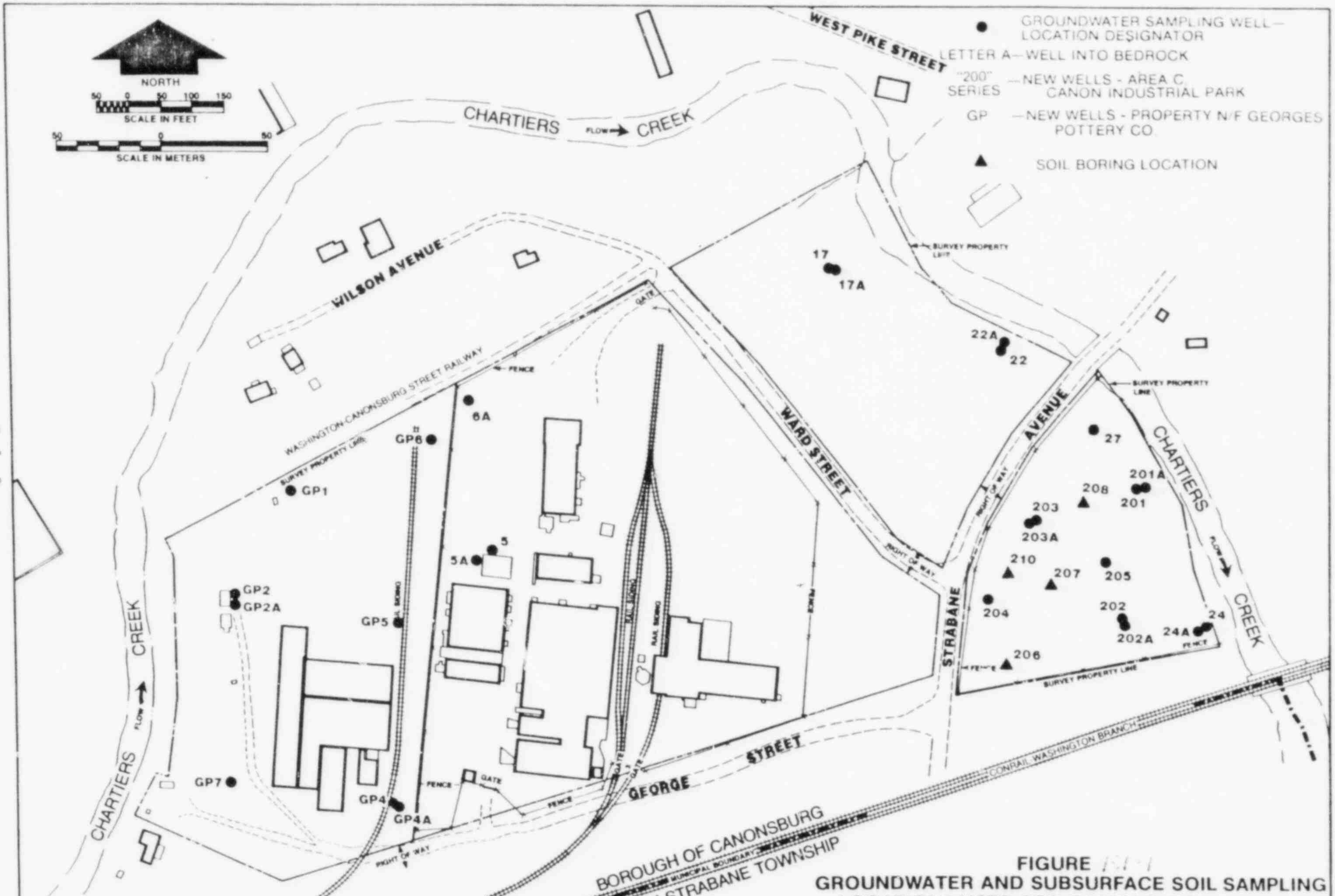
Pathway	Medium	Type of contamination	Standard or guideline	Source	Limit	Maximum value found at Canonsburg	Maximum value found at Burrell
Surface contamination	Building material	Gross alpha (from Ra-226)	Regulatory Guide 1.86 "Decontamination Guidelines for Facilities and Equipment"	USNRC, 1976	300 dpm/100 sq cm	40,000 dpm/100 sq cm	Not applicable
		Removable gross alpha (from Ra-226)			20 dpm/100 sq cm	400 dpm/100 sq cm	Not applicable
		Gross beta			0.2 mrad/hour at 1 cm	8.5 mrad/hour at 1 cm	Not applicable
External radiation	Not applicable	Not applicable	"Dose Limits to Public Individuals"	ICRP, 1971	500 m.em/year	4,000 mrem/year	1,260 mrem/year
			"Clean-up Criteria for Uranium Mill Sites"	USNRC, 1978	140 mrem/year		
			"Decont...ination Guidelines for Facilities and Equipment"	USNRC, 1976	0.2 mrad/hour	25 mrad/hour	5.4 mrad/hour
Air	Concentration within buildings	Rn-222 Pb-210 Ra-226 Th-230 U-238	DOE 5480.1[a]	USDOE, 1981	3 pCi/l 4×10^{-3} pCi/l 3×10^{-3} pCi/l 8×10^{-5} pCi/l 3×10^{-3} pCi/l	300 pCi/l 1.3×10^{-4} pCi/l 8.1×10^{-5} pCi/l 2.1×10^{-4} pCi/l 3.5×10^{-4} pCi/l	2.65 pCi/l No data No data No data No data
		Rn-222 + daughters	10 CFR 20 40 CFR 192 (proposed)	USNRC, 1960 USEPA, 1980	0.033 WL 0.015 WL	0.51 WL	0.001 WL

[a]Also 10 CFR 20, except for U-238.

Table F.1-1. Comparison of radiological observations at the Canonsburg and Burrell sites with pertinent regulatory guidelines and standards (continued)

Pathway	Medium	Type of contamination	Standard or guideline	Source	Limit	Maximum value found at Canonsburg	Maximum value found at Burrell
Ground water	Onsite	Ra-226 + 228	40 CFR 192 (proposed)	USEPA, 1980	5 pCi/l	4,500 pCi/l	10 pCi/l
		Uranium, total			10 pCi/l	14,380 pCi/l	403 pCi/l
		Ra-226	10 CFR 20	USNRC, 1960	30 pCi/l	(U-235 + 238)	(U-238)
		U-238			40,000 pCi/l		
		U-234			30,000 pCi/l		
		U-235			30,000 pCi/l		
		Bi-214			3,000 pCi/l		
		Th-230			2,000 pCi/l		
		Th-232			2,000 pCi/l		
		Ac-227, Ac-228			90,000 pCi/l		
		Pb-210			100 pCi/l		
Soil	Floor drain sediments	U-238	10 CFR 40	USNRC, 1961	172 pCi/g	270 pCi/g	Not applicable
		Ra-226	40 CFR 192 (proposed)	USEPA, 1980	5 pCi/g	310 pCi/g	Not applicable
	Surface onsite	U-238	46 FR 52061	USNRC, 1981	200 pCi/g[a]	51,000 pCi/g	360 pCi/g
		Ra-226	40 CFR 192 (proposed)	USEPA, 1980	5 pCi/g	4,200 pCi/g	5,000 pCi/g
	Surface offsite	U-238	46 FR 52061	USNRC, 1981	10 pCi/g	10 pCi/g	No data
		Ra-226	40 CFR 192 (proposed)	USEPA, 1980	5 pCi/g	3,100 pCi/g	No data

[a]If site is to be restricted.



NOTE: THIS MAP IS BASED ON SURVEYS BY KURCH-HOUSLEY & ASSOC., PITTSBURGH, PA., DATED 6/14/78 AND 9/15/81, AND ON MAPS OF THE CHARTIERS CREEK BASIN, PA. BY U.S. ARMY, CORPS OF ENGINEERS, PITTSBURGH, PA., DATED 6/3/73

FIGURE [illegible]
GROUNDWATER AND SUBSURFACE SOIL SAMPLING LOCATIONS USED FOR RADIOLOGICAL SURVEY CANONSBURG SITE

Table F.1-2. Radiological analysis of subsurface soil samples taken from the Canon Industrial Park

Sample location and depth (feet)	Sample (results in picocuries per gram (pCi/g))			
	Ra-226	U-234	U-235	U-238
203				
2-3	3,400	3,020	5.0	35.3
3.5-3.8	10,900	464	12	307
5.6-6.8	18,400	4,240	138	1,960
8.5-9.5	130	38.1	1.2	30.3
204				
5-6	2,260	1,090	19.5	267
11-12	21.4	4.8	0.13	3.91
13-14	38.7	10.3	0.33	10.3
205				
3.5-4	10,000	128	3.2	73.8
4.5	21,800	961	33	395
6	18,500	950	32	325
206				
4-6	8,480	186	5.1	119
6-7	3,790	406	7.9	3.37
16-17	39.6	8.79	0.33	8.66
207				
0-2	18,900	81.7	1.9	17.1
2-4	785	26.6	1.6	25.8
8-10	5,930	1,630	31	424
208				
2-4	12,000	628	19	470
4-6	7,850	125	3.6	91
6-8	7,220	282	3.3	209
210				
0-3	2,000	400	13.5	218
3.5-5.5	548	54	2.4	50.8
5.5-7.5	6,490	4,590	48	329
11.5-13.5	2,110	1,280	3.43	639

[a]Locations are shown on Figure F.1-1.
Source: Weston (1982) field data.

Table F.1-3. Radiological analysis of ground-water samples taken from the Canon Industrial Park and Georges Pottery properties

Location[a]	U-234	U-235	U-238	Ra-226	Ac-227	Ac-228	Th-230	Th-232	Pb-210	Bi-214	Total uranium	Gross alpha	Gross beta
	Nuclide (results in picocuries per liter (pCi/l))												
5	---[b]	434	8,161	4,500	378	<31	13,823	40.6	<2.2	4,400	---	---	---
5A	---	1.9	11.3	<66	<2.6	<14	48.1	<3.6	<1.8	<4.9	---	---	---
6A	---	<1.2	8.8	<37	1.3	<8	16.3	0.24	<2.0	<4.3	---	---	---
17	---	<28	<450	75	---	<13	<4.48	<4.59	<1.4	65.5	---	---	---
17A	---	15.7	19.6	61	3.9	<6.9	308.4	3.2	<1.5	13	---	---	---
22	---	9.4	127.8	<81	<1	<11	164.8	<3.3	<1.6	14	---	---	---
22A	---	<2.5	9.1	<34	6.6	---	207.7	2.8	<1.6	---	---	---	---
24	---	<12	<440	<39	---	<7.5	<2.27	<1.42	<1.7	130	---	---	---
24A	---	<1.6	14.8	81	3.2	<11	158.6	0.9	<1.8	70	---	---	---
27	---	27.3	259.7	190	<15	<15	875	<9	<2	69	---	---	---
201	117	4.2	119	<1	---	---	---	---	---	---	---	720	460
201A	5.5	0.15	2.54	<1	---	---	---	---	---	---	---	16	17
202	146	5.8	142	54.9	---	---	---	---	---	---	---	1,800	1,100
202A	5.13	0.18	4.11	2.26	---	---	---	---	---	---	---	35	30
203	2.66	0.13	2.87	178	---	---	---	---	---	---	---	1,100	640
203A	4.21	0.20	3.30	3.77	---	---	---	---	---	---	---	53	34
204	3,310	74	3,270	87.2	---	---	---	---	---	---	---	6,900	1,700
205	3,780	97	3,950	518	---	---	---	---	---	---	---	15,000	5,700
GP-1	---	---	---	<0.167	<0.725	---	<0.725	<0.418	---	---	93.5	---	---
GP-2	---	---	---	0.594	<0.764	---	2.88	<0.541	---	---	8.42	---	---
GP-2A	---	---	---	0.316	<1.01	---	<1.31	<1.01	---	---	3.11	---	---
GP-4	---	---	---	18.3	<1.16	---	3.98	<1.04	---	---	4,570	---	---
GP-4A	---	---	---	1.65	<1.10	---	<1.27	<0.899	---	---	291	---	---
GP-5	---	---	---	0.46	<0.752	---	<0.921	<1.06	---	---	375	---	---
GP-6	---	---	---	0.279	<0.144	---	<1.28	<0.642	---	---	4.96	---	---
GP-7	---	---	---	0.213	<0.777	---	<1.10	<0.550	---	---	139	---	---
EPA standard	10	10	10	5[c]	---	---	---	---	---	---	10	15	---
NRC - DOE standard	30,000	30,000	40,000	30	2,000	90,000	2,000	2,000	100	3,000	30,000[d]	30[e]	3,000[f]

[a]Locations are shown on Figure F.1-1.

[b]Dashes indicate no analysis was performed.

[c]This limit is for radium-226 plus radium-228.

[d]This limit is for natural uranium.

[e]This limit is for an unknown radionuclide(s) that decays by alpha emission or spontaneous fission.

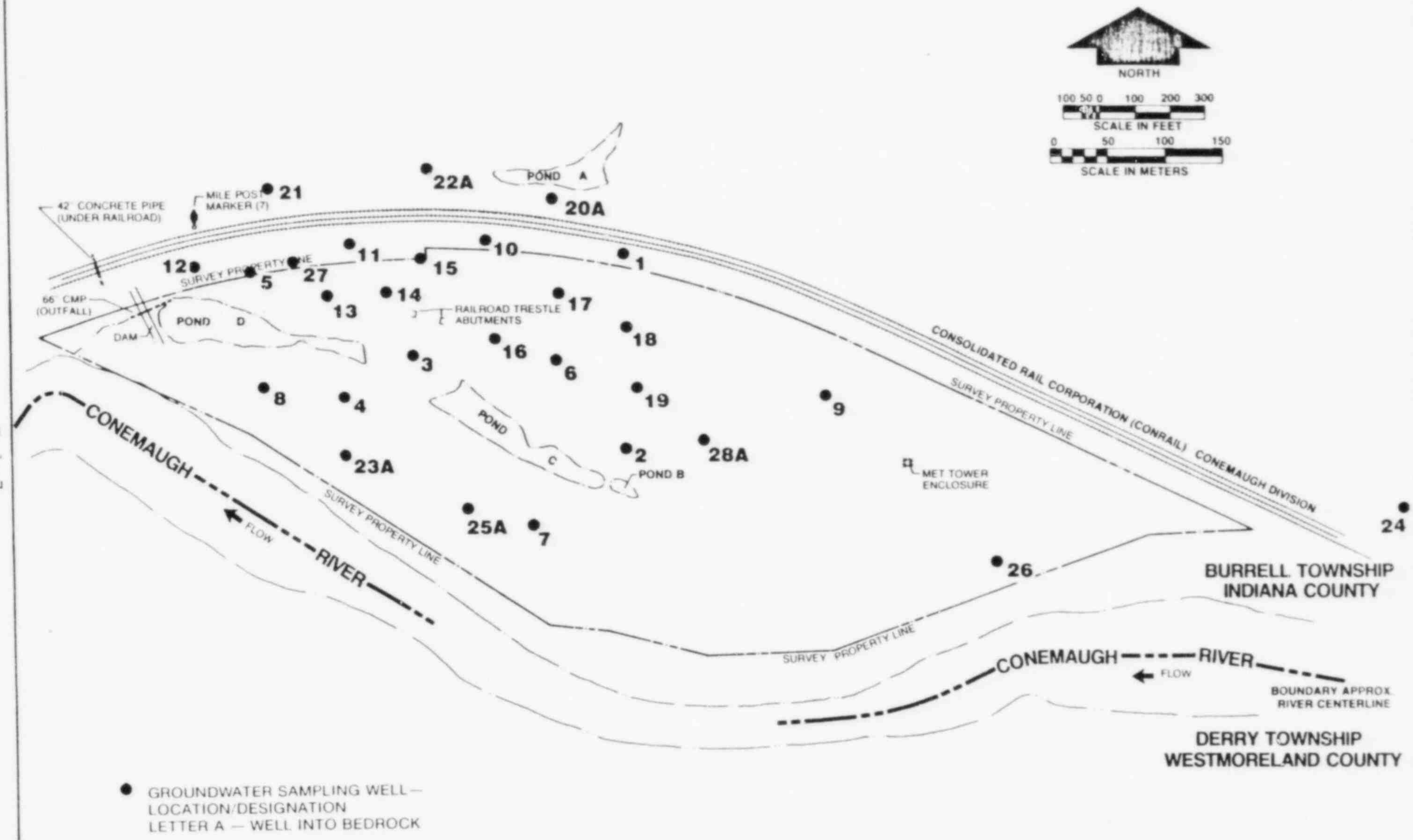
[f]This limit is for an unknown radionuclide(s) that decays by other than alpha emission or spontaneous fission with half lives greater than 2 hours.

Source: Weston (1982) field data.

Table F.1-4. Radiological analysis of sediment samples taken from Chartiers Creek

Location	Th-230	U-235	U-238	Ra-226	Ac-228	Bi-214	Th-232	Cs-137	K-40
	Nuclide (results in picocuries per gram-dry (pCi/g))								
Upstream of site near railroad track	6.5	<0.26	<10	2.0	1.2	0.86	0.52	0.12	12
North of Wilson Avenue	8.3	<0.39	<5.9	1.9	0.98	0.76	0.17	0.11	11
Northeast corner of site	1.5	<0.37	<6.7	2.8	1.2	0.82	0.27	0.30	13

Source: Weston field data (1979).



NOTE 1. PROPERTY LINE DATA FROM PLAN OF PROPERTY FOR UNION CARBIDE CORP., BY RICHARD G. BACH & ASSOC., ZELIENOPLE, PA-DATED 11/16/77

2. TOPOGRAPHICAL DETAIL FROM MAP: TEST HOLE LOCATIONS FOR ROY F. WESTON INC. BY KURCH-HOUSLEY & ASSOC. PITTSBURGH, PA-DATED 11/6/81 REV. 3/2/82

FIGURE

LOCATION OF GROUNDWATER SAMPLING WELLS USED FOR RADIOLOGICAL SURVEY BURRELL TOWNSHIP SITE

Table F.1-5. Radiological analysis of ground-water samples from the Burrell site

Well number[a]	Nuclide (results in picocuries per liter (pCi/l))					
	Ra-226	U-234	U-235	U-238	Gross alpha	Gross beta
Sample dates July 27-30, 1981						
2	2.02	0.54	<0.05	0.52	<5	17
3	<1.0	1.81	<0.10	1.63	<10	17
5	<1.0	3.56	0.12	3.28	<40	<40
6	<1.0	2.78	0.13	2.37	<10	15
7	<1.0	1.17	<0.05	0.93	< 5	25
8	<1.0	0.60	<0.05	0.52	<10	18
9	1.28	6.57	0.22	5.34	<40	66
10	<1.0	0.30	<0.05	0.21	< 5	3.5
11	<1.0	3.74	0.13	3.81	<10	<4
12	1.37	0.56	<0.05	0.52	6	6.1
13	<1.0	5.87	0.40	5.73	16	21
14	<1.0	3.51	0.16	2.86	<10	5.2
15	<1.0	0.13	<0.05	<0.10	<4	4.0
16	<1.0	1.7	<0.10	1.62	<4	4.3
17	<1.0	0.47	<0.05	0.42	<4	3.7
18	1.34	0.10	<0.05	<0.10	4.0	5.8
19	<1.0	1.30	<0.05	1.27	<10	21
20	1.00	0.74	<0.05	0.77	<4	4.4
21	<1.0	<0.10	<0.05	<0.10	<30	<40
22	<1.0	0.85	<0.05	<0.10	<7	13
23	<1.0	<0.10	<0.05	0.67	<9	16
24	---[b]	---	---	---	---	---
25	---	---	---	---	---	---
26	---	---	---	---	---	---
27	---	---	---	---	---	---
28	---	---	---	---	---	---

[a]Location of wells is shown on Figure F.1-2.

[b]Dashes indicate no sample was taken.

Source: Weston (1982) field data.

Table F.1-5. Radiological analysis of ground-water samples from the Burrell site (continued)

Well number[a]	Nuclide (results in picocuries per liter (pCi/l))					
	Ra-226	U-234	U-235	U-238	Gross alpha	Gross beta
Sample dates January 21 - February 11, 1982						
2	---[b]	---	---	---	---[b]	---
3	---	---	---	---	---	---
5	---	---	---	---	---	---
6	<1.0	1.33	<0.04	1.12	<2	15
7	---	---	---	---	---	---
8	---	---	---	---	---	---
9	<1.0	4.38	0.16	3.44	51	110
10	---	---	---	---	---	---
11	<1.0	0.75	<0.02	0.70	<4	5.7
12	---	---	---	---	---	---
13	<1.0	0.97	<0.02	0.74	<3	16
14	<1.0	0.88	<0.03	0.92	<3	4.3
15	---	---	---	---	---	---
16	---	---	---	---	---	---
17	---	---	---	---	---	---
18	---	---	---	---	---	---
19	---	---	---	---	---	---
20	---	---	---	---	---	---
21	---	---	---	---	---	---
22	---	---	---	---	---	---
23	---	---	---	---	---	---
24	<1.0	0.30	<0.03	0.18	<5	3.7
25	<1.0	0.21	<0.02	0.13	<2	4.0
26	<1.0	1.3	<0.10	0.95	<2	8.1
27	<1.0	0.22	<0.02	0.16	<3	3.8
28	<1.0	0.55	0.068	0.16	<4	<2

Appendix F.2

DESCRIPTION OF THE MILDOS CODE AND THE INPUTS USED

Appendix F.2

DESCRIPTION OF THE MILDOS COMPUTER CODE AND THE INPUTS USED

F.2.1 Introduction

The MILDOS computer code (NRC, 1980) was developed by the NRC to serve as the primary licensing evaluation tool for assessment of radiological impacts resulting from uranium-milling operations. The code can be used to evaluate compliance with the EPA's uranium fuel cycle radiation protection standard (40 CFR 190), compliance with EPA's remedial-action standards for inactive uranium-processing sites (40 CFR 192), and the maximum air-concentration limits and radiation doses embodied in the NRC's standards for protection against radiation (10 CFR 20). MILDOS uses the calculational models and data, as described in the NRC Regulatory Guide 3.51, "Calculational Models for Estimating Radiation Doses to Man from Airborne Radioactive Materials Resulting from Uranium Milling Operations," except the inhalation dose factors have been modified to reflect new information on radionuclide dosimetry. The actual doses calculated include those from inhalation, ingestion, and external exposure to radionuclides.

F.2.2 Calculational regime

The translocation and airborne concentrations of radon gas and radioactive particulates removed from a contaminated area, such as buried or above-ground uranium-mill tailings, are estimated from theoretical and empirical wind-erosion equations according to wind speed and direction, particle size distribution, surface roughness, and atmospheric stability class, and the mill tailings' radionuclide concentrations. A dispersion-deposition-resuspension model is used. This Gaussian model allows for source depletion, as a result of deposition, radioactive decay, and in-growth of radon-daughter products. The average air concentration is calculated to be constant during each annual release period because of the use of annual average meteorological data and average radionuclide concentrations in the tailings. Surface contamination is estimated by including buildup from deposition, in-growth of radioactive daughters, and removal by radioactive decay, weathering, and other environmental processes. The deposition velocity is estimated on the basis of particle size, density, and physical and chemical environmental conditions that influence the behavior of the smaller particles.

The calculation of the individual organ doses and dose rates to populations and individuals is based on the International Commission on the Radiological Protection (ICRP) Task Group Model (ICRP, 1966). Estimates of the dose to the bronchial epithelium of the lung from inhalation of radon and its short-lived daughters are calculated based on a dose-conversion factor, which Weston modified to reflect the most recent accepted value (Harley and

Pasternack, 1982). External radiation exposure includes radiation from airborne radionuclides, and exposure to radiation from contaminated ground. Individual dose commitments, population dose commitments, and environmental dose commitments can then be computed.

F.2.3 MILDOS inputs

The data inputs to MILDOS consist of the following:

1. Meteorological data concerning annual average wind speed and direction by atmospheric stability class for each site (refer to Section 4.3 and Appendix B.1).

2. The population distribution around each site for each ordinal direction in 0.5-kilometer (0.31 mile) increments out to a distance of 2 kilometers (1.24 miles) (refer to Section 4.12, Figures G-6 and G-7, and Tables G-5, G-9, and G-11).

3. The average radionuclide release rates for the time periods of interest and the average radionuclide concentrations at each site in excess of the natural background.

Of these inputs, the site radioactivity data have the greatest inherent error because of the averaging process. Based on the number of results available for each site, the relative standard error has been statistically estimated at 20 percent. The inherent errors in the meteorological and population data are small and do not materially affect the overall data error. Thus, the calculated doses are within 20 percent of the doses likely to be received by the general public and remedial-action workers at each site under each alternative. The total population and worker doses for each alternative were determined by summing the calculated doses at each site and adding to these sums the external gamma dose rates from buried materials. The specific input data used are described in the subsection that follows.

F.2.4 Specific input data

The population and meteorological data were specific for each site and alternative. The only inputs that changed between alternatives was the radioactivity. These radiological inputs are discussed in the paragraphs that follow on a site by alternative basis.

F.2.4.1 Canonsburg site

The Canonsburg site was divided into three area sources, Areas A, B, and C; one or more sources as a result of loading and unloading contaminated materials; and one or more sources for above-ground and in-ground tailings-pile storage during each of the remedial actions, as appropriate.

Alternative 1

Radioactivity		Area A	B	C
Radon-222:	curies per year	355	71.2	1,732
Radium-226:	picocuries per gram	271	124	5,605
Uranium-238:	picocuries per gram	161	59.2	315

Alternative 2

Radioactivity		Area A	B	C	Encapsulation[a] area
Radon-222:	curies per 96 weeks	546	120	2,596	0[a]
Radium-226[b]:	curies per 96 weeks	41.8 E-6	0	2.18 E-4	2.34 E-4
Uranium-238[b]:	curies per 96 weeks	2.49 E-6	0	1.22 E-5	1.64 E-5
Radium-226:	picocuries per gram	271	124	5,606	-[c]
Uranium-238:	picocuries per gram	161	59.2	315	-

[a]The radon-222 release is 0 as that value is included in the Area A, B, and C values.

[b]These values are for loading and dumping contaminated materials.

[c]Dashes indicate that no input is required.

Alternative 3

Radioactivity		Area A	Area B	Area C	Encapsulation area
Radon-222:	curies per 96 weeks	546	120	2,596	0
Radium-226:	curies per 96 weeks	41.8 E-6	0	2.18 E-4	2.22 E-4
Uranium-238:	curies per 96 weeks	2.49 E-6	0	1.22 E-5	1.47 E-5
Radium-226:	picocuries per gram	271	124	5,605	-
Uranium-238:	picocuries per gram	161	59.2	315	-

Alternatives 4 and 5

Radioactivity		Area A	Area B	Area C	Pile 1	Pile 2	Pile 3
Radon-222:	curies per 96 weeks	464	118	2,398	2.06	0.20	74
Radium-226:	curies per 96 weeks	1.17 E-4	1.30 E-5	1.32 E-3	---	---	---
Uranium-238:	curies per 96 weeks	6.97 E-5	6.22 E-6	7.40 E-5	---	---	---
Radium-226:	picocuries per gram	271	124	5,605	146	14.3	1,940
Uranium-238:	picocuries per gram	161	59.2	315	86.7	6.83	109

After Alternatives 2 through 5

Radioactivity		Area A	Area B	Area C
Radon-222:	curies per year	2.62	1.15	0.618

F.2.4.2 Burrell site

The Burrell site was divided into two area sources, E (the eastern portion of the site) and W (the western portion of the site), and one pile for above-ground-tailings storage during Alternatives 2 and 4.

Alternative 1

Radioactivity		Area E	Area W
Radon-222:	curies per year	2.13	109
Radium-226:	picocuries per gram	1.78	203
Uranium-238:	picocuries per gram	0.76	21

Alternatives 2 and 4

Radioactivity		Area E	Area W	Pile
Radium-222:	curies per 96 weeks	1.22	62.9	22.8
Radium-226:	curies per 96 weeks	1.53 E-7	1.74 E-5	1.76 E-5
Uranium-238:	curies per 96 weeks	2.94 E-8	8.08 E-7	8.37 E-7
Radium-226:	picocuries per gram	2.05	234	73.7
Uranium-238:	picocuries per gram	0.88	24.2	8.09

Alternatives 3 and 5

Radioactivity		Area E	Area W
Radon-222:	curies per 96 weeks	0.71	36.3
Radium-226:	picocuries per gram	0.59	67.7
Uranium-238:	picocuries per gram	0.25	7.0

After Alternatives 2 through 5

Radioactivity	Area E	Area W
Radon-222: curies per year	2.13	1.07

F.2.4.3 Hanover site

The Hanover site is currently not contaminated with radioactive materials and is evaluated as a potential repository only under Alternatives 4 and 5. This site was considered to be a single area source.

Alternative 4

Radon-222:	curies per 96 weeks	379
Radium-226:	curies per 96 weeks	1.47 E-3
Uranium-238:	curies per 96 weeks	1.51 E-4

Alternative 5

Radon-222:	curies per 96 weeks	113
Radium-226:	curies per 96 weeks	1.45 E-3
Uranium-238:	curies per 96 weeks	1.50 E-4

After Alternatives 4 and 5

Radon-222:	curies per year	2.52

Appendix F.3

RADIOLOGICAL IMPACT ASSESSMENTS

Appendix F.3

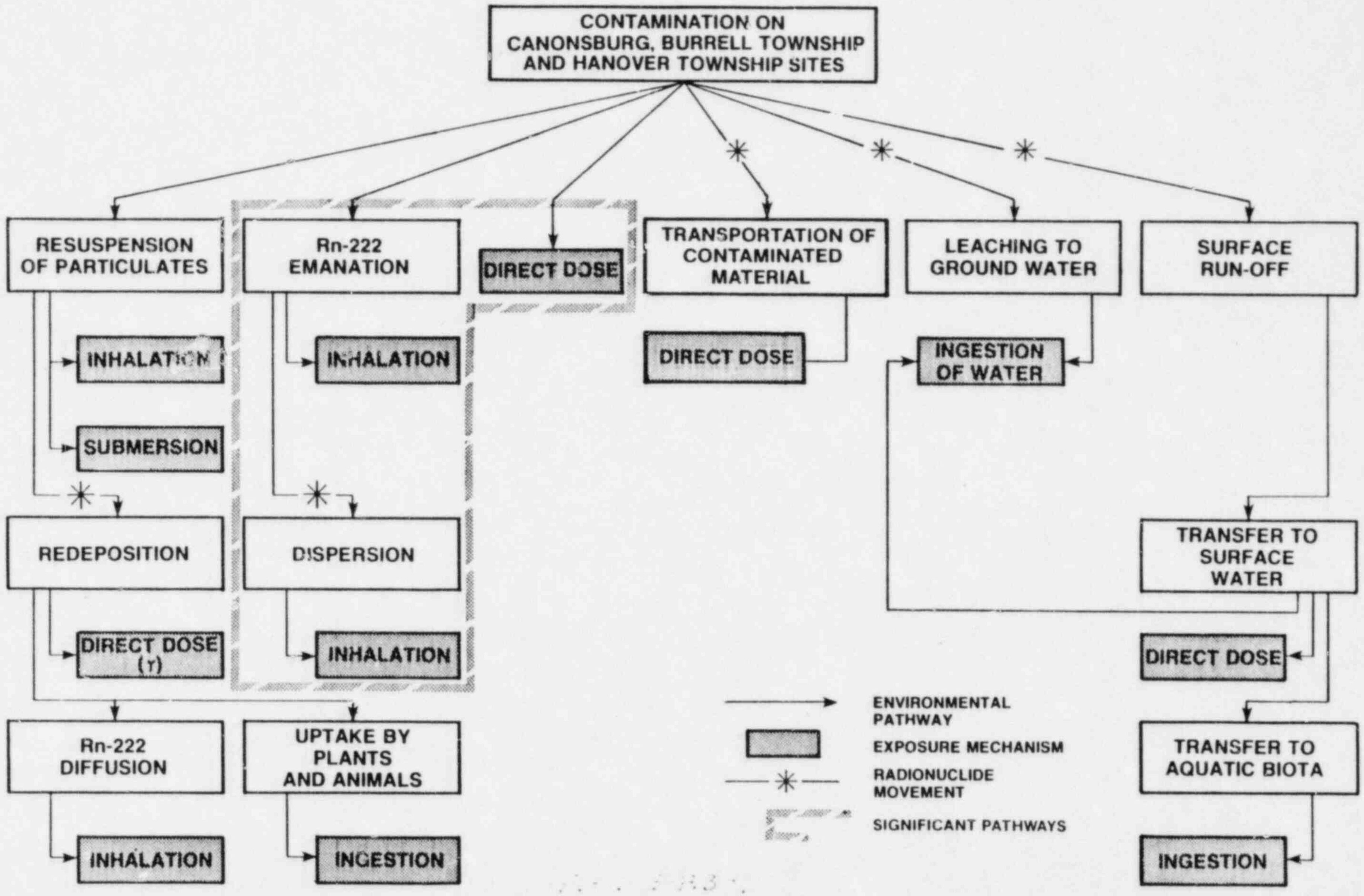
RADIOLOGICAL IMPACT ASSESSMENTS

F.3.1 Exposure pathways

Potential exposure pathways by which people could be exposed to radioactive materials during this project are shown on Figure F.3-1. The pathways of concern are inhalation of radon gas and particulate radioactive materials, and external exposure due to submersion in a radioactive cloud and materials deposited on or already in the ground. Exposure of individuals to radioactive materials in surface water for the no-action alternative is insignificant. Based on a projected soil loss of 1.15 tons per year from Area C, the most contaminated area, into Chartiers Creek, the resultant increase in radionuclide concentrations would be approximately 0.3 picocurie per liter, essentially undetectable. This concentration is not expected to increase during any of the remedial-action alternatives and thus is not evaluated. Another pathway that is usually included in a radiological assessment, but is omitted here, is the food ingestion pathway. Since there is no significant agricultural land use near any of the sites, it is reasonable to assume that radiological impacts along this pathway are minimal.

During the remedial action there will be no planned releases of radioactive materials directly into surface waters or into ground-water systems. The only releases that could occur, under normal operating conditions, would be because of the unavoidable release of small amounts of radioactivity resulting from the remedial action. If an accident occurred, potentially greater amounts of radioactive materials could be introduced to surface or ground waters; however, since neither Chartiers Creek nor the Conemaugh River are drinking-water sources and ground water from the sites enters these surface waters directly, this potential exposure pathway is not significant. Thus, while there is a slight possibility of radionuclide contamination, the amounts involved will be minimal, and the dilution factor high; therefore, the impacts from the waterborne-exposure pathway to the general public becomes insignificant for this radiological assessment.

In order to evaluate the effects of exposure via the two pathways of concern, the radiation doses have been calculated, and the health effects based on these doses have been determined. In all dose calculations the average radioactivity levels, less the normal background levels, are used for impact evaluation. Thus, the excess radiation exposures and health effects that would occur as a result of remedial action on the Canonsburg and Burrell sites have been calculated. The specific evaluation techniques are summarized in the paragraphs that follow.



POTENTIAL RADIATION EXPOSURE PATHWAYS TO THE GENERAL PUBLIC AND REMEDIAL ACTION WORKERS

The health effects from inhalation of radon-daughter products and other airborne radionuclides and direct external gamma radiation are calculated by considering the measured or predicted dose and the size of the population exposed. The units for expressing these doses are the rem (where 1 rem is approximately equal to 1 roentgen) and the man-rem. The number of man-rems is determined by multiplying the dose in rems by the number of persons exposed.

F.3.2 Methods of impact assessment

Radiation doses to the general population and remedial-action workers were evaluated using the MILDOS computer program (U.S. NRC, 1980), which is described in Appendix F.2. The MILDOS program provides estimates of potential radiation exposure to individuals in the vicinity of a uranium-mill-tailings-disposal site. The inputs to this program consist of the following:

1. Population distribution data.
2. Meteorological data.
3. Radionuclide-emission-rate data.
4. Radionuclide-concentration data.

The meteorological and population data used are described in Appendices B.1 and G of this EIS, respectively.

The radionuclide-emission rates used were of several kinds: the emission of radon from the surface, especially from newly exposed material; particulates made airborne by wind erosion; and particulates resulting from loading trucks. Surface radon-222 releases were inferred from radium-226 concentrations as reported by ORNL (Leggett et al., 1978, 1979) using the relation, 1 picocurie per gram of radium-226 = 1 picocurie per square meter per second of radon-222.

The release of wind-eroded particulates depends on the areas of nuclide-containing material exposed during the remedial actions. These areas were obtained from the engineering plans for the alternatives outlined in Section 3.1. MILDOS contains wind-suspension factors based on experimental data. During truck loading of contaminated material, some contaminated particulates (dust) are picked up by the wind. This process and the amount of such dust are described in Section 5.3 and Appendix B.2. In estimating the amounts of airborne particulates, no credit was taken for the fugitive dust control techniques described in Section 5.21.

The outputs from this program include estimates of the radiological doses from inhalation of radon-daughter products and other radionuclides and from external exposure to gamma radiation.

In Alternatives 4 and 5, people are exposed to gamma radiation from passing trucks containing contaminated material from Canonsburg. This material contains a trace amount of radioactivity; the measured gamma levels on the Canonsburg site average 227 microroentgens per hour at a height of 3 feet (1 meter). At greater distances the levels will be less. The radiation dose commitment to the public from passing trucks has been calculated using equation F.3-1, assuming a population density of 2000 people per square mile and an average truck speed of 10 miles per hour.

$$D = \frac{2KP_d}{V} \int_d^{\infty} \frac{e^{-\mu r} B(r)\,dr}{r\sqrt{r^2 - d^2}} \qquad (F.3\text{-}1)$$

Where:

- D = Dose commitment.
- K = Dose rate factor (227 microroentgens).
- P_d = Population density (0.00076 people per square meter).
- V = Truck speed (10 mph).
- μ = Attenuation coefficient (0.0035 per meter).
- r = Maximum distance from source.
- $B(r)$ = Buildup factor (1).
- d = Minimum distance from source.

This dose commitment is about 0.01 man-microrem per loaded truck-mile. The dose commitment for truck drivers is about 22 man-microrems per loaded truck-mile.

Under Alternative 2 materials are brought from Burrell to Canonsburg. Using equation F.3-1 and a dose rate factor of 11 microroentgens, the population exposure is approximately 0.0005 man-microrem per loaded truck-mile and the dose commitment for the truck drivers is approximately 0.1 man-microrem per loaded truck-mile. Similarly under Alternative 4, the Burrell residues are transported to Hanover, and the population exposure is approximately 0.0002 man-microrem per loaded truck-mile based on a population density of 0.00036 people per square meter around the Burrell site. The truck driver dose commitment remains unchanged at 0.1 man-microrem per loaded truck-mile.

Excess cancer deaths due to radiation exposure were calculated using the following risk factors (National Academy of Sciences, 1980; Cohen, 1981; Evans, et al, 1981):

1. Lung cancer deaths from inhalation of radon-daughter products = 20 per lifetime of the exposed population per 1,000,000 man-rems

2. All cancer deaths from gamma exposure = 120 per lifetime of the exposed population per 1,000,000 man-rems

A man-rem is the product of the average radiation dose commitment and the number of people receiving that dose. It is the dose-measurement unit used in this report. Excess cancer deaths from continuous, long-term exposure are taken as 32.5 times the above figures, 32.5 being the average remaining years of life of the populace.

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Appendix G

LAND USE, POPULATION, AND SOCIOECONOMICS

Appendix G

LAND USE, POPULATION, AND SOCIOECONOMICS

G.1 INTRODUCTION

This appendix contains a description of the socioeconomic surveys performed in the Canonsburg, Burrell, and Hanover site areas, and survey results used in preparing Sections 4.9, 4.11, and 4.12. This supporting material is presented in the order in which it is discussed in the main text.

G.2 SOCIOECONOMIC ELEMENT

G.2.1 Canonsburg site

The socioeconomic work element for this study was developed through the steps discussed in the paragraphs that follow.

G.2.1.1 Step 1: Data review -- baseline information gathering

Under this step the site and the communities within the 1-mile radius and the 5-mile radius of the site were identified on USGS quads. The municipalities within the 1-mile radius and in Washington County, in which the site is located, were contacted by telephone calls, letters, and visits to the municipal and county offices and real-estate agencies to collect baseline information on socioeconomic, land-use, and transportation-related data. The information collected included the following:

1. Local and county land-use studies and comprehensive plans.
2. Local area population distribution and projections.
3. Employment locations.
4. Municipal zoning and subdivision regulations.
5. Recreational studies.
6. Traffic patterns and transportation networks.
7. Community facilities and utility services.
8. Tax structure and revenue sources.

State and Federal agencies were contacted for transportation, population, and historical and archaeological information.

From a preliminary review of the available data, it was concluded that there was a need for a socioeconomic door-to-door survey covering the 1-mile radius area, especially to estimate the current population, and their type of employment, outdoor activities, food habits, etc.

G.2.1.2 Step 2: Conduct detailed field surveys

The data collected under step 1 were updated or supplemented by conducting windshield surveys within the 1-mile radius analysis area. This survey helped in organizing the door-to-door socioeconomic survey conducted during the week of September 24, 1979.

In preparation for the socioeconomic survey, a two-page questionnaire with 28 related items was prepared, and given approval by the DOE program office. (A copy of this questionnaire follows.) Local municipalities were contacted by telephone and by letter requesting their cooperation with the survey team. The local residents were also informed of the survey through press releases to local newspapers.

The survey team consisted of four persons led by a Weston senior staff person (a certified planner). After a reconnaissance survey of the 1-mile radius area, each team member took a different street, and visited every fourth house on either side of the street within the one-quarter-mile radius area, every eighth house within the one-quarter to one-half-mile zone, and every fifteenth house within the one-half to 1-mile zone. The homes visited were identified on a master map; comparisons were made at regular intervals to avoid duplication of survey effort. The survey covered more than 10 percent of the households within the 1-mile radius area. The major types of data obtained from the survey included the following:

1. Population living in each sector and within the three zones; up to one-quarter mile, one-half mile, and 1-mile from the site.

2. Age distribution.

3. mployment location.

4. Family income.

5. Time spent in outdoor activities.

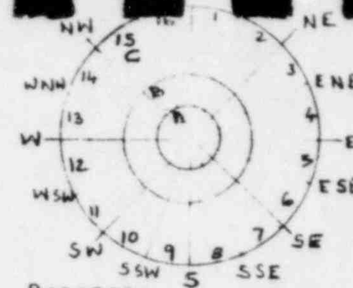
6. Produce raised in vegetable gardens, and use of area wells.

7. Ethnic background of the population.

Contacts were made with local municipalities and regional, state, and Federal agencies to supplement or update the data collected under step 1.

G.2.1.3 Step 3: Baseline data documentation and impact assessment

The data collected in steps 1 and 2 were analyzed and documented in the format specified in the Contents of Environmental Impact Statements (Sandia National Laboratories, 1981). The impacts of the remedial-action alternatives on the socioeconomic setting of the Canonsburg site were determined and documented in accordance with the guidelines. The major items considered were the following:



SOCIO ECONOMIC SURVEY

QUESTIONNAIRE

1. Street Address . . . . Municipality . . . .
2. Previous Address . . . . Municipality . . . .
3. Duration of stay at the Present Address (No. of years)
   (A) 0-2 (B) 2-5 (C) 5-10 (D) 10-20 (E) >20
4. Type of Home:
   (A) Single Family (B) Apartment (C) Town House (D) Duplex/Twin (E) Other
5. Number of persons presently living at this address
6. Age/Sex Distribution of Occupants:

	0-1 ≤	1-5 ≤	5-11 ≤	11-17 ≤	17-40 ≤	40-65 ≤	65 and >
Male							
Female							

7. Estimate of time (hours/day) spent at home:

Male							
Female							

8. Number of employed persons: (A) 1 (B) 2 (C) 3 (D)>3
9. Place of Employment:
   (A) Canonsburg/Houston (B) North Strabane (C) Chartiers (D) Cicil/Peters
   (E) South Strabane (F) Washington/Pittsburg (G) Other
10. Distance to work (miles): (A)<1 (B) 1-2 (C) 2-5 (D)>5
11. Mode of Travel: (A) Car (B) Bus (C) Walk (D) Other
12. Type of Occupation (such as Teacher, Executive, Clerical, Coal Miner, etc.)
13. Duration of Work (Hours Per Week):
    (A) 0-20 (B) 20-40 (C) 40-60 (D) 60-80 (E) >80
14. Number of Working Hours spent in the Open:
    (A) None (B) 0-20 (C) 20-40 (D) 40-60 (E) 60-80 (F) >80

    (Note: If response to Question 8 is other than (A), complete for (B) and (C) similar to that of (A)).
15. Did you ever work at Canon Industrial Park? (A) Yes (B) No
16. If yes, When? (A) At present, since 19 . .
    (B) During 19 . . to 19 . . Period
17. Annual family income ($1,000):
    (A)<5 (B) 5-10 (C) 10-15 (D) 15-25 (E) >25

Response

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SOCIO ECONOMIC SURVEY

QUESTIONNAIRE (CONTINUED)

Response

18. Outdoor activities of members of household:
    (A) Hiking (B) Biking (C) Swimming (D) Gardening (E) Other 18

19. Use of Chartiers Creek for:
    (A) Fishing (B) Boating (C) Swimming (D) Other 19

20. Did/do your children play in/around Canon Industrial Park?
    (A) Yes (B) No 20

21. If yes, 1. When? (A) At present (B) Previously 21.1
    2. For how long? (hours/day)
    (A) < 2 (B) 2-5 (C) > 5 hours 21.2

22. Transient use of Canon Industrial Park and vicinity:
    (A) Regular (B) Occasional (C) Seldom 22

23. If (A) Regular, purpose of such use:
    (A) Drive thru (B) Hike (C) Walk (D) Other 23

24. Use of backyard/frontyard of your home:
    (A) Recreational (B) Vegetable garden (C) Other 24

25. If you have a vegetable garden,
    1. Type of products:
    (A) Leafy vegetables (lettuce, spinach, cabbage, . . .
    (B) Root variety (carrots, beats, potatoes, onions, radishes, . . .
    (C) Others (beans, cauliflower, tomato, peas, ... 25.1
    2. Use of garden products: (A) Home Consumption (B) Sale (C) Friends/Relatives 25.2
    3. Duration of consumption: (A) Seasonal (B) Year-round 25.3
    4. Vegetable produced from the garden and used for home consumption as percent of total required vegetable diet for the season/year.
    (A) < 25 (B) 25-50 (C) 50-75 (D) 75-100 . . . . 25.4
    5. If sold/given away, to: (A) Neighbor (B) General area (C) Outside 25.5
    6. Method of preservation, if applicable. 25.6
    7. Do you use surface or groundwater for your garden? (A) Yes (B) No 25.7
    8. If yes, which? (A) surface water (B) Groundwater (C) Other 25.8
    9. Is there any other home-grown products?
    (A) None (B) Milk (C) Egg (D) Meat (E) Fruit (F) Other 25.9

26. Do you have an on-site well? (A) Yes (B) No 26

27. If yes, 1. Depth of the well (ft.) 27.1
    2. Depth of the casing of the well (ft.) 27.2

28. Ethnic background of the household. 28

Survey conducted by Roy F. Weston, Inc., West Chester, Pennsylvania, as supplemental data for the preparation of the Environmental Impact Statement for the Canon Industrial Park vicinity, Canonsburg in Washington County, PA, September 1979

1. Loss of employment at the Canon Industrial Park.

2. Temporary employment during the project execution period.

3. Potential for new employment and economic growth after the cleanup effort is completed.

4. Changes in the tax base of the site and the vicinity properties, including their market values.

5. Effect on the residential communities in the vicinity of the site.

6. Effect on community services including schools, hospitals, utilities, police and fire, and recreation from changes in the number of users.

7. Effect on the local streets and their users during and after the completion of the project.

G.2.2 Burrell site

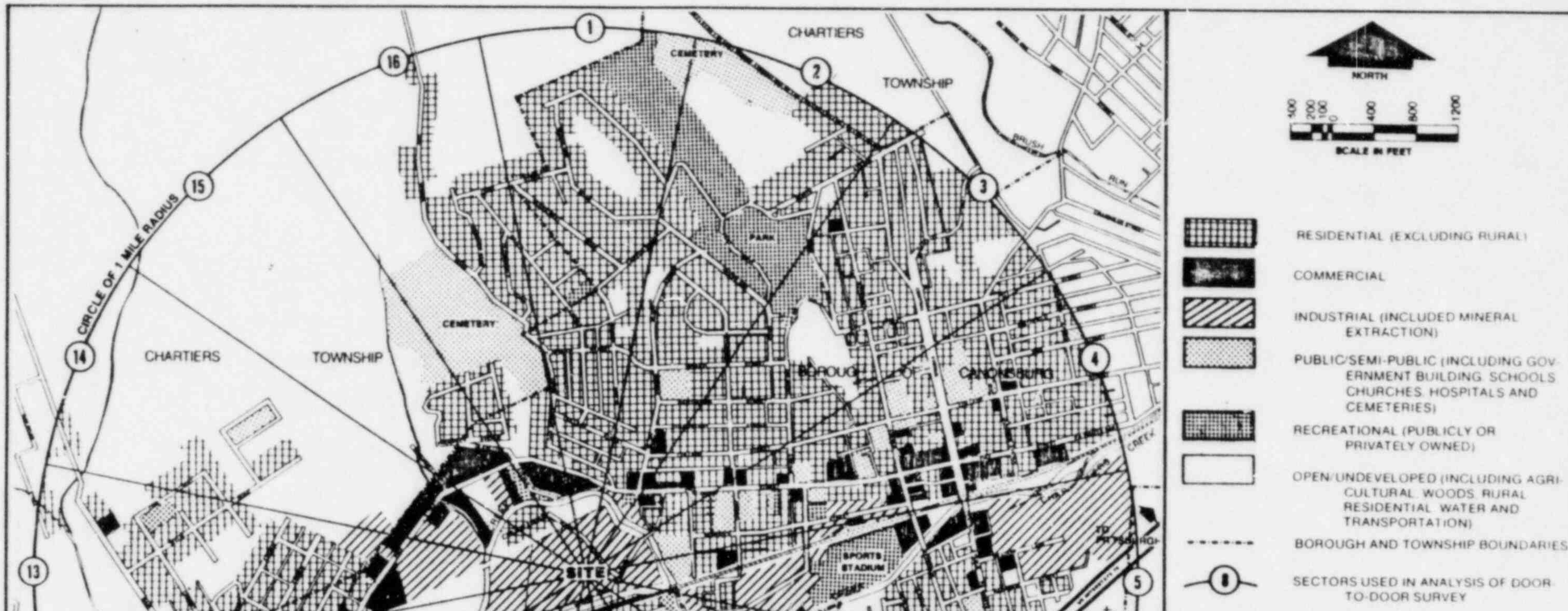
Except for the door-to-door socioeconomic survey, all of the steps used for the Canonsburg site were also used for Burrell to prepare the baseline socioeconomic setting and impact assessment. The study-area communities were determined and identified on the USGS quads using aerial photographs of the area from the U.S. Army Corps of Engineers office associated with the Conemaugh Reservoir project.

The 1-mile radius analysis area included parts of Burrell Township and Blairsville Borough in Indiana County and Derry Township in Westmoreland County. Thus, most of the baseline data were collected through contacts and visits to the respective municipal and county agencies. The local area population distribution and land-use data were collected through a series of windshield surveys conducted by Weston personnel and assisted by the local municipal authorities. In addition, meetings were held on three occasions with the representatives of the associated municipalities and the Torrance State Hospital.

G.2.3 Hanover site

Much of the information on the Hanover site and its vicinity was obtained through a review of aerial photographs, and contacts with Washington County and Hanover and Jefferson Township officials. In addition, local real-estate agencies and state and Federal agencies were contacted for data on the economic growth potential of the site and its vicinity, and the transportation network in the general area connecting the site with the Canonsburg and Burrell sites.

A field reconnaissance survey was conducted to identify the land uses and population distribution within the 1-mile radius of the site. The baseline information and impact assessment were documented in a manner similar to the Canonsburg site.



SOURCES

1. LAND USES — DOOR TO DOOR SOCIOECONOMIC SURVEY, SEPTEMBER 1979, AND WINDSHIELD SURVEY, FEBRUARY 1982
2. MAP FROM BOROUGH AND TOWNSHIP MAPS CHECKED AGAINST PENNDOT COUNTY MAP (WASHINGTON CO. – 1976) AND USGS 7½ MIN QUADS (PHOTO-REVISED TO 1969)

FIGURE
EXISTING LAND USES — 1980, IN THE VICINITY OF THE CANONSBURG SITE

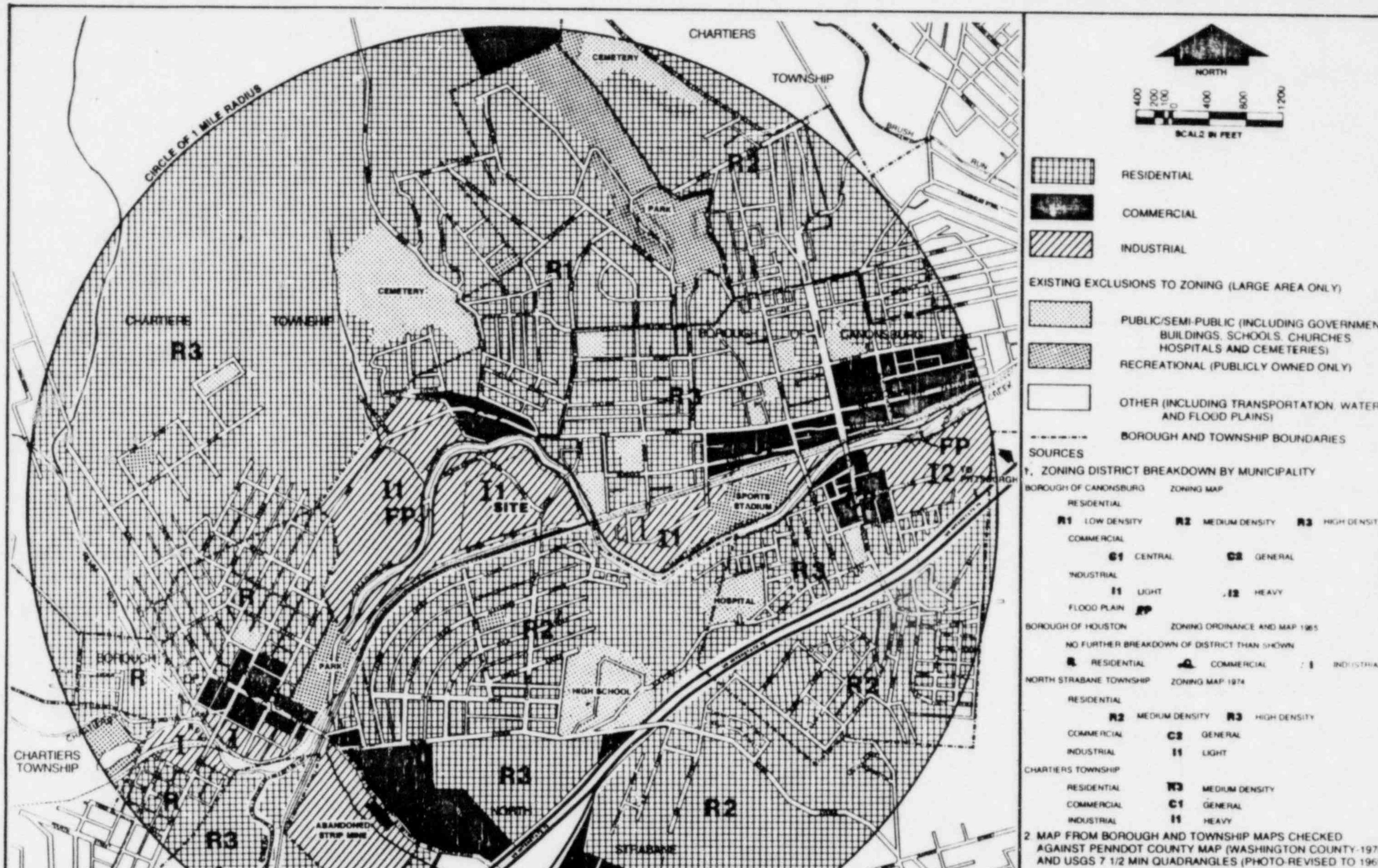
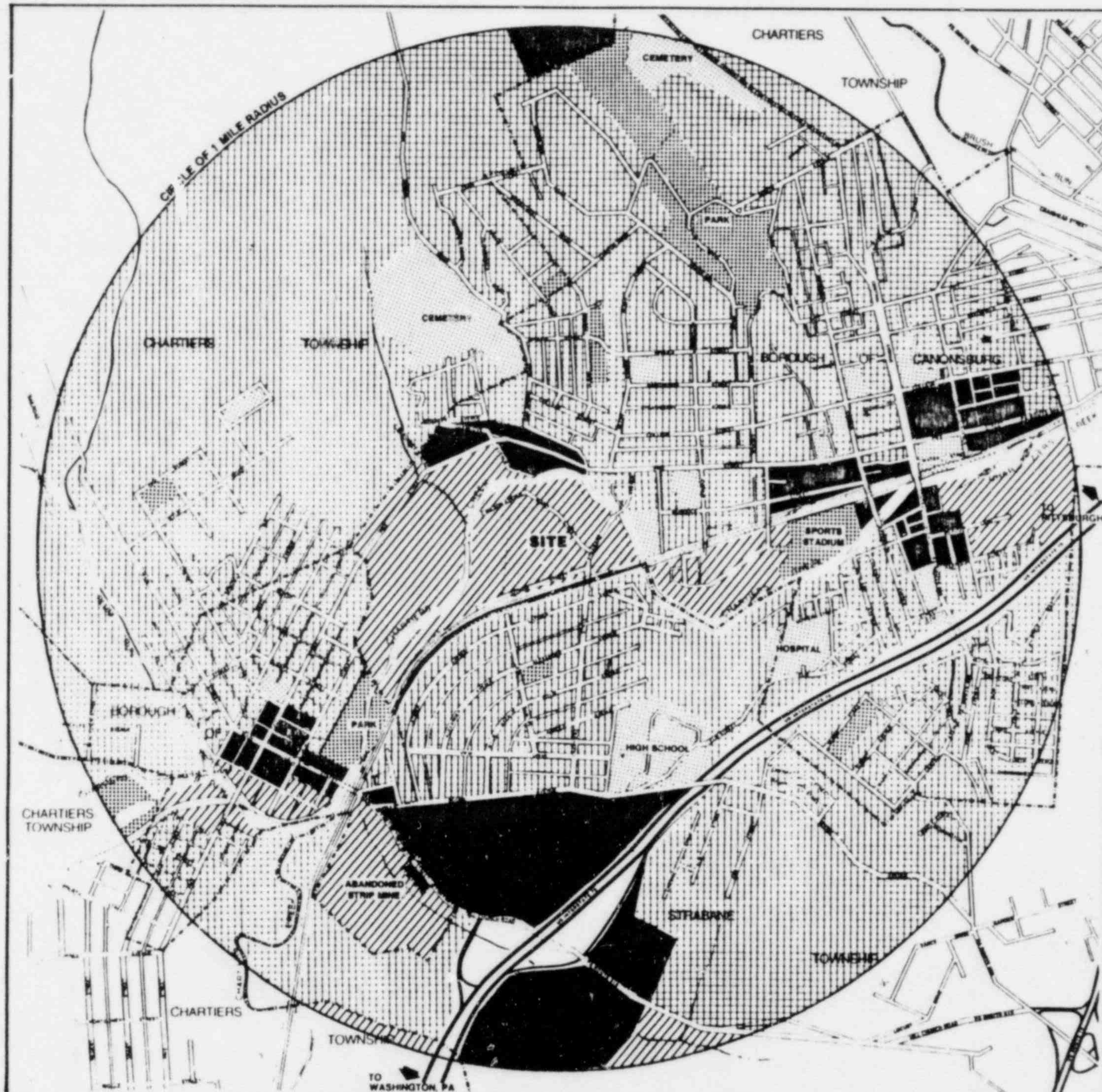


FIGURE
LAND USE ZONING IN THE VICINITY OF THE CANONSBURG SITE



RESIDENTIAL (INCLUSIVE OF ALL DENSITIES)

COMMERCIAL

INDUSTRIAL

PUBLIC/SEMI-PUBLIC (INCLUDING GOVERNMENT BUILDINGS, SCHOOLS, CHURCHES, HOSPITALS AND CEMETERIES)

RECREATIONAL (PUBLICLY OWNED ONLY)

OTHER (INCLUDING TRANSPORTATION, WATER AND FLOOD PLAIN)

BOROUGH AND TOWNSHIP BOUNDARIES

SOURCES:

1. BOROUGH OF CANONSBURG - COMPREHENSIVE PLAN 1971
   BOROUGH OF HOUSTON (NO COMPREHENSIVE PLAN, USE OF ZONING)
   NORTH STRABANE TOWNSHIP - COMPREHENSIVE PLANNING PROGRAM PARK AND RECREATION PLAN 1977
   CHARTIERS TOWNSHIP - MASTER PLAN 1974
2. MAP FROM BOROUGH AND TOWNSHIP MAPS CHECKED AGAINST PENNDOT COUNTY MAP (WASHINGTON COUNTY 1976) AND USGS 7 1/2 MIN QUADRANGLES (PHOTO-REVISED TO 1969)

FIGURE
FUTURE LAND USE PLAN IN THE VICINITY OF THE CANONSBURG SITE

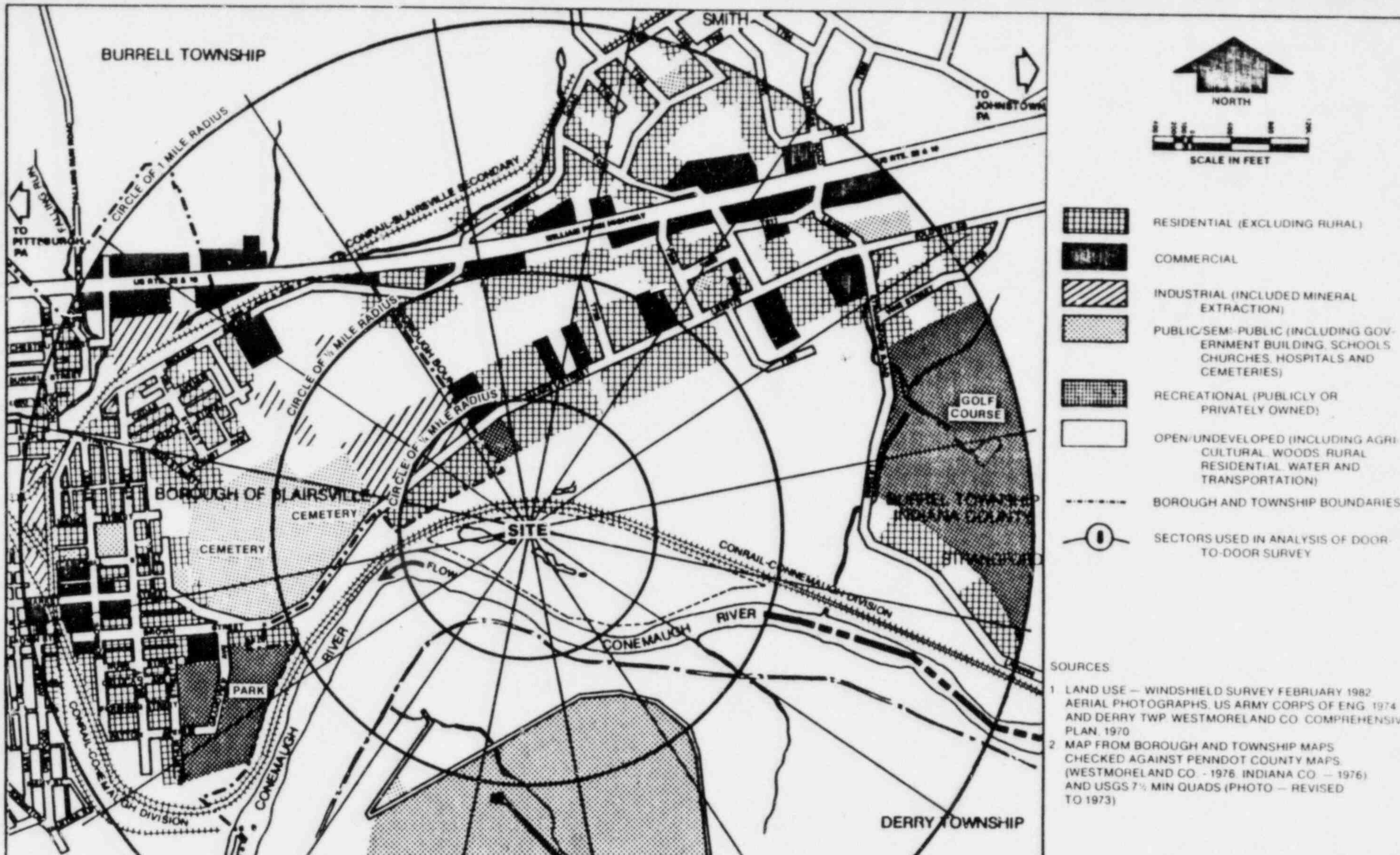


FIGURE
EXISTING LAND USES — 1980 IN THE VICINITY OF THE BURRELL TOWNSHIP SITE

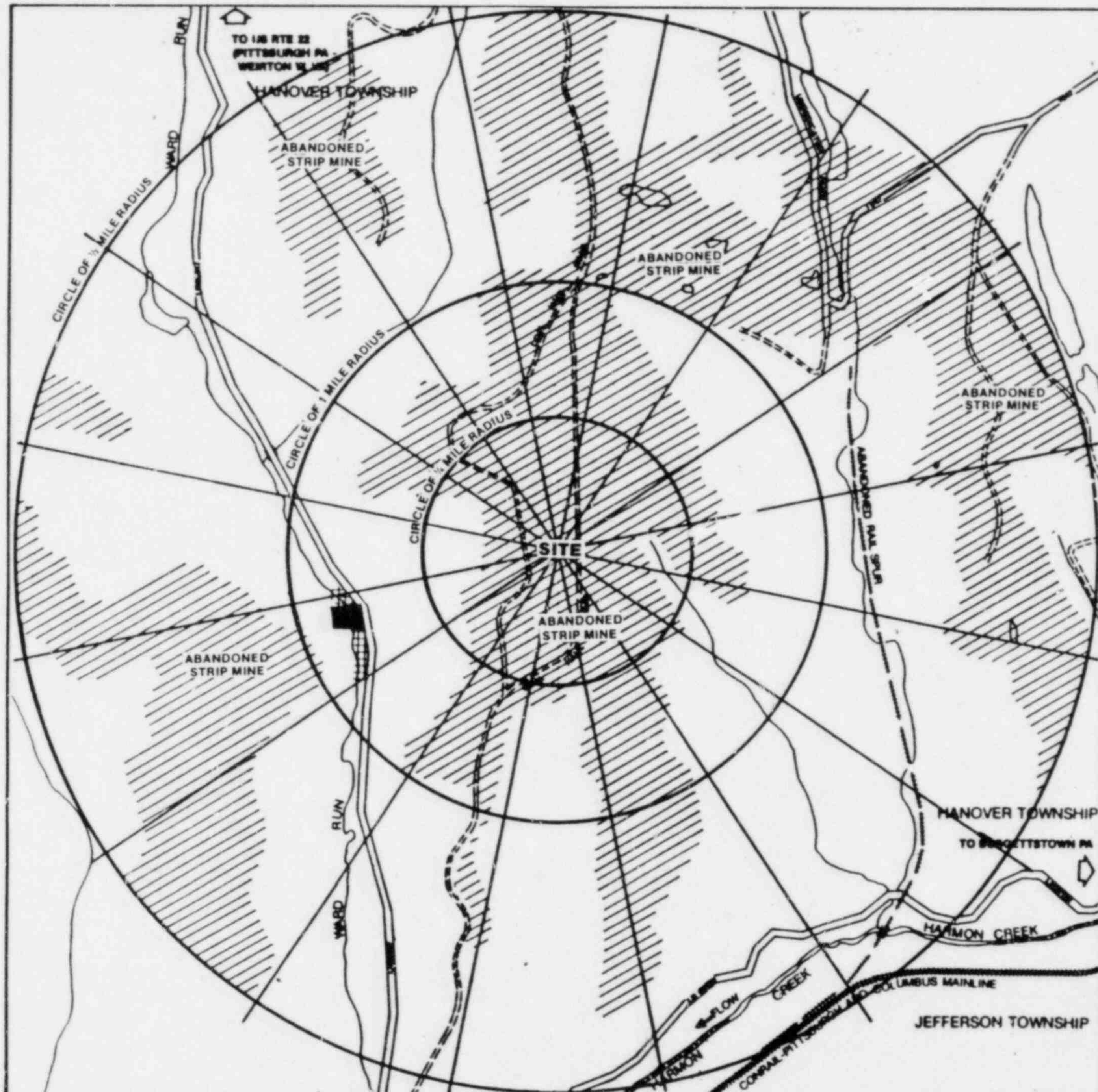


FIGURE
EXISTING LAND USES — 1980 IN THE VICINITY OF THE HANOVER TOWNSHIP SITE

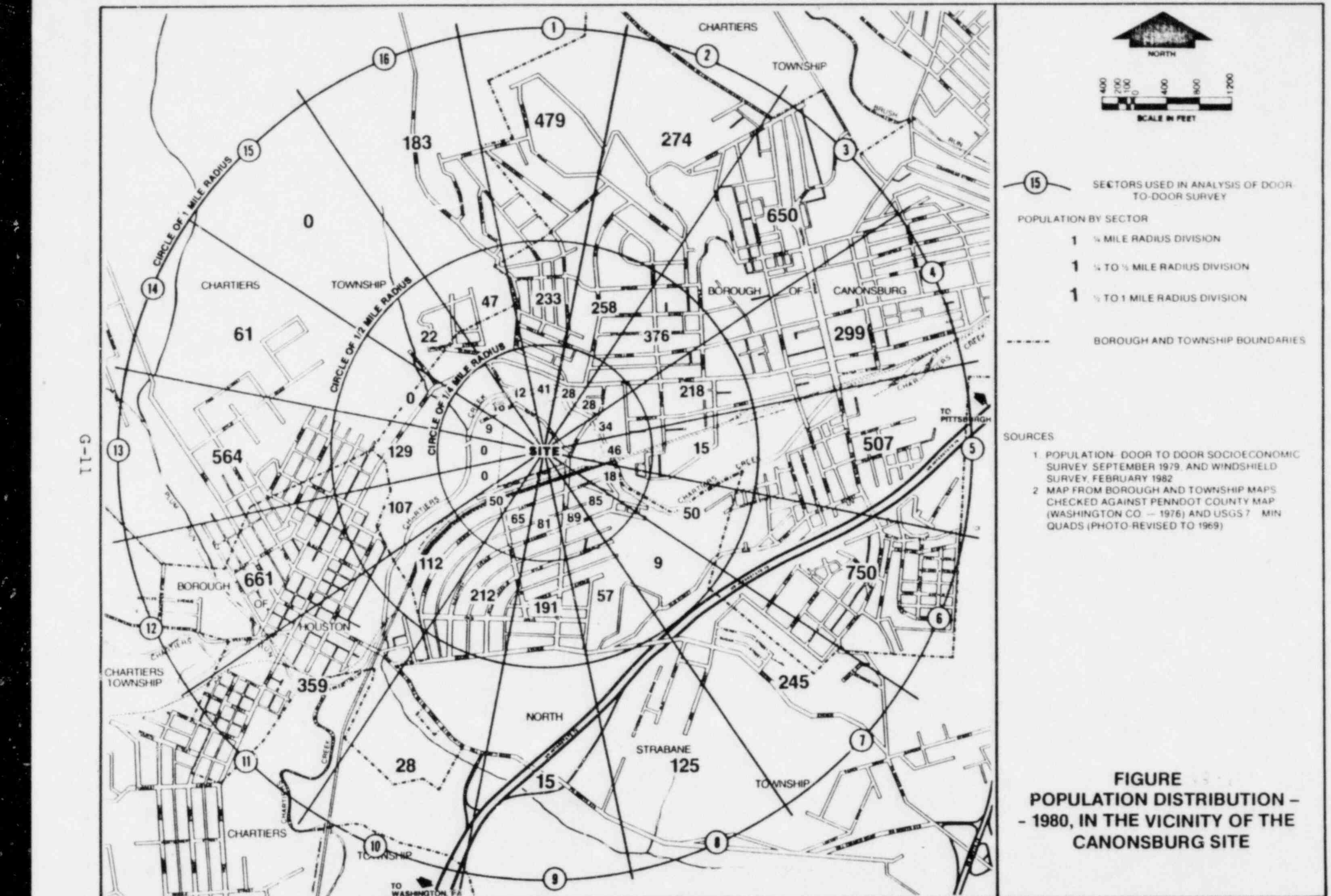


FIGURE
POPULATION DISTRIBUTION – 1980, IN THE VICINITY OF THE CANONSBURG SITE

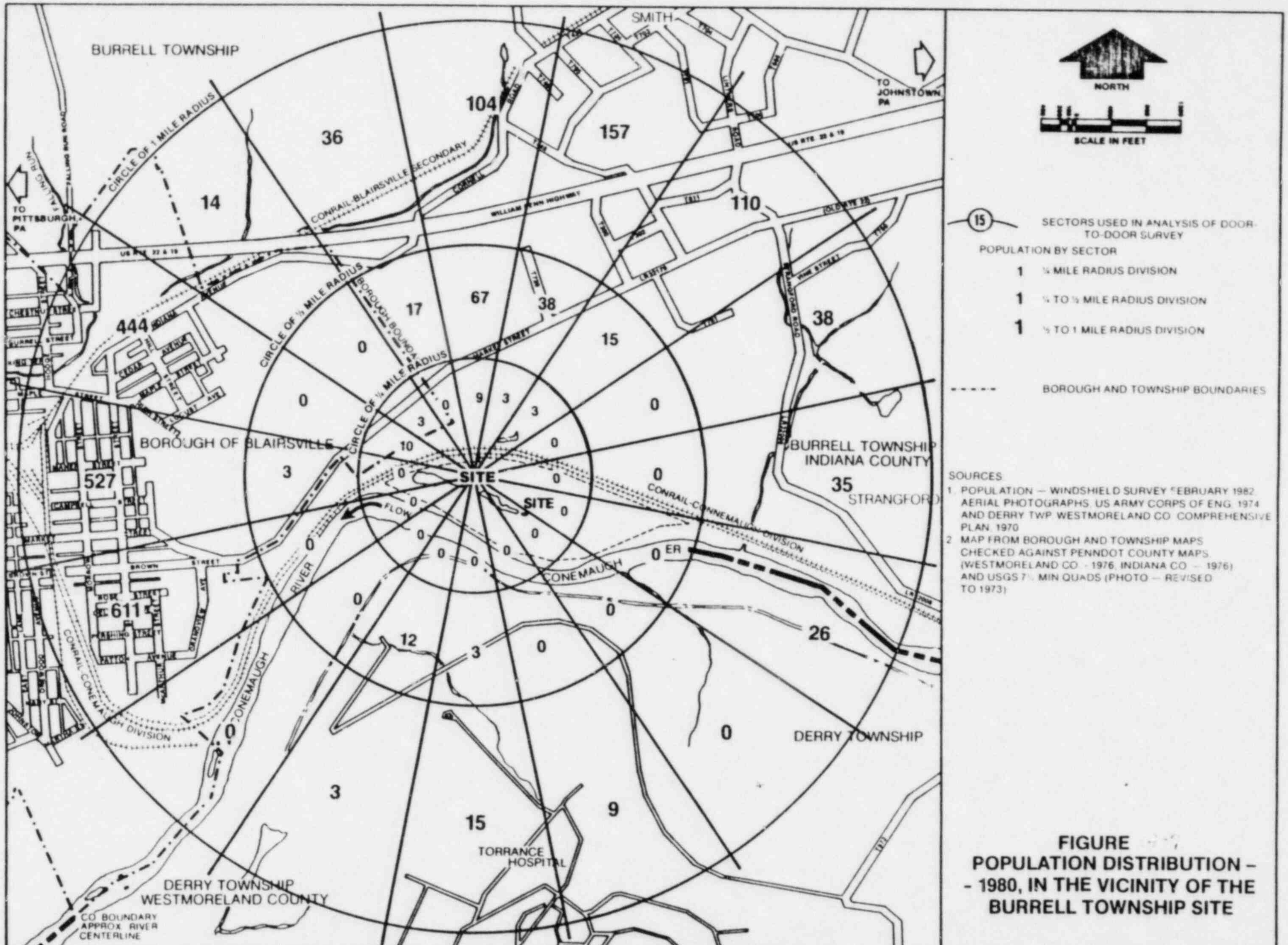


FIGURE
POPULATION DISTRIBUTION – 1980, IN THE VICINITY OF THE BURRELL TOWNSHIP SITE

Table G-1. Generalized land uses -- Canonsburg site vicinity

Land-use category	Distance from site (miles) 0 - 1/4 Acres	0 - 1/4 % of Total	1/4 - 1/2 Acres	1/4 - 1/2 % of Total	1/2 - 1 Acres	1/2 - 1 % of Total	Total Acres	Total % of Total
Residential (excluding rural)	32	25.4	112	29.7	390	25.9	534	26.6
Commercial	9	7.1	19	5.0	20	1.3	48	2.4
Industrial	33	26.2	23	6.1	60	4.0	116	5.8
Public/semi-public	5	4.0	44	11.7	50	3.3	99	4.9
Recreational	4	3.2	14	3.7	40	2.7	58	2.9
Open, undeveloped	43	34.1	165	43.8	947	62.8	1155	57.4
Total	126	100.0	377	100.0	1507	100.0	2010	100.0

Notes: Refer to Figure G-1.
Industrial -- Also includes quarries and strip-mining areas.
Public/semi-public -- Includes government buildings, schools, churches, hospitals, and cemeteries.
Recreational-(public or private) -- Parks, etc., including halls, clubs, bowling alleys, and open spaces.
Open/undeveloped -- Agricultural, rural-residential, woods, water bodies, and transportation networks.

Sources: U.S. Geological Survey quads; socioeconomic survey, September 1979; site visits, April and July 1981, January 1982; reviews of community data and reports.

Table G-2. Generalized land uses -- Burrell site vicinity

Land-use category	Distance from site (miles) 0 - 1/4 Acres	0 - 1/4 % of Total	1/4 - 1/2 Acres	1/4 - 1/2 % of Total	1/2 - 1 Acres	1/2 - 1 % of Total	Total Acres	Total % of Total
Residential (excluding rural)	13	10.3	26	6.9	166	11.0	205	10.2
Commercial	1	0.8	2	0.5	77	5.1	80	4.0
Industrial	3	2.4	38	10.1	23	1.5	64	3.2
Public/semi-public	0	0	57	15.1	274	18.2	331	16.5
Recreational	1	0.8	2	0.5	112	7.4	115	5.7
Open, undeveloped	108	85.7	252	66.9	855	56.8	1215	60.4
Total	126	100.0	377	100.0	1507	100.0	2010	100.0

Notes: Refer to Figure G-4.
Industrial -- Also includes quarries and strip-mining areas.
Public/semi-public -- Includes government buildings, schools, churches, hospitals, and cemeteries.
Recreational-(public or private) -- Parks, etc., including golf courses, halls, clubs, and open spaces.
Open/undeveloped -- Agricultural, rural-residential, woods, water bodies, and transportation.

Sources: U.S. Geological Survey quads; site visits, April and July 1981, January 1982; reviews of community data and reports; meetings with representatives of municipalities and institutions.

Table G-3. Generalized land uses -- Hanover site vicinity

Land-use category	Distance from site (miles) 0 - 1/4 Acres	0 - 1/4 % of Total	1/4 - 1/2 Acres	1/4 - 1/2 % of Total	1/2 - 1 Acres	1/2 - 1 % of Total	Total Acres	Total % of Total
Residential (excluding rural)								
Commercial			2	0.5			2	0.1
Industrial	100	79.4	173	45.9	523	34.7	796	39.6
Public/semi-public								
Recreational								
Open, undeveloped	26	20.6	202	53.6	984	65.3	1212	60.3
Total	126	100.0	377	100.0	1507	100.0	2010	100.0

Notes: Refer to Figure G-5.
Industrial -- Also includes quarries and strip-mining areas.
Open/undeveloped also includes rural-residential, agricultural, water bodies, and transportation.

Sources: U.S. Geological Survey quads; site visit, January 1982; review of community data and reports; and contact with representatives of county and municipal agencies.

Table G-4. Structures of historical interest located in the general vicinity of the sites

Structure/Location	Date
Canonsburg Site	
Black Horse Tavern North Central Avenue, Canonsburg A favorite rendezvous for the Whiskey Insurrectionists	1790
John Hegarty House Houston	1805
Hill Church Route 19, North Strabane Township	1776
Jefferson Academy (old Jefferson College Building) North Central Avenue, Canonsburg	1780
Pittsburgh National Bank Pike and Central Streets	1850
Polish National Church College Street	Early 20th century
Quail House Route 19, Canonsbu[illegible]	1832
St. John's Russian Orthodox Church Vine Street, Canonsburg	1918
St. Michaels Byzantine Catholic Church East College Street	1949
Tenement House Pike Street, Canonsburg	1840
Burrell Site	
None	
Hanover Site	
Florence Academy Old Route 22	1833
Phillips House Route 538, Kings Creek Road	1820
Smith, Della House Route 352, Burgettstown	1820
Tucker Methodist Episcopal Church Route 22, 2 miles west of Florence	1824
Wallace House Route 18 North	

Source: Washington County Planning Commission, 1979a.

Table G-5. Population distribution by direction -- 1980: Canonsburg site vicinity

Sector	Direction	Population at distance from site (miles) 0-1/4	1/4-1/2	1/2-1	Total
1	N	41	233	479	753
2	NNE	28	258	274	560
3	NE	28	376	650	1054
4	ENE	34	218	399	651
5	E	46	15	507	568
6	ESE	18	50	750	818
7	SE	85	9	245	339
8	SSE	89	57	125	271
9	S	81	191	15	287
10	SSW	65	212	28	305
11	SW	50	112	359	521
12	WSW	0	107	661	768
13	W	0	129	564	693
14	WNW	9	0	61	70
15	NW	16	22	0	38
16	NNW	12	47	183	242
	Total	602	2036	5300	7938

Sources: Socioeconomic survey, September 1979; U.S. Bureau of the Census, 1980 census advance counts.

Table G-6. Age and sex characteristics -- 1980: Canonsburg site vicinity

Age group	Percent distribution		
	Male	Female	Total
Less than 1 year	2.4	0.6	1.5
1 to 5 years	3.8	3.5	3.6
5 to 11	8.0	10.1	9.0
11 to 17	12.4	12.1	12.3
17 to 40	29.2	29.2	29.2
40 to 65	31.6	28.4	30.0
65 and over	12.6	16.1	14.4
Total	100.0	100.0	100.0

Source: Socioeconomic survey, September 1979; U.S. Bureau of the Census, 1980 census advance counts.

Table G-7. Historical and future populations of municipalities in the vicinity of the Canonsburg site

Municipality	Historical[a] 1960	Historical[a] 1970	Historical[a] 1980	Projected[b] 1990	Projected[b] 2000
Canonsburg Borough	17,877	11,439	10,459	10,212	9,814
Houston Borough	1,865	1,812	1,568	1,502	1,411
North Strabane Township	7,332	7,578	8,490	9,422	9,534
Chartiers Township	7,225	7,324	7,715	8,606	8,840

Sources:

[a]U.S. Bureau of the Census 1960 and 1970 censuses; 1980 census advance counts.

[b]Washington County Planning Commission, 1981.

Table G-8. Historical and projected population distribution among municipalities within a 1-mile radius of the Canonsburg site

Municipality	Historical (1980) Population	Historical (1980) Percent of total population	Historical (1980) Land area (acres)	Historical (1980) Population (persons/acre)	Projected (2000) Population
Canonsburg Borough	4481	56.4	794	5.64	4293
Houston Borough	1201	15.1	197	6.10	1081
North Strabane Township	1316	16.6	498	2.64	1478
Chartiers Township	940	11.9	521	1.80	1077
Total	7938	100.0	2010	3.95	7929

Sources: U.S. Bureau of the Census, 1980 census advance counts; Tables G-5 and G-7.

Table G-9. Population distribution by direction -- 1980: Burrell site vicinity

Sector	Direction	Population at distance from site (miles)			
		0-1/4	1/4-1/2	1/2-1	Total
1	N	9	67	104	180
2	NNE	3	38	157	198
3	NE	3	15	110	128
4	ENE	0	0	38	38
5	E	0	0	35	35
6	ESE	0	0	26	26
7	SE	0	0	0	0
8	SSE	0	0	9	9
9	S	0	3	15	18
10	SSW	0	12	3	15
11	SW	0	0	0	0
12	WSW	0	0	611	611
13	W	0	3	527	530
14	WNW	10	0	444	454
15	NW	3	0	14	17
16	NNW	0	17	36	53
	Total	28	155	2129	2312

Sources: Photo interpretation of 1974 aerial photographs; U.S. Geological Survey quads for the area; U.S. Bureau of the Census, 1980 census advance counts; contacts with representatives of municipalities and institutions.

Table G-10. Historical and future populations of municipalities - Burrell site vicinity

Municipality	Historical[a] 1960	Historical[a] 1970	Historical[a] 1980	1980 population within 1-mile radius of site[b]: Population	1980 population within 1-mile radius of site[b]: Percent of total population	Projected[c] 1990	Projected[c] 2000
Blairsville Borough	4,930	4,411	4,166	1,636	70.8	4,126	4,640
Burrell Township	3,476	3,672	4,152	634	27.4	4,064	5,096
Derry Township	15,445	15,902	16,193	42	1.8	17,050	19,078
Total				2,312	100.0		

Sources:

[a]U.S. Bureau of the Census, 1960 and 1970 censuses; 1980 census advance counts.

[b]Table G-9, Figure G-7.

[c]Southeastern Pennsylvania Regional Planning Commission, 1980.

Table G-11. Population distribution by direction -- Hanover site vicinity

Sector	Direction	Population at distance from site (miles) 0-1/4	1/4-1/2	1/2-1	Total
1	N	0	0	0	0
2	NNE	0	0	3	3
3	NE	0	0	6	6
4	ENE	0	0	0	0
5	E	0	0	0	0
6	ESE	0	0	0	0
7	SE	0	0	15	15
8	SSE	0	0	9	9
9	S	0	0	0	0
10	SSW	0	0	12	12
11	SW	0	0	12	12
12	WSW	0	9	0	9
13	W	0	0	0	0
14	WNW	0	0	6	6
15	NW	0	0	6	6
16	NNW	0	0	0	0
	Total	0	9	69	78

Sources: Site visit, January 1982; U.S. Bureau of the Census, 1980 census advance counts.

Table G-12. Historical and future populations of municipalities - Hanover site vicinity

Municipality	Historical[a]			Projected[b]	
	1960	1970	1980	1990	2000
Burgettstown Township		2118	1867	1803	1653
Hanover Township	2456	3016	3275	3411	3340
Jefferson Township		1301	1369	1435	1397
Smith Township		5812	5583	5746	5790

[a]U.S. Bureau of the Census, 1960 and 1970 censuses; 1980 census advance counts.

[b]Washington County Planning Commission (1981).

G.3 ECONOMIC STRUCTURE

This subsection presents the characteristics of the economic structure of Canonsburg Borough, Burrell Township, and Hanover Township, including information available at the county, municipal, and local levels. This subsection focuses on the basic economic resources and sources of income in Washington and Indiana Counties.

G.3.1 Canonsburg site

Canonsburg Borough is geographically situated on Interstate Highway 79, which links Washington, the county seat of Washington County, with Pittsburgh. In addition, Canonsburg is located north of Interstate Route 70, which ties into the Pennsylvania Turnpike at New Stanton, east of Canonsburg. Washington County and Canonsburg are significantly influenced by the Pittsburgh economy, as demonstrated by the easterly concentration of population and industry in the county.

In terms of land use, forest land covers 35 percent of Washington County, and crop and pasture land covers an additional 47 percent. The county produces agricultural products valued at $16 to 20 million annually (Washington County Planning Commission, 1979a). The dairy industry leads the county in agricultural sales, with earnings averaging more than $10 million, followed by meat animals ($3 million), poultry ($1.6 million), and field crops ($3.3 million). Most of the revenue produced by Washington County farms remains in the area as families purchase goods and services from local suppliers. In addition, there are more than 70 agriculture-related industries engaged in the manufacture of foods and associated products, with annual payrolls of more than $4 million.

The major industries in the county are coal mining and manufacturing. The total value of industrial production was estimated at $1.145 billion in 1976. Washington County leads all other counties in Pennsylvania in annual coal production and the amount of available coal reserves. More than 12.4 million tons of coal were mined during 1976; 11 million tons were taken from deep mines, and the remainder from strip mines. In 1976, 61 deep and strip mines were operating in Washington County with an average payroll estimated at more than $80 million. The associated support industries producing mining machinery and equipment have an estimated average payroll of over $12 million annually (Washington County Planning Commission, 1979a).

In 1976, manufacturing in Washington County was led by steel and primary metals with an annual payroll in excess of $84 million. The manufacture of electrical machinery was second with an annual payroll of over $45 million, and glass manufacturing equipment was third with a payroll of over $35 million.

Canonsburg Borough is a significant location for industrial activity in the county. At one time, the Canonsburg area (Chartiers and North Strabane Townships) was active in coal mining. Today the area surrounding the borough has many abandoned strip- and deep-mine sites, and is reported to be underlain with mineable coal and natural gas reserves (Kohl and Briggs, 1976; Wagner and Lytle, 1976; Washington County Planning Commission, 1979b). It is believed that no economically recoverable coal deposits lie beneath the Canonsburg site.

The economy of the borough and the surrounding area is typical of the county, supporting agriculture, coal mining, and primary metals. Industries are engaged in manufacturing mining machinery, steel fabrication and distribution, and food preparation and distribution. Machine shops and light-manufacturing high-technology operations are also evident.

G.3.2 Burrell site

The Burrell site can be reached from Pittsburgh by U.S. Highway 22, and is characterized by commercial and light industrial development. Indiana, the largest city in Indiana County, is located 10 miles north of the Burrell site in the central part of the county.

In 1977, the county produced more than 10.5 million tons of coal and ranked second to Washington County in total coal production in the western 27-county region. Indiana County, with 54 percent of its area in forest land, is the leading producer of forest and maple products in the state. The county annually harvests more than 20 million Christmas trees. The county also has a substantial deer population and derives additional income from deer hunting.

In 1976, an estimated 1445 farms in the county produced cash crops worth nearly $22.5 million. Approximately 71 percent of the total was derived from livestock products. The leading industry in the county is manufacturing. The value of production during 1976 was $203.9 million, when the county ranked 46th among the state's 67 counties. In 1977, the value of production increased to $240.4 million, an increase of over 15 percent. The primary production activity in 1977 was in fabricated metal products, estimated at $67 million (28 percent), and nonelectrical machinery, estimated at $30.6 million (13 percent).

Indiana County offers numerous tourist attractions including four covered bridges, several museums, and state and local parks. In 1976, tourist-related revenue was estimated at $14.3 million; the tourist-related payroll was approximately $2.9 million.

Most of the industrial activity in Indiana County in 1977 was centered in Indiana Borough and White Township, located 15 miles north of Blairsville. There are 66 industrial establishments in the county. Of these, 25 are located in this area, and in 1977 they accounted for 64 percent of the county wages and salaries, and 62 percent of the production value.

The area including Burrell Township and Blairsville is a secondary center of production and employment, as is Homer City. These centers are linked by U.S. Highways 119 and 22 and rail transportation to Indiana. These secondary centers account for the major portion of the remaining economic activity in Indiana County. There are three industrial firms in Burrell Township and nine in Blairsville. In 1977, these firms accounted for $3.5 million in wages and salaries, $24.0 million in production, and $9.2 million in manufacturing (Pennsylvania Department of Commerce, 1978).

G.3.3 Hanover site

In addition to the local and county economies, Hanover is influenced by the nearby communities of Weirton, West Virginia, and Steubenville, Ohio, and the significant steel manufacturing activity in these areas. For example, in Weirton, West Virginia, Weirton Steel (a division of National Steel) employs 12,500 people, and Wheeling-Pittsburgh Steel Corporation in Steubenville employs over 1,000 people. In Toronto, Ohio, the Titanium Metals Company provides employment for 750 to 1000 people (Weirton, West Virginia and Steubenville, Ohio, 1982).

In the Pittsburgh SMSA, one out of every ten employed persons works in the primary metals industry (Pennsylvania Department of Labor and Industry, 1979). In Hanover, this ratio is probably higher. In addition to the primary metals industries, coal, oil, and gas resources are located in Hanover Township. As a result, major portions of the area are owned by coal companies (i.e., Starvaggi and Bologna) and have been strip mined. Today, Hanover has many unreclaimed and abandoned strip and deep mines, as well as abandoned oil wells. The area is reported to have moderate to major mine pollution problems (Washington County Planning Commission, 1979b). The local economy is characterized by small machine and metal shops and by trucking and coal-related facilities.

The communities nearest the Hanover site are Burgettstown in Smith Township, Pennsylvania and Weirton, West Virginia. Due to its undeveloped rural setting, this area is suited for outdoor recreation (Hillman State Park and State Game Lands No. 117 are located in the area), but strip mine and chemical dump wastes limit this potential.

G.4 WORK FORCE

G.4.1 Canonsburg site

The total employment in the Canonsburg area can be described by data for the Pittsburgh SMSA (including Washington, Allegheny, Beaver, and Westmoreland counties). The total employment in December 1981, including the nonagricultural manufacturing and nonmanufacturing work forces, was approximately 934,900 persons (Pennsylvania Department of Labor and Industry, 1982; Wilson, 1982). Over the preceding year, employment declined by 22,200 from 957,100 employees, reflecting the effects of the 1981 economic recession. The 1981 SMSA data show the following breakdown by major employer: industrial manufacturing -- 225,700 employees; services -- 215,800 employees; retail trade -- 163,100 employees; transportation -- 55,400 employees; wholesale trade -- 52,400 employees; construction -- 43,600 employees; and finance -- 45,100 employees.

Over the past year declines were reported in all categories except wholesale trade and construction.

In Washington County 336 industries and businesses were reported in 1980 (Washington County Board of County Commissioners, 1980). These firms employed 27,878 people. In December 1981, the county's resident civilian labor force was approximately 96,200 people (Pennsylvania Department of Labor and Industry, 1982; Wilson, 1982) with 87,700 employed, and approximately 60,000 working in firms located in the county. By category, the major employers in 1980 were: mining -- 5845 employees; steel -- 3956 employees; electronics -- 3323 employees; glass equipment -- 2385 employees; trucking -- 628 employees; and machine/job shops -- 1089 employees.

Steel manufacturing in Washington County and in West Virginia (e.g., Weirton Steel Co.) also provides major employment opportunities for county residents. Between 1978 and 1980 industrial opportunities were fairly stable. The 1980 Industrial Directory of Washington County (Washington County Board of County Commissioners, 1980) lists 30 industries or businesses not listed in 1978, and deletes 30 industries or businesses that consolidated under a new name, went out of business, or moved.

In 1979, Washington County as a whole had a labor-force-participation rate of 41.8 percent (ratio of number of persons in the labor force to total population) in a total estimated population of 215,519 persons. Within the 1-mile radius of the site, however, the labor-force-participation rate was much lower because of the larger proportion of persons aged 65 years and over compared to that of the Pittsburgh SMSA. The high percentage of households remaining in their present locations for at least 20 years has indirectly contributed to the lowering of the labor-force-participation rate. Assuming a lower labor-force-participation rate (38.9 percent) for the area, based on the state estimate of population and labor force for Washington County, the area had a total labor force of 3088 people. By the year 2000, the county's labor-force-participation rate will be 40.9 percent, and the projected labor force within the 1-mile radius will be 4107 people.

Employment data collected from a survey in September 1979 showed that about 34.4 percent of the total population in the area were employed on either a full-time or part-time basis (equivalent to 2730 persons employed out of the total population of 7938 persons). Thus, the area had an unemployment rate of nearly 11.6 percent (ratio of number of persons unemployed to the total labor force). For comparison, the unemployment rate for the Pittsburgh labor market area (Allegheny, Beaver, Washington, and Westmoreland Counties combined) in December 1981 was 8.2 percent (8.8 percent adjusted seasonally) (Pennsylvania Department of Labor and Industry, 1982) and 5.7 percent in 1978.

Between 1973 and 1980 mining employment was a major growth area in the county. Over this period employment increased from 3966 to 5845 people. This 47-percent increase reflects the expanded economic interest in western Pennsylvania coal, oil, and gas resources. The ten largest employers in Washington County in 1980 are given in Table G-13.

Table G-13. Ten largest employers in Washington County - 1980

Company	Municipal location	Employment
Wheeling-Pittsburgh Steel Co.	Allenport	2361
McGraw Edison Power Systems Division[a]	Canonsburg	2296
Bethlehem Mines Corp.	Eighty-four sites	1826
Consolidated Coal Co.[a]	Washington	1646
Corning Glass Works	Charleroi	1135
RCA Corp.[a, b]	Meadowlands	1001
U.S. Steel Co. (Frick Distributors Coal Operation)	New Eagle	934
Jessop Steel Co.[a]	Washington	920
Brockway Glass Co.[a]	Washington	900
Washington Steel Co.[a]	Washington	675

[a]Within the vicinity of the project sites.

[b]Facility under new ownership.

Source: Washington County Board of County Commissioners (1980).

The manufacturing employment statistics show that the 21 industries in Canonsburg employ 2828 persons. The major manufacturing employer was the McGraw-Edison Power Systems Division, employing 2296 persons. The nine industries in Houston employ 255 manufacturing workers. The industrial employment in North Strabane Township was 255 (seven firms), and the industrial employment in Chartiers Township was 1428 (11 firms). The most recent employment counts of major industrial firms are given in Table G-14. Employment in Canonsburg firms with more than 15 employees accounted for 3626 workers in 1980, and five firms in Houston employed 141 people.

The majority of the firms in the area employ either 15 to 30 people or 100 to 300 people. Historically, these firms expand and decline with the general economic conditions. Between 1978 and 1980 six firms listed in Table G-14 increased their levels of employment and six declined. These changes resulted in a net increase of 66 employees in the firms listed. In 1978, 15 firms were operating in the Canon Industrial Park, and they employed approximately 70 persons. The firms included a truck-freight terminal, metal-work operations, machine shops, climate-control equipment services, a laundry terminal, and various warehouses.

Based on Canonsburg Borough 1981 records, three firms still occupy the Canon Industrial Park. They are A. P. A. Transport, 9; Crile Metallizing Co., 11; and Michael J. Lunardini, Inc., 5. Since 1978, the Canon Industrial Park has lost 45 employees as firms have gone out of business or moved from the site.

Major employment centers within the one-quarter mile radius of the site are the Burger Chef on Pike Street (31 employees), and the Woodcraft Company on Pike Street (20 employees). The total number of employees within the one-quarter mile radius ranges between 200 and 22 persons, most of whom live in the general site area, and work a minimum of 40 hours a week. In addition, there are a number of private clubs in the area that employ local residents. These are: VFW on Pike Street; AFU No. 149 on Salwyn Street; Strabane International Ballroom on Chartiers Street; SNPJ Hall and Bowling Alley on Latimer Avenue; and Moose Lodge on West Pike Street.

The establishments in the immediate vicinity of the site include bars, gasoline and service stations, repair and service shops, and grocery and eating places. The Alexander Cooperative Market on Latimer Avenue is the closest establishment that is frequented by a large number of customers from within the 1-mile radius of the site.

A survey conducted in the area revealed that 8.6 percent of the households have a family member who had worked at the Canon Industrial Park at one time. A large percentage are in the 65 years and over age group. The 1974 employment statistics for the municipalities in the immediate vicinity of the site are presented in Table G-15.

Table G-14. Industrial employment -- 1980: Canonsburg site vicinity

Establishment	Location	Product	Number of employees
All-Clad Metalcrafters, Inc.	R.D. 2	Cookware	25
American Specialty Foods	R.D. 1	Potato chips, etc.	60
Canon Tool Company	Valley Road	Nuclear components	35
Canonsburg General Woodcrafting Co.	W. Pike Street	Cabinets, vanities	20
Canonsburg Milling Co.	N. Central Avenue	Animal/poultry feeds	22
Clad Metals, Inc.	R.D. 2	Speciality clad metals	62
Controlled Climate Systems, Inc.	Canon Industrial Park	Heating/air conditioning	17
Crile Metallizing Co.	Canon Industrial Park	Manufacturing operations	18
Donaldson Supply and Equipment	Murdock Street	Builders supplies	18
Forbes Steel Corporation	Iron Street	Steel fabricating	150
Fort Pitt Bridge Division	Meadow Lane	Fabricated steel structures	305
Hankison Corporation	Philadelphia Street	Air dryers, metal products	148
Joy Manufacturing Company	Meadowlands	Warehousing	114
Michael J. Lunardini, Inc.	Canon Industrial Park	Equipment supplies	5
Mac Plastics, Inc.	Murdock Street	Plastics	162
McGraw-Edison Power Systems Div.	Canonsburg	Electrical power equipment	2296
Quasitronics, Inc.	W. Water Street	Electrical control systems	19
Ram Construction Company	R.D. 2	Heavy/highway construction	150
Canon Plastics	Plum Run Road	Plastics	50
Fort Pitt Fixture Company	W. Pike Street	Store fixtures	29
J & F Tire	Route 519	Tire retreading	20
Superior Concrete Products Co.	Johnson Road	Concrete block	20
Swanson Analysis Systems	Johnson Road	Structural analysis	22

Note: Industries with less than 15 employees are excluded from this list.

Source: Washington County Board of County Commissioners (1980).

Table G-15. Industrial classification of persons employed in municipalities in the vicinity of the Canonsburg site (1974-2000)

Category	Canonsburg Borough 1974	Canonsburg Borough 2000	Houston Borough 1974	Houston Borough 2000	North Strabane Township 1974	North Strabane Township 2000	Chartiers Township 1974	Chartiers Township 2000
Agriculture	12	7	0	0	45	24	59	31
Mining	132	280	0	0	0	0	0	0
Construction	50	47	64	51	304	379	70	117
Transportation, utilities, communications	75	141	22	22	27	47	129	206
Wholesale trade	60	80	0	2	71	177	69	193
Retail trade	438	445	180	181	391	600	65	203
Finance, insurance, real estate	123	185	14	20	13	20	16	36
Services	787	1424	132	141	447	523	647	916
Government	182	173	22	21	19	18	185	176
Manufacturing	3734	3958	164	159	260	295	2823	3222
Total	5593	6740	598	597	1577	2083	4063	5100

Source: Southeastern Pennsylvania Regional Planning Commission (1980).

About one-half of all the employees in the area work within 2 miles of their homes, and more than one-third work at least 5 miles away, as seen in Table G-16.

Table G-16. Distances people travel to work

Distance from place of residence	Percent of total employees in area
Less than 1 mile	13.7
1 to 2 miles	34.8
2 to 5 miles	14.1
More than 5 miles	37.4
	100.0

Source: Socioeconomic survey, September 1979.

The December 1981 unemployment rate in the Pittsburgh SMSA (including Washington, Allegheny, Beaver, and Westmoreland Counties) was estimated at 8.2 percent (unadjusted) and 8.8 percent (seasonally adjusted). In Washington County employment trends are depressed (decrease of 13,800 employees) below December 1980 levels, and unemployment rates are 8.5 percent and 8.8 percent (seasonally adjusted). The major losses are: primary metals industry (i.e., steel) -- decrease of 5200 people; fabricated metals industry -- decrease of 800 people; machinery -- decrease of 1100 people; electrical machinery -- decrease of 100 people; and transportation -- decrease of 4100 people.

Similar losses have also affected nonmanufacturing industries with decreases in state and local government employment (4900 employees), transportation (3700 employees), and services (1800 employees).

The per capita income in Washington County was estimated at $8,362 in 1976. This compares with other counties in the Pittsburgh SMSA: Allegheny County -- $9,704; Beaver County -- $8,331; and Westmoreland County -- $8,321. The state average per capita income was $8,558.

Recent income data at the municipal level (socioeconomic survey, September 1979) show that more than one-third of all of the families within the 1-mile radius of the Canonsburg site earned more than $15,000 annually, and 10.7 percent of the families had an annual income of less than $5,000. The income distribution among families is as follows:

Annual family income (in 1979 dollars)	Percent of total number of families
Less than $ 5,000	10.7
$5,000 - $10,000	24.5
$10,001 - $15,000	29.3
$15,001 - $25,000	27.6
More than $25,000	7.9
	100.0

Source: Socioeconomic survey, September 1979.

G.4.2 Burrell site

In December 1981, the total employment in Indiana County, in the manufacturing and nonmanufacturing industries, was 32,200 persons (an increase of 800 over 1980), out of a total civilian labor force of 43,400. Approximately 26,900 employees worked in nonmanufacturing jobs; the remaining 5,300 employees were employed in manufacturing positions. The number of people unemployed was 3700, or 8.5 percent (Pennsylvania Department of Labor and Industry, 1982).

In 1977, according to the industrial census, the total employment in the 66 manufacturing industries in Indiana County was 5658, of which 4107 were production and related workers. There are four Standard Industrial Classification (SIC) categories that are significant employers in the county, and represent 75 percent of the total manufacturing employment. The categories are given in Table G-17.

Table G-17. Manufacturing employment -- Indiana County

SIC	Total employment	Percent of county employment
Rubber	566	10
Fabricated metals	1575	28
Machinery	823	14
Measuring/analyzing	1333	23

Source: Pennsylvania Department of Commerce (1978).

In 1977, there were 12 manufacturing firms employing 385 people in Burrell Township and Blairsville Borough (Table G-18).

The major employer in the area makes transportation equipment. More than 50 percent of the industrial employment in the local area was reported by a single manufacturer of tanks and tank components. The second largest employer (60 employees) was in apparel followed by one in fabricated metals with 43 employees.

Nonmanufacturing employment in Indiana County was estimated at 26,500 in December 1981, an increase of 600 employees over December 1980 data (Pennsylvania Department of Labor and Industry, 1982). The 1981 nonmanufacturing employment was primarily in mining (5600 employees), wholesale and retail trade (6100 employees), and service and miscellaneous categories (4200 employees). Smaller components of the nonmanufacturing work force included transportation (2200 employees), finance (800 employees), and construction (800 employees). Over the period 1980 to 1981 employment varied slightly with employment increases in wholesale and retail trade (200 employees), and services (400 employees). Declines in employment were

Table G-18. Industrial employment - Burrell site vicinity

Municipality	Category	Number of businesses	Number of employees
Blairsville Borough	Apparel	1	60
	Lumber	1	8
	Printing	1	5
	Stone/clay	1	32
	Fabricated metals	2	36
	Machinery	2	12
	Transportation	1	206
Burrell Township	Lumber	1	2
	Fabricated metals	1	7
	Electrical	1	17
Total		12	385

Source: Pennsylvania Department of Commerce (1978).

reported in transportation (200 employees), while mining, contract construction, and finance were unchanged (Wilson, 1982). Nonmanufacturing work-force estimates were not available at the local level.

Unemployment in Indiana County was reported at 8.5 percent (unadjusted) for December 1981 (Pennsylvania State Employment Service, 1981). Since December 1980, employment trends have generally been up with manufacturing employment up by 600 employees, mostly through an increase of 500 in fabricated metals. Manufacturing employment showed increases over 1980 with employment increases in services (400 employees), in state and local government (200 employees), and in wholesale and retail trade (200 employees).

The per-capita income in Indiana County was estimated at $7,312 in 1976. This compares with other counties in the nearby Pittsburgh SMSA as follows: Allegheny County -- $9,704; Beaver -- $8,331; and Westmoreland -- $8,321. The state average per-capita income was $8,558 in 1976.

G.4.3 Hanover site

Hanover is influenced primarily by the steel and primary metals industries in nearby Weirton, West Virginia, and Steubenville and Toronto, Ohio. The employment statistics for Hanover identify one firm in machinery with eight employees. Burgettstown, which is approximately 5 miles from the Hanover site, reports 67 employees; 5 employees in newspapers, and 62 employees in mining machinery (Pennsylvania Department of Commerce, 1980). Detailed information on the employment, income, and unemployment situations in Washington County, in which the Hanover site is located, are given in subsection G.4.1.

Table G-19. Number of housing units in the municipalities in the vicinity of the sites

Municipality	1970	1980	Percent change
Canonsburg site			
Canonsburg Borough	3,857	4,228	9.6
Chartiers Township	2,202	2,678	21.6
Houston Borough	655	668	2.0
North Strabane Township	2,345	2,972	26.7
Total	9,059	10,546	
Burrell site			
Blairsville Borough	1,610	1,765	9.6
Burrell Township	1,129	1,452	28.6
Derry Township	4,386	5,487	25.1
Total	7,125	8,704	
Hanover site			
Hanover Township	888	1,082	21.8
Burgettstown Township	680	725	6.6
Jefferson Township	373	461	23.6
Smith Township	1,849	2,001	8.2
Total	3,790	4,269	

Source: U.S. Bureau of the Census, 1980 census advance counts.

Table G-20. 1980 asking prices of dwelling units in the vicinity of the Canonsburg site

Municipality/location	Description	Price ($)
Canonsburg		
Marple Avenue	Two story, 1 bedroom, frame	22,900
W. College Avenue	Two story, 2 bedroom, stucco	31,000
Ridge Avenue	Two story, 2 bedroom, frame	38,500
Duquesne Avenue	Ranch, 3 bedroom	38,900
N. Central Avenue	Two story, townhouse, 2 bedroom, brick	45,900
W. College Avenue	Two story, 4 bedroom, stone	52,000
Hutchinson Avenue	Semi-colonial, 3 bedroom, brick	55,000
W. College Avenue	Two story, brick and frame	70,700
Houston		
N. Maine Street	Two story, duplex, 3 bedroom, frame	37,500
Reed Avenue	Two story, 3 bedroom, brick	46,500
Meadow Oaks Development	Split entry, 3 bedroom, brick and aluminum	87,900
Chartiers		
Washington Avenue	Ranch, 3 bedroom	49,500
Ridgeview Way	Ranch, 3 bedroom, brick	59,900
Washington Avenue	Two story, 4 bedroom, brick	138,000
North Strabane		
Latimer Avenue	One story, 2 bedroom	29,900
Dicio Street	Cape Cod, 4 bedroom, brick	56,900
Old Meadow Court	Colonial, 3 bedroom	59,900
Mansfield Road	Ranch, 3 bedroom, brick	64,500
Pearl Drive	Two story, 4 bedroom, brick	79,900

Note: The variations in prices reflect the accessories, age, and location of the building.

Source: Local real estate listings from area realtors.

Table G-21. Financial statistics of area municipalities near the Canonsburg site (1978)

Municipality	Revenues						Expenditures	
			Real estate					
	Total revenues	Total taxes collected	Assumed valuation	Tax rate (mills)	Real estate taxes	Total Act 511	Total expend-itures	Total O&M
Canonsburg Borough	$1,631,594	$ 729,923	$11,854,000	39.25	$469,873	$260,050	$1,754,342	$1,696,007
Chartiers Township	$ 838,376	$ 379,229	$10,221,000	12.00	$122,969	$256,260	$ 626,594	$ 626,594
Houston Borough	$ 155,845	$ 81,663	$ 1,626,000	23.00	$ 36,457	$ 43,631	$ 134,927	$ 125,047
North Strabane Township	$ 893,719	$ 509,214	$15,249,000	13.00	$200,528	$308,686	$1,117,441	$ 731,947
Total	$3,519,534	$1,700,029	$38,950,000		$829,827	$868,627	$3,633,304	$3,179,595
Percent of county	15	15	14		17	14	14	15

Source: Pennsylvania Department of Community Affairs (1981).

Table G-22. 1982 assessed values, market values, and tax rates for municipalities near the Canonsburg site

	Assessed valuation[a] (million $)	Market value[a] (million $)	Tax rate[a,b] Munic-ipality (mills)	Tax rate[a,b] School (mills)
Canonsburg Borough	12.890	143.2	41.25	99
Chartiers Township	12.963	144.0	14.0	119
Houston Borough	1.800	20.0	23.0	119
North Strabane Township	18.332	203.7	27.0	99

[a]Washington County Tax Assessors Office, 1982 original charts.
[b]Washington County Tax Assessors Office, 1981-1982.

Table G-23. Major revenue sources for municipalities near the Burrell site

Municipality		1978 fiscal statistics
Burrell Township		
Total revenue		$ 324,778
Real estate tax	$ 21,851	
Act 511 tax	$ 85,770	
Total taxes collected	$108,238	
Total expenditures		$ 583,218
Total O&M	$493,912	
Assessed valuation		$5,383,000
Tax rate (mills)		4
Blairsville Borough		
Total revenues		$ 774,928
Real estate tax	$107,808	
Act 511 tax	$117,852	
Total taxes collected	$225,660	
Total expenditures		$ 767,180
Total O&M	$756,190	
Assessed valuation		$7,351,000
Tax rate (mills)		15

Source: Pennsylvania Department of Community Affairs (1981).

Table G-24. Tax rates for municipalities near the Burrell site

Municipality	1980 County	1980 School district	1980 Muni-cipal	1980 Total	1981 County	1981 School district	1981 Muni-cipal	1981 Total
Burrell Township	16	73.9	3	92.9	19	84	5	108
Blairsville	16	73.9	14.75	104.65	19	84	19	122

Source: Indiana County Tax Assessment Office (1982).

Table G-25. Fiscal statistics -- Hanover Township

Item	1978 fiscal statistics[a]	
Total revenue		$ 213,233
Real estate tax	$ 202[b]	
Act 511 tax	$ 85,761	
Total taxes collected	$ 85,963	
Total expenditures		$ 262,145
Total operations and maintenance	$255,545	
Assessed valuation of real estate		$3,438,000

[a]Pennsylvania Department of Community Affairs (1981).

[b]Based on current millage = 8. Pennsylvania Economy League, Inc. (1980).

G.5 COMMUNITY SERVICES

G.5.1 Canonsburg site

G.5.1.1 Community services

The area is served by the Canon-McMillan and Chartiers-Houston School Districts. The Canon-McMillan Senior High School, bounded by Hitchman Street, Boone Avenue and Interstate I-79, is within one-half mile of the site. Most of the school traffic uses Strabane Avenue and passes through the site boundary. The school closest to the site is St. Patrick's School at Hutchinson Avenue, one-quarter mile from the site. Other nearby schools are: Hawthorne School (elementary) on Hawthorne Street, Canonsburg; South Central Elementary School, South Central Avenue, Canonsburg; Houston Elementary School, Cherry Avenue, Houston; Canon-McMillan Junior High School, Canonsburg; and First Street School, Canonsburg.

The population of the area and the surrounding region is served by the Canonsburg General Hospital located on Barr Street within one-half mile of the site. Primary access to the hospital from the site is via Strabane Avenue (Chartiers Street to Boone Avenue and Elms Street). For the surrounding communities, the I-79 Canonsburg or Houston exit is the primary access to the hospital. Washington Hospital is the next closest facility with a 500-bed capacity. In addition, St. Clair Hospital and numerous other medical centers located between Washington and Pittsburgh are available for the health-care needs of the area's population.

The municipalities in the area have their individual police forces and patrol cars providing 24-hour protection. There are a number of call boxes located throughout Canonsburg, providing a direct communication link for the residents with the police-station-emergency-communication system.

The area is protected by volunteer fire organizations located in the boroughs and the townships. The various fire companies operating in these and adjacent municipalities have a reciprocal relationship for emergencies, thus providing greater fire protection than the capabilities of a single fire company.

The sanitary sewerage system of the Canonsburg-Houston Joint Authority provides offsite disposal facilities for the Houston and Canonsburg Boroughs, Strabane Village of North Strabane Township, and along the southeastern and eastern portions of Chartiers Township. The treatment plant is being renovated to provide increased capacity and tertiary treatment. Chartiers Creek is the receiving stream for the treatment facility.

The municipalities are served by public water provided by the privately owned Citizens Water Company. Rural areas of North Strabane and Chartiers Townships use onsite sources, primarily wells, for their water supply.

Solid wastes, including garbage, rubbish, and inorganic wastes, are collected once a week from residences in the area by an independent hauler (Table G-26).

Table G-26. Landfills near the Canonsburg site

Landfill	Location
Arden Landfill site	Chartiers Township
South Hills site	North Strabane Township
Pittsburgh Coal Company site	Chartiers and Mt. Pleasant Townships
Pittsburgh Coal Company site	Cecil Township

Source: Washington County Planning Commission (1979b).

Electricity for the area is provided by West Penn Power Company, while natural gas used as heating fuel is furnished by three companies: Columbia Gas of Pennsylvania, Equitable Gas Company, and People's Natural Gas Company.

G.5.1.2 Recreational activities

The major recreational locations in the area within a 1-mile radius of the site are identified on the existing land-use map (Figure G-1, Table G-27). The closest location for recreational activities was Area C (3.1 acres), located east of Strabane Avenue within the general boundary of the affected site, where a ball diamond had been placed over filled ground. For the past two years, however, the ballfield has been fenced and prohibited from public use because of its high radiation level. The ballfield was used by 6 percent of the area population until it was fenced.

Although 5 percent of the population uses Chartiers Creek for recreational purposes, fishing success is minimal. The SNPJ Hall and Bowling Alley on Latimar Avenue is the closest place of recreational and cultural activities. This facility is a private club catering to the cultural and recreational needs of the local community.

Table G-27. Public recreational facilities near the Canonsburg site

Location	Area (acres)	Facilities, comments
<u>Borough of Canonsburg</u>[a]		
Borough Park	38.0	Swimming pool, bathhouse, wading pool, sun deck, three pavilions, picnic areas, children's play area, tennis courts, basketball courts, volleyball area.
Cecil Street (Valley View Road)	0.24	Swings, slides, teeter-totter.
Gladden Avenue (Cecil Township)	11	
School site recreational facilities		
- Hawthorne Elementary, Canonsburg Memorial Stadium, and baseball field.		
- Glenn Avenue area.		
- South Central Avenue Elementary, Senior High.		
- Junior High.		
- First Street Elementary.		
- Perry Como Playground.		
<u>Borough of Houston</u>		
Borough of Houston recreational area between East McNutt Street and the Pennsylvania Railroad, on either side of Chartiers Creek.		
<u>North Strabane Township</u>[b]		
Alexander Parkette	0.5	Facilities for children and teenagers.
Canon-McMillan Senior High School	2.2	Play areas and tennis courts.
Lindley Mine Park	70	Area was originally strip mined, and needs reforestation to provide a setting for active and passive recreational facilities.
<u>Chartiers Township</u>[c]		
No designated recreational areas exist within the 1-mile radius, except open fields and the private cemetery properties often used for recreational purposes.		
In addition, there are a number of regional recreational facilities in the general site area, including:		
Canonsburg Lake located off Route 19		Facilities primarily for fishing (Pennsylvania Fish Commission site).
Mingo Creek County Park, located off Route 88	2,500 (approx.)	Designed to preserve its natural state and provide picnic areas, trails, a swimming pool, and camping, as well as game areas and facilities for winter sports.
Cross Creek Park located off Route 50.	1,000	Man-made lake for swimming, fishing, boating, and flood control.
Allegheny County -- Regional Park No. 7, South Park, and Regional Park No. 6.		

[a] Canonsburg Borough Planning Commission (1971).

[b] North Strabane Township Planning Commission (1977).

[c] The Selck Minnerly Group (1974).

G.5.2 Burrell site

G.5.2.1 Community services

The area is served by two school districts: the Blairsville-Saltsburg District for the Indiana County portion of the area; and the Derry Area School District for the portion of the area in Westmoreland County.

The Blairsville Municipal Water Authority serves all of the Town of Blairsville and a limited area outside and adjacent to the town. The town's sewer system has a 1-mgd capacity, and is designed to serve a population of 7500 persons. It serves all of the present water users in the town and parts of adjacent areas.

The Burrell Township water supply is administered by the Lower Indiana County Municipal Authority. There are also a number of individual wells in the township. Burrell Township does not have a public-sewer system (Bartos, 1982).

There are a number of private water-supply companies in the Derry Township portion of the site area. Parts of the township also depend on privately owned wells for their water supply. There is no public sewage system in the township; however, the township is in the process of joining the Latrobe Borough sewer system. Torrance State Hospital operates and maintains its own collection system and disposal plant on McGee Run (Bolinger, 1979).

Fire stations close to the site are in Blairsville and Black Lick. Police protection for the area is provided by the Pennsylvania State Police. The nearest hospital is in Blairsville.

G.5.2.2 Recreational activities

The immediate site vicinity, between the ConRail tracks and the Conemaugh River, is occasionally used for hunting. The U.S. Army Corps of Engineers permits limited recreational use of the Conemaugh River reservoir area for hunting, picnicking, and other recreational activities but not use of the river itself due to its polluted condition (U.S. Army Corps of Engineers, 1974). Under a license agreement, the Town of Blairsville maintains two ballfields in the reservoir area (Bellante and Clauss, Inc., 1967). There are a number of major parks and recreational attractions outside the 1-mile radius, such as Keystone State Park, Mannito County Club, Laurel Highlands, and the Latrobe Elks Club south of the river, and the country club north of Strangford (Baker, 1970).

G.5.3 Hanover site

G.5.3.1 Community services

There are no community facilities located within the 1-mile radius of the site. The closest is the Hanover Township School located on old U.S. Route 22, more than 2 miles north of the site. The closest community services are in Burgettstown, about 4 miles east of the site, and Weirton Heights on Route 22 in West Virginia. In fact, the local economy is very dependent on the industrial firms located in Weirton County, West Virginia.

G.5.3.2 Recreational activities

There are no recreational facilities located within the 1-mile radius of the site. The State Game Lands No. 117 (4919 acres), located in Smith Township, provides hunting opportunities. The undeveloped Hillman State Park (3654 acres) is located north of State Game Lands No. 117 in Hanover Township.

There are three privately owned and operated paid fishing lakes in Hanover Township, all located along SR 18; i.e., Star Lake, Lake Suzanne, and Bennett Lake. The Pennsylvania Fish Commission has designated Aunt Clara Fork in Hanover Township as "approved trout waters" for a length of 4.0 miles.

Devil's Dam, located north of Paris in Hanover Township, is one of the 11 natural areas in the county accessible to the public for entertainment, and is a geological and ecological resource.

Table G-28. Traffic counts -- 1980

Location	Average daily traffic (ADT)
Canonsburg Borough	
Route I-79 (between Meadowlands and Houston)	25,800
U.S. Route 19 (just north of Pennsylvania Route 519 intersection)	15,000
Pennsylvania Route 519 (near Boone Avenue intersection)	10,000
Pennsylvania Route 980 (Adams Avenue)	12,500
West Pike Street (west of Strabane Avenue)	12,500
West Pike Street (between Strabane and Central Avenues)	10,600
East Pike Street (between Central and Adams Avenue)	12,900
Strabane Avenue (south of Pike Street)	3,150
South Central Avenue (south of Pike Street)	8,400
North Central Avenue (north of Pike Street)	4,300
Chartiers Street (near Boone Avenue)	3,600
Burrell Township	
U.S. Route 22 (crossing Conemaugh River and before Blairsville)	17,200
U.S. Route 22 (near LR 32006)	17,100
Pennsylvania Route 217 (at the bridge over Conemaugh River)	7,300
Pennsylvania Route 217 (south of LR 64059)	5,200
Pennsylvania Route 217 (just before LR 32179 in Blairsville)	11,000
LR 32006 (near intersection with township road 784)	125
LR 32179 (in Blairsville at township line)	5,500
LR 64059 (east of intersection with Pennsylvania Route 217)	2,500
Hanover Township	
U.S. Route 22 (old)	7,000
U.S. Route 22 (new)	4,000
Pennsylvania Route 18	6,500
LR 62017	550
LR 62122	225

Source: Pennsylvania Department of Transportation (1982).

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COMMONWEALTH OF PENNSYLVANIA
PENNSYLVANIA HISTORICAL AND MUSEUM COMMISSION
WILLIAM PENN MEMORIAL MUSEUM AND ARCHIVES BUILDING
BOX 1026
HARRISBURG, PENNSYLVANIA 17120

March 17, 1982

Mr. Korah T. Mani, AICP
Roy F. Weston, Inc.
Weston Way
West Chester, Pennsylvania 19380

Re: W.O. 214: 01-01
Historic & archeological site findings within and in the immediate vicinity of two sites in Washington County and one site in Indiana County, Pa. associated with the disposal of radiation-contaminated waste materials.
File No. ER 82-042M-0114

Dear Mr. Mani:

The above named project has been reviewed by the Bureau for Historic Preservation in accordance with Section 106 of the National Historic Preservation Act of 1966, Executive Order 11593 and the regulations of the Advisory Council on Historic Preservation (36 CFR 800).

To our best knowledge, there are no eligible or listed historic or archeological properties in the area of this proposed project and therefore, this project should have no effect upon such resources. Should the applicant become aware, from any source, that historic or archeological resources are located at or near the project site, please contact the Division of Planning & Protection, Bureau for Historic Preservation, Pennsylvania Historical & Museum Commission, Box 1026, Harrisburg 17120 or call (717) 783-8947.

Sincerely,

Greg Ramsey, Chief
Division of Planning & Protection
Bureau for Historic Preservation
(717) 783-8947

Appendix H

ACOUSTICAL SURVEY AND ENVIRONMENTAL IMPACT PROJECTION FOR OPERATIONS AT CANONSBURG, PENNSYLVANIA

Franklin Research Center
A Division of The Franklin Institute

Report No. C5240-01
September, 1979

ACOUSTICAL SURVEY AND ENVIRONMENTAL IMPACT PROJECTION FOR OPERATIONS AT CANONSBURG, PENNSYLVANIA

for

WESTON
WEST CHESTER, PENNSYLVANIA

C.W. Hargens, P.E.

The Benjamin Franklin Parkway, Philadelphia, Pa. 19103 (215) 448-1000 TWX-710 670 1889

ACOUSTICAL SURVEY
CANONSBURG, PENNSYLVANIA

1. Location of Tests, Procedures and Other Pertinent Considerations

Weather data for the test day were obtained from the U.S. Weather Service and are given in Appendix I.

The test locations, nine in all, were chosen by examining a plan map of the property, areas A, B and C. Sufficient perimeter locations were selected to permit a comprehensive environmental noise survey of the site as well as the surrounding community. Since the site and surrounding community are now rather quiet with few outstanding sound sources that would produce a complex sound field, it is felt that the measurement sites chosen fulfill this requirement in number and location.

The measurement points are at critical boundaries representing a coverage of the general areas and specific sources such as manufacturing (metal working) sounds and those of vehicular transportation where they do exist. It is against the customary background levels which characterize existing noise conditions in these areas that the sounds of various equipment to be used in removal of contaminated material will impact.

2. Documentation Considerations

The methodology utilized in conducting this noise survey generally followed the "Guidelines for Preparing Environmental Impact Statements on Noise" as prepared by the Committee on Hearing, Bioacoustics and Biomechanics (CHABA) of the National Research Council. [1]. It first considers the question of how much noise analysis is required based upon the severity and duration of the impact. The particulars of the case at hand influence the screening process by which the appropriate degree of Noise Environment Documentation is determined.

Types of environmental impacts can be classified in one way with respect to time. The noise of contaminated material removal, the contemplated project that we are evaluating, falls into a category referred to as a Short Term Temporary Change. In all of the evaluation processes, the question asked is how much and for how long the noise impact will be. A short term temporary change is a change in the acoustical environment that exists for less than six months. This would seem to fit most closely the expected disruption at the Canonsburg site during the presence of heavy equipment operations. Long Term Temporary Change covers the period from 6 months to 10 years and would hardly seem applicable to the initial clean-up program. However, the guidelines do suggest that an EIS cover the long-range effects, for say 20 years, if the initial project will influence a future movement of people into or out of the area and thus produce a noise impact in a secondary way. We do visualize in this case that the Canonsburg site, if cleaned and decontaminated, might experience development which would populate the area considerably. At this time one cannot tell whether such a development would bring light or heavy industry or residential or sports activity or something else. It is likely, however, that any future use of such a large area surrounded by urban activity would bring in more people and vehicles with a resulting increase in noise. This would represent some impact although not nearly so intense as the clean-up operation.

The Canonsburg site is surrounded on several sides by sensitive areas, primarily residential. Their noise environment will be affected by the clean-up operation and therefore the Noise Environment Documentation and impact assessment are needed for an Environmental Impact Statement.

3. Acoustical Characterization of the Site, Survey Results

Test Areas A, B and C are shown in Figure 1 together with the numbered Test Locations. The measured A-weighted background levels are listed together with notes in Table 1. Tape recordings were also made at each location using precision equipment (Nagra). These are for future reference in the event that it should become desirable to further analyze the sounds, their amplitude variations and spectra. Figure 2 shows the surrounding communities.

Nearly all of the background sounds at the various locations were steady within several dB except for passing aircraft or land vehicles which were discounted in the normal way. Further, the sources were such as to have minimal diurnal variation, so that it was reasonable to compute an equivalent

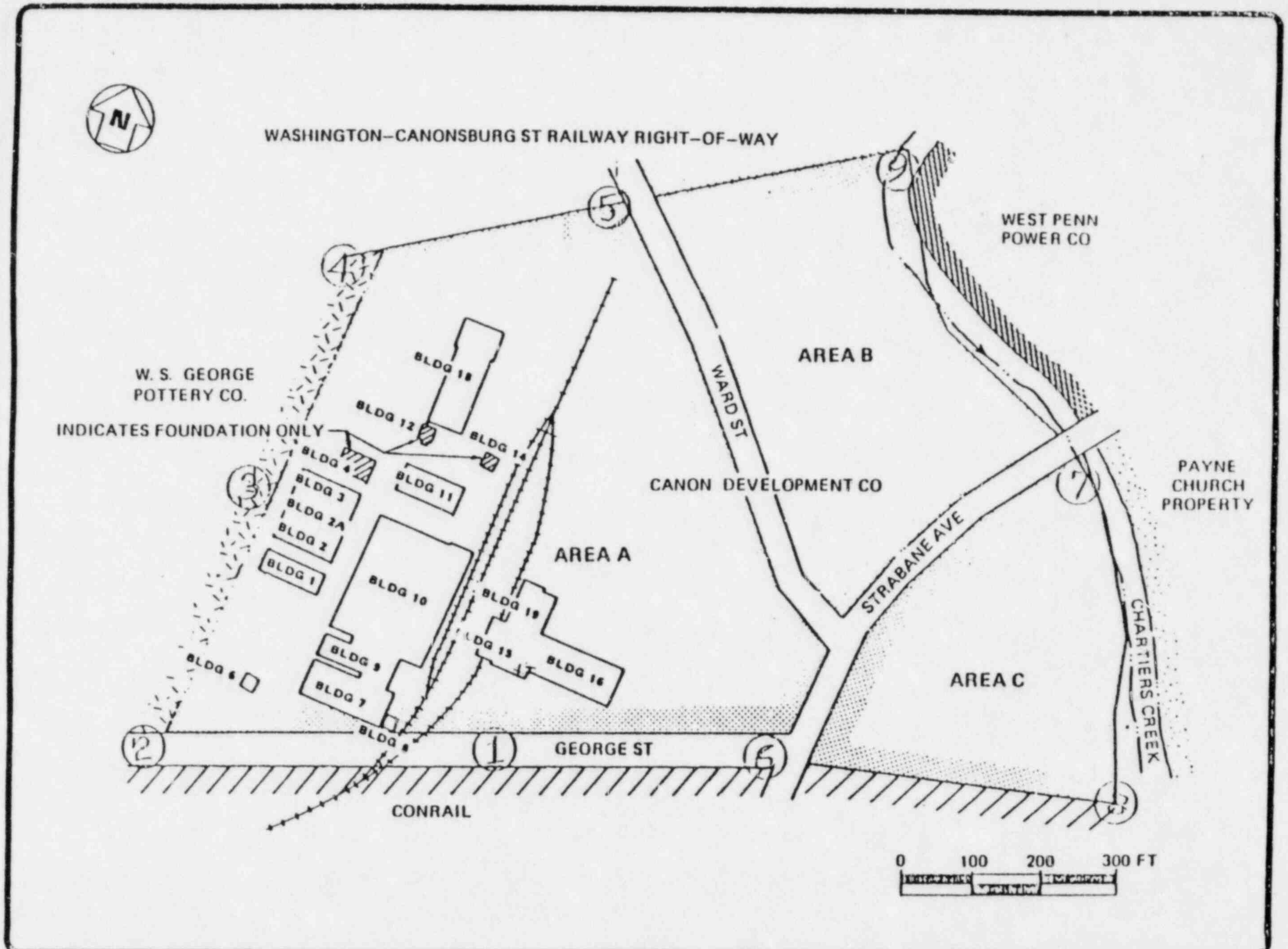

Figure 1. Test Locations

September 13, 1979
Sunny & Clear

Table 1. Recorded Sound Levels

Canonsburg Area "A" GR 1933 Slm + Nagra Recorder

Location No. 1 Property Line

Bldg. 15 (See Fig. 1)
Background: 55 dBA
Mfg. Pulses +1 -2 dB
No particular sound source

GR 1933 set on 40-50-60 dB scale
Modulometer: - 15 dB

Nagra Ref. -6 dB

Location No. 2 (near residential properties 300-500 ft. to south of ind. property corner)

No mfg. activity
AC overflight only sound (60 dBA)
Background: 47 dBA

Location No. 3 S-N Mid-Prop. Line

Workers - painting, etc.
Background: 45 dBA

Location No. 4 NW Corner

Residences 200 ft. away
Background: 45 dBA
AC overflights (60 - 70 dBA) 5-10 minutes apart
Fork lifts, occasional sound associated with trucking operation sound sources

Location No. 5 Areas "A" and "B" (including nearby residences)

Highway to North
Background: 55 dBA av.

Location No. 6 Areas "A" and "C"

Background: 52 dBA Cars and trucks passing naturally drive this level upward

Location No. 7 Areas "B" and "C" (near bridge over Chartiers Creek)

Background: 55 dBA AC and cricket sound sources

Location No. 8 Area "C"

Background: 50 dBA AC, waterfall and insect sound sources

Location No. 9 Area "B"

Background: 57 dBA Mostly acceptable natural sounds, rapids in stream and insect sound sources.
Highway on other side of water.
Populated area there experiences background similar to this and No. 7.

Figure 2. Surrounding Communities

day-night average sound level, L_{dn}. These values are given in Table 2 and have importance as the primary measure for describing noise in an EIS.

The average and extreme values of L_{dn} for our test areas and communities are marked on the annoyance charts given in Figures 3 and 4. These indications show why there have been few complaints under present conditions. We will now consider the projections that may accompany the contemplated clean-up project.

4. Sound Level Projections for Clean-Up Activity (Daytime Only)

Figure 5 shows ranges of A-weighted sound levels for a variety of equipment that might be used in the proposed clean-up effort. The steady levels reach 95 dBA at 50 ft. and are nearly all above 70. It is likely also that a number of equipments will operate simultaneously, and their sounds will add in combinations which could increase the levels shown by as much as 6 to 10 dB.

Thus a figure of over 100 dBA could exist at some point 50 feet away from one piece of operating machinery due to the presence of another at a similar distance not necessarily of the same type. One can only speculate about the true level, because these sound spectra may be different and the sound pressure summations will be very complex. However, the sounds of internal combustion engines are sufficiently similar to add approximately as indicated.

Projecting these levels to the residences an average 300 feet away reduces them in the propagation process by only 16 dB to 84 dBA. This level for an 8-hour day verges upon an intensity which otologists consider to have hearing damage potential. It would certainly interfere with outdoor conversation, even at close range.

Translated to an indoor level by subtracting an average of 24 dB for a residential building's attenuation, 84 dBA noise outside produces sound at a 60 dBA level inside. This is far above acceptable levels inside residences (See Table 3). Relaxed conversation with 100% sentence intelligibility in a typical living room cannot be enjoyed above a 45 dB background. People tend to raise their voices when this exceeds 45 to 50 dB.

Table 2. Present Day-Night Average Sound Levels (L_{dn})*

Location	L_{dn} (dB)
1	61
2	53
3	51
4	51
5	61
6	58
7	61
8	56
9	63
	Av. = 57

*Characterization of average sound levels in residential areas throughout the day and night, L_{dn}.

$$L_{dn} = 10 \log_{10} \left[\frac{1}{24} \left(\int_{0000}^{0700} 10^{[L_A(t) + 10]/10} \, dt + \int_{0700}^{2200} 10^{L_A(t)/10} \, dt + \int_{2200}^{2400} 10^{[L_A(t) + 10]/10} \, dt \right) \right]$$

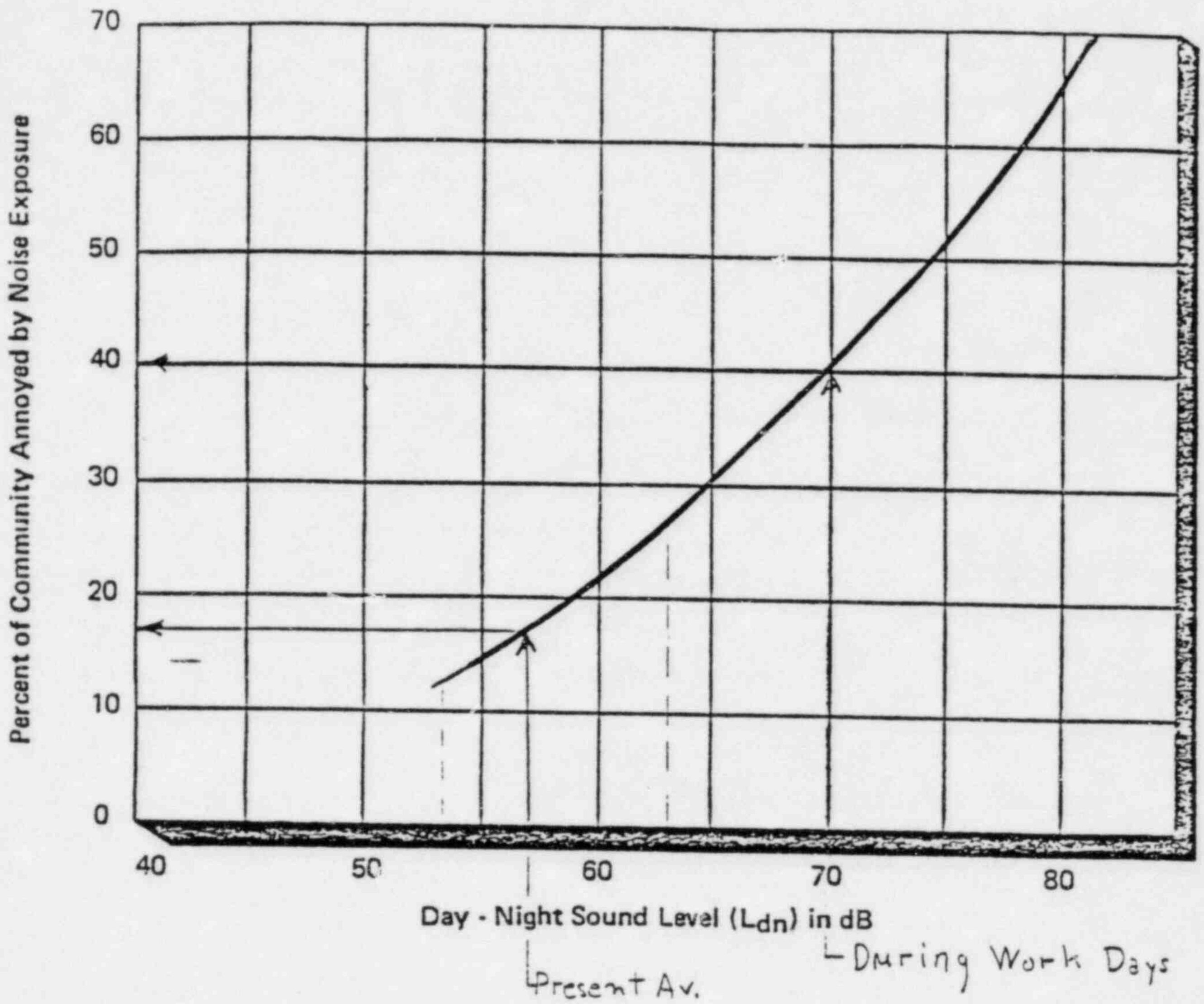

Figure 3. Percentage of Population Annoyed by Community Noise (Heathrow Airport Study) Ref. No. 3 Canonsburg Levels and Projections Indicated.

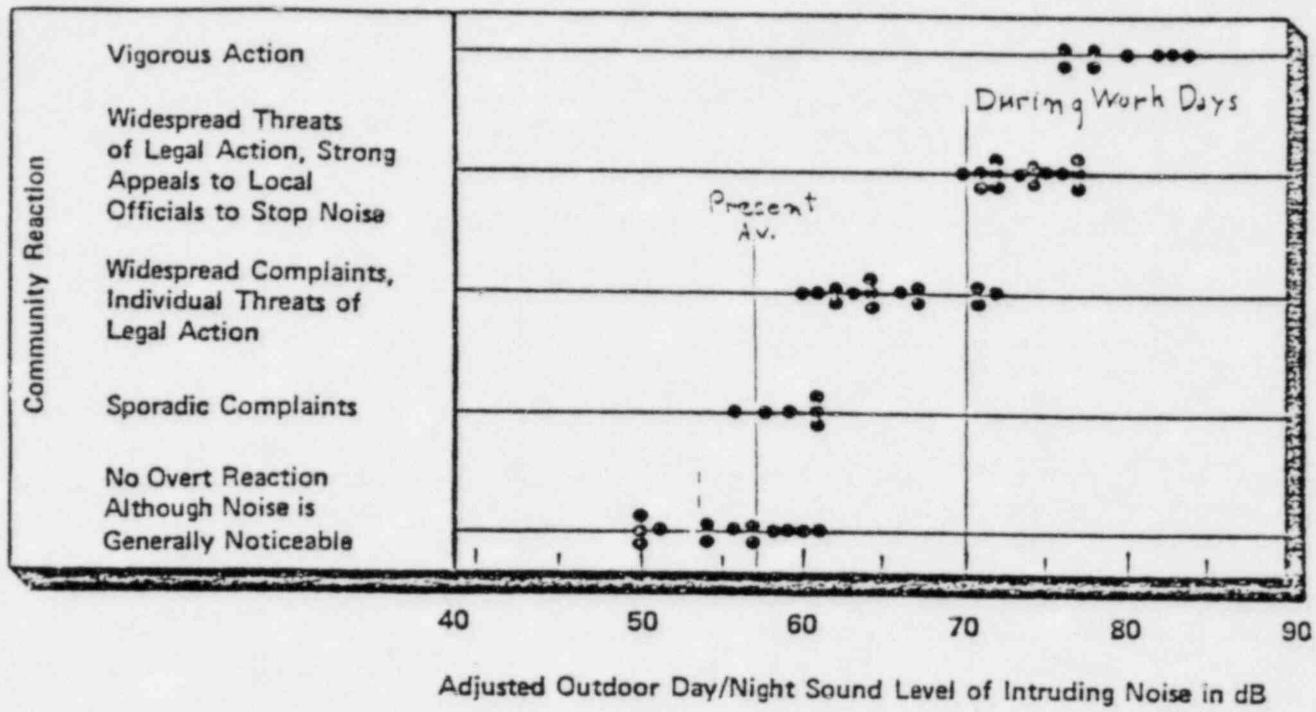

Figure 4. Combined Data From Community Case Studies Adjusted for Conditions of Exposure. Ref. No. 3 Canonsburg Levels and Projections Indicated.

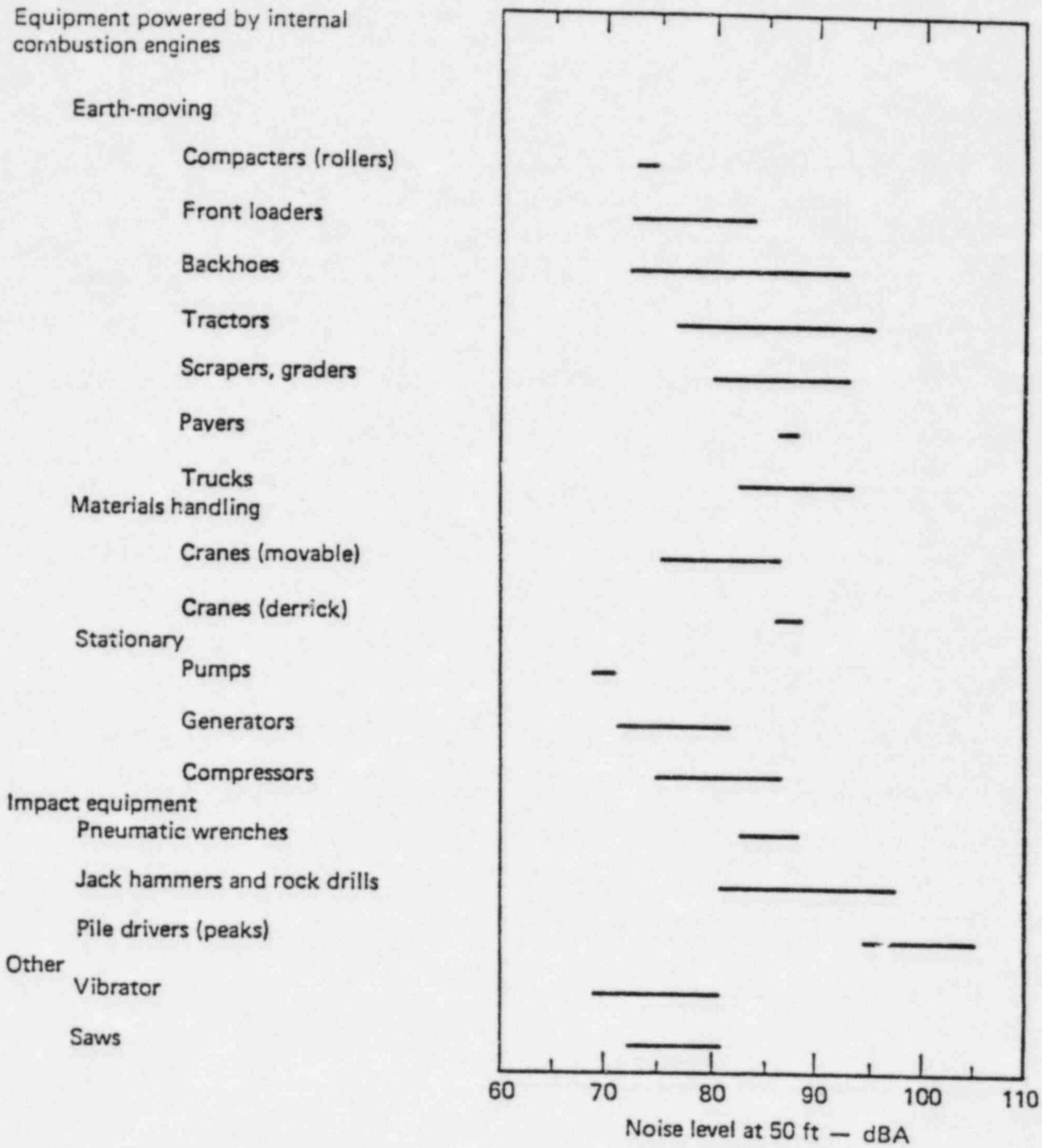

Figure 5. Noise Levels from Construction Equipment, Based on Limited Available Data Samples. Sources: Ref. Nos. 4 and 5

Table 3. Range of Design Goals for Air-Conditioning System Sound Control

Type of Area	Range of A-Sound Levels, Decibels	Range of NC Criteria Curves
RESIDENCES		
Private homes (rural and suburban)	25–35	20–30
Private homes (urban)	30–40	25–35
Apartment houses, 2- and 3-family units	35–45	30–40
HOTELS		
Individual rooms or suites	35–45	30–40
Ball rooms, Banquet rooms	35–45	30–40
Halls and corridors, Lobbies	40–50	35–45
Garages	45–55	40–50
Kitchens and laundries	45–55	40–50
HOSPITALS AND CLINICS		
Private rooms	30–40	25–35
Operating rooms, Wards	35–45	30–40
Laboratories, Halls and corridors Lobbies and waiting rooms	40–50	35–45
Washrooms and toilets	45–55	40–50
OFFICES		
Board room	25–35	20–30
Conference rooms	30–40	25–35
Executive office	35–45	30–40
Supervisor office, Reception room	35–50	30–45
General open offices, Drafting rooms	40–55	35–50
Halls and corridors	40–55	35–55
Tabulation and computation	45–65	40–60
AUDITORIUMS AND MUSIC HALLS		
Concert and opera halls Studios for sound reproduction	25–35	20–25
Legitimate theaters, Multi-purpose halls	30–40	25–30
Movie theaters, TV audience studios Semi-outdoor amphitheaters Lecture halls, planetarium	35–45	30–35
Lobbies	40–50	35–45
CHURCHES AND SCHOOLS		
Sanctuaries	25–35	20–30
Libraries	35–45	30–40
Schools and classrooms	35–45	30–40
CHURCHES AND SCHOOLS (Cont'd)		
Laboratories	40–50	35–45
Recreation halls	40–55	35–50
Corridors and halls	40–55	35–50
Kitchens	45–55	40–50
PUBLIC BUILDINGS		
Public libraries, Museums, Court rooms	35–45	30–40
Post offices, General banking areas, Lobbies	40–50	35–45
Washrooms and toilets	45–55	40–50
RESTAURANTS, CAFETERIAS, LOUNGES		
Restaurants	40–50	35–45
Cocktail lounges	40–55	35–50
Night clubs	40–50	35–45
Cafeterias	45–55	40–50
STORES RETAIL		
Clothing stores Department stores (upper floors)	40–50	35–45
Department stores (main floor) Small retail stores	45–55	40–50
Supermarkets	45–55	40–50
SPORTS ACTIVITIES INDOOR		
Coliseums	35–45	30–40
Bowling alleys, gymnasiums	40–50	35–45
Swimming pools	45–60	40–55
TRANSPORTATION (RAIL, BUS, PLANE)		
Ticket sales offices	35–45	30–40
Lounges and Waiting rooms	40–55	35–50
MANUFACTURING AREAS	Use Speech Interference Level or Damage Risk Criteria, as required.	
Foreman's office		
Assembly lines, Light machinery		
Foundries, Heavy machinery		

From ASHRAE* Guide and Data Book - Systems and Equipment for 1967, pg. 379

* American Society of Heating, Refrigerating and Air-Conditioning Engineers

Even if we are less severe in selecting the probable equipment noise levels in Figure 5 and choose a 10 dB lower value, say 85 dBA at 50 ft., the result would still exceed the residential values in Table 3. These calculations were for closed window conditions which might not pertain in summer if the work were done during that season, and the problem would be further aggravated.

One can also compute the L_{dn} for the working days. Taking the average area non-working sound pressures of approximately 50 dBA and 75 dBA for 8-hours, daytime-only operation, one derives an L_{dn} of 70 dB. Under these conditions Figure 3 shows 40% of the community annoyed by the noise, and Figure 4 suggests that "Widespread Complaints, Threats of Legal Action and Appeals to Local Officials" could occur.

It should be further pointed out that we have selected in the computation rather modest levels for the equipment noise which could be considerably higher. Therefore we tend to believe that the projected noise impact is quite credible and not exaggerated.

REFERENCES

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2. "Public Health and Welfare Criteria for Noise," Environmental Protection Agency 550/9-73-002, July 27, 1973.

3. "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety," U.S. Environmental Protection Agency 550/9-74-004, March 1974.

4. "Noise from Construction Equipment and Operations, Building Equipment and Home Appliances," U.S. Environmental Protection Agency, Washington, D.C., Report PB 206717 (1971).

5. "Transportation Noise and Noise from Equipment Powered by Internal Combustion Engines," U.S. Environmental Protection Agency, Washington, D.C. Report NTID 300.13 (1971).

APPENDIX I

Pittsburgh Weather Thursday, 13 September 1979

Increasing cloudiness and warm

High in low 80s

Rain tonight and Friday, heavy at times

Low tonight in 50s

High Friday in 70s

Chance of rain 20% today, 100% tonight and Friday

Temperature (11 a.m.) 72°F

Relative Humidity 61%

Sealevel Barometric Pressure 30.19 inches, steady

Wind SE 14 mph

THE FRANKLIN INSTITUTE RESEARCH LABORATORIES
THE BENJAMIN FRANKLIN PARKWAY · PHILADELPHIA, PENNSYLVANIA 19103

Donald R. Phoenix, Ph.D.
Project Manager
Life Systems Department
Weston
Weston Way
West Chester, PA 19380

October 15, 1979

2 copies of Report No. C5240-01 titled "Acoustical Survey and Environmental Impact Projection for Operations at Canonsburg, PA." dated 9/79.

Re: RECEIPT OF MATERIAL FOR SPONSORED PROJECT

Receipt of the material listed above is hereby acknowledged.

Original to be signed personally by the recipient and returned to C. W. HARGENS.
Duplicate to be retained by the recipient addressed.
Triplicate by sender for suspense file.

____________________(Date) ____________________(Signature)

Appendix I

TRANSPORTATION OF URANIUM-MILL TAILINGS FROM SELECTED SITES

TRANSPORATION OF
URANIUM MILL TAILINGS
FROM SELECTED SITES

SEPTEMBER 13, 1982

Transportation and Distribution Associates, Inc.
600 N. Jackson Street
Media, PA 19063
215-565-0238

September 16, 1982

Mr. Jack C. Newell, P.E.
Vice President
Program Department
Weston
Weston Way
West Chester, PA 19380

Dear Mr. Newell:

Transportation and Distribution Associates, Inc. (TAD) is pleased to submit this final report pertaining to the movement of uranium mill tailings from selected sites.

Very truly yours,

Alan B. Buchan
Vice President

ABB/sb
0110/282900/1370

TABLE OF CONTENTS

I INTRODUCTION

BACKGROUND

In 1978, Congress passed the Uranium Mill Tailings Radiation Control Act (UMTRCA) acknowledging the potential health hazards associated with uranium-mill tailings. Under this act the U.S. Environmental Protection Agency (EPA) was charged with establishing standards for these sites and the U.S. Department of Energy (DOE) was authorized to work with affected states and Indian tribal governments to clean up these sites. The UMTRCA specifically listed the Canonsburg, Pennsylvania site as one of the sites requiring cleanup. Included with Canonsburg is a site in Burrell Township which contains material previously imported from Canonsburg. The DOE and the Commonwealth of Pennsylvania entered into a cooperative agreement on September 5, 1980 to perform remedial work at the site.

In 1980 the Commonwealth of Pennsylvania studied a number of potential disposal sites for the Canonsburg material to be used if the site was to be decontaminated. This study resulted in the selection of a property in Hanover Township, Pennsylvania, as the best available site. This property (the Hanover site) is located in Washington County, approximately 16 miles northwest of Canonsburg. The site is basically a long, dry trench that was formed by strip-mining activities on a ridgetop.

OBJECTIVE

The objective of this report is to provide costs for various transportation alternatives and discuss the impact of moving the uranium mill tailings by truck versus by rail.

SCOPE

The scope of work is as outlined below.

1. Determine the cost to rehabilitate/construct rail loading/unloading facilities at the Canonsburg, Burrell, and Hanover sites (this task is confined to the costing of track additions/modifications only).

2. Determine the cost to transport the contaminated material from staging piles adjacent to the railroad side track at each site via rail to unload at a point adjacent to the receiving railroad side track.

   As part of the cost to ship via rail, develop equipment requirements based on various types of rail cars, i.e., hoppers, gondolas, or box cars, etc., including issues involved in the tainting of railcars.

3. Determine the cost to transport clean fill via rail from borrow pits (specified by Weston) to the contaminated sites.

4. Report on the highway network from borrow pit locations to state highways based on ground reconnaissance including a review of bridges, traffic density, grades, and built-up areas.

5. Report on the highway network from contaminated sites to state highways based on ground reconnaissance similar to item 4.

6. While in the Pittsburgh area, determine the availability of trucking firms and equipment and hauling costs.

7. Develop a discussion of the feasibility and impacts of moving the contaminated material by truck versus by rail from the engineering and safety standpoints.

II RAIL ALTERNATIVE

FACILITY REQUIREMENTS

Burrell Township

Present facilities for loading rail cars at the Burrell Township site are non-existent. Based on the present triweekly frequency of local freight service on the adjacent rail line, the lading capacity of appropriate freight equipment and the project duration, sufficient track capacity to load and store 20 rail cars of 60-foot overall length each will be required. It is recommended that this be accomplished by constructing two 1,200-foot stub-end tracks connected to the Conrail main track with a 200-foot lead. Construction of rail spurs will present no unusual problems as the ground is presently properly graded and follows the grade of the adjacent right-of-way (ROW).

Canonsburg

Facilities for loading rail cars at the Canonsburg site presently exist in the form of two yard tracks north of the Conrail Washington Branch main track. Based on the present triweekly frequency of local freight service on this branch, the lading capacity of appropriate freight equipment, and the project duration, sufficient track capacity to store 20 rail cars of 60-foot overall length each will be required. Sufficient yard track presently exists to meet this requirement but some rehabilitation (primarily in the form of tie renewal) should be undertaken to reduce the probability of any derailments. Also, a crossover should be installed just west of Strabane Ave. In order to load the cars while standing on these yard tracks it will be necessary for the contractor to lease the tracks for the duration of the project. Conrail presently stores some flat cars on the west end of these yard tracks; however it is believed that storage room for these flat cars can be found elsewhere within the Canonsburg area.

Hanover Township

The Hanover Township site at one time had a spur track extending about one mile from the Conrail main track and which terminated within 4,000 feet of the proposed trench in Area 7. This spur has been abandoned for years as evidenced by the growth of trees up to four inches in diameter within the ROW. Most of the ROW is intact and reconstruction of the spur would require only minor clearing, limited regrading, reconstruction of two culverts, partial bank restcration, and track installatio.. Two open deck steel plate girder bridges over Hanover Creek and Legislative Route (LR) 62122 are in good condition and need only new timber decks. Some erosion of soil around the header walls was observed but is not believed to be a problem. About 50% of the rail required to recpen the spur is on-site and could be used; however, ownership of both the ROW and rail is unknown. In addition to the spur a two-track, stub-end yard with capacity to hold 20 cars would be required at the end of the line. This assumes that the Burrell and Canonsburg sites would be worked sequentially rather than concurrently. If the Burrell and Canonsburg sites were worked concurrently and rail was used from both sites the yard capacity would need to be expanded to accommodate 40 cars.

EQUIPMENT

The feasibility of utilizing various railcar designs is governed by tradeoffs among material handling ease, security, decontamination, etc. It is readily apparent that most types of rail equipment are not specifically designed to match all expected requirements for waste hauling. Further, the scope of the project in terms of carloads and time will require the dedication of carrier equipment or the purchase or lease of private cars.

In general two types of cars can be considered, bulk-handling cars and open or closed cars for various palletized or packaged commodities. Examples of these types have been abstracted from The Car and Locomotive Cyclopedia 1980 Edition, Simmons Boardman, Omaha, NE and are shown in Appendix A.

Bulk handling cars include open and covered hoppers, high- and low-side gondolas, and side dump cars.

Open Top Hoppers

Hopper cars transport ladings varying from heavy ores to lighter materials such as coal. Although hopper cars could be easily loaded at the cleanup sites, major constraints on the use of hoppers are: bottom unloading capabilities such as trestles would be desirable to facilitate unloading; lumpy or cohesive materials such as soils may pack in the pockets, impeding unloading; and, in some cases, cubic capacities are so great that weight limits may be exceeded if completely filled with dense commodities.

Covered Hoppers

Covered hoppers are designed for less-dense, free-flowing commodities, such as grains, chemicals, and pelletized plastics requiring protection from the elements. Security is greatly enhanced in such cars at the expense of loading ease through top hatches. Furthermore, unloading gates would be more likely to be plugged by soils and cubic capacities are generally well above requirements.

Gondolas

High-side gondolas are solid-floor cars of capacities similar to hoppers. While bottom unloading problems are eliminated, specialized unloading facilities such as rotary dumpers are required for unloading and cubic capacities may greatly exceed load limits imposed by soils.

Low-side or conventional gondolas are smaller capacity designs commonly used in hauling steel mill products and high-density ladings. They are ideally suited to moving soils in terms of weight and cubic capacity limits but unloading could be tedious.

Side Dump Cars

Side dump cars are a specialized type of gondola designed for handling of railway construction materials. The car body can be tilted to either side by pneumatic cylinders allowing rapid discharge of the load in less than 10 seconds at trackside. While they are ideally suited in capacities and loading and unloading characteristics, availability could be limited since they are dedicated to railway maintenance of way usage.

Open or closed cars for various palletized or packaged commodities include box cars and flat cars.

Box Cars

Box car designs accommodate very light lading densities such as appliances, packaged foods, etc. They afford excellent containment but impose more laborious loading and unloading techniques.

Flat Cars

Flat cars deserve consideration only if wastes can be containerized. While this allows flexibility in material-handling concepts, net weights transported are reduced by the tare weights of both the rail car and the containers used. Some flat cars are specifically designed to accept standardized containers or trailers but load limits of these cars are on the order of 70 tons to match highway loading limits on trailers.

LADING DENSITY

Quantitative evaluations of lading densities, cubic capacities, and weight limits have been developed as follows:

- Typical lading density values were derived for each car type using the ratio of load limits to cubic capacities. This tabulation demonstrates that, except for gondolas and some aggregate cars, most cars are designed for ladings of lower density than the wastes.

- Next, car volumes were tabulated in cubic feet and cubic yards, along with maximum weights in tons to permit calculation of allowable loads.
- Maximum loads in cubic yards were then calculated, applying a soil density of 1.21 tons per cubic yard[1]. In most cars, the load limits were reached before the cars could be filled to maximum cubic capacities, which implies that special monitoring would be essential at loading sites to preclude overloading. Several designs were well suited; namely, the side dump car and the gondola in that cubic capacities nearly equal the volumes of maximum loads.

EQUIPMENT APPLICATIONS

From an applications viewpoint, a variety of factors were assessed by assigning qualitative scores ranging from 1 to 4 implying poor to excellent characteristics, against weighted objectives (ranging from 0 to 3) defined as follows:

1) Loading ease considers the placement of excavated soil in cars by means of front-end loaders, clamshell buckets, or conveyor belt and is weighted at 2.0.
2) Unloading ease considers removal by bottom dumping, side dumping, clam shell bucket, or container handling to facilitate transfer to the

1 Standard Handbook for Civil Engineers Pg. 7-58, 1968 Edition, McGraw-Hill, New York, NY.

disposal site and is weighted at 3.0 as the most critical factor.

3) Spill prevention considers the packaging (car body) integrity in preventing contamination of transfer points and rights of way due to leakage and is weighted at 1.0. For example, hopper doors and pockets generally allow leakage and would require patching, special linings or sealing gaskets to eliminate such problems.

4) Security enroute considers public access to the wastes based on the package type. This is both a psychological factor, i.e., the reaction of people to the knowledge that a hazardous waste is nearby in a given container type, and also a physical factor, i.e., the prospect of tampering by trespassers and is weighted at 1.0.

5) Overload prevention considers matching the weight and volume limits along with the likelihood of greatly exceeding load limits if cubic capacities are too large. This factor can be controlled by loading monitors and is thus weighted at 0.5.

6) Decontamination and reuse aspects consider the the ease of cleaning the equipment and the risks, both real and esthetic, that subsequent use of the cars could impact on food chains. These are important aspects weighted at 2.0.

A detailed assessment of each applicable car type follows, ranking the various car types for suitability to the clean-up project based on the evaluations shown in Exhibit II-1. However, additional factors such as regulations, availability, and costs (carrier supplied versus purchased or leased cars), must also be considered.

Open top hoppers attained a score of 28.0 out of a possible 38.0. For these cars, loading ease is excellent.

EQUIPMENT REQUIREMENTS FOR RAIL TRANSPORT

EQUIPMENT REQUIREMENTS FOR RAIL TRANSPORT

R* E F.	Car Type	Lading Density Range lb/cu.ft.	Capacity[1] cu.ft.	Capacity[1] cu.yd.	Max. Load (tons)	Max.[2] Load (cu.yd.)	Loading[3] Ease F=2.0	Unloading Ease F=3.0	Spill Prevention F=1.0	Security[5] Enroute F=1.0	Overload Prevention F=0.5	Decontamination & Reuse Aspects F=2.0	Score	#2 80K cu.yd. 272K cu.yd.	#3 N/A 323K cu.yd.	#4 330K cu.yd. 471K cu.yd.	#5 250K cu.yd.[7] 493 cu.yd.[8]
	EQUIPMENT CHARACTERISTICS						**EQUIPMENT APPLICATIONS ASPECTS[4] (Qualitative Estimates)**							**CAR LOAD REQUIRED PER ALTERNATIVE**			
A	Coal Hoppers	50/65	3420	127	100	82.6	4	2	2	3	2	4	28.0	·970	0	4000	3030
B	Ballast	82	2400	89	96	79.3	4	2	2	3	3	4	28.5	1070	0	4170	3160
C	H7d0717	100	2000	74	100	82.6	4	2	2	3	4	4	29.0	970	0	4000	3030
D	Aggregate	91	2200	81	100	82.6	4	2	2	3	4	4	29.0	970	0	4000	3030
E	Gons	89	2244	83	100	82.6	4	2	3	3	4	4	30.0	970	0	4000	3030
F	HS Gons	50	4240	157	106	87.6	4	1	3	3	2	4	25.0	920	0	3800	2880
G	Cov Hop	70	2980	110	104	86	2	1	3	4	1	1	16.5	930	0	3840	2910
H	Cov Hop	70	2917	108	102	84.3	2	1	3	4	1	1	16.5	950	0	3920	2970
I	Cov Hop	70	3000	111	105.5	87.2	2	1	3	4	1	1	16.5	920	0	3800	2880
J	Box	27	6540	242	89	73.5	1	1	4	4	1	1	14.5	1090	0	4500	3410
K	Box	29	5277	195	77.3	63.9	1	1	4	4	1	1	14.5	1260	0	5160	3910
L	Box	33	5277	195	86.3	71.3	1	1	4	4	1	1	14.5	1120	0	4620	3500
M	Side Dump	135/140	1480	55	94	77.7	4	4	2	3	4	4	35.0	1460	0	6000	4550
	(Specialized M of W Cars)				72.6	60.0								1340	0	5500	4170
N	Flat	Variable			77												
N	20ft. Cont.	29	1250	46.3	18	12	4	3	3	4	2	3	31.0	1450		5990	4540
	# 4/car		5000	185.2	67[9]	55.4											
N	40ft. Cont.	29	2500	92.6	27	18	4	3	3	4	2	3	31.0	1800		7430	5630
	# 2/car		5000	185.2	54	44.6											

NOTES:

1 Struck Capacities for for Hoppers, Gondolas, and Side Cars

2 Soil Density Loose: 90lb./cu.ft. = 1.21 tons/cu.yd.

3 Relative merit factor = F

4 1 = Poor, 2 = Acceptable
3 = Good, 4 = Excellent

5 Assumes tarpaulins over loads in open top cars

6 Calc by waste cu.yd. ÷ cu.yd. / 21 tons car loads

7 Waste material exported

8 Fill material imported
Not included in car loads estimate

9 Less 500 lbs. per container.

10 At struck capacity

11 At heaped capacity

* See Appendix A

EXHIBIT II-1

Unloading could be troublesome if facilities are not upgraded and if soils tend to cohere and hamper bottom dumping. Spill prevention was classed acceptable provided that pockets and doors are capable of being sealed to prevent leakage. If loads are covered with tarpaulins, security enroute was rated good. Overload prevention was rated acceptable, but since these cars would have about 40 cubic yards of excess capacity, test loads would have to be run over a track scale and stripes painted on each car to indicate the allowable load height. Decontamination/reuse aspects were rated excellent since washing and wipe tests should eliminate any residual radioactivity and the normal assignments of these cars do not involve food chains.

Three variations of hopper cars were also evaluated leading to slightly higher scoring. All of the above comments apply except that the cars with lesser cubic capacities were less likely to be overloaded thus increasing ratings for this factor.

Gondola cars were judged excellent for loading ease but poor for unloading. The unloading problems could be eliminated by using containers since removing soil by clam shell bucket would be inefficient. Spill prevention is improved for gondolas since they have flat solid bottoms eliminating enroute leakage. Security enroute was rated good if tarpaulins are used. Gondolas are also available with covers, normally in three sections and a crane is required for removal. Overload protection was considered excellent as were decontamination/reuse aspects leading to an overall score of 32.0.

High side gondolas were rated lower since they are of similar capacity to open top hoppers and typically have internal diagonal braces which would greatly complicate unloadings.

Several types of covered hoppers were evaluated leading to similar low scores. Both loading and unloading would be troublesome due to the configuration of top hatches and pocket gates. Some penalty is associated with this car type since reuse for grain service or other food processing industries would be compromised.

Box cars were found to have similar characteristics as covered hoppers except that loading would be even more awkward; consequently, their scores were even lower.

Side dump cars were found to provide a nearly ideal match to project requirements. Special attention could be required to the side seals to prevent leakage while underway and afford adequate security but all other application factors were judged excellent. Provided that sufficient cars are available for assignment to this project, car-cycle times would be greatly improved and unloading site upgrading costs minimized.

Finally, flat cars got a high score if provisions could be made to containerize the wastes. If dumping capabilities were included in container design criteria, considerable savings at the unloading site would be possible. Containers could also be loaded into gondola cars to permit transport of greater weights. This approach would allow a load limit of 100 tons per car rather than the 77 tons typical of intermodal flat car designs and could also minimize some tie down problems.

In summary, the equipment rankings at this stage indicate that side dump cars are preferred, followed by containerized loads in gondolas, and, lastly, bulk in gondolas.

REGULATORY AND TARIFF CONSIDERATIONS

The feasibility of rail transport is also governed by various regulations of federal and state agencies along with any rates and constraints imposed by Conrail.

The attached abstracts from BOE Tariff 6000-A, Hazardous Material Regulations, define Low Specific Activity (LSA) wastes as less than .001 milliCuries/gram or 1μC/gm. In contrast, the wastes at the two sites range from 5 to over 100 picoCuries/gram. Since one pC is $10^{-6}\mu C$, the materials involved are on the order of $1 \times 10^{-4}\mu C/gm$. ($100pC = 100 \times 10^{-6}\mu C = 1 \times 10^{-4}\mu C$).

A further limit for shipment is that surface radiation from carloads must not exceed 10 millerem/hour at any point 2 meters (about 6 feet) from vertical planes projected from the outer edges of the vehicle. Open carloads would develop a gross activity of approximately 9 milliCuries; thus radiation levels in rem/hr should be surveyed or estimated for such lading configurations to assure compliance. It has been called to our attention by Mr. D. McDonald of the Pennsylvania Bureau of Radiation Protection and Toxicology, Harriburg, PA that some "hot spots" may exist in a former lagoon zone at Canonsburg at which specific activities considerably exceed 100pC/gm but it was not known whether they exceed 1μC/gm.

The recent Resource Conservation and Recovery (RCR) Act stipulates manifest requirements for generators, transporters, and disposers of hazardous wastes. Conrail's Safety and and Environmental Control Departments would be involved in technical evaluations arising from these regulations. In the Conrail Safety Department, Mr. James McNally at 215-893-6505 would evaluate transportation aspects, while Mr. Tom Pendergast at 215-893-6542 would rule on compliance with Conrail's environmental controls and manifesting aspects.

During transport, spillage and fugitive dust aspects must be considered. Open top equipment would necessitate use of tarpaulins to cover loads or possibly treatment with dust control agents such as are supplied for coal transfer and storage sites. The state regulators (Mr. E. Sajeski of the Pennsylvania Department of Transportation, Harrisburg) have indicated that their regulations simply parallel the U.S. Department of Transportation regulations previously referred to.

RAIL OPERATION AND FLEET SIZE

Duration of Project

Given the expected duration of the project at Canonsburg (104 weeks), Burrell (81 weeks), and Hanover (120 weeks), it is assumed that all of the contaminated material should be removed from Canonsburg in one and one-half years or 75 weeks, leaving the remaining time for site restoration. This will require removal of approximately 700 cubic yards of contaminated material per day or about 850 tons per day, assuming 1.21 tons per cubic yard. Assuming the same rate of removal the duration of the Burrell removal is 24 weeks.

If Canonsburg and Burrell are progressed sequentially, 21 weeks would be available at Hanover for finishing operations. Approximate elapsed times for each task are as follows:

Move in Canonsburg material	75	weeks
Move in Burrell material	24	weeks
Available for Finishing and Cleaning	21	weeks
Allocated time for Hanover	120	weeks

A sequential loading operation will permit the use of the same rail equipment at each loading site, minimizing track construction requirements at Hanover and reducing the rail car fleet requirements.

Existing Rail Services

Existing rail service at the Burrell site is by a triweekly turnaround local on Monday, Wednesday, and Friday by a train originating at Kiskiminetas Junction yard located near Freeport.

Existing local rail service at Canonsburg is by a train originating at Canonsburg five days per week. On Monday, Wednesday, and Friday this train works north to Scully near Carnegie where it connects with through trains. Contaminated material moving to Hanover would move on these days. On Tuesdays and Thursdays this train operates to Washington and return.

Existing local rail service at the Hanover site is by a train operating from Conway to Weirton and Mingo Junction seven days a week.

See Exhibit II-2 for rail network diagram.

Fleet Size

In developing a fleet size for the movement of contaminated material, it is necessary to determine an equipment cycle time which is based on the connections of these local trains plus the other trains required for road moves. This is done by sequentially following a set of cars through loading, movement to Hanover, unloading, and return to loading site to be loaded again. Care must be taken to assure that sufficient sets of equipment exist for loading each day. This is especially critical where train service is triweekly because a failure to place or pull cars could mean the loss of two days' loadings and bring some of the activities at the site to a standstill.

The maximum number of equipment sets to support rail movement, based on present Conrail operating plans, are as follows:

Burrell to Hanover	6 sets of 10 cars each
Canonsburg to Hanover	5 sets of 10 cars each
Burrell to Canonsburg	6 sets of 10 cars each

It is expected, therefore, that 60 rail cars will be required to adequately support the movement of these materials.

Unloading Operations

Based on the previously discussed evaluation, the car types in order of preference are side dump cars and gondolas. Side dump cars are not immediately available, especially while maintenance of way activities are in full operation on the railroad, usually April to October. Purchase of such cars would be prohibitively expensive and a canvassing of car leasing companies reveals these cars are generally not available for leasing. Therefore, it is expected gondolas will be used.

In unloading gondolas a clamshell bucket would be utilized. The maximum load that a 30-ton crane can lift when equipped with clamshell and with a 40-, 50-, or 60-foot boom is

RAIL NETWORK DIAGRAM

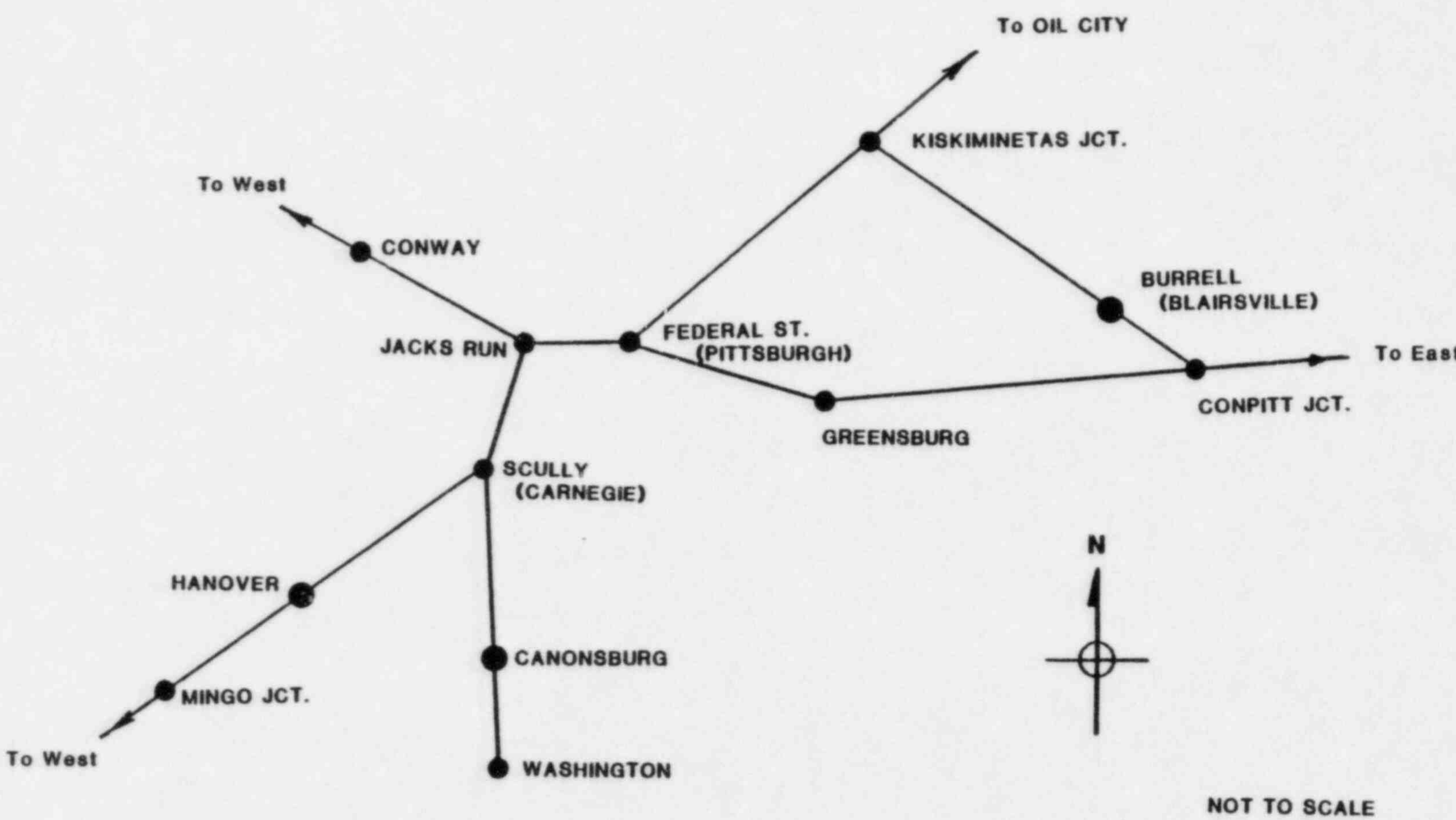

EXHIBIT II-2

10,300 pounds.[1] The largest bucket that can be handled is 1.5 cubic yards (the 2-cubic yard bucket exceeds to the crane's capacity by 531 pounds).

Bucket Size (Cubic Yards)	Capacity in[2] Cubic Feet at Plate-Line	Bucket Weight Pounds	Lading Weight[3]	Total Weight
1 1/4	37.6	4,980	3,384	8,364
1 1/2	43.7	6,000	3,933	9,933
2	51.5	6,206	4,635	10,841

The crane and bucket must be capable of unloading 20 rail cars per day (two days' loadings). With an expected unloading cycle of about 30 seconds[4], 146 cubic yards can be unloaded and placed into trucks for disposal in a 45-minute hour. This results in 90 cycles per hour.

Twenty carloads are the equivalent of 1,400 cubic yards which would be handled with an expected unloading time of 9.59 hours. If production could be pushed to 100 cycles per hour, i.e., 50 productive minutes per hour, the unloading time would still exceed eight hours by 28 minutes.

In the case of cars from Burrell, the overtime could be avoided by modifying Conrail's operating plan as only ten cars per day would need to be unloaded. Not only will this plan eliminate the overtime, but it will reduce the fleet size by ten cars. However, to achieve this plan operationally, Conrail would have to give absolute cooperation which we believe could be difficult over a sustained period of 24 weeks. Should the

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[1]R.L. Penrifoy, Construction Planning, Equipment, and Methods, McGraw-Hill, 1979 (page 236).

[2]Ibid, page 243.

[3]At 90 lbs. per cubic foot.

[4]Ibid, page 245.

material be moved from Burrell to Hanover by rail under a modified operating plan it is recommended that the fleet of rail cars be held at 60. This would permit some slippage on Conrail's part without jeopardizing production. It will also give the unloading contractor the ability to get out of trouble by working overtime. He would not have this ability when overtime is planned into the schedule.

In the case of the movement of material from Canonsburg to Hanover, the use of a 60-car fleet requires unloading of only ten cars per day.

In addition to the crane and clamshell, a group of four or five laborers with hand shovels will have to clean each gondola because the bucket is not able to clean the corners or along the edges of the car. These men would be subject to breathing dust because they would be working in a confined area where wind would not readily carry away the dust.

Use of Containers to Facilitate Unloading Operations

Youngstown Steel Door provides a 200 cubic yard container which was widely used in the steel mill operations. Eleven of these containers will fit into a standard 52-foot 6-inch gondola. The containers have a bottom unloading door which will permit discharge directly into trucks.

Because of the heavy weight of the material being handled only 178 cubic feet (eight tons) of each container's capacity is usable.

In unloading operations a crane moving adjacent to the rail cars can affix a sling to the container, lift and swing the container over a waiting truck, discharge the contents into the truck, and return the container to the car. Using this method 240 containers (21 carloads) can be unloaded per day. This daily productivity is sufficient to unload two day's loadings without overtime. No men will be required to clean the interior of the car. No movement of rail cars will be necessary once placed by Conrail.

Loading Operations

Without containerization, a tractor loader or crane would be used to load the gondola cars. A tractor loader with a 2.5-ton bucket will handle about 95 cubic yards of material per hour and load 700 cubic yards of material in 7.37 hours.

A 30-ton crane with a 1.5-cubic yard clamshell bucket will be able to load 700 cubic yards in 4.8 hours. In either case a Trackmobile will move and spot the rail cars at the loading location.

In a containerized operation, a Trackmobile would move cars to a surge bin equipped with a loading chute similar to that used in grain loading. A 30-ton crane with a 1.5-cubic yard clamshell bucket will place exactly four buckets (eight tons) into the surge bin which will then be unloaded into the container on the rail car. As the Trackmobile is positioning the next container, the crane is recharging the surge bin. It is estimated that a container can be loaded every four minutes.

Loading and Unloading Costs

The cost of loading rail cars at each loading site is assumed to be the same. The costs were developed for movements with and without the use of containers.

The operaton consists of:

- A 30-ton crawler crane with clamshell bucket
- A Trackmobile capable of moving ten loaded cars
- Equipment operators and helpers
- Clean up laborers

The projected cost per ton is $1.31 using containers and $1.45 not using containers.

The cost of unloading rail cars is assumed to be the same at each location. As with loading, the costs were developed with and without the use of containers.

The operation consists of:

- A 30-ton crane with a clamshell bucket for use without containers or with a sling for use with containers
- Equipment operators and helpers
- Clean up laborers.

The projected cost per ton is $0.88 using containers and $1.44 not using containers.

Cost Advantage In Using Containers

As can be seen from the previous discussion, the use of containers lowers the costs of loading and unloading. The estimated cost for a new container is $2,750 and it is assumed that upon completion of the project the containers would be scrapped. If all contaminated material (330,000 cubic yards) was outloaded in containers the cost of using containers is $4.28 per ton. It is therefore assumed that containers would not be used if the rail option were selected.

The resulting cost differential is $3.58 in favor of not using containers as shown in Exhibit II-3.

RAIL LOADING/UNLOADING COST/TON

	Cost Per Ton	
Operation	With Containers	Without Containers
Loading	$1.31	$1.45
Unloading	0.88	1.44
Container Purchase	$4.28*	-
	$6.47	$2.89

* Assumes maximum use of 330,000 cubic yards

EXHIBIT II-3

COST

Facilities

The cost to rehabilitate/construct the necessary rail facilities at each site is estimated below, including expected salvage (scrap) value, all in 1982 dollars.

Burrell Township
Installation 1400' side track and two turnouts - $220,000
Expected Salvage value - $10,800.

Canonsburg
Renew 1600 yard ties, renew 1 set switch timber and
Install one crossover - $63,050
Expected salvage value - $902

Hanover
Install two turnouts, construct 5250' track,
Rehabilitate 2850' track and install two timber
Bridge decks - $498,000.

(Not including purchase of ROW and assuming rail presently at site would be left there upon project completion)

Expected salvage value - $15,500

Equipment

Costs to Use Carrier-Supplied Cars

Conrail's Open Top Hopper Business Group, has indicated that LSA wastes can be hauled in hopper or gondola cars at a rate of $.75 per hundred weight (from Canonsburg) to $1.15 per hundred weight (cwt) (from Burrell) for loads of 90 tons or more. For shipments in 100 ton open top cars this amounts to $1900 per carload. Further, if special trains are run, a surcharge of $2200 per train is imposed. This information is published in Conrail's Tariff 4426B, Schedule D, and is included in Appendix C. Conrail has also indicated that rates are negotiable depending on the volumes of waste, daily carloading estimates, and their adaptability to existing freight schedules. In other words, rates in the tariff basically consider movements of one to a few carloads; since several thousand carloads could be generated by the clean up project, lower rates could be negotiated.

Costs to Lease Cars

Of five inquiries, two lessors have responded with estimated costs so far. PLM indicates that 4000-cubic-foot capacity, three-pocket hopper cars can be leased on a full lessor maintenance basis for $400 per car-month. Evans Railcar indicates that lower capacity gondolas or hoppers can be leased for $300 to $400 per car-month depending on type, age, availability etc. All lessors are sensitive to the radioactivity aspects and would require clauses to assign liabilities for contamination of equipment to the lessee.

The cost to lease a fleet of 60 cars has been estimated to be $432,000 to $960,000.

It must be recognized that leasing arrangements are seldom straightforward, simple contracts since the railroads also influence operating costs. In some instances, the railroads allow rebates on a car mile basis for leased cars since their own cars do not experience wear and tear. The lessors interviewed would not venture estimates of what rebates, in cents per car mile, might be negotiated. Further they indicated that no rebates might be available presently; in fact, surcharges might even be imposed in some circumstances. Since Conrail now has many cars idle, it is not too likely that they would welcome use of a leased fleet for this project.

Costs to Buy and Operate Cars

Given the current low levels of traffic and utilization, it is likely that older but suitable cars could be purchased from either railroads or lessors and scrapped upon completion of the project. Prices for new open top cars are in the $45,000 range; however, cars 30 or so years old could be acquired at prices not exceeding $8,000 each, leading to the following estimate:

Purchase 60 open top cars	=	$480,000
Maintenance at 5¢/car-mile	=	22,000
Scrap credit at $40 per ton	=	72,000
Total Estimated Cost		$574,000

Recommendation

Based on the above evaluation the use of carrier supplied cars is recommended.

Transportation of Contaminated Material

Burrell to Hanover - 80,000 cubic yards

Burrell to Canonsburg - 80,000 cubic yards

Loading @$1.45/ton	$ 141,520
Over-the-road @$1.15/cwt	1,840,000
Unloading @$1.44/ton	140,544
	$2,122,064

Canonsburg to Hanover - 250,000 cubic yards

Loading @$1.45/ton	$ 442,250
Over-the-road @$0.75/cwt	3,750,000
Unloading @$1.44/ton	439,200
	$4,631,450

Transportation of Fill Material

While specific borrow pit locations were not identified it was assumed that when the project begins sufficient borrow pits will be located within 10 to 20 miles of each site. With the borrow pits in such close proximity to the site, coupled with the double handling required if moved by rail the moving of land fill by rail was disregarded as too costly and as presenting too much of a logistical problem, especially if rail was to be used to move out contaminated material.

COST SUMMARY*

Contaminated Material Burrell to Hanover (Aternative 4)

Facilities	$ 718,000
Movement out	2,122,064
Expected salvage	(26,300)
Net	$2,813,764

Contaminated Material Burrell to Canonsburg (Alternative 2)

Facilities	$ 283,050
Movement out	2,122,064
Expected salvage	(11,700)
	$2,393,414

Contaminated Material Canonsburg to Hanover (Alternative 4)

If material from Burrell was moved by rail to Hanover:

Facilities	$ 63,050
Movement out	4,631,450
Expected salvage	(900)
	$4,693,600

If material from Burrell was not moved by rail (ie. truck) to Hanover:

Facilities	$ 561,050
Movement out	4,631,450
Expected salvage	(16,400)
	$5,176,100

Contaminated Material Canonsburg to Hanover (Alternative 5)

Facilities	$ 561,050
Movement out	4,631,450
Expected salavage	(16,400)
	$5,176,100

*Does not include movement of fill material to each site.

III TRUCK ALTERNATIVE

SITE ACCESS

Burrell Township

Present access to the Burrell Township Site from public roads is fair at best. Access for evacuation of contaminated material from its present location to existing public roads will require the following:

- Construction of 1,350-foot two-lane gravel and dirt access road from loading areas to the Conrail ROW property line.
- Rehabilitation of a two-lane private gravel grade crossing over the Conrail three-track main line. A Conrail flagman will also be required at the crossing during all hours of use.
- Rehabilitation of a two-lane 2,800-foot cinder access road adjacent to the Conrail tracks to a point of junction with Strangford Road.

Strangford Road, LR 32004, is the only available public road from the site and is deemed to be inadequate to support a sustained operation of a fleet of dump trucks (about 4,500 round trips are involved; approximately 4.6 trucks in each direction per hour, eight hours per day, five days per week for 24 weeks) to and from the site.

The road has a 15-ton load limit with asphalt paving which ranges from 12 to 15 feet wide with inadequate shoulders. The grade of the road varies and is moderately steep for short distances. The road traverses a sparse to medium density residential area for a distance of about 4,500 feet where it connects with old Route US 22, LR 32179 (Old 22), a two-lane, uncontrolled-access highway with a 45 to 50 mph speed limit and no special weight restrictions. The intersection of Strangford Road and Old 22 will prove to be extremely hazardous because of inadequate sight distance from Strangford Road to observe oncoming eastward traffic on Old 22, because of the Old 22 speed limits, and because of an inadequate turning radius for trucks to turn off Strangford Road eastward to Old 22. Improvement of sight distance by vegetation removal and regrading would, by itself, be inadequate. A speed restriction to 30 mph would be required for 1,500 feet on both sides of the intersection on Old 22, installation of "Caution-Turning Truck" signs, and quite possibly Caution/Stop flashers at the intersection. Improvement of the turning radius requires relocation of an existing two-story, single-family, frame dwelling about 300 feet. Property exists for such a relocation. An alternative would be to relocate the Strangford/Old 22 intersection about 300 feet to the east, thus improving the sight distance and the turning radius. This can be accomplished with minimal disruption as the present property is only a cut grass field. From this point the access to the present US 22 (Blairsville By-Pass) is adequate.

Canonsburg

Present access to the Canonsburg site is via Strabane Avenue, to West Pike Street, to PA 519, and to I-79.

Strabane Avenue north of Chartiers Creek is essentially lined with single family dwellings for about 400 feet. The intersection with West Pike Street is controlled by a traffic light. While the turning radius at this intersection is small it is alleviated to some degree by the set back of the stop lines. The turning radius could be further improved by setting the stop lines further back for the eastward traffic on West Pike Street. West Pike Street is heavily settled, mixed residential, commercial, and light industrial for about 5,600 feet to its intersection with PA 519 in the Borough of Houston. This intersection is also controlled by traffic signals. While the turning radius is better than the Strabane Avenue intersection, traffic stop lines will have to be relocated back from the lights to facilitate a larger turning radius. PA 519 is essentially commercially developed, with development decreasing as I-79 is approached. PA 519 will be travelled for 2,500 feet to the intersection of I-79.

While this route is capable of supporting a truck traffic density of about 14,000 round trips (approximately 4.7 trucks in each direction per hour, eight hours per day, five days per week for 75 weeks), portions of the road will no doubt require resurfacing on completion of the project. While not specifically part of the scope of this report it is believed that local public opinion will make this an undesirable route even if the inhabitants realize that the contaminated material is being removed.

An alternative exists in that an access road can be constructed to the south of and adjacent to the Conrail branch line between Strabane Avenue and PA 519. A railroad access road exists for most of the distance now and could be extended by eliminating the Conrail stub-end track west of Strabane Avenue. There is no apparent reason for Conrail to resist removal of this track. If that is not possible, a similar route could be accomplished either via Strabane Avenue, south to Latimer Avenue, and then west to PA 519; or, alternatively, via Strabane Avenue, south to Boone Avenue, and then west to PA 519.

Hanover Township

The only present access to the Hanover Township site which could be found during a ground reconnaissance without traversing private roads was via LR 62122 which parallels the Conrail mainline and Harmon Creek westward from PA 18, then via coal-haul roads. LR 62122 traverses the heart of Burgettstown and any volume of truck movement through the town would be virtually impossible. Access revealed through a map reconnaissance indicates a possibility of using T647 westward from PA 18; this route does not traverse any built-up areas. Also, Old US 22 west from the vicinity of Florence could be used to enter the site from the north.

OVER THE ROAD OPERATIONS

Burrell to Hanover

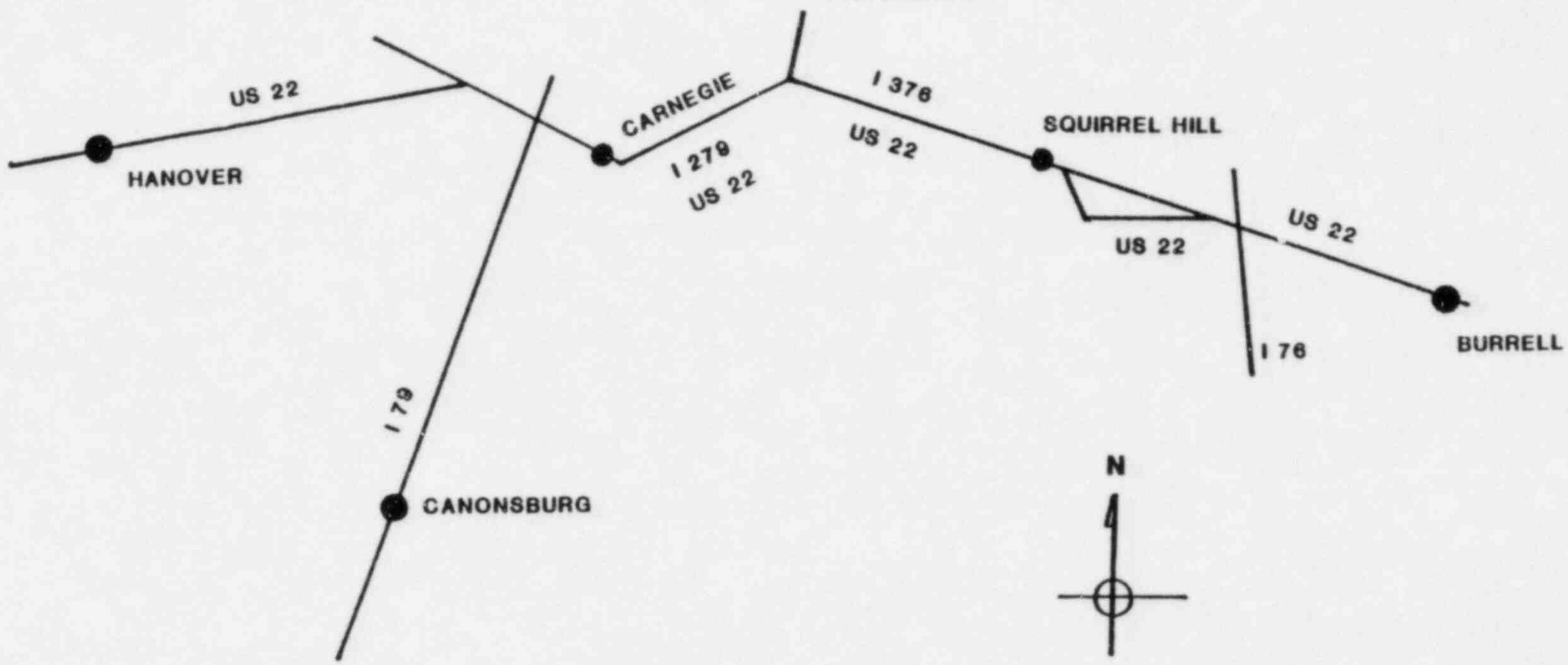
US 22 is essentially a three-lane, paved, unlimited-access highway for 26.5 miles providing a lane for each direction with the third (middle) lane designated for turning or passing as appropriate. Portions of this section are four-lane primarily at intersections with major cross roads. Most intersections are not grade-separated. The grades are moderate and the road is lined with commercial establishments with the density of occupation increasing close to Pittsburgh. The last three miles just prior to merging with I-376 is four-lane, heavily built-up, and congested.

I-376/US 22 is primarily a four-lane, paved, limited-access highway with at least two lanes in each direction for 15 miles. The grades are moderate and the route traverses a one mile tunnel at Squirrel Hill. Reconstruction of portions of this route are presently under way, permitting only one lane of traffic in each direction. This portion of the route passes through downtown Pittsburgh, generally following the north bank of the Monongahela River.

At the end of I-376/US 22, the route becomes I-279/US 22 and turns south over the Monongahela River and into the Fort Pitt tunnel. This section is a paved four-lane, limited-access highway with moderate grades for five miles to the junction with I-79. At this point the route designation is US 22/US 30. This section is a four-lane, paved, limited-access highway with moderate to heavy grades for 18 miles. Reconstruction is presently underway on portions of this section, allowing only one lane traffic in some stretches. This route ends at the grade-separated intersection with PA 18 which would be used for immediate access to the Hanover site.

This is a rather long route over roads that during the peak commutation periods are heavily utilized. Traffic in the downtown Pittsburgh area near the intersection of I-376 and I-279 can be heavy and congested even during off-peak periods. Truck hauls on this route would be limited to two round trips per eight-hour day with the probability of operation back to the starting site requiring more than an eight-hour day. See Exhibit III-1.

HIGHWAY NETWORK DIAGRAM



NOT TO SCALE

EXHIBIT III-1

Burrell to Canonsburg

The same route as previously described for Burrell to Hanover would be used except that, at the junction of I-79, traffic would turn onto I-79 south for 15 miles to PA 519. I-79 is a four-lane, paved, limited-access highway with flat to moderate grades. PA 519 would be used for immediate access to the Hanover site. This route is essentially the same length as the Burrell to Hanover route and truck operation would be limited to two trips per eight-hour day with the probability of a frequent occurrence of operation beyond eight hours. See Exhibit III-1.

Canonsburg to Hanover

Essentially there are three available routes between Canonsburg and Hanover, as shown in Exhibit III-2.

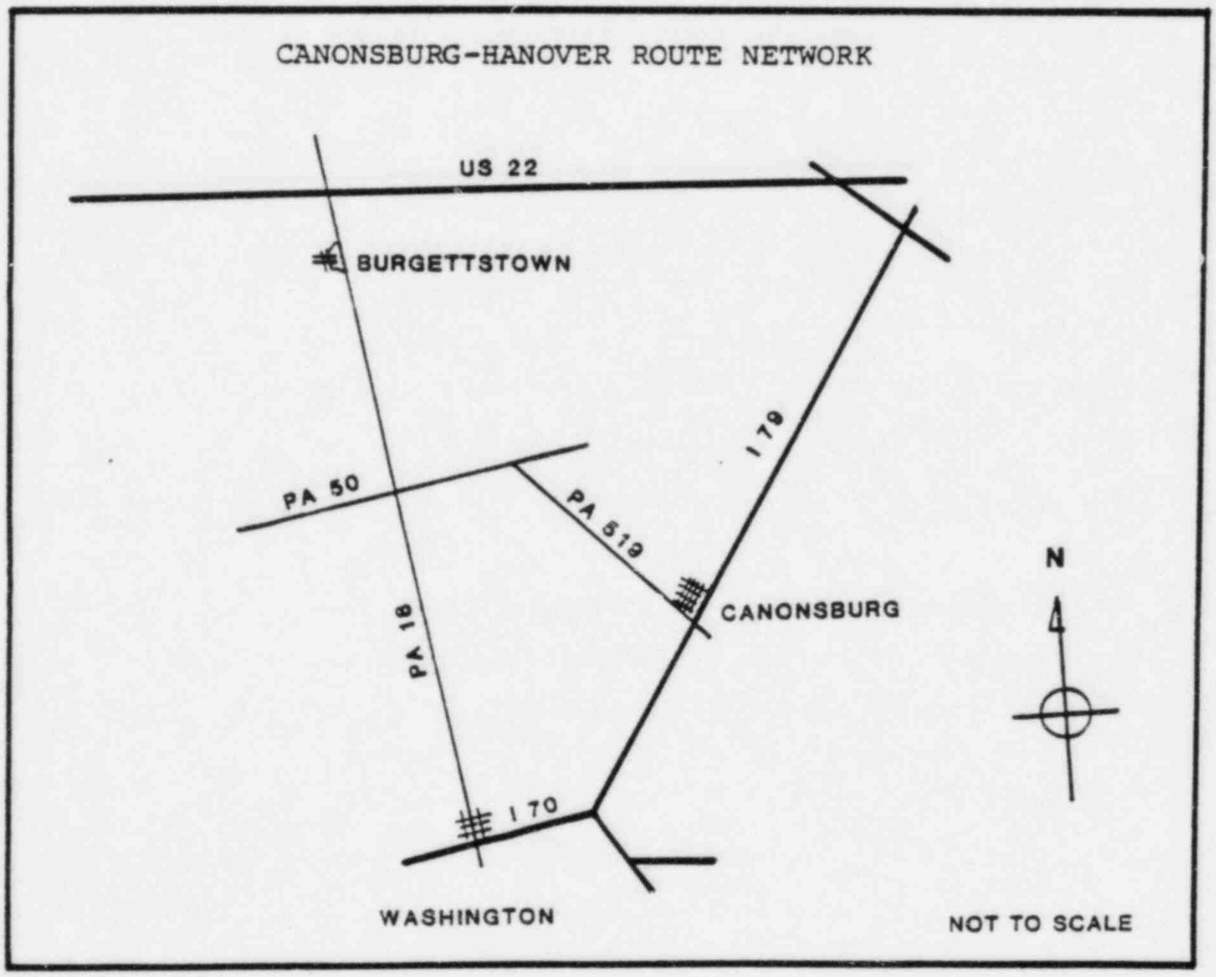


EXHIBIT III-2

Route 1 - via I-79 and US 22. This is a paved, four-lane, limited-access highway route of 33 miles and offers the best route from the standpoints of capacity, grades, and avoidance of populated areas.

Route 2 - via PA 519, PA 50, and PA 18. This is a paved, two-lane, unlimited-access highway route of 19 miles with moderate grades and limited capacity and it traverses several built up areas including the Borough of Houston and the small towns of Westland, Hickory, and Atlasburg; it bypasses the outskirts of Burgettstown on a limited-access, four-lane bypass.

Route 3 - via I-79, I-70, and PA 18. This is a paved route with six miles of four-lane Interstate and 24 miles of two-lane PA 18 with moderate grades, limited capacity, and traversing two built up areas including downtown Washington which resembles West Pike Street in Canonsburg.

EQUIPMENT

For highway transport of the wastes, two types of dump trucks can be considered: Triaxle trucks which can handle 16 to 18 cubic yards and tractor trailer types with dump bodies which can handle 18 to 20 cubic yards while remaining within gross highway load limits of 73,280 lbs. The movement of such vehicles on the routes previously discussed should present no operating or weight problems.

The cleanup project will require dedication of a fleet of trucks to haul both wastes and fill. Two contractors in the Pittsburgh area, (D. Tesone - 412-781-4551 and Sciaretti - 412-462-1233) appear capable of meeting project requirements, with heavy fleets of 96 to 150 trucks. Also, at least one is familiar with hazardous waste hauling regulations of the U.S. DOT and state Department of Environmental Resources.

III-8

COST

Based on discussions with two trucking companies in the area the following round-trip truck transportation rates are provided based on the one-way distances shown and assuming 18 cubic yards per truckload:

10 miles	$43.20	- $2.40/cubic yard
20 miles	$75.60	- $4.20/cubic yard
50 miles	$135.00	- $7.50/cubic yard
70 miles	$156.60	- $8.70/cubic yard

The above rates do not include cost for excavating and loading nor do they include the cost for the fill material.

Cost for fill material can vary from $1 to $6 per cubic yard depending on the quality of soil and the owners need to get rid of the material.

Based on the rates shown above the over the road truck transportation costs are estimated below:

Contaminated Material

Burrell to Hanover
80,000 cubic yards - $696,000

Burrell to Canonsburg
80,000 cubic yards - $696,000

Canonsburg to Hanover
250,000 cubic yards - $1,050,000

Fill Material (with borrow pits assumed to be within 10 miles)

At Burrell (Alternatives 2 and 4)
16,000 cubic yards - $38,500

At Burrell (Alternatives 3 and 5)
72,000 cubic yards - $172,800

At Canonsburg (Alternatives 3, 4, and 5)
251,000 cubic yards - $602,600

At Canonsburg (Alternative 2)
256,000 cubic yards - $614,300

At Hanover (Alternative 4)
204,000 cubic yards - $481,600

At Hanover (Alternative 5)
170,000 cubic yards - $408,000

Discussion with the company that hauled clean fill for the Conrail chloroform spill at Midway, M&M Equipment Sales, indicated that the cost per cubic yard of fill for that job was about $19 which included a good grade of soil, excavation, loading and hauling on a 20 mile round trip.

IV DISCUSSION OF ALTERNATIVES

It is quite obvious from a cost standpoint that the use of trucks is the preferred method of transportation for all alternatives.

It appears that adequate trucks will be available to handle the quantities involved.

Based on the route reconnaissance conducted there are no unusual highway design or safety hazards which will preclude the use of trucks, except those specifically pointed out in the discussion of site access.

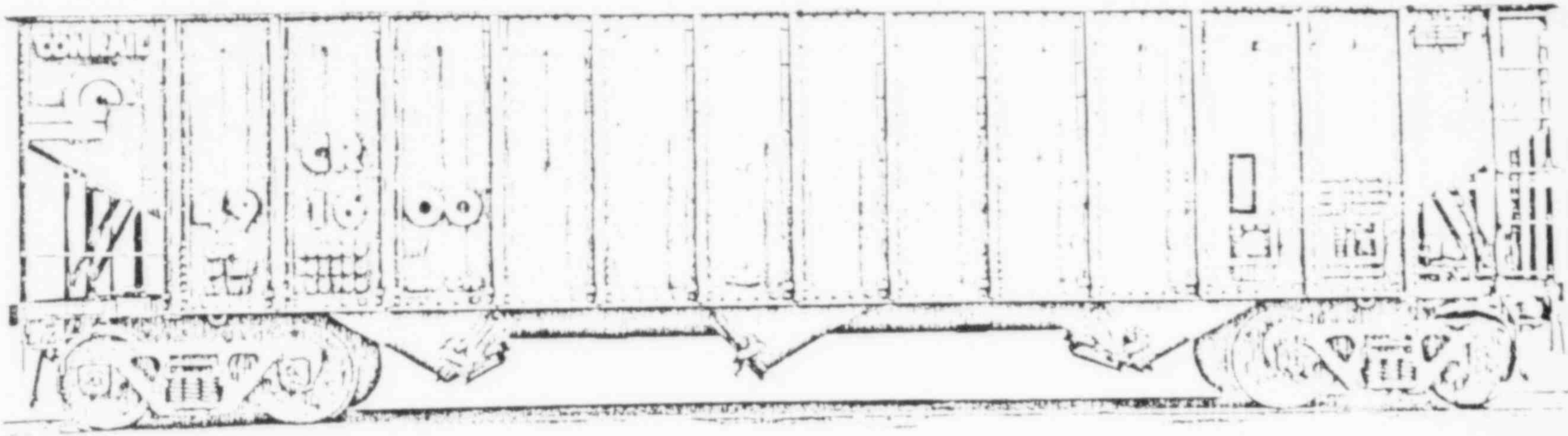
The only potential problems associated with the use of trucks are the length of haul from the Burrell Township site and the exposure of this traffic between Squirrel Hill and Carnegie, in the downtown Pittsburgh area.

APPENDIX A

RAIL CAR DESCRIPTIONS

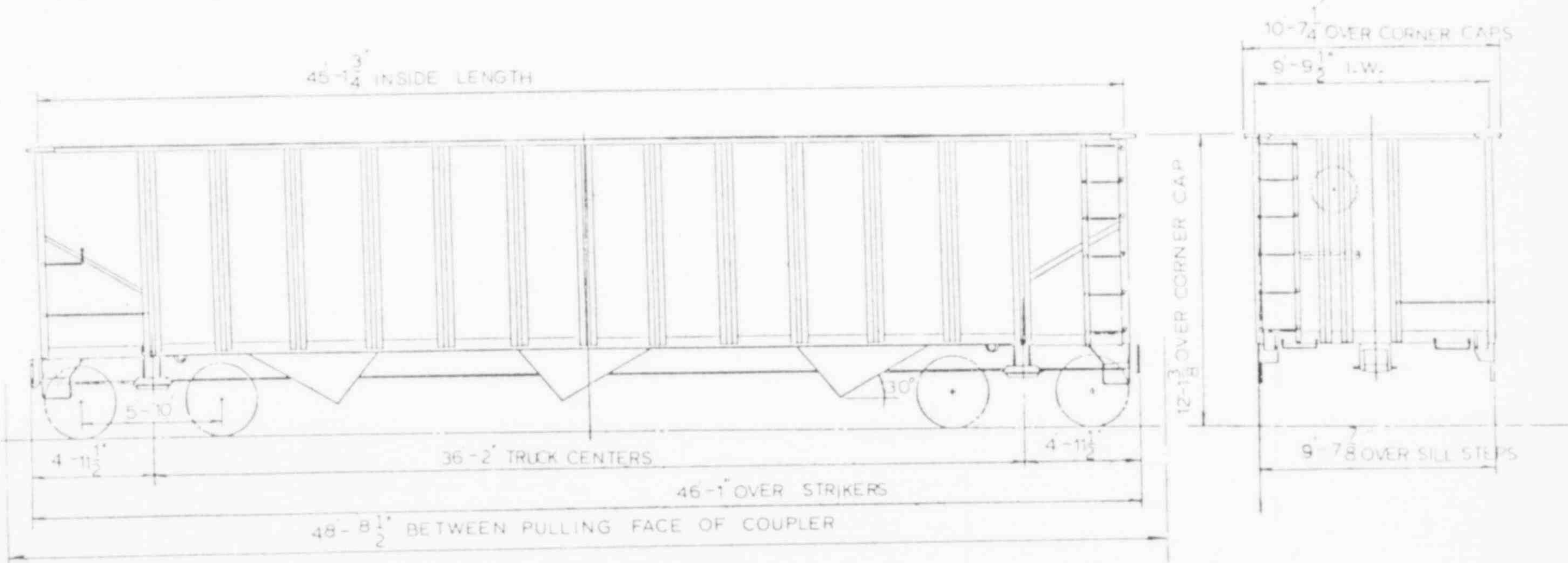
APPENDIX A

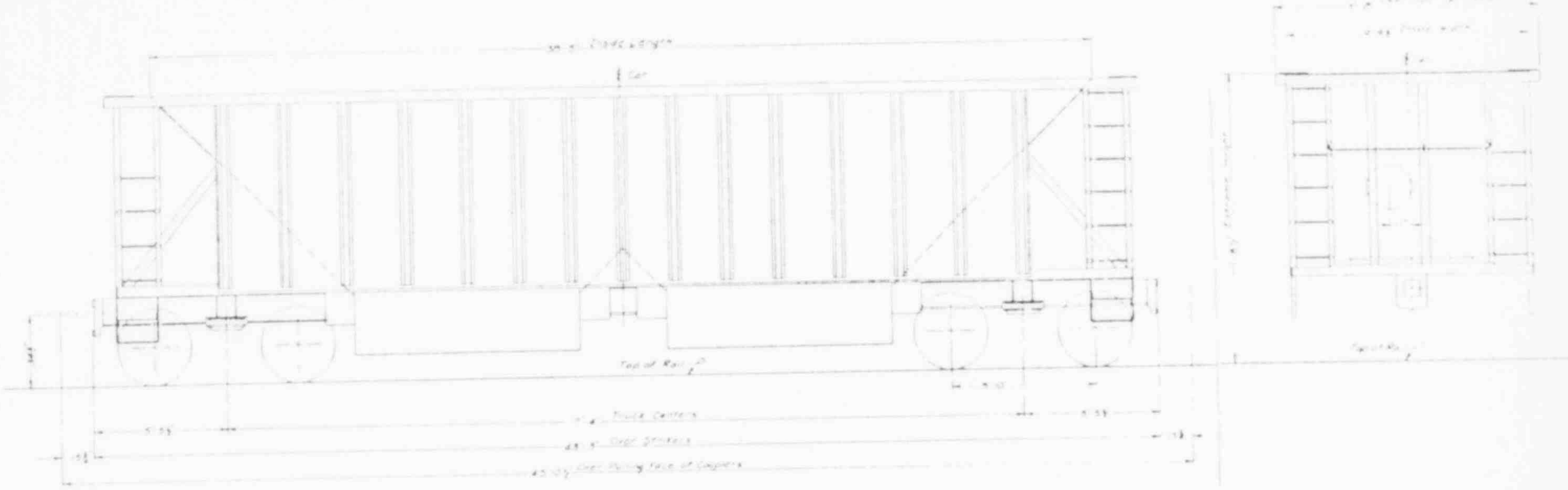
RAIL CAR DESCRIPTIONS



Conrail 100-Ton Triple Hopper Car.
Inside length 45 ft. 2 in., inside width 9 ft. 9 in., length over pulling face coupler 48 ft. 8 in. Extreme width 10 ft. 7 in., extreme height 12 ft. 2 in., rated capacity 200,000 lbs. or 3420 cu. ft. Built by Greenville Steel Car Co., 1979.

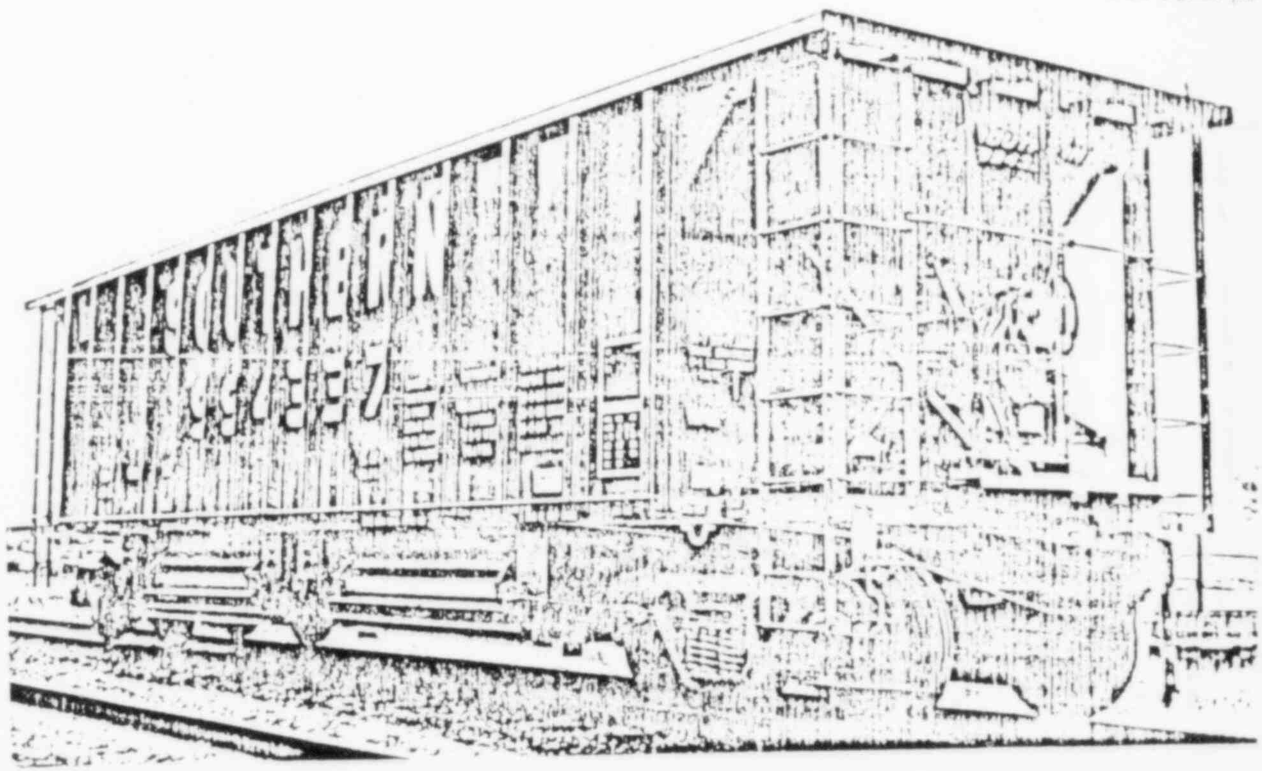
GREENVILLE STEEL CAR COMPANY



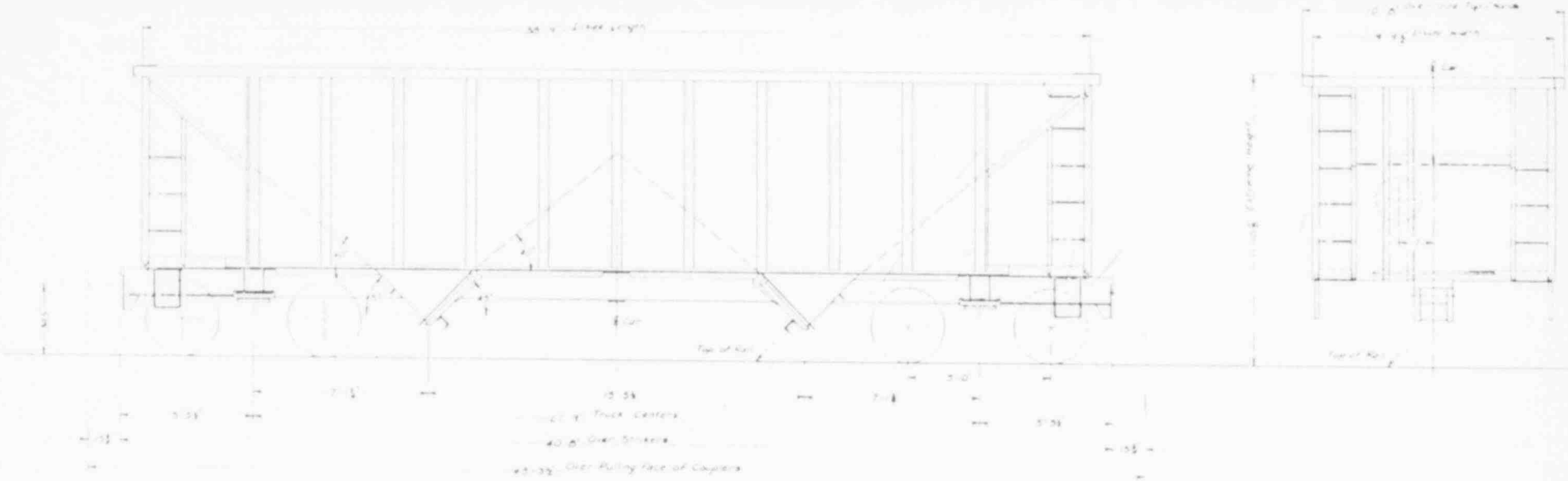


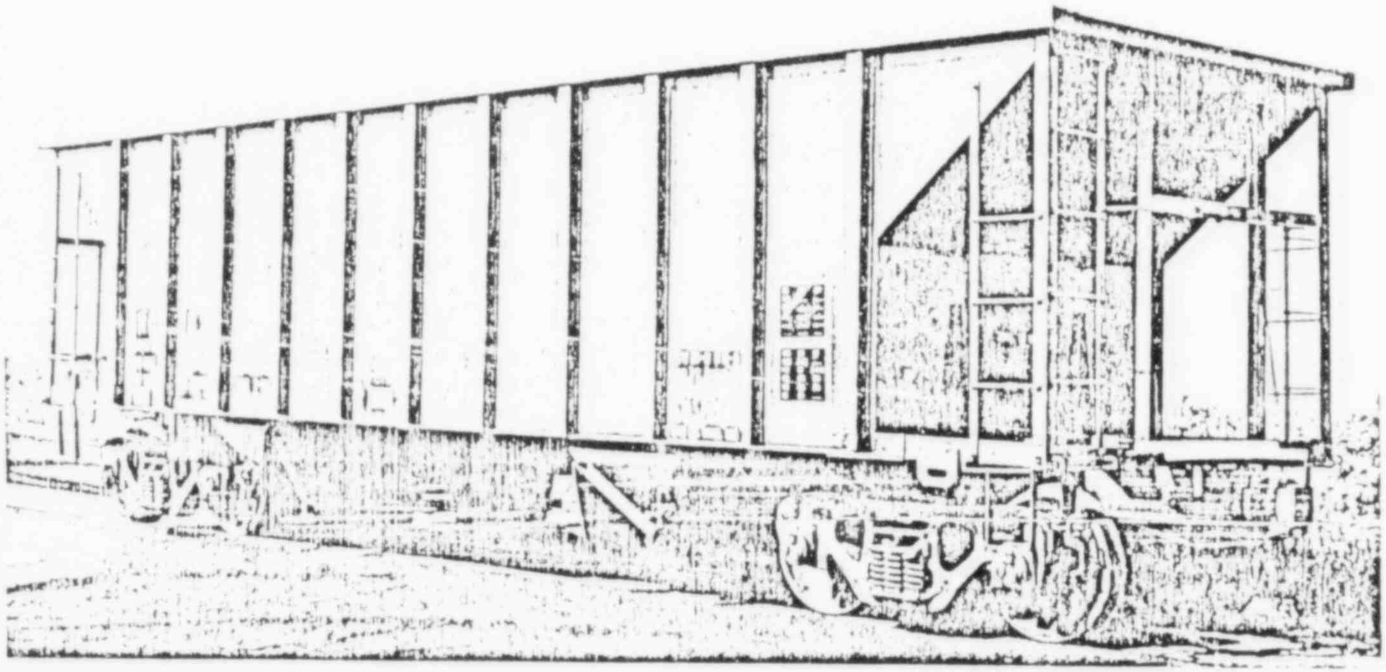
H-770804
Southern 100-Ton Ballast Car

Rated capacity is 192,000 lbs. or 2400 cubic feet. End floor slope sheets are 45°. Built by PORTEC, INC., Railcar Division, 1979.



Portec inc. Railcar Division

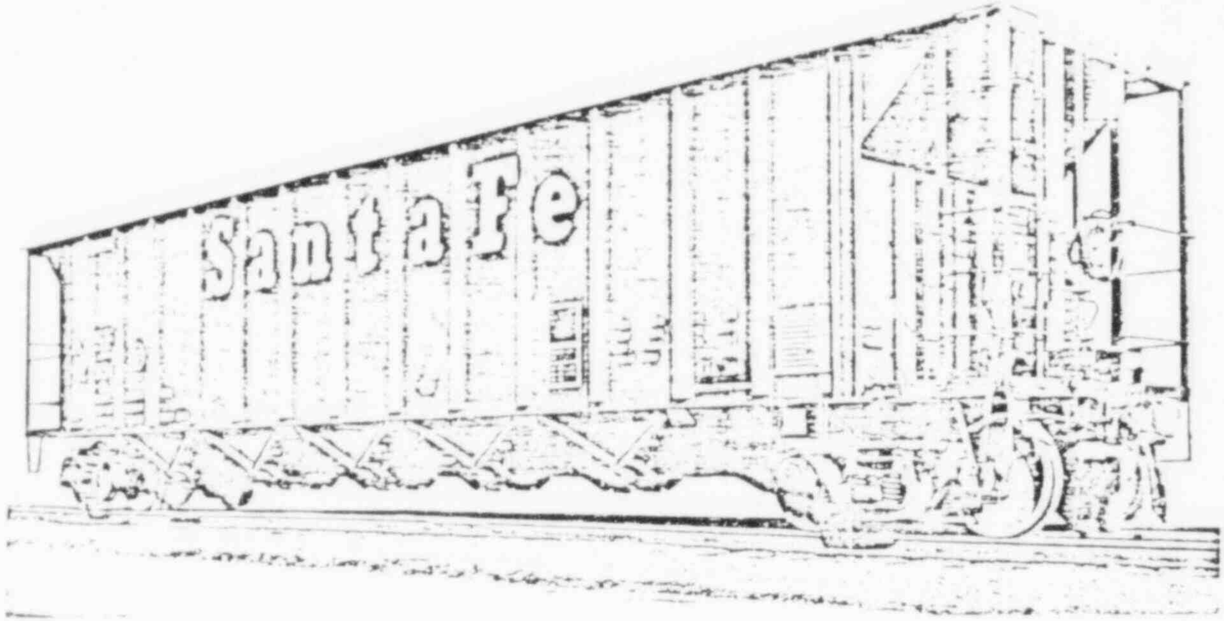




H-780717 100-Ton Open Top Hopper Car

It has a rated capacity of 200,000 lbs. or 2,000 cubic feet. Built by PORTEC, INC., Railcar Division, 1979.

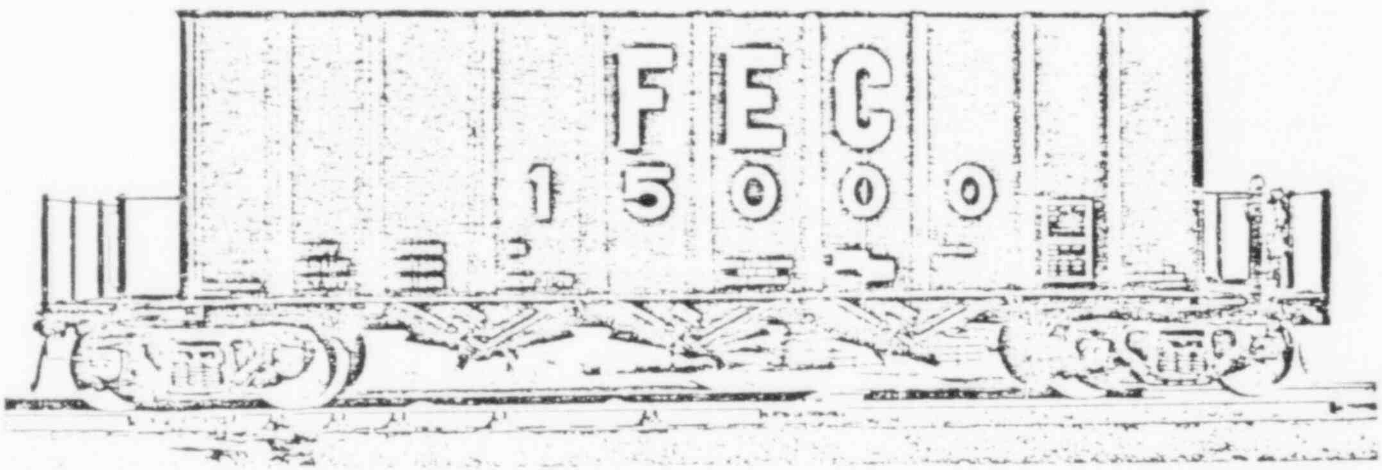
Portec inc. Railcar Division



SANTA FE RAILROAD RAPID DISCHARGE® CAR. BUILT BY ORTNER FREIGHT CAR CO.

Five-pocket, fully-automated 100-ton Rapid Discharge® coal car. Cars are used in shuttle train operations in Arizona and New Mexico.

Coupled length	57'7" 17.53 meters
Length between truck centers	45'1" 13.72 meters
Inside length	49'11" 15.24 meters
Inside width	9'10" 2.97 meters

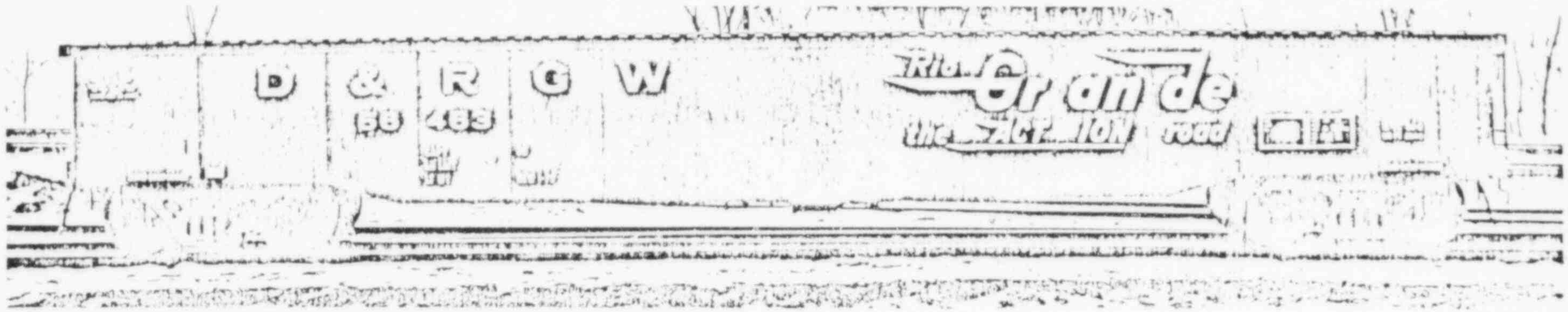


FLORIDA EAST COAST RAILROAD RAPID DISCHARGE® AGGREGATE CAR. BUILT BY ORTNER FREIGHT CAR CO.

This three-pocket, 100-ton aggregate car was built in 1979. These cars are being used to haul limestone out of the Miami area.

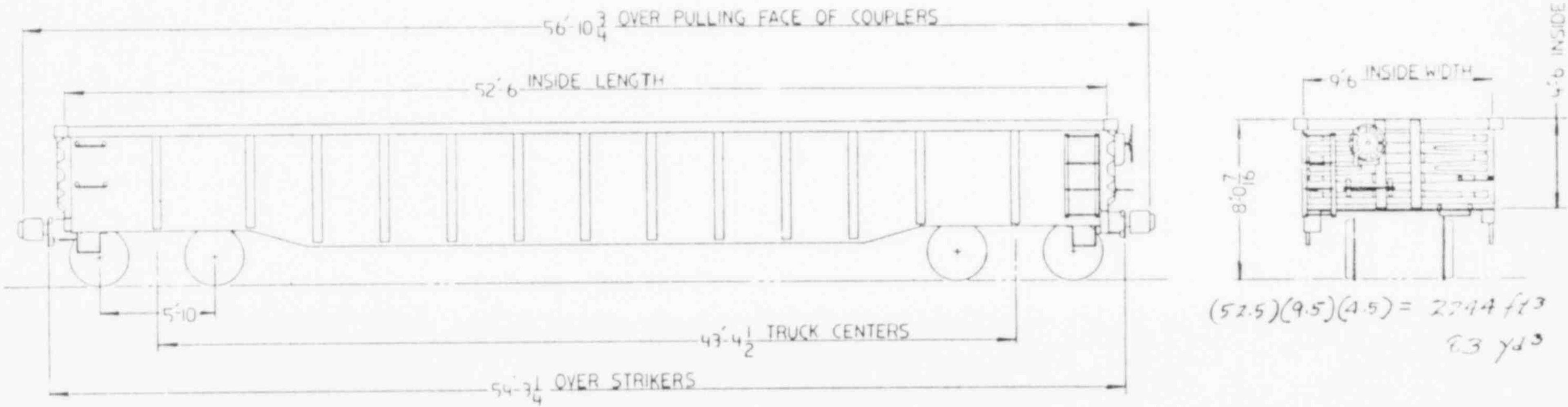
Cubic Capacity	2200 cu. ft. 62.3 cu. meters
Length over truck centers	31'3⅜" 9.54 meters
Inside length	29'3" 8.91 meters
Inside width	9'10" 3 meters

ORTNER FREIGHT CAR CO.



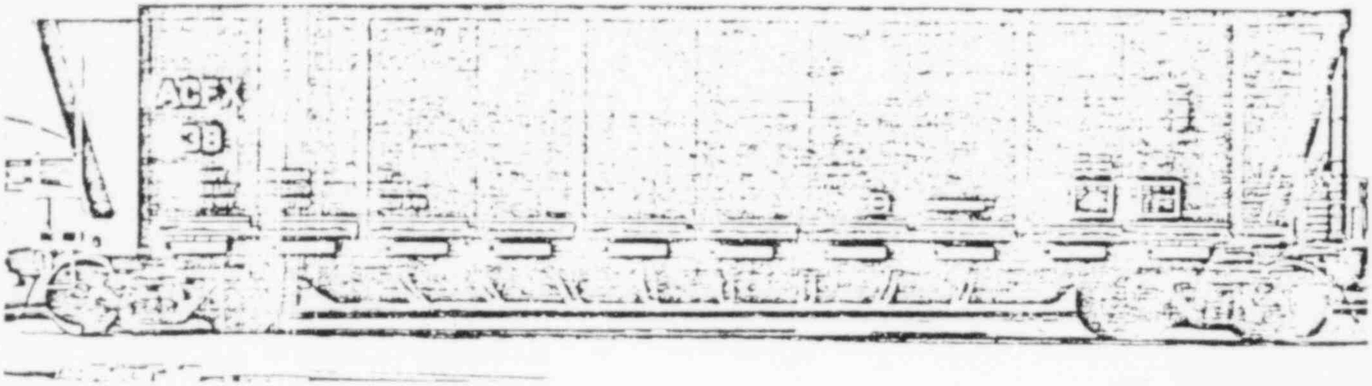
Denver & Rio Grande Gondola.
Solid Bottom Gondola Car.
Class GS.
52'6" Inside Length.
4'6" Inside Height.
100 Ton Capacity.
Continuous Bar Type Lading Band Anchors.
Collapsible Stake Pockets.
Used in Steel Service.
Built by International Car Co., 1978.

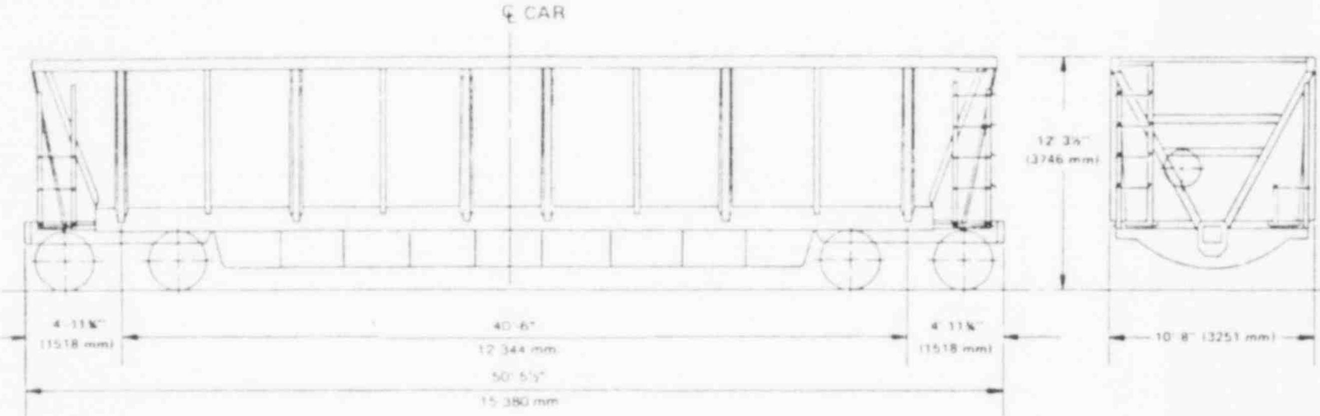
PACIFIC CAR AND FOUNDRY COMPANY

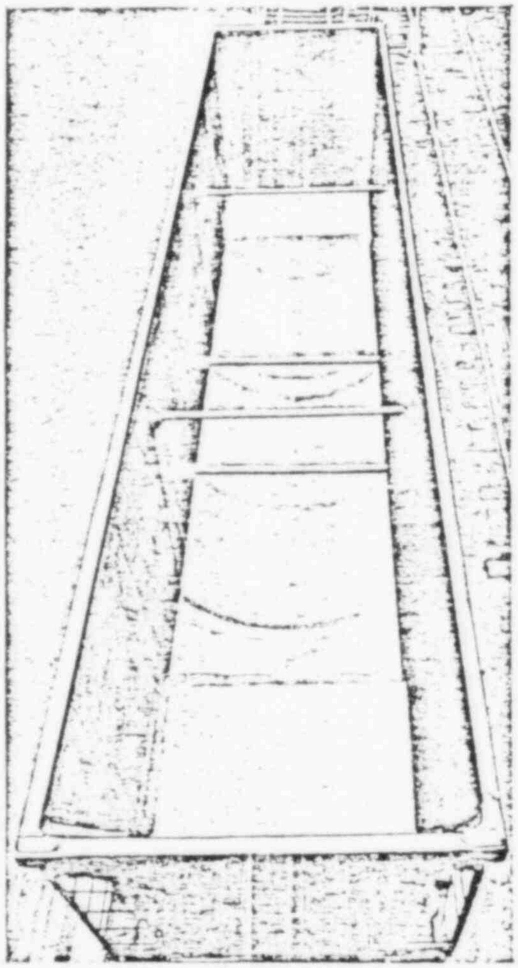


$(52.5)(9.5)(4.5) = 2244\ ft^3$

$83\ yd^3$





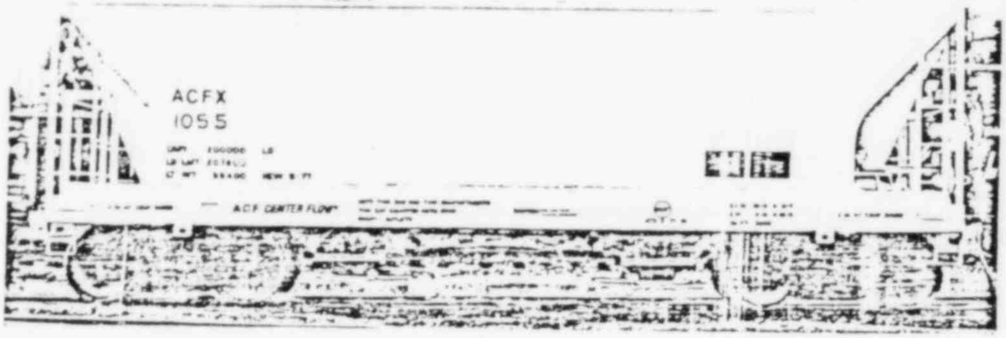


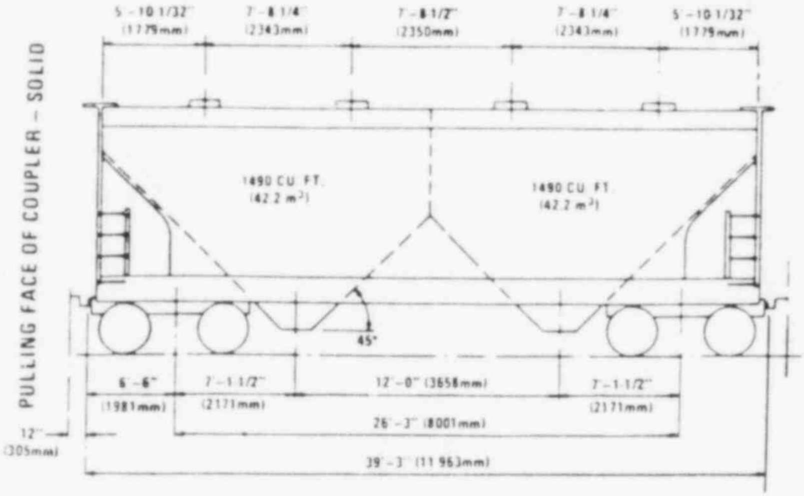
100-Ton Coalveyor™ Gondola built by ACF Industries.

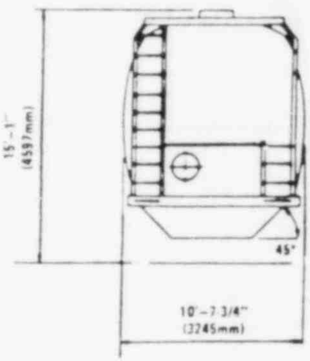
The car's basic reinforced circular bottom configuration provides a lighter car weight, dramatically increasing coal payload. It can carry more than 106 tons of coal per car. Inside length 48 ft. 0 in., capacity 4240 cu. ft., lightweight 50,700 lbs, load limit 212,300 lbs.

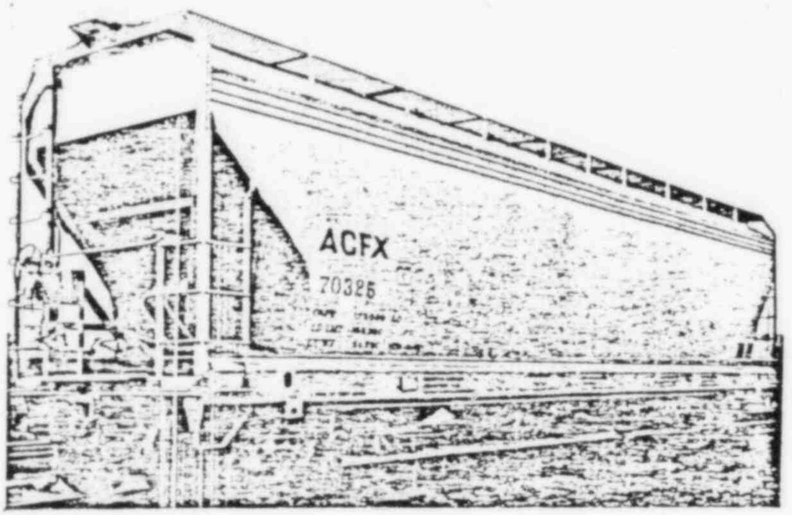
Two-Compartment 2980 CENTER FLOW 100-Ton Covered Hopper

Designed to transport very high density dry bulk ladings (70 to over 100 lbs. per cu. ft.). Inside length 38 ft. Rated capacity is 2980 cu. ft. or 208,000 lbs. Built in 1977 by ACF.



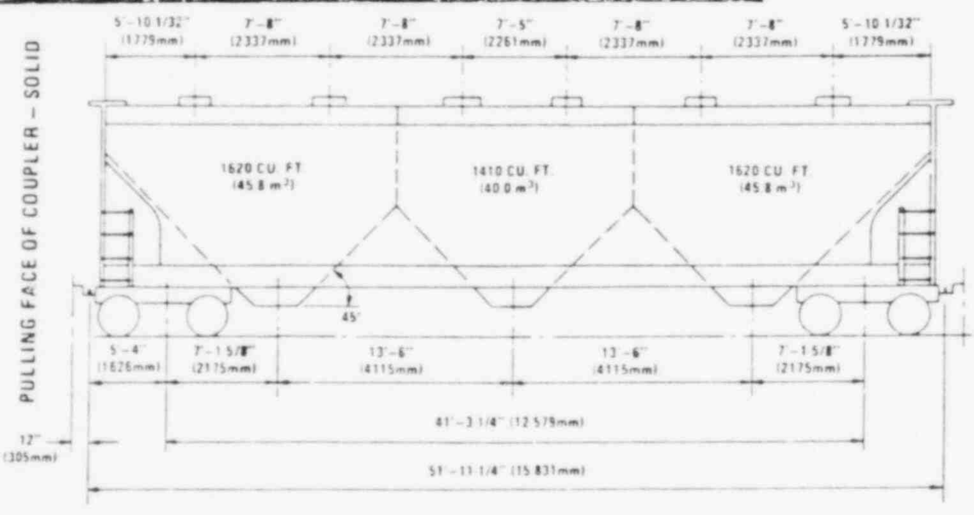


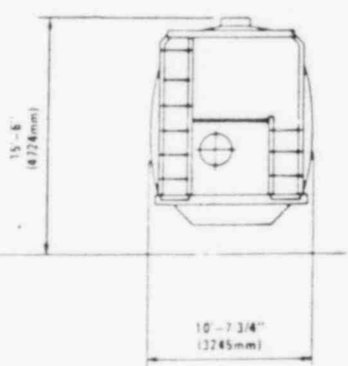


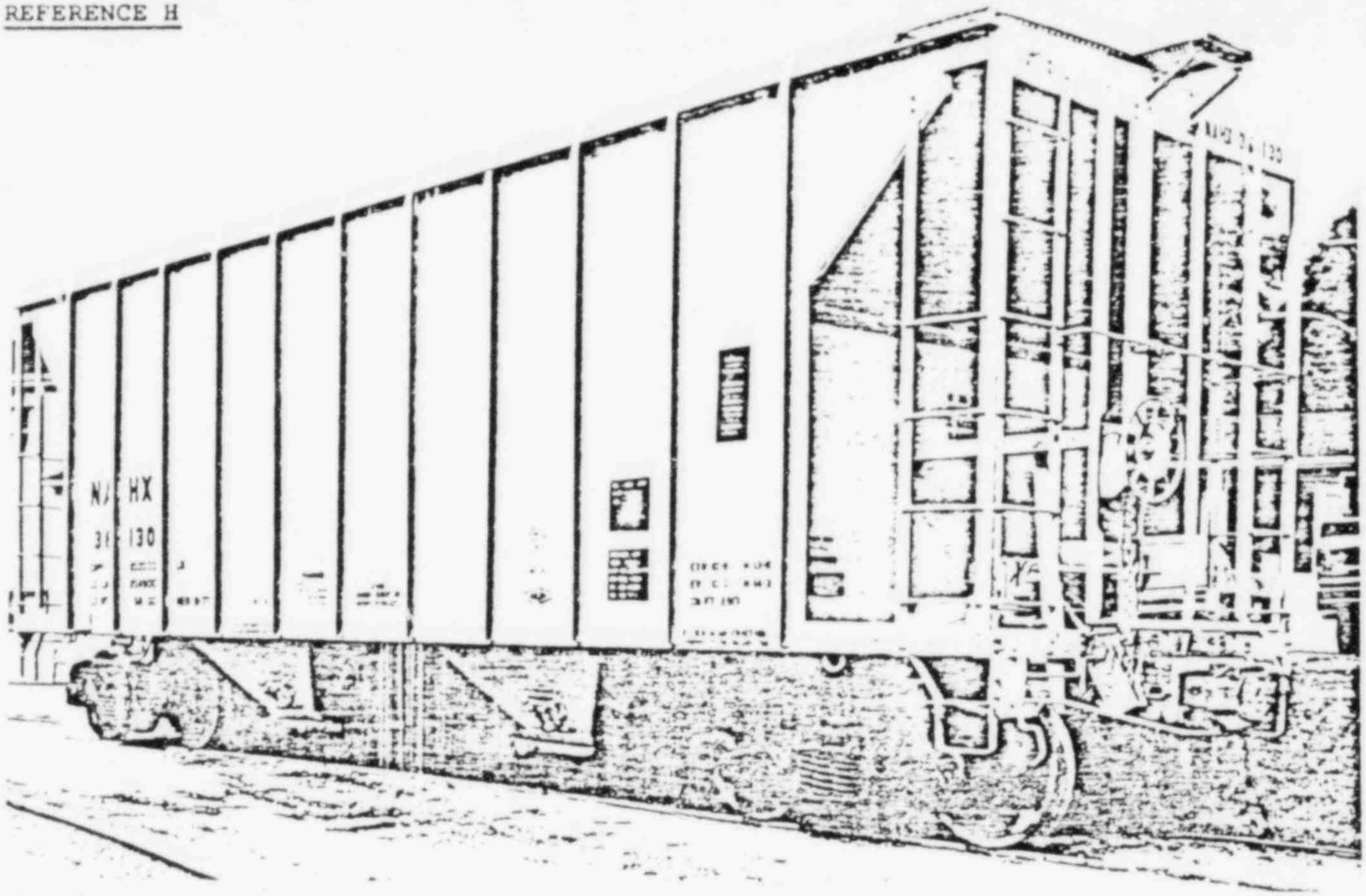


Three-Compartment 4650 CENTER FLOW 100-Ton Covered Hopper

Designed to transport intermediate-weight dry bulk ladings (42 to 50 lbs. per cu. ft.). Inside length 48 ft. 9 in. Rated capacity is 4650 cu. ft. or 198,000 lbs. Built in 1979 by ACF.

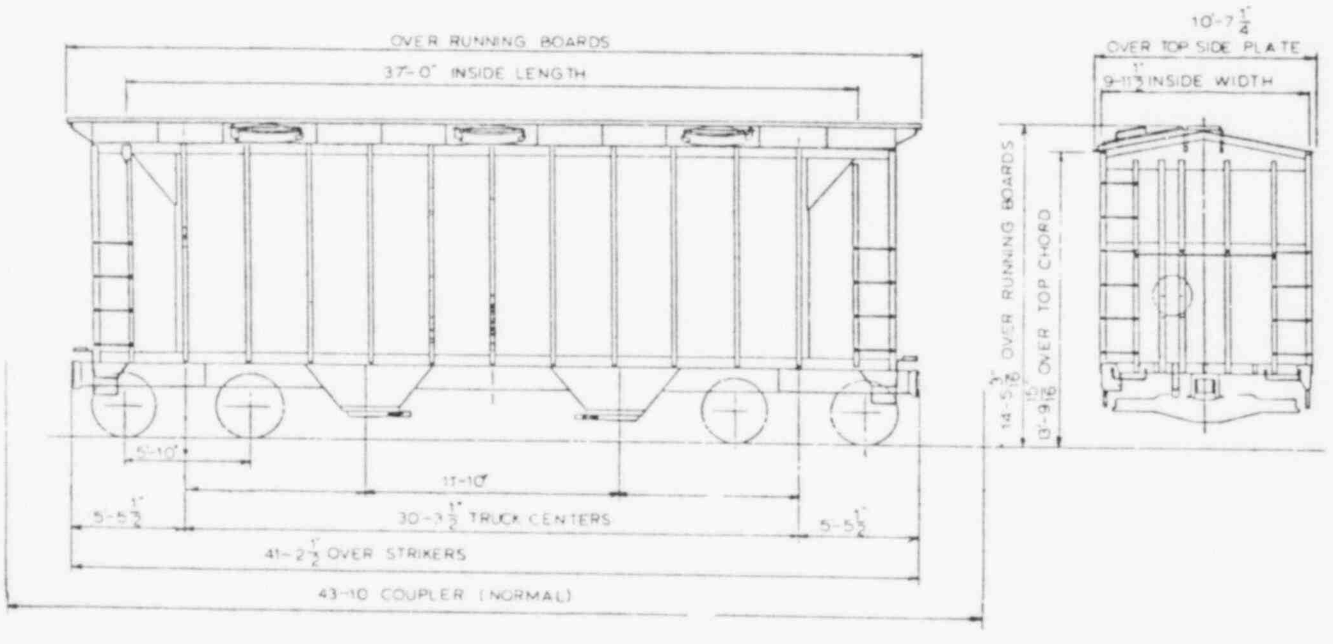




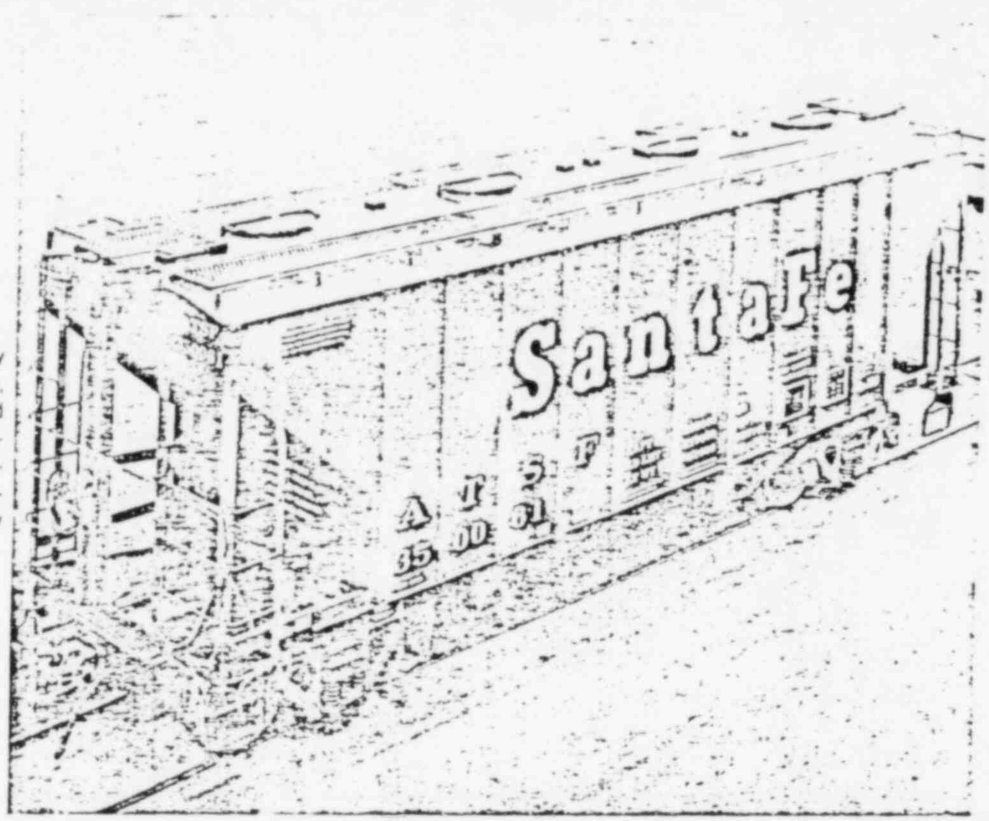


North American Car 100-Ton Twin Covered Hopper Car.
Inside length 37 ft., inside width 9 ft. 11 in., extreme width 10 ft. 8 in., extreme height 14 ft. 9 in., length between pulling face coupler 43 ft. 10 in. Rated capacity 200,000 lbs. or 2917 cu. ft. Equipped with six 2 ft. 6 in. dia. loading hatches and four 13 in. x 24 in. sliding type discharge doors. Built by Greenville Steel Car Co., 1977.

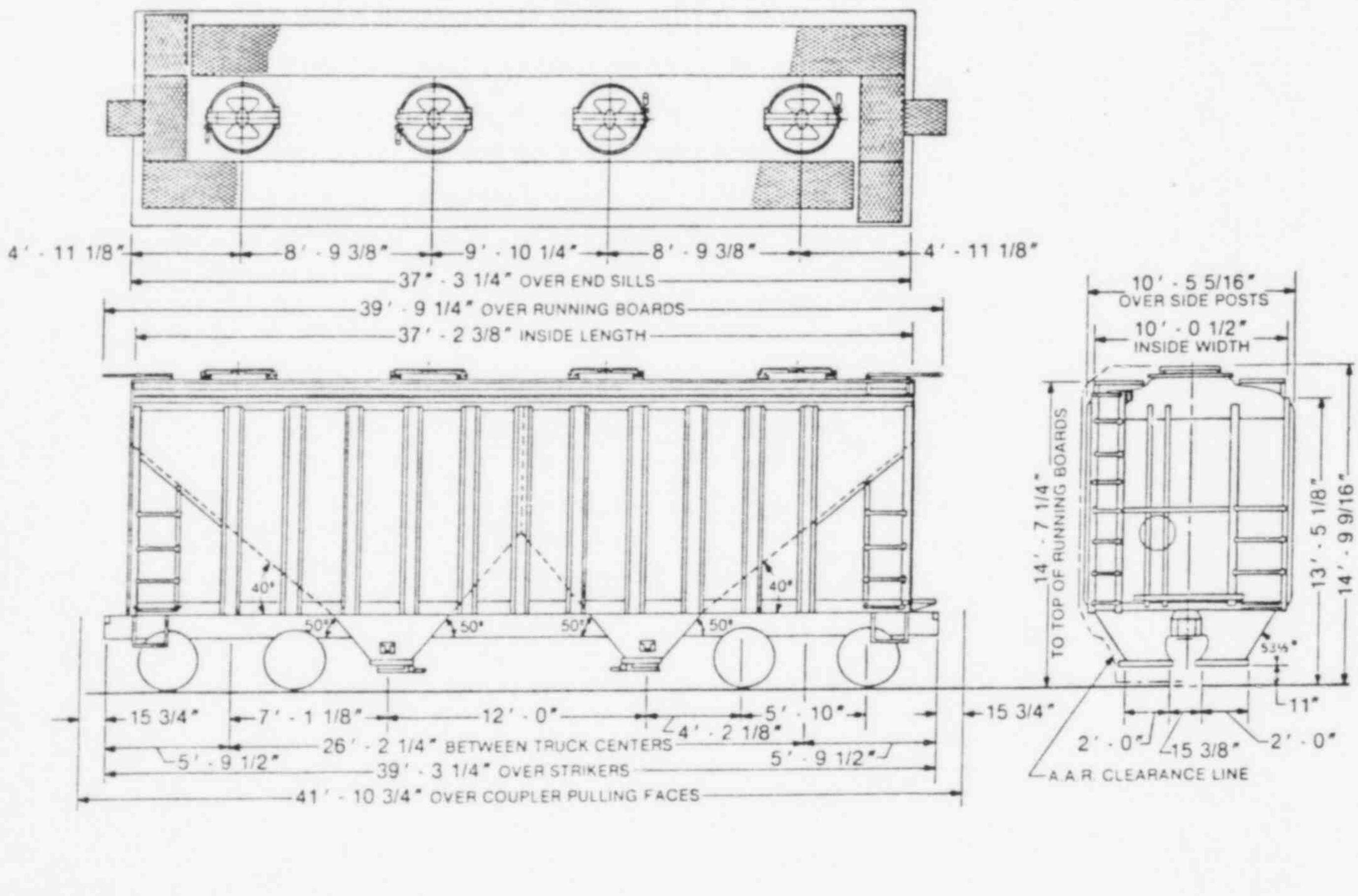
GREENVILLE STEEL CAR COMPANY



Santa Fe Covered Hopper Car.
Capacity 208,000 lbs., cubic capacity 3000 cu. ft. Twin hoppers and gravity, side discharge arrangement. Equipped with 30" round hatches. Built for cement service or other heavy bulk commodity lading. See general arrangement diagram for dimensions. Built by Pullman Standard, 1978.



PULLMAN STANDARD



Pullman Standard 3000 cu. ft. Covered Hopper Car.

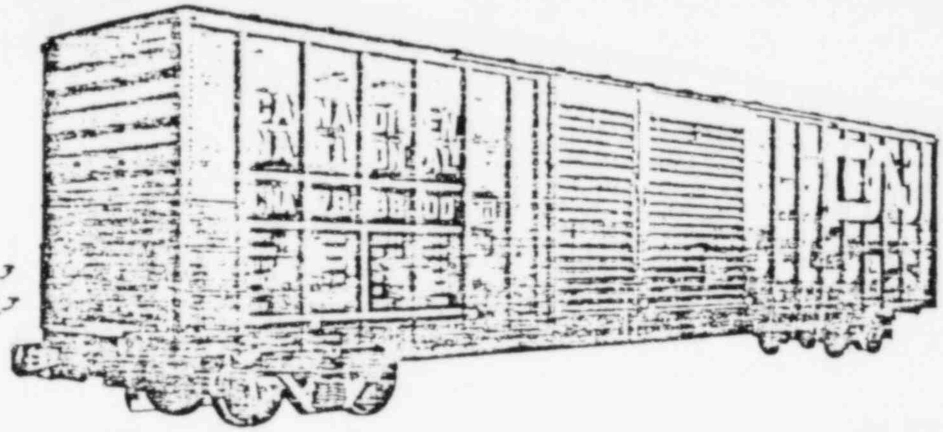
REFERENCE J

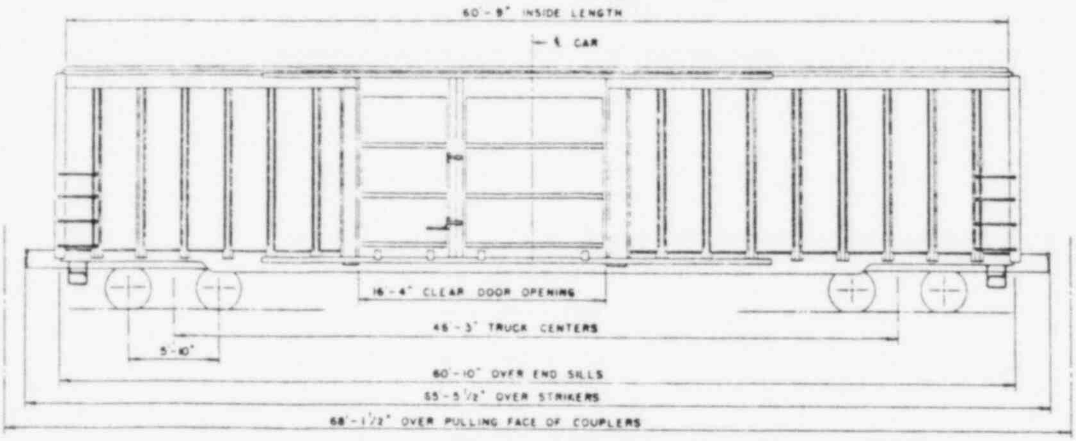
AUTO PARTS CAR

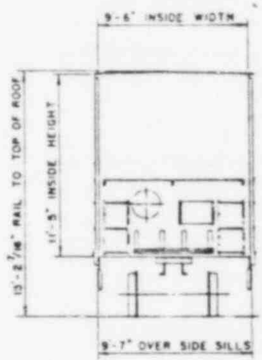
• 100 Ton Box Car XL • Built By FGE Co. 1980 • 60'9" Inside Length • 9'6¼" Inside Width • 11'4" Inside Height • Nominal Lt. Wt. 85,000 lbs. • 16'4" Clear Door Opening

20" Travel Sliding Sill • 1¾" Nailable Steel Floor • 12 Belt Rails • 3 Steel Rub Rails Full Length

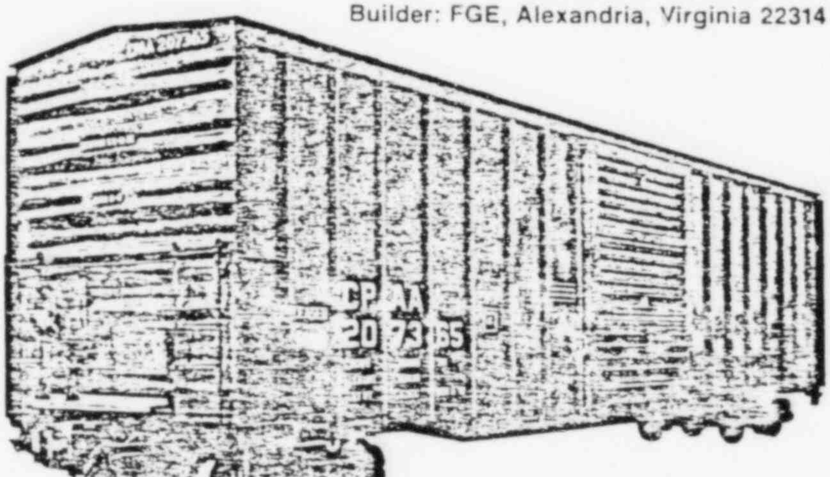
(60.75)(9.5)(11.33) = 6540 ft³
242 yd³
263 000
85 000
178 000 max LD







Builder: FGE, Alexandria, Virginia 22314



REFERENCE K

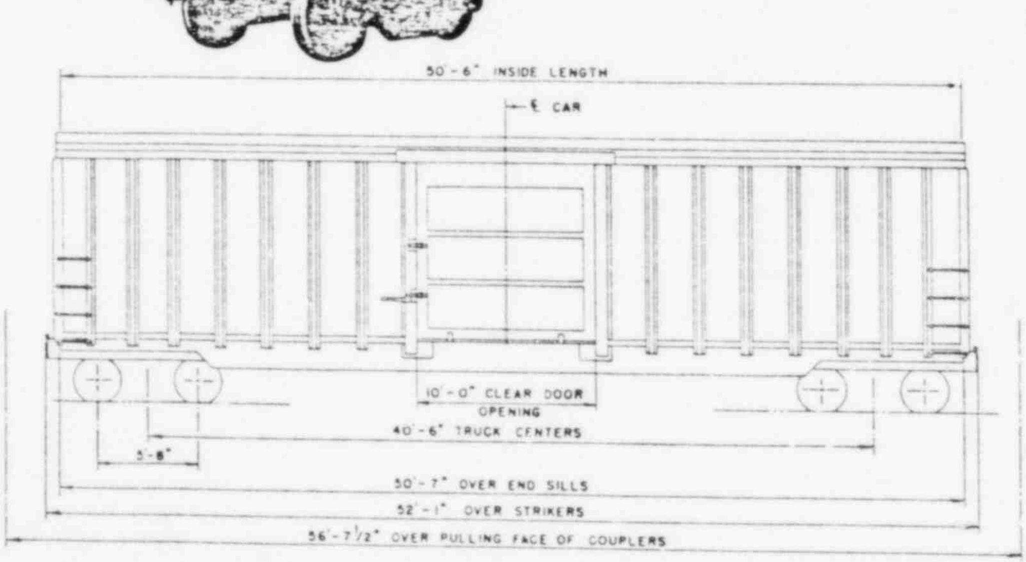
GENERAL PURPOSE CAR

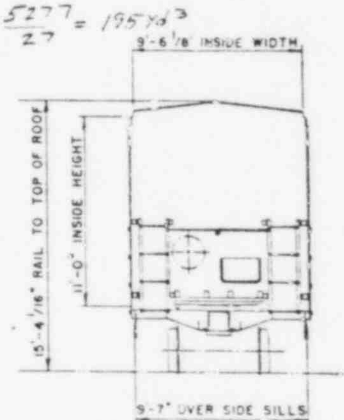
• 70 Ton Box Car XF • Built By FGE Co. 1979 • 50'6" Inside Length • 9'6⅛" Inside Width • 11'0" Inside Height • Nominal Lt. Wt. 62,600 • 10'0" Clear Door Opening

• 10" EOC Hydraulic Cushioning • 1¾" Nailable Steel Floors • FDA White Epoxy Interior

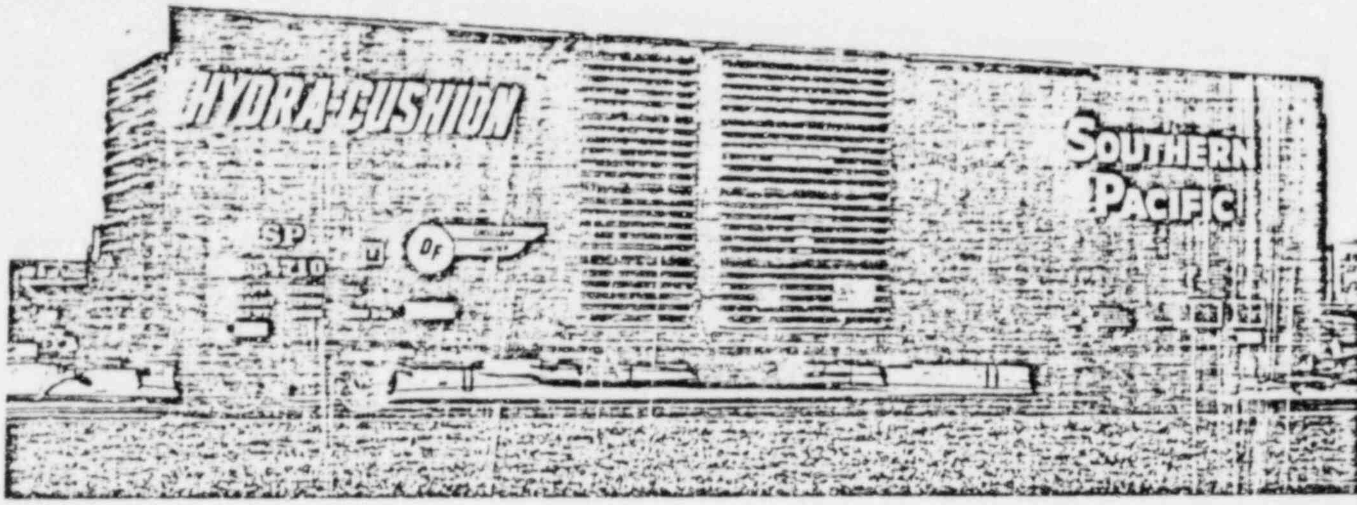
157400 / (50.5)(9.5)(11.0) = 29.3

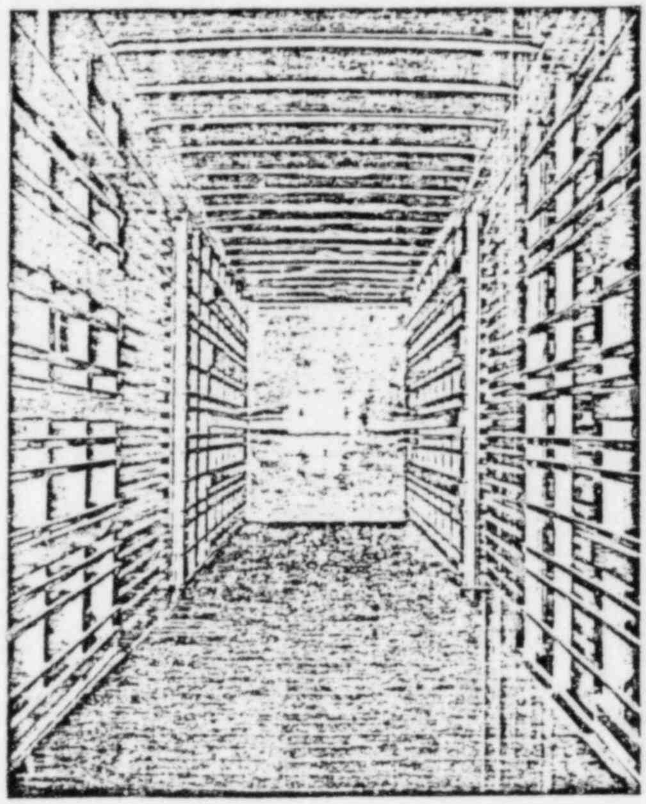
5277 / 27 = 195 yd³





Builder: FGE, Alexandria, Virginia 22314



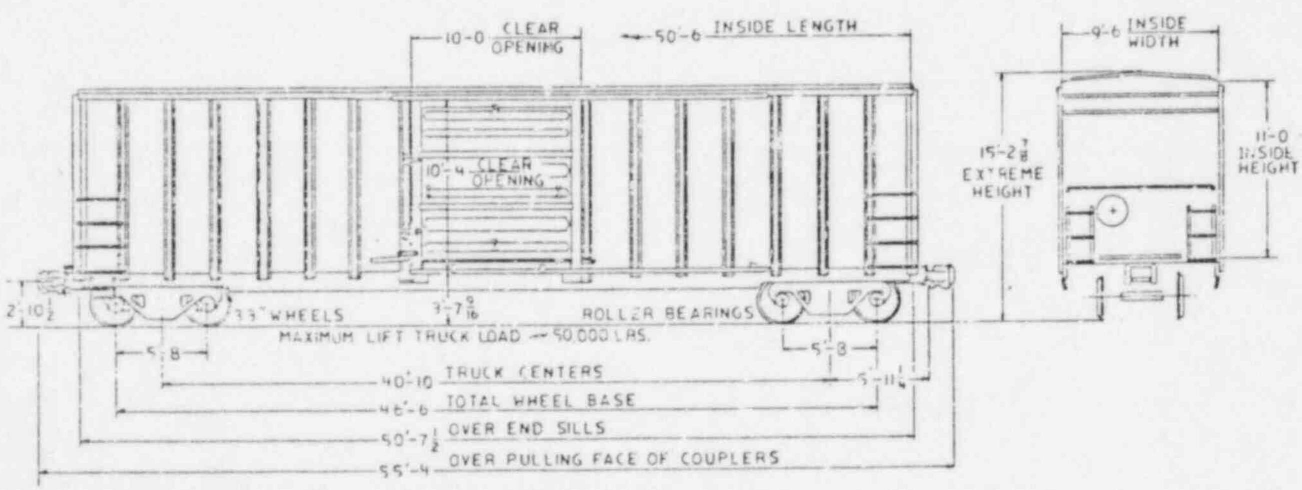


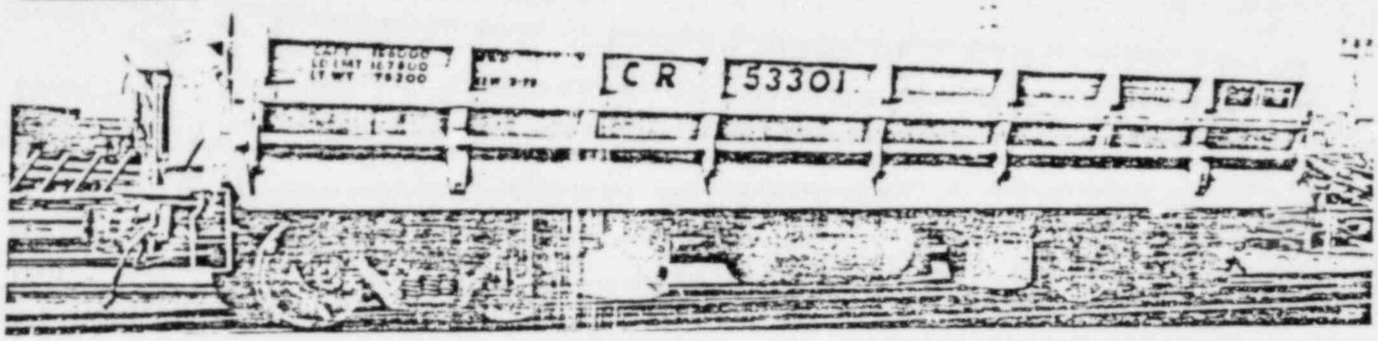
Southern Pacific Box Car.
Steel sheath box car.
Class XL.
60'11" inside length.
13'1" inside height.
100 ton capacity.
Cross bar type loader side rails.
20" travel sliding sill underframe.
Used in auto parts service.
Built by Pacific Car and Foundry Co., 1978.

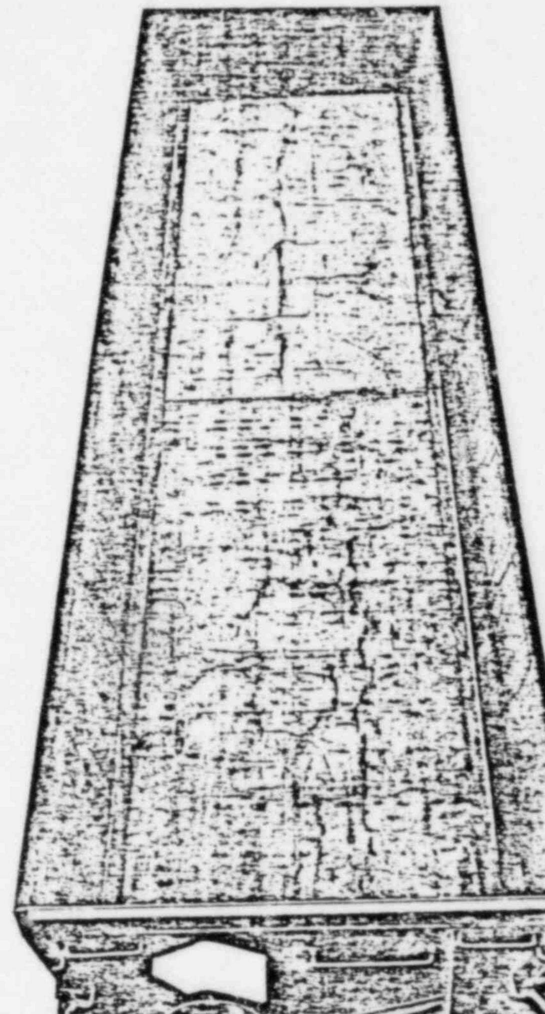
(50.5)(9.5)(11.0) = 5277 ft^3
195 yd^3

172 700 max wt =

PACIFIC CAR AND FOUNDRY COMPANY







Consolidated Rail Maintenance of Way Car.
Air side dump.
Class M.W.D.
38'1" inside length.
3'9" inside height.
100 ton capacity. ? 55 yd³ NOMINAL
Built by Pacific Car and Foundry Co., 1978.

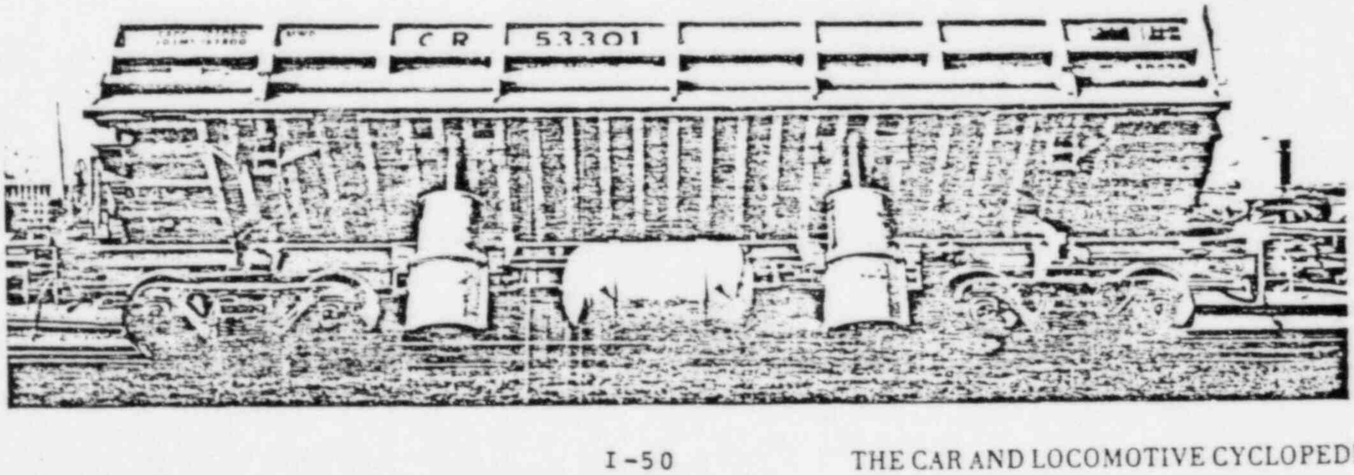
STENCILLED 187,800 LB LD LMT

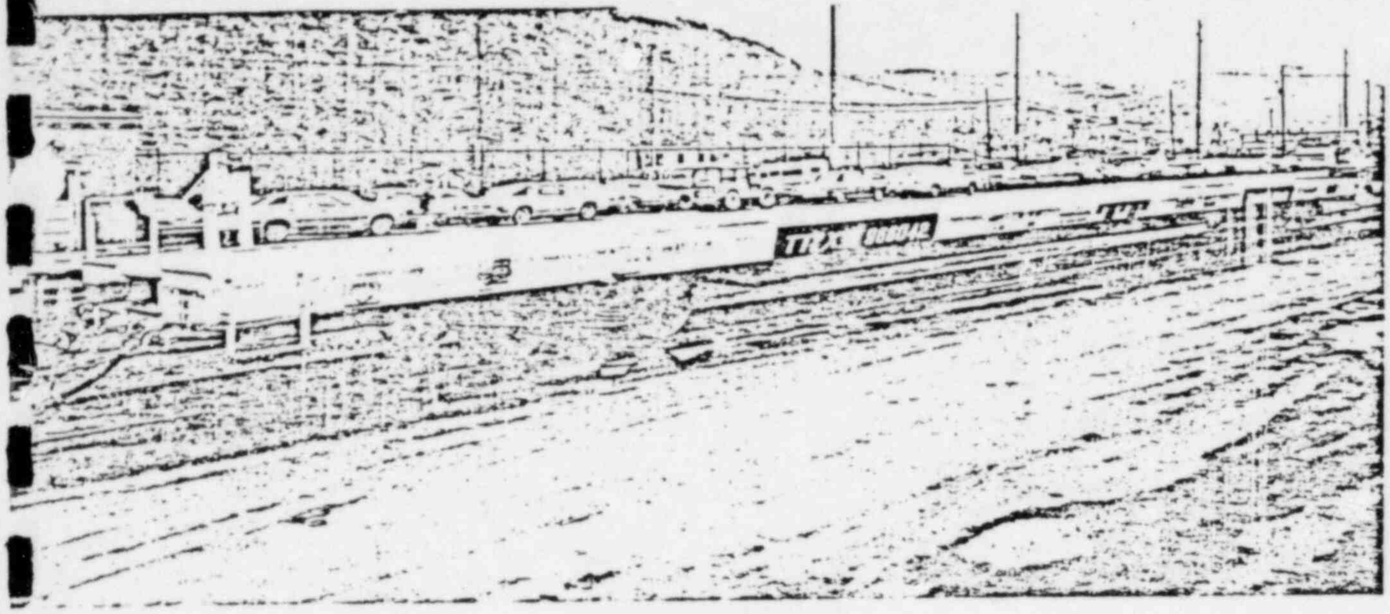
$$\frac{187,800}{(50)(27)} = 140 \text{ lb/ft}^3 \text{ max}$$

$$\frac{200\,000}{(54.2)(27)} = 137 \text{ lb/ft}^3$$

$$\frac{187\,800}{(2000)(1.21)} = 77.6 \text{ yd}^3 \text{ heaped}$$

PACIFIC CAR AND FOUNDRY COMPANY





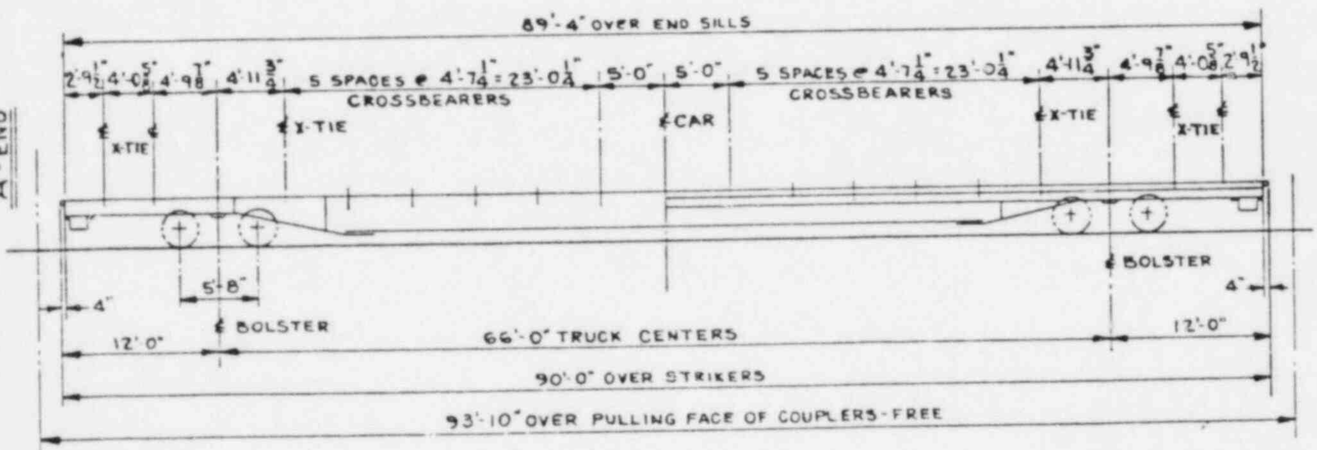
GENERAL SPECIFICATION

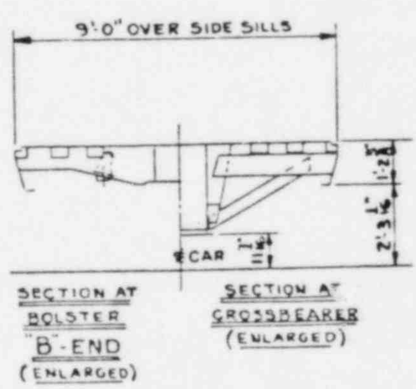
FOR

89' – 4" STANDARD DECK FLAT CARS

GENERAL DIMENSIONS:

Length Over End Sills	89' - 4"
Over Strikers	90' - 0"
Over Pulling Faces of Free Couplers	93' - 10"
Truck Centers	66' - 0"
Center of Truck to Striker Face	12' - 0"
Width Over Side Sill	9' - 0"
Height Rail to Top of Side Sill	3' - 5-1/16"
Rail to Top of Floor	3' - 5-7/16"
Rail to Centerline of Coupler	2' - 10-1/2"
Side Bearing Centers	4' - 2"





BETHLEHEM STEEL CORPORATION

APPENDIX B

ABSTRACTED HAZARDOUS MATERIALS REGULATIONS FOR WASTE TRANSPORT

Ala. P. S. C. No. 17
A. C. C. No. 15
⊕Ark. T. C. No. 22
C. T. C. No. 20
Conn. P. U. C. No. 19
F. P. S. C. No. 11
I. P. U. C. No. 18
Ia. C. C. No. 16
Ill. C. C. No. 8
I. R. C. No. 18
P. S. C. I. No. TR-16
K. R. C. No. 18

P. S. C. Md. No. 34
M. D. P. U. No. 19
M. P. S. C. No. 22
Minn. P. S. C. No. 18
Miss. P. S. C. No. 11
Mont. R. C. No. 18
N. P. S. C. No. 16
P. U. C. N. J. No. 18
N. M. S. C. C. No. 11
D. O. T.-N. Y. No. 15
D. O. T.-N. Y. MT No. 15
P. U. C. O. No. 18

Pa. P. U. C. No. 33
R. I. P. U. A. No. 18
P. U. C. S. D. No. 16
R. C. T. No. 18
P. S. C. U. No. 11
Vt. P. S. B. No. 18
V. C. C. No. 18
P. S. C. W. Va. No. 18
⊕P. S. C. Wis. No. 16
Wyo. P. S. C. No. 16

I. C. C. No. BOE—6000-A
Cancels I. C. C. No. BOE—6000

F. M. C. F. No. 29
Cancels F. M. C. F. No. 28

⊕Applicable except where it conflicts with State statutes.

Bureau of Explosives'

(Thomas A. Phemister, Agent)
(Elizabeth P. Rabben, Alternate Agent)

TARIFF No. BOE—6000—A

(Cancels Tariff No. BOE—6000)

PUBLISHING

Hazardous Materials Regulations of the Department of Transportation

BY

AIR, RAIL, HIGHWAY, WATER

AND

MILITARY EXPLOSIVES BY WATER

INCLUDING

SPECIFICATIONS FOR SHIPPING CONTAINERS

(Regulations for Transportation of Explosives and Other Dangerous Articles in Rail Express and Rail Baggage services are also included herein for information.)

Prescribed under the Act of September 6, 1970 (74 Stat. 808: 18 U. S. C. 831-835)

AND RESTRICTIONS COVERING THE ACCEPTANCE AND TRANSPORTATION OF EXPLOSIVES AND OTHER DANGEROUS ARTICLES BY CARRIERS PARTIES TO THIS TARIFF

ISSUED November 18, 1980 — EFFECTIVE December 18, 1980

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The provisions published herein will, if effective, not result in an effect on the quality of the human environment.

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Element[1]	Radionuclide[3]	Transport group I	II	III	IV	V	VI	VII
adium (88)	Ra-223		X					
	Ra-224		X					
	Ra-226	X						
	Ra-228	X						
Radon (86)	Rn-220				X			
	Rn-222		X					
Rhenium (75)	Re-183				X			
	Re-186				X			
	Re-187				X			
	Re-188				X			
	Re Natural				X			
Rhodium (45)	Rh-103m				X			
	Rh-105				X			
Rubidium (37)	Rb-86				X			
	Rb-87				X			
	Rb Natural				X			
Ruthenium (44)	Ru-97				X			
	Ru-103				X			
	Ru-105				X			
	Ru-106			X				
Samarium (62)	Sm-145			X				
	Sm-147			X				
	Sm-151				X			
	Sm-153				X			
Scandium (21)	Sc-46			X				
	Sc-47				X			
	Sc-48				X			
Selenium (34)	Se-75				X			
Silicon (14)	Si-31				X			
Silver (47)	Ag-105				X			
	Ag-110m			X				
	Ag-111				X			
Sodium (11)	Na-22			X				
	Na-24				X			
Strontium (38)	Sr-85m				X			
	Sr-85				X			
	Sr-89			X				
	Sr-90		X					
	Sr-91			X				
	Sr-92				X			
Sulphur (16)	S-35				X			
Tantalum (73)	Ta-182			X				
Technetium (43)	Tc-96m				X			
	Tc-96				X			
	Tc-97m				X			
	Tc-97				X			
	Tc-99m				X			
	Tc-99				X			
Tellurium (52)	Te-125m				X			
	Te-127m				X			
	Te-127				X			
	Te-129m			X				
	Te-129				X			
	Te-131m			X				
	Te-132				X			
Terbium (65)	Tb-160			X				
Thallium (81)	Tl-200				X			
	Tl-201				X			
	Tl-202				X			
	Tl-204			X				
Thorium (90)	Th-227		X					
	Th-228	X						
	Th-230	X						
	Th-231	X						
	Th-232			X				
	Th-234		X					
	Th Natural			X				
Thulium (69)	Tm-168			X				
	Tm-170			X				
	Tm-171				X			
Tin (50)	Sn-113				X			
	Sn-117m			X				
	Sn-121			X				
	Sn-125				X			
Tritium (1)	H-3				X			
	H-3 (as a gas, as luminous paint, or absorbed on solid material)							X
Tungsten (74)	W-181				X			
	W-185				X			
	W-187				X			
Uranium (92)	U-230		X					
	U-232	X						
	U-233[4]		X					
	U-234		X					
	U-235[4]			X				
	U-236		X					
	U-238			X				
	U Natural			X				
	U Enriched[4]			X				
	U Depleted			X				
Vanadium (23)	V-48				X			
	V-49			X				

Notes: See footnotes at end of tables.

Element[1]	Radionuclide[3]	Transport group I	II	III	IV	V	VI	VII
Xenon (54)	Xe-125			X				
	Xe-131m			X				
	Xe-131m (uncompressed)[2]					X		
	Xe-133			X				
	Xe-133 (uncompressed)[2]						X	
	Xe-135		X					
	Xe-135 (uncompressed)[2]					X		
Ytterbium (70)	Yb-175				X			
Yttrium (39)	Y-88			X				
	Y-90				X			
	Y-91m			X				
	Y-91			X				
	Y-92				X			
	Y-93				X			
Zinc (30)	Zn-65				X			
	Zn-69m				X			
	Zn-69				X			
Zirconium (40)	Zr-93				X			
	Zr-95			X				
	Zr-97				X			

[1] Atomic number shown in parentheses.
[2] Uncompressed means at a pressure not exceeding 14.7 p.s.i. (absolute).
[3] Atomic weight shown after the radionuclide symbol.
[4] Fissile radioactive material.

(b) Any radionuclide not listed in the above table shall be assigned to one of the groups in accordance with the following table:

Radionuclide	Radioactive half-life: 0-1,000 days	1,000 days to 10^6 years	Over 10^6 years
Atomic number 1-81	Group III	Group II	Group III
Atomic number 82 and over	Group I	Group I	Group III

Note 1: No unlisted radionuclides shall be assigned to Groups IV, V, VI, or VII.

(c) For mixtures of radionuclides the following shall apply:

(1) If the identity and respective activity of each radionuclide are known, the permissible activity of each radionuclide shall be such that the sum, for all groups present, of the ratio between the total activity for each group to the permissible activity for each group will not be greater than unity.

(2) If the groups of the radionuclides are known but the amount in each group cannot be reasonably determined, the mixture shall be assigned to the most restrictive group present.

(3) If the identity of all or some of the radionuclides cannot be reasonably determined, each of those unidentified radionuclides shall be considered as belonging to the most restrictive group which cannot be positively excluded.

(4) Mixtures consisting of a single radioactivity decay chain where the radionuclides are in the naturally occurring proportions shall be considered as consisting of a single radionuclide. The group and activity shall be that of the first member present in the chain, except if a radionuclide "x" has a half-life longer than that of that first member and an activity greater than that of any other member including the first at any time during transportation; in that case, the transport group of the nuclide "x" and the activity of the mixture shall be the maximum activity of that nuclide "x" during transportation.

§ 173.391 Limited quantities of radioactive materials and radioactive devices. **(a)** Limited quantities of radioactive materials in normal form not exceeding 0.01 millicurie of Group I radionuclides; 0.1 millicurie of Group II radionuclides; 1 millicurie of Groups III, IV, V, or VI radionuclides; 25 curies of Group VII radionuclides; tritium oxide in aqueous solution with a concentration not exceeding 0.5 millicuries per milliliter and with a total activity per package of not more than 3 curies; or 1 millicurie of radioactive material in special form, and not containing more than 15 grams of uranium-235 are excepted from specification packaging, marking, and labeling, and are excepted from the provisions of § 173.393, if the following conditions are met:

(1) The materials are packaged in strong tight packages such that there will be no leakage of radioactive materials under conditions normally incident to transportation.

(2) The package must be such that the radiation dose rate at any point on the external surface of the package does not exceed 0.5 millirem per hour.

(3) There must be no significant removable radioactive surface contamination on the exterior of the package (see § 173.397).

(4) The outside of the inner container must bear the marking "Radioactive."

(b) Manufactured articles such as instruments, clocks, electronic tubes or apparatus, or other similar devices, having limited quantities of radioactive materials (other than liquids) in a nondispersible form as a component part, are excepted from specification packaging, marking, and labeling, and are excepted from the provisions of § 173.393, if the following conditions are met:

Note 1: For radioactive gases, the requirement for the radioactive material to be in a nondispersible form does not apply.

(1) Radioactive materials are securely contained within the devices or are securely packaged in strong, tight packages, so that there will be no leakage of radioactive materials under conditions normally incident to transportation.

(2) The radiation dose rate at four inches from any unpackaged device does not exceed 10 millirem per hour.

(3) The radiation dose rate at any point on the external surface of the outside of the package may not exceed 0.5 millirem per hour. However, for exclusive use shipments only, the radiation at the external surface of the package or the item may exceed 0.5 millirem per hour, but must not exceed 2 millirem per hour.

(4) There must be no significant removable radioactive surface contamination on the exterior of the package (see § 173.397).

(5) The total radioactivity content of a package containing radioactive devices must not exceed the quantities shown in the following table:

Transport group	Quantity in curies	
	Per device	Per package
I	0.0001	0.001
II	0.001	0.05
III	0.01	3
IV	0.05	3
V or VI	1	1
VII	25	200
Special form	0.05	20

(6) No package may contain more than 15 grams of fissile material.

(c) A manufactured article, other than a reactor fuel element, in which the only radioactive material is metallic natural or depleted uranium or natural thorium or alloys thereof, is excepted from specification packaging, marking, and labeling, and is excepted from the provisions of § 173.393, if the following conditions are met:

(1) The radiation dose rate at any point on the external surface of the outside container does not exceed 0.5 millirem per hour.

(2) There must be no significant radioactive surface contamination on the exterior of the package. To determine whether "significant," the standard in § 173.397 must be used.

(3) The total radioactivity content of each article must not exceed 3 curies.

(4) The outer surface of the uranium or thorium is enclosed in a non-radio-active, sealed, metallic sheath.

Note: Such articles may be packagings for the transportation of radioactive materials.

(d) Shipments made under this section for transportation are not subject to Subpart F of Part 172 of this subchapter, to Part 174 of this subchapter except § 174.24 and to Part 177 of this subchapter except § 177.817.

§ 173.392 Low specific activity radioactive material. (a) Low specific activity (LSA) radioactive materials, other than materials consigned as exclusive use, are exempt from the provisions of § 173.393(a) through (e) and (g). However, they must be packaged in accordance with the requirements of § 173.395 and must be marked and labeled as required in §§ 172.300 and 172.400 of this subchapter.

(b) LSA radioactive materials which are transported in a transport vehicle (except aircraft) and consigned as exclusive use are exempt from specification packaging, marking, and labeling, provided the shipment meets the requirements of paragraph (c) or (d) of this section.

(c) Packaged shipments of low specific activity materials transported in transport vehicles (except aircraft) assigned for the sole use of that consignor must comply with the following:

(1) Materials must be packaged in strong, tight packages so that there will be no leakage of radioactive material under conditions normally incident to transportation.

(2) Packages must not have significant removable surface contamination (see § 173.397).

(3) External radiation levels must comply with § 173.393(j).

(4) Shipments must be loaded by consignor and unloaded by consignee from the transport vehicle in which originally loaded.

(5) There must be no loose radioactive material in the car or vehicle.

(6) Shipment must be braced so as to prevent leakage or shift of lading under conditions normally incident to transportation.

(7) Except for shipments of uranium or thorium ores, unconcentrated, the transport vehicle must be placarded with the placards prescribed in accordance with § 172.500 of this subchapter, as appropriate.

(8) The outside of each outside package must be stencilled or otherwise marked "Radioactive—LSA."

(9) Specific instructions for maintenance of exclusive use (sole use) shipment controls must be provided by the shipper to the carrier. Such instructions must be included with the shipping paper information.

(d) Unpackaged (bulk) shipments of low specific activity materials transported in closed transport vehicles (except aircraft) assigned for the sole use of that consignor must comply with the following:

(1) Authorized materials are limited to the following:

(i) Uranium or thorium ores and physical or chemical concentrates of those ores.

(ii) Uranium metal or natural thorium metal, or alloys of these materials; or

(iii) Materials of low radioactive concentration, if the average estimated radioactivity concentration dose not exceed 0.001 millicurie per gram and the contribution from Group I material does not exceed one percent of the total radioactivity.

(iv) Objects of nonradioactive material externally contaminated with radioactive material, if the radioactive material is not readily dispersible and the surface contamination, when averaged over one square meter, does not exceed 0.0001 millicurie per square centimeter of Group I radionuclides or 0.001 millicurie per square centimeter of other radionuclides. Such objects must be suitably wrapped or enclosed.

(2) Bulk liquids must be transported in the following:

(i) Specification 103CW, 111A60W7 (§§ 179.200, 179.201, 179.202 of this subchapter) tank cars. Bottom openings in tanks prohibited.

(ii) Spec. MC 310, MC 311, MC 312, or MC 331 (§ 178.330, § 178.331, § 178.337, or § 178.343 of this subchapter) cargo tanks. Authorized only where the radioactivity concentration does not exceed 10 percent of the specified low specific activity levels (see § 173.389(c).) The requirements of § 173.393(g) do not apply to these cargo tanks. Bottom fittings and valves are not authorized. Trailer-on-flat-car service is not authorized.

(3) External radiation levels must comply with subparagraphs (2), (3), and (4) of § 173.393(j).

(4) Shipments must be loaded by the consignor, and unloaded by the consignee from the transport vehicles in which originally loaded.

(5) Except for shipments of uranium or thorium ores, unconcentrated, the transport vehicle must be placarded with the placards prescribed in accordance with § 172.500 of this subchapter, as appropriate.

(6) There must be no leakage of radioactive materials from the vehicle.

(7) Specific instructions for maintenance of exclusive use (sole use) shipment controls must be provided by the shipper to the carrier. Such instructions must be included with the shipping paper information.

§ 173.393 General packaging and shipment requirements. (a) Unless otherwise specified, all shipments of radioactive materials must meet all requirements of this section, and must be packaged as prescribed in §§ 173.391 through 173.396.

(b) The outside of each package must incorporate a feature such as a seal, which is not readily breakable and which, while intact, will be evidence that the package has not been illicitly opened.

(c) The smallest outside dimension of any package must be 4 inches or greater.

(d) Each radioactive material must be packaged in a packaging which has been designed to maintain shielding efficiency and leak tightness, so that, under conditions normally incident to transportation, there will be no release of radioactive material. If necessary, additional suitable inside packaging must be used. Each package must be capable of meeting the standards in §§ 173.398(b) and 173.24.

(1) Internal bracing or cushioning, where used, must be adequate to assure that, under the conditions normally incident to transportation, the distance from the inner container or radioactive material to the outside wall of the package remains within the limits for which the package design was based, and the radiation dose rate external to the package does not exceed the transport index number shown on the label. Inner shield closures must be positively secured to prevent loss of the contents.

(e) The packaging must be designed, constructed, and loaded so that during transport:

(1) The heat generated within the package because of the radioactive materials present will not, at any time during transportation, affect the efficiency of the package under the conditions normally incident to transportation, and

(2) The temperature of the accessible external surfaces of the package will not exceed 122° F. in the shade when fully loaded, assuming still air at ambient temperature. If the package is transported in a transport vehicle consigned for the sole use of the consignor, the maximum accessible external surface temperature shall be 180° F.

(f) Pyrophoric materials, in addition to the packaging prescribed in this subpart, must also meet the packaging requirements of § 173.134 or § 173.154. Pyrophoric radioactive liquids may not be shipped by air.

(g) Liquid radioactive material in Type A quantities must be packaged in or within a leak-resistant and corrosion-resistant inner containment vessel. In addition:

(1) The packaging must be adequate to prevent loss or dispersal of the radioactive contents from the inner containment vessel if the package were subjected to the 9 meter (30-foot) drop test prescribed in § 173.398(c)(2)(i); and either

(2) Enough absorbent material must be provided to absorb at least twice the volume of radioactive liquid contents. The absorbent material may be located outside the radiation shield only if it can be shown that

if the radioactive liquid contents were taken up by the absorbent material the resultant dose rate at the surface of the package would not exceed 1,000 millirem per hour, or

(3) A secondary leak-resistant and corrosion-resistant containment vessel must be provided to retain the radioactive contents under the normal conditions of transport as prescribed in § 173.398(b), assuming the failure of the inner primary containment vessel.

(h) There must be no significant removable radioactive surface contamination on the exterior of the package (see § 173.397).

(i) Except for shipments described in paragraph (j) of this section, all radioactive materials must be packaged in suitable packaging (shielded, if necessary) so that at any time during the normal conditions incident to transportation the radiation dose rate does not exceed 200 millirem per hour at any point on the external surface of the package, and the transport index does not exceed 10.

(j) Packages for which the radiation dose rate exceeds the limits specified in paragraph (i) of this section, but does not exceed at any time during transportation any of the limits specified in paragraphs (j)(1) through (4) of this section may be transported in a transport vehicle which has been consigned as exclusive use (except aircraft). Specific instructions for maintenance of the exclusive use (sole use) shipment controls must be provided by the shipper to the carrier. Such instructions must be included with the shipping paper information.

(1) 1,000 millirem per hour at 3 feet from the external surface of the package (closed transport vehicle only).

(2) 200 millirem per hour at any point on the external surface of the car or vehicle (closed transport vehicle only).

(3) Ten millirem per hour at any point 2 meters (six feet) from the vertical planes projected by the outer lateral surface of the car or vehicle, or if the load is transported in an open transport vehicle, at any point 2 meters (six feet) from the vertical planes projected from the outer edges of the vehicle.

(4) 2 millirem per hour in any normally occupied position in the car or vehicle, except that this provision does not apply to private motor carriers.

(k) [Reserved]

(l) Packages consigned for export are also subject to the regulations of the foreign governments involved in the shipment. See §§ 173.8, 173.9, and 173.393b. (The regulations of the International Atomic Energy Agency (IAEA) are used by most foreign governments.)

(m) Prior to the first shipment of any package, the shipper shall determine by examination or appropriate test that:

(1) The packaging meets the specified quality of design and construction, and

(2) The effectiveness of the shielding and containment, and, where necessary, the heat transfer characteristics of the package are within the limits applicable to or specified for the package design.

(n) Prior to each shipment of any package, the shipper shall insure by examination or appropriate test that:

(1) The package is proper for the contents to be shipped;

(2) The packaging is in unimpaired physical condition except for superficial marks;

(3) Each closure device of the packaging, including any required gasket, is properly installed and secured and free of defects;

(4) For a fissile material, any moderator and neutron absorber, if required, is present in proper condition;

(5) Any special instructions for filling, closing, and preparation of the package for shipment have been followed;

(6) Each closure, valve, and any other opening of the containment system through which the radioactive content might escape is properly closed and sealed;

(7) Each package containing liquid in excess of a Type A quantity and destined for air shipment is tested to demonstrate that it is leak tight under an ambient atmospheric pressure differential of at least 0.5 atmosphere (absolute) (7.3 p.s.i.a. or 0.5 kg./cm.^{2}); the test may be conducted on the entire containment system or on any receptacle or vessel within the containment system, as appropriate to determine compliance with the requirement;

(8) If the maximum normal operating pressure of a package is likely to exceed 0.35 kg./cm.^{2} (gage), the internal pressure of the containment system will not exceed the design pressure during transportation, and

(9) External radiation and contamination levels are within the allowable limits.

(o) No person may offer for transportation a package of radioactive materials until the temperature of the packaging system has reached equilibrium (see also paragraph (e) of this section) unless, for the specific contents, he has ascertained that the maximum applicable surface temperature limits cannot be exceeded.

(p) No person may offer for transportation aboard a passenger carrying aircraft any radioactive material unless that material is intended for use in, or incident to, research, or medical diagnosis or treatment, or is excepted under the provisions of § 175.10 of this subchapter.

(q) No person may offer for transportation aboard a passenger-carrying aircraft any single package with a transport index greater than 3.0 nor an overpack with a transport index greater than 3.0.

(r) If an overpack is used to consolidate individual packages of radioactive materials, the packages must comply with the packaging, marking, and labeling requirements of this subchapter, and the following conditions must be met:

(1) The overpack must be labeled as prescribed in § 172.403 of this subchapter except as follows:

(i) The "contents" entry on the label may state "mixed" unless each inside package contains the same radionuclide(s).

(ii) The "number of curies" entry on the label must be determined by adding together the number of curies of the radioactive materials packages contained therein.

(iii) For a non-rigid overpack, the required label together with required package markings must be affixed to the overpack by means of a securely attached, durable tag. The transport index must be determined by adding together the transport indexes of the radioactive materials packages contained therein.

(iv) For a rigid overpack, the transport index must be determined by—

(A) Adding together the transport indexes of the radioactive materials packages contained in the overpack, or

(B) Except for fissile radioactive materials, direct measurements as prescribed in § 173.389(i)(1) which have been taken by the person initially offering the packages contained within the overpack for shipment.

(2) The overpack must be marked as prescribed in Subpart D of Part 172 of this subchapter and § 173.25(a).

(3) The transport index of the overpack may not exceed 3.0 for passenger-carrying aircraft shipments, nor 10.0 for cargo-only aircraft shipments.

§ 173.393a U.S. Atomic Energy Commission approved packages; standard requirements and conditions. **(a)** In addition to the applicable requirements of the USAEC approval and Parts 170-189 of this subchapter, each shipper of a package containing radioactive material, which has been approved by the U.S. Atomic Energy Commission in accordance with § 173.394(b)(3), (c)(2), § 173.395(b)(2), (c)(2), § 173.396(b)(4), or § 173.396(c)(3), also shall comply with the following:

(1) Before the first shipment in a package approved by the U.S. Atomic Energy Commission for use by another person, each shipper shall register in writing with the USAEC, Division of Materials Licensing, his name and address, the name of the person to whom the USAEC approval was issued, and the approval number assigned to the package. Each shipper shall have a copy of the USAEC approval and the document referred to in the approval in his possession. Each shipment must be made in compliance with the terms and conditions of the approval.

(2) The outside of each package must be durably and legibly marked with the package identification marking indicated in the USAEC approval;

(3) Each shipping paper related to the shipment of this package must bear a notation of the package identification marking indicated in the USAEC approval.

(4) Before the first export shipment of the package, the shipper shall submit a copy of the applicable competent authority certificate applying to that package design to the competent national authority of each country into or through which the package will be transported, unless a copy has already been furnished to this party by another person. (Detailed requirements for the issuance and content of competent authority certificates are provided in marginal C-6 of the IAEA "Regulations for the Safe Transport of Radioactive Materials, safety series No. 6, 1967 edition," hereinafter referred to as the "IAEA Regulations." A list of the national competent authorities of each country is published annually by the IAEA.);

(5) Each package of fissile radioactive material must be marked with the numerical value for the transport index if the shipment is fissile class II. Any vehicle limitation indicated in the USAEC approval applies if the shipment is fissile class III; and

(6) For a fissile class III shipment the statement prescribed in § 172.203(d)(1)(vi) of this subchapter must be included with the shipping papers.

§ 173.393b International shipments and foreign-made packages; standard requirements and conditions. **(a)** In addition to the other applicable requirements of Parts 170-189 of this subchapter, each shipper of a package containing radioactive material, for which a foreign competent authority certificate has been issued and revalidated pursuant to the IAEA regulations and § 173.394(b)(4), § 173.394(c)(3), § 173.395(b)(3), § 173.395(c)(3), § 173.396(b)(5), or § 173.396(c)(4), also shall comply with the following:

(1) Before the first shipment of the package, each shipper shall register in writing his identity and type of package with the Office of Hazardous Materials Regulation, U.S. Department of Transportation, Washington, D.C. 20590, furnishing a copy of the foreign certificate or revalidation thereof which is applicable to that package, unless a copy has already been furnished by another person.

SUBPART J

DETAILED REQUIREMENTS FOR POISONOUS MATERIALS

§ 174.600 Special handling requirements for Poison A materials. A tank car containing Poison A may not be transported by rail unless it is originally consigned or subsequently reconsigned to a party having a private track on which it is to be delivered and unloaded (see § 171.8) or to a party using railroad siding facilities which are equipped for piping the liquid or gas from the tank car to permanent storage tanks or sufficient capacity to receive the entire contents of the car.

§ 174.615 Cleaning cars. **(a)** A rail car which has contained arsenic, arsenate of lead, sodium arsenate, calcium arsenate, Paris green, calcium cyanide, potassium cyanide, sodium cyanide, or other poisonous materials which show any evidence of leakage from packages, must be thoroughly cleaned after unloading before the car is returned to service.

(b) After poisonous materials are unloaded from a rail car, that car must be thoroughly cleaned unless the car is used exclusively in the carriage of poisonous materials.

§ 174.680 Poisons with foodstuffs. A carrier may not transport any package of material bearing a poison label in the same car with material which is marked as or known to be foodstuffs, feed, or any other edible material intended for consumption by humans or animals.

SUBPART K

DETAILED REQUIREMENTS FOR RADIOACTIVE MATERIALS

§ 174.700 Special handling requirements for radioactive materials. **(a)** Each rail shipment of low specific activity materials as defined in § 173.389(c) of this subchapter must be loaded so as to avoid spillage and scattering of loose material. Loading restrictions are prescribed in § 173.392 of this subchapter.

(b) The number of packages of radioactive materials that may be transported in any rail car or stored at any single location is limited to that number which does not make a total transport index number (as defined in § 173.389(j) of this subchapter, and determined by adding together the transport index numbers on the labels of the individual packages) of more than 50. This provision does not apply to exclusive use shipments as described in §§ 173.389(o) and 173.392, 173.393(j), or 173.396(f).

(c) Each package of radioactive material bearing **RADIOACTIVE YELLOW-II** or **RADIOACTIVE YELLOW-III** labels when being placed in a rail car, depot, or other place may not be placed closer than three feet to an area (or dividing partition between areas) which may be continuously occupied by any passenger, rail employee, or shipment of animals, nor closer than 15 feet to any package containing undeveloped film (if so marked). If more than one package of radioactive materials is present, the distance must be computed from the table below on the basis of the total transport index number (determined by adding together the transport index numbers on the labels of the individual packages) of packages in the car or storeroom.

Total transport index	Minimum separation distance in feet to nearest undeveloped film [1]	Minimum distance in feet to area of persons, or minimum distance in feet from dividing partition of a combination car [2]
None	0	0
0.1 to 10.0	15	3
10.1 to 20.0	22	4
20.1 to 30.0	29	5
30.1 to 40.0	33	6
40.1 to 50.0	36	7

[1] In feet to nearest undeveloped film.

[2] In feet to area of persons, or minimum distance in feet from dividing partition of a combination car.

Note.—The distance in the table must be measured from the nearest point on the packages of radioactive materials.

(d) Each fissile Class III radioactive material shipment (as defined in § 173.389(a)(3) of this subchapter) must be transported in accordance with one of the methods prescribed in § 173.396(g) of this subchapter. The transport controls must be adequate to assure that no fissile Class III shipment is transported in the same rail car with any other fissile Class III shipment. In loading and storage areas each fissile Class III shipment must be segregated by a distance of at least 20 feet from other packages required to bear one of the "radioactive" labels described in Part 172 of this subchapter.

(e) A flatcar may be used to transport radioactive materials in a container weighing 15,000 pounds or more. A gondola car (other than a drop bottom car) may be used to transport any of the following:

(1) Radioactive materials in containers weighing 5,000 pounds or more;

(2) Strong wooden boxes with inside containers of solid radioactive material, securely braced and cushioned; or

(3) Radioactive material in concrete-filled metal drums or in concrete vaults weighing 700 pounds or more.

(f) A person may not remain unnecessarily in a rail car containing radioactive materials.

§ 174.715 Cleanliness of cars after use. **(a)** Each transport vehicle used for transporting radioactive materials as exclusive use, as defined in § 173.389(e), must be surveyed with appropriate radiation detection instruments after each use. A vehicle may not be returned to service until the radiation dose rate at any accessible surface is 0.5 millirem per hour or less, and there is no significant removable radioactive surface contamination, as defined in paragraph (a) of this section.

(b) This section does not apply to any rail car used solely for transporting radioactive materials if a survey of the interior surface of the car shows that the radiation dose rate does not exceed 10 millirem per hour at the interior surface or 2 millirem per hour at 3 feet from any interior surface. The car must be stenciled with the words **"FOR RADIOACTIVE MATERIALS USE ONLY"** in lettering at least 3 inches high in a conspicuous place on both sides of the exterior of the car and it must be kept closed at all times other than during loading and unloading.

§ 174.750 Incidents involving leakage. **(a)** In addition to the incident reporting requirements of §§ 171.15 and 171.16 of this subchapter, the carrier shall also notify the shipper at the earliest practicable amount following any incident in which there has been breakage, spillage, or suspected radioactive contamination involving radioactive materials shipments. Vehicles, buildings, areas, or equipment in which radioactive materials have been spilled may not be again placed in service or routinely occupied until the radiation dose rate at any accessible surface is less than 0.5 millirem per hour and there is no significant removable radioactive surface contamination (see § 173.397 of this subchapter).

(b) The package or materials should be segregated as far as practicable from personnel contact. If radiological advice or assistance is needed, the Energy Research and Development Administration (ERDA) should also be notified. In case of obvious leakage, or if it appears likely that the inside container may have been damaged, care should be taken to avoid inhalation, ingestion, or contact with the radioactive material. Any loose radioactive materials should be left in a segregated area and held pending disposal instructions, from qualified persons. Information involving the handling of radioactive materials in the event of a wreck may be found in Bureau of Explosives Pamphlet No. 1 and No. 2.

supports having clamps or securing bands capable of holding the cylinders upright when they are subjected to an acceleration of at least 2 "g" in any horizontal direction.

The combined total of the hydrogen venting rates as marked on the cylinders on one motor vehicle must not exceed 60 standard cubic feet per hour.

(ii) Motor vehicles loaded with cylinders containing liquefied hydrogen may not be driven through tunnels.

(iii) Highway transportation is limited to private and contract motor carriers only and to direct movement from point of origin to destination.

(b) Portable tank containers containing compressed gases shall be loaded on motor vehicles only as follows:

(1) Onto a flat floor or platform of a motor vehicle.

(2) Onto a suitable frame of a motor vehicle.

(3) In either such case, such containers shall be safely and securely blocked or held down to prevent movement relative to each other or to the supporting structure when in transit, particularly during sudden starts and stops and changes of direction of the vehicle.

(4) Requirements of subparagraphs (1) and (2) of this paragraph shall not be construed as prohibiting stacking of containers, provided the provisions of subparagraph (3) of this paragraph are fully complied with.

(c) [Reserved]

(d) Engine to be stopped in tank motor vehicles, except for transfer pump. No flammable compressed gas shall be loaded into or on or unloaded from any tank motor vehicle with the engine running unless the engine is used for the operation of the transfer pump of the vehicle. Unless the delivery hose is equipped with a shut-off valve at its discharge end, the engine of the motor vehicle shall be stopped at the finish of such loading or unloading operation while the filling or discharge connections are disconnected.

(e) Chlorine cargo tanks shall be shipped only when equipped (1) with a gas mask of a type approved by the U.S. Bureau of Mines for chlorine service; (2) with an emergency kit for controlling leaks in fittings on the dome cover plate.

(f) No chlorine tank motor vehicle used for transportation of chlorine shall be moved, coupled or uncoupled, when any loading or unloading connections are attached to the vehicle, nor shall any semi-trailer or trailer be left without the power unit unless such semi-trailer or trailer be checked or equivalent means be provided to prevent motion.

(g) Each liquid discharge valve on a cargo tank, other than an engine fuel line valve, must be closed during transportation except during loading and unloading.

§ **177.841 Poisons.** (See also § 177.834(a) to (k).)

(a) Arsenical compounds in bulk. Care shall be exercised in the loading and unloading of "arsenical dust", "arsenic trioxide", and "sodium arsenate", allowable to be loaded into sift-proof, steel hopper-type or dump-type motor-vehicle bodies equipped with water-proof, dust-proof covers well secured in place on all openings, to accomplish such loading with the minimum spread of such compounds into the atmosphere by all means that are practicable; and no such loading or unloading shall be done near or adjacent to any place where there are or are likely to be, during the loading or unloading process assemblages of persons other than those engaged in the loading or unloading process, or upon any public highway or in any public place.

(1) The motor vehicles must be marked in accordance with § 173.368(b) of this chapter.

(2) Before any motor vehicle may be used for transporting any other articles, all detectable traces of arsenical materials must be removed therefrom by flushing with water, or by other appropriate method, and the marking removed.

(b) No Class A or irritating materials in cargo tanks. No poison, Class A, or irritating material may be loaded into or transported in any cargo tank.

(c) Class A poisons or irritating materials. The transportation of a Class A poison or an irritating material is not permitted if there is any interconnection between packagings.

(d) Poisons in cargo tanks. A person shall not drive a tank motor vehicle and a motor carrier shall not require or permit a person to drive a tank motor vehicle containing poisons (regardless of quantity) unless—

(1) All manhole closures on the cargo tank are closed and secured;

(2) All valves and other closures in liquid discharge systems are closed and free of leaks.

(e) A carrier may not transport a package bearing a poison label in the same transport vehicle with material that is marked as or known to be foodstuff, feed or any other edible material intended for consumption by humans or animals.

§ **177.842 Radioactive material. (a)** The number of packages of radioactive materials in any motor vehicle, trailer, or storage location must be limited so that the total transport index number, as defined in § 173.389(i) of this subchapter and determined by adding together the transport index numbers on the labels of the individual packages, does not exceed 50. This provision does not apply to exclusive use shipments described in §§ 173.393(j), 173.396(f), or 173.392 of this subchapter.

(b) Packages of radioactive material bearing "radioactive yellow-II" or "radioactive yellow-III" labels must not be placed in a motor vehicle or in any other place closer than the distances shown in the following table to any area which may be continuously occupied by passengers, employees, or shipments of animals, nor closer than the distances shown in the table below to any package containing undeveloped film (if so marked). If more than one of these packages is present, the distance shall be computed from the following table on the basis of the total transport index number (determined by adding together the transport index numbers on the labels of the individual packages) or packages in the vehicle or storeroom. Where more than one group of packages is present in any single storage location, a single group may not have a total transport index greater than 50. Each group of packages must be handled and stowed not closer than 6 meters (20 feet) (measured edge to edge) to any other group.

(c) Shipments of low specific activity materials, as defined in § 173.391 of this subchapter, must be loaded so as to avoid spillage and scattering of loose materials. Loading restrictions are set forth in § 173.397 of this subchapter.

(d) Packages must be so blocked and braced that they cannot change position during conditions normally incident to transportation.

Total transport index	Minimum separation distances in feet to nearest undeveloped film for various times of transit					Minimum distance in feet to area of persons, or minimum distance in feet from dividing partition of cargo compartments
	Up to 2 hours	2-4 hours	4-8 hours	8-12 hours	Over 12 hours	
None	0	0	0	0	0	0
0.1 to 1.0	1	2	3	4	5	1
1.1 to 5.0	3	4	6	8	11	2
5.1 to 10.0	4	6	9	11	15	3
10.1 to 20.0	5	8	12	16	22	4
20.1 to 30.0	7	10	15	20	29	5
30.1 to 40.0	8	11	17	22	33	6
40.1 to 50.0	9	12	19	24	36	7

Note 1: The distance in the table must be measured from the nearest point on the packages of radioactive materials.

(e) Persons should not remain unnecessarily in a vehicle containing radioactive materials.

(f) Each fissile class III radioactive material shipment (as defined in § 173.389(a)(3) of this subchapter) must be transported in accordance with one of the methods prescribed in § 173.396(g) of this subchapter. The transport controls must be adequate to assure that no fissile class III shipment is transported in the same transport vehicle with any other fissile radioactive material shipment. In loading and storage areas each fissile class III shipment must be segregated by a distance of at least 20 feet from other packages required to bear one of the "Radioactive" labels described in § 173.416 of this subchapter.

§ **177.843 Contamination of vehicles. (a)** Each motor vehicle used for transporting low specific activity radioactive materials in truckload lots under the provisions of § 173.392(d) of this subchapter must be surveyed with appropriate radiation detection instruments after each use. Carriers must not return such vehicles to service until the radiation dose rate at any accessible surface is not more than 0.5 millirem per hour, and there is no significant removable radioactive surface contamination (see § 173.399 of this subchapter).

(b) This section does not apply to any vehicle used solely for transporting radioactive material if a survey of the interior surface shows that the radiation dose rate does not exceed 10 millirem per hour at the interior surface or 2 millirem per hour at 3 feet from any interior surface. These vehicles must be stenciled with the words "For Radioactive Materials Use Only" in lettering at least 3 inches high in a conspicuous place, on both sides of the exterior of the vehicle. These vehicles must be kept closed at all times other than loading and unloading.

(c) In case of fire, accident, breakage, or unusual delay involving shipments of radioactive material, see § 177.861.

§ **177.844 Other regulated materials.** Asbestos must be loaded, handled, and unloaded, and any asbestos contamination of transport vehicles removed, in a manner that will minimize occupational exposure to airborne asbestos particles released incident to transportation. (See § 173.1090 of this subchapter.)

APPENDIX C

CONRAIL TARIFF CR4426-B

The provisions published herein will, if effective, not result in an effect on the quality of the human environment.
No change in Rates, except as indicated by Reference Mark "♠".
Subject (except as otherwise provided) to ICC TEA 9000 and ICC TEA RCCR X082, supplements thereto or successive issues thereof.

CTPUC CR 4426-B	MDOT CR 4426-B	**ICC CR 4426-B**
ILL CC 97	NJDOT CR 4426-B	PAPUC CR 4426-B
INRC CR 4426-B	NYDOT CR 4426-B	RIPUC CR 4426-B
MDPSC CR 4426-B	OHPUC CR 4426-B	VCC CR 4426-B
MDPU CR 4426-B		PSC-WVA CR 4426-B

(see Page 2 for Cancellations)

Consolidated Rail Corporation

FREIGHT TARIFF CR 4426-B

(See Page 2 for Cancellation)

LOCAL AND PROPORTIONAL FREIGHT TARIFF
ON
RADIOACTIVE MATERIALS
AND
RADIOACTIVE MATERIAL SHIPPING CASKS OR CONTAINERS
AS DESCRIBED HEREIN

CARLOADS

FROM STATIONS ON	TO STATIONS ON
CONSOLIDATED RAIL CORPORATION	CONSOLIDATED RAIL CORPORATION

IN THE STATES OF:

CONNECTICUT, DELAWARE, DISTRICT OF COLUMBIA, ILLINOIS, INDIANA, KENTUCKY, MARYLAND, MASSACHUSETTS, MICHIGAN, MISSOURI, NEW JERSEY, NEW YORK, OHIO, PENNSYLVANIA, RHODE ISLAND, VIRGINIA, WEST VIRGINIA

– VIA –

CONSOLIDATED RAIL CORPORATION DIRECT

INTRASTATE APPLICATION OF TARIFF

This Tariff also applies on Intrastate Traffic in the States of:

CONNECTICUT, DELAWARE, DISTRICT OF COLUMBIA, ILLINOIS, INDIANA, MARYLAND, MASSACHUSETTS, MICHIGAN, NEW JERSEY, NEW YORK, OHIO, PENNSYLVANIA, RHODE ISLAND, VIRGINIA, WEST VIRGINIA

RADIOACTIVE MATERIALS TARIFF

Governed, except as otherwise provided herein, by Uniform Classification, and by Exceptions to said Classification. (See Item 5).

ISSUED: FEBRUARY 2, 1982 **EFFECTIVE: FEBRUARY 25, 1982**

This publication filed on less than 20 days' notice under authority of Section 10762 of the Interstate Commerce Act.

Issued by:
H.A. TRAUTMANN, Jr.
Manager - Tariff Publications
30th Street Station Building
Philadelphia, Pa. 19104

♠ Reduction

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(JSS-821-DRB) (200) Printed in USA) (V8,N1)

TABLE OF CONTENTS

CANCELLATION NOTICE

This Tariff cancels the following Consolidated Rail Corporation Tariff in full:

ICC AND TARIFF	CTPUC	ILL CC	INRC	MDPSC	MDPU	MDOT	NJDOT	NYDOT	OHPUC	PAPUC	RIPUC	VCC	PSC-WVA
CR 4426-A	CR 4426-A	88	CR 4426-A	CR 4426-A	CR 4426-A	CR 4426-A	CR 4426-A	CR 4426-A	CR 4426-A	CR 4426-A	CR 4426-A	CR 4426-A	CR 4426-A

For Explanation of Abbreviations, see concluding page of this Tariff.

RULES AND OTHER GOVERNING PROVISIONS

GENERAL RULES AND REGULATIONS

ITEM	SUBJECT	APPLICATION
5	DESCRIPTION OF GOVERNING CLASSIFICATION AND EXCEPTIONS.	The terms "Uniform Classification" and "Exceptions to Uniform Classification" when used herein, mean respectively: ICC UFC 6000 SERIES. Exceptions to Uniform Classification, ICC TEA 2009-Series.
10	STATION LIST AND CONDITIONS	This tariff is governed by ICC OPSL 6000 Series, to the extent shown below: PREPAY REQUIREMENTS AND STATION CONDITIONS (a) For additions and abandonments of stations and except as otherwise shown herein, for prepay requirements, changes in names of stations, restrictions as to acceptance or delivery of freight, and changes in station facilities. When a station is abandoned as of a date specified in the above named tariff, the rates from and to such station as published in this tariff are unapplicable on and after that date. GEOGRAPHICAL LIST OF STATIONS (b) For geographical locations of stations referred to in this tariff by station numbers. STATION NUMBERS (c) For the identification of stations when stations are shown or referred to by numbers in this tariff.
20	REFERENCE TO TARIFFS, ITEMS, NOTES, RULES, ETC	(a) Where reference is made in this tariff to tariffs, items, notes, rules, etc., such references are continuous and include supplements to and successive issues of such tariffs and reissues of such items, notes, rules, etc. (b) Where reference is made in this tariff to another tariff by ICC number, such reference applies also to such tariff to the extent it may be applicable on intrastate traffic.
25	TERMINAL OR TRANSIT PRIVILEGES OR SERVICES. . . .	Shipments made under the rates contained in this tariff are not entitled to terminal and transit services and privileges.
40	CONSECUTIVE NUMBERS	Where consecutive numbers are represented in this tariff by the first and last numbers connected by the word "to" or a hyphen, they will be understood to include both of the number shown. If the first number only bears a reference mark, such reference mark also applies to the last number shown and to all numbers between the first and last number.
45	CAPACITIES AND DIMENSIONS OF CARS	For marked capacities, lengths, dimensions and cubical capacities of cars, see ICC RER 6410 Series. Cars may not be loaded in excess of the load limit.
60	NATIONAL SERVICE ORDER TARIFF.	This tariff is subject to provisions of various Interstate Commerce Commission Service Orders and General Permits as shown in ICC NSO 6100 Series.
75	METHOD OF CANCELLING ITEMS	As this tariff is supplemented, numbered items with letter suffixes cancel correspondingly numbered items in the original tariff or in a prior supplement. Letter suffixes will be used in alphabetical sequence starting with A. EXAMPLE.--Item 445-A cancels Item 445, and Item 365-B cancels Item 365-A in a prior supplement, which, in turn, cancelled Item 365.
100	METHOD OF DENOTING REISSUED MATTER IN SUPPLEMENTS.	Matter brought forward without change from one supplement to another, will be designated as "Reissued" by a reference mark in the form of a square enclosing a number, the number being that of the supplement in which the reissued matter first appeared in its currently effective form. To determine its original effective date, consult the supplement in which the reissued matter first became effective.

For Explanation of Abbreviations, see concluding page of this Tariff.

RULES AND OTHER GOVERNING PROVISIONS

SPECIAL RULES AND REGULATIONS - UNLIMITED

ITEM	SUBJECT	APPLICATION
200	APPLICATION OF SURCHARGES. . .	The rates and charges named in this tariff,as amended,are to be increased for the account of any individual carrier to the extent provided in any applicable surcharge tariff issued by such individual carrier and lawfully on file with the Interstate Commerce Commission. To determine the surcharge to be assessed,consult the applicable surcharge tariff separately published by such individual carrier. Rule 1300.4 (i) of 49 CFR 1300.0 waived; ICC Special Tariff Authority No. 81-4908 of June 16, 1981.
205	RULE 24 EXCEPTIONS,WAIVER OF TARIFF PUBLISHING RULES .	Where items or other provisions in this tariff now provide that rates are not subject to the provisions of Rule 24 of the Uniform Freight Classification, as described in Item 5,such rates will not be subject to "Exceptions to Rule 24" of Uniform Freight Classification, as described in Item 5.
210	RULES,REGULATIONS AND PACKING REQUIREMENTS. . .	The commodities for which carload rates are provided for in this tariff, will be subject to all rules,regulations and packing requirements of the Governing Classification and Exceptions thereto,as named in Item 5,unless otherwise specifically provided herein.
215	PACKAGING, LABELING,AND PLACARDING OF SHIPMENTS . . .	Shipments must be packaged,labelled,and placarded in accordance with Title 49,Code of Federal Regulations,Parts 171-179 inclusive,of Bureau of Explosives Tariff No. ICC BOE-6000 Series,supplements thereto or successive issues thereof. This item supersedes any packing requirements of Item 210 of this Tariff.
220	SHIPPING PAPERS.	Shipments must be described in accordance with regulations contained in Title 49,Code of Federal Regulations,Part 172. Commodity shall also be described as listed in Items 270-305 of this tariff for proper application of freight rates.
225	49 SERIES STANDARD TRANSPORTATION COMMODITY CODE (STCC) . .	The appropriate 49-series Standard Transportation Commodity Code from Section 3 of Standard Transportation Commodity Code Tariff ICC STCC 6001-Series, supplements thereto, or successive issues thereof, must be shown on the bill of lading.
230	LIABILITY. . . .	Shipments to which this tariff applies will not be received for transportation unless the shipper executes an agreement, endorsed upon or attached to the bill of lading in the following form: "In partial consideration for carrier's acceptance of this shipment for transportation, shipper agrees that the declared value of the property does not exceed 40 cents per pound and that carrier shall not be liable for loss of or damage to the property in excess of said amount".. Shipments of irradiated fuel elements and radioactive waste material will not be received for transportation unless the shipper executes a certificate, endorsed upon or attached to the bill of lading, reading as follows: "This is to certify that the articles named within or in the attached bill of lading are properly described, and are packed, marked and in proper condition for transportation according to the regulations prescribed by the U.S. Department of Transportation. The shipper is making the shipment described in such bill of lading (1) as contractor or licensee of the Nuclear Regulatory Commission under the provisions of the Atomic Energy Act of 1954, as amended by the "Price-Anderson Act", Public Law 85-256, as amended or (2) to such contractor or licensee; that there is now in full force and effect a contract between such contractor or licensee and such Commission under such Act, indemnifying such contractor or licensee and the carrier or carriers handling this shipment against public liability as defined in such Act, and (1) that there are no monetary, exclusions or limitations in such contract of indemnity, except as stated in such Act, or (2) that there is in full force and effect a policy or policies of insurance issued by an insurance company or companies licensed to do business in the State of New York or other adequate financial protection as provided by regulations of such Commission in an amount equal to that provided under such Act and regulations thereunder holding the carrier or carriers handling such shipment free and harmless of and from all public liability". If shipper fails or is unable to execute and furnish the above certificate the Consolidated Rail Corporation does not hold itself out as a common carrier to transport shipments of irradiated fuel elements and radioactive waste material.

For Explanation of Abbreviations, see concluding page of this Tariff.

RULES AND OTHER GOVERNING PROVISIONS

SPECIAL RULES AND REGULATIONS

UNLIMITED

ITEM	SUBJECT	APPLICATION
240	EQUIPMENT SUPPLY . . .	Furnishing of Nuclear Regulatory Commission licensed casks, or cask cars, or tank cars shall be the responsibility of the shipper. Originating carrier shall be responsible for furnishing box cars or gondolas.
245	MILEAGE ALLOWANCES	Applicable mileage allowances under Tariff ICC PHJ 6007 Series will be paid.
250	MOVEMENT OF SHIPMENTS IN SPECIAL TRAIN SERVICE . . .	If shipper requests movement of commodities in special train service, special train charges published in CR Tariff ICC CR 9500 Series, supplements thereto, or successive issues thereof, will be assessed. These special train charges will be in addition to rates published in this tariff.
255	PHYSICAL SECURITY. . .	Any physical security provided, either in compliance with NRC or DOT regulations, or at the request of the shipper, shall be at the expense of the shipper. It is not included in the rates.
260	ATTENDANTS . . .	Any attendants accompanying the shipment; either as physical security or technical personnel, will be transported in accordance with charges published in Tariff ICC WTL 9001-Series, supplements thereto, or successive issues thereof.
265	ROUTING OF SHIPMENTS . . .	Routing between Consolidated Rail Corporation stations or interchanges, shall be determined by Consolidated Rail Corporation. Any specific Consolidated Rail Corporation internal routing requested by shipper, either voluntarily or to comply with regulations of a local, county, state or federal government agency will cause the shipment to be billed at rates for the actual operating miles between intermediate stations for the routes utilized. These mileages are published in Conrail Tariff ICC CR 9516-Series.

SPECIAL RULES AND REGULATIONS

APPLICATION OF RATES

ITEM	COMMODITY	APPLICATION
270	Fuel elements, nuclear reactor, irradiated and requiring protective shielding, or irradiated parts or constituents shipped in General Electric cask car (STCC 28 107 10)	Apply Table "A"
275	shipped in NLI cask car (STCC 28 107 10)	Apply Table "B"

For Explanation of Abbreviations, see concluding page of this Tariff.

RULES AND OTHER GOVERNING PROVISIONS

SPECIAL RULES AND REGULATIONS

APPLICATION OF RATES

ITEM	COMMODITY	APPLICATION
280	Casks, radioactive material, shipping, steel and lead or steel and uranium metal combined, empty General Electric IF 300 Cask, empty (STCC 34 919 40)	Apply Table "A"
285	NLI 10/24 Cask, empty (STCC 34 919 40)	Apply Table "B"
290	Containers, radioactive material, shipping, steel and lead or steel and uranium metal combined, empty - shipped in gondola cars (STCC 34 919 40)	Apply Table "D"
295	Radioactive material or radioactive waste, low specific activity, having no reclamation value, in drums or packages - shipped in box cars (STCC 40 251 33)	Apply Table "C"
300	Radioactive waste, low specific activity, having no reclamation value - shipped in gondola cars - ♦shipped in flat cars (STCC 40 251 33)	Apply Table "D"
305	Radioactive waste, low specific activity, liquid, having no reclamation value - shipped in bulk, in tank cars (STCC 40 251 33)	Apply Table "E"
310	Fuel elements, nuclear reactor, irradiated and requiring protective shielding, or irradiated parts or constituents, in containers, shipped on a Government-owned DODX depressed center flat car. (STCC 28 197 10)	Apply Table "F"
315	Casks or containers, radioactive material shipping, empty, permanently mounted or shipped on a Government-owned DODX depressed center flat car. (STCC 34 919 40)	Apply Table "G"
320	Irradiated components, shipped on Government-owned DODX flat cars. (STCC 28 197 10)	Apply Table "H"

325 (Applicable only when specific reference is made to this Item)

Rates will only apply on shipments moving between stations served by Consolidated Rail Corporation.

To determine a rate from a given origin to a given destination, find the Rate Basis Number applicable from point of origin to point of destination in ICC TEA 1009 Series or ICC WTL 1002 Series, disregarding the letter suffix, if any, and then apply the rate provided for that Rate Basis Number in Tables "A", "B", "C", "D", "E", "F", "G", or "H", of this tariff.

The rates published herein, from or to points for which Rate Basis Numbers are provided in tariffs, shown above, will also apply from or to points taking same rates as shown in ICC NRB 6000 Series.

♦ - Reduction.

For Explanation of Abbreviations, see concluding page of this Tariff.

RATE TABLE "A"

COMMODITIES AS DESCRIBED IN ITEMS 270 AND 280

(Ⓘ)RATES IN CENTS PER 100 POUNDS (SEE ITEM 325)

RATE BASIS	CARLOAD MINIMUM WEIGHT				RATE BASIS	CARLOAD MINIMUM WEIGHT			
NOT OVER	144,000 Pounds	160,000 Pounds	170,000 Pounds	180,000 Pounds	NOT OVER	144,000 Pounds	160,000 Pounds	170,000 Pounds	180,000 Pounds
20	31	28	27	26	1020	241	229	224	217
40	35	32	31	30	1040	245	233	227	222
60	39	36	35	33	1060	249	237	231	226
80	44	40	38	37	1080	253	242	235	229
100	48	45	43	40	1100	258	246	239	233
120	52	48	47	46	1120	262	249	243	236
140	56	52	50	49	1140	266	253	247	241
160	61	56	54	52	1160	271	258	250	245
180	65	61	59	56	1180	275	262	255	248
200	69	64	62	60	1200	279	265	259	252
220	72	68	66	64	1220	283	269	262	256
240	77	72	70	68	1240	288	274	266	260
260	81	77	73	71	1260	292	278	271	264
280	85	81	78	76	1280	296	282	275	267
300	89	84	82	79	1300	300	285	278	272
320	94	88	85	83	1320	305	290	282	275
340	98	93	89	87	1340	309	294	286	279
360	102	97	94	91	1360	313	298	290	283
380	107	101	98	95	1380	317	301	294	286
400	111	104	101	99	1400	322	306	298	291
420	115	109	105	102	1420	325	310	301	295
440	119	113	110	107	1440	329	314	306	298
460	124	117	113	110	1460	333	318	310	302
480	128	120	117	114	1480	338	322	313	306
500	132	125	121	118	1500	342	326	317	310
520	136	129	125	121	1520	346	330	322	314
540	141	133	129	126	1540	350	334	325	317
560	145	137	133	129	1560	355	338	329	322
580	149	141	136	133	1580	359	342	333	325
600	153	145	141	137	1600	363	346	338	329
620	157	149	145	141	1620	367	350	341	353
640	161	153	148	145	1640	372	355	345	337
660	165	157	152	148	1660	376	358	349	341
680	169	161	157	152	1680	380	362	353	349
700	174	165	161	157	1700	384	366	357	348
720	178	169	164	160	1720	389	371	361	353
740	182	174	168	164	1740	393	374	364	356
760	186	177	173	167	1760	397	378	368	360
780	191	181	176	171	1780	402	382	373	363
800	195	185	180	176	1800	406	387	376	367
820	199	190	184	179	1820	409	391	380	372
840	203	193	187	183	1840	413	394	384	375
860	208	197	192	186	1860	417	398	388	379
880	212	201	196	191	1880	422	403	392	382
900	216	206	199	195	1900	426	407	396	387
920	220	210	203	198	1920	430	410	400	391
940	225	213	208	202	1940	435	414	404	394
960	229	217	211	207	1960	439	419	408	398
980	233	222	215	210	1980	443	423	412	403
1000	237	226	219	214	2000	447	427	415	406

(Ⓘ) - Not subject to Sections 1 or 3 of ICC TEA 9000, as provided on Title Page.

For Explanation of Abbreviations, see concluding page of this Tariff.

RATE TABLE "B"

COMMODITIES AS DESCRIBED IN ITEMS 275 AND 285

(Ⓘ)RATES IN CENTS PER 100 POUNDS (SEE ITEM 325)

RATE BASIS	CARLOAD MINIMUM WEIGHT			RATE BASIS	CARLOAD MINIMUM WEIGHT		
NOT OVER	200,000 Pounds	210,000 Pounds	220,000 Pounds	NOT OVER	200,000 Pounds	210,000 Pounds	220,000 Pounds
20	20	20	19	1020	208	202	198
40	24	23	22	1040	211	206	201
60	28	27	27	1060	215	210	204
80	32	31	30	1080	218	213	209
100	35	34	33	1100	223	217	212
120	39	38	37	1120	226	220	215
140	43	42	40	1140	230	224	219
160	47	46	44	1160	233	228	223
180	50	49	48	1180	237	231	226
200	54	52	51	1200	241	235	230
220	58	56	54	1220	245	239	233
240	62	60	59	1240	248	243	237
260	65	64	62	1260	252	246	241
280	69	67	65	1280	256	249	244
300	72	71	69	1300	260	253	248
320	77	75	72	1320	263	257	251
340	80	78	77	1340	267	261	255
360	84	82	80	1360	271	264	259
380	87	85	83	1380	275	268	262
400	92	89	87	1400	278	272	265
420	95	93	91	1420	282	275	269
440	99	97	94	1440	285	279	273
460	102	100	98	1460	290	282	276
480	107	103	101	1480	293	286	280
500	110	108	104	1500	297	290	283
520	114	111	109	1520	300	294	288
540	117	115	112	1540	305	297	291
560	121	118	115	1560	308	300	294
580	125	122	119	1580	312	305	298
600	129	126	122	1600	315	308	301
620	132	129	127	1620	320	312	305
640	136	133	130	1640	323	315	309
660	140	136	133	1660	327	320	312
680	144	141	137	1680	330	323	315
700	147	144	141	1700	334	326	320
720	151	147	144	1720	338	330	323
740	154	151	148	1740	342	333	326
760	159	154	151	1760	345	338	330
780	162	159	154	1780	349	341	333
800	166	162	159	1800	353	344	338
820	169	166	162	1820	357	348	341
840	174	169	165	1840	360	351	344
860	177	173	169	1860	364	356	348
880	181	177	173	1880	367	359	351
900	185	180	177	1900	372	363	355
920	189	184	180	1920	375	366	359
940	193	187	183	1940	379	370	362
960	196	192	187	1960	382	374	365
980	200	195	191	1980	387	377	370
1000	203	198	194	2000	390	381	373

(Ⓘ) - Not subject to Sections 1 or 3 of ICC TEA 9000, as provided on Title Page.

For Explanation of Abbreviations, see concluding page of this Tariff.

RATE TABLE "C"

COMMODITIES AS DESCRIBED IN ITEM 295

(I) RATES IN CENTS PER 100 POUNDS (SEE Item 325)

RATE BASIS	CARLOAD MINIMUM WEIGHT					RATE BASIS	CARLOAD MINIMUM WEIGHT				
NOT OVER	60,000 Pounds	80,000 Pounds	100,000 Pounds	120,000 Pounds	140,000 Pounds	NOT OVER	60,000 Pounds	80,000 Pounds	100,000 Pounds	120,000 Pounds	140,000 Pounds
20	209	158	128	108	93	1020	1105	878	741	650	585
40	226	173	140	118	103	1040	1124	392	753	660	594
60	244	186	152	129	113	1060	1142	906	766	672	605
80	262	201	164	140	122	1080	1159	921	777	683	615
100	280	215	177	151	132	1100	1177	935	790	693	624
120	298	230	189	162	143	1120	1195	950	802	704	634
140	316	244	201	173	152	1140	1213	964	815	715	644
160	334	259	213	183	162	1160	1231	979	826	726	654
180	351	273	226	194	171	1180	1249	993	839	737	663
200	370	288	237	206	181	1200	1266	1007	851	748	673
220	388	301	250	216	192	1220	1284	1021	864	758	684
240	406	316	263	227	201	1240	1302	1036	875	769	693
260	424	330	275	237	211	1260	1321	1050	888	781	703
280	442	345	288	248	230	1280	1339	1065	901	791	712
300	459	359	299	260	231	1300	1357	1079	913	802	722
320	477	374	312	271	241	1320	1375	1094	925	813	733
340	495	388	324	281	250	1340	1391	1108	937	823	742
360	513	403	337	292	260	1360	1410	1123	950	834	752
380	531	417	348	302	271	1380	1428	1136	962	846	761
400	550	431	361	313	280	1400	1446	1151	974	856	772
420	567	446	373	325	290	1420	1464	1165	986	867	782
440	585	460	386	335	299	1440	1482	1180	[illegible]	878	791
460	603	475	397	346	310	1460	1500	1194	[illegible]	888	801
480	621	489	410	357	320	1480	1518	1209	1023	900	812
500	639	504	422	367	329	1500	1536	1223	1035	911	821
520	657	518	435	379	339	1520	1554	1238	995	921	831
540	675	533	446	390	348	1540	1572	1251	1060	932	840
560	692	546	459	400	359	1560	1590	1266	1072	943	851
580	710	561	471	411	368	1580	1607	1280	1084	954	861
600	728	575	484	422	378	1600	1625	1295	1097	965	870
620	747	590	495	433	388	1620	1643	1310	1109	976	880
640	765	604	508	444	398	1640	1661	1324	1121	986	890
660	783	619	520	455	408	1660	1680	1339	1133	997	900
680	800	633	533	465	417	1680	1698	1353	1146	1007	910
700	818	648	544	476	427	1700	1716	1367	1158	1019	919
720	836	661	557	487	438	1720	1733	1381	1170	1030	929
740	854	676	570	498	447	1740	1751	1396	1182	1041	939
760	872	690	581	509	457	1760	1769	1410	1195	1051	949
780	890	705	594	520	466	1780	1787	1425	1207	1062	959
800	908	719	606	530	477	1800	1805	1439	1219	1074	968
820	925	734	619	541	487	1820	1823	1454	1232	1084	979
840	944	748	630	553	496	1840	1840	1468	1244	1095	988
860	962	763	643	563	506	1860	1858	1482	1257	1105	998
880	980	776	655	574	517	1880	1877	1496	1268	1116	1007
900	998	791	668	585	526	1900	1895	1511	1281	1128	1018
920	1016	805	679	595	536	1920	1913	1525	1293	1138	1028
940	1033	820	692	607	545	1940	1931	1540	1306	1149	1037
960	1051	834	704	618	555	1960	1949	1554	1317	1160	1047
980	1069	849	717	628	566	1980	1966	1569	1330	1170	1058
1000	1087	864	728	639	575	2000	1984	1583	1342	1181	1067

(I) - Not subject to Sections 1 or 3 of ICC TEA 9000, as provided on Title Page.

For Explanation of Abbreviations, see concluding page of this Tariff.

RATE TABLE "D" †

COMMODITIES AS DESCRIBED IN ITEMS 290 AND 300

(I)RATES IN CENTS PER 100 POUNDS (SEE ITEM 325)

RATE BASIS	CARLOAD MINIMUM WEIGHT					RATE BASIS	CARLOAD MINIMUM WEIGHT				
NOT OVER (MILES)	100,000 Pounds	120,000 Pounds	140,000 Pounds	160,000 Pounds	180,000 Pounds	NOT OVER	100,000 Pounds	120,000 Pounds	140,000 Pounds	160,000 Pounds	180,000 Pounds
20	126	105	92	81	72	1020	803	702	629	575	534
40	138	117	102	91	82	1040	817	714	640	586	542
→60	152	129	113	100	91	1060	830	725	651	595	552
80	166	142	124	111	100	1080	843	738	661	605	561
100	179	153	134	120	110	1100	857	750	673	615	570
120	193	165	145	130	118	1120	871	761	684	625	579
140	207	177	155	141	128	1140	873	773	694	635	589
160	220	189	167	150	137	1160	898	785	705	644	597
180	233	201	178	160	146	1180	912	798	716	655	607
200	247	213	189	169	155	1200	919	809	726	665	617
220	261	225	199	180	165	1220	938	821	737	674	625
240	275	236	210	190	174	1240	952	833	748	684	635
260	288	248	220	199	183	1260	966	845	758	694	644
280	301	261	231	210	193	1280	979	857	770	704	653
300	315	273	242	219	201	1300	993	869	781	714	662
320	328	284	252	229	211	1320	1006	881	791	724	672
340	342	296	264	240	220	1340	1019	892	802	734	681
360	356	308	275	249	229	1360	1033	904	813	743	690
380	370	321	285	260	239	1380	1047	917	823	754	700
400	382	332	296	268	248	1400	1061	929	834	764	708
420	396	344	307	279	257	1420	1074	940	845	773	718
440	410	356	317	289	268	1440	1087	952	855	783	726
460	424	367	328	298	276	1460	1101	964	867	793	736
480	437	380	339	309	284	1480	1115	977	878	803	746
500	450	392	349	318	294	1500	1128	988	888	813	754
520	464	404	360	328	302	1520	1142	1000	899	823	764
540	477	415	372	338	312	1540	1156	1012	910	833	773
560	491	427	382	348	322	1560	1168	1023	920	842	782
580	505	440	397	358	330	1580	1182	1036	931	852	791
600	519	452	404	367	340	1600	1196	1048	941	863	801
620	531	463	414	378	349	1620	1240	1060	952	872	809
640	545	475	425	388	358	1640	1233	1071	963	882	819
660	559	487	436	397	367	1660	1236	1083	974	892	829
680	573	499	446	407	377	1680	1250	1096	985	902	837
700	586	511	457	417	386	1700	1264	1108	996	912	847
720	600	523	469	427	395	1720	1277	1119	1006	921	856
740	613	535	479	437	405	1740	1291	1131	1017	932	865
760	626	546	490	447	413	1760	1205	1143	1006	941	885
780	640	559	501	457	423	1780	1317	1102	1038	951	884
800	654	571	511	466	432	1800	1331	1167	996	962	892
820	668	583	522	476	441	1820	1345	1179	1060	971	902
840	681	594	533	487	450	1840	1359	1191	1071	981	912
860	694	606	543	496	460	1860	1372	1202	1082	990	920
880	708	619	554	506	469	1880	1386	1214	1093	1001	930
900	722	630	566	517	478	1900	1398	1227	1103	1011	949
920	735	642	576	526	488	1920	1413	1239	1114	1020	948
940	749	654	587	536	496	1940	1426	1250	1125	1031	957
960	763	666	597	545	506	1960	1440	1262	1135	1041	966
980	775	678	688	556	514	1980	1454	1274	1146	1050	976
1000	789	690	619	566	524	2000	1467	1287	1157	1060	985

(I) - Not subject to Sections 1 or 3 of ICC TEA 9000, as provided on Title Page.

For Explanation of Abbreviations, see concluding page of this Tariff.

† + 4.7% INCR EFF 1/1/82 THRU 1/1/83

RATE TABLE "E"

COMMODITIES AS DESCRIBED IN ITEM 305

(I) RATES IN CENTS PER 100 POUNDS (SEE ITEM 325)

RATE BASIS	CARLOAD MINIMUM WEIGHT		RATE BASIS	CARLOAD MINIMUM WEIGHT	
NOT OVER	160,000 Pounds	180,000 Pounds	NOT OVER	160,000 Pounds	180,000 Pounds
20	59	52	1020	730	671
40	71	65	1040	743	684
60	85	78	1060	756	695
80	99	89	1080	770	708
100	112	102	1100	784	720
120	126	115	1120	797	733
140	138	127	1140	810	746
160	152	140	1160	823	757
180	166	151	1180	837	770
200	179	164	1200	851	782
220	193	177	1220	864	794
240	207	186	1240	878	807
260	219	201	1260	891	819
280	233	213	1280	904	832
300	246	226	1300	918	843
320	260	239	1320	931	856
340	274	250	1340	945	869
360	286	263	1360	959	881
380	300	275	1380	971	894
400	313	288	1400	985	906
420	327	300	1420	998	918
440	341	312	1440	1012	931
460	354	325	1460	1026	943
480	367	337	1480	1038	955
500	380	349	1500	1052	968
520	394	362	1520	1065	980
540	408	374	1540	1079	993
560	421	387	1560	1093	1004
580	435	399	1580	1105	1017
600	447	411	1600	1119	1030
620	461	424	1620	1132	1042
640	475	436	1640	1146	1054
660	488	448	1660	1160	1066
680	502	461	1680	1173	1079
700	515	473	1700	1186	1092
720	518	486	1720	1200	1103
740	542	497	1740	1213	1116
760	555	510	1760	1227	1128
780	569	523	1780	1240	1141
800	583	535	1800	1254	1153
820	595	547	1820	1267	1165
840	609	559	1840	1280	1178
860	622	572	1860	1294	1198
880	636	585	1880	1307	1202
900	650	596	1900	1321	1215
920	662	609	1920	1334	1227
940	676	621	1940	1347	1240
960	689	634	1960	1361	1252
980	703	646	1980	1374	1264
1000	717	658	2000	1388	1277

(I) - Not subject to Sections 1 or 3 of ICC TEA 9000, as provided on Title Page.

For Explanation of Abbreviations, see concluding page of this Tariff.

RATE TABLE "F"

COMMODITIES AS DESCRIBED IN ITEM 310

(I) RATES IN CENTS PER 100 POUNDS (SEE ITEM 325)

RATE BASIS	CARLOAD MINIMUM WEIGHT		RATE BASIS	CARLOAD MINIMUM WEIGHT	
NOT OVER	231,000 Pounds	300,000 Pounds	NOT OVER	231,000 Pounds	300,000 Pounds
20	13	11	1020	107	104
40	15	13	1040	109	107
60	17	15	1060	110	108
80	18	16	1080	112	110
100	20	18	1100	114	112
120	22	20	1120	116	114
140	24	22	1140	118	115
160	27	23	1160	119	117
180	28	26	1180	121	119
200	30	28	1200	124	121
220	32	30	1220	126	122
240	34	31	1240	127	125
260	35	33	1260	129	127
280	37	35	1280	131	129
300	39	37	1300	133	130
320	42	38	1320	134	132
340	43	40	1340	136	134
360	45	43	1360	138	136
380	47	45	1380	141	137
400	49	46	1400	142	140
420	50	48	1420	144	142
440	52	50	1440	146	144
460	54	52	1460	148	146
480	56	53	1480	149	147
500	58	55	1500	151	149
520	60	58	1520	153	151
540	62	60	1540	155	153
560	64	62	1560	157	154
580	65	63	1580	159	157
600	67	65	1600	161	159
620	69	67	1620	163	161
640	71	69	1640	164	162
660	72	70	1660	166	164
680	75	72	1680	168	166
700	77	75	1700	170	168
720	79	77	1720	171	169
740	80	78	1740	174	171
760	82	80	1760	176	174
780	84	82	1780	178	176
800	86	84	1800	179	177
820	87	85	1820	181	179
840	89	87	1840	183	181
860	92	89	1860	185	183
880	94	92	1880	186	184
900	95	93	1900	189	186
920	97	95	1920	191	189
940	99	97	1940	193	191
960	101	99	1960	194	192
980	102	100	1980	196	194
1000	104	102	2000	198	196

(I) - Not subject to Sections 1 or 3 of ICC TEA 9000, as provided on Title Page.

For Explanation of Abbreviations, see concluding page of this Tariff.

RATE TABLE "G"

COMMODITIES AS DESCRIBED IN ITEM 315

(I)RATES IN CENTS PER 100 POUNDS (SEE ITEM 325)

RATE BASIS	CARLOAD MINIMUM WEIGHT			RATE BASIS	CARLOAD MINIMUM WEIGHT		
NOT OVER	142,000 Pounds	218,000 Pounds	245,000 Pounds	NOT OVER	142,000 Pounds	218,000 Pounds	245,000 Pounds
20	25	14	13	1020	144	108	105
40	27	16	14	1040	146	109	108
60	29	17	16	1060	148	111	110
80	32	19	18	1080	150	113	112
100	34	21	20	1100	153	115	113
120	36	23	21	1120	155	116	115
140	38	24	23	1140	158	118	117
160	40	27	26	1160	160	120	119
180	44	29	28	1180	163	122	121
200	46	31	29	1200	165	124	122
220	48	32	31	1220	167	126	125
240	50	34	33	1240	169	128	127
260	53	36	35	1260	173	130	129
280	55	38	37	1280	175	131	130
300	58	39	38	1300	177	133	132
320	60	42	40	1320	179	135	134
340	63	44	43	1340	182	137	136
360	65	46	45	1360	184	138	137
380	67	47	46	1380	186	141	140
400	69	49	48	1400	189	143	142
420	72	51	50	1420	191	145	144
440	75	53	52	1440	194	146	145
460	77	54	53	1460	196	148	147
480	79	56	55	1480	198	150	149
500	82	59	58	1500	200	152	151
520	84	61	60	1520	203	153	152
540	86	62	61	1540	206	155	154
560	88	64	63	1560	208	158	157
580	91	66	65	1580	210	160	159
600	94	68	67	1600	213	161	160
620	96	69	68	1620	215	163	162
640	98	71	70	1640	217	165	164
660	100	73	72	1660	219	167	166
680	103	76	75	1680	223	168	167
700	105	77	76	1700	225	170	169
720	108	79	78	1720	227	173	171
740	110	81	80	1740	229	175	174
760	113	83	82	1760	231	176	175
780	115	84	83	1780	234	178	177
800	117	86	85	1800	236	180	179
820	119	88	87	1820	239	182	181
840	122	91	89	1840	241	183	182
860	125	92	91	1860	244	185	184
880	127	94	93	1880	246	187	186
900	129	96	95	1900	248	190	189
920	132	98	97	1920	250	192	190
940	134	100	98	1940	253	193	192
960	136	101	100	1960	256	195	194
980	138	103	102	1980	258	197	196
1000	141	105	104	2000	260	199	197

(I) - Not subject to Sections 1 or 3 of ICC TFA 9000, as provided on Title Page.

For Explanation of Abbreviations, see concluding page of this Tariff.

RATE TABLE "H"

COMMODITIES AS DESCRIBED IN ITEM 320

(I) RATES IN CENTS PER 100 POUNDS (SEE ITEM 325)

RATE BASIS	CARLOAD MINIMUM WEIGHT			RATE BASIS	CARLOAD MINIMUM WEIGHT		
NOT OVER	96,000 Pounds	135,000 Pounds	180,000 Pounds	NOT OVER	96,000 Pounds	135,000 Pounds	180,000 Pounds
20	46	33	24	1020	460	323	246
40	54	38	29	1040	469	328	250
60	63	45	34	1060	427	334	255
80	71	50	38	1080	486	340	259
100	80	56	43	1100	494	346	263
120	87	62	47	1120	502	351	267
140	96	67	51	1140	510	357	273
160	104	73	55	1160	519	363	277
180	113	79	60	1180	527	368	281
200	120	85	65	1200	535	375	285
220	129	91	69	1220	543	380	290
240	137	97	73	1240	552	387	294
260	146	102	78	1260	560	392	298
280	154	109	82	1280	569	398	304
300	162	114	86	1300	576	404	308
320	170	119	91	1320	585	409	312
340	179	126	96	1340	593	415	316
360	187	131	100	1360	602	421	321
380	196	137	104	1380	609	427	325
400	203	143	109	1400	618	432	329
420	212	149	113	1420	626	439	334
440	220	154	117	1440	635	444	339
460	229	161	121	1460	643	450	343
480	236	166	127	1480	651	456	347
500	245	171	131	1500	659	461	351
520	253	178	135	1520	668	468	356
540	262	183	140	1540	676	473	361
560	271	190	144	1560	684	479	365
580	278	195	148	1580	692	485	370
600	286	201	153	1600	701	491	374
620	295	207	158	1620	709	496	378
640	301	212	162	1640	718	502	382
660	311	218	166	1660	725	508	387
680	320	224	170	1680	734	513	392
700	328	230	175	1700	742	520	396
720	337	235	179	1720	751	525	400
740	345	242	184	1740	758	531	405
760	353	247	189	1760	767	537	409
780	361	253	193	1780	775	543	413
800	370	259	197	1800	784	548	417
820	378	264	201	1820	792	554	423
840	386	271	206	1840	800	560	427
860	394	276	210	1860	808	566	431
880	403	282	215	1880	817	572	436
900	411	288	219	1900	825	577	440
920	420	294	224	1920	833	584	444
940	427	299	228	1940	841	589	448
960	436	306	232	1960	850	595	454
980	444	311	236	1980	858	601	458
1000	453	316	241	2000	867	606	462

(I) - Not subject to Sections 1 or 3 of ICC TEA 9000, as provided on Title Page.

For Explanation of Abbreviations, see concluding page of this Tariff.

EXPLANATION OF ABBREVIATIONS

BOE - - - - Bureau of Explosives, Thomas A. Phemister, Agent.

CONRAIL - - Consolidated Rail Corporation.

CR- - - - - Consolidated Rail Corporation.

CT PUC- - - Connecticut Public Utilities Commission.

DOT - - - - Department of Transportation.

ICC - - - - Interstate Commerce Commission.

ILLCC - - - Illinois Commerce Commission.

INRC - - - Public Service Commission of Indiana.

MDOT- - - - Michigan Department of Transportation.

MD PSC- - - Public Service Commission of Maryland.

NJ DOT- - - New Jersey - Department of Transportation.

NRB - - - - National Rate Basis (Western Trunk Line Committee, Agent).

NRC - - - - Nuclear Regulatory Commission.

NSO - - - - National Service Order.

NY DOT- - - New York - Department of Transportation.

OH PUC- - - Public Utilities Commission of Ohio.

OPSL- - - - Official List of Open and Prepay Stations (Station List Publishing Company, Agent).

PAPUC - - - Pennsylvania Public Utility Commission.

PHJ - - - - H. J. Positano, Agent.

RCCR- - - - Rail Cost Recovery Tariff (Traffic Executive Association-Eastern Railroads, Agent).

RIPUC - - - Rhode Island Division of Public Utilities and Carriers.

STCC- - - - Standard Transportation Commodity Code (Traffic Executive Association-Eastern Railroads, Agent).

TEA - - - - Traffic Executive Association - Eastern Railroads, Agent.

UFC - - - - Uniform Freight Classification (Uniform Classification Committee, Agent).

VCC - - - - Commonwealth of Virginia State Corporation Commission.

PSCWVA- - - West Virginia Public Service Commission.

WTL - - - - Western Trunk Lines (Western Trunk Line Committee, Agent).