# OPERATION AND MAINTENANCE PLAN
# GROUNDWATER EXTRACTION WELLS
# AND
# GROUNDWATER TREATMENT SYSTEM MODIFICATIONS (PHASE 2)
# BAYOU BONFOUCA SUPERFUND SITE
# SLIDELL, LOUISIANA

**PREPARED FOR**

**LOUISIANA DEPARTMENT OF ENVIRONMENTAL QUALITY**

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## ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| ABS | acrylonitrile-butadiene-styrene |
| AC | alternating current |
| AMS | Automated Monitoring System |
| bgs | below ground surface |
| BNA | base neutral acids |
| °C | degrees centigrade |
| CERCLA | Comprehensive Environmental Response, Compensation and Liability Act |
| CFR | Code of Federal Regulations |
| cfm | cubic feet per minute |
| CLECO | Central Louisiana Power Company |
| CO | Contracting Officer |
| DC | direct current |
| ESD | Explanation of Significant Differences |
| °F | degrees Fahrenheit |
| $ft^3$ | cubic foot |
| FSP | Field Sampling Plan |
| GAC | granular activated carbon |
| gpm | gallons per minute |
| GWTS | Groundwater Treatment System |
| Hz | hertz |
| HDPE | high density polyethylene |
| ID | inside diameter |
| LCP | Local Control Point |
| LDEQ | Louisiana Department of Environmental Quality |
| LDPE | low density polyethylene |
| L/min | liter per minute |
| mA | milliampere |
| MCC | Motor Control Center |
| MCP | Main Control Panel |
| MHz | megahertz |

| | |
|---|---|
| mg/L | milligrams per liter |
| mL | milliliters |
| mL/min | milliliter per minute |
| MSL | mean sea level |
| NEMA | National Electrical Manufacturers' Association |
| NGVD | National Geodetic Vertical Datum |
| NPDES | National Pollutant Discharge Elimination System |
| NPL | National Priorities List |
| NPT | National Pipe Thread |
| NTU | nephelometric turbidity units |
| O&M | operation and maintenance |
| OD | outside diameter |
| OU | operable unit |
| PAH | polynuclear aromatic hydrocarbon |
| PFA | perfluoroalkoxy |
| pH | negative logarithm of hydrogen ion concentration |
| PPE | Personal Protective Equipment |
| Ppm | parts per million |
| Psi | pounds per square inch |
| Psig | pounds per square inch gage |
| QAPP | Quality Assurance Project Plan |
| RCRA | Resource Conservation and Recovery Act |
| ROD | Record of Decision |
| RPM | Remediation Project Manager |
| SSHP | Site Safety and Health Plan |
| S.U. | Standard Units |
| TERC | Total Environmental Restoration Contract |
| TOC | total organic carbon |
| T.O.C. | top of casing |
| TSDF | Treatment, Storage and Disposal Facility |
| µg/L | micrograms per liter |
| USACE | United States Army Corps of Engineers |

| | |
|---|---|
| U.S. EPA | United States Environmental Protection Agency |
| V | Volt |
| WAM | Work Assignment Manager |
| WMP | Waste Management Plan |

# 1.0 INTRODUCTION

This Operation and Maintenance (O&M) Plan addresses the extraction and treatment of creosote contaminated groundwater from the Bayou Bonfouca Superfund Site. The primary goal of the groundwater remedy is to recover free-phase creosote from beneath the site (at both on-site and off-site areas) by pumping oil bearing groundwater, while at the same time preventing surface subsidence. The contaminated groundwater is pumped to an on-site treatment system where the oil is separated and treated water returned to the bayou. The separated oil is disposed of off-site as a hazardous waste.

During earlier recovery system operations, groundwater drawdown was monitored and controlled to prevent subsidence. A subsidence monitoring program was implemented to provide settlement data to evaluate and adjust future recovery system pumping rates to prevent or control subsidence. This monitoring program has been extended to monitor subsidence associated with the expanded extraction networks.

The purpose of this O&M Plan is to present operational goals, and describe process operations and maintenance procedures for the groundwater recovery and treatment system for the Bayou Bonfouca Superfund Site. Procedures presented in this plan for operation of recovery and treatment equipment are both general and specific in nature.

This O&M Plan is to be used in conjunction with other facility documents. Specific analytical sampling activities, and health and safety requirements are detailed in the *Quality Assurance Project Plan* (QAPP), (IT Corporation/OHM Remediation Services [IT/OHM], 1999a) the *Field Sampling Plan* (FSP), (IT/OHM, 1999b), the *Site Safety and Health Plan* (SSHP) (IT/OHM, 1999c), and the *Waste Management Plan* (WMP) (IT/OHM, 1999d). Specific operations and maintenance procedures for vendor-supplied equipment are contained in the Operations Manual located at the Bayou Bonfouca treatment plant building.

## 1.1 UPDATING

During extended operation, the operator should update this plan as needed in response to operational changes. The following information will be in the updates:

- Contractor-supplied, equipment-specific O&M manuals which will be incorporated into the Operations Manual (CH2M Hill, 1990).
- As-built drawings.
- Specific process operating sequences for the general procedures specified in Section 6.0 of this plan.
- Spare parts lists and maintenance sheets supplied by equipment manufacturers which will be incorporated into the plant Operations Manual for the groundwater plant.
- Changes required based on actual operations data.
- Operational changes if additional equipment is added to the remediation system.

## 1.2 ORGANIZATION OF PLAN

This plan has been organized into nine sections. A brief summary of each section follows:

- Section 1.0 Introduction. Discusses site history and project responsibilities.
- Section 2.0 Subsurface Conditions. Provides general overview of subsurface conditions at the site.
- Section 3.0 Regulatory Standards. Discusses environmental regulations as they relate to operation of the extraction and treatment system.
- Section 4.0 Operation of Groundwater Recovery System. Describes operational goals and procedures for the recovery system.
- Section 5.0 Operation of Groundwater Treatment System. Describes scope, rationale, goals and procedures for the treatment system. Power service and instrumentation of the remediation system are also discussed.
- Section 6.0 Electrical Service. Describes electrical service available at the site for groundwater remediation activities.
- Section 7.0 Subsidence Monitoring Program. Provides subsidence monitoring goals and requirements.
- Section 8.0 Reports. Describes data management and record keeping requirements.
- Section 9.0 References.

## 1.3 SITE LOCATION AND HISTORY

The Bayou Bonfouca site is in Slidell, Louisiana, located approximately 25 miles east of New Orleans, Louisiana (Figure 1). The site is the location of a former creosote-based wood treating facility that operated under various ownerships between 1872 and 1970. During its operating history there were numerous spills of creosote. In 1970, a fire destroyed the plant and a large amount of creosote reportedly was released from storage tanks onto the site and into Bayou Bonfouca. In 1982, the United States Environmental Protection Agency (U.S. EPA) included the Bayou Bonfouca site on its Superfund National Priorities List (NPL) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

A remedial investigation and feasibility study was completed between 1983 and 1986, and the Record of Decision (ROD) was signed in March 1987. In 1987, the U.S. EPA selected a remedial alternative to mitigate threats posed by hazardous waste at the Bayou Bonfouca site. The selected remedy was presented in the Bayou Bonfouca ROD. The selected remedy consisted of removal and incineration of contaminated sediments and surface waste piles, containment of free-phase creosote and groundwater contamination with a slurry wall, groundwater extraction and treatment, and capping of contaminated soil with a Resource Conservation and Recovery Act (RCRA) cap.

Subsequently new information was revealed through additional investigations, and an Explanation of Significant Differences (ESD) document was prepared by the EPA in 1990 which concluded that a slurry wall would not be required at the time; however, the need would be evaluated in the future. The two on-site contaminated groundwater plumes were to be remediated through extraction, treatment, and discharge to the bayou. The off-site plume lying beneath the residential area west of the bayou would be addressed after the removal of contaminated sediments from the bayou. Figure 2 shows the site including the approximate locations of the creosote plumes in December 1998.

Remediation of the two on-site creosote plumes was initiated in July 1991, and remediation of the source area plume was completed in May 1993. Remediation of the eastern drainage channel plume is ongoing (Array 2). The source area recovery system (Array 1) was removed in order to construct the on-site landfill. Though the source operable unit (OU) cleanup was completed in July 1995, the off-site portion of the groundwater remedy was not started.

In 1998, the EPA's remedial action contractor, CH2M Hill, published the *Performance Evaluation Report* for Shallow Artesian Aquifer Remediation (PERSAAR) (CH2M Hill, 1998a) that recommended a design investigation be conducted to obtain current information on the distribution of creosote in the on-and off-site creosote plumes to assess the need for modifications to the Groundwater Treatment System (GWTS). Subsequently, the EPA tasked CH2M Hill to prepare a design report specifying the recommended modifications to the groundwater extraction system and treatment plant. This report evolved into the *Groundwater Extraction Treatment Systems Modifications Preliminary Design Submittal* (referred to as the PDS) (CH2M Hill, 1999).

The major recommendations in the PDS are summarized as follows:

- Construction of a new on-site extraction well network (Array 1a) for capture of dissolved and free-phase creosote along the downgradient margins of landfill area. This new array will include 12 new extraction wells configured in a linear-semicircular pattern around the southwest landfill perimeter.
- Construction of a new groundwater extraction well network (Array 3) to recover dissolved and free-phase creosote from the off-site plume beneath the residential neighborhood on the west side of Bayou Bonfouca.
- Installation of all associated flow control and monitoring equipment and conveyance piping necessary to supply air to the new extraction well pumps and to transport free-and dissolved-phase creosote to the treatment system for recovery and treatment.

The current system, as completed by IT/OHM under contract to the USACE, consists of three on-site extraction well networks (arrays), manifolded together with underground dual-wall high density polyethylene (HDPE) piping to form Arrays 1a, 2, and 3. Outbound piping from the GWTS conveys compressed air to the wells, while the return piping carries fluids from the wells to the treatment system.

The system treats extracted groundwater, sand filter backwash water, and stormwater that collects inside the treatment system containment area. Major components of the system include an oil/water separator, sand filter, oleophilic filter, carbon filter unit, post-aeration tank, backwash tank, recovered oil tank, stormwater sump, air compressors, air dryer system, and air blower. Treated water is discharged to Bayou Bonfouca under regulations (see Section 3.7.1).

## 1.4 PROJECT RESPONSIBILITIES AND ORGANIZATION

This subsection provides descriptions of the agencies and operating contractors, and project responsibilities. Table 1 is a contact list of addresses, and telephone numbers for agency and operating contractor personnel.

### 1.4.1 United States Environmental Protection Agency (EPA)

The U.S. EPA, under CERCLA, was the administrator of the Bayou Bonfouca Superfund Site during the Remedial Action. The site transitioned to Operation and Maintenance (O&M) with the LDEQ assuming the role of lead site management of the O&M activities in 2001.

### 1.4.2 Louisiana Department of Environmental Quality (LDEQ)

The Louisiana Department of Environmental Quality (LDEQ), through a cooperative agreement with U.S. EPA, has lead oversight of the operation and maintenance activities at the Bayou Bonfouca Superfund Site and currently contracts with Southern Environmental Management and Specialties, Inc. (SEMS) for O&M operations at the site.

### 1.4.3 Technical Oversight

The U.S. EPA has an agreement with LDEQ for contracting of the remedial action and technical oversight of remedial action implementation at the Bayou Bonfouca Superfund Site. The LDEQ, as the contracting agency, is the operating contractor's primary contact and is responsible for providing technical direction on operation of the groundwater extraction and treatment systems. The LDEQ is also responsible for oversight and approval of day-to-day operational activities such as carbon change-out and oil disposal.

### 1.4.4 Operating Contractor

SEMS, as operating contractor, is responsible for the day-to-day operation of the facility. These responsibilities include the operation and maintenance of the facility, procurement of treatment chemicals (as required), disposal of extracted oil and spent carbon, and monitoring, record-keeping, and reporting of operations. SEMS has operated the system from July 2010 to the present.

## 2.0 SUBSURFACE CONDITIONS

This section summarizes the subsurface stratigraphy and aquifer characteristics that influence the migration and recovery of free-phase and dissolved-phase creosote at the site. Sediments ranging in size from clay to medium-grained sand have been identified in the subsurface and are described below as five stratigraphic units. This information was obtained from the PERSAAR (CH2M Hill, 1998a) and from observations during drilling of Array 1a and Array 3 extraction well networks.

**Uppermost Unit** - The uppermost unit consists mainly of light gray to brown clay and silt with some fill material in places. This unit occurs from surface grade to depths ranging up to 9 feet below ground surface (bgs). Infiltration of rainwater can produce temporary perched zones of groundwater in the unit.

**Upper Cohesive Unit** - The upper cohesive unit occurs beneath the uppermost unit and consists of light gray to light brown, plastic, clay and silty clay. East of the bayou (on-site), the unit extends to approximately 24 feet bgs. West of the bayou (off-site), the unit extends to approximately 19 feet bgs (due to the lower ground surface elevations east of the bayou). Although interstitial pore water is present, the unit has very low permeability values and essentially functions as an aquitard.

**Shallow Artesian Aquifer Unit** - Underlying the upper cohesive unit is the shallow artesian aquifer unit. The unit is comprised of relatively permeable sediments primarily consisting of interbedded, light bluish-gray to brownish gray, clayey silt, silt, sandy silt, and clayey to silty very fine-grained sand. The unit occurs at depths ranging from approximately 24 to 34 feet bgs on-site and 15 to 25 feet bgs off-site. The unit is typically 6 to 8 feet thick and contains a distinctive shell bed commonly less than one foot thick. Creosote product occurs almost exclusively in this unit.

**Lower Cohesive Unit** - The lower cohesive unit underlies the shallow artesian aquifer unit. The unit consists of gray, plastic, clayey silt, silty clay, and clay. The unit ranges in thickness from approximately 8 to 28 feet bgs. Due to its low permeability, this unit functions as an aquitard and represents a significant barrier to vertical groundwater flow and contaminant transport.

**Deep Artesian Aquifer Unit** - The deep artesian aquifer unit is composed of fine- to medium-grained sand. The unit is at least 10 feet thick. Subsurface investigations indicate creosote contamination does not occur in this unit.

The primary zones of horizontal groundwater flow are in the shallow and deep aquifer units. The flow direction in both of the aquifers is southwest towards Lake Pontchartrain. Hydraulic conductivity values for the shallow artesian aquifer unit, the focus of the cleanup, ranged from 1 to 20 feet per day during aquifer tests conducted as part of the design investigation. Long-term sustained pumping rates in wells screened in the shallow aquifer ranged from approximately 0.6 to 0.9 gallons per minute (gpm), with short-term rates up to approximately 1.5 gpm.

The objectives of the groundwater cleanup program are to recover the free-phase creosote product by extracting impacted groundwater at an optimal rate without inducing sediment subsidence. Since 1991, the elevations of survey monuments installed at on-site locations have been monitored and groundwater drawdown has been controlled as part of a subsidence monitoring program. The subsidence monitoring data have been calculated and presented in monthly operational reports. Baseline data, action levels for total and differential settlement, and graphs showing total settlement for the on-site monitoring stations are presented in the PERSAAR (CH2M Hill, 1998a). The subsidence monitoring program is described in Section 7.0 of this plan. The initial elevations of the survey monuments, survey benchmarks, and the top of casings at new and existing monitoring wells are listed on Table 11.

## 3.0 REGULATORY STANDARDS

Operation and maintenance of the Bayou Bonfouca GWTS is subject to the rules and regulations pursuant to CERCLA. Accordingly, plant activities must comply with the rules and regulations established in the ROD for this Superfund Site. These rules specify the disposition of waste residuals generated during O&M activities, as well as general procedures for operation of the treatment system.

## 3.1 TYPE AND CLASSIFICATION OF RESIDUAL WASTES

Operation and maintenance of the Bayou Bonfouca GWTS results in the generation of the following residual waste streams:

- Recovered Creosote Oil
- Spent Sand Filter Media
- Spent Oleophilic Filter Media
- Spent Granulated Activated Carbon

Title 40 of the Code of Federal Regulations (CFR) Part 261.32 specifies hazardous wastes from specific sources. Included in that listing is the following designation:

- U051 – Wastewater treatment sludges generated in the production of creosote

The U.S. EPA has designated that process residuals generated as a result of treatment of extracted groundwater be classified as U051. Therefore, the above treatment plant residuals are managed as U051 wastes.

Operation and maintenance of the extraction well network and general plant area may also periodically result in residual wastes. For example, repair or replacement of extraction wells will result in waste materials such as contaminated drill cuttings, well casings, and tubing. Pursuant to 40 CFR 261.32, these materials are designated U051 Creosote because of the presence of residual creosote contamination.

## 3.2 WASTEWATER TREATMENT EFFLUENT

Industrial wastewater discharges subject to regulation under Section 402 of the Clean Water Act are excluded from definition as a solid waste, and therefore from definition as a hazardous waste [40 CFR Part 261.4(a)(2)]. Discharges of treated groundwater from the treatment system to the bayou are eligible for this exclusion. The exclusion applies only to the actual point source discharge. Any spills, leaks, or other releases of wastewater that occur upstream of the discharge point must be managed as a release of hazardous waste.

The exclusion does not apply to the groundwater while it is being collected, stored, or treated. However, treated effluent exiting the groundwater recovery and treatment system is eligible for the exclusion and therefore is not subject to the standards of RCRA.

## 3.3 PERSONAL PROTECTIVE EQUIPMENT

Personal protective equipment (PPE) will come in contact with creosote waste and will therefore be considered as U051 wastes. PPE must be handled as a hazardous waste. A batch of PPE is generated when the initial volume of PPE is placed into a storage container.

## 3.4 TANK MANAGEMENT STANDARDS

Operation and maintenance of the storage and process tanks at the Bayou Bonfouca GWTS must meet the requirements for a Treatment, Storage and Disposal Facility (TSDF) [40 CFR Part 262.34(a)(i)]. Those requirements are:

- Tanks must be labeled with the words “Hazardous Waste” [40 CFR Part 262.34(a)(3)]
- Tanks are inspected on a daily basis for leaks and differential pressure (40 CFR Part 264.195)
- Managed so that releases and spills are collected within 24 hours of detection to prevent environmental contamination (40 CFR Part 264.196)

## 3.5 LAND DISPOSAL RESTRICTIONS

Wastes listed as K035 or U051 are restricted from land disposal (placement in a landfill, surface impoundment, land farm or waste pile) under the “Land Disposal Restrictions,” codified in 40 CFR Part 268. Treatment of K035 or U051 waste must meet the hazardous waste treatment standards of associated organic and inorganic constituents (40 CFR 268.40). Shipments of K035 or U051 to off-site RCRA-permitted TSDFs must be accompanied by a notice identifying the waste as restricted from land disposal (40 CFR Part 268.7).

## 3.6 EPA OFF-SITE POLICY

Federal Regulation 40 CFR 300.440, Procedures for Planning and Implementing Off-Site Response Actions, applies to hazardous wastes generated at the site. This regulation in essence states that hazardous wastes produced from CERCLA cleanups must go to RCRA-permitted TSDFs that 1) are in compliance with RCRA and state rules, and 2) do not have releases to the environment.

In order to comply with applicable regulations, the operations contractor should contact the RCRA compliance group in each U.S. EPA region where an off-site TSDF is located that will receive site hazardous wastes, to verify that the TSDF is acceptable under the regulations. The status of the TSDF should be verified before each shipment of waste off-site.

## 3.7 CLEAN WATER ACT REGULATIONS

Clean Water Act requirements applicable to the groundwater collection and treatment system at the Bayou Bonfouca Superfund Site are summarized in the following subsections.

### 3.7.1 Effluent Limit Implications

Because it is a Superfund facility, the discharge from the Bayou Bonfouca site does not require a National Pollutant Discharge Elimination System (NPDES) permit. It does, however, have to meet applicable NPDES requirements and effluent limitations assigned by the LDEQ. LDEQ has provided the effluent limitations listed in Table 2.

### 3.7.2 Collection System Impacts

The U.S. EPA and LDEQ regulations both require that wastewater treatment facilities may not be bypassed unless necessary to avoid loss of life, personal injury, or severe property damage [40 CFR 112.41(m)]. Further, U. S. EPA oil discharge regulations (40 CFR 110.3) prohibit discharge of any wastewater which would cause an oil sheen on the receiving water. Since the untreated groundwater may contain free oil, discharge from the collection system could produce a sheen and is prohibited.

## 4.0 OPERATION OF THE GROUNDWATER RECOVERY SYSTEM

The Bayou Bonfouca GWTS has been in continuous operation since July of 1991. The extraction well network portion of the GWTS has undergone several modifications over this period.

- July 1991. Source area recovery system (Array 1) and eastern drainage channel network (Array 2) in operation.
- May 1993. Source area recovery system (Array 1) removed.
- May 2000. Landfill boundary system (Array 1a) and off-site recovery system (Array 3) installed and operating.

The current recovery system consists of three extraction well networks comprising 44 individual extraction wells.

### 4.1 RECOVERY SYSTEM GOALS

The goal of the groundwater recovery system is to extract dissolved and free-phase creosote oil from the shallow artesian aquifer and prevent land surface subsidence. Subsidence is controlled by limiting the water level drawdown in the shallow artesian aquifer. Drawdown is measured in monitoring wells associated with the recovery system. On-site and off-site land surface elevation data are included in the monthly reports and used to evaluate the effect of aquifer drawdown on settlement. This information is used to adjust the pumping rates in individual extraction wells.

### 4.2 SYSTEM DESCRIPTION

An on-site extraction well network has been installed to provide for improved capture of dissolved and free-phase creosote along the southwest (downgradient) margins of the site. This array, labeled 1a, includes 12 extraction wells configured in a semicircular array along the southwest side of the landfill.

An extraction well network, labeled Array 3, has been installed to recover dissolved and free-phase creosote from the off-site plume beneath the residential neighborhood on the west side of Bayou Bonfouca. This array includes 10 extraction wells which are located along the west side of the bayou along with five new subsidence monitoring wells.

The eastern drainage channel recovery system remains in-place and consists of twenty-two extraction wells (Array 2) and six subsidence monitoring wells.

Location of Array 1a, Array 2, and Array 3 wells are shown on Figure 3 and Figure 4.

## 4.3 EXTRACTION WELLS

The forty-four extraction wells that comprise the recovery system are screened in the water-bearing zone designated the shallow artesian aquifer. Thirty-four wells (Array 1a, Array 2) are located onsite on the eastern side of Bayou Bonfouca in two well arrays. Array 1a has 12 wells and Array 2 has 22 wells. Ten wells (Array 3) are located off-site in private property on the west side of Bayou Bonfouca.

The twenty-two wells that comprise Array 1a and Array 3 were installed in February and March, 2000. These wells consist of 4-inch stainless steel casing with 0.010-inch slot screen.

Seventeen of the 22 wells that comprise Array 2 consist of 4-inch carbon steel casing with 0.015-inch slot screen. Five of the existing Array 2 wells (2-2, 2-5, 2-9, 2-11, and 2-14) were replaced in March 2000 and were constructed with 4-inch stainless casing and 0.010-inch slot screen. The actual well depth, casing length, and screen length varies from well to well. Typical well details are shown on Figures 5 and 6. Detailed construction drawings of each well are contained in the Operations Manual located at the Bayou Bonfouca treatment plant.

## 4.4 MONITORING WELLS

The purpose of the 11 on-site and off-site subsidence monitoring wells is to measure water level drawdown resulting from groundwater recovery operations. The water level data, in conjunction with monthly ground surface elevation measurements, are used to control possible land subsidence that could result from recovery operations. The overall subsidence monitoring program is described in Section 7.0. Six monitoring wells (SM-1, SM-3, SM-5, SM-7, SM-8, and SM-9) are utilized for system operation and on-site subsidence monitoring. Five new monitoring wells (OSM-1, OSM-2, OSM-3, OSM-4, and OSM5) were installed specifically for the subsidence-monitoring program on the west side of Bayou Bonfouca. The six on-site monitoring wells consist of 4-inch carbon steel casing and carbon steel screen installed in nominal 6-inch diameter boreholes. A typical well has 4-inch casing to a depth of 20 feet and 0.015-inch slot from 20 to 30 feet. The five off-site monitoring wells consist of 4-inch stainless steel casing and stainless steel screen installed in nominal 6-inch diameter boreholes. The six on-site monitoring wells consist of 4-inch carbon steel casing and carbon steel screen installed in nominal 6-inch diameter boreholes. The monitoring wells and their baseline conditions are given in Table 3. A typical off-site subsidence-monitoring well is illustrated in Figure 7.

## 4.5 RECOVERY PUMPS

Each extraction well is equipped with an air-operated, bottom-loading pump (QED, Model AP-4/BL) capable of removing both creosote and water. The pumps are positioned approximately 0.25 feet from the bottom of the wells and suspended from the well cap with a stainless steel cable. Operating air is supplied to each pump from the GWTS compressors. Water and creosote are discharged from the extraction wellheads through 1-inch HDPE piping into the 4-inch by 2-inch dual-wall HDPE manifold piping and conveyed to the treatment plant for phase separation and treatment. Each wellhead includes a check valve regulator and sampling port. Typical extraction wellheads are illustrated in Figures 5 and 6.

The pump is positioned in an extraction well(s) with its bottom inlet submerged below the static groundwater level. Given a regulated supply source of compressed air, the pump is cyclically emptied in response to being filled through the bottom inlet. As the pump fills, an internal float rises until it comes in contact with an upper stop that is connected to a mechanical lever assembly which simultaneously opens an air supply poppet valve and closes an air exhaust poppet valve. As a result, air pressure builds within the pump body and displaces the fluid contents up and out of the pump through a discharge ball check valve. As the discharge cycle progresses, the float falls and, prior to being completely empty, comes in contact with a lower stop that triggers the lever/valve assembly again, closing the air supply poppet and opening the air exhaust poppet. The pressurized air then exhausts and the pump is allowed to refill itself, thus beginning a new cycle.

When the AP-4/BL pump is pumping at a rate equal to the well yield for a specific drawdown level, the fluid level in the well is maintained roughly two-thirds above the bottom inlet of the pump. A typical Model AP-4/BL recovery pump is illustrated in Figure 8.

## 4.6 PUMP REMOVAL

The extraction pumps occasionally require removal for routine maintenance or repairs. Using 2 two-man crews, the following procedure is used for environmentally safe removal of the extraction pumps.

1. Close the airline and fluid valves leading into the well.
2. Mount a pulley frame over the well casing.
3. Run a 1/4-inch nylon rope through the pulley and hook to the suspended cable eyelet connected to the pump.
4. Pull the cable outward from the casing until the pump is above the well casing. As the pump is being hoisted from the well, the HDPE air and fluid lines need to be guided from the well.
5. The pump should be suspended for several minutes above the well opening to allow most of the fluid (i.e., groundwater and creosote, if present) to drain back into the well.
6. By hand, take the weight of the pump off the cable line and disconnect the line from the hook (i.e., using two people).
7. Hoist the pump, by hand, out of the well and over the side of the protective casing (Array 2) or vault (Array 1a, 3) and lay the pump onto a plastic sheet spread onto the ground.
8. Disconnect the pump air line and fluid line headers.
9. Place the pump inside a container, such as a drum, to prevent potential drainage of residual creosote.
10. Prior to replacement of the pump, redevelop well according to Section 4.8.2 of this O&M Plan, (unless the well has been redeveloped within the last 2 years).
11. Lay the repaired pump on a clean sheet of plastic.
12. Connect the air and fluid lines. Attach the suspension cable to the pump.
13. Cover the well with a board or piece of metal to prevent the pump from slipping into the well.
14. Lift the new pump into a position over the well and connect the rope to the cable that is connected to the pump.
15. Pull the slack out of the rope.
16. Remove the cover that is over the well opening and lower the pump into the well.
17. Disconnect the rope from the cable that is connected to the pump.

18. Open the valves to the air and return lines.
19. Manually trigger ejection of the pump contents into the line.

## 4.7 EXTRACTION WELL OPERATIONS

The Bayou Bonfouca GWTS extraction well network is operated to achieve three major objectives; (1) recover free-phase creosote oil from the shallow artesian aquifer, (2) recover dissolved-phase creosote compounds from the shallow artesian aquifer, and (3) minimize/prevent land surface subsidence. The first two objectives are achieved by extracting groundwater and free-phase creosote oil from the aquifer through the 44 extraction wells in Array 1a, Array 2, and Array 3. The third objective is achieved by monitoring the water level in the aquifer through the 11 groundwater monitor wells and monthly surveys of ground surface. The operation and rate of groundwater extraction is continually adjusted by the plant operators in response to the water level measurements of the monitoring wells.

Operational experience has indicated that maximizing total fluid extraction does not necessarily maximize the rate of extraction of free-phase creosote oil. The bottom-loading extraction pumps have proven to be efficient at removing the oil even at very low flows. Also, through operational observation, it appears that high extraction rates tend to elongate the pools of free-phase creosote oil rather than move the oil faster to the well. Conversely, low flow rates appear to allow the oil to accumulate in the vicinity of the well bore. High flow rates are also not necessary to control the movement of dissolved-phase creosote since the overall movement of groundwater in the shallow artesian aquifer is very slow.

Recent operating experience during shakedown of the expanded well network has demonstrated a rapid response in aquifer water levels from operation of the extraction wells. At the new off-site network (Array 3), even low flow rates from the extraction wells will cause a 1- to 3-foot drop in the aquifer water levels at the new monitor wells (OSM-1 through OSM-5) within 24 to 48 hours. This effect is magnified during periods of dry weather and by the limiting effect of the sheetpile wall on recharge. Operation of Array 2 has a similar effect on the water levels measured in SM-8 and SM-9. The new on-site network (Array 1a) has been observed to cause water level drawdown in wells SM-1 and SM-3.

Land surface elevation is measured, recorded, and reported monthly at thirty-four (34) stations throughout the Bayou Bonfouca Site. Seven of those stations are survey benchmarks, five are foundation monuments, and 22 are monitor well elevations. These stations and their initial elevations are summarized in Table 4 Table 4 also shows the results of a recent monthly survey (July 2000). To date, no variation in land surface elevation greater than 0.20 feet has been observed.

### 4.7.1 Extraction System General Procedure

During the shakedown of the expanded recovery system, aquifer drawdown is controlled by monitoring water levels in the shallow artesian aquifer using the AMS and adjusting extraction well operations in response to observed elevations. The general procedure for operation and adjustment of the extraction wells is as follows:

1. Once a month (at a minimum), the treatment plant operator draw down records, the water level for each monitoring well, and charts the water level on the groundwater elevation hydrographs shown on Figures 9 and 10.
2. If the water level in any monitor well is below minus four (-4) feet mean sea level (MSL), the treatment plant operator will shut down the extraction wells closest to that monitor well.
3. The treatment plant operator records the wells in operation on any given day in the daily log.

### 4.7.2 Adjustments To Pumping Rates

It is periodically desirable to adjust recovery system pumping rates to optimize creosote recovery. Pumping rates for individual wells are anticipated to be adjusted up to achieve maximum oil recovery and minimum aquifer drawdown. It should be noted that factors such as rainfall and bayou water level also affect the optimization of extraction well pumping rates. Also, adjustments to pumping rates include cycling wells in operation as well as adjusting the flow rate from individual wells.

After adjusting extraction well pumping rates or the number of wells in operation, the observed water levels in the monitoring wells are compared to the -4 feet MSL criterion. Pumping rates shall be adjusted as necessary, to allow the aquifer level to be maintained above -4 feet MSL.

The periodic adjustments to both total system and individual well pumping rates will be made for the purpose of enhancing free-phase creosote recovery while limiting drawdowns.

### 4.7.3 Pumping Rate Control

This section provides general guidelines for setting individual well pumping rates. Details of control strategy and control layout, and terminology may differ depending on current conditions such as rainfall and bayou water level. The operator should refer to the Operations Manual, located in the treatment plant control building, for specific procedures on setting pumping rates for the AP-4/BL recovery pumps.

Setting Pumping Rates

The following general steps are to be followed when setting or resetting pumping rates:

1. Prior to setting or resetting pumping rates, measure water levels in all monitoring wells.
2. Check that compressed air is available at each pump according to the manufacturer's prescribed pressure at each well.
3. Following the manufacturer's specific instructions, set the "ON" time and "OFF" time cycles to the times estimated to yield the 50 percent pumping rates.
4. Direct pump discharge to a calibrated vessel. In order to prevent accidental discharge during this procedure, disconnect air supply from the pump during this operation.
5. Reapply air pressure. After all air has been purged from the discharge piping (5 to 6 cycles), note the volume of water within the calibrated vessel.
6. Measure the duration of a minimum of three cycles (on-time and off-time) and determine the volume pumped into the calibrated vessel.
7. Calculate the pumping rate in gallons per minute (gpm) and gallons per cycle.
8. Adjust cycle times and repeat steps 8 and 9 as required to establish the pumping rate specified (50 percent of the listed pumping rates). A variance of ±15 percent from the specific rate is acceptable. Record adjusted cycle times and volumes.
9. When the pumping rate has been verified within the specified range, record the timer settings and measured pumping rate on the data sheet. Shut off the air and reconnect the discharge piping.
10. After all controllers have been set, the recovery system may be placed in operation. Coordinate recovery system startup with the treatment system startup.
11. After 48 hours of operation at the 50-percent pumping rate, repeat the preceding steps for the long-term (100 percent) pumping rates.

Inspection and Balancing

All extraction well heads and pumps are inspected daily for leaks and correct operation. If any well is found to be not pumping because of low water level, pumping in this well is discontinued.

Approximately 24 hours after the pumping rates or wells in operation have been adjusted, the aquifer water level is checked. If the water level has dropped below -4 feet MSL, pumping in the six nearest extraction wells is adjusted until observed water level rises above -4 feet MSL. The treatment plant operator shall determine adjusted pumping rates based on monitoring well response data generated by ongoing recovery system operations. Pumping rates need not be adjusted to compensate for drawdowns less than the acceptable level.

## 4.8 AQUIFER MONITORING PROGRAM

The monitoring program for the groundwater recovery system includes water level and groundwater sampling, analysis in monitoring wells, and creosote/water recovery rates.

### 4.8.1 Water Level Measurements

Water level measurements are made monthly/manually. The treatment plant operator pulls draw down, records the water level data, and produces the groundwater elevation hydrographs as shown on Figures 9 and 10. More frequent water level measurements will be required in extraction wells during initial system startup and following adjustments in recovery rates. Manual water level measurements are made monthly.

The general procedure for manual water level measurement is listed below:

1. **Decontaminate Materials**. Before measuring, clean all equipment that will contact groundwater using a quality, laboratory cleaning agent, and triple-rinse with distilled water.
2. **Confirm Well Elevations**. Confirm the elevations generated from the most recent survey for the absolute NGVD elevation of each well's top of casing (the magnetic north side of the innermost casing). Note the elevation on a water level measurement log.
3. **Determine Water Elevations**. Measure depth-to-water in each well using an appropriate measuring device. Calculate the elevation of water surface using the most recent survey data for each well. Measure levels within a 24-hour period.
4. **Repeat Measurements**. Repeat water level measurements in monitoring wells to confirm results. Repeat measurements are not required in extraction wells. Measurements shall be repeated until successive readings differ by less than 0.05 feet.

### 4.8.2 Well Development

Periodically, monitor wells or extraction wells require redevelopment. The general procedure for well development is listed below:

1. **Equipment Removal**. The downhole pump will be removed for well development, as described in Section 4.6. While the pump is out of the well, it will be inspected and maintenance repairs will be completed if required.
2. **Clean Development Materials**. Before development, clean all equipment that will contact the media during development.
3. **Measure Depth of Well and Depth of Water**. Measure the depth of water from the magnetic north side of the innermost well casing as described in Section 4.8.1, *Water Level Measurements*. Then sound the well to the bottom using an interface detector probe. If an oil layer exists, measure the thickness of the oil layer. Record this information on a well development log (Table 5).
4. **Calculate Purge Volume**. Calculate the volume of water contained in the well casing using the information recorded above. Extraction wells shall not be purged. Collect samples directly from pump discharge.
5. **Purge Monitoring Well**. Purge the well until a minimum of three well volumes are removed and negative logarithm of hydrogen ion concentration (pH), conductivity, and temperature readings stabilize, or until five well volumes are removed. Purge the well according to the following procedure.

    a. Place a piece of polyethylene sheeting (approximately 4 feet by 4 feet) around protective well casing to prevent contamination of adjacent ground surface.
    b. Purge the well using acceptable method and equipment (e.g., bailer or pump).
    c. Contain the purged effluent (if contaminated) in 55-gallon steel drums in accordance with the WMP (IT/OHM, 1999d).
    d. Upon completion, place sheeting/PPE/trash in plastic bag for proper disposal.
    e. If the purging equipment is not dedicated to monitoring well, decontaminate it using distilled water and a quality laboratory-cleaning agent. Store in a clean, dry area until the next use.
    f. Take drums of contaminated effluent back to the treatment plant for subsequent treatment.

6. **Monitor Purge Water Properties**. A minimum of five pH, conductivity, and temperature measurements shall be taken during purge activities. Readings shall be considered stable when consecutive pH, conductivity, and temperature readings are within 0.1 pH units, 10 percent, and 1 degree centigrade (°C) (monitoring wells only), respectively. Continue purge activities until stable readings are indicated. All measurements shall be recorded on the well development log (see Table 5).
7. **Reinstall Pump**. After the well development is complete, the pump will be reinstalled in the well.

### 4.8.3 Well Sampling

Groundwater samples shall be collected from four monitoring wells each quarter for analysis of semi-volatile organic compounds by USEPA SW-846 Method 8270C. The wells sampled can vary each month at the discretion of the plant operator. The groundwater samples shall be collected directly from the pump discharge sampling port at the top of the well. The sampling event and analytical results are to be included in the monthly reports referred to in Section 8.0.

In the event that groundwater samples are required to be collected from monitoring wells for contaminant analysis, the following procedures are to be used:

1. **Clean Equipment.**
2. **Measure Depth of Well and Depth of Water**. Measure the depth of the well and the depth to water as described in Section 4.8.2.
3. **Calculate Purge Volume**. Calculate the volume of water in the well as described in Section 4.8.2.
4. **Purge Monitoring Well**. Purge the well as described in Section 4.8.2.
5. **Monitor Purge Water Properties**. Monitor the purge water as described in Section 4.8.2.
6. **Collect Samples**. Collect groundwater samples from the purged well using a bailer and handle the samples according to the procedures described in Section 5.0 of the Field Sampling Plan (IT/OHM, 1999b).

### 4.8.4 Modification of Operating Program

The operating program will be modified from time to time based on observed system performance. Modifications may consist of increasing or decreasing pumping rates or discontinuing pumping of some wells, and possibly adding or deleting extraction wells to the system. Modifications may be made as indicated by system performance or field conditions.

The first modification of the program may be initiated before the initial startup based on observations of the presence or absence of creosote in individual wells in each array. Additional modifications will be made at a frequency dependent upon results presented in monthly operation reports. It is anticipated that direct recovery system modifications occur approximately once every two (2) months.

## 4.9 EXTRACTION SYSTEM MAINTENANCE

### 4.9.1 Inspections

Repairs to well piping and fittings shall be made in accordance with the manufacturer's instructions. The nature of the repair and downtime of the recovery piping system shall be reported on the Monthly Operations Report.

Pumping equipment, including wellhead controls, shall be inspected for performance in accordance with the manufacturer's instructions and performance criteria. Repairs to the pumping equipment shall be made in accordance with manufacturer's instructions. The nature of the repair and the downtime of the pump shall be reported on the monthly system operation report.

### 4.9.2 Well Maintenance

The only maintenance items anticipated for the recovery and monitoring wells are periodic sediment removal and possibly redevelopment. Routine maintenance of the well operation shall be as follows:

- Periodically, measure the depth of each extraction well and compare with the pre-startup depth. Record the amount of sedimentation on a water level measurement log. If more than 1 foot of fill is present in the well screen, remove the pump. Remove the sediment from the screened area using a bottom-filling bailer or other appropriate device.

- Periodically, measure the depth of each well and compare with the pre-startup depth. Record the amount of sediment on the water level data sheet. Remove sediment accumulation. Based on the nature of the sediment, evaluate the need for well maintenance based on the following criteria:
  - If sediment is predominantly fine sand or silt, redevelopment is indicated. Develop by surging and bailing or pumping until virtually clear and free of sand. Development shall continue until a representative sample of well water contains less than 10 milliliters (mL) of solids as measured after three minutes settling time in an Imhoff cone or similar device. Collect and containerize materials generated during redevelopment.

- Label all containers as to the date of generation, physical properties (solid or liquid), and general description of materials contained. Return liquids to the oil/water separator for treatment.
- If sediment is predominantly creosote-contaminated sands and silts, and free-phase creosote, then lowering of the pump is indicated.

#### 4.9.3 Pump Troubleshooting

If the pumping rate of any extraction well drops suddenly, remove the pump and check for sedimentation within the screened interval. Remove sediment (if present) and assess corrective well maintenance. If sedimentation of the well has not occurred, refer to the Operations Manual for specific procedures to assess the pump for proper operation.

#### 4.9.4 Reporting Requirements

Extraction and monitor well operations data is recorded daily and reported monthly in the Monthly Operations Report. The data included in the Monthly Operations Report includes:

- Daily total flow from each Array (1a, 2, and 3);
- Groundwater elevation hydrographs for all 11 monitor wells;
- Water level measurements as recorded manually from each of 11 monitor wells;
- Tabular summary of wells in operation during the month;
- Subsidence measurements for each of 11 monitor wells and other site benchmarks; and
- Daily status report for each extraction well.

### 4.10 GENERAL SITE INSPECTIONS AND MAINTENANCE

General inspection and maintenance of the site, RCRA cap, groundwater treatment building, groundwater treatment plant, and well vaults shall be routinely performed as follows:

- The RCRA cap shall be inspected each month. The inspection should be thorough with emphasis placed on identifying any erosion of the cap at or near the surface following periods of heavy rainfall. Evidence of any potential or existing compromise in cap integrity shall be reported to the LDEQ as soon as possible. The problem shall be remedied as directed by the LDEQ. Details of the cap inspection and remedy are to be included in the monthly reports referred to in Section 8.0.

- The groundwater treatment building, groundwater treatment plant, and well vaults shall be inspected daily for overall structural integrity and safety concerns. Evidence of any potential or existing problems shall be reported to the LDEQ as soon as possible. Problems shall be remedied as directed by the LDEQ. Details of the inspections and remedies are to be included in the monthly reports referred to in Section 8.0.
- The grass lawn at the site shall be mowed once a month or as needed. No shrubs or trees shall be allowed to grow on the RCRA-compliant cap area.

# 5.0 OPERATION OF GROUNDWATER TREATMENT SYSTEM

Procedures of this section are both general and specific in nature depending upon differences in contractor-supplied equipment and potential deviations in construction of the facility from the original plans and specifications. The procedures of this system provide the intent of treatment system operation. Specific operation and maintenance are presented in applicable equipment O&M manuals provided by equipment suppliers.

This section of the O&M Plan should be updated periodically to incorporate changes in construction of the system and in operational goals made due to knowledge gained during system operation.

## 5.1 SYSTEM OVERVIEW

### 5.1.1 Treatment System Description

The groundwater treatment system will treat recovered groundwater from the site and discharge treated water into the bayou. The oil/water separator, filtration systems, and granular activated carbon vessels are designed to remove free-phase and dissolved creosote to below established discharge limits.

Major components of the treatment system include an oil/water separator, filter feed tank, sand filtration vessels, oleophilic filters, granular activated carbon vessels, backwash tank, recovered oil tank, post-aeration tank, stormwater sump, air compressors, air dryer system, and air blower. General operating and design conditions are summarized in Table 6. A plan view of the system is shown in Figure 6. Major system components are described below.

### 5.1.2 Unit Process Description

The following unit process descriptions are intended to be general.

#### 5.1.2.1 Oil/Water Separator

The well arrays pump influent to the oil/water separator at a nominal flow rate of 10 gpm with a 45-gpm peak flow capacity when the stormwater sump pumps are operating. The influent passes through a surge column to reduce the velocity surges characteristic of pneumatic well pumps so that the flow can be accurately metered. Creosote sludge settles in the hopper bottom of the oil/water separator and is pumped to the recovered oil tank.

Oils are disposed of off-site as a hazardous waste.

#### 5.1.2.2 Filter Feed Tank

Oil/water separator effluent flows by gravity into the filter feed tank. This tank serves as a holding basin to supply the filter feed pumps. The filter feed pumps can manually be set at a constant speed which results in a relatively steady flow rate to the remainder of the treatment system. That flow rate must exceed the average influent flow rate. The pumps are automatically activated by high level in the filter feed tank and deactivated by low level in the same tank. This mode of operation results in a series of batch runs through the treatment system.

#### 5.1.2.3 Sand Filters

Filter influent is pumped through one of two sand filter vessels. Only one filter is online at a time except during a switchover. These filters are intended to remove residual oil and suspended solids that are not removed in the oil/water separator.

The sand filter units can be air-scoured and backwashed. These operations are fully automated with the backwash sequence being initiated by a high differential pressure across the filter beds (indicating a fouled filter), by a timer sequence (initially set at once per day), or manually by the operator.

#### 5.1.2.4 Oleophilic Filter

The oleophilic filter media is intended to remove residual oil that may pass through the sand filter. This filter can be manually backwashed.

#### 5.1.2.5 Granular Activated Carbon

Four granular activated carbon (GAC) vessels are provided to remove dissolved creosote compounds from the water leaving the oleophilic filter. The GAC vessels can be operated by placing carbon units in series or in parallel. The interconnecting piping and valving shall allow for any three of the four GAC vessels to be operated in parallel or in series, and allow for the operation of any single vessel independent of the other vessels in the train.

GAC vessels are each capable of being manually backwashed. Backwashing of the GAC vessels removes accumulated solids and biological growth that may decrease the flow rate through the vessels. Periodic or as needed (differential pressure greater than 15 psi at 45 gpm) backwashing should minimize these accumulations.

#### 5.1.2.6 Post-Aeration Tank

A blower supplies low-pressure air through a coarse-air diffuser to aerate the effluent before discharge to the bayou. Effluent overflows to the bayou through a gravity discharge line. The post-aeration tank also provides a source of water to backwash filter vessels. Prior to backwashing filter vessels, aeration for the post-aeration tank should be discontinued in order to minimize air entrainment and backwash pump cavitation.

#### 5.1.2.7 Backwash Tanks

The backwash tank is used to contain the water resulting from backwashing any of the filter vessels. Backwash water can be stored in this tank and is metered into the treatment process with the backwash solids pumps. Metering of backwash water is either a manual or automatic procedure. Typically, this should be done by placing the pumps into "AUTO" mode. The backwash water will be metered into the process and controlled by the backwash tank level.

#### 5.1.2.8 Recovered and Skimmed Oil Tank(s)

The recovered oil tank is used to store "heavy" oil recovered in the oil/water separator. Floating oil is stored separately in the skimmed oil tank.

The recovered oil tank is equipped with outlets in the side of the tank to allow for removal of water floating on the oil and disposal of a recovered product with a high oil-to-water ratio. On a periodic basis both tanks will be emptied into a tank truck for off-site disposal.

#### 5.1.2.9 Stormwater Sump

The stormwater sump is used primarily for the collection and containment of rainwater until conditions allow for the treatment of this water through the treatment system. In addition, this sump also receives treatment area spills and tank cleanouts and overflows. The stormwater sump pump can be operated either in manual or automatic mode. AUTO mode operates the sump pump by a level within the stormwater sump. Manual operation disables the level control. Typical operation of the sump pump should be in AUTO mode.

#### 5.1.2.10 Air Compressors

Two new rotary screw air compressors are used to supply air to extraction well pumps, the pneumatic control valves, and filter air-scour. These compressors are now air cooled.

#### 5.1.2.11 Air Dryer System

Air that exits the compressors is dried using a dual column, regenerative air dryer. This air dryer prevents the accumulation of condensation in the air lines and pneumatic valves. Refer to the vendor's O&M Manual for startup procedures and maintenance requirements.

#### 5.1.2.12 Air Blower

The air blower delivers air to the post-aeration tank to raise the dissolved oxygen content of the effluent before discharge to the bayou. The amount of air going to the post-aeration tank can be valved to supply more or less air, depending on specific aeration needs. Refer to the vendor's O&M manual for startup procedures and maintenance requirements.

## 5.2 GENERAL OPERATION ACTIVITIES

General activities presented in this section apply to operations involving more than one unit process that will be conducted on an infrequent basis such as system startup, shutdown, and emergency actions.

### 5.2.1 Treatment System Startup

During the operational period of the groundwater recovery system, equipment maintenance activities may require short-term shutdowns.

The following general procedures should be followed whenever the treatment system is started up following a shutdown:

1. Close all vessel and tank drains and sample ports.
2. Close all manual backwash valves to pressure vessels, and plug valves downstream of the extracted oil quick-disconnect fitting.
3. Open the isolation valves on pumps, flow motors, compressor piping, extraction well effluent lines, and pressure vessels.
4. Open the ball valves on the extraction well high-pressure air lines.
5. Open the outlet valves on the backwash tank and filter feed tank.
6. Open all manual process valves on the sand filter.
7. Open the valving sequence developed by the contractor to select a three-vessel parallel arrangement of carbon absorbers with the remaining vessels in series.
8. Open the ball valves on the compressor high-pressure discharge.
9. Open and close the compressor receiver and blower drain valve to drain accumulated condensation.
10. Open the high-pressure air valves distributing air to the air scour, control valves, and extraction wells.
11. Compressors are now air cooled.
12. Set pumps and backwash system to AUTO mode.
13. Start the compressors and allow system pressure to accumulate.
14. Set the extraction well control panels to AUTO. Groundwater will now begin to flow into the oil/water separator.
15. As the oil/water separator overflows to the filter feed tank, the filter feed pumps will start automatically.
16. When the water level in the post-aeration tank is about four feet from the bottom of the tank, start the aeration blower.

The treatment system will now be operating under automatic control at a flow rate dependent upon extraction well flow rates, stormwater flow rate, and backwash tank volume.

### 5.2.2 Treatment System Shutdown

Specific shutdown procedures for each piece of process equipment are provided in respective O&M manuals. The following general procedures are intended for short-term shutdowns for equipment maintenance:

1. Manually close the main extraction well air control valve. The extraction wells will pump through several cycles (approximately 5 to 8 hours) due to the residual air within the air line.
2. The filter feed pumps can either be switched off or allowed to partially empty the filter feed tank, thereby shutting the pumps off on low-level in the tank.
3. Shut off the post aeration blower.
4. Switch off pump(s) as required to isolate system requiring maintenance.
5. Switch off air compressors and drain air receiver.
6. Drain tank(s) to the stormwater sump as required. Refer to Section 5.3.2 “Tank Draining” for additional information.

## 5.3 RAPID SHUTDOWN PROCEDURES

In the event of an emergency in the well field and a rapid shutdown of the treatment facility is required, the following procedures should be followed:

1. Shut off air compressor.
2. Shut off extracted groundwater flow by closing the influent ball valves.
3. Shut off feed pumps, backwash solids pumps, and stormwater pumps.

These steps will stop the flow of water through the treatment system.

### 5.3.1 Tank Cleaning

The tanks may require periodic cleaning to remove sediment accumulation in the bottom of the tanks and scale from the walls. All tanks are provided with manways to provide interior access. Specifically, the backwash tank and extracted oil tank will require the periodic removal of settled solids from the tank floor. The post-aeration, filter feed, and skimmed oil tanks will require periodic removal of scale from tank walls. Tank cleaning is recommended. Tank cleaning should always be performed in accordance with appropriate procedures for confined space entry.

### 5.3.2 Tank Draining

All of the treatment system vessels may be partially or completely drained. Generally, drained water, with the exception of that contained in the post-aeration tank, will require collection in the stormwater sump for treatment following startup of the treatment system. Depending on the reason for tank draining, post-aeration tank contents may also require re-treatment. Any vessel (except the recovered and skimmed oil tanks) may be drained by isolating it from the remainder of the treatment process and draining the vessel through the drain port at the tank's base to the stormwater sump. Each vessel, vessel unit, and tank is provided with a hub drain to accomplish necessary draining.

If the complete system requires draining, the following general procedures can be performed:

1. With the treatment system operating, disable the automatic sand filter backwash sequence by switching the backwash controls to MANUAL.
2. Manually close the extraction well air supply control valve.
3. Pump water collected in the stormwater sump and the backwash tank through the treatment system. This will empty the stormwater sump and drain the backwash tank.
4. Operate the treatment system until the oil/water separator stops overflowing into the filter feed tank and the filter feed pumps shut off on low-level in the filter feed tank.
5. Using a portable pump, pump clarified water from the oil/water separator to the filter feed tank.
6. Manually pump water level in the filter feed tank down to the suction pipe of the feed pumps.
7. Individually drain the remaining water in the filter feed tank and media vessels to the stormwater sump through the hub drain.
8. Using a portable pump, pump stormwater sump to temporary storage tanks for future treatment.
9. The post-aeration tank can be drained directly into the drainage channel through the drain valve at the bottom of the tank
10. Run the oil transfer pump to remove the remaining oil from the oil/water separator.
11. The extracted oil tank and skimmed oil tank can only be drained by pumping the extracted oil for off-site disposal.

### 5.3.3 Alarm Responses

Instrumentation of the groundwater treatment system includes several alarms and lights to warn of problems with process equipment. Table 7 lists equipment and alarm situations. Response to individual alarms vary, but generally comprises three actions: (1) confirmation of situation, (2) response to situation (if required), (3) documentation of cause and response.

The operators should respond to system alarms as follows:

- **Recovered oil tank level high or high-high.** On high level in the recovered-oil tank, the oil transfer pump will be disabled. High-high level is an alarm. The operator should verify either of these conditions and make arrangements for disposal of extracted oil as soon as possible. Extracted oil should be disposed of before this alarm occurs.
- **Post-aeration tank level high**. The operator should verify that the gravity discharge from the tank is not obstructed.
- **Filter feed tank level high-high**. On high-high level in the filter feed tank, the flow from the sumps and extraction wells will be disabled. The operator should verify that this condition has occurred and that the filter feed pumps are operating correctly.
- **Stormwater sump level high-high**. On high-high level in the stormwater sump, the operator should verify that the stormwater sumps are operable and that valving allows flow to the oil/water separator.
- **Backwash control system fails**. On low level in the post-aeration tank, or high level in the backwash tank, or when control air pressure is low, the backwash sequence will be disabled. On failure of the backwash sequence, the operator should verify that the level in the post-aeration tank is adequate to support a backwash sequence and that sufficient backwash tank volume is available for discharge. Upon continuing failure of the backwash sequence, the operator should verify that control air pressure is available and the appropriate valving is operating correctly for the backwash sequence.
- **Filter feed pump alarm**. Upon high differential pressure across the lead pump in AUTO mode (greater than 100 psi), the lead pump will stop, and the filter feed pump-fail annunciator will light up. The operator should investigate the source of the high-pressure alarm (for example, a closed isolation valve, or high differential pressure across media vessels) and select the standby pump for the AUTO mode if the lead pump has failed.
- **Backwash solids pump alarm**. Upon high differential pressure across the lead pump in AUTO mode (greater than 100 psi), the lead pump will stop, and the backwash solids pump-fail annunciator will light up. The operator should investigate the source of the

high-pressure alarm (such as closed isolation valves) and select the standby pump for AUTO mode if the lead pump has failed.

- **Air compressor low-pressure alarm**. Upon low discharge pressure from the air compressors, the lag compressor will start to supplement the lead and the air compressor low-pressure annunciator will light up. The operator should verify that the lag compressor has started and investigate the source of the low-pressure alarm (such as high compressor temperature, low oil level, or high pressure air line leaks).
- **Air dryer system failure**. After sensing high moisture content in the discharge from the air dryer system, the air dryer system-fail annunciator will light up. The operator should investigate the source of the failure (for example, exhausted desiccant beds).
- **Air scour pressure low**. Upon low pressure to the air scour system, the sand filter backwash sequence will be disabled. The operator should follow the Air Compressor Low Pressure Alarm procedure.
- **Extraction well air pressure low**. Upon low pressure in the recovery pump air line, an annunciator will light up. The operator should follow the Air Compressor Low Pressure Alarm procedure.

## 5.4 SAMPLING OPERATIONS

Sampling of the water within the treatment system is done through sample ports located throughout the system (see Figure 11). Procedures shall follow those submitted in the FSP (IT/OHM, 1999b). Procedures for sampling are the same for all sampling ports with the exception of sampling of the extracted oil tank. Whenever possible, samples shall be taken when the treatment system has been in constant operation for four (4) hours or more. Water samples within the treatment facility shall be taken using Contracting Officer (CO)-approved, contractor-prepared FSP procedures.

Samples of recovered oil from the extracted oil tank shall be taken using procedures specified in the FSP. Samples of recovered oil are taken as follows:

1. Calculate oil present in active volume of extracted oil tank based on tank diameter and oil level.
2. Calculate the incremental oil volume corresponding to the number of discrete oil samples to be combined to make the composite moisture sample. The incremental oil volume

equals the active volume of extracted oil divided into four to six equal portions, as approved by the CO.

3. Based on the flow measurement of the oil disposal flow meter, collect equal sample volumes of oil at each incremental sample volume.
4. Combine the individual sample volumes into a composite sample.
5. Thoroughly mix the composite sample.
6. Place thoroughly mixed sample into container.
7. Seal the container securely and label it.
8. Dispose of any waste creosote oil into the extracted oil tank.

## 5.5 FREEZE PROTECTION

Complete draining of the system should be considered for anticipated long-term sub-freezing weather. Less severe conditions may require the draining of non-used lines and maintaining a constant flow in others. Heat tracing has not been provided for the facility. Freeze protection activities shall include but are not limited to the following activities:

1. Shutting down the extraction system.
2. Draining the extraction well heads and aboveground piping.
3. Shutting down and draining the waste water treatment system.

## 5.6 HURRICANE EVENTS

Preparation for hurricane events shall include but not be limited to the following activities:

1. Notification of impending events and preparations.
2. Shutting down the recovery and treatment system.
3. Storing any loose equipment or materials located on site.
4. Protecting the treatment system control building from flying objects by covering all exterior glass surfaces with protective material.

## 5.7 FLOOD EVENTS

Flood events may or may not be associated with hurricane events. Should flood preparations become necessary, the following activities should be conducted at minimum:

1. Notification of impending events and preparations.
2. Shutting down the recovery and treatment system.
3. Storing any loose equipment or materials located on site.
4. Capping extraction well casings to prevent surface water inflow.

## 5.8 SPECIFIC PROCESS ACTIVITIES

This section describes specific process activities that will be undertaken on a regular basis whenever the treatment system is in operation. It is intended that the procedures of this section shall be followed in conjunction with the vendors' O&M manuals located on site. The process and instrumentation diagrams sheets for the GW treatment system have been included as Figures 12, 13, and 14.

## 5.9 STORMWATER SUMP PUMP

The treatment area stormwater sump collects spills, wash-down water, and stormwater. Accumulated stormwater and spilled creosote is considered contaminated and shall be pumped to the oil/water separator. Collected water can be pumped to the filter feed tank but this operation should be avoided due to the potential for contaminating the sand beds with creosote oil.

### 5.9.1 Stormwater Sump Pump Controls

Loop 7-1 monitors water level in the stormwater sump and controls stormwater pump(s) (P-07-1, -2) based on that level. At a low sump level, both pumps are disabled. At a high level, an alarm sounds at the control building.

The loop is controlled from a Local Control Panel (LCP) (7-1). A switch on the LCP establishes MANUAL or AUTO control. AUTO is the preferred operational mode.

### 5.9.2 Stormwater Sump Pump Procedures

- Verify that valves direct flow from the stormwater sump to the oil/water separator.
- For automatic LCP control of stormwater pumping, turn the selector switch to AUTO. For manual operation, set selector switch to MANUAL. Automatic operation of this pump is the recommended standard operating procedure.

## 5.10 TRUCK RAMP SUMP PUMP

Accumulated rainwater and spilled creosote on the truck ramp is pumped directly to the treatment area stormwater sump.

### 5.10.1 Truck Ramp Sump Pump Controls

Loop 7-3 controls flow from the truck sump pump (P-07-3) based on water level in the truck sump. At low level, the pump is stopped. At high level, the pump starts. If the filter feed tank is at a high-high level, the truck sump pump is stopped.

This loop is controlled from a local control panel. A hand switch allows a choice of MANUAL or AUTO operation.

### 5.10.2 Truck Ramp Sump Pump Procedures

1. Verify that the ball valve on discharge piping is open.
2. For operator control, turn the selector switch on the local control panel to MANUAL and start the pump. Stop the pump at the desired water level.
3. For automatic operation based on sump water level, turn the selector switch to AUTO. Automatic operation of this pump is the recommended standard operating procedure.

## 5.11 OIL TRANSFER FROM STORAGE TANK TO TANK TRUCK

The oil storage tank is used to contain "heavy" creosote oil removed from the oil/water separator. The skimmed oil tank is used to contain "light" oil removed from the oil/water separator by the oil skimmer. Accumulated oil in the extracted oil tank must be disposed. Oil transfer is accomplished using the extracted oil pump.

### 5.11.1 Oil Transfer Controls

Loop 2-1 monitors and indicates the oil level in the oil/water separator and uses this information to control the oil transfer pump (P-02-1). Also, the discharge pressure of the oil transfer pump is monitored and if it is too high, the pump automatically shuts off. Optionally, the oil transfer pump can be operated in manual mode to transfer the oil.

Loop 2-2 monitors the oil level in the recovered oil tank (T-02-2). At high level, an alarm sounds and the oil transfer pump (P-02-1) is stopped. At a high-high level, an additional alarm sounds. The recovered oil pump (P-02-3) can be used to transfer recovered oil from T-02-2 to a tank truck. At low levels, Loop 2-2 sends a signal to stop the recovered oil pump. Alternatively, the treatment system operator may choose to utilize a vacuum truck to remove recovered oil.

5.11.2 Oil Transfer Procedures

1. Schedule oil disposal activities to occur before the full level is reached in the extracted oil tank.
2. Upon arrival of the tank truck, connect the tank truck hose to the discharge of the extracted oil pump using the quick-disconnect fitting located in the truck ramp area.
3. Verify appropriate valving sequence to allow oil transfer from the extracted oil tank to the tank truck.
4. Close the plug valve on the outlet of the skimmed oil tank to prevent backflow into this tank while transferring the contents of the extracted oil tank.
5. Start the extracted oil pump in the AUTO mode.
6. Periodically collect discrete oil samples as discussed in the FSP (IT/OHM, 1999b).
7. When the extracted oil tank is empty, the extracted oil pump will shut off.
8. Close the plug valve on the outlet of the extracted oil tank.
9. Open the plug valve on the outlet of the skimmed oil tank.
10. Switch the operation of the extracted oil pump to MANUAL mode and start the pump.
11. When the skimmed oil tank is empty, manually shut off the extracted oil pump.
12. Reconfigure valving to isolate both oil tanks and the oil transfer piping.
13. Verify with the truck driver that oil transfer has been completed to allow time for the closing of the proper valves on the tank truck.
14. Place a bucket or other container beneath the transfer hose fitting.
15. Disconnect the transfer hose from the quick disconnect fitting.
16. Drain the oil remaining in the hose into the bucket. Return this oil to the oil storage tank.
17. Complete hazardous waste manifesting for transfer of oil custody to the transporter.
18. Spilled creosote should be transferred to the stormwater sump according to the procedures of truck ramp sump pump instructions as outlined in Section 5.10.

## 5.12 TRANSFER BACKWASH SOLIDS TO OIL/WATER SEPARATOR

The backwash solids tank contains the backwash water and residual solids produced by the backwash process. Transfer of backwash solids to the oil/water separator is initiated by level in the backwash tank.

### 5.12.1 Backwash Transfer Controls

Loop 3-2 initiates transfer of solids from the backwash tank (T-03-2) to the oil/water separator. At a low tank level, the backwash solids pump (P-03-2-1, -2) will stop. At a medium level, the backwash solids pump will start. At a high level, a signal is sent to the backwash control system to prevent a backwash.

Excessive discharge pressure from the backwash solids pump will stop pump operation. Pump operation is also stopped if the filter feed tank (T-03-1) is at a high level.

### 5.12.2 Backwash Transfer Procedures

1. Verify proper valves positions.
2. For automatic control, set the selector switch for the backwash solids pump on the main control panel to AUTO. Manually set the speed of the pumps so that the tank will be drained at a slow rate but before the next backwash cycle begins. This will avoid a surge on the treatment system. When the level in the backwash tank reaches a low level, the backwash solids pump will stop.
3. For manual control of the pump, set the selector switch on the main control panel to MANUAL.
4. Start the pump. Pump backwash water until the water level is in the cone bottom of the tank.
5. Stop the pump.
6. Reset selector switch to AUTO. This is the recommended mode of operation for this process.

## 5.13 FILTER FEED PUMP OPERATION

The filter feed pumps are used to pump the contents of the filter feed tank through the filters and absorbers. The pumps have variable-frequency drives. The pump flow rate is manually set by the operator.

### 5.13.1 Filter Feed Pump Controls

Loop 3-1 initiates flow of water to the treatment filters based on water levels in the filter feed tank (T-031). When the water level in the filter feed tank is at the low-low level, the filter feed pumps shut off. As the water level rises, the filter feed pump(s) start and hold a constant speed as set by the operator. At a high tank level, signals are sent to stop the flow into the oil/water separator from the extraction wells and the backwash solids pumps. This situation is most likely to occur during a storm event when water level would backup in the stormwater sump. Therefore, only the stormwater pumps are allowed to pump into the oil/water separator until the stormwater sump is pumped down to its normal level. At a high-high level, an alarm sounds in the control building and a signal is sent to shut off the truck ramp sump pump (P-07-3).

This loop also monitors filter feed pump discharge pressure. Those pumps are shutdown for high discharge pressure. Based on the filter feed pump speed, this loop provides a signal for a future filter feed polymer pacing system.

### 5.13.2 Filter Feed Pump Procedures

1. Verify proper valve positions to allow water to flow from the filter feed tank to the sand filters.
2. For automatic control, set the selector switch for the filter feed pumps on the main control panel to AUTO. The filter feed pumps will discharge wash-water through the pressure vessels based on filter feed tank levels.
3. For manual control of the filter feed pumps set the switch on the main control panel to MANUAL. Start the pump(s). Pump until the desired tank level is reached. Stop the pump(s).
4. Reset selector switch to AUTO. This is the recommended mode of operation for this process.

## 5.14 SAND FILTER OPERATION

The sand filters remove residual solids and oil from the groundwater that may be present following the oil/water separator. Filter operation is either AUTOMATIC, SEMI-AUTOMATIC or MANUAL. Refer to the Pressure Filtration System O&M manual provided on site for specific process activities.

5.14.1 Sand Filter Controls

Loops 9-1 and 9-2 control the flow to the sand filter(s) (M-9-1,-2), respectively. In AUTOMATIC, excess differential pressure across the active sand bed initiates a backwash. When initiated, flow is diverted to the other sand filter vessel. Valving is then changed to drain the initial filter to the stormwater sump and to allow air scouring and backwashing. Draining is discontinued when the filter water level is just above the sand media.

The sand media is then scoured with air. A combined scour and backwash is initiated and continues until the filter is nearly full. Air scouring is then stopped and backwashing continues by itself. Backwashing is terminated and the media is allowed to settle and is ready for future use.

Backwash operations are stopped by signals indicating high level in the backwash tank (T-03-2), low level in the post-aeration tank (T-06-1), low control air pressure, or that the pump discharge path is closed.

Backwash operations can be controlled manually, automatically, or semi-automatically at the motor control panel. Manual operation occurs by opening and closing valves by hand to start and stop operations in the proper sequence and at the proper times.

Automatic operation opens and closes valves in the proper sequence and at the proper times automatically in response to either a high differential pressure or to exceeding a set time (initially 24 hours) since the last backwash sequence. In semi-automatic mode, an offline filter can be backwashed automatically by manual initiation of backwashing operations. The semi-automatic mode does not affect the online status of either sand filter.

Loop 8-1 controls and monitors backwash flow. The filter backwash pump (P-8-1) is controlled by a signal from the backwash control system. Backwash pump operation is stopped by low level in the post-aeration tank (T-06-1).

5.14.2 Sand Filter Procedures

**Automatic Mode**. In AUTOMATIC mode, the filter will automatically proceed through a backwash sequence once it has been initiated. The backwash sequence is initiated by a high differential pressure switch, or by a timer which will initiate backwash after a set time if the backwash has not been initiated by differential pressure, or by pushing the BACKWASH

SEQUENCE MANUAL INITIATE button. The sequencer automatically brings the clean filter online and takes the dirty filter offline. Automatic operation is recommended as standard operating procedure for backwashing.

**Semi-automatic Mode**. In SEMI-AUTOMATIC mode, the automatic backwash of an offline filter is initiated with the BACKWASH SEQUENCE MANUAL INMATE button. This mode does not affect the ONLINE/OFFLINE status of the filters.

**Manual Mode.** In MANUAL mode, the operator will manually open and close valves and start and stop the backwash pump and air scour for a single sand filter via the panel-mounted control switches. The operator can vary the length of backwashing and scouring to suit a particular need, such as extra scouring, to break up clumped material.

The operator can manually backwash either one of the sand filters by using the following procedure:

1. Place backwash control system selector switch, located on main control panel door, in the manual position.
2. Using the valve selector switches (located on the main control panel door) and the valve position sequence chart, sequence the valves to the proper position for each filter regeneration cycle.
3. Isolate the vessel to be backwashed from the process flow by closing the manually operated valves provided.
4. Manually sequence the filter valves to the proper position for the drain cycle.
5. Drain vessel to stormwater sump. End drain when water is just above the sand media.
6. Manually sequence the filter valves to the proper position for the air scour cycle. Scour sand media with air pressure initially set at 65 cubic feet per minute (cfm), 45 psi for a period of two minutes.
7. Manually sequence the filter valves to the proper position for the scour/backwash cycle and switch the backwash pump on using the selector switch located in the main control panel. Scour and backwash the filter media simultaneously until the filter is nearly full. Air scouring is then stopped and backwash continues by itself.
8. Manually sequence the filter valves to the proper position for the backwash cycle. Backwash the filter media at the rate of 250 gpm for a period of five minutes.
9. Switch "off" the backwash pump. Manually sequence the filter valves to the proper position for the clarify cycle. Verify that the filter feed pump is running. During the clarify cycle, the water from the filter feed pump enters the filter and is discharged to the backwash tank.

10. Manually sequence the filter valves to the proper position to place the regenerated filter in the stand-by mode. Allow the sand media to settle, but do not drain the filter because the initial stage of refilling might disturb the media.
11. Place backwash control system selector switch, located on the main control panel door, in the automatic position.

## 5.15 SAND FILTER MEDIA CHANGEOUT

Replacement of sand is expected to be a relatively infrequent operation. The two main reasons for sand replacement are fouling by oil or loss by over-scouring. Operation personnel may be able to prevent the need for sand disposal by cleaning procedures such as hot water, detergent, or caustic washing. If these methods are ineffective in cleaning the sand, replacement is appropriate. Sand shall be manually removed from the vessel. Replacement sand shall be slurried to the vessel from a delivery container. The treatment process will continue to operate during sand changeout using the second filter.

### 5.15.1 Sand Filter Media Changeout Procedures

1. Isolate the sand filter requiring media changeout from the treatment process using appropriate valves.
2. Drain the sand filter to the stormwater sump.
3. Connect the sand transfer lines to the sand vessels.
4. Slurry old sand out of filter into truck.

## 5.16 OLEOPHILIC FILTER OPERATION

The oleophilic filter removes residual free-phase oil carried through the sand filters. This filter prevents free oil from contacting the granular activated carbon and provides a relatively constant dissolved oil concentration to the granular activated carbon absorbers. Operation of the oleophilic filter is completely manual, including backwashing. Backwashing of the vessel is recommended when the differential pressure exceeds 15 psi at 45 gpm across the vessel.

If backwashing does not relieve the pressure differential across this vessel, media changeout may be appropriate. Backwashing and media changeout procedures are similar to those described for the sand filters, except that backwashing is completely manual and no air scouring capability is supplied.

### 5.16.1 Oleophilic Filter Controls

Loop 10-1 monitors the pressure differential across the oleophilic media filter (M-10-1). If the pressure differential is too great, manual backwashing may be appropriate. Operation personnel shall manually valve the oleophilic vessel to receive backwash water from the backwash control system and discharge the backwash water to the backwash tank (T-03-2). Refer to the vendor's O&M manual provided on site for specific valve sequencing of oleophilic media backwashing.

The backwash pump is stopped when there is a high level in the backwash tank or low level in the post-aeration tank. Backwashing to the oleophilic filter should not be attempted when the sand filter is being backwashed.

## 5.17 GAC VESSEL OPERATION

The GAC vessels remove dissolved organic compounds from the treated water. The vessels are operated all in series, with the last carbon filter vessel in the series acting as a stand-by unit.

GAC-treated water will be sampled and monitored in accordance with the FSP (IT/OHM, 1999b). The need for changeout of granular activated carbon must be documented by analysis of treated water taken from the 80 percent bed depth of the third carbon vessel operated in series. Samples taken from that point must show the presence of one or more organic base neutral acids (BNA) compounds at concentrations of 50 percent or more of the discharge limits. Carbon changeout is initiated once one of the carbon beds is spent and the fourth bed is brought online.

Operation of the GAC vessels is completely manual, including backwashing. Backwashing of the GAC vessels is recommended when the differential pressure across a carbon bed exceeds 15 psi at 45 gpm. Upon initially filling the vessels with carbon, each vessel should be repeatedly backwashed, until the effluent runs clear, to remove the carbon fines.

If backwashing does not relieve the pressure differential across a GAC vessel, the need for media may be indicated. Backwashing and media changeout procedures are similar to those described for the sand filters, except that backwashing is completely manual and no air scouring capability is supplied.

### 5.17.1 GAC Vessel Controls

Loops 11-1, 11-2, 11-3 and 11-4 monitor pressure differential across the granular activated carbon filters (M-10-1, -2, -3, -4). If the pressure differential is too great, manual backwashing is indicated. Operation personnel shall manually valve any granular activated carbon vessel to receive backwash water from the backwash control system and discharge the backwash water to the backwash tank (T-03-2).

The backwash pump is stopped when there is a high level in the backwash tank or low level in the post-aeration tank. Backwashing carbon filters should not be attempted when a sand filter is being backwashed.

## 5.18 POST-AERATION TANK OPERATION

The post-aeration tank allows for proper contact time between treated effluent and blower-supplied air to provide the necessary dissolved oxygen content before to discharge to the bayou. This tank also provides a source of backwash water for the sand filters.

### 5.18.1 Post-Aeration Tank Controls

Loop 6-1 monitors and controls the operation of the air blower (M-06-1) and monitors and controls backwash operations based on post-aeration tank (T-06-1) level. At a low tank level, a signal is sent that prevents backwashing. At a high tank level, backwashing and air scouring of sand filters are enabled. At a high-high level, an alarm sounds in the control room. Air can be valved to control its flow.

The air blower discharge pressure is shown on an indicator. Blower operation is switched manually either at the blower or in the control building.

## 5.19 AIR COMPRESSOR SYSTEM OPERATION

The air compressor system consists of the air compressors (M-1-1-1, M-1-1-2), air receiver (T-1-1), air dryer system (M-01-2-1), and associated controls. The control loops included in this system are described below.

- Loop 1-1 LDEQ installed new air compressors in 2011 when Loop 6-2 detects that treated effluent flow is low. Loop 1-1 also contains an alarm that sounds in the control room when the air compressor(s) fail.
- Loop 1-2 monitors the air dryer system and the air supply pressure. Alarms sound in the control room for failure of the air dryer system and low pressure in the air supply line.
- Loop 1-3 controls air flow to the extraction well pumps. The air flow control valve can be controlled manually or automatically. When in the automatic mode, the air flow control valve will close if the filter feed tank (T-03-1) is at a high level.
- Loop 1-4 monitors air pressure available for backwash of the filters. If the available air is at low pressure, a low pressure alarm will light in the control room, and a low air pressure signal will be sent to the sand filter backwash control system. A pressure gauge indicates air pressure and allows manual adjustment.
- Loop 1-5 monitors the air pressure available for control valves. A pressure gauge indicates air pressure and allows manual adjustment.

## 5.20 FLOW MONITORING OPERATIONS

Several flow metering and recording devices are included in the remediation system for payment and reporting requirements. These loops are described below.

- Loop 2-3 regulates pumping of extracted oil to the disposal truck. The extracted oil pump (P-02-3) is stopped either by a low level in the extracted oil tank (T-02-2) or by a high pump discharge pressure. Oil flow mass rate and quantity is measured by this loop.
- Loop 2-4 monitors and totalizes flows from the two (2) groundwater extraction well arrays. Arrays 1a, 2, and 3 are metered individually.
- Loop 6-2 monitors, totalizes and records flow from the pressure vessel treatment system. For low flow conditions, a signal is sent to the air compressor(s) (M-1-1-1, -2) to allow tap water to make up flow needed for cooling.

- Loop 6-3 monitors and totalizes the total discharge to the bayou.

### 5.21 OPERATIONAL LOGS

A record of analytical and operating data will be maintained to manage day-to-day operations and to evaluate the system performance over the long-term. Daily recordkeeping requirements for the remediation system are listed in Table 8. An appropriate log format will be developed for the client's approval. The data generated by the operations program will be maintained daily in a standard format for ease of recordkeeping, review and retrieval. Key performance and analytical data will be compiled on a microcomputer database as required by the FSP (IT/OHM, 1999b).

### 5.22 ADMINISTRATIVE REPORTS

Requirements for operational logs and discharge monitoring reports are presented in Section 8.0.

## 6.0 ELECTRICAL SERVICE

This section describes electrical service available at the site for the groundwater recovery and treatment system. No emergency power supply has been provided for the remediation system. In the event of electrical power failure, the remediation system will cease operations until power is resumed. Startup of equipment following power failure should be in accordance with manufacturer recommendations.

### 6.1 ELECTRICAL SUPPLY

Overhead power is supplied to an existing power pole near the northeast corner of the treatment system area by the Central Louisiana Power Company (CLECO). Power (480 V, 3 phase) is then carried beneath the access road to the CLECO metering equipment in 2- to 4-inch diameter conduits. Outside transformer and metering equipment are located near the central north wall of the control building.

## 6.2 ELECTRICAL DISTRIBUTION

Power enters the motor control center (MCC) room for metering (voltage and amperage) and distribution to major pieces or groups of related equipment.

The MCC is made up of electrical panels that contain motor branch circuit breakers, motor controllers, motor overloads, control switches, indicating lights, and equipment branch circuit breakers. In addition, the panels also carry circuit breakers for feeders that go to facility auxiliaries such as lighting panels and power panels.

Motor and equipment circuit breakers and the circuit breakers for auxiliaries protect the equipment by opening the circuit in the event of an overload or a short circuit.

The motor overloads protect the motor by opening the control circuit in the event of high motor current draw. Motor-controllers, or motor starters, supply the power to the motor and allow power to the motor to be controlled by various control devices.

Motor status indicating lights are found at the Main Control Panel (MCP). "Red" means that the motor is running. The operator is to check the alarm indicators to be sure that the status indicated by the red lights is correct.

If an alarm condition should occur, the operator will find and correct the problem before restarting the motor. For example: pressing the RESET button will reset the motor-overload protection devices located in the motor starter. If the RESET does not solve the problem, the operator should not attempt to open the starter compartment door to further investigate the problem; instead appropriate maintenance personnel should be notified. Maintenance personnel should follow equipment-specific lockout and repair procedures.

Table 9 lists equipment supplied from the MCC and their maximum current ratings. The circuits listed in Table 9 receive 480V power. Individual isolation transformers convert AC to DC for use in the two local control panels (LCP-3-1-1, LCP-3-1-2) for the filter feed pumps. Panel L transformers step the power from 480V to 120V/240V prior to further distribution. Panel L circuits are described in Table 10.

# 7.0 SUBSIDENCE MONITORING PROGRAM

## 7.1 PROGRAM OVERVIEW

Drawdowns created by operation of the groundwater recovery and treatment system shall be limited to 4 feet as measured in the on-site and off-site monitoring wells. This limitation is anticipated to minimize off-site and on-site settlement while allowing larger drawdowns. The results of on-site and off-site settlements can then be used to modify operation of the recovery system to better meet the other recovery system goal of creosote oil recovery.

Startup procedures for the groundwater recovery system are presented in Section 4.0, subsection "Recovery System Startup Procedures." Subsequent changes to operation of the recovery system will be based on results of the subsidence monitoring and groundwater recovery programs.

The Subsidence Monitoring Program is a process for measuring the ground surface settlements resulting from operation of the groundwater recovery system. Based on actual on-site settlement trends, preventative measures can be evaluated and implemented to avoid excessive settlements that might cause damage to on-site and off-site structures or on-site waste capping systems.

In addition to the survey monuments and monitoring wells existing on-site, new survey monuments and subsidence monitoring wells have been constructed off-site (Array 3). The survey of monuments and monitoring wells shall be made to measure changes in surface elevations and in corresponding groundwater levels at a frequency of once per month. In addition, photographs shall be made periodically of on-site and off-site structures. A database shall be kept of measurements and periodic reports shall be on file.

## 7.2 GENERAL SUBSIDENCE ISSUES

The purpose of the on-site Subsidence Monitoring Program is to identify potentially damaging differential settlement at the treatment system to allow the contractor to reduce the groundwater drawdown or to adjust treatment plant equipment to accommodate the subsidence. Reduction of recovery pumping rates and resulting groundwater drawdowns will be according to directions by the client.

Contractor will be responsible for maintaining all equipment within equipment manufacturers' recommended operating level tolerances.

Differential settlement between recovery and treatment system components could stress rigid or semi-rigid pipe joints. Daily inspections shall include exposed aboveground pipe joints within the site boundaries. Leaking joints or joint distress caused by differential movement shall be identified, documented, repaired, and reported.

Drawdown and associated ground surface subsidence are anticipated to decrease with distance from the extraction system. Monitoring of on-site and off-site survey monuments, and water levels, shall be conducted to identify and prevent potential damage to surrounding facilities. Settlement trends and rates shall be monitored to identify excessive settlement. Settlement rates shall be compared to groundwater drawdowns.

## 7.3 BENCHMARKS

On-site benchmarks are expected to subside and shall not be used for reference points. The initial survey and periodic re-surveys of on-site and off-site survey monuments and subsidence monitoring wells shall be referenced to three benchmarks established at least 800 feet from the property boundary during Phase 2 construction. The three off-site benchmarks shall be referenced to an existing offsite NGVD monument upon installation, and at 6-month intervals thereafter. Elevations shall be established to third-order accuracies. Any changes in elevations of any of the offsite benchmarks greater than allowable third-order errors in elevation shall be immediately reviewed to determine the need for re-surveying to the NGVD, or for adjustment of the elevations of on-site and off-site monuments based on the benchmark elevations. Review of survey data and the determination of the need for re-surveys will be performed.

## 7.4 WATER LEVEL MEASUREMENTS

Water level depths at each of the wells shall be measured using methods detailed in Section 4.0, "Operation of the Groundwater Recovery System." For purposes of the Subsidence Monitoring Program, measurements shall be made to the nearest 0.05 feet from the top of the magnetic north side of the innermost casing. Water level elevations shall be reported to the nearest 0.10 feet.

Initial water levels in the new and existing wells shall be measured after construction of new wells is completed, but before startup of the recovery system. These measurements shall be the initial water levels used for comparison to subsequent monitoring activities.

Water levels shall be determined at each of the wells at the time of each periodic re-survey described below. Water level elevations shall be referenced to the most recent survey of the top of the casing at each well.

## 7.5 PERIODIC RE-SURVEYS

Operation personnel will measure elevations of the survey monuments, survey benchmarks, and the top of casings at new and existing monitoring wells listed in Table 11. Vertical control shall be established to third-order accuracies. Each periodic survey shall be referenced to at least two of the off-site benchmarks.

## 7.6 SURVEY FREQUENCY

Elevations and water levels will be measured on a monthly basis of extraction well operation. The frequency of the surveys may be adjusted based on the results of actual settlement measurements.

Settlement is considered to have stabilized when four consecutive settlement measurements show changes less than or equal to 0.01 feet.

## 7.7 REPORTING

### 7.7.1 Initial Survey

A table (see Table 4) listing the initial elevations of each surveyed point shall be attached in the report. The table shall also list depth-to-groundwater at each monitoring well and corresponding calculated groundwater elevations. Supporting survey data such as sight distances, instrument readings, calculations, and data reduction shall also be provided.

7.7.2 Periodic Re-Surveys

For periodic re-surveys, the elevations of surveyed monuments and water levels shall be reported in a format relating the current measurements to their initial measurements. For each measurement location, calculate and report the current elevations settlements, groundwater elevations, and drawdowns as defined below:

- Groundwater elevation = (Current elevation of top of casing) minus (depth-to-water measurement below the top-of-casing)
- Drawdown = (Initial water elevation) minus (current water elevation)
- Settlement = (Initial elevation) minus (current elevation)

A database of survey measurements and reported information shall be developed and maintained on site. The database shall include, as a minimum, the following information:

- Date;
- Location;
- Measured elevation;
- Measured water depth;
- Water elevation;
- Settlement; and
- Drawdown.

Table 11 is an example of an acceptable format for the database.

A report of each set of survey and water level measurements (with supporting calculations) will be submitted within 48 hours of completion of the survey. The report shall provide the following items: date of measurement, surveyed location (such as benchmark, monument, or well number), elevation, water depth below top of casing and groundwater elevation. A completed Table 11 is acceptable for this report.

Submit separate, comprehensive reports for survey monument or monitoring well in the format of Table 12. Provide the following information:

- Date of measurement
- Date of last survey
- Days since start of extraction well pumping
- Number of days of extraction well operation since last report
- Measured elevation of monument or top of casing
- Initial elevation
- Settlement of monument
- Change in settlement since the previous survey effort
- Incremental settlement rate
- Current water elevation of monitoring wells
- Drawdown of monitoring wells

### 7.8 EMERGENCY ACTIONS

A review and revision of extraction well pump rates may be required based on the data generated from the periodic surveys.

If any incremental settlement is recorded and confirmed by approved re-survey, and is above third-order surveying errors, the structures near the affected monuments shall be inspected and photographed for cracking or evidence of structural damage caused by settlement. If structural damage is noted, the extraction wells adjacent to the affected areas will be shut down while subsidence prevention measures are evaluated and implemented. If no evidence of structural damage is shown, the rate of settlement will be evaluated and additional instruction on modifications to recovery system operation will be provided.

## 8.0 REPORTS

This section expands on the intent of the reporting requirements presented in the operational period contract. Daily, monthly, and quarterly operational and discharge monitoring reports are required to document remediation system operational activities as discussed in the following subsections. If discrepancies exist between the discussion presented in this section and the requirements of the contract, the requirement of the contract govern.

## 8.1 REPORT SUBMISSION

Submit copies of all reports to the LDEQ in accordance with contract requirements.

## 8.2 REPORT CONTENT

Required reports include both written and electronic database submittals. This subsection presents an overview of the contents of reports and databases.

## 8.3 ELECTRONIC DATABASE

Data generated during groundwater and treatment system sampling, as well as analytical analyses, operations data, maintenance schedules, and subsidence monitoring shall be compiled and stored in an electronic database.

Data shall be entered into the data files as numerals so that only one numeral is contained within a cell. Rows and columns of data shall be capable of being plotted either as x-or y-coordinates using Microsoft EXCEL® software. Rows and columns of data shall be capable of being statistically analyzed using Microsoft EXCEL® software. Data rows and columns shall conform to Table 13 for monitoring well and treatment system analytical results, respectively. For subsidence monitoring data, rows and columns shall conform to the format specified in Table 11.

## 8.4 OPERATIONAL REPORTS

### 8.4.1 Daily Reports

Each week, the contractor shall submit copies of the previous week's daily reports. A typewritten cover letter shall accompany the daily reports. The cover letter shall summarize the major events of the previous week including but not limited to:

- Days of operation
- Reasons for downtime
- Total gallons of water recovered

- Total gallons of water treated
- Total gallons of extracted oil
- Subsidence monitoring activities
- Maintenance activities undertaken
- Weekly rainfall
- Other events, at contractor's discretion

8.4.2 Monthly Reports

On a monthly basis, an operational report including a database summary will be submitted. The operational report will include a narrative summary of the daily operational logs, groundwater monitoring data and trends, treatment system performance data, and subsidence monitoring data for the previous month. Special emphasis will be placed upon the groundwater elevations throughout the aquifer, treatment system performance, oil removal, maintenance performed, extraction or treatment system operational problems, carbon replacement and oil disposal requirements, monument subsidence and associated groundwater levels, and recommendations for improved operations.

The report will also include a data summary sheet describing, in tabular form, monthly and cumulative quantities for the following items, at a minimum:

- Number of days of operation;
- Reasons for downtime;
- Total gallons of recovered groundwater;
- Total gallons of treated water;
- Total pounds of carbon consumed (based on replacement weight of carbon);
- Total number of sand filter backwashes;
- Average influent concentration of parameters listed in Table 13;
- Total gallons of extracted oil;
- Subsidence data plots as specified in Section 8.0;
- Total gallons of city water used;
- Total kilowatt hours of electricity used; and
- Total monthly rainfall (at site and at Slidell Municipal Airport).

The monthly operational report will also include the following trend graphs to be updated monthly:

- Days of operation (x-axis) versus gallons of recovered groundwater (y-axis);
- Days of operation (x-axis) versus extraction well operation hours (y-axis);
- Days of operation (x-axis) versus treatment system operating hours (y-axis);
- Months of operation (x-axis) versus treated effluent concentration of naphthalene or other; indicator parameter (y-axis) determined by the CO;
- Months of operation (x-axis) versus total pounds of recovered creosote (y-axis); and
- Data specified in Section 7.0 for subsidence monitoring.

## 8.5 MISCELLANEOUS REPORTS

Other reports and notifications are required during operation of the groundwater recovery and treatment system. Requirements for these reports are described below.

### 8.5.1 Waste Disposal Report

A waste disposal report shall be submitted whenever materials identified as hazardous waste are removed from the site. The waste disposal report shall include the following:

- Quantity of waste disposed;
- Physical state and description of waste (solid or liquid, general description of material);
- Analytical results associated with the disposed material;
- Name and identification numbers of transportation and disposal companies;
- Generator manifest signed by the initial transporter (see Figure 15); and
- The expected date of receipt of the manifest copy signed by the disposal company.

### 8.5.2 Survey Elevations Reports

As described in Table 12, elevations of all surveyed objects shall be submitted within 48 hours of completion of any survey.

### 8.5.3 Subsidence Monitoring Reports

As described in Section 8.0, a comprehensive report of subsidence monitoring data shall be submitted with the monthly operational reports.

## 9.0 REFERENCES

CH2M Hill, 1999. Groundwater Extraction Treatment Systems Modifications Preliminary Design Submittal, Prepared for Bayou Bonfouca Site, Slidell, Louisiana. Houston, Texas.

CH2M Hill, 1998a. Performance Evaluation Report for Shallow Artesian Aquifer Remediation, Prepared for Bayou Bonfouca Superfund Site, Slidell, Louisiana. Houston, Texas.

CH2M Hill, 1998b. Design Criteria Report, Prepared for Bayou Bonfouca Site, Slidell, Louisiana. Houston, Texas.

CH2M Hill, 1990. Operations Manual, Groundwater Recovery and Treatment System Facility, Phase I, Bayou Bonfouca Superfund Site, Slidell, Louisiana. Prepared for the U.S. Environmental Protection Agency, Region VI, Updated by Chemical Waste Management, Inc., ENRAC-South, July 1, 1991. Slidell, Louisiana.

IT Corporation/OHM Remediation Services Corp. (IT/OHM) 1999a. Quality Assurance Project Plan, Groundwater Extraction Wells and Groundwater Treatment System Modifications (Phase 2), Bayou Bonfouca Superfund Site, Slidell, Louisiana. Houston, Texas.

IT/OHM, 1999b. Field Sampling Plan, Groundwater Extraction Wells and Groundwater Treatment System Modifications (Phase 2), Bayou Bonfouca Superfund Site, Slidell, Louisiana. Houston, Texas.

IT/OHM, 1999c. Site Safety and Health Plan, Groundwater Extraction Wells and Groundwater Treatment System Modifications (Phase 2), Bayou Bonfouca Superfund Site, Slidell, Louisiana. Houston, Texas.

IT/OHM, 1999d. Waste Management Plan, Groundwater Extraction Wells and Groundwater Treatment System Modification (Phase 2), Bayou Bonfouca Superfund Site, Slidell, Louisiana. Houston, Texas.

IT/OHM, 2001. Final Report, Groundwater Extraction Wells and Groundwater Treatment System Modifications (Phase 2), Bayou Bonfouca Superfund Site, Slidell, Louisiana. Houston, Texas.

**TABLES**

## TABLE 1
## LDEQ AND EPA CONTACTS

| Team Member | Project Responsibilities | Address/Phone Number |
|---|---|---|
| Mr. Tom Harris<br>LDEQ | LDEQ Administrator | P.O. Box 4312<br>Baton Rouge, LA 70821-4312<br>225 219-3913 |
| Ms. Casey Luckett<br>U.S. EPA Region 6 | USEPA Technical Oversight | 1445 Ross Ave., Ste. 1200<br>Dallas, TX 75202-2711 |
| Mr. John Halk<br>LDEQ | Project Manager | P.O. Box 4312<br>Baton Rouge, LA 70821-4312<br>225 219-3652 |

# TABLE 2
# GROUNDWATER RECOVERY
# AND
# TREATMENT SYSTEM DAILY MAXIMUM EFFLUENT LIMITATIONS

| PARAMETER | DAILY MAXIMUM EFFLUENT LIMITATIONS | SAMPLING FREQUENCE | SAMPLE TYPE |
|---|---|---|---|
| $BOD^5$ | 20 mg/L | 1/Month | Grab |
| COD (Total) | 70 mg/L | 1/Month | Grab |
| TOC (Total) | 35mg/L | 1/Month | Grab |
| TSS | 45 mg/L | 1/Month | Grab |
| TDS | Report | 1/Month | Grab |
| Oil and Grease | 15 mg/L | 1/Month | Grab |
| Chloride | Report | 1/Month | Grab |
| Sulfate | Report | 1/Month | Grab |
| Turbidity | 50 NTU | 1/Month | Grab |
| Dissolved Oxygen | 5 mg/L | 1/Month | Grab |
| pH | 6.0 to 8.5 S.U. | 1/Month | Grab |
| Arsenic | 0.05 mg/L | 1/Quarter | Grab |
| Total Chromium | 0.15 mg/L | 1/Quarter | Grab |
| Zinc | 0.5 mg/L | 1/Quarter | Grab |
| **Purgeable Organics** | | 1/Quarter | Grab |
| Acrolein | 100 μg/L | | |
| 1,1,2,2-Tetrachloroethane | 100 μg/L | | |
| 2-Chloroethyl Vinyl Ether | 100 μg/L | | |
| Methyl Bromide | 100 μg/L | | |
| Bromoform | 100 μg/L | | |
| Dichlorobromomethane | 100 μg/L | | |
| Chlorodibromomethane | 100 μg/L | | |
| Acrylonitrile | 232 μg/L | | |
| Benzene | 134 μg/L | | |
| Toluene | 74 μg/L | | |
| Ethylbenzene | 380 μg/L | | |
| Carbon Tetrachloride | 380 μg/L | | |
| Chlorobenzene | 380 μg/L | | |
| 1,2-Dichloroethane | 574 μg/L | | |
| 1,1,1-Trichloroethane | 59 μg/L | | |
| 1,1-Dichloroethane | 59 μg/L | | |
| 1,1-Dichloroethylene | 60 μg/L | | |
| 1,1,2-Trichloroethane | 127 μg/L | | |
| Chloroethane | 295 μg/L | | |
| Chloroform | 325 μg/L | | |
| 1,2-Dichloropropane | 794 μg/L | | |
| 1,3-Dichloropropylene Cis and Trans | 794 μg/L | | |

## TABLE 2
## GROUNDWATER RECOVERY
## AND
## TREATMENT SYSTEM DAILY MAXIMUM EFFLUENT LIMITATIONS

| PARAMETER | DAILY MAXIMUM EFFLUENT LIMITATIONS | SAMPLING FREQUENCE | SAMPLE TYPE |
|---|---|---|---|
| Methylene Chloride | 170 µg/L | | |
| Methyl Chloride | 295 µg/L | | |
| Tetrachloroethylene | 164 µg/L | | |
| Vinyl Chloride | 69 µg/L | | |
| 1,2-Trans-Dichloroethylene | 172 µg/L | | |
| **Base/Neutral Extractable Organics** | | 1/Month | Grab |
| bis (2-Chloroethoxy) Methane | 100 µg/L | | |
| 2-Chloronaphthalene | 100 µg/L | | |
| Isophorone | 100 µg/L | | |
| 4-Bromophenyl Phenyl Ether | 100 µg/L | | |
| Benzo (b) Fluoranthene | 100 µg/L | | |
| Ideno (1,2,3-c,d) Pyrene | 100 µg/L | | |
| Dibenzo (a,h) Anthracene | 100 µg/L | | |
| Benzo (g,h,i) Perylene | 100 µg/L | | |
| 4-Chlorophenyl Phenyl Ether | 100 µg/L | | |
| 3,3-Dichlorobenzidine | 100 µg/L | | |
| bis (2-Chloroethyl) Ether | 100 µg/L | | |
| 1,2-Diphenylhydrazine | 100 µg/L | | |
| Hexachlorocyclopentadiene | 100 µg/L | | |
| N-Nitrosodiphenylamine | 100 µg/L | | |
| Di-n-Octyl Phthalate | 100 µg/L | | |
| Butyl Benzyl Phthalate | 100 µg/L | | |
| N-Nitrosodimethylamine | 100 µg/L | | |
| N-Nitrosodi-n-Propylamine | 100 µg/L | | |
| 1,2-Dichlorobenzene | 794 µg/L | | |
| 1,3-Dichlorobenzene | 380 µg/L | | |
| 1,4-Dichlorobenzene | 380 µg/L | | |
| 1,2,4-Trichlorobenzene | 794 µg/L | | |
| Hexachloroethane | 794 µg/L | | |
| Naphthalene | 47 µg/L | | |
| Nitrobenzene | 6,402 µg/L | | |
| 2,4-Dinitrotoluene | 100 µg/L | | |
| 2,6-Dinitrotoluene | 100 µg/L | | |
| bis (2-Ethylhexyl) Phthalate | 258 µg/L | | |
| Phenanthrene | 47 µg/L | | |
| Anthracene | 47 µg/L | | |
| Benzo(a)Anthracene | 47 µg/L | | |
| Benzo(k)Fluoranthene | 47 µg/L | | |
| Benzo(a)Pyrene | 48 µg/L | | |

**TABLE 2**
**GROUNDWATER RECOVERY**
**AND**
**TREATMENT SYSTEM DAILY MAXIMUM EFFLUENT LIMITATIONS**

| PARAMETER | DAILY MAXIMUM EFFLUENT LIMITATIONS | SAMPLING FREQUENCE | SAMPLE TYPE |
|---|---|---|---|
| Dimethyl Phthalate | 47 µg/L | | |
| Di-n-Butyl Phthalate | 43 µg/L | | |
| Fluorene | 47 µg/L | | |
| Fluoranthene | 54 µg/L | | |
| Chrysene | 47 µg/L | | |
| Pyrene | 48 µg/L | | |
| Acenaphthylene | 47 µg/L | | |
| Acenaphthene | 47 µg/L | | |
| bis(2-Chilloroisopropyl) Ether | 794 µg/L | | |
| Diethyl Phthalate | 113 µg/L | | |
| Benzidine | 100 µg/L | | |
| **Acid Extractable Organics** | | 1 Quarter | Grab |
| Pentachlorophenol | 100 µg/L | | |
| p-Chlorophenol | 100 µg/L | | |
| 2,4,6-Trichlorophenol | 100 µg/L | | |
| Phenol | 47 µg/L | | |
| 2-Nitrophenol | 231 µg/L | | |
| 4-Nitrophenol | 567 µg/L | | |
| 2,4-Dinitrophenol | 4,291 µg/L | | |
| 4,6-Dinitro-o-Cresol | 277 µg/L | | |
| 2-Chlorophenol | 100 µg/L | | |
| 2,4-Dichlorophenol | 100 µg/L | | |
| 2,4-Dimethylphenol | 47 µg/L | | |

NOTES:
µg/L = micrograms per liter
mg/L = milligrams per liter
NTU = nephelometric turbidity units
S.U. = standard units
$BOD^5$ = biochemical oxygen demand – 5 day
COD = chemical oxygen demand
TOC = total organic carbon
TSS = total suspended solid
TDS = total dissolved solid
pH = negative logarithm of hydrogen ion concentration

**TABLE 3**
**MONITORING WELL DATA**

| Well Number | T.O.C. [1] Elevation (Feet) | Initial Water Elevation (feet) | Remarks |
|---|---|---|---|
| | | | **Existing On-Site** |
| SM-1 | 10.63 | 0.42 | Subsidence monitoring well |
| SM-3 | 7.70 | -0.44 | Subsidence monitoring well |
| SM-5 | 11.70 | 0.14 | Subsidence monitoring well |
| SM-7 | 11.40 | 2.70 | Subsidence monitoring well |
| SM-8 | 10.48 | 0.54 | Subsidence monitoring well |
| SM-9 | 7.47 | 0.51 | Subsidence monitoring well |
| | | | **New Off-Site** |
| OSM-1 | 3.51 | 0.12 | Subsidence Monitoring Wells |
| OSM-2 | 2.69 | -0.55 | Subsidence Monitoring Wells |
| OSM-3 | 2.95 | -0.46 | Subsidence Monitoring Wells |
| OSM-4 | 3.40 | -0.28 | Subsidence Monitoring Wells |
| OSM-5 | 3.22 | -0.16 | Subsidence Monitoring Wells |

NOTES: T.O.C. = Top of Casing

Elevations are based on the National Vertical Geodetic Datum (NVGD) of 1929, as referenced to mean sea level (MSL).

## TABLE 4
## MONTHLY SUBSIDENCE MONITORING PROGRAM STATIONS AND INITIAL ELEVATIONS

| Station Designation | Initial Elevation[1] (feet) | July 2000 Recorded Elevation (feet) | Station Type/Location |
|---|---|---|---|
| BB SM-1 | 8.48 | 8.50 | Survey Benchmark |
| BB SM-2 | 9.72 | 9.74 | Survey Benchmark |
| BB SM-3 | 9.26 | 9.28 | Survey Benchmark |
| SM-1M | 7.49 | 7.33 | Well SM-1 Monument |
| SM-1C | 10.80 | 10.63 | Well SM-1 T.O.C. |
| SM-3M | 4.19 | 4.18 | Well SM-3 Monument |
| SM-3C | 7.68 | 7.70 | Well SM-3 T.O.C. |
| SM-5M | 8.13 | 8.10 | Well SM-5 Monument |
| SM-5C | 11.69 | 11.70 | Well SM-5 T.O.C. |
| SM-7M | 8.00 | 7.92 | Well SM-7 Monument |
| SM-7C | 11.44 | 11.40 | Well SM-7 T.O.C. |
| SM-8M | 7.34 | 7.31 | Well SM-8 Monument |
| SM-8C | 10.49 | 10.48 | Well SM-8 T.O.C. |
| SM-9M | 4.57 | 4.51 | Well SM-9 Monument |
| SM-9C | 7.47 | 7.47 | Well SM-9 T.O.C. |
| SM-2 | 8.17 | 8.07 | Survey Benchmark |
| SM-4 | 6.84 | 6.80 | Survey Benchmark |
| SM-10 | 9.26 | 9.27 | Survey Benchmark |
| SM-12 | 7.07 | 7.08 | Survey Benchmark |
| SM-16 | 10.06 | 10.04 | GWTS Tank Farm |
| SM-17 | 10.03 | 10.02 | GWTS Tank Farm |
| SM-18 | 10.02 | 10.01 | GWTS Tank Farm |
| SM-19 | 10.04 | 10.02 | GWTS Tank Farm |
| OSM-1M | **2.98** | 2.99 | Well OSM-1 Monument |
| OSM-1C | **3.51** | 3.52 | Well OSM-1 T.O.C. |
| OSM-2M | **2.36** | 2.37 | Well OSM-2 Monument |
| OSM-2C | **2.69** | 2.69 | Well OSM-2 T.O.C. |
| OSM-3M | **1.63** | 1.64 | Well OSM-3 Monument |
| OSM-3C | **2.95** | 2.97 | Well OSM-3 T.O.C. |
| OSM-4M | **3.00** | 3.01 | Well OSM-4 Monument |
| OSM-4C | **3.40** | 3.42 | Well OSM-4 T.O.C. |
| OSM-5M | **2.55** | 2.55 | Well OSM-5 Monument |
| OSM-5C | **3.22** | 3.22 | Well OSM-5 T.O.C. |
| OSM-6 | **9.91** | 9.92 | Perkins Foundation |

Notes:
Elevations are based on the National Vertical Geodetic Datum (NVGD) of 1929, as referenced to mean sea level (MSL).
T.O.C. = Top of Casing
[1] Plain type elevations are dated January 1991. Bold type elevations are dated February 2000.

**TABLE 5**
**WELL DEVELOPMENT LOG**

Well Number or Sampling Point: ____________________

Date: ____________ Time: ____________________

Sampling Team: ____________________

Oil Layer:
Present or Absent: ________ Thickness of Oil Layer: ____________

Purge Data:
Depth of Well: ________ Depth of Water: ____________

Well Volume: ________ Purge Method: ____________

Purging Record:

| Volume (gal) | Temp (°C) | pH (s.u.) | Specific Conductivity (μmho/cm) | Description of Appearance |
|---|---|---|---|---|
| | | | | |
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| | | | | |

Sampling Record:

Sampling Method: ____________________

Number of Samples: ____________________

Types of Samples: ____________________

Time Sampling Began: ____________ Completed: ________

## TABLE 6
## OPERATING AND DESIGN CONDITIONS AND PRINCIPLE EQUIPMENT

| | |
|---|---|
| **Steam Characteristics** | |
| Description | Well Water/Creosote Oil |
| Density at 68 °F | 62.4 lbs/ft$^3$ |
| Viscosity at 68 °F | 43 Centipoises (Creosote Oil) |
| **Flow Rate** | |
| Average Flow | 5-20 gpm |
| Design Flow | 50 gpm |
| Maximum Instantaneous Flow | 50 gpm |
| **Temperature** | |
| Design Operating | Ambient |
| Maximum Instantaneous | 150 °F |
| **Vessel Rating** | |
| Design Pressure | 100 psig |
| Design Temperature | 150 °F |
| **Backwashing** | |
| Initial | 250 gpm, 15 minutes |
| Normal | 250 gpm, 15 minutes |
| **Treatment Vessel Capacities** | |
| 1-Oil/Water separator | 1,900 gal. |
| 4-Granular Activated Carbon | |
| Carbon Quantity (maximum) | 3,000 lbs |
| Carbon Volume (3,000 lbs) | 100 ft$^3$ |
| Total Adsorber Volume | 400 ft$^3$ |
| 1-Oleophilic Media | |
| Quantity (maximum) | 2,200 lbs |
| Oleophilic Media Volume | 37 ft$^3$ |
| Total Filter Volume | 75 ft$^3$ |
| 2-Sand Filters | |
| Sand Quantity (maximum) | 5,500 lbs |
| Sand Media Volume | 44 ft$^3$ |
| Total Volume | 88 ft$^3$ |
| **Air Pressure Supply** | |
| Compressors (2) | 50 HP |
| Air Dryer (1) | 250 SCFM |
| **1-Backwash Tank Volume** | 9,000 gal. |
| **Backwash Tank Level Band** | 16 ft. 0 in. |
| **1-Recovered Oil Tank Volume** | 9,000 gal. |
| **1-Recovered Oil Tank Level Band** | 10 ft. 6 in. |
| **1-Filter Feed Tank Volume** | 4,500 gal. |
| **Filter Feed Tank Level Band** | 8 ft. 0 in. |
| **2- Stormwater Sump Volume** | 3,000 gal |
| **Stormwater Sump Level Banked** | 4ft. |
| **1-Post Aeration Tank Volume** | 7,000 gal |

## TABLE 6
## OPERATING AND DESIGN CONDITIONS AND PRINCIPLE EQUIPMENT

| | |
|---|---|
| **Post Aeration Tank Level Band** | 12 ft. |
| **1-Skimmed Oil Tank Volume** | 350 gal. |
| **Skimmed Oil Tank Level Band** | 7ft. 6 in. |
| **Pump Sizes** | |
| 2-Filter Feed Pumps | 50 gpm at 100 psi – Borne man |
| 1-Oil Transfer Pump | 5 gpm at 150 psi – Borne man |
| 1-Recovered Oil Pump | 50 gpm at 50 psi – Borne man |
| 2-Backwash Solids Pump | 10 gpm at 50 psi – Borne man |
| 1-Truck Ramp Sump Pump | 15 gpm at 10 psi - Baldoe |
| 2-Stormwater Sump Pump | 15 gpm at 10 psi - Baldor |
| 1-Filter Backwash pump | 250 gpm at 60 psi – Ingersoil-Rand |

Notes:

| | | |
|---|---|---|
| $lbs/ft^3$ = pounds per cubic foot | ft = foot | $ft^3$ = cubic foot |
| gpm = gallons per minute | in = inches | gal = gallon |
| psi = pounds per square inch | lbs = pounds | psig = pounds per square inch gage |
| °F = degrees Fahrenheit | | |

## TABLE 7

## GROUNDWATER REMEDIATION SYSTEM

| Equipment | Alarm and Light Event |
|---|---|
| Recovered Oil Tank (T-02-2) | High Level<br>High, High Level |
| Post-Aeration Tank (T-06-1) | High, High Level |
| Filter feed Tank (T-03-1) | High, High Level |
| Stormwater Sump | High, High Level |
| Backwash Control System | Failure |
| Filter feed Pump (P-03-1-1,-2) | Failure |
| Backwash Solids Pump (P-03-2-1,-2) | Failure |
| Air Compressor (M-1-1-1,-2) | Failure |
| Air Dryer (M-01-02-1) | Failure |
| Air Scour Pressure (PVC-1-4) | Low Air Pressure |
| Extraction well Air Supply | Low Air Pressure |

## TABLE 8
## DAILY RECORDKEEPING REQUIREMENTS [a,b]

| System | Data |
|---|---|
| Groundwater monitoring | Water levels |
| Extraction wells | Pump cycles |
| | Pump hours |
| | Estimated extraction volume |
| | Maintenance/adjustments |
| Recovery System | Start/Stop times |
| | Total flow |
| | Quality control/quality assurance records (BNA) (when performed) |
| Treatment System | Start/stop times, backwash cycles |
| | Average flow rate |
| | Effluent quality (BNA, DO, O&G, etc.) |
| | Setpoints |
| | Maintenance/adjustments |
| | Volume discharged |
| General | Operating personnel onsite |
| | Ambient temperature |
| | Temperature forecast (freezing) |
| | Precipitation |
| | Instances of reduced or no flow from recover wells |
| | Online carbon configuration (lead, lag, online, offline, etc.) |
| | Cumulative volumetric flow through each vessel |
| | Cumulative volumetric flow through system |

Notes:

[a] To be recorded if performed on any specific day.
[b] This list is not intended as a guide for preparation of actual recordkeeping activities.
The contractor's recordkeeping requirements should be based on specific equipment, procedures, and data management activities.
BNA = base neutral acids
DO = dissolved oxygen
O&G = oil & grease
TOC = total organic carbon

## TABLE 9
## MCC POWER DISTRIBUTION

| | | |
|---|---|---|
| Main | Main Power Feed | 400 |
| Air Compressor Motor | M-01-1-1 (Air Compressor #1) | 100 |
| Air Compressor Motor | M-01-1-2 (Air Compressor #2) | 100 |
| Local Control Panel-3-1-1 | P-03-1-1 (Filter Feed Pump #1) | 20 |
| Local Control Panel-3-1-2 | P-03-1-2 (Filter Feed Pump #2) | 20 |
| Air Blower Motor | M-06-1 | 15 |
| Extracted oil Pump | P-02-3 | 15 |
| Oil Transfer Pump | P-02-1 | 3 |
| Filter Backwash Pump | P-08-1 | 30 |
| Stormwater Pump | P-07-1 (Stormwater Pump #1) | 3 |
| Stormwater Pump | P-07-2 (Stormwater Pump #2) | 3 |
| Truck Sump Pump | P-07-3 | 3 |
| Air Cooled Condensing Unit | ACCU-1 | 40 |
| Air Supply Unit Fan | ASU-1 | 7 |
| Electric Duct Heater | EDH-1 | 15 |
| Electric Duct Heater | EDH-2 | 15 |
| Electric Duct Heater | EDH-3 | 15 |
| Exhaust Fan | EF-1 | 3 |
| Electric Unit Heater | EUH-1 | 15 |
| Panel L Transformer | See Table 5-3 | 125 |

**TABLE 10**
**PANEL L POWER DISTRIBUTION**

| | | |
|---|---|---|
| Panel L | Panel L Feed | 200 |
| 1 | Receptacles – Treatment Plan | 20 |
| 2 | Receptacles – Storage, Compressor Rooms | 20 |
| 3 | Lights – MCC Room, Offices | 20 |
| 4 | Lights – Storage, Compressor Rooms | 20 |
| 5 | Receptacles – MCC, Office, Mechanical Rooms | 20 |
| 6 | Receptacles - Office | 20 |
| 7 | Lights – Mechanical, Clean, Toilet Rooms | 20 |
| 8 | Lights – Breezeway, Treatment Plant | 20 |
| 9 | Receptacles – Toilet, Clean Rooms, Hall | 20 |
| 10 | Receptacles – Mud Room | 20 |
| 11 | Panel ECP | 20 |
| 12, 14 | EF-2 (Exhaust Fan #2) | 20 |
| 13 | M-02-1 (Oil Skimmer Rope) | 20 |
| 15 | LCP-7-3, LSL-7-3, LSH-7-3 | 20 |
| 16 | FT-2-3, LSH-3-2 | 20 |
| 17 | LCP-3-2-1 | 20 |
| 18 | LCP-3-2-2 | 20 |
| 19 | FIT-2-4-1, FIT-2-4-2 | 20 |
| 20 | FT-6-2, FT-6-3 | 20 |
| 21 | M-01-2-1 (Air Dryer) | 20 |
| 22 | MCP-1 | 20 |
| 23,25 | WH-1 (Water Heater) | 20 |
| 24 | MCP-2 | 20 |
| 26 | FT-2-1 | 20 |
| 27 | LSL-2-2, LSH-2-2, LSH-2-2 | 20 |
| 28 | LSL-3-1, LSH-3-1, LSHH-3-1 | 20 |
| 29 | Spare | 20 |
| 30 | Lights – Mud Room | 20 |
| 31 | Spare | 20 |
| 32 | Spare | 20 |
| 33 | Spare | 20 |
| 34 | Spare | 20 |
| 35 | Spare | 20 |
| 36 | Spare | 20 |
| 37 | Not Used | - |
| 38 | Not Used | - |
| 39 | Not Used | - |
| 40 | Not Used | - |
| 41 | Not Used | - |
| 42 | Not Used | - |

## TABLE 11

## SURVEY ELEVATIONS REPORT

Date of Survey ______________________

Days since Beginning Recovery Operations; ______________________
Days of Active Extraction well Operation: ______________________

| Monument/T.O.C. | | | Water Level | | | | Calculated | | |
|---|---|---|---|---|---|---|---|---|---|
| **Well/Monument Number** | **Initial Elevation** | **Current Elevation** | **Depth to Water** | **Initial Elevation** | **Current Elevation** | **Drawdown** | **Incremental Settlement** | **Change in Settlement** | **Settlement Rate** |
| BB SM-1 | 8.48 | | | | | | | | |
| BB SM-2 | 9.72 | | | | | | | | |
| BB SM-3 | 9.26 | | | | | | | | |
| SM-1M | 7.49 | | | | | | | | |
| SM-1C | 10.80 | | | | | | | | |
| SM-3M | 4.19 | | | | | | | | |
| SM-3C | 7.68 | | | | | | | | |
| SM-5M | 8.13 | | | | | | | | |
| SM-5C | 11.69 | | | | | | | | |
| SM-7M | 8.00 | | | | | | | | |
| SM-7C | 11.44 | | | | | | | | |
| SM-8M | 7.34 | | | | | | | | |
| SM-8C | 10.49 | | | | | | | | |
| SM-9M | 4.57 | | | | | | | | |
| SM-9C | 7.47 | | | | | | | | |
| OSM-1M | 2.98 | | | | | | | | |
| OSM-1C | 3.51 | | | | | | | | |
| OSM-2M | 2.36 | | | | | | | | |
| OSM-2C | 2.69 | | | | | | | | |
| OSM-3M | 1.63 | | | | | | | | |
| OSM-3C | 2.95 | | | | | | | | |
| OSM-4M | 3.00 | | | | | | | | |
| OSM-4C | 3.40 | | | | | | | | |
| OSM-5M | 2.55 | | | | | | | | |
| OSM-5C | 3.22 | | | | | | | | |

## TABLE 11
## SURVEY ELEVATIONS REPORT

| Monument/T.O.C. | | | Water Level | | | | Calculated | | |
|---|---|---|---|---|---|---|---|---|---|
| Well/Monument Number | Initial Elevation | Current Elevation | Depth to Water | Initial Elevation | Current Elevation | Drawdown | Incremental Settlement | Change in Settlement | Settlement Rate |
| OSM-6 | 9.91 | | | | | | | | |
| SM-2 | 8.17 | | | | | | | | |
| SM-4 | 6.84 | | | | | | | | |
| SM-10 | 9.26 | | | | | | | | |
| SM-12 | 7.07 | | | | | | | | |
| SM-16 | 10.06 | | | | | | | | |
| SM-17 | 10.03 | | | | | | | | |
| SM-18 | 10.02 | | | | | | | | |
| SM-19 | 10.04 | | | | | | | | |

Notes:
Elevations are based on the National Vertical Geodetic Datum (NVGD) of 1929, as referenced to mean sea level (MSL). All measurements are in feet.
T.O.C. = Top of Casing
M = Monument
C = Casing

# TABLE 12

## SURVEY MONITORING REPORT

Well/Monument Number ____________ Days since Beginning Recovery Operations; ____________

Survey Monument Days of Active Recovery Operations this Period: ____________

Or Monitoring well:

| Monument/T.O.C. | | | Water Level | | | | Calculated | | |
|---|---|---|---|---|---|---|---|---|---|
| **Date** | **Initial Elevation** | **Current Elevation** | **Depth to Water** | **Initial Elevation** | **Current Elevation** | **Drawdown** | **Incremental Settlement** | **Change in Settlement** | **Settlement Rate** |
| | | | | | | | | | |
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Notes:

T.O.C. = Top of Casing In addition to monument elevation, provide T.O.C elevation.

## TABLE 13
## ACCEPTABLE FORMAT FOR ANALYTICAL DATA

Sample Date:____________________________ (NOTE: Each sample date shall be listed separately)

| | Sample Point | | | | | | |
|---|---|---|---|---|---|---|---|
| Parameter | Discharge limit | Inlet O/W Separator | Inlet Sand Filter | Inlet Oleolinic Filter | Inlet Carbon No. 1[a] | 80% Carbon[b] No. 3[c] | Discharge |
| $BOD^5$ (ppm) | | | | | | | |
| COD (ppm) | | | | | | | |
| TOD (ppm) | | | | | | | |
| TSS (ppm) | | | | | | | |
| TDS (ppm) | | | | | | | |
| O & G (ppm) | | | | | | | |
| CL (ppm) | | | | | | | |
| $SO^4$ (ppm) | | | | | | | |
| Turbidity (NTU) | | | | | | | |
| D.O. (ppm) | | | | | | | |
| pH (S.U.) | | | | | | | |
| Arsenic | | | | | | | |
| Total Chromium | | | | | | | |
| Zinc | | | | | | | |
| VOC (List individually) | | | | | | | |
| BNA (List individually) | | | | | | | |

Notes:

[a] Carbon No. 1 is defined to be the first carbon vessel in series or parallel operation.

[b] Carbon No. 3 is defined to be the next to last carbon vessel operated in series. If only two vessels are operated in series, Carbon No. 1 and Carbon No. 3 are the same vessel.

[c] Samples collected for BNA from the 80% Carbon No. 3 bed depth and the discharge shall be analyzed and laboratory data made available to the contractor within 3 work days of sample collection.

$BOD^5$ = biochemical oxygen demand – 5 day demand
DO = dissolved oxygen
TSS = total suspended solid
pH = negative logarithm of hydrogen ion concentration
VOC = volatile organic compound
S.U. = Standard Units

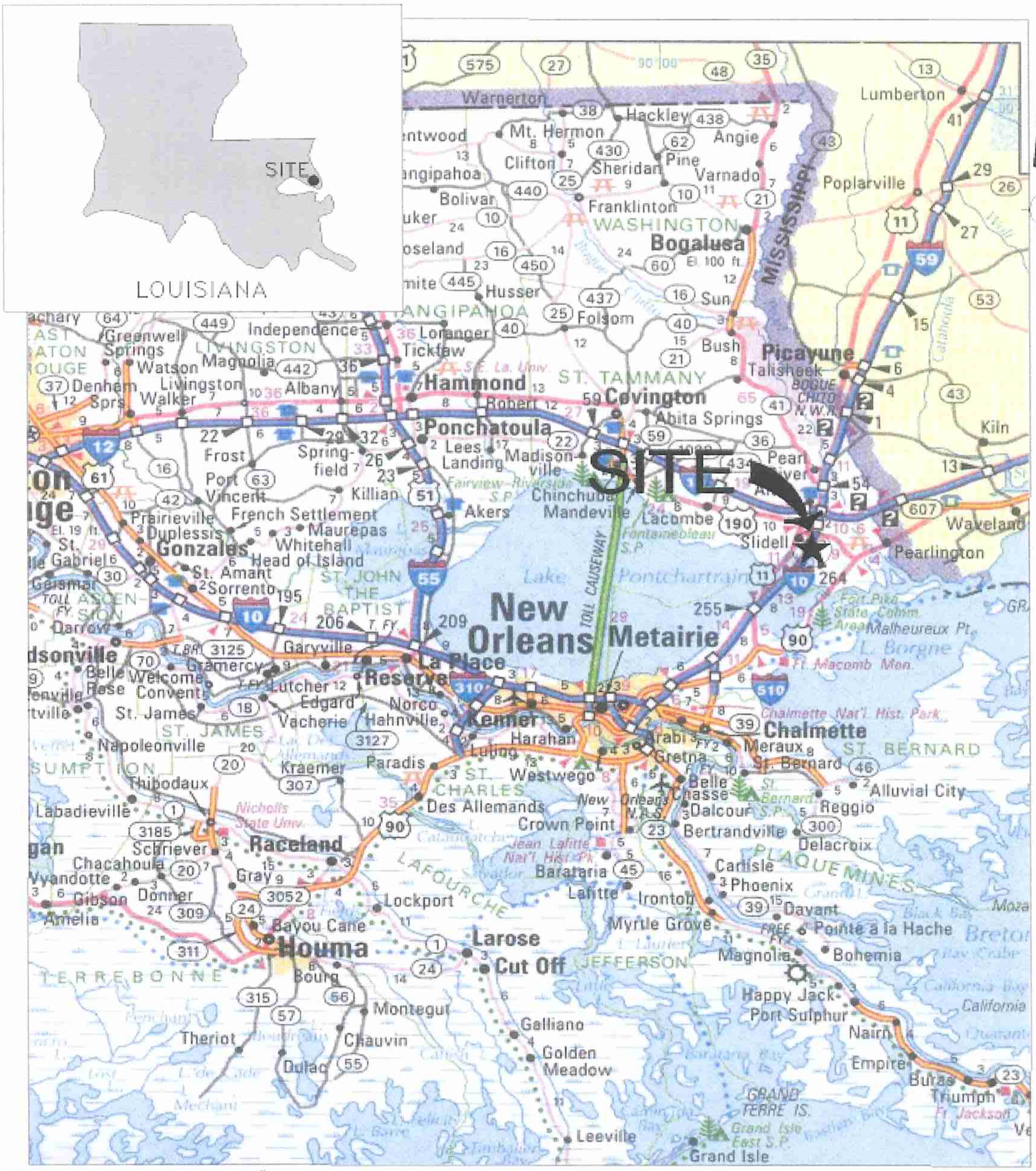
O&G = oil & grease
Cl = chloride
NTU = Nephelometric Turbidity Units
TDS = total dissolved solid

BNA = base neutral acids
TOC = total organic carbon

COD = chemical oxygen
ppm = parts per million
$SO_4$ =sulfate

**FIGURES**

**FIGURE 1**
**SITE LOCATION MAP**




DRAWING NUMBER 781612-A16 | OFFICE Houston, Texas | X-REF --- | IMAGE SLM2

PLOT DATE 11/22/00
FORMAT REVISION 3/25/99

REFERENCE:
SITE LOCATION MAP PREPARED FROM RAND McNALLY ROAD ATLAS (1994)

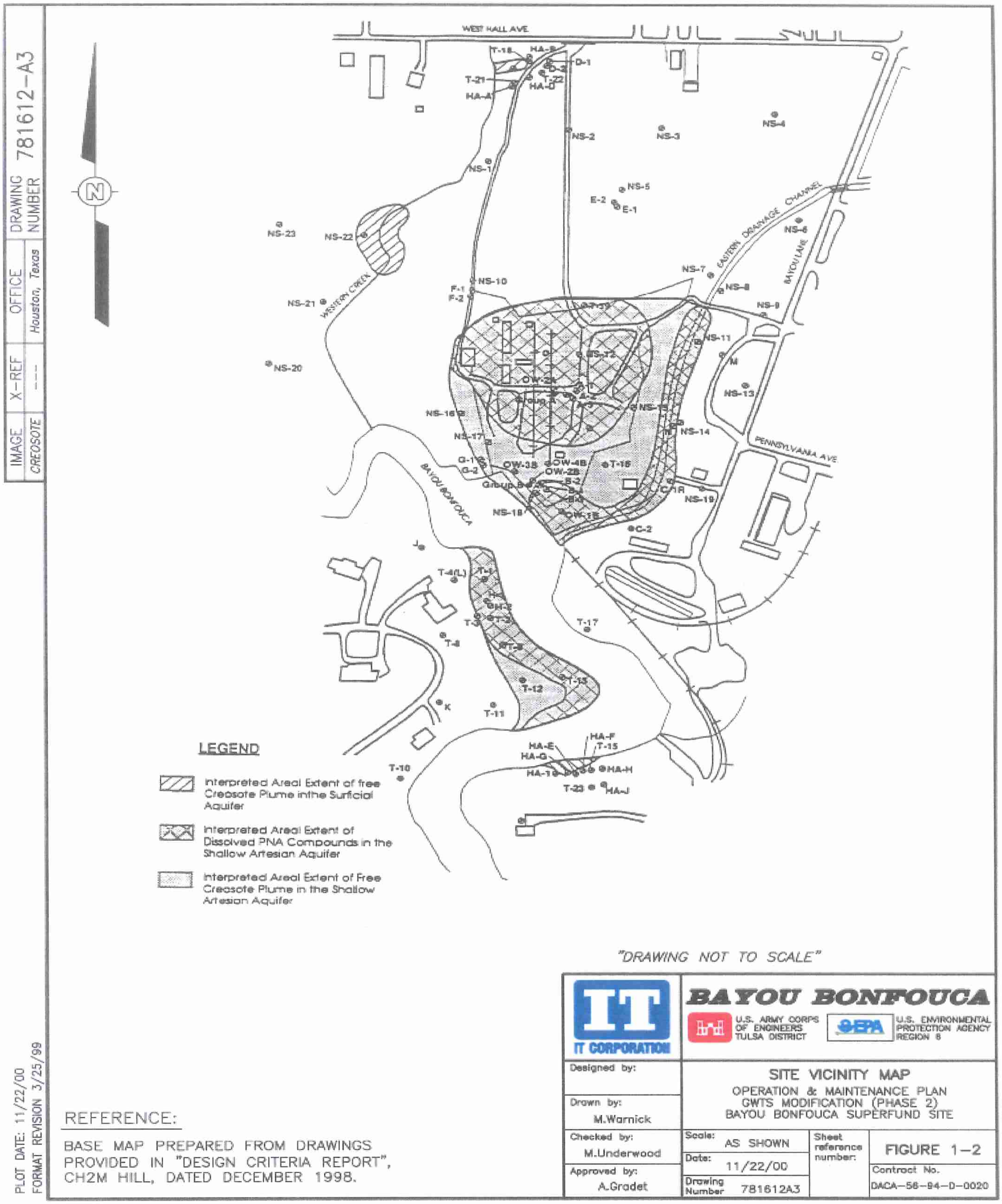
IT CORPORATION

BAYOU BONFOUCA

U.S. ARMY CORPS OF ENGINEERS TULSA DISTRICT
EPA U.S. ENVIRONMENTAL PROTECTION AGENCY REGION 6

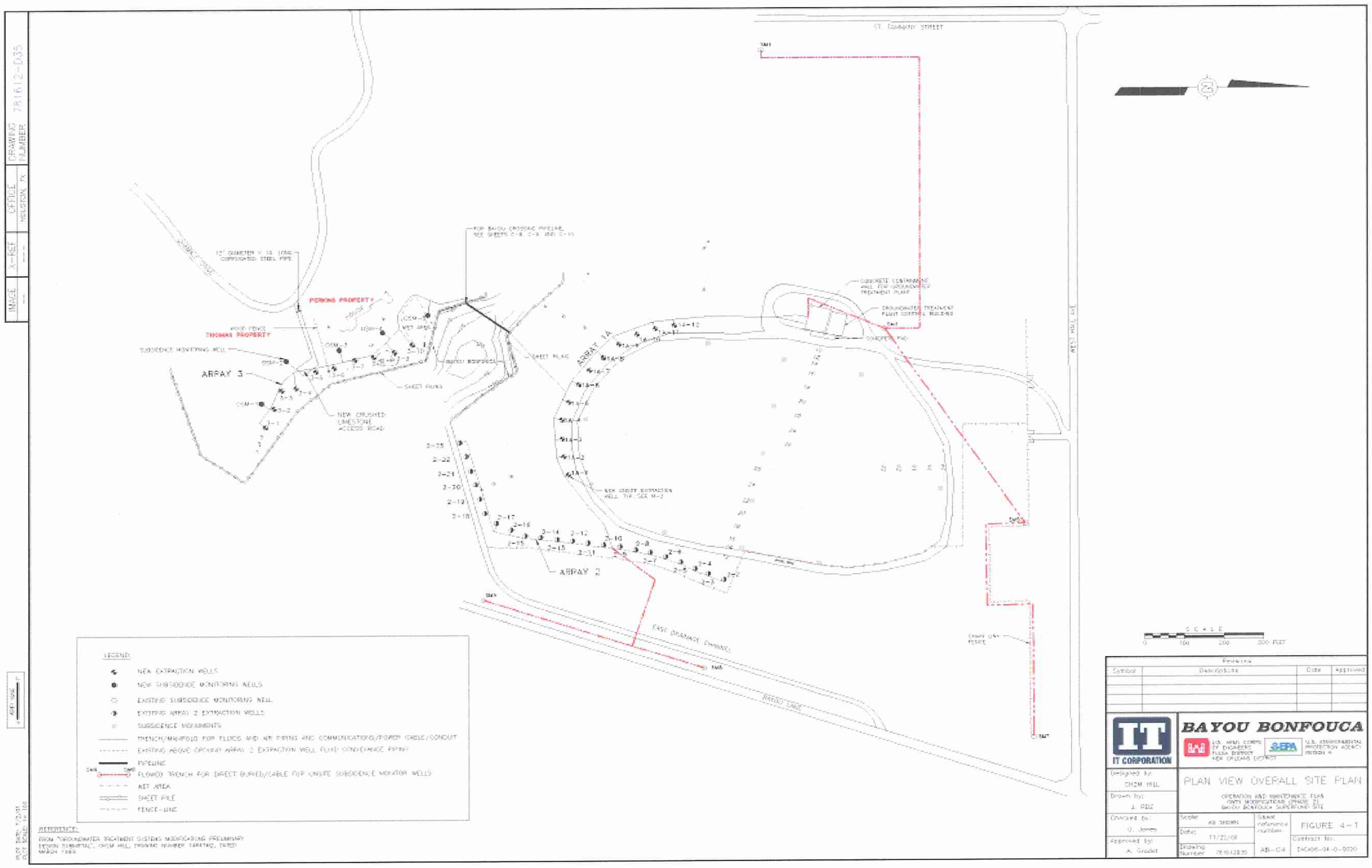
| | |
|---|---|
| Designed by: | SITE LOCATION MAP<br>OPERATION AND MAINTENANCE PLAN<br>GWTS MODIFICATIONS (PHASE 2)<br>BAYOU BONFOUCA SUPERFUND SITE |
| Drawn by: M.Warnick | |
| Checked by: M.Underwood | Scale: AS SHOWN / Date: 11/22/00 / Sheet reference number: FIGURE 1-1 |
| Approved by: A.Gradet | Drawing Number 781612A16 / Contract No. DACA56-94-D-0020 |

**FIGURE 2**
**SITE VACINITY MAP**

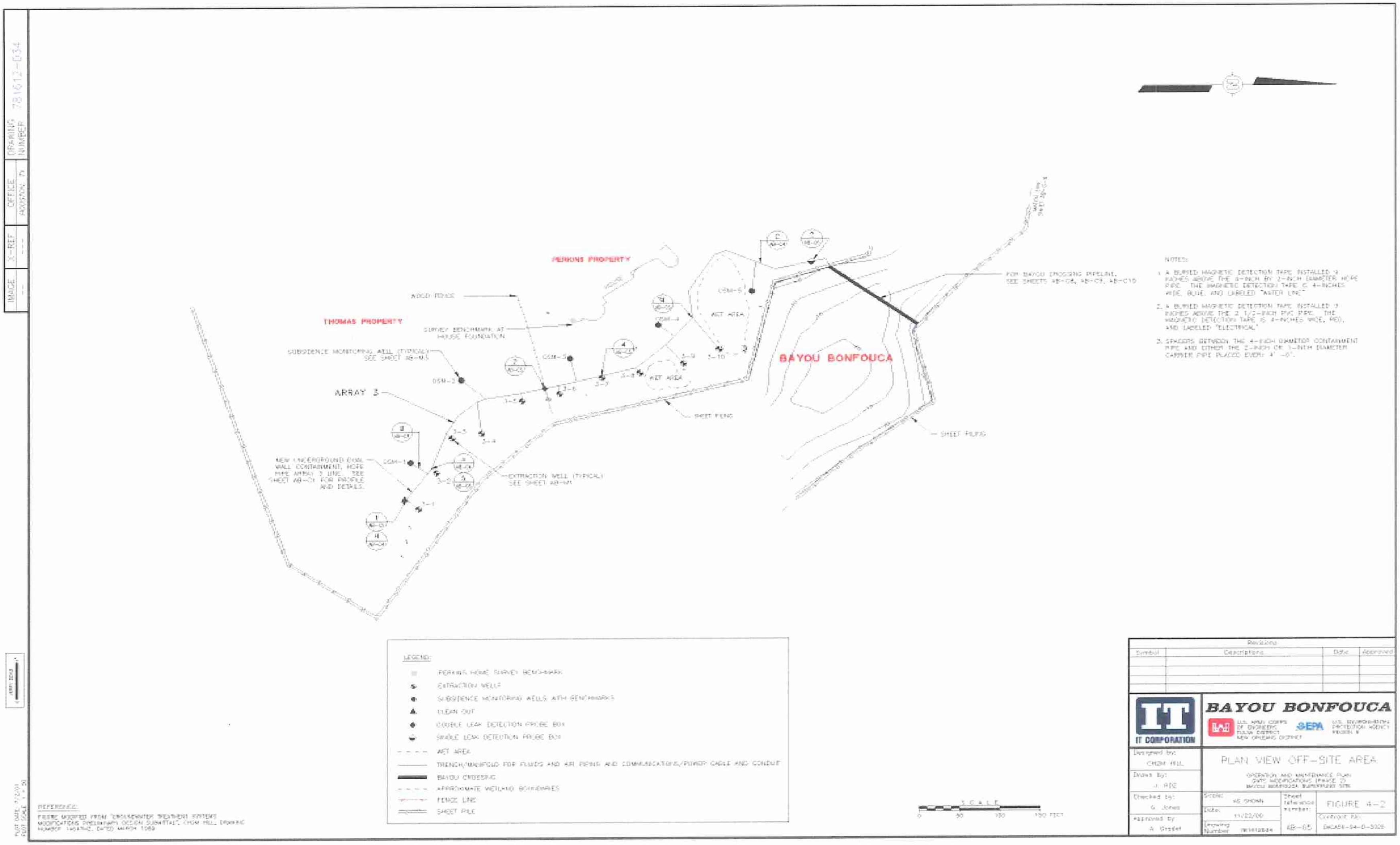



The current system, as completed by IT/OHM under contract to the USACE, consists of three

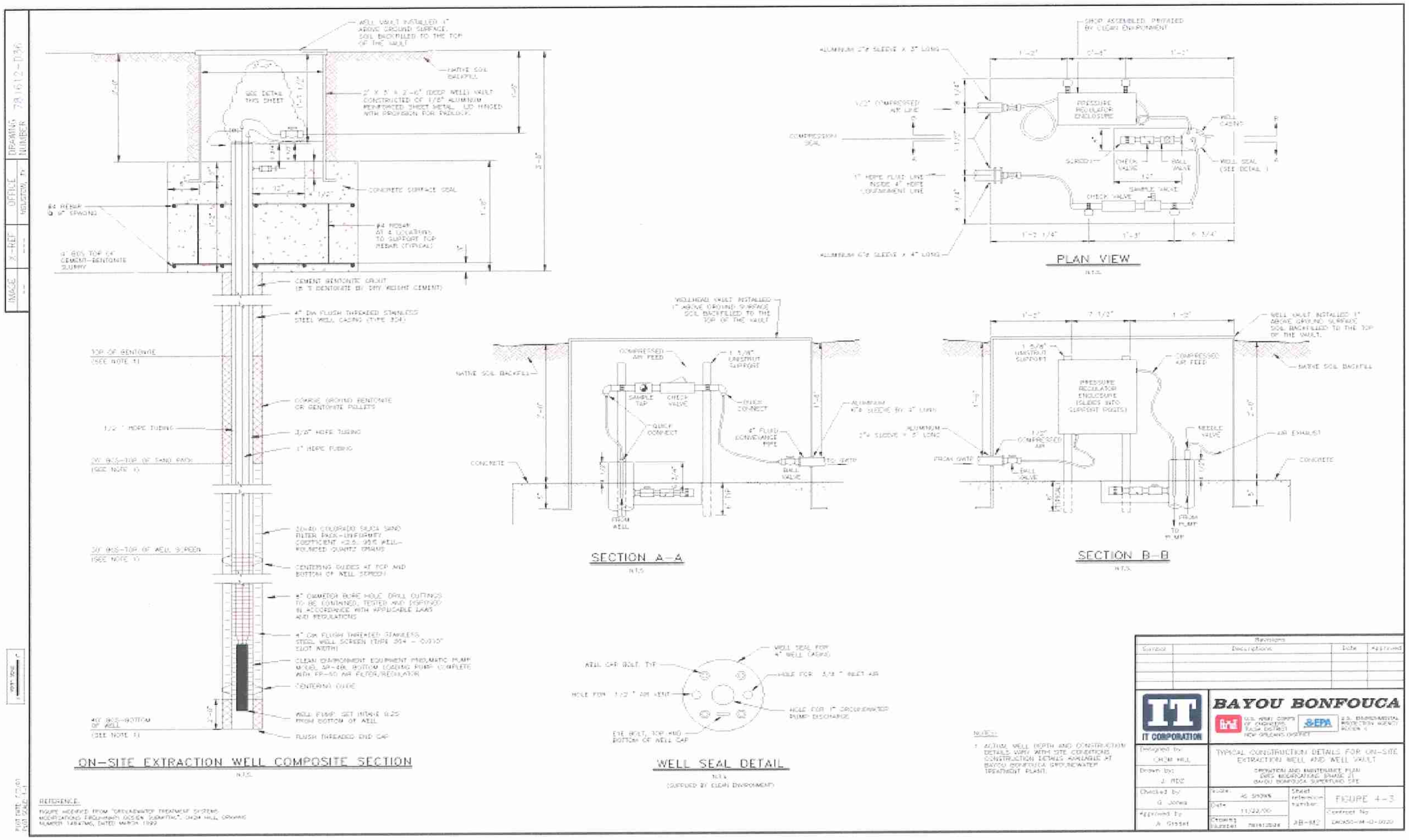
# FIGURE 3
# PLAN VIEW OVERALL SITE PLAN



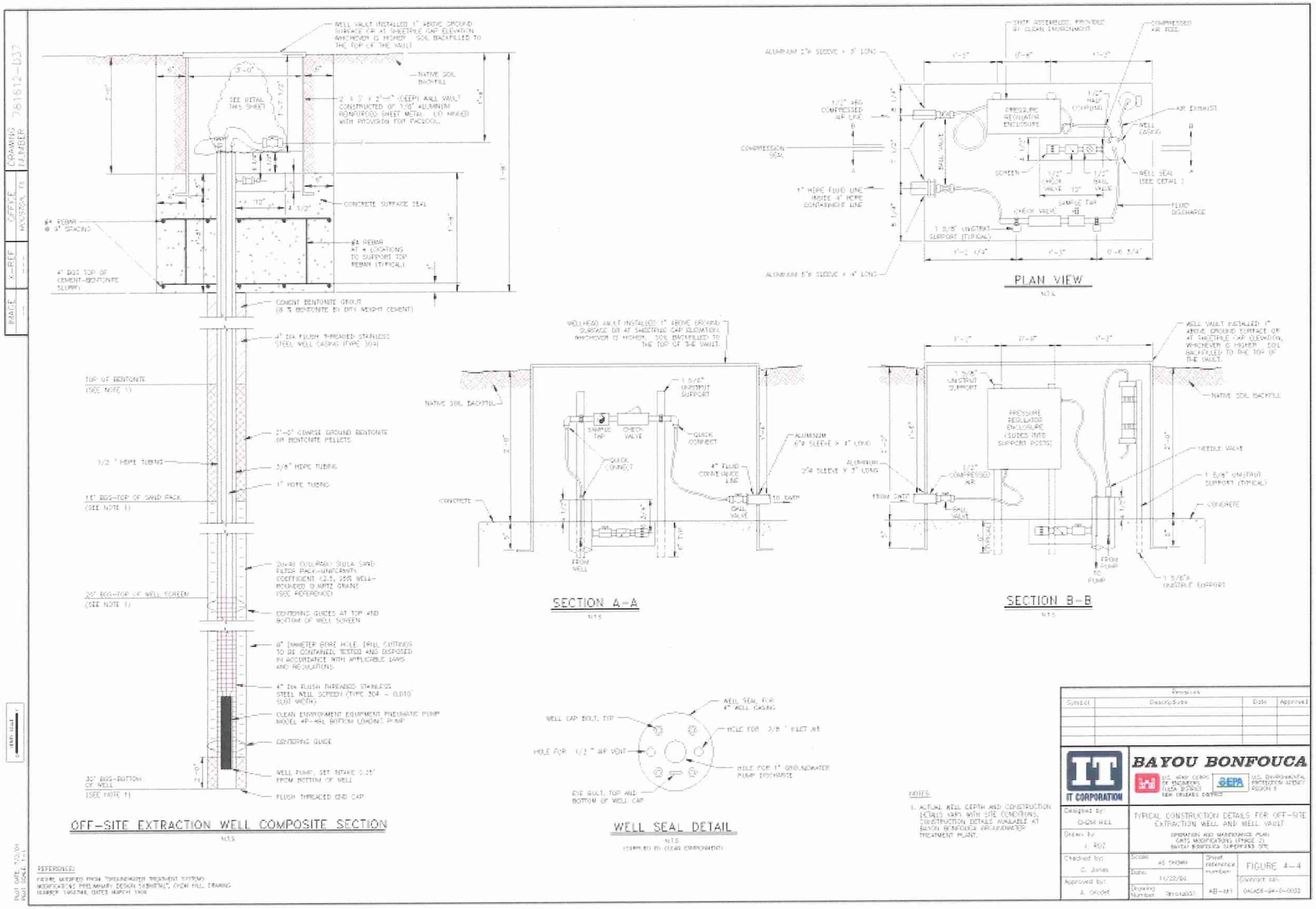
# FIGURE 4
# PLAN VIEW OFF-SITE AREA



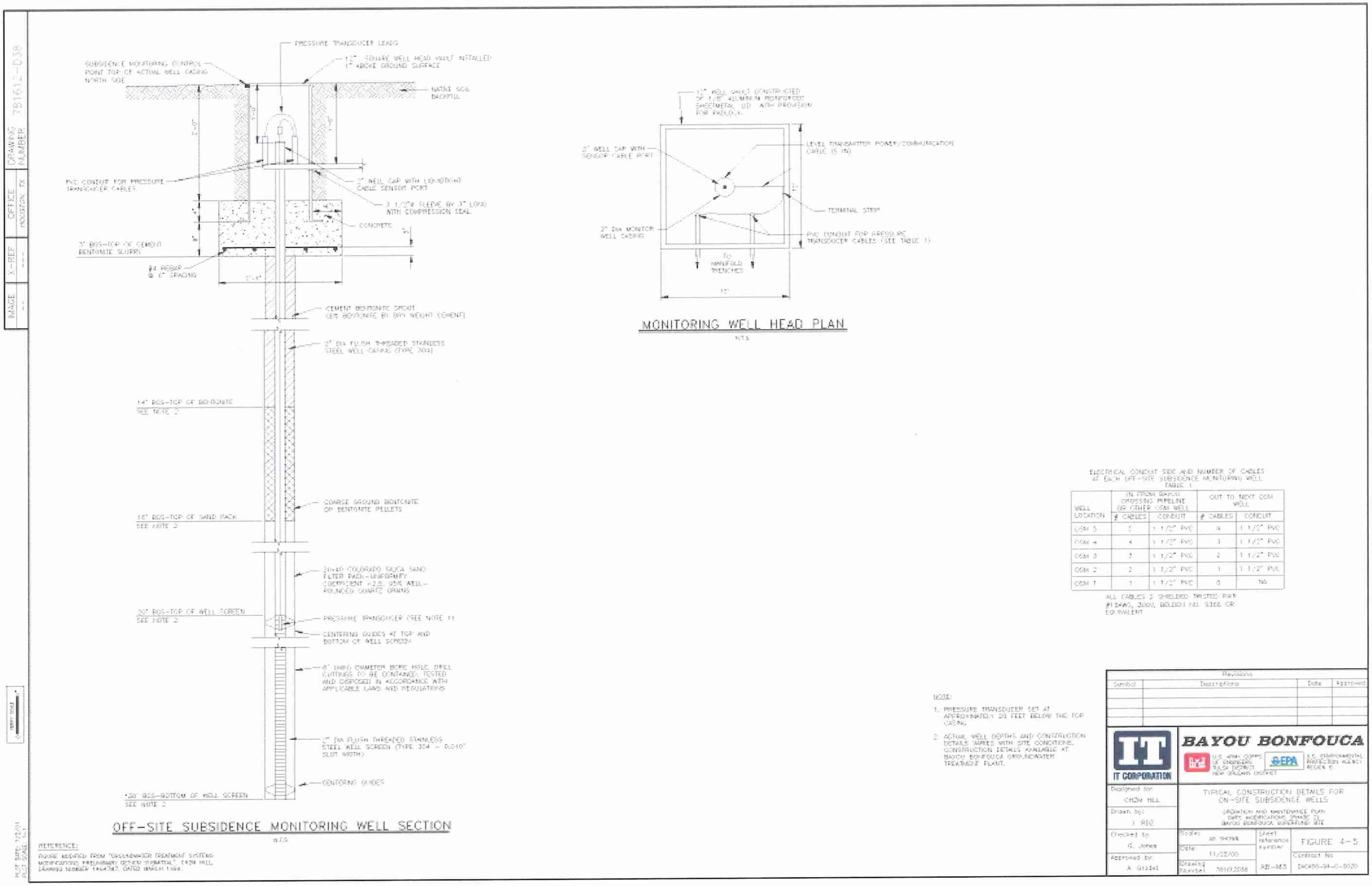
# FIGURE 5
# TYPICAL CONSTRUCTION DETAILS FOR ON-SITE EXTRACTION WELL AND WELL VAULT



# FIGURE 6
# TYPICAL CONSTRUCTION DETAILS FOR OFF-SITE EXTRACTION WELL AND WELL VAULT



# FIGURE 7
# TYPICAL CONSTRUCTION DETAILS FOR ON-SITE SUBSIDENCE WELLS




ELECTRICAL CONDUIT SIDE AND NUMBER OF CABLES AT EACH OFF-SITE SUBSIDENCE MONITORING WELL
TABLE 1

| WELL LOCATION | IN FROM BAYOU CROSSING PIPELINE OR OTHER OSM WELL | | OUT TO NEXT OSM WELL | |
|---|---|---|---|---|
| | # CABLES | CONDUIT | # CABLES | CONDUIT |
| OSM 5 | 5 | 1 1/2" PVC | 4 | 1 1/2" PVC |
| OSM 4 | 4 | 1 1/2" PVC | 3 | 1 1/2" PVC |
| OSM 3 | 3 | 1 1/2" PVC | 2 | 1 1/2" PVC |
| OSM 2 | 2 | 1 1/2" PVC | 1 | 1 1/2" PVC |
| OSM 1 | 1 | 1 1/2" PVC | 0 | NA |

ALL CABLES 3 SHIELDED TWISTED PAIR #18AWG, 300V, BELDEN NO. 9368 OR EQUIVALENT

## FIGURE 8
## TYPICAL MODEL AP-4/BL RECOVERY PUMP

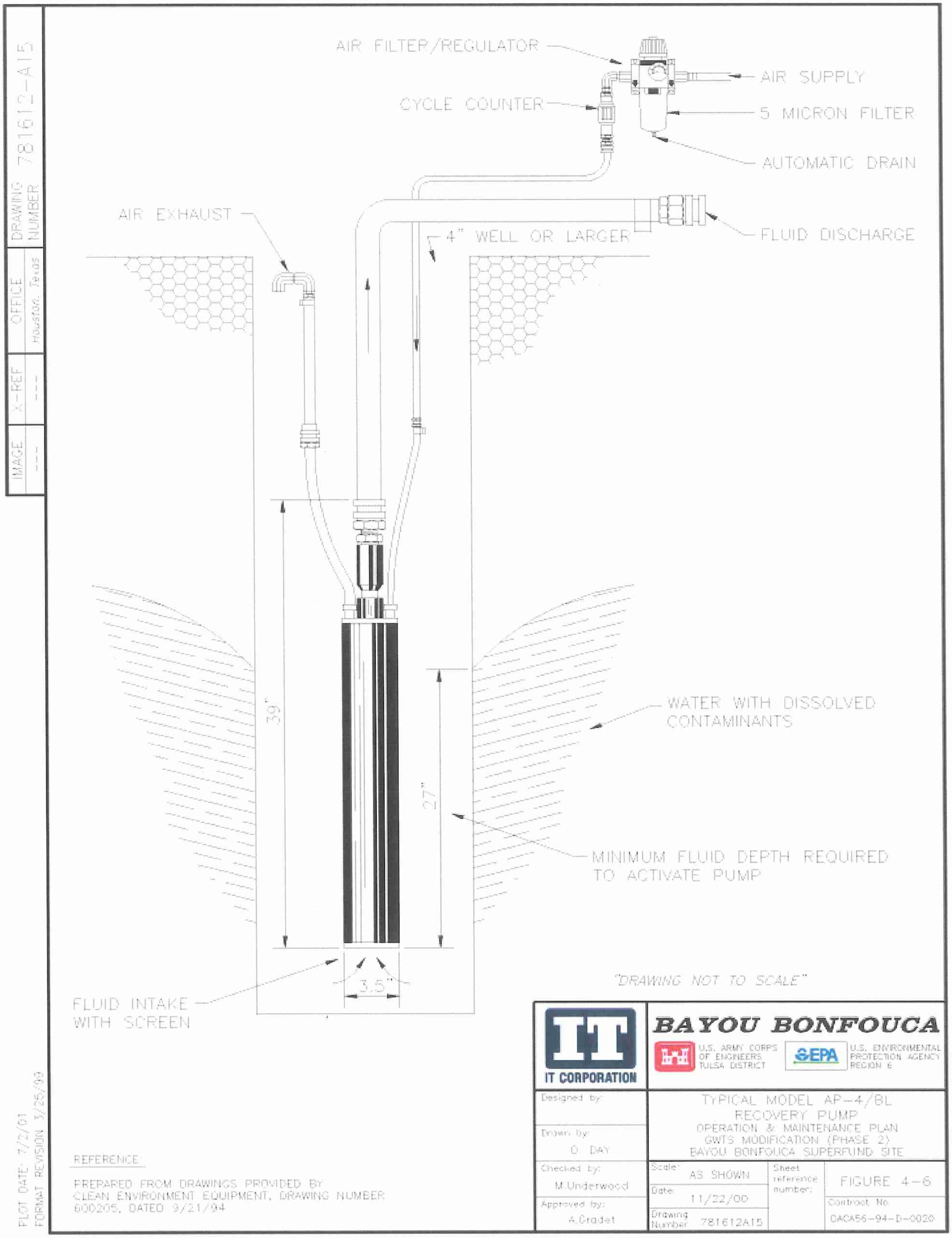


FIGURE 9

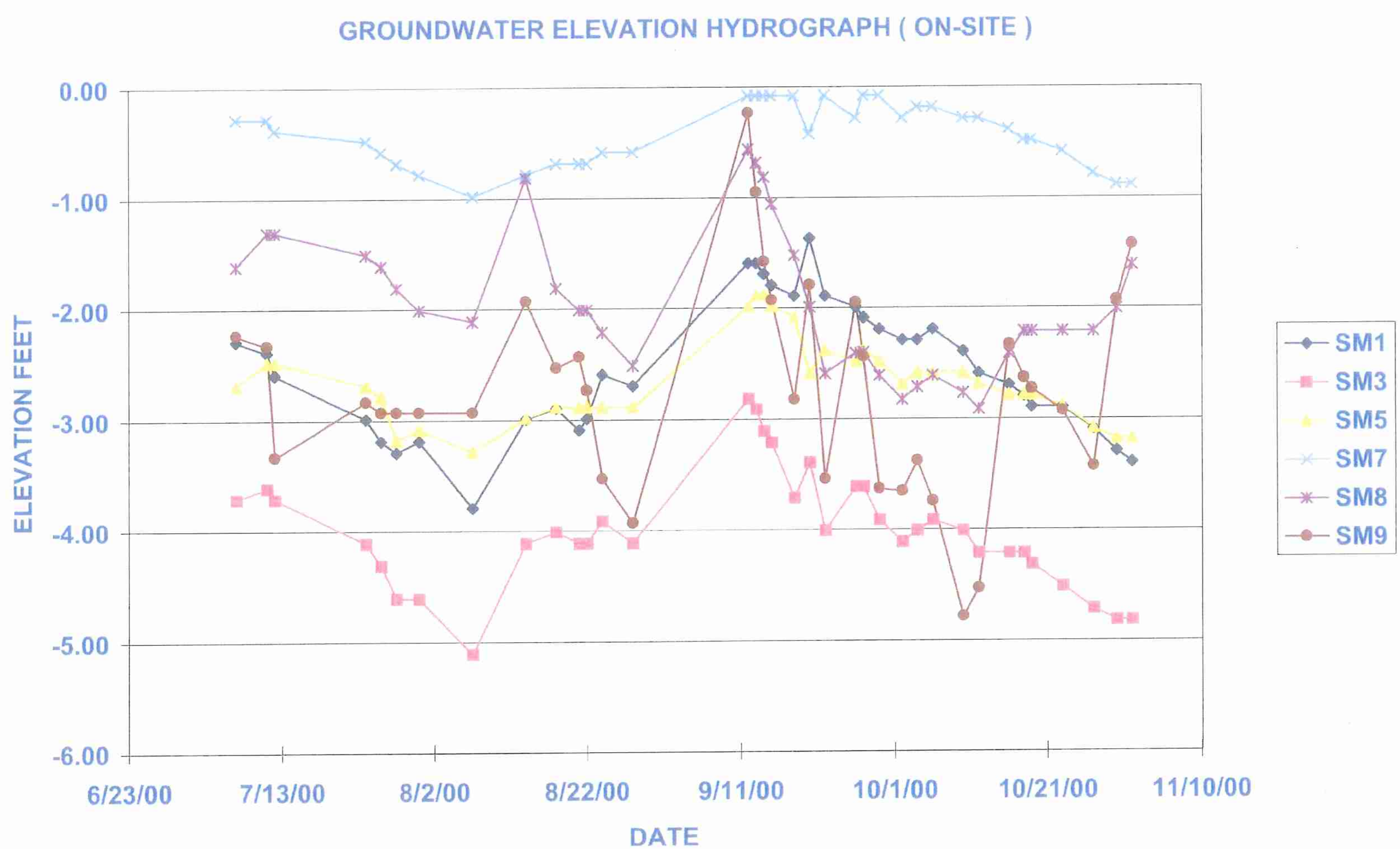
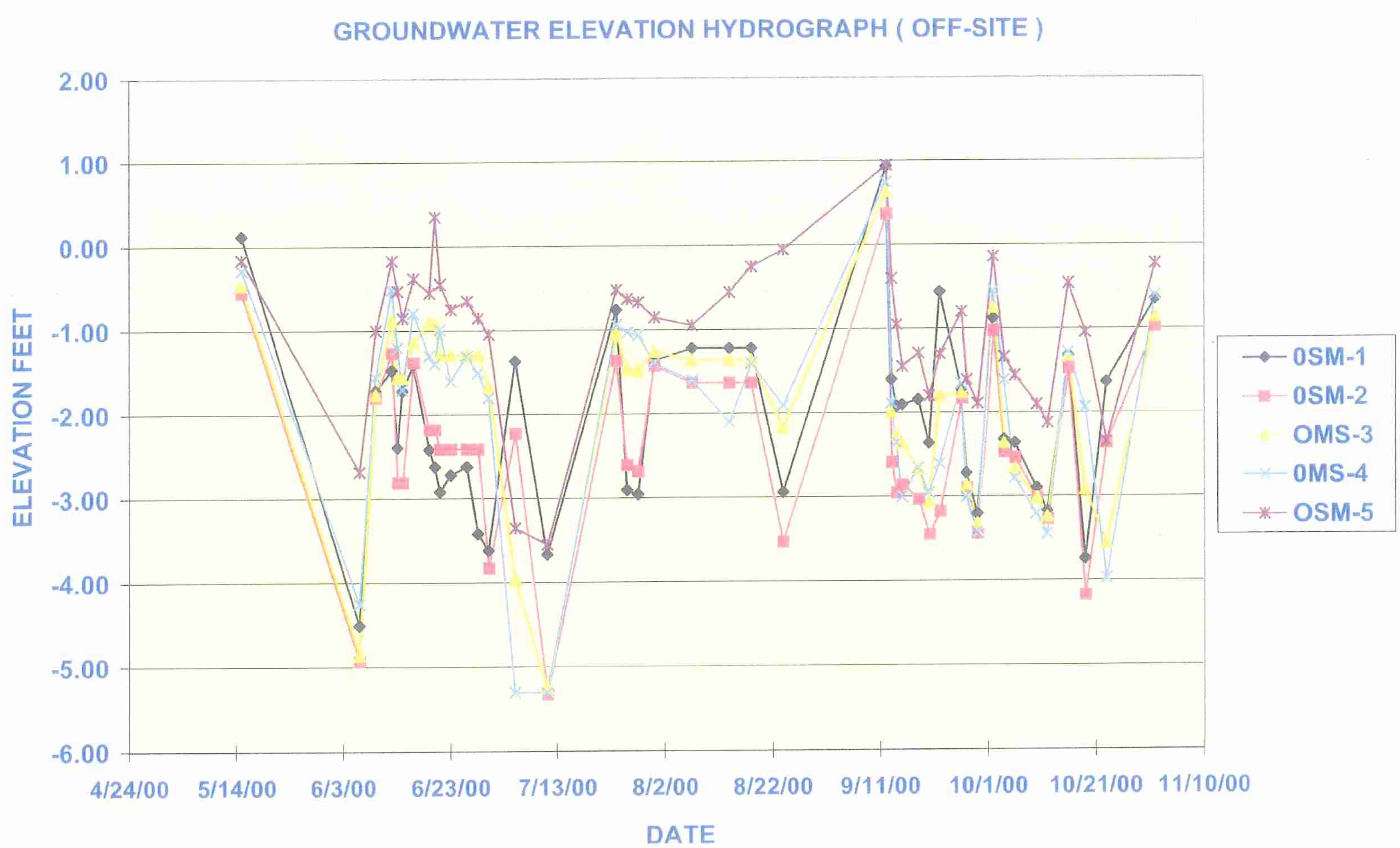

GROUNDWATER ELEVATION HYDROGRAPH ( ON-SITE )
0.00
-1.00
-2.00
-3.00
-4.00
-5.00
-6.00
ELEVATION FEET
6/23/00
7/13/00
8/2/00
8/22/00
9/11/00
10/1/00
10/21/00
11/10/00
DATE
SM1
SM3
SM5
SM7
SM8
SM9

FIGURE 10


GROUNDWATER ELEVATION HYDROGRAPH ( OFF-SITE )
ELEVATION FEET
2.00
1.00
0.00
-1.00
-2.00
-3.00
-4.00
-5.00
-6.00
4/24/00
5/14/00
6/3/00
6/23/00
7/13/00
8/2/00
8/22/00
9/11/00
10/1/00
10/21/00
11/10/00
DATE
0SM-1
0SM-2
OMS-3
0MS-4
OSM-5

# FIGURE 11
# PLAN VIEW GROUNDWATER TREATMENT PLANT

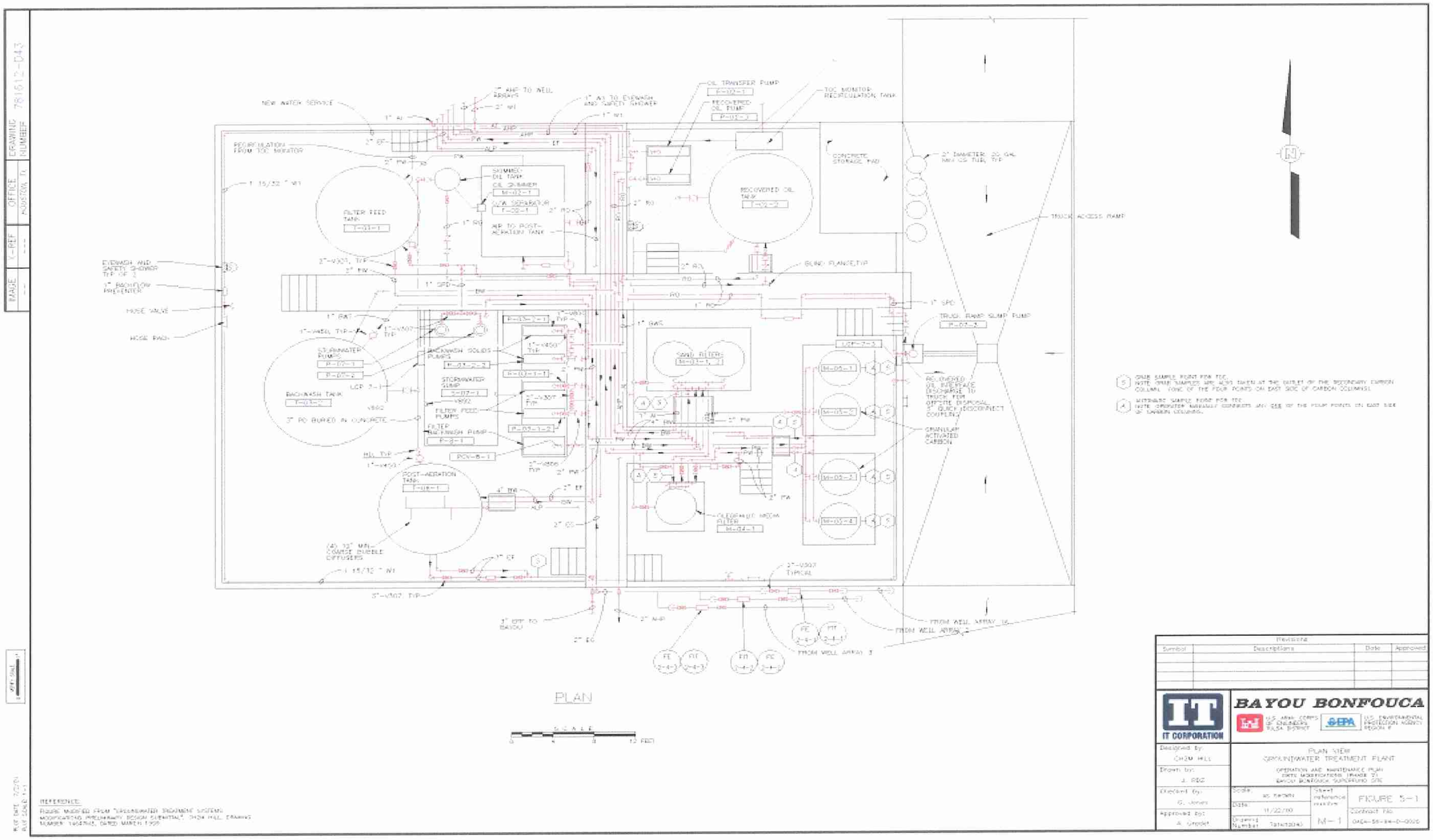
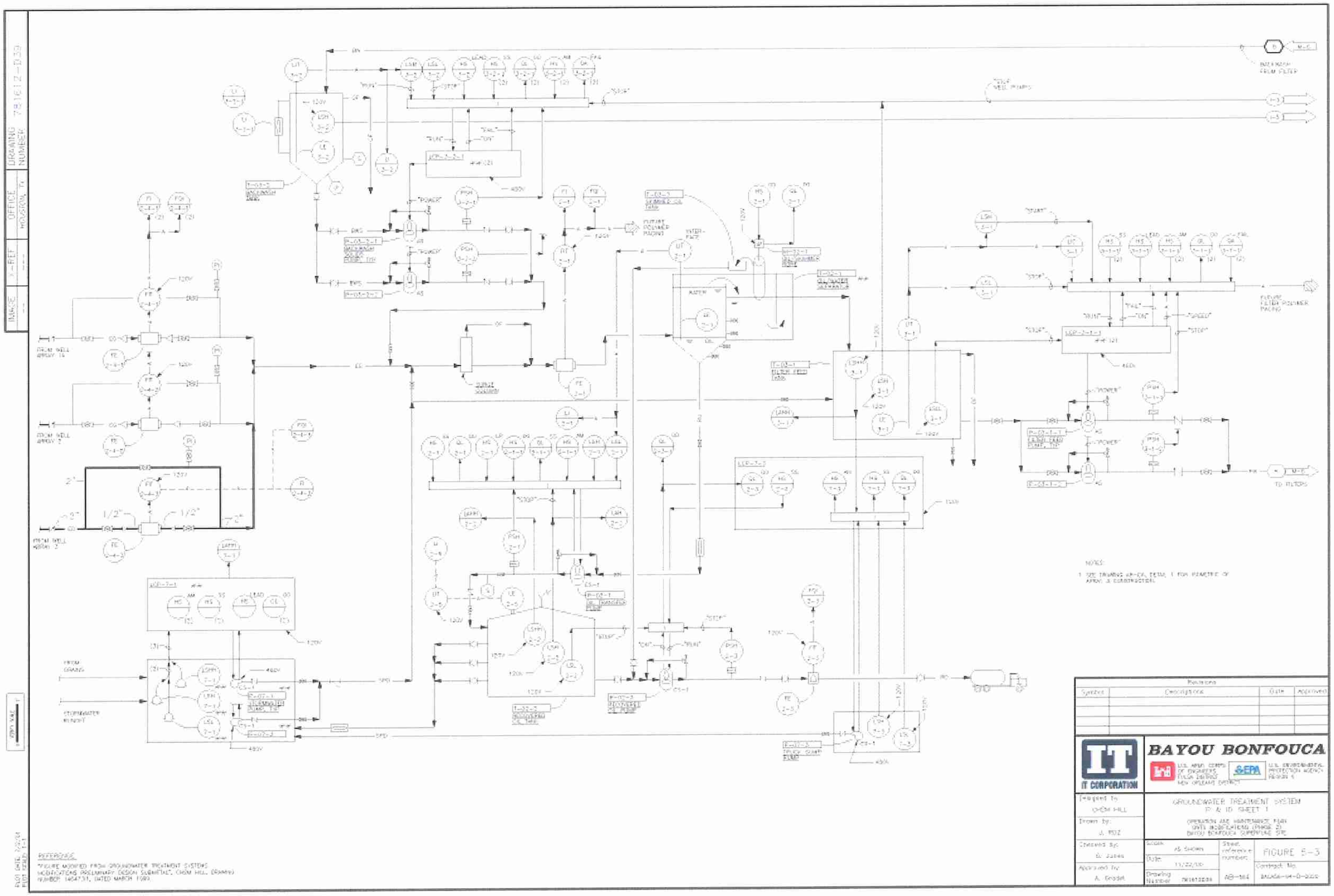
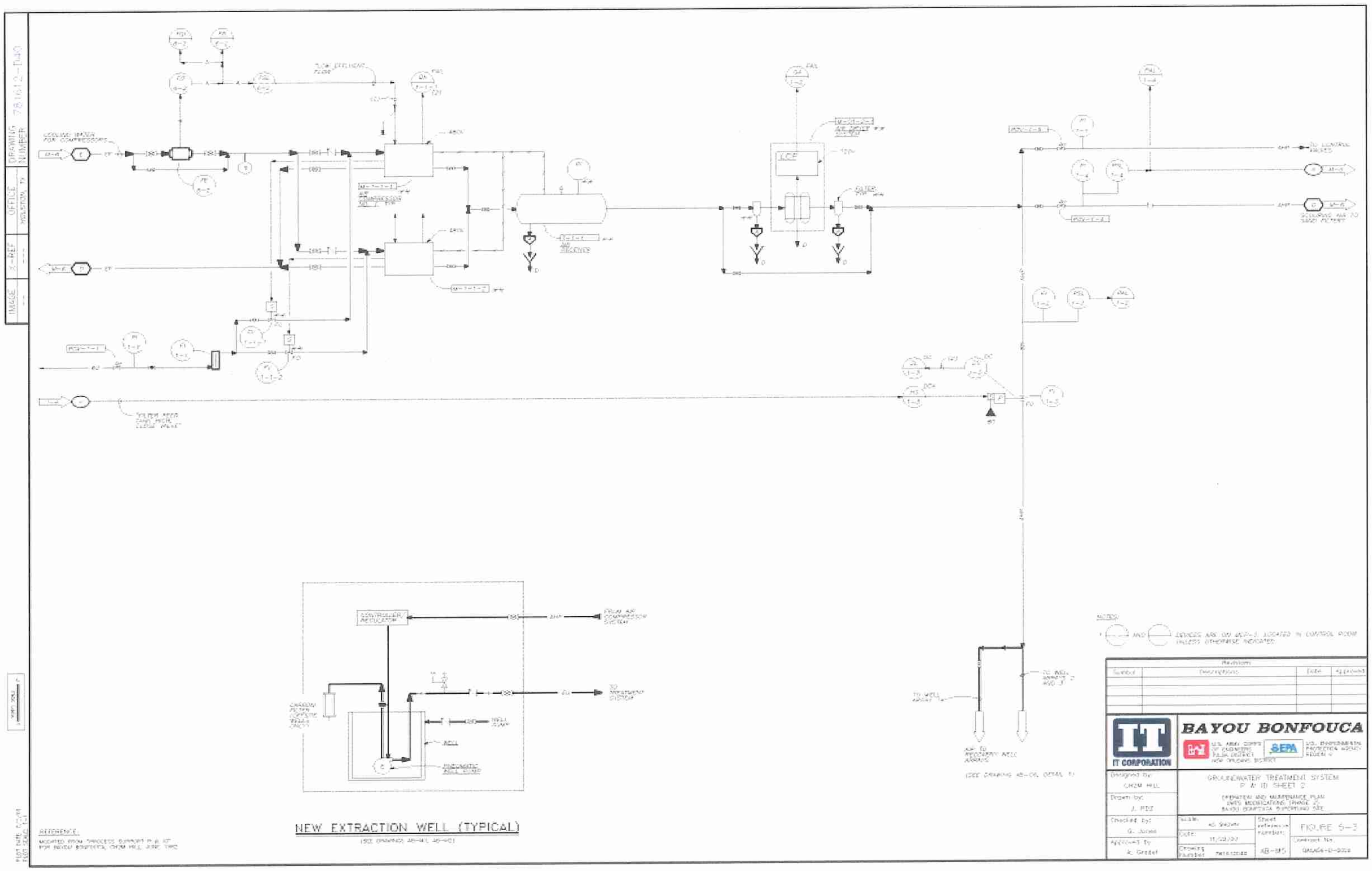


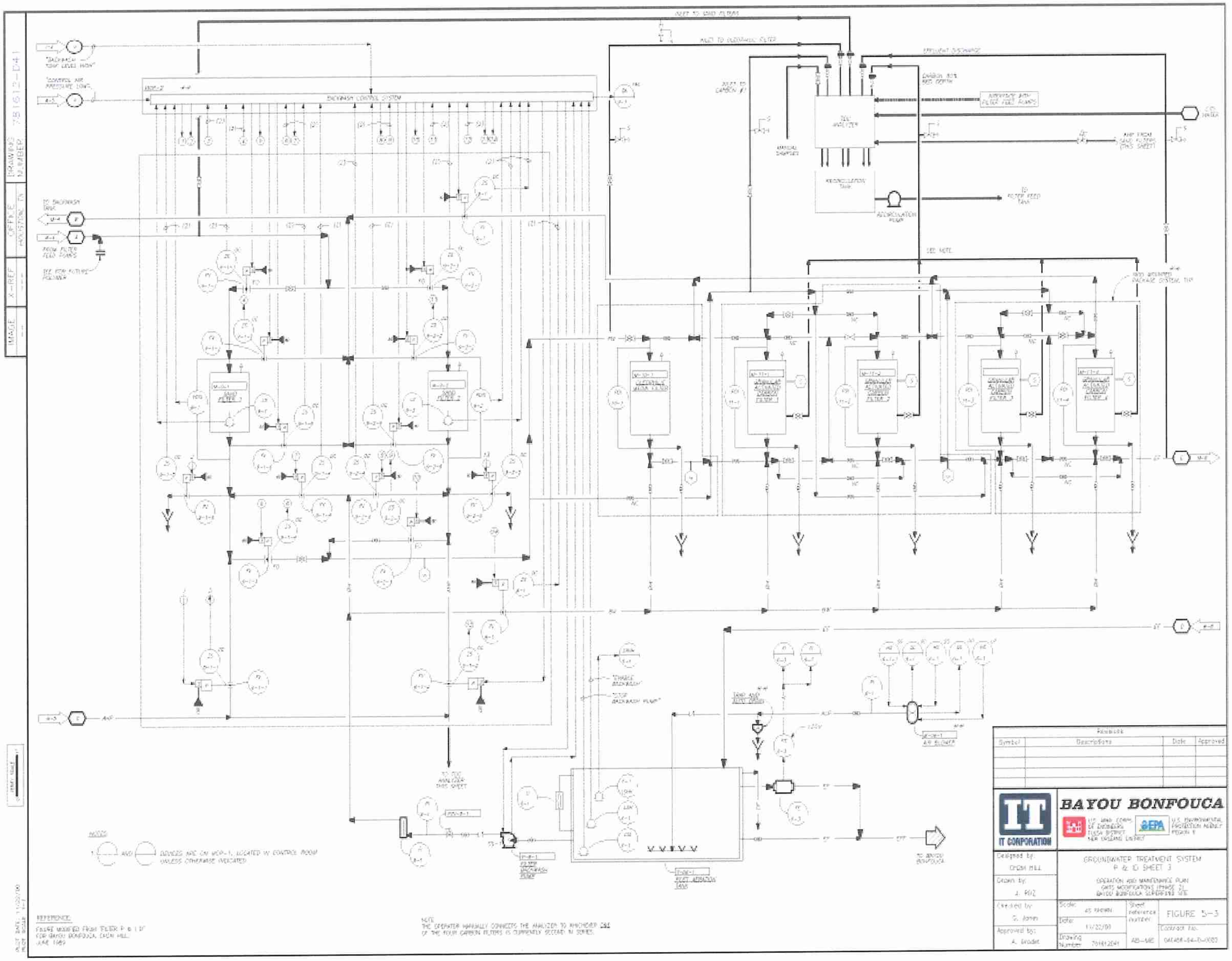
**FIGURE 12**
**GROUNDWATER TREATMENT SYSTEM P & ID SHEET 1**



# FIGURE 13
# GROUNDWATER TREATMENT SYSTEM P & ID SHEET 2



# FIGURE 14
# GROUNDWATER TREATMENT SYSTEM P & ID SHEET 3



# FIGURE 15
# UNIFORM HAZARDOUS WASTE MANIFEST

TEXAS NATURAL RESOURCE
CONSERVATION COMMISSION
P.O. Box 13087
Austin, Texas 78711-3087

THE STATE OF TEXAS

CMLR

Please print or type (Form designed for use on elite (12-pitch typewriter)

Form approved OMB No. 2050.0039 expires 9/30/95

| UNIFORM HAZARDOUS WASTE MANIFEST | 1. Generator's US EPA ID No. | Manifest Document No. | 2. Page 1 of | Information in the shaded areas is not required by Federal law |
|---|---|---|---|---|

| | |
|---|---|
| 3. Generator's Name and Mailing Address<br>US EPA REGION VI<br>425 W. HALL AVE.<br>SLIDELL LA. 70460-2538<br>4. Generator's Phone (504) 847-1122 | A. State Manifest Document Number<br>CWM 0015041<br>B. Generator's ID.<br>99922 |
| 5. Transporter 1 Company Name / 6. USEPA ID Number | C. State Transport's ID<br>D. Transport's Phone |
| 7. Transporter 2 Company Name / 8. USEPA ID Number | E. State Transport's ID<br>F. Transporter's Phone |
| 9. Designated Facility Name and Site Address / 10. USEPA ID Number | G. State Facility's ID<br>H. Facility's Phone |

| 11A HM | 11. US DOT Description (Including Proper Shipping Name, Hazard Class, and ID) | 12. Containers No. | 12. Containers Type | 13. Total Quantity | 14. Unit Wt Vol | I. Waste No. |
|---|---|---|---|---|---|---|
| | A. | | | | | |
| | B. | | | | | |
| | C. | | | | | |
| | D. | | | | | |

| | |
|---|---|
| J. Additional Descriptions for Material Listed Above | K. Handling Codes for Wastes Listed Above |

15. Special Handling Instructions and Additional Information

15. Special Handling Instructions and Additional Information

16. GENERATOR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by PROPER SHIPPING name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable international and national government regulations, including applicable state regulations.

If I am a large quantity generator, I certify that I have a program in place to reduce the volume and toxicity of waste generated to the degree I have determined to be economically practicable and that I have selected the practicable method of treatment, storage, or disposal currently available to me which minimizes the present and future threat to human health and the environment; OR, if I am a small quantity generator, I have made a good faith effort to minimize my waste generation and select the best waste management method that is available to me and that I can afford.

Printer/Typed Name — Signature — Month Day Year

GENERATOR

TRANSPORTER

17. Transporter 1 Acknowledgement of receipt of materials — Date

Printer/Typed Name — Signature — Month Day Year

18. Transporter 1 Acknowledgement of receipt of materials — Date

Printer/Typed Name — Signature — Month Day Year

FACILITY

19. Discrepancy Indication Space

20. Facility Owner Operator, Certification of receipt of hazardous materials covered by this manifest except as noted in item 19 — Date

IT CORPORATION

BAYOU BONFOUCA

U.S. ARMY CORPS OF ENGINEERS TULSA DISTRICT

EPA U.S. ENVIRONMENTAL PROTECTION AGENCY REGION 6

| | | | |
|---|---|---|---|
| Designed by: | UNIFORM HAZARDOUS WASTE MANIFEST<br>OPERATION & MAINTENANCE PLAN<br>GWTS MODIFICATION (PHASE 2)<br>BAYOU BONFOUCA SUPERFUND SITE | | |
| Drawn by: M.Womick | | | |
| Checked by: M.Underwood | Scale: AS SHOWN | Sheet reference number: | FIGURE 8-1 |
| Approved by: A.Gradet | Date: 11/22/00<br>Drawing Number: 781612A17 | | Contract No. DACA-56-94-D-0020 |

DRAWING NUMBER 781612-A17 | OFFICE Houston, Texas | X-REF --- | IMAGE ---

PLOT DATE 7/2/01
FORMAT REVISION 3/25/99

ATTACHMENT A

P & ID LEGENDS AND SYMBOLS SHEET

| IMAGE | X-REF | OFFICE | DRAWING NUMBER |
|---|---|---|---|
| SURVMARK | --- | HOUSTON, TX | 731612-D42 |

# P & I DIAGRAM INSTRUMENT IDENTIFICATION

| CODE LETTER | FIRST LETTER(S) | | SUCCEEDING LETTER(S) | | |
|---|---|---|---|---|---|
| | MEASURED OR INITIATING VARIABLE | MODIFIER | READOUT OR PASSIVE FUNCTION | OUTPUT FUNCTION | MODIFIER |
| A | | | Alarm | | |
| C | | | | Control | |
| E | Voltage | | Element | | |
| F | Flow | | | | |
| G | Gaging | | | | |
| H | Hand | | | | |
| I | Current | | Indicate | | |
| J | Power | | | | High |
| L | Level | | Light | | |
| P | Pressure | | | | Low |
| Q | | Totalize | | | |
| R | | | Record | | |
| S | | | | Switch | |
| T | Temperature | | | Transmit | |
| V | | | | Valve | |

## GENERAL SYMBOLS

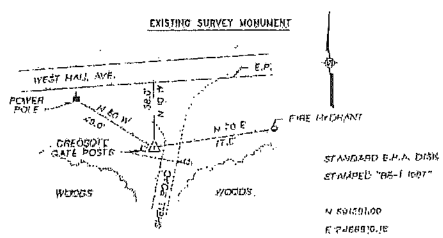
| SYMBOL | DESCRIPTION |
|---|---|
| | NATIVE SOIL BACKFILL |
| | CONCRETE |
| | CEMENT BENTONITE SLURRY |
| | COARSE GROUND BENTONITE OR BENTONITE PELLETS |
| | SILICA SAND FILTER PACK |
| | SAND (95% COMPACTED) |
| | PEA GRAVEL |

## DETAIL AND SECTION DESIGNATIONS

Number Indicates Detail, Letter Indicates Elevation Or Section

Sheet Where Elevation, Section, Or Detail is Drawn Or Taken ( – Indicates Same Sheet)

## EXISTING SURVEY MONUMENT




STANDARD E.P.A. DISK STAMPED "BS-1 1997"

N 59[illegible]
E 24[illegible]

## GENERAL INSTRUMENT OR FUNCTION SYMBOLS

FIELD MOUNTED

PANEL MOUNTED (OPERATOR ACCESSIBLE)

## PRIMARY ELEMENT SYMBOLS

ELECTROMAGNETIC FLOWMETER

PRESSURE GAUGE

## PIPING IDENTIFICATION

AHP – AIR, HIGH PRESSURE
EG – EXTRACTED GROUNDWATER
EF – EFFLUENT
PW – PROCESS WATER

## PUMP AND COMPRESSOR SYMBOLS

CENTRIFUGAL WET PIT PUMP OR TURBINE PUMP

GEAR PUMP OR BLOWER (POSITIVE DISPLACEMENT)

RECIRCULATION PUMP

## ABBREVIATION AND LETTER SYMBOLS

| | |
|---|---|
| ø | DIAMETER |
| AB | AS-BUILT |
| ABS | ACRYLONITRILE BUTADIENE STYRENE |
| AM | AUTO-MANUAL |
| HDPE | HIGH DENSITY POLYETHYLENE |
| MCC-X | MOTOR CONTROL CENTER NO. X |
| OC | OPEN-CLOSE (D) |
| OO | ON-OFF |
| OSM | OFF-SITE SUBSIDENCE MONITORING WELL |
| PTFE | POLYTETRAFLUOROETHYLENE |
| PVC | POLYVINYL CHLORIDE |
| SCH | SCHEDULE |
| SM | ON-SITE SUBSIDENCE MONITORING WELL |
| SS | START-STOP |
| SST | STAINLESS STEEL |
| TYP | TYPICAL |

## MECHANICAL SYMBOLS

BALL VALVE
CHECK VALVE
QUICK CONNECT
AUTOMATIC SHUTOFF VALVE
REDUCER
SAMPLE VALVE
NEEDLE VALVE
ROTAMETER

## GENERAL NOTES

1. Locations of existing utilities and structures are from the best information available. Exact locations and completeness are not guaranteed. All existing utilities and improvements that are damaged during construction shall be restored completely by the contractor, at the contractor's own expense, to the satisfaction of the utility owner. The contractor shall request that underground facilities be located and marked in the field a minimum of 48 hours prior to the start of construction by calling Underground Services Alert telephone number 1 (800) 642-2444. The contractor shall be responsible for confirming the location of all utilities and interferences.
2. Drawings are intended to cover layout and design of work. Do not scale for exact measurements.
3. Survey Coordinate System is based on the 1927 Louisiana State Plan Coordinate System.

REFERENCE:
OPERATIONS MANUAL FOR GROUNDWATER [illegible] TREATMENT SYSTEM FACILITY, CH2M HILL [illegible] [illegible], DATED MARCH 199[illegible].

PLOT DATE: 11/22/00
PLOT SCALE: 1=1

| Revisions | | | |
|---|---|---|---|
| Symbol | Descriptions | Date | Approved |
| | | | |

**IT CORPORATION**

# BAYOU BONFOUCA

U.S. ARMY CORPS OF ENGINEERS TULSA DISTRICT NEW ORLEANS DISTRICT — U.S. ENVIRONMENTAL PROTECTION AGENCY REGION 6

PIPING AND INSTRUMENTATION LEGENDS AND SYMBOLS SHEET

OPERATION AND MAINTENANCE PLAN
GWTS MODIFICATIONS (PHASE 2)
BAYOU BONFOUCA SUPERFUND SITE

| | | | |
|---|---|---|---|
| Designed by: CH2M HILL | Scale: AS SHOWN | Sheet reference number: AB-02 | |
| Drawn by: J. RO7 | Date: 11/22/00 | | Contract No. DACA56-91-D-0020 |
| Checked by: O. Jones | Drawing Number 781612D42 | | |
| Approved by: A. Gradel | | | |