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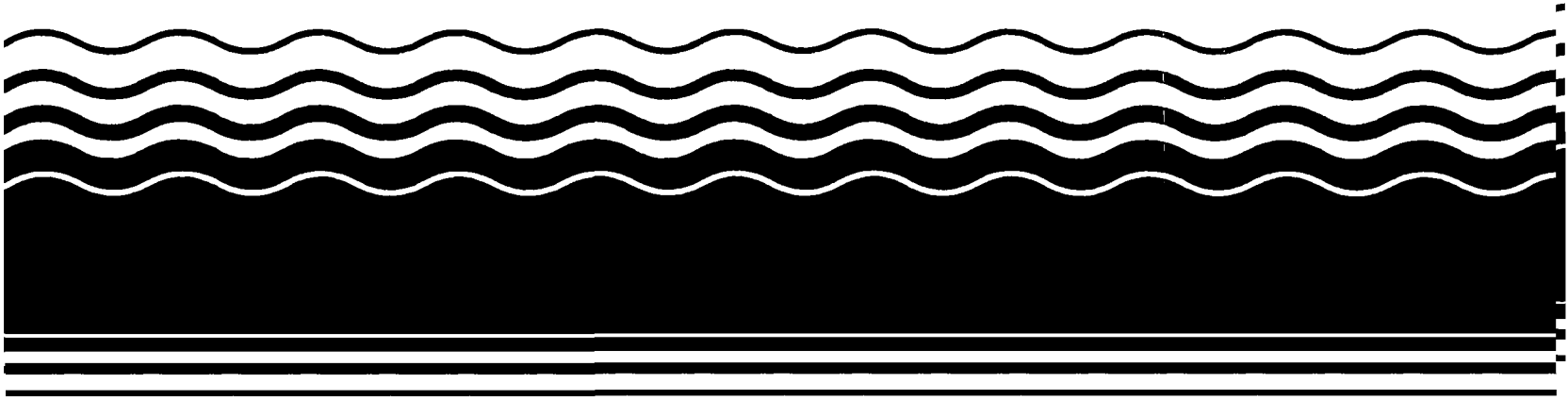
EPA Superfund Record of Decision:

Bendix Corp/Allied Automotive
St. Joseph, MI
9/30/1997



RECORD OF DECISION

REMEDIAL ACTION

BENDIX SUPERFUND SITE

ST. JOSEPH, MICHIGAN

September, 1997

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DECLARATION

SELECTED REMEDIAL ACTION
FOR THE
BENDIX SUPERFUND SITE
ST. JOSEPH, MICHIGAN

STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedial action for the Bendix Superfund Site (Bendix Site) in St. Joseph, Michigan and describes the legal and technical basis for the selection. The remedial action was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986, and is in compliance with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) to the extent practicable. This decision is supported by documentation contained in the Administrative Record for the Bendix Site.

The State of Michigan Department of Environmental Quality (MDEQ) concurs with the selected remedy.

ASSESSMENT OF THE BENDIX SITE

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

DESCRIPTION OF THE SELECTED REMEDY

This final remedial action addresses contamination associated with two ground water plumes at the Bendix Site (Western Plume and Eastern Plume). The statutory and regulatory requirements for the remedial action at the Bendix Site are to:

- Reduce/eliminate the potential risks to human health associated with exposure to chlorinated volatile organic compounds (VOCs) in the Western and Eastern Plumes;
- Reduce the concentrations of VOCs in the Western and Eastern Plumes to drinking water standards;
- Reduce/control the VOC source of contaminants; and
- Satisfy Applicable or Relevant and Appropriate Requirements (ARARs).

The selected remedial alternative for the Bendix Site is Alternative 3: Ground Water Institutional Controls and Deed Restrictions, Soil Vapor Extraction (Eastern Plume Inferred Source Removal), and Monitored Natural Attenuation (Eastern and Western Plumes). The selected remedy focuses on confirming and monitoring the natural degradation of contaminants that is occurring in the Western and Eastern Plumes. If GSI criteria exceedences are predicted or detected through monitoring, contingency plans will be implemented to insure compliance with the GSI criteria. In addition, a soil vapor extraction (SVE) system in the vicinity of the Eastern Plume source area would be used to control/reduce VOCs in the vadose zone soils. The major components of this remedy include:

- Environmental monitoring to evaluate the effectiveness of natural attenuation processes in the Plumes
- Deed restrictions to prohibit future ground water use
- Land use restrictions to restrict access to Bendix Site-related VOCs in vadose zone soils
- Natural attenuation of ground water Plumes to continue destruction of ground water contaminants
- Five-year site reviews

In addition the following three components will be implemented to address the Eastern Plume source area:

- Maintenance of existing cover system to minimize infiltration of precipitation to VOCs in vadose zone soils and restrict access to/direct contact with those soils
- Operation of SVE system to control/reduce contaminants in the vadose zone
- Installation of SVE vapor phase treatment system to remove VOCs from the treatment off-gases

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 or resource recovery technologies to the maximum extent practicable and satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element.

Because this remedy will result in hazardous substances remaining on site, a review will be conducted within five years after start-up of the remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment. This review will be conducted at least every five years as long as hazardous substances are present above health-based clean-up levels.

STATE CONCURRENCE

Upon receipt, the State of Michigan concurrance letter will be included in the Administrative Record and Appendix A of this ROD.

Wm. E. Muno

William E. Muno
Superfund Division Director
U. S. EPA Region V

9/30/97
Date

DECISION SUMMARY

I. SITE NAME, LOCATION, AND DESCRIPTION

The Bendix Superfund Site is a National Priorities List (NPL) site located in Lincoln Township, Berrien County, Michigan, approximately four miles south of the City of St. Joseph (Figure 1). The Bendix Site is located at 3737 Red Arrow Highway, approximately one-half mile from the eastern shore of Lake Michigan, and approximately one-third mile west of Hickory Creek, and bordered to the west by Red Arrow Highway.

The Bendix Site's topography is generally flat and the land surface is mostly covered by manufacturing buildings and pavement. The land surface rises slightly to the west of the Bendix Plant to the lake bluff. The land surface to the east gently slopes toward Hickory Creek falling steeply away at the creek. Land surface between Hickory Creek and Lake Michigan is generally open and covered with grass, allowing rainwater to recharge ground water. Ground water flows beneath the Bendix Site from the south. A natural divide causes ground water to flow from the Bendix Site toward Hickory Creek (to the east) and toward Lake Michigan (to the west). Hickory Creek and Lake Michigan are used for recreational purposes. Ground water associated with the Bendix Site is not used. The entire area adjacent to the Bendix Site is supplied with drinking water from the City of St. Joseph municipal water supply. The source of the drinking water is Lake Michigan.

Currently, land use in the vicinity of the Bendix Site is a mixture of commercial, residential, and industrial. The area between Red Arrow Highway and Lake Michigan is mostly residential. Commercial and industrial facilities are located between the Bendix Site and Hickory Creek. Areas north and south of the Bendix Site are a mixture of commercial and residential properties.

II. SITE HISTORY AND ENFORCEMENT ACTIVITIES

The Bendix Site was originally farmland but was developed in 1939 by the Nylen Products Corporation. The 36-acre facility consisted of an iron casting foundry and a machine shop. The Bendix Corporation (Bendix) purchased the property in 1952 that was later acquired by Allied Chemical in 1983. It's successor, AlliedSignal Inc. sold the facility to Bosch Braking Systems Corporation (Bosch, current owner) in 1996. The facility currently contains a foundry and a manufacturing plant (Figure 2).

Oil-based cutting fluids were used at the facility during the 1950s and 1960s. Water-soluble cutting fluids were used beginning in 1967. Chlorinated solvents were reportedly used in the 1960s and 1970s. From 1965 to 1975, foundry dust collector and machine shop oily waste waters were disposed into three former unlined lagoons: (1) foundry "A" lagoon, (2) south lagoon, and (3) the loading dock lagoon. The foundry "A" lagoon and the loading dock lagoon were closed and their contents disposed into the south lagoon. The south lagoon was closed in 1978 with the installation of a Michigan Department of Natural Resources (MDNR)-approved clay cap. Bendix used an on-site liquid incinerator, lagoons, and off-site commercial disposal facilities until the mid 1970s. A landfill (Maiden Lane Landfill) was also used from 1966 to 1979 for the disposal of foundry residues, asbestos in brake shoes, and encapsulated asbestos pellets. Environmental investigations began at the Bendix Site in 1975 when three ground water wells were installed around the south lagoon. Since that time numerous investigations have been conducted to evaluate the nature and distribution of industrial chemicals in soil, ground water, surface water, and sediments associated with the Bendix Site and

neighboring properties. Industrial chemicals identified in the environment include both organic and inorganic compounds associated with the manufacture of braking systems.

In June 1988, the Bendix Site was proposed for inclusion on the NPL. AlliedSignal, Inc., owners of the Bendix Site at that time, were informed that it was potentially responsible for contamination at the Bendix Site. On February 13, 1989, AlliedSignal entered into a Consent Agreement with U.S. EPA to conduct a Remedial Investigation and Feasibility Study (RI/FS). The Bendix Site was officially listed on the NPL on February 15, 1990.

As a result of industrial activities at the Bendix Site and the natural ground water divide, two VOC Plumes have been identified (Eastern and Western Plumes). The major site-related contaminants are trichloroethylene (TCE) and its degradation products. The Eastern Plume source is in the vicinity of the loading dock, creating a Plume that extends northeast to its primary discharge point along Hickory Creek. The Western Plume originates in the area of the north parking lot and extends to the northwest where it discharges to Lake Michigan (see Figure 2). The closed south lagoon is located over the ground water divide and continues to release low levels of industrial cutting oil residuals to the ground water.

III. HIGHLIGHTS OF COMMUNITY PARTICIPATION

A complete chronology of community relations activities for the Bendix Superfund Site is provided in the Responsiveness Summary (Appendix C). Recent activities include issuance of the RI/FS report and the Proposed Plan for the Bendix Site. These documents were introduced into the Administrative Record on August 12, 1997. Bendix Site documents are available to the public as part of the Administrative Record which is housed at three information repository locations: (1) U.S. EPA Docket Room for Region V in Chicago, Illinois; (2) Maud Preston Palenske Memorial Library in St. Joseph, Michigan; and (3) Lincoln Township Public Library in Stevensville, Michigan. The Administrative Record index and addresses of the Information Repositories are presented in Appendix B.

A Public Comment period was held from August 14, 1997 to September 12, 1997. U.S. EPA and Bosch ran a concurrent news release on August 13, 1997, in the St. Joseph Herald Palladium to announce the comment period and the Public Meeting. A Public Meeting was held August 20, 1997 at the Lincoln Township Hall in Stevensville, Michigan. The meeting included a summary of site history and a presentation of the proposed remedy. The response to the comments received during the public comment period is included in the Responsiveness Summary (Appendix C).

IV. SCOPE AND ROLE OF THE RESPONSE ACTION

The selected remedy for the Bendix Site provides a comprehensive approach for site remediation. The remedy includes natural attenuation of the Eastern and Western Plumes by natural degradation of VOCs in Bendix Site ground water. If GSI criteria exceedences are predicted or detected through monitoring, contingency plans will be implemented to insure compliance with the GSI criteria. Additionally, an SVE treatment system in the vicinity of the Eastern Plume source area will be utilized to remove VOCs from vadose zone soils. These VOCs are a source of ground water contamination in the Eastern Plume. Contaminants will be captured through vapor extraction wells. Emissions from the SVE capture system will be treated using photocatalytic oxidation to destroy VOCs in the off-gases prior to discharge.

These remedial actions will prevent the potential for future human health risks associated with exposure to

VOCs in the ground water Plumes and the air through volatile emissions by (1) reducing VOC concentrations in the Eastern Plume source area (2) reducing volatile emissions in the vadose zone over the Eastern Plume, and (3) reducing concentrations of VOCs in ground water associated with the Eastern and Western Plumes. In the event that monitoring shows confirmed, statistically significantly exceedences of ground water contamination above the established values at the point of compliance (POC), a contingency plan will be implemented to prevent further release of contaminants into surface water bodies.

V. SUMMARY OF SITE CHARACTERISTICS

A. LAND USE

Land use in the area of the Bendix Site is a mixture of agricultural, industrial, residential, and recreational. The source of drinking water in the area is primarily Lake Michigan surface water via the St. Joseph municipal water supply system. The entire area in the vicinity of the Bendix Site has access to this public water supply. Water supply surveys have been conducted by MDEQ and Bendix/Bosch over the past several years. The results indicate that contaminated ground water is not being used as a primary drinking water source. Select residential drinking water wells located primarily to the east of Hickory Creek will continue to be monitored periodically for site contaminants.

B. SURFACE WATER

Two surface water bodies dominate the surface water drainage in the vicinity of the Bendix Site; Lake Michigan to the west and Hickory Creek to the east (see Figure 2). The Bendix Site is situated on a topographic divide approximately one-half mile east of Lake Michigan and one-third of a mile west of Hickory Creek. Bosch is currently discharging non-contact cooling water and storm water runoff to Hickory Creek. This is a permitted discharge in compliance with the provisions of the Federal Water Pollution Control Act. The storm water collection system for the plant is fully described in the Bosch MDNR National Pollutant Discharge Elimination System permit No. MI003174.

C. GEOLOGY

The current land surface features are dominated by the deposition and subsequent erosion of Wisconsin continental ice sheets. These deposits are generically referred to as glacial drift, which was deposited as the ice sheet advanced (tills and moraine deposits), or as the ice melted and reworked unconsolidated deposits. The majority of the area around the Bendix Site was submerged below glacial Lake Chicago and consists of lacustrine deposits, which are characterized as deep water deposits made up of fine sand, silts and clay. The final stages of deglaciation resulted in unvegetated planes of exposed sand. This sand was reworked by surface drainages, creating the incised drainage currently occupied by Hickory Creek. Dune sand deposits along the present-day shoreline of Lake Michigan are windblown sand forming the lake shore bluff.

The uppermost soil unit at the Bendix Site is a fine to medium sand. This sand extends from the surface to approximately 40 to 50 feet below ground surface. This medium to fine sand unit allows rain water to infiltrate the subsurface and recharge the ground water. This unit also has the greatest hydraulic conductivity (K), which has been measured in the 10^{-3} to 10^{-4} cm/sec range (Keck, 1986 and W&C, 1995). Therefore, this unit is of particular interest with regard to contaminant transport. These fine to medium sands grade to fine silty sands with depth.

At an elevation of between 580 and 560 feet above Mean Sea Level (MSL), the soil type changes to

interlayered clayey silts and silty sands with occasional gravel. This unit is discontinuous and is most prevalent below the eastern side of the Bendix Site. When present, this fine-grained unit ranges in thickness from a few feet to approximately 20 feet. The K values of the silt/clay layers are generally 10^{-5} cm/sec with occasional 10^{-6} cm/sec values in the clay units (W&C, 1995). The interlayered silty sands have K values ranging from 10^{-4} to 10^{-5} cm/sec. Ground water movement through this interlayered unit will occur principally within the more conductive thin silty sand layers.

Below the interlayered clayey silt sand is a stiff clay to silty clay. This clay unit is most prevalent at the center of the Bendix Site near the plant. The K value of this unit was measured at 10^{-6} cm/sec (W&C, 1995). This unit has a significantly lower permeability than the sands located stratigraphically above, and will act as a hydraulic barrier to the vertical migration of ground water and/or contaminants.

D. HYDROGEOLOGY

Regional ground water flow is toward Lake Michigan with a current lake elevation of 580 feet above MSL. The maximum ground water elevation in the vicinity of the plant is approximately 600 feet above MSL. Superimposed on this regional flow are the localized effects of Hickory Creek. Hickory Creek has incised the sandy surface soils to a current creek elevation of 586 feet above MSL. This elevation difference between the ground water and the creek causes the localized ground water to flow toward Hickory Creek. This has created a ground water divide in the vicinity of the Bendix/Bosch plant (see Figure 2). Ground water on the east side of this divide flows toward and discharges to Hickory Creek, while ground water on the west side of this divide flows toward and discharges to Lake Michigan.

Directly beneath the Bendix Site, there are three distinct hydrogeologic units, the unconfined water table aquifer; a series of aquicludes (semi-confining layers) consisting of interbedded silts and sands; and the lower clay unit acting as an aquatard (confining layer).

VI. MAJOR FINDINGS - REMEDIAL INVESTIGATION AND RISK ASSESSMENT

In July of 1997, the RI report for the Bendix Site was issued. The nature and distribution of contaminants at the Bendix Site have been investigated since the early 1980s. Industrial chemicals identified in the environment include both organic compounds and inorganic elements associated with the manufacture of braking systems. The most frequently detected contaminants at the Bendix Site are TCE and 1,1,1-trichloroethane (1,1,1-TCA), along with their degradation products, vinyl chloride, cis-1,2-dichloroethene (cis-1,2-DCE) and trans-1,2-dichloroethene (trans-1,2-DCE), and 1,1-dichloroethane (1,1-DCA).

The Bendix Site is located on a ground water divide approximately half way between Lake Michigan to the west and Hickory Creek to the east. As a result of industrial activities occurring at the Bendix Site and the natural ground water divide, two VOC ground water Plumes have been identified as the Western and Eastern Plumes (see Figure 2).

A. SOURCE AREAS

The Western Plume originates in the area of the north parking lot and extends to the northwest where it discharges to Lake Michigan. The Eastern Plume originates in the area of the current loading dock creating a Plume that extends northeast to its discharge point along Hickory Creek. During the RI several potential source areas were evaluated, and the following three were identified as significant continuing sources of

contaminants to ground water:

- the former south lagoon;
- the inferred deep VOC source below the north parking lot; and
- the inferred shallow VOC source in the vicinity of the loading dock.

1. Former South Lagoon

The former south lagoon is located at the south end of the Bendix Site upgradient of the plant. This location is situated across the ground water divide (see Figure 2). As a result, ground water flowing below the former south lagoon diverges, moving both east toward Hickory Creek and west toward Lake Michigan. The lagoon was operated as an evaporation/infiltration lagoon from 1965 to 1975. The lagoon received waste water from the foundry and manufacturing plant. This material contained both petroleum- and vegetable-based cutting oils, and possibly some chlorinated hydrocarbons. The non-chlorinated compounds appear to be the primary food source (substrate) for microbial activity occurring in the ground water below and down gradient of the closed south lagoon. As a result of this microbial activity, the ground water below and down gradient of the lagoon has become anoxic (depleted of oxygen). This is a critical step in the anaerobic dechlorination of chlorinated VOCs that is occurring within both the Western and Eastern Plumes.

2. Western Plume

The inferred source of the Western Plume is a deep TCE dense non-aqueous phase liquid (DNAPL) that is located beneath the north parking lot approximately 70 to 80 feet below ground surface. VOCs detected above the federal Maximum Contaminant Levels (MCLs) in the Western Plume include vinyl chloride, 1-1-dichloroethene (1,1-DCE), 1,2-dichloroethene (1,2-DCE) (total of cis- and trans-), and TCE. Once the source material has dissolved into the ground water, it travels predominantly by advection. The ground water in this area is flowing toward and discharging to Lake Michigan (see Figure 2). VOCs were not detected in the surface water of Lake Michigan, however they do exceed estimated mixing zone based criteria.

3. Eastern Plume

The Eastern Plume is primarily a chlorinated solvent Plume that emanates from the area of the loading dock and to a lesser extent the former south lagoon. VOCs detected above the MCLs in the Eastern Plume include vinyl chloride, 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE, and TCE. The Plume extends from the loading dock area to the northeast; in the vicinity of Maiden Lane, the Plume is drawn to the east by the low head conditions created along Hickory Creek (see Figure 2). Based on the results of the RI, the source of the Eastern Plume is located at approximately 30 feet below ground surface in the vicinity of the water table (Figure 4). This source material is inferred and has not been directly observed or sampled. The nature of the source material and its location has been inferred based on ground water samples collected directly below the loading dock. High concentrations of VOCs (cis-1,2-DCE at 440,000 μg/L) in the shallow ground water with correspondingly low concentrations of VOCs from deeper ground water samples indicate the presence of a non aqueous phase liquid (NAPL) at or near the capillary fringe directly below the loading dock, but not deeper within the aquifer.

The Eastern Plume consists primarily of TCE and its degradation products (e.g., cis-1,2-DCE and vinyl chloride). The Plume extends from the source areas (former south lagoon and loading dock area) to Hickory Creek. Eastern Plume ground water appears to be discharging to Hickory Creek. Concentrations of Plume-related contaminants detected in the shallow ground water monitoring wells closest to Hickory Creek exceed the MDEQ estimated Ground Water/Surface Water (GSI) mixing zone based criteria. Predictive mixing-

zone based modeling for Hickory Creek indicates the Plume complies with the mixing-zone based GSI criteria at the Ground Water/Surface Water discharge point, and will be verified during remedial action activities. Long-term monitoring of the ground water is required to confirm the model and the assumptions used in the predictive model. Contingency plans will be developed and if necessary implemented to bring potential discharges back into compliance with the GSI criteria.

B. FATE AND TRANSPORT OF SITE-RELATED CONTAMINANTS

The ground water contamination in both the Western and Eastern Plumes consists primarily of VOCs (i.e., TCE, DCE, and vinyl chloride). U.S. EPA's Kerr Laboratory has attributed the occurrence of DCE and vinyl chloride to the natural anaerobic degradation of TCE.

U.S. EPA's Kerr Laboratory has conducted extensive evaluations of the conditions at the Bendix Site, and has indicated that the most important natural degradation mechanism is reductive dechlorination. This mechanism involves microbially catalyzed reactions caused by the replacement of chlorine atoms on the organic solvent molecules with hydrogen atoms. Reductive dechlorination of TCE results in the formation of daughter products, most significantly cis-1,2-DCE and vinyl chloride (Figure 5). Vinyl chloride, in turn, is degraded either aerobically or anaerobically to carbon dioxide or ethene, respectively.

All biodegradation reactions require an electron donor and an electron acceptor. In reductive dechlorination reactions, the contaminants (i.e., TCE, DCE) serve as electron acceptors rather than the primary food source (election donor) for microbes. Thus, a primary organic substrate (food source) is necessary to serve as the electron donor for microbial energy and reproduction. A number of low molecular weight organic compounds can serve as electron donors. Data from the Bendix Site suggests that one source of the primary substrate (electron donors) used by anaerobic microorganisms to drive the dechlorination reactions originates from the former south lagoon. The low levels of soluble cutting oil residuals and other non-chlorinated organic compounds are being released into the ground water from the former south lagoon.

Reductive dechlorination of TCE and DCE leads to the production of vinyl chloride. Vinyl chloride is more readily treated in aerobic and iron-reducing conditions than in anaerobic conditions. The model for the destruction of TCE in both the Western and Eastern Plumes (see Figure 5) occurs in two steps:

Anaerobic reduction of TCE to cis-1,2-DCE, vinyl chloride, and finally to ethene.
Aerobic oxidation of any remaining vinyl chloride to carbon dioxide.

VII. SUMMARY OF SITE RISK

A Baseline Risk Assessment was conducted to evaluate potential risks from contaminant exposure at this facility, and determine the need for and extent of remediation. The complete Human Health Risk Assessment and the Ecological Risk Assessment is presented in Section 6.0 of the RI Report (W&C, 1997a). Risk assessment was conducted in accordance with U.S. EPA's guidance, including: "Risk Assessment Guidance for Superfund: Volume I Human Health Evaluation" (U.S. EPA, 1989a) and "Risk Assessment Guidance for Superfund: Volume II Environmental Evaluation Manual" (U.S. EPA, 1989b). These documents provide the methodology and standard assumptions used for evaluating risk and developing appropriate cleanup standards.

A. OBJECTIVES

The specific objectives of the baseline risk assessment for the Bendix Site facility are to provide:

- an evaluation of potential human health and ecological risks and a basis for determining the need, as required, for remedial action at this facility;
- a basis for determining the appropriate remedial target cleanup levels for contaminants in soils, ground water, sediments, and/or surface water, as necessary; and
- a basis for comparing the health impacts of various proposed remedial alternatives.

B. HUMAN HEALTH

The Human Health Risk Assessment for the Bendix Site is a quantitative evaluation, conducted in accordance with U.S. EPA and state guidance, and consists of the following components:

- Hazard Assessment;
- Exposure Assessment;
- Toxicity Assessment; and
- Risk Characterization.

The Human Health Risk Assessment for the Bendix Site indicates that the ground water contaminant concentrations present in the Eastern and Western Plumes result in carcinogenic and non-carcinogenic risk estimates greater than the U.S. EPA target risk range. Other media evaluated (i.e., site soils, surface water, and sediments) were below target risk ranges and are therefore not considered a potential risk.

1. Hazard Assessment

The objective of the Hazard Assessment is to identify the compounds of potential concern (CPCs) for each medium. Identification of CPCs are selected based on historical use at the Bendix Site, the frequency, spatial distribution, and magnitude of detection in each medium of concern, and comparison of detected concentrations to appropriate health/risk-based federal and state criteria. Table 1 presents identified CPCs for Bendix Site ground water including: frequency of detection; minimum, maximum, and average concentrations; and federal and state drinking water standards, as appropriate.

2. Exposure Assessment

The purpose of the Exposure Assessment is to estimate the type and magnitude of potential exposure to CPCs at or migrating from the Bendix Site based on site-specific conditions. Exposure is quantified by calculating exposure doses for each exposure scenario. Exposure doses are calculated based on the exposed populations, exposure point concentrations, and exposure pathways using the equations and default values presented in U.S. EPA and state guidance (U.S. EPA 1988, 1989a, 1991, and MDEQ 1996). Standard equations and exposure parameters used for estimating exposure doses, organized by exposure medium, exposure route, and population are presented as Table 6-6 of the RI (W&C, 1997a). The exposure assessment considers both current and future potential land uses to identify potentially exposed populations. The Bendix Site is currently used for industrial purposes, and it is expected that future uses will remain industrial. A significant portion of the Bendix Site consists of buildings and paved areas, and the property boundary is fenced. The Bendix Site slopes to the east towards Hickory Creek and rises slightly to the west towards Lake Michigan. Land use between the Bendix Site and Hickory Creek is industrial. Residences are present on the east (far) side of Hickory Creek. Land use between the Bendix Site and Lake Michigan is a

mixture of residential and commercial. City of St. Joseph municipal water is available in this area. Hickory Creek and Lake Michigan are used for recreational purposes. Table 2 presents a summary of the media evaluated, exposed population and complete exposure pathways.

3. Toxicity Assessment

The toxicity assessment provides information regarding the potential for a specific CPC to cause adverse effects in humans, and characterizes the relationship between the dose of a chemical and the incidence of adverse health effects in the exposed population This assessment, therefore, identifies a dose-response value that can be used to quantitatively evaluate potential health risks as a function of chemical exposure.

Carcinogens

Carcinogenicity is quantified by the cancer slope factor (CSF). The CSF is U.S. EPA's upper-bound lifetime probability of an individual developing cancer as a result of a lifetime exposure to a carcinogen. CSFs are determined by U.S. EPA and published in an integrated risk information system (IRIS, 1995d), an on-line database for toxicity data, and health effects assessment summary tables (HEAST, 1994a). A summary of the oral dose-response information for carcinogenic effects, including the CSFs, for each CPC is provided in Table 6-13 of the RI report (W&C, 1997a).

Non-Carcinogens

Non-carcinogens are those compounds that cause an effect (e.g., liver damage) other than carcinogenicity. Carcinogens may also have non-carcinogenic effects; these effects are considered and included with the effects of non-carcinogenic compounds. In addition, non-carcinogenic compounds differ from carcinogens in that they are believed to have threshold dosage levels below which adverse effects are not expected. U.S. EPA's preferred criterion for quantifying non-carcinogenic risk is the reference dose (RfD), which corresponds to U.S. EPA's identification of the threshold effects level with an added margin of safety. The IRIS database maintains a current listing of all the verified RfDs, which are reported in units of mg/kg-day. By definition, the RfD is an estimate of an average daily exposure level below which significant, adverse non-carcinogenic health effects are not expected. Table 6-14 presented in the RI report presents the chronic RfDs and oral dose-response information for non-carcinogenic effects for each CPC. Toxicity profiles for the CPCs are available from the IRIS database.

4. Risk Characterization

The Risk Characterization integrates the quantitative exposure and toxicity values for each exposure scenario. Table 3 presents a summary of the quantitative summary of site risk.

Carcinogenic Effects

Carcinogenic risks are evaluated by multiplying the estimated exposure dose by the CSF to obtain an estimate of incremental risk, as follows:

$$\text{Carcinogenic Risk} = \text{Exposure Dose (mg/kg-day)} \times \text{CSF (mg/kg-day)}^{-1}$$

The cancer risks of each compound are summed within each exposure scenario. U.S. EPA's guidelines state that the total incremental carcinogenic risk for an individual resulting from exposure at a hazardous waste site should not exceed a target risk range of 1×10^{-6} to 1×10^{-4} (U.S. EPA 1990). In this risk assessment, the

estimated carcinogenic risk for each exposure scenario was compared to these values. If the estimated risk is below the acceptable range, no further action is recommended. If the estimated risk is within the acceptable range, the exposure scenario is reviewed to determine whether further actions are warranted, depending on where the estimated risks fall within that range. Further actions are recommended for estimated risks exceeding the upper end of the target risk range ($1x10^{-4}$).

Non-carcinogenic Effects

Non-carcinogenic effects are quantified in terms of a Hazard Index (HI), which is calculated by dividing the exposure dose by the RfD:

Hazard Index (HI) = Exposure Dose (mg/kg-day) / RfD (mg/kg-day)

Non-carcinogenic risks are evaluated by dividing the exposure dose of each compound by its respective RfD, and summing the resulting hazard index for each compound within each exposure scenario. The resulting cumulative non-carcinogenic risk for each exposure scenario was compared to the U.S. EPA target HI of 1. If the HI is less than or equal to 1, no adverse health effects are anticipated from the predicted exposure dose level. If the HI is greater than 1, the predicted exposure dose level could potentially cause adverse effects (U.S. EPA 1989a). Table 3 presents a summary of the carcinogenic and non-carcinogenic risk estimates for each exposure scenario.

5. Summary of Human Health Risk Assessment

Based on the Bendix Site conceptual model developed in the RI, five media at and surrounding the Bendix Site were identified as the focus of this assessment:

- Site soils;
- Eastern Ground Water Plume;
- Western Ground Water Plume;
- Hickory Creek surface water and sediments; and
- Lake Michigan surface water.

Site Soils

Based on the results of this risk assessment, no remedial action is necessary to protect human health due to contaminants present in subsurface site soils, given the current and foreseeable industrial land use. Contamination in site soils is limited to the Bosch property. A site-specific quantification of potential risks was calculated using a utility worker scenario. The estimated carcinogenic and non-carcinogenic risks were well below U.S. EPA target risk ranges. At each exposure point where a receptor may come into contact with known or potentially contaminated media, exposure point concentrations (EPCs) are determined for each CPC. To provide a range of risk estimates, the maximum and/or average (arithmetic mean) concentrations of the CPCs were used as the EPCs for each medium. The qualitative evaluation indicated that none of the EPCs exceeded the Draft MDEQ soil direct contact values or U.S. EPA residential soil screening level for lead. Furthermore, the EPCs did not exceed the MDEQ Volatile Soil Inhalation Criteria (MDEQ, April 1997) for potential commercial/industrial exposures due to the volatilization of VOCs from soil to air.

Eastern and Western Ground Water Plumes

The risk assessment indicates that the ground water contaminant concentrations present in the Eastern and

Western Plumes result in carcinogenic and non-carcinogenic risk estimates greater than the U.S. EPA target risk range, based on residential drinking water scenarios. Contamination in ground water is migrating off-site in the Eastern Plume (discharging to Hickory Creek) and Western Plume (discharging to Lake Michigan). Ground water in the area of the plant is identified as a potential future drinking water resource by the MDEQ. However this area is provided with municipal water. Future potential receptors were assumed to be residents using the ground water for drinking water. Potential drinking water exposure could be via ingestion, dermal contact, or inhalation of VOCs from ground water.

A site-specific quantification of potential risks was calculated for ground water from within both the Eastern and Western Plume areas using the residential drinking water scenario. The estimated carcinogenic and non-carcinogenic risks (using both maximum and average EPCs) exceeded the U.S. EPA target risk ranges for the Eastern Plume and the Western Plume. The results of the qualitative human health risk assessment indicate that the majority of the CPCs are at or above federal or state drinking water standards and/or other state screening criteria. These contaminants include vinyl chloride, 1,1-DCE, 1,2-DCE (total), TCE, cis-1,2-DCE, trans-1,2-DCE, 1,1,2-TCA, aluminum, arsenic, iron, manganese, and zinc in the Eastern Plume. In the Western Plume, the contaminants exceeding these criteria are vinyl chloride, 1,1-DCE, 1,2-DCE (total), TCE, 1,1,2-TCA, cis-1,2-DCE benzene, iron, manganese, zinc.

Hickory Creek

The results of this risk assessment indicate that no remedial action is necessary to protect human health due to contaminants present in Hickory Creek surface water and sediments.

Contaminated ground water from the Eastern Plume appears to discharge into Hickory Creek. Potential exposure points are surface water and sediments in the creek. Potential receptors were identified as children using the creek for recreational purposes. Potential exposure was evaluated as surface water ingestion/dermal contact, or sediment ingestion/dermal contact. A site-specific quantification of potential risks was calculated using a child recreational scenario. The estimated carcinogenic and non-carcinogenic risks were below the U.S. EPA target risk ranges.

The compounds in surface water were also qualitatively compared to drinking water criteria. No surface water CPCs exceeded drinking water standards, with the exception of high iron and manganese values, which are due to the high background values for these metals. No applicable standards or criteria are available to qualitatively evaluate exposure to sediments.

Lake Michigan

The results of this risk assessment indicate that no remedial action is necessary to protect human health due to the Western Plume discharging to Lake Michigan surface water.

Ground water from the Western Plume is discharging to Lake Michigan. Potential exposure points in the lake are surface water. No Plume-related chemicals were detected in the surface waters of Lake Michigan. However, to provide a conservative risk evaluation, concentrations of Plume-related chemicals measured in the Western Plume ground water were also compared to federal and state criteria. A dilution factor of 10 was applied to projected ground water concentrations based on the common dilution factor used by MDEQ for developing mixing zone based criteria for discharges to Lake Michigan. Potential receptors were identified as adults and children using the lake for recreational purposes (e.g. swimming). Potential exposure could be via surface water ingestion/dermal contact.

A site-specific quantification of potential risks was calculated using child and adult recreational scenarios. The estimated carcinogenic and non-carcinogenic risks were below the U.S. EPA target risk ranges. The results of the qualitative risk assessment indicate that none of the EPCs exceed federal/state health based drinking water standards.

C. ECOLOGICAL RISK ASSESSMENT

The objective of the Baseline Ecological Risk Assessment is to characterize the current and future potential ecological risks that may exist at the Bendix Site. This Ecological Assessment is based on a qualitative evaluation, by comparing reported concentrations with appropriate standards. An exposure assessment was conducted to determine ecologically sensitive areas that may be potentially impacted by the site contaminants. CPCs were selected for contaminated media in these areas. The EPCs were then compared to environmental screening criteria.

1. Exposure Assessment

The Bendix Site is industrial, consisting of pavement and buildings, and does not contain significant ecological habitats. Contaminated soils are located under pavement, buildings, or are capped, and are not directly accessible to ecological receptors. Ground water is located 25 to 30 feet below ground surface and is not accessible to ecological receptors. However, ground water discharges to two surface water bodies that are the subject of this ecological risk assessment.

The exposure assessment identifies ecologically sensitive areas as a result of the contamination at the Bendix Site. These include the areas where the Eastern Plume discharges to Hickory Creek and where the Western Plume discharges to Lake Michigan. Potential ecological receptors include the flora and fauna associated with Hickory Creek and Lake Michigan ecosystems.

Hickory Creek is located approximately one-third of a mile to the east of the plant, and is a perennial stream approximately 30 feet across and generally one to two feet deep. Hickory Creek water use is classified by MDEQ as suitable for agriculture, navigational, industrial water supply, public water supply at the point of intake, cold water fish, other indigenous aquatic life and wildlife, partial body contact recreation, and total body contact recreation from May through October (MDEQ Fact Sheet Permit No. MI0003174). Hickory Creek receives non-contact cooling water from the Bosch facility, as well as storm water runoff from the Bosch facility and the municipal storm water system. The confluence of Hickory Creek and St. Joseph River is approximately three miles to the north, with the St. Joseph River entering Lake Michigan approximately six miles downstream of the plant.

Lake Michigan is located approximately one-half mile to the west of the plant. The lake is used for recreational purposes, including swimming, fishing, and navigation, and is suitable for cold water fish and other indigenous aquatic life and wildlife.

2. Evaluation of Protected Species in the St. Joseph Area

Currently there is no available documentation that suggests that protected or endangered species are present within the area of the Bendix Site. The following is a summary of the Michigan Natural Features Inventory review of the Bendix Site conducted by the MDEQ: "there are no known occurrences of federal- or State-listed endangered, threatened or otherwise significant species, natural plant communities, or natural features at the location specified: Berrien County, T5S R19W, Sections 3,4,9,10."

3. Selection of Compounds of Potential Concern

CPCs and EPCs were selected for the surface water and sediments in Hickory Creek and surface water of Lake Michigan based on a review of the existing data base. The same CPCs identified in the human health risk assessment were retained as CPCs in the ecological risk assessment. The only compounds detected and eliminated from this evaluation were sodium, magnesium, and calcium (see Table 1). To provide a conservative estimate of risk, the EPC for each CPC was the maximum detected concentration.

4. Qualitative Ecological Risk Characterization

The qualitative assessment of potential risk to the environment consists of comparing the EPCs of each CPC for each media to applicable environmental screening criteria. Concentrations of Plume-related chemicals measured in Hickory Creek surface water were compared to the federal and state standards, as presented in Table 4. No Plume-related chemicals were reported from the surface water of Lake Michigan (Table 5). However, to provide a conservative risk evaluation, concentrations of Plume-related chemicals measured in the Western Plume ground water were also compared to federal and state criteria. A dilution factor of 10 was applied to projected ground water concentrations based on the common dilution factor used by MDEQ for developing mixing zone based criteria for discharges to Lake Michigan. The Criteria are:

- Federal Ambient Water Quality Criteria (AWQCs). These criteria are established by the U.S. EPA to be protective of aquatic organisms in surface water (U.S. EPA, 1986). Fresh water chronic and acute criteria are available for many of the CPCs.

- Michigan Ground Water/Surface Water Interface (GSI) values are criteria used to evaluate the potential impact of contaminated ground water venting to a surface water body. These criteria are developed by the state in accordance with Rule 323.1057 of Part 4 of Part 31 of the Natural Resources and Environmental Protection Act, 1994 PA 451 (Part 31). Under this act mixing zones may also be allowed. Mixing zone allowances for ground water are applied in the same manner as for point source discharges, except that no permit is required. However, like point source discharges, mixing-zone-based discharged criteria are calculated on a case by case basis in accordance with Part 31.

Contaminant concentrations measured in Hickory Creek sediments were compared to the following environmental criteria:

- Effects Range-Low (ER-L). The U.S. EPA screening guidelines include the ER-L for comparison of compounds detected in sediments. The ER-L value is the concentration equivalent to that calculated at the lower 10th percentile of the available, screened sediment toxicity data. As such, it represents the low end of the range of concentrations at which effects were observed.

- Apparent Effects Threshold (AET). The U.S. EPA screening guidelines include the AET values, which relate the chemical concentrations in sediments to at least one biological indicator of injury (e.g., sediment bioassays or altered benthic fauna abundance) to determine the concentration of the contaminant above which biological effects would always be expected.

Hickory Creek

Mixing zone-based GSI criteria were estimated using the MDEQ Interim Environmental Response Division

Operational Memorandum #17 dated April, 1996. Mixing zone based GSI criteria are exceeded in the existing ground water monitoring wells nearest Hickory Creek.

However, predictive modeling for the Eastern Plume indicates the Plume will comply with the mixing-zone-based GSI values as the Plume migrates and discharges to Hickory Creek. Because this is a prediction only, long-term monitoring of the Plume is required to ensure ground water does not vent to Hickory Creek above GSI criteria. If GSI criteria exceedances are predicted or detected through monitoring, contingency plans will be implemented to insure compliance with the GSI criteria.

The surface water quality for Hickory Creek also includes a requirement of 6 mg/l dissolved oxygen (DO) for cold water fish (R 323.1065, MDNR 1994). Based on the DO measurement collected during the surface water and sediment investigation (W&C 1996), the cold water fish requirement is satisfied. Surface water samples collected from Hickory Creek and Lake Michigan do not contain Plume-related contaminants that exceed federal Ambient Water Quality Criteria (U.S. EPA, 1986). The contaminant concentrations in Hickory Creek sediments are below the ER-L and AET criteria, indicating the CPC concentrations are below levels considered to have an effect on aquatic biota.

Lake Michigan

To evaluate the potential impact of the Western Plume on Lake Michigan, U.S. EPA Kerr Laboratory and the University of Michigan have completed several surface water and shallow ground water investigations along the interface of the Western Plume and Lake Michigan. The results of these investigations are summarized in Section 5.0 of the RI report (W&C, 1997a) and provide the basis for this ecological assessment.

Western Plume ground water is discharging to Lake Michigan. Concentrations of Plume-related contaminants detected in existing ground water monitoring wells nearest to Lake Michigan exceed estimated MDEQ GSI mixing zone-based values. However, predictive modeling for the Western Plume indicates the Plume will comply with the mixing-zone based GSI values as the Plume migrates and discharges to Lake Michigan. Long-term monitoring of the ground water is required to ensure ground water does not vent to Lake Michigan above GSI criteria. If GSI criteria exceedances are predicted or detected through monitoring, contingency plans will be implemented to insure compliance with the GSI criteria.

5. Summary of Ecological Risk Assessment

Based on this qualitative assessment, the Ecological Risk Assessment concludes that the contaminant concentrations in Hickory Creek and Lake Michigan surface water and sediments do not pose a significant threat to the environment. Estimated GSI mixing zone based criteria are exceeded in monitoring wells near Hickory Creek and Lake Michigan. Predictive modeling for the Plumes venting to Lake Michigan and Hickory Creek indicates the Plumes will comply with the mixing-zone based GSI criteria at the Ground Water/Surface Water discharge points. Long term monitoring will be required to evaluate the remedy and demonstrate compliance with GSI criteria. Contingency plans will be implemented in a timely manner in the event monitoring indicates GSI exceedences are predicted or have occurred.

VIII. DESCRIPTION OF ALTERNATIVES

Twenty six potential remedial technologies were identified in the FS (Table 3-1 of FS). Six options were retained for detailed analysis of the Western Plume, and eight options were retained for detailed analysis of

the Eastern Plume. These alternatives range from No Action (used as a baseline to compare with the other alternatives) to containment to permanent treatment. Four alternatives were selected for the Proposed Plan and are discussed below. Detailed descriptions of each alternative can be found in Section 6.0 of the FS report.

A. ALTERNATIVE 1 - NO ACTION

This alternative was developed and evaluated in the FS to serve as a baseline with which to compare the other remedial alternatives. For the No Action Alternative, no institutional controls would be implemented and no remedial actions would be conducted. This alternative would not implement institutional controls to prevent the potential for future exposure to contaminated ground water and would not include remedial action statutory and regulatory requirements to reduce ground water VOC concentrations to drinking water standards.

Ground water flow modeling was conducted to estimate remedial time frames for the Eastern and Western Plumes. The limiting factor associated with meeting drinking water standards throughout the aquifer is the dissolution of inferred source material to the dissolved phase in ground water. Based on the current natural attenuation processes occurring in the Plumes, it is estimated that it will take approximately 150 to 250 years for chlorinated VOCs to be degraded to drinking water standards throughout the aquifer. This estimate assumes that active remedial activities would not be conducted for the Eastern and Western Plume inferred source areas.

A detailed discussion of the ground water flow modeling used to estimate the remedial time line frames is presented in Appendix A of the FS report.

Estimated Time to Design and Construct = No remedial activities required
Estimated Remedial Time Frame = 150 to 250 years
Estimated Capital Cost = $0
Estimated Operation and Maintenance Costs (net present worth) = $0
Estimated Total Cost (net present worth) = $0

B. ALTERNATIVE 2 - GROUND WATER INSTITUTIONAL CONTROLS AND DEED RESTRICTIONS, SOIL VAPOR EXTRACTION (SVE) TREATMENT OF THE EASTERN Plume SOURCE AREA, SOURCE CONTAINMENT OF WESTERN Plume, TREATMENT WITHIN THE CONTAINMENT SYSTEM, AND MONITORED NATURAL ATTENUATION (EASTERN AND WESTERN PlumeS), WITH PROTECTIVE CONTINGENCIES

This alternative would consist of the following components:

- Environmental Monitoring
- Institutional Controls
- Natural Attenuation of Dissolved Plumes
- Five-year Site Reviews

Eastern Plume Source Area

- Maintenance of Existing Cover System
- Operation of SVE System to remove volatile contaminants from the vadose zone
- Installation of SVE Vapor Phase Treatment System

Western Plume Source Containment

- Installation of Low Permeability Barrier System
- Installation of Ground Water Extraction System
- Installation and Operation of Ground Water Treatment System within Low Permeability Barrier System
- Discharge of Treated Ground Water

1. Environmental Monitoring

Environmental monitoring will be used to evaluate (1) the effectiveness of natural attenuation processes in the Plume, (2) the subsurface microbial environment, (3) compliance with appropriate MDEQ GSI criteria, and (4) evaluating the change in risks to human health and the environment over time. Environmental monitoring will consist of routine periodic sampling and analysis of ground water and Lake Michigan and Hickory Creek surface water.

Contaminated ground water discharging to Hickory Creek and Lake Michigan will be monitored at the POC and at sentinel wells within the ground water Plumes. The protection criteria for the POC will be the more restrictive of either the contaminant concentrations found during the monitoring well installation, as a baseline value, or the calculated GSI mixing zone-based value. POC wells will be installed in the ground water Plumes as close to Hickory Creek and Lake Michigan as possible where ground water gradients demonstrate movement toward the creek and the lake.

Sentinel wells are to be located in the Plumes between the inferred source areas and the POC. Sentinel wells are used to predict or provide early warning of potential exceedances of POC criteria and to monitor the effectiveness of the remedy to reduce the level of contaminants within the Plume.

The details of establishing progress toward aquifer restoration will be developed in the Long Range Monitoring Plan in the Statement of Work and will be based on mathematical projections showing the projected/actual change in the ground water concentrations over time. The individual contaminants, and the cumulative risk posed by these contaminants, will be evaluated at each monitoring event to establish the trend (improving or deteriorating) of the ground water restoration. Least square fit and linear regression analysis are two mathematical approaches that can be used to show these trends. A contingency plan will be provided in the Long-Term Monitoring Plan and will be implemented to protect human health and the environment if environmental monitoring predicts or detects exceedences of POC criteria. For mathematical trends that predict POC exceedences this plan will require an evaluation of the impacts of the exceedence, potentially leading to increased monitoring, or the implementation of one of the ground water control measures identified in the FS, or other suitable methods, to prevent further release of contaminants to the surface water body. These measures may include: ground water pump-and-treat (either on site or off-site); ground water bioventing and/or biosparging; enhanced biodegradation of contaminants in the Plume; in-well stripping; a combination of these procedures; or other technology advanced by the PRPs and approved by

the U.S. EPA, in consultation with MDEQ, felt suitable for remediation. For confirmed, statistically significant exceedances of contaminants above the established values at the POC, the contingency plan will require the implementation of additional ground water control measures, as indicated above, to prevent further release of contaminants to the surface water body.

The remedial action will be continued until the Eastern and Western Plumes have been restored to drinking water standards throughout the Plumes.

2. Institutional Controls

Institutional controls in the form of deed and land use restrictions will be implemented to (1) restrict/control utility and maintenance work in the vicinity of the loading dock (Eastern Plume source area) and former south lagoon to minimize potential future human health risks associated with site-related contaminants in vadose zone soils and (2) prohibit the potential future use of Eastern and Western Plume ground water on- and off-site.

3. Natural Attenuation

This alternative includes Natural Attenuation for control and remediation of VOCs in the Eastern and Western Plumes. Studies have indicated that biodegradation is occurring within the Western Plume at a rate of approximately 600 pounds per year. Natural Attenuation is providing active treatment of VOCs in the Plumes. The containment barrier would effectively isolate the Western Plume inferred source area. The slurry wall would restrict dissolution and natural attenuation of the inferred source, resulting in a 400 year estimated remedial time. Estimated remediation time for the Eastern Plume would be the same as the No Action Alternative (150 to 250 years).

4. Five-Year Site Reviews

Five-year site reviews consisting of ground water and surface water sampling at least once every five years will be conducted to assess the impacts of contaminants to ground water, Lake Michigan and Hickory Creek surface water, and to evaluate potential risks to human health and the environment, until the ground water had been restored to drinking water standards.

5. Eastern Plume Source Area

A SVE system will be designed, installed and operated to control/reduce VOCs in vadose zone soils above the ground water (Eastern Plume and source area). This will reduce the mass of source material that is contaminating the ground water, reduce the concentration of volatile contaminants in the vadose zone, and reduce the time to achieve drinking water standards in the Eastern Plume. The extracted VOCs will be oxidized and vented to the atmosphere. The VOC treatment system will be monitored to ensure compliance with state and federal emission requirements.

6. Western Plume Source Containment

Under this alternative, a containment wall (i.e., slurry wall) approximately 1,260 feet long and 100 feet deep, would be installed around the deep inferred source of the Western Plume to reduce the mobility of contaminants and the volume of upgradient ground water contacting this inferred source. A Ground water Extraction System would be installed to achieve hydraulic containment within the low permeability barrier system and to collect contaminated ground water from within the barrier for treatment. The ground water

treatment system would be designed to reduce the influent concentrations to drinking water standards. The FS evaluated the following ground water treatment system: pretreatment to remove inorganics, iron and manganese oxidation, UV-oxidation, residual peroxide reduction, treated water disposal, sludge thickening, and sludge dewatering.

The FS evaluated ground water reinjection/reinfiltration (e.g., reinfiltration pond, tile field, wells) and surface water discharge options. The surface water discharge option assumed Hickory Creek to be the receiving stream because the local publicly-owned treatment works will only accept treated ground water on a temporary basis. The Bendix Site currently has a permit to discharge non-contact cooling water and storm water to Hickory Creek.

Residual risks would remain at the Bendix Site from contaminants in ground water in the remainder of the Western Plume. Institutional Controls would restrict the potential future access to and use of ground water, thereby eliminating this exposure pathway as a source of residual risk.

Estimated Time to Design and Construct = 2 years
Estimated Remedial Time Frame: Eastern Plume = 150 to 250 years
Estimated Remedial Time Frame: Western Plume = 150 to 400 years
Total Capital Costs = $10,553,000
Total Operation and Maintenance Costs (net present worth)= $4,963,000
Total Costs (net present worth) = $15,516,000

C. ALTERNATIVE 3 - GROUND WATER INSTITUTIONAL CONTROLS AND DEED RESTRICTIONS, SOIL VAPOR EXTRACTION TREATMENT (EASTERN Plume INFERRED SOURCE REMOVAL), MONITORED NATURAL ATTENUATION (EASTERN AND WESTERN PlumeS), WITH PROTECTIVE CONTINGENCIES

This alternative will consist of the following components:

- Environmental Monitoring
- Institutional Controls
- Natural Attenuation of Dissolved Plumes
- Five-year Site Reviews

Eastern Plume Source Area

- Maintenance of Existing Cover System
- Operation of SVE System to remove volatile contaminants from the vadose zone
- Installation of SVE Vapor Phase Treatment System

The components of Alternative 3 are the same as described for Alternative 2 except that Alternative 3 does not include the Western Plume Source Containment components. For Alternative 3, the estimated remediation time for the Eastern Plume is 150 to 200 years. This is slightly lower than Alternatives 1 and 2 (150 to 250 years) because the SVE treatment system will reduce the mass of inferred source contaminants, thereby reducing the time required to restore the aquifer to drinking water standards.

Estimated remediation time for the Western Plume is the same as Alternative 1 (estimated remediation time is 150 to 250 years). This is significantly lower than Alternative 2 (remediation time up to 400 years)

because the Western Plume containment barrier would not be installed.

Estimated Time to Design and Construct = 2 months
Estimated Remedial Time Frame: Eastern Plume = 150 to 200 years
Estimated Remedial Time Frame: Western Plume = 150 to 250 years
Total Capital Costs = $756,000
Total Operation and Maintenance Costs (net present worth)= $3,412,000
Total Costs (net present worth) = $4,168,000

D. ALTERNATIVE 4 - GROUND WATER INSTITUTIONAL CONTROLS AND DEED RESTRICTIONS, MONITORED NATURAL ATTENUATION (EASTERN AND WESTERN PlumeS), WITH PROTECTIVE CONTINGENCIES

This alternative would consist of the following components:

- Environmental Monitoring
- Institutional Controls
- Natural Attenuation of Dissolved Plumes
- Five-year Site Reviews
- Eastern Plume Source Area -Maintenance of Existing Cover System

The components of Alternative 4 are the same as the components for Alternative 2 except that Alternative 4 does not include the Eastern Plume source area SVE system or the Western Plume containment system. Each of the Alternative 4 components are described in Part B of this Section (see Alternative 2).

Alternative 4 includes maintenance and/or repair of the asphalt and concrete cover system that currently exists over the inferred Eastern Plume source area. This will reduce the potential flushing of source material into the ground water beneath the Bendix Site, and reduce potential access/direct contact to these soils by on-site workers.

Because Alternative 4 includes natural attenuation of the Eastern and Western Plumes, the estimated remediation time is the same as Alternative 1 (150 to 250 years).

Estimated Time to Design and Construct = Readily implementable
Estimated Remedial Time Frame = 150 to 250 years
Total Capital Costs = $624,000
Total Operation and Maintenance Costs (net present worth) = $2,270,000
Total Costs (net present worth) = $2,894,000

IX. SUMMARY OF THE COMPARATIVE ANALYSIS OF ALTERNATIVES

The relative performance of each remedial alternative was evaluated in the FS using the nine criteria set forth in the NCP at 40 CFR Section 300.430. A remedial action providing the "best balance" of trade-offs with respect to the nine criteria is determined from this evaluation.

A. THRESHOLD CRITERIA

1. **Overall protection of human health and the environment** addresses whether or not a remedy provides adequate protection and describes how risks posed through each pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

2. **Compliance with ARARs** describes how the alternative complies with chemical-, location-, and action-specific ARARs, or other criteria, advisories, and guidance.

B. PRIMARY BALANCING CRITERIA

The following five criteria are used to compare and evaluate the elements of one alternative to another that meet the threshold criteria.

1. **Long-term effectiveness and permanence** evaluates the effectiveness of alternatives in protecting human health and the environment after response objectives have been met, in terms of the magnitude of residual risk and the adequacy and reliability of controls.

2. **Reduction in toxicity, mobility, or volume through treatment** evaluates the treatment technologies by the degree of expected reduction in toxicity, mobility, or volume of hazardous material. This criterion also evaluates the irreversibility of the treatment process and the type and quantity of residuals remaining after treatment.

3. **Short-term effectiveness** addresses the period of time needed to achieve protection and any adverse impacts on human health and the environment that may be posed during the construction and implementation period, until the remedial action objectives are achieved.

4. **Implementability** assesses the ability to construct and operate the technology; the reliability of the technology; the ease of undertaking additional remedial actions; and the ability to monitor the effectiveness of the remedy. Administrative feasibility is addressed in terms of the ability to obtain approvals from other agencies. This criterion also evaluates the availability of required resources, such as equipment, facilities, specialists, and capacity.

5. **Cost** evaluates the capital and operation and maintenance costs of each alternative, and provides an estimate of the total present worth cost of each alternative.

C. MODIFYING CRITERIA

The modifying criteria are used in the final evaluation of remedial alternatives after public comment on the RI/FS and Proposed Plan has been received.

1. **State acceptance** addresses whether, based on its review of the RI/FS and Proposed Plan, the state concurs with, opposes, or has no comment on the proposed remedial alternative.

   The State of Michigan has provided comments on the RI/FS and the Proposed Plan and has documented its concurrence with the remedial action in its letter of concurrence, and upon receipt, will be presented in Appendix A.

2. **Community acceptance** addresses whether the public concurs with the Proposed Plan. Community acceptance of the Proposed Plan was evaluated based on comments received at the Public Meeting and during the public comment period. This is documented in the Responsiveness Summary presented in Appendix C.

The section below presents the nine criteria and a brief summary of each alternative and its strengths and weaknesses according to the detailed and comparative analyses.

Overall Protection of Human Health and the Environment

Site conditions currently pose no risks to human health and the environment. However, the potential exists for future human health risks associated with exposure to ground water. Alternative 3 will reduce contaminant concentrations in ground water to levels protective of human health risk. Alternative 3 also includes source control of the Eastern Plume which will reduce the time required to achieve drinking water standards. Alternatives 1 and 4 will reduce contaminant concentrations in ground water over time to levels that would reduce human health risk. Containment associated with Alternative 2 would isolate the Western Plume source which could significantly increase the time required to meet drinking water standards.

Compliance with Applicable or Relevant and Appropriate Requirements

The alternatives will comply with chemical-specific ARARs over time (i.e., when drinking water standards are achieved). Location- and action-specific ARARs will not apply to Alternatives 1 and 4 because remedial activities will not be conducted. The other alternatives will be designed to meet location- and action-specific ARARs.

Long-term Effectiveness and Permanence

Alternative 3 and Alternative 4 will provide effective and permanent treatment over time by allowing the natural degradation processes occurring in the Eastern and Western Plumes to continue until drinking water standards are achieved. If the Western Plume inferred source area can be located, Alternative 2 would minimize the migration of ground water contaminants via containment. However, Alternative 2 would only be effective if the barrier is installed around the actual Western Plume source area (which has not been directly observed or sampled to date). Additional studies would be required to locate this source. Alternatives 2 and 3 would also minimize potential exposure to on-site workers associated with Eastern Plume vadose zone soils via SVE treatment. The No Action alternative would not include institutional controls to prevent the potential future human health risks associated with exposure to ground water.

Reduction in Toxicity, Mobility, or Volume through Treatment

Natural Attenuation appears to be effectively controlling the spread of the Eastern and Western Plumes. Alternative 3 will decrease the volume of contaminants within the Eastern Plume source area via SVE treatment and natural attenuation processes will reduce the toxicity of chemicals in both Plumes. Natural biodegradation processes associated with the No Action and Natural Attenuation alternatives (Alternatives 1 and 4) will reduce the toxicity of ground water contaminants via natural biodegradation processes occurring within the Plume. However, these alternatives would not provide containment/control of contaminants in Eastern Plume source area vadose zone soils. However, this would also restrict dissolution and biodegradation of the source material, resulting

in a significant increase in time to achieve drinking water standards.

Short-term Effectiveness

Alternatives 1, 3, and 4 will have no adverse effects to the community or the environment.

Implementability

The No Action and Natural Attenuation alternatives (Alternatives 1 and 4) would be readily implementable because no remedial activities would be required. Alternative 3 could be implemented in approximately two (2) months. Pilot-scale testing will be required to evaluate and optimize the SVE system associated with the selected alternative. The containment barrier associated with Alternative 2 would be difficult to install because (1) the specific location of the source is uncertain and (2) it would have to be set 90 to 100 feet below ground surface adjacent to existing structures and utilities. Alternative 2 would require approximately two (2) years to implement.

Cost

The capital, operation and maintenance costs, and net present worth costs are presented for each alternative in the Description of Alternatives (Section VIII). The No Action alternative is the least costly of the alternatives. Alternative 3 is less costly than Alternative 2 because it utilizes the natural attenuation processes within the Plume and does not require the installation of a deep containment barrier. The selected remedy is more costly than Alternative 4 (Natural Attenuation) because it includes using the SVE system to promote source control of the Eastern Plume to reduce the volume of contaminants contributing to ground water contamination.

State Acceptance

The State of Michigan has provided comments on the FS and the Proposed Plan and has documented its concurrence with the remedial action as stated in Section XIII. Upon receipt, a copy of the State's letter of concurrence will be included as Appendix A.

Community Acceptance

Community acceptance of the Proposed Plan was evaluated based on comments received at the Public Meeting and during the public comment period. There were only a few comments concerning the Proposed Plan. There was no opposition raised to the Selected Remedy. This is documented in the Responsiveness Summary presented in Appendix C.

X. THE SELECTED REMEDY

U.S. EPA has selected Alternative 3 as the remedy for the Bendix Superfund Site. Alternative 3 addresses ground water and source areas associated with the Western and Eastern Plumes. Alternative 3 includes:

Alternative 3 - Ground Water Institutional Controls and Deed Restrictions, Soil Vapor Extraction Treatment (Eastern Plume inferred source and vadose contamination removal), and Monitored Natural Attenuation (Eastern and Western Plume), with protective contingencies.

U.S. EPA and MDEQ have determined that the selected remedy provides the best compliance with the nine criteria. The selected remedy meets the requirements of CERCLA and has received favorable public comment.

A. CLEANUP LEVELS

Drinking water standards were selected as cleanup levels for the Bendix Site based on the results of the baseline risk assessment and set at the more stringent federal or state promulgated drinking water standards, or derived as a health-based standard where no MCL is available. This approach is consistent with the NCP that defines acceptable exposure for noncarcinogens as a Hazard Index (HI) equal to 1 and carcinogenic risk between 10^{-4} to 10^{-6}. Therefore, a noncarcinogenic HI less than 1 (e.g., 0.8) or a carcinogenic risk less than 10^{-6} (e.g., 10^{-7}) is considered to be protective of human health.

The results of the baseline risk assessment indicate that potential future exposure to ground water results in an unacceptable "exposure level" to human health. Compounds are present at concentrations associated with a noncarcinogenic risk greater than an HI equal to 1 and/or carcinogenic risk greater than 10^{-4}. The data used to evaluate potential future risks from ground water exposure are discussed in Section 6.0 of the RI. The selection of compound-specific drinking water standards is discussed separately for the Western and Eastern Plumes.

1. Western Plume

Six organic compounds (vinyl chloride, 1,1-DCE, TCE, 1,1,2-TCA, benzene, and 1,2-DCE) are present at concentrations associated with elevated risk estimates. Exposure to these compounds accounts for 100 percent of the baseline carcinogenic risk and 99.9 percent of the baseline noncarcinogenic risks. These compounds are listed in Table 7 with the frequency and range of detection, federal MCL and state drinking water standard (DWS) concentrations, and frequency at which each compound was detected at concentrations in excess of the federal MCL/state DWS.

Three of the six compounds listed in Table 7 (vinyl chloride, 1,2-DCE [total], and TCE) are present at elevated concentrations in multiple locations within the Western Plume ground water and are identified as the CPCs. Drinking water standards are proposed as cleanup levels for each of these compounds (see Table 7). The cleanup levels for these compounds were set at federal MCLs, which are the same concentrations as the state DWSs. Remedial actions taken to reduce exposure to or concentration of these compounds will result in a concurrent reduction of exposure to other compounds present in the ground water.

2. Eastern Plume

Six compounds (vinyl chloride, 1,1-DCE, TCE, 1,2-DCE, arsenic, and manganese) are present at concentrations associated with elevated risk estimates. Exposure to these compounds accounts for 100 percent of the carcinogenic risk and 99.9 percent of the noncarcinogenic risks. These compounds are listed in Table 8 with the frequency and range of detection, federal and state drinking water standard concentrations, and frequency at which each compound was detected at concentrations in excess of the federal MCL/state DWS.

Four of the six compounds listed in Table 8 (vinyl chloride, 1,1-DCE, 1,2-DCE [total], and TCE) are present at elevated concentrations in multiple locations within the Eastern Plume ground water and are identified as the CPCs. Cleanup levels are proposed for each of these compounds and were set at federal MCLs (see

Table 8). State drinking water standards for these compounds are the same concentrations as the MCL.

B. DESCRIPTION OF REMEDIAL COMPONENTS

The selected remedial alternative for the Eastern and Western Plumes and their source areas acknowledges the natural biodegradation processes occurring within the Plumes. Environmental monitoring will be conducted to evaluate the continued effectiveness of natural attenuation processes and institutional controls will be implemented to protect public health by restricting future use of ground water. This alternative includes the following components:

- Environmental Monitoring with protective contingency plans;
- Institutional Controls;
- Natural Attenuation of Dissolved Plumes;
- Five-year Site Reviews;
- Eastern Plume Source Area-Maintenance of Existing Cover System;
- Eastern Plume Source Area-Operation of SVE System; and
- Eastern Plume Source Area-Installation of SVE Vapor Phase Treatment System.

1. Environmental Monitoring

Environmental monitoring will be used to evaluate (1) the effectiveness of natural attenuation processes in the Plume, (2) the subsurface microbial environment, (3) compliance with appropriate MDEQ GSI criteria, and (4) the change in risks to human health and the environment over time. Environmental monitoring will consist of routine periodic sampling and analysis of ground water and Lake Michigan and Hickory Creek surface water.

Contaminated ground water discharging to Hickory Creek and Lake Michigan will be monitored at the POC and at sentinel wells within the ground water Plumes. The protection criteria for the POC will be the more restrictive of either the contaminant concentrations found during the monitoring well installation (baseline value), or the calculated GSI mixing zone-based value. POC wells will be installed in the ground water Plumes as close to Hickory Creek and Lake Michigan as possible where ground water gradients demonstrate movement toward the creek and the lake.

Sentinel wells are to be located in the Plumes between the inferred source areas and the POC. Sentinel wells are used to predict or provide early warning of potential exceedances of POC criteria and to monitor the effectiveness of the remedy in reducing the level of contaminants within the Plume.

The details of establishing progress toward aquifer restoration will be developed in the Long Range Monitoring Plan in the Statement of Work and will be based on mathematical projections showing the projected/actual change in the ground water concentrations over time. The individual contaminants, and the cumulative risk posed by these contaminants, will be evaluated at each monitoring event to establish the trend (improving or deteriorating) of the ground water restoration. Least square fit and linear regression analysis are two mathematical approaches that can be used to show these trends. A contingency plan will be provided in the Long-Term Monitoring Plan and will be implemented to protect human health and the environment if environmental monitoring predicts or detects exceedences of POC criteria. For mathematical trends that predict POC exceedences this plan will require an evaluation of the impacts of the exceedence, potentially leading to increased monitoring, or the implementation of one of the ground water control measures identified in the FS, or other suitable methods, to prevent further release of contaminants to the

surface water body. These measures may include: ground water pump-and-treat (either on site or off-site); ground water bioventing and/or biosparging; enhanced biodegradation of contaminants in the Plume; in-well stripping; a combination of these procedures; or other technology and approved by the U.S. EPA, in consultation with MDEQ, felt suitable for remediation. For confirmed, statistically significant exceedances of contaminants above the established values at the POC, the contingency plan will require the implementation of additional ground water control measures, as indicated above, to prevent further release of contaminants to the surface water body.

The remedial action will be continued until the Eastern and Western Plumes have been restored to drinking water standards.

2. Institutional Controls

Institutional controls in the form of deed and land use restrictions will be implemented to prohibit ground water use associated with the Eastern and Western Plumes both on- and off-site. Institutional controls will be drafted, implemented, and enforced in cooperation with adjacent property owners and the federal, state, and local governments.

3. Natural Attenuation

The selected remedial alternative includes natural attenuation for treatment of site-related VOCs (i.e., TCE, 1,2-DCE, and vinyl chloride) in Eastern and Western Plume ground water. U.S. EPA Kerr Laboratory has concluded that the most important natural attenuation mechanism at the Bendix Site is biological reductive dechlorination (Wilson et al., 1996, Weaver et al., 1996a, and Weaver et al., 1996b). Based on environmental data collected to date, natural attenuation is providing active treatment of chlorinated organics in the Western Plume. TCE is degraded to DCE, which is then degraded to vinyl chloride in the strongly reducing, anaerobic conditions within the Plume. Vinyl chloride is degraded to either ethene or carbon dioxide, depending on the subsurface conditions (either anaerobic or aerobic, respectively). By the time the Plume reaches the Lake Michigan beach front, much of the chlorinated mass has been degraded to ethene.

Extensive site characterization data indicate that natural attenuation is effectively containing the spread of contamination by reducing contaminant concentrations. Natural attenuation is an appropriate remediation method only where it is fully protective of human health and the environment, and where it can be demonstrated capable of achieving site-specific remediation objectives (e.g., drinking water standards) within a reasonable time frame. The NCP states that remediation time frame for restoring ground water to its beneficial use should be developed based on specific site conditions. Under these natural attenuation processes, the time to achieve drinking water standards is estimated to be between approximately 150 to 250 years. County well permit regulations preclude the use of this aquifer for residential use, and the time frame projections shown are reasonable given this site specific circumstance.

4. Five-year Site Reviews

Under CERCLA Section 121(c), a remedial action that results in hazardous wastes, pollutants, or contaminants remaining on site should be reviewed every five years. Data collected during the monitoring program will be used to assess potential impacts of contaminants, and evaluate whether human health and the environment continue to be protected by the alternative.

5. Eastern Plume Source Area - Existing Cover System

The cover system above the Eastern Plume source area consists of asphalt, concrete slab, and existing buildings. The cover system will be visually inspected annually and repaired as necessary (e.g., resurfaced, patched). This cover system will continue to minimize infiltration to vadose zone soils, thereby reducing the amount of contaminants released to ground water, and will also reduce potential access/direct contact to these soils by on-site workers.

6. Eastern Plume Source Area - Operation of SVE System

The SVE treatment system is an in situ vadose zone treatment technology that operates via application of a vacuum to promote vapor flow through the vadose zone. Contaminants will volatilize from soil and be swept by air flow to air extraction wells located throughout the contaminated area. Extracted air will be treated using photocatalytic oxidation to achieve air emission requirements.

C. LONG TERM MONITORING PLAN

The Long-Term Monitoring Plan will present specific details of the long-term sampling and analysis requirements for compliance monitoring of air emissions, surface water, and ground water as required by the selected remedy for the Bendix Site. This plan will present the location of each sampling point, sampling protocol, analytical method, analytical level, data evaluation level employed for each sampling location during the long-term monitoring phase of the remedial action. The Long-Term Monitoring Plan will also present the method used to determine what constitutes an exceedence or projected exceedence, when and what action(s) (contingencies) will be taken to protect human health and the environment if exceedences are reported above determined action levels.

XI. STATUTORY DETERMINATIONS

The selected remedy for the Bendix Site is consistent with CERCLA and in compliance with the NCPto the extent practicable. The selected remedy is protective of human health and the environment, attains ARARs, and is cost-effective. The selected remedy also satisfies the statutory preference for treatment that permanently and significantly reduces the toxicity, mobility, or volume of hazardous substances as a principal element. The following describes how the selected remedy meets these requirements.

A. THE SELECTED REMEDY IS PROTECTIVE OF HUMAN HEALTH AND THE ENVIRONMENT

The selected remedy will provide adequate protection of human health and the environment through institutional controls to prevent exposures to ground water and through the treatment technologies to be employed. The potential future risks associated with access to/use of site ground water will decrease over time because Natural Attenuation will reduce the concentration of contaminants to the drinking water standards listed in Table 1.

B. THE SELECTED REMEDY ATTAINS ARARs

The selected remedy will comply with identified federal and state ARARs. Potential chemical-and location-specific ARARs were identified, defined, and summarized in Section 7.0 of the RI report. Potential action-specific ARARs were identified in Section 2.0 of the FS report.

Table 9 presents the chemical-specific ARARs for the selected remedy. Because remedial actions will not impact natural resources (e.g., wetland areas), location-specific ARARs do not apply to the selected remedy. Action-specific ARARs for the Eastern Plume remedial activities are listed in Table 9. Activities associated with the selected remedy will be conducted according to regulations outlined by OSHA.

A brief narrative of significant chemical- and action-specific ARARs, and other criteria, follows.

1. Water Regulations

Chemical-specific ARARs for site ground water include regulations and criteria promulgated under the Safe Drinking Water Act (SDWA), Clean Water Act, and State of Michigan statutes. In addition, certain other numerical goals will be attained. The federal National Drinking Water Regulations consist of contaminant-specific standards known as MCLs and Maximum Contaminant Level Goals (MCLGs). MCLs are enforceable standards that are the maximum permissible level for specific contaminants in public water supplies. MCLGs are non-enforceable health-based goals that establish levels at which no known or anticipated adverse health effects occur. The NCP, 300.430(e)(2)(I)(B) and (C), requires that MCLGs above zero, and MCLs, be attained for ground water sources that are current or potential sources of drinking water.

Under the Michigan Drinking Water Rules, the state adopted federal MCLs. Because ground water associated with the Bendix Site is potentially a drinking water source, MCLs are not applicable at the site, but they are relevant and appropriate. In developing the cleanup levels, the Risk Assessment compared ground water contaminant concentrations with federal MCLs, Michigan drinking water standards, and Michigan aesthetic drinking water values. Cleanup levels were set at MCLs. Michigan drinking water standards adopted federal MCLs. The selected remedy will be complete when drinking water standards have been achieved in the ground water Plumes.

Part 201 (Environmental Remediation) of the Michigan Natural Resources and Environmental Protection Act of 1994 (Public Act 451) is applicable to the selected remedy and specifies rules for establishing risk-based cleanup criteria for a site. If risk-based cleanup criteria established for ground water under this rule differ from (a) the state drinking water standard, or (b) criteria for adverse aesthetic characteristics, the cleanup criteria for the site will be the more stringent of (a) or (b) unless use of the aquifer is restricted. The Bendix Site aquifer will also be restricted by implementing institutional controls and deed restrictions.

Under Rule 323.1057 of Part 4 of Part 31 of the Natrual Resources and Environmental Protection Act, 1994, as amended; PA 451of the National Toxics Rule (NTR; Federal Register, December 22, 1992, VOL. 57(246): 60848-60923) Ground Water Surface Water (GSI) criteria have been identified as goals for the selected remedy. These GSI criteria identify the maximum ground water contaminant discharge to surface water. The final GSI value is the more restrictive of the Rule 57 value and the NTR value, where both are available (excluding arsenic whose GSI value is the Rule 57 value). Under the 1995 amendments to Part 31, mixing zones for ground water venting to a surface water body are allowed. Mixing zone determinations and discharge criteria are developed on a case by case basis in accordance with Part 31.

2. Air Regulations

The Clean Air Act provides primary and secondary air quality standards to protect human health from known or anticipated adverse effects of pollutants. The Michigan Air Pollution Control Act (Act No. 348) and Part 55 of Michigan Public Act 451 (Air Pollution Control) contain contaminant-specific regulations that pertain to allowable emissions of pollutants from various air containment source categories and processes. These requirements are applicable to the selected remedy because the SVE treatment system associated with the

Eastern Plume will produce VOC emissions. The SVE off-gas treatment system will be monitored on a monthly basis to ensure compliance with state and federal permitting and emission requirements.

C. THE SELECTED REMEDY IS COST-EFFECTIVE

The remedy provides overall effectiveness proportionate to its cost. The estimated costs associated with this remedy are:

- Capital Cost: $ 756,000
- Operation and Maintenance Costs (net present worth): $3,412,000
- Total Cost (net present worth): $4,168,000

Alternative 3 is considered cost-effective because it takes advantage of the natural attenuation processes occurring in the Plumes. The remedy provides protection against the potential for future human health risks associated with exposure to site ground water. Major capital costs associated with the selected remedy include well installation for long-term monitoring, and legal and engineering support associated with implementing institutional controls. Major operation and maintenance costs include the five year site reviews and operation and maintenance of the SVE system.

The No Action alternative is less costly, but it would not provide protection from the potential future risks associated with ground water exposure. Alternative 4 (Natural Attenuation) is less costly than the selected remedy. However, the selected remedy utilizes the SVE treatment system to reduce the concentration of VOCs in vadose zone soils, thereby minimizing potential exposure to on-site workers.

The selected remedy affords overall effectiveness when measured against CERCLA Section 121 criteria and the NCP's nine evaluation criteria, and costs are proportionate to the protection that will be achieved.

D. THE SELECTED REMEDY UTILIZES PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT OR RESOURCE RECOVERY TECHNOLOGIES TO THE MAXIMUM EXTENT PRACTICABLE

The selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be used in a cost-effective manner at the Bendix Site. The remedy permanently removes the contaminants from the natural environment in the following manner:

VOCs are extracted from vadose soils (at the source of the Eastern Plume) by a SVE system with photo-oxidation destruction of the off-gassed vapors.

U.S.EPA Kerr Laboratory has determined that through the natural attenuation (microbial anaerobic and aerobic dechlorination) process approximately 600 lbs. of TCE are destroyed annually in the Western Plume.

Natural attenuation is also occurring along the Eastern Plume, destroying TCE.

The selection remedy is protective of human health and the environment, complies with federal and state requirements that are legally applicable or relevant and appropriate, and is cost effective.

Natural Attenuation of the Eastern and Western Plumes combined with Eastern Plume source control SVE to control/reduce VOCs in vadose zone soils; maintenance of the existing vadose zone soil

cover system; environmental monitoring; and restrictions to prohibit access to vadose zone soils and ground water through institutional controls will provide the most permanent solution practicable, proportionate to cost.

E. THE SELECTED REMEDY SATISFIES THE PREFERENCE FOR TREATMENT THAT PERMANENTLY AND SIGNIFICANTLY REDUCES THE TOXICITY, MOBILITY, OR VOLUME OF THE HAZARDOUS SUBSTANCES AS A PRINCIPAL ELEMENT

The principal element of the selected remedy is treatment of the contaminated ground water by natural attenuation of contaminants in the Western and Eastern Plumes. This remedy permanently reduces the toxicity, mobility, and volume of contaminants in ground water by the microbial degradation of TCE. Vadose soils that continue to be a source of contaminants to ground water will be removed by an SVE system, off-gases will be destroyed by a photo-oxidation vapor treatment. This remedy addresses the potential threat to human health and the environment by the restoration of the ground water resource by the permanent destruction of hazardous substances. This will significantly reduce the toxicity, mobility, and volume of the hazardous substances.

XII. DOCUMENTATION OF SIGNIFICANT CHANGES

There are no significant changes from the recommended alternative described in the proposed plan.

TABLE 1
EASTERN AND WESTERN GROUNDWATER PLUMES - COMPOUNDS OF POTENTIAL CONCERN (CPCs)

RECORD OF DECISION
BENDIX SITE
ST. JOSEPH, MICHIGAN

COMPOUND	FREQUENCY OF DETECTION	MINIMUM CONC.	MAXIMUM CONC.	AVERAGE	FEDERAL MCLs/ STATE DWSs	STATE ADWVs
EASTERN GROUNDWATER PLUME						
VOCs, ug/l						
vinyl chloride	18/47	9.5J	4,200	323	2/2	NS
1,1-DCE	6/23	4J	12	5.2	7/7	NS
1,1-DCA	27/47	1.8J	240	79	NS/880***	NS
1,2-DCE (total)	8/17	6J	7,600	1,159	70/70	NS
TCE	9/47	5.5	530	47	5/5	NS
1,1,2-TCA	2/23	4J	5J	4	5/5	NS
toluene	23/47	1.1	28	35*	1,000/1,000	790
m,p-xylene	6/24	2.7	9.7	59*	10,000/10,000	280
o-xylene	7/24	1.2	9	58*	10,000/10,000	280
trans-1,2-DCE	1/30	290	290	54	100/100	NS
cis-1,2-DCE	16/30	1.3	170,000	20,611	70/70	NS
Inorganics, ug/l						
aluminum	8/23	19.8B	963	72.8	NS/NS	50
arsenic	15/23	1.2B	62.9	17.5	50/50	NS
iron	23/23	19.5B	22,100	3,881	NS/NS	300
manganese	22/23	4.6B	7,710	668	NS/180***	50
zinc	9/23	10B	4,410	297	NS/2,400***	5000
WESTERN GROUNDWATER PLUME						
VOCs, ug/l						
vinyl chloride	54/96	0.1	960	74	2/2	NS
chloroethane	1/7	6J	23	6.4	NS/220**	NS
1,1-DCE	8/44	1	28	2.4	7/7	NS
1,1-DCA	4/14	2J	93	372*	NS/880**	NS
1,2-DCE (total)	4/7	44	680	248	70/70	NS
TCE	25/96	1.3	85,000	900	5/5	NS
1,1,2-TCA	1/7	7J	7J	5.3	5/5	NS
benzene	4/44	1.5	7.1	115*	5/5	NS
toluene	5/44	1.2J	17	115*	1,000/1,000	790
cis-1,2-DCE	31/96	0.6	160,000	1,847	70/70	NS
trans-1,2-DCE	20/89	0.4	26.3	58*	100/100	NS
Inorganics, ug/l						
iron	6/7	15.2B	3,840	860	NS/NS	300
manganese	6/7	34.9	168	79	NS/180**	50
zinc	3/7	123	4,030	647	NS/2,400**	5000

NOTES.

B = for inorganics, value detected between instrument detection limit and practical quantitation limit.
J = estimated value.
blank = compound detected in the method blank
NS = No standard
* When calculating the average, 1/2 the detection limit was used for non-detects. In some cases, the average is higher than the maximum detected, due to extraordinarily high detection limits for some samples. For those compounds selected as CPCs, the maximum concentration will be used instead of the average to calculate quantitative risk estimates.

MCLs = Federal Maximum Contaminant Levels, EPA, 1996. ** indicates federal action level (MDNR, 1995a & 1995b)
DWSs = Michigan Drinking Water Standards. *** indicates health-based drinking water value (MDNR, 1995a & 1995b)
ADWVs = Michigan aesthetic drinking water values (MDNR, 1995a & 1995b)

TABLE 2
SUMMARY OF EXPOSURE SCENARIOS

RECORD OF DECISION
BENDIX SITE
ST. JOSEPH, MICHIGAN

Media	Exposed Population	Complete Exposure Pathways
Site Soils	Utility Worker	Soil Contact/Ingestion/Inhalation
Eastern Groundwater Plume	Residents	Potential Future Drinking Water Scenario Via Groundwater Contact/ Ingestion/ Inhalation
Western Groundwater Plume	Residents	Potential Future Drinking Water Scenario Via Groundwater Contact/ Ingestion/ Inhalation
Hickory Creek	Children Recreation	Surface Water Contact/Ingestion Sediment Ingestion
Lake Michigan	Children Recreation Adult Recreation	Surface Water Contact/Ingestion Surface Water Contact/Ingestion

TABLE 3
SUMMARY OF SITE RISK

RECORD OF DECISION
BENDIX SITE
ST. JOSEPH, MICHIGAN

SCENARIO	Carcinogenic Risk		Hazard Index (HI)	
	Max.	Avg.	Max.	Avg.
Soils				
Ingestion	6.6E-07	8.1E-08	0.085	0.011
Dermal	0.0E+00	0.0E+00	0.0062	0.00037
Total	6.6E-07	8.1E-08	0.092	0.012
Eastern Groundwater Plume				
Ingestion	**9.5E-02**	**7.6E-03**	**540**	**66**
Inhalation (Showering)	**5.6E-02**	**4.3E-03**	**55000**	**4800**
Dermal	**1.3E-03**	**1.0E-04**	0.52	0.076
Total	**1.5E-01**	**1.2E-02**	**56000**	**4900**
Western Groundwater Plume				
Ingestion	**3.3E-02**	**1.8E-03**	**830**	**11**
Inhalation (Showering)	**3.5E-02**	**1.3E-03**	**1200**	**570**
Dermal	**6.5E-04**	**2.8E-05**	**12**	0.14
Total	**6.9E-02**	**3.1E-03**	**2000**	**580**
Hickory Creek				
Ingestion Sediments	1.0E-07	4.8E-08	0.023	0.011
Dermal Sediments	NA	NA	NA	NA
Ingestion Surface Water	3.3E-10	1.6E-10	0.0018	0.0014
Dermal Surface Water	4.9E-10	2.3E-10	0.000032	0.000011
Total	1.0E-07	4.8E-08	0.025	0.012
Lake Michigan				
Children				
Ingestion to Surface Water		2.4E-08		0.00013
Dermal Surface Water		3.4E-08		0.00013
Total Children		5.8E-08		0.00026
Adults				
Ingestion Surface Water		2.0E-08		0.000028
Dermal Surface Water		5.6E-08		0.000053
Total Adults		7.6E-08		0.000081

Bold indicates calculated risk exceeds 1E-6 or HI exceeds 1.

TABLE 4
HICKORY CREEK SURFACE WATER AND SEDIMENT
EXPOSURE POINT CONCENTRATIONS (EPCs) COMPARED TO ENVIRONMENTAL SCREENING CRITERIA

RECORD OF DECISION
BENDIX SITE
ST. JOSEPH, MICHIGAN

SURFACE WATER

COMPOUND	EPC (MAXIMUM CONC.)	AWQCs Chronic/Acute
VOCs, ug/l		
Chloroform	1.7	28,900 / 1,240
Bromodichloromethane	0.57	NC / NC
cis-1,2-DCE	1.6	11,600 / NC
Metals, ug/l		
Iron	504	NC / 1,000
Manganese	101	NC / NC

SEDIMENTS

COMPOUND	EPC (MAXIMUM CONC.)	FEDERAL/STATE SCREENING CRITERIA	
		ER-L	AET
VOCs, ug/kg			
Vinyl Chloride	43	NC	NC
1,1-DCA	2J	NC	NC
cis-1,2-DCE	10J	NC	NC
Xylene	1J	NC	40
Metals, mg/kg			
Aluminum	2,200	NC	NC
Arsenic	6.3	8.2	57
Barium	42.6	NC	NC
Chromium	19.5	81	260
Copper	19.7	34	390
Iron	17,200	NC	NC
Lead	8.3	46.7	450
Manganese	466	NC	NC
Nickel	13.4	20.9	140
Vanadium	8	NC	NC
Zinc	63.5	150	410

AWQCs - Ambient Water Quality Criteria
ER-L = Effects Range - Low
AET = Apparant Effects Threshold
Source: EPA, 1986

NC = No criteria.
J = estimated value.

TABLE 5
LAKE MICHIGAN SURFACE WATER EXPOSURE POINT CONCENTRATIONS
COMPARED TO ENVIRONMENTAL SCREENING CRITERIA

RECORD OF DECISION
BENDIX SITE
ST. JOSEPH, MICHIGAN

COMPOUND	EPC (AVERAGE CONC.)	AWQC's Acute/Chronic
VOCs, ug/l		
vinyl chloride	8.3	11,600/NC
1,1-DCE	0.9	NC
1,2-DCA	0.6	NC
TCE	14.5	5,280/840
benzene	0.9	5,300/NC
cis-1,2-DCE	52.7	11,600/NC
trans-1,2-DCE	2	11,600/NC

AWQCs = ambient water quality criteria,
National Oceanic and Atmospheric Administration.
NC = no criteria.

Note: The EPCs were calculated by using the average concentrations of the Lake Michigan groundwater CPCs identified in the Human Health Risk Assessment and applying a 10 times dilution factor.
Example: Vinyl Chloride EPC concentration in surface water is the average concentration (83 ug/l)/dilution factor (10) = 8.3 ug/l.

TABLE 6
COMPONENTS OF THE REMEDIAL ALTERNATIVES

RECORD OF DECISION
BENDIX SITE
ST. JOSEPH, MICHIGAN

ALTERNATIVE	KEY COMPONENTS
ALTERNATIVE 1: NO ACTION	• Five-year site reviews
ALTERNATIVE 2: GROUNDWATER INSTITUTIONAL CONTROLS AND DEED RESTRICTIONS, SOIL VAPOR EXTRACTION (SVE) TREATMENT OF THE EASTERN PLUME SOURCE AREA, SOURCE CONTAINMENT OF THE WESTERN PLUME, TREATMENT WITHIN THE CONTAINMENT SYSTEM, AND MONITORED NATURAL ATTENUATION (EASTERN AND WESTERN PLUMES)	• Environmental monitoring • Institutional controls (deed restrictions, zoning) • Maintenance of existing cover system (i.e., pavement over Eastern Plume source area) • Use of existing SVE system in the Eastern Plume source area to collect chlorinated organics in the vadose zone • Treatment of SVE off-gases • Installation of a circumferential, impermeable barrier (e.g., slurry wall) in Eastern Plume source area • Installation of groundwater extraction system within the barrier • Treatment of groundwater (e.g., UV/oxidation) • Groundwater discharge (e.g., groundwater reinjection, surface water discharge) • Natural attenuation of dissolved organics in Eastern and Western Plumes • Five-year site reviews
ALTERNATIVE 3: GROUNDWATER INSTITUTIONAL CONTROLS AND DEED RESTRICTIONS, SOIL VAPOR EXTRACTION TREATMENT (EASTERN PLUME INFERRED SOURCE REMOVAL), AND MONITORING NATURAL ATTENUATION (EASTERN AND WESTERN PLUMES)	• Environmental monitoring • Institutional controls (deed restrictions, zoning) • Maintenance of existing cover system (i.e., pavement over Eastern Plume source area) • Use of existing SVE system in the Eastern Plume source area to collect chlorinated organics in the vadose zone • Treatment of SVE off-gases • Natural Attenuation of dissolved organics in Eastern and Western Plumes • Five-year site reviews
ALTERNATIVE 4: GROUNDWATER INSTITUTIONAL CONTROLS AND DEED RESTRICTIONS, MONITORED NATURAL ATTENUATION (EASTERN AND WESTERN PLUMES)	• Environmental monitoring • Institutional controls (deed restrictions, zoning) • Maintenance of existing cover system (i.e., pavement over Eastern Plume Source Area) • Natural attenuation of dissolved organics in Eastern and Western Plumes • Five-year site reviews

NOTE:

SVE = soil vapor extraction

TABLE 7
CLEANUP LEVELS FOR GROUNDWATER - WESTERN PLUME

RECORD OF DECISION
BENDIX SITE
ST. JOSEPH, MICHIGAN

COMPOUND	FREQUENCY OF DETECTION	MINIMUM CONC.	MAXIMUM CONC.	[1]AVERAGE	FEDERAL MCL/ STATE DWS	NO. OF DETECTIONS GREATER THAN MCL/STATE DWS	CLEANUP LEVEL
VOCs, µg/L							
vinyl chloride	54/96	0.1	960*	74*	2	18/96	2
1,2-DCE (total)	38/96	0.4	160000*	960*	70	15/96	70
TCE	25/96	1.3	85000*	900*	5	20/96	5
1,1-DCE	8/44	1	28*	2.4	7	2/44	[2]--
1,1,2-TCA	1/7	7J*	7J*	5.3*	5	1/7	[2]--
benzene	4/44	1.5	7.1*	7.1*	5	1/44	[2]--

NOTES:

[1] When calculating the average, 1/2 the detection limit was used for non-detects.
In some cases, the average is higher than the maximum detected, due to high detection limits for some samples
In these cases, the maximum conc. is used instead of the average.

[2] No cleanup level proposed because this compound was not retained as a CPC.

MCL = Federal Maximum Contaminant Level
DWS = Michigan Drinking Water Standard

*Site concentrations that exceed cleanup levels.

TABLE 8
CLEANUP LEVELS FOR GROUNDWATER - EASTERN PLUME

RECORD OF DECISION
BENDIX SITE
ST. JOSEPH, MICHIGAN

COMPOUND	FREQUENCY OF DETECTION	MINIMUM CONC.	MAXIMUM CONC.	[1]AVERAGE	FEDERAL MCL/ STATE DWS	USEPA GUIDANCE/ CRITERIA	NO. OF DETECTIONS GREATER THAN MCL/STATE DWS	CLEANUP LEVELS
VOCs, µg/l								
vinyl chloride	19/47	9.5J*	4200*	320*	2	--	19/47	2
1,1-DCE	6/23	4J	12*	5.2	7	--	4/23	7
1,2-DCE (total)	24/47	1.3	170000*	7000*	70	--	15/47	70
TCE	9/47	5.5*	530*	47*	5	--	9/47	5
Inorganics, µg/l								
arsenic	15/23	1.28	62.9*	18	50	--	3/23	[2] --
manganese	22/23	4.68	7710*	670	NA	840 e	3/23	[2] --

NOTES:

[1] When calculating the average, 1/2 the detection limit was used for non-detects.
In some cases, the average is higher than the maximum detected, due to high detection limits for some samples.
In these cases, the maximum conc. is used instead of the average.

[2] *No cleanup level proposed because this compound was not retained as a CPC.*

MCL = Federal Maximum Contaminant Level
DWS = Michigan Drinking Water Standard
e = USEPA derived risk-based concentration for residential drinking water (IRIS, November 1995).

*Site concentrations that exceed the cleanup levels.

TABLE 9
ARARs CRITERIA AND GUIDANCE FOR THE SELECTED REMEDY

RECORD OF DECISION
BENDIX SITE
ST. JOSEPH, MICHIGAN

Chemical-Specific ARARs

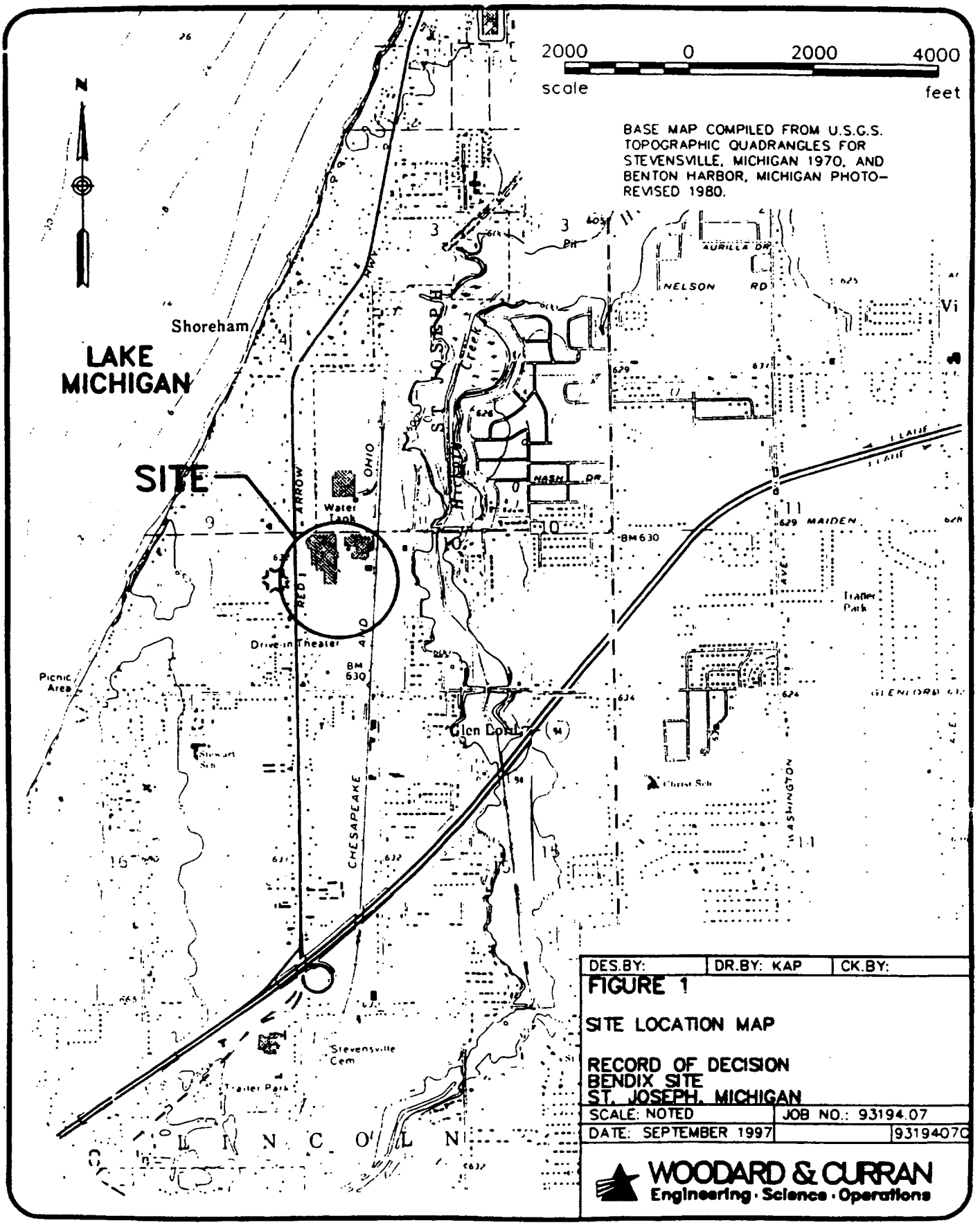
- Safe Drinking Water Act (SDWA) - MCLs
- SDWA-MCLGs
- Clean Water Act (CWA) - Ambient Water Quality Criteria
- Clean Air Act - National Primary and Secondary Ambient Air Quality Standards
- Michigan Natural Resources and Environmental Protection Act 451 (Part 201)
- Part 31 of Public Act 451
- Michigan Safe Drinking Water Act
- Michigan Air Pollution Control Act (Act No. 348) of the Public Acts of 1965

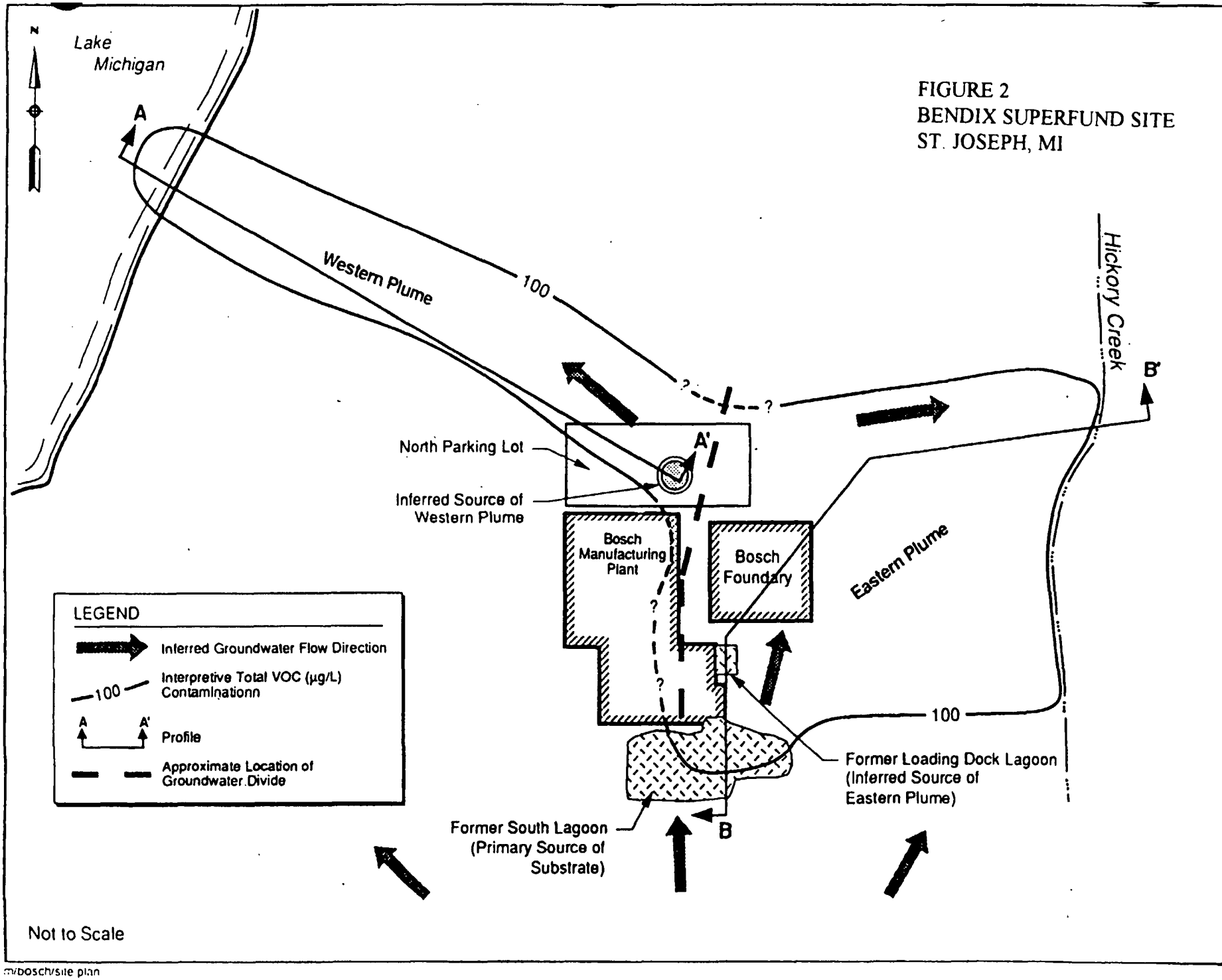
The following chemical-specific criteria were also considered:

- USEPA Risk Reference Doses
- USEPA Carcinogen Assessment Group Cancer Slope Factors
- USEPA Health Advisories
- MDNR Operational Memoranda #8 and #14
- MDEQ Operational Memoranda #17
- MDNR Interim Generic Utility Worker Groundwater Contact Criteria: Addendum to Operational Memos #8 and #14

Action-Specific ARARs

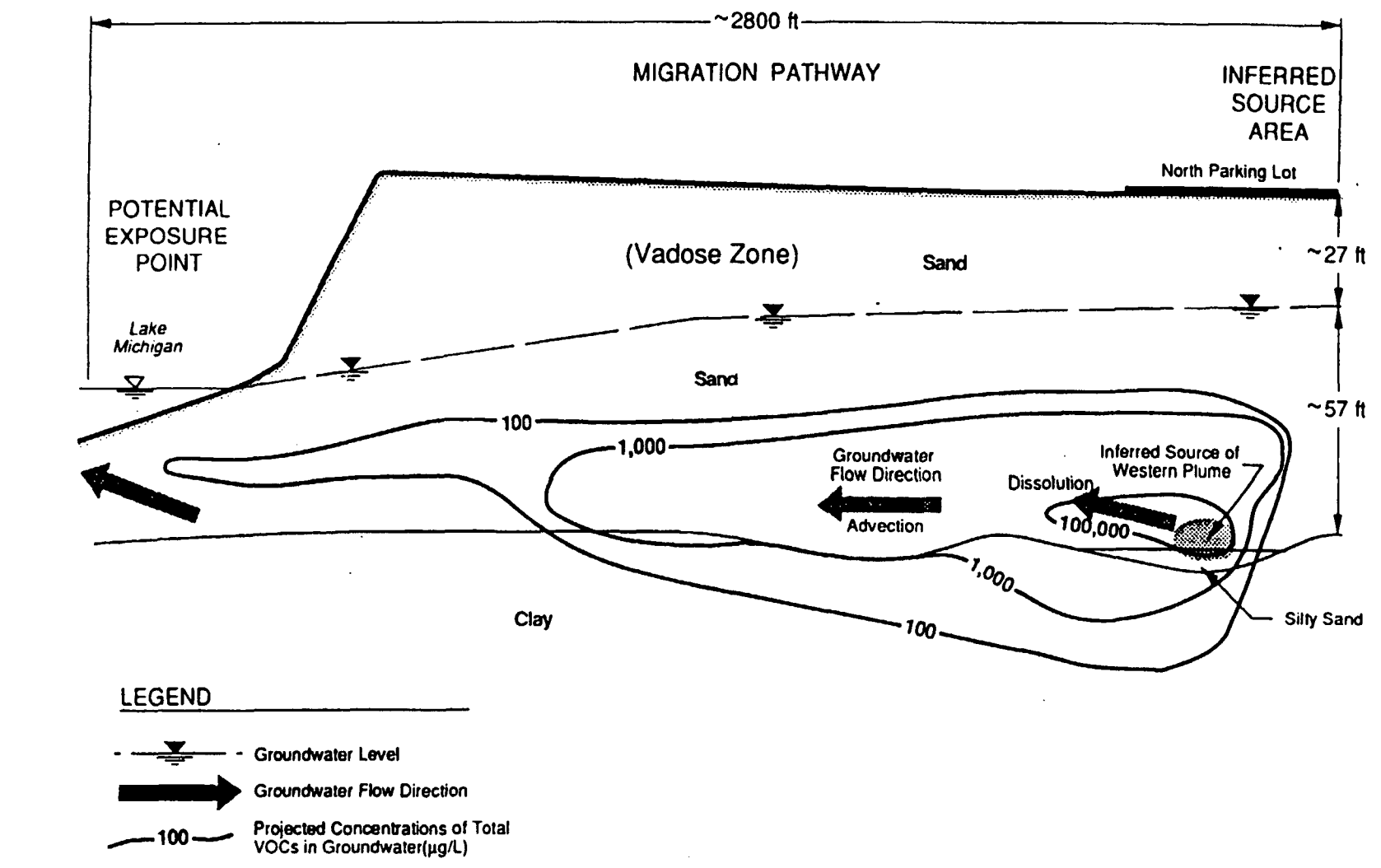
- State of Michigan Part 55 of Public Act 451, Air Pollution Control (formerly Act. No. 348) Part 2 and Part 7


2000 0 2000 4000
scale
feet
N
BASE MAP COMPILED FROM U.S.G.S. TOPOGRAPHIC QUADRANGLES FOR STEVENSVILLE, MICHIGAN 1970, AND BENTON HARBOR, MICHIGAN PHOTO-REVISED 1980.
LAKE MICHIGAN
SITE
Shoreham
Water Tank
Drive-in Theater
Picnic Area
Glen Park
Stevensville Cem
Trailer Park
Trailer Park
ARROW HWY
OHIO
ST JOSEPH
CHESAPEAKE
WASHINGTON
NELSON RD
AURILLA DR
MAIDEN
HASH DR
BM 630
BM 630
DES.BY:
DR.BY: KAP
CK.BY:
FIGURE 1
SITE LOCATION MAP
RECORD OF DECISION
BENDIX SITE
ST. JOSEPH, MICHIGAN
SCALE: NOTED
JOB NO.: 93194.07
DATE: SEPTEMBER 1997
9319407C
WOODARD & CURRAN
Engineering · Science · Operations



m/bosch/site plan

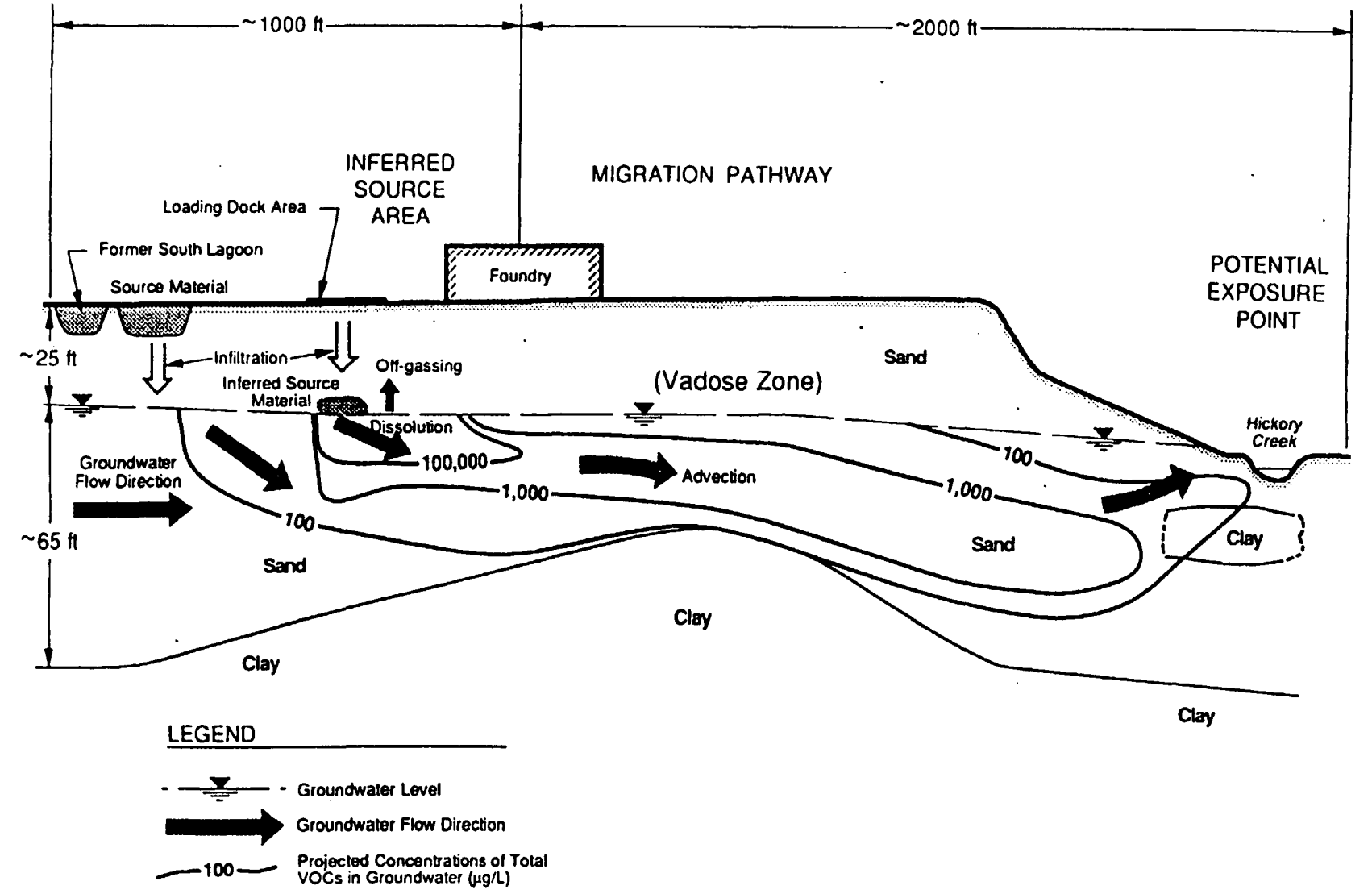
FIGURE 3
BENDIX SUPERFUND SITE
ST. JOSEPH, MI



Not to Scale

m/boschva-a

FIGURE 4
BENDIX SUPERFUND SITE
ST. JOSEPH, MI



Not to Scale

mvboscrvb-b'

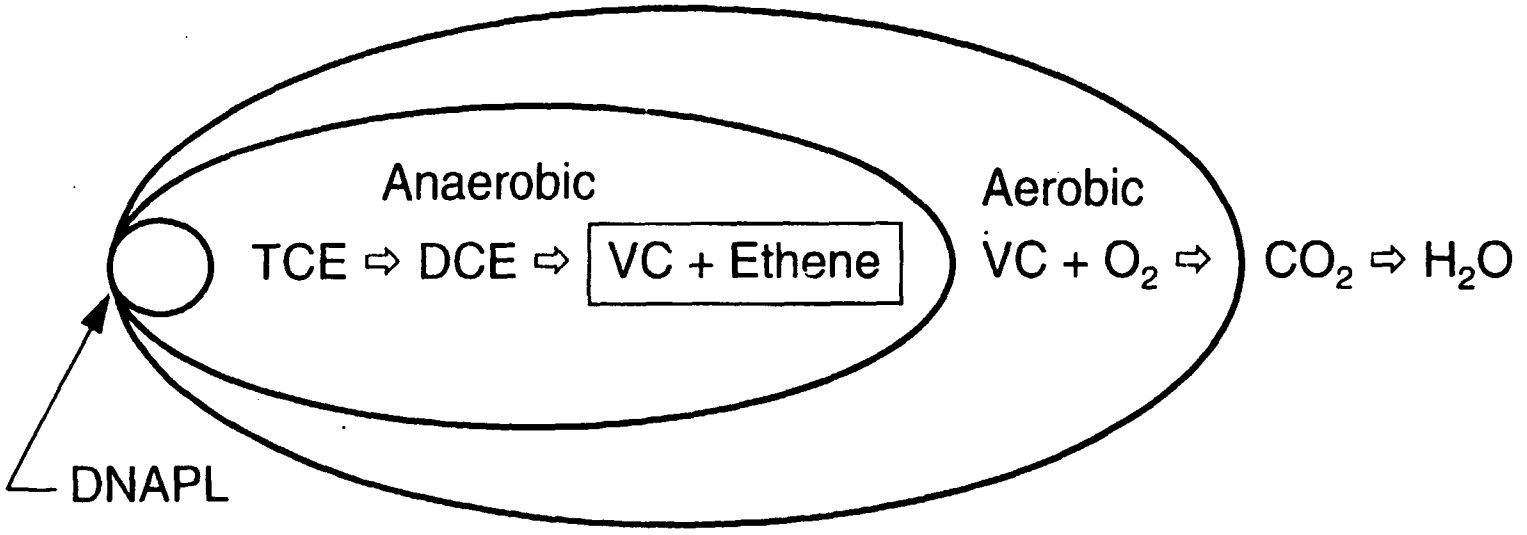


Figure 5
Example of Natural Attenuation
Record of Decision
Bendix/St. Joseph Site
St. Joseph, Michigan

APPENDIX A

MDEQ LETTER OF CONCURRENCE

STATE OF MICHIGAN

JOHN ENGLER, Governor

DEPARTMENT OF ENVIRONMENTAL QUALITY

HOLLISTER BUILDING, PO BOX 30473, LANSING MI 48909-7973

INTERNET: http://www.deq.state.mi.us

RUSSELL J. HARDING, Director

October 20, 1997

Mr. William E. Muno, Director, Superfund Division
U.S. Environmental Protection Agency
Region 5
77 West Jackson Boulevard, S-6J
Chicago, Illinois 60604-3590

Dear Mr. Muno:

SUBJECT: Concurrence with the Record of Decision (ROD) for the Bendix Superfund Site

We are in receipt of the September 30, 1997 Record of Decision for the Bendix Superfund Site in St. Joseph, Michigan. The Michigan Department of Environmental Quality (MDEQ) concurs with the ROD. We expect that when the remedy is implemented, the groundwater monitoring system and all necessary groundwater use controls will comply with all applicable state requirements.

If you have any questions, please feel free to contact Ms. Claudia Kerbawy, Chief of the Superfund Section, Environmental Response Division, at 517-335-3397, or you may contact me.

Sincerely,

Russell J. Harding
Director
517-373-7917

cc: Mr. David Ullrich, EPA
Mr. Alan J. Howard, MDEQ
Mr. Claudia Kerbawy, MDEQ
Dr. George Carpenter, MDEQ
Mr. William Harmon, MDEQ

APPENDIX B

ADMINISTRATIVE RECORD INDEX
AND
LOCATIONS

REPOSITORIES:

LINCOLN TOWNSHIP PUBLIC LIBRARY
2099 WEST JOHN BEERS ROAD
STEVENSVILLE, MICHIGAN 49127

MAUD PRESTON PALENSKE MEMORIAL LIBRARY
(ST. JOSEPH PUBLIC LIBRARY)
500 MARKET STREET
ST. JOSEPH, MICHIGAN 49085

ADMINISTRATIVE RECORD INDEX
BENDIX CORPORATION SITE
ST. JOSEPH, MICHIGAN

FRAME	PAGES	DATE	TITLE	AUTHOR	RECIPIENT	DOCUMENT TYPE	DOCNUMBER
	3	01/05/89	Letter re: The extension in the matter of Bendix, St. Joseph proposed Superfund site until January 27, 1989	P. Miller, USEPA	K. Miller, Allied-Signal	Correspondence	1
	4	88/06/28	Letter re: Special Notice of Potential Liability; USEPA has documented the release or threatened release of hazardous substances, pollutants and contaminants at the referenced sites	H. Gade, USEPA	Bendix Chassis&Brake Corp	Correspondence	2
	8	88/08/23	Letter re: Allied-Signal Inc./Bendix National Priority List	R. Black, Bendix Automotive Brake systems	S. Ziegle, USEPA	Correspondence	3
	2	88/08/29	Letter re: Special Notice of Potential Liability Request for Good Faith Proposal Bendix Corporation's Site - St. Joseph, MI	D.S. Currie Bendix	H.Gade, USEPA	Correspondence	4
	2	88/12/15	Letter Re: Bendix St. Joseph Proposed Superfund Site; acknowledgement of receipt EPA's latest proposed revisions to the "Administrative Consent Order"	K. Miller, Allied-Signal	P.Miller,K.Kovalski-USEPA	Correspondence	5
	2	89/10/31	Memo re: Bendix Superfund Site, Status Update	S. Sander, USEPA	J. Griffin	Memorandum	6
	1	87/10/31	National Priorities List - Bendix Corp/ Allied Automotive			Other	7

ADMINISTRATIVE RECORD INDEX
BENDIX CORPORATION SITE
ST. JOSEPH, MICHIGAN

YFRAME	PAGES	DATE	TITLE	AUTHOR	RECIPIENT	DOCUMENT TYPE	DOCNUMBER
			St. Joseph, MI				
	32	89/02/01	Administrative Order by Consent re: RI/FS in the matter of: The Bendix Corporation Site St. Joseph, MI	USEPA		Pleadings/Orders	8
	29	06/00/00	Statement of Work for Conducting a RI/FS at the Bendix Site St. Joseph, MI			Reports/Studies	9
	30	86/00/00	Site Background; brief chronological narrative of the historical aspects of the Bendix Corporation site			Reports/Studies	10
	11	89/05/00	Endangerment Assessment Workplan for Bendix Automotive Brake Systems Site - St. Joseph, Michigan	Engineering-Science Inc., (ES)		Reports/Studies	11
	13	89/05/00	Data Management Plan for RI/FS St. Joseph Michigan	Engineering-Science Inc. (ES)		Reports/Studies	12
	82	89/05/00	Health and Safety Plan for Allied Signal, Inc. Bendix Automotive St. Joseph, Michigan	Engineering-Science		Reports/Studies	13
	217	89/12/00	Quality Assurance Project Plan for RI/FS at Allied-Signal, Inc., Bendix Automotive Brake Systems St. Joseph, Michigan	Engineering-Science, Inc. (ES)		Reports/Studies	14
	283	89/12/00	Work Plan for RI/FS - St. Joseph, MI	Engineering-Science		Reports/Studies	15

ADMINISTRATIVE RECORD INDEX
BENDIX CORPORATION SITE
ST. JOSEPH, MICHIGAN

FRAME	PAGES	DATE	TITLE	AUTHOR	RECIPIENT	DOCUMENT TYPE	DOCNUMBER
			Bendix Autonotive Brake Systems - North America, St. Joseph, MI				

Raw Data and Sampling Data have not been copied, but are available for review at the U.S.EPA Region V, Chicago, IL.

GUIDANCE INDEX
BENDIX CORPORATION SITE
Guidance Documents are available for review at
USEPA Region V-Chicago IL

TLE	AUTHOR	DATE
EPA Guide for Identifying Cleanup Alternatives at Hazardous Waste Sites and Spills: Biological Treatment	Pacific NW Lab/Reinere/CorvallisERL	00/00/00
Sediment Sampling Quality Assurance User's Guide	Barth&Starks/U of NV,Brown/ORD/EARD	04/05/01
Practical Guide for Ground-Water Sampling	Barcelona,etal./IL St. Water Survey	85/09/01
CERCLA Compliance with Other Environmental Statutes	Porter,J./OSWER	85/10/02
Protocol for Ground-Water Evaluations	Haz. Waste GroundWater Task Force	86/09/01
ata Quality Objectives r Remedial Response ctivities: Development Process	CDM Federal Programs Corp/OERR/OWPE	87/03/01
Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA	OSWER/OERR	88/10/01

U.S. ENVIRONMENTAL PROTECTION AGENCY
REMEDIAL ACTION

ADMINISTRATIVE RECORD
FOR
BENDIX CORPORATION SITE
ST. JOSEPH, BERRIEN COUNTY, MICHIGAN

UPDATE #1
AUGUST 12, 1997

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
1	00/00/00	Weaver, J., et al; U.S. EPA/NRMRL	U.S. EPA	Paper: "Case Study of Natural Attenuation of Trichloroethene at St. Joseph, Michigan"	4
2	00/00/00	Weaver, J., et al; U.S. EPA/NRMRL	U.S. EPA	Paper: "Extraction of Degradation Rate Constants from the St. Joseph, Michigan, Trichloroethene Site"	5
3	06/13/86	Keck Consulting Services, Inc.	U.S. EPA	Hydrogeologic Study Final Investigation for the Bendix Site	310
4	01/00/90	Engineering-Science, Inc.	U.S. EPA	Technical Memorandum: Clay Surface Mapping and Screened Auger Results for the Bendix RI/FS	51
5	01/00/90	Engineering-Science, Inc.	U.S. EPA	Technical Memorandum in Support of the RI/FS for the Bendix Site	53
6	03/19/90	Beebe, S., MDNR	Whittaker, K., Engineering-Science, Inc.	Letter Forwarding Attached Information Concerning Michigan ARARs for the Bendix Site	75
7	10/00/90	Engineering-Science, Inc.	U.S. EPA	Phase I Technical Memorandum for the RI/FS at the Bendix Site	168
8	10/00/90	Engineering-Science, Inc.	U.S. EPA	Work Plan Addendum for Phase II Remedial Investigation Activities at the Bendix Brake Systems Site	111
9	12/13/91	Dykstra, M., Allied-Signal, Inc.	Kuhns, J., U.S. EPA	Letter re: Groundwater Investigation Historical Summary at the Bendix Site	10

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
10	05/06/92	Semprini, L., et al.	U.S. EPA	Paper: "Design and Treatability of In Situ Bioremediation of Chlorinated Aliphatics by Methanotrophs at St. Joseph, Michigan" (U.S. EPA: Symposium on Bioremediation of Hazardous Wastes, May 5-6, 1992)	12
11	05/26/92	Willard, C., and K. Whitaker; Engineering-Science, Inc.	Wilson, D., Allied Signal-Bendix	Letter re: Results of Investigation Aquifer Characterization Study Phase II In-Situ Bioremediation Testing at the St. Joseph Plant	23
12	08/00/92	McCarty, P., Stanford University and J. Wilson, U.S. EPA	U.S. EPA	Paper: "Natural Anaerobic Treatment of a TCE Plume at the St. Joseph, Michigan, NPL Site" (U.S. EPA: Bioremediation of Hazardous Wastes [EPA/600/R-92/126])	5
13	12/00/92	Engineering-Science, Inc.	U.S. EPA	An Evaluation of the Closed Maiden Lane Landfill Site	164
14	04/00/93	Engineering-Science, Inc.	U.S. EPA	Final Phase II Work Plan for the RI/FS at the Bendix Site	335
15	05/00/93	U.S. EPA/ ORD	U.S. EPA	Abstract: "Natural Anaerobic Bioremediation of TCE at the St. Joseph, Michigan, Superfund Site" (Kitanidis, P., et al; Symposium on Bioremediation of Hazardous Wastes: Research, Development, and Field Evaluations, May 4-6, 1993)	5
16	10/00/93	Engineering-Science, Inc.	U.S. EPA	Phase IIA Technical Memorandum for the RI/FS at the Bendix Site	79

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
17	04/18/94	Wilson, J., U.S. EPA/ RSKERL	Kuhns, J., U.S. EPA	FAX Transmission Forwarding Attached Paper: "Intrinsic Bioremediation of TCE in Ground Water at an NPL Site in St. Joseph, Michigan" (Wilson, J., et al.)	7
18	03/27/95	Wilson, J., U.S. EPA/ RSKERL	Kuhns, J., U.S. EPA	Letter Forwarding Attached Information re: Intrinsic Bioremediation	54
19	04/00/95	Semprini, L., et al.		Journal Article: "Anaerobic Transformation of Chlorinated Aliphatic Hydrocarbons in a Sand Aquifer Based on Spatial Chemical Distributions" (Water Resources Research)	12
20	08/00/95	Weaver, J., et al.; U.S. EPA/ NRMRL	U.S. EPA	Project Summary: "Natural Bioattenuation of Trichloroethene at the St. Joseph, Michigan, Superfund Site" (EPA/600/SV-95/001)	4
21	09/00/95	Woodard & Curran	U.S. EPA	Phase IIB Technical Memorandum for the Bendix Site (FINAL)	72
22	09/00/95	Woodard & Curran	U.S. EPA	Phase IIC Technical Memorandum for the Bendix Site	55
23	09/00/95	Woodard & Curran	U.S. EPA	Surface Water and Sediment Sampling Plan for the Bendix Site	35
24	00/00/96	Weaver, J., et al; U.S. EPA	U.S. EPA	Excerpt: "Field-Derived Transformation Rates for Modeling Natural Bio-attenuation of Trichloro-ethene and its Degradation Products" (Delic, G. and M. Wheeler: Next Generation Environmental Models and Computational Methods, Chapter 20)	12

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
25	04/00/96	U.S. EPA/ OSWER	Public	Technology Fact Sheet: "A Citizen's Guide to Bioremediation" (EPA-542-F-96-007)	4
26	09/00/96	Woodard & Curran	U.S. EPA	Surface Water and Sediment Sampling Report for the Bendix Site	246
27	10/00/96	U.S. EPA/ OSWER	Public	Technology Fact Sheet: "A Citizen's Guide to Natural Attenuation" (EPA-542-F-96-015)	4
28	05/01/97	Adriaens, P., et al.		Excerpt: "Biogeochemistry and Dechlorination Potential at the St. Joseph Aquifer-Lake Michigan Interface" (In Situ and On-Site Bioremediation Symposium: April 28 - May 1, 1997)	7
29	07/00/97	Woodard & Curran	U.S. EPA	Feasibility Study Report for Bosch Braking Systems (FINAL)	448
30	07/00/97	Woodard & Curran	U.S. EPA	Remedial Investigation Report for Bosch Braking Systems: Volume 1 (Text, Tables and Figures) [FINAL]	253
31	07/00/97	Woodard & Curran	U.S. EPA	Remedial Investigation Report for Bosch Braking Systems: Volume 2 (Appendices A-H) [FINAL]	262
32	07/24/97	Kerr, G., Bosch Braking Systems Corporation	Glatz, K., U.S. EPA	Letter Forwarding Attached Revised Pages to the Surface Water and Sediment Sampling Report	14

U.S. ENVIRONMENTAL PROTECTION AGENCY
REMEDIAL ACTION

ADMINISTRATIVE RECORD
FOR
BENDIX CORPORATION SITE
ST. JOSEPH, BERRIEN COUNTY, MICHIGAN

UPDATE #2
SEPTEMBER 25, 1997

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
1	08/00/97	U.S. EPA	Public	Proposed Plan for the Bendix/Bosch Braking Systems Site	13
2	08/20/97	O'Brien & Bails	U.S. EPA	Transcript of August 20, 1997 U.S. EPA Public Meeting re: the Allied Signal/Bosch Contamination Site	59
3	09/03/97	Berrien County, Ohio	U.S. EPA	Berrien County Private and Type III Public Ground Water Supply Ordinance (UNSIGNED)	5
4	09/08/97	Berrien County, Ohio	U.S. EPA	Berrien County Water Ordinance: Water Supply System No. 2 Operation	6
5	09/10/97	Kerr, G., Bosch Braking Systems Corporation	Glatz, K., U.S. EPA	Letter re: Bosch's Response to U.S. EPA's Proposed Plan for the Bendix Site	3

APPENDIX C

RESPONSIVENESS SUMMARY

OVERVIEW

The public participation requirements of CERCLA sections 113 (k) (2) (i-v) and 117 of CERCLA have been met during the remedy selection process. Section 113 (k) (2) (B) (iv) and 117 (b) of CERCLA require the 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 a remedial action. The Responsiveness Summary addresses concerns expressed by the public, potentially responsible parties, and governmental bodies in written and oral comments received by U.S. EPA and MDEQ regarding the proposed remedy for the Bendix Superfund Site.

BACKGROUND OF COMMUNITY INVOLVEMENT

Community involvement was initiated when the Bendix Site was placed on the NPL in February 1990. The following is a chronology of community relations activities to date:

U.S. EPA met with several local residents, the Berrien County Commissioner, and a representative from the County Health Department to identify community concerns and interests Regarding the Bendix Site (January 1990).

Community Relations Plan (CRP) was prepared based on concerns and interests generated from community interviews (August 1990).

U.S. EPA published two Public Meeting notices in the Herald Palladium to discuss site investigations and to announce the meeting.

A Fact Sheet was distributed to inform the community about the Public Meeting, provide background on the Bendix Site, and provide information on proposed Phase I RI activities (February 1990).

A Public Meeting was held on February 8, 1990 at the Lincoln Township Hall in Stevensville to explain the RI/FS process, discuss proposed Bendix Site investigations, and to receive comments and questions from the public regarding the Bendix Site. U.S. EPA also announced to the public the availability of the Administrative Record. Locations of the Information Repositories are listed below (February 1990).

Announcement was placed in the Herald Palladium that the Bendix facility had been added to the NPL (February 1990).

MDNR released Progress Report #1 to keep area residents and other interested persons informed of progress, findings, and proposed activities for the Bendix Site (March 1990).

MDNR met with residents at the St. Joseph Township Hall to discuss community concerns associated with the foundry emissions at the facility (not related to the site Superfund process) (March 1990).

A Fact Sheet was distributed to inform the community of Phase I RI results and to describe Phase II activities (August 1991).

The RI, FS, and Proposed Plan for the Bendix Site were released to the public on August 12, 1997.

The public comment period was held from August 13, 1997 to September 12, 1997. Comments received during this period and U.S. EPA's responses to those comments are included in this Responsiveness Summary (September 1997).

A Public Meeting was held on August 20, 1997 to discuss the FS and Proposed Plan. Representatives from U.S. EPA and MDEQ answered questions about the Bendix Site and the proposed remedial alternative. A transcript of this public meeting has been placed in the Administrative Record. Written comments were also accepted at the meeting. Approximately 35 people attended, including local residents and Bosch representatives.

RESPONSE TO COMMENTS

Two concerns were advanced during the Comment Period. Ms. Cathy Knauf, a resident near the Western Plume, is concerned about the long term safety of her children, should the ground water plume pattern change over time and vent contaminants at the beach, where her children may be exposed. It was explained that the Monitoring phase of the remedy will detect changes in ground water concentrations and flow patterns, and would provide adequate warning of changes in the plume pattern. The results of these Monitoring events will be placed in both Repositories. Ms. Knauf felt she may not be aware of the Monitoring events and requested that the results of all Monitoring events be sent to her. The Statement of Work will include a provision that a copy of all Monitoring results will be sent to Ms. Cathy Knauf at her present address.

Mr. Jim Scholz, also a resident on the south edge of the western plume, expressed concern that his water rights would be compromised by the deed restrictions placed on the use of ground water near the plume, and that he would not be able to place a well in this aquifer until the Remedy had been complete. In consideration of this concern, current Berrien County regulations require that a permit be acquired to install a well on the property of any Berrien County resident. The Berrien County policy is to deny a well permit to any resident currently on the St. Joseph Municipal Water System. Mr Scholz is on the St. Joseph System. However, should the regulation change, and Mr Scholz installs a well on his property, Bosch would be required to test this well on an annual basis until the ground water remedy is complete. This is consistent with the residential well monitoring program that will be included in the Statement of Work (SOW) for private wells near the plume. A copy of the pertinent Berrien County regulations have been placed in the Administrative Record and the repositories.

Response to Bosch Letter of September 10, 1997. U.S. EPA appreciates Bosch's support of the selected remedy. Bosch takes exception to the phrase "more restrictive" in setting the POC monitoring value for the plumes. Bosch suggests that the ground water contaminant concentrations can increase at the POC without necessarily exceeding the GSI values, and therefore should not trigger contingency considerations specified in the ROD. The following explanation justifies the "more restrictive" wording used in the ROD to identify the ground water compliance criteria. The plumes represent unique situations, since they discharge to surface water bodies thus creating the GSI condition. There are three requirements that must be satisfied to allow and set Alternate Concentration Limits (ACLs) as calculated using GSI numbers. They are: a) the condition of the ground water plume cannot further deteriorate; b). deed restrictions must be in place to control the use of the ground water during the remedy; and c) the ground water plume must be discharging to

a surface water body. For reason a) above, the phrase "the more restrictive" as used in the ROD to characterize the baseline conditions to evaluate the progress, or lack of progress, of the restoration of the contaminated ground water plumes, is justified, and will be retained in the ROD. The details of establishing progress toward aquifer restoration will be developed in the Long Range Monitoring Plan in the Statement of Work. In principal it will consist of mathematically evaluating the monitoring data as it is acquired, and establishing the trend (improving or deteriorating) of the ground water quality. The individual contaminants, as well as the cumulative risk posed by these contaminants, will be evaluated. Least square fit and linear regression analysis are two mathematical approaches that can be used to show trends. The monitoring schedule will set the base period for establishing trends from the baseline contaminant values. This approach is consistent with GSI ACL principles and with the NCP policy requiring that a remedy restore an aquifer to its most beneficial use in a reasonable time frame. The wording used in the ROD is consistent with these policies.

A copy of Bosch's letter has been included in the Administrative Record, and in the repositories.

LIST OF ACRONYMS

1,1-DCA	1,1-dichloroethane
1,1-DCE	1,1-dichloroethene
1,2-DCE	1,2-dichloroethene
1,1,1-TCA	1,1,1-trichloroethane
1,1,2-TCA	1,1,2-Trichloroethane
ARAR	Applicable or Relevant and Appropriate Requirement
AWQC	ambient water quality criterion
Bosch	Bosch Braking System
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cis-1,2-DCE	cis-1,2-dichloroethylene
CPC	Compound of Potential Concern
cm/sec	centimeter/second
DNAPL	Dense Non Aqueous Phase Liquid
EPC	exposure point concentration
ER-L	Effective Range-Low
FS	Feasibility Study
GSI	ground water/surface interface
HA	Health Advisory
HEAST	Health Effects Assessment Summary Tables
HI	Hazard Index
IRIS	Integrated Risk Information System
K	hydraulic conductivity
Keck	Keck Consulting Services Inc.
MCL	maximum contaminant level
MCLG	Maximum Contaminant Level Goal
MDEQ	Michigan Department of Environmental Quality
MDNR	Michigan Department of Natural Resources
MGS	Michigan Geologic Survey
MSL	mean sea level
NAPL	non-aqueous phase liquid
NCP	National Contingency Plan

LIST OF ACRONYMS
(continued)

NPL	National Priorities List
NOAA	National Oceanic and Atmospheric Administration
POC	Point of Compliance
POTW	Publicly Owned Treatment Works
PRG	Preliminary Remediation Goal
RI	Remedial Investigation
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SVE	soil vapor extraction
TCE	trichloroethylene
Trans-1,2-DCE	trans-1,2-dichloroethylene
μg/L	micrograms per liter
U.S. EPA	United States Environmental Protection Agency
VOCs	volatile organic compounds
W&C	Woodard & Curran

LIST OF REFERENCES

Keck Consulting Services, Inc., 1986. "Hydrogeologic Study: Final Investigations"; June 1986.

Michigan Department of Environmental Quality, 1997. "Part 201 Generic Soil Inhalation Criteria for Ambient Air: Technical Support Document." April 1997.

Michigan Department of Environmental Quality, 1996b. "Interim Environmental Response Division Operational Memorandum #17: Instructions for Obtaining Determinations on Mixing Zone-Based Ground Water Surface Water Interface Criteria for Inclusion in Remedial Action Plans and Monitoring Compliance with Criteria for Discharges of Ground Water Contaminants to Surface Water"; April 12, 1996.

Michigan Department of Natural Resources, 1995a. "Interim Environmental Response Division Operational Memorandum #8, Revision 4: Generic Residential Cleanup Criteria"; June 8, 1995.

Michigan Department of Natural Resources, 1995b. "Interim Environmental Response Division Operational Memorandum #14 Revision 2: Remedial Action Plans Using Generic Industrial or Generic Commercial Cleanup Criteria and Other Requirements"; June 1995.

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