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DECLARATION OF THE RECORD OF DECISION

Site Name and Location

Kohler Company Landfill
Kohler, Wisconsin

Statement of Basis and Purpose

This decision document presents the selected remedial action for the Kohler Company Landfill (KCL) in Kohler, Wisconsin, which was chosen in accordance with CERCLA, as amended by SARA, and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the administrative record for the site.

The State of Wisconsin 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 an imminent and substantial endangerment to public health, welfare, or the environment.

Description of the Selected Remedy

This remedy is the first operable unit for the KCL site and addresses the source of contamination through containment of the waste mass. The primary goal of the remedial action at this site is:

> to reduce infiltration into the landfill which is the source of ground water contamination and to reduce the risks associated with exposure to contaminated materials.

The KCL Remedial Investigation identified contaminated ground water as the principal threat, with the waste materials acting as the source of that contamination due to infiltration and the contact between portions of the waste mass and the ground water.

The major components of the selected remedy consist of:

- Closure of the landfill and placement of a clay/soil cap over the fill material to reduce infiltration into the waste mass. (Constructed in accordance with NR 504 Wis. Adm. Code).

- Collection and treatment of leachate prior to discharge to the Sheboygan River through the installation of a perimeter leachate collection drain and treatment system.

- Impose access and use restrictions.

- Implement operational and surface controls for remaining period of landfill operation.

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 for this site. However, because treatment of the principal threats of this site was not found to be practicable nor within the limited scope of this action, this remedy does not satisfy the statutory preference for treatment as a principal element.

Subsequent actions are planned to address fully the principal threats posed by the conditions at this site. As required by SARA, when hazardous substances are left on site, a review will be conducted within 5 years after commencement of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

for Valdas V. Adamkus, Regional Administrator
U.S. Environmental Protection Agency, Region V

3/30/92
Date

RECORD OF DECISION

DECISION SUMMARY

KOHLER COMPANY LANDFILL

SOURCE CONTROL OPERABLE UNIT

KOHLER, WISCONSIN

Prepared By:

U.S. Environmental Protection Agency

Region V

Chicago, Illinois

March 1992

SUMMARY OF REMEDIAL ALTERNATIVE SELECTION
KOHLER COMPANY LANDFILL SITE, SOURCE CONTROL OPERABLE UNIT
KOHLER, WISCONSIN

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I. SITE LOCATION AND DESCRIPTION

The Kohler Company Landfill Site (the "Site"), comprised of about 40 acres, is located about one-half mile southeast of the Kohler Company manufacturing plant in the Village of Kohler, Sheboygan County. The site is bounded on the north by County Highway PP, on the south and east by the Sheboygan River, and on the west by County Highway A. The Village of Kohler is located approximately four miles west of Lake Michigan, halfway between the cities of Sheboygan Falls to the west and Sheboygan to the east. The Site is located in the NE 1/4 of the SE 1/4 of Section 29, T15N, R22. See Figure 1.

The site is a State-licensed landfill for the disposal of industrial wastes generated by the Kohler Company and continues to operate today. (See Figure 2) Most of the area immediately surrounding the site is undeveloped and is part of the Kohler Company's 800-acre River Wildlife Reserve. In the immediate vicinity of the Site, the principal demographic feature is the Village of Kohler and the Kohler Company operations. The plant employs approximately 6,400 persons. County Highway PP is a frequently used transportation artery between the Village of Kohler and Cities of Sheboygan and Sheboygan Falls.

It is estimated that 57,000 people live within three miles of the site. The nearest private homes (two residences) are located approximately one-quarter mile south of the landfill on the opposite side of the Sheboygan River. The nearest private well is situated near these two homes and is used by the residents for drinking and non-drinking purposes. Drinking water for the Village of Kohler and the Kohler manufacturing facility is supplied by the Sheboygan municipal system from Lake Michigan. There are no water supply intakes in the Sheboygan River downstream of the Site. There are several non-potable water supply wells located on Kohler Company property including two on the plant's premises, but none of these are located on nor have been impacted by contamination from the Site.

The landfill site is located in an area which originally consisted of a sloping plateau and the historical Sheboygan River floodplain. Presently, the surface elevation of the majority of the fill area is at approximately 660 ft. above mean sea level (msl). The base of the landfill along its eastern edge marks the Sheboygan River 100-year flood plain. The Site lies above the 100-year floodplain. The surface of the landfilled area slopes between three and five percent on average, and the side slopes of the waste disposal mound range from a 3:1 (33 percent) to a 4:1 (25 percent) horizontal:vertical slope.

The landfill material thickness varies from 6 to 15.5 ft in the western portion of the fill to 44 to 58 ft in the central to eastern portions of the fill. The most abundant material identified in landfill borings is black foundry sand, pottery cull, clay slurry and other non-hazardous foundry wastes. Between 1950 and the mid-1970s, at least four pits were constructed for the disposal of waste solvents, hydraulic oils, chrome plating sludges, and paint wastes. Figure 2 shows the landfill boundaries and approximate locations of the disposal pits.

The Sheboygan River is a principal surface feature in the vicinity of the Site and has a mean annual discharge of 258 cubic feet per second (cfs) at the United States Geological Survey gaging station which is situated immediately downstream from the Site. The river flows 178 stream-miles from the headwaters in eastern Fond du Lac County through the Sheboygan Marsh and toward Lake Michigan while draining a 432 square mile watershed. Major tributaries include the Onion River and Mullet River. The Sheboygan River flows over a series of bedrock outcrops forming the falls and rapids at Sheboygan Falls. Near the landfill, the river flows in a series of incised meanders and several oxbow lakes are present. The Sheboygan River watershed has been identified as one of the 43 "Areas of Concern" on the Great Lakes. An Area of Concern, as defined in the Great Lakes Water Quality Agreement between the United States and Canada, is a geographic area that fails to meet the general or specific objectives of the Agreement where such failure has caused or is likely to cause impairment of beneficial use or of the area's ability to support aquatic life. The Sheboygan River and Harbor comprise another Superfund site and is, therefore, not an explicit part of the Kohler Company Landfill Remedial Investigation/Feasibility Study (RI/FS), except to the extent that the river and harbor have been or may be affected by the landfill. The Kohler Company has been identified as one of the potentially responsible parties for the Sheboygan River and Harbor site.

The geologic setting at the Site consists of up to 100 ft. of unconsolidated sediments of glacial and alluvial origin underlain by Niagara Dolomite of Silurian-age. The unconsolidated material can be divided into four units: the upper, middle, and lower units of glacial origin, and the alluvium unit.

Two aquifers have been identified at the Site, within the unconsolidated and bedrock units. Ground water at the site, derived from local recharge, typically flows through the upper unconsolidated units. Steep downward gradients present in the shallower units cause a portion of the local recharge to percolate into the lower bedrock aquifer prior to discharge to the river. Due to the highly permeable nature of the landfill materials (more permeable than the upper till units), the landfill materials act as the source of contaminants to the ground water. Ground water and precipitation that has percolated downward flow through the landfill materials picking up the contaminants. Data gathered during the RI indicated that the landfill has affected ground water in both aquifers, that the affected ground water is discharging into the Sheboygan River, and that the potential exists for movement of the contaminants under the river to the east. Additional monitoring activities planned for the Ground Water Operable Unit (GWOU) will further address the concern for contaminant migration under the Sheboygan River.

II. SITE HISTORY AND ENFORCEMENT ACTIVITIES

The Kohler Company Landfill has been in operation since the early 1950s, primarily for the disposal of foundry and manufacturing wastes produced by the Kohler Company manufacturing facilities. The landfill is owned and operated by the Kohler Company. In 1969, Kohler obtained a landfill license from the Wisconsin Department of Natural Resources (WDNR) for the operation of the landfill, which continues today under that license. The majority of the wastes disposed of in the landfill consist of foundry wastes including sand, cores, dust collector waste, slag, and pottery wastes including cull, clay, molds, and clarifier waste. These waste streams are not considered listed or characteristic waste pursuant to the Resource Conservation and Recovery Act (RCRA).

General landfill practices between the 1950s and mid-1970s consisted of the construction of cells for waste disposal and other standard filling practices. During this period, practices also included the construction of waste disposal pits, including the Old Waste Pit, the Northern Burn Pit, the Southern Burn Pit, the Non-Flammable Pit (which was located in a portion of the Northern Burn Pit), and the Suspected Pit. The location of the pits, the approximate limits of the fill, and the approximate boundary of the landfill are presented in Figure 2. Waste streams which were disposed of in these pits included hydraulic oils, solvents, paint wastes, enamel powder (containing lead and cadmium), lint from brass polishing, and chrome plating sludges. Most of these waste streams would be defined as hazardous waste under RCRA. These cells were closed by 1975 and were subsequently filled over with non-hazardous wastes.

Beginning in 1975, all hazardous waste liquids (by definition under RCRA) were shipped for off-site disposal. Disposal of all solid hazardous waste (by definition under RCRA) in the landfill ceased prior to 1980. Since implementation of the hazardous waste requirements under RCRA in November 1980, all RCRA-regulated wastes have been shipped off site for disposal.

As the western half of the landfilled area reached capacity, new disposal cells were developed to the east. This continued through the 1970s and 1980s. By May 1989, a single disposal cell was in use in the northern portion of the eastern half of the Site. Since 1990, solid wastes have been placed along the western slope of the landfill, while waste slurries have been placed in shallow trenches in the northern portion of the eastern half of the Site.

Contaminated surface-water runoff was detected at the landfill in 1983. The following year, the site was placed on the National Priorities List. Kohler Company was identified as the only potentially responsible party (PRP) for the Site. RI/FS activities began in 1985 with the signing of an Administrative Order by Consent (U.S. EPA Docket Number V-W-85-C-018, dated September 30, 1985) whereby Kohler Company, U.S. EPA and WDNR agreed that Kohler Company would conduct an RI/FS for the site. Following three phases of investigatory work, the RI including the Baseline Risk Assessment was completed in August 1991. In May 1991, U.S. EPA directed Kohler Company to assess site remedial options as two separate operable units, the first covering source control and the second covering ground water management. These two operable units together will comprise the final remedy for the site. The Source Control Operable Unit Feasibility Study (SCOUFS) was completed in September 1991. Currently, additional ground-water monitoring efforts are underway for polychlorinated biphenyls (PCBs). Additional studies are planned for the GWOU including an ecological assessment and additional ground-water monitoring.

III. HIGHLIGHTS OF COMMUNITY PARTICIPATION

A Community Relations Plan for the Site was finalized in April 1987. This document lists contacts and interested parties throughout the local and government community. It also establishes communication pathways to ensure timely dissemination of pertinent information.

The RI, SCOUFS, and the Proposed Plan were released to the public in October 1991. All of these documents were made available in the information repository maintained at the Kohler Public Library. An administrative record file containing these documents and other site-related documents are located at the Kohler Public Library. The notice of availability of these documents was published in the Sheboygan Press on October 10,

1991. Press releases were also sent to all local media. A public comment period was held from October 14, 1991 to January 6, 1992. Notices of two comment period extensions were placed in the November 11 and December 14, 1991 editions of the Sheboygan Press. In addition, a public meeting was held on October 15, 1991 to present the results of the RI/FS and the recommended alternative as presented in the Proposed Plan for the Site. All comments are addressed in the Responsiveness Summary which is the final section of this ROD.

Two fact sheets were developed, in June 1991 and October 1991, to explain the findings of the RI. These fact sheets were sent to everyone on U.S. EPA's mailing list for the Kohler site.

An RI "kickoff" meeting was held on July 22, 1986 to explain the RI process. A fact sheet was developed in conjunction with this meeting. An advertisement was placed in the July 18, 1986 edition of the Sheboygan Press and a press release was sent to all local media. U.S. EPA representatives attended a Kohler Company-sponsored briefing on Superfund on January 4, 1986.

Upon the signing of the Consent Order in September 1985, U.S. EPA held a 30-day public comment period. A press release was sent to all local media and advertisements were placed.

IV. SCOPE AND ROLE OF RESPONSE ACTION

As with many Superfund sites, the conditions at the Kohler Company Landfill site are complex. As a result, U.S. EPA organized the work into two planned activities. The remedial action selected in this ROD addresses the first of these two activities or operable units at the site. This ROD addresses the source of ground-water contamination, namely, the waste material in the landfill. This source control operable unit (SCOU) is consistent to the maximum extent practicable with the National Contingency Plan ("NCP"), and is being implemented to protect human health and the environment by controlling the migration of contaminants from the waste to the ground water.

This source control action, by controlling the migration of contaminants, is fully consistent with all future site work. In addition, this action will positively affect the cost of the final ground-water remedy by limiting the amount of additional ground water that becomes contaminated by this source.

The area that poses the greatest risk is considered to be the ground water contaminant plume. The contaminated waste in the landfill is considered to be a long-term threat to human health and the environment, primarily as a principal source of ground-water contamination. The volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and metals in the waste are considered to be the principal threats for this SCOU.

The selected remedy involves the closure of the landfill, placement of a cap, and installation of a leachate collection and treatment system. More specifically, the SCOU response action encompasses the following activities:

- Closure of the landfill;
- Installation of a WAC NR 504 multi-layer cap over the landfill;
- Installation of a perimeter leachate collection drain;
- Treatment of the leachate prior to discharge to the Sheboygan River;
- Institutional/operational and surface controls;
- Zoning and deed restrictions; and
- Effective security control measures.

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 for this site. However, because treatment of the principal threats of the site was not found to be practicable within the limited scope of this action, this remedy does not satisfy the statutory preference for treatment as a principal element.

V. SUMMARY OF SITE CHARACTERISTICS

In August 1991, the RI for the Site was completed by Kohler Company under the guidance and oversight of U.S. EPA and WDNR. An extensive database of information was developed to define the physical and chemical conditions at the Site. The main objective of the RI was to determine the nature and extent of contamination at the site.

The following is a summary of the RI results:

Geology: The Site is underlain by 20 to 100 ft of unconsolidated sediments of glacial and alluvial origin underlain by Niagara Dolomite of Silurian-age. The unconsolidated material can be divided into four units: the upper, middle, and lower units of glacial origin, and the alluvium unit. Figures 3 - 7 represent geologic cross-sections through the site. These units have been identified consistently across the site; in places these units have been eroded, or deposited, by the Sheboygan River.

The uppermost geologic unit, identified as glacial till, is comprised of poorly sorted silt, clay, and fine sand. The average thickness of this unit, except where eroded, is approximately 25 ft.

The middle unit is also glacial till; however, this unit is comprised primarily of clay to silty-clay material with zones of gravel and fine sand. This unit is up to 55 ft thick at the site and averages approximately 20 ft thick. This unit is absent in the northeast portion of the site, presumably eroded by the Sheboygan River. The lower glacial unit is a basal till and contains compacted gravel, sand, silt, and clay. This unit is thinner than the two upper units; it averages approximately 15 ft thick.

The fourth geologic unit is the alluvium deposited by the Sheboygan River. The alluvium primarily overlies the middle till unit and consists of well-sorted interbedded gravel, sand, silt, and clay. Where the middle till has been eroded near the river, the alluvium overlies the lower till. The alluvium is up to 12 ft thick where it exists along the Sheboygan River.

The unconsolidated sediments overlie dolomite bedrock. The bedrock in the vicinity of the site is fractured. In addition, distinct zones of weathering have been noted. The presence and extent of the weathering is very irregular. The landfill materials have been deposited in the Sheboygan River valley. As such, the landfill materials overlie the alluvium, and the glacial deposits on the hillsides.

Waste Characterization: Landfill borings indicate that the majority of wastes in the landfill consist of foundry wastes including foundry sand, cores, and slag; and pottery wastes including cull, clay, and molds. These materials are over 50 ft thick in places. Chemical analysis of the landfill materials show it to contain significant concentrations of VOCs including 1,2-dichloroethene (DCE) and trichloroethene (TCE); SVOCs including polynuclear aromatic hydrocarbons (PAHs), phenolic compounds, and polychlorinated biphenyls (PCBs); and inorganic compounds including chromium, cadmium, lead, copper, antimony, and zinc. Portions of the landfill waste materials are below the water table, most notably the central to western portions of the landfill. The maximum thickness of the saturated wastes is about 8 feet. The landfill mass has been and continues to be the primary source of contamination to the ground water. Figures 8, 9, and 10 provide a pictorial representation of the spatial extent of chemical compounds found in the landfill materials.

Vapors within the landfill contain a variety of VOCs including vinyl chloride, TCE, and DCE. Figures 11 and 12 can be referenced for information on concentrations of VOCs in the landfill vapors.

Ground Water: The main source of ground water at the site is the local infiltration of precipitation into the subsurface. The water table lies fairly close to the surface (about 2-12 feet below the surface). Lateral ground-water flow is generally west to east. Shallow ground water, though, is affected by the steep topography of the site. As a result, shallow ground-water flow is generally radially away from the center of the landfill and toward the Sheboygan River which surrounds it on three sides.

The bedrock beneath the site and a portion of all the glacially deposited till units are saturated, as are a portion of the river deposits and the landfill materials. The middle till unit tends to impede downward flow of ground water, but steep downward gradients in the upper unconsolidated units and in the landfill have resulted in the migration of landfill contaminants into the lower glacial unit and bedrock. Lateral ground-water flow through the saturated portions of the waste material may also be a contributing factor. As a result of the site hydraulics, a plume of contaminated ground water migrates towards and discharges into the Sheboygan River. The plume extends from the Site to the Sheboygan River on the east and south sides. The question of whether contaminants are migrating under the river to the east has not been satisfactorily answered. Long-term monitoring will determine whether the contaminant plume may also be migrating under the river to impact wells located on the other side.

Ground water beneath and adjacent to the site is contaminated with the same chemical constituents found in landfill wastes and vapors, including VOCs, SVOCs, and inorganic compounds. Many of these chemicals are at levels exceeding NR 140 (Wisconsin ground water) Enforcement Standards (ESs) or Safe Drinking Water Act Maximum Contaminant Levels (MCLs). Table 1 provides a summary of the chemical constituents detected in the ground water and highlights those which exceed the MCLs or ESs, whichever is most stringent for each constituent.

Leachate: The leachate contains primarily VOCs and inorganic compounds. Table 2 presents the data available on leachate.

Surface-water runoff and sediment: The surface-water runoff and sediment contain SVOCs and inorganic compounds. Surface runoff patterns have been altered since this data was collected. Runoff channels were utilized for much of the Site's operating history. Sheet flow drainage has been established with the placement and grading of cover soils.

Wetlands: A preliminary wetlands assessment of the Site concluded that several small stands of hydrophilic vegetation were observed along the toe of the fill on the east and southeast sides of the Site, and northeast of the Site. Shallow test pits indicated that hydric soils are present in these areas and a wetlands hydrology exists. These small stands have been classified as wetlands.

VI. SUMMARY OF SITE RISKS

A Baseline Risk Assessment was completed pursuant to the NCP to determine whether the contaminants of concern identified at the site pose a current or potential risk to human health and the environment in the absence of any remedial action. It provides information used in determining whether remedial action is necessary and is one justification for performing remedial actions. The Superfund Baseline Risk Assessment process may be viewed as consisting of an exposure assessment component and a toxicity assessment component, the results of which are combined to develop an overall characterization of risk. These assessments are site specific and, therefore, may vary widely in the extent to which qualitative and quantitative analyses are utilized.

The Baseline Risk Assessment for the Site was completed to evaluate public health and environmental risks associated with the chemical constituents detected in ground water, leachate, and surface water. A number of scenarios were evaluated and estimated risks calculated. Two of the scenarios exceeded U.S. EPA's health-based guidelines of 1 X 10-4 to 1 X 10-6 for excess lifetime cancer risk and 1.0 for the hazard index (HI). Potable use of ground water by hypothetical future residents (both adults and children) resulted in risk estimates that exceed the guidelines. Exposure to VOCs while showering by hypothetical future adults using water drawn from the unconsolidated unit resulted in an HI exceeding 1.0. Table 4 provides the risk summary.

Excess lifetime cancer risks are determined by multiplying the intake level with a cancer potency factor. These risks are probabilities that are generally expressed in scientific notation (e.g., 1 X 10-6 means that an individual has an additional one in one million chance of developing cancer as a result of site-related exposure to a carcinogen over a 70-year lifetime under the specific exposure conditions at a site).

Potential concern for noncarcinogenic effects of a single contaminant in a single medium is expressed as the hazard quotient (HQ) (or the ratio of the estimated intake derived from the contaminant concentration in a given medium to the contaminant's reference dose). By adding the HQs for all contaminants within a medium or across all media to which a given population may reasonably be exposed, the HI can be generated. The HI provides a useful reference point for gauging the potential significance of multiple contaminant exposures within a single medium or across media.

Constituent Characterization

Based on the occurrence of specific constituents and a comparison of the constituent concentrations to standards and criteria, a listing of chemicals of concern (COCs) was developed. The COCs are as follow:

benzene	aluminum
2-butanone	antimony
carbon disulfide	arsenic
chlorobenzene	barium
chloroethane	beryllium
1,1-dichloroethane	cadmium
1,2-dichloroethane	chromium
1,1-dichloroethene	cobalt
1,2-dichloroethene (total)	copper
ethylbenzene	fluoride
4-methyl-2-pentanone	iron
toluene	lead
1,1,1-trichloroethane	magnesium
trichloroethene	manganese
vinyl chloride	nickel
xylene	nitrate-nitrite
butylbenzylphthalate	selenium
4-chloro-3-methylphenol	silver
2,4-dimethylphenol	sulfate
di-n-octyl phthalate	vanadium
2-methylphenol	zinc
4-methylphenol	
phenanthrene	
phenol	
pyrene	

Table 1 provides a summary of the concentrations of the COCs detected in the ground water at the site and highlights those which exceed either the MCLs or ESs whichever is most stringent for each constituent. As shown in this table, the levels of contaminants found in Site wells far exceed Federal and State standards. The data clearly indicates that the landfill materials are acting as a source of ground-water contamination. With the discharge of the contaminated ground water into the Sheboygan River, additional loading of persistent toxic chemicals into Lake Michigan lend toward the potential for toxic effects to be felt by the aquatic environment. This source will continue to load contaminants to the ground water and the Sheboygan River unless addressed by a remedial action.

Toxicity Assessment

Cancer potency factors (CPFs) have been developed by U.S. EPA's Carcinogenic Assessment Group for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic chemicals. CPFs, which are expressed in units of (mg/kg/day)-1, are multiplied by the estimated intake of a potential carcinogen, in mg/kg/day, to provide an upper-bound estimate of the excess lifetime cancer risk associated with exposure at that intake level. The term "upper bound" reflects the conservative estimate of the risks calculated from the CPF. Use of this approach makes underestimation of the actual cancer risk highly unlikely. CPFs are derived from the results of human epidemiological studies or chronic animal bioassays to which animal-to-human extrapolation and uncertainty factors have been applied (e.g.,, to account for the use of animal data to predict effects on humans).

Reference doses (RfDs) have been developed by U.S. EPA for indicating the potential for adverse health effects from exposure to chemicals exhibiting noncarcinogenic effects. RfDs, which are expressed in units of mg/kg/day, are estimates of lifetime daily exposure levels for humans, including sensitive individuals. 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. RfDs are derived from human epidemiological studies or animal studies to which uncertainty factors have been applied (e.g., to account for the use of animal data to predict effects on humans). These uncertainty factors help ensure that the RfDs will not underestimate the potential for adverse noncarcinogenic effects to occur.

Based on the list of COCs, the physical and chemical properties as they relate to fate and transport in the environment were developed. The following properties were considered: molecular weight, water solubility, specific gravity, vapor pressure, Henry's Law constant, organic carbon partition coefficient, octanol-water coefficient, fish bioconcentration factor, and half-life in water. A summary of toxicological properties was also developed for the COCs. This included RfDs for non-carcinogenic effects and cancer classification and cancer slope factors (CSFs) for carcinogenic effects.

Constituents were also classified according to their carcinogenic and non-carcinogenic toxicity effects. For carcinogenic compounds, the excess lifetime cancer risk provides an estimate of the increased risk of cancer which results from lifetime exposure, at specified average daily dosages, to constituents detected in media at the site. For non-carcinogenic compounds, the HQ is used to define the ratio of the estimated exposure dose to the reference dose (based upon a dose which elicits no effect when evaluating the most sensitive response). Because of these differing approaches to calculating risk, the risks associated with carcinogenic effects are generally much higher than those associated with non-carcinogenic effects, particularly at the low-dose levels associated with environmental exposures. Table 3 summarizes the recognized toxic responses associated with the site-specific COCs.

Exposure Characterization

The exposure characterization completed in the Risk Assessment included a release/source analysis, an evaluation of exposure pathways, exposure points and receptors; and calculation of exposure point levels and exposure doses for ground water, leachate, and surface water. Figure 13 provides a summary model for potential exposure at the site. The landfill material constitutes the source area for VOCs, SVOCs, and inorganic compounds. Leaching of the source area is the primary release mechanism. Leachate seeps and ground water discharged to the Sheboygan River are also release mechanisms. There is no evidence that on-going erosional runoff is an important release source from the landfill.

Exposure scenarios were developed to describe potential human exposures via these pathways under current site conditions and future potential site uses. Potential effects on the environment were also evaluated in a qualitative manner.

Risk Characterization

The risk characterization for the Kohler Company Landfill site provides a quantitative risk estimate for human exposure to ground water, leachate, and surface water. The estimated risks were quantified by calculating an excess lifetime cancer risk and HI for each reasonable maximum exposure scenario. Excess lifetime cancer risks are determined by multiplying the intake level with the CPF. These risks are probabilities that are generally expressed in scientific notation (e.g., 1 X 10-6). An excess lifetime cancer risk of 1 X 10-6 indicates that, as a plausible upper bound, an individual has a one in one million chance of developing cancer as a result of site-related exposure to a carcinogen over a 70-year lifetime under the specific exposure conditions at a site.

Potential concern for noncarcinogenic effects of a single contaminant in a single medium is expressed as the hazard quotient (HQ). By adding the HQs for all contaminants within a medium or across all media to which a given population may reasonably be exposed, the HI can be generated.

Three hypothetical future ground-water exposures (equipment washing by a future worker, and potable use by a future resident at the site, via ingestion and via showering); two potentially existing leachate exposures (site worker and trespasser); two hypothetical future leachate exposures (adult and child residents); and two potentially existing surface-water exposures (swimming and fish consumption) were evaluated. Table 4 provides a summary of these risks.

Equipment washing by future worker: A hypothetical future scenario involving workers using site ground water for equipment washing activities over a 25-year period was developed. These risks were calculated for hypothetical non-potable water supply wells in each of the three water units. Excess lifetime cancer risks ranged from 1 x 10-7 for wells completed in the deep bedrock to 6 x 10-6 for wells in the unconsolidated deposits and shallow bedrock unit. The HIs ranged from 0.030 for the deep bedrock and shallow bedrock units to 0.10 for the unconsolidated unit. These values are below or within the range of acceptable health guidelines.

Potable use by a future resident: Risks for a reasonable maximum exposure scenario (30-year residence period) for a hypothetical future adult resident using potable water from a well completed at the site were calculated in the Baseline Risk Assessment. Excess lifetime cancer risk estimates ranged from 1 x 10-4 for a well completed in the deep bedrock to 5 x 10-3 for a well completed in the shallow bedrock. The HIs ranged from 30 for the unconsolidated deposits to 60 for the deep bedrock. Tables 5, 6, and 7 provide a summary of these risk estimates. Risks from ingestion of ground water by a future child resident (age 0 to 6 years) were evaluated. The excess lifetime cancer risks ranged from 6 x 10-5 in the deep bedrock unit to 2 x 10-3 in the shallow bedrock and unconsolidated units. The HIs ranged from 60 for the unconsolidated deposit to 100 for the deep bedrock.

Risks to a hypothetical future adult resident from inhalation of vapors released during showering were also calculated separately for each of the three hydrogeological units. Excess lifetime cancer risk estimates range from 3 x 10-6 (deep bedrock unit) to 1 x 10-4 (unconsolidated and shallow bedrock units). The HIs range from 0.020 (deep bedrock unit) to 2.0 (unconsolidated unit).

Values for both ingestion and showering are shown to exceed the acceptable health guidelines.

Leachate exposure by site worker or trespasser:
Leachate seeps occur at the site and exposure to this media was evaluated for the potentially existing pathways (site worker and trespasser) and for the hypothetical future pathways (adult and child residents). The excess lifetime cancer risk was 2 x 10-6

for a current worker and 3 x 10 -6 for a trespasser. The HIs were 0.0060 and 0.20 for the current worker and the trespasser, respectively. The excess lifetime cancer risk for the future resident exposure to leachate was 6 X 10-6 for an adult and 2 X 10-5 for a child. The HIs were 0.020 for an adult and 0.20 for a child. These values lie within the acceptable health guidelines.

<u>Surface-water exposures (swimming and fish ingestion)</u>: Estimates of potential constituent concentrations in the Sheboygan River based on levels observed in the ground water were evaluated in lieu of river water data. The highest 95 percent upper confidence limit (UCL) on the arithmetic average concentrations for COCs from the three ground-water units were used to estimate a surface-water exposure point concentration. Several simplifying assumptions were made: (1) the aquifer is homogenous and isotropic; (2) the constituents are distributed equally over the entire site as 95 percent UCL concentrations of each constituent; (3) the ground water acts as a continuous source; and (4) no dispersion, biodegradation, or adsorption occurs along the flow path from the site to the river. Table 8 provides the estimated Sheboygan River surface water concentrations.

The excess lifetime cancer risk for adults swimming in the Sheboygan River (for this site alone) was 1 x 10-12 and the HI was 0.0020. Consuming fish caught in the Sheboygan River (for this site alone) was calculated to produce an excess lifetime cancer risk in adults of 2 x 10-11 and an HI of 0.30. Risks for children engaging in these activities were calculated, and were similar to the values for adults. These values for potential recreational use of the Sheboygan River under these assumptions are below or within health-based guidelines.

<u>Cumulative site risk</u>: A cumulative site risk can be derived by the summation of excess lifetime cancer risks and HIs across exposure routes for all media at the site. Current total site risk was estimated by assuming that a site worker could, in addition to leachate exposure, be exposed to constituents estimated in the Sheboygan River during recreational activities. The combined risk for the on-site leachate exposure pathway and the surface water pathways results in an excess lifetime cancer risk of 4 x 10-6 and an HI of 0.30.

The hypothetical future total site risk values are based upon a future resident living on site, using the ground water for drinking and showering, swimming in the river, and eating fish caught from the river. These values are 5 x 10-3 and 60 for the excess lifetime cancer risk and HI values, respectively. The total site risk for a future child resident results in an excess lifetime cancer risk and HI of 2 x 10-3 and 100, respectively. These two scenarios are outside of U.S. EPA's health-based guidelines of 1 X 10-4 to 1 X 10-6 for excess lifetime cancer risk and 1.0 for the HI. Table 5 provides the risk estimation summary for the Site.

Chemical constituents contained in the landfill materials have affected ground water in the vicinity of the Site. Data obtained from on-site ground water monitoring wells indicate that substantial amounts of chemical constituents have been and continue to be released from the landfill materials to the ground water. Potential future risks from use of the ground water are unacceptable. As shown in Table 9 (and also referring to Table 1), the levels of the COCs in the ground water exceed Federal and State standards. Continued leaching of these COCs from the landfill materials to the ground water will result in continued unacceptable risks. Should these COCs migrate under the Sheboygan River to existing private wells, or in the event of future site development involving the installation of a water supply well, contaminant exposure via ground-water use and consumption may occur.

Based on the Baseline Risk Assessment and RI, it is concluded that actual and/or threatened releases of hazardous substances from the Site, if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment.

Environmental Assessment

The potential environmental risks of affected ground water on the aquatic and terrestrial ecosystems around the site were assessed qualitatively. The calculated constituent concentrations in the Sheboygan River are at least one order of magnitude below the Wisconsin surface-water criteria or the Federal Ambient Water Quality Criteria. Table 10 provides a comparison of the COCs estimated in the Sheboygan River water to the applicable or relevant and appropriate water-quality criteria.

The bioaccumulation potential for the majority of the COCs by aquatic organisms is relatively low, based on a comparison of fish bioaccumulation factors (BCFs) with the value of 1,000 L/kg which was used in the Baseline Risk Assessment. The BCF relates the concentration of a chemical in plant and animal tissues to the concentration of the chemical in the water in which they live. Fish BCFs greater than 1,000 L/kg are believed to bioaccumulate significantly. Two COCs have BCFs exceeding 1,000 L/kg: silver and di-n-octyl phthalate.

The presence of PCBs in the landfill has been documented through chemical analysis of samples of the landfill materials during the final phase of investigative activities. Ground water was not investigated for the presence of PCBs during the three phases of the RI. The extent of any PCB-contamination in the ground water is being investigated as part of the ground-water operable unit. Further investigation is needed to determine whether PCBs may be migrating from the landfill via the ground water and discharging into the Sheboygan River. PCBs have a high BCF and numerous studies have documented their toxic impacts on both aquatic life and human health. The concentrations and extent of PCB contamination in the Sheboygan River and Sheboygan River fish and water fowl has been well documented in the Remedial Investigation/Enhanced Screening Report and Alternative Specific Remedial Investigation under the on-going Sheboygan River and Harbor RI/FS. Should PCBs be detected in the ground water, conclusions made in the Baseline Risk Assessment regarding human health and environmental impacts will need to be re-evaluated.

A comparison of the 95 percent UCL ground-water concentrations to the appropriate water-quality criteria was conducted to evaluate the potential ground-water discharge might have on benthic dwelling organisms. This comparison is presented in Table 10. This qualitative evaluation suggests that the potential exists for the ground water to affect sediment dwelling organisms.

Risks to terrestrial organisms associated with the Site were not quantitatively evaluated. The Site has not been identified as a critical habitat for any species, and no State nor Federal endangered species that have been reported as migrating through the Wildlife Reserves are known to reside in the immediate vicinity of the Site. Terrestrial animals could be exposed via ingestion of surface water or aquatic life. The level of exposure to constituents in the leachate is unknown and difficult to quantify.

Without a more comprehensive assessment of the potential or actual impacts of the Site on aquatic and terrestrial ecosystems, final conclusions regarding environmental risk cannot be made. As a result, an ecological assessment has been initiated to provide a more definitive answer to this question. The results of the ecological assessment will be available for the GWOU remedy selection process.

VII. DOCUMENTATION OF SIGNIFICANT CHANGES

A significant change has been made in the remedy selected for the SCOU since the publication of the FS and Proposed Plan in October 1991. The remedy recommended in the Proposed Plan was Alternative Number 5, Solid Waste Cap with Soil Vapor Extraction (SVE) Treatment. The remedy selected in this ROD is Alternative Number 3, Solid Waste Cap. This change is a logical outgrowth based on the information available during the public comment period and the comments submitted. Alternative Number 3, Solid Waste Cap, has been determined to provide the most appropriate balance of tradeoffs among alternatives, with respect to the nine criteria, in light of public comment.

The primary means for protection of human health and the environment in this alternative is the Solid Waste Cap and associated institutional controls which preclude direct exposure to the waste material. The cap provides a substantial reduction in infiltration of precipitation through the landfill. The primary means of contaminant transport from the landfill is from infiltration, although the potential for lateral ground-water flow affecting contaminant migration exists. This will be further addressed in the GWOU.

Public comments have correctly pointed out that the SVE system is tied directly to ground-water quality since its primary objective is to significantly reduce the source of VOCs to the ground water. The goal of the SVE system would be to achieve a level of VOCs in the waste and vapors necessary to achieve protective levels of VOCs in the ground water. A determination of these levels cannot take place until ground-water cleanup levels are in place. In addition, to meet the remedial action objectives set forth in Section VIII, the SVE system must be designed and implemented to remove VOCs from both the vadose and saturated zones of the landfill materials, perhaps necessitating a need to dewater the landfill. Therefore, based on public comment, the remedy selected in this ROD for the SCOU has been changed from that presented in the Proposed Plan.

VIII. DESCRIPTION OF ALTERNATIVES

The FS identified five remedial action objectives for this operable unit based on the information gathered during the RI and potential exposure routes and risks identified in the Baseline Risk Assessment. The objectives identified in the SCOUFS are:

(1) Reduce and control the movement of contaminants from the waste material to ground water, surface water, and air;

(2) Prevent exposure to waste materials and leachate seeps through direct contact, ingestion, or inhalation;

(3) Manage leachate seeps to protect surface water resources;

(4) Remove and treat VOC-contaminated vapors within the waste to the extent practical; and

(5) Minimize long-term site management and maintenance.

A comprehensive list of appropriate remedial technologies was identified for source control. These technologies were screened based on their cost, implementability, and effectiveness, characteristics of the Site and the characteristics of the contaminants. Technologies which satisfied the initial screening were refined to form remedial action alternatives. A summary of the five alternatives, including the no action alternative, is provided in Figure 14. A narrative description of these options follows:

ALTERNATIVE 1: NO ACTION

This alternative is evaluated as required by the NCP to determine the public health, public welfare and environmental consequences of taking no further action. Under this alternative, nothing would be done at the site regarding the waste mass. The site would continue to operate under its operating license.

Capital Cost:	$0
Total Present Worth Cost:	$0
Time to Implement:	None

ALTERNATIVE 2: LIMITED ACTION

The Limited-Action alternative would consist of several remedial activities that would be implemented to provide for the protection of human health and the environment. Institutional controls in the form of access and deed restrictions would be used to prevent access to the site, to limit future land use of the Site, and to prohibit placement of ground-water extraction wells within the contaminated portion of the aquifer. This is in conformance with NR 112, Wis. Adm. Code which requires that no drinking water wells be located within 1,200 feet of a landfill unless a variance is obtained from the WDNR. In addition, NR 504 and NR 514 Wis. Adm. Code address final uses of landfill sites and prohibit certain activities on landfill sites including the construction of buildings. Operational controls would provide for the continued acceptable and safe operation of the landfill. Operational controls are also addressed under State regulations NR 500-520 Wis. Adm. Code.

Access restrictions would be provided in the form of the installation of a fence surrounding the landfill area. A sufficient number of warning signs would be placed along the perimeter fence and security measures would be implemented to deter unauthorized entry. Deed and zoning restrictions would be initiated through the local authorities. Deed restrictions would preclude future development of the Site for residential construction and prohibit the placement of ground-water wells within the affected portion of the aquifer for potable or non-potable use.

Operational controls would include an investigation of waste minimization procedures at the manufacturing plant that could reduce total waste quantities, a reduction in the quantity of high moisture content wastes, and continued management of waste deposition to maintain proper slope stability. Surface controls would be continued, to improve the topography of the site, increase slope stability, and control precipitation runon and runoff.

Capital Cost: $70,500
Total Present Worth Cost: $89,000

ALTERNATIVE 3: SOLID WASTE CAP

The major elements of this alternative are closure of the landfill in conformance with Wisconsin Administration Code (WAC) NR 500 through 520, and the installation of an NR 504 Wis. Adm. Code solid waste cap over the entire landfill (which is in conformance with a RCRA Subtitle D cap). This alternative also includes the use of institutional/operational controls and surface controls similar to Alternative 2 with the exception that a perimeter fence is not included since the cap will provide a suitable barrier against exposure. In addition, shallow interceptor trenches are included in this alternative as part of the cap design to collect leachate seepage from the fill. Based on data collected during the RI, treatment via air stripping is also included. Discharge of the treated leachate to the Sheboygan River will meet the requirements of WAC NR 102, 104, 105, 106, and 207, and as such, WDNR will determine the final treatment and discharge option during the remedial design when leachate quality and technology-based treatment standards are finalized.

The cap will provide a barrier to direct exposure to the waste material as well as limiting water infiltration into the landfill. The institutional controls will limit future site usage in order to maintain cap integrity and prevent exposure to affected ground water.

Capital Cost: $3.7 million
Total Present Worth Cost: $4.7 million
Time to Implement: 8 - 12 months

ALTERNATIVE 4: HAZARDOUS WASTE CAP

This alternative is essentially the same as the previous alternative except that a RCRA Subtitle C cap in conformance with WAC NR 181 would be used instead of a WDNR solid waste cap. The RCRA Subtitle C cap would provide additional layers of material over that of the solid waste cap to reduce the amount of infiltration and provide additional protection against subsidence and cap damage. This alternative includes the use of institutional and operational controls as described under Alternative 2, with the exception that a fence will not be included because of the effective barrier provided by the cap. Shallow interceptor trenches are also included in this alternative as part of the cap design to collect leachate seepage from the fill. This alternative limits future site uses, limits exposure, and controls contaminant migration as in Alternative 3. Leachate treatment, similar to that described in Alternative 3, is also included to ensure compliance with the identified ARARs prior to discharge of the effluent to the Sheboygan River.

Capital Cost:	$6 million
Total Present Worth Cost:	$7.1 million
Time to Implement:	12 - 15 months

ALTERNATIVE 5: SOLID WASTE CAP WITH SOIL VAPOR EXTRACTION (SVE) TREATMENT

Alternative 5 includes the implementation of the components of Alternative 3, and combines it with treatment of VOC source areas. The treatment component would consist of an SVE system with treatment of the collected vapors prior to emission. SVE refers to the practice of inducing an air flow through the soil or waste matrix to remove volatile contaminants. As a result, not only is the infiltration of water through the waste material reduced but most of the VOCs, which contribute significantly to site risks, are also reduced.

The SVE system would consist of vapor-extraction wells placed strategically at the Site, and an air-treatment system would be employed as needed to meet Wisconsin air-quality standards. The vapor-extraction wells draw air containing VOCs to the surface where it is treated as necessary to meet Wisconsin air-quality standards (WAC NR 400 through 484) prior to discharge to the atmosphere. Catalytic oxidation has been identified as the most effective technology for treating the air emissions. WDNR would make the final determination of treatment standards during the remedial design when adequate data regarding emission quality and rates is available.

Capital Cost:	$4.3 million
Total Present Worth Cost:	$6 million
Time to Implement:	12 - 16 months to place the cap and SVE system; 3 - 5 years SVE operation

Phasing of the Remedy

The "Time to Implement" information provided for each of the alternatives refers to the implementation period beginning with landfill closure. This is not necessarily representative at the Kohler site because it is an operating landfill. Operations at the landfill will continue for the time specified in the Final Closure Plan pursuant to the Operating Permit. This will allow the site to be filled to a final grade that ensures proper drainage and construction of the cap in accordance with State requirements. This will most likely add approximately 2 years to the "Time to Implement" estimates provided. Elements of the selected response action, such as institutional/operational controls, surface controls, grading of the fill materials, zoning and deed restrictions, and security control measures will be implemented prior to final closure of the Site. In addition, it is anticipated that the placement of the cap will be accomplished in phases as each section of the site achieves final grade.

IX. SUMMARY OF THE COMPARATIVE ANALYSIS OF ALTERNATIVES

The alternatives are evaluated against the nine criteria contained in the NCP [40 CFR 300.430(e)(9)(iii)], by balancing long-term effectiveness and permanence, reduction of toxicity, mobility, or volume through treatment, short-term effectiveness and implementability with the cost of the remedy. This evaluation determines the most protective and cost-effective alternative that will meet the remedial action objectives at the Kohler Company Landfill site. The nine criteria are:

(1) Overall Protection of Human Health and the Environment

U.S. EPA measures each alternative by how effectively risks posed by each exposure pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

(2) Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

The alternatives are evaluated for compliance with State and Federal ARARs determined to be applicable, or relevant and appropriate to the site or provide grounds for invoking a waiver.

(3) Long-Term Effectiveness and Permanence

This criterion relates to the degree of residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup goals have been met.

(4) Reduction of Toxicity, Mobility,or Volume through Treatment

This criterion relates to the anticipated performance of the treatment technologies a remedy may employ.

(5) Short-Term Effectiveness

This criterion addresses the period of time needed to achieve protection against any adverse impacts on human health and the environment that may be posed during the remedy's construction and implementation period, until cleanup requirements are achieved.

(6) Implementability

This criterion addresses the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement a particular option.

(7) Cost

This criterion includes estimated capital costs, operation and maintenance costs, and present net worth costs.

(8) State Acceptance

This criterion addresses the State's comments on the proposed remedial action.

(9) Community Acceptance

This criterion summarizes the public's general response to the alternatives described in the Proposed Plan and FS.

1. Overall Protection of Human Health and the Environment

Alternatives 3, 4, and 5 are protective of human health and the environment since each would minimize the risks posed by direct contact, inhalation, or ingestion of site-related contaminants in the waste through containment of the waste. Containment of the waste would limit exposure to the waste material and reduce the potential for contaminant movement from the waste mass into the ground-water by reducing infiltration. The institutional controls, by minimizing site access and controlling land and ground water use, would add to the protectiveness. Collection and treatment of leachate will reduce potential exposure and the discharge of leachate into the Sheboygan River. The SVE system in Alternative 5 would provide some additional protectiveness through the removal and treatment of VOCs from the waste mass, but would not affect the SVOCs nor inorganic compounds. The solid waste cap and SVE system would be implemented to ensure that the remedy is effective in meeting the ground-water cleanup standards to be determined in the ground-water operable unit.

Alternative 2 would reduce human exposure to contaminants through institutional controls, but would not be as protective as the previously listed alternatives since they employ a cap. Alternative 1 will not provide protection from risks associated with the site contaminants. Ground water will continue to degrade due to release from the source. Therefore, Alternative 1 will not be included for further consideration.

2. Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

Alternatives 3, 4, and 5 will comply with State and Federal ARARs for this operable unit. State solid waste regulations, NR 500 through 520 Wis. Adm. Code, for existing landfills are applicable for this Site because it is a licensed solid waste landfill. The landfill caps described in Alternatives 3 and 4, and used in Alternative 5, meet current Wisconsin requirements for solid waste and hazardous waste landfill closures. The closure plan required pursuant to NR 514.07 Wis. Adm. Code must address long term care of the site (operation and maintenance) and include a final use plan. NR 504.07 Wis. Adm. Code requires that final use of the site must be compatible with the final cover system and prohibits the establishment or construction of buildings on the site or excavation into the cover. NR 112 Wis. Adm. Code prohibits the placement of water wells within 1,200 feet of the site. These are applicable requirements and will be addressed in the site closure plan. Water from the leachate collection drain in Alternatives 3, 4, and 5 would be treated prior to discharge to the Sheboygan River in accordance with State requirements for treatment and discharge to a surface water, WAC NR 102, 104, 105, 106, and 207. Contaminants extracted from the waste material by the SVE system pursuant to Alternative 5 would be monitored and treated as necessary to ensure that Wisconsin Air-quality standards, WAC NR 400 through 484 are met.

In addition, Alternatives 3, 4, and 5 will reduce infiltration of rain water into the landfill, thereby reducing the migration of additional contaminants into the ground water. Alternative 2 fails to meet the Wisconsin ARAR which requires the use of a cap at the site (WAC NR 500 through 520). Alternative 2 therefore will not be included for further consideration.

3. Long-Term Effectiveness and Permanence

The long-term effectiveness of those alternatives which employ a cap as a barrier to exposure and a means of reducing infiltration through the fill (Alternatives 3, 4, and 5) are roughly equal since the cap and associated institutional controls provide for permanent protection. Alternative 5 reduces risk by removing from the waste material some of the more volatile and mobile compounds. This reduction is judged marginal since infiltration through the unsaturated zone of the landfill will be substantially reduced by the cap. Leachate collection and treatment (in alternatives 3, 4, and 5) will add to the permanence of the site by contributing to the cap integrity and by removing an additional source to the river. These technologies are considered reliable and proven and can be easily maintained. Thus, the source control alternatives 3, 4, and 5 are determined to provide roughly equal long-term protection.

4. Reduction of Toxicity, Mobility, or Volume through Treatment

The alternatives which include a cap (Alternatives 3, 4, and 5), while not reducing mobility directly through treatment, offer a reduction in the migration of the hazardous constituents in the fill by reducing infiltration and therefore decreasing the potential for leaching of contaminants into the ground water. Alternative 5, by incorporating the collection and treatment of VOCs in the SVE system, reduces the toxicity, mobility, and volume of VOCs by removing and treating them. The SVE system is not effective in reducing toxicity, mobility, nor volume of SVOCs and inorganic compounds since they are not affected by the system.

The collection of the leachate in the perimeter collection drain (Alternatives 3, 4, and 5) will result in a small reduction of the contaminant discharge into the Sheboygan River, and will result in a minor reduction in toxicity, mobility, and volume through treatment of the contaminants. The perimeter collection drain will not affect the discharge of contaminants to the Sheboygan River via ground water. Further reductions of contaminant discharge through ground water will be addressed in the GWOU.

5. Short-Term Effectiveness

Alternatives 3, 4, and 5 offer similar degrees of short-term effectiveness because the major factors influencing short-term effectiveness involve closure of the landfill and construction of the cap, which is a main component of each of these alternatives. Because construction activities of the selected remedy will not be initiated for about 2 years while the Site is brought to final grade (see Section VIII, Phasing of the Remedy), protection to the community would be addressed through the implementation of institutional and operational/surface controls, and access and deed restrictions immediately. In addition, the use of operational and surface controls will help to minimize infiltration until the cap is in place. The construction of the cap will be accomplished in stages as sections of the landfill reach final grade, which will also reduce infiltration.

The potential for site personnel to be exposed through direct contact with waste materials during the closure and capping activities is considered minimal or nonexistent and was not considered in the Baseline Risk Assessment, The landfill accepts only non-hazardous wastes and the potential risk associated with handling and disposal activities was determined to be a health and safety issue addressed as part of employment.

Installation of the cap would potentially increase particulate emissions. Dust suppression techniques are available and would be used as warranted by the conditions. Construction of the cap could also potentially increase traffic accidents in the area surrounding the site due to the large number of trucks required to haul clay and soil. The risks to site construction personnel would be mitigated through use of Occupational Health and Safety (OSHA) standards and proper safety procedures for the work performed. While the risks to the community may be slightly increased during implementation, the short period of time for construction of the cap should still have a moderate degree of short-term effectiveness.

6. Implementability

No major implementability problems are anticipated for Alternatives 3, 4, or 5. The technologies included in each alternative are technically feasible, readily available, easily implemented, and are considered reliable. The hazardous waste cap in Alternative 4 would take longer to install than the solid waste cap in Alternative 3 since it is more complex (8 months vs. 12 months). Alternative 5 offers some added complexity over a solid waste cap alone (Alternative 3) since the SVE system would have to be integrated with the cap design and construction schedule. The need to conduct pilot and treatability studies before the system is fully implemented could cause some delay.

7. Cost

Alt.	Capital Cost	O&M Cost	Total Present Worth Cost
3	$3.7 million	$1 million	$4.7 million
4	$6 million	$1.1 million	$7.1 million
5	$4.3 million	$1.6 million	$6 million

Note: O&M = Annual Operation and Maintenance Cost

8. State Acceptance

The State of Wisconsin is in agreement with the selection of Alternative 3 for remediation of the Kohler Company Landfill site and has provided U.S. EPA with a letter of concurrence.

9. Community Acceptance

Based on the comments received by U.S. EPA, the selected remedy is acceptable to the community. U.S. EPA responses to the comments are found in the attached Responsiveness Summary.

X. THE SELECTED REMEDY

As provided in CERCLA and the NCP, and based upon the evaluation of the RI/FS and the nine criteria, U.S. EPA, in consultation with the WDNR, has identified Alternative 3 as the selected remedial alternative for the source control remedial action at the Kohler Company Landfill Site. Alternative 3 represents the best balance among evaluation criteria and satisfies the statutory requirements for protectiveness, compliance with ARARs, cost effectiveness, and the use of permanent solutions and treatment to the maximum extent practicable.

Alternative 3: Solid Waste Cap

Time to Implement:	8 - 12 months
Capital Cost:	$3.7 million
Annual O&M Cost:	$1 million
Total Present Worth Cost:	$4.7 million

Major components of the selected remedy are the following:

* Closure of the Kohler Company Landfill;
* Installation of a multi-layer solid waste cap over the landfill;
* Installation of a perimeter leachate collection drain;
* Collection and treatment of leachate with discharge to the Sheboygan River;
* Institutional/operational and surface controls;
* Zoning and deed restrictions; and,
* Effective security control measures.

XI. STATUTORY DETERMINATIONS

Under its legal authorities, the primary responsibility of U.S. EPA at Superfund sites is to undertake remedial actions that achieve adequate protection of human health and the environment. In addition, Section 121 of CERCLA, establishes several other statutory requirements and preferences. Section 121 requires that the selected remedy must:

a. Protect human health and environment;
b. Comply with ARARs;

c. Be cost effective;
d. Utilize permanent solutions and alternate treatment technologies to the maximum extent practicable; and
e. Satisfy the preference for treatment as a principal element of the remedy or document in the ROD why the preference for treatment was not satisfied.

The following sections discuss how the selected remedy (Alternative 3) meets these requirements.

a. Protection of Human Health and the Environment

Implementation of the selected alternative will reduce and control potential risks to human health and the environment posed by exposure to contaminated waste by closure and capping of the landfill.

Capping the landfill, in addition to reducing any potential risks that may be posed by direct exposure to contaminated waste, will reduce the infiltration of precipitation through the landfill, thereby reducing the ground water contaminant loading.

No unacceptable short-term risks will be caused by implementation of the remedy. The site workers may be exposed to noise and dust nuisances during construction of the cap. A standard health and safety program will manage any short-term risks. Dust control measures would reduce those risks as well.

b. Compliance with ARARs

The selected alternative will meet all Federal and State ARARs. The following is a description of the environmental laws which are legally applicable or relevant and appropriate to different components of the remedy:

Solid Waste Cap/Landfill Closure
State solid waste regulations, NR 500 through 520 Wis. Adm. Code, for existing landfills are applicable for this Site because it is a licensed operating solid waste landfill. NR 504.07 Wis. Adm. Code contains the requirements for the solid waste cap that is included in the selected alternative. While both solid and hazardous waste requirements were reviewed as potential ARARs, the hazardous waste requirements (including RCRA) were not found to be relevant and appropriate because the State solid waste requirements provide adequate protection. In addition, the Site did not receive RCRA listed wastes after November 19, 1980. Therefore, it was determined that an NR 504.07 cap, in conjunction with a perimeter leachate collection drain, provides adequate protection. NR 504.07 seeks to minimize infiltration by specifying clay type, slope, and topsoil requirements for a final cover for the Site. Although State regulations may require a gas venting system to relieve

gas buildup beneath the cap (NR 445, NR 504.07, NR 506, NR 508, NR 514.07 Wis. Adm. Code), the Site is an industrial (as opposed to municipal) landfill and buildup of methane and other gases resulting from the anaerobic decomposition of waste is not a primary concern. Therefore, the requirements for a gas venting system are not appropriate.

The Closure Plan required pursuant to NR 514.07 Wis. Adm. Code will address long term care including an inspection/maintenance schedule. A Final Use Plan is also required. NR 504.07 Wis. Adm. Code requires the final use of a landfill site to be compatible with the final cover system and specifically prohibits the establishment or construction of buildings on the site or excavation into the cover.

<u>Leachate Collection and Treatment</u>
The selected remedy will achieve State ARARs for discharge to surface water through discharge of treated leachate to the Sheboygan River. Wisconsin effluent levels for discharge to the Sheboygan River will be established in accordance with NR 102, NR 104, NR 106, NR 108, and NR 207 Wis. Adm. Code. The requirements of NR 220 Wis. Adm. Code must also be satisfied. Effluent limitations based on the use of best available control technology economically available (BAT), or best practicable control technology currently available, will be determined by the WDNR during the remedial design phase of the project.

Additional ARARs which will be met follow: NR 112, Wis. Adm. Code requiring that no drinking water wells be located within 1,200 feet of a landfill unless a variance is obtained from the WDNR; NR 116 Wis. Adm. Code, Wisconsin's floodplain management program which governs all activities taking place in a floodplain; NR 112 and NR 141.25 Wis. Adm. Code, which specify abandonment requirements for monitoring wells and boreholes; Clean Water Act (CWA), Ambient Water Quality Criteria for protection of aquatic life; 40 CFR Part 268, Land Disposal Restrictions, would be applicable if residuals generated through leachate treatment exhibit hazardous characteristics.

<u>Wetlands</u>
Construction activities involved with the placement of a solid waste cap and installation of a leachate collection/treatment system may impact small areas located at the toe of the fill and to the northeast which are currently classified as wetlands. The selected alternative through the reduction of infiltration and collection of the leachate seeps may result in drying up these wetlands areas. CWA, Section 404 regulates the disposal of fill materials in waters of the United States including wetlands. 40 CFR Part 6 contains regulations requiring Federal agency actions (such as fill activities) to avoid or minimize adverse impacts on wetlands, and to preserve and enhance the natural values of wetlands. These are applicable at this Site

and will be met through one of the following responses: Kohler Company may be required to pay into a national fund for wetlands restoration an amount commensurate with the damage incurred to wetlands at the Site; Kohler Company may be required to create wetlands similar in scope and nature to those damaged in a nearby area; or if the overall wetlands impact is negligible, then no response may be deemed necessary. The determination of wetland impact and the required response will be made by U.S. EPA during the remedial design stage.

Following completion of this ROD, the Site will become State enforcement lead. The State will therefore ensure that compliance with the identified ground-water ARAR, Wisconsin Statute, Chapter 160 and NR 140, WAC, is achieved through the selection and implementation of the final remedy for addressing ground water.

c. Cost Effectiveness

Cost effectiveness compares the effectiveness of an alternative in proportion to its cost of providing its environmental benefits. Alternative 3 is a cost-effective alternative providing for protection of human health and the environment and long-term effectiveness. Alternative 2 is somewhat less expensive than the selected remedy, but attains a lesser degree of long-term effectiveness because the landfill continues to operate and no cap is placed. Because there is no cap, there is a greater risk of contaminants continuing to affect the ground water with Alternative 2 over the long term. Alternative 4 is the most expensive alternative without providing proportional increased effectiveness. Alternative 5 is more costly than Alternative 3 and provides no proportional increase in effectiveness.

d. Utilization of Permanent Solutions and Alternative Treatment Technologies or Recovery Technologies to the Maximum Extent Practicable

U.S. EPA and the State of Wisconsin believe the selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a cost-effective manner for the SCOU remedy at the Kohler Company Landfill site. Of the alternatives that are protective of human health and the environment and comply with ARARs, U.S. EPA and the State have determined that the selected remedy provides the best balance of tradeoffs in terms of long-term effectiveness and permanence, reduction of toxicity, mobility or volume achieved through treatment, short-term effectiveness, implementability, cost, the statutory preference for treatment as a principal element, and State and community acceptance.

Alternative 3 complies with ARARs; provides long-term effectiveness; and protects human health and the environment equally as well as Alternatives 4 and 5. The major tradeoffs that provide the basis for this selection decision are short-term effectiveness, implementability, and cost. In terms of short-term effectiveness, Alternative 3 takes the shortest time to implement because there are no substantive permit requirements, as needed for Alternative 5. Alternative 3 also poses minimal risk to remediation workers and the community during the implementation period. Alternative 3 will be easier to implement technically because it requires less construction, and administratively because it will require less coordination within the WDNR and U.S. EPA. Finally, Alternative 3 is the least costly alternative that affords the protection of closing and capping the site. The selected remedy is more reliable and can be implemented more quickly, with less difficulty and at less cost than the other treatment alternative and is therefore determined to be the most appropriate solution for source control at the Kohler Company Landfill site.

The State of Wisconsin is in concurrence with the selected remedy. Public comments are fully addressed in the Responsiveness Summary.

e. Preference for treatment as a principal element

The selected response action does not satisfy the statutory preference for remedies that employ treatment as a principal element. Treatment of the waste mass (i.e., SVE system) to permanently and significantly reduce toxicity, mobility, or volume of the contaminants (VOCs) was not found to be practicable nor cost effective for this operable unit.

The goal of the SVE system is to achieve a level of VOCs in the waste and vapors necessary to achieve a protective level of VOCs in the ground water, thus tying the design of the SVE system directly to ground water-quality. This determination of acceptable levels of VOCs in the waste and vapors cannot occur until the ground-water cleanup levels are in place. Thus, the SVE system is considered an integral part of the ground-water remedy at this site and this treatment element will be considered when the ground-water alternatives are evaluated.

XII. RESPONSIVENESS SUMMARY

This Responsiveness Summary has been prepared to meet the requirements of Sections 113(k)(2)(B)(iv) and 117(b) of CERCLA, as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), which requires U.S. EPA to respond "...to each of the significant comments, criticisms, and new data submitted in written or oral presentations" on a proposed plan for remedial action. The Responsiveness Summary addresses concerns expressed by the public, PRPs, and governmental bodies in the comments received by U.S. EPA regarding the proposed plan for remedial action at the Site.

Public Response to U.S. EPA's Preferred Remedy

In general there is not a high level of community interest in the Site. Despite advertisements, press releases and fact sheet mailings, the Oct. 15, 1991 public meeting was poorly attended by local residents. The majority of those present at the public meeting, and from whom comments were received, were the PRP at the site and their representatives, and representatives for the PRPs of the Sheboygan River and Harbor site (of which Kohler Company is one).

Responses include those received from Kohler Company (through its contractor) and from Tecumseh Products Company (through its contractor). The general theme of the PRP comments was that the remedy should be changed on the basis of new information received during the public comment period. Sheboygan River and Harbor PRP comments pertained to the documentation provided in the administrative record which provides the basis for the preferred remedy.

Background on Community Involvement

Community interest and involvement at the Site has been minimal. Public meetings have been poorly attended by the community and the press. Fact sheet mailings have failed to generate interest as evidenced by the lack of questions and requests for information on the Site. The October 15, 1991 public meeting in which U.S. EPA presented the recommended alternative did not result in any oral public comments.

Of those who did present written comments, the following topics are of concern for the Site commenters:

- preference for a different alternative than that recommended;
- operable unit approach;
- administrative record; and
- the RI/FS.

A number of comments were also provided which dealt with subjects that did not pertain to this public comment period. Specifically these comments dealt with ground water operable unit activities, ground water ARARs, ground water remedies, alternate concentration limits, Kohler Company's involvement in the preparation of fact sheets, additional data collection efforts, and ground-water protection standards.

Summary of Public Comments and Agency Responses

Two sets of written comments were received by U.S. EPA. The comments and responses for the first commenter follow.

COMMENT: The commenter expressed concern that the remedy recommended be changed from solid waste cap with SVE treatment (Alternative 5) to solid waste cap (Alternative 3). The only difference between these two alternatives is the incorporation of an SVE system in Alternative 5. The commenter points out that the SVE system is tied directly to ground-water quality at the Site since soil gas cleanup levels are linked with ground-water protection standards. Therefore, the commenter states, a "...decision regarding SVE technology (should) be deferred for analysis as part of the overall ground-water remedy at the Site when it can be evaluated along with other remedies and when applicable or relevant and appropriate requirements for the ground-water remedy are better defined."

RESPONSE: U.S. EPA agrees and, in consultation with the WDNR, has selected Alternative 3, solid waste cap, as the remedy selected for the SCOU ROD.

COMMENT: The commenter questioned the basis and need for splitting site remediation into operable units. The commenter believes that the basis for the operable unit approach was not consistent with the NCP. In addition, the commenter critiques the need for such an approach since the SVE system is an integral part of the ground-water remedy for the Site.

RESPONSE: U.S. EPA chose the operable unit approach for the Site on the basis of expediting site closure and capping, thereby providing a substantial reduction in the infiltration of precipitation, and contaminant movement through the landfill into the ground water and Sheboygan River. Part 300.430(a)(1)(ii)(A) of the NCP outlines three reasons for using the operable unit approach. Specifically, the third reason, "to expedite the completion of the total site cleanup," provided the basis for this approach.

COMMENT: The commenter expressed concern over the lack of certain documents being placed in the administrative record in a timely manner. A list of "Proposed Administrative Records Additions" was provided. The commenter requested an extension to the public comment period in order to review those additional documents placed in the administrative record. A second set of comments was provided following the closure of the public comment period.

RESPONSE: U.S. EPA reviewed the administrative record and provided those missing documents. The "Proposed Administrative Records Additions" provided by the commenter was reviewed and all documents considered or relied upon in the decision-making process were added into the administrative record. The public comment period was extended twice, running from October 14, 1991 through January 6, 1992, thereby accounting for 75 days in which the public could provide comments. In addition, U.S. EPA accepted and is responding to comments dated January 17, 1992, eleven days following closure of the public comment period.

The commenter provided several specific comments regarding the Proposed Plan. These are addressed in the following responses.

COMMENT: The requirement for treatment of leachate prior to discharge to the Sheboygan River and of VOC-contaminated emissions from the SVE system is questioned.

RESPONSE: Leachate is required to be treated prior to discharge to the river in order to be in compliance with the ARARs for the Site, NR 102, 105, 106, and 207 Wis. Adm. Code. Treatment of VOC-contaminated vapors prior to emission is required as necessary to meet standards provided in NR 400 - 484 Wis. Adm. Code.

COMMENT: The data characterizing runoff water and runoff water sediment is not representative of current conditions at the site.

RESPONSE: The RI, FS, and Phase I Technical Memorandum provide a clear confirmation the runoff water and runoff water sediment (i.e., soil) data is representative of Phase I conditions collected in Spring 1987. A second round of select soil samples was collected during Phase II for confirmatory purposes.

COMMENT: The commenter pointed out that the present worth cost given for the HW CAP on page 5 is not the same as provided on page 6.

RESPONSE: This discrepancy is correct. The cost provided on page 5 should be $7.1 million, not $6.9 million.

COMMENT: The commenter provided a clarification of the final sentence on paragraph 1 of the description of alternative 5 on page 5. The commenter indicated that VOCs in the unsaturated zone "...do not contribute to (site) risks unless they travel into the ground water and this ground water is used for consumption or showering. With the implementation of a cap the migration route for VOCs in the unsaturated zone to the ground water is reduced...even without an SVE system, the threat posed by the (VOCs) in the unsaturated zone is significantly reduced."

RESPONSE: U.S. EPA agrees with the commenter.

COMMENT: The commenter indicated that the FS "...points out that uncertainties relating to the leachate collection and SVE portions of the remedies, primarily regarding compliance with ARARs, makes the judgement on the short-term effectiveness, implementability, and cost of Alternatives 3, 4, and 5 also subject to uncertainty," and requested an explanation of how these uncertainties affect the remedy selection process.

RESPONSE: U.S. EPA understands that the uncertainties referred to in the FS are in regard to the type of leachate treatment required prior to discharge in order to be in compliance with the identified ARARs, and the final scope of any required treatment of SVE emissions in accordance with ARARs. This understanding hinges upon discussions between the author of the FS, U.S. EPA, and WDNR, and is the basis for assumptions made in the FS.

To carry out the nine criteria evaluation, certain assumptions were made concerning the scope of leachate and VOC-contaminated vapor treatment. Treatment of these waste streams must be performed in conformance with the identified ARARs. The most conservative, and therefore most protective, assumptions were made, i.e., that treatment would be necessary. The assumptions regarding the scope of the treatment were based on the leachate and soil vapor data available through RI data collection activities. The final decisions regarding treatment will be made based on the analyses of leachate collected by the perimeter drain and of soil vapors extracted by the SVE system, and treatability studies which are planned for the remedial design stage.

COMMENT: The commenter was concerned about item 4 on page 6, regarding the reduction of toxicity, mobility, or volume through treatment discussion as it relates to treatment of leachate and SVE-contaminated vapors. The commenter indicated that the "...treatment of leachate or SVE emissions is unfounded."

RESPONSE: The ARARs relating to the requirement for treatment of these waste streams prior to discharge are discussed above.

The second commenter provided written comments on the RI Report, Baseline Risk Assessment, and FS Report. Each of these comments are responded to in the same order of presentation in the following paragraphs.

RI Report

COMMENT: The commenter stated that waste sampling and analysis should have been conducted in areas of the landfill where old haul roads were located. This is based on records indicating that waste hydraulic fluids, oils, and coolants were commonly used for dust control on the site haul roads during the early years of operation, and, that PCBs were found in both the hydraulic systems and electrical equipment during a Toxic Substances Control Act (TSCA) inspection by the Agency.

RESPONSE: While U.S. EPA agrees with the commenter, the waste sampling was performed due to the significant concentrations of VOCs found in the vapors within the waste materials and for the purpose of evaluating an SVE component for possible addition to the remedial alternatives to be evaluated in the FS.

COMMENT: The commenter does not believe that all of the information necessary for assessing human health and ecological risks has been collected; specifically, sampling of riverbank sediments, fish, and wildlife should be conducted.

RESPONSE: U.S. EPA agrees with the commenter. The remedy selected in this ROD is a source control action and comprises the first of two operable units. The operable-unit approach was undertaken in order to expedite response action at the Site. Additional data collection activities are planned and will take into consideration the commenter's concerns.

COMMENT: The commenter indicated that ground water should be sampled for PCBs.

RESPONSE: U.S. EPA has already initiated sampling and analysis of the ground water for PCBs and the results will be made available over the next several months.

COMMENT: The commenter stated that the Sheboygan River, "...rather then being an effective barrier, ... is really acting as a 'sink' or discharge area for landfill constituents, and should be referred to as such."

RESPONSE: U.S. EPA agrees with the commenter. The Sheboygan River, and more specifically the sediments and biota, are a "sink" for those constituents which are not otherwise lost through such processes as volatilization. This concern will be addressed in upcoming data collection activities.

COMMENT: Comments are provided regarding the collection of landfill runoff water samples, concerning method of collection, and the lack of information regarding frequency collected and magnitude of the storm event.

RESPONSE: The runoff water samples were collected in a manner consistent with U.S. EPA protocol. Runoff water sediment samples (referred to as soil samples in the RI) were also collected in order to address the settlement of solids onto the land surface. Information regarding the magnitude of the storm event is not available.

COMMENT: Regarding runoff water sampling, the commenter indicated that one sample for analysis of VOCs is insufficient to assess the potential for contaminant transport.

RESPONSE: While that is true, the intent of the runoff water sampling was to characterize runoff water for semivolatile and inorganic compounds. Due to the high volatility of VOCs, it was not expected that VOCs would be readily detected in runoff water.

COMMENT: The commenter requested that the term "floodplain" (in terms of a storm event such as '10-year') be defined in relation to the locations of the soil samples from Phase II. The commenter indicated that it is difficult to determine the ultimate source of the PCBs in the floodplain soils without this information.

RESPONSE: The 100-year floodplain is delineated by the eastern base of the landfill (page 6 of the RI). The reference to the regional floodplain on page 61 of the RI is a reference to the 100-year floodplain. A document in the administrative record entitled: Draft Phase II Technical Memorandum (which discusses the activities of phase II during which the second round of soil samples were collected) contains the surveyed locations of the soil samples. Sample KL-SD11 was located outside of the 100-year floodplain. The other sample locations were within the 100-year floodplain. But the question as to whether any of them were within the 10-year floodplain cannot be answered at this time with the information that is available.

COMMENT: The commenter stated that the soil sampling protocol (for soil sampling conducted during phases I and II) was not included in the RI and wants to know at what depth the samples were collected.

RESPONSE: The phase I and phase II protocols are summarized in the Phase I Technical Memorandum and draft Phase II Technical Memorandum, in addition to the Project Operation Plans. The same sampling protocol was utilized during both phases. Samples were collected from a depth of approximately 4 - 6 inches using a hand trowel. Although phase I and II data were included in the RI, only the phase III protocol was included due to the existence of these two previous Technical Memorandums.

COMMENT: The commenter asked why leachate was not sampled for PCBs.

RESPONSE: The leachate was analyzed for those constituents known or suspected of being in the landfill based on the information available at that time. The remedy selected in this ROD addresses leachate with the installation of a perimeter collection drain and treatment system. Additional analysis of the leachate (which will include PCBs) will be done at that time in order to determine the most appropriate treatment system and to finalize discharge standards for the treated effluent.

COMMENT: The commenter indicated that the waste characterization task was insufficiently scoped to fully characterize the landfill wastes.

RESPONSE: The objective of the waste characterization program was not to fully characterize the landfill wastes throughout the landfill, but to provide additional information regarding possible "hot spot" areas for VOCs within the landfill. The locations of the borings were based on the results of the soil gas survey (which provided only information regarding the distribution of VOCs in the landfill) and on information from waste disposal records and aerial photographs regarding the probable locations of the waste disposal pits.

COMMENT: The commenter asked why the site is not fenced.

RESPONSE: Fencing of a landfill site may not be necessary when the landfill is located in a rural area and occasional trespassing does not present a risk, or where the landfill is capped. The Site is located in a rural area and surrounded by the Sheboygan River on two sides. As an operating landfill, the equipment operator and truck drivers are able to provide additional surveillance to the site. The side slopes have received a cap as the landfill reaches final grade in those areas.

COMMENT: The commenter asked why the runoff water was not sampled for PCBs.

RESPONSE: The runoff water was not sampled for PCBs due to the nature of PCBs in that they have a strong affinity for soil particles. In addition, as with the leachate, the known or expected chemical constituents in the landfill formed the rationale behind the sampling program.

COMMENT: The commenter provided an additional comment regarding the floodplain soil samples.

"Based on the review of the historic aerial photos, landfilling operations took place along the western and southern end of the landfill during the period of the 1960s and early 1970s. This would have been the time frame that PCB hydraulic fluids could have been utilized for dust control in the landfill. The aerial photographs from September 26, 1961 and August 28, 1967 depict signs of a surface water channel running from the southwest corner of the landfilled area to the Sheboygan River. Therefore, it is reasonable to assume that runoff would have been directed to the southern portion of the Kohler property, west of all the surface soil sampling locations. It is unfortunate that this portion of the landfill is now covered by County Route A embankment."

The commenter also stated that previous areas of runoff should have been identified for sampling.

RESPONSE: U.S. EPA agrees with the commenter regarding the interpretation of the aerial photographs in question and agrees it is unfortunate that County Highway A now covers old drainage areas.

COMMENT: The commenter stated that a comparison of surface soil inorganic results to average concentrations of inorganics in eastern U.S. soils was inappropriate due to the industrialization of the eastern U.S. and that background soil samples should have been obtained for comparison purposes.

RESPONSE: U.S. EPA agrees that the collection of background samples would have been most appropriate for the purposes of comparison if the objective of the soil sampling had been to characterize the floodplain soils adjacent to the landfill. The characterization of floodplain soils is being considered for inclusion in upcoming data collection efforts.

COMMENT: The commenter believed that the phase I boring into the Old Waste Pit was insufficient for determining the sampling program for the entire site. The concern apparently stems from the fact that PCBs were excluded from the sampling program.

RESPONSE: U.S. EPA agrees. The ground water and waste characterization undertaken in the subsequent phases of the RI included the U.S. EPA list of VOCs, SVOCs, and inorganic compounds, except for PCBs. Additional ground-water investigations are underway for PCBs. In addition, the phase I boring into the Old Waste Pit was undertaken to obtain descriptive and chemical information concerning the wastes placed into it. That information, in conjunction with landfill and other records, was used to finalize the phase I ground water sampling program.

COMMENT: The commenter provided several observations regarding the phase III waste characterization task. The first is that the use of HNU readings was not an appropriate screening mechanism for PCBs and metals.

RESPONSE: U.S. EPA agrees. Visual observation of the waste core was also a screening factor with several samples collected on this basis. The waste borings were placed primarily to obtain information to use in evaluating a soil vapor extraction system as a remedial alternative in the FS. (A soil vapor extraction system removes VOCs from the soils.)

COMMENT: Secondly, the commenter provided the following observation: "Five of the 24 samples had detectable quantities of PCBs, with one sample showing a concentration of 540 ppm. It is inconsistent, based on these statistics, and the employee interviews previously cited, that PCBs were not investigated further in the landfill waste materials. Additional review of the data indicates that 5 of 6 borings placed in known former pits had detectable levels of PCBs. These pits were characterized as receiving oils, hydraulic fluids, etc. As such, this data substantiates that PCBs were disposed in the former pits. It would also be appropriate to analyze soils/materials from former pits for dioxin at an appropriate detection limit, since 2 of these pits were considered 'burning pits'". The commenter goes on to state that further characterization of the pits should be undertaken for PCBs, dioxin, and other constituents.

RESPONSE: U.S. EPA agrees with many of the comments. U.S. EPA does not feel that additional waste characterization efforts are necessary at this time. But, additional ground-water investigatory efforts for PCBs are underway.

COMMENT: The commenter provided additional observations regarding the PCBs detected in the waste samples:

"...it was reported that during early landfill operations, oil, hydraulic fluid and coolant were commonly used for dust control. In addition, it was stated that 'through a review of past purchases of hydraulic fluid, it was found that the facility had not purchased any PCB fluids in at least the last 10 years' (Versar, Inc., Report on Inspection to Determine Compliance with the Federal PCB Disposal and Marketing Regulations, Kohler Company, June 9, 1983). [Note: The referenced document was produced in 1983, so that 'the last 10 years,' would likely mean back to 1973]. However, PCBs were commonly used in hydraulic fluids since the late 1950s and early 1960s. By 1973, concerns over PCBs were raised, and many PCB users were replacing PCB hydraulic fluids with non-PCB materials...Based on information contained in the Versar report...the Aroclors identified in the landfill material are the same as those found in hydraulic and electrical oil samples taken in the early 1980s."

The commenter also suggested that Kohler Company's purchase information relative to hydraulic oil purchases prior to 1973 be reviewed.

RESPONSE: U.S. EPA agrees with the commenter and has plans to look further into this situation.

COMMENT: The commenter made the following statement relative to page 116 of the RI:

"The following statement is made: 'There are no landfill records of PCBs ever being disposed of in the landfill and the source of these PCBs is unknown.' This statement is irrelevant and misleading, since records of materials landfilled at the Kohler facility were not initiated until 1989 (Kohler Co., Kohler Co. Landfill Modification Plan, January 1990). Further, regardless of there being no records of PCBs being disposed in the landfill, they are indeed present and should be investigated accordingly."

RESPONSE: U.S. EPA agrees with the commenter. Additional ground-water investigatory efforts for PCBs are underway.

COMMENT: Referring to page 117, the commenter asked why soils adjacent to the landfill were not analyzed for inorganic compounds.

RESPONSE: The sentence on page 117 (first sentence under paragraph 5.5.3.2) being referred to by the commenter is inappropriate to the discussion in section 5.5, which is waste characterization. To clarify the discussion, no background soil samples were collected for inorganic analyses for the purpose of comparison with foundry waste inorganic analyses. The inorganic composition of soil is an inappropriate basis of comparison for waste materials.

<u>Risk Assessment:</u>
COMMENT: The commenter provided several specific comments regarding two major issues of concern: lack of risk characterization for exposures via surface soils, and lack of data on Sheboygan River media (such as biota and sediments).

RESPONSE: Regarding the lack of a risk characterization for exposures via surface soils: The surface soil data was not collected to characterize floodplain soils but to characterize sediments from surface drainage channels, and as a component of surface runoff sampling. This risk scenario was not quantified because the required data was not available. In addition, there is an overlap between the Kohler Company Landfill site and the Sheboygan River & Harbor site since both site boundaries enclose the floodplain between the landfill and river. The Sheboygan River & Harbor risk assessment is looking at dermal exposure to floodplain soils for PCBs. U.S. EPA guidance on conducting human health risk assessments indicates that best professional judgement should be used in selecting exposure pathways and that certain pathways may be excluded should the potential magnitude of exposure from a pathway is low or the probability of the exposure occurring is very low and the risks are not high. Due to the lack of accessibility of the Site and the heavy vegetation present, it was determined that on the above basis this exposure pathway would be eliminated.

Also, U.S. EPA is planning additional data collection efforts. Should the data resulting from that study warrant re-evaluation in a human health context, U.S. EPA will perform a risk characterization for this exposure scenario.

Regarding the lack of data on Sheboygan River biota and sediments, U.S. EPA plans to conduct an ecological assessment to look at impacts of the discharge of contaminated ground water on the Sheboygan River.

COMMENT: A comment is provided stating that all ground-water data should have been used in the risk assessment.

RESPONSE: U.S. EPA's guidance document, Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual Part A, indicates that the most recent data set may be used in the quantitative risk assessment. The phase III ground-water data, being the most current and comprehensive data set, was felt to be most representative of conditions and therefore used in the risk assessment.

COMMENT: The selection of the COCs is questioned for particular chemicals.

RESPONSE: The COCs were selected in accordance with the risk assessment guidance referenced in the above response.

COMMENT: A reference is made to page R-36 of the Baseline Risk Assessment where it states that RfDs are used in place of reference concentrations (RfC) where RfCs are not available. The commenter stated that when applied to metals at the site, this extrapolation is inappropriate.

RESPONSE: The potential risk of the inhalation of COCs was calculated for VOCs. Therefore, the RfD was substituted for the RfC for VOCs and not for metals.

COMMENT: The commenter indicated that since the Kohler Company high production wells alter ground-water flow patterns, that one round of sampling of these wells, the golf course and club house wells, and residential wells is insufficient. The commenter also indicated concern for the elevated detection limits reported for several of the constituents from these wells.

RESPONSE: The potential for migration of the contaminants under the Sheboygan River and the potential impact on residential wells, and the golf course and club house wells will be re-evaluated during future monitoring activities at the site.

COMMENT: The commenter indicated that the likely exposed area of the body for a site worker to leachate is both the hands and forearms, the same as for the adult resident, whereas the Baseline Risk Assessment considered only the hands.

RESPONSE: The assumptions used in the leachate exposure assessment were found to be acceptable and in accordance with U.S. EPA guidance.

COMMENT: A comment was provided regarding the method used to estimate the COCs concentrations in fish would yield an underestimate of the actual uptake. The commenter stated: "Estimates obtained in this fashion are likely to underestimate true uptake, as accumulation through food-chain (ingestion) and from contaminated sediments are not considered." The commenter goes on to say: "...the use of these values in subsequent risk calculations will underestimate risk from ingesting these fish." The commenter also indicates a need for analytical data describing fish body burdens of the COCs.

RESPONSE: U.S. EPA agrees and will be including fish sampling and analysis in the upcoming ecological assessment.

COMMENT: The commenter indicated that risks from exposures other than those from potable water may be significant, including child and adult ingestion of fish, child trespasser exposure to leachate seeps, and adult resident exposure to leachate seeps.

RESPONSE: U.S. EPA evaluated these risk scenarios in the risk assessment. These risks fall within the U.S. EPA health-based guidelines of 1 X 10-4 to 1 X 10-6 for excess lifetime cancer risk and 1.0 for the hazard index (as given in U.S. EPA guidance and policy). Refer to section VI of the ROD for a discussion on these scenarios. These scenarios will be re-evaluated as warranted in conjunction with upcoming data collection efforts.

Feasibility Study:

COMMENT: The commenter stated the determination that certain waste streams are nonhazardous under RCRA needs further documentation.

RESPONSE: This determination was made by the State of Wisconsin through the operating permit process for acceptance of certain waste streams for disposal at the landfill. This information is available in the State files.

COMMENT: The commenter requested a description of the municipal waste disposed by the Village of Kohler.

RESPONSE: This information is not available, but it is expected that this waste is typical household/landscape waste based on what is known about municipal waste and that there are no other industries in the Village.

COMMENT: The commenter indicated that the data in the RI for runoff water samples for PCBs should be included in the FS.

RESPONSE: No runoff water samples were collected and analyzed for PCBs. Runoff water sediment samples were analyzed for PCBs. These have also been referred to as soil and floodplain soil samples.

COMMENT: The commenter asked how a conclusion given on page 3-12 of the FS, that overall ground water flow to the river is not affected by off-site wells, can be substantiated when pumping of the East Yard well does impact ground-water flow.

RESPONSE: The statement at the bottom of page 3-12 of the FS reads: "Lastly, data also show that pumping from off-site wells does not affect the long-term ground-water flow patterns at the site" (emphasis is made by author). Pumping of the East Yard well affects the short-term ground water flow patterns. The Kohler Company production wells are run intermittently. Once the pump is turned off, the eastward flow pattern resumes.

COMMENT: The commenter pointed out an inconsistency in the concentration of PCBs reported for soil boring 4 on page 3-21 of the FS and figure 3-18.

RESPONSE: Page 3-21 contains a typographical error. The correct concentration should be 10 mg/kg.

COMMENT: The commenter indicated that certain treatment technologies for the leachate were screened out based on the contaminants present and uncertainties involving applicability, and that treatability studies would be one method of making such a determination.

RESPONSE: U.S. EPA agrees that treatability studies provide useful information about various treatment technologies. Treatability studies are not needed when viable treatment methods exist. Much information exists regarding the treatment of landfill leachate. Treatment technologies that effectively address the chemical constituents in the leachate were retained for the detailed evaluation in the FS.

COMMENT: The commenter stated that PCBs should have been included as a contaminant of concern due to their detection at the site, and that the site was not adequately characterized with regard to them.

RESPONSE: PCBs were detected in waste samples collected in the final phase of investigative activities. At that time, a program was begun to investigate ground water for the presence of PCBs. This information will be made available Spring 1992. Additional investigative efforts with regard to PCBs are in the planning stages.

COMMENT: The commenter questioned the "beneficial uses" and "needs and desires of the community" in the discussion regarding the alternative "limited action" on page 7-8 of the FS.

RESPONSE: The potential future use of the property is being referred to.

COMMENT: The commenter stated that exposure through direct contact with leachate seepage and through inhalation of volatilized constituents are exposure routes that should be addressed in the discussion of the alternative "limited action" on page 7-10 of the FS.

RESPONSE: The Baseline Risk Assessment concluded that exposure to leachate seeps did not pose a risk outside of acceptable health guidelines. Air monitoring for VOC vapors, hydrogen sulfide gas, hydrogen cyanide gas, and methane was conducted during field activities in order to ensure the safety of the field personnel. The air monitoring did not detect any of these constituents.

COMMENT: The commenter stated that without sediment data and an analysis of leachate for the full Target Compound and Target Analyte List of chemicals, that the impact of untreated leachate on the Sheboygan River cannot be determined.

RESPONSE: U.S. EPA believes that the data collected has met the objectives set forth for the RI/FS. In addition, the action selected in the ROD incorporates a solid waste cap and a perimeter leachate collection system with treatment, which will be designed to prevent any future potential impacts on the river by leachate. Additional data collection efforts will be undertaken as part of an ecological assessment to study potential/actual impacts of the landfill on the river.

COMMENT: The commenter made a reference to page 7-24 of the FS and the discussion on reduction of toxicity, mobility, and volume through treatment and disagreed with the statement that leachate treatment will not "affect river quality significantly."

RESPONSE: Due to the sporadic nature of the leachate seeps and the low levels of the constituents analyzed for, U.S. EPA does not believe that the statement is necessarily unjustified. In addition, U.S. EPA will be looking into impacts the Site may have or is having on the Sheboygan River in the upcoming ecological assessment.

COMMENT: The commenter believed that the cost of site grading should have been included in the cost estimates for the capping alternatives.

RESPONSE: While U.S. EPA agrees, the Site is an operating landfill and this cost would be born with the costs of the daily operations.

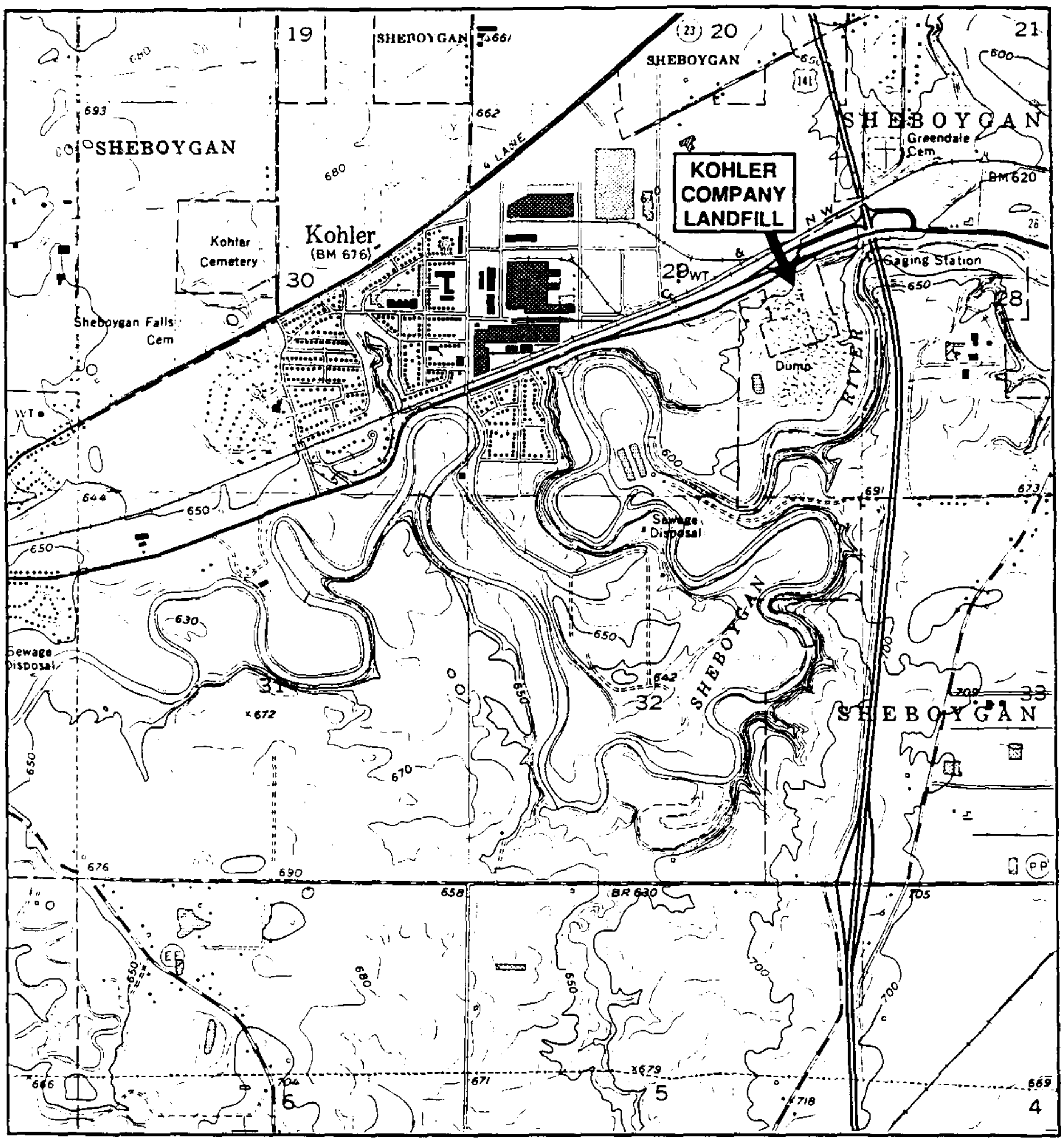
COMMENT: The commenter questioned why the mobilization and temporary erosion control costs differ between the two capping scenarios.

RESPONSE: The mobilization and temporary erosion control costs are given as 2.5 per cent and 1 per cent, respectively, of the cover construction costs which differ.

COMMENT: The commenter questioned the assumption of a five-year period for operation of the SVE system.

RESPONSE: Many assumptions went into the scope of the SVE system for the purposes of the FS. It is recognized that a pilot test will need to be run to more accurately determine the various parameters. The actual length of time the SVE system will be run will depend on the performance standards set and on the monitoring of the emissions and soil vapors.

FIGURES



SOURCE: USGS 7.5 Minute Topographic Map, SHEBOYGAN FALLS, WISCONSIN Quadrangle, 1973

N

0 1000 2000 4000

SCALE IN FEET

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Environmental Services

FIGURE 1
SITE LOCATION MAP
KOHLER COMPANY LANDFILL
KOHLER, WISCONSIN

Kohler Company Landfill Site
Kohler, Wisconsin

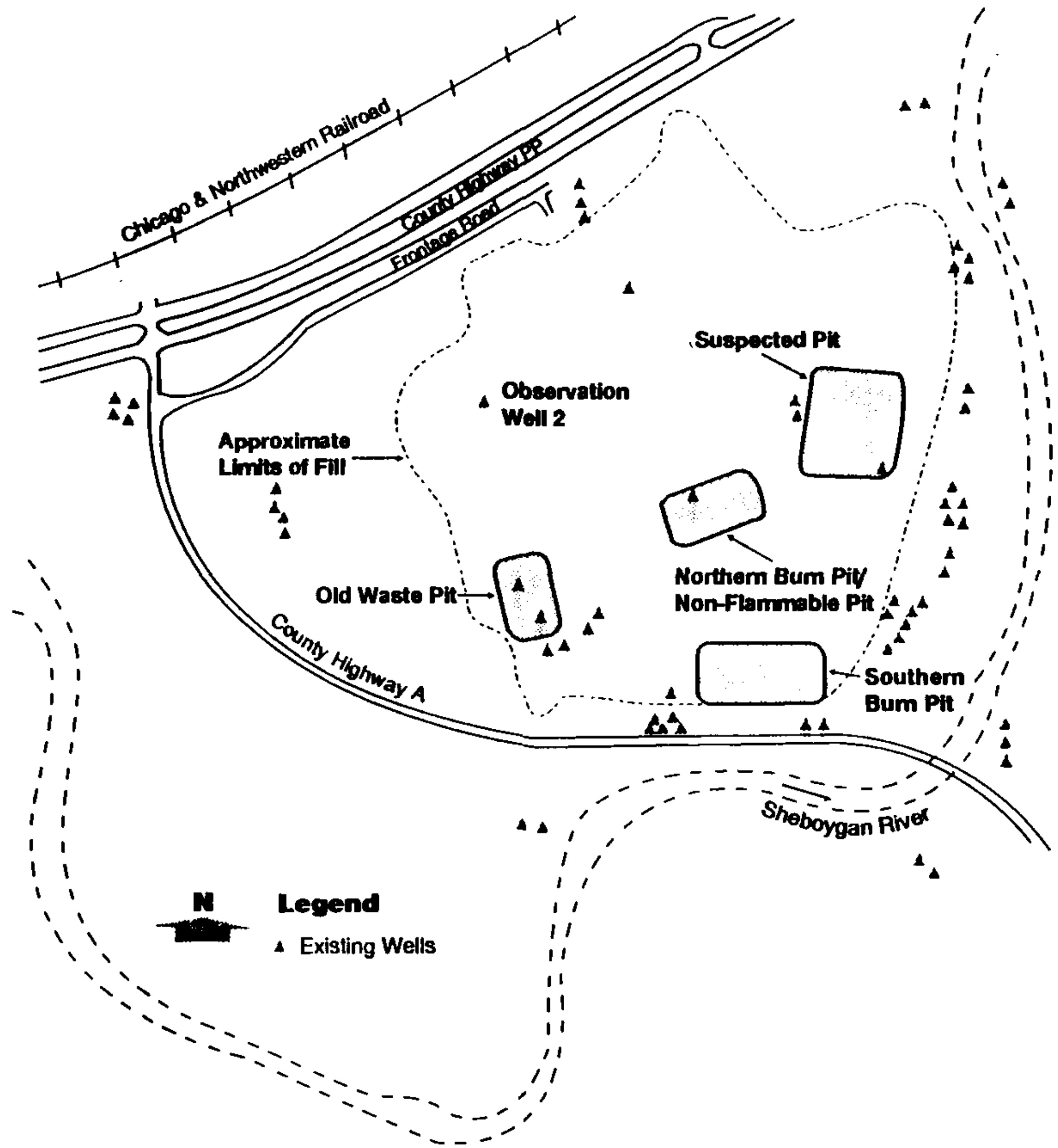

Figure 2

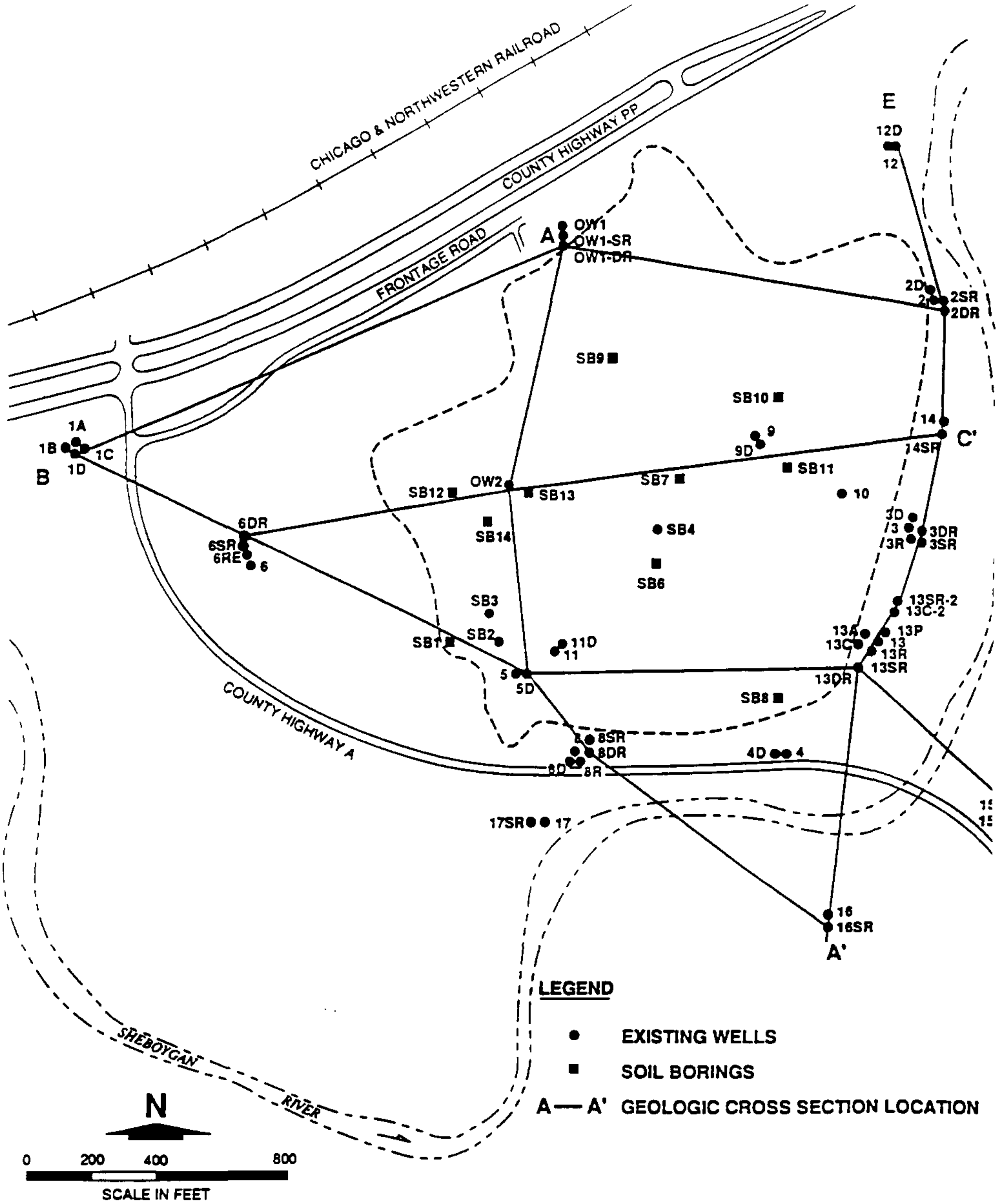

FIGURE
GEOLOGIC CROSS SECTION LOCATION M.
KOHLER COMPANY LANDF
KOHLER, WISCONS

GERAGHTY & MILLER, INC.
Environmental Services

WI164.01 - 00

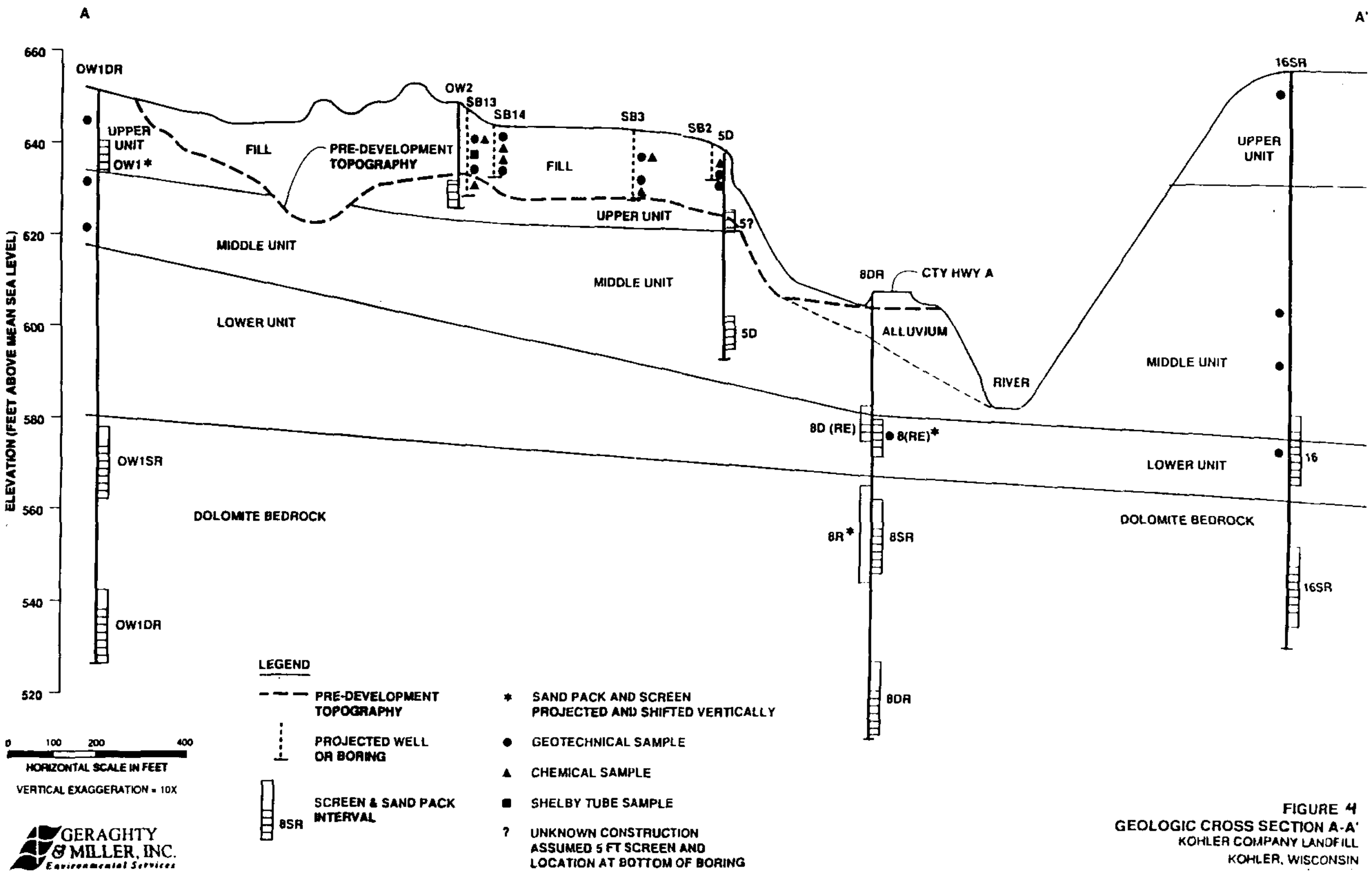

FIGURE 4
GEOLOGIC CROSS SECTION A-A'
KOHLER COMPANY LANDFILL
KOHLER, WISCONSIN

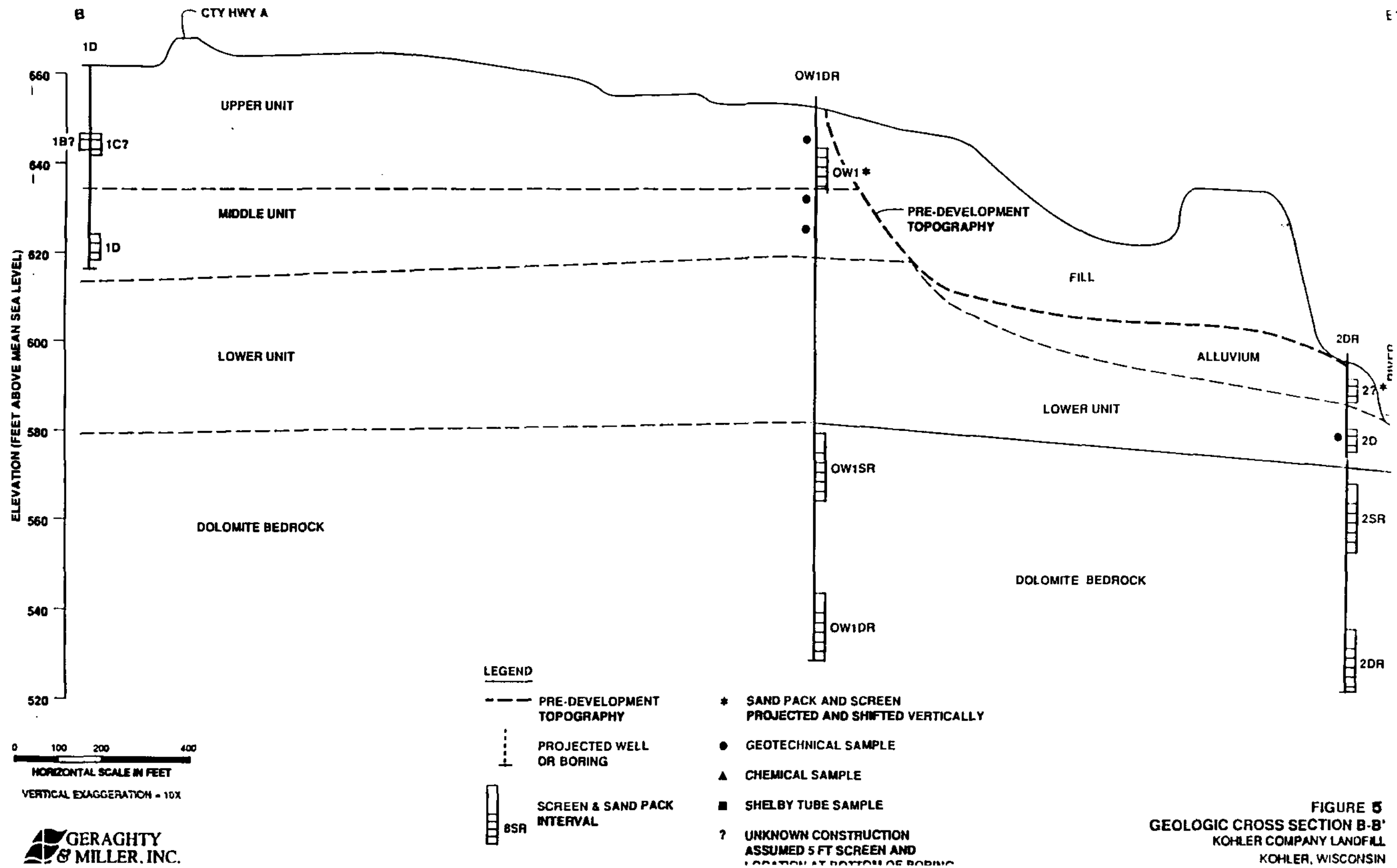

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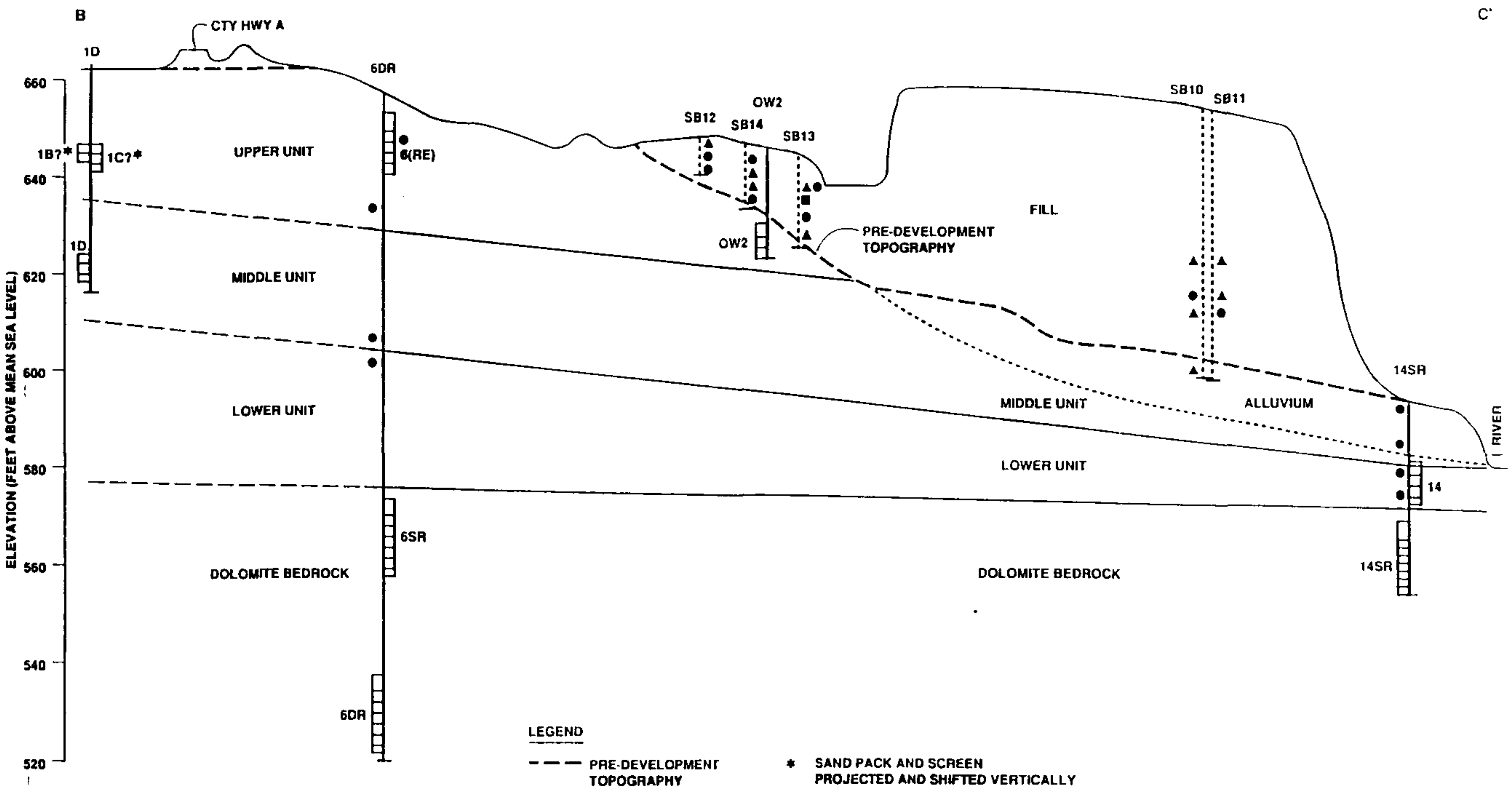
FIGURE 5
GEOLOGIC CROSS SECTION B-B'
KOHLER COMPANY LANDFILL
KOHLER, WISCONSIN



0 100 200 400

HORIZONTAL SCALE IN FEET

VERTICAL EXAGGERATION = 10X

LEGEND

- PRE-DEVELOPMENT TOPOGRAPHY
- PROJECTED WELL OR BORING
- 8SR SCREEN & SAND PACK INTERVAL
- * SAND PACK AND SCREEN PROJECTED AND SHIFTED VERTICALLY
- ● GEOTECHNICAL SAMPLE
- ▲ CHEMICAL SAMPLE
- ■ SHELBY TUBE SAMPLE
- ? UNKNOWN CONSTRUCTION ASSUMED 5 FT SCREEN AND LOCATION AT BOTTOM OF BORING

GERAGHTY & MILLER, INC.
Environmental Services

FIGURE 6
GEOLOGIC CROSS SECTION B-C'
KOHLER COMPANY LANDFILL
KOHLER, WISCONSIN

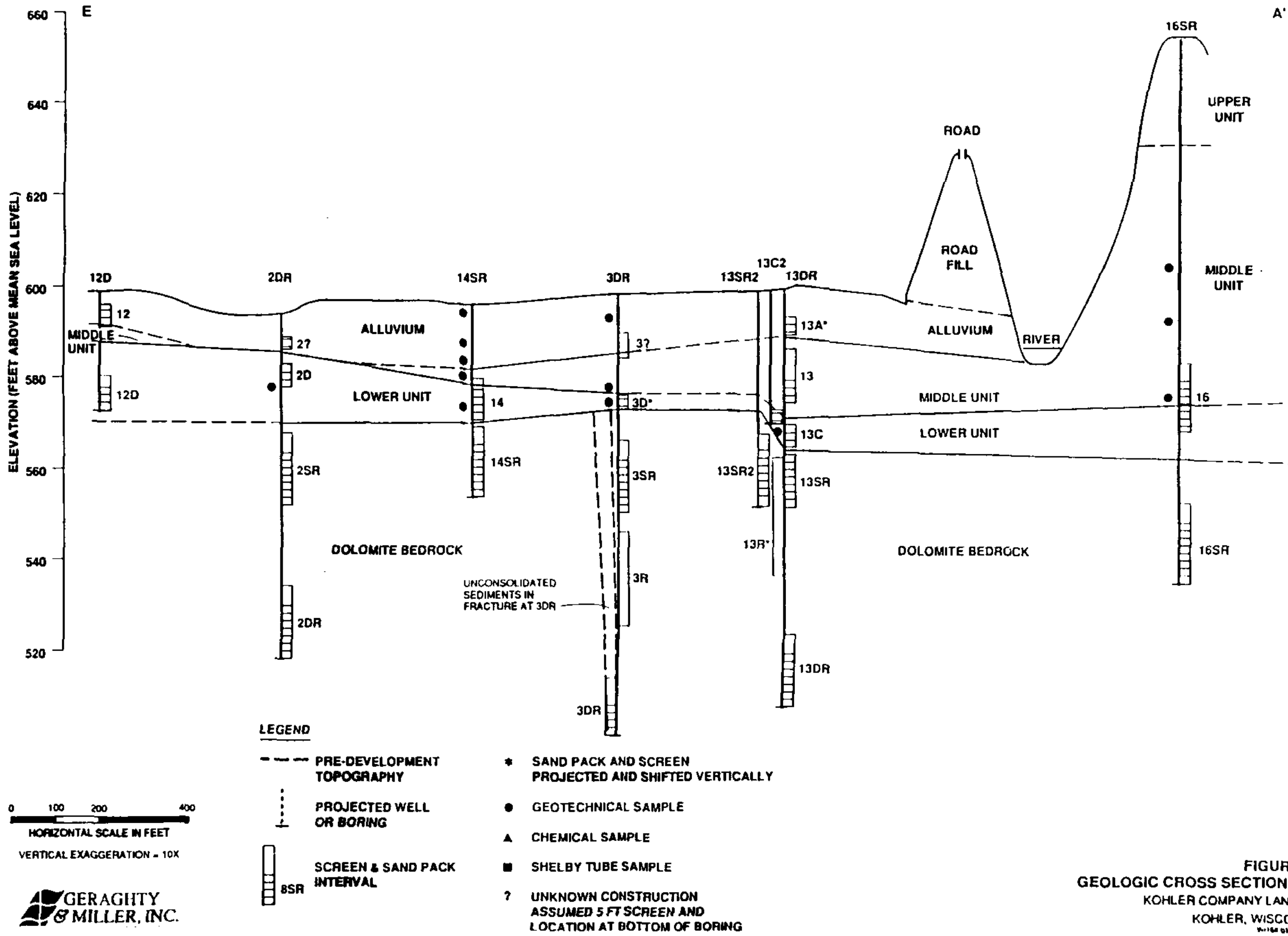


FIGURE 7
GEOLOGIC CROSS SECTION E-A'
KOHLER COMPANY LANDFILL
KOHLER, WISCONSIN

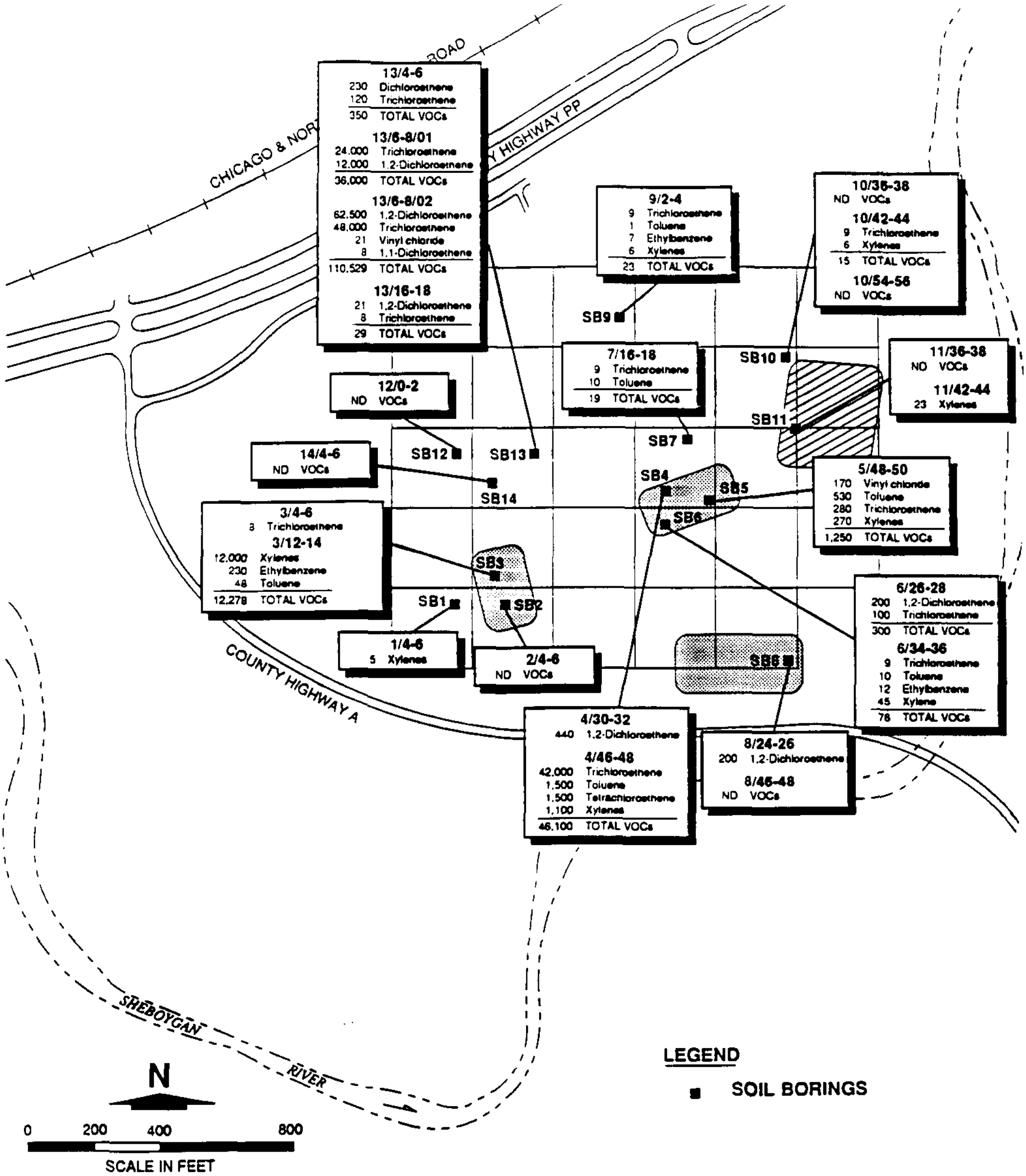


FIGURE 8
PHASE III VOCs (ug/kg) IN SOIL BORINGS
KOHLER COMPANY LANDFILL
FEASIBILITY STUDY
KOHLER, WISCONSIN
WI164.01 - 0349

GERAGHTY & MILLER, INC.
Environmental Services

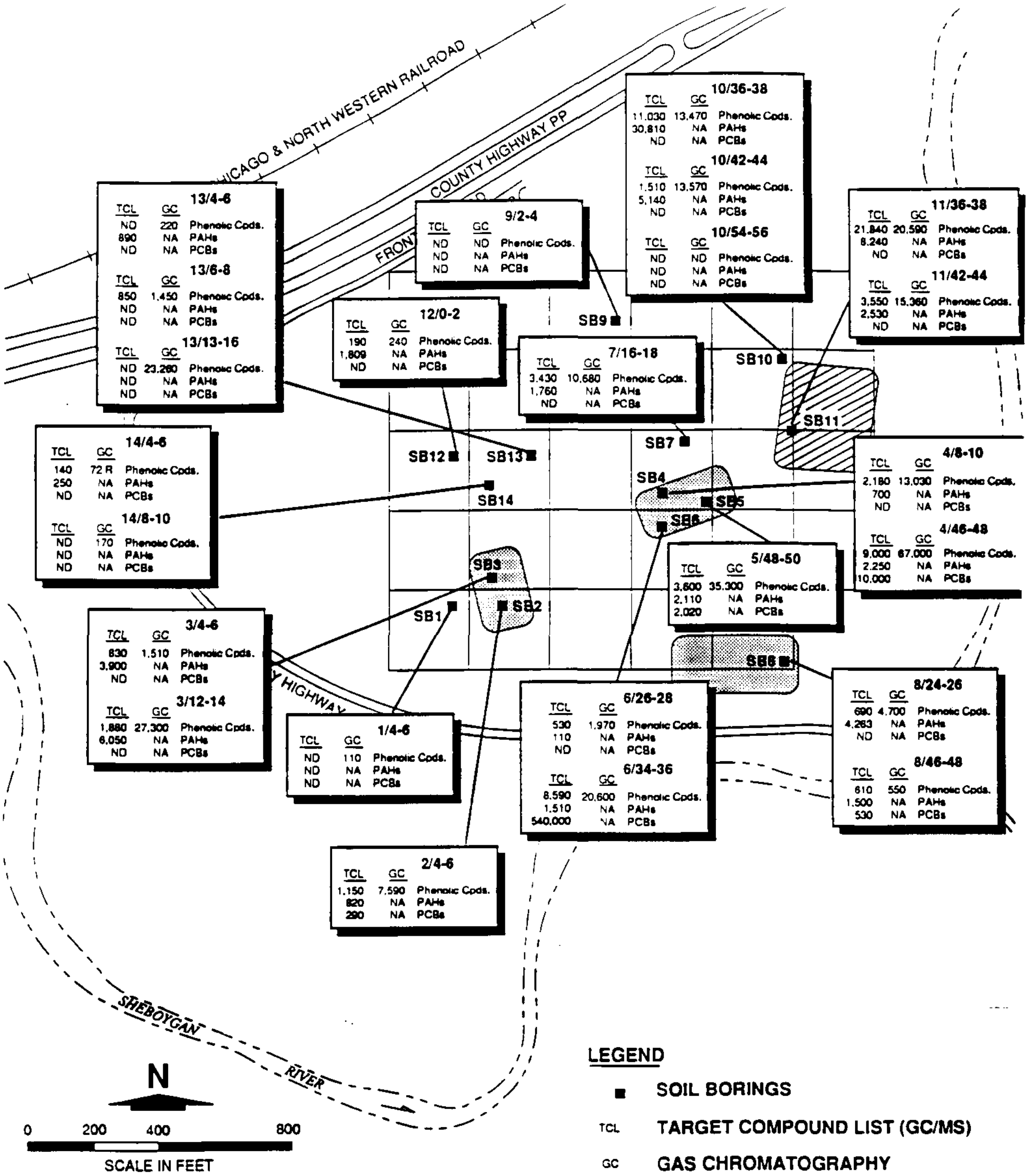


FIGURE 9
PHASE III SEMI-VOLATILE COMPOUNDS (ug/kg) IN SOIL BORINGS
KOHLER COMPANY LANDFILL
FEASIBILITY STUDY
KOHLER, WISCONSIN
WI16401 - 0349.04

GERAGHTY & MILLER, INC.
Environmental Services

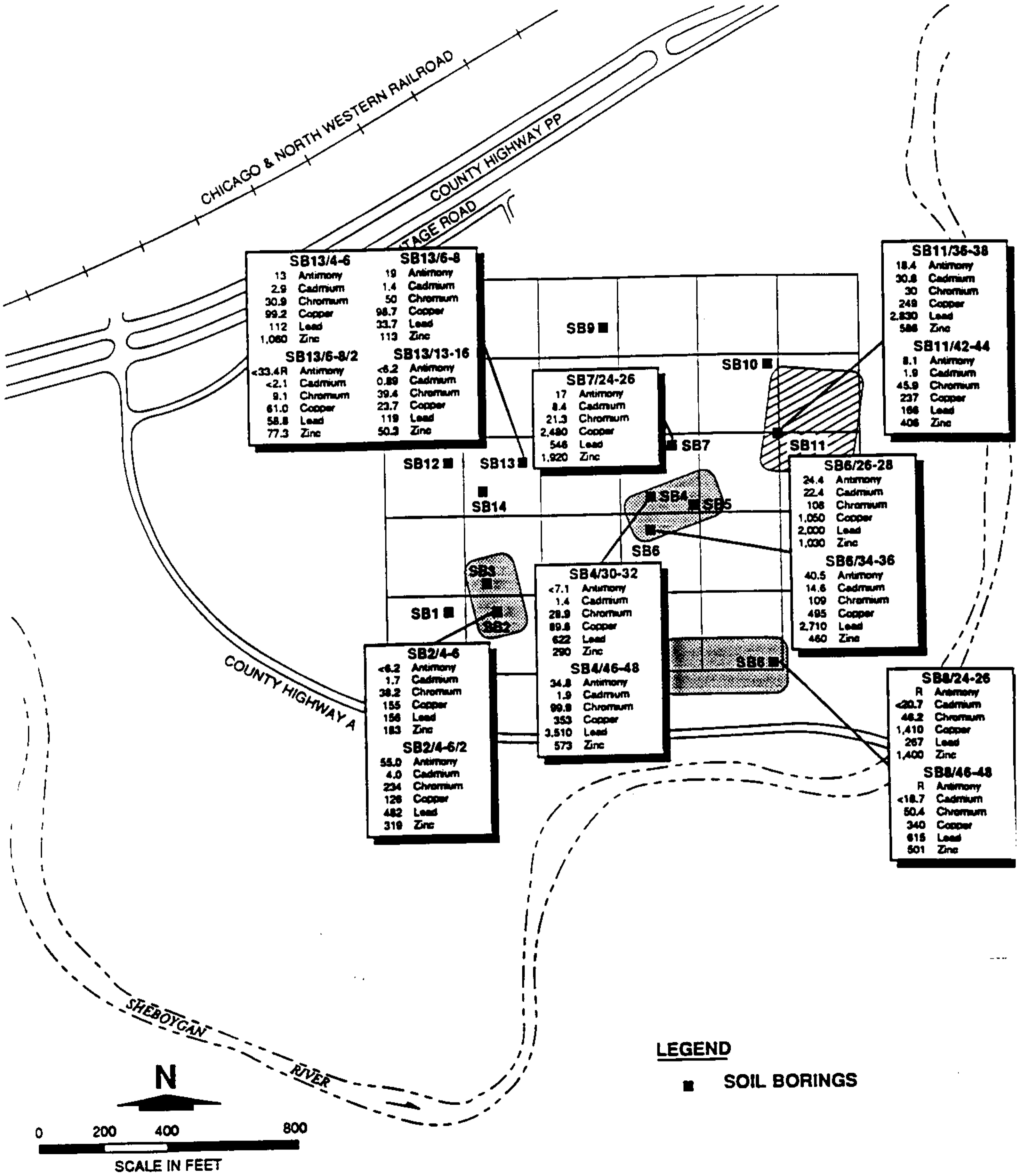


FIGURE 10
PHASE III INORGANICS (mg/kg) IN SOIL BORINGS
KOHLER COMPANY LANDFILL
KOHLER, WISCONSIN
W116401 - 0053.06

GERAGHTY & MILLER, INC.

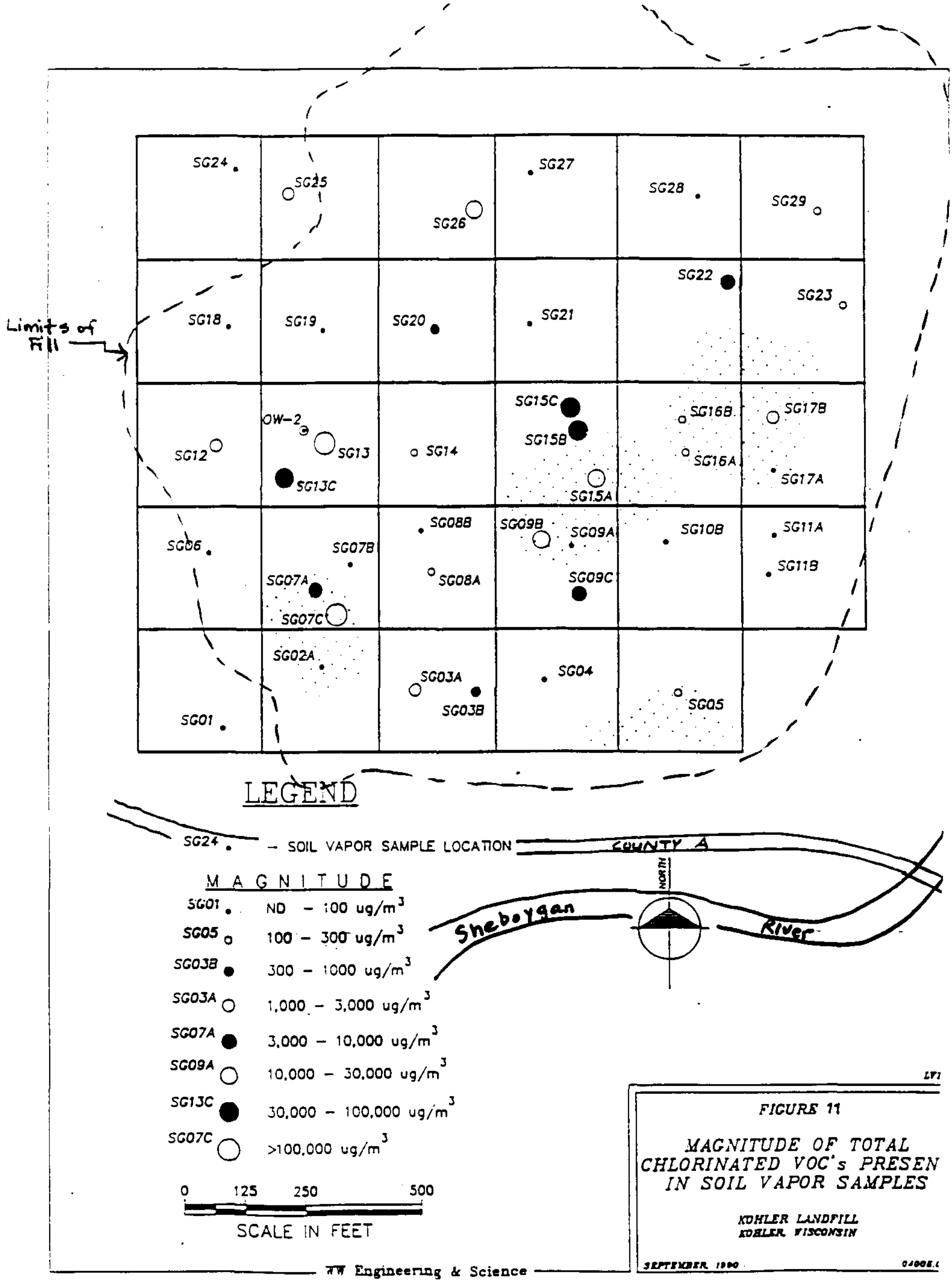
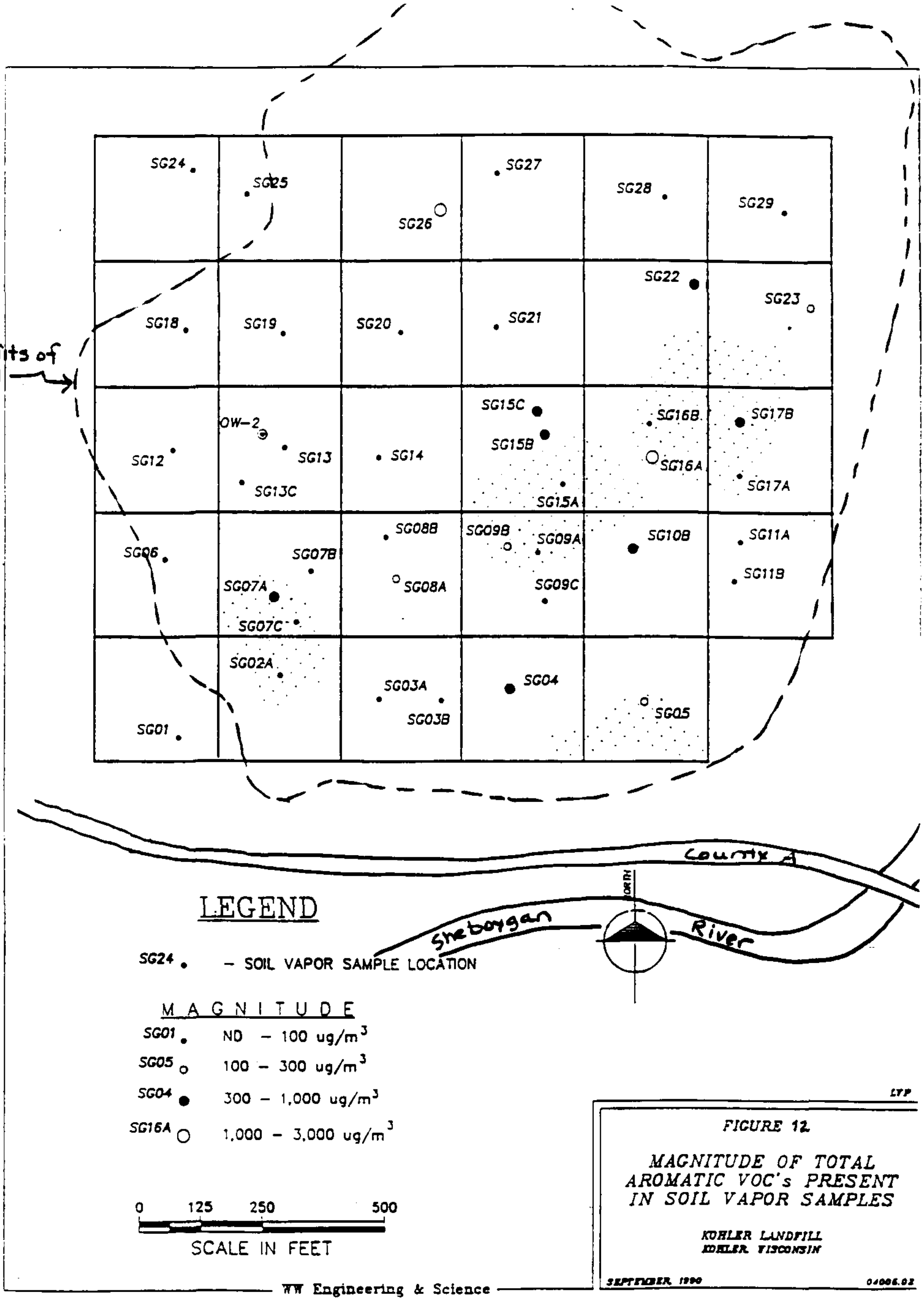


FIGURE 11

MAGNITUDE OF TOTAL CHLORINATED VOC's PRESEN IN SOIL VAPOR SAMPLES

KOHLER LANDFILL
KOHLER, WISCONSIN

SEPTEMBER 1990 04008.



LTP

FIGURE 12

MAGNITUDE OF TOTAL AROMATIC VOC's PRESENT IN SOIL VAPOR SAMPLES

KOHLER LANDFILL
KOHLER, WISCONSIN

SEPTEMBER 1990

04006.02

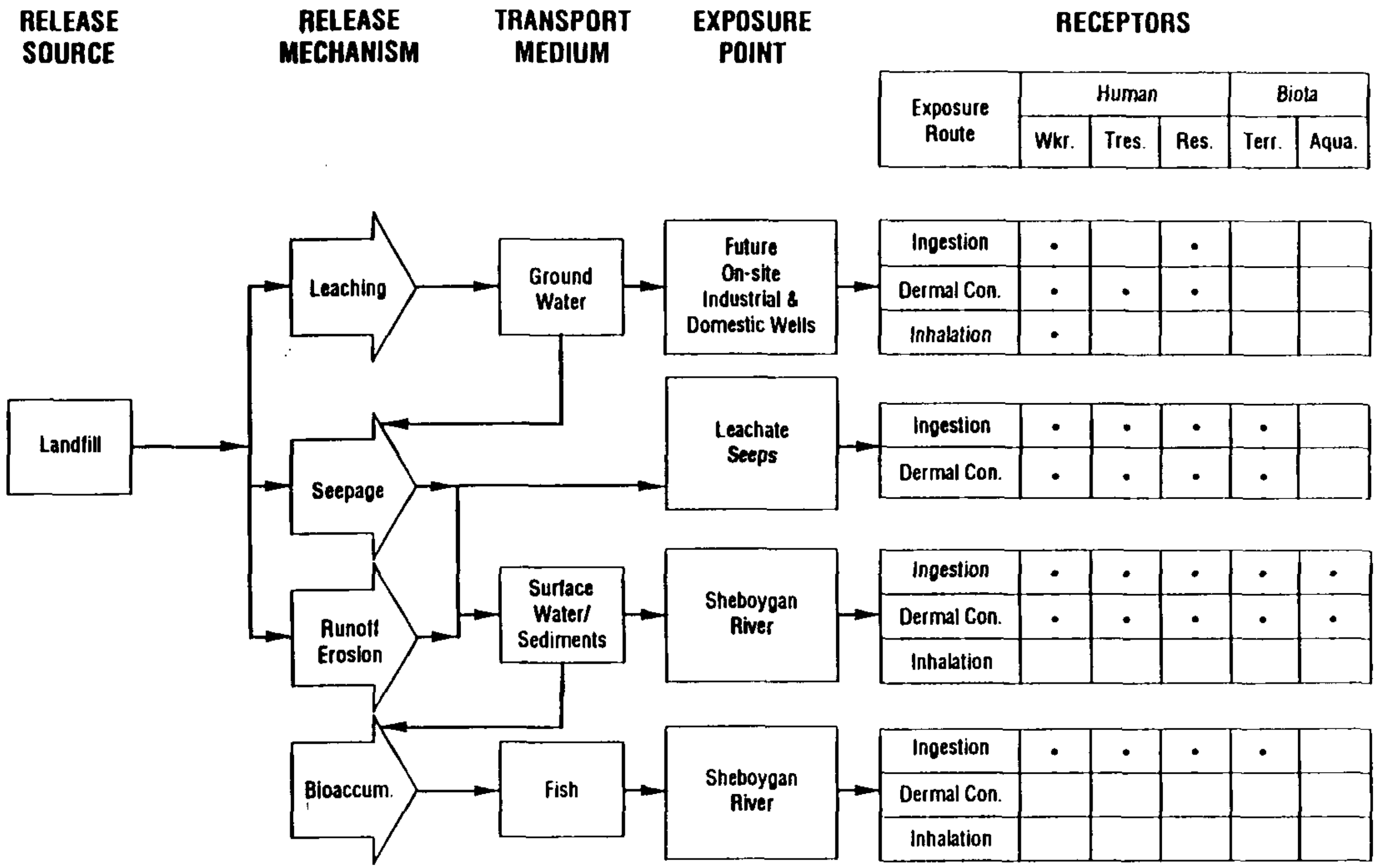


FIGURE 13
CONCEPTUAL SITE MODEL FOR POTENTIAL EXPOSURE
KOHLER COMPANY LANDFILL
SOURCE CONTROL FEASIBILITY STUDY
KOHLER, WISCONSIN
WI164.01 · 0154.18

GERAGHTY & MILLER, INC.
Environmental Services

Figure 14
Source Control Alternatives
Kohler Company Landfill, Source Control Feasibility Study

Response Actions			Alternatives				
			NA	LA	BC	RC	BC/SVE
Medium	Action	Type	No Action	Limited Action	Base Cap with Leachate Treatment	RCRA Guidance Cap with Leachate Treatment	Base Cap with SVE and Air Emissions Treatment
Source Area	Institutional/ Operational Controls			•	•	•	•
	Capping	Wisconsin NR 504.07 Cap			•		•
		RCRA Guidance Cap				•	
	Treatment	Vapor Extraction					•
		SVE Emissions Treatment					•
Leachate Seeps	Collection	Trenches			•	•	•
	Treatment				•	•	•
	Discharge	River			•	•	•

TABLES

Table 1 Summary of Chemical Constituents (μg/L) Detected in Ground-Water Samples, Kohler Company Landfill, Kohler, Wisconsin.

Sample ID	MCL ES	1C-01	1D-01	OW1SR-01	OW1DR-01	2-01	2-02	2D-01	2SR-01	2DR-01	2DR-02	OW2-01	3-01
VOLATILE ORGANIC COMPOUNDS													
Vinyl Chloride	0.2	<10	<10	<10	<10	<10	NA	6	<10	5 J	3 J	<10	10
Chloroethane		<10	<10	<10	<10	<10	NA	<10	<10	<10	<10	<10	<10
Carbon Disulfide		<5	<5	<5	<5	<5	NA	<10 J	<5	<5	<5	<5	<5
1,1-Dichloroethene	7	<5	<5	<5	<5	<5	NA	<5	<5	<5	<5	<5	<5
1,1-Dichloroethane	850	<5	<5	<5	<5	<5	NA	<5	<5	<5	<5	<5	<5
1,2-Dichloroethene (total)	100	<5	<5	2 J	<5	15	NA	190 DJ	2 J	4 J	3 J	<5	62
Chloroform	6	<5	<5	3 J	<5	<5	NA	<5	<5	<5	<5	<5	<5
1,2-Dichloroethane	5	<5	<5	<5	<5	<5	NA	<5	<5	<5	<5 J	<5	<5
1,1,1-Trichloroethane	200	<5	<5	<5	<5	<5	NA	<5	<5	<5	<5 J	<5	<5
Bromodichloromethane	179	<5	<5	1 J	<5	<5	NA	<5	<5	<5	<5 J	<5	<5
Trichloroethene	5	<5	<5	<5	<5	1 J	NA	<5	<5	<5	<5	<5	<5
Benzene	5	<5	<5	<5	<5	<5	NA	<5	<5	<5	<5	<5	<5
4-Methyl-2-Pentanone		<10	<10	<10	<10	<10	NA	<10	<10	<10	<10	<10	<10
Toluene	343	<5	<5	<5	<5	<5	NA	<5	<5	<5	<5	<5	<5
Chlorobenzene		<5	<5	<5	<5	<5	NA	<5	<5	<5	<5	<5	<5
Ethylbenzene	1360	<5	<5	<5	<5	<5	NA	<5	<5	<5	<5	<5	<5
Xylene (total)	620	<5	<5	<5	<5	<5	NA	<5	<5 J	<5	<5	<5	<5 J
SEMI-VOLATILE ORGANICS													
Phenol		<10	<10	<10	<13	<10	<10	<10	<10	<10	NA	<10	NA
Bis(2-Chloroethyl)Ether		<10	<10	<10	19 U	<10	<10	<10	<10	<10	NA	<10	NA
2-Methylphenol		<10	<10	<10	<13	<10	<10	<10	<10	<10	NA	<10	NA
Bis(2-Chloroisopropyl)Ether		<10	<10 J	<10	<13	<10 J	<10	<10	<10 J	<10	NA	<10	NA
4-Methylphenol		<10	<10	<10	<13	<10	<10	<10	<10	<10	NA	<10	NA
2,4-Dimethylphenol		<10	<10	<10 J	<13 J	<10	<10	<10	<10	<10	NA	<10	NA
Napthalene		<10	<10	<10 J	<13 J	<10	<10	<10	<10	<10	NA	<10	NA
Fluoranthene		<10	<10	<10	<13	<10	<10	<10 J	<10	<10	NA	<10	NA
Pyrene		<10	<10	<10	<13	<10	<10	<10	<10	<10	NA	<10	NA
Benzo(a)Anthracene		<10	<10	<10	<13	<10	<10	<10	<10	<10	NA	<10	NA
Chrysene		<10	<10	<10	<13	<10	<10	<10	<10	<10	NA	<10	NA
Bis(2-Ethylhexyl)Phthalate		10 U	10 U	5 J	7 J	10 U	4	<10 J	<10	7 J	NA	6 J	NA
PHENOLS													
4-Chloro-3-Methylphenol		<3.6	<7.2	<3.6 J	<4.8 J	<10	NA	<3.6 J	<3.6 J	<3.6 J	NA	<3.6	NA
2,4-Dichlorophenol		<3.9	<7.8	<3.9 J	<5.2 J	<11	NA	<3.9 J	<3.9 J	<3.9 J	NA	<3.9	NA
2,4-Dimethyphenol		<3.2	<6.4	<3.2 J	<4.3 J	<9.2	NA	<3.2 J	<3.2 J	<3.2 J	NA	<3.2	NA
Phenol		5.7	<2.8	<1.4 J	<1.9 J	<4.0	NA	<1.4	<1.4 J	<1.4 J	NA	<1.4	NA
2,4,6-Trichlorophenol		<6.4	<13	<6.4 J	<8.5 J	<18	NA	<6.4 UJ	<6.4 J	<6.4 J	NA	<6.4	NA

NA = No analysis.

☐ Constituent was detected at designated concentration.

☐ Value exceedes Safe Drinking Water Act [42 U.S.C. 300(f) et. seq.] Maximum Contaminant Levels (MCL) or Enforcement Standards (ES) (s. NR 140.10, Wis. Adm. Code)

Data qualifiers are provided in Appendix Q.

KOHLERRI/TABLES/2/chemcngw.wk1

GERAGHTY & MILLER, INC.

Table 1 Summary of Chemical Constituents (µg/L) Detected in Ground-Water Samples, Kohler Company Landfill, Kohler, Wisconsin.

Sample ID	MCL ES	3-02	3D-01	3R-01	3DR-01	3SR-01	4-01	4D-01	5-01	5D-01	6-01	6DR-01	8(RE)-01
VOLATILE ORGANIC COMPOUNDS													
Vinyl Chloride	0.2	32	74	120	<10	240 D	<10	<10	<10	770 D	<10	<10	<10
Chloroethane		<10 J	<10	<10 J	<10 J	<10	<10	<10	<10 J	6 J	<10 J	<10	<10
Carbon Disulfide		9	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5
1,1-Dichloroethene	7	<5	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5
1,1-Dichloroethane	850	<5	2 J	3 J	<5	5	<5	<5	<5	43	<5	<5	<5
1,2-Dichloroethene (total)	100	36	42	130	<5	120	36	2 J	4 J	690 D	<5	2 J	<5
Chloroform	6	<5	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5
1,2-Dichloroethane	5	<5	<5	<5 J	<5 J	<5	<5	<5	<5	<10	<5	<5	<5
1,1,1-Trichloethane	200	<5	<5	<5 J	<5 J	<5	<5	<5	<5	<10	<5	<5	<5
Bromodichloromethane	179	<5	<5	<5 J	<5 J	<5	<5	<5	<5	<10	<5	<5	<5
Trichloroethene	5	<5	<5	<5	<5	<5	8	<5	2 J	10	<5	2 J	<5
Benzene	5	<5	<5	<5	<5	<5	<5	<5	<5	7 J	<5	1 J	<5
4-Methyl-2-Pentanone		<10	<10	<10 J	<10 J	<10 J	<10	<10	<10	<20	<10	<10	<10 J
Toluene	343	<5	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	6
Chlorobenzene		<5	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5
Ethylbenzene	1360	<5	<5	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5
Xylene (total)	620	<5	<5	<5	<5	<5 J	<5	<5	<5	4 J	<5	<5 J	<5 J
SEMI-VOLATILE ORGANICS													
Phenol		NA	<10	<10	<10	<10	<10	<10	<10	4 J	12	<10	<10
Bis(2-Chloroethyl)Ether		NA	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
2-Methylphenol		NA	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Bis(2-Chloroisopropyl)Ether		NA	<10	<10	<10	<10	<10	<10	<10 J	<10 J	<10 J	<10 J	<10
4-Methylphenol		NA	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
2,4-Dimethylphenol		NA	<10	<10	<10	<10	<10	<10	<10	31	<10	<10	<10
Napthalene		NA	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Fluoranthene		NA	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Pyrene		NA	<10	<10	<10	<10	<10	<10	<10	3 J	<10	<10	<10
Benzo(a)Anthracene		NA	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Chrysene		NA	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Bis(2-Ethylhexyl)Phthalate		NA	7 J	7 J	8 J	<10	5 J	<10	18 U	<10	18	<10	<10
PHENOLS													
4-Chloro-3-Methylphenol		NA	<3.6	<3.6	<3.6	<7.2	<14	<3.6 J	<3.2 J	<3.6 J	<3.6	<3.6 J	<3.6
2,4-Dichlorophenol		NA	<3.9	<3.9	<3.9	<7.8	<16	<3.9 J	<3.5 J	79 J	<3.9	<3.9 J	<3.9
2,4-Dimethyphenol		NA	<3.2	<3.2	<3.2	<6.4	<13	<3.2 J	<2.9 J	22 J	<3.2	<3.2 J	<3.2
Phenol		NA	<1.4	<1.4	<1.4	<2.8	<5.6	<1.4 J	<1.3 J	2.2 J	20	<1.4 J	<1.4
2,4,6-Trichlorophenol		NA	<6.4	<6.4	<6.4	<13	<26	<6.4 J	<5.8 J	<6.4 J	8.2 J	<6.4 J	<6.4

NA = No analysis.

Constituent was detected at designated concentration.

Value exceedes Safe Drinking Water Act [42 U.S.C. 300(f) et. seq.] Maximum Contaminant Levels (MCL) or Enforcement Standards (ES) (s. NR 140.10, Wis. Adm. Code)

Data qualifiers are provided in Appendix Q.

KOHLERR/TABLES#2/chemcngw.wk1

Table 1 Summary of Chemical Constituents (µg/L) Detected in Ground-Water Samples, Kohler Company Landfill, Kohler, Wisconsin.

Sample ID	MCL ES	8D(RE)-01	8DR-01	8R-01	8SR-01	8SR-01RE	11-01	11D-01	12-01	13-01	13R-01	13SR-01
VOLATILE ORGANIC COMPOUNDS												
Vinyl Chloride	0.2	6	<10	140	26	18	28 J	380	<10	<10	9 J	11
Chloroethane		<10	<10 J	<10 J	<10	<10 J	380	<50	<10	<10	<10 J	<10
Carbon Disulfide		<5	<5	<5	<5	<5	<25	52	<5	<5	<5	<5
1,1-Dichloroethene	7	<5	<5	2 J	<5	<5	14 J	10 J	<5	<5	<5	<5
1,1-Dichloroethane	850	<5	<5	13	2 J	<5	8,100 D	140	<5	<5	<5	<5
1,2-Dichloroethene (total)	100	77	5	1,400 D	170	190	1,200 D	370	2 J	<5	100	97
Chloroform	6	<5	<5	<5	<5	<5	<25	<25	<5	<5	<5	<5
1,2-Dichloroethane	5	<5	<5 J	<5	<5	<5 J	170 J	19 J	<5	<5	<5 J	<5
1,1,1-Trichloroethane	200	<5	<5 J	<5	<5	<5 J	200	280	<5	<5	<5 J	<5
Bromodichloromethane	179	<5	<5 J	<5	<5	<5 J	<25	<25	<5	<5	<5 J	<5
Trichloroethene	5	7	<5	370 D	38	44	14,000 D	200	<5	<5	5	5
Benzene	5	<5	<5	<5	<5	<5	50	41	<5	<5	<5	<5
4-Methyl-2-Pentanone		<10	<10 J	<10 J	<10 J	<10 J	45 J	34 J	<10	<10	<10 J	<10
Toluene	343	<5	<5	<5 J	<5 J	<5	540	210	<5	<5	<5	<5
Chlorobenzene		<5	<5	2 J	<5 J	<5	120	<25	<5	<5	<5	<5
Ethylbenzene	1360	<5	<5	<5 J	<5 J	<5	44	14 J	<5	<5	<5	<5
Xylene (total)	620	<5	<5	<5 J	<5 J	<5	190	56	<5.	<5	<5	<5
SEMI-VOLATILE ORGANICS												
Phenol		<10	<10	<10	<10	NA	66	6 J	<10	<10	<10	<10
Bis(2-Chloroethyl)Ether		<10	<10	<10	<10	NA	<20	<10	<10	<10	<10	<10
2-Methylphenol		<10	<10	<10	<10	NA	230	110	<10	<10	<10	<10
Bis(2-Chloroisopropyl)Ether		<10	<10	<10 J	<10	NA	<20	<10 J	<10	<10	<10	<10
4-Methylphenol		<10	<10	<10	<10	NA	180	230 D	<10	<10	<10	<10
2,4-Dimethylphenol		<10	<10	<10	<10	NA	14,000 D	3,200 DJ	<10	<10	<10	<10
Napthalene		<10	<10	<10	<10	NA	<20	<10	<10	<10	<10	<10
Fluoranthene		<10	<10	<10	<10	NA	<20	<10	<10	<10	<10	<10
Pyrene		<10	<10	3 J	<10	NA	<20	<10	<10	<10	<10	<10
Benzo(a)Anthracene		<10	<10	<10	<10	NA	<20	<10	<10	<10	<10	<10
Chrysene		<10	<10	<10	<10	NA	<20	<10	<10	<10	<10	<10
Bis(2-Ethylhexyl)Phthalate		<10	10 U	10 U	10 U	NA	8 J	<10	<10	10 U	10 U	<10
PHENOLS												
4-Chloro-3-Methylphenol		<3.6	<3.6	<3.6 J	<3.6	NA	NA	50 DJ	<3.6	<3.6	<3.6	<3.6
2,4-Dichlorophenol		<3.9	<3.9	<3.9 J	<3.9	NA	NA	<39 J	<3.9	<3.9	<3.9	<3.9
2,4-Dimethyphenol		<3.2	<3.2	<3.2 J	<3.2	NA	NA	2,000 DJ	<3.2	<3.2	<3.2	<3.2
Phenol		<1.4	<1.4	<1.4 J	2.7	NA	NA	<14 J	<1.4	<1.4	<1.4	<1.4
2,4,6-Trichlorophenol		<6.4	<6.4	<6.4 J	<6.4	NA	NA	<64 J	<6.4	<6.4	<6.4	<6.4

NA = No analysis.

☐ Constituent was detected at designated concentration.

☐ Value exceedes Safe Drinking Water Act [42 U.S.C. 300(f) et seq.] Maximum Contaminant Levels (MCL) or Enforcement Standards (ES) (s. NR 140.10, Wis. Adm. Code)

Data qualifiers are provided in Appendix Q.

KOHLERRI/TABLES#2/chemongw.wk1

Table 1 Summary of Chemical Constituents (µg/L) Detected in Ground-Water Samples, Kohler Company Landfill, Kohler, Wisconsin.

Sample ID	MCL ES	13SR-01RE	13DR-01	14-01	14SR-01	15-01	15DR-01	15SR-01	16-01	16SR-01	16SR-01DUP	17SR-01
VOLATILE ORGANIC COMPOUNDS												
Vinyl Chloride	0.2	9 J	<10	210 D	430 D	<10	<10	<10	<10	<10	<10	<10
Chloroethane		<10 J	<10	<10	2 J	<10 J	<10	<10	<10 J	<10	<10	<10
Carbon Disulfide		<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
1,1-Dichloroethene	7	<5	<5	<5	3 J	<5	<5	<5	<5	<5	<5	<5
1,1-Dichloroethane	850	<5	<5	7	16	<5	<5	<5	<5	<5	<5	<5
1,2-Dichloroethene (total)	100	82	2 J	260 D	700 D	<5	<5	<5	<5	<5	<5	<5
Chloroform	6	<5	1 J	<5	<5	2 J	<5	2 J	1 J	2 J	3 J	2 J
1,2-Dichloroethane	5	<5 J	<5 J	<5 J	<5	<5	<5 J	<5	<5 J	<5	<5	<5
1,1,1-Trichloroethane	200	<5 J	<5 J	15	<5	<5	<5	<5	<5 J	<5	<5	<5
Bromodichloromethane	179	<5 J	<5 J	<5	<5	<5	<5	<5	<5 J	<5	<5	<5
Trichloroethene	5	3	<5	<5	2 J	<5	<5	<5	<5	<5	<5	<5
Benzene	5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
4-Methyl-2-Pentanone		<10 J	<10	<10	<10	<10	<10 J	<10	<10 J	<10	<10	<10
Toluene	343	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Chlorobenzene		<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Ethylbenzene	1360	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Xylene (total)	620	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
SEMI-VOLATILE ORGANICS												
Phenol		NA	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Bis(2-Chloroethyl)Ether		NA	<10	<10	<10	<10	<10	<10	<10	<10	<10	190 U
2-Methylphenol		NA	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Bis(2-Chloroisopropyl)Ether		NA	<10	<10 J	<10 J	<10 J	<10 J	<10	<10	<10	<10	10 U
4-Methylphenol		NA	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
2,4-Dimethylphenol		NA	<10	3 J	<10	4 J	<10	<10	<10	<10	<10	<10
Napthalene		NA	<10	<10	<10	<10	<10	<10	<10	<10	<10	1 J
Fluoranthene		NA	2 J	<10	<10	<10	<10	<10	<10	<10	2 J	<10
Pyrene		NA	3 J	2 J	<10	<10	<10	<10	<10	<10	3 J	<10
Benzo(a)Anthracene		NA	<10	<10	<10	<10	<10	<10	<10	<10	2 J	<10
Chrysene		NA	<10	<10	<10	<10	<10	<10	<10	<10	3 J	<10
Bis(2-Ethylhexyl)Phthalate		NA	<10	<10	5 J	3 J	5 J	3 J	17	12 B	10 B	<10
PHENOLS												
4-Chloro-3-Methylphenol		NA	<3.6	<3.6 J	<3.6	<3.6	<3.6	<3.6	<3.6	<3.6	<3.6	<3.6 J
2,4-Dichlorophenol		NA	<3.9	<3.9 J	<3.9	<3.9	<3.9	<3.9	<3.9	<3.9	<3.9	<3.9 J
2,4-Dimethyphenol		NA	<3.2	<3.2 J	<3.2	<3.2	<3.2	<3.2	<3.2	<3.2	<3.2	<3.2 J
Phenol		NA	<1.4	<1.4 J	1.7	5.7	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4 J
2,4,6-Trichlorophenol		NA	<6.4	<6.4 J	<6.4	<6.4	<6.4	<6.4	<6.4	<6.4	<6.4	<6.4 J

NA = No analysis.

☐ Constituent was detected at designated concentration.

☐ Value exceedes Safe Drinking Water Act [42 U.S.C. 300(f) et. seq.] Maximum Contaminant Levels (MCL) or Enforcement Standards (ES) (s. NR 140.10, Wis. Adm. Code)

Data qualifiers are provided in Appendix Q.

KOHLERR\TABLES#2/chemcngw.wk1

GERAGHTY & MILLER, INC.

Table 1 -B. Summary of Inorganic Constituents Detected in Till Wells, Concentrations are μg/L, Except Flouride and Nitrate-Nitrite at mg/L.

Sample ID	Background (Maximum)	MCL ES	2	2D	OW2	3D	4	4D	5	5D	8(RE)	8D	11
Antimony	96		<32.0 J	91.2	70.6 UJ	109 UJ	NA	59.9 UJ	<32.0 J	<32.0 J	68.9 J	49.7 UJ	657 J
Arsenic	7.3	50	<15.0	3.7 UJ	<2.0 J	<2.0 J	NA	<2.0	<3.0 J	<3.0	<3.0 R	5.5 J	18.4 J
Barium	361	1,000	34.8 U	49.4 J	48.2 J	39.4 J	NA	24.7 J	55.2 J	80.6 J	48.8	54.1 J	14.2 U
Cadmium	5.7	10	<2.0	3.4 UJ	<2.0	2.5 J	NA	2.6 UJ	<2.0	7.8 U	<2.0 J	3.5 UJ	4.2 U
Chromium	12.2*	50	24.9 UJ	17.9	7.2 J	47.9 J	NA	9.6 J	<5.4 UJ	17.4 UJ	<4.0	13.1 J	79.0 J
Copper	68.7		53.6 R	69.0 J	84.6	53.2	NA	118	75.7 R	60.7 R	6.3 U	74.7 U	92.3 R
Iron	223		212 UJ	392 J	176	195	NA	75.3 J	41.5 UJ	127 UJ	24.8 U	73.9 J	320 UJ
Lead	<1	50	<1.0 J	<1.0	1.0 J	<1.0	NA	<1.0	<1.0 J	<1.0 J	<1.0	<1.0	100
Silver	7.9	50	2.7 J	7.8 UJ	9.1 UJ	7.5 UJ	NA	6.0 UJ	5.8 J	4.3 J	<2.0	<2.0	4.2 J
Zinc	32.3		41.9 J	38.9	59.6	44.4	NA	150	82.6 J	60.1 J	<3.0	37.7 U	87.0 J
Flouride (Dist)	1.04	4	NA	2.02	0.439	2.21	NA	0.832	NA	NA	NA	0.418	NA
Flouride (Elect)	0.367	4	0.501	0.280	0.271	2.17	NA	0.474	0.225	0.195	0.447	0.334	NA
Nitrate-Nitrite	0.509	10	0.286	1,001	0.299	0.101	0.073	0.174	0.146	0.350	0.093	0.267	NA

NS = No sample collected.
NA = No analysis.
Data qualifiers are provided in Appendix Q.

☐ = Value is above background concentration.

☐ = Value exceeds Safe Drinking Water Act [42 USC 300(f) et seq.] Maximum Contaminant Levels (MCLs) or Enforcement Standards (NR140.10 Wisconsin Administration Code).

* = Chromium concentration from Well OW1 was not included in the calculation for the background chromium concentration.

805KOHI ERRI(tables)#2/tillwell.wk1

Table 1 -B. Summary of Inorganic Constituents Detected in Till Wells, Concentrations are µg/L, Except Flouride and Nitrate-Nitrite at mg/L.

Sample ID	Background (Maximum)	MCL ES	11D	12	12D	13	14	15	16	17
Antimony	96		46.3 J	53.4 UJ	40.8 UJ	<640 J	42.7 J	32.1 U	854 J	<32.0 J
Arsenic	7.3	50	7.7 J	<2.0	<2.0 J	<3.0	<3.0 J	5.8 J	3.6 J	5.2 J
Barium	361	1000	30.7 U	56.9 J	35.7 J	186 J	41.6 U	91.6 J	126 J	76.8 J
Cadmium	5.7	10	<2.0	2.8 UJ	<2.0	66.0 J	4.2 U	<2.0	<40.0	<2.0
Chromium	12.2*	50	40.2 J	5.2 J	35.3 J	<80.0	14.4 UJ	9.1 UJ	<80.0	16.2 UJ
Copper	68.7		66.1 R	83.0	64.8	<40.0 J	31.0 R	38.0 UJ	<40.0 J	36.4 R
Iron	223		328 UJ	55.6 J	264	<100	389 UJ	2,510	<100	64.1 UJ
Lead	<1	50	<1.0 J	<1.0	<1.0	5.6	<1.0 J	1.1 J	<1.0	3.2 UJ
Silver	7.9	50	4.1 J	2.5 J	6.4 UJ	90.0 J	9.1 J	2.9 UJ	40.0 J	3.3 J
Zinc	32.3		47.0 J	78.9	47.0	<60.0	61.7 J	29.0 U	<60.0	45.4 J
Flouride (Dist)	1.04	4	NA	0.223	0.555	NA	NA	NA	NA	NA
Flouride (Elect)	0.367	4	15.1	<0.1	0.677	0.407	0.346	0.413	0.589	0.503
Nitrate-Nitrite	0.509	10	0.267	0.292	0.203	0.232	0.041	0.092	0.445	0.149

NS = No sample collected.
NA = No analysis.
Data qualifiers are provided in Appendix Q.

[box] = Value is above background concentration.

[box] = Value exceeds Safe Drinking Water Act [42 USC 300(f) et seq.] Maximum Contaminant Levels (MCLs) or Enforcement Standards (NR140.10 Wisconsin Administration Code).

* = Chromium concentration from Well OW1 was not included in the calculation for the background chromium concentration.

805KOHLERRI(tables)#2/tillwell.wk1

Table 1 -C. Inorganic Constituents Detected in Bedrock Wells, Concentrations are $\mu g/L$, except Flouride and Nitrate-Nitrite at mg/L.

Sample ID	Background (Maximum)	MCL ES	2SR	2DR	3R	3SR	3DR	8R	8SR	8DR	13R
Antimony	61.4		<32 J	78.3 UJ	<640 J	<32 J	<640 J	40.4 J	<640 J	778 J	902 J
Arsenic	6.3	50	<3.0	NR	4.4 J	<3.0 R	<3.0	5.5 J	<3.0	<3.0 J	<3.0
Barium	60.1	1,000	43.7 J	56.8 J	130 J	121 J	174 J	84.6 J	288 J	1,650 J	168 J
Cadmium	3.3	10	3.6 U	<2.0	50.0 J	3.3 UJ	<40.0	3.2 U	<40.0	<40.0	<40.0
Chromium	15.9	50	55.3 J	16.3 UJ	<80	<4.0	<80.0	16.0 UJ	<80.0	400	<80.0
Copper	47.9		97.2 R	48.5	<40.0 J	5.5 U	<40.0 J	43.3 R	<40.0 J	<40.0 J	<40.0 J
Iron	253		172 UJ	178	520 J	23.4 U	<100	75.7 UJ	<100	5,370	<100
Lead	1.5	50	<1.0	<1.0 J	<1.0	<1.0	<1.0	2.8 U	<1.0	<1.0	<1.0 J
Silver	9.7	50	2.7 J	8.3 UJ	<40.0 J	<2.0	126 J	<2.0 J	54.0 J	122 J	76.0 J
Zinc	66.7		53.6 J	37.7	<60.0	5.5 J	<60.0	62.6 J	<60.0	154 J	<60.0
Flouride (Dist)	0.533	4	NA	NA	NA	NA	NA	NA	NA	NA	NA
Flouride (Elect)	0.514	4	0.580	NS	0.391	0.373	0.456	0.326	0.442	0.416	0.446
Nitrate-Nitrite	0.187	10	285	0.018	0.067	0.093	0.074	0.324	0.194	0.289	0.181

NS = No sample collected.

NA = No analysis.

NR = Not reported.

Data qualifiers are provided in Appendix Q.

☐ Value is above background concentrations.

☐ Value exceeds Safe Drinking Water Act [42 U.S.C. 300(f) et seq.] Maximum Containment Levels (MCLs) or Enforcement Standards (s. NR 140.10 Wisc. Admin. Code).

805KOHLERRI(tables)#2/bedrock.wk1

Table 1 -C. Inorganic Constituents Detected in Bedrock Wells, Concentrations are µg/L, except Flouride and Nitrate-Nitrite at mg/L.

Sample ID	Background (Maximum)	MCL ES	13SR	13DR	14SR	15SR	15DR	16SR	16SR DUP	17SR
Antimony	61.4		<640 J	<3.2	<32.0	<640 J	53.7 U	740 J	652	83.5 UJ
Arsenic	6.3	50	<3.0	<0.30	<3.0 J	<3.0	<3.0 J	<3.0	<3.0	<2.0 J
Barium	60.1	1,000	108 J	<0.30	96.2 J	228 J	76.6 J	160 J	148	102 J
Cadmium	3.3	10	<40.0	<0.20	<2.0	46.0 J	<2.0	<40.0	<40	3.5 J
Chromium	15.9	50	<80.0	<0.40	4.4 UJ	<80.0	6.8 UJ	<80.0	<80	10.7 UJ
Copper	47.9		<40.0 J	0.97 UJ	23.8 UJ	<40.0 J	24.5 UJ	<40.0 J	<40	49.4
Iron	253		<100	<0.50 J	1,110	<100	26.1 UJ	<100	268	45.9 UJ
Lead	1.5	50	<1.0	<0.10 J	<1.0 J	<1.0 J	<1.0 J	1.3 J	<1.0	<1.0
Silver	9.7	50	148 J	0.26 UJ	6.4 UJ	<70.0 J	3.5 UJ	76.0 J	60.0	5.7 UJ
Zinc	66.7		<60.0	0.94 UJ	8.9 UJ	<60.0	6.6 UJ	<60.0	<60.0	40.4
Flouride (Dist)	0.533	4	NA	NA	NA	NA	NA	NA	NA	0.456
Flouride (Elect)	0.514	4	0.449	0.416	0.648	0.533	0.450	0.498	0.413	0.394
Nitrate-Nitrite	0.187	10	0.200	0.022	1.56	0.075	0.076	0.09	0.20	0.098

NS = No sample collected.

NA = No analysis.

NR = Not reported.

Data qualifiers are provided in Appendix Q.

☐ Value is above background concentrations.

☐ Value exceeds Safe Drinking Water Act [42 U.S.C. 300(f) et seq.] Maximum Containment Levels (MCLs) or Enforcement Standards (s. NR 140.10 Wisc. Admin. Code)

805KOHLERRI(tables)#2/bedrock.wk1

Table 2. Detected Constituents from Phase I Leachate Samples.

Parameter	KL-LS01-01	KL-LS01DP-DUP	KL-LS02-01	KL-LS03-01
	Sample Numbers			
VOCs (µg/l)				
Vinyl Chloride	<10	4 J	31	32
Trans-1,2-Dichloroethene	<5	7	23	38
Trichloroethene	<5	3 J	1 J	2
Inorganic (µg/L)				
Aluminum	2,720	80	1,810	315
Antimony	11	<1.4	<1.4	<1.4
Arsenic	1.9	<1.4	2	2.1
Barium	91	31	62	40
Cadmium	2	<1.9	<1.9	<1.9
Calcium	397,000	159,000	627,000	587,000
Chromium	11	<4.4	8	5
Copper	53	<12	23	17
Iron	4,760	137	21,500	14,000
Lead	57	<1.1	36	12
Magnesium	62,900	42,400	50,200	46,900
Manganese	448	75	1,040	966
Nickel	18	<18	<18	<18
Potassium	28,000	17,000	22,000	24,000
Silver	6.7	<6.7	<6.7	<6.7
Sodium	256,000	127,000	26,600	230,000
Zinc	92	<4.3	235	120
Hardness (mg CaCO3/L)	1,250	572	1,772	1,659

J = Estimated Value.

805kohler/leachate.wk1

Table 3. Toxicity Summaries for Constituents of Concern, Kohler Company Landfill, Kohler, Wisconsin.

Constituent	Acute Toxicity Summary	Chronic Toxicity Summary	Cancer Potential	Other
<u>VOCs</u>				
Benzene	Central nervous system (CNS) depression marked by dizziness, nausea, headache, staggering, narcosis, coma, and death. Nonlethal effects are reversible.	Chronic exposures affect the hematological and immune systems. Aplastic anemia, increased susceptibility to infection, and bone marrow depression reported.	Benzene inhalation has been associated with leukemia. Benzene has produced both solid tumors and leukemias in rats dosed orally.	Benzene (and metabolites) cause chromosome aberrations in humans and animals but rarely result in gene mutations.
2-Butanone	Irritation of eyes and respiratory passages, headaches, dizziness, and vomiting.	Chronic data are lacking. Subchronic data indicate low toxicity: liver enzyme changes, organ weight changes, body weight changes, nerve conduction velocity changes at high doses in rats.	No evidence.	One study concluded that 2-butanone is embryotoxic, fetotoxic, and potentially teratogenic in high doses in rats. 2-Butanone potentiates hepatoxic effects of haloalkanes and haloalkenes.
Carbon disulfide	Acute exposure results in dizziness, headaches, poor sleep, fatigue, nervousness, anorexia, weight loss, psychosis, polyneuritis, Parkinson-like symptoms, ocular changes, and cardio-vascular and gastrointestinal abnormalities.	Chronic exposure results in polyneuritis including lower extremity weakness and paresthesias. In dogs, lesions of the corpor-atstriata, Purkinje cells of the cerebellum, and loss of anterior horn cells of the spinal cord have been demonstrated. Chronic exposure to fumes resulted in damage to the optic nerve.	NCI carcinogenicity study results inconclusive.	Teratogenic in rats and mice dosed by inhalation.

Table 3. Toxicity Summaries for Constituents of Concern, Kohler Company Landfill, Kohler, Wisconsin.

Constituent	Acute Toxicity Summary	Chronic Toxicity Summary	Cancer Potential	Other
Chlorobenzene	Inhalation exposure results in respiratory and eye irritation, and CNS depression (sedation and narcosis), necrosis of the liver, interference with porphyrin metabolism, and swelling of tubular and glomerular epithelia.	Chronic exposure to vapors may cause blood dyscrasia, hyperlipidemia, and cardiac dysfunction in humans. Liver and kidney damage have been observed in laboratory animals.	Statistically significant increase in the incidence of neoplastic nodules of the liver in high dosed (120 mg/kg/day) male rats. No increased incidence of hepatocellular carcinomas were observed in the male rats.	Not mutagenic in Ames assay, but has shown reverse mutations in Streptococcus antiboticus and Aspirgillis nodulans. No observed teratogenic effects in high dosed pregnant rats and rabbits.
Chloroethane	CNS and cardiac depression, and nausea at high inhalation doses (>20,000 ppm). Has caused death in humans when used as an anesthetic. May also irritate eyes and skin. Kidney and liver effects reported in animals.	No non-cancer effects reported in 2-year study of rats exposed to 15,000 ppm. Mild kidney effects and hyperactivity reported in mice exposed to 15,000 ppm for 2 years. One report of narcotic use in humans indicated cerebellar dysfunction which was reversible.	Recently completed inhalation study reported significant increase in uterine carcinomas and hepatocellular carcinomas in female mice. Equivocal evidence in rats for carcinogenicity. Equivocal evidence for genotoxic effects. No evidence for reproductive or developmental effects.	
1,1-Dichloroethane	High exposure results in CNS depression (drowsiness, unconsciousness, etc.) and skin irritation. Oral LD_{50} (rats) of 725 mg/kg.	Kidney and liver damage observed in animals exposed to high concentrations. Some evidence of hepatotoxicity in humans.	NCI bioassay inconclusive for laboratory animals. No epidemiological evidence in humans.	Not mutagenic in Ames assay. Inhalation of high doses (>16,000 mg/m^3) caused retarded fetal development in rats.

Table 3. Toxicity Summaries for Constituents of Concern, Kohler Company Landfill, Kohler, Wisconsin.

Constituent	Acute Toxicity Summary	Chronic Toxicity Summary	Cancer Potential	Other
1,2-Dichloroethane	Inhalation causes irritation of mucous membranes, headache, dizziness, nausea, vomiting, abdominal pain, and liver and kidney dysfunction. Exposure via inhalation for 1 hour to 4,000 ppm has resulted in leukocytosis. Oral LD_{50} (rats) 670 mg/kg.	Worker exposure for 2 to 5 months resulted in CNS depression, nausea, and vomiting; however, workers recovered when removed from exposure.	Induces a variety of tumors in rats and mice. No epidemiologic evidence of cancer in humans.	Mutagenic in bacterial and insect test systems.
1,1-Dichloroethene	Acute exposure to high doses causes CNS depression. Did not appear to be teratogenic but caused embryotoxicity and fetotoxicity when administered to rats and rabbits by inhalation. Oral LD_{50} (rats) 200 mg/kg.	Chronic exposure to oral doses as low as 5 mg/kg/day caused liver changes in rats. Neurotoxicity has not been demonstrated in studies involving low-level chronic exposures.	Caused kidney tumors (in males only) and leukemia in one study of mice exposed by inhalation, but the results of other studies were equivocal or negative.	Mutagenic in several bacterial assays.
c-1,2-Dichloroethene	CNS depression, nausea, fatty liver, and transient renal toxicity. Also irritates skin and mucous membranes.	No data available for chronic exposures. Liver and kidney effects likely.	Has not yet been studied for carcinogenicity.	Mutagenic and genotoxic effects reported in mice.
t-1,2-Dichloroethene	High concentrations have anesthetic properties as a result of CNS depression. Irritation of eyes and respiratory system.	Repeated exposure via inhalation to 800 mg/m^3 reportedly produced fatty degeneration of the liver in rats. Possible interaction with hepatic drug-metabolizing mono-oxygenase system.	No data available.	Not mutagenic in assay using E. coli, Salmonella, or mouse bone-marrow cells.

Table 3. Toxicity Summaries for Constituents of Concern, Kohler Company Landfill, Kohler, Wisconsin.

Constituent	Acute Toxicity Summary	Chronic Toxicity Summary	Cancer Potential	Other
Ethylbenzene	No effects in humans at inhalation concentrations of 100 ppm. Exposure to higher levels causes sleepiness, fatigue, headache, and mild eye and respiratory irritation.	Increases in liver and kidney weights and cloudiness and swelling of hepatocytes and renal tubular epithelium of rats orally dosed for 6 months.	No data available from NCI bioassay.	Not mutagenic in assays using Salmonella typhimurium and Saccharomyces cervisiae.
4-Methyl-2-pentanone	Headaches, nausea, vomiting, and eye irritation at air concentrations of 200 to 2,000 mg/m³.	Kidney damage observed in rats exposed via inhalation at 400 mg/m³. Damage appeared to be reversible.	No data available.	
Toluene	CNS effects such as: fatigue, weakness, confusion, euphoria, dizziness, headache, insomnia, muscular weakness, and incoordination have been reported.	Chronic exposure to vapors at 200 to 800 ppm are associated with disturbances in memory and psycho-motor skills. Cerebral and cerebellar dysfunction reported in chronic abusers of toluene, as well as hepatic and renal function changes. Oral administration to mice at doses of 260 mg/kg has increased embryonic lethality; 434 mg/kg has decreased fetal weight; and 867 mg/kg has increased incidence of cleft palate.	No evidence of carcinogenicity.	Not reported as genotoxic or teratogenic to humans.

Table 3. Toxicity Summaries for Constituents of Concern, Kohler Company Landfill, Kohler, Wisconsin.

Constituent	Acute Toxicity Summary	Chronic Toxicity Summary	Cancer Potential	Other
1,1,1-Trichloroethane	Depression of the CNS is the primary toxic effect in humans exposed to high levels via inhalation. Acute, high-level exposures can adversely affect the cardiovascular system. Accidental ingestion results in CNS depression and gastrointestinal upset. It is irritating to skin; liquid can be absorbed through the skin. Acute exposures indicate that this compound is relatively non-toxic, aside from CNS effects. The oral LD_{50} (rats) is about 11,000 mg/kg.	Long-term inhalation studies in animals resulted in liver changes. Occupational studies did not indicate any statistically significant effects after prolonged inhalation exposures. It appears to be no more toxic upon long-term exposure than acute exposure. Large oral doses given to test animals over a 78-week period indicated little apparent histopathological change in any organ.	Recent NTP study inconclusive. Evidence of human carcinogenicity.	Equivocal evidence of mutagenicity from bacterial assays.

Table 3. *Toxicity Summaries for Constituents of Concern, Kohler Company Landfill, Kohler, Wisconsin.*

Constituent	Acute Toxicity Summary	Chronic Toxicity Summary	Cancer Potential	Other
Trichloroethene	Exposure results in CNS depression which is demonstrated by dizziness, headache, visual disturbances, incoordination (similar to that induced by alcohol), tremors, sleepiness, nausea, and vomiting. Cardiac arrhythmias and death due to ventricular fibrillation and cardiac arrest from acute exposure above 15,000 ppm. Accidental ingestion of about 150 ml resulted in acute kidney failure and liver and cardiovascular damage. Local exposure to vapors may cause irritation to eyes, nose, and throat. Oral LD_{50} (rats) of about 7,200 mg/kg.	Prolonged occupational exposure to vapors (200 to 400 ppm) resulted in CNS symptoms including headache, dizziness, nausea, tremors, sleepiness, fatigue, and vomiting. These symptoms were reversible. Lower exposures (100 to 200 ppm) to humans resulted in biochemical changes in liver function. In test animals, chronic exposure induces low to moderate liver and kidney toxicity. Prolonged inhalation exposures to test animals at levels greater than 2,000 mg/m^3 resulted in renal toxicity, hepatotoxicity, and neurotoxicity.	Has produced an increase in heptacellular carcinomas in mice after oral administration. Other tests with mice and rats have produced negative results. Epidemiological data are inconclusive.	Mutagenic in bacterial assays.
Vinyl chloride	At high levels CNS effects occur including dizziness, headaches, euphoria, narcosis, and death. Lower doses have resulted in ataxia, congestion and edema in lungs, and hyperemia in liver.	Chronic toxicity symptoms of workers include hepatotoxicity, acroosteolysis, CNS disturbances, pulmonary insufficiency, cardiovascular toxicity, and gastrointestinal toxicity.	Liver angiosarcomas as well as tumors of the brain, lung, hematopoietic tissues, and lymphopoietic tissues have been associated with occupational exposure. Vinyl chloride is reported to be carcinogenic in rats, mice, and hamsters.	Mutagenic in bacterial and mammalian cellular assays. Equivocal evidence of possible teratogenic or reproductive effects.

Table 3. Toxicity Summaries for Constituents of Concern, Kohler Company Landfill, Kohler, Wisconsin.

Constituent	Acute Toxicity Summary	Chronic Toxicity Summary	Cancer Potential	Other
Xylenes	CNS disturbances and irritation of mucous membranes occur following acute exposure.	Chronic inhalation exposure of rats at 3,500 mg/m³ resulted in slight renal tubular degeneration. Xylene is not teratogenic, but has caused fetotoxicity in rats and mice.	Oral NTP study, while not finalized, indicated xylenes do not appear to be carcinogenic in rats.	Not mutagenic in the Ames test or other short-term in-vitro assays.
<u>Semi-VOCs</u>				
Butylbenzylphthalate	No evidence.	Decreased body weight in rats; also testicular lesions, and increased liver weights.	In rats, an increase in mononuclear cell leukemia or lymphoma has been observed.	
4-Chloro-3-methylphenol		Very little toxicity data are available. Possible lethal dose in the range of 50 to 500 mg/kg.	Reported as non-irritating to the skin at 0.5 to 1.0 percent in alcohol.	No data available.
Di-n-octyl phthalate	Low acute toxicity in mice, with oral and intraperitoneal LD_{50} values of 6.5 and 65 mg/kg, respectively. Eye and skin irritant.	A chronic LD_{50} value of 1.3 mg/kg was determined for mice injected intraperitoneally.	No evidence.	Some evidence of fetotoxicity and abnormalities in rats following intraperitoneal injections.
2,4-Dimethylphenol			Possible topical co-carcinogen.	

Table 3. Toxicity Summaries for Constituents of Concern, Kohler Company Landfill, Kohler, Wisconsin.

Constituent	Acute Toxicity Summary	Chronic Toxicity Summary	Cancer Potential	Other
2-Methylphenol 4-Methylphenol	Tissue burns, followed by loss of feeling. When absorbed into the body, toxic effects may develop in 30 minutes. These effects include weakness of muscles, headache, dizziness, impaired vision, rapid breathing and possible death.	Skin irritation, and chronic poisoning to the skin, mucous membranes, or respiratory tract. Symptoms of chronic poisoning include vomiting, difficulty in swallowing, salivation, diarrhea, loss of appetite, fainting, mental disturbances, and skin rash.		
Phenanthrene	Very little data available.	Photosensitization of skin. Acute toxicity is expected to be low.	No evidence.	Epoxide has produced mutagenic and tumorigenic responses.
Phenol	Phenol is very toxic. The probable human oral lethal dose is 50 to 500 mg/kg. These lethal amounts may be absorbed via skin or inhaled. Rats, however, exposed to 780 mg/kg/day of phenol in the drinking water have survived a 90-day exposure period. Skin exposure may be followed by numbness. Oral exposure signs include sonorous breathing and frothing at the mouth and nose.	Hepatic and kidney diseases are generally aggravated by exposure to phenol. Other symptoms include burning in the mouth and throat, bloody diarrhea, pallor, sweating, headache, dizziness, shock, ringing in the ears, and drop in body temperature.	Under review by USEPA.	Some evidence of fetotoxicity. Phenol administered to pregnant rats at doses of 120 mg/kg/day causes decrease in fetal body weight.

Table 3. Toxicity Summaries for Constituents of Concern, Kohler Company Landfill, Kohler, Wisconsin.

Constituent	Acute Toxicity Summary	Chronic Toxicity Summary	Cancer Potential	Other
Pyrene	Very little data available. Acute toxicity is expected to be low.	Fatty liver and enlarged liver.	No evidence	Was not mutagenic in most assays.
Inorganics				
Aluminum	Binding of phosphorus in the intestinal tract may lead to phosphate depletion and osteomalacia. Ingestion of high concentrations may result in constipation.	Relationship between aluminum and Alzheimer's disease in humans has been suggested.	No evidence.	
Antimony	Vomiting, watery diarrhea, irregular breathing, lowered body temperature, and death can occur in humans following acute oral exposure.	Cardiovascular damage has been observed in humans and laboratory animals. Pneumoconiosis and dermatitis have occurred in humans following inhalation and dermal exposure, respectively.	The trioxide has been associated with lung cancer (in humans and rats), but it is not classified as a potential carcinogen.	Mutagenic in some bacterial test systems. May cause reproductive effects in females occupationally exposed.
Arsenic	Ingestion of sufficient level can result in burning and dryness of the oral and nasal cavities, gastrointestinal disturbance, vertigo, delirium, coma, and death.	Occupational and ingestion exposure have caused progressive polyneuropathy (both motor and sensory) in humans, especially in the extremities.	Lung and skin cancer have been observed in humans.	Chromosomal aberrations have been observed in humans and laboratory animals. Causes birth defects and reproductive effects in laboratory animals and perhaps in humans when exposed occupationally.

Table 3. Toxicity Summaries for Constituents of Concern, Kohler Company Landfill, Kohler, Wisconsin.

Constituent	Acute Toxicity Summary	Chronic Toxicity Summary	Cancer Potential	Other
Barium	Rare occurrence but ingestion of soluble barium salts has produced gastroenteritis, muscular paralysis, decreased pulse rate, vascular constriction, and ventricular fibrillation. Potassium deficiency may also occur. Alkaline compounds irritate eyes, nose, throat, and skin.	Inhalation of dust may produce a benign pneumoconiosis (baritosis) which is reversible.	No evidence.	
Beryllium	Inhalation can cause rhinitis, pharyngitis, tracheo-bronchitis, and acute pneumonitis. Dermal contact can cause dermatitis. The conjunctiva of the eye is also sensitive.	Chronic exposure can cause granulomatous lung inflammation with cough, chest pain, and weakness. Other effects include liver and spleen enlargement, cyanosis, digital clubbing, and kidney stones.	Reported to cause cancer in several laboratory animal species; may also cause cancer in humans.	Evidence of genetic damage is equivocal.

Table 3. Toxicity Summaries for Constituents of Concern, Kohler Company Landfill, Kohler, Wisconsin.

Constituent	Acute Toxicity Summary	Chronic Toxicity Summary	Cancer Potential	Other
Cadmium	Nausea, vomiting, diarrhea, muscular cramps, salivation, sensory disturbances, liver injury, convulsions, shock, renal failure, cardio-pulmonary depression, and death can occur in humans following exposure to sufficient quantities of cadmium.	Renal dysfunction has been observed in both humans and laboratory animals following exposure to cadmium. Immuno-suppression has been observed in laboratory animals. Anemia, osteomalacia, osteoporosis, and pulmonary disease have been observed in humans following long-term exposure to cadmium. The endocrine and sensory systems may also be targets of cadmium toxicity.	Cancer has been observed in laboratory animals exposed to cadmium by inhalation and injection. This is not thought to be relevant to oral exposure.	Cadmium may impair DNA repair, but probably is not directly mutagenic. Reproductive impairment has been observed in laboratory animals.
Chromium	Occupational exposure to hexavalent chromium (Cr VI) compounds causes dermatitis, hand and forearm ulcers, and perforation of nasal septum. Trivalent chromium (Cr III) is much less toxic; the main effect is contact dermatitis in susceptible individuals.	May damage liver, kidney, and respiratory system.	Certain salts of Cr VI are carcinogenic in rats. Epidemiologic studies have reported an increased incidence in lung cancer in workers occupationally exposed to Cr VI (as chromic acid or chromate).	Trace amount of Cr III are essential for carbohydrate metabolism in mammals. Cr VI is mutagenic. Embryotoxic and teratogenic effects occur in mice and hamsters.

Table 3. Toxicity Summaries for Constituents of Concern, Kohler Company Landfill, Kohler, Wisconsin.

Constituent	Acute Toxicity Summary	Chronic Toxicity Summary	Cancer Potential	Other
Cobalt	Therapeutic administration of excessive amounts was reported to produce vomiting, diarrhea, and a sensation of warmth in humans. Oral LD_{50} of 1,500 mg/kg in the rat.	Children receiving between 1 and 6 mg per day as treatment for anemia have experienced goiter and decreased thyroid function, increased heart and respiration rates, and blood lipid changes.	No evidence of carcinogenicity via significant routes of exposure.	Limited data suggest that cobalt chloride has mutagenic activity.
Copper	Inhalation of dust can cause short-term chills, fever, headache, aching muscles, and dryness of mouth and throat. Inhalation of fumes can cause irritation of the upper respiratory tract, a metallic taste, nausea, metallic fume fever, and discoloration of skin and hair. Ingestion of high levels can cause excess salivation, nausea, vomiting, diarrhea, and gastritis; extremely high levels can cause hemolysis, liver damage, gastrointestinal bleeding, convulsions, and death.	May result in anemia.	No evidence of carcinogenicity in animals or humans for oral or inhalation routes of exposure.	No evidence of mutagenic effects or birth defects in humans or laboratory animals.

Table 3. Toxicity Summaries for Constituents of Concern, Kohler Company Landfill, Kohler, Wisconsin.

Constituent	Acute Toxicity Summary	Chronic Toxicity Summary	Cancer Potential	Other
Fluoride	Fluoride exhibits calcium-binding effects which exhibit symptoms such as vomiting, abdominal pain, nausea, and diarrhea, followed by paresthesias, hyperactive reflexes, and tonic and clonic convulsions. Death from respiratory paralysis or cardiac failure may result.	Controlled studies with recommended levels of added fluoride have shown no adverse effects. Adverse effects, except in rare cases, have not been reported in water containing fluoride until the concentration is many times that recommended for artificial fluoridation.	Equivocal results were obtained in a recent NTP bioassay using sodium fluoride in rodents.	
Iron	Ingestion of >0.5 grams results in toxicity: vomiting, ulceration of gastrointestinal tract, liver damage, and kidney failure.	Iron overload can occur when body iron content is increased 5 to 10 times due to increased absorption or dietary intake. Clinical signs include liver function and endocrine disturbances, diabetes, and cardiovascular effects. Pneumoconiosis reported in workers exposed to > 10 mg/m^3.	No evidence.	Iron is an essential metal.

Table 3. Toxicity Summaries for Constituents of Concern, Kohler Company Landfill, Kohler, Wisconsin.

Constituent	Acute Toxicity Summary	Chronic Toxicity Summary	Cancer Potential	Other
Lead	Lead is primarily a chronic toxin. Organolead compounds are more acutely toxic than inorganic compounds. A reversible renal tubular dysfunction has been reported in children acutely exposed to inorganic lead. Blood lead concentrations associated with renal effects and brain damage range from about 80 to 100 $\mu g/dL$; death has been reported at concentrations > 125 $\mu g/dL$. Blood levels greater than 10 $\mu g/dL$ have been associated with premature birth, low birth weight, and neurobehavioral effects.	Chronic exposure via ingestion or inhalation can result in brain encephalopathy, permanent brain damage, peripheral neuropathies, and permanent kidney damage. Low-level chronic exposure can result in learning disabilities and anemia due to a reduction to the life span of circulating red blood cells, and can also result in a reduction of the biologically active form of Vitamin D.	A dose-dependent increase in renal tumors has been reported in rats dosed at 500 to 2,000 ppm of lead acetate in the diet.	Lead is a cellular poison. Short-term tests to predict mutagenicity result in cellular toxicity before mutagenicity can be expressed. Severe lead toxicity can cause sterility and abortion.
Manganese	Inhalation exposure to high levels of manganese dusts can cause manganese pneumonitis, increased susceptibility to respiratory disease, and proliferation of mononuclear cells in humans.	Liver dysfunction and CNS degeneration can result from chronic exposure, causing emotional disturbances, mask-like face, and Parkinson's-like syndrome in humans.	No evidence of carcinogenicity in humans. Direct injections of manganese-compounds into rodents can cause lymphomas and tumors.	No evidence of teratogenicity.

Table 3. Toxicity Summaries for Constituents of Concern, Kohler Company Landfill, Kohler, Wisconsin.

Constituent	Acute Toxicity Summary	Chronic Toxicity Summary	Cancer Potential	Other
Magnesium	Magnesium oxide dust can irritate the eyes and respiratory tract. Ingestion of large amounts of magnesium salts results in a laxative effect.	Intoxication in humans via ingestion generally only occurs in humans with severe kidney disease. Symptoms include sudden drop in blood pressure and respiratory paralysis due to CNS depression.	No evidence of carcinogenicity in laboratory animals or humans.	No evidence of mutagenicity, birth defects, or reproductive effects.
Nickel	Acute effects of nickel carbonyl inhalation include both immediate and delayed symptoms including chemical pneumonitis. Oral toxicity is low. Dermal sensitization has been demonstrated.	Chronic inhalation can cause rhinitis, nasal sinusitis, and nasal mucosal injury in humans. Oral toxicity is low.	Inhalation of insoluble nickel compounds is associated with lung and nasal cavity cancer in humans and cancer in laboratory animals.	Mutagenicity and chromosomal aberrations are caused by several forms of nickel. Data indicate that nickel can cause reproductive effects in laboratory animals, but birth defects have not been demonstrated.
Nitrate-Nitrite	Methemoglobinemia in infants is caused by high levels of nitrite, or indirectly from nitrate, in humans. Results of difficulty in oxygen transport have been reported.	It has been proposed that nitrate in water may be converted to N-nitrosos compounds that are carcinogenic agents.	High concentrations of nitrate in the drinking water have been associated with stomach cancer, although the findings are only suggestive.	

Table 3. Toxicity Summaries for Constituents of Concern, Kohler Company Landfill, Kohler, Wisconsin.

Constituent	Acute Toxicity Summary	Chronic Toxicity Summary	Cancer Potential	Other
Selenium	Acute effects are similar across species and routes (oral, dermal, and inhalation) and include degeneration of liver, kidney, and myocardia, digestive tract hemorrhaging, and brain damage. Inhalation exposure can also cause eye, nose, and throat irritation.	Chronic toxicity is similar across species and forms of selenium. Effects include depression, nervousness, dermatitis, gastrointestinal disturbances, dental caries and discoloration, lassitude, and loss of hair and nails. Toxicity is associated with ingestion of high levels of selenium.	There is no evidence of carcinogenicity in humans; evidence from laboratory animals studies is equivocal. Recent evidence suggests that appropriate dosages of selenium may inhibit the occurrence of tumors.	Birth defects and reproductive effects are suggested by anecdotal evidence from farm animals, but further testing is necessary. Inadequate data are available for predicting mutagenic potential.

Table 3. Toxicity Summaries for Constituents of Concern, Kohler Company Landfill, Kohler, Wisconsin.

Constituent	Acute Toxicity Summary	Chronic Toxicity Summary	Cancer Potential	Other
Silver	Large oral doses can cause violent abdominal pain, vomiting, convulsions, and death.	Excessive absorption by the oral or inhalation routes can cause local or generalized argyria (impregnation of tissues) in humans, sometimes resulting in blue-gray pigmentation of the skin, hair, internal organs, and conjunctiva of the eye. Lesions of the liver, kidney, bone marrow, and lungs have also been reported in humans. Hemorrhaging of the kidneys, decreased immunologic resistance, growth depression, lowered conditioned reflex activity, and pathologic changes in the morphology of liver, kidney, stomach, and small intestine have been observed in laboratory animals exposed to silver in their drinking water.	Silver is not known to cause cancer by relevant routes of exposure.	No significant mutagenic or teratogenic effects in humans or laboratory animals.
Sulfate	No chronic or acute adverse responses have been reported for concentrations of 750 to 1,000 mg/L.		No evidence.	

Table 3. Toxicity Summaries for Constituents of Concern, Kohler Company Landfill, Kohler, Wisconsin.

Constituent	Acute Toxicity Summary	Chronic Toxicity Summary	Cancer Potential	Other
Vanadium	Acute exposure to vanadium via inhalation can result in upper and lower respiratory irritation with mucous discharge and bronchitis, cough, bronchospasm, and chest pain. Ingestion can cause gastrointestinal disturbances and dislocation of the oral mucosa and tongue.	Enzymatic dysfunction is common with long-term exposure.		No evidence of mutagenicity, teratogenicity, or reproductive effects in humans or animals.
Zinc	Ingestion of excessive amounts of zinc can cause fever, vomiting, stomach cramps, and diarrhea.	Excessive dietary intake has caused growth retardation, hypochromic anemia, and defective mineralization of bone in laboratory animals.	Zinc is not thought to cause cancer by relevant routes of exposure.	No data suggest mutagenic or teratogenic effects.

References: Constituent-specific documents from Agency for Toxic Substances and Disease Registry (ATSDR), National Toxicology Program (NTP) Technical Reports, USEPA Health Effects Assessment Documents, Registry of Toxic Effects of Chemical Substances (RTECS), and Sax and Lewis (1984).

Table 4 Risk Estimation Summary, Kohler Company Landfill, Source Control Feasibility Study, Kohler, Wisconsin.

	Excess Lifetime Cancer Risk[a]		Hazard Index[b]	
Non-Potable Ground Water				
Hypothetical Future Worker (Unconsolidated Unit)	6×10^{-6}		0.10	
Hypothetical Future Worker (Shallow Bedrock Unit)	6×10^{-6}		0.030	
Hypothetical Future Worker (Deep Bedrock Unit)	1×10^{-7}		0.030	
Potable Ground Water				
Ingestion:	Adult	Child	Adult	Child
Hypothetical Future Resident (Unconsolidated Unit)	4×10^{-3}	2×10^{-3}	30	60
Hypothetical Future Resident (Shallow Bedrock Unit)	5×10^{-3}	2×10^{-3}	40	90
Hypothetical Future Resident (Deep Bedrock Unit)	1×10^{-4}	6×10^{-5}	60	100
Showering:	Adult	Child	Adult	Child
Hypothetical Future Resident (Unconsolidated Unit)	1×10^{-4}	NE	2.0	NE
Hypothetical Future Resident (Shallow Bedrock Unit)	1×10^{-4}	NE	1.0	NE
Hypothetical Future Resident (Deep Bedrock Unit)	3×10^{-6}	NE	0.020	NE
Leachate				
Current Worker	2×10^{-6}		0.0060	
Current Trespasser	3×10^{-6}		0.020	
Hypothetical Future Adult Resident	6×10^{-6}		0.020	
Hypothetical Future Child Resident	2×10^{-5}		0.20	
Surface Water				
	Adult	Child	Adult	Child
Swimming	1×10^{-7}	5×10^{-8}	0.0020	0.0040
Fish Ingestion	2×10^{-6}	2×10^{-6}	0.30	1.0

a An excess lifetime cancer risk range above 1×10^{-4} is typically deemed "unacceptable" by regulatory agencies. In some site specific cases values above 1×10^{-6} are deemed "unacceptable".

b A hazard index value greater than 1 is typically deemed "unacceptable" by regulatory agencies.

NE Not evaluated.

Table 5. Adult Resident Risk Scenario, **Unconsolidated Unit**, Hypothetical Future Potable Ground-Water Exposure Doses (PGWExDs), Hazard Quotients, and Excess Lifetime Cancer Risks , Kohler Company Landfill, Source Control Feasibility Study, Kohler, Wisconsin

Constituent	C_{gw}	PGWExD		Cancer Risk and Hazard Quotient
CANCER EFFECTS				
VOCs				
Benzene	0.011	1.3E-04		3.7E-06
1,1-Dichloroethane	1.0	1.2E-02		NA
1,2-Dichloroethane	0.024	2.8E-04		2.6E-05
1,1-Dichloroethene	0.0045	5.3E-05		3.2E-05
Trichloroethene	1.7	2.0E-02		2.2E-04
Vinyl chloride	0.14	1.6E-03		3.1E-03
Semi-VOCs				
Butylbenzylphthalate	0.0093	1.1E-04		NA
2-Methylphenol	0.041	4.8E-04		NA
4-Methylphenol	0.047	5.5E-04		NA
Inorganics				
Arsenic	0.0047	5.5E-05		9.7E-05
Beryllium	0.0010	1.2E-05		5.0E-05
Lead	0.015	1.8E-04		NA
			ELCR	4E-03
Non-Cancer Effects				
VOCs				
Benzene	0.011	3.0E-04		4.3E-01
Carbon disulfide	0.0095	2.6E-04		2.6E-03
Chlorobenzene	0.018	4.9E-04		2.5E-02
Chloroethane	0.052	1.4E-03		3.6E-03
1,1-Dichloroethane	1.0	2.7E-02		2.7E-01
1,2-Dichloroethane	0.024	6.6E-04		2.6E-03
1,1-Dichloroethene	0.0045	1.2E-04		1.4E-02
1,2-Dichloroethene (total)	0.24	6.6E-03		6.6E-01
Ethylbenzene	0.0083	2.3E-04		2.3E-03
4-Methyl-2-pentanone	0.012	3.3E-04		6.6E-03
Toluene	0.081	2.2E-03		1.1E-02
1,1,1-Trichloroethane	0.051	1.4E-03		1.6E-02
Trichloroethene	1.7	4.7E-02		6.3E+00
Vinyl chloride	0.14	3.8E-03		3.0E+00
Xylene	0.029	7.9E-04		4.0E-04

Table 5. Adult Resident Risk Scenario, Unconsolidated Unit, Hypothetical Future Potable Ground-Water Exposure Doses (PGWExDs), Hazard Quotients, and Excess Lifetime Cancer Risks, Kohler Company Landfill, Source Control Feasibility Study, Kohler, Wisconsin

Constituent	C_{gw}	PGWExD	Cancer Risk and Hazard Quotient
Semi-VOCs			
Butylbenzylphthalate	0.0093	2.5E-04	1.3E-03
4-Chloro-3-methylphenol	0.015	4.1E-04	2.1E-04
2,4-Dimethylphenol	2.0	5.5E-02	2.7E+00
Di-n-octyl phthalate	0.0071	1.9E-04	9.7E-03
2-Methylphenol	0.041	1.1E-03	2.2E-02
4-Methylphenol	0.047	1.3E-03	2.6E-02
Phenol	0.015	4.1E-04	6.8E-04
Pyrene	0.0030	8.2E-05	2.7E-03
Inorganics			
Aluminum	1.1	3.0E-02	NA
Antimony	0.14	3.8E-03	9.6E+00
Arsenic	0.0047	1.3E-04	1.3E-01
Barium	0.065	1.8E-03	2.5E-02
Beryllium	0.0010	2.7E-05	5.5E-03
Cadmium	0.010	2.7E-04	5.5E-01
Chromium	0.033	9.0E-04	1.8E-01
Cobalt	0.040	1.1E-03	NA
Copper	0.066	1.8E-03	NA
Fluoride	3.2	8.8E-02	1.5E+00
Iron	0.33	9.0E-03	NA
Lead	0.015	4.1E-04	NA
Magnesium	62	1.7E+00	NA
Manganese	0.35	9.6E-03	9.6E-02
Nickel	0.073	2.0E-03	1.0E-01
Nitrate	170	4.7E+00	NA
Selenium	0.0020	5.5E-05	1.8E-02
Silver	0.016	4.4E-04	1.5E-01
Sulfate	370	1.0E+01	NA
Vanadium	0.075	2.1E-03	2.9E-01
Zinc	0.065	1.8E-03	8.9E-03
		HI	3E+01

C_{gw} Ground-water concentration (mg/L).
ELCR Excess lifetime cancer risk (sum of cancer risks [PGWExD x CSF] see Table R-11).
HI Hazard index (sum of the hazard quotients [PGWExD/RfD_o] see Table R-11).
PGWExD Potable ground water exposure dose (mg/kg/day).
NA No USEPA-verified toxicity values available to estimate risk.

Table 6. Adult Resident Risk Scenario, **Shallow Bedrock Unit**, Hypothetical Future Potable Ground Water Exposure Doses (PGWExDs), Hazard Quotients, and Excess Lifetime Cancer Risks, Kohler Company Landfill, Source Control Feasibility Study, Kohler, Wisconsin

Constituent	C_{gw}	PGWExD		Cancer Risk and Hazard Quotient
CANCER EFFECTS				
VOCs				
1,1-Dichloroethane	0.0094	1.1E-04		NA
1,1-Dichloroethene	0.0027	3.2E-05		1.9E-05
Trichloroethene	0.12	1.4E-03		1.5E-05
Vinyl chloride	0.20	2.3E-03		4.5E-03
Inorganics				
Arsenic	0.0032	3.8E-05		6.6E-05
Beryllium	0.0024	2.8E-05		1.2E-04
Lead	0.0012	1.4E-05		NA
			ELCR	5E-03
NON-CANCER EFFECTS				
VOCs				
Chlorobenzene	0.0020	5.5E-05		2.7E-03
Chloroethane	0.0020	5.5E-05		1.4E-04
1,1-Dichloroethane	0.0094	2.6E-04		2.6E-03
1,1-Dichloroethene	0.0027	7.4E-05		8.2E-03
1,2-Dichloroethene (total)	0.59	1.6E-02		1.6E+00
Trichloroethene	0.12	3.3E-03		4.4E-01
Vinyl chloride	0.20	5.5E-03		4.2E+00
Semi-VOCs				
Phenol	0.0015	4.1E-05		6.8E-05
Pyrene	0.0030	8.2E-05		2.7E-03
Inorganics				
Aluminum	0.93	2.5E-02		NA
Antimony	0.41	1.1E-02		2.8E+01
Arsenic	0.0032	8.8E-05		8.8E-02
Barium	0.17	4.7E-03		6.7E-02
Beryllium	0.0024	6.6E-05		1.3E-02
Cadmium	0.024	6.6E-04		1.3E+00
Chromium	0.040	1.1E-03		2.2E-01

Table 6. Adult Resident Risk Scenario, **Shallow Bedrock Unit**, Hypothetical Future Potable Ground Water Exposure Doses (PGWExDs), Hazard Quotients, and Excess Lifetime Cancer Risks, Kohler Company Landfill, Source Control Feasibility Study, Kohler, Wisconsin.

Constituent	C_{rw}	PGWExD	Cancer Risk and Hazard Quotient
Inorganics (cont.)			
Cobalt	0.21	5.8E-03	NA
Copper	0.050	1.4E-03	NA
Fluoride	0.51	1.4E-02	2.3E-01
Iron	0.46	1.3E-02	NA
Lead	0.0012	3.3E-05	NA
Magnesium	60	1.6E+00	NA
Manganese	0.14	3.8E-03	3.8E-02
Nickel	0.15	4.1E-03	2.1E-01
Nitrate-Nitrite	91	2.5E+00	NA
Silver	0.066	1.8E-03	6.0E-01
Sulfate	230	6.3E+00	NA
Vanadium	0.30	8.2E-03	1.2E+00
Zinc	0.044	1.2E-03	6.0E-03
		HI	4E+01

C_{rw} Ground-water concentration (mg/L).
ELCR Excess lifetime cancer risk (sum of cancer risks [PGWExD x CSF] see Table R-11).
HI Hazard index (sum of the hazard quotients [PGWExD/RfD_o] see Table R-11).
PGWExD Potable ground water exposure dose (mg/kg/day).
NA No USEPA-verified toxicity values available to estimate risk.

Table 7. Adult Resident Risk Scenario, **Deep Bedrock Unit**, Hypothetical Future Potable Ground-Water Exposure Doses (PGWExDs), Hazard Quotients, and Excess Lifetime Cancer Risks, Kohler Company Landfill, Source Control Feasibility Study, Kohler, Wisconsin.

Constituent	C_{gw}	PGWExD		Cancer Risk and Hazard Quotient
<u>CANCER EFFECTS</u>				
<u>VOCs</u>				
Vinyl chloride	0.0050	5.9E-05		1.1E-04
<u>Inorganics</u>				
Beryllium	0.00022	2.6E-06		1.1E-05
Nickel	0.35	4.1E-03		NA
			ELCR	1E-04
<u>NON-CANCER EFFECTS</u>				
<u>VOCs</u>				
1,2-Dichloroethene (total)	0.0050	1.4E-04		1.4E-02
Vinyl chloride	0.0050	1.4E-04		1.1E-01
<u>Semi-VOCs</u>				
Pyrene	0.0030	8.2E-05		2.7E-03
<u>Inorganics</u>				
Aluminum	1.4	3.8E-02		NA
Antimony	0.71	1.9E-02		4.9E+01
Barium	1.4	3.8E-02		5.5E-01
Beryllium	0.00022	6.0E-06		1.2E-03
Chromium	0.34	9.3E-03		1.9E+00
Cobalt	0.33	9.0E-03		NA
Copper	0.045	1.2E-03		NA
Fluoride	0.46	1.3E-02		2.1E-01
Iron	4.5	1.2E-01		NA
Magnesium	550	1.5E+01		NA
Manganese	3.8	1.0E-01		1.0E+00
Nickel	0.35	9.6E-03		4.8E-01
Nitrate-Nitrite	0.25	6.8E-03		NA

Table 7. Adult Resident Risk Scenario, Depp Bedrock Unit, Hypothetical Future Potable Ground-Water Exposure Doses (PGWExDs), Hazard Quotients, and Excess Lifetime Cancer Risks, Kohler Company Landfill, Source Control Feasibility Study, Kohler, Wisconsin.

Constituent	C_{gw}	PGWExD	Cancer Risk and Hazard Quotient
Inorganics (cont.)			
Silver	0.13	3.6E-03	1.2E+00
Sulfate	300	8.2E+00	NA
Vanadium	0.53	1.5E-02	2.1E+00
Zinc	0.14	3.8E-03	1.9E-02
		HI	6E+01

C_{gw} Ground-water concentration (mg/L).
ELCR Excess lifetime cancer risk (sum of cancer risks [PGWExD x CSF] see Table R-11).
HI Hazard index (sum of the hazard quotients [PGWExD/RfD_o] see Table R-11).
PGWExD Potable ground water exposure dose (mg/kg/day).
NA No USEPA-verified toxicity values available to estimate risk.

Table 8. Concentrations for Constituents of Concern Detected in Ground-Water Samples, and Estimated Sheboygan River Surface-Water Concentrations, Kohler Company Landfill, Source Control Feasibility Study, Kohler, Wisconsin.

Constituent	Highest UCL[a]	Ground-Water Unit	Estimated Surface Water Concentration[b]
VOCs			
Benzene	0.011	Unconsolidated	3.2×10^{-5}
Carbon disulfide	0.0095	Unconsolidated	2.8×10^{-5}
Chlorobenzene	0.018	Unconsolidated	5.3×10^{-5}
Chloroethane	0.052	Unconsolidated	1.5×10^{-4}
1,1-Dichloroethane	1.0	Unconsolidated	2.9×10^{-3}
1,2-Dichloroethane	0.024	Unconsolidated	7.0×10^{-5}
1,1-Dichloroethene	0.0045	Unconsolidated	1.3×10^{-5}
1,2-Dichloroethene (total)	0.59	Shallow Bedrock	1.7×10^{-3}
Ethylbenzene	0.0083	Unconsolidated	2.4×10^{-5}
4-Methyl-2-pentanone	0.012	Unconsolidated	3.5×10^{-5}
Toluene	0.081	Unconsolidated	2.4×10^{-4}
1,1,1-Trichloroethane	0.051	Unconsolidated	1.5×10^{-4}
Trichloroethene	1.7	Unconsolidated	5.0×10^{-3}
Vinyl chloride	0.20	Shallow Bedrock	5.9×10^{-4}
Xylenes	0.029	Unconsolidated	8.5×10^{-5}
Semi-VOCs			
Butylbenzylphthalate	0.0093	Unconsolidated	2.7×10^{-5}
4-Chloro-3-methylphenol	0.015	Unconsolidated	4.4×10^{-5}
2,4-Dimethylphenol	2.0	Unconsolidated	5.9×10^{-3}
Di-n-octyl phthalate	0.0071	Unconsolidated	2.1×10^{-5}
2-Methylphenol	0.041	Unconsolidated	1.2×10^{-4}
4-Methylphenol	0.047	Unconsolidated	1.4×10^{-4}
Phenol	0.015	Unconsolidated	4.4×10^{-5}
Pyrene	0.003	Unconsolidated, Shallow, and Deep Bedrock	8.8×10^{-6}

All results given in milligrams per liter (mg/L)

Table 8. Concentrations for Constituents of Concern Detected in Ground-Water Samples, and Estimated Sheboygan River Surface-Water Concentrations, Kohler Company Landfill, Source Control Feasibility Study, Kohler, Wisconsin.

Constituent	Highest UCL[a]	Ground-Water Unit	Estimated Surface Water Concentration[b]
Inorganics			
Aluminum	1.4	Deep Bedrock	4.1×10^{-3}
Antimony	0.71	Deep Bedrock	2.1×10^{-3}
Arsenic	0.0047	Unconsolidated	1.4×10^{-5}
Barium	1.4	Deep Bedrock	4.1×10^{-3}
Beryllium	0.0024	Shallow Bedrock	7.0×10^{-6}
Cadmium	0.024	Shallow Bedrock	7.0×10^{-5}
Chromium	0.34	Deep Bedrock	9.8×10^{-4}
Cobalt	0.33	Deep Bedrock	9.7×10^{-4}
Copper	0.066	Unconsolidated	1.9×10^{-4}
Fluoride	3.2	Shallow Bedrock	9.4×10^{-3}
Iron	4.5	Deep Bedrock	1.3×10^{-2}
Lead	0.015	Unconsolidated	4.4×10^{-5}
Magnesium	550	Deep Bedrock	1.6
Manganese	3.8	Deep Bedrock	1.1×10^{-2}
Nickel	0.35	Deep Bedrock	1.0×10^{-3}
Nitrate-Nitrite	91	Shallow Bedrock	2.7×10^{-1}
Selenium	0.002	Unconsolidated	5.9×10^{-6}
Silver	0.13	Deep Bedrock	3.8×10^{-4}
Sulfate	370	Deep Bedrock	1.1
Vanadium	0.53	Deep Bedrock	1.5×10^{-3}
Zinc	0.14	Deep Bedrock	4.0×10^{-4}

a UCL refers to the upper 95 percent confidence limit on the arithmetic average (obtained from Tab 4-2, 4-3, or 4-4).

b Estimated by multiplying the highest UCL concentration in ground water by the dilution factor of ground water discharge flow (Q_{gw}) to river flow (Q_R):

$$\frac{Qgw \times C_{gw}}{Qgw + Q_R} = \frac{5.0 \times 10^{-2} \text{ cfs} \times C_{gw}}{5.0 \times 10^{-2} \text{ cfs} + 17 \text{ cfs}}$$

All results given in milligrams per liter (mg/L)

Table 9. Comparison of Constituents of Concern in Ground Water with Available Water-Quality Criteria, Kohler Company Landfill, Kohler, Wisconsin.

Constituent	Highest Ground-Water UCL[a]	Surface-Water Criteria[b]	Does Water Concentration Exceed Criteria?
VOCs			
Benzene	1.1×10^{-2}	5.3×10^{-2} [c]	No
Carbon disulfide	9.5×10^{-3}	---	No
Chlorobenzene	1.8×10^{-2}	5.0×10^{-3} [d]	Yes
Chloroethane	5.2×10^{-2}	---	No
1,1-Dichloroethane	1.0×10^{0}	---	No
1,2-Dichloroethane	2.4×10^{-2}	2.0×10^{0} [e]	No
1,1-Dichloroethene	4.5×10^{-3}	1.15×10^{-1} [f]	No
1,2-Dichloroethene (total)	5.9×10^{-1}	1.15×10^{-1} [f]	Yes
Ethylbenzene	8.3×10^{-3}	3.2×10^{0} [e]	No
4-Methyl-2-pentanone	1.2×10^{-2}	---	No
Toluene	8.1×10^{-2}	1.75×10^{-1} [c]	No
1,1,1-Trichloroethane	5.1×10^{-2}	1.8×10^{-1} [g]	No
Trichloroethene	1.7×10^{0}	2.19×10^{0} [c]	Yes
Vinyl chloride	2.0×10^{-1}	---	No
Xylenes	2.9×10^{-2}	---	No
Semi-VOCs			
Butylbenzylphthalate	9.3×10^{-3}	3.6×10^{-1} [i]	No
4-Chloro-3-methylphenol	1.5×10^{-2}	---	No
2,4-Dimethylphenol	2.0×10^{0}	2.12×10^{-2} [c]	Yes
Di-n-octyl phthalate	7.1×10^{-3}	3.6×10^{-1} [i]	No
2-Methylphenol	4.1×10^{-2}	---	No
4-Methylphenol	4.7×10^{-2}	---	No
Phenol	1.5×10^{-2}	2.56×10^{-1} [e]	No
Pyrene	3.0×10^{-3}	1.3×10^{-2} [j]	No
Inorganics			
Aluminum	1.4×10^{0}	8.7×10^{-2} [k]	Yes
Antimony	7.1×10^{-1}	3.0×10^{-2} [i]	Yes
Arsenic	4.7×10^{-3}	1.53×10^{-1}	No
Barium	1.4×10^{0}	---	No
Beryllium	2.4×10^{-3}	5.3×10^{-4} [e]	Yes
Cadmium	2.4×10^{-2}	1.9×10^{-3} [l]	Yes

Footnotes appear on pages 2 and 3.

Table 9. Comparison of Constituents of Concern in Ground Water with Available Water-Quality Criteria, Kohler Company Landfill, Kohler, Wisconsin.

Constituent	Highest Ground-Water UCL[a]	Surface-Water Criteria[b]	Does Water Concentration Exceed Criteria?
<u>Inorganics</u> (cont'd)			
Chromium (+6)	3.4×10^{-1}	9.74×10^{-3}	Yes
Cobalt	3.3×10^{-1}	—	No
Copper	6.6×10^{-2}	3.7×10^{-2} [l]	Yes
Fluoride	3.2×10^{0}	—	No
Iron	4.5×10^{0}	1.0×10^{0} [m]	Yes
Lead	1.5×10^{-2}	4.8×10^{-2} [l]	No
Magnesium	5.5×10^{2}	—	No
Manganese	3.8×10^{0}	1.5×10^{0} [n]	Yes
Nickel	3.5×10^{-1}	1.9×10^{-1} [l]	Yes
Nitrate-Nitrite	9.1×10^{1}	—	No
Selenium	2.0×10^{-3}	7.07×10^{-3}	No
Silver	1.3×10^{-1}	8.4×10^{-3} [l]	No
Sulfate	3.7×10^{2}	—	No
Vanadium	1.4×10^{-1}	—	No

All concentrations reported in milligrams per liter (mg/L).

— No standard or criteria available.

a From Table R-17.

b Wisconsin Chronic Toxicity Criteria (NR105.06, WAC) for Warm Water Sportfish, unless specified otherwise.

c Insufficient data to develop Federal Water-Quality Criterion (FWQC). Value presented is the lowest observed effect level (LOEL) via acute exposure, reduced by a factor of 100 (USEPA, 1986c).

d Insufficient data to develop FWQC. Value presented is the LOEL via chronic exposure to chlorinated benzenes, reduced by a factor of 10 (USEPA, 1986c).

e Insufficient data to develop FWQC. Value presented is the LOEL via chronic exposure, reduced by a factor of 10 (USEPA, 1986c).

f Insufficient data to develop FWQC. Value presented is the LOEL via acute exposure to dichloroethenes, reduced by a factor of 100 (USEPA, 1986c).

Table 9. Comparison of Constituents of Concern in Ground Water with Available Water-Quality Criteria, Kohler Company Landfill, Kohler, Wisconsin.

g Insufficient data to develop FWQC. Value presented is the LOEL via acute exposure to trichlorinated ethanes, reduced by a factor of 100 (USEPA, 1986c).
h Insufficient data to develop FWQC. Value presented is the LOEL via acute exposure, reduced by a factor of 100 (IRIS, 1991).
i Proposed federal chronic FWQC (55 FR 93).
j Proposed chronic FWQC (USEPA, 1988b).
k Chronic FWQC (USEPA, 1988c).
l Hardness-related Wisconsin criterion. Criterion presented was calculated assuming a Sheboygan River water hardness of 343 mg/L as $CaCO_3$.
m Chronic FWQC (USEPA, 1986c).
n Value presented is not a criterion or standard but a threshold concentration below which no adverse effects to fish would be expected (USEPA, 1986c).

Table 10. Comparison of Constituents of Concern Estimated in Sheboygan River Surface Water with Available Water-Quality Criteria, Kohler Company Landfill, Kohler, Wisconsin.

Constituent	Estimated Surface-Water Concentration[a]	Surface-Water Criteria[b]	Does Water Concentration Exceed Criteria?
VOCs			
Benzene	3.2×10^{-5}	5.3×10^{-2} [c]	No
Carbon disulfide	2.8×10^{-5}	---	No
Chlorobenzene	5.3×10^{-5}	5.0×10^{-3} [d]	No
Chloroethane	1.5×10^{-4}	---	No
1,1-Dichloroethane	2.9×10^{-3}	---	No
1,2-Dichloroethane	7.0×10^{-5}	2.0×10^{0} [e]	No
1,1-Dichloroethene	1.3×10^{-5}	1.15×10^{-1} [f]	No
1,2-Dichloroethene (total)	1.7×10^{-3}	1.15×10^{-1} [f]	No
Ethylbenzene	2.4×10^{-5}	3.2×10^{0} [e]	No
4-Methyl-2-pentanone	3.5×10^{-5}	---	No
Toluene	2.4×10^{-4}	1.75×10^{-1} [c]	No
1,1,1-Trichloroethane	1.5×10^{-4}	1.8×10^{-1} [g]	No
Trichloroethene	5.0×10^{-3}	2.19×10^{0} [e]	No
Vinyl chloride	5.9×10^{-4}	---	No
Xylenes	8.5×10^{-5}	---	No
Semi-VOCs			
Butylbenzylphthalate	2.7×10^{-5}	3.6×10^{1} [i]	No
4-Chloro-3-methylphenol	4.4×10^{-5}	---	No
2,4-Dimethylphenol	5.9×10^{-3}	2.12×10^{-2} [c]	No
Di-n-octyl phthalate	2.1×10^{-5}	3.6×10^{1} [i]	No
2-Methylphenol	1.2×10^{-4}	---	No
4-Methylphenol	1.4×10^{-4}	---	No
Phenol	4.4×10^{-5}	2.56×10^{-1} [e]	No
Pyrene	8.8×10^{-6}	1.3×10^{-2} [j]	No
Inorganics			
Aluminum	4.1×10^{-3}	8.7×10^{-2} [k]	No
Antimony	2.1×10^{-3}	3.0×10^{-2} [i]	No
Arsenic	1.4×10^{-5}	1.53×10^{-1}	No
Barium	4.1×10^{-3}	---	No
Beryllium	7.0×10^{-6}	5.3×10^{-4} [e]	No

Footnotes appear on page 2.

Table 10. Comparison of Constituents of Concern Estimated in Sheboygan River Surface Water with Available Water-Quality Criteria, Kohler Company Landfill, Kohler, Wisconsin.

Constituent	Estimated Surface-Water Concentration[a]	Surface-Water Criteria[b]	Does Water Concentration Exceed Criteria?
Inorganics (cont'd)			
Cadmium	7.0×10^{-5}	1.9×10^{-3} l	No
Chromium (+6)	9.8×10^{-4}	9.74×10^{-3}	No
Cobalt	9.7×10^{-4}	---	No
Copper	1.9×10^{-4}	3.7×10^{-2} l	No
Fluoride	9.4×10^{-3}	---	No
Iron	1.3×10^{-2}	1.0×10^{0} m	No
Lead	4.4×10^{-5}	4.8×10^{-2} l	No
Magnesium	1.6	---	No
Manganese	1.1×10^{-2}	1.5×10^{0} n	No
Nickel	1.0×10^{-3}	1.9×10^{-1} l	No
Nitrate-Nitrite	2.7×10^{-1}	---	No
Selenium	5.9×10^{-6}	7.07×10^{-3}	No
Silver	3.8×10^{-4}	8.4×10^{-3} l	No
Sulfate	1.1	---	No
Vanadium	1.5×10^{-3}	---	No
Zinc	4.0×10^{-4}	1.4×10^{-1} l	No

All concentrations reported in milligrams per liter (mg/L).

--- No standard or criteria available.

a Estimated by multiplying the highest UCL concentration in ground water (C_{gw}) (from Table R-17) by the dilution factor of ground-water discharge flow (Q_{gw}) to river flow (Q_R):

$$\frac{Q_{gw} \times C_{gw}}{Q_{gw} + Q_R} = \frac{5.0 \times 10^{-2} cfs \times C_{gw}}{5.0 \times 10^{-2} cfs + 17 cfs}$$

b Wisconsin Chronic Toxicity Criteria (NR105.06, WAC) for Warm Water Sportfish, unless specified otherwise.

c Insufficient data to develop Federal Water Quality Criterion (FWQC). Value presented is the lowest observed effect level (LOEL) via acute exposure, reduced by a factor of 100 (USEPA, 1986c).

d Insufficient data to develop FWQC. Value presented is the LOEL via chronic exposure to chlorinated benzenes, reduced by a factor of 10 (USEPA, 1986c).

e Insufficient data to develop FWQC. Value presented is the LOEL via chronic exposure, reduced by a factor of 10 (USEPA, 1986c).

f Insufficient data to develop FWQC. Value presented is the LOEL via acute exposure to dichloroethenes, reduced by a factor of 100 (USEPA, 1986c).

g Insufficient data to develop FWQC. Value presented is the LOEL via acute exposure to trichlorinated ethanes, reduced by a factor of 100 (USEPA, 1986c).

Table 10. Comparison of Constituents of Concern Estimated in Sheboygan River Surface Water with Available Water-Quality Criteria, Kohler Company Landfill, Kohler, Wisconsin.

h Insufficient data to develop FWQC. Value presented is the LOEL via acute exposure, reduced by a factor of 100 (IRIS, 1991).
i Proposed federal chronic FWQC (55 FR 93).
j Proposed chronic FWQC (USEPA, 1988b).
k Chronic FWQC (USEPA, 1986c).
l Hardness related Wisconsin criterion. Criterion presented was calculated assuming a Sheboygan River water hardness of 343 mg/L as $CaCO_3$.
m Chronic FWQC (USEPA, 1986c).
n Value presented is not a criterion or standard but a threshold concentration below which no adverse effects to fish would be expected (USEPA, 1986c).

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