*Draft Site Management Plan*

# DNAPL/Groundwater Collection System

# Velsicol Chemical Superfund Site Operating Unit #2, St. Louis, Michigan

Prepared for

**United States Environmental Protection Agency**

May 2010

CH2MHILL

# Contents

**Section** **Page**

**Table**



**Appendixes**

# Acronyms and Abbreviations

| | |
|---|---|
| DNAPL | dense nonaqueous phase liquid |
| Dynecol | Dynecol Inc. |
| gpm | gallons per minute |
| GWCS | Groundwater Collection System |
| HASP | Health and Safety Plan |
| HBB | hexabromobenzene |
| HDPE | high density polyethylene |
| MDEQ | Michigan Department of Environmental Quality |
| MH | Manhole |
| NAPL | nonaqueous phase liquid |
| O&M | operations and maintenance |
| OU | Operating Unit |
| PBB | polybrominated biphenyls |
| PCB | polychlorinated biphenyl |
| PEL | PEL Spectrum Analytical Inc. |
| QAPP | Quality Assurance Project Plan |
| QC | quality control |
| RA | Remedial Action |
| ROD | Record of Decision |
| RTL | Review Team Leader |
| Site | Velsicol Chemical Superfund Site |
| SM | Site Manager |
| SMP | Site Management Plan |
| SOP | Standard Operating Procedure |
| SSC | Site Safety Coordinator |

| | |
|---|---|
| SVOC | semivolatile organic constituent |
| TCLP | Toxicity Characteristic Leaching Procedure |
| TDH | total dynamic head |
| TTM | Technical Task Manager |
| T&D | transportation and disposal |
| USEPA | United States Environmental Protection Agency |
| VOC | volatile organic compounds |
| WAM | Work Assignment Manager |
| WHMD | Waste and Hazardous Material Division |

SECTION 1

# Introduction

This Site Management Plan (SMP) was prepared under Work Assignment 058-RARA-0532 for the Velsicol Chemical Superfund Site Operable Unit 2 (OU2) in St. Louis, Michigan (Site). This SMP is based on and replaces the existing SMP for the Site (CH2M HILL, 1999). This SMP includes new information related to the management of operations and contingency planning for the dense non-aqueous phase liquid/groundwater collection system (DNAPL/GWCS) installed at the Site during previous remedial action work. The purpose of this SMP is to aid operations and maintenance (O&M) operators in performing routine and non-routine O&M activities, including startup, operation, shutdown, troubleshooting, ongoing inspections, monitoring, maintenance, and reporting requirements, and to provide the emergency procedures and contacts.

## 1.1 Site Description

The Site is located at 324 North Street, St. Louis, Gratiot County, Michigan, and encompasses contaminated portions of the Pine River. There are two operable units (OU) at the Site. OU1 consists of the 52-acre main plant site, which was the location of the former Velsicol Chemical Company chemical manufacturing facility. OU2 consists of approximately 38 acres of sediments in the Pine River and Mill Pond including contaminated fish in the St. Louis Impoundment and Pine River. The remedial activities completed at OU2 between 1998 and 2006 removed the majority of the contaminated sediments and capped residual contamination in place.

The site is located in a predominantly residential area. A recreational park (Penny Park) borders the river's northern bank across from the Velsicol Chemical Company property. OU2 extends from the shoreline of the Velsicol Chemical Company property along the northwestern corner of the property on the west to the St. Louis Municipal Hydroelectric Dam in Mill Pond on the east. Although the Pine River is navigable, swimming and boating have been restricted or considered undesirable due to the presence of contaminated sediments, and a no consumption fish advisory has been in effect since 1977.

## 1.2 Remedial Actions

The Record of Decision (ROD) issued in February 1999 and the Action Memorandum issued in February 2003 defined the selected remedy for OU2 of the Site. The following major components of the OU2 remedy were completed between 1999 and 2006:

- Installation of sheet piling to form remedial cells in the Pine River.
- Excavation, dewatering, and stabilization of DDT-contaminated sediments from the river.
- Onsite treatment of water from the sediment dewatering process.
- Offsite disposal of stabilized sediments.

- Installation of a system for collection of DNAPL observed to be seeping with groundwater from the Site shoreline (DNAPL/GW collection system).
- Removal and offsite disposal of DNAPL.
- Installation of a clay cap in areas of the river that were observed to be affected by DNAPL.

## 1.3 Project Organization and Responsibility

The organizational structure of the project team is described below.

### 1.3.1 USEPA

The United States Environmental agency (USEPA) is ultimately responsible for all activities at the facility related to the operation of the DNAPL/GW collection system. **Tom Alcamo** is the USEPA Work Assignment Manager (WAM) for the remedial action (RA).

### 1.3.2 CH2M HILL Program Manager

The CH2M HILL program manager has overall responsibility for meeting USEPA objectives and CH2M HILL quality standards. In addition, the program manager is responsible for technical quality control (QC) and project oversight. The CH2M HILL program manager is **Ike Johnson**.

### 1.3.3 CH2M HILL Site Manager and Technical Task Manager

The CH2M HILL Site Manager (SM), **Theo Von Wallmenich**, and the Technical Task Manager (TTM), **Scott Pratt**, are responsible for implementing the project and are authorized to commit resources to meet project objectives and requirements. Their primary function is to achieve technical, financial, and scheduling objectives. The SM will report directly to the USEPA Region 5 WAM during the RA and will be the major point of contact for matters concerning the project. The TTM is in direct communication with the SM. The SM and TTM will perform the majority of their duties from the CH2M HILL office in Lansing and Southfield, Michigan, but will visit the site on an as-needed basis. More specifically, the SM and TTM will perform the following:

- Define project objectives and develop a detailed work plan and schedule.
- Establish project policy and procedures to address the specific needs of the project as a whole, as well as the objectives of each task.
- Acquire and apply technical and corporate resources to meet budget and schedule requirements.
- Orient field leaders and support staff with regard to the project's special considerations.
- Monitor and direct other team members.
- Develop and meet ongoing project or task staffing requirements, including mechanisms to review and evaluate each task product.

- Review the work performed on each task to ensure quality, responsiveness, and timeliness.
- Review and analyze overall task performance with regard to planned schedule and budget.
- Review external reports (deliverables) before submission to the USEPA Region 5 WAM.
- Represent the project team at meetings and public hearings.
- Supervise CH2M HILL staff and assist them in resolving project-related issues that cannot be adequately resolved at a lower level.

### 1.3.4 CH2M HILL Review Team Leader

The role of the review team leader (RTL) is to support the SM in site management activities planning activities. **Gina Bayer** is the RTL for this RA.

### 1.3.5 CH2M HILL Contract Specialist

CH2M HILL's RAC Program Contract Administrator is responsible for the contract documents created in support of RA activities. Specific responsibilities include the following:

- Contracting the analytical laboratories
- Contracting the subcontractors
- Resolving any contract disputes

CH2M HILL's contract administrator is **Matt Kluge**.

### 1.3.6 Site Safety Coordinator

Two Site Safety Coordinators (SSCs) will be designated for this RA: **Scott Pratt**, who will be serving as the TTM for CH2M HILL, and **Travis Pendry**, who will serve as the primary system O&M operator for CH2M HILL. As the SSCs, they will be responsible for pre-emergency planning and will assume charge during an emergency should one occur during the RA. Specific aspects of the SSC's role are described later in the contingency plan section of this SMP as well as the site-specific Health and Safety Plan (HASP) which is a separate stand-alone document (CH2M HILL, 2009a).

### 1.3.7 Laboratories

Analytical testing services will be provided by PEL Spectrum Analytical Inc. (PEL), Tampa, Florida. Responsibilities and criteria for the laboratories are detailed in the Draft Quality Assurance Project Plan (QAPP) which is a separate stand-alone document (CH2M HILL, 2009b).

### 1.3.8 Liquid Waste Transportation and Disposal Subcontractor

Dynecol Inc. of Detroit, Michigan (Dynecol) is the liquid waste transportation and disposal (T&D) subcontractor selected by CH2M HILL. The liquid waste T&D subcontractor is

responsible for providing the materials, equipment, and personnel for performing and controlling liquid waste T&D work in accordance with the subcontract documents.

## 1.4 Plan Organization

This SMP is intended to serve as a "road map" for quick reference to needed O&M information. Manufacturers' O&M manuals and product information for individual components are referenced and support the information presented in this manual. This manual is organized into the following sections:

- **Section 1: Introduction—**Describes the purpose of the document**.**
- **Section 2: DNAPL/GW Collection System Background and Description—**Provides a brief background of the DNAPL/GW collection system and describes system components.
- **Section 3: DNAPL/GW Collection System Startup Testing—**Describes activities associated with the system operations test.
- **Section 4: DNAPL/GW Collection System Operations—**Describes the system performance objectives, routine maintenance and inspections, operations, monitoring, and reporting requirements.
- **Section 5: Liquid Waste Transport and Disposal Procedures—**Describes the liquid waste handling, manifesting, and transport procedures.
- **Section 6: Contingency Plan—**Describes procedures designed to supplement the site-specific HASP in the event of an emergency.

SECTION 2

# DNAPL/GWCS Background and Description

## 2.1 DNAPL/GWCS Background

DNAPL and contaminated groundwater were observed in various locations during the OU2 RA and are described in more detail in the *NAPL Investigation Summary Report* (CH2M HILL, 2003). The largest quantities of DNAPL were found pooled on the glacial till after removal of the overlying sediments in the Hot Spot Cell and Area 3.

In July 2002, a large pool of DNAPL was encountered within a natural sand and gravel channel incised into the glacial till in the Hot Spot Cell. Eventually, 2,700 gallons of DNAPL were pumped from the sand and gravel channel into 55-gallon drums for temporary storage until it could be transported offsite for disposal at a hazardous waste handling facility. Analytical testing of the "Hot Spot Cell DNAPL" showed that it was composed primarily of DDT analogues, with some chlorobenzene. Analytical results for this NAPL were included in the *NAPL Investigation Summary Report* (CH2M HILL, 2003). DNAPL also was found during excavation of Area 3. An isolated pool of "Area 3 DNAPL" that could be pumped was not encountered, but the DNAPL was present over most of Area 3.

In response to the discovery of the DNAPL, the DNAPL/GW collection system was installed in the remedial area in 2002. The purpose of the system is to collect the residual DNAPL left within sand seams in the glacial till and to protect the river from contamination present on the former plant site. The trenches consisted of three separate main segments along the base of the shoreline and five trench laterals extending perpendicular to the shoreline.

The construction details for the DNAPL collection trenches, trench laterals, groundwater collection system, associated utilities, and the installed cap are included in Appendix A.

## 2.2 DNAPL/GCS System Description and Components

### 2.2.1 DNAPL Collection Trenches

The DNAPL collection system consists primarily of the collection trenches, collection laterals, and three manholes. The manholes consist of a 3-foot sump installed in the middle of each trench segment to facilitate removal of DNAPL by pumping. The trenches and trench laterals were constructed of 4-inch-diameter perforated high density polyethylene (HDPE) piping sloped back toward each manhole. The trenches were filled with 2 feet of stone fill, followed by compacted granular fill, after placement of the HDPE pipe.

### 2.2.2 Groundwater Collection System

The DNAPL/GW collection system was designed and constructed to enable the removal of contaminated groundwater accumulating in the NAPL collection trench manholes and conveyance to onsite collection tanks for storage and subsequent disposal. The DNAPL/GW

collection system was installed in 2005. When tested in April 2006, it demonstrated the ability to achieve approximately 12 feet of drawdown (elevation 707 feet above mean sea level) in MH-1 and MH-2, and approximately 8 feet (elevation 711 feet) in MH-3.

#### 2.2.2.1 Groundwater Collection System Components

Subsurface Components. The subsurface components of the DNAPL/GW collection system include the elements contained within each manhole. The components were designed to reduce/eliminate foreseeable operation, maintenance, and monitoring situations where entry into the manholes would be required. The subsurface components of the DNAPL/GW collection system include the following (for each manhole):

- Three-inch HDPE downhole piping
- Float switch assembly (currently not in operation)

Surface Components. The surface components of the DNAPL/GW collection system include the following for each manhole:

- Pump box, where the 3-inch HDPE piping is reduced to 2-inch galvanized steel piping
- Two-inch horizontal end suction self-priming centrifugal pump
- A 3- by 6-inch double-wall HDPE piping outside the manhole and pump box
- Electrical service and heat tracing components
- Flow system totalizer

The system pumps are Gorman-Rupp Series 80 self priming centrifugal pumps and have a design rating of 80 gallons per minute (gpm) at 32 feet of total dynamic head (TDH) and run at 1.5 horsepower on 230 volts. The manufacturer's installation, operation, and maintenance manual for the system pumps is included in Appendix B.

### 2.2.3 Compacted Clay Cap and Restored Shoreline

Once the DNAPL/GW collection system installation was completed, the river shoreline was cut back to establish a maximum slope of 18 degrees and a protective cap was installed. The cap consists of a 6-inch layer of protective sand placed and compacted up the shoreline, a 40-mil textured HDPE geomembrane placed over the slope from top to bottom, and a second 6-inch layer of protective sand placed over the geomembrane. The protective sand layer was covered with a 2-foot layer of clay placed and compacted over the entire slope.

The remainder of the OU2 shoreline disturbed by OU2 sediment excavation was restored using clean imported earthfill. This included the eastern half of the Cell 6 shoreline and the entire Cell 1, 2, 3, Cell 5, Cell 7, Cell 8, and Mill Pond Cell shorelines. The earthfill was compacted as it was placed and graded to a maximum slope of approximately 18 degrees. Geotextile fabric and riprap were then placed on the portion of the shoreline potentially exposed to erosion from wave action.

SECTION 3

# DNAPL/GCS System Testing and Start Up Activities

DNAPL/GW collection system operational testing was completed by CH2M HILL in July 2009 to ensure that the system operational components were functional and to support development of the RA Work Plan (CH2M HILL, 2009). The following tasks were completed during the DNAPL/GW collection system check-out:

- The main system header was pressure tested with air. The test results indicated that the main system header does not leak. Additionally, while the system was pressurized, all main header valves were checked for leaks. All valves passed (no leaks were detected).
- Main header secondary leak detection system was verified operational. The individual leak detectors were pulled and tested for function (all satisfactory). Additionally, all leak detectors were dry indicating that there are no breaches in the main header.
- Centrifugal pumps for each manhole were tested. All pumps are operating and capable of conveying water to the area where the wastewater storage tanks are located.
- The flow system volume totalizer was determined to be non-operational. Troubleshooting efforts concluded that the flow system volume totalizer needed to be replaced.

The result of the system start-up and testing activities determined that the DNAPL/GW collection system is operational and functional and that additional system procurement and operational preparations could be completed. Additional system startup activities included the following:

- Delivery and installation of two wastewater storage tanks.
- Collection of initial wastewater characterization samples in October 2009 and development of the waste manifests.
- Procurement of operational components and subcontracted services required for satisfactory operation of the DNAPL/GW collection system.

SECTION 4

# DNAPL/GW Collection System Operations

The following sections describe the inspection, maintenance, operations, and reporting requirements for operation of the DNAPL/GW collection system.

## 4.1 System Performance Objective

The objective of the DNAPL/GW collection system is to prevent OU1 DNAPL migration from re-contaminating sediments in the Pine River (OU2).

This will be accomplished by annual removal of accumulated DNAPL from each manhole collection sump and weekly operation of the DNAPL/GW collection system. Water removal from the DNAPL/GW collection system will be such that the groundwater elevation will be maintained below the surface elevation of the Pine River in order to maintain an inward gradient across the installed cap and to facilitate DNAPL flow into the DNAPL collection trenches and sumps.

## 4.2 Routine Inspections

This section describes the routine inspection and maintenance requirements for the DNAPL/GW collection system. Inspection and maintenance activities are performed to keep equipment operating efficiently, reduce unscheduled and non-routine downtime, extend equipment life, and promote a safe working environment. Checklists to be completed during weekly inspections are included in Appendix C.

### 4.2.1 System Component Inspections

Routine system inspection will be performed on a weekly basis. The O&M operator will conduct an inspection of DNAPL/GW collection system components and the DNAPL collection trench manholes during the weekly site visits. This weekly inspection includes tasks such as checking system components for leaks/unusual noises (squeaks), pump lubrication, motor lubrication, tank inspection, inspection of secondary containment berms for erosion or potential leaks, totalizer operation, manhole level measurements, and discharge hose inspection. The O&M operator will conduct the inspections prior to and in conjunction with DNAPL/GW collection system operation since that is typically when mechanical and electrical failures, leaks, or other problems are evident.

### 4.2.2 Shoreline Inspections

The shoreline for the entire main plant site will be inspected by the O&M operator on a monthly basis for signs of erosion and DNAPL or groundwater seeps both in the southern half of the Pine River/OU2 area and along the OU1 shoreline and upstream of the OU2 area. Deficiencies noted during the shoreline inspection will be located in the field (i.e.,

staked) by the O&M operator. The results of the shoreline inspection will be documented in the field log and on the shoreline inspection form (Appendix C).

## 4.3 Routine Maintenance

Routine maintenance activities, such as checking pump lubrication and verifying totalizer operations are performed as preventive measures to keep equipment operating properly and efficiently. The maintenance requirements for the DNAPL/GW collection system are based on equipment manufacturers' recommendations (Appendix B) and are included as elements in the system component checklist.

Routine maintenance activities associated with the site will include dewatering of the secondary containment pad and maintaining roadways and parking areas on the site. These activities will be completed on an as needed basis.

## 4.4 Non-routine Maintenance

Non-routine maintenance activities are generally required as a result of failed system operation and typically results from the findings obtained during troubleshooting activities.

Before conducting any non-routine maintenance activity, the TTM and O&M operator will prepare a summary of the problem, proposed corrective measure, associated costs, and impacts to the operation program and schedule. The summary shall be presented by the TTM to the SM for discussion and approval prior to implementation. All non-routine maintenance activities will be documented as directed by the TTM. The cause, implemented corrective measure, and plans for future preventive maintenance to prevent the event from recurring shall be documented and included within an updated version of the SMP, as needed, to ensure procedures are appropriately modified to prevent future occurrences of the same non-routine downtime.

## 4.5 Normal System Operation

The DNAPL/GW collection system is designed to be operated manually by an onsite system O&M operator. This section provides the standard operating procedures (SOPs) and sequences for normal operation of the DNAPL/GW collection system. Operation, monitoring, and maintenance of the DNAPL collection trenches include the following:

- Water level and DNAPL gauging
- Groundwater removal, storage, and disposal
- DNAPL removal, storage, and disposal

SOPs are included in Appendix D and are to be used by site personnel when performing the O&M-related activities on the DNAPL/GW collection system. When system conditions change such that the operating procedure is no longer appropriate, the SOP shall be revised by the TTM and the affected pages of the manual replaced.

### 4.5.1 Groundwater Removal, Storage, and Disposal

Groundwater removal will be accomplished by the O&M operator who is onsite 2 days per week. On the first day, the O&M operator will operate the DNAPL/GWCS to remove groundwater from each of the three NAPL collection trenches and transfer it to the appropriate storage tank on the secondary containment pad. The groundwater removal will be done by pumping one manhole at a time (MH-3, MH-2, and then MH-1) until the required volume is extracted or significant drawdown has been achieved. The quantity of groundwater generated during the weekly groundwater removal activities is estimated to be approximately 6,000 to 7,000 gallons from each of the three manholes. On the second day, the groundwater will be pumped from the storage tanks into tanker trucks and transported offsite for disposal. Normal system operation will be completed in accordance with SOPs included in Appendix D.

### 4.5.2 DNAPL Collection

It is assumed that approximately 750 gallons of DNAPL will be collected, transported, and disposed of on an annual basis. The DNAPL will be present in two onsite DNAPL collection sumps (MH-1 and MH-3), that are approximately 5 feet in diameter. The DNAPL will be accumulated in the bottom of each sump with approximately 30 to 40 feet of groundwater overlying the DNAPL. DNAPL removal operations will be completed by the waste T&D subcontractor under the supervision of CH2M HILL personnel. DNAPL removal operations will be completed in accordance with the SOP included in Appendix D.

## 4.6 Monitoring and Reporting Requirements

The purpose of this section is to summarize the monitoring, data management, and reporting requirements for the DNAPL/GW collection system. Monitoring and reporting will be performed as specified in the RA Work Plan (CH2M HILL, 2009c). The general monitoring requirements for operations as well as the guidelines for internal reporting and for data management are included in this section.

### 4.6.1 System Monitoring Requirements

On a weekly basis, the following information will be recorded and become part of the site operating record:

- Manhole groundwater elevation
- Manhole total depth
- Manhole NAPL thickness
- Relative river elevation
- System flow volume (totalizer readings)
- Inspection checklists
- NAPL presence and (if applicable) thickness in WMW-48D1

The data will be recorded on the weekly operations data sheet (see Appendix C).

### 4.6.2 Data Management

All data collection sheets and inspection checklists will be maintained in the site operating record located in the onsite construction trailer. On a monthly basis, all data collection sheets and inspection checklists will be digitally scanned into an electronic file and transmitted to the TTM for storage on a company server.

### 4.6.3 Reporting Requirements

System reporting will be completed in accordance with the RA Work Plan. Monthly reporting will consist of a brief technical memorandum summarizing the DNAPL/GW collection system operation activities, flow volumes, results of shoreline inspections, and a description of any maintenance activities performed during that month.

At the completion of the work assignment, a summary technical memorandum that summarizes system data, performance tests, system operations, maintenance activities, and other relevant system operational information associated with the DNAPL/GW collection system will be submitted.

SECTION 5

# Liquid Waste Transport and Handling Procedures

Dynecol has been awarded the liquid waste transportation and disposal subcontract. The following sections present the results of the waste characterization sampling, waste handling procedures, and draft waste manifest forms.

## 5.1 Waste Characterization Sample Results

The results of the groundwater and DNAPL waste characterization samples are discussed below.

### 5.1.1 Trench Wastewater Characterization

The results of previous waste characterization sampling determined that the extracted groundwater from MH-1 and MH-2 was non-hazardous liquid waste, while the extracted groundwater from MH-3 was determined to be hazardous liquid waste. Based on those results, extracted groundwater from MH-1 and MH-2 are combined in a single larger tank, and the extracted groundwater from MH-3 is pumped into a separate tank.

In order to verify the previous findings and to support preparation of current waste shipment documentation, representative samples were obtained from the DNAPL/GWCS. Waste characterization samples were collected from the MH-1/MH-2 and MH-3 tanks on October 13, 2009, and submitted to PEL for laboratory analysis. The groundwater waste characterization samples were analyzed utilizing for the following parameters:

- pH by EPA SW-846 Method 9045C
- Volatile organic constituents (VOCs) by EPA SW-846 Method 8260B/1311.
- Semi- volatile organic constituents (SVOCs) by EPA SW-846 Method 8270C/1311.
- Pesticides (including 2,4' and 4,4'-DDx isomers) by EPA SW-846 Method 8081/1311.
- Total polychlorinated biphenyls (PCB) Aroclors, hexabromobenzene (HBB) and polybrominated biphenyls (PBB) by EPA SW-846 Method 8082.
- Metals (including arsenic and mercury) by EPA SW-846 Method 6010B / 7470/1311.
- Herbicides by EPA SW-846 Method 8151/1311.

The results of the waste characterization sampling are summarized on Table 1. The analytical data indicate that the extracted groundwater from both the combined MH-1/MH-2 tank as well as the MH-3 tank are hazardous waste based on the concentrations of benzene, carbon tetrachloride, chloroform, tetrachloroethene, trichloroethene, and vinyl chloride. Therefore, initial waste disposal operations will treat all groundwater removed by the DNAPL/GW

collection system as hazardous waste. System operation over time may reduce the concentrations present in the combined MH-1/MH-2 tank, or other system configurations may be possible to reduce the hazardous waste stream volume. Therefore, additional waste characterization samples will be collected from the system to determine if the amount of liquid waste classified as hazardous can be minimized in the future. The results of additional waste characterization samples will be used to modify the method of waste disposal and the pages of this plan amended to reflect the completion of these tasks, as required.

### 5.1.2 DNAPL Waste Characterization

Current waste characterization samples results are not available for the DNAPL. However, previous DNAPL testing indicates that the DNAPL is a hazardous waste by characteristic (flammability) and although not previously tested for toxicity, it is reasonably assumed to be a hazardous waste based on toxicity as well based on percentage level concentrations of persistent or otherwise toxic organic chemicals.

Prior to conducting DNAPL removal, transportation, and disposal operations, the DNAPL will be fully characterized and the pages of this plan amended to reflect the completion of these tasks.

## 5.2 Waste Manifests

Copies of the uniform hazardous waste manifest, land disposal restriction, and waste approval forms generated by Dynecol are included in Appendix E.

Dynecol will generate a uniform hazardous waste manifest for each load of hazardous waste removed from the site. CH2M HILL is an authorized signatory of the USEPA and will sign each uniform hazardous waste manifest "on behalf of the USEPA."

The TTM will be responsible for submitting the uniform hazardous waste manifests to the Michigan Department of Environmental Quality (MDEQ), Waste and Hazardous Materials Division (WHMD) on a monthly basis. The uniform hazardous waste manifests for a given month are to be submitted to WHMD no later than the tenth calendar day of the following month.

TABLE 1
Waste Characterization Sample Results (Tanks)
Manholes 1&2 and Manhole 3, October 13, 2009
*Velsicol Chemical – Pine River Site, OU2*

| | | | MH-1/2-tank | MH-3-tank |
|---|---|---|---|---|
| **Detected Parameters** | **Method** | **Units** | **10CV02-01** | **10CV02-02** |
| ***Metals*** | | | | |
| Arsenic | SW6010B | mg/L | <0.0331 | 0.044 |
| Barium | SW6010B | mg/L | 0.201 | 0.683 |
| Cadmium | SW6010B | mg/L | 0.0137 | 0.0146 |
| Chromium | SW6010B | mg/L | 0.0114 | 0.00857 |
| Lead | SW6010B | mg/L | <0.037 | <0.037 |
| Selenium | SW6010B | mg/L | <0.041 | <0.041 |
| Silver | SW6010B | mg/L | <0.0052 | <0.0052 |
| Mercury | SW7470A | mg/L | 0.000467 | 0.000766 |
| ***Pesticides*** | | | | |
| 2,4'-DDD | SW8081A | µg/L | 1.2 | <1 |
| 2,4'-DDE | SW8081A | µg/L | 0.058 | <1 |
| 2,4'-DDT | SW8081A | µg/L | 1.2 | <1 |
| 4,4'-DDD | SW8081A | µg/L | 1.3 | <1 |
| 4,4'-DDE | SW8081A | µg/L | 0.11 | <1 |
| 4,4'-DDT | SW8081A | µg/L | 0.65 | <1 |
| alpha-Chlordane | SW8081A | µg/L | <1 | <1 |
| Endrin | SW8081A | µg/L | <1 | <1 |
| gamma-BHC (Lindane) | SW8081A | µg/L | <1 | <1 |
| gamma-Chlordane | SW8081A | µg/L | <1 | <1 |
| Heptachlor | SW8081A | µg/L | <1 | <1 |
| Heptachlor epoxide | SW8081A | µg/L | <1 | <1 |
| Methoxychlor | SW8081A | µg/L | <1 | <1 |
| Toxaphene | SW8081A | µg/L | <10 | <10 |
| Toxaphene-1 | SW8081A | µg/L | <0 | <0 |
| Toxaphene-2 | SW8081A | µg/L | <0 | <0 |
| Toxaphene-3 | SW8081A | µg/L | <0 | <0 |
| Toxaphene-4 | SW8081A | µg/L | <0 | <0 |
| Toxaphene-5 | SW8081A | µg/L | <0 | <0 |
| ***Polychlorinated Biphenyls (PCBs)*** | | | | |
| Aroclor-1016 | SW8082 | µg/L | <0.51 | <0.51 |
| Aroclor-1221 | SW8082 | µg/L | <0.51 | <0.51 |
| Aroclor-1232 | SW8082 | µg/L | <0.51 | <0.51 |
| Aroclor-1242 | SW8082 | µg/L | <0.51 | <0.51 |
| Aroclor-1248 | SW8082 | µg/L | <0.51 | <0.51 |
| Aroclor-1254 | SW8082 | µg/L | <0.51 | <0.51 |
| Aroclor-1260 | SW8082 | µg/L | <0.51 | <0.51 |
| Aroclor-1262 | SW8082 | µg/L | <0.51 | <0.51 |
| Aroclor-1268 | SW8082 | µg/L | <0.51 | <0.51 |
| Hexabromobenzene | SW8082 | µg/L | <0.51 | <0.51 |

TABLE 1
Waste Characterization Sample Results (Tanks)
Manholes 1&2 and Manhole 3, October 13, 2009
*Velsicol Chemical – Pine River Site, OU2*

| | | | MH-1/2-tank | MH-3-tank |
|---|---|---|---|---|
| **Detected Parameters** | **Method** | **Units** | **10CV02-01** | **10CV02-02** |
| ***Herbicides*** | | | | |
| 2,4,5-TP (Silvex) | SW8151A | µg/L | <10 | <10 |
| 2,4'-D | SW8151A | µg/L | <10 | <10 |
| ***Volatile Organic Compounds*** | | | | |
| 1,1-Dichloroethene | SW8260B | µg/L | <10 | <10 |
| 1,2-Dichloroethane | SW8260B | µg/L | 5330 | 46000 |
| 2-Butanone | SW8260B | µg/L | <80 | 62.4 |
| Benzene | SW8260B | µg/L | 1290 | 2900 |
| Carbon tetrachloride | SW8260B | µg/L | <10 | 799 |
| Chlorobenzene | SW8260B | µg/L | 28000 | 174 |
| Chloroform | SW8260B | µg/L | 1040 | 22700 |
| Tetrachloroethene | SW8260B | µg/L | 21.6 | 20.4 |
| Trichloroethene | SW8260B | µg/L | 109 | 513 |
| Vinyl chloride | SW8260B | µg/L | 6.6 | 104 |
| ***Semivolatile Organic Compounds*** | | | | |
| 1,4-Dichlorobenzene | SW8270C | µg/L | 48.2 | <21.6 |
| 2,4,5-Trichlorophenol | SW8270C | µg/L | <27.2 | <27.2 |
| 2,4,6-Trichlorophenol | SW8270C | µg/L | <28.8 | <28.8 |
| 2,4-Dinitrotoluene | SW8270C | µg/L | <22.4 | <22.4 |
| 2-Methylphenol (o-Cresol) | SW8270C | µg/L | <20.8 | <20.8 |
| 4-Methylphenol | SW8270C | µg/L | 32.8 | <48.8 |
| Hexachlorobenzene | SW8270C | µg/L | <16 | <16 |
| Hexachlorobutadiene | SW8270C | µg/L | <20 | <20 |
| Hexachloroethane | SW8270C | µg/L | <20.8 | <20.8 |
| Nitrobenzene | SW8270C | µg/L | <22.4 | <22.4 |
| Pentachlorophenol | SW8270C | µg/L | <80 | <80 |
| Pyridine | SW8270C | µg/L | <16.8 | <16.8 |
| ***General Chemistry*** | | | | |
| pH | E150.1 | pH | 5.98 | 6.23 |

Notes:

mg/kg = milligrams per kilogram or parts per million
µg/kg = micrograms per kilogram or parts per billion

SECTION 6

# Contingency Plan

The Site is a Large Quantity Generator of hazardous waste and the development of a contingency plan with emergency procedures required by 40 CRF 262.34(a)(4) is appropriate. The Contingency Plan outlines emergency response procedures for the site and is meant to act as an informational supplement to the facility-specific HASP (CH2M HILL, 2009a). The elements included in the Contingency Plan are to be reviewed by O&M operators prior to work commencement. The purpose of this Contingency Plan is as follows:

- Supplement the site-specific HASP.
- Minimize hazards to human health or the environment from fires, explosions, or any unplanned sudden or non-sudden release of hazardous waste constituents or polluting materials to air, soil, or surface water.
- Summarize procedures and instructions to efficiently respond to an emergency.
- Provide a document that all team members can easily use, including new team members.

## 6.1 Site Identification Information

### Site Name

Velsicol Chemical Superfund Site in St. Louis, Michigan

### Site Owner

The property tile owner is the bankruptcy trustee, Lepetomane III Inc., Chicago, Illinois. The site work owner is the USEPA.

### Site Address/Location

Velsicol Chemical Superfund Site in St. Louis, Michigan
324 North Street
St. Louis, Gratiot County, MI 48880

### Key Contacts

**Theo Von Wallmenich**
Site Manager
Office: 989-285-1515
Cell: 517-483-3015

**Scott Pratt**
Technical Task Manager
Office: 248-223-6075
Cell: 248-219-7146

**Travis Pendry**
Principal O&M Operator
Office: 248-545-3075
Cell: 313-657-8452

### Site Telephone Number

Contact: Scott Pratt or Travis Pendry

## 6.2 Emergency Response Plan

### 6.2.1 Site Specific Training and Orientation

The TTM is responsible for ensuring that SSCs are properly trained and that a site-specific orientation for all SSC/O&M operations personnel has been completed prior to work completion at the site.

### 6.2.2 Pre-Emergency Planning

The SSC will perform the applicable pre-emergency planning tasks before starting field activities:

- Locate nearest telephone to the site and inspect onsite communications.
- Locate chemical, safety, and biological hazards.
- Confirm and post emergency telephone numbers and map of route to hospital.
- Post site map marked with locations of emergency equipment and supplies.
- Review emergency response plan for applicability to any changes in site conditions, alterations to onsite operations, or personnel availability.
- Designate one vehicle as the emergency vehicle. Place hospital directions and map inside. Keep keys accessible during field activities.
- Inventory and check site emergency equipment and supplies.
- Review emergency procedures for personnel injury, exposures, fires, explosions, and extracted groundwater releases with field personnel.
- Locate onsite emergency equipment and supplies of clean water.
- Verify local emergency contacts, hospital routes, evacuation routes, and assembly points.
- Drive route to hospital.
- Review names of onsite personnel trained in first aid and CPR.

- Review notification procedures for contacting CH2M HILL's medical consultant and team member's occupational physicians.
- Brief new workers on the emergency response plan.

### 6.2.3 Emergency Equipment and Supplies

The SSC will mark the locations of the following emergency equipment on the site map and post the site map in the support zone:

- A 20-lb ABC fire extinguisher
- Industrial first aid kit
- Facility emergency equipment
- Additional emergency equipment
- Nearest phone

### 6.2.4 Emergency Medical Treatment

The SSC will assume charge during a medical emergency until the ambulance arrives or the injured person is admitted to the emergency room. The following procedure will be implemented:

- Prevent further injury
- Initiate first aid and CPR
- Call the ambulance and hospital
- Determine if decontamination will make injury worse
- Make certain that injured person is accompanied to emergency room
- Notify the SM of the injury
- Notify the CH2M HILL SM/TTM. The SM will be responsible for notifying the CH2M HILL Regional Health and Safety Manager
- Prepare an incident report as directed by the SM.

### 6.2.5 Evacuation

- Evacuation routes will be designated by the SSC before beginning work.
- Onsite and offsite assembly points will be designated before beginning work.
- An air horn will be used for the emergency signal.
- Personnel will exit the work area and assemble at the onsite assembly point upon hearing the emergency signal for evacuation.
- The SSC and a "buddy" will remain onsite after the site has been evacuated (if possible) to assist local responders and advise them of the nature and location of the incident.
- The SSC will account for all personnel in the onsite assembly zone.

- A person designated by the SSC (before work) will account for personnel at the offsite assembly area.
- The SSC is to write up the incident as soon as possible after it occurs, and submit a report to the CH2M HILL Corporate Director of Health and Safety.

Emergency contacts and emergency notification procedures are presented on the attached forms. These forms will be posted in the field trailer for quick and easy access in the event of an emergency.

### 6.2.6 Working Alone

The majority of the work performed as part of this RA will be completed by CH2M HILL personnel working under the "lone worker" scenario. O&M operators will be required to follow the lone worker provisions of the HASP and to notify the TTM or the SM of their status at the onset of work, at 4 hour intervals during work completion, and at the end of the work day.

## 6.3 First Aid Medical Information

One person who is trained in first aid and CPR will be onsite during work hours. The SSCs are trained in first aid and CPR and will be responsible for first aid during emergencies. The SSCs will review the names of trained personnel and note them at the health and safety briefings and will designate a trained individual for those occasions when he or she is not onsite.

In the event of an emergency, the information noted on the Emergency Response Numbers form will be provided to the emergency response provider.

## 6.4 Route to Hospital

Directions to the nearest hospital, Gratiot County Community Hospital, are as follows.

1. From the Site gate turn right onto North Street
2. 0.1 miles to Watson Street (turn left)
3. 0.3 miles to M-46/BR 27 (turn right)
4. 2.5 miles to Wright Avenue (turn left)
5. 1.1 miles to Warwick (turn left)
6. 0.1 miles to hospital entrance – Gratiot County Community Hospital

Total distance: 4.1 miles

Travel time: 10 minutes

## 6.5 Emergency Numbers

| Emergency Service | Address | Telephone |
|---|---|---|
| Ambulance | | 911 |
| Hospital | Gratiot Community Hospital<br>300 Warwick Drive<br>Alma, MI 48801 | 989-755-1101 |
| Police Department | 108 W. Saginaw Street<br>St. Louis, MI 48801 | 911<br>989-681-2211 |
| Fire Department | 108 W Saginaw Street<br>St. Louis, MI 48801 | 911<br>989-681-3111 |
| Poison Control | Gratiot Community Hospital<br>300 Warwick Drive<br>Alma, MI 48801 | 989-755-1111 |
| Poison Control Center | | 800-343-2722 |
| Electric Company | St. Louis Electric Utility<br>412 N. Mill Street<br>St. Louis, MI 48880 | 989-681-3351 |
| Water Department | St. Louis City Water Department<br>404 E. Prospect Street<br>St. Louis, MI 48880 | 989-681-3567 |
| National Spill Response Center | | 800-424-8802 |
| EPA Emergency Response Team | | 908-321-6660 |

**When calling 911, be prepared to answer the following questions:**

**Who:** Velsicol Chemical Superfund Site
**Where:** 324 North Street; St. Louis, MI

**How many are injured?**

**Describe the type of injuries/illnesses and first aid being administered.**

An individual must meet the emergency vehicle at the site entrance and direct them to the victim(s).

## 6.6 Emergency Notification Procedure

An emergency can be an injury to a worker, an evacuation, fire, etc. An unusual situation could involve equipment failures, work that is not being performed appropriately, or anything involving risk or exposure to the public. If an emergency or unusual situation should come to the attention of an onsite worker, it is their responsibility to notify others of the situation. If an emergency or unusual situation occurs, emergency services will be notified, followed by notification to the CH2M HILL SM or TTM as soon as conditions allow.

| Name | Work Telephone | Home Telephone |
|---|---|---|
| Theo Von Wallmenich, Site Manager | 989-285-1515<br>517-483-3015 (cell) | |
| Scott Pratt, Technical Task Manager | 248-223-6075 | 248-219-7146 |
| | 248-219-7146 (cell) | |

Calling must continue until one of the above persons has been notified of the situation. The facts of the matter, status of emergency services, effect on the public, and any other pertinent information will be identified.

Communication with members of the press will be through the USEPA WAM. The WAM will be contacted by the SM as needed.

# 6.7 Spill Management and Reporting

## 6.7.1 Spill Management Procedures

### 6.7.1.1 Waste Water

The waste water storage tanks consist of one 21,000 gallon steel tank and one 6,500 gallon vertical HDPE tank. The tanks are located inside a secondary containment area that has a volume (26,800 gallons) greater than 110 percent of the volume of the largest vessel. The base of the secondary containment area is sloped such that water flows to the drainage sump located at its lowest point. Storm water run-on that accumulates into the secondary containment system is removed weekly as a part of normal system operations.

Spills can occur during filling of the waste water storage tanks, filling of waste disposal tanker trucks, or as the result of a tank rupture. Procedures have been developed and incorporated into the operations SOPs to prevent spills associated with tank realignment during system operations and waste hauling operations, and in the event that a spill does occur the spill will be confined to the secondary containment pad. These precautions include inspection of delivery lines and ensuring prior to system operations the lines are secure and cannot move during system operation.

In the event that a spill does occur during routine system operations from a leak or rupture of the delivery lines or a tank rupture the following procedures will be implemented.

1. Evacuate personnel from the immediate area.
2. The secondary containment pad isolation valve should be immediately shut and pumping system shut down.
3. Don PPE (tyveck, boots, gloves) as appropriate.
4. Barricade the spill area with caution tape and notify others in surrounding areas.
5. Estimate the quantity of release, document the situation, and notify the TTM.

6. If the spill is caused by a leak or rupture in a delivery line the spilled trench water that accumulates in the secondary containment pad will be pumped into one of the waste water storage tanks using a utility pump located in the site trailer.
7. If the spill is caused by a ruptured storage tank, the system operator will transfer waste water accumulated in the secondary containment pad to the remaining storage tank as volume allows. The TTM will contact emergency response personnel to ensure that the spill is cleaned up as soon as possible and will take steps to ensure that the failed tank is replaced as soon as possible.
8. The TTM and the SM will be responsible for ensuring the spill is properly documented and reported.

#### 6.7.1.2 DNAPL

DNAPL is present in the collection sumps at the bottom of each manhole. DNAPL will be removed from the manholes by the T&D subcontractor, under the direct supervision of CH2M HILL personnel, on an annual basis. It is assumed that approximately 750 gallons of DNAPL will be present in the collection sumps at MH-1 and MH-3 (DNAPL has not been observed in MH-2). The removal of DNAPL from the manholes will involve the temporary installation of a diaphragm (or similar) pump for DNAPL collection. The T&D subcontractor will be responsible for providing the DNAPL collection pump and all associated conveyance lines and other equipment, as required. The DNAPL will be removed from the manhole and placed directly into either 55-gallon drums equipped with overpacks, or directly into a tanker truck. The determination of which waste hauling method to be used will be made once an approximate volume of DNAPL to be removed is determined.

CH2M HILL will ensure that the subcontractor has taken precautions to prevent DNAPL spills and that the subcontractor has a satisfactory plan and equipment for responding to spills. The T&D subcontractor will provide an emergency spill kit to be used in the event of a DNAPL spill. At a minimum, the kit will contain personal protective equipment (Tyvek® suits, gloves, boots, and goggles) and spill containment equipment such as containment socks and pillows, absorbent pads, and oil absorbing clay (oil dry or equivalent).

### 6.7.2 Spill Documentation And Reporting

Spills will be documented in the field/daily notes. In the event of a reportable spill, a spill report will be prepared that will include the following:

- Description of the material spilled (including identity, quantity).
- Whether the amount is USEPA or state reportable including when and to whom it was reported.
- Time, location, and a description of the area involved.
- Receiving stream or waters.
- Cause of the incident, equipment, and personnel involved.
- Injuries or property damage.

- Containment procedures initiated.
- Summary of contact with government agencies, contracting officer, engineer, or owner.
- Description of the cleanup procedures employed or to be employed including the disposal location of contaminated material.

**SECTION 7**

# References

CH2M HILL. 1999. Site Management Plan, Velsicol/Pine River Site St. Louis, Michigan - Remedial Action.

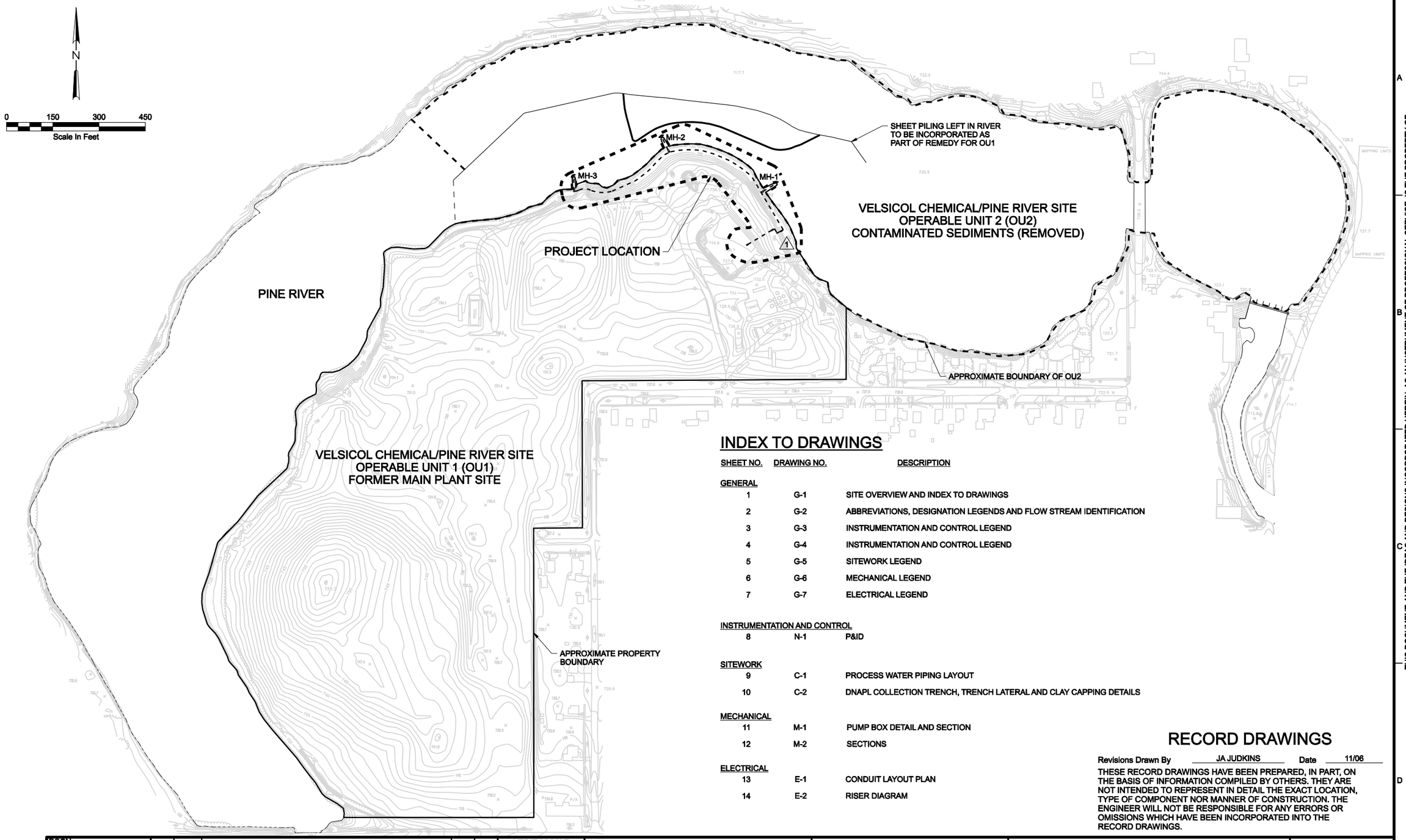
CH2M HILL. 2003. NAPL Investigation Summary. Velsicol Chemical/Pine River Site, St. Louis, Michigan.

CH2M HILL. 2009a. Health and Safety Plan, Velsicol Chemical/Pine River Site, St. Louis, Michigan.

CH2M HILL . 2009b. Draft Quality Assurance Project Plan. Velsicol Chemical/Pine River Site, St. Louis, Michigan.

CH2M HILL. 2009c. Work Plan Velsicol Chemical/Pine River Site OU2, St. Louis, Michigan, Remedial Action.

# Appendix A
# DNAPL/GW Collection System Design Drawings




## INDEX TO DRAWINGS

| SHEET NO. | DRAWING NO. | DESCRIPTION |
|---|---|---|
| **GENERAL** | | |
| 1 | G-1 | SITE OVERVIEW AND INDEX TO DRAWINGS |
| 2 | G-2 | ABBREVIATIONS, DESIGNATION LEGENDS AND FLOW STREAM IDENTIFICATION |
| 3 | G-3 | INSTRUMENTATION AND CONTROL LEGEND |
| 4 | G-4 | INSTRUMENTATION AND CONTROL LEGEND |
| 5 | G-5 | SITEWORK LEGEND |
| 6 | G-6 | MECHANICAL LEGEND |
| 7 | G-7 | ELECTRICAL LEGEND |
| **INSTRUMENTATION AND CONTROL** | | |
| 8 | N-1 | P&ID |
| **SITEWORK** | | |
| 9 | C-1 | PROCESS WATER PIPING LAYOUT |
| 10 | C-2 | DNAPL COLLECTION TRENCH, TRENCH LATERAL AND CLAY CAPPING DETAILS |
| **MECHANICAL** | | |
| 11 | M-1 | PUMP BOX DETAIL AND SECTION |
| 12 | M-2 | SECTIONS |
| **ELECTRICAL** | | |
| 13 | E-1 | CONDUIT LAYOUT PLAN |
| 14 | E-2 | RISER DIAGRAM |

## RECORD DRAWINGS

Revisions Drawn By JA JUDKINS Date 11/06

THESE RECORD DRAWINGS HAVE BEEN PREPARED, IN PART, ON THE BASIS OF INFORMATION COMPILED BY OTHERS. THEY ARE NOT INTENDED TO REPRESENT IN DETAIL THE EXACT LOCATION, TYPE OF COMPONENT NOR MANNER OF CONSTRUCTION. THE ENGINEER WILL NOT BE RESPONSIBLE FOR ANY ERRORS OR OMISSIONS WHICH HAVE BEEN INCORPORATED INTO THE RECORD DRAWINGS.



| | | | | | | | |
|---|---|---|---|---|---|---|---|
| DSGN RA YOLO<br>DR MA REICHERT<br>CHK LA AMUNDSON<br>APVD RA YOLO | 1 | 11/06<br>08/06 | RECORD DRAWING.<br>ADDED PB-4 AND VB-2. | JAJ<br>PAK | RCS<br>RAY | VERIFY SCALE<br>BAR IS ONE INCH ON ORIGINAL DRAWING.<br>0 1"<br>IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY. | CH2MHILL |
| | NO. | DATE | REVISION | BY | APVD | | |

2005 SEDIMENT REMEDIAL ACTION
GROUNDWATER RECOVERY SYSTEM
AND DNAPL COLLECTION TRENCH

VELSICOL/PINE RIVER SITE
ST. LOUIS, MICHIGAN

GENERAL

SITE OVERVIEW
AND INDEX TO DRAWINGS

| | |
|---|---|
| SHEET | 1 |
| DWG | G-1 |
| DATE | MARCH 2005 |
| PROJ | 184199 |

FILENAME: PRng001d_184199.dgn PLOT DATE: 10/31/2006 PLOT TIME: 2:44:00 PM

# ABBREVIATIONS

| | |
|---|---|
| @ | AT |
| AB | ANCHOR BOLT |
| ABDN | ABANDONED |
| ACBD | ACOUSTICAL BOARD |
| ACCU | AIR-COOLED CONDENSING UNIT |
| ACST | ACOUSTICAL TILE |
| ACT | ACOUSTICAL |
| ACU | AIR CONDITIONING UNIT |
| AD | AREA DRAIN |
| ADDL | ADDITIONAL |
| ADJ | ADJACENT |
| AHR | ANCHOR |
| AHU | AIR HANDLING UNIT |
| AL | ALUMINUM |
| ALTN | ALTERNATE |
| ANOD | ANODIZED |
| APPROX | APPROXIMATE |
| APVD | APPROVED |
| ARCH | ARCHITECTURAL |
| ARD | ACID RESISTANT DRAIN |
| ASSY | ASSEMBLY |
| ASU | AIR SUPPLY UNIT |
| AVG | AVERAGE |
| BC | BOOSTER HEATING COIL |
| BETW | BETWEEN |
| BF | BOTTOM FACE |
| BG | LOW WALL GRILLE |
| BLDG | BUILDING |
| BM | BEAM |
| BOD | BOTTOM OF DUCT |
| $BOD_5$ | BIOCHEMICAL OXYGEN DEMAND (5 DAY TEST) |
| BOT | BOTTOM |
| BRG | BEARING |
| CAB. | CABINET |
| C/C | CHLORINE CONTACT |
| CD | CEILING DIFFUSER |
| CEM PLAS | CEMENT PLASTER |
| CF | CEILING FAN |
| CG | CEILING GRILLE |
| CHEM | CHEMICAL |
| CHKD | CHECKERED |
| CFM | CUBIC FEET PER MINUTE |
| CJ | CONSTRUCTION JOINT |
| CI | CAST IRON |
| CISP | CAST IRON SOIL PIPE |
| CL | CENTER LINE |
| $CL_2$ | CHLORINE |
| CLDI | CEMENT LINED DUCTILE IRON |
| CLG | CEILING |
| CLP | CLAY PIPE |
| CLR | CLEAR |
| CMP | CORRUGATED METAL PIPE |
| CMU | CONCRETE MASONRY UNITS |
| COL | COLUMN |
| CONC | CONCRETE |
| CONN | CONNECTION |
| CONST | CONSTRUCTION |
| CONT | CONTINUOUS |
| COR | CORNER |
| CP | CONCRETE PIPE |
| CPLG | COUPLING |
| CPVC | CHLORINATED POLYVINYL CHLORIDE |
| CR | CEILING REGISTER |
| C TO C | CENTER TO CENTER |
| CTR | CENTER |
| CTRD | CENTERED |
| CU FT | CUBIC FEET |
| C/W | COMPLETE WITH |
| △ | CENTRAL ANGLE |
| DAF | DISSOLVED AIR FLOTATION |
| DBA | DEFORMED BAR ANCHOR |
| DBL | DOUBLE |
| DECHLOR | DECHLORINATION |
| DEG ° | DEGREE |
| DET | DETAIL |
| DG | DOOR GRILLE |
| DIA | DIAMETER |
| DIAG | DIAGONAL |
| DIM | DIMENSION |
| DIP | DUCTILE IRON PIPE |
| DIR | DIRECTION |
| DISCH | DISCHARGE |
| DS | DOWNSPOUT |
| DN | DOWN |
| DRWR | DRAWER |
| DWG | DRAWING |
| DWL | DOWEL |
| E | EAST |
| E | EXTERNAL |
| EA | EACH |
| ELB | ELBOW |
| EC | ELECTRIC CONVECTOR |
| ECC | ECCENTRIC |
| EDH | ELECTRIC DUCT HEATER |
| EF | EACH FACE OR EXHAUST FAN |
| EFL | EFFLUENT |
| EL | ELEVATION |
| ELEC | ELECTRICAL |
| EQL | EQUAL |
| EQL SP | EQUALLY SPACED |
| EQPT | EQUIPMENT |
| EW | EACH WAY |
| EXA | EXHAUST AIR |
| EXP JT | EXPANSION JOINT |
| EXT | EXTERIOR |
| EXST | EXISTING |
| FAB | FABRICATION |
| F FL EL | FINISHED FLOOR ELEVATION |
| FACIL | FACILITY |
| FC | FLEXIBLE CONNECTION |
| FCA | FLANGED COUPLING ADAPTER |
| FCTY, FACT. | FACTORY |
| F.EXT | FIRE EXTINGUISHER |
| FD | FLOOR DRAIN OR FIRE DAMPER |
| FDN | FOUNDATION |
| FLEX | FLEXIBLE |
| FLG | FLANGE |
| FLR | FLOOR |
| FNSH | FINISH |
| FRP | FIBERGLASS REINFORCED PLASTIC |
| FT | FEET |
| FTC | FIN TUBE CONVECTOR |
| G | GAS |
| GA | GAUGE |
| GAC | GRANULAR ACTIVATED CARBON |
| GB | GRAB BAR |
| GBD | GRAVITY BACKDRAFT DAMPER |
| GAL | GALLON |
| GALV | GALVANIZED |
| GALVS | GALVANIZED STEEL |
| GCL | GEOSYNTHETIC CLAY LINER |
| GIV | GRAVITY INTAKE VENTILATOR |
| GPD | GALLONS PER DAY |
| GRV | GRAVITY RELIEF VENTILATOR |
| GUH | GAS UNIT HEATER |
| GVL | GRAVEL |
| GWB | GYPSUM WALLBOARD |
| GYP PLAS | GYPSUM PLASTER |
| H.A.S | HEADED ANCHOR STUD |
| HCR | HIGH CAPACITY REGISTER |
| HD | HUB DRAIN |
| HDNR | HARDENER |
| HDR | HEADER |
| HGT | HEIGHT |
| HPT | HIGH POINT ELEVATION |
| HORIZ | HORIZONTAL |
| HM | HOLLOW METAL |
| HR | HOUR |
| HTR | HIGH THROW REGISTER |
| HV | HOSE VALVE |
| I&C | INSTRUMENTATION AND CONTROL |
| ID | INSIDE DIAMETER |
| IF | INSIDE FACE |
| INFL | INFLUENT |
| INSTL | INSTALL |
| INSUL | INSULATION |
| INVT | INVERT |
| ITG | INSULATED TEMPERED GLASS |
| JT | JOINT |
| L | LENGTH OF CURVE |
| LB | POUNDS |
| LB/D | POUNDS PER DAY |
| LCP | LOCAL CONTROL PANEL |
| LF | LINIER FEET |
| LG | LONG |
| LLV | LONG LEG VERTICAL |
| LNTL | LINTEL |
| LONG | LONGITUDINAL |
| LPT | LOW POINT ELEVATION |
| LR | LONG RADIUS |
| LT | LIGHT |
| MATL | MATERIAL |
| MAU | MAKE UP AIR UNIT |
| MAX | MAXIMUM |
| MB | MACHINE BOLT |
| MCC | MOTOR CONTROL CENTER |
| MD | MOTORIZED DAMPER |
| MECH | MECHANICAL |
| MFR | MANUFACTURER |
| MGD | MILLION GALLONS PER DAY |
| MG/L | MILLIGRAMS PER LITER |
| MH | MANHOLE |
| MIN | MINIMUM |
| MIR | MIRROR |
| MISC | MISCELLANEOUS |
| MJ | MECHANICAL JOINT |
| MO | MASONRY OPENING |
| MON | MONUMENT |
| MTG | MOUNTING |
| MTL | METAL |
| MTRG | METERING |
| M&BH | MOP AND BROOM HOLDER |
| N | NORTH |
| NIC | NOT IN CONTRACT |
| NO. | NUMBER |
| NOM | NOMINAL |
| NORM | NORMAL |
| NTS | NOT TO SCALE |
| OA | OUTSIDE AIR |
| OC | ON CENTER |
| OD | OUTSIDE DIAMETER OR OVERFLOW DRAIN |
| OF | OUTSIDE FACE |
| O/H | OVERHEAD |
| O TO O | OUT TO OUT |
| OPNG | OPENING |
| OPP | OPPOSITE |
| PC | POINT OF CURVATURE |
| PE | PLAIN END |
| PI | POINT OF INTERSECTION |
| P&ID | PROCESS AND INSTRUMENTATION DIAGRAM |
| PJF | PREMOLDED JOINT FILLER |
| PL | PLATE |
| PLAM | PLASTIC LAMINATE |
| PLC | PROGRAMMABLE LOGIC CONTROLLER |
| PLYWD | PLYWOOD |
| POC | POINT ON CURVE |
| POT | POINT ON TANGENT |
| PR | PAIR |
| PRCST | PRECAST |
| PS | PUMP STATION |
| PSF | POUNDS PER SQUARE FOOT |
| PSI | POUNDS PER SQUARE INCH |
| PT | POINT OF TANGENCY |
| PTD | PAPER TOWEL DISPENSER |
| PTD/R | PAPER TOWEL DISPENSER/RECEPTACLE |
| PVC | POINT OF VERTICAL CURVATURE OR POLYVINYL CHLORIDE |
| PVI | POINT OF VERTICAL INTERSECTION |
| PVMT | PAVEMENT |
| PVT | POINT OF VERTICAL TANGENCY |
| QDRNT | QUADRANT |
| R OR RAD | RADIUS OR RISER |
| RC | REINFORCED CONCRETE |
| RCP | REINFORCED CONCRETE PIPE |
| RD | ROOF DRAIN |
| RDCR | REDUCER |
| RDVF | ROTATING DRUM VACUUM FILTER |
| REHAB | REHABILITATION/REHABILITATED |
| REINF | REINFORCE |
| REQD | REQUIRED |
| RESIL | RESILIENT |
| RM | ROOM |
| RO | ROUGH OPENING |
| RR | REDUCER |
| RST | REINFORCING STEEL |
| S | SOUTH |
| SA | SUPPLY AIR |
| SAT | SUSPENDED ACOUSTICAL TILE |
| SCHED | SCHEDULE |
| SD | SOAP DISPENSER OR SLOT DIFFUSER |
| SECT | SECTION |
| SG | SAFETY GLASS |
| SH | SHEET |
| SHTG | SHEETING |
| SIM | SIMILAR |
| SLV | SHORT LEG VERTICAL |
| S.O. | SHUTOFF |
| SPECD | SPECIFIED |
| SPECS | SPECIFICATIONS |
| SPG | SPACING |
| SQ | SQUARE |
| SST | STAINLESS STEEL |
| STA | STATION |
| STD | STANDARD |
| STIF | STIFFENER |
| STOR | STORAGE |
| STR | STRAIGHT |
| STRUCT | STRUCTURAL |
| STL | STEEL |
| SYMM | SYMMETRICAL |
| T | TREAD OR TANGENT LENGTH |
| TAR | TRANSFER AIR REGISTER |
| T&B | TOP AND BOTTOM |
| TC | TOP OF CONCRETE |
| TCU | TERMINAL CONTROL UNIT |
| TEMP | TEMPERED |
| TF | TOP FACE |
| TG | TEMPERED GLASS |
| THK | THICK |
| THRD | THREADED |
| T.O. | TOP OF |
| TPD | TONS PER DAY OR TOILET PAPER DISPENSER |
| TPI | TURNOUT POINT OF INTERSECTION |
| TRANSV | TRANSVERSE |
| TSS | TOTAL SUSPENDED SOLIDS |
| TST | TOP OF STEEL |
| TTD | TOILET TISSUE DISPENSER |
| TW | TOP OF WALL |
| TYP | TYPICAL |
| UH | UNIT HEATER |
| UON | UNLESS OTHERWISE NOTED |
| V | VENT |
| VAT | VINYL ASBESTOS TILE |
| VERT | VERTICAL |
| VCP | VITRIFIED CLAY PIPE |
| VD | VOLUME DAMPER |
| VFD | VARIABLE FREQUENCY DRIVE |
| VTR | VENT THRU ROOF |
| VWC | VINYL WALL COVERING |
| W | WEST |
| W/ | WITH |
| WD | WOOD |
| WG | WIRE GLASS |
| WH | WATER HEATER |
| WK | WEEK |
| WRB | WATER RESISTANT GYPSUM WALLBOARD |
| WR | WASTE RECEPTACLE |
| WS | WATER STOP OR WATER SURFACE OR WELDED STEEL |
| WSG | WALL SUPPLY GRILLE |
| WSR | WALL SUPPLY REGISTER |
| WWM | WELDED WIRE MESH |
| XFMR | TRANSFORMER |
| YR | YEAR |

NOTE:

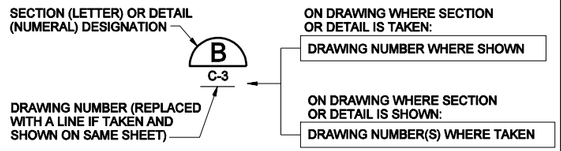
1. CONTACT THE ENGINEER FOR ABBREVIATIONS NOT LISTED.

## DRAWING NUMBER DESIGNATION

C-1
- INDICATES DRAWING NUMBER
- INDICATES DISCIPLINE(S):

| | |
|---|---|
| C | SITEWORK |
| G | GENERAL |
| M | MECHANICAL |
| N | INSTRUMENTATION AND CONTROL |
| E | ELECTRICAL |

## DETAIL, SECTION AND VIEW DESIGNATION




## FLOW STREAM IDENTIFICATION

| | |
|---|---|
| GWD | GROUND WATER DOUBLE WALL |
| GWS | GROUND WATER SINGLE WALL |

## RECORD DRAWINGS

Revisions Drawn By JA JUDKINS Date 11/06

THESE RECORD DRAWINGS HAVE BEEN PREPARED, IN PART, ON THE BASIS OF INFORMATION COMPILED BY OTHERS. THEY ARE NOT INTENDED TO REPRESENT IN DETAIL THE EXACT LOCATION, TYPE OF COMPONENT NOR MANNER OF CONSTRUCTION. THE ENGINEER WILL NOT BE RESPONSIBLE FOR ANY ERRORS OR OMISSIONS WHICH HAVE BEEN INCORPORATED INTO THE RECORD DRAWINGS.

## GENERAL NOTE

1. THIS IS A STANDARD LEGEND SHEET. SOME ABBREVIATIONS MAY APPEAR ON THIS SHEET AND NOT ON THE PLANS.

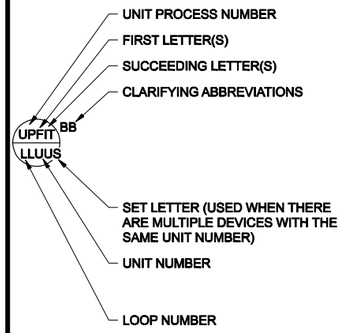


| | | | | | | | |
|---|---|---|---|---|---|---|---|
| DSGN RA YOLO | | | | | | VERIFY SCALE | 2005 SEDIMENT REMEDIAL ACTION GROUNDWATER RECOVERY SYSTEM AND DNAPL COLLECTION TRENCH | GENERAL | SHEET 2 |
| DR MA REICHERT | | | | | | BAR IS ONE INCH ON ORIGINAL DRAWING. 0 1" | | ABBREVIATIONS, DESIGNATION LEGENDS AND FLOW STREAM IDENTIFICATION | DWG G-2 |
| CHK LA AMUNDSON | | | | | | IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY. | CH2MHILL | | DATE MARCH 2005 |
| APVD RA YOLO | NO. | DATE | REVISION | BY | APVD | | VELSICOL/PINE RIVER SITE ST. LOUIS, MICHIGAN | | PROJ 184199 |
| | | 11/06 | RECORD DRAWING. | JAJ | RCS | | | | |

FILENAME: PRng002d_184199.dgn PLOT DATE: 10/31/2006 PLOT TIME: 2:44:09 PM

# INSTRUMENT IDENTIFICATION

## EXAMPLE SYMBOLS




## INSTRUMENT IDENTIFICATION LETTERS TABLE

| | FIRST-LETTER | | SUCCEEDING-LETTERS | | |
|---|---|---|---|---|---|
| LETTER | PROCESS OR INITIATING VARIABLE | MODIFIER | READOUT OR PASSIVE FUNCTION | OUTPUT FUNCTION | MODIFIER |
| A | ANALYSIS (+) | | ALARM | | |
| B | BURNER, COMBUSTION | | USER'S CHOICE(*) | USER'S CHOICE(*) | USER'S CHOICE(*) |
| C | USER'S CHOICE(*) | | | CONTROL | |
| D | DENSITY (S.G) | DIFFERENTIAL | | | |
| E | VOLTAGE | | PRIMARY ELEMENT, SENSOR | | |
| F | FLOW RATE | RATIO (FRACTION) | | | |
| G | USER'S CHOICE(*) | | GLASS, GAUGE VIEWING DEVICE | GATE | |
| H | HAND (MANUAL) | | | | HIGH |
| I | CURRENT (ELECTRICAL) | | INDICATE | | |
| J | POWER | SCAN | | | |
| K | TIME, TIME SCHEDULE | TIME RATE OF CHANGE | | CONTROL STATION | |
| L | LEVEL | | LIGHT (PILOT) | | LOW |
| M | MOTION | MOMENTARY | | | MIDDLE, INTERMEDIATE |
| N | TORQUE | | USER'S CHOICE(*) | USER'S CHOICE(*) | USER'S CHOICE(*) |
| O | USER'S CHOICE(*) | | ORIFICE, RESTRICTION | | |
| P | PRESSURE, VACUUM | | POINT (TEST) CONNECTION | | |
| Q | QUANTITY | INTEGRATE, TOTALIZE | | | |
| R | RADIATION | | RECORD OR PRINT | | |
| S | SPEED, FREQUENCY | SAFETY | | SWITCH | |
| T | TEMPERATURE | | | TRANSMIT | |
| U | MULTIVARIABLE | | MULTIFUNCTION | MULTIFUNCTION | MULTIFUNCTION |
| V | VIBRATION, MECHANICAL ANALYSIS | | | VALVE, DAMPER, LOUVER | |
| W | WEIGHT, FORCE | | WELL | | |
| X | UNCLASSIFIED (+) | X AXIS | UNCLASSIFIED (+) | UNCLASSIFIED (+) | UNCLASSIFIED (+) |
| Y | EVENT, STATE OR PRESENCE | Y AXIS | | RELAY, COMPUTE, CONVERT | |
| Z | POSITION | Z AXIS | | DRIVE, ACTUATOR, UNCLASSIFIED FINAL CONTROL ELEMENT | |

TABLE BASED ON THE INSTRUMENTATION, SYSTEMS, AND AUTOMATION SOCIETY (ISA) STANDARD.

(+) WHEN USED, EXPLANATION IS SHOWN ADJACENT TO INSTRUMENT SYMBOL. SEE ABBREVIATIONS AND LETTER SYMBOLS.

(*) WHEN USED, DEFINE THE MEANING HERE FOR THE PROJECT

## DIGITAL SYSTEM INTERFACES

- ▲ ANALOG INPUT
- ▼ ANALOG OUTPUT
- △x DISCRETE INPUT
- ▽x DISCRETE OUTPUT

WHERE X=
A = ALARM
H = MAINTAINED
M = MOMENTARY
S = STATUS

## GENERAL INSTRUMENT OR FUNCTIONAL SYMBOLS

- FIELD MOUNTED
- REAR-OF-PANEL MOUNTED (OPERATOR INACCESSIBLE)
- PANEL MOUNTED (OPERATOR ACCESSIBLE)
- MCC MOUNTED
- COMPUTER FUNCTION
- PLC FUNCTION
- SHARED DISPLAY, SHARED CONTROL

## SPECIAL CASES

YL OO — ON AND OFF EVENT LIGHTS

HS OO — ON-OFF HAND SWITCH. MAINTAINED CONTACT SWITCH (CONTROLLED DEVICE WILL RESTART ON RETURN OF POWER AFTER POWER FAILURE).

HS SS — STOP-START HAND SWITCH MOMENTARY CONTACT SWITCHES (CONTROLLED DEVICE WILL NOT RESTART ON RETURN OF POWER AFTER POWER FAILURE).

## TRANSDUCERS

| | | | |
|---|---|---|---|
| A | ANALOG | I | CURRENT |
| D | DIGITAL | P | PNEUMATIC |
| E | VOLTAGE | PF | PULSE FREQUENCY |
| F | FREQUENCY | PD | PULSE DURATION |
| H | HYDRAULIC | R | RESISTANCE |

EXAMPLE:

FY I/P — CURRENT TO PNEUMATIC TRANSDUCER (BACK OF PANEL, IN A FLOW LOOP)

## ACCESSORY DEVICES

EXAMPLE: TRANSMITTER AS AN ACCESSORY TO A FLOW ELEMENT

FT / T

A = ALARM
C = CONTROLLER
I = INDICATOR
R = RECORDER
S = SWITCH
T = TRANSMITTER
X = UNCLASSIFIED

# LINE LEGEND

- PROCESS (CLOSED CONDUIT, DASHED LINE INDICATES ALTERNATE FLOW STREAM)
- PROCESS (OPEN CHANNEL)
- ANALOG SIGNAL (4 TO 20 mAdc, ETC.)
- DISCRETE SIGNAL (ON/OFF, ETC.)
- PNEUMATIC SIGNAL
- FILLED SYSTEM SIGNAL
- HYDRAULIC SYSTEM SIGNAL
- DATA LINK
- BUILDING OR FACILITY BOUNDARY
- PACKAGE SYSTEM EQUIPMENT

PARALLELING LINES

(2) 3(2)

(A) (B)

(A) TOTAL OF 2 SIGNALS

(B) 3 TYPICAL SETS OF 2 SIGNALS EACH. TOTAL OF 6 SIGNALS.

- CONNECTING LINES
- NON-CONNECTING LINES

# INTERFACE SYMBOLS

S WA — WA D

= PROCESS INTERFACE

= SIGNAL INTERFACE

W = SOURCE UNIT PROCESS NO. (1 OR 2 DIGITS)

A = INTERFACE NO. (2 DIGITS)

D = DESTINATION DRAWING NO.

S = SOURCE DRAWING NO.

N — PROCESS OR SIGNAL LINE CONTINUATION N=1,2,3,ETC — N

INTERFACE TO OR FROM PROCESS EXTERNAL TO PROJECT

# ABBREVIATIONS & LETTER SYMBOLS

| | |
|---|---|
| AC | ALTERNATING CURRENT |
| AM | AUTO-MANUAL |
| CAM | COMPUTER-AUTO-MANUAL |
| CCS | CENTRAL CONTROL SYSTEM |
| $CL_2$ etc. | CHLORINE (TYPICAL: USE STANDARD CHEMICAL ELEMENT ABBREVIATION) |
| CM | COMPUTER-MANUAL |
| COD | CHEMICAL OXYGEN DEMAND |
| CP-X | CONTROL PANEL NO. X |
| DC | DIRECT CURRENT |
| DCS | DISTRIBUTED CONTROL SYSTEM |
| DCU | DISTRIBUTED CONTROL UNIT |
| DO | DISSOLVED OXYGEN |
| $FCL_2$ | FREE CHLORINE RESIDUAL |
| FOS | FAST-OFF-SLOW |
| FOSA | FAST-OFF-SLOW-AUTO |
| FOSR | FAST-OFF-SLOW-REMOTE |
| FP-W-X | FIELD PANEL NO. WX (W = UNIT PROCESS NUMBER X = PANEL NUMBER) |
| FR | FORWARD-REVERSE |
| HOA | HAND-OFF-AUTO |
| HOR | HAND-OFF-REMOTE |
| ISR | INTRINSICALLY SAFE RELAY |
| LEL | LOWER EXPLOSIVE LIMIT |
| LOS | LOCKOUT STOP |
| LR | LOCAL-REMOTE |
| MA | MANUAL-AUTO |
| MC | MODULATE-CLOSE |
| MCC-X | MOTOR CONTROL CENTER NO. X |
| MSC | MANUFACTURER SUPPLIED CABLE |
| OC | OPEN-CLOSE (D) |
| OCR | OPEN-CLOSE-REMOTE |
| OCA | OPEN-CLOSE-AUTO |
| OO | ON-OFF |
| OOA | ON-OFF-AUTO |
| OOR | ON-OFF-REMOTE |
| ORP | OXIDATION REDUCTION POTENTIAL |
| OSC | OPEN-STOP-CLOSE |
| pH | HYDROGEN ION CONCENTRATION |
| PLC | PROGRAMMABLE LOGIC CONTROLLER |
| RIO | REMOTE I/O UNIT |
| RM-X | REMOTE MULTIPLEXING MODULE NO. X |
| RTU-X | REMOTE TELEMETRY UNIT NO. X |
| SF | SLOWER-FASTER |
| SS | START-STOP |
| SSC | SUPERVISORY SET POINT CONTROL |
| $TCL_2$ | TOTAL CHLORINE RESIDUAL |
| TOC | TOTAL ORGANIC CARBON |
| TOD | TOTAL OXYGEN DEMAND |
| TURB | TURBIDITY |
| VHC | VOLATILE HYDROCARBONS |
| VIB | VIBRATION |
| Δ | DIFFERENCE |
| Σ | SUM |
| X | MULTIPLY |
| ÷ | DIVIDE |
| f(x) | CHARACTERIZED |
| $X^n$ | RAISE TO THE Nth POWER |
| √‾ | SQUARE ROOT |
| AVG | AVERAGE |
| 1:1 | REPEAT OR BOOST |
| > | SELECT HIGHEST SIGNAL |
| < | SELECT LOWEST SIGNAL |
| } | BIAS |
| % | GAIN OR ATTENUATE |

RECORD DRAWINGS

Revisions Drawn By: JA JUDKINS — Date: 11/06

THESE RECORD DRAWINGS HAVE BEEN PREPARED, IN PART, ON THE BASIS OF INFORMATION COMPILED BY OTHERS. THEY ARE NOT INTENDED TO REPRESENT IN DETAIL THE EXACT LOCATION, TYPE OF COMPONENT NOR MANNER OF CONSTRUCTION. THE ENGINEER WILL NOT BE RESPONSIBLE FOR ANY ERRORS OR OMISSIONS WHICH HAVE BEEN INCORPORATED INTO THE RECORD DRAWINGS.

# SELF CONTAINED VALVE & EQUIPMENT TAG NUMBERS

W-D-X-Y

W = UNIT PROCESS NUMBER

D: ARV = AIR RELEASE VALVE
AVRV = AIR AND VACUUM RELEASE VALVE
E = EJECTOR
G = GATE
M = MECHANICAL EQUIPMENT
P = PUMP
T = TANK

X = LOOP NUMBER
Y = UNIT NUMBER

# GENERAL NOTES

1. COMPONENTS AND PANELS SHOWN WITH A SINGLE ASTERISK ( * ) ARE TO BE PROVIDED AS PART OF A PACKAGE SYSTEM.
2. COMPONENTS AND PANELS SHOWN WITH A DOUBLE ASTERISK ( ** ) ARE TO BE PROVIDED UNDER DIVISION 16, ELECTRICAL.
3. THIS IS A STANDARD LEGEND. THEREFORE, NOT ALL OF THIS INFORMATION MAY BE USED ON THIS PROJECT.
4. FOR FLOW STREAM IDENTIFICATION, SEE DRAWING G-2.
5. PIPES SHOWN ON P&IDS ARE SHOWN FOR REFERENCE ONLY. PIPES SHOWN ON MECHANICAL DRAWINGS TAKE PRECEDENCE OVER P&IDS UNLESS OTHERWISE NOTED.



| | NO. | DATE | REVISION | BY | APVD |
|---|---|---|---|---|---|
| DSGN RA YOLO | | | | | |
| DR MA REICHERT | | 11/06 | RECORD DRAWING. | JAJ | RCS |
| CHK LA AMUNDSON | | | | | |
| APVD RA YOLO | | | | | |

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

CH2MHILL

2005 SEDIMENT REMEDIAL ACTION
GROUNDWATER RECOVERY SYSTEM
AND DNAPL COLLECTION TRENCH

VELSICOL/PINE RIVER SITE
ST. LOUIS, MICHIGAN

GENERAL

INSTRUMENTATION AND CONTROL LEGEND

| | |
|---|---|
| SHEET | 3 |
| DWG | G-3 |
| DATE | MARCH 2005 |
| PROJ | 184199 |

FILENAME: PRng003d_184199.dgn PLOT DATE: 10/31/2006 PLOT TIME: 2:44:20 PM

## VALVE SYMBOLS

- GATE
- KNIFE GATE
- BUTTERFLY
- GLOBE
- BALL
- VEE- BALL
- PLUG
- SEAT PORT ECCENTRIC PLUG
- DIAPHRAGM
- PINCH
- NEEDLE
- SWING CHECK
- BALL CHECK
- BACKFLOW PREVENTER
- ROTARY
- PRESSURE RELIEF
- AIR AND/OR VACUUM RELEASE
- REGULATED SIDE PRESSURE CONTROL
- MULTI-PORT VALVES (GATE VALVE SHOWN. FOR OTHER VALVE TYPES, APPROPRIATE VALVE SYMBOL SHOWN. ) SEAT PORTS ARE IMPLIED BY INDICATED FLOW PATTERN.
- ANGLE GATE
- TELESCOPE
- SAMPLE
- MUD
- PRESSURE REGULATING (CLAY-TYPE)

## GATE SYMBOLS

- SLUICE
- BUTTERFLY
- FABRICATED SLIDE
- FLAP
- STOP LOG

## ACTUATOR SYMBOLS

- XX PNEUMATIC DIAPHRAM SPRING-OPPOSED, SINGLE OR DOUBLE ACTING
- XX PNEUMATIC CYLINDER SINGLE OR DOUBLE ACTING ACTUATED BY ONE INPUT
- XX ELECTRIC MOTOR
- XX SOLENOID
- XX HYDRAULIC
- VALVE POSITIONER
- MANUAL
- XX ELECTROHYDRAULIC
- DIAPHRAGM, DIFFERENTIAL PRESSURE

NOTE:
ON LOSS OF PRIMARY POWER (PNEUMATIC, ELECTRICAL OR HYDRAULIC)
XX: FO =FAIL OPEN
FC =FAIL CLOSED
FLP=FAIL TO LAST POSITION

## PRIMARY ELEMENT SYMBOLS

- PARSHALL FLUME
- WEIR
- ORFICE PLATE
- FLOW TUBE
- PITOT-STATIC
- VORTEX METER
- ULTRASONIC FLOWMETER
- ELECTROMAGNETIC FLOWMETER
- PROPELLER OR TURBINE METER
- THERMAL FLOWMETER
- FI ROTAMETER
- DE DENSITY METER
- XX GENERIC
- LE LEVEL (ULTRASONIC)
- LEVEL (BUBBLER TUBE)
- LS LEVEL (FLOAT)

## MISCELLANEOUS SYMBOLS

- DIAPHRAGM SEAL
- BLIND FLANGE
- AIR GAP
- V VENT TO ATMOSPHERE
- AERATOR
- PLUG
- RECEPTACLE
- A SELF CONTAINED AIR SUPPLY
- SD COMPOSITE SAMPLER (DIPPER TYPE) D
- SS COMPOSITE SAMPLER (SUCTION TYPE)
- TV TV CAMERA
- I OR I INTERLOCK. SEE CONTROL DIAGRAMS
- X PURGE SET X : W = WATER A = AIR SEE
- XX AIR SET XX= SUPPLY PRESSURE IN PSIG.
- FILTER/ REGULATOR/ GAUGE SET
- FLEXIBLE CONNECTOR
- PULSATION DAMPENER
- FILTER
- T DRIP TRAP
- FLAME TRAP
- STRAINER
- HORN
- 120V 120 VOLT, 60 HZ POWER
- 480V 480 VOLT, 60 HZ POWER
- ANNULAR DIAPHRAGM SEAL
- RUPTURE DISK (PRESSURE)
- RUPTURE DISK (VACUUM)
- PIG INSERT POINT
- OR PIG CATCH POINT
- MIXER
- M ELECTRIC MOTOR
- TV TV MONITOR
- A / B AND C LOGIC ELEMENT: IF A AND NOT B THEN C
- A / B OR C LOGIC ELEMENT: IF A OR B THEN C
- F FLUSHING CONNECTION
- HOSE ADAPTOR
- S SEAL WATER SET
- SIGHT GLASS
- FFLCPLLLX PANEL CONTINUED ON SAME OR OTHER DRAWING
- PANEL OUTLINE
- PANEL NAME
- SKIMMING MECHANISM
- SCREW
- SCREW CONVEYOR
- INLINE SILENCER
- PIPE CAP
- CALIBRATION COLUMN

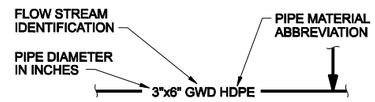
## PUMP AND COMPRESSOR SYMBOLS

NOTE: XX: AS ADJUSTABLE SPEED
CS-1 CONSTANT SPEED (SINGLE SPEED)
CS-2 CONSTANT SPEED (TWO SPEED)

- CENTRIFUGAL PUMP (DRY PIT)
- CENTRIFUGAL WET PIT PUMP OR TURBINE PUMP
- RECIPROCATING OR METERING PUMP (POSITIVE DISPLACEMENT)
- DIAPHRAGM PUMP
- GEAR PUMP OR BLOWER (POSITIVE DISPLACEMENT)
- PISTON PUMP
- PROGRESSIVE CAVITY PUMP
- COMPRESSOR (CENTRIFUGAL)
- COMPRESSOR (PISTON)
- BLOWER OR FAN (CENTRIFUGAL)
- EJECTOR
- SUBMERSIBLE SUMP PUMP
- VACUUM PUMP
- ROTARY PUMP
- SCREW PUMP

## LINE SIZE AND MATERIAL IDENTIFICATION

FOR FLOW STREAM IDENTIFICATION SEE DRAWING G-2.




A"xB" DENOTES DOUBLE WALL PIPING

GALV GALVANIZED STEEL
HDPE HIGH DENSITY POLYETHYLENE

## RECORD DRAWINGS

Revisions Drawn By JA JUDKINS Date 11/06

THESE RECORD DRAWINGS HAVE BEEN PREPARED, IN PART, ON THE BASIS OF INFORMATION COMPILED BY OTHERS. THEY ARE NOT INTENDED TO REPRESENT IN DETAIL THE EXACT LOCATION, TYPE OF COMPONENT NOR MANNER OF CONSTRUCTION. THE ENGINEER WILL NOT BE RESPONSIBLE FOR ANY ERRORS OR OMISSIONS WHICH HAVE BEEN INCORPORATED INTO THE RECORD DRAWINGS.



| | | | | | |
|---|---|---|---|---|---|
| DSGN RA YOLO | | | | | VERIFY SCALE |
| DR MA REICHERT | | | | | BAR IS ONE INCH ON ORIGINAL DRAWING. 0 1" |
| CHK LA AMUNDSON | | | | | IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY. |
| APVD RA YOLO | 11/06 | RECORD DRAWING. | JAJ | RCS | |
| NO. | DATE | REVISION | BY | APVD | |

CH2MHILL

2005 SEDIMENT REMEDIAL ACTION
GROUNDWATER RECOVERY SYSTEM
AND DNAPL COLLECTION TRENCH

VELSICOL/PINE RIVER SITE
ST. LOUIS, MICHIGAN

GENERAL

INSTRUMENTATION AND CONTROL LEGEND

| | |
|---|---|
| SHEET | 4 |
| DWG | G-4 |
| DATE | MARCH 2005 |
| PROJ | 184199 |

FILENAME: PRng004d_184199.dgn PLOT DATE: 10/31/2006 PLOT TIME: 2:44:34 PM

## GENERAL SITE NOTES:

1. MAINTAIN, RELOCATE, OR REPLACE EXISTING SURVEY MONUMENTS, CONTROL POINTS, AND STAKES WHICH ARE DISTURBED OR DESTROYED. PERFORM THE WORK TO PRODUCE THE SAME LEVEL OF ACCURACY AS THE ORIGINAL MONUMENT(S) IN A TIMELY MANNER, AND AT THE CONTRACTOR'S EXPENSE.
2. UNLESS SHOWN ON THE LANDSCAPING PLANS, ALL DISTURBED AREAS NOT RECEIVING A HARD SURFACE SHALL BE COVERED WITH GRASS.
3. CONTRACTOR SHALL BE RESPONSIBLE FOR IMPLEMENTING AND MAINTAINING EROSION CONTROL DEVICES DURING CONSTRUCTION.
4. CONTRACTOR SHALL TAKE ALL OTHER MEASURES TO POSITIVELY PRECLUDE EROSION MATERIALS FROM LEAVING THE SITE. CONTRACTOR TO SUBMIT EROSION CONTROL PLAN.

## GENERAL YARD PIPING AND UTILITIES NOTE:

1. EXISTING UNDERGROUND UTILITIES OBTAINED FROM AS-BUILTS AND FROM FIELD SURVEY. CONTRACTOR SHALL FIELD VERIFY DEPTH AND LOCATION PRIOR TO EXCAVATION. PROTECT ALL EXISTING UTILITIES DURING CONSTRUCTION.

## GENERAL NOTE:

1. THIS IS A STANDARD LEGEND SHEET. THEREFORE, NOT ALL OF THE INFORMATION SHOWN MAY BE USED ONTHIS PROJECT.

## RECORD DRAWINGS

Revisions Drawn By JA JUDKINS Date 11/06

THESE RECORD DRAWINGS HAVE BEEN PREPARED, IN PART, ON THE BASIS OF INFORMATION COMPILED BY OTHERS. THEY ARE NOT INTENDED TO REPRESENT IN DETAIL THE EXACT LOCATION, TYPE OF COMPONENT NOR MANNER OF CONSTRUCTION. THE ENGINEER WILL NOT BE RESPONSIBLE FOR ANY ERRORS OR OMISSIONS WHICH HAVE BEEN INCORPORATED INTO THE RECORD DRAWINGS.

## SITEWORK LEGEND

| EXISTING | THIS CONTRACT | |
|---|---|---|
| × 157.7 | ⊗ 158.5 | SPOT ELEVATION |
| 155 | 155 | CONTOUR LINE |
| | 3:1 | EMBANKMENT AND SLOPE |
| | | DRAINAGEWAY OR DITCH |
| | | CATCH BASIN OR INLET |
| | | TRENCH DRAIN |
| | OR | SIGN |
| | | MANHOLE |
| | | ELECTRICAL MANHOLE |
| | | ELECTRIC HANDHOLE |
| | | POST OR GUARD POST |
| | | GUY ANCHOR |
| | | FIRE HYDRANT |
| | | UTILITY POLE |
| | | LIGHT POLE |
| | | BENCH MARK |
| | | SURVEY CONTROL POINT OR POINT OF INTERSECTION |
| | | BRUSH/TREE LINE |
| | | TREE |
| | | PROPERTY LINE |
| | | CENTER LINE, BUILDING, ROAD, ETC. |
| | | STAGING OR WORK AREA LIMITS |
| | N 1000.00 E 1000.00 | STRUCTURE, BUILDING OR FACILITY LOCATION POINT - COORDINATES |
| | B-1 | BORING LOCATION AND NUMBER |
| | TP-2 | TEST PIT LOCATION AND NUMBER |
| | △ P-3 | PIEZOMETER LOCATION AND NUMBER |
| OR OR | | DEMOLITION |
| OR | OR | STRUCTURE, BUILDING OR FACILITY |
| | | ASPHALT CONCRETE PAVEMENT |
| | | GRAVEL SURFACING |
| | | CONCRETE PAVEMENT |
| | | CURB |
| | | CURB AND GUTTER |
| | | SINGLE SWING GATE |
| | | DOUBLE SWING GATE |
| | | SLIDING GATE |
| | | GUARD RAIL |
| | | CHAIN LINK FENCE |
| | | ARCHITECTURAL FENCE |
| | | WIRE FENCE |
| | | CULVERT |

## YARD PIPING LEGEND

| EXISTING | THIS CONTRACT | |
|---|---|---|
| | | NOMINAL PIPE DIAMETER |
| | 8" PE | PIPE USE IDENTIFICATION |
| 8" PE | 8" PE | PIPING < 30" DIAMETER |
| | | PIPING ≧ 30" DIAMETER |
| | | EXISTING PIPE TO BE ABANDONED |
| | | EXISTING PIPE TO BE REMOVED |
| | | NON-FREEZE HOSE VALVE (V-X) X = NO. IN SPECIFICATIONS |
| | | NON-FREEZE HOSE VALVE WITH HOSE RACK (V-X) X = NO. IN SPECIFICATIONS |
| | | INDICATOR POST VALVE |
| | | GATE VALVE AND VALVE BOX |
| | | BUTTERFLY VALVE AND VALVE BOX |
| | | PLUG VALVE AND VALVE BOX |
| | | FLEXIBLE COUPLING |
| | | 90° ELBOW UP |
| | | 90° ELBOW DOWN |
| | | BEND < 90° UP |
| | | BEND < 90° DOWN |
| | | CONCENTRIC REDUCER |
| | | CAP OR PLUG |
| | | CLEANOUT |
| | | FIRE HYDRANT |

## EROSION CONTROL LEGEND

| COVER PRACTICES | SYMBOL |
|---|---|
| TEMPORARY SEEDING | TS |
| MULCHING AND MATTING | MU |
| CLEAR PLASTIC COVERING | CPC |
| BUFFER ZONES | BZ |
| PERMANENT SEEDING AND PLANTING | PS |
| CONSTRUCTION ENTRANCE | |
| INTERCEPTOR DIKE | ID |
| INTERCEPTOR SWALE | IS |
| CHECK DAMS | |
| OUTLET PROTECTION / RIPRAP | |
| FILTER FENCE | |
| STRAW BALE BARRIER (BIOFILTER) | |
| SEDIMENT TRAP (OR SUMP) | |
| SEDIMENT POND OR BASIN | |



| NO. | DATE | REVISION | BY | APVD |
|---|---|---|---|---|
| | 11/06 | RECORD DRAWING. | JAJ | RCS |

DSGN RA YOLO
DR MA REICHERT
CHK LA AMUNDSON
APVD RA YOLO

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING. 0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

CH2MHILL

2005 SEDIMENT REMEDIAL ACTION
GROUNDWATER RECOVERY SYSTEM
AND DNAPL COLLECTION TRENCH

VELSICOL/PINE RIVER SITE
ST. LOUIS, MICHIGAN

GENERAL

SITEWORK LEGEND

| | |
|---|---|
| SHEET | 5 |
| DWG | G-5 |
| DATE | MARCH 2005 |
| PROJ | 184199 |

FILENAME: PRng005d_184199.dgn PLOT DATE: 10/31/2006 PLOT TIME: 2:44:44 PM

# PIPE AND FITTING SYMBOLS

| DOUBLE LINE | SINGLE LINE | |
|---|---|---|
| | | EXISTING PIPE |
| | | NEW PIPE |
| | | EXISTING PIPE TO BE ABANDONED |
| | | EXISTING PIPE TO BE REMOVED |
| | | FLANGED COUPLING ADAPTER |
| | | FLEXIBLE COUPLING |
| | | METAL BELLOWS EXP JOINT |
| | | ELASTOMER BELLOWS EXP JOINT |
| | | ELBOW UP |
| | | ELBOW DOWN |
| | | TEE UP |
| | | TEE DOWN |
| | | LATERAL UP |
| | | LATERAL DOWN |
| | | CONCENTRIC REDUCER |
| | | ECCENTRIC REDUCER |
| | | REDUCING BUSHING |
| | | UNION |
| | | CAP |
| | | ANCHOR |
| | | ELBOW, 90 DEGREE |
| | | CROSS |
| | | TEE |
| | | ELBOW, 45 DEGREE |
| | | LATERAL |

NOTES:

1. ONLY FLANGED END CONNECTIONS ARE SHOWN HERE FOR DOUBLE LINE FITTINGS. FITTINGS WITH OTHER END PATTERNS ARE SHOWN SIMILARLY ON THE CONSTRUCTION DRAWINGS. ALSO SEE PIPING SPECIFICATIONS.
2. SYMBOLS SHOWN HERE FOR SINGLE LINE FITTINGS ARE GENERIC ONLY. REFER TO PIPING SPECIFICATIONS FOR SPECIFIC END CONNECTIONS FOR SINGLE LINE PIPE AND FITTINGS.
3. EXISTING PIPE AND EQUIPMENT IS SHOWN LIGHT-LINED AND/OR SCREENED AND IS NOTED AS EXISTING. NEW PIPING AND EQUIPMENT IS SHOWN HEAVY-LINED.

# MECHANICAL LEGEND AND NOTES

## GENERAL PIPING NOTES

1. LAY PIPE TO UNIFORM GRADE BETWEEN INDICATED ELEVATION POINTS.
2. SIZE OF FITTINGS SHOWN ON PLANS SHALL CORRESPOND TO ADJACENT STRAIGHT RUN OF PIPE, UNLESS OTHERWISE INDICATED. TYPE OF JOINT AND FITTING MATERIAL SHALL BE THE SAME AS SHOWN FOR ADJACENT STRAIGHT RUN OF PIPE.
3. LOCATION AND NUMBER OF PIPE HANGERS AND PIPE SUPPORTS, IF SHOWN, IS ONLY APPROXIMATE. FINAL SUPPORT REQUIREMENTS SHALL BE AS REQUIRED IN THE SPECIFICATIONS.
4. ALL JOINTS SHALL BE WATERTIGHT. WALL PIPES SHALL BE USED WHEREVER PIPING PASSES FROM A STRUCTURE TO BACKFILL.
5. ALL FLEXIBLE CONNECTORS AND FLANGED COUPLING ADAPTERS SHALL BE PROVIDED WITH THRUST TIES, BLOCKS, AND ANCHORS, UNLESS OTHERWISE NOTED. THRUST PROTECTION SHALL BE ADEQUATE FOR TEST PRESSURES SPECIFIED.
6. SYMBOLS, LEGENDS, AND PIPE USE IDENTIFICATIONS SHOWN SHALL BE FOLLOWED THROUGHOUT THE PLANS, WHEREVER APPLICABLE. NOT ALL OF THE VARIOUS PIPING COMPONENTS ARE NECESSARILY USED IN THE PROJECT.
7. ALL BURIED PIPING SPECIFIED TO BE PRESSURE TESTED, EXCEPT FLANGED, WELDED, OR SCREWED PIPING, SHALL BE PROVIDED WITH CONCRETE THRUST BLOCKS AT ALL DIRECTION CHANGES, UNLESS OTHERWISE NOTED.
8. NUMBER AND LOCATION OF UNIONS SHOWN ON PLANS IS ONLY APPROXIMATE. PROVIDE ALL UNIONS NECESSARY TO FACILITATE CONVENIENT REMOVAL OF VALVES AND MECHANICAL EQUIPMENT.
9. WHERE A GROOVED END COUPLING IS SHOWN, IT SHALL BE THE RIGID JOINT TYPE, UNLESS OTHERWISE SPECIFIED. WHERE A FLANGED COUPLING ADAPTER IS SHOWN, A STANDARD FLANGE SHALL BE JOINED TO THE COUPLING ADAPTER.
10. FOR FLOWSTREAM IDENTIFICATION SEE DRAWING G-2.
11. SEE INSTRUMENTATION AND CONTROL LEGEND FOR ADDITIONAL VALVE SYMBOLS.

# MISCELLANEOUS PIPING SYMBOLS

- STRAINER
- SIGHT GLASS
- FLEXIBLE (ELASTOMER) PIPE CONNECTION
- GAUGE WITH COCK
- THERMOMETER
- ROTAMETER
- PIG LAUNCHER
- PIG CATCHER
- REDUCER
- FLEXIBLE HOSE
- FLEXIBLE CONNECTOR
- TYPICAL INSTRUMENT SYMBOL (SEE I&C LEGEND) — PS 26-1-2
- GAUGE GLASS WITH COCKS
- FLOW SWITCH — FS
- FLOW METER X = NO. SHOWN IN SPECS — FM X
- PRESSURE SWITCH — PS

# VALVE SYMBOLS

- HOSE VALVE

# PLANT AIR LEGEND

- AP — AIR PURGE SET
- XX — AIR SET XX = SUPPLY PRESSURE IN PSIG

# VALVE DESIGNATIONS

## MANUAL VALVES AND CHECK VALVES

3" - V 400

- 3" — SIZE OF VALVE
- V — VALVE DESIGNATION
- 400 — VALVE TYPE, SEE SPECIFICATIONS

## RECORD DRAWINGS

Revisions Drawn By JA JUDKINS Date 11/06

THESE RECORD DRAWINGS HAVE BEEN PREPARED, IN PART, ON THE BASIS OF INFORMATION COMPILED BY OTHERS. THEY ARE NOT INTENDED TO REPRESENT IN DETAIL THE EXACT LOCATION, TYPE OF COMPONENT NOR MANNER OF CONSTRUCTION. THE ENGINEER WILL NOT BE RESPONSIBLE FOR ANY ERRORS OR OMISSIONS WHICH HAVE BEEN INCORPORATED INTO THE RECORD DRAWINGS.



| | | | | | |
|---|---|---|---|---|---|
| DSGN RA YOLO | | | | | VERIFY SCALE |
| DR MA REICHERT | | | | | BAR IS ONE INCH ON ORIGINAL DRAWING. 0 1" IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY. |
| CHK LA AMUNDSON | | 11/06 | RECORD DRAWING. | JAJ | RCS |
| APVD RA YOLO | NO. | DATE | REVISION | BY | APVD |

CH2MHILL

2005 SEDIMENT REMEDIAL ACTION
GROUNDWATER RECOVERY SYSTEM
AND DNAPL COLLECTION TRENCH

VELSICOL/PINE RIVER SITE
ST. LOUIS, MICHIGAN

GENERAL

MECHANICAL LEGEND

| | |
|---|---|
| SHEET | 6 |
| DWG | G-6 |
| DATE | MARCH 2005 |
| PROJ | 184199 |

FILENAME: PRng006d_184199.dgn PLOT DATE: 10/31/2006 PLOT TIME: 2:44:53 PM

# ELECTRICAL LEGEND

| SYMBOL | DESCRIPTION |
|---|---|
| | CONNECTION POINT TO EQUIPMENT SPECIFIED. FURNISHED AND INSTALLED UNDER OTHER DIVISIONS. RACEWAY, CONDUCTOR AND CONNECTION SPECIFIED IN DIVISION 16. COORDINATE FINAL CONNECTION WITH EQUIPMENT SUPPLIER. |
| MCC-A | MAJOR ELECTRICAL COMPONENT OR DEVICE - NAME OR IDENTIFYING SYMBOL AS SHOWN. |
| | BRANCH CIRCUIT PANELBOARD |
| UH | UNIT HEATER |
| TTC | TELEPHONE TERMINAL CABINET |
| CTC | COMPUTER TERMINAL CABINET |
| TJB | TERMINAL JUNCTION BOX |
| M | MOTOR, SQUIRREL CAGE INDUCTION, HORSEPOWER INDICATED ON ONE-LINE DIAGRAM, (M) SHOWN ON PLANS |
| 1 | LUMINAIRE, SEE SCHEDULE |
| 2 | LUMINAIRE, SEE SCHEDULE |
| 3 | LUMINAIRE, UNSWITCHED, SEE SCHEDULE |
| 4 | LUMINAIRE AND POLE, SEE SCHEDULE |
| 5 | WALL MOUNTED LUMINAIRE, SEE SCHEDULE |
| 6 | EMERGENCY LIGHTING UNIT |
| | EXIT LIGHTS, SEE SCHEDULE |
| Sa or 2a | SMALL LETTER SUBSCRIPT AT SWITCH AND LUMINAIRE INDICATES SWITCHING. SUBSCRIPT NUMBER AT LUMINAIRE INDICATES CIRCUIT IN PANELBOARD. |
| LA-2 | HOME RUN - DESTINATION SHOWN |
| — or —G | EXPOSED CONDUIT AND CONDUCTORS* |
| — or —G | CONCEALED CONDUIT AND CONDUCTORS* |

NOTE:
* ALL UNMARKED CONDUIT RUNS CONSIST OF TWO NO.12 CONDUCTORS IN CONDUIT. RUNS MARKED WITH CROSSHATCHES INDICATE NUMBER OF NO. 12 CONDUCTORS. CROSSHATCH WITH SUBSCRIPT "G" INDICATES GREEN GROUND WIRE. SIZE CONDUIT ACCORDING TO SPECIFICATIONS AND APPLICABLE CODE.

| | |
|---|---|
| [ ] | CIRCUIT CALLOUT, [1*C,3#8,1#10G] CONDUIT, CONDUCTOR, AND NUMBER INDICATED. [2-3*C,3-350 KCMIL, 1#1/0G EA]; INDICATES TWO CONDUITS, EACH WITH CONDUCTORS INDICATED. |
| | GROUND TEST WELL |
| | GROUND ROD |
| | CROSSHATCHES WITH BAR INDICATE #10 CONDUCTOR. SIZE CONDUIT ACCORDING TO SPECIFICATIONS AND APPLICABLE CODE. |
| | CONDUIT DOWN |
| | CONDUIT UP |
| | CONDUIT, STUBBED AND CAPPED AS SHOWN |
| B | BUS DUCT, SEE SPECIFICATIONS |
| CE | CONCRETE ENCASED CONDUIT |
| DB | DIRECT BURIED CONDUIT |
| G | GROUND |
| P | TRENCHING FOR UTILITY COMPANY PRIMARY POWER CIRCUITS |
| T | TRENCHING FOR TELEPHONE COMPANY CIRCUITS |
| S | SWITCH: |

WALL SWITCH:
- 2- DOUBLE POLE
- 3- THREE WAY
- 4- FOUR WAY
- CRE- CORROSION RESISTANT
- D- DIMMER
- K- KEY OPERATED
- P- PILOT LIGHT
- WP- WEATHERPROOF

MOTOR SWITCH:
- M- MOTOR RATED TOGGLE SWITCH WITHOUT OVERLOADS
- MANUAL MOTOR STARTER WITH OVERLOADS
- MS- STARTER WITH OVERLOADS

| SYMBOL | DESCRIPTION |
|---|---|
| | CONVENIENCE RECEPTACLE - DUPLEX UNLESS SPECIFIED OTHERWISE<br>WP- WEATHERPROOF C- CLOCK HANGER<br>TL- TWIST LOCK CRE- CORROSION RESISTANT |
| 30 | RECEPTACLE - 240V, 1PH, AMPERAGE INDICATED |
| 30 | RECEPTACLE, SPECIAL PURPOSE - AMPERAGE INDICATED |
| | DUPLEX CONVENIENCE RECEPTACLE - FLUSH IN FLOOR |
| | MULTI-OUTLET ASSEMBLY |
| | CLOCK HANGER CONVENIENCE RECEPTACLE |
| | TELEPHONE RECEPTACLE (OUTLET BOX ONLY) FLUSH IN FLOOR |
| | TELEPHONE RECEPTACLE (OUTLET BOX ONLY) |
| | DATA RECEPTACLE (OUTLET BOX ONLY) |
| HH | GENERAL CONTROL OR WIRING DEVICE. LETTER SYMBOLS OR ABBREVIATIONS INDICATE TYPE OF DEVICE. |
| CS | CONTROL STATION, SEE CONTROL DIAGRAMS FOR TYPE. |
| J | CONDUIT FITTING OR JUNCTION BOX |
| S | EXPLOSION PROOF SEAL |
| 30 | NONFUSED DISCONNECT SWITCH, SIZE INDICATED, 3 POLE UNLESS INDICATED OTHERWISE. |
| 60/40 F | FUSED DISCONNECT SWITCH, SIZE INDICATED (60/40, 60 = SWITCH RATING: 40 = FUSE RATING) 3 POLE UNLESS INDICATED OTHERWISE. |
| 2 | CONTACTOR, MAGNETIC, NEMA SIZE INDICATED. |
| 30 L | LIGHTING CONTACTOR, CURRENT RATING INDICATED. FOR NUMBER OF POLES, SEE CONTROL DIAGRAM. |
| 2 | STARTER MAGNETIC NEMA SIZE INDICATED, SEE CONTROL DIAGRAM. |
| 2 | COMBINATION (FUSE OR CIRCUIT BREAKER AS INDICATED) MAGNETIC STARTER, NEMA SIZE INDICATED, SEE CONTROL DIAGRAM. |
| | METERING FACILITIES |
| | GROUND ROD |
| | MULTI-PARTY DESK TOP COMMUNICATIONS SYSTEM STATION WITH REMOTE AMPLIFIER |
| W | MULTI-PARTY WALL MOUNTED COMMUNICATIONS SYSTEM STATION WITH INTEGRAL AMPLIFIER |
| | CONE TYPE PAGING SPEAKER, CEILING MOUNTED |
| | INTERIOR PAGING TRUMPET SOUND REPRODUCER, WITH REMOTE AMPLIFIER, SURFACE MOUNTED. |
| | OUTDOOR PAGING TRUMPET SOUND REPRODUCER, WITH REMOTE AMPLIFIER, SURFACE MOUNTED. |
| | TERMINAL CABINET FOR COMMUNICATIONS SYSTEM |

## RECORD DRAWINGS

Revisions Drawn By JA JUDKINS Date 11/06

THESE RECORD DRAWINGS HAVE BEEN PREPARED, IN PART, ON THE BASIS OF INFORMATION COMPILED BY OTHERS. THEY ARE NOT INTENDED TO REPRESENT IN DETAIL THE EXACT LOCATION, TYPE OF COMPONENT NOR MANNER OF CONSTRUCTION. THE ENGINEER WILL NOT BE RESPONSIBLE FOR ANY ERRORS OR OMISSIONS WHICH HAVE BEEN INCORPORATED INTO THE RECORD DRAWINGS.

| SYMBOL | DESCRIPTION |
|---|---|
| 1 | CONTACT - NORMALLY OPEN WITH NEMA SIZE INDICATED AS APPLICABLE |
| | CONTACT - NORMALLY CLOSED |
| | OVERLOAD RELAY HEATER |
| 1 | MAGNETIC STARTER WITH NEMA SIZE INDICATED |
| 100/M | CIRCUIT BREAKER, MAGNETIC TRIP ONLY, FRAME SIZE SHOWN, 3 POLE UNLESS INDICATED OTHERWISE. |
| 400 | CIRCUIT BREAKER, THERMAL MAGNETIC TRIP SHOWN, 3 POLE UNLESS INDICATED OTHERWISE. |
| 100 | SWITCH - CURRENT RATING INDICATED, 3 POLE UNLESS INDICATED OTHERWISE. |
| 225 | FUSE - RATING INDICATED |
| | DRAWOUT CIRCUIT BREAKER, LOW VOLTAGE |
| | DRAWOUT CIRCUIT BREAKER, MEDIUM VOLTAGE |
| | DRAWOUT FUSED SWITCH, MEDIUM VOLTAGE |
| | SURGE ARRESTER |
| 10 | CAPACITOR - KVAR INDICATED |
| VS V 0-600V | METER WITH SWITCH - SCALE RANGE SHOWN |
| | GROUND |
| 120V or 120/240V 15 KVA, 1PH | TRANSFORMER, SECONDARY VOLTAGES, PHASE AND RATING INDICATED AS APPLICABLE |
| GFR 25A 0.1 | PICK-UP SETTING<br>TIME CURRENT CHARACTERISTIC<br>} GROUND FAULT RELAY WITH CURRENT TRANSFORMER |
| | PUSH-BUTTON SWITCH, MOMENTARY CONTACT, NORMALLY OPEN |
| | PUSH-BUTTON SWITCH, MOMENTARY CONTACT, NORMALLY CLOSED |
| | PUSH BUTTON SWITCH, MAINTAINED CONTACTS WITH MECHANICAL INTERLOCK |
| | NORMALLY CLOSED, TIME DELAY OPENING |
| | NORMALLY CLOSED, TIME DELAY CLOSING |
| | NORMALLY OPEN, TIME DELAY CLOSED |
| | NORMALLY OPEN, TIME DELAY OPEN |
| | REMOTE DEVICE |
| O H A X00 00X | SELECTOR SWITCH - MAINTAINED CONTACT - CHART IDENTIFIES OPERATION: |

| CKT | POSITION HAND | OFF | AUTO |
|---|---|---|---|
| 1 | X | O | O |
| 2 | O | O | X |

X - CLOSED CONTACT
O - OPEN CONTACT

| | |
|---|---|
| (3) | CURRENT TRANSFORMER, NUMBER INDICATED |
| A | INDICATING LIGHT, PUSH-TO-TEST, LETTER INDICATES COLOR |
| A | INDICATING LIGHT - LETTER INDICATES COLOR<br>A - AMBER G - GREEN<br>B - BLUE R - RED<br>C - CLEAR W - WHITE |

# ABBREVIATIONS

| ABBREVIATIONS | DESCRIPTION |
|---|---|
| A | AMMETER, AMPERE, AMBER |
| AF | AMPERE FRAME |
| AFD | ADJUSTABLE FREQUENCY DRIVE |
| AFF | ABOVE FINISHED FLOOR |
| AFG | ABOVE FINISHED GRADE |
| AS | AMMETER SWITCH, AMPERE SENSOR |
| ASU | AIR SUPPLY UNIT |
| AT | AMPERE TRIP |
| ATC | AUTOMATIC THROWOVER CONTROL |
| ATS | AUTOMATIC TRANSFER SWITCH |
| BC | BARE COPPER |
| BRKR | BREAKER |
| C | CONDUIT, CONTACTOR |
| CB | CIRCUIT BREAKER |
| CC | CONTROL CABLE |
| CKT | CIRCUIT |
| CPT | CONTROL POWER TRANSFORMER |
| CR | CONTROL RELAY |
| CRE | CORROSION-RESISTANT |
| CRS | COATED RIGID STEEL CONDUIT |
| CT | CURRENT TRANSFORMER |
| DC | DIRECT CURRENT |
| DIV | DIVISION |
| E | EMPTY |
| EO | ELECTRIC OPERATOR |
| EQPT | EQUIPMENT |
| ESS | EMERGENCY SHUTDOWN SWITCH |
| ETM | ELAPSED TIME METER |
| EXST | EXISTING |
| FDR | FEEDER |
| F | FUSE |
| FLR | FLOOR |
| FLUOR | FLUORESCENT |
| FVNR | FULL VOLTAGE NON-REVERSING |
| FVR | FULL VOLTAGE REVERSING |
| G | GREEN, GROUND |
| GALV | GALVANIZED |
| GFCI | GROUND FAULT CIRCUIT INTERRUPTER |
| GFR | GROUND FAULT RELAY |
| GND | GROUND |
| H | HIGH SPEED |
| HH | HANDHOLE |
| HID | HIGH INTENSITY DISCHARGE |
| HPS | HIGH PRESSURE SODIUM |
| HS | HAND SWITCH |
| IC | INTERRUPTING CAPACITY |
| I &C | INSTRUMENTATION AND CONTROL |
| INCAND | INCANDESCENT |
| INST | INSTANTANEOUS |
| J, J-BOX | JUNCTION BOX |
| K | KEY INTERLOCK |
| L | LIGHTING CONTACTOR, LOW SPEED |
| LOS | LOCKOUT STOP PUSH BUTTON |
| LR | LATCHING RELAY |
| LT FLEX | LIQUID TIGHT FLEX CONDUIT |
| LTS | LIGHTS |

| ABBREVIATIONS | DESCRIPTION |
|---|---|
| M | MAGNETIC CONTACTOR COIL |
| MCC | MOTOR CONTROL CENTER |
| MH | MANHOLE, METAL HALIDE |
| MO | MOTOR OPERATOR |
| MS | MOTOR STARTER |
| MT | MOUNT |
| MTD | MOUNTED |
| N | NEUTRAL |
| NA | NON-AUTOMATIC |
| NC | NORMALLY CLOSED |
| NL | NIGHT LIGHT |
| NO | NORMALLY OPEN |
| NP | NAMEPLATE |
| OC | ON CENTER |
| OL | OVERLOAD RELAY |
| PB | PULL BOX, PUSH BUTTON SWITCH |
| PC | PHOTOCELL |
| PH | PHASE |
| PMR | PHASE MONITOR RELAY |
| PNL | PANEL |
| PS | PRESSURE SWITCH |
| PT | POTENTIAL TRANSFORMER |
| PVC | POLYVINYL CHLORIDE CONDUIT |
| R | RED |
| RCPT | RECEPTACLE |
| REQD | REQUIRED |
| RM | REMOTE MULTIPLEXER |
| RS | RIGID STEEL CONDUIT |
| RT | REMOTE TELEMETRY |
| RVNR | REDUCED VOLTAGE NON-REVERSING |
| RVR | REDUCED VOLTAGE REVERSING |
| SA | SURGE ARRESTOR |
| SCCR | SHORT CIRCUIT CURRENT RATING |
| S/N | SOLID NEUTRAL |
| SPD | SPEED |
| SST | STAINLESS STEEL |
| SV | SOLENOID VALVE |
| SW | SWITCH |
| T | THERMOSTAT |
| TB | TERMINAL BOARD |
| TC | TIME CLOSE |
| TD | TEMPERATURE DETECTOR RELAY |
| TDR | TIME DELAY RELAY |
| TJB | TERMINAL JUNCTION BOX |
| T.O. | TIME OPEN |
| TS | AUTO TRANSFORMER TEMPERATURE SWITCH |
| TSP | TWISTED SHIELDED PAIR |
| TST | TWISTED SHIELDED TRIAD |
| TYP | TYPICAL |
| UH | UNIT HEATER |
| UVR | UNDER VOLTAGE RELAY |
| V | VOLTMETER, VOLT |
| VS | VOLTMETER SWITCH |
| W | WATT |
| WHD | WATTHOUR DEMAND METER |
| WP | WEATHERPROOF |
| XFDR | TRANSDUCER |
| XFMR | TRANSFORMER |
| XFPR | TRANSPONDER |

NOTES:
1. THIS IS A STANDARD LEGEND SHEET. SOME SYMBOLS OR ABBREVIATIONS MAY APPEAR ON THIS DRAWING AND NOT ON THE PLANS.
2. FOR ADDITIONAL ABBREVIATIONS OF OTHER DIVISIONS (HVAC, MECHANICAL, AND STRUCTURAL/ARCHITECTURAL), SEE OTHER LEGENDS.



| NO. | DATE | REVISION | BY | APVD |
|---|---|---|---|---|
| | 11/06 | RECORD DRAWING. | JAJ | RCS |

DSGN RE NAGEL
DR MA REICHERT
CHK BM WILLIAMS
APVD RE NAGEL

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING. 0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

CH2MHILL

2005 SEDIMENT REMEDIAL ACTION
GROUNDWATER RECOVERY SYSTEM
AND DNAPL COLLECTION TRENCH

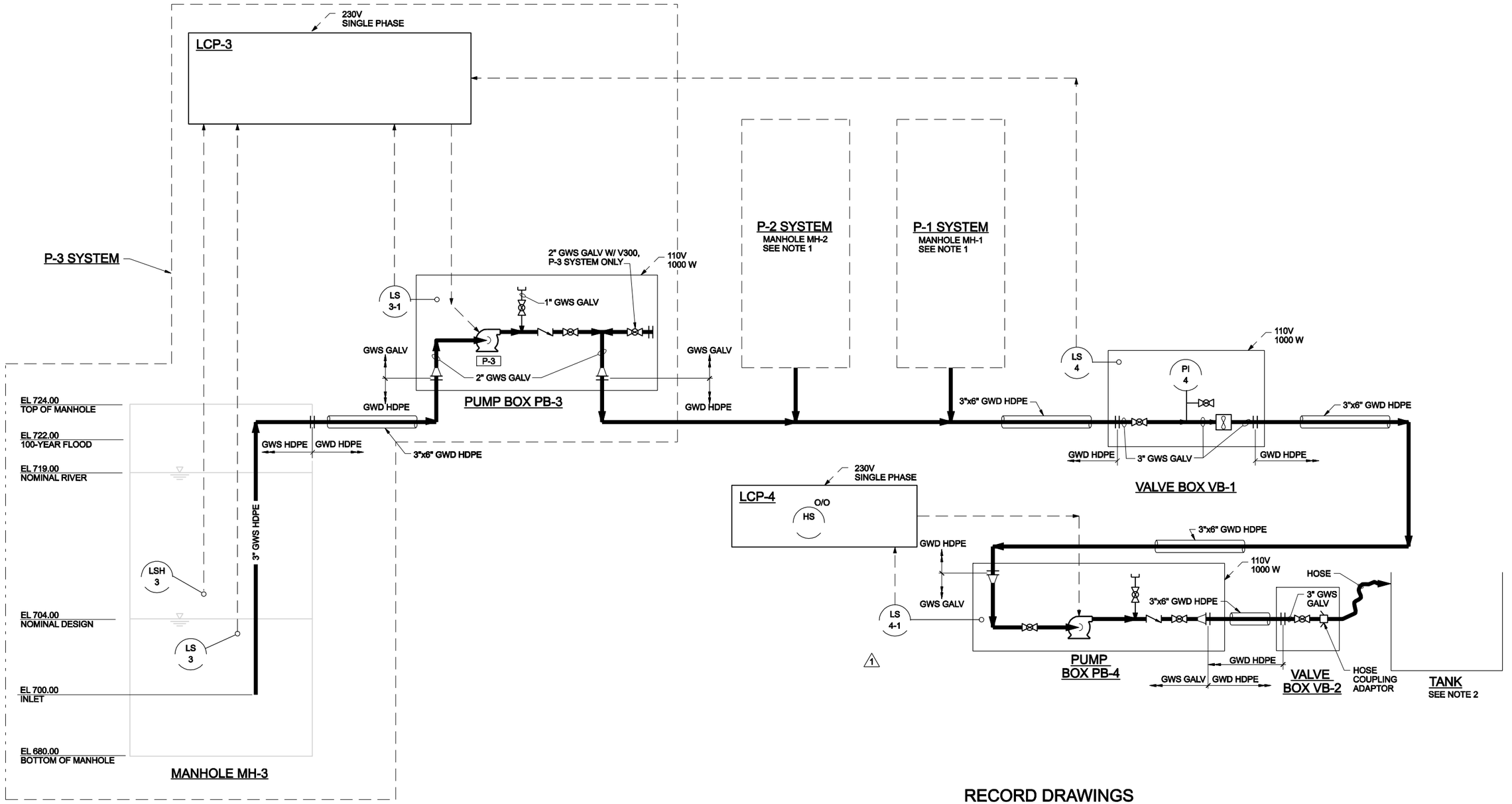
VELSICOL/PINE RIVER SITE
ST. LOUIS, MICHIGAN

GENERAL

ELECTRICAL LEGEND

| | |
|---|---|
| SHEET | 7 |
| DWG | G-7 |
| DATE | MARCH 2005 |
| PROJ | 184199 |

FILENAME: PRng007d_184199.dgn PLOT DATE: 10/31/2006 PLOT TIME: 2:45:01 PM




## RECORD DRAWINGS

Revisions Drawn By JA JUDKINS Date 11/06

THESE RECORD DRAWINGS HAVE BEEN PREPARED, IN PART, ON THE BASIS OF INFORMATION COMPILED BY OTHERS. THEY ARE NOT INTENDED TO REPRESENT IN DETAIL THE EXACT LOCATION, TYPE OF COMPONENT NOR MANNER OF CONSTRUCTION. THE ENGINEER WILL NOT BE RESPONSIBLE FOR ANY ERRORS OR OMISSIONS WHICH HAVE BEEN INCORPORATED INTO THE RECORD DRAWINGS.

NOTES:
1. P-3 SYSTEM SHOWN, TYPICAL FOR SYSTEMS P-1 AND P-2.
1 2. TANK AND HOSE TO BE PROVIDED BY OTHERS.



| | | | | | | | |
|---|---|---|---|---|---|---|---|
| DSGN RA YOLO<br>DR MA REICHERT<br>CHK LA AMUNDSON<br>APVD RA YOLO | 1 | 11/06 | RECORD DRAWING.<br>ADDED PB-4 AND VB-2. | JAJ<br>PAK | RCS<br>RAY | VERIFY SCALE<br>BAR IS ONE INCH ON ORIGINAL DRAWING.<br>0 1"<br>IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY. | CH2MHILL |
| | NO. | DATE | REVISION | BY | APVD | | |

2005 SEDIMENT REMEDIAL ACTION
GROUNDWATER RECOVERY SYSTEM
AND DNAPL COLLECTION TRENCH

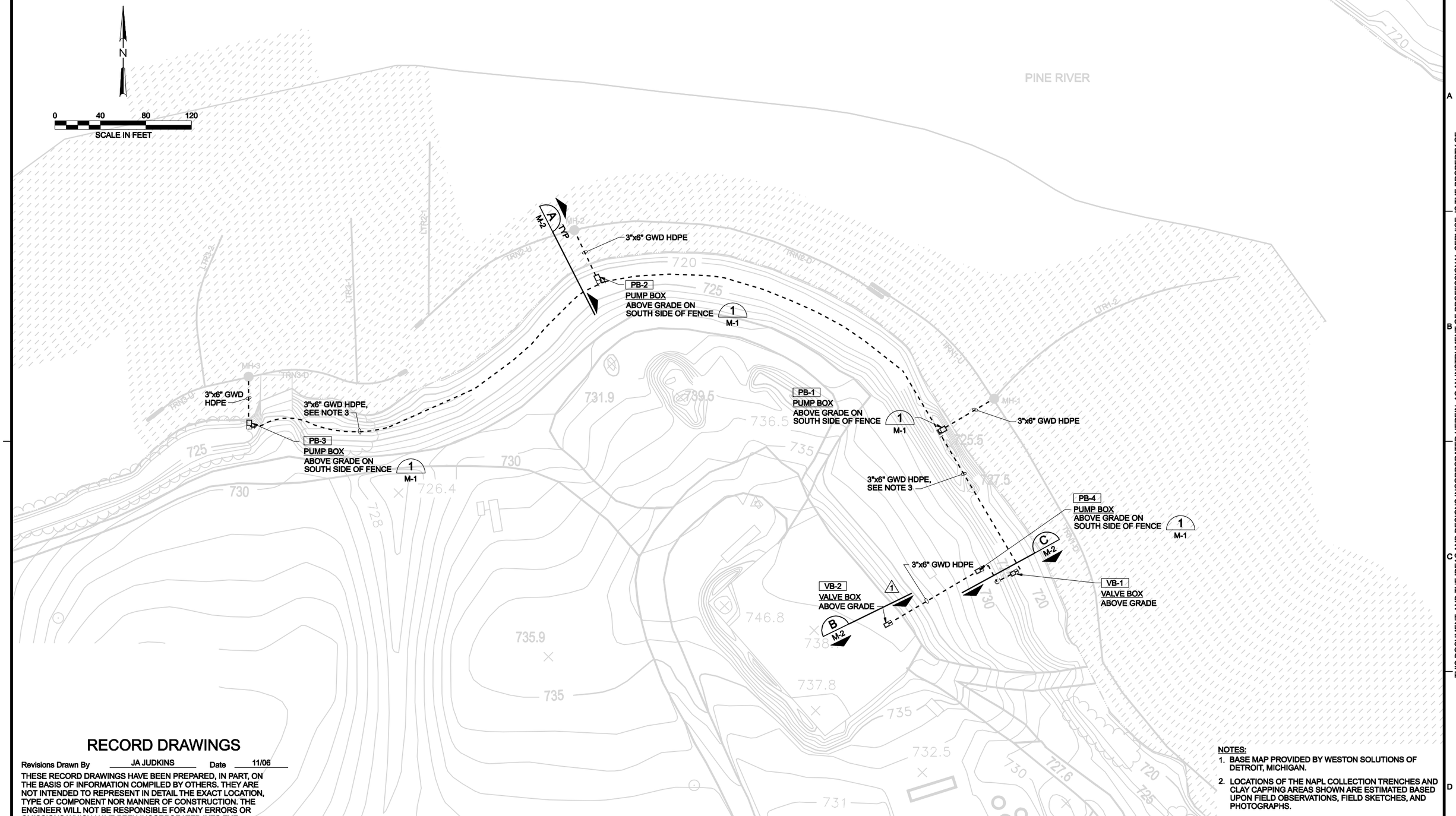
VELSICOL/PINE RIVER SITE
ST. LOUIS, MICHIGAN

INSTRUMENTATION AND CONTROL

P&ID

| | |
|---|---|
| SHEET | 8 |
| DWG | N-1 |
| DATE | MARCH 2005 |
| PROJ | 184199 |

FILENAME: PRnn001d_184199.dgn PLOT DATE: 10/31/2006 PLOT TIME: 2:45:11 PM




## RECORD DRAWINGS

Revisions Drawn By JA JUDKINS Date 11/06

THESE RECORD DRAWINGS HAVE BEEN PREPARED, IN PART, ON THE BASIS OF INFORMATION COMPILED BY OTHERS. THEY ARE NOT INTENDED TO REPRESENT IN DETAIL THE EXACT LOCATION, TYPE OF COMPONENT NOR MANNER OF CONSTRUCTION. THE ENGINEER WILL NOT BE RESPONSIBLE FOR ANY ERRORS OR OMISSIONS WHICH HAVE BEEN INCORPORATED INTO THE RECORD DRAWINGS.

**NOTES:**

1. BASE MAP PROVIDED BY WESTON SOLUTIONS OF DETROIT, MICHIGAN.
2. LOCATIONS OF THE NAPL COLLECTION TRENCHES AND CLAY CAPPING AREAS SHOWN ARE ESTIMATED BASED UPON FIELD OBSERVATIONS, FIELD SKETCHES, AND PHOTOGRAPHS.
3. GENERALLY RUN PIPE ON TOP OF CAP AND RUN FLAT OR SLOPE FROM PUMP BOX PB-3 TO VALVE BOX VB-1.

| | | | | | |
|---|---|---|---|---|---|
| DSGN RA YOLO | | | | | VERIFY SCALE |
| DR JM ZAFFKE | | | | | BAR IS ONE INCH ON ORIGINAL DRAWING. 0 1" IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY. |
| CHK LA AMUNDSON | 1 | 11/06 | RECORD DRAWING. ADDED PB-4 AND VB-2. | JAJ | RCS |
| APVD RA YOLO | 08/06 | | | PAK | RAY |
| | NO. | DATE | REVISION | BY | APVD |

CH2MHILL

2005 SEDIMENT REMEDIAL ACTION
GROUNDWATER RECOVERY SYSTEM
AND DNAPL COLLECTION TRENCH

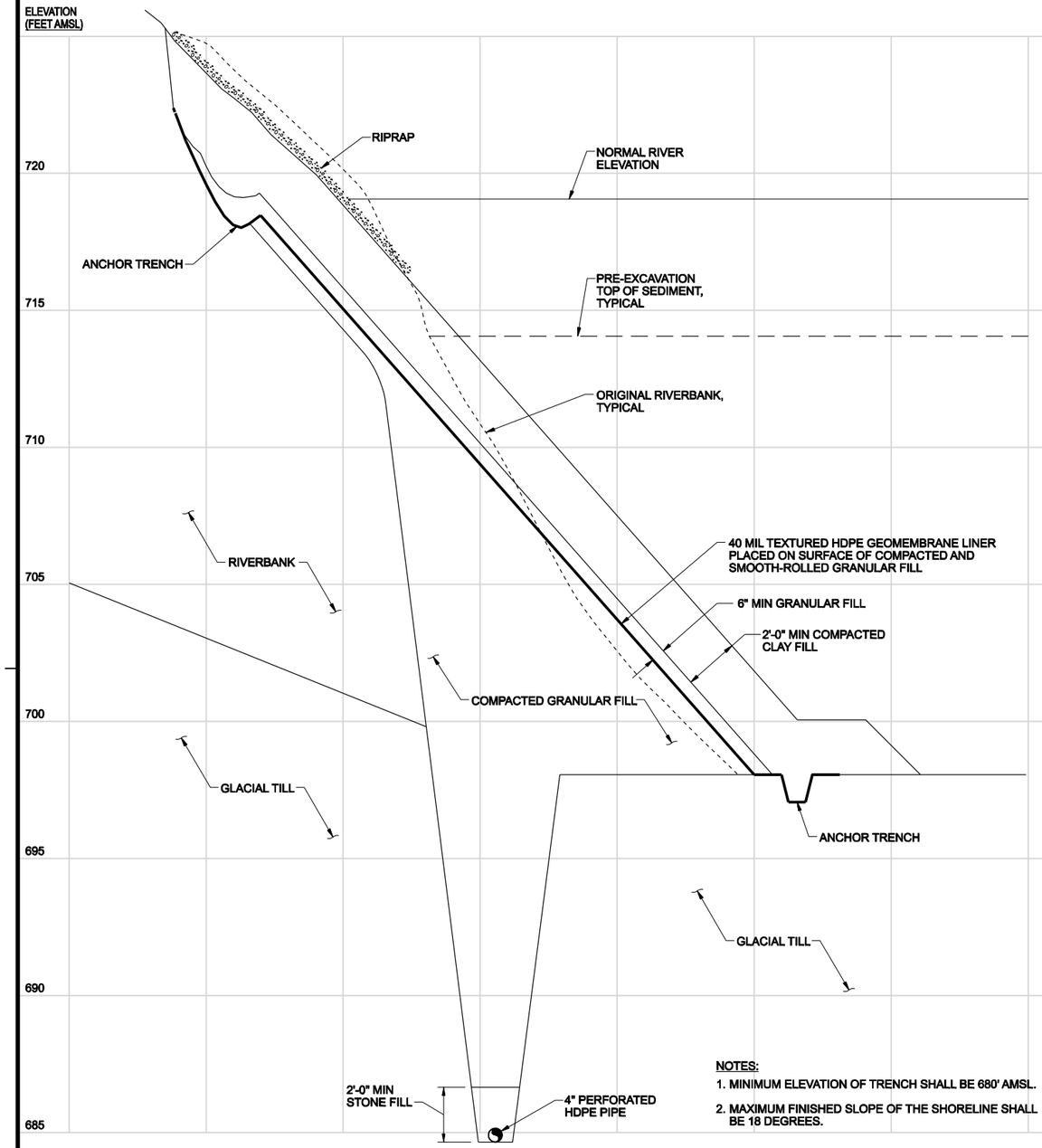
VELSICOL/PINE RIVER SITE
ST. LOUIS, MICHIGAN

SITEWORK

PROCESS WATER PIPING LAYOUT

| | |
|---|---|
| SHEET | 9 |
| DWG | C-1 |
| DATE | MARCH 2005 |
| PROJ | 184199 |

FILENAME: PRnc001d_184199.dgn PLOT DATE: 10/31/2006 PLOT TIME: 2:45:21 PM

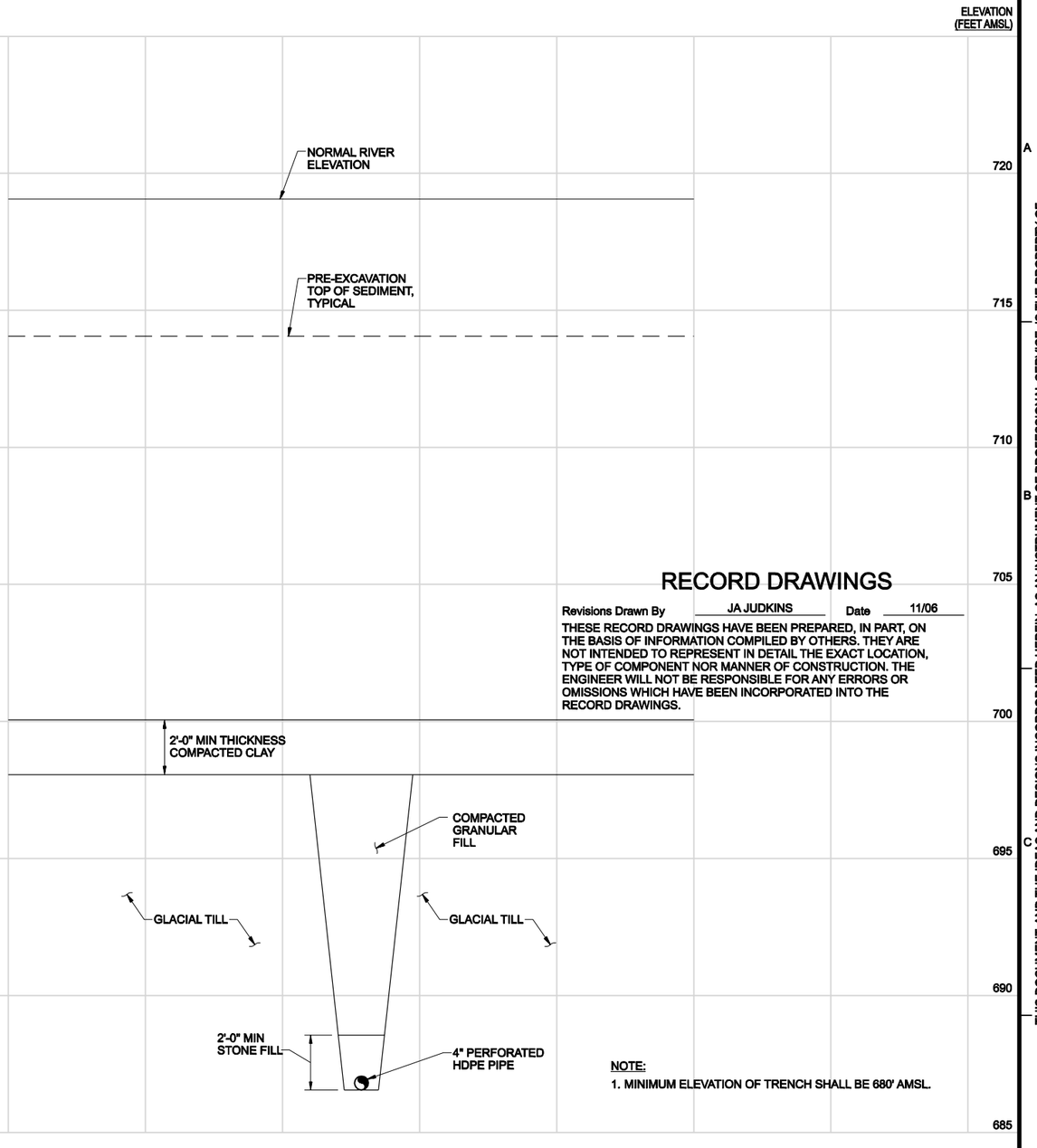



NOTES:

1. MINIMUM ELEVATION OF TRENCH SHALL BE 680' AMSL.
2. MAXIMUM FINISHED SLOPE OF THE SHORELINE SHALL BE 18 DEGREES.

## DNAPL COLLECTION TRENCH AND CLAY CAPPING DETAIL

1"=10' HORIZONTAL
1"=2.5' VERTICAL




NOTE:

1. MINIMUM ELEVATION OF TRENCH SHALL BE 680' AMSL.

## DNAPL COLLECTION TRENCH LATERAL AND CLAY CAPPING DETAIL

1"=10' HORIZONTAL
1"=2.5' VERTICAL

## RECORD DRAWINGS

Revisions Drawn By JA JUDKINS Date 11/06

THESE RECORD DRAWINGS HAVE BEEN PREPARED, IN PART, ON THE BASIS OF INFORMATION COMPILED BY OTHERS. THEY ARE NOT INTENDED TO REPRESENT IN DETAIL THE EXACT LOCATION, TYPE OF COMPONENT NOR MANNER OF CONSTRUCTION. THE ENGINEER WILL NOT BE RESPONSIBLE FOR ANY ERRORS OR OMISSIONS WHICH HAVE BEEN INCORPORATED INTO THE RECORD DRAWINGS.



| | | | | | |
|---|---|---|---|---|---|
| DSGN RC STRYKER | | | | | VERIFY SCALE |
| DR JM ZAFFKE | | | | | BAR IS ONE INCH ON ORIGINAL DRAWING. 0 1" |
| CHK RC STRYKER | | 11/06 | RECORD DRAWING. | JAJ | RCS | IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY. |
| APVD DJ OLSON | NO. | DATE | REVISION | BY | APVD | |

CH2MHILL

2005 SEDIMENT REMEDIAL ACTION
GROUNDWATER RECOVERY SYSTEM
AND DNAPL COLLECTION TRENCH

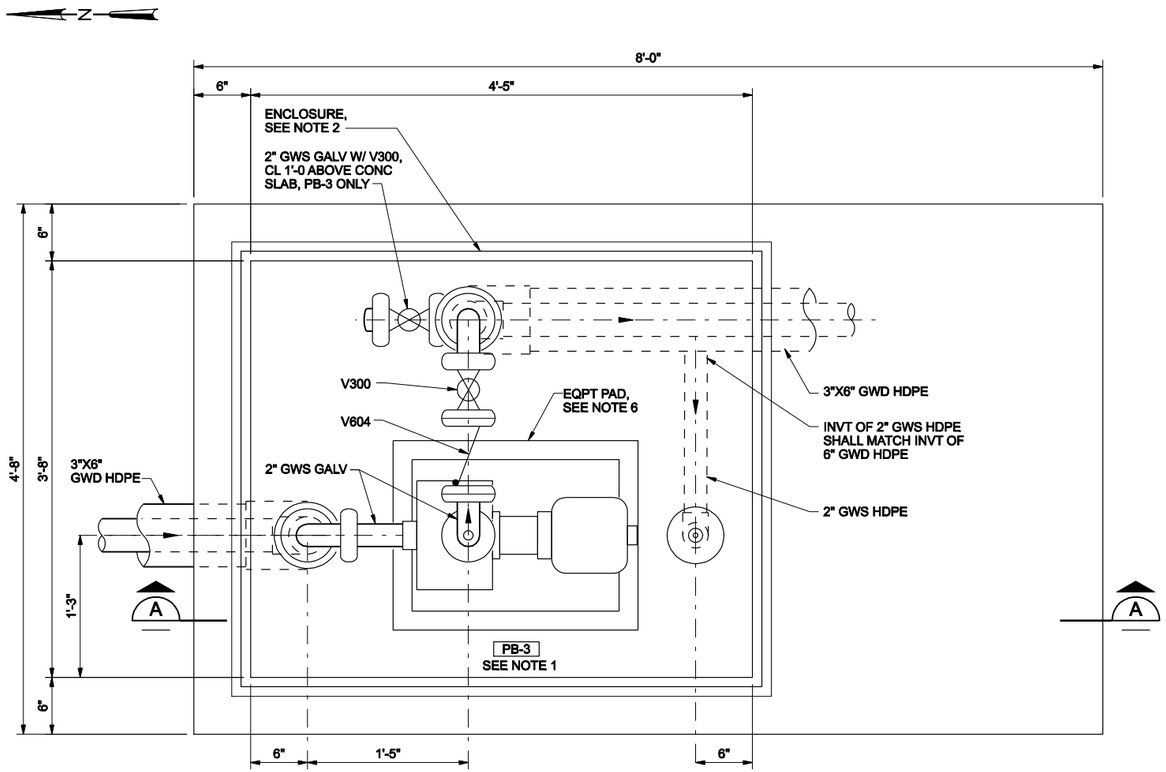
VELSICOL/PINE RIVER SITE
ST. LOUIS, MICHIGAN

SITEWORK

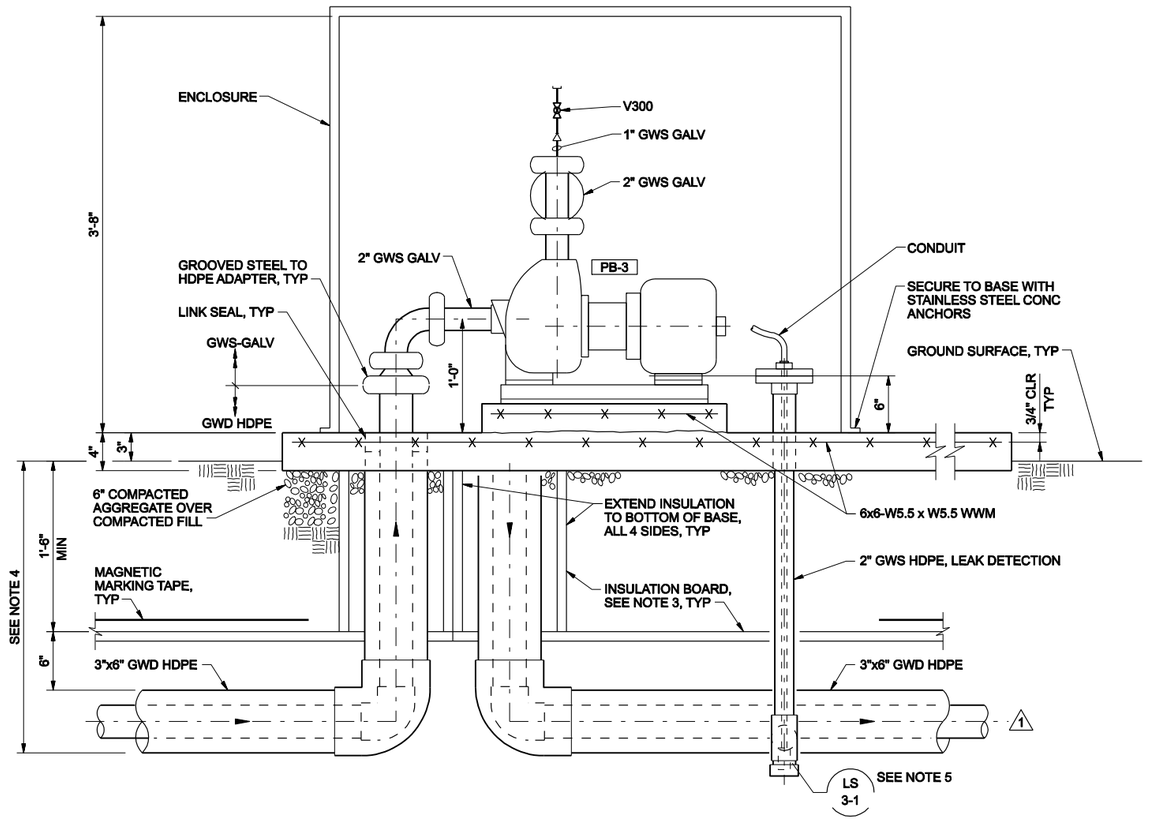
DNAPL COLLECTION TRENCH, TRENCH LATERAL AND CLAY CAPPING DETAILS

| | |
|---|---|
| SHEET | 10 |
| DWG | C-2 |
| DATE | MARCH 2005 |
| PROJ | 184199 |

FILENAME: PRnc002d_184199.dgn PLOT DATE: 10/31/2006 PLOT TIME: 2:45:29 PM




PUMP BOX PB-1, 2, 3 AND 4 DETAIL 1
1 1/2"=1'-0" C-1, M-2




1 SECTION A
1 1/2"=1'-0"

## RECORD DRAWINGS

Revisions Drawn By JA JUDKINS Date 11/06

THESE RECORD DRAWINGS HAVE BEEN PREPARED, IN PART, ON THE BASIS OF INFORMATION COMPILED BY OTHERS. THEY ARE NOT INTENDED TO REPRESENT IN DETAIL THE EXACT LOCATION, TYPE OF COMPONENT NOR MANNER OF CONSTRUCTION. THE ENGINEER WILL NOT BE RESPONSIBLE FOR ANY ERRORS OR OMISSIONS WHICH HAVE BEEN INCORPORATED INTO THE RECORD DRAWINGS.

NOTES:

1. PUMP BOX 3 SHOWN, PUMP BOXES 1, 2 AND 4 ARE THE SAME AS PB-3 EXCEPT AS NOTED.
2. PUMP ENCLOSURE PB-1, 2, 3 AND 4: (53"L x 44"W x 44"H) HOTBOX STANDARD MODEL NO. PG4000F "PUMP GUARD" INSULATED FIBERGLASS FLIP-TOP ENCLOSURE WITH INTERNAL ANCHORING KIT AND 120-VOLT, 1000 WATT REGULATED HEAT SOURCE.
3. 1-INCH THICK EXTRUDED POLYSTYRENE FOAM INSULATION, 4-FEET WIDE, CENTERED OVER ENTIRE LENGTH OF PIPE.
4. 30-INCHES NOMINAL THICKNESS OF CAP. DO NOT DIG BELOW CAP.
5. LEVEL SWITCH - KOBOLD TYPE NCP 2554 WITH PVC STEM AND 2" FLANGE.
6. EQUIPMENT PAD SHALL BE INSTALLED LEVEL. ANCHOR PUMP PER MANUFACTURERS RECOMMENDATIONS WITH CONCRETE ANCHORS. ANCHORS SHALL BE INSTALLED WITH 4" MINIMUM EDGE DISTANCE IN EACH DIRECTION.
7. CONCRETE SLAB AND EQUIPMENT PAD SHALL BE 3,000 PSI CONCRETE.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| DSGN RA YOLO<br>DR BR LEHMAN<br>CHK LA AMUNDSON<br>APVD RA YOLO | 1 | 11/06<br>06/06 | RECORD DRAWING.<br>ADDED PB-4 AND VB-2. | JAJ<br>PAK | RCS<br>RAY | VERIFY SCALE<br>BAR IS ONE INCH ON ORIGINAL DRAWING.<br>0 1"<br>IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY. | CH2MHILL |
| | NO. | DATE | REVISION | BY | APVD | | |

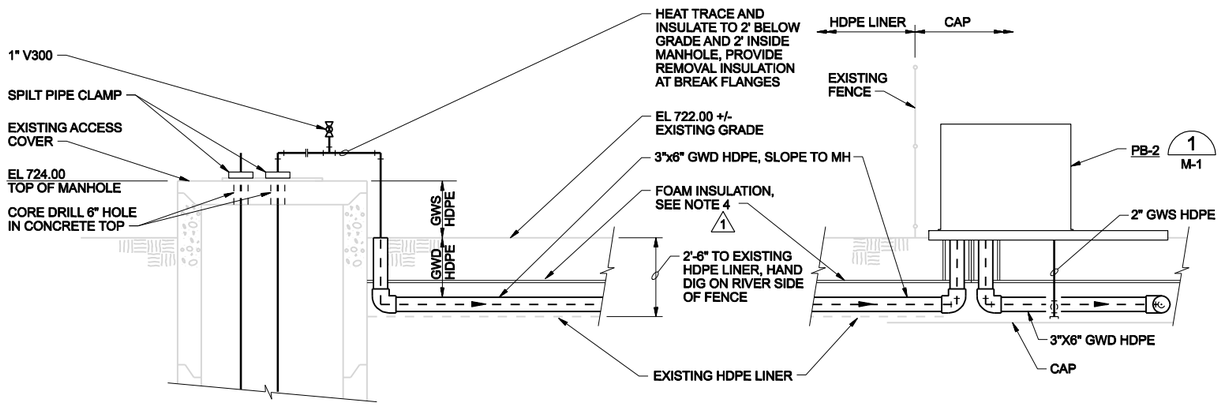
2005 SEDIMENT REMEDIAL ACTION
GROUNDWATER RECOVERY SYSTEM
AND DNAPL COLLECTION TRENCH

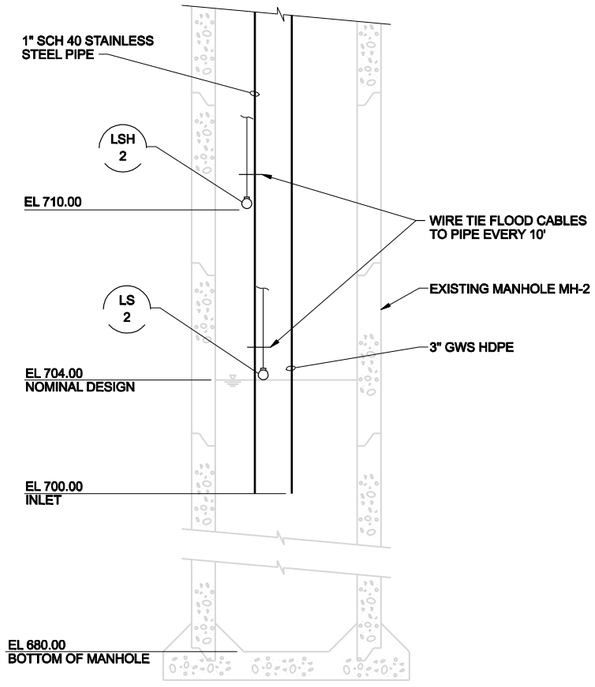
VELSICOL/PINE RIVER SITE
ST. LOUIS, MICHIGAN

MECHANICAL
PUMP BOX
DETAIL AND SECTION

| | |
|---|---|
| SHEET | 11 |
| DWG | M-1 |
| DATE | MARCH 2005 |
| PROJ | 184199 |

FILENAME: PRnm001d_184199.dgn PLOT DATE: 10/31/2006 PLOT TIME: 2:45:37 PM




(TYPICAL FOR MANHOLES MH-1 AND MH-3)

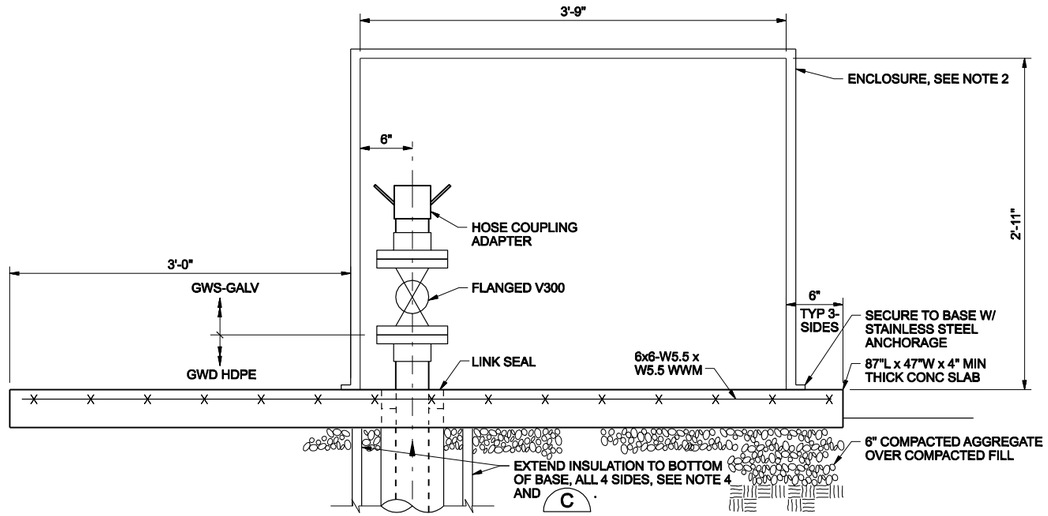
## 1 MANHOLE MH-2 SECTION A

3/8"=1'-0" C-1

# RECORD DRAWINGS

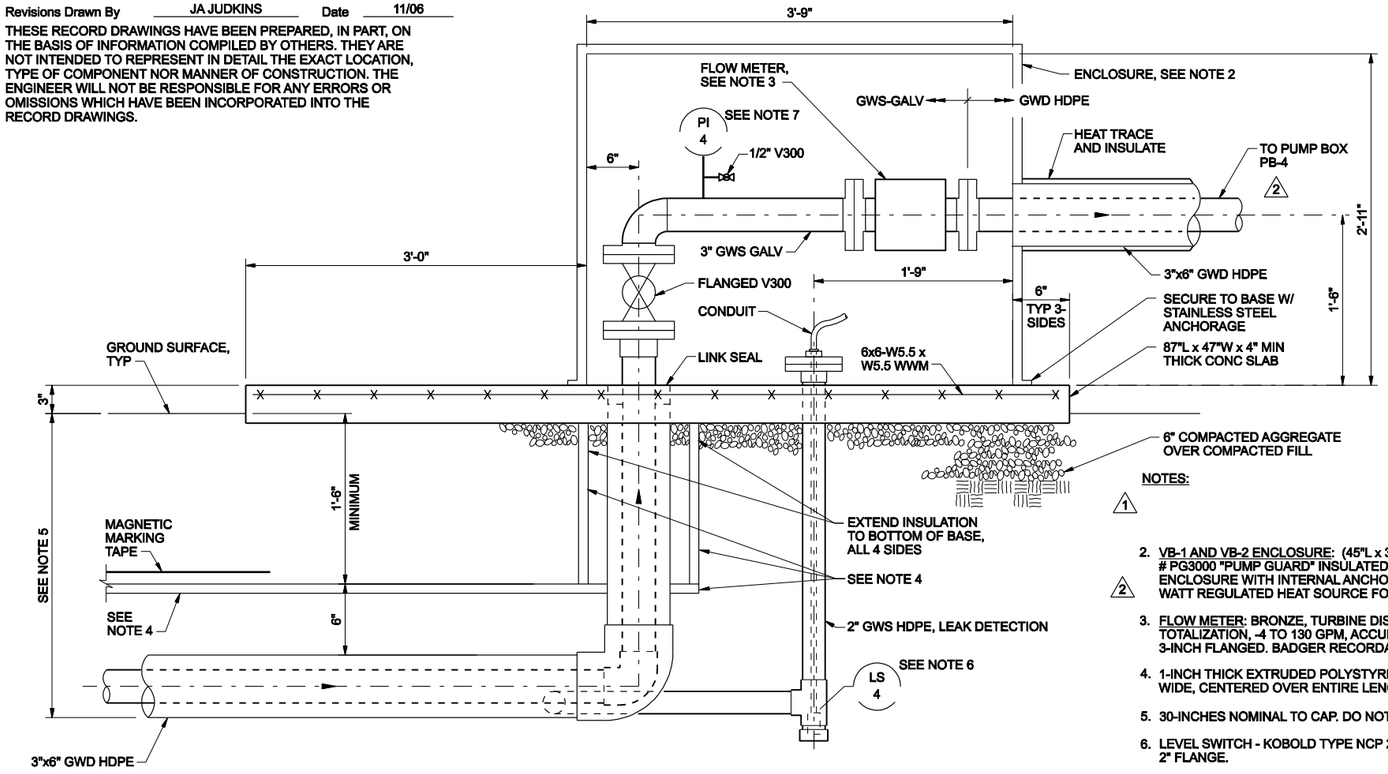
Revisions Drawn By JA JUDKINS Date 11/06

THESE RECORD DRAWINGS HAVE BEEN PREPARED, IN PART, ON THE BASIS OF INFORMATION COMPILED BY OTHERS. THEY ARE NOT INTENDED TO REPRESENT IN DETAIL THE EXACT LOCATION, TYPE OF COMPONENT NOR MANNER OF CONSTRUCTION. THE ENGINEER WILL NOT BE RESPONSIBLE FOR ANY ERRORS OR OMISSIONS WHICH HAVE BEEN INCORPORATED INTO THE RECORD DRAWINGS.




## 2 VALVE BOX VB-2 SECTION B

1 1/2"=1'-0" C-1




## 2 VALVE BOX VB-1 SECTION C

1 1/2"=1'-0" C-1

NOTES:

1.

2. VB-1 AND VB-2 ENCLOSURE: (45"L x 35"W x 35"H) HOTBOX STANDARD # PG3000 "PUMP GUARD" INSULATED FIBERGLASS FLIP-TOP ENCLOSURE WITH INTERNAL ANCHORING KIT. PROVIDE 120-VOLT, 1000 WATT REGULATED HEAT SOURCE FOR VB-1.
3. FLOW METER: BRONZE, TURBINE DISC TYPE METER, RATE AND TOTALIZATION, -4 TO 130 GPM, ACCURACY 1 1/2% OF READING, 3-INCH FLANGED. BADGER RECORDALL TURBO RCDL, OR EQUAL.
4. 1-INCH THICK EXTRUDED POLYSTYRENE FOAM INSULATION, 4-FEET WIDE, CENTERED OVER ENTIRE LENGTH OF PIPE.
5. 30-INCHES NOMINAL TO CAP. DO NOT DIG INTO CAP.
6. LEVEL SWITCH - KOBOLD TYPE NCP 2554 WITH PVC STEM AND 2" FLANGE.
7. PRESSURE GAUGE 0-25 PSI STAINLESS STEEL ITT BARTON OR EQUAL.



| NO. | DATE | REVISION | BY | APVD |
|---|---|---|---|---|
| 2 | 11/06<br>08/06 | RECORD DRAWING.<br>ADDED PB-4 AND VB-2. | JAJ<br>PAK | RCS<br>RAY |
| 1 | 07/05 | REVISED MANHOLE, PIPING, NOTES, AND LEVEL SWITCHES | PAK | RAY |

DSGN RA YOLO
DR MA REICHERT
CHK LA AMUNDSON
APVD RA YOLO

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

CH2MHILL

2005 SEDIMENT REMEDIAL ACTION
GROUNDWATER RECOVERY SYSTEM
AND DNAPL COLLECTION TRENCH

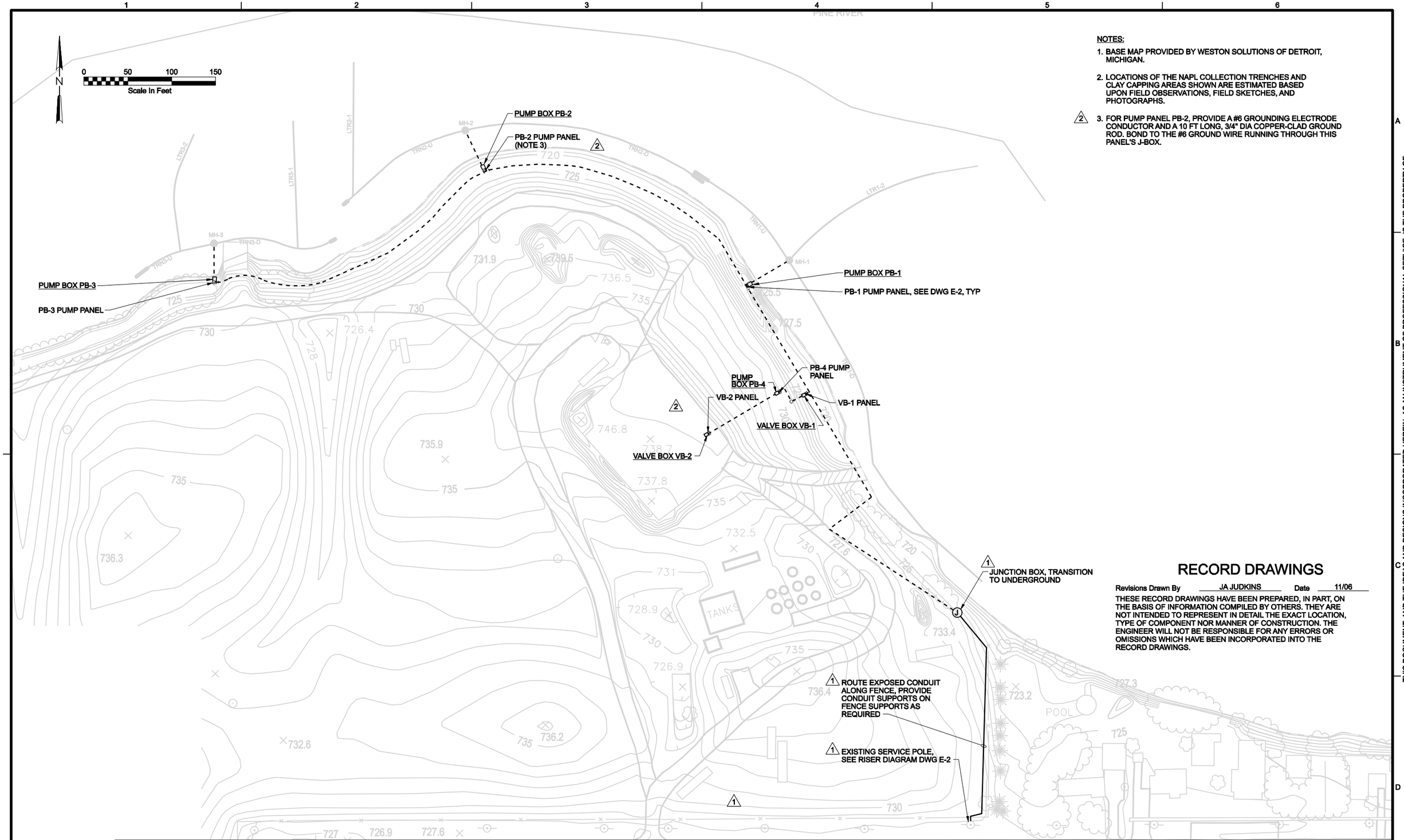
VELSICOL/PINE RIVER SITE
ST. LOUIS, MICHIGAN

MECHANICAL

SECTIONS

| | |
|---|---|
| SHEET | 12 |
| DWG | M-2 |
| DATE | MARCH 2005 |
| PROJ | 184199 |

FILENAME: PRnm002d_184199.dgn PLOT DATE: 10/31/2006 PLOT TIME: 2:45:45 PM




NOTES:

1. BASE MAP PROVIDED BY WESTON SOLUTIONS OF DETROIT, MICHIGAN.
2. LOCATIONS OF THE NAPL COLLECTION TRENCHES AND CLAY CAPPING AREAS SHOWN ARE ESTIMATED BASED UPON FIELD OBSERVATIONS, FIELD SKETCHES, AND PHOTOGRAPHS.
3. FOR PUMP PANEL PB-2, PROVIDE A #6 GROUNDING ELECTRODE CONDUCTOR AND A 10 FT LONG, 3/4" DIA COPPER-CLAD GROUND ROD. BOND TO THE #6 GROUND WIRE RUNNING THROUGH THIS PANEL'S J-BOX.

## RECORD DRAWINGS

Revisions Drawn By JA JUDKINS Date 11/06

THESE RECORD DRAWINGS HAVE BEEN PREPARED, IN PART, ON THE BASIS OF INFORMATION COMPILED BY OTHERS. THEY ARE NOT INTENDED TO REPRESENT IN DETAIL THE EXACT LOCATION, TYPE OF COMPONENT NOR MANNER OF CONSTRUCTION. THE ENGINEER WILL NOT BE RESPONSIBLE FOR ANY ERRORS OR OMISSIONS WHICH HAVE BEEN INCORPORATED INTO THE RECORD DRAWINGS.



| | | | | | | |
|---|---|---|---|---|---|---|
| DSGN RE NAGEL | | | | | | VERIFY SCALE |
| DR MA REICHERT | 2 | 11/06 | RECORD DRAWING. | JAJ | RCS | BAR IS ONE INCH ON ORIGINAL DRAWING. 0 1" |
| CHK BM WILLIAMS | 2 | 08/06 | ADDED PB-4 AND VB-2. | PAK | RAY | |
| APVD RE NAGEL | 1 | 07/05 | REVISED CONDUIT. | PAK | BMW | IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY. |
| | NO. | DATE | REVISION | BY | APVD | |

CH2MHILL

2005 SEDIMENT REMEDIAL ACTION
GROUNDWATER RECOVERY SYSTEM
AND DNAPL COLLECTION TRENCH

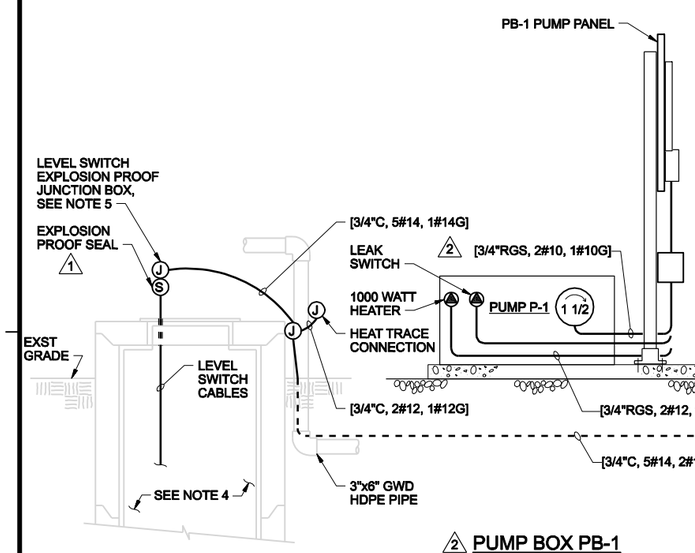
VELSICOL/PINE RIVER SITE
ST. LOUIS, MICHIGAN

ELECTRICAL

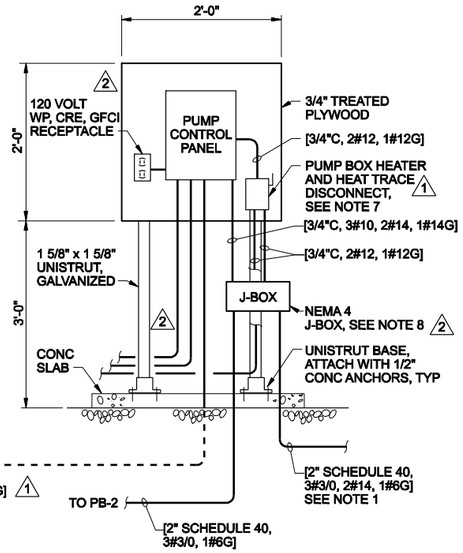
CONDUIT LAYOUT PLAN

| | |
|---|---|
| SHEET | 13 |
| DWG | E-1 |
| DATE | MARCH 2005 |
| PROJ | 184199 |

FILENAME: PRne001d_184199.dgn PLOT DATE: 10/31/2006 PLOT TIME: 2:45:55 PM



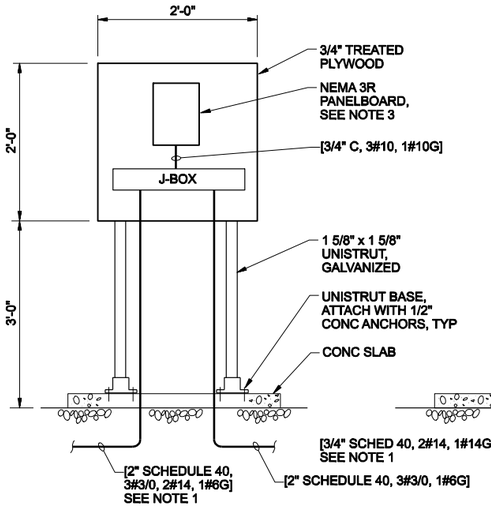

1 EXISTING MANHOLE MH-1
(MH-2 AND MH-3 SIMILAR)




2 PUMP BOX PB-1
(TYPICAL FOR PUMP BOXES PB-2, PB-3 AND PB-4)

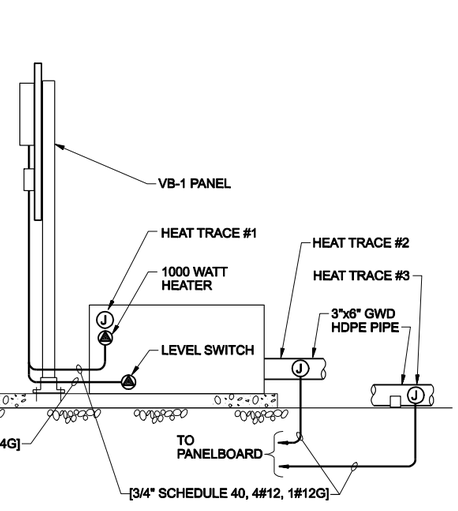
PB-1 PUMP PANEL

2 (SIMILAR FOR PANELS PB-2 AND PB-3. PB-4 PANEL IS SIMILAR BUT HAS NO LEVEL SWITCH INPUT.)

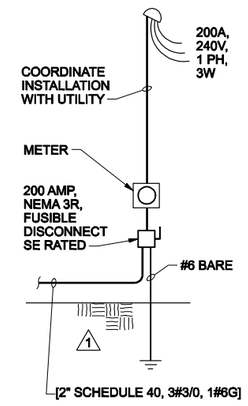



2 VALVE BOX VB-1 PANEL

2 (VALVE BOX VB-2 SIMILAR EXCEPT WITH 1P/20 GFI WEATHER PROOF OUTLET, NO EXTERNAL HEAT TRACE CONNECTIONS, NO LEVEL SWITCH AND NO HEATER.)




VALVE BOX VB-1




1 SERVICE CONNECTION

1 RISER DIAGRAM
NTS

NOTES:

1. PULL 2 #14's FROM VALVE BOX #1 LEVEL SWITCH THROUGH 2-INCH CONDUIT TO PUMP PANEL 1 AT PB-1 TO INDICATE LEAKS.
2. DIRECT BURY DUCTBANK MAXIMUM 2 FEET BELOW FINISHED GRADE.
3. NEMA 3R PANELBOARD WITH 30 AMP MAIN, ONE 1P/15 TO VALVE BOX HEATER, THREE 1P/20 GFI TO HEAT TRACING J-BOXES. BALANCE THE 120V LOADS ACROSS THE HOT LEGS. (2)
4. INTERIOR OF MANHOLES ARE CLASSIFIED AS CLASS 1, DIVISION 1, GROUP D.
5. INSTALL LEVEL SWITCHES IN MANHOLES WITH LEVEL AS INDICATED ON DRAWING M-2.
6. ABOVE GRADE CONDUIT TO BE RIGID GALVANIZED STEEL. BELOW GRADE CONDUIT TO BE SCHEDULE 40 PVC.
7. (1) PROVIDE UL-LISTED DISCONNECT SWITCH, GFCI CIRCUIT BREAKER TYPE, NEMA 4X ENCLOSURE SUITABLE FOR 20 AMPS, 120 VOLT, 1-POLE CIRCUITS AS INDICATED. DISCONNECT SWITCH SHALL SERVE HEAT TRACE AND PUMP BOX HEATER LOADS.
8. (2) BALANCE THE 120V LOADS ACROSS THE HOT LEGS.

## RECORD DRAWINGS

Revisions Drawn By JA JUDKINS Date 11/06

THESE RECORD DRAWINGS HAVE BEEN PREPARED, IN PART, ON THE BASIS OF INFORMATION COMPILED BY OTHERS. THEY ARE NOT INTENDED TO REPRESENT IN DETAIL THE EXACT LOCATION, TYPE OF COMPONENT NOR MANNER OF CONSTRUCTION. THE ENGINEER WILL NOT BE RESPONSIBLE FOR ANY ERRORS OR OMISSIONS WHICH HAVE BEEN INCORPORATED INTO THE RECORD DRAWINGS.

| NO. | DATE | REVISION | BY | APVD |
|---|---|---|---|---|
| 2 | 11/06<br>08/06 | RECORD DRAWING.<br>ADDED PB-4 AND VB-2. | JAJ<br>PAK | RCS<br>RAY |
| 1 | 07/05 | REVISED CONDUIT AND ADDED HEAT TRACE CONNECTION. | PAK | BMW |

DSGN RE NAGEL
DR MA REICHERT
CHK BM WILLIAMS
APVD RE NAGEL

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING. 0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

CH2MHILL

2005 SEDIMENT REMEDIAL ACTION
GROUNDWATER RECOVERY SYSTEM
AND DNAPL COLLECTION TRENCH

VELSICOL/PINE RIVER SITE
ST. LOUIS, MICHIGAN

ELECTRICAL

RISER DIAGRAM

| | |
|---|---|
| SHEET | 14 |
| DWG | E-2 |
| DATE | MARCH 2005 |
| PROJ | 184199 |

FILENAME: PRne002d_184199.dgn PLOT DATE: 10/31/2006 PLOT TIME: 2:48:03 PM

**Appendix B**

# Gorman-Rupp Series 80 Self Priming Centrifugal Pump Installation, Operation, and Maintenance Manual

OM-00843—03
March 31, 1980
Rev. C 07-08-08

# INSTALLATION, OPERATION, AND MAINTENANCE MANUAL

**WITH PARTS LIST**

GORMAN-RUPP PUMPS

## 80 SERIES PUMP

**MODEL**

**82E2—B**

**THE GORMAN-RUPP COMPANY • MANSFIELD, OHIO**
www.grpumps.com
**GORMAN-RUPP OF CANADA LIMITED • ST. THOMAS, ONTARIO, CANADA** Printed in U.S.A.

Register your new
Gorman-Rupp pump online at
**www.grpumps.com**

Valid serial number and e-mail address required.

## RECORD YOUR PUMP MODEL AND SERIAL NUMBER

Please record your pump model and serial number in the spaces provided below. Your Gorman-Rupp distributor needs this information when you require parts or service.

Pump Model: _____

Serial Number: _____

## TABLE OF CONTENTS

## TABLE OF CONTENTS
## (continued)

# INTRODUCTION

**Thank You** for purchasing a Gorman-Rupp pump. **Read this manual** carefully to learn how to safely install and operate your pump. Failure to do so could result in personal injury or damage to the pump.

This Installation, Operation, and Maintenance manual is designed to help you achieve the best performance and longest life from your Gorman-Rupp pump.

This pump is an 80 Series, semi-open impeller, self-priming centrifugal model with a suction check valve. The pump is designed for straight-in suction where the medium being pumped enters directly into the impeller eye. It is designed for handling most non-volatile, non-flammable liquids containing specified entrained solids. The basic material of construction for wetted parts is gray iron.

Because pump installations are seldom identical, this manual cannot possibly provide detailed instructions and precautions for every aspect of each specific application. Therefore, it is the responsibility of the owner/installer of the pump to ensure that applications not addressed in this manual are performed **only** after establishing that neither operator safety nor pump integrity are compromised by the installation. Pumps and related equipment **must** be installed and operated according to all national, local and industry standards.

If there are any questions regarding the pump or its application which are not covered in this manual or in other literature accompanying this unit, please contact your Gorman-Rupp distributor, or write:

**The Gorman-Rupp Company**
**P.O. Box 1217**
**Mansfield, Ohio 44901—1217**
**Phone: (419) 755—1011**
or:
**Gorman-Rupp of Canada Limited**
**70 Burwell Road**
**St. Thomas, Ontario N5P 3R7**
**Phone: (519) 631—2870**

The following are used to alert maintenance personnel to procedures which require special attention, to those which could damage equipment, and to those which could be dangerous to personnel:

**DANGER!**

**Immediate hazards which WILL result in severe personal injury or death. These instructions describe the procedure required and the injury which will result from failure to follow the procedure.**

**WARNING!**

**Hazards or unsafe practices which COULD result in severe personal injury or death. These instructions describe the procedure required and the injury which could result from failure to follow the procedure.**

CAUTION

Hazards or unsafe practices which COULD result in minor personal injury or product or property damage. These instructions describe the requirements and the possible damage which could result from failure to follow the procedure.

**NOTE**

*Instructions to aid in installation, operation,and maintenance, or which clarify a procedure.*

# SAFETY - SECTION A

**This information applies to 80 Series basic pumps. Gorman-Rupp has no control over or particular knowledge of the power source which will be used. Refer to the manual accompanying the power source before attempting to begin operation.**

**WARNING!**

**Before attempting to open or service the pump:**

1. **Familiarize yourself with this manual.**
2. **Lock out or disconnect the power source to ensure that the pump will remain inoperative.**
3. **Allow the pump to completely cool if overheated.**
4. **Check the temperature before opening any covers, plates, or plugs.**
5. **Close the suction and discharge valves.**
6. **Vent the pump slowly and cautiously.**
7. **Drain the pump.**

**WARNING!**

**This pump is designed to handle most non-volatile, non-flammable liquids containing specified entrained solids. Do not attempt to pump volatile or flammable liquids which may damage the pump or endanger personnel as a result of pump failure.**

**WARNING!**

**Use lifting and moving equipment in good repair and with adequate capacity to prevent injuries to personnel or damage to equipment. The bail is intended for use in lifting the pump assembly only. Suction and discharge hoses and piping must be removed from the pump before lifting.**

**WARNING!**

**After the pump has been installed, make certain that the pump and all piping or hose connections are tight, properly supported and secure before operation.**

**WARNING!**

**Do not operate the pump without the shields and/or guards in place over the drive shaft, belts, and/or couplings, or other rotating parts. Exposed rotating parts can catch clothing, fingers, or tools, causing severe injury to personnel.**

**WARNING!**

**Do not operate the pump against a closed discharge valve for long periods of time. If operated against a closed discharge valve, pump components will deteriorate, and the liquid could come to a boil, build pressure, and cause the pump casing to rupture or explode.**


**Overheated pumps can cause severe burns and injuries. If overheating of the pump occurs:**

1. **Stop the pump immediately.**
2. **Ventilate the area.**
3. **Allow the pump to completely cool.**
4. **Check the temperature before opening any covers, plates, gauges, or plugs.**
5. **Vent the pump slowly and cautiously.**
6. **Refer to instructions in this manual before restarting the pump.**


**Do not remove plates, covers, gauges, pipe plugs, or fittings from an overheated pump. Vapor pressure within the pump can cause parts being disengaged to be ejected with great force. Allow the pump to completely cool before servicing.**


**Never run this pump backwards. Be certain that rotation is correct before fully engaging the pump.**

# INSTALLATION — SECTION B

**Review all SAFETY information in Section A.**

Since pump installations are seldom identical, this section offers only general recommendations and practices required to inspect, position, and arrange the pump and piping.

Most of the information pertains to a standard **static lift** application where the pump is positioned above the free level of liquid to be pumped.

If installed in a **flooded suction application** where the liquid is supplied to the pump under pressure, some of the information such as mounting, line configuration, and priming must be tailored to the specific application. Since the pressure supplied to the pump is critical to performance and safety, **be sure** to limit the incoming pressure to 50% of the maximum permissible operating pressure as shown on the pump performance curve (see Section E, Page 1). If the pump is fitted with a Gorman-Rupp double grease lubricated seal, the maximum incoming pressure must be reduced to 10 p.s.i.

For further assistance, contact your Gorman-Rupp distributor or the Gorman-Rupp Company.

### Pump Dimensions

See Figure 1 for the approximate physical dimensions of this pump.

**OUTLINE DRAWING**

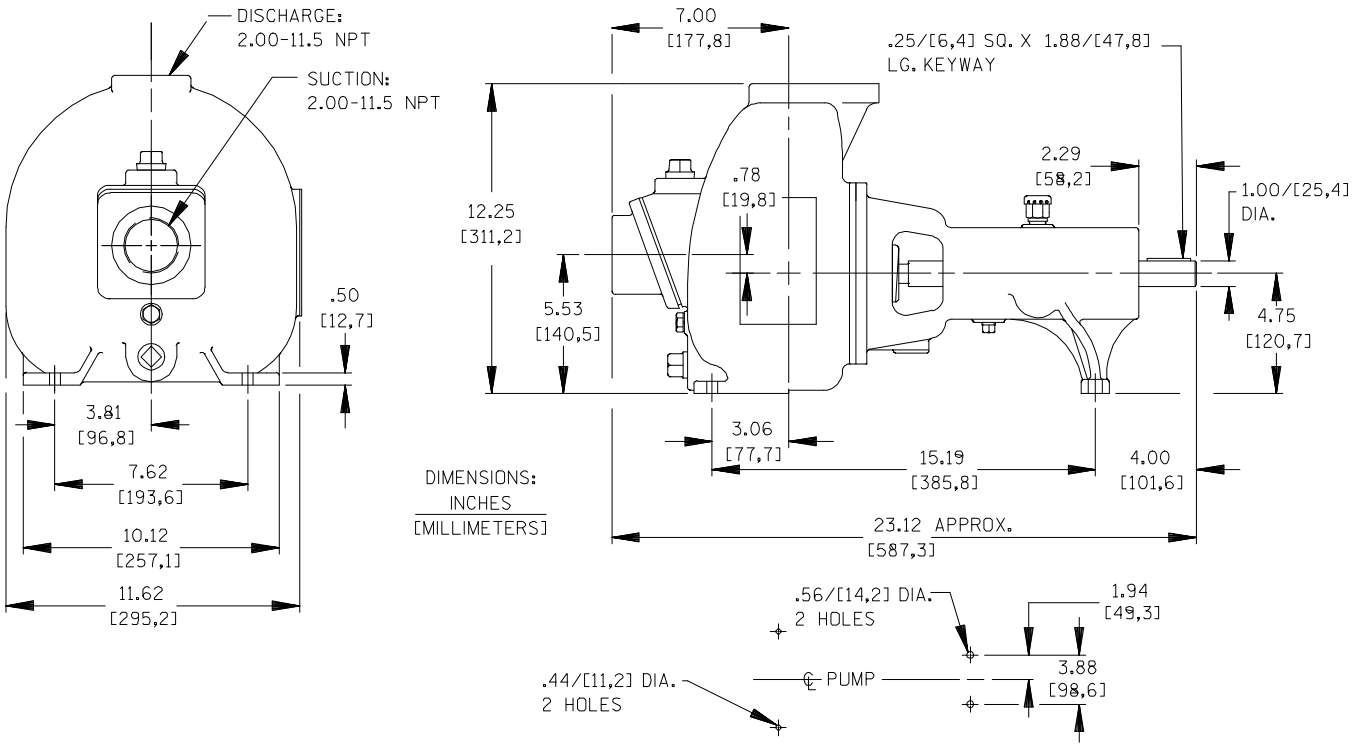



**Figure 1. Pump Model 82E2—B**

## PREINSTALLATION INSPECTION

The pump assembly was inspected and tested before shipment from the factory. Before installation, inspect the pump for damage which may have occurred during shipment. Check as follows:

a. Inspect the pump for cracks, dents, damaged threads, and other obvious damage.

b. Check for and tighten loose attaching hardware. Since gaskets tend to shrink after drying, check for loose hardware at mating surfaces.

c. Carefully read all tags, decals, and markings on the pump assembly, and perform all duties indicated.

**CAUTION**

Only operate this pump in the direction indicated by the arrow on the pump body and on the accompanying decal. Otherwise, the impeller could become loosened from the shaft and seriously damage the pump. Refer to **Rotation** in **OPERATION**, Section C.

d. Check levels and lubricate as necessary. Refer to **LUBRICATION** in the **MAINTENANCE AND REPAIR** section of this manual and perform duties as instructed.

e. If the pump has been stored for more than 12 months, some of the components or lubricants may have exceeded their maximum shelf life. These **must be inspected or replaced** to ensure maximum pump service.

If the maximum shelf life has been exceeded, or if anything appears to be abnormal, contact your Gorman-Rupp distributor or the factory to determine the repair or updating policy. **Do not** put the pump into service until appropriate action has been taken.

## POSITIONING PUMP

**WARNING!**

**Use lifting and moving equipment in good repair and with adequate capacity to prevent injuries to personnel or damage to equipment. Suction and discharge hoses and piping must be removed from the pump before lifting.**

### Lifting

Pump unit weights will vary depending on the mounting and drive provided. Check the shipping tag on the unit packaging for the actual weight, and use lifting equipment with appropriate capacity. Drain the pump and remove all customer-installed equipment such as suction and discharge hoses or piping before attempting to lift existing, installed units.

**CAUTION**

The pump assembly can be seriously damaged if the cables or chains used to lift and move the unit are improperly wrapped around the pump.

### Mounting

Locate the pump in an accessible place as close as practical to the liquid being pumped. Level mounting is essential for proper operation.

The pump may have to be supported or shimmed to provide for level operation or to eliminate vibration.

## SUCTION AND DISCHARGE PIPING

Pump performance is adversely effected by increased suction lift, discharge elevation, and friction losses. See the performance curve on Page E—1 to be sure your overall application allows pump to operate within the safe operation range.

### Materials

Either pipe or hose maybe used for suction and discharge lines; however, the materials must be compatible with the liquid being pumped. If hose is used in suction lines, it must be the rigid-wall, reinforced type to prevent collapse under suction. Using piping couplings in suction lines is not recommended.

### Line Configuration

Keep suction and discharge lines as straight as possible to minimize friction losses. Make minimum use of elbows and fittings, which substantially increase friction loss. If elbows are necessary, use the long-radius type to minimize friction loss.

### Connections to Pump

Before tightening a connecting flange, align it exactly with the pump port. Never pull a pipe line into place by tightening the flange bolts and/or couplings.

Lines near the pump must be independently supported to avoid strain on the pump which could cause excessive vibration, decreased bearing life, and increased shaft and seal wear. If hose-type lines are used, they should have adequate support to secure them when filled with liquid and under pressure.

### Gauges

Most pumps are drilled and tapped for installing discharge pressure and vacuum suction gauges. If these gauges are desired for pumps that are not tapped, drill and tap the suction and discharge lines not less than 18 inches (457,2 mm) from the suction and discharge ports and install the lines. Installation closer to the pump may result in erratic readings.

## SUCTION LINES

To avoid air pockets which could affect pump priming, the suction line must be as short and direct as possible. When operation involves a suction lift, the line must always slope upward to the pump from the source of the liquid being pumped; if the line slopes down to the pump at any point along the suction run, air pockets will be created.

### Fittings

Suction lines should be the same size as the pump inlet. If reducers are used in suction lines, they should be the eccentric type, and should be installed with the flat part of the reducers uppermost to avoid creating air pockets. Valves are not normally used in suction lines, but if a valve is used, install it with the stem horizontal to avoid air pockets.

### Strainers

If a strainer is furnished with the pump, be certain to use it; any spherical solids which pass through a strainer furnished with the pump will also pass through the pump itself.

If a strainer is not furnished with the pump, but is installed by the pump user, make certain that the total area of the openings in the strainer is at least three or four times the cross section of the suction line, and that the openings will not permit passage of solids larger than the solids handling capability of the pump.

This pump is designed to handle up to 3/4—inch (19,1 mm) diameter spherical solids.

### Sealing

Since even a slight leak will affect priming, head, and capacity, especially when operating with a high suction lift, all connections in the suction line should be sealed with pipe dope to ensure an airtight seal. Follow the sealant manufacturer's recommendations when selecting and applying the pipe dope. The pipe dope should be compatible with the liquid being pumped.

### Suction Lines In Sumps

If a single suction line is installed in a sump, it should be positioned away from the wall of the sump at a distance equal to 1-1/2 times the diameter of the suction line.

If there is a liquid flow from an open pipe into the sump, the flow should be kept away from the suc-

tion inlet because the inflow will carry air down into the sump, and air entering the suction line will reduce pump efficiency.

If it is necessary to position inflow close to the suction inlet, install a baffle between the inflow and the suction inlet at a distance 1-1/2 times the diameter of the suction pipe. The baffle will allow entrained air to escape from the liquid before it is drawn into the suction inlet.

If two suction lines are installed in a single sump, the flow paths may interact, reducing the efficiency of one or both pumps. To avoid this, position the suction inlets so that they are separated by a distance equal to at least 3 times the diameter of the suction pipe.

### Suction Line Positioning

The depth of submergence of the suction line is critical to efficient pump operation. Figure 2 shows recommended minimum submergence vs. velocity.

**NOTE**

*The pipe submergence required may be reduced by installing a standard pipe increaser fitting at the end of the suction line. The larger opening size will reduce the inlet velocity. Calculate the required submergence using the following formula based on the increased opening size (area or diameter).*

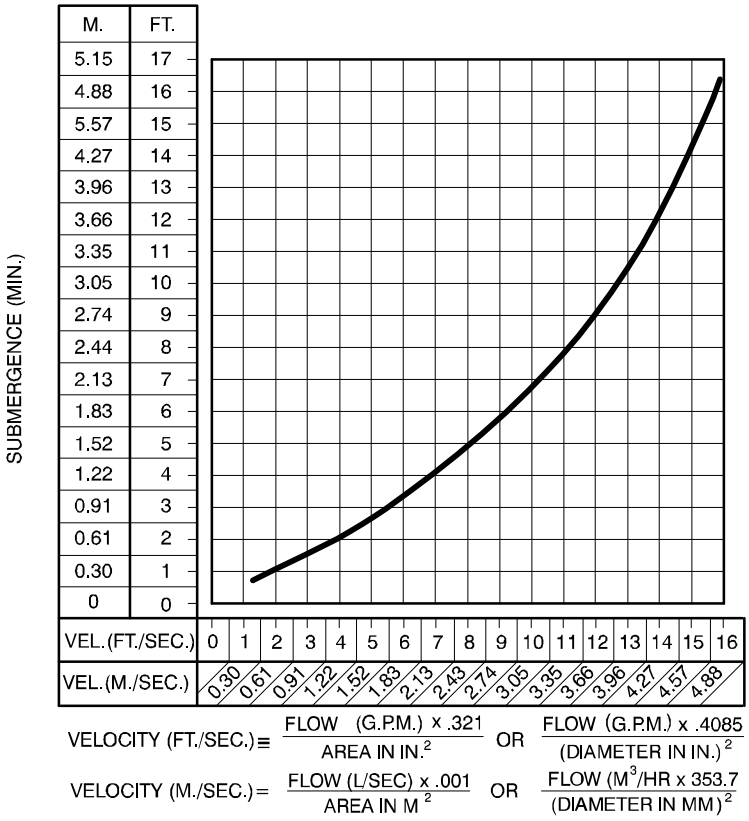



**Figure 2. Recommended Minimum Suction Line Submergence vs. Velocity**

## DISCHARGE LINES

### Siphoning

Do not terminate the discharge line at a level lower than that of the liquid being pumped unless a siphon breaker is used in the line. Otherwise, a siphoning action causing damage to the pump could result.

### Valves

If a throttling valve is desired in the discharge line, use a valve as large as the largest pipe to minimize friction losses. Never install a throttling valve in a suction line.

With high discharge heads, it is recommended that a throttling valve and a system check valve be installed in the discharge line to protect the pump from excessive shock pressure and reverse rotation when it is stopped.

**CAUTION**

If the application involves a high discharge head, gradually close the discharge throttling valve before stopping the pump.

#### Bypass Lines

If a system check valve is used due to high discharge head, it may be necessary to vent trapped air from the top of the pump during the priming process. This may be accomplished by installing a bypass line from the top of the pump, back to the source of liquid. The end of the bypass line must be submerged. The line must be large enough to prevent clogging, but not so large as to affect pump discharge capacity.

## ALIGNMENT

The alignment of the pump and its power source is critical for trouble-free mechanical operation. In either a flexible coupling or V-belt driven system, the driver and pump must be mounted so that their shafts are aligned with and parallel to each other. It is imperative that alignment be checked after the pump and piping are installed, and before operation.

**NOTE**

*Check **Rotation**, Section C, before final alignment of the pump.*

When mounted at the Gorman-Rupp factory, driver and pump are aligned before shipment. Misalignment will occur in transit and handling. Pumps **must** be checked and realigned before operation.

Before checking alignment, tighten the foundation bolts. The pump casing feet and/or pedestal feet, and the driver mounting bolts should also be tightly secured.

**WARNING!**

**When checking alignment, disconnect the power source to ensure that the pump will remain inoperative.**

**CAUTION**

Adjusting the alignment in one direction may alter the alignment in another direction. check each procedure after altering alignment.

#### Coupled Drives

When using couplings, the axis of the power source must be aligned to the axis of the pump shaft in both the horizontal and vertical planes. Most couplings require a specific gap or clearance between the driving and the driven shafts. Refer to the coupling manufacturer's service literature.

Align spider insert type couplings by using calipers to measure the dimensions on the circumference of the outer ends of the coupling hub every 90 degrees. The coupling is in alignment when the hub ends are the same distance apart at all points (see Figure 3A).

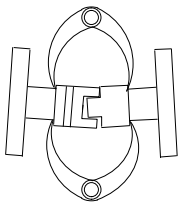


**Figure 3A. Aligning Spider Type Couplings**

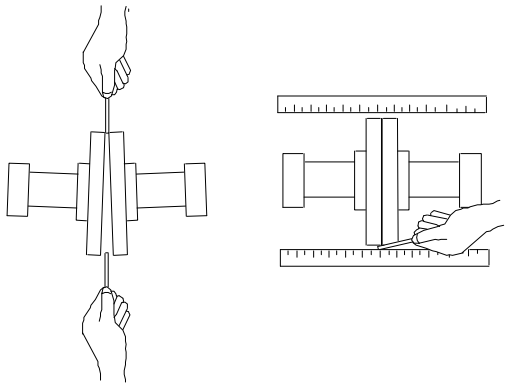


**Figure 3B. Aligning Non-Spider Type Couplings**

Align non-spider type couplings by using a feeler gauge or taper gauge between the coupling halves every 90 degrees. The coupling is in alignment when the hubs are the same distance apart at all points (see Figure 3B).

Check parallel adjustment by laying a straightedge across both coupling rims at the top, bottom, and side. When the straightedge rests evenly on both halves of the coupling, the coupling is in horizontal parallel alignment. If the coupling is misaligned, use a feeler gauge between the coupling and the straightedge to measure the amount of misalignment.

### V-Belt Drives

When using V-belt drives, the power source and the pump must be parallel. Use a straightedge along the sides of the pulleys to ensure that the pulleys are properly aligned (see Figure 3C). In drive systems using two or more belts, make certain that the belts are a matched set; unmatched sets will cause accelerated belt wear.

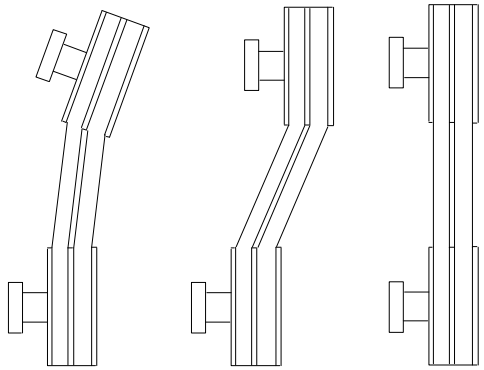



**Figure 3C. Alignment of V-Belt Driven Pumps**

Tighten the belts in accordance with the belt manufacturer's instructions. If the belts are too loose, they will slip; if the belts are too tight, there will be excessive power loss and possible bearing failure. Select pulleys that will match the proper speed ratio; overspeeding the pump may damage both pump and power source.

**WARNING!**

**Do not operate the pump without the shields and/or guards in place over the drive shaft, belts, and/or couplings, or other rotating parts. Exposed rotating parts can catch clothing, fingers, or tools, causing severe injury to personnel.**

# OPERATION — SECTION C

**Review all SAFETY information Section A.**

**Follow the instructions on all tags, labels and decals attached to the pump.**

**WARNING!**

**This pump is designed to handle most non-volatile, non-flammable liquids containing specified entrained solids. Do not attempt to pump volatile or flammable liquids which may damage the pump or endanger personnel as a result of pump failure.**

CAUTION

Pump speed and operating condition points must be within the continuous performance range shown on the curve (see Section E, Page 1).

## PRIMING

Install the pump and piping as described in **INSTALLATION**. Make sure that the piping connections are tight, and that the pump is securely mounted. Check that the pump is properly lubricated (see **LUBRICATION** in **MAINTENANCE AND REPAIR**).

This pump is self-priming, but the pump should never be operated unless there is liquid in the pump casing.

CAUTION

Never operate this pump unless there is liquid in the pump casing. The pump will not prime when dry. Extended operation of a dry pump will destroy the seal assembly.

Add liquid to the pump casing when:

1. The pump is being put into service for the first time.
2. The pump has not been used for a considerable length of time.
3. The liquid in the pump casing has evaporated.

Once the pump casing has been filled, the pump will prime and reprime as necessary.

**WARNING!**

**After filling the pump casing, reinstall and tighten the fill plug. Do not attempt to operate the pump unless all connecting piping is securely installed. Otherwise, liquid in the pump forced out under pressure could cause injury to personnel.**

To fill the pump, remove the pump casing fill cover or fill plug in the top of the casing, and add clean liquid until the casing is filled. Replace the fill cover or fill plug before operating the pump.

## STARTING

Consult the operations manual furnished with the power source**.**

### Rotation

The correct direction of pump rotation is counterclockwise when facing the impeller. If the pump is operated in the wrong direction, the impeller could become loosened from the shaft and seriously damage the pump.

CAUTION

Only operate this pump in the direction indicated by the arrow on the pump body and on the accompanying decal. Otherwise, the impeller could become loosened from the shaft and seriously damage the pump.

Consult the operating manual furnished with the power source before attempting to start the power source.

If an electric motor is used to drive the pump, remove V-belts, couplings, or otherwise disconnect the pump from the motor before checking motor rotation. Operate the motor independently while observing the direction of the motor shaft, or cooling fan.

If rotation is incorrect on a three-phase motor, have a qualified electrician interchange any two of the three phase wires to change direction. If rotation is incorrect on a single-phase motor, consult the literature supplied with the motor for specific instructions.

## OPERATION

### Lines With a Bypass

Close the discharge throttling valve (if so equipped) so that the pump will not have to prime against the weight of the liquid in the discharge line. Air from the suction line will be discharged through the bypass line back to the wet well during the priming cycle. When the pump is fully primed and liquid is flowing steadily from the bypass line, open the discharge throttling valve. Liquid will then continue to circulate through the bypass line while the pump is in operation.

### Lines Without a Bypass

Open all valves in the discharge line and start the engine. Priming is indicated by a positive reading on the discharge pressure gauge or by a quieter operation. The pump may not prime immediately because the suction line must first fill with liquid. If the pump fails to prime within five minutes, stop it and check the suction line for leaks.

After the pump has been primed, partially close the discharge line throttling valve in order to fill the line slowly and guard against excessive shock pressure which could damage pipe ends, gaskets, sprinkler heads, and any other fixtures connected to the line. When the discharge line is completely filled, adjust the throttling valve to the required flow rate.

### Leakage

No leakage should be visible at pump mating surfaces, or at pump connections or fittings. Keep all line connections and fittings tight to maintain maximum pump efficiency.

### Liquid Temperature And Overheating

The **maximum** liquid temperature for this pump is 110° F (43°C). Do not apply it at a higher operating temperature.

Overheating can occur if operated with the valves in the suction or discharge lines closed. Operating against closed valves could bring the liquid to a boil, build pressure, and cause the pump to rupture or explode. If overheating occurs, stop the pump and allow it to cool before servicing it. Refill the pump casing with cool liquid.

**WARNING!**

**Do not remove plates, covers, gauges, pipe plugs, or fittings from an overheated pump. Vapor pressure within the pump can cause parts being disengaged to be ejected with great force. Allow the pump to cool before servicing.**

### Strainer Check

If a suction strainer has been shipped with the pump or installed by the user, check the strainer regularly, and clean it as necessary. The strainer should also be checked if pump flow rate begins to drop. If a vacuum suction gauge has been installed, monitor and record the readings regularly to detect strainer blockage.

**Never** introduce air or steam pressure into the pump casing or piping to remove a blockage. This could result in personal injury or damage to the equipment. If backflushing is absolutely necessary, **liquid pressure** must be limited to 50% of the maximum permissible operating pressure shown

on the pump performance curve. (See Section E, Page 1.)

**Pump Vacuum Check**

With the pump inoperative, install a vacuum gauge in the system, using pipe dope on the threads. Block the suction line and start the pump. At operating speed the pump should pull a vacuum of 20 inches (508,0 mm) or more of mercury. If it does not, check for air leaks in the seal, gasket, or discharge valve.

Open the suction line, and read the vacuum gauge with the pump primed and at operation speed. Shut off the pump. The vacuum gauge reading will immediately drop proportionate to static suction lift, and should then stabilize. If the vacuum reading falls off rapidly after stabilization, an air leak exists. Before checking for the source of the leak, check the point of installation of the vacuum gauge.

## STOPPING

Never halt the flow of liquid suddenly. If the liquid being pumped is stopped abruptly, damaging shock waves can be transmitted to the pump and piping system. Close all connecting valves slowly.


If the application involves a high discharge head, gradually close the discharge throttling valve before stopping the pump.

After stopping the pump, lock out or disconnect the power source to ensure that the pump will remain inoperative.

**Cold Weather Preservation**

In below freezing conditions, drain the pump to prevent damage from freezing. Also, clean out any solids by flushing with a hose. Operate the pump for approximately one minute; this will remove any remaining liquid that could freeze the pump rotating parts. If the pump will be idle for more than a few hours, or if it has been pumping liquids containing a large amount of solids, drain the pump, and flush it thoroughly with clean water. To prevent large solids from clogging the drain port and preventing the pump from completely draining, insert a rod or stiff wire in the drain port, and agitate the liquid during the draining process. Clean out any remaining solids by flushing with a hose.

## BEARING TEMPERATURE CHECK

Bearings normally run at higher than ambient temperatures because of heat generated by friction. Temperatures up to 160°F (71°C) are considered normal for bearings, and they can operate safely to at least 180°F (82°C).

Checking bearing temperatures by hand is inaccurate. Bearing temperatures can be measured accurately by placing a contact-type thermometer against the housing. Record this temperature for future reference.

A sudden increase in bearing temperatures is a warning that the bearings are at the point of failing to operate properly. Make certain that the bearing lubricant is of the proper viscosity and at the correct level (see **LUBRICATION** in Section E). Bearing overheating can also be caused by shaft misalignment and/or excessive vibration.

When pumps are first started, the bearings may seem to run at temperatures above normal. Continued operation should bring the temperatures down to normal levels.

# TROUBLESHOOTING — SECTION D

**Review all SAFETY information in Section A.**

**WARNING!**

**Before attempting to open or service the pump:**

1. **Familiarize yourself with this manual.**
2. **Lock out or disconnect the power source to ensure that the pump will remain inoperative.**
3. **Allow the pump to completely cool if overheated.**
4. **Check the temperature before opening any covers, plates, or plugs.**
5. **Close the suction and discharge valves.**
6. **Vent the pump slowly and cautiously.**
7. **Drain the pump.**

| TROUBLE | POSSIBLE CAUSE | PROBABLE REMEDY |
|---|---|---|
| PUMP FAILS TO PRIME | Not enough liquid in casing. | Add liquid to casing. See **PRIMING**. |
| | Suction check valve contaminated or damaged. | Clean or replace check valve. |
| | Air leak in suction line. | Correct leak. |
| | Lining of suction hose collapsed. | Replace suction hose. |
| | Leaking or worn seal or pump gasket. | Check pump vacuum. Replace leaking or worn seal or gasket. |
| | Suction lift or discharge head too high. | Check piping installation and install bypass line if needed. See **INSTALLATION**. |
| | Strainer clogged. | Check strainer and clean if necessary. |
| PUMP STOPS OR FAILS TO DELIVER RATED FLOW OR PRESSURE | Air leak in suction line. | Correct leak. |
| | Lining of suction hose collapsed. | Replace suction hose. |
| | Leaking or worn seal or pump gasket. | Check pump vacuum. Replace leaking or worn seal or gasket. |
| | Strainer clogged. | Check strainer and clean if necessary. |
| | Suction intake not submerged at proper level or sump too small. | Check installation and correct submergence as needed. |

| TROUBLE | POSSIBLE CAUSE | PROBABLE REMEDY |
|---|---|---|
| PUMP STOPS OR FAILS TO DELIVER RATED FLOW OR PRESSURE (cont.) | Impeller or other wearing parts worn or damaged. | Replace worn or damaged parts. Check that impeller is properly centered and rotates freely. |
| | Impeller clogged. | Free impeller of debris. |
| | Pump speed too slow. | Check driver output; check belts or couplings for slippage. |
| | Discharge head too high. | Install bypass line. |
| | Suction lift too high. | Measure lift w/vacuum gauge. Reduce lift and/or friction losses in suction line. |
| PUMP REQUIRES TOO MUCH POWER | Pump speed too high. | Check driver output; check that sheaves or couplings are correctly sized. |
| | Discharge head too low. | Adjust discharge valve. |
| | Liquid solution too thick. | Dilute if possible. |
| | Bearing(s) frozen. | Disassemble pump and check bearing(s). |
| PUMP CLOGS FREQUENTLY | Liquid solution too thick. | Dilute if possible. |
| | Discharge flow too slow. | Open discharge valve fully to increase flow rate, and run power source at maximum governed speed. |
| | Suction check valve or foot valve clogged or binding. | Clean valve. |
| EXCESSIVE NOISE | Cavitation in pump. | Reduce suction lift and/or friction losses in suction line. Record vacuum and pressure gauge readings and consult local representative or factory. |
| | Pumping entrained air. | Locate and eliminate source of air bubble. |
| | Pump or drive not securely mounted. | Secure mounting hardware. |
| | Impeller clogged or damaged. | Clean out debris; replace damaged parts. |
| BEARINGS RUN TOO HOT | Bearing temperature is high, but within limits. | Check bearing temperature regularly to monitor any increase. |
| | Low or incorrect lubricant. | Check for proper type and level of lubricant. |
| | Suction and discharge lines not properly supported. | Check piping installation for proper support. |
| | Drive misaligned. | Align drive properly. |

## PREVENTIVE MAINTENANCE

Since pump applications are seldom identical, and pump wear is directly affected by such things as the abrasive qualities, pressure and temperature of the liquid being pumped, this section is intended only to provide general recommendations and practices for preventive maintenance. Regardless of the application however, following a routine preventive maintenance schedule will help assure trouble-free performance and long life from your Gorman-Rupp pump. For specific questions concerning your application, contact your Gorman-Rupp distributor or the Gorman-Rupp Company.

Record keeping is an essential component of a good preventive maintenance program. Changes in suction and discharge gauge readings (if so equipped) between regularly scheduled inspections can indicate problems that can be corrected before system damage or catastrophic failure occurs. The appearance of wearing parts should also be documented at each inspection for comparison as well. Also, if records indicate that a certain part (such as the seal) fails at approximately the same duty cycle, the part can be checked and replaced before failure occurs, reducing unscheduled down time.

For new applications, a first inspection of wearing parts at 250 hours will give insight into the wear rate for your particular application. Subsequent inspections should be performed at the intervals shown on the chart below. Critical applications should be inspected more frequently.

**Preventive Maintenance Schedule**

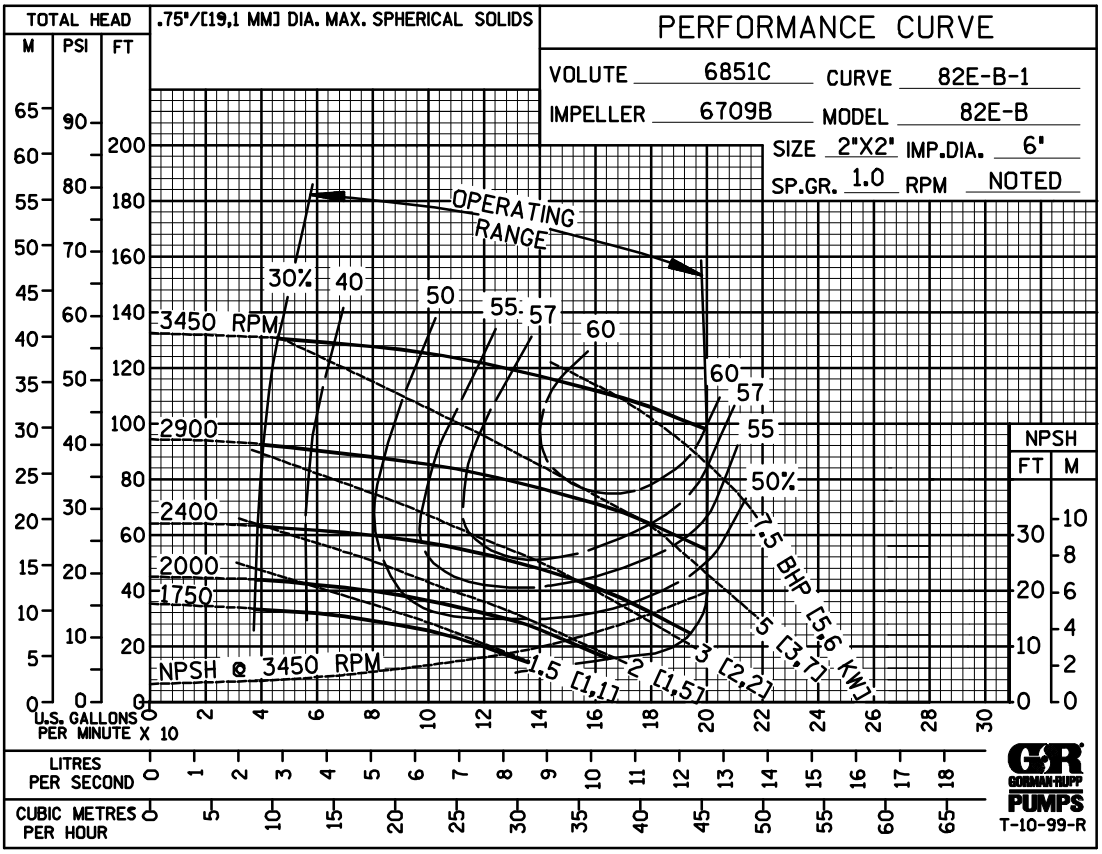
| Item | Service Interval* | | | | |
|---|---|---|---|---|---|
| | Daily | Weekly | Monthly | Semi-Annually | Annually |
| General Condition (Temperature, Unusual Noises or Vibrations, Cracks, Leaks, Loose Hardware, Etc.) | I | | | | |
| Pump Performance (Gauges, Speed, Flow) | I | | | | |
| Bearing Lubrication | | I | | | R |
| Seal Lubrication (And Packing Adjustment, If So Equipped) | | I | | | R |
| V-Belts (If So Equipped) | | | I | | |
| Air Release Valve Plunger Rod (If So Equipped) | | | I | C | |
| Front Impeller Clearance (Wear Plate) | | | | I | |
| Rear Impeller Clearance (Seal Plate) | | | | I | |
| Check Valve | | | | | I |
| Pressure Relief Valve (If So Equipped) | | | | | C |
| Pump and Driver Alignment | | | | | I |
| Shaft Deflection | | | | | I |
| Bearings | | | | | I |
| Bearing Housing | | | | | I |
| Piping | | | | | I |
| Driver Lubrication — See Mfgr's Literature | | | | | |

Legend:
I = Inspect, Clean, Adjust, Repair or Replace as Necessary
C = Clean
R = Replace

* Service interval based on an intermittent duty cycle equal to approximately 4000 hours annually. Adjust schedule as required for lower or higher duty cycles or extreme operating conditions.

# PUMP MAINTENANCE AND REPAIR – SECTION E

**MAINTENANCE AND REPAIR OF THE WEARING PARTS OF THE PUMP WILL MAINTAIN PEAK OPERATING PERFORMANCE.**




**✳ STANDARD PERFORMANCE FOR PUMP MODEL 82E2–B**

✳ Based on 70° F (21° C) clear water at sea level with minimum suction lift. Since pump installations are seldom identical, your performance may be difference due to such factors as viscosity, specific gravity, elevation, temperature, and impeller trim.

If your pump serial number is followed by an "N", your pump is **NOT** a standard production model. Contact the Gorman-Rupp Company to verify performance or part numbers.

**CAUTION**

Pump speed and operating condition points must be within the continuous performance range shown on the curve.

## SECTION DRAWING

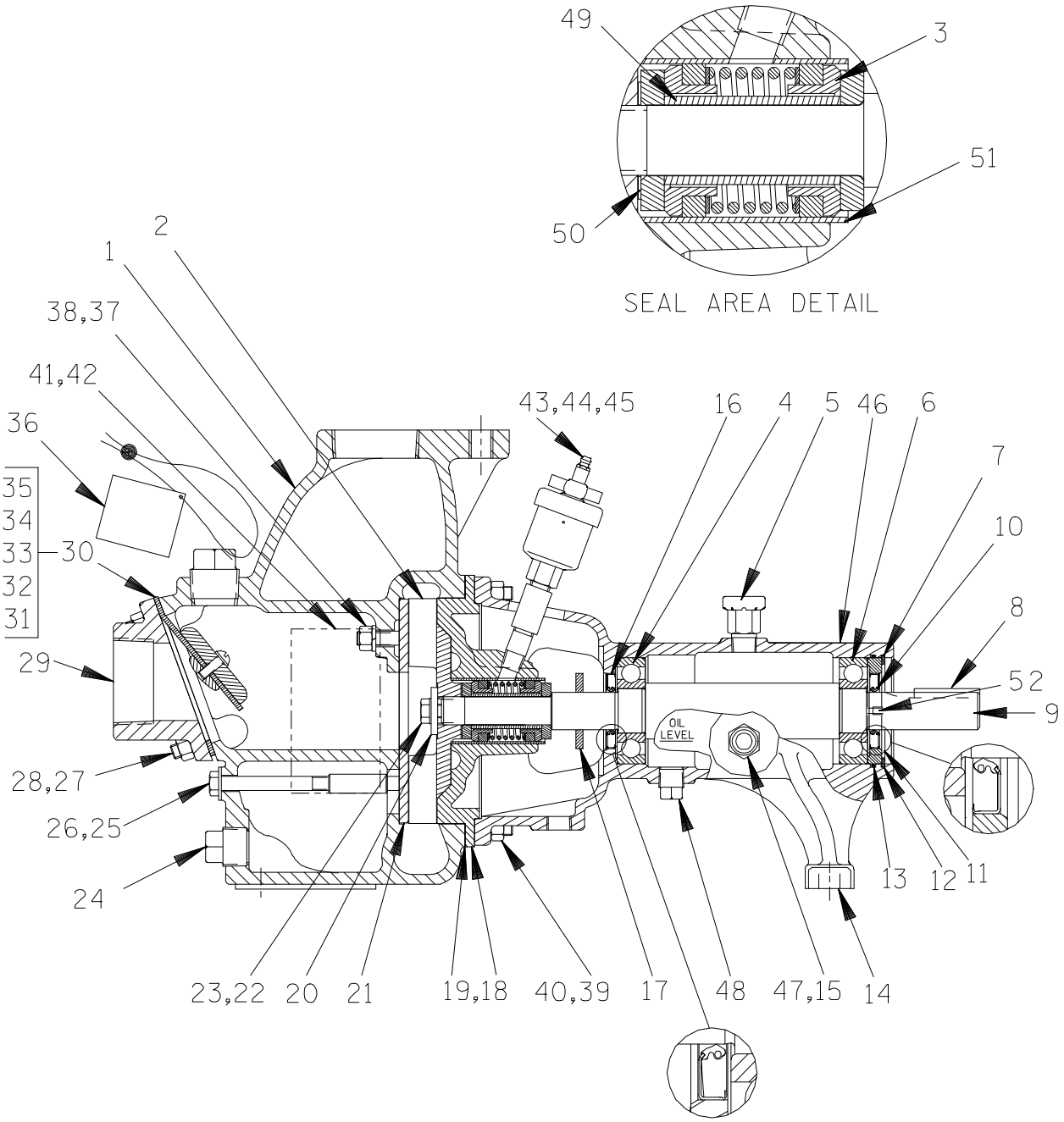



**Figure 1. Pump Model 82E2—B**

# PARTS LIST
## Pump Model 82E2–B
(From S/N 717191up)

If your pump serial number is followed by an "N", your pump is **NOT** a standard production model. Contact the Gorman-Rupp Company to verify part numbers.

| ITEM NO. | | PART NAME | PART NUMBER | MAT'L CODE | QTY |
|---|---|---|---|---|---|
| 1 | | PUMP CASING | 6851C | 10010 | 1 |
| 2 | ✳ | IMPELLER | 6709B | 10010 | 1 |
| 3 | ✳ | SEAL ASSEMBLY | GS750 | ––– | 1 |
| 4 | ✳ | BALL BEARING | S390 | ––– | 1 |
| 5 | | AIR VENT | S1703 | ––– | 1 |
| 6 | ✳ | BALL BEARING | S390 | ––– | 1 |
| 7 | | RETAINING RING | S219 | ––– | 1 |
| 8 | ✳ | KEY | N0407 | 15990 | 1 |
| 9 | | IMPELLER SHAFT | 38514–209 | 15010 | 1 |
| 10 | ✳ | OIL SEAL | 25227–216 | ––– | 1 |
| 11 | ✳ | BEARING ADJ SHIM SET | S464 | ––– | 1 |
| 12 | | BEARING RETAINER | 38322–517 | 26000 | 1 |
| 13 | ✳ | O-RING | 25152–149 | ––– | 1 |
| 14 | | PEDESTAL | 3212C | 10010 | 1 |
| 15 | | SIGHT GAGE | 26714–011 | ––– | 1 |
| 16 | ✳ | OIL SEAL | 25227–216 | ––– | 1 |
| 17 | | SLINGER RING | 2351 | 19120 | 1 |
| 18 | | SEAL PLATE ASSY | 388A | 10010 | 1 |
| 19 | ✳ | GASKET SET | 229G | 18000 | 1 |
| 20 | ✳ | WASHER | 3118 | 15990 | 1 |
| 21 | ✳ | WEAR PLATE ASSY | 6822 | 15990 | 1 |
| 22 | | HEX HD CAP SCREW | B0603 | 15991 | 1 |
| 23 | | T-TYPE LOCK WASHER | AK06 | 15991 | 1 |
| 24 | | PIPE PLUG | P12 | 15079 | 1 |
| 25 | | HEX HD CAP SCREW | B0614 | 15991 | 1 |
| 26 | | FLAT WASHER | KF06 | 18040 | 1 |
| 27 | | STUD | C0606 | 15991 | 4 |
| 28 | | HEX NUTS | D06 | 15991 | 4 |
| 29 | | SUCTION FLANGE | 1361 | 10010 | 1 |
| 30 | | FLAP VALVE ASSY | 1361A | ––– | 1 |
| 31 | | –SMALL VALVE WEIGHT | 1354 | 15160 | 1 |
| 32 | | –RD HD MACH SCREW | X0403 | 17090 | 1 |
| 33 | | –LOCK WASHER | J04 | 17090 | 1 |
| 34 | | –LARGE VALVE WEIGHT | 19B | 10010 | 1 |
| 35 | ✳ | –FLAP VALVE GASKET | 1361G | 19070 | 1 |
| 36 | | FILL PLUG ASSY | 48271–062 | ––– | 1 |
| 37 | | HEX NUT | D06 | 15991 | 1 |
| 38 | | LOCK WASHER | J06 | 15991 | 1 |
| 39 | | STUD | C0607 | 15991 | 6 |
| 40 | | HEX NUTS | D06 | 15991 | 6 |
| 41 | | NAME PLATE | 388818–019 | 13990 | 1 |
| 42 | | DRIVE SCREW | BM#04–03 | 17000 | 4 |
| 43 | | GREASE CUP | S36 | ––– | 1 |
| 44 | | PIPE COUPLING | AE04 | 15079 | 1 |
| 45 | | PIPE NIPPLE | T0406 | 15079 | 1 |
| 46 | | ROTATION DECAL | 2613M | ––– | 1 |
| 47 | | PIPE PLUG | P06 | 15079 | 1 |
| 48 | | PIPE PLUG | P06 | 15079 | 1 |
| 49 | ✳ | SPACER SLEEVE | NOT AVAILABLE | | REF |
| 50 | ✳ | IMPELLER ADJ SHIM SET | 2Y | 17090 | REF |
| 51 | ✳ | SEAL LINER | 82 | 14080 | 1 |
| 52 | | SET SCREW | GA#10–01S | 15990 | 2 |
| NOT SHOWN: | | | | | |
| | | G-R DECAL | GR–03 | ––– | 1 |
| | | LUBE DECAL | 388816–079 | ––– | 1 |
| | | INSTRUCTION TAG | 38817–011 | ––– | 1 |
| | | INSTRUCTION TAG | 38817–028 | ––– | 1 |
| | | SUCTION STICKER | 6588AG | ––– | 1 |
| | | PRIMING STICKER | 6588AH | ––– | 1 |
| | | GREASE CUP INSTR | 6588BD | ––– | 1 |
| | | DISCHARGE STICKER | 6588BJ | ––– | 1 |
| OPTIONAL: | | | | | |
| | | 2" STRAINER | 26841–025 | ––– | 1 |
| | | IRON SEAL | GS750A | ––– | 1 |
| | | IRON SEAL | GS750B | ––– | 1 |
| | | STREET ELBOW | RS32 | 11999 | 1 |

✳ INDICATES PARTS RECOMMENDED FOR STOCK

## PUMP AND SEAL DISASSEMBLY AND REASSEMBLY

**Review all SAFETY information Section A.**

**Follow the instructions on all tags, label and decals attached to the pump.**

This pump requires little service due to its rugged, minimum-maintenance design. However, if it becomes necessary to inspect or replace the wearing parts, follow these instructions which are keyed to the sectional view (see Figure 1) and the accompanying parts lists.

As described on the following pages, this manual will alert personnel to known procedures which require special attention, to those which could damage equipment, and to those which could be dangerous to personnel. However, this manual cannot possibly anticipate and provide detailed precautions for every situation that might occur during maintenance of the unit. Therefore, it is the responsibility of the owner/maintenance personnel to ensure that **only** safe, established maintenance procedures are used, and that any procedures not addressed in this manual are performed **only** after establishing that neither personal safety nor pump integrity are compromised by such practices.

Before attempting to service the pump, lock out or disconnect the power source to ensure that it will remain inoperative. Close all valves in the suction and discharge lines.

For power source disassembly and repair, consult the literature supplied with the power source, or contact your local power source representative.

**WARNING!**

**Before attempting to open or service the pump:**

1. **Familiarize yourself with this manual.**
2. **Lock out or disconnect the power source to ensure that the pump will remain inoperative.**
3. **Allow the pump to completely cool if overheated.**
4. **Check the temperature before opening any covers, plates, or plugs.**
5. **Close the suction and discharge valves.**
6. **Vent the pump slowly and cautiously.**
7. **Drain the pump.**

**WARNING!**

**Use lifting and moving equipment in good repair and with adequate capacity to prevent injuries to personnel or damage to equipment. Suction and discharge hoses and piping must be removed from the pump before lifting.**

**Suction Check Valve Disassembly**

Before attempting to service the pump, remove the pump casing drain plug (24) and drain the pump. Clean and reinstall the drain plug.

To service the suction check valve, remove the suction piping. Remove the nuts (28) securing the suction flange (29) and the check valve assembly (30) to the pump casing (1). Pull the check valve assembly from the suction port.

Inspect the check valve parts for wear or damage. If replacement is required, remove the hardware (32 and 33) and separate the valve gasket (35) and weights (31 and 34).

If no further disassembly is required, see **Suction Check Valve Installation**.

**Pump Casing Removal**

To service the impeller (2), wear plate assembly (21) and seal assembly (3), disconnect the discharge piping. Remove the hardware securing the pump casing (1) to the base.

Remove the nuts (40) securing the pump casing and gasket set (19) to the pedestal (14) and seal plate (18). Install a standard 5/8–11 UNC lifting eye in the tapped hole in the top of the pump casing. **Be sure** to screw the eye into the casing until fully engaged. Use a hoist and sling of suitable capacity to separate the casing from the seal plate and pedestal.

**WARNING!**

**Do not attempt to lift the complete pump unit using the lifting eye. It is designed to facilitate removal or installation of individual components only. Additional weight may result in damage to the pump or failure of the eye bolt.**

Remove the gasket set (19) from the pedestal and seal plate. Tie and tag the gaskets, or measure and record their thickness for ease of reassembly. Tie and tag any leveling shims used under the casing mounting feet to ease reassembly.

Inspect the wear plate assembly and replace it if badly scored or worn. To remove the wear plate assembly, remove the capscrew (25) and fiber washer (26) just below the suction port. Reach through the suction port and disengage the hardware (37 and 38) from the wear plate. Tap the wear plate assembly free of the casing.

**Impeller Removal**

Before removing the impeller, turn the cross arm on the automatic grease cup (8) clockwise until it rest against the cover (see Figure 4). This will prevent the grease from escaping when the impeller is removed. Remove the grease cup and piping (43, 44 and 45).

Immobilize the impeller by wedging a block of wood between the vanes. Remove the hardware (20, 22 and 23) securing the impeller to the shaft. If removed, install the shaft key (8). Install a lathe dog on the drive end of the shaft (9) with the “V” notch positioned over the shaft keyway.

With the impeller rotation still blocked, strike the lathe dog sharply in a counterclockwise direction (when facing the drive end of the shaft). The impeller may also be loosened by using a long piece of heavy bar stock to pry against the arm of the lathe dog in a counterclockwise direction (when facing the drive end of the shaft) as shown in Figure 2. **Use caution** not to damage the shaft or keyway. When the impeller breaks loose, remove the lathe dog and wood block and unscrew the impeller from the shaft.

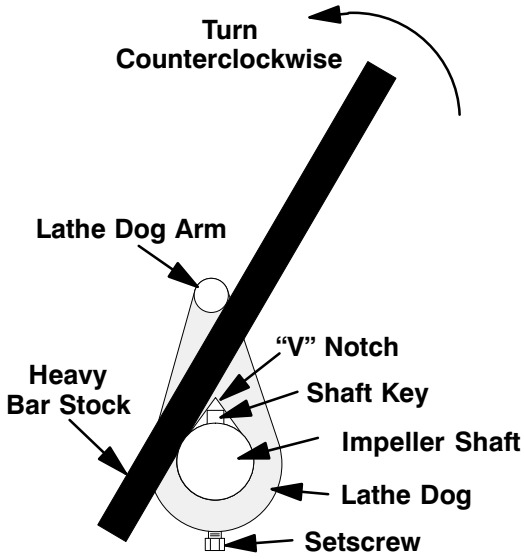



**Figure 2. Loosening Impeller**

Unscrew the impeller from the shaft. Use caution when removing the impeller; tension on the seal spring will be released as the impeller is unscrewed.

Inspect the impeller and replace it if cracked or badly worn. Slide the impeller adjusting shims (50) off the impeller shaft. Tie and tag the shims, or measure and record their thickness for ease of reassembly.

**Seal Removal and Disassembly**

**(Figures 1 or 3)**

Carefully remove the outer rotating and stationary seal elements, packing ring, stationary washer, seal spring and shaft sleeve from the seal plate. Use a stiff wire with a hooked end to remove the inboard stationary washer, packing ring, stationary and rotating seal elements.

Inspect the seal liner (51) for wear or grooves which could cause leakage or damage to the seal packing rings. The seal liner is a press fit in the seal plate and does not normally require replacement. If replacement is necessary, disengage the hardware (9 and 10) and separate the seal plate from the engine. See **Seal Reassembly And Installation** for seal liner replacement.

If no further disassembly is required, see **Seal Reassembly and Installation**.

**Shaft And Bearing Removal And Disassembly**

When the pump is properly operated and maintained, the pedestal should not require disassembly. Disassemble the shaft and bearings **only** when there is evidence of wear or damage.

**CAUTION**

Shaft and bearing disassembly in the field is not recommended. these operations should be performed only in a properly-equipped shop by qualified personnel.

Remove the pedestal drain plug (48) and drain the pedestal. Clean and reinstall the plug.

Remove the slinger ring (17) from the shaft. Remove the pedestal mounting hardware from the base. Tie and tag any shims used under the mounting feet for leveling.

Use snap ring pliers to remove the bearing retaining ring (7) from the pedestal bore. Remove the bearing shim set (11); tie and tag the shims, or measure and record their thickness for ease of reassembly.

Remove the setscrews (52) from the bearing retainer (12) and install two machine screws (#10—32 X 1—inch long, not supplied). Pry the retainer from the pedestal bore using a pair of screwdrivers against the heads of the machine screws. **Do not** use the machine screws to jack against the ball bearing. Remove the machine screws and reinstall the setscrews.

Press the oil seal (10) from the bearing retainer, and remove the O-ring (13) from the pedestal bore.

Place a block of wood against the impeller end of the shaft and tap the shaft and assembled bearings (4 and 6) out of the pedestal.

Press the oil seal (16) from the pedestal bore.

After removing the shaft and bearings, clean and inspect the bearings **in place** as follows.

**CAUTION**

To prevent damage during removal from the shaft, it is recommended that bearings be cleaned and inspected **in place**. It is **strongly** recommended that the bearings be replaced **any** time the shaft and bearings are removed.

Clean the pedestal, shaft and all component parts (except the bearings) with a soft cloth soaked in cleaning solvent. Inspect the parts for wear or damage and replace as necessary.

**WARNING!**

**Most cleaning solvents are toxic and flammable. Use them only in a well-ventilated area free from excessive heat, sparks, and flame. Read and follow all precautions printed on solvent containers.**

Inspect the shaft for distortion, nicks or scratches, or thread damage on the impeller end. Dress small nicks and burrs with a fine file or emery cloth. Replace the shaft if defective.

Clean the bearings thoroughly in **fresh** cleaning solvent. Dry the bearings with filtered compressed air and coat with light oil.

**CAUTION**

Bearings must be kept free of all dirt and foreign material. Failure to do so will greatly shorten bearing life. **Do not** spin dry bearings. This may scratch the balls or races and cause premature bearing failure.

Rotate the bearings by hand to check for roughness or binding and inspect the bearing balls. If rotation is rough or the bearing balls are discolored, replace the bearings.

The bearing tolerances provide a tight press fit onto the shaft and a snug slip fit into the pedestal.

Replace the bearings, shaft, or pedestal if the proper bearing fit is not achieved.

If bearing replacement is required, use a bearing puller to remove the inboard and outboard bearings from the impeller shaft.

**Shaft And Bearing Reassembly And Installation**

Clean and inspect the bearings as indicated in **Shaft and Bearing Removal and Disassembly**.

**CAUTION**

To prevent damage during removal from the shaft, it is recommended that bearings be cleaned and inspected **in place**. It is **strongly** recommended that the bearings be replaced **any** time the shaft and and bearings are removed.

The bearings may be heated to ease installation. An induction heater, hot oil bath, electric oven, or hot plate may be used to heat the bearings. Bearings should **never** be heated with a direct flame or directly on a hot plate.

**NOTE**

*If a hot oil bath is used to heat the bearings, both the oil and the container must be **absolutely** clean. If the oil has been previously used, it must be **thoroughly** filtered.*

Heat the bearings to a uniform temperature **no higher than** 250°F (120°C), and slide the bearings onto the shaft, one at a time, until they are fully seated. This should be done quickly, in one continuous motion, to prevent the bearings from cooling and sticking on the shaft.

**WARNING!**

**Use caution when handling hot bearings to prevent burns.**

After the bearings have been installed and allowed to cool, check to ensure that they have not moved out of position in shrinking. If movement has occurred, use a suitably sized sleeve and a press to reposition the bearings.

If heating the bearings is not practical, use a suitably sized sleeve and an arbor (or hydraulic) press to install the bearings on the shaft.

**CAUTION**

When installing the bearings onto the shaft, **never** press or hit against the outer race, balls, or ball cage. Press **only** on the inner race.

Slide the shaft and assembled bearings into the pedestal until the inboard bearing is fully seated against the bore shoulder.

**CAUTION**

When installing the shaft and bearings into the bearing bore, push against the outer race. **Never** hit the balls or ball cage.

Position the inboard oil seal (23) in the pedestal (14) with the lip positioned as shown in Figure E—1. Press the oil seal into the pedestal until the face is **just flush** with the machined surface in the housing.

Position the oil seal (10) in the bearing retainer (12) with the lip positioned as shown in Figure 1. Press the oil seal into the retainer until fully seated.

Replace the bearing retainer O-ring (13) in the pedestal, and lubricate it with grease. Press the bearing retainer into the pedestal until it seats against the bearing. Be careful not to cut the oil seal lip on the shaft keyway. **Be sure** the setscrews (52) in the bearing retainer are positioned horizontally inline.

Install the same thickness of bearing adjusting shims (11) as previously removed. Reinstall the retaining ring (7) and check shaft endplay.

**NOTE**

*Shaft endplay should be .002 to .005 inch (0,05 to 0,12 mm). Add or remove bearing adjusting shims to obtain this endplay.*

Install the slinger ring (17) and shaft key (8). Install any leveling shims used under the pedestal feet.

**Seal Reassembly and Installation**

**(Figures 1 and 3)**

Clean the seal cavity and shaft with a cloth soaked in fresh cleaning solvent.

**WARNING!**

**Most cleaning solvents are toxic and flammable. Use them only in a well-ventilated area free from excessive heat, sparks, and flame. Read and follow all precautions printed on solvent containers.**

The seal is not normally reused because wear patterns on the finished faces cannot be realigned during reassembly. This could result in premature failure. If necessary to reuse an old seal in an emergency, **carefully** wash all metallic parts in fresh cleaning solvent and allow to dry thoroughly.

Handle the seal parts with extreme care to prevent damage. Be careful not to contaminate precision finished faces; even fingerprints on the faces can shorten seal life. If necessary, clean the faces with a non-oil based solvent and a clean, lint-free tissue. Wipe **lightly** in a concentric pattern to avoid scratching the faces.

Inspect the seal components for wear, scoring, grooves, and other damage that might cause leakage. Clean and polish the shaft sleeve, or replace it if there are nicks or cuts on either end. If any components are worn, replace the complete seal; **never mix old and new seal parts**.

If a replacement seal is being used, remove it from the container and inspect the precision finished faces to ensure that they are free of any foreign matter.

To ease installation of the seal, lubricate the spacer sleeve (49) with water or a very **small** amount of oil, and apply a drop of light lubricating oil on the finished faces. Assemble the seal as follows, (see Figure 3).

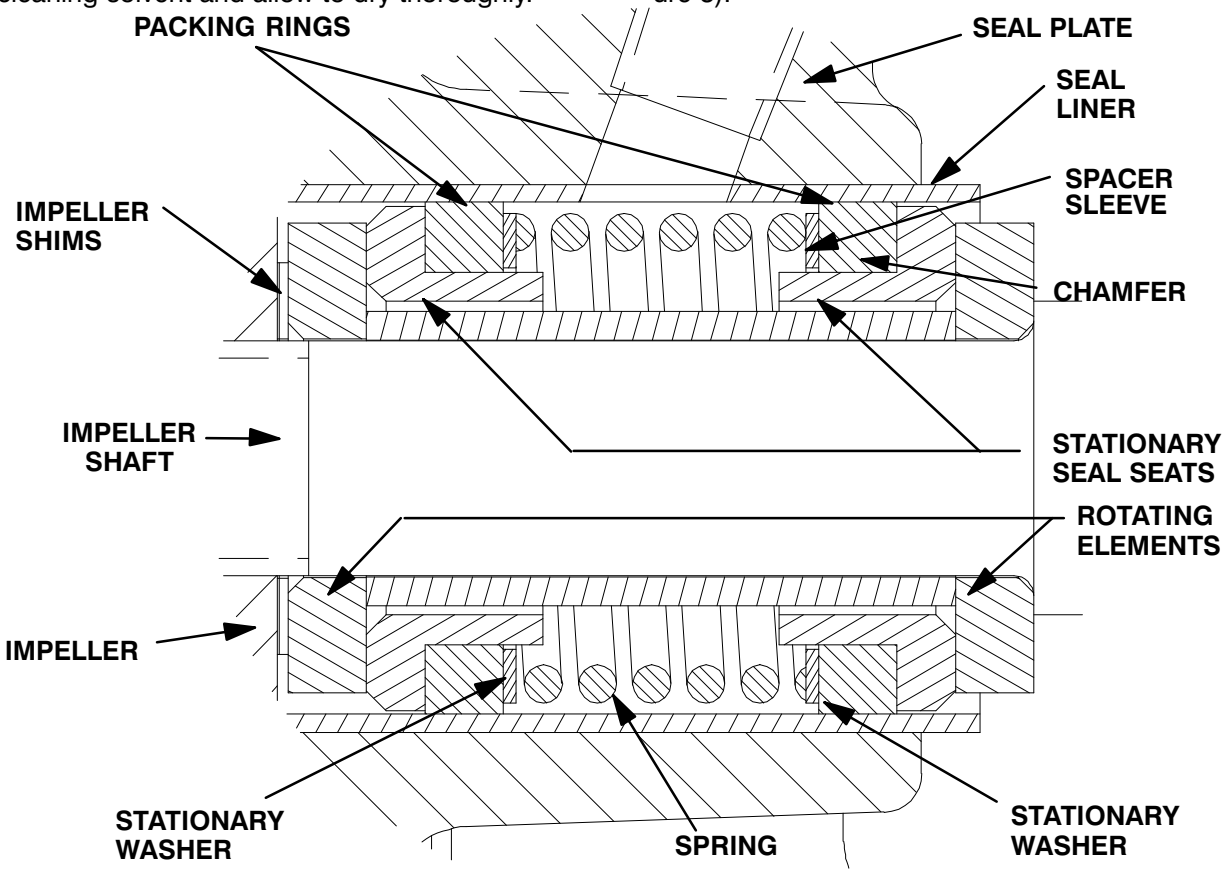



**Figure 3. GS750 Seal Assembly**

**CAUTION**

This seal is not designed for operation at temperatures above 110°F (43°C). Do not use at higher operating temperatures.

Position the inboard rotating element on the shaft with the larger chamfered side **toward the impeller**, and slide it on until fully seated.

Subassemble the inboard stationary seat, packing ring and stationary washer. Press this unit into the lubricated seal liner until the seal faces contact. A push tube cut from a length of plastic pipe would aid this installation. The I.D. of the tube should be approximately the same size as the I.D. of the seal spring.

Install the spacer sleeve and seal spring.

Subassemble the outboard stationary seat, packing ring and stationary washer. Press this unit into the lubricated seal liner. Install the outboard rotating element with the chamfered side **toward the impeller**.

**Impeller Installation and Adjustment**

Inspect the impeller, and replace it if cracked or badly worn. Install the same thickness of impeller shims (50) as previously removed, and screw the impeller onto the shaft until tight.

A clearance of .010 to .020 inch (0,25 to 0,51 mm) between the impeller and the seal plate is necessary for maximum pump efficiency. Measure this clearance and add or remove impeller shims until this clearance is reached.

**NOTE**

*Be sure the seal plate is tight against the pedestal while measuring this clearance.*

After the back clearance is set, secure the impeller with the hardware (20, 22 and 23).

Install the automatic grease cup and piping (43, 44 and 45) in the seal plate. After the impeller is installed, lubricate the seal assembly as indicated in **LUBRICATION**.

**Pump Casing Installation**

If the wear plate assembly (21) was removed, position the replacement wear plate assembly squarely against the casing shoulder and secure it with the mounting hardware (25, 26, 37 and 38). Replace the fiber washer (26) if badly worn or compressed.

Remove the hardware temporarily securing the seal plate to the pedestal. Install the same thickness of pump casing gaskets (19) as previously removed. Secure the pump casing (1) to the seal plate and pedestal with the nuts (40). **Do not** fully tighten the nuts at this time.

A clearance of .008 to .015 inch (0,20 to 0,38 mm) between the impeller and the wear plate is also recommended for maximum pump efficiency. Set this clearance by adding or removing gaskets in the pump casing gasket set (19) until the impeller scrapes against the wear plate when the shaft is turned by hand. After the impeller scrapes, add approximately .008 inch (0,20 mm) of gaskets.

Secure the pump casing to the base with the previously removed hardware. Be sure to reinstall any leveling shims used under the mounting feet of the pump casing.

If a lifting eye was used to move the pump casing, **be sure** to remove the lifting eye from the pump casing.

**WARNING!**

**Do not attempt to lift the complete pump unit using the lifting eye. It is designed to facilitate removal or installation of individual components only. Additional weight may result in damage to the pump or failure of the eye bolt.**

**Suction Check Valve Installation**

Inspect components of the check valve assembly (30) and replace as required. If separated at disassembly, assemble the check valve weights (31 and 34) to the check valve gasket (35) with the hardware (32 and 33).

Position the check valve assembly in the suction port with the large weight (34) facing toward the inside of the pump casing. Install the suction flange (29) and secure with the nuts (28). Check the operation of the check valve to ensure proper seating and free movement.

### Final Pump Assembly

**Be sure** the pump and power source are securely mounted to the base. Reconnect the power source to the pump.

Install the suction and discharge lines and open all valves. Make certain that all piping connections are tight, properly supported and secure.

If a lifting eye was used to move the pump casing, **be sure** to remove the lifting eye from the pump casing.

**Be sure** the pump and power source have been properly lubricated, see **LUBRICATION**.

Fill the pump casing with clean liquid. Reinstall the fill plug (8) and tighten it.

Refer to **OPERATION**, Section C, before putting the pump back into service.

## LUBRICATION

### Seal Assembly

**(Figures 1 and 4)**

Fill the grease cup (43) through the grease fitting with No. 2 lithium base grease until grease escapes from the relief hole. Turn the grease cup arm counterclockwise until it is at the top of the stem; this will release the spring to apply grease to the seal (see Figure 4).

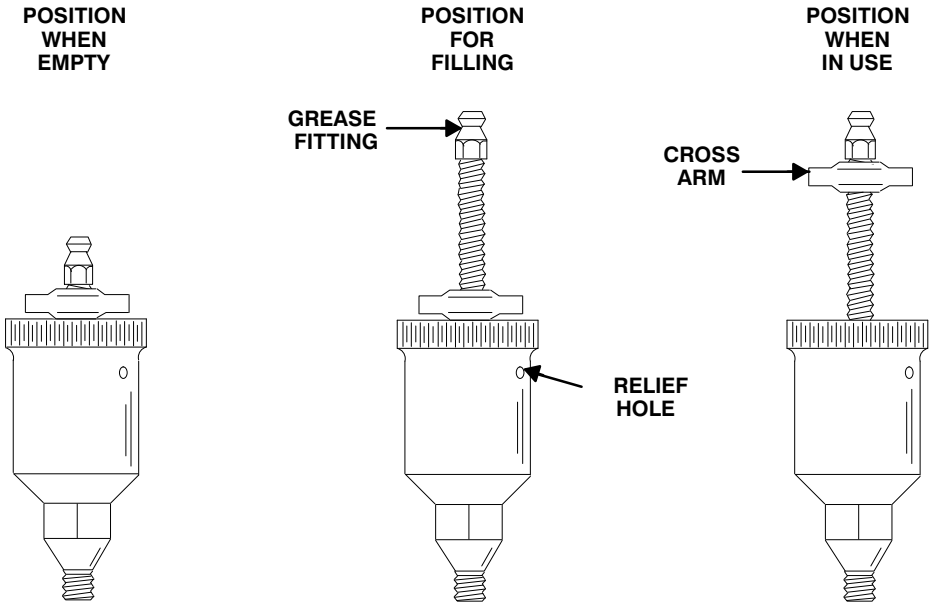



**Figure 4. Automatic Lubricating Grease Cup**

### Bearings

The pedestal was fully lubricated when shipped from the factory. Check the oil level regularly through the sight gauge (15) and maintain it at the middle of the gauge. When lubrication is required, add SAE No. 30 non-detergent oil through the hole for the air vent (5). **Do not** over-lubricate. Over-lubrication can cause the bearings to over-heat, resulting in premature bearing failure.

**NOTE**

*The white reflector in the sight gauge must be positioned horizontally to provide proper drainage.*

Under normal conditions, change the oil each 5000 hours or once each year, more frequently if the pump is operated continuously or installed in an environment with rapid temperature change.


Monitor the condition of the bearing lubricant regularly for evidence of rust or moisture condensation. This is especially important in areas where variable hot and cold temperatures are common.

For cold weather operation, consult the factory or a lubricant supplier for the recommended grade of oil.

**Power Source**

Consult the literature supplied with the power source, or contact your local power source representative.

**For U.S. and International Warranty Information,**
**Please Visit www.grpumps.com/warranty**
**or call:**
**U.S.: 419—755—1280**
**International: +1—419—755—1352**

**For Canadian Warranty Information,**
**Please Visit www.grcanada.com/warranty**
**or call:**
**519—631—2870**

THE GORMAN-RUPP COMPANY ● MANSFIELD, OHIO
GORMAN-RUPP OF CANADA LIMITED ● ST. THOMAS, ONTARIO, CANADA

## Appendix C
# Inspection Forms

**DNAPL/GW Collection System Inspection Form**
**Velsicol/Pine River Site**
**St, Louis, Michigan**

Date:_____ Inspector/Operator_____

**Rating Evaluations: S = Satisfactory U = Unsatisfactory**

| | S | U | Notes/ActionsTaken |
|---|---|---|---|
| **Secxondary Containment Pad** | | | |
| Control panel boxes secure with no evidence of tampering? | | | |
| Totalizer operation | | | |
| Discharge hose in good condition with no leaks present | | | |
| Tanks in good condition with no evidence of leaks or tampering? | | | |
| Secondary containment pad dewatering complete (as needed, can be accomplished in conjuntion with inspection/operation)? | | | |
| Centrifigal (system booster pump) pump lubrication (oil level and grease cup) (See ISMP, Appendix B) | | | |
| Heat trace operational? (cold weather only) | | | |
| Other/non-routine issues: | | | |
| **MH-1 control station** | | | |
| Gate to manhole secure and locked? | | | |
| Control panel boxes secure with no evidence of tampering? | | | |
| Pump and valve boxes in good repair with no evidence of tampering? | | | |
| Submersible pump operation (if Unsatisfactory/abnormal, explain at right): | | | |
| Pump Box dry with no evidence of leaks? | | | |
| Pump box heater operational (Cold weather Only) | | | |
| Secondary Leak alarm status (S=no leak indicated; U=leak indiocated) | | | |
| Centrifigal pump lubrication (oil level and grease cup) (See ISMP, Appendix B) | | | |
| Manhole cover secure and intact? | | | |
| Other/non-routine issues: | | | |

**DNAPL/GW Collection System Inspection Form**
**Velsicol/Pine River Site**
**St, Louis, Michigan**

Date:_____ Inspector/Operator_____

**Rating Evaluations: S = Satisfactory U = Unsatisfactory**

| | S | U | Notes/ActionsTaken |
|---|---|---|---|
| **MH-2 control station** | | | |
| Gate to manhole secure and locked? | | | |
| Control panel boxes secure with no evidence of tampering? | | | |
| Pump and valve boxes in good repair with no evidence of tampering? | | | |
| Submersible pump operation (if Unsatisfactory/abnormal, explain at right): | | | |
| Pump Box dry with no evidence of leaks? | | | |
| Pump box heater operational (Cold weather Only) | | | |
| Secondary Leak alarm status (S=no leak indicated; U=leak indiocated) | | | |
| Centrifigal pump lubrication (oil level and grease cup) (See ISMP, Appendix B) | | | |
| Manhole cover secure and intact? | | | |
| Other/non-routine issues: | | | |
| **MH-3 control station** | | | |
| Gate to manhole secure and locked? | | | |
| Control panel boxes secure with no evidence of tampering? | | | |
| Pump and valve boxes in good repair with no evidence of tampering? | | | |
| Submersible pump operation (if Unsatisfactory/abnormal, explain at right): | | | |
| Pump Box dry with no evidence of leaks? | | | |
| Pump box heater operational (Cold weather Only) | | | |
| Secondary Leak alarm status (S=no leak indicated; U=leak indiocated) | | | |
| Centrifigal pump lubrication (oil level and grease cup) (See ISMP, Appendix B) | | | |
| Manhole cover secure and intact? | | | |
| Other/non-routine issues: | | | |

Inspection Form Completed by: _____

# Monthly Shoreline Inspection Form

**Velsicol Pine River Site**
**St. Louis, Michigan**

**Inspector:** _____

**Date:** _____

The monthly shoreline inspection for the date indicated has been completed by the O&M operator. The shorline was free from signs of erosion as well as DNAPL or groundwater seeps, with the following exceptions. The locations noted on this inspection form have been staked in the field and the TTM has been notified.

| Location | Notes/Description |
|---|---|
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |

# DNAPL/GW Collection System Weekly Data Sheet

**Velsicol Pine River Site**
**St. Louis, Michigan**

**Inspector:** _____

**Date:** _____

| MH-1 | Intial | Post Pumping |
|---|---|---|
| Depth to groundwater (feet below top of manhole) | | |
| Relative River Elevation (feet below top of manhole) | | NA |
| DNAPL Thickness (feet) | | NA |
| Total Sump Depth (feet below top of manhole) | | NA |

| MH-2 | Intial | Post Pumping |
|---|---|---|
| Depth to groundwater (feet below top of manhole) | | |
| Relative River Elevation (feet below top of manhole) | | NA |
| DNAPL Thickness (feet) | | NA |
| Total Sump Depth (feet below top of manhole) | | NA |

| MH-3 | Intial | Post Pumping |
|---|---|---|
| Depth to groundwater (feet below top of manhole) | | |
| Relative River Elevation (feet below top of manhole) | | NA |
| DNAPL Thickness (feet) | | NA |
| Total Sump Depth (feet below top of manhole) | | NA |

# DNAPL/GW Collection System Weekly Data Sheet

**Velsicol Pine River Site**
**St. Louis, Michigan**

**Inspector:** _____

**Date:** _____

| **MH-1 Groundwater Removal** | |
|---|---|
| Initial Totalizer Reading (gallons) | |
| Final Totalizer Reading (gallons) | |
| | |
| Total Volume Removed (gallons) | |
| | |
| Time start: | |
| Time stop: | |

| **MH-2 Groundwater Removal** | |
|---|---|
| Initial Totalizer Reading | |
| Final Totalizer Reading | |
| | |
| Total Volume Removed | |
| | |
| Time start: | |
| Time stop: | |

| **MH-3 Groundwater Removal** | |
|---|---|
| Initial Totalizer Reading | |
| Final Totalizer Reading | |
| | |
| Total Volume Removed | |
| | |
| Time start: | |
| Time stop: | |

## Appendix D
# Standard Operating Procedures

**STANDARD OPERATING PROCEDURE 01**

# DNAPLGW Collection System – Manhole Groundwater and DNAPL Measurements

## I. Purpose

To provide the O&M operator with the procedures required for groundwater depth and DNAPL thickness measurements.

## II. Equipment and Materials

1. Site/gate keys.
2. Weighted steel tape and paste.
3. Nitrile gloves
4. Alconox, water, 5 gallon bucket, and paper towels

## III. Procedures and Guidelines

1. Open manhole cover. Do not enter the manhole under any circumstance.
2. All measurements are to be made relative to the top of each manhole.
3. Apply Kolor Kut® gauging paste to the bottom 3 feet of the steel tape. Apply a small amount of the gauging paste to the tape weight.
4. Slowly lower the weighted steel tape into the manhole until it contacts the groundwater surface; record this depth (the tape weight is approximately 0.35 feet tall, add 0.35 feet to the depth indicated on the tape and record).
5. Slowly lower the tape to until it reaches the bottom of the manhole; record this depth (the tape weight is approximately 0.35 feet tall, add 0.35 feet to the depth indicated on the tape and record).
6. Slowly rewind weighted steel tape.
7. Inspect the bottom 3 feet of the weighted steel tape (the portion of the tape where Kolor Kut® gauging paste was applied). If DNAPL is present in the manhole, the Kolor Kut® gauging paste will have changed color from pink to dark red. The length of tape where the Kolor Kut® gauging paste has changed color represents the thickness of DNAPL present in the manhole, record as accurately as possible the thickness from the tape (the tape weight is approximately 0.35 feet tall, add 0.35 feet to the depth indicated on the tape and record).
8. Rinse the steel tape after each using the alconox and water spray bottles. Collect water from rinsing steel tape and place into each manhole upon completion.

9. Close and lock manhole.
10. Repeat at each manhole.
11. When all measurements are completed thoroughly, decontaminate weighted steel tape, dry, and store in a large ziplock bag.

# IV. Attachments

System data record sheets.

# V. Key Check and Items

- Ensure that all equipment is properly decontaminated as needed.
- Care shall be taken when making manhole measurements to ensure that proper depths of water, DNAPL thickness, and total depth are achieved.

**STANDARD OPERATING PROCEDURE 02**

# DNAPL GW Collection System Normal Operations – Startup and Shutdown

## I. Purpose

To provide the O&M operator with the procedures required for normal DNAPL/GW collection system.

## II. Equipment and Materials

1. Site/gate keys
2. Steel tape and paste
3. Nitrile gloves and paper towels
4. Inspection checklists and system data sheets
5. Cellular phone

## III. Procedures and Guidelines

1. Measure and record the depth to water and total thickness of DNAPL present at each system manhole (refer to SOP 1). During this step inspect the secondary level alarms present on each pump control station and ensure that the system valves are in the system shutdown positions. System shutdown position for system valves is listed below:
    - Isolation valve for Pump #1 – closed – valve is located in Pump Box #1
    - Isolation valve for Pump #2 – closed - valve is located in Pump Box #2
    - Isolation valve for Pump #3 – closed - valve is located in Pump Box #3
    - Isolation valve for Pump #4 (system booster pump) – open - valve is located in Pump Box #4
    - Containment pad isolation valve – closed – valve is located at the secondary containment pad
2. Record the flow system totalizer reading on system operations log sheet.
3. Inspect flexible discharge hose installed on MH-3 tank and the flexible discharge hose that will be used to connect tank to system to ensure that the hoses are in satisfactory operating condition. Additionally, ensure that the discharge hose installed on the MH-3 tank is secure and directed to flow into tank. If flexible discharge hoses are not in good

operations conditions replace hose with spare(s) located in construction trailer and contact TTM.

4. Connect flexible discharge hose to the one installed on the MH-3 tank.
5. Connect flexible discharge hose to cam lock connection located on secondary containment pad operation station.
6. Prime Pump #3 (as needed see SOP 3) and start Pump #3 by turning operations switch to manual. Ensure flow from Pump #3 audibly or by cracking open the small valve located on top of the pump.
7. Open Pump #3 isolation valve and proceed to secondary containment pad.
8. Open secondary containment pad isolation valve. Ensure flow from system to MH-3 tank.
9. Start booster pump by turning operations switch at secondary containment pad operation station to manual.
10. Remove approximately 6,000 gallons of water from Manhole #3. Periodically read flow system totalizer and visually observe MH-3 tank level.
11. After required water volume is removed from Manhole #3, turn system booster pump to off and close secondary containment pad isolation valve. Proceed smartly to Pump #3 control box and close Pump #3 isolation valve and turn off Pump #3.
12. Record water level at Manhole #3.
13. Record flow system totalizer reading.
14. Prime (as needed) and start Pump #2 by turning operations switch to manual. Ensure flow from Pump #2 audibly or by cracking open the small valve located on top of the pump.
15. Open Pump #2 isolation valve.
16. Open secondary containment pad isolation valve. Ensure flow from system to MH-3 tank.
17. Pump approximately 200 to 225 gallons of MW-2 water into MH-3 tank to flush the piping system prior to realigning tank discharge hoses.
18. Close secondary containment pad isolation valve. Proceed to Pump #2 operation station, close Pump #2 isolation valve and turn Pump #2 to off.
19. Disconnect flexible discharge hose from the hose mounted on MH-3. Securely place the flexible discharge hose so that system discharge is directed to the 21,000 gallon MH-1/MH-2 tank.
20. Re-start Pump #2 by turning operations switch to manual. Ensure flow from Pump #2 audibly or by cracking open the small valve located on top of the pump.
21. Open Pump #2 isolation valve and proceed to secondary containment pad.

22. Open secondary containment pad isolation valve. Ensure flow from system to MH-1/MH-2 tank.
23. Start booster pump by turning operations switch at secondary containment pad operation station to manual.
24. Remove approximately 7,000 gallons of water from Manhole #2. Periodically read flow system totalizer and visually observe MH-1/MH-2 tank level.
25. After required water volume is removed from Manhole #2, turn system booster pump to off and close secondary containment pad isolation valve. Proceed to Pump #2 control box and close Pump #2 isolation valve and turn off Pump #2.
26. Record water level at Manhole #2.
27. Record flow system totalizer reading.
28. Prime (as needed) and start Pump #1 by turning operations switch to manual. Ensure flow from Pump #1 audibly or by cracking open the small valve located on top of the pump.
29. Open Pump #1 isolation valve and proceed to secondary containment pad.
30. Open secondary containment pad isolation valve ensure flow from system to MH-1/MH-2 tank.
31. Start booster pump by turning operations switch at secondary containment pad operation station to manual.
32. Remove approximately 7,000 gallons of water from Manhole #1. Periodically read flow system totalizer and visually observe MH-1/MH-2 tank level.
33. After required water volume is removed from Manhole #1, turn system booster pump to off and close secondary containment pad isolation valve. Proceed to Pump #1 control box and close Pump #1 isolation valve and turn off Pump #1.
34. Record water level at Manhole #1.
35. Record flow system totalizer reading.
36. Ensure system valves are returned to the system secure position (see Step #1).
37. Secure the system discharge hose.

# IV. Attachments

System data record sheets.

System inspection sheets

# V. Key Check and Items

- Ensure that all equipment is properly decontaminated as needed.

- Use mixing tub to ensure that the water in the discharge hose is contained when the discharge hose is switched from Tank-3 to Tank-1/2.
- Care shall be taken when making manhole measurements to ensure that proper depths of water and total depth are achieved.

**STANDARD OPERATING PROCEDURE 03**

# DNAPL/GW Collection System – Priming Centrifugal Pumps

## I. Purpose

To provide the O&M personnel with the procedures required for priming DNAPL/GW collection system centrifugal pumps.

## II. Equipment and Materials

1. Site/gate keys
2. Water source
3. General tools

## III. Procedures and Guidelines

The DNAPL/GW collection system pumps are Gorman-Rupp Series 80 self priming centrifugal pumps and have a design rating of 80 gallons per minute (gpm) at 32 feet of total dynamic head (TDH) and run at 1.5 horsepower on 230 volts. The manufacturer's installation, operation, and maintenance manual for the system pumps is included in Appendix B if the ISMP. Prime the pumps as needed by:

1. Remove pump casing fill plug on the top of the casing.
2. Add water until the pump casing is full (Operator's Note: The pump casing can not be overfilled. Excess water added to the pump casing will simply flow into the pumps suction line and aid in the priming process).
3. Re-install and tighten the fill plug before operating the pump.

## IV. Attachments

None.

## V. Key Check and Items

- Never operate these pumps unless there is liquid in the pump casing. The pump will not prime when dry. Extended operation of a dry pump will destroy the seal assembly.
- These pumps are self priming and should not need to be primed unless the pump has not been used for a considerable length of time or the liquid in the pump casing has evaporated.
- Do not attempt to operate the pump unless all connecting piping is securely installed. Otherwise, liquid in the pump forced out under pressure could cause injury to personnel.

**STANDARD OPERATING PROCEDURE 04**

# DNAPL/GW Collection System – DNAPL Removal Event

## I. Purpose

To provide the O&M operator with the procedures required for DNAPL removal from each manhole.

## II. Equipment and Materials

1. Site/gate keys
2. Air monitoring equipment

## III. Procedures and Guidelines

For the purposes of this SOP, it is assumed that a subcontractor will remove approximately 750 gallons of NAPL from MH-1 and MH-3 on an annual basis. The DNAPL will be present in the DNAPL collection sumps at the bottom of each manhole. The waste hauling subcontractor will be responsible for the completion of this work, under the direct supervision of CH2M HILL personnel, and the purpose of this SOP is to give O&M personnel a general approach to be taken by the subcontractor. The Technical Task Manager should be onsite for all DNAPL removal operations.

1. Ensure that DNAPL gauging (SOP 1) has been performed prior to commencement of these activities.
2. Ensure that secondary containment pad is dewatered prior to the commencement of these activities.
3. The O&M operator will hold a health and safety briefing with subcontractor personnel prior to the any site operations.
4. The O&M operator will ensure that the subcontractor has taken precautions to prevent DNAPL spills and that the subcontractor has a satisfactory plan and equipment for responding to spills.
5. Entry into the manhole by personnel is prohibited under all circumstances.
6. The removal of DNAPL from the manholes will involve the temporary installation of a diaphragm (or similar) pump for DNAPL collection. The subcontractor will be responsible for providing the DNAPL collection pump and all associated conveyance lines and other equipment, as required.
7. Connection of the discharge hose to the DNAPL collection apparatus.

8. Activation of the DNAPL pump.
9. Observation of the NAPL flowing into the collection apparatus until water is discharged.
10. Water should be run through the pump and conveyance lines until each is thoroughly flushed.
11. Disconnection of the discharge hose from collection apparatus and removal of the diaphragm (or similar) pump from the manhole.
12. Removal of gross contamination should be completed over the top of the manhole. Ensure that the pump is free from dripping DNAPL prior to moving it away from the manhole.
13. The balance of equipment decontamination will be completed on subcontractor supplied containment at the tank secondary containment. Accumulated decontamination water will be transferred to the MH-3 tank using a utility pump.
14. Subcontractor will remove activity derived waste during demobilization.

It is anticipated that the work will be completed in Level D PPE. Additional safety procedures required for Area 3 manhole are described below.

1. Only those people directly involved with the DNAPL collection operation are allowed in the vicinity when the Area 3 manhole is open.
2. All work will be performed upwind of the open manhole or other potential source of Area 3 NAPL. This is particularly important for equipment wipe down where Area 3 NAPL may remain on equipment even after flushing. It is permissible to rinse pump with a power washer while the pump is still hanging in the manhole.
3. A ventilation fan will be used to create an inward flow of clean air into the manhole. The ventilation suction will be placed as low as practical inside the manhole and at least 5 feet below manhole level. An air flow rate of three air changes per hour or greater is required. No work in or on the manhole will begin until at least one air change has occurred.
4. A smoke test or other visual means to confirm airflow into the manhole will be performed prior to working in or on the manhole.
5. After pumping operations have ended and equipment has been flushed, one or both of the ventilation fans will be used to provide ventilation for equipment removal and wipe down.
6. Direct reading air monitoring for oxygen, combustible gas, and ionizable vapor (PID) will be conducted by CH2M HILL before work begins in the vicinity of the manholes. Air sampling as described in the site specific HASP will also be performed by CH2M HILL personnel.
7. Entry into the manholes is prohibited.

The subcontractor shall include in the cost estimate one NAPL removal event per year (2009, 2010, and 2011) of the contract term. DNAPL profiling will be provided to the subcontractor by CH2M HILL when available.

Upon completion of the work, any disturbances or impacts to the site caused by the Subcontractor shall be remedied by the Subcontractor and the site returned to the condition prior to beginning the SOP.

# IV. Attachments

System data record sheets.

# V. Key Check and Items

- Ensure that all equipment is properly decontaminated as needed.
- Inspect subcontractor decontamination area containment to ensure it is adequate and will not leak.
- A narrative of the entire event should be maintained in the field book.
- All air monitoring measurements should be recorded in the field log book.
- O&M operator will ensure that the waste manifest form is correct and complete before signing (on behalf of USEPA).

## Appendix E

# Waste Manifest and Waste Approval Form

DYNECOL
MID 074259565

DYNECOL,

(313) 571-

# CERTIFICATION FORM

(Submit with waste approval package)

## UNDERLYING CONSTITUENTS/VOLATILE ORGANIC COMPOUNDS (VOC)

APPROVAL NUMBER: _____ EPA ID NUMBER: MID 000 722 439

GENERATOR NAME: USEPA/Velsicol Pine River Superfund Site

EPA HAZARDOUS WASTE NUMBERS: D018, D019, D022, D029, D039

D040, D043

MANIFEST NUMBER (IF APPLICABLE): _____

PLEASE PLACE A CHECK MARK IN THE APPROPRIATE BOX:

- ☐ THIS WASTE IS NOT PROHIBITED FROM LAND DISPOSAL. (NOTE – ADDITIONAL CERTIFICATIONS MAY BE REQUIRED)
- ☒ THIS WASTE IS PROHIBITED FROM LAND DISPOSAL.
- ☐ THE WASTE DOES NOT CONTAIN UNDERLYING HAZARDOUS CONSTITUENTS LISTED IN 40 CFR 268.48 TABLE UTS-UNIVERSAL TREATMENT STANDARDS (EXCLUDING FLUORIDE, VANADIUM AND/OR ZINC).
- ☒ THE WASTE DOES CONTAIN UNDERLYING HAZARDOUS CONSTITUENTS LISTED IN 40 CFR 268.48 TABLE UTS-UNIVERSAL TREATMENT STANDARDS (EXCLUDING FLUORIDE, VANADIUM AND/OR ZINC).
- ☐ THE WASTE DOES NOT CONTAIN VOLATILE ORGANIC COMPOUNDS GREATER THAN 500 PPM.
- ☒ THE WASTE DOES CONTAIN VOLATILE ORGANIC COMPOUNDS GREATER THAN 500 PPM.

NOTE: ADDITIONAL INFORMATION AS REQUIRED PER 40 CFR 268.7 GENERAL PAPERWORK REQUIREMENTS TABLE CAN BE FOUND IN THE ATTACHED DYNECOL WASTE APPROVAL FORM.

I CERTIFY UNDER PENALTY OF LAW THAT I HAVE PERSONALLY EXAMINED AND AM FAMILIAR WITH THE WASTE THROUGH ANALYSIS AND TESTING OR THROUGH KNOWLEDGE OF THE WASTE, AND BELIEVE THAT THE INFORMATION I SUBMITTED IS TRUE, ACCURATE AND COMPLETE. I AM AWARE THAT THERE ARE SIGNIFICANT PENALTIES FOR SUBMITTING A FALSE CERTIFICATION, INCLUDING A POSSIBILITY OF A FINE AND/OR IMPRISONMENT.

| AUTHORIZED SIGNATURE | PRINTED NAME | DATE |
|---|---|---|
| Thomas Alcamo | Thomas Alcamo | 12/1/09 |

## TABLE UTS– 268.48 UNIVERSAL TREATMENT STANDARDS

| ORGANIC CONSTITUENTS | ww-mg/L | ww-mg/L | ORGANIC CONSTITUENTS | ww-mg/L | ww-mg/L | ORGANIC CONSTITUENTS | ww-mg/L | ww-mg/L | ORGANIC CONSTITUENTS | ww-mg/L | ww-mg/L |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A2213 | 0.042 | 1.4 | m-Cresol | 0.11 | 5.6 | Fluoranthene | 0.068 | 3.4 | Phenol | 0.039 | 6.2 |
| Acenaphthene | 0.059 | 3.4 | p-Cresol | 0.77 | 5.6 | Fluorene | 0.059 | 3.4 | o-Phenylenediamine | 0.056 | 5.6 |
| Acenaphthylene | 0.059 | 3.4 | o-Cresol | 0.77 | 5.6 | Fometanate hydrochloride | 0.056 | 1.4 | Phorate | 0.021 | 4.6 |
| Acetone | 0.28 | 160 | m-Cumenyl methylcarbamate | 0.056 | 1.4 | Formparanate | 0.056 | 1.4 | Phthalic acid | 0.055 | 28 |
| Acetonitrile | 5.6 | 38 | Cyclohexanone | 0.36 | 75 mg/L | Heptachlor | 0.0012 | 0.066 | Phthalic anhydride | 0.055 | 28 |
| Acetophenone | 0.010 | 9.7 | o,p'-DDD | 0.023 | 0.087 | Heptachlor epoxide | 0.016 | 0.0066 | Physostigmine | 0.056 | 1.4 |
| 2-Acetylaminofluorene | 0.059 | 140 | p,p'-DDD | 0.023 | 0.087 | Hexachlorobenzenes | 0.055 | 10 | Physostigmine salicylate | 0.056 | 1.4 |
| Acrolein | 0.29 | NA | o,p'-DDE | 0.031 | 0.087 | Hexachlorobutadiene | 0.055 | 5.6 | Promecarb | 0.056 | 1.4 |
| Acrylamide | 19 | 23 | p,p'-DDE | 0.031 | 0.087 | Hexachlorocyclopentadiene | 0.057 | 2.4 | Pronamide | 0.093 | 1.5 |
| Acrylonitrile | 0.24 | 84 | o,p'-DDT | 0.0039 | 0.087 | hexachlorodibenzo-furans | 0.000063 | 0.001 | Propham | 0.056 | 1.4 |
| Aldecarb sulfone | 0.056 | 0.28 | p,p'-DDT | 0.0039 | 0.087 | Hexachlorodibenzo-p-dioxins | 0.000063 | 0.001 | Propoxur | 0.056 | 1.4 |
| Aldrin | 0.021 | 0.066 | Dibenz(a,h)anthracene | 0.055 | 8.2 | Hexachloroethane | 0.055 | 30 | Prosulfocarb | 0.042 | 1.4 |
| 4-Aminobiphenyl | 0.13 | NA | Dibenzo(a,e)pyrene | 0.061 | NA | Hexachloropropylene | 0.035 | 30 | Pyrene | 0.067 | 8.2 |
| Aniline | 0.81 | 14 | 1,2-Dibromo-3-chloropropane | 0.11 | 15 | Indeno(1,2,3-c,d) pyrene | 0.0055 | 3.4 | Pyridine | 0.014 | 16 |
| Anthracene | 0.059 | 3.4 | 1,2-Dibromoethane/Ethylene dibromide | 0.028 | 15 | Iodomethane | 0.19 | 65 | Safrole | 0.081 | 22 |
| Aramite | 0.36 | NA | Dibromoethane | 0.11 | 15 | Isobutanol | 5.6 | 170 | 1,2,4,5-Tetrachlorobenzene | 0.055 | 14 |
| Barban | 0.056 | 1.4 | m-Dichlorobenzene | 0.036 | 6.0 | Isodrin | 0.021 | 0.066 | Tetrachlorodibenzo-furans | 0.000063 | 0.001 |
| Bendiocarb | 0.056 | 1.4 | o-Dichlorobenzene | 0.088 | 6.0 | Isolan | 0.056 | 1.4 | Tetrachlorodibenzo-p-dioxins | 0.000063 | 0.001 |
| Bendiocarb phenol | 0.056 | 1.4 | p-Dichlorobenzene | 0.09 | 6.0 | Isosafrole | 0.081 | 2.6 | 1,1,1,2-Tetrachloroethane | 0.057 | 6.0 |
| Benomyl | 0.056 | 1.4 | Dichlorodifluoromethane | 0.23 | 7.2 | Kepone | 0.0011 | 0.13 | 1,1,2,2-Tetrachloroethane | 0.057 | 6.0 |
| alpha-BHC | 0.0001 | 0.066 | 1,1-Dichloroethane | 0.059 | 6.0 | Methacrylonitrile | 0.24 | 84 | Tetrachloroethylene | 0.056 | 6.0 |
| beta-BHC | 0.0001 | 0.066 | 1,2-Dichloroethane | 0.21 | 6.0 | Methanol | 5.6 | 75 mg/L | 2,3,4,6-Tetrachlorophenol | 0.030 | 7.4 |
| delta-BHC | 0.023 | 0.066 | 1,1-Dichloroethylene | 0.025 | 6.0 | Methapyrilene | 0.081 | 1.5 | Thiodicarb | 0.019 | 1.4 |
| gamma-BHC | 0.0017 | 0.066 | trans-1,2-Dichloroethylene | 0.054 | 30 | Methiocarb | 0.056 | 1.4 | Thiophanate-methyl | 0.056 | 1.4 |
| Benzal Chloride | 0.055 | 6.0 | 2,4-Dichlorophenol | 0.044 | 14 | Methomyl | 0.028 | 0.14 | Tirpate | 0.056 | 0.28 |
| Benz(a)anthracene | 0.059 | 3.5 | 2,6-Dichlorophenol | 0.044 | 14 | Methoxychlor | 0.25 | 0.18 | Toluene | 0.080 | 10 |
| Benzene | 0.14 | 10 | 2,4-D | 0.72 | 10 | 3-Methylcholanthrene | 0.0055 | 15 | Toxaphene | 0.0095 | 2.6 |
| Benzo(b)fluoranthene | 0.11 | 6.8 | 1,2-Dichloropropane | 0.85 | 18 | 4,4-Methylene bis(2-chloroaniline) | 0.50 | 30 | Triallate | 0.042 | 1.4 |
| Benzo(k)fluoranthene | 0.11 | 6.8 | cis-1,3-Dichlorpropylene | 0.036 | 18 | Methylene chloride | 0.089 | 30 | 1,2,4-Trichlorobenzene | 0.055 | 19 |
| Benzo(g,h,i) perylene | 0.0055 | 1.8 | trans-1,3-Dichchloropropylene | 0.036 | 18 | Methyl ethyl ketone | 0.28 | 36 | 1,1,1-Trichloroethane | 0.054 | 6.0 |
| Benzo(a) pyrene | 0.061 | 3.4 | Dieldrin | 0.017 | 0.13 | Methyl isobutyl ketone | 0.14 | 33 | 1,1,2-Trichloroethane | 0.054 | 6.0 |
| bis(2-Chloroethoxy) methane | 0.036 | 7.2 | Diethyl phthalate | 0.20 | 28 | Methyl methacrylate | 0.14 | 160 | Trichloroethylene | 0.054 | 6.0 |
| bis(2-Chloroethyl) ether | 0.033 | 6.0 | Diethylene glycol, dicarbamate | 0.056 | 1.4 | Methyl methanesulfonate | 0.018 | NA | Trichlorofluoromethane | 0.020 | 30 |
| bis(2-Ethylhexyl) phthalate | 0.28 | 28 | p-Dimethylaminoazobenzene | 0.13 | NA | Methyl parathion | 0.014 | 4.6 | 2,4,5-Trichlorophenol | 0.018 | 7.4 |
| Bromodichloromethane | 0.35 | 15 | 2,4-Dimethylphenol | 0.036 | 14 | Metolcarb | 0.056 | 1.4 | 2,4,6-Trichlorophenol | 0.035 | 7.4 |
| Bromoform (Tribromomethane) | 0.63 | 15 | Dimethyl phthalate | 0.047 | 28 | Mexacarbate | 0.056 | 1.4 | 2,4,5-T | 0.72 | 7.9 |
| Bromomethane (Methyl bromide) | 0.11 | 15 | Dimetilan | 0.056 | 1.4 | Molinate | 0.042 | 1.4 | 2,4,5-TP (Silvex) | 0.72 | 7.9 |
| 4-Bromophenyl phenyl ether | 0.055 | 15 | Di-n-butyl phthalate | 0.057 | 28 | 2-Naphthylamine | 0.52 | NA | 1,2,3-Trichloropropane | 0.85 | 30 |
| n-Butanol (n-Butyl alcohol) | 5.6 | 2.6 | 1,4-Dinitrobenzene | 0.32 | 2.3 | Naphthalene | 0.059 | 5.6 | 1,1,2-Trichloro-1,2,2-trifluoroethane | 0.057 | 30 |
| Butyl benzyl phthalate | 0.017 | 28 | 4,6-Dinitro-o-cresol | 0.28 | 160 | o-Nitroaniline | 0.27 | 14 | Triethylamine | 0.081 | 1.5 |
| Butylate | 0.042 | 1.4 | 2,4-Dinitrophenol | 0.12 | 160 | p-Nitroaniline | 0.028 | 28 | Tris(2,3-Dibromopropyl) phosphate | 0.11 | 0.10 |
| 3-sec-Butyl-4,6-dinitrophenol (Dinoseb) | 0.066 | 2.5 | 2,4-Dinitrotoluene | 0.32 | 140 | Nitrobenzenze | 0.068 | 14 | Vernolate | 0.042 | 1.4 |
| Carbaryl | 0.006 | 0.14 | 2,6-Dinitrotoluene | 0.55 | 28 | 5-Nitro-o-toluidine | 0.32 | 28 | Vinyl chloride | 0.27 | 6.0 |
| Carbendazim | 0.056 | 1.4 | Di-n-octyl phthalate | 0.017 | 28 | o-Nitrophenol | 0.028 | 13 | Xylene-sum of mixed isomers | 0.32 | 30 |
| Carbofuran | 0.006 | 0.14 | Di-n-propylnitrosamine | 0.40 | 14 | p-Nitrophenol | 0.12 | 29 | METALS AND INORGANICS | ww-mg/L | ww-mg/L |
| Carbofuran phenol | 0.056 | 1.4 | 1,4-Dioxane | 12.0 | 170 | N-Nitroso-di-n-butylamine | 0.40 | 17 | Antimony | 1.9 | 1.15 |
| Carbon disulfide | 3.8 | 4.8 mg/L | Diphenylamine | 0.92 | 13 | N-Nitrosodiethylamine | 0.40 | 28 | Arsenic | 1.4 | 5.0 |
| Carbon tetrachloride | 0.057 | 6.0 | Diphenylnitrosamine | 0.92 | 13 | N-Nitrosodimethylamine | 0.40 | 2.3 | Barium | 1.2 | 21 |
| Carbosulfan | 0.028 | 1.4 | 1,2-Diphenyl hydrazine | 0.087 | NA | N-Nitrosomethylethylamine | 0.40 | 2.3 | Beryllium | 0.82 | 1.22 |
| Chlordane (alpha and gamma) | 0.0033 | 0.26 | Disulfoton | 0.017 | 6.2 | N-Nitrosomorpholine | 0.40 | 2.3 | Cadmium | 0.69 | 0.11 |
| p-Chloroaniline | 0.46 | 16 | Dithiocarbamates (total) | 0.028 | 28 | N-Nitrosopiperidine | 0.013 | 35 | Chromium (Total) | 2.77 | 0.60 |
| Chlorobenzene | 0.057 | 6.0 | Endosulfan I | 0.023 | 0.066 | N-Nitrosopyrrolidine | 0.013 | 35 | Cyanide (Total) | 1.2 | 590 |
| Chlorobenzilate | 0.10 | NA | Endosulfan II | 0.029 | 0.13 | Oxamyl | 0.056 | 0.28 | Cyanide (Amenable) | 0.86 | 30 |
| 2-Chloro-1,3-butadiene | 0.057 | 0.28 | Endosulfan sulfate | 0.029 | 0.13 | Parathion | 0.014 | 4.6 | Fluoride* | 35 | NA |
| Chlorodibromomethane | 0.057 | 15 | Endrin | 0.0028 | 0.13 | Total PCB's | 0.10 | 10 | Lead | 0.69 | 0.75 |
| Chloroethane | 0.27 | 6.0 | Endrin aldehyde | 0.025 | 0.13 | Pebulate | 0.042 | 1.4 | Mercury (retort residues) | NA | 0.20 |
| Chloroform | 0.046 | 6.0 | EPTC | 0.042 | 1.4 | Pentachlorobenzene | 0.055 | 10 | Mercury (all others) | 0.15 | 0.025 |
| p-Chloro-m-cresol | 0.018 | 14 | Ethyl acetate | 0.34 | 33 | Pentachlorodibenzo-p-dioxins | 0.000063 | 0.001 | Nickel | 3.98 | 11 |
| 2-Chloroethyl vinyl ether | 0.062 | NA | Ethyl benzene | 0.057 | 10 | Pentachlordibenzo-furans | 0.000035 | 0.001 | Selenium | 0.82 | 5.7 |
| Chloromethane (Methyl Chloride) | 0.19 | 30 | Ethyl cyanide (Propanenitrile) | 0.24 | 360 | Pentachloroethane | 0.055 | 6.0 | Silver | 0.43 | 0.14 |
| 2-Chloronaphthalene | 0.055 | 5.6 | Ethyl ether | 0.12 | 160 | Pentachloronitrobenzene | 0.055 | 4.8 | Sulfide | 14 | NA |
| 2-Chlorophenol | 0.044 | 5.7 | Ethyl methacrylate | 0.14 | 160 | Pentachlorophenol | 0.089 | 7.4 | Thallium | 1.4 | 0.20 |
| 3-Chloropropylene | 0.036 | 30 | Ethylene oxide | 0.12 | NA | Phenacetin | 0.081 | 16 | Vanadium* | 4.3 | 1.6 |

**DYNECOL, INC.**
*6520 GEORGIA STREET*
*DETROIT, MICHIGAN 48211*
*PHONE: (313) 571-7140*
*FAX: (313) 571-7190*

# WASTE APPROVAL FORM

| I. General Information | | | | | |
|---|---|---|---|---|---|
| **Approval Number** | | | **Cust./Gen.Code:** | | |
| **Generator Name:** | USEPA/Velsicol Pine River Superfund Site | | | | |
| **Address:** | 324 North Street | | | | |
| **City:** | St. Louis | **State:** | MI | **Zip Code:** | 48880 |
| **Contact Name:** | Tom Alcamo | | | | |
| **Phone Number:** | 312 886 7278 | | **Fax Number:** | | 312 886 4071 |
| **24 Hour Emergency #:** | | | | | |
| **EPA ID Number:** | MID 000 722 439 | | **SIC Code:** | | |
| **Customer Name:** | CH2M Hill Constructors, Inc. | | | | |
| **Customer Contact:** | Accounts Payable | | | | |
| **Address:** | 9191 South Jamaica Street | | | | |
| **City:** | Englewood | **State:** | CO | **Zip Code:** | 80112 |
| **Phone Number:** | 303 771 0900 | | **Fax Number:** | | |
| **24 Hour Emergency #:** | | | | | |

| II. Waste Description |
|---|
| **Waste Common Name:** Hazardous Wastewater |
| **Specific Process Generating the waste:** |
| Recovery of contaminated groundwater at USEPA Superfund site. Material is characteristically hazardous waste only based on generator knowledge of the site. This material is not a F, K P or U listed waste. |

**DYNECOL, INC. Waste Approval Form PAGE 2** **Approval Number:**

## III. Waste Composition (Must equal 100%)

| Constituent | Actual % of representative sample | Min. % of waste stream | Max. % of waste stream |
|---|---|---|---|
| Water | >99 | 98 | 100 |
| Organics | <1 | 0 | 2 |
| Sediment | Trace | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

## III. Waste Characterization

**A. Michigan Act 451 and EPA 40 CFR Information: (For the following, please use SW 846 test method for determination)**

1. Is this a hazardous waste as defined by either R299.9212-9214 or 261 Subpart B,C, or D?

Check One: **__x__ YES** **_____ NO**

a) *IF YES,* please list all applicable waste codes:

D018,D019,D022,D028,D029,D039, D040,D043

b) *IF NO*, please list all applicable non-hazardous waste codes as defined by Michigan Act 451 Part 121:

2. Does this waste indicate a volatile organic concentration in excess of 500 ppm or the compounds listed in 40 CFR 265 Appendix VI?:

Check One: **_x____ YES** **_____ NO**

a) *IF YES*, please indicate constituents and concentrations:

See attached

3. Does the analysis indicate PCB's above the detection limit?

Check One: **_____ YES** **__x___ NO**

*a) IF YES,* does the waste contain PCB contamination from a source with a concentration greater than or equal to 50 ppm?

Check One: **_____ YES** **x NO**

**DYNECOL, INC. Waste Approval Form PAGE 3** **Approval Number:**

## III. Waste Characterization (continued)

**B. Benzene/NESHAP Information (For the following, please use SW 846 method 8020 and/or EPA 602 and/or 624 for determination)**

1. Does the waste stream have a benzene concentration of 10 ppm or more?

Check One: _____ **YES** _x_____ **NO**

*IF YES,* please indicate total benzene concentration of waste:

2. Does the waste stream contain greater than 10% water ?

Check One: __x___ **Yes** ___ **NO**

3. Does the generator manage wastes from facilities with Total Annual Benzene (TAB) greater or equal to 10 mg/year?

Check One: _____ **Yes** ___x__ **NO**

*IF YES*, please indicate TAB quantity for generator facility:

**C. Land Disposal Restriction Information (For the following, please see 40 CFR part 268.2 for definitions)**

1. Does the waste stream contain less than 1% by weight Total Organic Carbon (TOC) and less than 1% by weight Total Suspended Solids?

Check One: __x___ **YES** (wastewater) _____ **NO** (Non-wastewater)

## IV. General Characteristics (at 70 degrees F unless otherwise specified:

| | | |
|---|---|---|
| Color | Clear to coudy | Phases |
| pH | 4 to 9 | ☑ Single Layer |
| ☑ Liquid ☐ Sludge/Slurry ☐ Solid | | ☐ Double Layer |
| Odor: | | ☐ Multi-Layer |
| ☑ None ☐ Strong ☐ Mild | | |

## V. Shipping Information

**A. Determination of shipping name as defined by 29 CFR 172.101:**

| | | | | | | |
|---|---|---|---|---|---|---|
| 1. Proper Shipping Name: | RQ, Hazardous waste liquid, nos (Benzene, Chloroform) | | | | | |
| 2. Hazard Class: 9 | 3. UN/NA Number: NA 3082 | | | | | |
| 4. Packing Group (Circle one): | I | | II | | III | None |
| **B. Shipping Container** (Circle one) | **Bulk** | Drums | Pails | Totes | Roll Off | Other: |
| **C. Waste Volume** | 10,000 to 20,000 gallons | | | | | |
| **D. Shipping Frequency** (Circle one) | **Weekly** | | Monthly | Quarterly | Yearly | One Time Only |

**DYNECOL, INC. Waste Approval Form PAGE 4** **Approval Number:**

## VII. Comment Section

**Please list any additional comments concerning this waste stream below:**

## VIII. Generator Authorizations

**A. Authorization to correct material profile sheet**

I Thomas Alcamo (generator signature) hereby give authorization for Dynecol, Inc. to make corrections with oral authorization to establish consistency with the results of sample analysis and/or applicable federal and state regulations and the information on this profile. These changes WILL NOT include the addition or removal of waste codes and waste constituents which must have written authorization to be changed by the generator. I understand that Dynecol reserves the right to reject any material that does not conform to specifications described in profile.

**B. Certification**

I certify, under penalty of law, that I have personally examined, and am familiar with, the waste profiled through knowledge of the waste, and I believe the information submitted to be true, accurate, and complete.

| Thomas Alcamo | Remedial Project Manager |
|---|---|
| **Generator Name (Please print or type)** | **Title** |
| Thomas Alcamo | 11/30/09 |
| **Generator Signature** | **Date** |

## IX. Revision Section

**Please list any revisions made to form**

| Revision | Date of Revision | Generator Authorization |
|---|---|---|
| | | |
| | | |

## X. Dynecol Use only

**A. Approval Information**

| **CMF WASTES:** | | **PLANT WASTES:** | |
|---|---|---|---|
| Primary outbound approval number | | Plant treatment code | |
| Off-site management code | | On-site management code: | |
| | | | |
| WAF Initiator signature: | | | |
| Approved by: | | Date: | |

Please print or type. (Form designed for use on elite (12-pitch) typewriter.) Form Approved. OMB No. 2050-0039

**UNIFORM HAZARDOUS WASTE MANIFEST**

| 1. Generator ID Number | 2. Page 1 of | 3. Emergency Response Phone | 4. Manifest Tracking Number |
|---|---|---|---|
| MID000722439 | 1 | 313-571-7141 | 006404238 JJK |

**GENERATOR**

5. Generator's Name and Mailing Address
USEPA/Velsicol Pine River Su
324 North Street
St. Louis, MI 48880
Generator's Phone: (312) 886-7278

Generator's Site Address (if different than mailing address)

6. Transporter 1 Company Name: PVS Transportation — U.S. EPA ID Number: MIR000019554

7. Transporter 2 Company Name — U.S. EPA ID Number

8. Designated Facility Name and Site Address
Dynecal, Inc.
6520 Georgia Street
Detroit, MI 48211
Facility's Phone: (313) 571-7140

U.S. EPA ID Number: MID074259565

| 9a. HM | 9b. U.S. DOT Description (including Proper Shipping Name, Hazard Class, ID Number, and Packing Group (if any)) | 10. Containers No. | 10. Containers Type | 11. Total Quantity | 12. Unit Wt./Vol. | 13. Waste Codes | | |
|---|---|---|---|---|---|---|---|---|
| X | 1. RQ, Hazardous waste liquid, n.o.s., 9, NA3082, PG II (Benzene, Chloroform) | 001 | TT | | G | D018 | D019 | D022 |
| | | | | | | D028 | D029 | D039 |
| | 2. | | | | | | | |
| | 3. | | | | | | | |
| | 4. | | | | | | | |

14. Special Handling Instructions and Additional Information
1. Approval # 6201 (Hazardous Wastewater) D040, D043

15. GENERATOR'S/OFFEROR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations. If export shipment and I am the Primary Exporter, I certify that the contents of this consignment conform to the terms of the attached EPA Acknowledgment of Consent.
I certify that the waste minimization statement identified in 40 CFR 262.27(a) (if I am a large quantity generator) or (b) (if I am a small quantity generator) is true.

Generator's/Offeror's Printed/Typed Name | Signature | Month | Day | Year

**INTL**

16. International Shipments ☐ Import to U.S. ☐ Export from U.S. Port of entry/exit:
Transporter signature (for exports only): Date leaving U.S.:

**TRANSPORTER**

17. Transporter Acknowledgment of Receipt of Materials

Transporter 1 Printed/Typed Name | Signature | Month | Day | Year

Transporter 2 Printed/Typed Name | Signature | Month | Day | Year

**DESIGNATED FACILITY**

18. Discrepancy

18a. Discrepancy Indication Space ☐ Quantity ☐ Type ☐ Residue ☐ Partial Rejection ☐ Full Rejection

Manifest Reference Number:

18b. Alternate Facility (or Generator) — U.S. EPA ID Number

Facility's Phone:

18c. Signature of Alternate Facility (or Generator) | Month | Day | Year

19. Hazardous Waste Report Management Method Codes (i.e., codes for hazardous waste treatment, disposal, and recycling systems)

| 1. | 2. | 3. | 4. |
|---|---|---|---|
| | | | |

20. Designated Facility Owner or Operator: Certification of receipt of hazardous materials covered by the manifest except as noted in Item 18a

Printed/Typed Name | Signature | Month | Day | Year

EPA Form 8700-22 (Rev. 3-05) Previous editions are obsolete.

**DESIGNATED FACILITY TO DESTINATION STATE (IF REQUIRED)**

6520 Georgia
Detroit, Michigan 48211
(313) 571-7141
MID 074 259 565

# LAND DISPOSAL RESTRICTED AND PROHIBITED WASTE NOTICE AND CERTIFICATION

The wastes identified on manifest# 006404238 JJK and bearing the EPA Hazardous Waste Code(s) listed below are subjected to the land restrictions of 40 CFR Part 268. The required information applicable to each waste is identified below:

SECTION 9b

| | | | | |
|---|---|---|---|---|
| ⊘ 1 | O 2 | O 3 | O 4 | The wastes do not meet the treatment standards specified in Part 268 Subpart D or do not meet the prohibitions specified in 268.32 or RCRA Section 3004(d) |
| O 1 | O 2 | O 3 | O 4 | The wastes comply with the treatment standards specified in Part 268 Subpart D and all applicable prohibitions set forth in 268.32 or RCRA Section 3004(d) |

| Manifest Line Item# | Hazardous Waste Code(s) | Treatability Group | | Subcategory (If applicable or "Debris") | Underlying Hazardous Constituents | | |
|---|---|---|---|---|---|---|---|
| | | WW | NWW | | Yes* | No | n/a |
| 1 | D018, D019, D022, D028, D029, D035, D040, D043 | | ✓ | | ✓ | | |

* If Yes- Attach Table UTS-268.48 Universal treatment standards

I certify under penalty of law that I have personally examined and am familiar with the waste through analysis and testing or through knowledge of the waste, and I believe that the information I submitted is true, accurate, and complete. I am aware that there are significant penalties for submitting a false certification, including a possibility of fine and/or imprisonment.

Thomas Alm — Authorized Signature

USEPA / UELS COL - PINE RIVER SUPERFUND SITE — Company Name

LID 000722439 — EPA ID Number

11/30/09 — Date

PLEASE SEND ORIGINAL WITH SHIPMENT – GENERATOR MUST RETAIN A COPY FOR FILES

## TABLE UTS—268.40 UNIVERSAL TREATMENT STANDARDS

| ORGANIC CONSTITUENTS | [illegible] | [illegible] | ORGANIC CONSTITUENTS | [illegible] | [illegible] | ORGANIC CONSTITUENTS | [illegible] | [illegible] | ORGANIC CONSTITUENTS | [illegible] | [illegible] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A2213 | 0.042 | 1.4 | m-Cresol | 0.11 | 5.6 | Fluoranthene | 0.068 | 3.4 | Phenol | 0.039 | 6.2 |
| Acenaphthene | 0.059 | 3.4 | p-Cresol | 0.77 | 5.6 | Fluorene | 0.059 | 3.4 | o-Phenylenediamine | 0.056 | 5.6 |
| Acenaphthylene | 0.059 | 3.4 | o-Cresol | 0.77 | 5.6 | Formetanate hydrochloride | 0.056 | 1.4 | Phorate | 0.021 | 4.6 |
| Acetone | 0.28 | 160 | m-Cumenyl methylcarbamate | 0.056 | 1.4 | Formparanate | 0.056 | 1.4 | Phthalic acid | 0.055 | 28 |
| Acetonitrile | 5.6 | 38 | Cyclohexanone | 0.36 | 75 mg/L | Heptachlor | 0.0012 | 0.066 | Phthalic anhydride | 0.055 | 28 |
| Acetophenone | 0.010 | 9.7 | o,p'-DDD | 0.023 | 0.087 | Heptachlor epoxide | 0.016 | 0.066 | Physostigmine | 0.056 | 1.4 |
| 2-Acetylaminofluorene | 0.059 | 140 | p,p'-DDD | 0.023 | 0.087 | Hexachlorobenzene | 0.055 | 10 | Physostigmine salicylate | 0.056 | 1.4 |
| Acrolein | 0.29 | NA | o,p'-DDE | 0.031 | 0.087 | Hexachlorobutadiene | 0.055 | 5.6 | Promecarb | 0.056 | 1.4 |
| Aldrin | 0.021 | 0.066 | p,p'-DDE | 0.031 | 0.087 | Hexachlorocyclopentadiene | 0.057 | 2.4 | Pronamide | 0.093 | 1.5 |
| Acrylonitrile | 0.24 | 84 | o,p'-DDT | 0.0039 | 0.087 | Hexachlorodibenzo-furans | 0.000063 | 0.001 | Propham | 0.056 | 1.4 |
| Aldecarb sulfone | 0.056 | 0.28 | p,p'-DDT | 0.0039 | 0.087 | Hexachlorodibenzo-p-dioxins | 0.000063 | 0.001 | Propoxur | 0.056 | 1.4 |
| Aldrin | 0.021 | 0.066 | Dibenz(a,h)anthracene | 0.055 | 8.2 | Hexachloroethane | 0.055 | 30 | Prosulfocarb | 0.042 | 1.4 |
| 4-Aminobiphenyl | 0.13 | NA | Dibenzo(a,e)pyrene | 0.061 | NA | Hexachloropropylene | 0.035 | 30 | Pyrene | 0.067 | 8.2 |
| Aniline | 0.81 | 14 | 1,2-Dibromo-3-chloropropane | 0.11 | 15 | Indeno(1,2,3-cd) pyrene | 0.0055 | 3.4 | Pyridine | 0.014 | 16 |
| Anthracene | 0.059 | 3.4 | 1,2-Dibromoethane dibromide | 0.028 | 15 | Iodomethane | 0.19 | 65 | Safrole | 0.081 | 22 |
| Aramite | 0.36 | NA | Dibromomethane | 0.11 | 15 | Isobutanol | 5.6 | 170 | 1,2,4,5-Tetrachlorobenzene | 0.055 | 14 |
| Barban | 0.056 | 1.4 | m-Dichlorobenzene | 0.036 | 6.0 | Isodrin | 0.021 | 0.066 | Tetrachlorodibenzo-furans | 0.000063 | 0.001 |
| Bendiocarb | 0.056 | 1.4 | o-Dichlorobenzene | 0.088 | 6.0 | Isolan | 0.056 | 1.4 | Tetrachlorodibenzo-p-dioxins | 0.000063 | 0.001 |
| Bendiocarb phenol | 0.056 | 1.4 | p-Dichlorobenzene | 0.09 | 6.0 | Isosafrole | 0.081 | 2.6 | 1,1,1,2-Tetrachloroethane | 0.057 | 6.0 |
| Benomyl | 0.056 | 1.4 | Dichlorodifluoromethane | 0.23 | 7.2 | Kepone | 0.0011 | 0.13 | 1,1,2,2-Tetrachloroethane | 0.057 | 6.0 |
| alpha-BHC | 0.0001 | 0.066 | 1,1-Dichloroethane | 0.059 | 6.0 | Methacrylonitrile | 0.24 | 84 | Tetrachloroethylene | 0.056 | 6.0 |
| beta-BHC | 0.0001 | 0.066 | 1,2-Dichloroethane | 0.21 | 6.0 | Methanol | 5.6 | 25 mg/L | 2,3,4,6-Tetrachlorophenol | 0.030 | 7.4 |
| delta-BHC | 0.023 | 0.066 | 1,1-Dichloroethylene | 0.025 | 6.0 | Methapyrilene | 0.081 | 1.5 | Thiodicarb | 0.019 | 1.4 |
| gamma-BHC | 0.0017 | 0.066 | trans-1,2-Dichloroethylene | 0.054 | 30 | Methiocarb | 0.056 | 1.4 | Thiophanate-methyl | 0.056 | 1.4 |
| Benzal Chloride | 0.055 | 6.0 | 2,4-Dichlorophenol | 0.044 | 14 | Methomyl | 0.028 | 0.14 | Tirpate | 0.056 | 0.28 |
| Benz(a)anthracene | 0.059 | 3.5 | 2,6-Dichlorophenol | 0.044 | 14 | Methoxychlor | 0.25 | 0.18 | Toluene | 0.080 | 10 |
| Benzene | 0.14 | 10 | 2,4-D | 0.72 | 10 | 3-Methylcholanthrene | 0.0055 | 15 | Toxaphene | 0.0095 | 2.6 |
| Benzo(b)fluoranthene | 0.11 | 6.8 | 1,2-Dichloropropane | 0.85 | 18 | 4,4-Methylene bis(2-chloroaniline) | 0.50 | 30 | Triallate | 0.042 | 1.4 |
| Benzo(k)fluoranthene | 0.11 | 6.8 | cis-1,3-Dichloropropylene | 0.036 | 18 | Methylene chloride | 0.089 | 30 | 1,2,4-Trichlorobenzene | 0.055 | 19 |
| Benzo(g,h,i) perylene | 0.0055 | 1.8 | trans-1,3-Dichloropropylene | 0.036 | 18 | Methyl ethyl ketone | 0.28 | 36 | 1,1,1-Trichloroethane | 0.054 | 6.0 |
| Benzo(a) pyrene | 0.061 | 3.4 | Dieldrin | 0.017 | 0.13 | Methyl isobutyl ketone | 0.14 | 33 | 1,1,2-Trichloroethane | 0.054 | 6.0 |
| bis(2-Chloroethoxy) methane | 0.036 | 7.2 | Diethyl phthalate | 0.20 | 28 | Methyl methacrylate | 0.14 | 160 | Trichloroethylene | 0.054 | 6.0 |
| bis(2-Chloroethyl) ether | 0.033 | 6.0 | Diethylene glycol, dicarbamate | 0.056 | 1.4 | Methyl methanesulfonate | 0.018 | NA | Trichlorofluoromethane | 0.020 | 30 |
| bis(2-Ethylhexyl) phthalate | 0.28 | 28 | p-Dimethylaminoazobenzene | 0.13 | NA | Methyl parathion | 0.014 | 4.6 | 2,4,5-Trichlorophenol | 0.018 | 7.4 |
| Bromodichloromethane | 0.35 | 15 | 2,4-Dimethylphenol | 0.036 | 14 | Metolcarb | 0.056 | 1.4 | 2,4,6-Trichlorophenol | 0.035 | 7.4 |
| Bromoform (Tribromomethane) | 0.63 | 15 | Dimethyl phthalate | 0.047 | 28 | Mexacarbate | 0.056 | 1.4 | 2,4,5-T | 0.72 | 7.9 |
| Bromomethane (Methyl bromide) | 0.11 | 15 | Dimetilan | 0.056 | 1.4 | Molinate | 0.042 | 1.4 | 2,4,5-TP (Silvex) | 0.72 | 7.9 |
| 4-Bromophenyl phenyl ether | 0.055 | 15 | Di-n-butyl phthalate | 0.057 | 28 | 2-Naphthylamine | 0.52 | NA | 1,2,3-Trichloropropane | 0.85 | 30 |
| n-Butanol (n-Butyl alcohol) | 5.6 | 2.6 | 1,4-Dinitrobenzene | 0.32 | 2.3 | Naphthalene | 0.059 | 5.6 | 1,1,2-Trichloro-1,2,2-trifluoroethane | 0.057 | 30 |
| Butyl benzyl phthalate | 0.017 | 28 | 4,6-Dinitro-o-cresol | 0.28 | 160 | o-Nitroaniline | 0.27 | 14 | Triethylamine | 0.081 | 1.5 |
| Butylate | 0.042 | 1.4 | 2,4-Dinitrophenol | 0.12 | 160 | p-Nitroaniline | 0.028 | 28 | Tris(2,3-Dibromopropyl) phosphate | 0.11 | 0.10 |
| 2-sec-Butyl-4,6-dinitrophenol (Dinoseb) | 0.066 | 2.5 | 2,4-Dinitrotoluene | 0.32 | 140 | Nitrobenzene | 0.068 | 14 | Vernolate | 0.042 | 1.4 |
| Carbaryl | 0.006 | 0.14 | 2,6-Dinitrotoluene | 0.55 | 28 | 5-Nitro-o-toluidine | 0.32 | 28 | Vinyl chloride | 0.27 | 6.0 |
| Carbendazim | 0.056 | 1.4 | Di-n-octyl phthalate | 0.017 | 28 | o-Nitrophenol | 0.028 | 13 | Xylene-sum of mixed isomers | 0.32 | 30 |
| Carbofuran | 0.006 | 0.14 | Di-n-propylnitrosamine | 0.40 | 14 | p-Nitrophenol | 0.12 | 29 | METALS AND INORGANICS | [illegible] | [illegible] |
| Carbofuran phenol | 0.056 | 1.4 | 1,4-Dioxane | 12.0 | 170 | N-Nitroso-di-n-butylamine | 0.40 | 17 | Antimony | 1.9 | 1.15 |
| Carbon disulfide | 3.8 | 4.8 mg/L | Diphenylamine | 0.92 | 13 | N-Nitrosodiethylamine | 0.40 | 28 | Arsenic | 1.4 | 5.0 |
| Carbon tetrachloride | 0.057 | 6.0 | Diphenylnitrosamine | 0.92 | 13 | N-Nitrosodimethylamine | 0.40 | 2.3 | Barium | 1.2 | 21 |
| Carbosulfan | 0.028 | 1.4 | 1,2-Diphenyl hydrazine | 0.087 | NA | N-Nitrosomethylethylamine | 0.40 | 2.3 | Beryllium | 0.82 | 1.22 |
| Chlordane (alpha and gamma) | 0.0033 | 0.26 | Disulfoton | 0.017 | 6.2 | N-Nitrosomorpholine | 0.40 | 2.3 | Cadmium | 0.69 | 0.11 |
| p-Chloroaniline | 0.46 | 16 | Dithiocarbamates (total) | 0.028 | 28 | N-Nitrosopiperidine | 0.013 | 35 | Chromium (Total) | 2.77 | 0.60 |
| Chlorobenzene | 0.057 | 6.0 | Endosulfan I | 0.023 | 0.066 | N-Nitrosopyrrolidine | 0.013 | 35 | Cyanide (Total) | 1.2 | 590 |
| Chlorobenzilate | 0.10 | NA | Endosulfan II | 0.029 | 0.13 | Oxamyl | 0.056 | 0.28 | Cyanide (Amenable) | 0.86 | 30 |
| 2-Chloro-1,3-butadiene | 0.057 | 0.28 | Endosulfan sulfate | 0.029 | 0.13 | Parathion | 0.014 | 4.6 | Fluoride* | 35 | NA |
| Chlorodibromomethane | 0.057 | 15 | Endrin | 0.0028 | 0.13 | Total PCB's | 0.10 | 10 | Lead | 0.69 | 0.75 |
| Chloroethane | 0.27 | 6.0 | Endrin aldehyde | 0.025 | 0.13 | Pebulate | 0.042 | 1.4 | Mercury (retort residues) | NA | 0.20 |
| Chloroform | 0.046 | 6.0 | EPTC | 0.042 | 1.4 | Pentachlorobenzene | 0.055 | 10 | Mercury (all others) | 0.15 | 0.025 |
| p-Chloro-m-cresol | 0.018 | 14 | Ethyl acetate | 0.34 | 33 | Pentachlorodibenzo-p-dioxins | 0.000063 | 0.001 | Nickel | 3.98 | 11 |
| 2-Chloroethyl vinyl ether | 0.062 | NA | Ethyl benzene | 0.057 | 10 | Pentachlorodibenzo-furans | 0.000035 | 0.001 | Selenium | 0.82 | 5.7 |
| Chloromethane (Methyl Chloride) | 0.19 | 30 | Ethyl cyanide (Propanenitrile) | 0.24 | 360 | Pentachloroethane | 0.055 | 6.0 | Silver | 0.43 | 0.14 |
| 2-Chloronaphthalene | 0.055 | 5.6 | Ethyl ether | 0.12 | 160 | Pentachloronitrobenzene | 0.055 | 4.8 | Sulfide | 14 | NA |
| 2-Chlorophenol | 0.044 | 5.7 | Ethyl methacrylate | 0.14 | 160 | Pentachlorophenol | 0.089 | 7.4 | Thallium | 1.4 | 0.20 |
| 3-Chloropropylene | 0.036 | 30 | Ethylene oxide | 0.12 | NA | Phenacetin | 0.081 | 16 | Vanadium* | 4.3 | 1.6 |