United States Environmental Protection Agency
Office of Emergency and Remedial Response
EPA/ROD/R07-91/052
September 1991

Superfund Record of Decision:

People's Natural Gas, IA

50272-101

REPORT DOCUMENTATION PAGE	1. REPORT NO. EPA/ROD/R07-91/052	2.	3. Recipient's Accession No.

4. Title and Subtitle SUPERFUND RECORD OF DECISION People's Natural Gas, IA First Remedial Action - Final	5. Report Date 09/16/91 6.
7. Author(s)	8. Performing Organization Rept. No.
9. Performing Orgainization Name and Address	10. Project/Task/Work Unit No. 11. Contract(C) or Grant(G) No. (C) (G)
12. Sponsoring Organization Name and Address U.S. Environmental Protection Agency 401 M Street, S.W. Washington, D.C. 20460	13. Type of Report & Period Covered 800/000 14.

15. Supplementary Notes

16. Abstract (Limit: 200 words)

The 5-acre People's Natural Gas site is a former coal gasification plant in Dubuque County, Iowa. The city of Dubuque maintains a public works garage on the eastern portion of the site, and the Iowa Department of Transportation owns the western portion. The site is located 300 feet west of the Mississippi River, and is within the Mississippi River floodplain. In addition, the site overlies a silty sand unit and an alluvial aquifer, which has been determined to be a potential source of drinking water. Surrounding land use is primarily industrial and commercial, with adjacent residential areas. From at least the 1930's to 1954, the site was used to manufacture gas. By-products produced during this process included coal tar, which was stored in an underground tank and an above-ground tank, and cyanide-bearing woodchips, which were buried on the eastern portion of the site. From 1954 to 1964, the site was used as a natural gas distribution, storage, and maintenance facility. In 1986, EPA investigations identified extensive contamination of onsite soil and ground water at the site. In 1989, the PRPs conducted a removal action that included excavating 5,500 cubic yards of PAH-contaminated soil from the western portion of the site, removing tanks used to store coal tar, installing a leachate collection system to prevent contamination from leaching into the alluvial aquifer; and implementing

(See Attached Page)

17. Document Analysis a. Descriptors

Record of Decision - People's Natural Gas, IA
First Remedial Action - Final
Contaminated Medium: soil, gw
Key Contaminants: VOCs (benzene, toluene, xylenes), other organics (PAHs)

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

18. Availability Statement	19. Security Class (This Report) None	21. No. of Pages 86
	20. Security Class (This Page) None	22. Price

(See ANSI-Z39.18) *See Instructions on Reverse* OPTIONAL FORM 272 (4-77)
(Formerly NTIS-35)
Department of Commerce

Abstract (Continued)

institutional controls. This Record of Decision (ROD) addresses both soil and ground water contamination, as a final remedy. The primary contaminants of concern affecting the soil and ground water are VOCs including benzene, toluene, and xylenes; and other organics including PAHs.

The selected remedial action for this site includes excavating and incinerating an estimated 18,500 cubic yards of contaminated soil offsite; treating the soil and ground water within the silty sand unit, which are contaminated with coal tar wastes using in-situ bioremediation; pumping and onsite treatment of contaminated ground water using air stripping followed by offsite and storm sewers discharge to a publicly owned treatment works (POTW); ground water and air monitoring; and implementing institutional controls such as ground water and land use restrictions, as well as site access restrictions including fencing. A contingency for ground water treatment includes engineering controls and an ARAR waiver if the extraction system does not achieve cleanup levels. The estimated present worth cost for this remedial action is $8,000,000, which includes an estimated O&M cost of $788,000 for 10 years.

PERFORMANCE STANDARDS OR GOALS: Federal and State clean-up standards for soil have not been established at this time. Therefore, goals for soil clean-up are based on a carcinogenic risk level of 10^{-4}, and include 500 mg/kg for total PAHs and carcinogenic PAHs 100 mg/kg. Remediation levels for ground water are based on SDWA MCLs, and include benzene 1 ug/l.

RECORD OF DECISION

PEOPLES NATURAL GAS COAL GASIFICATION SITE

DUBUQUE, IOWA

Prepared by:

U. S. ENVIRONMENTAL PROTECTION AGENCY

REGION VII

KANSAS CITY, KANSAS

SEPTEMBER 1991

DECLARATION

Declaration for the Record of Decision

Peoples Natural Gas Coal Gasification Site

Dubuque, Iowa

Statement of Basis and Purpose

This decision document presents the selected remedial action for the Peoples Natural Gas Coal Gasification site, in Dubuque, Iowa. The selected remedy was chosen in accordance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision document explains the factual and legal basis for selecting the remedy for this site. The information supporting this remedial action decision is contained in the administrative record for this site.

The State of Iowa concurs with the selected remedy.

Assessment of the Site

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present a current or potential threat to public health, welfare, or the environment.

Description of the Selected Remedy

The principal threat at this site is buried coal tar waste and cyanide bearing woodchips that present a direct contact threat to on-site workers and has contaminated the ground water. Volatile organics and polynuclear aromatic hydrocarbons have leached from the tars into the ground water.

The major components of the selected remedy include the following:

• Excavation and off-site incineration of coal tar contaminated soil;

• Extraction of contaminated ground water to reduce concentrations to acceptable levels and treatment and discharge of extracted ground water to the City of Dubuque sewer system;

• The in-situ treatment of certain coal tar contaminated areas by the injection of nutrients into the aquifer to stimulate biological degradation, and

• Ground water monitoring to assure successful implementation of treatment systems.

Declaration of Statutory Determinations

The selected remedy is protective of human health and the environment, complies with federal and state requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. This remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable, and it satisfies the statutory preference for remedies that employ treatment that reduce toxicity, mobility, or volume as their principal element. Institutional controls will be installed at the site to insure that the remedy provides protection of human health and the environment. This protection is based on health-based levels that have been determined to be protective in conjunction with institutional controls. Because these controls will not allow for unlimited use and unrestricted exposure at the site, a review will be performed no less often than every five years after initiation of the selected remedial action.

Morris Kay
Regional Administrator
United States Environmental Protection Agency
Region VII

9-16-91
Date

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DECISION SUMMARY

1.0 SITE BACKGROUND

1.1 SITE LOCATION AND DESCRIPTION

The Peoples Natural Gas site is located in Dubuque, Iowa, a city of approximately 100,000 people, in eastern Dubuque County. The address of the site is 925 Kerper Boulevard. Maps of the vicinity and site location are shown in Figures 1-3.

The site occupies approximately 5 acres. It is bounded by 11th Street to the north, Kerper Boulevard to the south and east, and the Soo Line railroad track that parallels Pine Street to the west. The southeast boundary of the site extends to within 300 feet of Dove Harbor on the Mississippi River.

The eastern portion of the site is owned and occupied by the City of Dubuque. The City of Dubuque Street Division operates out of the public works garage built on the site. The garage and the surrounding land are used to store street maintenance vehicles and cars for city officials. Also, the Street Division stores snow removal chemicals (rock salt and liquid calcium chloride) as well as sand on the City's portion of the site. The western portion of the site is owned by the Iowa Department of Transportation (IDOT). A highway is scheduled for construction on this portion of the site with a projected completion date of July 1992. The highway corridor is diagramed in relation to the site in Figure 4.

The site is located 300 feet west of the Mississippi River on a broad Mississippi River flood plain. Sediments underlying the fill material at the site generally consist of unconsolidated silts, sands, and clays. The hydrogeologic setting of the site consists of surficial material and an underlying clay unit (upper confining unit), and an underlying thin silty sand (silty sand unit) which is separated from an alluvial sand (alluvial aquifer) by a thin clay unit (lower confining unit). Ground water in the silty sand unit and the alluvial aquifer flow to the northeast toward a high capacity well field located 1,800 feet north of the site. Ground water in the alluvial aquifer in the vicinity of the site is classified as Class IIB, a potential source of drinking water. The geologic features are shown in Figure 6 as a vertical cross section through the site shown as section 4 - 4' in Figure 5.

A well search was conducted for the area within a one-mile radius of the Peoples site to identify wells in the vicinity that could be affected by the site and to identify local wells that pump large enough volumes of water to influence ground water in the vicinity of the site. The results of the well search indicate that there are no wells on or near the site that are used as a source of drinking water.

1.2 SITE HISTORY AND ENFORCEMENT ACTIVITIES

The Peoples site is the location of a former coal gasification plant formerly owned and operated by the Key City Gas Company. The manufacture of gas at the site occurred from approximately the 1930's to 1954 and ceased with the availability of natural gas to the community.

During operations, the plant produced as by-products coal tar and cyanide-bearing woodchips and stored them on the site. The coal tar was stored in one 14,000 gallon underground concrete tank and one 7,000 gallon above ground tank. A large portion of the coal tar was transferred to railroad cars and sold for use as wood preservative and road treatment. The woodchips were buried on the eastern portion of the site. The hazardous constituents of concern associated with the coal gas process include: polycyclic aromatic hydrocarbons (PAHs); phenols; aromatic volatile organic compounds, including benzene, ethylbenzene, toluene, and xylene (BETX); and cyanide.

North Central Public Service Company acquired ownership of Key City Gas in approximately 1954. Northern Natural Gas Company, which later became Peoples Natural Gas (PNG), acquired ownership of the site in approximately 1957. PNG used the site as a natural gas distribution, storage, and maintenance facility. The City acquired the site property in 1964. IDOT acquired the western one-third of the site in 1985.

In November 1986 the Environmental Protection Agency (EPA) conducted an Expanded Site Investigation (ESI) at the site. The ESI documented extensive soil contamination and ground water releases of phenol, cyanide, and PAHs.

EPA proposed that the site be listed on the National Priorities List in June 1988. On August 30, 1990, the Peoples site was listed as a National Priorities List site.

On April 19, 1989, EPA issued an Administrative Order on Consent to Midwest Gas, a division of Iowa Public Service Company, the successor to North Central Public Service Company; the Iowa Department of Transportation; and the City of Dubuque. All three entities are parties to the Administrative Order on Consent. The order required these parties to conduct a removal action and a Remedial Investigation and Feasibility Study (RI/FS). The purpose of the Remedial Investigation was to determine the source as well as the nature and extent of contamination at the site and to collect the data necessary to determine the proper alternatives to be evaluated in the Feasibility Study. Midwest Gas contracted with Barr Engineering of Minneapolis, Minnesota to conduct sampling at the site, which included surface soil, ground water, sediment, and surface water samples. Midwest Gas prepared an RI/FS Report which was reviewed by EPA. The final RI/FS Report was completed in May 1991. Based on the findings of the FS, EPA prepared a Proposed Plan which described the selected remedy for this site.

The Administrative Order also required that the parties conduct a Site Characterization and Removal Alternative Study (SC/RAS) to determine the extent of contamination of soils in the Highway 61 corridor. Midwest Gas conducted the study and prepared a SC/RAS Report which was reviewed by EPA and used to determine the scope of removal activities in the highway corridor. The final SC/RAS Report was completed in January 1990. Based on information presented in the SC/RAS report EPA developed a Removal Action Decision Document (RADD) dated June 6, 1990 which presented the selected removal action for the highway portion of the site. The RADD also presented the factual and legal basis for the selected removal action.

1.3 REMOVAL ACTIONS

Midwest Gas is nearing completion of a removal action on the western portion of the Peoples site within the construction corridor for U.S. Highway 61. Figure 7 shows the extent of excavation conducted during the removal action. The excavation portions of the removal action were completed in July 1991 and included excavation of contaminated soils, removal of underground tanks used to store coal tar, installation of a leachate collection system to prevent contamination from leaching into the alluvial aquifer, and institutional controls to prevent public exposure to soils exceeding 100 mg/kg (milligrams per kilogram or PPM) carcinogenic PAHs. All soils exceeding the cleanup standards, which were excavated as part of removal action, will be incinerated off-site. Approximately 5,500 cubic yards of soils and stabilized coal tar sludges were excavated. Cyanide bearing woodchips were not encountered during removal activities.

As part of the removal action, soils to a depth of 6 feet were excavated which contained concentrations in excess of 100 mg/kg carcinogenic PAHs and 500 mg/kg total PAHs. This depth of excavation and these cleanup levels were selected to remove the threat of direct contact with site soils by persons working on the site or potential onsite residents. In addition, soils were excavated below 6 feet that contained concentrations in excess of 200 mg/kg carcinogenic PAHs and 2,900 mg/kg total PAHs. This depth of excavation and these cleanup levels were selected to protect the ground water from future leaching of volatile organic compounds and PAHs into the aquifers. The Agency for Toxic Substances and Disease Registry (ATSDR) was consulted regarding the cleanup level for soils excavated below 6 feet. As stated in ATSDR's response to EPA " ATSDR considers a concentration of 200 mg/kg total PAHs and 2,900 mg/kg carcinogenic PAHs remaining in the subsurface soils to be protective of human health."

Midwest Gas prepared a Removal Action Report (RAR) in July 1991. The RAR summarizes the removal action that was completed at the Peoples site within the Highway 61 corridor. Detailed descriptions of construction and excavation activities are included in the RAR.

1.4 COMMUNITY RELATIONS ACTIVITIES

The RI/FS Report and the Proposed Plan for the Peoples site were released to the public for comment. The public comment period was from June 17, 1991 to August 17, 1991. These two documents were made available to the public with the administrative record, which is located at the information repositories maintained at the Dubuque Public Library and at the EPA Region VII office. The notice of availability for these documents was published in the Dubuque Telegraph Herald on June 17, 1991. A public meeting was held on July 9, 1991 in Dubuque, Iowa. At this meeting, representatives from EPA, the State of Iowa, and the Agency for Toxic Substances and Disease Registry (ATSDR) answered questions about problems at the site and the remedial alternatives under consideration. A summary of comments received at this meeting and during the comment period and EPA's response to those comments, the Responsiveness Summary, is attached hereto as Appendix A. Community involvement activities were conducted as a requirement of Sections 113 and 117 of CERCLA.

2.0 SCOPE OF RESPONSE ACTIVITIES

The response activities described in this Decision Summary address all contaminants known at the site. When implemented, these actions will eliminate the need for future response actions at the site. This ROD is intended to be the final ROD for the site. The principal threat at this site is buried coal tar waste and cyanide bearing woodchips that present a direct contact threat to on-site workers and have contaminated the ground water. Volatile organics and polynuclear aromatic hydrocarbons have leached from the tars into the ground water.

3.0 SUMMARY OF SITE CHARACTERISTICS

3.1 CONTAMINANT CHARACTERIZATION

Coal tar waste contains polynuclear aromatic hydrocarbons (PAHs) such as naphthalene and benzo(a)pyrene. Also produced from coal tar wastes are volatile organic contaminants, such as benzene, ethylbenzene, toluene, and xylene (BETX), and semi-volatile contaminants, such as methylphenol, dibenzofuran, and phenol. Cyanide can also be associated with coal tar wastes including woodchips used for gas purification.

3.2 NATURE AND EXTENT OF CONTAMINATION

The Remedial Investigation identified the source of contamination and characterized the nature and extent of contamination at the site. The discussion of these findings is divided into four main groups: surface and shallow subsurface results, deep subsurface results, and ground water results. A site diagram displaying areas of soil contamination is shown in Figure 8. The removal action involved excavation of soil contamination in the tar tank area. The area excavated as part of the removal action is shown in Figure 7. Areas of contamination discussed in this section pertain to the soils not addressed during the removal action which are currently located on the eastern portion of the Peoples site.

Maximum contaminant concentrations for soil and source areas remaining at the site are summarized in Table 1. Maximum contaminant concentrations for ground water are summarized in Table 2. Standards for these contaminants are summarized in Table 5.

3.2.1 SURFACE AND SHALLOW SUBSURFACE RESULTS

The highest concentrations of PAHs in surface and shallow subsurface borings are at a location 4.5-6.5 feet deep northeast of the City of Dubuque public works garage at boring #21 (SB-21) with 4,300 mg/kg (milligrams per kilogram or parts per million) total PAHs and 1,800 mg/kg carcinogenic PAHs. Other areas with significant PAH concentrations in soil are borings SB-16 and SB-17 which are located along the northern edge of the site with 150-900 mg/kg total PAHs and 7.5-89 mg/kg carcinogenic PAHs at 4.5-6.5 feet below surface. Soil boring SB-12 contained 8,000 mg/kg total PAHs at 4.5-6.5 feet below surface and is located approximately 50 feet northeast of SB-21. Figure 10 displays PAH contamination in the subsurface as a vertical cross section through the site shown as section 4 - 4' in Figure 4.

Field screening indicated that BETX concentrations in the surface and shallow subsurface were below 50 mg/kg with the exception of SB-34 which gave a field screening result of 250 mg/kg at 2-4 feet below surface. Figure 11 displays BETX contamination in the subsurface. Table 3 summarizes contaminants detected in soils and source areas for each of the parameter groups addressed during the RI/FS; i.e., volatile organics, semivolatile organics, and cyanide.

3.2.2 DEEP SUBSURFACE RESULTS

The highest concentrations of contaminants in the deep subsurface testing were in three borings northeast of the public works garage. SB-21 resulted in concentrations of 5,400 mg/kg total PAHs, 120 mg/kg carcinogenic PAHs at a depth of 27-29 feet. SB-22 contained 2,700 mg/kg total PAHs, 240 mg/kg carcinogenic

PAHs at a depth of 7-9 feet. SB-12 contained 4,100 mg/kg total PAHs at a depth of 9.5-11.5 feet. Figure 9 shows the areas of PAH contamination in the silty sand unit.

The results obtained for BETX compounds confirm the PAH results. The highest concentrations were located at SB-22 with 560 mg/kg BETX compounds at 12-14 feet. SB-21 contained 98 mg/kg BETX compounds at 27-29 feet.

3.2.3 GROUND WATER RESULTS

Ground water samples were collected from 20 monitoring wells on and offsite in four rounds of sampling. Water samples were collected from both the silty sand and the alluvial aquifers. The analytical results of these samples show that both aquifers contain detectable levels of PAH and BETX compounds both on and off site. Table 4 summarizes contaminants detected in ground water for each of the parameter groups addressed during the RI/FS; i.e., volatile organics, semi-volatile organics, and cyanide.

The highest PAH concentrations were found in water table monitoring well W-2, adjacent to the west edge of the public works garage with 580 ug/l (micrograms per liter or part per billion) total PAHs and 52 ug/l carcinogenic PAHs. Alluvial aquifer monitoring well W-17 contained 43 ug/l total PAHs and silty sand aquifer P-110 monitoring well contained 18 ug/l total PAHs. Figure 12 displays locations of PAHs detected in the ground water.

The wells were analyzed for BETX compounds and similar results were found. Well W-2 had a total BETX concentration of 250 ug/l, W-17 500 ug/l total BETX, and P-110 had 5.0 ug/l total BETX. Many of the samples exceeded EPA primary drinking water standards for the BETX compound benzene. Alluvial aquifer monitoring well W-16, which is approximately 200 feet north of the site, contained 360 ug/l BETX. Figures 13 and 14 display locations of BETXs in the ground water.

Results of the RI indicate that the primary ground water flow is to the northeast while the exact ground water flow patterns will be investigated further during the Remedial Design, sufficient information is available from the RI to select a proper remedy for the ground water.

4.0 SUMMARY OF SITE RISKS

4.1 OVERVIEW OF BASELINE RISK ASSESSMENT

A baseline risk assessment is an evaluation of the potential threat to human health and the environment in the absence of any remedial action. A base line risk assessment is done in part to help EPA determine whether remedial action is necessary at a site. A baseline risk assessment was conducted for this site to determine the potential effects of the contamination on human health and the environment. In this evaluation, both current and future land-use scenarios were evaluated.

4.2 INDICATOR COMPOUNDS

Fifteen chemicals were identified in the Risk Assessment to be of potential concern, 13 of which were PAHs. Toxicity information was evaluated for all chemicals of concern, including cancer potency factors and noncarcinogenic effects. Contaminants of concern (COCs) are contaminants that have been detected at the site, have inherent toxic or carcinogenic effects, and are likely to pose the greatest concern with respect to the protection of human health and the environment. The compounds selected include the more mobile and persistent chemicals at the site, as well as those present at the highest concentrations. These indicator compounds are listed in Table 6. Toxicity information was evaluated for all indicator chemicals, including cancer potency factors and noncarcinogenic effects.

4.3 EXPOSURE ASSESSMENT

The exposure assessment identified potential pathways and routes for contaminants of concern to reach the receptors and the estimated contaminant concentration at the points of exposure. Pathways by which humans could be exposed to the chemicals of concern at the site were evaluated based on reasonable assumptions about current and future land uses. Calculations for site risks are based on upper bound values for contaminants of concern. The following pathways were evaluated:

- Exposure of public works garage workers on-site to contaminated soil through dermal contact and ingestion;

- Exposure of future construction workers on-site to contaminated soil through dermal contact and ingestion;

- Exposure of adults and children as potential on-site residents to contaminated soil through dermal contact and ingestion;

- Exposure of future adult and children residents to contaminated ground water used as a primary potable water source.

4.4 TOXICITY ASSESSMENT

Reference doses (RfDs) have been developed by EPA for indicating the potential for adverse effects from exposure to chemicals exhibiting noncarcinogenic effects. RfDs, which are expressed in units of mg/kg/day (parts per million/day), are estimates of daily exposure levels for humans that are likely to have an appreciable risk of adverse health effects. Estimated intakes of chemicals from environmental media (e.g., the amount of a chemical ingested from contaminated drinking water) can be compared to the RfD. The RfDs applicable at the Peoples site are listed in Tables 15 and 16.

Cancer potency factors (CPFs) or slope factors have been developed for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic chemicals. CPFs, which are also expressed in units of parts per million/day, are multiplied by the estimated intake of a potential carcinogen to provide an upper-bound estimate of the excess lifetime cancer risk associated with exposure at that intake level. The CPFs applicable to the Peoples site are listed in Tables 8 - 14.

4.5 RISK CHARACTERIZATION

The risk characterization quantifies present and/or potential future risk to human health that may result from exposure to the contaminants of concern found at the site. The site-specific risk values are estimated by incorporating information from the toxicity and exposure assessments.

Two quantitative evaluations are made: the incremental risk to the individual resulting from exposure to a carcinogen; or, for noncarcinogens, a numerical index or ratio of the exposure dose level to an acceptable reference dose.

4.5.1 RISKS FROM NON-CARCINOGENIC COMPOUNDS

A Hazard Index (HI) was calculated for each pathway evaluated. An HI of less than 1.0 (unity) indicates that the risks associated with that pathway are low. An HI above 1.0 indicates that some risk of noncarcinogenic effects exist and these risks increase proportional to the HI value. The HI value for potential offsite residents using the water table aquifer as a drinking water source is 3.8 (Table 16), which indicates that they are potentially at risk. However, the water table aquifer does not produce a continuous and reliable source of water for potential users of the aquifer, and therefore does not present a risk to potential residents. The HI for future workers on and offsite was determined to be less than one, indicating no significant noncarcinogenic risks.

4.5.2 RISKS FROM CARCINOGENIC COMPOUNDS

EPA has determined that remedial actions should mitigate risk to fall within a range of 10^{-4} to 10^{-6}, which the Agency believes to be a generally acceptable level of risk. A risk of 1×10^{-6} would mean that one person in a million is in potential danger of developing cancer from the site contaminants. The carcinogenic risks were calculated for the evaluated pathways at the site. The carcinogenic risk to future onsite residents is 3.7×10^{-4}. The risk to future offsite residents is 1.7×10^{-4}. Onsite risk to future construction workers at the site was calculated to be 3.4×10^{-5} and the risk to future onsite workers at the public works garage is 1.1×10^{-2}. Table 7 summarizes site risks for the various pathways.

4.5.3 RISKS FROM EXPOSURE TO SOILS

Based on the pathway analysis it was also determined that exposure to site soils results in an unacceptable risk to persons having direct contact with these site soils. Site soils contaminated with carcinogenic PAHs are the principal threat at the Peoples site due to the threat of direct exposure by public works garage workers to these soils. The risk for residential exposure by ingestion of chemicals in the soil by children is 1.2×10^{-3} (Table 8). The risk for residential exposure by ingestion of chemicals in the soil by adults is 2.0×10^{-4} (Table 9). The risk to workers at the public works garage is 1.1×10^{-2} based on exposure by ingestion of chemicals in the soil (Table 10). The risk for residential exposure by ingestion of chemicals in soil by construction workers is 3.4×10^{-5} (Table 11).

4.5.4 RISKS FROM EXPOSURE TO GROUND WATER

It was determined that exposure could result from ground water in zones contaminated by chemical compounds from the site, based on the potential ground water yield and consumption from both the silty sand and alluvial aquifers. A listing of well locations, compounds, and contaminant concentrations used in the risk calculations is provided in Table 12. The alluvial aquifer presents a carcinogenic risk of 1.70×10^{-4} for residential consumption of ground water by adults (Table 13).

4.5.4 CONCLUSION

In conclusion, based on the results of the risk assessment, EPA has determined that actual or threatened releases of hazardous substances from this site, if not remediated by the selected remedy may present a current or potential threat to public health, welfare, or the environment.

4.6 REMEDIATION GOALS

No federal and state cleanup standards for the contaminants of concern in soil have been established at this time. Therefore, it is appropriate to determine soil cleanup levels on a site-specific basis using the carcinogenic risk factors developed in the risk assessment. At this site, the 10^{-6} risk level would be protective if no institutional controls were in place. Using the proper institutional controls at the site, EPA believes that the cleanup of soil at this site would be adequately protective of human health and the environment when using the 10^{-4} risk level. Based on this risk level, EPA considers a cleanup level for soil, from surface level to six feet below surface, of 500 mg/kg for total PAH contaminants and 100 mg/kg carcinogenic PAH contaminants to be protective of human health. This cleanup level calculated to a risk of 5.8×10^{-4} for incidental soil ingestion by public works garage workers, the population with the highest potential for incidental exposure. PAH contaminants below 6 feet are not considered by EPA to constitute a direct contact threat to persons at the site. The purpose of clean up of soils below 6 feet would be to protect ground water from contamination from coal tar materials. The developed cleanup levels specify a concentration in the soil that is sufficiently protective of human health and the environment when considering institutional controls required at the site.

The 40 C.F.R. 300.430 states that preliminary remediation goals are to be set at a 10^{-6} excess upper bound lifetime cancer risk level as a point of departure, but may be revised to a risk level in the acceptable range (10^{-4} to 10^{-6}) based on consideration of appropriate factors, including uncertainty, technical, and exposure factors.

Federal and state cleanup standards have been established for ground water. EPA has established the Safe Drinking Water Act National Primary Drinking Water Standards' Maximum Contaminant Levels (MCLs) as cleanup criteria for drinking water aquifers. The Iowa Administrative Code Chapter 133, effective August 16, 1989, established action levels for contaminated ground water in Iowa. The level to first be considered is the EPA lifetime health advisory level (HAL), then the EPA negligible risk level (NRL), and finally MCLs. The most stringent level is considered to be the appropriate cleanup criteria for contaminated ground water. These levels correspond to a protective risk level of 10^{-6}.

For the Peoples site, EPA believes that a cleanup level of 1 ug/l (parts per billion) benzene, the most abundant volatile organic present in the contaminated ground water, would be protective of human health, based on the NRL. The level that EPA believes would be protective for carcinogenic PAHs such as benzo(a)pyrene is 0.2 ug/l (parts per billion), based on the analytical detection limit.

For carcinogenic PAHs for which there are no state or federal standards, the proposed cleanup levels will be established using the detection limits for each specific compound, based on the best available technology at the time of the signing of this ROD. The goal for these cleanup levels is to achieve a level protective of human health and the environment. EPA believes that a level established using the current best available detection limits will fulfill this goal. The minimum laboratory detection limits that can be achieved under ideal conditions for carcinogenic PAHs corresponds to a protective risk level of 10^{-5}. The best level that can be measured practically during routine laboratory operating conditions correspond to a protective risk level of 10^{-4}. The 10^{-4} risk level is considered appropriate for this site based on the uncertainty factor and the technical factors associated with the detection/quantification limits for contaminants.

The levels discussed in this section have been reviewed and approved by ATSDR. Table 5 lists the remediation levels that will be used for ground water remediation at this site, including the practical detection limits for the carcinogenic PAHs.

4.7 ENVIRONMENTAL RISKS

The U.S. Fish and Wildlife Service (USFWS) manages 194,000 acres of the upper Mississippi River from Wabasha, Minnesota to Rock Island, Illinois as the Upper Mississippi Wildlife and Fish Refuge. Although the industrial corridor of Dubuque is not managed as part of the refuge, areas in Wisconsin and Illinois directly across form Dubuque are included in the refuge. The USFWS has identified two endangered species that may be located in the general vicinity of Dubuque. These species are the Higgins eye pearly mussel and the bald eagle. The USFWS indicated that the selected remedy will not impact these species or other aquatic organisms associated with the Mississippi River if discharged site-related waters are treated to meet ARARs.

The principal threat to ground water is coal tar contaminated source materials which will be treated in the selected remedy. Remediation of the source materials will also diminish environmental exposures by removing the direct contact threat to contaminated soils.

5.0 SUMMARY OF ALTERNATIVES

The National Contingency Plan (NCP), 40 CFR Part 300, requires that certain alternatives be developed for evaluation in the Proposed Plan:

- An alternative that removes or destroys the hazardous constituents to the maximum extent feasible and eliminates the need for long-term monitoring and management;

- One or more additional alternatives that reduce the toxicity, mobility, or volume of the hazardous constituents;

- One or more alternatives that involve little or no treatment, but provide protection of human health and the environment by containing the hazardous constituents to control exposure to the wastes;

- One or more innovative treatment technology alternatives if those technologies offer the potential for comparable or superior performance or implementability, fewer adverse effects, or lower costs than demonstrated technologies;

- A limited number of remedial alternatives for ground water that attain site-specific remediation levels within different restoration time periods utilizing one or more different technologies; and

- The no-action alternative.

The alternatives that were evaluated in detail in the Feasibility Study are described in this section. Five alternatives were determined to be appropriate for consideration at this site. These alternatives provided a range of various remedial options to satisfy the requirements in the NCP. The following descriptions summarize the alternatives, including their treatment components, implementation requirements and the estimated time for completion and costs.

5.1 NO ACTION

The NCP requires that the no-action alternative be evaluated for every site. This alternative (Alternative 1) provides a baseline for comparing the effectiveness of other remedial options. This alternative involves no further action at the site to prevent the migration of contaminants from the site. There would be no costs associated with this alternative.

5.2 REMOVAL ACTION WITH GROUND WATER MONITORING

Alternative 2 does not include any remedial action beyond the removal action currently being completed in the highway corridor. This alternative would also include ground water monitoring involving periodic collection of ground water samples from upgradient and downgradient wells in both the silty sand and alluvial aquifer. The objective of ground water quality monitoring for Alternative 2 would be to provide a quantitative assessment of the effectiveness of the technologies implemented in the removal action toward minimizing the migration of coal tar contaminants to the aquifers.

The technologies previously incorporated as part of the removal action include: removal and treatment of contaminated soils in the highway corridor; incineration of excavated soils; a leachate collection system for residual contamination and gradient control in the silty sand aquifer; and institutional controls for the site that include deed restrictions.

It is estimated that the ground water monitoring plan would include semi-annual collection of samples for analysis of volatile organic chemicals (VOCs) and annual collection of samples for analysis of PAHs and other contaminants for a total of thirty years. It is assumed that samples would be collected from one upgradient and five downgradient wells in the alluvial aquifer and one upgradient and three downgradient wells in the silty sand aquifer. The present worth total cost for the ground water monitoring program is estimated to be $370,000 (excluding cost of the removal action).

5.3 LIMITED SOIL REMOVAL AND TREATMENT WITH GROUND WATER EXTRACTION AND TREATMENT.

Alternative 3 includes remedial actions to address the two major potential routes of exposure; direct contact with coal tar derived contamination in the soils and ingestion of contaminated ground water.

Surface soils would be excavated and removed from the site for treatment or disposal. It is estimated that 5,500 cubic yards of soil would be removed and treated or disposed offsite using one of three options. These options for treatment or disposal of excavated soils are incineration, land disposal, and biological treatment. Biological treatment of excavated soils would consist of either land treatment or aerobic biological reactor treatment. During excavation air monitoring would be conducted to determine potential contaminant exposure to area residents and workers. Berms would be constructed to collect surface runoff from excavation and soil storage areas.

Alternative 3 includes land disposal and biological treatment as options for disposal and/or treatment of excavated soils. This is a flexible alternative with regard to treatment of soils. If soil is treated biologically and replaced in the excavated areas, some residual contamination may be present in the soil after treatment thus reducing but not eliminating PAH contamination. Current technologies for biological treatment of PAHs in soil have not been demonstrated to effectively reduce concentrations of all PAHs to environmentally acceptable concentrations for the quantities of excavated soils which would be generated by Alternative 3. Biological treatment technologies are in development which may effectively reduce PAH concentrations to environmentally acceptable concentrations in large quantities of soil.

A ground water extraction system would be installed to remove contaminated ground water from the alluvial and silty sand aquifers. Ground water would be treated to achieve the remediation goals listed in Table 5. Extracted water from the alluvial aquifer would be treated with an air-stripper to remove VOCs and discharged to the storm sewer. Extracted water from the silty sand aquifer would be discharged to the sanitary sewer. This ground water extraction system would minimize the migration of contaminants to the alluvial aquifer from either the silty sand or the contaminated soils above the silty sand.

The ground water monitoring system described in Alternative 2 would be operated to determine the effectiveness of the soil removal and ground water extraction system in preventing migration of contaminants to the alluvial aquifer. The alluvial aquifer would be monitored for 10 years and the silty sand aquifer would be monitored for 30 years.

It is estimated that the soil could be excavated and removed from the site in 6 to 12 months at a cost of $720,000 for excavation and $700,000 for soil treatment or disposal. Ground water extraction and treatment systems could be placed in operation in approximately two years. It is estimated that the alluvial aquifer extraction system would be operated for 10 years and the silty sand system for 100 years. The present worth cost for the extraction system is estimated at $790,000 (cost assumes 30 years operation and maintenance for silty sand system). The present worth cost for Alternative 3 with incineration is estimated at $2,800,000 (excluding cost of the removal action). The present worth cost estimate for Alternative 3 with land disposal is $2,600,000 and with biological treatment of excavated soils is $2,700,000.

5.4 LIMITED SOIL REMOVAL AND TREATMENT WITH GROUND WATER EXTRACTION AND TREATMENT, CAPPING OF SOURCE SOILS, AND IN SITU BIOREMEDIATION

Alternative 4 includes all the elements of Alternative 3 plus in-situ bioremediation and capping of source soils. This would provide further reduction of contaminated source areas and decrease infiltration of water into the source areas. The operational lifetime of the ground water extractions systems presented in Alternative 3 would be reduced with biological treatment of source soils at depth.

In-situ bioremediation of contaminated soil and ground water would be conducted in the silty sand layer. An injection and extraction system would be developed to reduce the concentration of coal tar derived contaminants through biological degradation. Bioremediation should treat coal tar derived contamination in the ground water and contamination sorbed to the soil particles. Although capping and ground water extraction and treatment might achieve the remedial action objectives for the ground water, bioremediation should significantly reduce the time required to meet these objectives.

Capping is included in Alternative 4 to reduce leachate production by limiting infiltration. This would reduce the rate of release to the underlying silty sand and alluvial aquifers.

The cap would include a low permeability zone of compacted clay and a high density polyethylene (HDPE) membrane which is estimated to reduce infiltration by a minimum of 99 percent.

It is estimated that construction of the cap would require 4 to 8 months after completion of the soil excavation described in Alternative 3 and would cost $64,000. The time required for in-situ bioremediation would depend on completion of treatability studies to determine site-specific requirements. It is estimated that treatability testing and initial implementation of an in-situ bioremediation could be completed in two years at a present worth cost of $765,000 including 10 years of operation. The present worth cost for Alternative 4 with incineration of excavated soils is estimated at $3,500,000 (excluding cost of the removal action). The present worth cost estimate for Alternative 4 with land disposal is $3,300,000 and with biological treatment of excavated soils is $3,400,000.

5.5 LIMITED SOIL REMOVAL AND TREATMENT WITH GROUND WATER EXTRACTION AND REMOVAL OF SOURCE SOILS

Alternative 5 would include all the elements of Alternative 3 with additional removal of coal tar contaminated source soils at depth (greater than 6 feet below surface). Compared to Alternative 3, the operational lifetime of the ground water extraction systems would be reduced with removal of the source soils at depth.

This alternative includes the additional removal of coal tar contaminated soils at depth that may contribute contaminants to the silty sand or the alluvial aquifer. This removal would reduce the total mass of contaminants on the site and would result in a shorter operation of the silty sand ground water extraction system. The soil volume calculation includes excavation of all visibly contaminated soils as described in the boring logs. This soil volume estimate exceeds that provided in the RI/FS because it includes excavation to the lower confining unit.

It is estimated that 24,200 cubic yards of source soils would be removed and disposed or treated for this alternative. The overall present worth cost for Alternative 5 with incineration is estimated at $8,000,000 (excluding cost of the removal action). The present worth cost estimate for Alternative 5 with land disposal is $7,200,000 and with biological treatment of excavated soils is $7,500,000.

6.0 SUMMARY AND COMPARATIVE ANALYSIS OF ALTERNATIVES

The NCP has established nine criteria that are used to evaluate remedial alternatives. These criteria serve as the basis for conducting detailed analyses during the Feasibility

Study and subsequently are used to determine the appropriate remedy for the site.

A detailed analysis of the remedial alternatives was conducted, consisting of an assessment of the individual alternatives against each of the nine criteria and a comparative analysis that focused on the relative performance of each alternative against those criteria. As a result of this detailed analysis, EPA has determined that a combination of Alternatives 4 and 5 provides the best balance among the alternatives with respect to the criteria.

When conducting the analysis, the nine criteria are organized into three categories. The first such category is threshold criteria. An alternative must meet the following two requirements to be considered as a final remedy for the site:

6.1 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The selected remedy would involve the excavation and incineration of the source soil areas and contaminated soil areas. The highly contaminated soil areas remaining in the silty sand unit would also be addressed by in-situ bioremediation. Ground water from the alluvial aquifer would be treated with an air stripper and discharged to the storm sewer and the ground water from the silty sand aquifer would be discharged to the sanitary sewer. This would reduce exposure to contaminated soils and ground water to protective levels and also minimize the potential for contaminant migration. Air monitoring would be conducted to determine if concentrations of airborne contaminants exceed air quality criteria. If these criteria are exceeded control measures will be implemented. Access restrictions would prevent direct exposure to site soils by the general population.

The no-action alternative does not provide overall protection to human health and the environment and therefore will not be evaluated further because this threshold criteria is not attained. The alternatives involving incineration, 3 - 5, provide the permanent elimination of long-term residual risk. The long-term residual risk would also be eliminated by in-situ biological treatment in the silty sand unit to health-based levels of the contaminated soil in alternatives 4 and the selected remedy. Alternative 2 would not permanently eliminate residual risk and therefore does not provide for protection of human health and the environment. The alternatives which include ground water treatment and the selected remedy, provide for overall protection of human health and the environment.

6.2 COMPLIANCE WITH ARARS

The selected remedy would comply with all federal and state applicable or relevant and appropriate requirements (ARARs).

Applicable requirements are those state or federal requirements legally applicable to the release or remedial action contemplated that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at the site. If it is determined that a requirement is not applicable, it may still be relevant and appropriate to the circumstances of the release. Requirements are relevant and appropriate if they address problems or situations sufficiently similar to the circumstances of the release or remedial action contemplated, and are well-suited to the site.

Applicable chemical-specific requirements associated with this alternative include the National Ambient Air Quality Standards, promulgated under the Clean Air Act. Source control on emissions from the air-stripper would be implemented if air monitoring indicate exceedances of applicable air quality criteria. The MCLs for this site would be applicable and would have to be achieved. Also identified as applicable for this site are the Iowa Administrative Code Chapter 133 standards discussed in Section 4.6.

No location-specific ARARs were identified for the site. The federal action-specific ARARs that the selected remedy would have to comply with are: all pertinent Occupational Safety and Health Act requirements and all Hazardous Materials Transportation Act regulations; the Resource Conservation and Recovery Act (RCRA) regulations applicable to solid wastes, 40 C.F.R. 257; the Clean Water Act regulations applicable to discharge to POTWs and surface waters; and the Clean Air Act requirements applicable to incinerators. The action-specific state ARARs include the Iowa Environmental Quality Act regulations; the Iowa Air Pollution Control Regulations, Sections 22.4, 22.5, 23.1, 23.3, and 23.4; and the Iowa Water Pollution Control regulations, Sections 61.3, 62.1, 62.6, 62.8, 62.9 63, 64.2 and 64.3.

The hazardous waste treatment storage and disposal regulations under RCRA are applicable to wastes at this site where coal tars, when tested by the toxicity characteristic leachate procedure (TCLP), are found to contain concentrations of hazardous constituents in excess of regulatory values. Otherwise, RCRA regulations are considered relevant and appropriate, due to the hazardous nature of coal tars. Therefore the substantive requirements of RCRA, specifically 40 C.F.R. Parts 264 and 270, must be met for non-TCLP wastes, including the requirement that an incinerator destroy the contaminants at an efficiency of 99.99%. A trial burn was conducted and demonstrated this removal efficiency. Both the administrative and substantive requirements of Subtitle C of RCRA must be met for those hazardous constituents that exceed regulatory levels.

All waste generated as a result of remedial actions at the Peoples site are subject to requirements of the EPA off-site policy. The off site policy, as stated in CERCLA §121(d)(3), requires that hazardous substances, pollutants, or contaminants transferred off site for treatment, storage, or disposal during a CERCLA response action be transferred to a facility operating in compliance with §3004 and §3005 of RCRA and other applicable laws and regulations.

Alternative 2, which calls only for ground water monitoring rather than treatment, does not reduce the spread of contaminants in ground water and therefore does not provide adequate protection of human health and the environment. Also this alternative does not meet the chemical-specific ARARs associated with this site. Therefore, this alternative will not be further considered based on the threshold criteria.

Alternatives 3 - 5 would meet the ground water cleanup standards previously identified. Other chemical-specific ARARs, such as the Clean Air Act, would be met for all other alternatives. Air monitoring would be conducted to assure compliance with applicable air standards.

The action-specific ARARs would be met for all other alternatives considered. These ARARs include all OSHA requirements, all Hazardous Materials Transportation Act regulations, and the RCRA requirements previously discussed.

The second category of criteria is primary balancing criteria. The following five criteria are used to evaluate the alternatives to determine the option that provides the most balance for the final remedy for the site:

6.3 LONG-TERM EFFECTIVENESS AND PERMANENCE

The incineration of the contaminated soils and the treatment of ground water in alternatives 3 - 5 and the selected remedies would eliminate the long-term risks associated with direct contact and potential migration of these areas, providing a permanent solution. Highly contaminated source soil areas would continue to leach contaminants into the environment if not treated or removed. The source soil removal of Alternative 5 and the enhanced in-situ biodegradation process of Alternative 4 would reduce contamination in these areas, adding to the long-term effectiveness of these alternatives. The selected remedy involves a combination of these technologies which would reduce contamination and provide for long-term effectiveness.

The alternatives involving incineration as a soil disposal option, 3 - 5 and the selected remedy would eliminate the risks associated with source areas and provide a permanent remedy for contaminated soils. The residual risk associated with contaminants in ground water above health-based levels would be eliminated by alternatives 3 - 5 and the selected remedy. Long-term ground water monitoring would be required for all alternatives. Alternative 3 does not involve excavation of contaminated soils at depth and would not permanently eliminate residual risk, requiring long-term control measures throughout the life of the alternative, estimated at 100 years.

Alternative 4 would reduce contamination in the silty sand unit through the in-situ biodegradation process. However, this alternative does not remove highly contaminated source soil areas from 6 feet below surface to the top of the upper confining layer. This would leave a large volume of contaminated soils as a source of chemicals of concern that could potentially leach into the ground water over time. Alternative 5 relies on ground water extraction to remove contaminants form the silty sand unit which would require a much longer period to reduce contaminant concentrations to acceptable levels.

6.4 REDUCTION OF TOXICITY, MOBILITY, OR VOLUME

The selected remedy treats contaminated surface soils (surface to 6 feet below surface), highly contaminated soil areas, and ground water to achieve reduction of toxicity, mobility and volume of contaminants at the site. The incineration of these soils provides permanent treatment. The excavated nonhazardous waste materials would be incinerated offsite in accordance with the substantive requirements of RCRA, with a 99.99% destruction and removal efficiency (DRE) of contaminants. Those materials that exceed TCLP levels would be managed in accordance with all RCRA requirements. The enhanced in-situ bioremediation process would reduce the toxicity, mobility, or volume of the highly contaminated soils in the silty sand unit. This would also reduce the volume of contaminated ground water that will eventually need to be treated at the site, since these highly contaminated areas will continue to leach contaminants into the environment. The biodegradation process would treat these areas.

The other alternatives involving incineration (3 - 5), would provide a permanent treatment for the excavated contaminated soils. The ground water treatment alternatives would also provide a permanent treatment. Alternative 3 would not treat highly contaminated source soils and therefore not provide for the permanent reduction of the toxicity, mobility or, volume of the contaminants in the source soil areas. Alternative 4 does not remove a large volume of contaminated soil above the silty sand unit and relies on a cap to reduce mobility which will require long-term maintenance.

Alternatives 3 - 5 include land disposal and biological treatment as options for disposal and/or treatment of excavated soils. If soil is treated biologically and replaced in the excavated areas, some residual contamination may be present in the soil after treatment thus reducing but not eliminating PAH contamination. Current technologies for biological treatment of PAHs in soil have not been demonstrated to effectively reduce concentrations of all PAHs to environmentally acceptable concentrations for the quantities of excavated soils which would be generated by Alternatives 3 - 5, or the selected remedy. Biological treatment technologies are in development which may effectively reduce PAH concentrations to environmentally acceptable concentrations in large quantities of soil. Land disposal of contaminated soils would not provide a reduction of toxicity or volume, but would reduce mobility. Land disposal would not provide treatment of excavated soils.

6.5 SHORT-TERM EFFECTIVENESS

The short-term risks associated with the selected remedy would involve the normal construction hazards associated with the excavation of source and soil areas and with the construction and installation of wells. Volatile emissions might also be released during excavation and materials handling, and during the drilling and sampling of wells. This alternative would involve the transportation of wastes and would have short-term risks associated with offsite transport.

Any potential for exposure can be effectively minimized or controlled by compliance with the action-specific ARARs and by implementing engineering controls at the site, such as restricting access to the site, monitoring for volatile emissions, and adhering to a site-specific safety plan. In conformance to OSHA standards, all site workers would be health-and-safety trained, wear the appropriate protective clothing, and participate in a medical monitoring program.

Workers at the City of Dubuque public works garage may be working on the Peoples site during excavation of contaminated soils. Air monitoring would be conducted during soil excavation activities to determine airborne concentrations of PAHs and BETXs. If levels of these contaminants exceed OSHA standards the City of Dubuque would be notified.

The selected remedy would require 24 to 36 months to complete the removal and treatment of source areas and contaminant soil. Incineration of excavated soils is estimated to require 24 months. The time estimated for installation of the ground water extraction system and the establishment of the plume containment is 24 months. The time necessary to achieve a reduction in contaminant levels to the health-based standards is estimated at 10 to 20 years. Installation of the biological remediation system is estimated at 24 months.

Alternative 5 will require excavation of larger soil volumes than the selected remedy or Alternatives 3 and 4. Incineration would require storage onsite while soil is transported offsite for incineration. It is estimated that soils may be stored on site for a period of 8 months longer than the selected remedy. As previously noted, compliance with the action-specific ARARs would effectively minimize and control the potential exposure during implementation of the alternative.

Incineration for alternatives 3 and 4 would require 6 to 12 months to complete the removal and treatment of contaminated soil. Construction of the cap in alternative 3 would require 4 to 8 months. All the remaining alternatives would require 24 months for installation of the ground water system and the establishment of the plume containment. The biological treatment of the soil areas in Alternative 4 is estimated to take 24 months.

6.6 IMPLEMENTABILITY

Implementation of the selected remedy would involve conventional construction technologies. Excavation, pumping, decontamination, and gradient control are frequently used technologies that have been proven to be effective. Incineration is a proven technology for coal tar wastes and a trial burn conducted at a power plant boiler has demonstrated it can achieve the RCRA destruction efficiency for site derived coal tar wastes. The enhanced in-situ bioremediation process has not been extensively used at coal gas sites and therefore would be implemented after conducting an extensive treatability study.

The other alternatives involving incineration and the ground water treatment system would have the same ease in implementability. Capping is also a frequently used technology. Excavation below the upper confining unit would not be practical near the public works garage and Kerper Boulevard as it would require excavation to approximately 30 feet. Insufficient space is available on the site for the setback requirements to excavate to this depth. Sheet pilings may not provide sufficient stability.

Biological treatment of excavated soils would require sufficient space onsite to construct a biological reactor system. It would be difficult to locate this system on the site due to space limitations. Biological treatment by land farming technologies would require offsite facilities in order to have the necessary space to implement this technology.

6.7 COST

The cost of the selected remedy would be the cost for alternative 4 plus the additional cost for source soils removal less construction costs for capping. The present worth cost for the selected remedy is estimated at $8,000,000 (excluding cost for the removal). This includes operation and maintenance costs for 10 years of operation.

The selected remedy would remove highly contaminated source soil areas below 6 feet to the top of the upper confining layer. This would remove a source of chemicals of concern that could potentially leach into the ground water. Alternative 4 would not remove these source soil areas below 6 feet potentially causing an increase in the time requirements for ground water remediation.

The range of total present worth costs for the alternatives is from $370,000 for alternative 2 to $8,000,000 for alternative 5 (excluding costs for the removal action).

The present worth cost estimates stated above include incineration as the disposal method for excavated soils. Costs for biological treatment or land disposal of soils do not differ significantly from those for incineration.

The third category of criteria is modifying criteria. The following two criteria are considered when evaluating the alternatives and are used to help determine the final remedy for the site:

6.8 STATE ACCEPTANCE

The State of Iowa supports the remedy selected for the cleanup of contaminated soils and ground water at the Peoples site.

6.9 COMMUNITY ACCEPTANCE

Community acceptance of the selected remedy was evaluated during the public comment period. The comments received are contained in the Responsiveness Summary, Appendix A.

7.0 SUMMARY OF SELECTED REMEDY

Based on the evaluations prepared for each of the proposed alternatives, EPA has made a determination that the appropriate remedy for the Peoples site is a combination of Alternatives 4 and 5 described as follows: excavation and incineration of contaminated soil from surface to 6 feet below grade that exceed 100 mg/kg carcinogenic PAHs and 500 mg/kg total PAHs; excavation and incineration of contaminated source soils that have visible coal tar contamination from 6 feet below grade to the surface of the upper confining unit; enhanced in-situ bioremediation to treat the contaminated ground water and contaminated source soils in the silty sand unit; ground water extraction of both the silty sand and alluvial aquifers to reduce concentrations to levels required by the State of Iowa Administrative Code Chapter 133; and ground water monitoring of both the silty sand and alluvial aquifers to assure successful implementation of ground water treatment systems. This alternative provides the best balance of the factors identified by the nine criteria.

The selected remedy would require 24 to 36 months to complete the removal and treatment of source areas and contaminated soil. Incineration of excavated soils is estimated to require 24 months. The time estimated for installation of the ground water extraction system and the establishment of the plume containment is 24 months. The time necessary to achieve a reduction in contaminant levels to the health-based standards is estimated at 10 to 20 years. Installation of the biological remediation system is estimated at 24 months.

It is estimated that 18,500 cubic yards of contaminated soils would be removed and treated by incineration. It is estimated that operation of the alluvial extraction system would continue for 10 years, 5 years for the silty sand aquifer extraction system, and 5 years for the bioremediation system. However, the operation of these systems would continue as long as necessary if results of the ground water monitoring indicate contaminant concentrations have not attained the remedial criteria. Injection of ground water into any aquifer would not be used as a method of disposal for ground water. Ground water removed from the silty sand extraction system will be discharged to the City of Dubuque sanitary sewer system. Ground water removed from the alluvial extraction system will be treated and discharged to the City of Dubuque storm sewer system.

The selected remedy is in addition to the removal action completed in July 1991 which eliminated contamination sources in the Highway 61 corridor on the western portion of the site. The provisions of the removal order require institutional controls including restriction of site access and deed restrictions allowing only commercial use of the property. The site will remain secured to prevent access by the general population. The technologies previously incorporated as part of the removal action include: removal and treatment of contaminated soils in the highway corridor; incineration of excavated soils; a leachate collection system for residual contamination and gradient control in the silty sand aquifer.

The horizontal extent of excavation will be determined using the 100 mg/kg carcinogenic PAH/500 mg/kg total PAH level. The vertical extent of excavation may also be adjusted in the field, with a maximum vertical excavation of 6 feet based on this level. Excavation from 6 feet below grade to the top of the upper confining unit will be based on visible coal tar contamination. A procedure will be developed to determine the existence of visible coal tar contamination. Excavation will cease at the top of the upper confining unit. The base of each excavation area will be divided into sections and sampled to determine the concentration of contaminants that remain. The base of the excavation areas will be determined by either the 100 mg/kg carcinogenic PAH/ 500 mg/kg total PAH level or the visible coal tar standard depending on which is applicable as previously described.

This cleanup level of 500 mg/kg total PAH/100 mg/kg carcinogenic PAH calculates to a risk of 5.8×10^{-4} for incidental soil ingestion by public works garage workers, the population with the highest potential for incidental exposure. PAH contaminants below 6 feet are not considered by EPA to constitute a direct contact threat to persons at the site. The purpose of clean up of soils below 6 feet would be to protect ground water from contamination from coal tar materials.

Excavated material will be separated to remove materials not compatible with the incineration process. All material greater than 2 inches in diameter will be separated. Materials less than 2 inches in diameter will be placed in the contaminated soil storage area, along with source tars, before being transported to the incinerator. This pad will meet the substantive requirements of RCRA. All material that cannot be reduced to a manageable size will be steam-cleaned and sent for disposal in accordance with RCRA. The proper transportation requirements will be met and the trucks will be decontaminated.

Chemical dust-suppressants and/or water will be used for dust control during activities at the site. Volatile emissions will be monitored during all operations. Berms will be constructed and grading performed to control water run-on and run-off, and sumps will collect water for treatment. Clean fill will be added to excavated areas. Storage piles of contaminated excavated soils will be covered with 60-mil high density polyethylene (HDPE) until removed for incineration.

Monitoring wells will be installed at various locations at the site to confirm the efficacy of the ground water extraction system. Extraction wells will be installed in both the silty sand and alluvial aquifers for the removal of ground water and subsequent treatment. The goal of the treatment process will be 1 ug/l (ppb) benzene, which corresponds to the 10^{-6} risk level. The process will also meet the ground water remediation levels listed in Table 5, which includes the current practical detection limits for carcinogenic PAHs. If, in EPA's judgment, implementation of the selected ground water remedy clearly demonstrates that it will be technically impracticable to achieve and maintain the ground water remediation levels established in this ROD, EPA will re-evaluate those levels. For example, the cleanup levels for ground water may be re-evaluated if it has been demonstrated that contaminant levels have ceased to decline over time and are remaining constant at some statistically significant level above remediation goals. In such a case, an alternate concentration level may be established and/or a chemical-specific ARAR waiver may be invoked. Any newly established remediation levels must be protective of human health and the environment. The ROD will be amended or an explanation of Significant Differences will be issued to inform the public of the details if such actions occur.

The water pumped from the alluvial aquifer will be treated using air stripper technology and discharged to the City of Dubuque storm sewer system. Water pumped from the alluvial aquifer will be analyzed as required by the Clean Water Act (CWA) prior to discharge to a surface water body. Water discharged to the storm sewer must meet all applicable CWA requirements and must be treated as necessary to remove contaminants as required by the CWA. Air modeling and/or analysis will be conducted to determine potential requirements for emission controls on the air stripper. Emission controls will be installed as required by EPA and State of Iowa regulations.

The water pumped from the silty sand aquifer will be discharged to the City of Dubuque sanitary sewer system for treatment at the publicly-owned treatment works (POTW). Water discharged to the sanitary sewer must meet all CWA pretreatment requirements for discharge to the POTW through the sanitary sewer system.

Air monitoring will be conducted in connection with both the excavation activities and the air stripping of water pumped from the alluvial aquifer. All applicable National Ambient Air Quality Standards, promulgated State of Iowa air standards, or other promulgated federal air standards must not be exceeded at the site boundaries. Appropriate control measures will be implemented as necessary to achieve all applicable air quality standards. Air monitoring and/or modeling will be conducted to determine air quality control measure requirements.

The in-situ bioremediation process will begin with a pilot study to determine the proper types and amounts of nutrients and possible engineered organisms to inject into the aquifer for stimulating natural biological degradation. The nutrients, dissolved oxygen, and organisms will be added to treated ground water and reinjected into the aquifer using injection wells. Injection well placement will be determined through ground water modeling. The system will use injection and extraction wells as determined through ground water modeling and treatability studies. Procedures for determining the efficacy of the bioremediation system will be determined and implemented. The system will be modified as necessary to reduce concentrations of contaminants in the silty sand unit.

The goal of this remedial action is to restore the ground water to its beneficial use as required by IDNR regulations. Based on information obtained during the remedial investigation, and the analysis of the remedial alternatives EPA and the State of Iowa believe that the selected remedy may be able to achieve this goal. Ground water contamination may be especially persistent in the immediate vicinity of the contaminants' source. The ability to achieve cleanup levels throughout the area of attainment, or plume, cannot be determined until the extraction system has been implemented, modified as necessary, and plume response monitored over time. If the selected remedy cannot meet the specified remediation at any or all of the monitoring points during implementation, the contingency measures described in this section may replace the selected remedy and the remediation levels for these portions of the plume. These measures are considered to protect human health and the environment, and are technically practicable under the corresponding circumstances.

The selected remedy will include ground water extraction for an estimated period of 10 years for the alluvial aquifer and an estimated 5 years for the silty sand aquifer, during which time the system's performance will be monitored on a regular basis and adjusted as warranted by the performance data collected during operation. Modifications may include any or all of the following:

- Discontinuing pumping at individual wells where cleanup goals have been attained
- Alternating pumping at wells to eliminate stagnation points
- Pulse pumping to allow aquifer equilibrium and encourage adsorbed contaminants to partition to the ground water
- Installing additional extraction wells to facilitate or accelerate cleanup of the contaminant plume

To ensure that cleanup levels are maintained, the aquifer will be monitored at those wells where pumping has ceased following discontinuation of ground water extraction.

If it is determined, on the basis of the preceding criteria and the system performance data, that certain portions of the aquifer cannot be restored to their beneficial uses, all of the following measures involving long-term management may occur, for an indefinite period of time, as a modification of the existing system:

- Engineering controls such as physical barriers or long-term gradient control provided by low level pumping, will be implemented as containment measures
- Chemical Specific ARARs will be waived for cleanup of for those portions of the aquifer based on the technical impracticability or achieving further contaminant reduction

- Institutional control will be provided and maintained to restrict access to those portions of the aquifer that remain above remediation levels

- Monitoring of specified wells will continue

- Remedial technologies for ground water restoration will be reevaluated periodically

The decision to invoke any or all of these measures may be made during a periodic review of the remedial action, which will occur at a minimum of 5 year intervals in accordance with Section 121(c) of CERCLA.

The site will be fenced and ground water and land-use restrictions will be implemented to minimize activities which would provide direct contact with contaminants. Initially, well-monitoring will be performed bimonthly after the remedy is implemented. After the first year, monitoring will be performed quarterly for 5 years, then biannually for the next thirty years, to ensure that the remedy was successful.

A review of the effectiveness of the selected remedy will be conducted each five years following completion of construction activities as required for implementation of the selected remedy. Five year reviews are conducted pursuant to Section 121(c) of CERCLA which requires the review of remedial actions no less often that each five years for sites where the remedial action results in any hazardous substances, pollutants, or contaminants remaining at the site. The purpose of the five review is to assure that human health and the environment are being protected by the implementation of the selected remedy.

Table 17 lists the capital costs for each major component of the selected remedy. The total construction costs are estimated to be $7,000,000 and the total operations and maintenance costs are estimated to be $1,000,000 giving a total present worth of $8,000,000.

Changes may be made to the selected remedy during remedial design work and the processes of construction.

8.0 STATUTORY DETERMINATIONS

The selected remedy satisfies the statutory requirements of Section 121 of CERCLA, 42 U.S.C. § 9721, as follows:

8.1 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The selected remedy will be protective of human health and the environment by providing for the permanent destruction of contaminated soil areas. These areas will be excavated to a level protective of human health and the environment that corresponds to the 10^{-4} risk level. Proper institutional controls will be taken at the site, including site fencing, ground water use restrictions and land use restrictions.

The ground water will be treated until the off-site contaminants are below health-based standards, providing protection to the 10^{-6} risk level for benzene and the 10^{-4} risk level for carcinogenic PAHs. Ground water from the alluvial aquifer will be treated with an air stripper and discharged to the storm sewer. Air monitoring will be conducted to determine if concentrations of airborne contaminants exceed air quality criteria and if these criteria are exceeded control measures will be implemented. The enhanced in-situ bioremediation process will address contaminated soil areas that will not be excavated.

The selected remedy will provide maximized long-term effectiveness and will reduce the toxicity, mobility and volume of wastes to the greatest extent practicable. The selected alternative will also have minimal short-term risks and the proper controls will be taken to minimize these risks.

8.2 COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

The selected remedy complies with all ARARs associated with this site. All chemical-specific ARARs will be met, including CAA, RCRA and the Iowa Administrative Code Chapter 133, which requires one of three standards, MCLs, HALs, or NRLs. All action-specific ARARs, including all OSHA, RCRA, and DOT requirements, will also be met. No location-specific ARARs were identified at this site.

8.3 COST-EFFECTIVENESS

The overall effectiveness of the selected remedy is proportional to its estimated cost of $8,000,000. The soil excavation and incineration and the ground water treatment process are necessary to provide protection of human health and the environment. The added cost of the bioremediation system is reasonable when considering the added protection that will be provided for human health and the environment in addressing the contaminants. There would be a reduction in the time needed for treatment of the aquifer, resulting in a decreased cost.

8.4 UTILIZATION OF PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT TECHNOLOGIES TO THE MAXIMUM EXTENT PRACTICABLE

The EPA has determined that the selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a cost-effective manner for the Peoples Natural Gas Site. Of those alternatives that are protective of human health and the environment and comply with ARARs, EPA has determined that this selected remedy provides the best balance in terms of long-term effectiveness and permanence, reduction in toxicity, mobility, or volume achieved through treatment, short-term effectiveness, implementability, and cost. Also EPA considered the statutory preference for treatment as a principal element, and considered input from the community. The State of Iowa agrees with these determinations.

The selected remedy utilizes proven technologies in incineration and the ground water treatment system that can be effectively implemented. These processes provide the best solutions in addressing the contaminants at the site. The enhanced in-situ bioremediation process will provide treatment for the contaminated silty sand unit which would otherwise have to be left unattended and therefore significantly add to the time required for treating the ground water. Therefore this remedy provides treatment technologies to the maximum extent practicable at this site.

The selected remedy permanently destroys the contaminated soil areas and treats the off-site ground water to below health-based standards, providing for long-term effectiveness and permanence. Alternatives 2 does not permanently eliminate risks at the site. All other alternatives provide permanent protection.

The selected remedy provides maximum reduction of toxicity, mobility, and volume. The other alternatives involving incineration, 3, 4, and 5, also provide for the reduction of toxicity, mobility, or volume, however alternative 2 would not treat the contaminated ground water. The other alternatives involving incineration (3 - 5), would provide a permanent treatment for the excavated contaminated soils. The ground water treatment alternatives would also provide a permanent treatment. Alternatives 3 would not treat highly contaminated source soils and therefore not provide for the permanent reduction of the toxicity, mobility, or volume of the contaminants in the source soil areas. Alternative 4 does not remove a large volume of contaminated soil above the silty sand unit and relies on a cap to reduce mobility which will require long-term maintenance.

The short-term risks associated with the selected remedy are minimal and will be attended to with the proper controls at the site. The same general short-term risks apply to all alternatives utilizing excavation and transport of waste which involve more short-term risks. These risks will be minimized through compliance with ARARs.

The selected remedy utilizes proven and implementable technologies in excavation, incineration, and ground water treatment. The in-situ biological alternative portions provide added reduction in the toxicity, mobility, and volume at a reasonable cost. Alternative technologies for biological treatment of PAHs in excavated soils will require further development before being considered for implementation at the site.

In order to satisfy the preference for a permanent solution, alternatives 2 was eliminated. The incineration of the contaminated soils and the treatment of ground water in alternatives 3 - 5 and the selected remedy would eliminate the long-term risks associated with direct contact and potential migration of these areas, providing a permanent solution. Highly contaminated source soil areas would continue to leach contaminants into the environment if not treated or removed. The source soil removal of Alternative 5 and the enhanced in-situ biodegradation process of Alternative 4 would reduce contamination in these areas, adding to the long-term effectiveness of these alternatives. The selected remedy involves a combination of these technologies which would reduce contamination and provide for long-term effectiveness.

The alternatives involving incineration as a soil disposal option, 3 - 5 and the selected remedy, would eliminate the risks associated with source areas and provide a permanent remedy for contaminated soils. The residual risk associated with contaminants in ground water above health-based levels would be eliminated by alternatives 3 - 5 and the selected remedy. Long-term ground water monitoring would be required for all alternatives. Alternative 3 does not involve excavation of contaminated soils at depth and would not permanently eliminate residual risk, requiring long-term control measures throughout the life of the alternative, estimated at 100 years.

Alternative 4 would reduce contamination in the silty sand unit through the in-situ biodegradation process. However, this alternative does not remove highly contaminated source soil areas from 6 feet below surface to the top of the upper confining layer. This would leave a large volume of contaminated soils as a source of chemicals of concern that could potentially leach into the ground water over time. Alternative 5 relies on ground water extraction to remove contaminants form the silty sand unit which would require a much longer period to reduce contaminant concentrations to acceptable levels. Alternative 5 would involve the excavation of 24,200 cubic yards of soil as opposed to 18,500 cubic yards for the selected remedy.

For these reasons, the selected alternative provides the best balance of trade-offs with respect to these criteria.

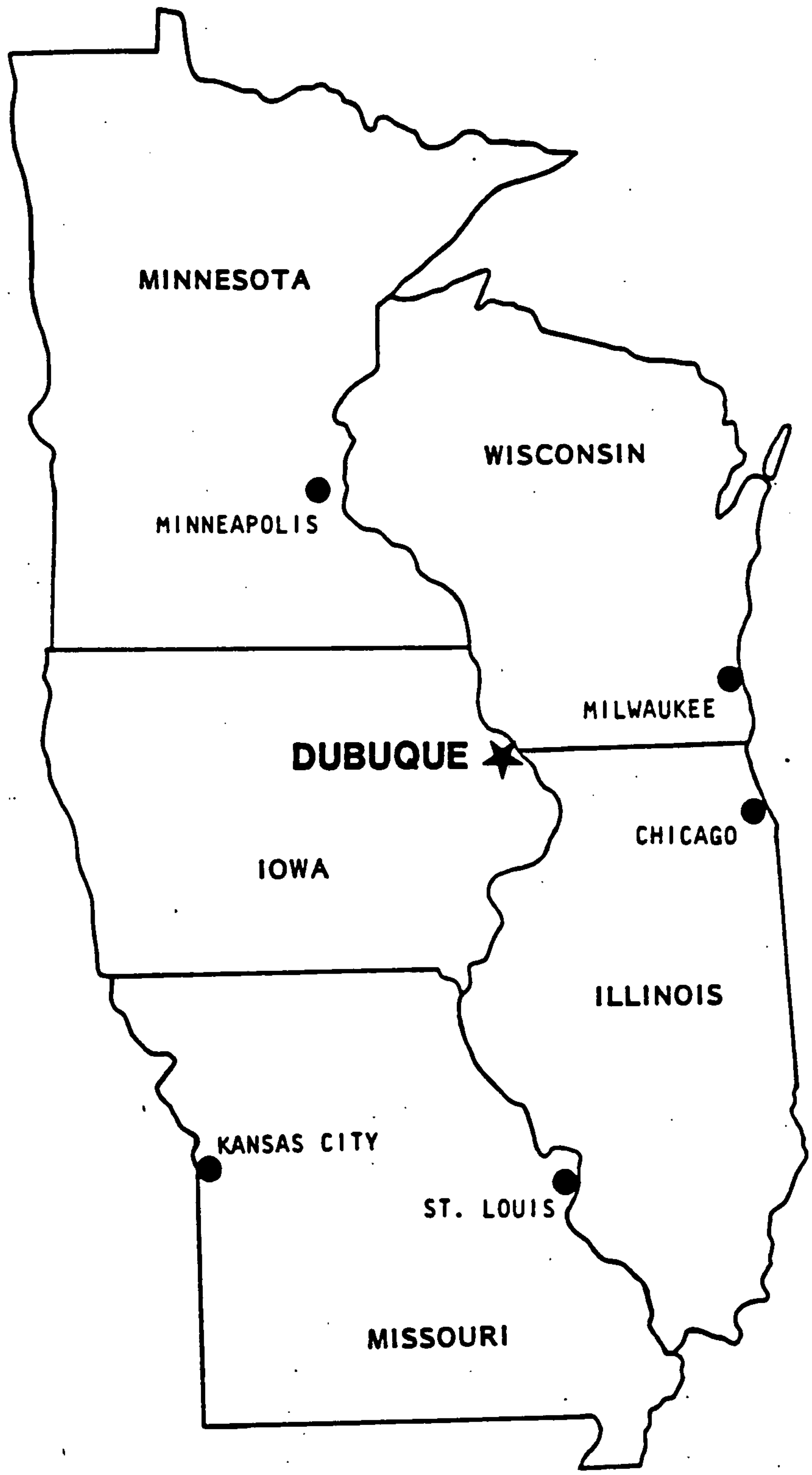
8.5 PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT

The selected remedy involves treatment of the contaminated soil and source areas by incineration. The ground water is treated by the City of Dubuque POTW or by other technologies yet to be determined. The unexcavated source areas will be treated by the in-situ enhance bioremediation process. Therefore, the statutory preference for remedies that employ treatment as a principal element is satisfied.

9.0 DOCUMENTATION OF SIGNIFICANT CHANGES

No significant changes were made in selecting the preferred alternative as described in the Proposed Plan.

FIGURES



POOR QUALITY ORIGINAL

Figure 1

LOCATION MAP

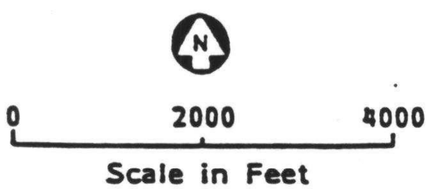


Figure 2

VICINITY MAP
PEOPLES NATURAL GAS SITE

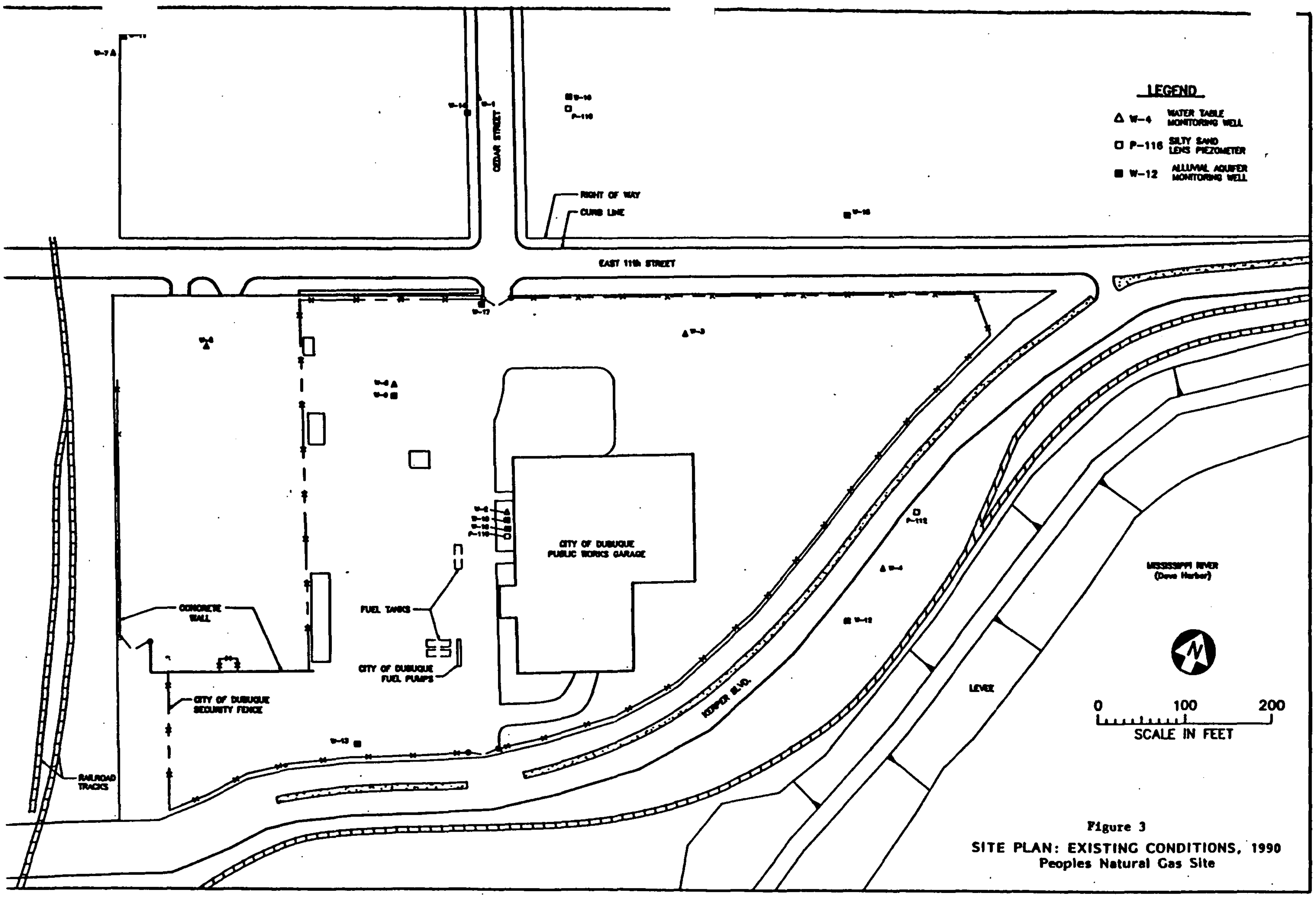


Figure 3

SITE PLAN: EXISTING CONDITIONS, 1990
Peoples Natural Gas Site

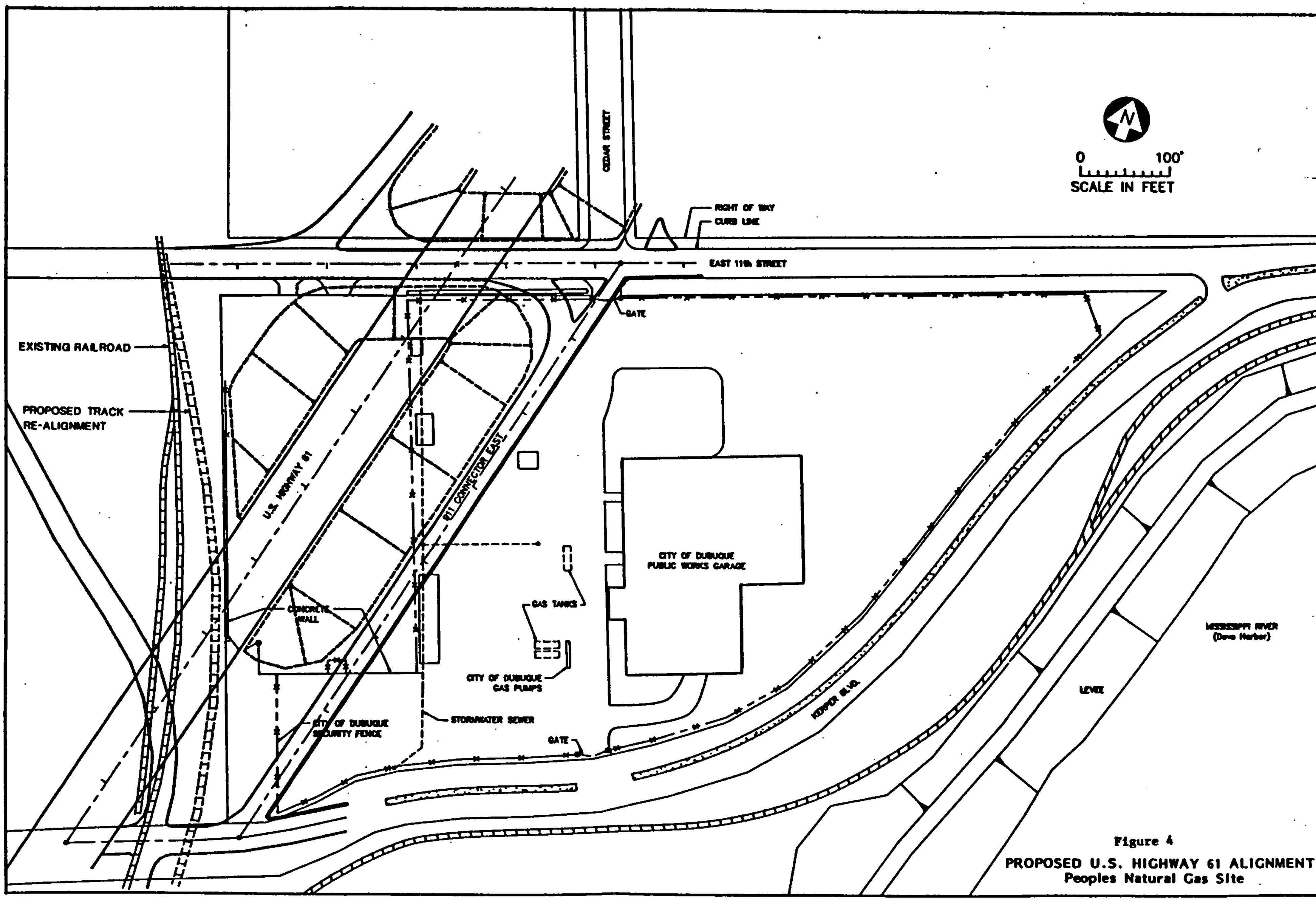


Figure 4

PROPOSED U.S. HIGHWAY 61 ALIGNMENT
Peoples Natural Gas Site

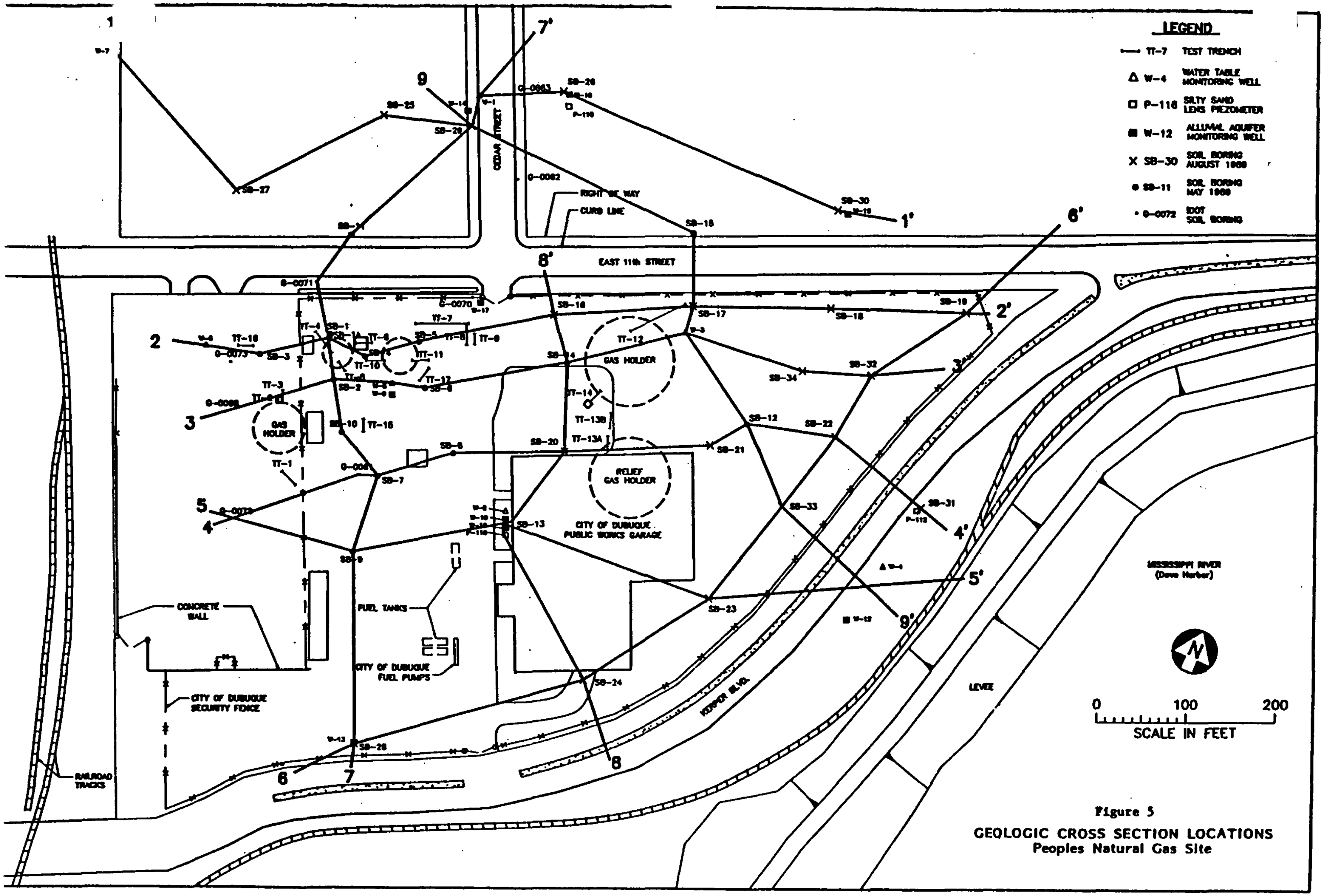


Figure 5

GEOLOGIC CROSS SECTION LOCATIONS
Peoples Natural Gas Site

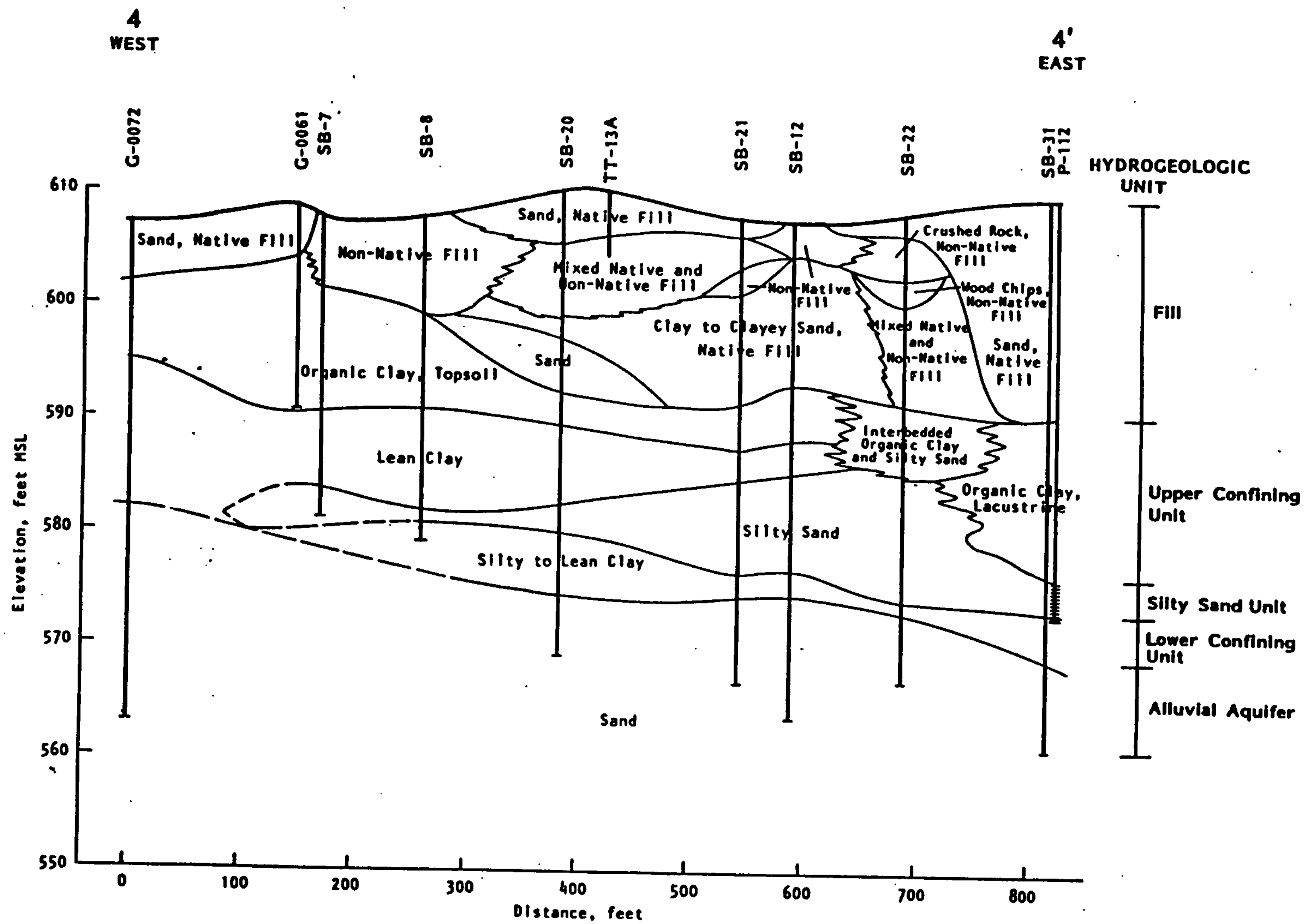


Figure 6

GEOLOGIC CROSS SECTION 4-4'
Peoples Natural Gas Site

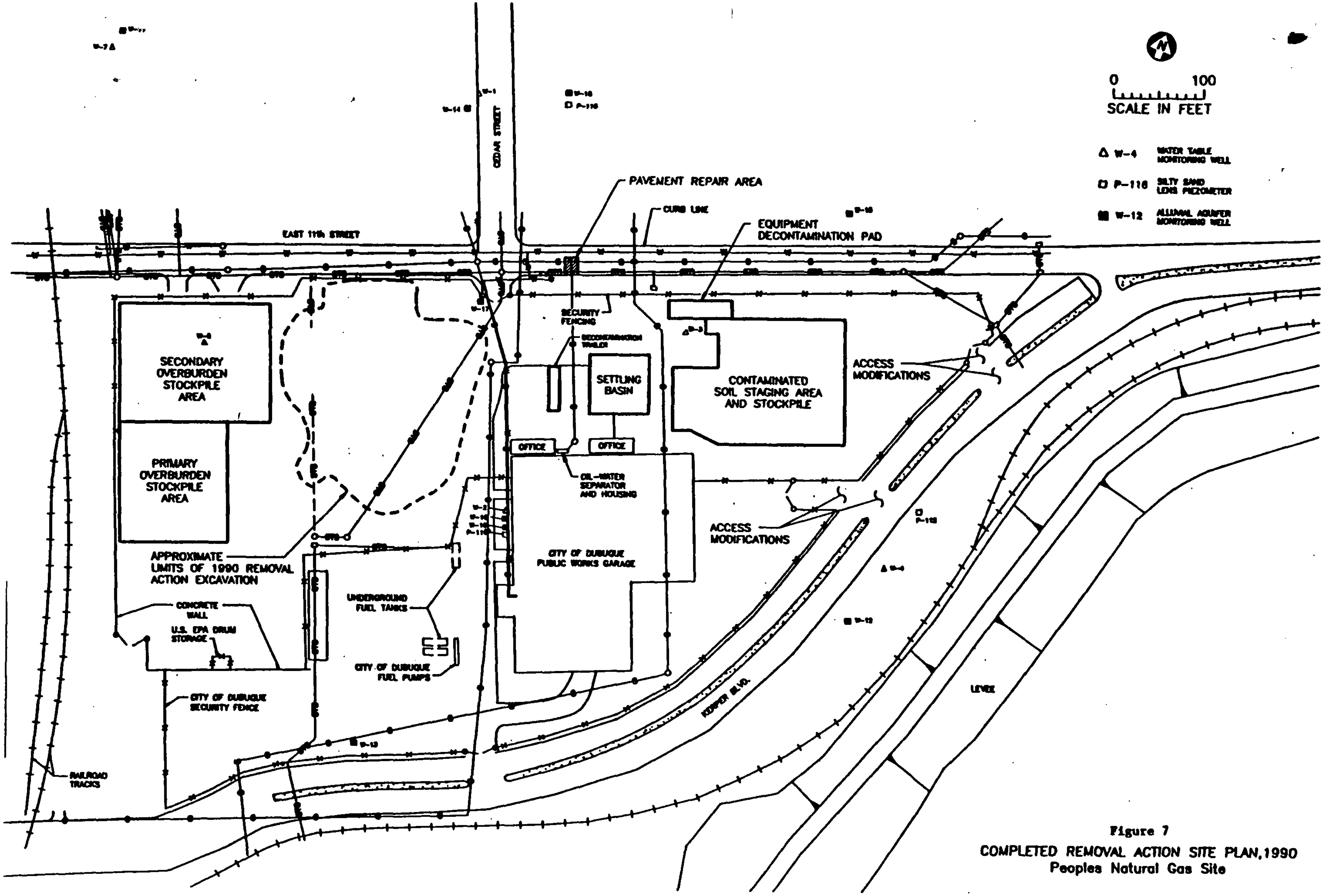


Figure 7

COMPLETED REMOVAL ACTION SITE PLAN, 1990
Peoples Natural Gas Site

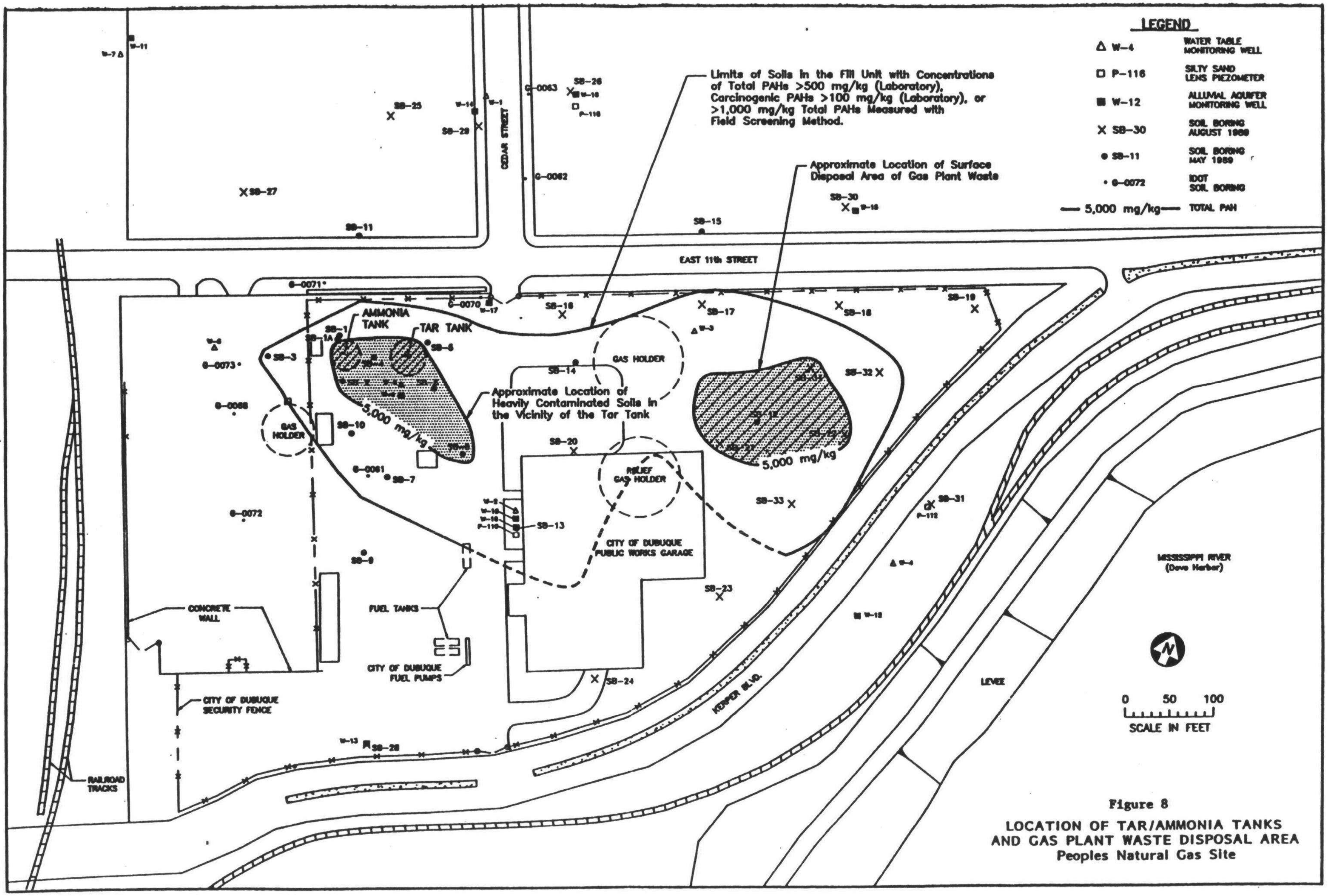


Figure 8

LOCATION OF TAR/AMMONIA TANKS AND GAS PLANT WASTE DISPOSAL AREA
Peoples Natural Gas Site

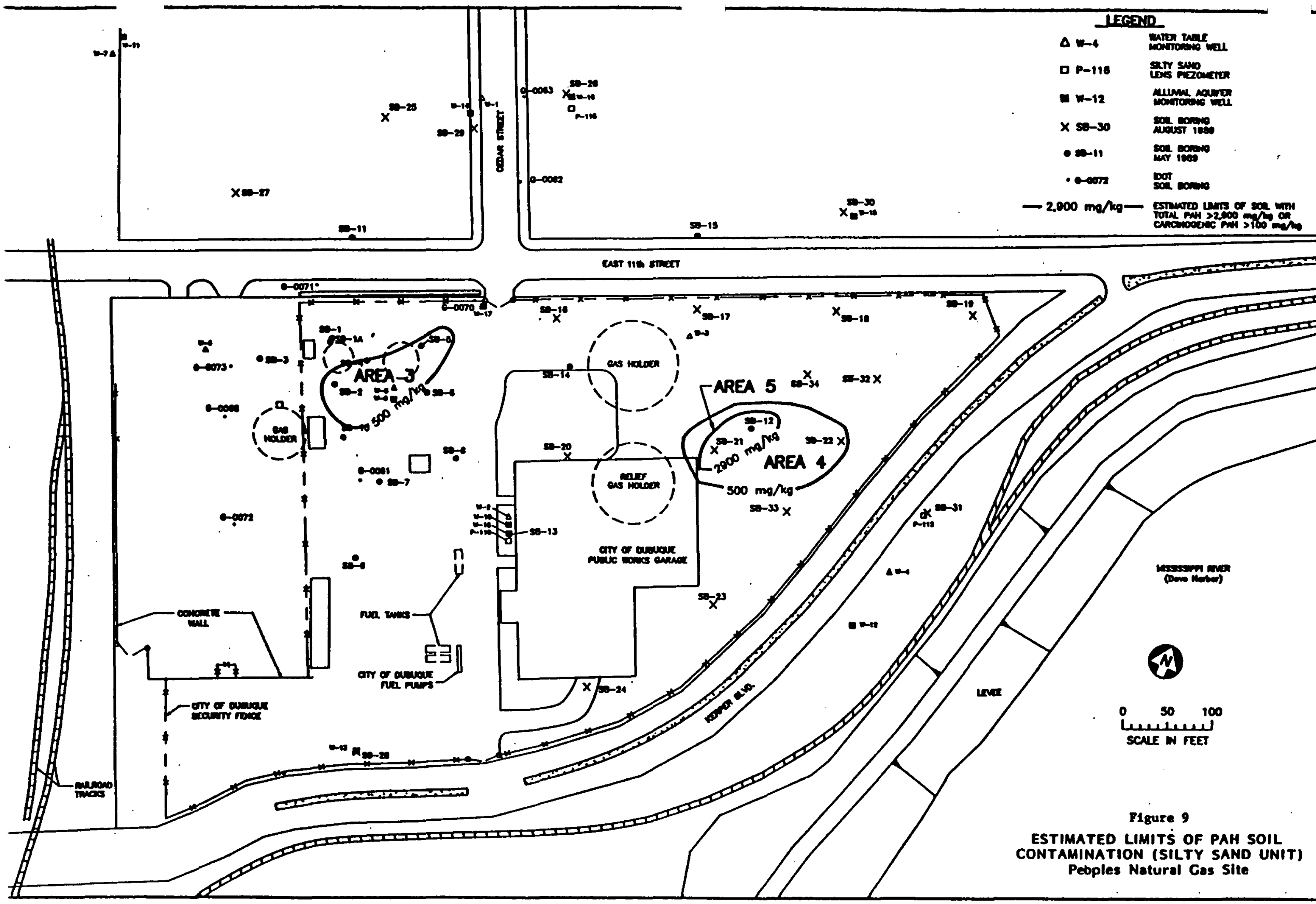


Figure 9

ESTIMATED LIMITS OF PAH SOIL CONTAMINATION (SILTY SAND UNIT)
Peoples Natural Gas Site

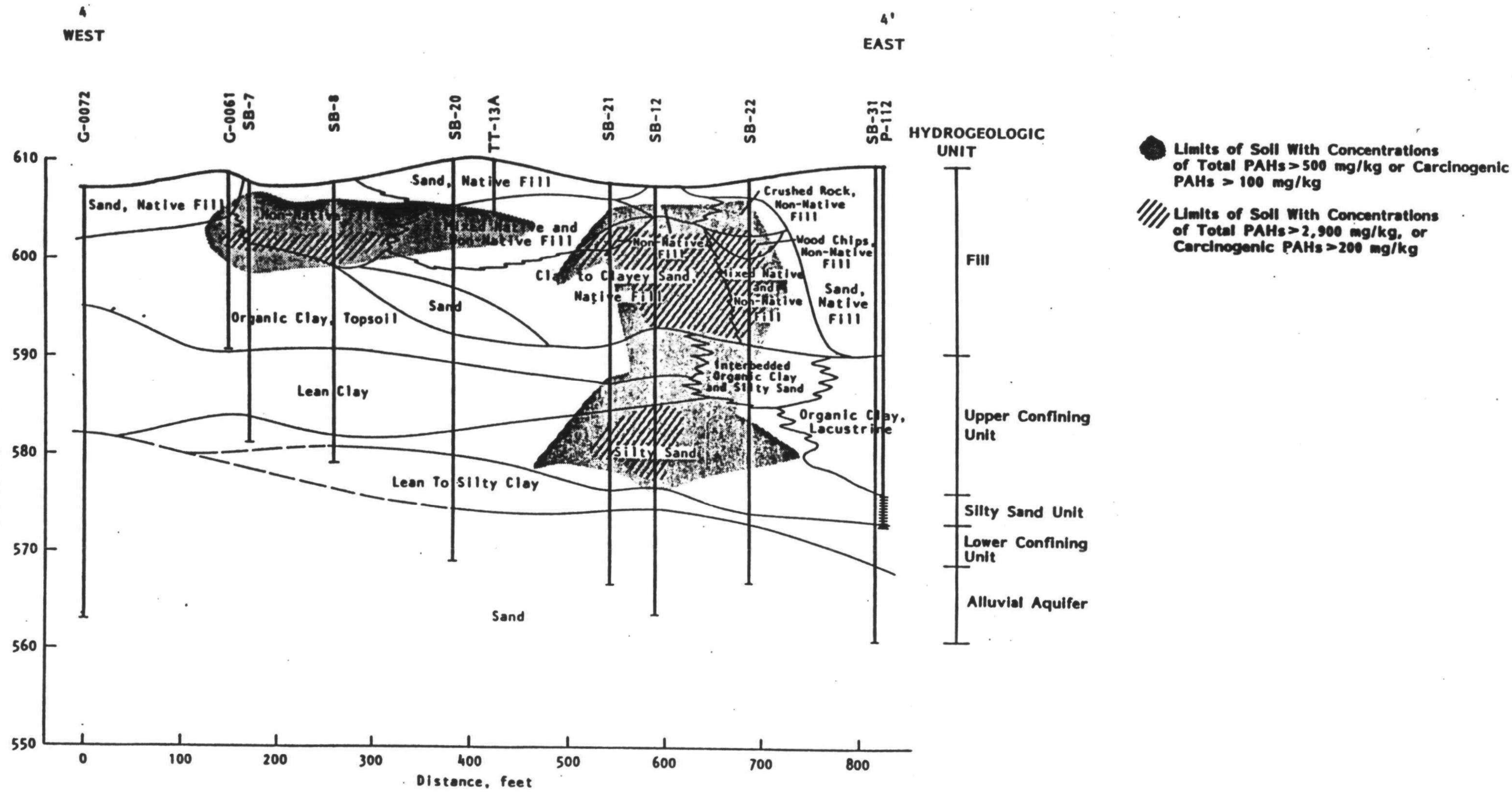


Figure 10

PAH CROSS SECTION 4-4'
Peoples Natural Gas Site

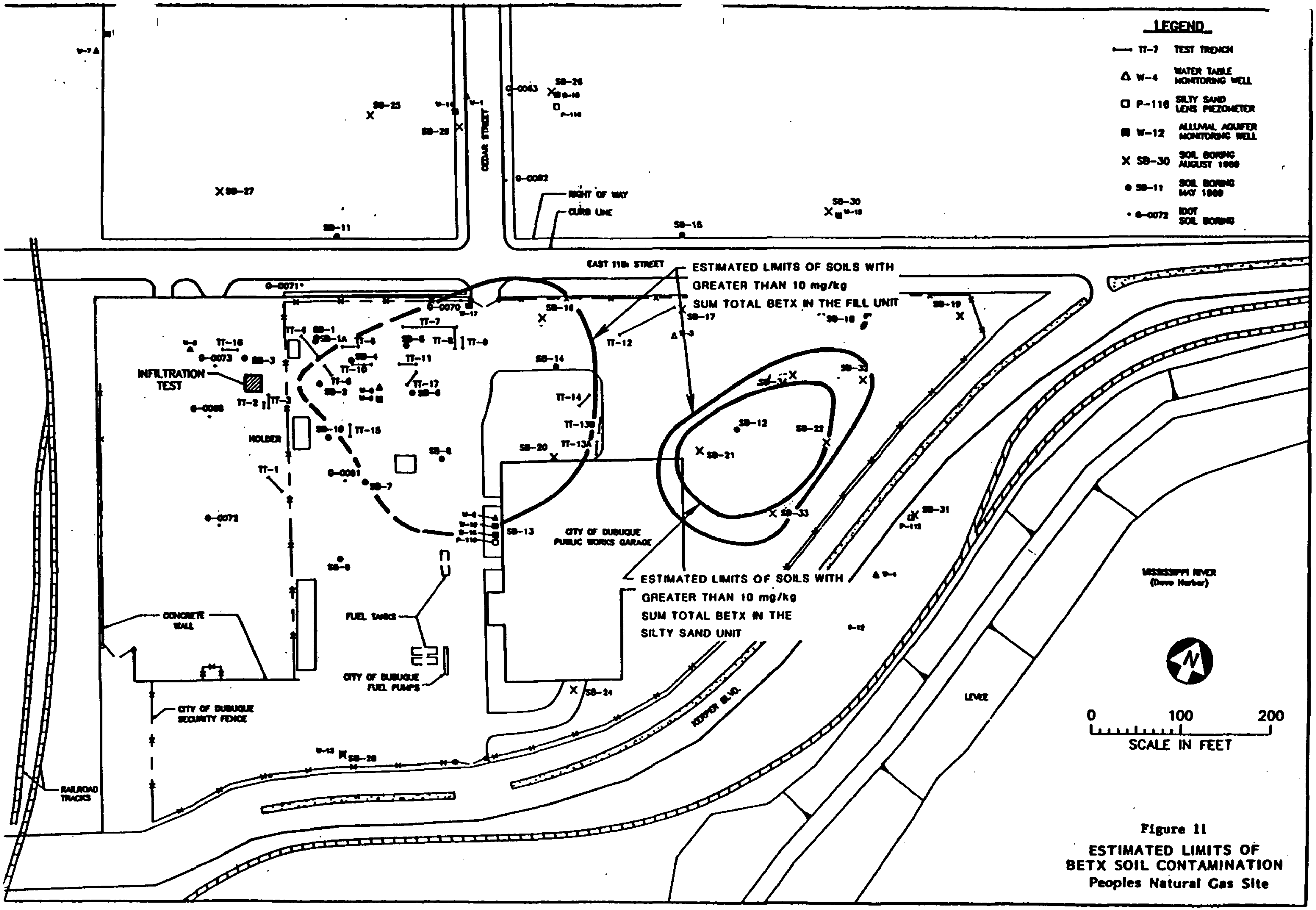


Figure 11

ESTIMATED LIMITS OF BETX SOIL CONTAMINATION
Peoples Natural Gas Site

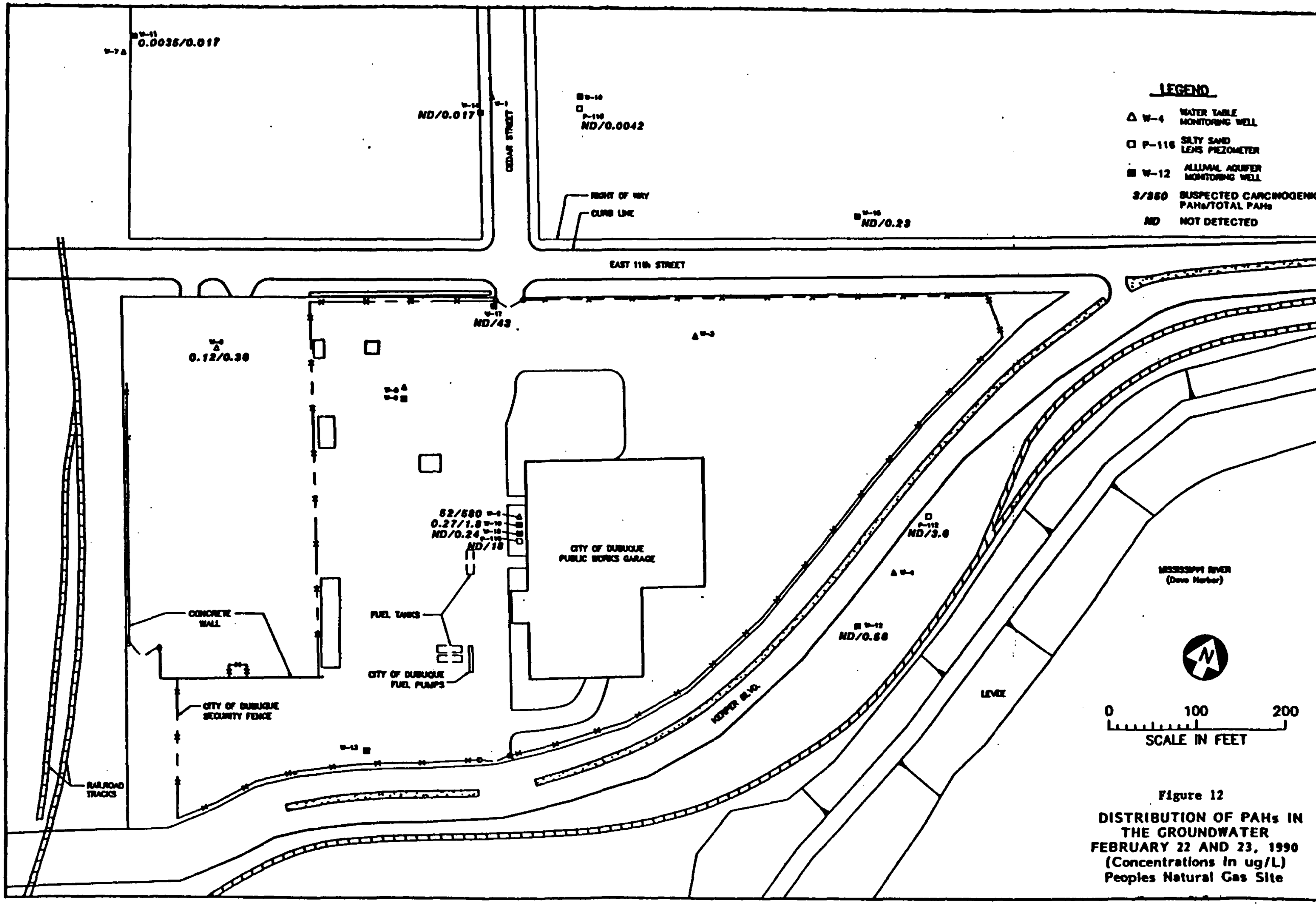


Figure 12

DISTRIBUTION OF PAHs IN THE GROUNDWATER
FEBRUARY 22 AND 23, 1990
(Concentrations in ug/L)
Peoples Natural Gas Site

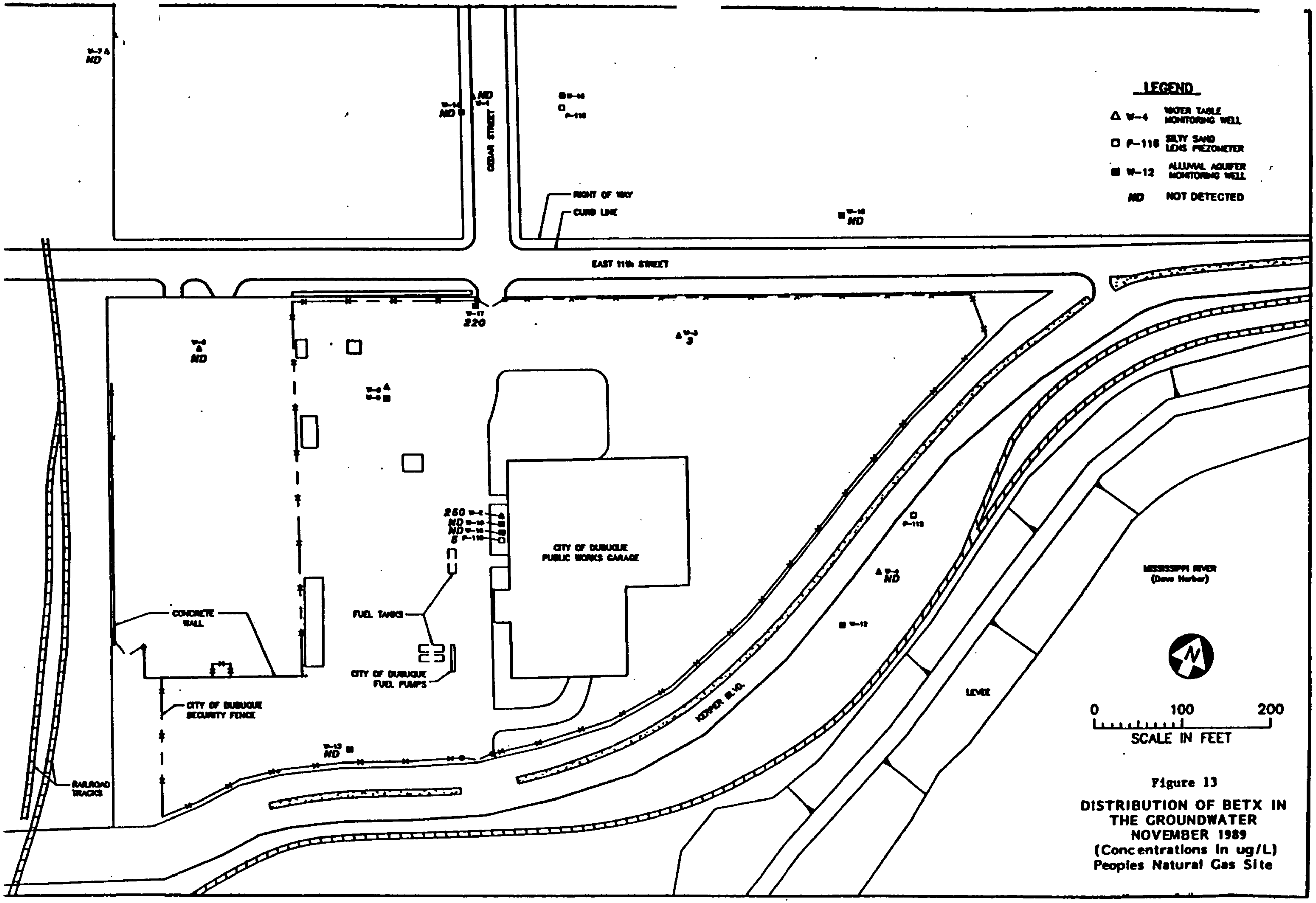


Figure 13

DISTRIBUTION OF BETX IN THE GROUNDWATER NOVEMBER 1989 (Concentrations in ug/L) Peoples Natural Gas Site

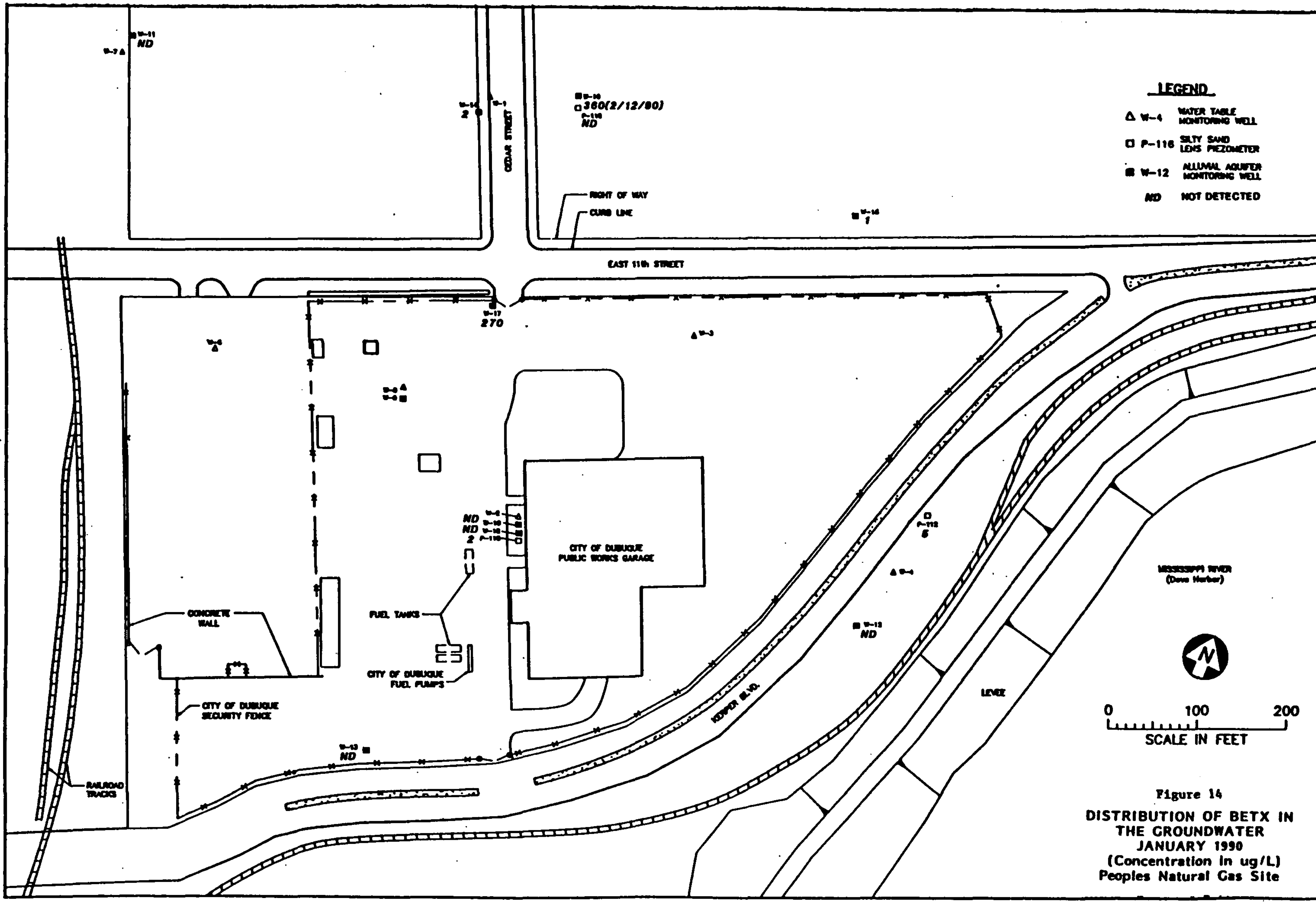


Figure 14

DISTRIBUTION OF BETX IN THE GROUNDWATER JANUARY 1990 (Concentration in ug/L) Peoples Natural Gas Site

TABLES

TABLE 1

SUMMARY OF MAXIMUM CONTAMINANT CONCENTRATIONS FOR WASTE DISPOSAL AREA

PEOPLES NATURAL GAS SITE
DUBUQUE, IOWA

Compound of Concern	WASTE DISPOSAL AREA			
	Boring 12* Soil	Boring 21 Soil	Boring 22 Soil	Boring 34 Soil
Total Carcinogenic PAHs (in mg/kg)	920	1800	240	44
Total PAHs (in mg/kg)	8,000	5,400	2,700	350
Sum of VOCs (in ppb)	140,000	98,000	560,000	14,000
Total Cyanides (in mg/kg)	870	41	1,100	38

Data Source: Barr Engineering Company, May 1991 (Table 2.1-2)
* Barr Engineering Company, January 1991 (Table 8)

PAHs - Polynuclear Aromatic Hydrocarbons
VOCs - Volatile Organic Compounds

TABLE 2

SUMMARY OF MAXIMUM CONTAMINANT CONCENTRATIONS IN GROUNDWATER

PEOPLES NATURAL GAS SITE
DUBUQUE, IOWA

(Concentration in ug/l)

COMPOUND OF CONCERN	WATER TABLE/UPPER CONFINING UNIT	ALLUVIAL AQUIFER					SILTY SAND AQUIFER
	Well W2	Well W8	Well W9	Well W12	Well W16	Well W17	Piezometer 112
Total Carcinogenic PAHs	52	350	ND	ND	ND	ND	ND
Total PAHs	580	9300	48	0.56	8	43	4
Sum of Volatile Organics (BETX)	250	7500	-	21	360	500	8100
Total Cyanides	620	4700j	18j	100	-	160	30

Data Source: Barr Engineering Company, May 1991 (Table 2.5-4, 2.5-6, 2.5-7)

BETX = Benzene, Ethyl Benzene, Toluene, Xylene
ND = Not detected
- = Not analyzed
j = Estimated Value

rodtbl-2.wk1

TABLE 3

(continued)

SUMMARY STATISTICS FOR ANALYTICAL DATA
DETECTED COMPOUNDS - SOIL
PEOPLES NATURAL GAS SITE
DUBUQUE, IOWA

PARAMETER	Positive/ Total	Range of Positives (ug/Kg)	Arithmetic Mean (ug/Kg)
VOLATILE ORGANIC COMPOUNDS			
Benzene	1 / 1	29 - 29	29
Ethyl Benzene	1 / 1	1,100 - 1,100	1,100
Toluene	1 / 1	140 - 140	140
Xylene	1 / 1	2,600 - 2,600	2,600
CYANIDE			
Cyanide	7 / 8	1,200 - 1,100,000	222,000
SOIL DATA BELOW 6 FEET			
BASE/NEUTRAL COMPOUNDS			
Acenaphthene	37 / 101	64 - 360,000	10,950
Acenaphthylene	35 / 101	53 - 2,500,000	40,866
Anthracene	34 / 101	51 - 1,300,000	21,677
Benzo(a)anthracene	32 / 101	46 - 610,000	10,224
Benzo(a)pyrene	25 / 101	52 - 360,000	6,573
Benzo(b)fluoranthene	20 / 101	60 - 290,000	6,644
Benzo(ghi)perylene	11 / 101	260 - 170,000	4,519
Benzo(k)fluoranthene	19 / 101	34 - 260,000	5,979
Chrysene	36 / 101	49 - 520,000	9,122
Dibenzo(ah)anthracene	3 / 101	800 - 3,200	7,474
Ideno(1,2,3,cd)pyrene	14 / 101	42 - 160,000	4,381
Fluoranthene	40 / 101	63 - 1,700,000	28,351
Fluorene	35 / 101	120 - 2,200,000	37,258
Phenanthrene	45 / 101	67 - 3,600,000	63,100
Pyrene	42 / 101	64 - 1,100,000	20,007
Naphthalene	56 / 101	74 - 7,700,000	134,039
2-Methylnaphthalene	47 / 101	58 - 3,400,000	67,888
Dibenzofuran	33 / 101	47 - 1,000,000	15,341

Data Source: Barr Engineering Company, May 1991 (Table 4.1-1)

Arithmetic means were calculated assuming a concentration of half the detection limit for compounds below the detection limit.

TABLE 3

SUMMARY STATISTICS FOR ANALYTICAL DATA
DETECTED COMPOUNDS - SOIL
PEOPLES NATURAL GAS SITE
DUBUQUE, IOWA

PARAMETER	Positive/ Total	Range of Positives (ug/Kg)	Arithmetic Mean (ug/Kg)
SOIL DATA 0-6 FEET			
BASE/NEUTRAL COMPOUNDS			
Acenaphthene	6 / 18	470 - 850,000	16,000
Acenaphthylene	14 / 18	200 - 380,000	42,474
Anthracene	15 / 18	190 - 360,000	36,152
Benzo(a)anthracene	16 / 18	70 - 240,000	34,521
Benzo(a)pyrene	14 / 18	150 - 420,000	39,641
Benzo(b)fluoranthene	13 / 18	990 - 310,000	35,567
Benzo(ghi)perylene	12 / 18	590 - 230,000	26,712
Benzo(k)fluoranthene	13 / 18	910 - 330,000	37,952
Chrysene	16 / 18	71 - 240,000	33,519
Dibenzo(ah)anthracene	9 / 18	190 - 64,000	12,976
Indeno(1,2,3,cd)pyrene	12 / 18	520 - 250,000	27,180
Fluoranthene	17 / 18	100 - 770,000	91,198
Fluorene	13 / 18	100 - 410,000	40,854
Phenanthrene	17 / 18	110 - 820,000	97,716
Pyrene	17 / 18	66 - 480,000	67,318
Naphthalene	16 / 18	79 - 2,800,000	283,884
2-Methylnaphthalene	10 / 18	210 - 720,000	89,599
Dibenzofuran	11 / 18	200 - 230,000	23,235
Benzo(e)pyrene	1 / 1	5,000 - 5,000	5,000
Carbozole	1 / 1	370 - 370	370
Indene	1 / 1	770 - 770	770
Perylene	1 / 1	1,700 - 1,700	1,700
Triphenylene	1 / 1	4,700 - 4,700	4,700
Bis(2-ethylhexyl)phthalate	2 / 9	140 - 160	19,753
Di-n-butyl phthalate	1 / 9	41 - 41	19,802
PHENOLS			
Benzoic acid	1 / 9	140 - 140	94,321

Data Source: Barr Engineering Company, May 1991 (Table 4.1-1)

Arithmetic means were calculated assuming a concentration of half the detection limit for compounds below the detection limit.

TABLE 4

SUMMARY STATISTICS FOR ANALYTICAL DATA
DETECTED COMPOUNDS - GROUNDWATER
PEOPLES NATURAL GAS SITE
DUBUQUE, IOWA

PARAMETER	Positive / Total	Range of Positives (ug/Kg)	Arithmetic Mean (ug/Kg)
BASE/NEUTRAL COMPOUNDS			
2,3-Benzofuran	8 / 22	0.0054 - 8	1.08
2,3-Dihydroindene	14 / 22	0.0021 - 18	2.2
Indene	17 / 22	0.0064 - 33	4.42
Naphthalene	26 / 68	0.0052 - 5,800	207.14
Benzo(b)Thiophene	13 / 22	0.0064 - 22	3.04
Quinoline	2 / 22	3 - 4	0.74
Isoquinoline	3 / 22	2 - 18	1.64
2-Methylnaphthalene	12 / 68	0.0023 - 830	17.13
1-Methylnaphthalene	16 / 22	0.0012 - 22	3.23
Biphenyl	10 / 22	0.0012 - 39	2.52
Acenaphthylene	11 / 68	0.043 - 630	15.73
Acenaphthene	26 / 68	0.0028 - 380	19.21
Dibenzofuran	11 / 68	0.033 - 200	13.52
Fluorene	13 / 67	0.0045 - 300	12.96
Dibenzothiophene	5 / 22	0.0069 - 13	1.14
Phenanthrene	18 / 68	0.0037 - 520	19.57
Anthracene	11 / 68	0.0016 - 180	9.09
Carbozole	9 / 22	0.0024 - 65	4.49
Fluoranthene	16 / 68	0.0036 - 220	11.56
Pyrene	16 / 68	0.0028 - 170	10.08
Triphenylene	7 / 22	0.0011 - 9	0.93
Benzo(e)pyrene	3 / 22	0.02 - 5	0.79
Perylene	2 / 22	0.0049 - 2	0.65
Benzo(ghi)perylene	2 / 68	0.028 - 5	7.61
Bis(2-ethylhexyl)phthalate	8 / 27	1 - 1,100	56.67
Benzo(a)anthracene	8 / 68	0.017 - 100	7.66
Chrysene	8 / 68	0.0011 - 78	7.33
Benzo(b)fluoranthene	6 / 68	0.0024 - 92	7.65
Benzo(k)fluoranthene	5 / 68	0.0024 - 15	7.77
Benzo(a)pyrene	4 / 68	0.026 75	7.26
Ideno(1,2,3,cd)pyrene	3 / 68	0.019 6	7.61

Data Source: Barr Engineering Company, May 1991 (Table 4.1-1)

Arithmetic means were calculated assuming a concentration of half the detection limit for compounds below the detection limit.

TABLE 3

(continued)

SUMMARY STATISTICS FOR ANALYTICAL DATA
DETECTED COMPOUNDS - SOIL
PEOPLES NATURAL GAS SITE
DUBUQUE, IOWA

PARAMETER	Positive/ Total	Range of Positives (ug/Kg)	Arithmetic Mean (ug/Kg)
Methylnaphthalene	4 / 4	80 - 49,000	9,926
2,3-Dihydroindene	1 / 1	180 - 180	3,944
Benzo(b)thiophene	2 / 2	210 - 700	3,758
Biphenyl	1 / 6	1,200 - 1,200	3,843
Dibenzothiophene	1 / 6	1,500 - 1,500	3,893
Indene	4 / 6	100 - 35,000	6,578
Isoquinoline	2 / 6	61 - 62	3,901
Triphenylene	1 / 6	1,200 - 1,200	3,843
Bis(2-ethylhexyl)phthalate	11 / 40	46 - 610	14,834
Butyl benzyl phthalate	5 / 40	66 - 410	14,831
Diethyl phthalate	7 / 40	130 - 89,000	16,365
Di-n-butyl phthalate	1 / 40	38 - 38	14,851
PHENOLS			
2,4-Dimethylphenol	23 / 101	170 - 270,000	10,248
4-Chloro-m-cresol	1 / 47	2,100 - 2,100	13,167
o-Cresol	8 / 47	250 - 55,000	13,521
p-Cresol	8 / 47	770 - 160,000	16,194
Phenol	2 / 101	200 - 13,000	7,705
VOLATILE ORGANIC COMPOUNDS			
Benzene	24 / 43	1 - 55,000	1,839
Ethyl Benzene	21 / 43	2 - 110,000	3,149
Toluene	15 / 43	2 - 29,000	2,255
Xylene	22 / 43	5 - 390,000	11,138
CYANIDE			
Cyanide	8 / 27	1,000 - 48,000	4,600

Data Source: Barr Engineering Company, May 1991 (Table 4.1-1)

Arithmetic means were calculated assuming a concentration of half the detection limit for compounds below the detection limit.

TABLE 5

REMEDIATION LEVELS IN GROUNDWATER
PEOPLES NATURAL GAS SITE
DUBUQUE, IOWA

Contaminant	Remediation Level (ppb)	Standard/Detection Limit
Benzene	1	Negligible Cancer Risk Level
Ethylbenzene	700	Lifetime Health Advisory Level
Toluene	2,000	Lifetime Health Advisory Level
Xylene	10,000	Lifetime Health Advisory Level
Naphthalene	20	Lifetime Health Advisory Level
Benzo(a)pyrene	0.2	Practical Detection Limit
Benzo(a)anthracene	0.1	Practical Detection Limit
Benzo(b)fluoranthene	0.2	Practical Detection Limit
Benzo(k)fluoranthene	0.2	Practical Detection Limit
Chrysene	0.2	Practical Detection Limit
Dibenz(a,h)anthracene	0.2	Practical Detection Limit
Indenopyrene	0.4	Practical Detection Limit

TABLE 4
(continued)

SUMMARY STATISTICS FOR ANALYTICAL DATA
DETECTED COMPOUNDS - GROUNDWATER

PEOPLES NATURAL GAS SITE

DUBUQUE, IOWA

PARAMETER	Positive / Total	Range of Positives (ug/Kg)	Arithmetic Mean (ug/Kg)
PHENOLS			
Phenol	4 / 46	5 9,800	231
2,4-Dimethylphenol	8 / 41	4 - 25,000	634
VOLATILE ORGANIC COMPOUNDS			
Benzene	19 / 59	1 - 4,400	175
Ethyl Benzene	11 / 59	3 - 1,500	34
Toluene	11 / 59	1 - 2,000	63
Xylene	15 / 59	1 - 5,000	117
CYANIDE			
Cyanide	33 / 41	10 - 4,700	373

Data Source: Barr Engineering Company, May 1991 (Table 4.1-1)

Arithmetic means were calculated assuming a concentration of half the detection limit for compounds below the detection limit.

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CALCULATED INCREMENTAL LIFETIME CANCER RISKS AND GLOBAL HAZARD INDICES

BASELINE ENDANGERMENT ASSESSMENT
PEOPLES' NATURAL GAS SITE
DUBUQUE, IOWA

RISKS/HAZARD INDICES

Exposure Scenario	RECEPTOR			
	Municipal Worker	Local Resident (Adult)	Construction Worker	Local Resident (Child)
CARCINOGENIC RISKS				
VOC Inhalation During Excavation Activities			9.69E-10	
VOC Inhalation During Routine Activities	1.17E-07	5.64E-10		2.85E-09
Ingestion of On-Site (Alluvial Zone) Groundwater		1.70E-04		5.83E-05
Ingestion of Site Soils	1.09E-02	8.83E-04	3.40E-05	1.20E-03
Dermal Contact with Site Soils	2.92E-06	5.47E-08	4.10E-08	2.50E-04
Incremental Lifetime Cancer Risks	1.09E-02	1.05E-03	3.40E-05	1.51E-03
NONCARCINOGENIC HAZARDS				
VOC Inhalation During Excavation Activities			ND	
VOC Inhalation During Routine Activities	ND	ND		ND
Ingestion of On-Site (Alluvial Zone) Groundwater		2.27E-01		2.34E-01
Ingestion of Site Soils	1.40E-01	3.51E-03	6.12E-02	6.26E-02
Dermal Contact with Site Soils	9.68E-01	2.42E-02	9.17E-01	6.26E-02
Global Hazard Index	1.11E+00	2.55E-01	9.78E-01	3.59E-01

Data Source: Barr Engineering Company, May 1991 (Table 4.6-1)

TABLE 6

INDICATOR COMPOUNDS USED FOR RISK ASSESSMENT CALCULATIONS
PEOPLES NATURAL GAS SITE
DUBUQUE, IOWA

CARCINOGENIC INDICATOR COMPOUNDS

- Benzene
- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Benzo(k)fluoranthene
- Chrysene
- Dibenzo(a,h)anthracene
- Indeno(1,2,3-c,d)Pyrene

NONCARCINOGENIC INDICATOR COMPOUNDS

- Fluorene
- Fluoranthene
- Pyrene
- Acenaphthene
- Anthracene
- Naphthalene
- Cyanide

Reference: Barr Engineering Company, May 1991

TABLE 8

CARCINOGENIC RISKS

RESIDENTIAL EXPOSURE INGESTION OF CHEMICALS IN SOIL BY CHILDREN
PEOPLES NATURAL GAS SITE
DUBUQUE, IOWA

CONTAMINANT	CS* (MG/KG)	IR (MG/DAY)	CF (10-6 KG/MG)	FI (UNITLESS)	EF (EVENTS/YR)	ED (YRS)	BW (KG)	AT (DAYS)	INTAKE (MG/KG-DAY)	CPF** (MG/KG-DAY)-1	RISK
AVERAGE CASE											
BENZENE	7.1	200	1.0E-06	1	26	10	34	25550	4.25E-07	0.0292	1.24E-08
BENZO(a)ANTHRACENE	58	200	1.0E-06	0.95	26	10	34	25550	3.30E-06	11.5	3.79E-05
BENZO(a)PYRENE	82	200	1.0E-06	0.95	26	10	34	25550	4.66E-06	11.5	5.36E-05
BENZO(b)FLUORANTHENE	64	200	1.0E-06	0.95	26	10	34	25550	3.64E-06	11.5	4.19E-05
BENZO(K)FLUORANTHENE	63	200	1.0E-06	0.95	26	10	34	25550	3.58E-06	11.5	4.12E-05
CHRYSENE	57	200	1.0E-06	0.95	26	10	34	25550	3.24E-06	11.5	3.73E-05
DIBENZO(A,H)ANTHRACENE	15	200	1.0E-06	0.95	26	10	34	25550	8.53E-07	11.5	9.81E-06
INDENO(1,2,3-c,d)PYRENE	43	200	1.0E-06	0.95	26	10	34	25550	2.45E-06	11.5	2.81E-05
									TOTAL CARCINOGENIC RISK		2.50E-04
UPPER BOUND											
BENZENE	55	200	1.0E-06	1	26	10	34	25550	3.29E-06	0.0292	9.61E-08
BENZO(a)ANTHRACENE	240	200	1.0E-06	0.95	26	10	34	25550	1.36E-05	11.5	1.57E-04
BENZO(a)PYRENE	420	200	1.0E-06	0.95	26	10	34	25550	2.39E-05	11.5	2.75E-04
BENZO(b)FLUORANTHENE	310	200	1.0E-06	0.95	26	10	34	25550	1.76E-05	11.5	2.03E-04
BENZO(K)FLUORANTHENE	330	200	1.0E-06	0.95	26	10	34	25550	1.88E-05	11.5	2.16E-04
CHRYSENE	240	200	1.0E-06	0.95	26	10	34	25550	1.36E-05	11.5	1.57E-04
DIBENZO(A,H)ANTHRACENE	64	200	1.0E-06	0.95	26	10	34	25550	3.64E-06	11.5	4.19E-05
INDENO(1,2,3-c,d)PYRENE	250	200	1.0E-06	0.95	26	10	34	25550	1.42E-05	11.5	1.63E-04
									TOTAL CARCINOGENIC RISK		1.21E-03

Data Source: Barr Engineering Company, May 1991

* BASED ON ARITHMETIC MEAN OR MAXIMUM CONCENTRATION FROM BARR ENGINEERING COMPANY (TABLE 4.4-3)

**CPF FOR CARCINOGENIC PAHs BASED ON THE CPF FOR B(a)P. ND=NOT DETERMINED

LIST OF ACRONYMS

PEOPLES NATURAL GAS SITE
DUBUQUE, IOWA

TABLES 8, 9, 10, AND 11

AT	-	Averaging Time (ED years x 365 days/year; days)
BW	-	Body Weight (kg)
CF	-	Conversion Factor
CPF	-	Cancer Potency Factor (mg/kg/day)-1
CS	-	Chemical Concentration in Soil (mg/kg)
ED	-	Exposure Duration (years)
EF	-	Exposure Frequency (days/yr; events/yr)
FI	-	Fraction Ingested (unitless)
IR	-	Ingestion Rate (L/day)
RfD	-	Reference Dose (mg/kg/day)

TABLE 10

CARCINOGENIC RISKS

INGESTION OF CHEMICALS IN SOIL FOR MUNICIPAL GARAGE WORKERS
PEOPLES NATURAL GAS SITE
DUBUQUE, IOWA

CONTAMINANT	CS* (MG/KG)	IR (MG/DAY)	CF (10-6 KG/MG)	FI (UNITLESS)	EF (EVENTS/YR)	ED (YRS)	BW (KG)	AT (DAYS)	INTAKE (MG/KG-DAY)	CPF** (MG/KG-DAY)-1	RISK
AVERAGE CASE											
BENZENE	7.1	100	1.0E-06	1	240	40	70	25550	3.81E-06	0.0292	1.11E-07
BENZO(a)ANTHRACENE	58	100	1.0E-06	0.95	240	40	70	25550	2.96E-05	11.5	3.40E-04
BENZO(a)PYRENE	82	100	1.0E-06	0.95	240	40	70	25550	4.18E-05	11.5	4.81E-04
BENZO(b)FLUORANTHENE	64	100	1.0E-06	0.95	240	40	70	25550	3.26E-05	11.5	3.75E-04
BENZO(K)FLUORANTHENE	63	100	1.0E-06	0.95	240	40	70	25550	3.21E-05	11.5	3.69E-04
CHRYSENE	57	100	1.0E-06	0.95	240	40	70	25550	2.91E-05	11.5	3.34E-04
DIBENZO(A,H)ANTHRACENE	15	100	1.0E-06	0.95	240	40	70	25550	7.65E-06	11.5	8.80E-05
INDENO(1,2,3-c,d)PYRENE	43	100	1.0E-06	0.95	240	40	70	25550	2.19E-05	11.5	2.52E-04
										TOTAL CARCINOGENIC RISK	2.24E-03
UPPER BOUND											
BENZENE	55	100	1.0E-06	1	240	40	70	25550	2.95E-05	0.0292	8.62E-07
BENZO(a)ANTHRACENE	240	100	1.0E-06	0.95	240	40	70	25550	1.22E-04	11.5	1.41E-03
BENZO(a)PYRENE	420	100	1.0E-06	0.95	240	40	70	25550	2.14E-04	11.5	2.46E-03
BENZO(b)FLUORANTHENE	310	100	1.0E-06	0.95	240	40	70	25550	1.58E-04	11.5	1.82E-03
BENZO(K)FLUORANTHENE	330	100	1.0E-06	0.95	240	40	70	25550	1.68E-04	11.5	1.94E-03
CHRYSENE	240	100	1.0E-06	0.95	240	40	70	25550	1.22E-04	11.5	1.41E-03
DIBENZO(A,H)ANTHRACENE	64	100	1.0E-06	0.95	240	40	70	25550	3.26E-05	11.5	3.75E-04
INDENO(1,2,3-c,d)PYRENE	250	100	1.0E-06	0.95	240	40	70	25550	1.27E-04	11.5	1.47E-03
										TOTAL CARCINOGENIC RISK	1.09E-02

Data Source: Barr Engineering Company, May 1991

* BASED ON ARITHMETIC MEAN OR MAXIMUM CONCENTRATION FROM BARR ENGINEERING COMPANY, MAY 1991 (TABLE 4.4-3)
**CPF FOR CARCINOGENIC PAHs BASED ON THE CPF FOR B(a)P. ND=NOT DETERMINED

TABLE 9

CARCINOGENIC RISKS

RESIDENTIAL EXPOSURE INGESTION OF CHEMICALS IN SOIL BY ADULTS
PEOPLES NATURAL GAS SITE
DUBUQUE, IOWA

CONTAMINANT	CS* (MG/KG)	IR (MG/DAY)	CF (10-6 KG/MG)	FI (UNITLESS)	EF (EVENTS/YR)	ED (YRS)	BW (KG)	AT (DAYS)	INTAKE (MG/KG-DAY)	CPF** (MG/KG-DAY)-1	RISK
AVERAGE CASE											
BENZENE	7.1	100	1.0E-06	1	6	30	70	25550	7.15E-08	0.0292	2.09E-09
BENZO(a)ANTHRACENE	58	100	1.0E-06	0.95	6	30	70	25550	5.55E-07	11.5	6.38E-06
BENZO(a)PYRENE	82	100	1.0E-06	0.95	6	30	70	25550	7.84E-07	11.5	9.02E-06
BENZO(b)FLUORANTHENE	64	100	1.0E-06	0.95	6	30	70	25550	6.12E-07	11.5	7.04E-06
BENZO(K)FLUORANTHENE	63	100	1.0E-06	0.95	6	30	70	25550	6.02E-07	11.5	6.93E-06
CHRYSENE	57	100	1.0E-06	0.95	6	30	70	25550	5.45E-07	11.5	6.27E-06
DIBENZO(A,H)ANTHRACENE	15	100	1.0E-06	0.95	6	30	70	25550	1.43E-07	11.5	1.65E-06
INDENO(1,2,3-c,d)PYRENE	43	100	1.0E-06	0.95	6	30	70	25550	4.11E-07	11.5	4.73E-06
									TOTAL CARCINOGENIC RISK		4.20E-05
UPPER BOUND											
BENZENE	55	100	1.0E-06	1	6	30	70	25550	5.54E-07	0.0292	1.62E-08
BENZO(a)ANTHRACENE	240	100	1.0E-06	0.95	6	30	70	25550	2.29E-06	11.5	2.64E-05
BENZO(a)PYRENE	420	100	1.0E-06	0.95	6	30	70	25550	4.02E-06	11.5	4.62E-05
BENZO(b)FLUORANTHENE	310	100	1.0E-06	0.95	6	30	70	25550	2.96E-06	11.5	3.41E-05
BENZO(K)FLUORANTHENE	330	100	1.0E-06	0.95	6	30	70	25550	3.16E-06	11.5	3.63E-05
CHRYSENE	240	100	1.0E-06	0.95	6	30	70	25550	2.29E-06	11.5	2.64E-05
DIBENZO(A,H)ANTHRACENE	64	100	1.0E-06	0.95	6	30	70	25550	6.12E-07	11.5	7.04E-06
INDENO(1,2,3-c,d)PYRENE	250	100	1.0E-06	0.95	6	30	70	25550	2.39E-06	11.5	2.75E-05
									TOTAL CARCINOGENIC RISK		2.04E-04

Data Source: Barr Engineering Company, May 1991

* BASED ON ARITHMETIC MEAN OR MAXIMUM CONCENTRATION FROM BARR ENGINEERING COMPANY, MAY 1991 (TABLE 4.4-3)
**CPF FOR CARCINOGENIC PAHs BASED ON THE CPF FOR B(a)P. ND=NOT DETERMINED

TABLE 12

GROUND WATER RESULTS FOR RISK ASSESSMENT PURPOSES
PEOPLES NATURAL GAS SITE
DUBUQUE, IOWA

CHEMICAL	HIGHEST CONCENTRATION FOR ALL SAMPLING ROUNDS/ALL WELLS (UG/L)*			
	WATER TABLE WELLS (W1 THRU W7)	WELL NO.	ALLUVIAL AQUIFER WELLS (W10 THRU W15, W17, W18)	WELL NO.
BENZENE	230	W2	410	W17
BENZO(A)ANTHRACENE	0.045	W6	0.12	W10
BENZO(A)PYRENE	ND		0.026	W10
BENZO(B)FLUORANTHENE	ND		ND	
BENZO(K)FLUORANTHENE	ND		ND	
CHRYSENE	ND		ND	
DIBENZO(A,H)ANTHRACENE	ND		ND	
INDENO(1,2,3-C,D)PYRENE	ND		0.019	W10
FLUORENE	130	W2	0.051	W10
FLUORANTHENE	110	W2	0.61	W10
PYRENE	86	W2	0.47	W10
ACENAPHTHENE	380	W2	9	W17
ANTHRACENE	23	W2	0.035	W10
NAPHTHALENE	5100	W2	31	W17
CYANIDE	1.3	W4	0.16	W17

DATA SOURCE: BARR ENGINEERING COMPANY, MAY 1991
SEMIVOLATILE ORGANIC COMPOUNDS TABLE 2.5-4
VOLATILE ORGANIC COMPOUNDS TABLE 2.5-6
INORGANIC COMPOUNDS TABLE 2.5-7

ND - NOT DETECTED ABOVE QUANTITATION LIMIT OR WITHOUT A DATA QUALIFIER

TABLE 11

CARCINOGENIC RISKS

INGESTION OF CHEMICALS IN SOIL FOR CONSTRUCTION WORKERS
PEOPLES NATURAL GAS SITE
DUBUQUE, IOWA

CONTAMINANT	CS* (MG/KG)	IR (MG/DAY)	CF (10-6 KG/MG)	FI (UNITLESS)	EF (EVENTS/YR)	ED (YRS)	BW (KG)	AT (DAYS)	INTAKE (MG/KG-DAY)	CPF** (MG/KG-DAY)-1	RISK
AVERAGE CASE											
BENZENE	7.1	100	1.0E-06	1	30	1	70	25550	1.19E-08	0.0292	3.48E-10
BENZO(a)ANTHRACENE	58	100	1.0E-06	0.95	30	1	70	25550	9.24E-08	11.5	1.06E-06
BENZO(a)PYRENE	82	100	1.0E-06	0.95	30	1	70	25550	1.31E-07	11.5	1.50E-06
BENZO(b)FLUORANTHENE	64	100	1.0E-06	0.95	30	1	70	25550	1.02E-07	11.5	1.17E-06
BENZO(K)FLUORANTHENE	63	100	1.0E-06	0.95	30	1	70	25550	1.00E-07	11.5	1.15E-06
CHRYSENE	57	100	1.0E-06	0.95	30	1	70	25550	9.08E-08	11.5	1.04E-06
DIBENZO(A,H)ANTHRACENE	15	100	1.0E-06	0.95	30	1	70	25550	2.39E-08	11.5	2.75E-07
INDENO(1,2,3-c,d)PYRENE	43	100	1.0E-06	0.95	30	1	70	25550	6.85E-08	11.5	7.88E-07
									TOTAL CARCINOGENIC RISK		7.00E-06
UPPER BOUND											
BENZENE	55	100	1.0E-06	1	30	1	70	25550	9.23E-08	0.0292	2.69E-09
BENZO(a)ANTHRACENE	240	100	1.0E-06	0.95	30	1	70	25550	3.82E-07	11.5	4.40E-06
BENZO(a)PYRENE	420	100	1.0E-06	0.95	30	1	70	25550	6.69E-07	11.5	7.70E-06
BENZO(b)FLUORANTHENE	310	100	1.0E-06	0.95	30	1	70	25550	4.94E-07	11.5	5.68E-06
BENZO(K)FLUORANTHENE	330	100	1.0E-06	0.95	30	1	70	25550	5.26E-07	11.5	6.05E-06
CHRYSENE	240	100	1.0E-06	0.95	30	1	70	25550	3.82E-07	11.5	4.40E-06
DIBENZO(A,H)ANTHRACENE	64	100	1.0E-06	0.95	30	1	70	25550	1.02E-07	11.5	1.17E-06
INDENO(1,2,3-c,d)PYRENE	250	100	1.0E-06	0.95	30	1	70	25550	3.98E-07	11.5	4.58E-06
									TOTAL CARCINOGENIC RISK		3.40E-05

Data Source: Barr Engineering Company, May 1991

* BASED ON ARITHMETIC MEAN OR MAXIMUM CONCENTRATION FROM BARR ENGINEERING COMPANY, MAY 1991 (TABLE 4.4-3)

**CPF FOR CARCINOGENIC PAHs BASED ON THE CPF FOR B(a)P. ND=NOT DETERMINED

LIST OF ACRONYMS

PEOPLES NATURAL GAS SITE
DUBUQUE, IOWA

TABLES 13, 14, 15, AND 16

AT	-	Averaging Time (ED years x 365 days/year; days)
BW	-	Body Weight (kg)
CPF	-	Cancer Potency Factor (mg/kg/day)–1
CW	-	Chemical Concentration in Water (mg/L)
ED	-	Exposure Duration (years)
EF	-	Exposure Frequency (days/yr; events/yr)
IR	-	Ingestion Rate (L/day)
RfD	-	Reference Dose (mg/kg/day)

TABLE 13

CARCINOGENIC EXPOSURE CALCULATION FOR INGESTION OF CHEMICALS IN DRINKING WATER
ALLUVIAL AQUIFER
INCLUSION OF ALL CHEMICALS/ON-SITE CONCENTRATIONS
PEOPLES NATURAL GAS SITE, DUBUQUE, IOWA

CONTAMINANT	CW* (MG/L)	IR (L/DAY)	EF (DAYS/YR)	ED (YRS)	BW (KG)	AT (DAYS)	INTAKE (MG/KG-DAY)	CPF (MG/KG-DAY)-1	RISK
RESIDENTIAL ADULTS – UPPER BOUND ESTIMATE									
BENZENE	4.10E-01	2	365	30	70	25550	5.02E-03	0.0292	1.47E-04
BENZO(a)ANTHRACENE	1.20E-04	2	365	30	70	25550	1.47E-06	11.5	1.69E-05
BENZO(a)PYRENE	2.60E-05	2	365	30	70	25550	3.18E-07	11.5	3.66E-06
BENZO(b)FLUORANTHENE	ND	2	365	30	70	25550	ND	11.5	ND
BENZO(k)FLUORANTHENE	ND	2	365	30	70	25550	ND	11.5	ND
CHRYSENE	ND	2	365	30	70	25550	ND	11.5	ND
DIBENZO(a,h)ANTHRACENE	ND	2	365	30	70	25550	ND	11.5	ND
INDENO(1,2,3-c,d)PYRENE	1.90E-05	2	365	30	70	25550	2.33E-07	11.5	2.68E-06
FLUORENE	5.10E-05	2	365	30	70	25550	6.24E-07	—(b)	ND
FLUORANTHENE	6.10E-04	2	365	30	70	25550	7.47E-06	—	ND
PYRENE	4.70E-04	2	365	30	70	25550	5.76E-06	—	ND
ACENAPHTHENE	9.00E-03	2	365	30	70	25550	1.10E-04	—	ND
ANTHRACENE	3.50E-05	2	365	30	70	25550	4.29E-07	—	ND
NAPHTHALENE	3.10E-02	2	365	30	70	25550	3.80E-04	—	ND
CYANIDE	1.60E-04	2	365	30	70	25550	1.96E-06	—	ND
							TOTAL CARCINOGENIC RISK		1.70E-04

CONTAMINANT	CW* (MG/L)	IR (L/DAY)	EF (DAYS/YR)	ED (YRS)	BW (KG)	AT (DAYS)	INTAKE (MG/KG-DAY)	CPF (MG/KG-DAY)-1	RISK
RESIDENTIAL CHILDREN – UPPER BOUND ESTIMATE									
BENZENE	4.10E-01	1	365	10	34	25550	1.72E-03	0.0292	5.03E-05
BENZO(a)ANTHRACENE	1.20E-04	1	365	10	34	25550	5.04E-07	11.5	5.80E-06
BENZO(a)PYRENE	2.60E-05	1	365	10	34	25550	1.09E-07	11.5	1.26E-06
BENZO(b)FLUORANTHENE	ND	1	365	10	34	25550	ND	11.5	ND
BENZO(k)FLUORANTHENE	ND	1	365	10	34	25550	ND	11.5	ND
CHRYSENE	ND	1	365	10	34	25550	ND	11.5	ND
DIBENZO(a,h)ANTHRACENE	ND	1	365	10	34	25550	ND	11.5	ND
INDENO(1,2,3-c,d)PYRENE	1.90E-05	1	365	10	34	25550	7.98E-08	11.5	9.18E-07
FLUORENE	5.10E-05	1	365	10	34	25550	2.14E-07	—(b)	ND
FLUORANTHENE	6.10E-04	1	365	10	34	25550	2.56E-06	—	ND
PYRENE	4.70E-04	1	365	10	34	25550	1.97E-06	—	ND
ACENAPHTHENE	9.00E-03	1	365	10	34	25550	3.78E-05	—	ND
ANTHRACENE	3.50E-05	1	365	10	34	25550	1.47E-07	—	ND
NAPHTHALENE	3.10E-02	1	365	10	34	25550	1.30E-04	—	ND
CYANIDE	1.60E-04	1	365	10	34	25550	6.72E-07	—	ND
							TOTAL CARCINOGENIC RISK		5.83E-05

(a) DATA SOURCE: BARR ENGINEERING CO., MAY 1991 (TABLES 2.5-4, 2.5-6 AND 2.5-7)

(b) CSF VALUES HAVE NOT BEEN DEVELOPED BY U.S.EPA FOR THESE CHEMICALS.

ND=NOT DETERMINED

TABL 4

CARCINOGENIC EXPOSURE CALCULATION FOR INGESTION OF CHEMICALS IN DRINKING WATER
WATER TABLE WELLS
INCLUSION OF ALL CHEMICALS/ON-SITE CONCENTRATIONS
PEOPLES NATURAL GAS SITE, DUBUQUE, IOWA

CONTAMINANT	CW* (MG/L)	IR (L/DAY)	EF (DAYS/YR)	ED (YRS)	BW (KG)	AT (DAYS)	INTAKE (MG/KG-DAY)	CPF (MG/KG-DAY)-1	RISK
RESIDENTIAL ADULTS - UPPER BOUND ESTIMATE									
BENZENE	2.30E-01	2	365	30	70	25550	2.82E-03	0.0292	8.22E-05
BENZO(a)ANTHRACENE	4.50E-05	2	365	30	70	25550	5.51E-07	11.5	6.34E-06
BENZO(a)PYRENE	ND	2	365	30	70	25550	ND	11.5	ND
BENZO(b)FLUORANTHENE	ND	2	365	30	70	25550	ND	11.5	ND
BENZO(k)FLUORANTHENE	ND	2	365	30	70	25550	ND	11.5	ND
CHRYSENE	ND	2	365	30	70	25550	ND	11.5	ND
DIBENZO(a,h)ANTHRACENE	ND	2	365	30	70	25550	ND	11.5	ND
INDENO(1,2,3-c,d)PYRENE	ND	2	365	30	70	25550	ND	11.5	ND
FLUORENE	1.30E-01	2	365	30	70	25550	1.59E-03	---(b)	ND
FLUORANTHENE	1.10E-01	2	365	30	70	25550	1.35E-03	---	ND
PYRENE	8.60E-02	2	365	30	70	25550	1.05E-03	---	ND
ACENAPHTHENE	3.80E-01	2	365	30	70	25550	4.65E-03	---	ND
ANTHRACENE	2.30E-02	2	365	30	70	25550	2.82E-04	---	ND
NAPHTHALENE	5.10E+00	2	365	30	70	25550	6.24E-02	---	ND
CYANIDE	1.30E-03	2	365	30	70	25550	1.59E-05	---	ND
							TOTAL CARCINOGENIC RISK		8.86E-05
RESIDENTIAL CHILDREN - UPPER BOUND ESTIMATE									
BENZENE	2.30E-01	1	365	10	34	25550	9.66E-04	0.0292	2.82E-05
BENZO(a)ANTHRACENE	4.50E-05	1	365	10	34	25550	1.89E-07	11.5	2.17E-06
BENZO(a)PYRENE	ND	1	365	10	34	25550	ND	11.5	ND
BENZO(b)FLUORANTHENE	ND	1	365	10	34	25550	ND	11.5	ND
BENZO(k)FLUORANTHENE	ND	1	365	10	34	25550	ND	11.5	ND
CHRYSENE	ND	1	365	10	34	25550	ND	11.5	ND
DIBENZO(a,h)ANTHRACENE	ND	1	365	10	34	25550	ND	11.5	ND
INDENO(1,2,3-c,d)PYRENE	ND	1	365	10	34	25550	ND	11.5	ND
FLUORENE	1.30E-01	1	365	10	34	25550	5.46E-04	---(b)	ND
FLUORANTHENE	1.10E-01	1	365	10	34	25550	4.62E-04	---	ND
PYRENE	8.60E-02	1	365	10	34	25550	3.61E-04	---	ND
ACENAPHTHENE	3.80E-01	1	365	10	34	25550	1.60E-03	---	ND
ANTHRACENE	2.30E-02	1	365	10	34	25550	9.66E-05	---	ND
NAPHTHALENE	5.10E+00	1	365	10	34	25550	2.14E-02	---	ND
CYANIDE	1.30E-03	1	365	10	34	25550	5.46E-06	---	ND
							TOTAL CARCINOGENIC RISK		3.04E-05

(a) DATA SOURCE: BARR ENGINEERING CO., MAY 1991 (TABLES 2.5-4, 2.5-6 AND 2.5-7)

(b) CSF VALUES HAVE NOT BEEN DEVELOPED BY U.S.EPA FOR THESE CHEMICALS.

ND=NOT DETERMINED

TABLE 15

CHRONIC NONCARCINOGENIC EXPOSURE CALCULATION FOR INGESTION OF CHEMICALS IN DRINKING WATER
ALLUVIAL AQUIFER WELLS
INCLUSION OF ALL CHEMICALS/ON-SITE CONCENTRATIONS
PEOPLES NATURAL GAS SITE, DUBUQUE, IOWA

CONTAMINANT	CW(a) (MG/L)	IR (L/DAY)	EF (DAYS/YR)	ED (YRS)	BW (KG)	AT (DAYS)	INTAKE (MG/KG-DAY)	RfD (MG/KG-DAY)	HAZARD INDEX
RESIDENTIAL ADULTS - UPPER BOUND ESTIMATE									
BENZENE	4.10E-01	2	365	30	70	10950	1.17E-02	---(b)	ND
BENZO(a)ANTHRACENE	1.20E-04	2	365	30	70	10950	3.43E-06	---	ND
BENZO(a)PYRENE	2.60E-05	2	365	30	70	10950	7.43E-07	---	ND
BENZO(b)FLUORANTHENE	ND	2	365	30	70	10950	ND	---	ND
BENZO(k)FLUORANTHENE	ND	2	365	30	70	10950	ND	---	ND
CHRYSENE	ND	2	365	30	70	10950	ND	---	ND
DIBENZO(a,h)ANTHRACENE	ND	2	365	30	70	10950	ND	---	ND
INDENO(1,2,3-c,d)PYRENE	1.90E-05	2	365	30	70	10950	5.43E-07	---	ND
FLUORENE	5.10E-05	2	365	30	70	10950	1.46E-06	0.04	3.64E-05
FLUORANTHENE	6.10E-04	2	365	30	70	10950	1.74E-05	0.04	4.36E-04
PYRENE	4.70E-04	2	365	30	70	10950	1.34E-05	0.03	4.48E-04
ACENAPHTHENE	9.00E-03	2	365	30	70	10950	2.57E-04	0.06	4.29E-03
ANTHRACENE	3.50E-05	2	365	30	70	10950	1.00E-06	0.3	3.33E-06
NAPHTHALENE	3.10E-02	2	365	30	70	10950	8.86E-04	0.004	2.21E-01
CYANIDE	1.60E-04	2	365	30	70	10950	4.57E-06	0.02	2.29E-04
						TOTAL NONCARCINOGENIC HAZARD			2.27E-01
RESIDENTIAL CHILDREN - UPPER BOUND ESTIMATE									
BENZENE	4.10E-01	1	365	10	34	3650	1.21E-02	---(b)	ND
BENZO(a)ANTHRACENE	1.20E-04	1	365	10	34	3650	3.53E-06	---	ND
BENZO(a)PYRENE	2.60E-05	1	365	10	34	3650	7.65E-07	---	ND
BENZO(b)FLUORANTHENE	ND	1	365	10	34	3650	ND	---	ND
BENZO(k)FLUORANTHENE	ND	1	365	10	34	3650	ND	---	ND
CHRYSENE	ND	1	365	10	34	3650	ND	---	ND
DIBENZO(a,h)ANTHRACENE	ND	1	365	10	34	3650	ND	---	ND
INDENO(1,2,3-c,d)PYRENE	1.90E-05	1	365	10	34	3650	5.59E-07	---	ND
FLUORENE	5.10E-05	1	365	10	34	3650	1.50E-06	0.04	3.75E-05
FLUORANTHENE	6.10E-04	1	365	10	34	3650	1.79E-05	0.04	4.49E-04
PYRENE	4.70E-04	1	365	10	34	3650	1.38E-05	0.03	4.61E-04
ACENAPHTHENE	9.00E-03	1	365	10	34	3650	2.65E-04	0.06	4.41E-03
ANTHRACENE	3.50E-05	1	365	10	34	3650	1.03E-06	0.3	3.43E-06
NAPHTHALENE	3.10E-02	1	365	10	34	3650	9.12E-04	0.004	2.28E-01
CYANIDE	1.60E-04	1	365	10	34	3650	4.71E-06	0.02	2.35E-04
						TOTAL NONCARCINOGENIC HAZARD			2.34E-01

(a) DATA SOURCE: BARR ENGINEERING CO., MAY 1991 (TABLES 2.5-4, 2.5-6, AND 2.5-7)

(b) RfD VALUES HAVE NOT BEEN DEVELOPED BY U.S.EPA FOR THESE CHEMICALS.

ND=NOT DETERMINED

TABLE 16

CHRONIC NONCARCINOGENIC EXPOSURE CALCULATION FOR INGESTION OF CHEMICALS IN DRINKING WATER
WATER TABLE WELLS
INCLUSION OF ALL CHEMICALS/ON-SITE CONCENTRATIONS
PEOPLES NATURAL GAS SITE, DUBUQUE, IOWA

CONTAMINANT	CW(a) (MG/L)	IR (L/DAY)	EF (DAYS/YR)	ED (YRS)	BW (KG)	AT (DAYS)	INTAKE (MG/KG-DAY)	RfD (MG/KG-DAY)	HAZARD INDEX
RESIDENTIAL ADULTS - UPPER BOUND ESTIMATE									
BENZENE	2.30E-01	2	365	30	70	10950	6.57E-03	---(b)	ND
BENZO(a)ANTHRACENE	4.50E-05	2	365	30	70	10950	1.29E-06	---	ND
BENZO(a)PYRENE	ND	2	365	30	70	10950	ND	---	ND
BENZO(b)FLUORANTHENE	ND	2	365	30	70	10950	ND	---	ND
BENZO(k)FLUORANTHENE	ND	2	365	30	70	10950	ND	---	ND
CHRYSENE	ND	2	365	30	70	10950	ND	---	ND
DIBENZO(a,h)ANTHRACENE	ND	2	365	30	70	10950	ND	---	ND
INDENO(1,2,3-c,d)PYRENE	ND	2	365	30	70	10950	ND	---	ND
FLUORENE	1.30E-01	2	365	30	70	10950	3.71E-03	0.04	9.29E-02
FLUORANTHENE	1.10E-01	2	365	30	70	10950	3.14E-03	0.04	7.86E-02
PYRENE	8.60E-02	2	365	30	70	10950	2.46E-03	0.03	8.19E-02
ACENAPHTHENE	3.80E-01	2	365	30	70	10950	1.09E-02	0.06	1.81E-01
ANTHRACENE	2.30E-02	2	365	30	70	10950	6.57E-04	0.3	2.19E-03
NAPHTHALENE	5.10E+00	2	365	30	70	10950	1.46E-01	0.004	3.64E+01
CYANIDE	1.30E-03	2	365	30	70	10950	3.71E-05	0.02	1.86E-03
						TOTAL NONCARCINOGENIC HAZARD			3.69E+01
RESIDENTIAL CHILDREN - UPPER BOUND ESTIMATE									
BENZENE	2.30E-01	1	365	10	34	3650	6.76E-03	---(b)	ND
BENZO(a)ANTHRACENE	4.50E-05	1	365	10	34	3650	1.32E-06	---	ND
BENZO(a)PYRENE	ND	1	365	10	34	3650	ND	---	ND
BENZO(b)FLUORANTHENE	ND	1	365	10	34	3650	ND	---	ND
BENZO(k)FLUORANTHENE	ND	1	365	10	34	3650	ND	---	ND
CHRYSENE	ND	1	365	10	34	3650	ND	---	ND
DIBENZO(a,h)ANTHRACENE	ND	1	365	10	34	3650	ND	---	ND
INDENO(1,2,3-c,d)PYRENE	ND	1	365	10	34	3650	ND	---	ND
FLUORENE	1.30E-01	1	365	10	34	3650	3.82E-03	0.04	9.56E-02
FLUORANTHENE	1.10E-01	1	365	10	34	3650	3.24E-03	0.04	8.09E-02
PYRENE	8.60E-02	1	365	10	34	3650	2.53E-03	0.03	8.43E-02
ACENAPHTHENE	3.80E-01	1	365	10	34	3650	1.12E-02	0.06	1.86E-01
ANTHRACENE	2.30E-02	1	365	10	34	3650	6.76E-04	0.3	2.25E-03
NAPHTHALENE	5.10E+00	1	365	10	34	3650	1.50E-01	0.004	3.75E+01
CYANIDE	1.30E-03	1	365	10	34	3650	3.82E-05	0.02	1.91E-03
						TOTAL NONCARCINOGENIC HAZARD			3.80E+01

(a) DATA SOURCE: BARR ENGINEERING CO., MAY 1991 (TABLES 2.6-4, 2.6-6, AND 2.6-7)

(b) RfD VALUES HAVE NOT BEEN DEVELOPED BY U.S.EPA FOR THESE CHEMICALS.

ND=NOT DETERMINED

TABLE 17

COST ESTIMATE SUMMARY FOR SELECTED REMEDY

Item	Cost
I. Site Work	2,200,000
II. Soil Transportation and Treatment	3,700,000
III. Ground Water Extraction and Treatment	
1. Alluvial Aquifer	
Capital	240,000
O & M: Present Worth (10 Yrs. @ 9%)	313,000
2. Silty Sand Aquifer	
Capital	13,000
O & M: Present Worth (5 Yrs. @ 9%)	130,000
3. Bioremediation System	
Capital	195,000
O & M: Present Worth (10 Yrs. @ 9%)	345,000
IV. Ground Water Quality Monitoring	
1. Alluvial Aquifer: Present Worth (10 Yrs. @ 9%)	106,000
2. Silty Sand: Present Worth (10 Yrs. @ 9%)	129,000
V. Subtotal Cost of Selected Remedy	7,341,000
VI. Contingency for Commercial Soil Disposal	629,000
Total Estimated Cost for Selected Remedy	8,000,000