Engineering Feasibility Plan

Revision 7

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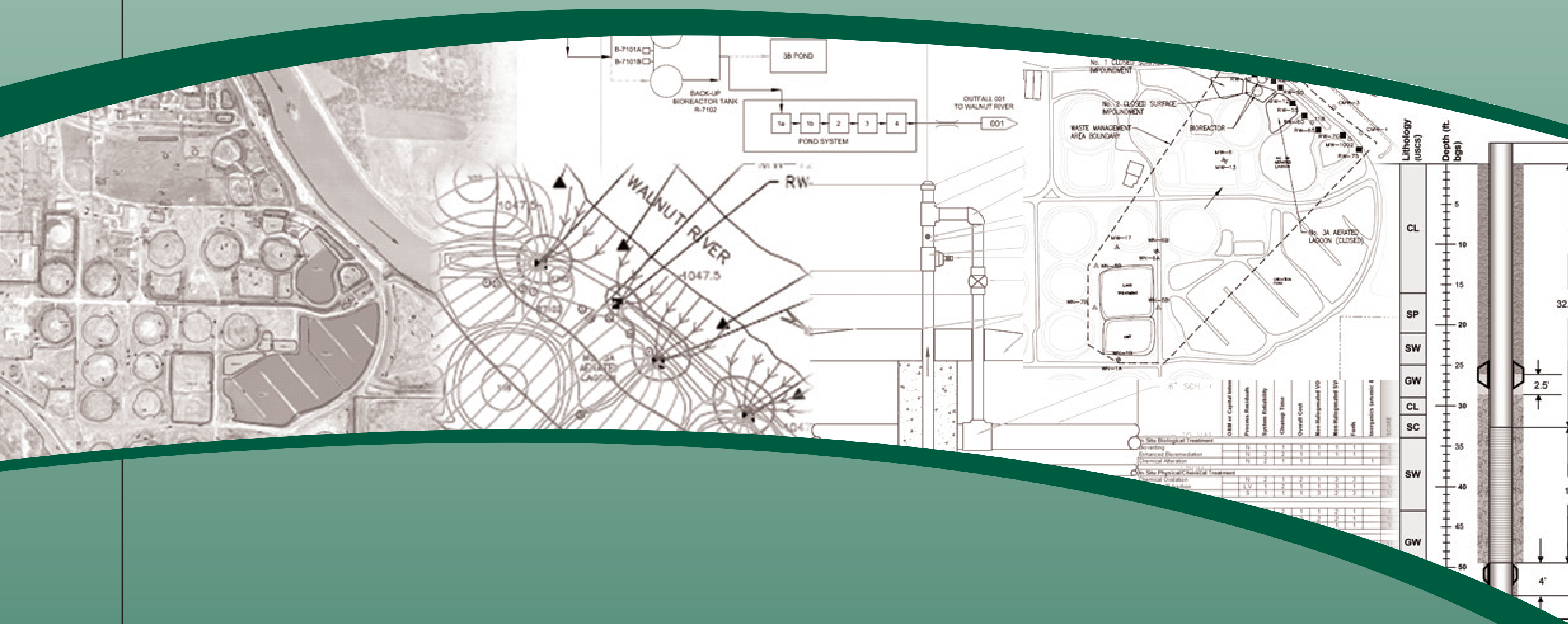

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BUILDING A BETTER WORLD

ENGINEERING FEASIBILITY PLAN

MRP Properties Company, LLC

ARKANSAS CITY, KANSAS

U.S. EPA ID No.: KSD087418695

Prepared for:

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1.0 INTRODUCTION

TPI Petroleum, Inc. (TPI) is a wholly owned subsidiary of Ultramar Diamond Shamrock Corporation. TPI's Arkansas City Refinery is located in Arkansas City, Kansas at the confluence of the Arkansas and Walnut Rivers. Figure 1-1 shows the location of the Refinery. A Resource Conservation and Recovery Act (RCRA) Permit, number KSD087418695 was issued by the Kansas Department of Health and Environment (KDHE) to TPI for operation of an onsite Land Treatment Unit (LTU) on November 16, 1987. The facility submitted a RCRA Part B Permit Renewal Application to KDHE on March 16, 1998. This Engineering Feasibility Plan (EFP) is intended to fulfill the requirement of 40 CFR 270.14(c)(8)(iii) and (iv).

The LTU was used by TPI to treat hazardous and non-hazardous wastes from many refinery operations at the facility. Quarterly LTU groundwater monitoring and annual groundwater reporting was initiated by TPI starting in 1988 in accordance with the RCRA Permit. Table 1-1 lists the chemical parameters and the associated Groundwater Protection Standard concentration limits (GWPS) in the original permit. These GWPS or "trigger values" were based upon the maximum concentration limits for drinking water or the established groundwater protection standard (normally five times the analytical detection limit).

There have been many groundwater sampling events where concentrations of hazardous constituents have exceeded the established trigger values Table 1-2. The major chemical constituents are benzene, toluene ethylbenzene, xylene (BTEX) and naphthalene. The results of these groundwater monitoring events were submitted to KDHE on a quarterly basis by TPI.

In accordance with CFR 264.100, the owner (TPI) must implement a corrective action plan that prevents hazardous constituents from exceeding their respective concentration limits at the point of compliance. A closure plan for the LTU was submitted to KDHE for review and approval with in the RCRA Part B Permit Application on March 16, 1998. This closure plan described closure alternatives including the long term management of the LTU.

This document describes the corrective measures planned to address groundwater impacts at the Waste Management Area (WMA) encompassing the LTU and the No. 1 and No.2 Closed Surface Impoundments and the closed No. 3A Aerated Lagoon.

Groundwater represents the only contaminant migration pathway from the LTU. There is no evidence to suggest that significant volatilization of organic compounds through the vadose zone is occurring into the atmosphere that would represent a threat to human and environmental receptors on site. Institutional controls exist to prevent public and wildlife exposure from the LTU surface soils. The Walnut River is a potential contaminant receptor due to downgradient groundwater migration.

1.1 Objectives

The objective of this EFP is to review and assess the ICM selection process for the property downgradient of the LTU and to evaluate the feasibility of the existing ICM System in containing, recovering and treating dissolved hazardous constituents in the groundwater downgradient of LTU. The original purpose of the existing ICM System was to stop the migration of free product from leaving the facility boundary and recovering and treating impacted groundwater. This plan assesses the feasibility of using the enhanced ICM system that is downgradient of the LTU (between recovery wells RW-40 and RW-80A) to contain and capture dissolved constituents detected in the groundwater flowing beneath the LTU and preventing offsite migration. This plan also summarizes the alternative selection process used to select the existing ICM System and a summary of the additional corrective action measures at the LTU. This feasibility plan will assess the ICM System construction and operation and determine its applicability to containing and treating the groundwater constituents from in the LTU area groundwater plume. A contingency plan for groundwater quality exceedances at the property boundary compliance wells is also included in this plan.

1.2 Report Organization

This feasibility report is organized into seven sections.

Section 1 (Introduction) provides the initial background information on the facility and the objective of the feasibility study.

Section 2 (Facility Background) contains the background information concerning the facility location, past operational history, RCRA status, local geology, hydrogeology, surface water and adjacent land use.

Section 3 (Land Treatment Unit Description) provides historical information about the LTU operational history, description, waste stream descriptions, waste characterizations, and the LTU groundwater conditions.

Section 4 (Waste Management Area Corrective Action Alternative Analysis and Selection Summary) provides a summary of the various remedial alternatives assessed to select the final ICM System. A brief discussion about the ICM is provided.

Section 5 (Engineering Feasibility Analysis) reviews the current operational status and capability of the ICM System following significant upgrades to the system that were made in the summer of 1998. A detailed discussion about the ICM System components such as well spacing, groundwater capture analysis (using the computer modeling MODFLOW), well depth, water conveyance and treatment capabilities. In addition the ICM System's operation and maintenance program is assessed. This section addresses the requirements in 40 CFR 270.14(c)(8)(iii).

Section 6 (Corrective Action Monitoring Program) discusses the monitoring program for the LTU ICM as required by 40 CFR 270.14 (c)(8)(iv) to demonstrate the adequacy of the system.

Section 7 (References) provides a detailed listing of references used to develop this plan.

2.0 FACILITY BACKGROUND

TPI, a wholly owned subsidiary of UDS, is the current owner and operator of the Arkansas City refinery located southeast of the incorporated limits of Arkansas City in southwestern Cowley County, Kansas. The refinery was initially constructed in the 1920's and has had several different owners. The refinery was purchased by TPI in April 1978 and UDS acquired TPI on September 25, 1997. The facility occupies approximately 300 acres and is located near the confluence of the Walnut River and the Arkansas River.

Crude oil was supplied to the refinery via pipeline and trucks. The refining processes included two crude fractionation units, HF alkylation, two catalytic reformers, gas plant, hydrocracker, propylene splitter, sulfur recovery plant and other supporting facilities.

The former refinery had a nominal operating capacity of 60,000 barrels per stream day. Products produced at the refinery included unleaded gasoline, liquefied petroleum gas (LPG), propylene, fuel oils, jet fuels, and asphalt. The refinery received approximately 85% of its crude oil supply by pipeline and transported approximately 85% of its refined products by pipeline. The remaining product was transported by truck.

The waste water treatment plant has an NPDES Permit issued by the State of Kansas from June 29, 1993 through December 1, 1997 under the provisions of the Clean Water Act (State of Kansas, 1993). The permit renewal has been submitted to State of Kansas Department of Health and Environment and TPI is awaiting the issuance of a new permit. In 1994, a major upgrade to the wastewater treatment plant was completed. The upgrades include improvements to the oil/water separators, groundwater transfer system, induced air floatation system, existing aeration ponds and the construction of a flow through bioreactor system (Raytheon, 1994). Refining operations ceased in September 1996, the facility continued to operate as an asphalt distribution terminal. The asphalt operations were idled in November 1998. The asphalt is received from offsite sources via truck and train. The asphalt is then mixed to specification before being transported off site via truck.

2.1 Background Information

The regional and local hydrogeological setting of the facility is summarized in the following sections. Regional hydrogeology was investigated as part of the RCRA Facility Investigation (RFI) and submitted with the August 4, 1992 Final RFI Report (RSA, 1992). The information on the local hydrogeology is derived from former and current investigations at the facility.

2.1.1 Surface Soil

According to the United States Department of Agriculture (USDA) Soil Survey of Cowley County (1980), there are four soil types found at the facility; the Canadian fine silty loam (CA), the Dale Silt Loam (DA), the Lincoln-Tivoli Complex (LG) and the Verdigris Silt Loam (VD). The approximate distribution of these soil types is shown on Figure 2-1. Canadian series (CA) soil is generally deep, well drained, with moderately rapid permeability. This soil type ranges in depth up to about 60 inches and is formed in loamy and sandy alluvium. Slopes of this soil type range from 0 to 1 percent. Canadian series soil is generally located in the southern portion of the facility.

Dale series (DA) soil type is generally deep, well drained and moderately permeable. Soil depths occur to about 60 inches, and are formed in loamy alluvium. This soil type has slopes of about 0 to 1 percent and trend in an east west direction in the central portion of the facility.

The Lincoln-Tivoli Complex (LG) soil type tends to be a deep soil that is excessively drained with rapid permeability. The depth of this soil type occurs within the upper 60 inches. This soil type is found on floodplain or terrace deposits. Slopes of this soil type range from 0 to 15 percent and are found along the Arkansas and Walnut Rivers at the northeastern and southern boundaries of the facility.

The Verdigris Series (VD) soil type is deep and moderately well drained and has moderate permeability. Soil depths occur to about 60 inches and form in silty alluvium. Slopes of this soil type is about 0 to 2 percent and are found on low terraces and floodplains. The Verdigris soil type is located on the northern side of the facility.

The refinery is located within the 100-year floodplain between the Walnut River and the Arkansas River, as shown on Figure 2-2. The facility has very little relief and gently slopes towards the northeast. Facility elevations range from approximately 1,078 feet above mean sea level (AMSL), near the southern boundary of the facility, to 1,045 feet AMSL, at the eastside of the facility.

2.1.2 Area Topography

The refinery is located within the 100-year floodplain between the Walnut River and the Arkansas River, as shown on Figure 2-2. The facility has very little relief and gently slopes towards the northeast. Facility elevations range from approximately 1,078 feet above mean sea level (AMSL), near the southern boundary of the facility, to 1,045 feet AMSL, at the eastside of the facility.

2.1.3 Area Geology

The refinery is located southeast of Arkansas City in Cowley County, Kansas. Cowley County is in south central Kansas. Structurally, this area is east of the Nemaha Ridge, and west of the Dexter Anticline. Locally, the facility is located at the confluence of the Arkansas and Walnut Rivers. The region is underlain by Permian-age rocks that dip toward the west (Bayne, 1962). Quaternary alluvium overlies these Permian deposits and is found along major rivers and streams.

The areas along both the Arkansas and Walnut Rivers, including the facility, are underlain by unconsolidated Quaternary-age alluvial deposits. These deposits consist of clay, silt, sand, and chert, and limestone gravel (RSA, 1992). The thickness of alluvial deposits in the region is typically less than 25 feet, although recent alluvial deposits along the Arkansas River can be as much as 50 feet in thickness.

2.1.4 Surface Water

The facility is located between the Arkansas and Walnut Rivers upstream of the confluence of the two rivers. The Arkansas River flows southeasterly through Arkansas City then meanders to the northeast where it merges with the south-southeast flowing Walnut River. The two rivers are principal waterways in Cowley County.

2.1.4.1 Surface Water Flow

The facility is located within the 100-year flood plain of the Walnut River and the Arkansas River. The maximum peak flow recorded on the Arkansas is 103,000 cubic feet per second (cfs) on June 10, 1923 and on the Walnut River, the maximum peak flow recorded is 105,000 cfs on April 23, 1944. The water year periods of record for the Arkansas and Walnut Rivers is 1903-1998 and 1922-1998 respectively.

Mean daily flows from the Arkansas City gauging station on the Arkansas River and the Walnut River for water years 1960 through 1998 were obtained from the USGS. For the Arkansas River at Arkansas City (USGS Station 07146500) the mean of the annual maximum mean daily flow was 25,027 cubic feet per second (cfs). The month when the annual maximum occurred was highly variable from year to year, occurring anytime from March through June, or August through November. The mean of the annual minimum mean daily flow at this station and for this period was 292 cfs. The month when the annual minimum occurred was generally June through September.

For the Walnut River at Winfield (USGS Station 07147800) the mean of the annual maximum mean daily flow for this period was 20,922 cfs. The month when the annual maximum occurred was again highly variable March through July, or September through November. The mean of the annual minimum mean daily flow for the Walnut River at Winfield for this period was 43 cfs. The month when the annual minimum occurred was generally August through November.

A flood event occurred in November of 1998, cresting on November 3. The peak flow on that day according to the River Forecast center in Tulsa Oklahoma was 95,500 cfs at Arkansas City (USGS Station 07146500) on the Arkansas River, and 91,600 cfs at Winfield (USGS Station 07147800) on the Walnut River.

2.1.4.2 Surface Water Quality

The water in the Walnut River was sampled on three occasions during the RFI Phase II field investigation during October and November 1999. Three locations were sampled on each of the three sampling events. The sample locations are shown on Figure 2-10. The upstream location (SW-1) represents the quality of surface water before passing the refinery, the central location (SW-2) represents surface water as it passes by the refinery and is adjacent to the waste management unit area boundary, and the downstream (SW-3) sample location represents surface water quality downstream of the refinery. The three sample locations were sampled on the same day for each sampling event. Nine samples in all were collected and submitted to a laboratory for analysis of the modified Skinner List constituents. These constituents include volatile organic compounds (VOC), semi-volatile organic compounds (SVOC), 13 metals and cyanide. The sampling events coincided with low flow periods on the Walnut River. The results of the laboratory analyses are presented on Table 2-1. The analytical results for the VOCs and SVOCs are non-detect with the exception of the detection of three VOCs. 2-Butanone (methyl ethyl ketone or MEK) was reported by the laboratory as an estimated concentration of 0.002 mg/L in the downstream sample during the first of the three sampling events. The laboratory's practical quantitation level for this constituent was 0.005 mg/L. Chloroform was detected at the upstream sample location in the last of the three sampling events at a concentration of 0.06 mg/L. Trichloroethene was detected in the downstream sample during the first sampling event at an estimated concentration of 0.003 mg/L. The laboratory's PQL for trichloroethene was 0.005 mg/L. Chloroform was detected in one upstream sample at a concentration exceeding the KDHE Food Procurement screening criteria.

The results of the metals and cyanide analyses are also presented on Table 2-1. Two of the metals had exceedances of the KDHE Food Procurement screening criteria. Beryllium was detected at all three sample locations (SW-1, SW-2 and SW-3) with concentrations ranging from 0.0003 to 0.0009 mg/L. Beryllium was detected at similar concentrations at the upstream and downstream locations. Mercury was detected at the upstream and midstream sample locations (SW-1 and SW-2) at concentrations ranging from 0.0001 to 0.0004 mg/L.

2.1.5 Area Hydrogeology

Groundwater occurs in alluvial and bedrock aquifers in the refinery vicinity. The alluvial deposits along the Arkansas River Valley provide large quantities of water (500 to 1000 gallons per minute) which ranges in quality from good to poor. Locally, groundwater from bedrock aquifers can yield large to small quantities of water that ranges from good to poor quality. Chloride concentrations in water wells completed in alluvial sediments at the refinery vicinity range from approximately 16 ppm to 650 ppm (Bayne, 1962). Figure 2-3 shows regional groundwater availability.

Recharge of alluvial aquifers in the region is due mainly to infiltration of precipitation. On an intermittent basis, the Arkansas and Walnut Rivers contribute to alluvial aquifer recharge (Bayne, 1962). During flood conditions, when river water elevations are above the level of the groundwater in the aquifer, movement is in the direction of the aquifer (away from the stream) and aquifer recharge occurs. Usually, discharge of groundwater occurs by flow to streams and rivers, evapotranspiration, pumping, and leakage into hydraulically connected aquifers.

2.1.6 Temperature

According to Army Corps of Engineers (ACOE), December 1984, the climate of Cowley County, Kansas is normal for middle latitude, interior continental areas. The climate is characterized by large variations in annual and daily temperatures, long, hot summers and cold, short winters. The average daily temperature in winter is 36.6°F. The recorded high and low temperatures for Cowley County are 118°F on August 12, 1936 and -27°F on February 13, 1905, respectively.

2.1.7 Precipitation

Precipitation in Cowley County is highest during the spring and summer (April-September). Seventy-two percent of the average annual precipitation of 33 inches occurs during late evening or nighttime thunderstorms. Ten to eleven inches of the annual precipitation occurs as snowfall.

2.1.8 Evaporation

The average evaporation from April to October 1979, of the three closest stations which record evaporation information near the facility is estimated to be 57 inches. The three closest weather stations which record evaporation data are: 1) The Hulah Dam Station, Oklahoma, located approximately 55 miles southeast of the facility; 2) the Great Salt Plains Dam Station, located approximately 75 miles southwest of the facility; 3) the Elk City Dam Station, Kansas, located approximately 55 miles east-northeast of the facility. It was necessary to estimate the average evaporation for the facility, since no evaporation data is recorded for Arkansas City, Kansas.

2.1.9 Facility Stratigraphy

The following section describes the geology of the alluvium and bedrock beneath the facility.

2.1.9.1 Alluvium

Alluvial sediments observed in test borings at the refinery ranged in thickness from approximately 38 to 52 feet. The alluvium is comprised primarily of sandy silt/silty sand, sand, and gravelly sand with varying amounts of silt and clay. Sediments typically become coarser with depth beneath the refinery, such that the saturated alluvium can be divided into upper and lower units. The upper alluvial unit is comprised of finer grained sediments including clay, silty clay, and sandy silt/silty sand which grade at depth into a very fine to coarse-grained sand. The upper unit ranges in thickness from approximately 8 feet to 40 feet. Commonly, only the basal portion of the upper unit is saturated. The upper alluvial unit is thickest at the northern end of the refinery, where sediments are generally finer grained.

The lower unit is comprised primarily of gravelly sand, and is the main water-bearing zone in the alluvial aquifer. The lower unit is found at depths between 10 and 35.5 feet and ranges in thickness between 8 and 29 feet. Underlying Quaternary alluvium are the shales and impure limestones of Permian age Chase Group. The upper and lower alluvial units and the Permian age bedrock are discussed in greater detail below.

Figures 2-4, 2-5, and 2-6 are geologic cross sections of the facility, which show stratigraphic relationships. Figure 2-7 shows the cross-section locations.

2.1.9.2 Bedrock

A shale bedrock underlies Quaternary alluvium at the facility at depths ranging from 38 to 52 feet. The bedrock, according to available information (Bayne, 1962), is part of the Permian age Chase Group. Beneath the facility, the bedrock was observed to consist of blue and gray calcareous shale containing some very hard, light yellowish brown, microcrystalline limestone. The thickness of the shale reportedly ranges up to 350 feet in the refinery vicinity (Bayne, 1962).

2.1.10 Facility Hydrogeology

The groundwater in the alluvial sediments is unconfined. Groundwater at the refinery was encountered at depths ranging from approximately 10 to 22 feet below the ground surface in October 1997. The uppermost groundwater beneath the facility occurs in the alluvial deposits, as shown in the geologic cross-sections (Figures 2-4, 2-5, and 2-6). The groundwater flow direction in the alluvial aquifer is northeast toward the Walnut River at an average gradient of 0.0025 feet/foot. A groundwater potentiometric surface contour map showing the potentiometric surface and the extent of phase separated hydrocarbons (PSH) in June, 1999 is included as Plate 1.

As shown on the potentiometric surface map, water from the Arkansas River enters the alluvial sediments and flows in a northeast direction beneath the facility toward the Walnut River. Effects of groundwater pumping from the ICM wells is indicated on the June, 1999 groundwater potentiometric surface contour map. The water table is depressed in the vicinity of the ICM recovery wells.

Comparison of water levels in clustered monitor wells at the LTU and the closed No. 1 and No. 2 surface impoundments indicate both upward and downward hydraulic gradients within the alluvial aquifer.

Generally, the calculated vertical gradients are of very low magnitude (less than 0.005 ft/ft, up or down) and are derived from head differences which are generally less than the range of measurement accuracy.

The alluvium at the site has been described by others (RSA, 1992) to consist of two zones, an upper and a lower zone based upon the lithology of the alluvium. These two zones are hydraulically connected. The upper zone is characterized by finer grained deposits, typically, sand and the lower zone is characterized by coarser deposits, typically, sandy gravel. The groundwater potentiometric surface is encountered in both zones. In the northern portion of the refinery, close to the Walnut River, the alluvium contains interbeds of clay and clayey silty sand, and the sandy gravel layer becomes a silty sandy gravel. Limited areas of perched groundwater may exist in this area. This alluvial sequence is illustrated on the north-south cross-section, Figure 2-6. In the area of the regulated units, from the LTU to the Walnut River, the finer grained sediments sit above the water table (except during flood conditions), and therefore have no impact on flow paths in the saturated zone.

Well logs show that the lithology of the saturated alluvial aquifer is relatively uniform. The direction of groundwater flow, and of contaminant migration is governed by the groundwater gradient; no apparent preferential pathways are indicated.

Paleochannels described by others (RSA, 1992), observed on the top of bedrock structure contour map shown on Figure 2-8 do not represent preferential pathways, and have no significant impact on contaminant migration. These undulations of the bedrock surface trend NNW-SSE across the site, essentially perpendicular to the groundwater flow direction. The westernmost 'undulation' passes through the locations of wells 92 and WN-8A, and the easternmost 'undulation' through MW-9 and MW-8. These wells are shown on the cross sections A-A' and B-B' on Figures 2-4 and 2-5. As the cross sections indicate, these are subtle features in comparison to the total saturated thickness of the alluvium. The material in the 'undulations' shown on section B-B' between the LTU and the Closed Surface Impoundments is gravelly sand or sand, and the surrounding material is mapped as gravelly sand.

The following sections further detail the shallow and deep zones of the alluvial aquifer as well as the bedrock aquifer. Although the alluvial aquifer is separated in this section for the purpose of discussion, the shallow and deep alluvial aquifer zones are hydraulically connected and coexist as one aquifer across the facility except near the northern boundary of the site.

The groundwater flow velocity was estimated for the alluvium and the bedrock. Groundwater flow velocities are calculated for the shallow alluvial aquifer zone, the deep alluvial aquifer zone due to the different hydraulic conductivities of the sands and gravels.

The groundwater particle velocity equation (USGS, 1972) was used to calculate the average groundwater horizontal flow velocity. The equation is:

$$v = -K\,I / n$$

Where:

v = Average particle velocity (ft/day)

K = Hydraulic Conductivity (ft/day)

I = Hydraulic Gradient (ft/ft)

n = Effective Porosity (percentage)

2.1.10.1 Shallow Alluvial Aquifer Zone Slug Testing

Based on slug tests conducted at the refinery, shallow alluvial monitor wells MW-1 through MW-6 had hydraulic conductivities that ranged from 1.98×10^{-2} centimeters per second (cm/sec) (56 feet/day) to 1.75×10^{-1} cm/sec (496 feet/day) with an arithmetic mean of 7.55×10^{-2} cm/sec (214feet/day). Based on an average hydraulic gradient of 0.0025 feet/foot, and an average effective porosity for a sandy gravel of 0.30, the calculated average flow velocity was calculated to be 1.8 feet/day. Using the 496 feet/day hydraulic conductivity value and a maximum gradient of 0.0034 ft/ft the calculated groundwater flow velocity is 5.6 feet per day.

2.1.10.2 Deep Alluvial Aquifer Zone Slug Testing

Monitor wells MW-7 through MW-16 were completed as deep alluvial wells. The hydraulic conductivities of these wells, based on rising and falling head slug tests, ranged from 2.59×10^{-2} cm/sec (73 feet/day) to 1.71×10^{-1} cm/sec (485 feet/day). The arithmetic mean for the deep alluvial wells was calculated to be 8.65×10^{-2} cm/sec (245 feet/day). Based on an average hydraulic gradient of 0.0025 feet/foot and an average effective porosity for a sandy gravel of 0.30, the calculated average flow velocity was 2 feet/day. Using the 485 feet/day hydraulic conductivity value and a maximum gradient of 0.0034 ft/ft the calculated groundwater flow velocity is 5.5 feet per day.

2.1.10.3 Bedrock Aquifer Slug Testing

Based on slug tests, the bedrock monitor well (BR-1) had a falling head calculated hydraulic conductivity of 5.83×10^{-5} cm/sec (0.165 feet/day) and rising head calculated hydraulic conductivity of 7.05×10^{-5} cm/sec (0.2 feet/day). At the time that the short-term groundwater monitoring program (RSA, 1992) was conducted (June 5, 1990), there was a difference in head of approximately 31.3 feet between the clustered deep alluvial monitor well (MW-7, 1046.71 feet, AMSL) and the bedrock monitor well (BR-1,1015.41 feet AMSL). It was concluded (RSA, 1992) that the alluvial and bedrock aquifers were not in hydraulic communication in the vicinity of the cluster wells.

Groundwater data from July 21, 1992 show that the groundwater in bedrock monitor well BR-1 had stabilized at an elevation of 1049.37 feet, AMSL. The groundwater elevation in monitor well MW-7 on July 21, 1992 was 1047.20 feet AMSL (approximately 2.17 feet of head difference) between monitor wells BR-1 and MW-7. Groundwater within the shale in the vicinity of monitor well BR-1 is confined and is not in direct communication with groundwater in the alluvial aquifer (RSA, 1992).

2.1.10.4 Groundwater Pumping Tests

Groundwater pumping tests have been conducted at the facility by other consultants. Based on a review of available information, calculated transmissivities for the alluvial aquifer have ranged from approximately 8,000 to 120,552 gallons per day per foot (Groundwater Technology, Inc., 1988 and Engineering Enterprises Inc, 1985). Given an average saturated thickness of approximately 26 feet at the facility and the above transmissivities, hydraulic conductivities ranging from approximately 1.5×10^{-2} cm/sec to 2.2×10^{-1} cm/sec (40 feet/day to 620 feet/day) can be calculated. Testing the ICM recovery wells yielded a maximum hydraulic conductivity in the vicinity of recovery well RW-40of 620 feet per day. This range in hydraulic conductivity is very similar to the range calculated from alluvial aquifer slug tests 1.98×10^{-2} cm/sec to 1.75×10^{-1} cm/sec (56 feet/day to 496 feet/day). Calculating the groundwater flow velocity using the 620 feet/day value for hydraulic conductivity and the higher gradient of 0.0034 ft/ft with 30 percent porosity yields a groundwater flow velocity of 7 feet per day.

2.1.11 Petroleum Hydrocarbons

This section provides a discussion of the nature, extent and sources of the petroleum hydrocarbons observed in the subsurface at the facility and a conceptual model of movement of petroleum hydrocarbons in the subsurface.

Petroleum Product Storage and Release Information

Liquid petroleum hydrocarbons have been stored in above ground tanks and conveyed in buried pipelines at this facility. During the operation of the facility which began in 1908 with a bulk plant, accidental spills of product occurred. These spills while responded to by facility personnel, contributed to soil and groundwater impacts at the site. Plate 2 shows locations of pipelines and product storage tanks with respect to the regulated units. This Plate also shows the tanks and reported releases between 1983 and 1998. Petroleum hydrocarbon recovery actions were implemented in the 1930s with significant enhancements in the 1980 and additional enhancements in 1995 with the ICM system.

Plate 2 illustrates that the storage tanks between the LTU and the Closed Surface Impoundments primarily stored gasoline product, tank 125 immediately north of the LTU was used to store kerosene. Other tanks upgradient of the LTU and west of the LTU contained gasoline, diesel and crude oil. The product release data presented on Plate 2 indicates releases between the LTU and the Closed Surface Impoundments were mainly from gasoline storage tanks. Historical data from tanks west of the LTU indicate gasoline and diesel product releases occurred, and crude oil releases have been reported from Tank 120 located upgradient of the LTU.

Product pipeline corridors are located parallel to both the west and east sides of the LTU as shown on Plate 2. These pipelines are operated by Conoco Inc. and Williams Pipeline Company.

Conceptual Model of Petroleum Hydrocarbon Migration

Liquid petroleum hydrocarbon product (product) exists as a separate, immiscible phase when in contact with water and/or air. Differences in the physical and chemical properties of water and the product result in the formation of a physical interface between the liquids which prevents the two fluids from mixing. Non-aqueous phase liquids are typically classified as either light non-aqueous phase liquids (LNAPLs) which have densities less than that of water, or dense non-aqueous phase liquids (DNAPLs) which have densities greater than that of water. The petroleum hydrocarbon constituents at the facility have densities less than water and float on top of the water table and are classified as light non-aqueous phase liquids (LNAPLs). The petroleum hydrocarbon products are multicomponent organic mixtures composed of chemicals with varying degrees of water solubility. Physical and chemical properties which affect transport and fate of selected refined petroleum products are presented in Table 2-2.

Movement of the product in the subsurface is controlled by several processes. Upon release to the environment, the product will migrate downward under the force of gravity. If a small volume of product is released to the subsurface, it will move through the unsaturated zone where a fraction of the product will be retained by capillary forces as residual globules in the soil pores, thereby depleting the contiguous product mass until movement ceases. If sufficient product is released, it will migrate until it encounters a physical barrier (e.g., low permeability strata) or is affected by buoyancy forces near the water table. Once the capillary fringe is reached, the product may move laterally as a continuous, free-phase layer along the upper boundary of the water-saturated zone due to gravity and capillary forces.

Although the principal migration may be in the direction of the maximum decrease in water-table elevation, some migration may occur initially in other directions. A large continuous product phase may hydrostatically depress the capillary fringe and water table. Once the source is removed, mounded product migrates laterally, product hydrostatic pressure is removed, and the water table eventually rebounds. Infiltrating precipitation and passing groundwater in contact with residual or mobile product will dissolve the soluble hydrocarbon components and form an aqueous-phase hydrocarbon constituent plume.

Product constituents may exist in any of four phases within the subsurface: as an immiscible liquid phase, dissolved phase, gaseous phase (soil gas), in the solid phase partitioned onto the soil or aquifer material.

Total began recovering phase separated petroleum hydrocarbons floating on top of the water table 1981. In 1995, the ICM System was installed. Plate 1 illustrates the extent of the free phase petroleum hydrocarbons at the refinery in June 1999. Figure 2-9 illustrates the extent of free phase petroleum hydrocarbons in July 1992. As illustrated by Plate 1, the accumulation of petroleum hydrocarbons has shrunk significantly between 1992 and 1999.

2.1.12 Summary of Groundwater Monitoring Results 1993-1998

Groundwater samples were analyzed for the general water quality parameters chloride and total dissolved solids (TDS); volatile organic compounds (VOCs); base, neutral, and acid extractable organics (BNAs); and the metals arsenic, barium, cadmium, chromium, lead, and nickel as totals. Groundwater analytical data from the December 1998 groundwater sampling event are included in Appendix A. Dissolved constituents that exceed the permit groundwater protection standards in 1998 are listed on Table 1-2.

2.1.12.1 Groundwater Monitoring Network

Groundwater samples were collected quarterly from the eight pairs of WN series wells located around the LTU as required by the RCRA permit. Additionally, the four pairs of MW series wells located at the No. 1 and No. 2 Closed Surface Impoundments are monitored quarterly for the post closure care requirements. Four RCRA-MW series wells were added to the monitoring network in 1993, for the then interim status No. 3A Aerated Lagoon. Figure 2-10 shows the locations of the groundwater monitoring wells.

Land Treatment Unit Monitoring Wells

The LTU groundwater monitoring network consists of eight pairs of monitoring wells. The monitoring wells are, designated as WN-1A through WN-8A, and WN-1B through WN-8B. The WN-A/B monitoring well pairs are located around the perimeter of the LTU. The "WN-A" series monitoring wells are screened beneath the water table, from approximately 15 to 20 feet above bedrock, and down to near the bedrock surface. The "WN-B" series monitoring wells were installed to intersect the water table surface and are screened to a depth of approximately 10 feet below the water table. Monitoring well pair WN-1A and WN-1B is upgradient. Well pairs: WN-2A/B, WN-3A/B, WN-4A/B, WN-5A/B and WN-6A/B are located hydraulically downgradient of the LTU. Monitoring well pair WN-7A/B are considered to be located cross-gradient to the groundwater flow direction. Monitoring well pair WN-8A/B is located west of the northwest corner of the LTU. The well pair are either cross-gradient or upgradient based upon the groundwater potentiometric surface data, however, these wells have been reported to be downgradient based upon historic groundwater level information. On rare occasion, the groundwater flow direction beneath the LTU, has been observed to be due north. Typically, the groundwater flow direction is to the northeast.

No. 1 and No. 2 Closed Surface Impoundments Monitoring Wells

The closed surface impoundments monitoring wells are identified as MW-3, MW-4, MW-5, MW-6, MW-10, MW-11, MW-12 and MW-13. The downgradient wells (MW-3, 4, 5, 10, 11, and 12) of the "MW" series monitoring wells are located along the downgradient perimeter of the No.1 and No.2 Closed Surface Impoundments. Monitoring wells MW-6 and MW-13 represent upgradient monitoring locations approximately 400 feet south of the two closed impoundments.

Monitoring wells MW-3, MW-4, MW-5, and MW-6 are screened across the water table surface and are designed to monitor the upper part of the shallow aquifer, while monitoring wells MW-10, MW-11, MW-12, and MW-13 are screened to monitor the lower 10 feet of the shallow aquifer.

No. 3A Aerated Lagoon (Closed)

The No. 3A Aerated Lagoon monitoring wells are identified as RCRA-MW-1, RCRA-MW-2, RCRA-MW-3, and RCRA-MW-4. RCRA-MW-1 through RCRA-MW-3 are located downgradient of the No. 3A Aerated Lagoon, and RCRA-MW-4 is located upgradient of the lagoon. Each of these monitoring wells are screened across the water table and are designed to monitor the upper portion of the shallow aquifer.

2.1.12.2 Groundwater Quality

The groundwater monitoring network at this facility is monitored on a quarterly schedule. The groundwater quality data from the monitoring network are presented in annual groundwater monitoring reports and the Part B Permit Renewal Application (Earth Tech, EnecoTech, 1998). In December 1998, Total sampled 17 additional groundwater monitoring wells to assess the nature and extent of groundwater impacts. Eleven of the additional monitoring wells are located between the LTU and the Closed Surface Impoundments. The results of the December 1998 groundwater sampling event are included in Appendix A. The additional monitoring wells were analyzed for the Skinner List constituents. The December 1998 groundwater sampling results indicate that benzene, toluene, ethylbenzene, xylene and naphthalene are the most commonly detected constituents.

Plates 3 through 7 present contour maps for dissolved concentrations of benzene, toluene, ethylbenzene, total xylenes and naphthalene in the groundwater during December 1998, respectively. Plate 8 presents the groundwater potentiometric surface contour map for December 1998.

The December 1998 groundwater sampling analytical data presented on Plates 3 though 7 indicate elevated concentrations of dissolved petroleum hydrocarbon constituents in the groundwater west of the LTU, downgradient of the LTU and downgradient of the No. 1 and No. 2 Closed Surface Impoundments and the Closed No. 3A Aerated Lagoon. The information presented on Plate 2 indicates that the petroleum hydrocarbon releases coincide with areas of elevated dissolved constituent concentrations in the groundwater. The tank service between the LTU and the closed surface impoundments is primarily gasoline. West of the LTU the tank service is diesel and crude oil. Upgradient of the LTU the tank service is crude oil. Releases of gasoline and diesel products have contributed to the impacts observed in the groundwater. The primary organic constituents observed include benzene, ethylbenzene, toluene, xylenes and naphthalene. These constituents are relatively soluble and mobile.

The groundwater potentiometric surface contour map presented on Plate 8 was constructed with water level measurements from the December 1998 groundwater sampling event. The groundwater potentiometric surface contours indicate the groundwater flow direction is to the northeast. The saturated thickness of the alluvial aquifer is several feet above the normal high due to the previous month's flood events on the Arkansas and Walnut Rivers.

2.1.12.3 Compliance Groundwater Monitoring Wells

In November 1999, TPI installed four monitoring wells between ICM groundwater recovery wells (RW-35 through RW-80A) and the Walnut River. The purpose of these wells will be to monitor the groundwater for compliance with the groundwater protection standards following the completion of the groundwater corrective action. These wells are located between and downgradient of the ICM groundwater recovery wells. These well locations will intercept a release from the refinery if there is incomplete groundwater capture. The monitoring wells are constructed from 2-inch PVC blank casing and machine slotted (screen) casing. The top of the well screen filter pack is located below the observed seasonally low groundwater level to prevent free product from contaminating the filter material. The locations and well design were pre-approved by KDHE. The wells have been designated as CMW-1, CMW-2, CMW-3 and CMW-4. The well locations are shown on Figure 2-10.

The CMW wells were sampled in December 1999 and March 2000 to provide groundwater quality data between the recovery well system and the Walnut River. The groundwater samples were analyzed for a modified Skinner List set of constituents consisting of VOCs, SVOCs, metals and cyanide. The results of these two sampling events are presented on Tables 2-3 and 2-4 for the 1999 and 2000 sampling events respectively.

The groundwater analyses indicate the ICM groundwater system is capturing impacted groundwater on the refinery. There were no detections of VOCs or SVOCs above the laboratory PQL in any of the monitoring wells for both monitoring events.

2.2 RCRA Regulated Units

The hazardous waste management units at the Refinery consist of the Land Treatment Unit (LTU), the Closed No. 1 and No. 2 Surface Impoundments, and the Closed No. 3A Aerated Lagoon. The LTU was the original unit permitted by KDHE. The No. 1 and No. 2 Surface Impoundments and the No. 3A Aerated Lagoon are under post closure care.

2.3 Adjacent Land and Water Uses and Potential Public Receptors

Land use adjacent to the refinery is residential use to the west, while northwest and southwest of the refinery use is mixed industrial, commercial and residential. Land use to the north and northeast side of the refinery across the Walnut River is agricultural, and the land south and southeast is used for hunting.

Groundwater use in the area is restricted to public water supply wells located approximately three miles northwest of the refinery (upgradient), and rural water district supply wells located approximately one mile southwest (upgradient) of the refinery and approximately three miles east (downgradient) of the refinery.

As shown on Figure 2-11, 60 water wells and one surface water intake were identified within a three-mile radius of the facility. Total well depth, depth to groundwater, geologic source, ownership, and water use are summarized on Table 2-5. This information was acquired from the Kansas Department of Health and Environment, Bureau of Water, Public Water Supply Section and the Kansas Department of Agriculture Water Resources Division.

3.0 LAND TREATMENT UNIT (LTU) DESCRIPTION

The land treatment unit was constructed in June 1981 and has been used to treat hazardous and non-hazardous refinery wastes (Figure 3-1). The LTU is divided into two cells (plots A and B). Plot A located north of plot B is approximately 2.22 acres and plot B is approximately 1.63 acres. On September 13, 1985, TPI submitted a RCRA Part B Application for the LTU and on November 16, 1987, KDHE and USEPA issued a RCRA permit to TPI. The LTU was permitted to accept hazardous and non-hazardous refinery waste streams. Before November 8, 1990, the LTU ceased accepting hazardous waste because of the RCRA Land Disposal Regulation.

The LTU continued accepting non-hazardous waste as allowed under the delay of closure rule. The application of non-hazardous waste ceased prior to August 1, 1998. The following summarizes the operating conditions for the LTU:

- Wastes were only applied annually from April through October 1997.
- Wastes were not applied during heavy precipitation.
- Waste was applied evenly and tilled in as soon as practical to facilitate aeration.
- Soil pH was maintained between 6.5 and 8.0.
- Additional tilling and fertilization was conducted as needed to facilitate degradation of contaminants.
- Quarterly groundwater sampling was conducted pursuant to the RCRA Permit requirements for groundwater monitoring.
- Annual soil core samples have been collected and analyzed.
- Biannual Lysimeter Sampling was performed and analyzed.

The closure period for the LTU began on August 1, 1998. Notification of intent to close the LTU was submitted to KDHE November 6, 1997 (Earth Tech, 1998). Closure of the unit will be conducted in accordance with the KDHE approved closure plan (February 4, 2000). Groundwater corrective action for the LTU will commence no later than 60 days after the permit is issued.

3.1 LTU Waste Characteristics

The information presented will provide a historical overview of the wastes managed at each of the regulated units and the characteristics of each waste stream. Both of the surface impoundments have been closed in accordance with KDHE approved closure plans and certified closed.

The LTU consists of two plots designated as Plot A (north) and Plot B (south). The LTU is a land farming treatment system for biological degradation of petroleum constituents. The LTU was permitted to accept hazardous and non-hazardous refinery waste streams. Hazardous waste streams applied to the LTU include slop oil emulsion solids, heat exchanger bundle cleaning sludge, tank bottoms, API separator sludge, oily coke deposits, cooling tower sludges, and dissolved air floatation (DAF) sludge. Non-hazardous wastes managed have included activated charcoal, Bauxite, mole sieve, attapulges clay, oily contaminated soils, non-hazardous oily coke deposits, tank bottoms, oily residues from the crude oil pipeline system, and wastes derived from tank clean-out operations (Earth Tech, 1998). Since November 8, 1990, only non-hazardous waste streams have been managed at the LTU.

The characteristics of the waste streams were variable. The waste streams were characterized as required under the existing waste analysis plan. The methods of characterization included: waste sampling and laboratory analysis, process knowledge, and knowledge of the characteristics of the source materials. Waste streams were characterized on a periodic basis to determine if the characteristics had changed. Appendices D, E, and F of the RCRA Part B Permit Renewal (Earth Tech & EnecoTech 1999) contain representative waste characterization information for waste streams managed at the LTU.

Estimated annual quantities for each of these wastes in addition to other miscellaneous wastes applied to the LTU are identified in Table 3-1. This table summarizes the quantities of waste applied to the LTU for the period from 1990 to 1997.

4.0 WASTE MANAGEMENT AREA CORRECTIVE ACTION ALTERNATIVE ANALYSIS AND SELECTION SUMMARY

This section of the report is divided into three parts. The first presents the analysis of corrective action alternatives used in the selection of the corrective action at the Walnut River downgradient of the WMA, the second part discusses additional corrective action technologies for the LTU, and the third part presents a summary of the selected technology or technologies.

As described in the previous sections, the contamination occurs as dissolved hydrocarbon constituents in groundwater and a free non-aqueous phase hydrocarbon layer on top of the water table. In addition, the natural groundwater table fluctuations have created a hydrocarbon smear zone that provides a leachable source of petroleum hydrocarbons to the groundwater. The alternatives analysis includes analysis of location and technology. The corrective action must provide for control at the downgradient edge of the WMA and address impacts downgradient of the LTU.

4.1 Downgradient Waste Management Area Corrective Action Alternative Analysis

In 1994, TPI performed an evaluation of ICM alternatives to stop offsite migration of free phase petroleum hydrocarbons on top of the water table and to minimize offsite migration of petroleum hydrocarbon constituents dissolved in the groundwater. This previous evaluation considered the entire downgradient property boundary of the facility that is adjacent to the Walnut River. The discussion presented in this section incorporates information from this ICM evaluation (EnecoTech, 1994) as it relates to the downgradient edge of the WMA. In the ICM evaluation report (EnecoTech, 1994) this area is identified as Zone 4.

The ICM alternative analysis report addressed five zones based upon hydrogeologic characteristics at the downgradient boundary of the facility. As part of this EFP an alternative analysis summary and selection interim corrective measure (ICM) for the portion of the facility associated with Zone 4 is presented.

This alternative analysis study selected the existing recovery wells RW-40, RW-50, RW-60, RW-70 and RW-80A for the groundwater containment and recovery. The facility's existing tank based water treatment system was selected as the best alternative to treat the recovered groundwater (EnecoTech, 1994).

The previous alternative analysis for the ICM System is directly applicable to the groundwater corrective action for the WMA. The use of existing ICM groundwater recovery system for the containment, recovery and treatment of the impacted groundwater in the WMA is appropriate since:

1. The ICM is operational thus already containing and treating contaminated groundwater;
2. The type of chemicals of concern and their relative concentrations between the LTU and the ICM system are the same;
3. The ICM recovery wells will intercept and capture the constituents found in the groundwater detected in the monitoring wells downgradient of the LTU; and,
4. The hydrogeologic conditions between the LTU and the location of the ICM system are similar.

The remainder of Section 4.1 provides the assessment of four groundwater containment alternatives and three groundwater treatment alternatives.

4.1.1 Groundwater Corrective Action Alternatives Analysis

Various groundwater control and containment and treatment technologies were considered as alternatives with the most viable and cost-effective selected for further detailed consideration. The alternatives were developed after reviewing previously collected site data and studies provided to EnecoTech by TPI and with consideration for restrictions imposed by the USACE river and levee activities.

Selected control and containment alternatives to prevent offsite migration of free phase and dissolved contaminants included subsurface barriers and groundwater and free phase recovery operations. The four ICM alternatives, which are detailed below, include:

- Alternative 1: Groundwater Hydraulic Barrier
- Alternative 2: Fully Penetrating Physical Barrier With Groundwater Extraction
- Alternative 3: Partially Penetrating Physical Barrier/Shallow Groundwater Recovery
- Alternative 4: Air Sparging Barrier

4.1.1.1 Alternative 1: Groundwater Hydraulic Barrier

The potential for offsite transport of impacted groundwater and free phase hydrocarbons can be significantly reduced with the creation of a groundwater hydraulic barrier. A groundwater hydraulic barrier can be created by inducing a gradient reversal at the bank of the Walnut River. The gradient or hydraulic control can be of sufficient magnitude to either halt the offsite migration of free product with capture of some impacted groundwater, or of greater magnitude to halt offsite migration of free product and intercept impacted groundwater for treatment. A line of recovery wells, aligned parallel to the Walnut River, can be installed and pumped at a rate sufficient to capture all groundwater approaching from the south, and induced recharge from the Walnut River. In the groundwater flow modeling (EnecoTech, 1994) four recovery wells were simulated in Zone 4 downgradient of the LTU at the Walnut River.

The advantages of this option include:

- Relatively easy installation. This alternative can readily be adapted to accommodate existing refinery structures and the proposed levee;
- Maximizes ability to incorporate existing product recovery and well system;
- Low capital and O&M cost relative to other options since recovery wells already exist;
- Routine verification of system performance could be achieved by monitoring the hydraulic gradient and flow direction; and,
- System performance is relatively unaffected by fluctuations in river stage.

The disadvantage of this option include:

- Requires a high rate of groundwater pumping, groundwater treatment and associated operational costs because of recharge from the Walnut River.

4.1.1.2 Alternative 2: Fully Penetrating Physical Barrier With Groundwater Extraction

This alternative proposes the use of a fully penetrating physical barrier (slurry wall, impermeable membrane, or sheetpile) parallel to the bank of the Walnut River to prevent offsite migration of impacted groundwater and free phase hydrocarbons. At Zone 4, five fully penetrating recovery wells were simulated at a location up-gradient of the physical barrier to capture essentially all groundwater flowing beneath the LTU and toward the Walnut River.

Shallow sumps for recovery of hydrocarbons accumulated next to the barrier would be installed on the south side of the barrier. The advantages of this option include:

- Reduces the required rate of groundwater extraction and treatment compared to Alternative 1 because it reduces pumping groundwater from the Walnut River;
- The fully penetrating subsurface barrier would prevent offsite transport of dissolved and free phase contaminants as long as the groundwater flow direction remains constant, and provide short term protection in case of well or treatment system shutdowns;
- Lower O&M cost from reduced pumping,
- Relatively unaffected by fluctuations in river stage; and
- Reduces pumping of groundwater from the river.

The disadvantages of this option include:

- Will require operation of the recovery wells as long as the barrier is present to prevent groundwater flow around the ends of the barrier;
- The water table would rise by several feet if the pumping system were shutdown resulting in increased thickness of the smear zone, potentially impacting clean soils;
- Would interfere with USACE proposed levee improvements;
- Extremely high capital cost to install and eventually remove; and,
- Hydrocarbons accumulated between the barrier and the river will not be recovered.

4.1.1.3 Alternative 3: Partially Penetrating Physical Barrier/Shallow Groundwater Recovery

Alternative 3 would consist of a partially penetrating barrier (slurry wall, impermeable membrane, or sheetpile) with free phase hydrocarbon and shallow groundwater recovery from five wells in Zone 4. This alternative would concentrate on "skimming" the free phase hydrocarbons and capturing the impacted groundwater in the upper portion of the aquifer. This approach would allow the relatively clean water at the base of the aquifer to continue to flow offsite.

If impacts are subsequently detected in the lower portion of the aquifer after the measure is in place, the system can be modified by addition of an in-situ air sparging system down-gradient of the barrier or the installation of fully penetrating recovery wells installed down to bedrock.

For this alternative, a partially penetrating barrier would be installed to a depth of approximately five to ten feet below the lowest groundwater level to intercept floating hydrocarbons and decreasing induced recharge from the Walnut River. Five shallow (partially penetrating) recovery wells would be installed in a line along the south side of the barrier with the screened interval from above the high water table elevation to approximately ten feet below the low water level. Pumping rates and screened depths would vary locally according to the depth of contamination and degree of stratification in the aquifer at a particular location.

Shallow sumps would be installed on the south side of the barrier to permit recovery of floating hydrocarbon accumulations.

The advantage of this option include:

- The partially penetrating barrier would prevent offsite migration of floating free phase hydrocarbons, even if the recovery wells or treatment are temporarily shut down.

The disadvantages of this option include:

- Requires a high rate of groundwater pumping, groundwater treatment and associated operational costs because of recharge from the Walnut River.
- More difficult to verify effectiveness, because this alternative allows presumably non-impacted water in the lower portion of the aquifer to flow offsite;
- Difficult to install adjacent to Walnut River because of surface facilities;
- Would interfere with USACE proposed levee improvements;
- Will be affected by fluctuations in river stage; and,
- Hydrocarbons between the barrier and the river will not be recovered.

4.1.1.4 Alternative 4: Air Sparging Barrier

Air sparging is an effective approach to free otherwise stagnated impacts from the groundwater/soil interface and thus increase the removal rate of impacts. When the air sparging points are located sufficiently close, an effective air sparging barrier, perpendicular to groundwater flow, can be formed.

In the air sparging process, air is injected under pressure below the water table. The air bubbles traverse horizontally and vertically through the soil medium, creating transient air filled regimes in the saturated zone. At the same time, the groundwater, made less dense with saturated air bubbles, will rise slightly above the static water level producing a gradient away from the sparging point. This small gradient can be effective, under the proper circumstances, in containing relatively thin layers of free product. In addition, volatile compounds exposed to this sparged air environment volatilize into the gas phase and are carried by the air movement into the vadose zone, where they can be captured by a venting system. Combining air sparging and venting is an effective means of treating volatile organic compounds both above and below the water table. Furthermore, air sparging and soil venting have been proven to promote biological degradation of petroleum hydrocarbons.

This option involves installing air-sparging wells along the levee that would act both as a barrier, as described above, but also provide treatment for impacted groundwater before leaving the site. This barrier would consist of a series of sparge wells placed along the river side of the levee wall. The air sparge system would act to strip volatile hydrocarbons from the groundwater migrating through the sparge barrier and act as a backup measure for the groundwater treatment if a recovery well failed. For this evaluation, sparging wells placed on 30 foot centers are considered to provide adequate coverage.

The advantage of this option include:

- Requires virtually no groundwater pumping and treatment.

The disadvantages of this option include:

- May push dissolved contaminants off-site;
- Difficult to monitor the effectiveness of groundwater mounding;
- Sparging may not be uniform due to preferential flow;
- Difficult to install adjacent to Walnut River because of surface facilities;
- Will not contain thick levels of free product in soil;
- Eventual remediation of accumulated hydrocarbons on the south side of the air sparging barrier may be difficult; and,
- May not be consistent with the USACE levee improvement design criteria.

4.1.2 Groundwater Treatment Alternatives

This section discusses treatment alternatives for the recovered groundwater. Several technologies for groundwater treatment were evaluated based upon specific site conditions, technology limitations, chemical characteristics, capital and annual costs, and compatibility with project goals and flexibility to fit with final corrective measures at the site. The options listed below include both above ground and in-situ treatment:

- Physical treatment (air stripping) with off gas treatment;
- Biological treatment; and,
- Air sparging (in-situ treatment).

These options could be implemented singly or in an appropriate combination and used to treat the groundwater contained or recovered during implementation of one alternative previously described. Based on initial evaluations and currently available data, these treatment methodologies are discussed in detail below:

4.1.2.1 Physical/Off Gas Treatment

A physical treatment system consists of a packed column air stripping tower to remove the volatile organic compounds from the recovered groundwater. A pretreatment system to remove iron may be necessary since clogging of the air stripping tower packed media can reduce removal efficiency and even stop water flow. An iron removal system would consist of an oxidation tank followed by an up-flow, continuous cleaning sand filter, backwash settling basin. The effluent from the sand filter would be directed into the top of the air stripping tower. Bromide injection before the iron oxidation tank may be required to control biological growth in the system. Iron sludge generated by the oxidation process would require removal and disposal.

Depending upon the limits and conditions of the final discharge permit, it may be necessary to polish air-stripper effluent using activated carbon to remove less volatile organic constituents. In addition, off-gas treatment of the stripped vapors may be required. Off-gas treatment options include:

- Activated carbon;
- Using an internal combustion engine technique; and,
- Using a small incinerator.

The potential advantages associated with the physical/off gas treatment system include:

- Lower initial capital costs;
- More established technology that has been successfully used for many similar applications; and,
- System operation is more straightforward and should not require specialized training for operators.

The potential disadvantages associated with the physical treatment system include:

- Pretreatment for iron removal may be required;
- Off gas treatment may be required;
- Higher operating and maintenance costs associated with mechanical equipment, controls, and instrumentation;
- Polishing air stripper effluent may be necessary prior to discharge;
- Cost for disposal of iron sludge generated by oxidation process; and,
- Potential for scaling in packed tower, will reduce removal efficiency.

4.1.2.2 Biological Treatment

Biological treatment breaks down and destroys the compounds of concern rather than physically transferring them to another medium as with other treatment technologies. A biological treatment system would consist of an attached growth bioreactor followed by a clarification process. The bioreactor contains submerged, fixed film media and is configured for multiple stage treatment.

Requirements for an equalization tank before the bioreactor may be needed to respond to fluctuations in quality and quantity in influent groundwater.

The potential advantages associated with biological treatment include:

- Minimal off-gas is produced, lowering emissions and potentially eliminating the need for off-gas treatment;
- A biological system already exists at the facility that will require no additional capital to retrofit for groundwater treatment;

- Biological treatment breaks down the compounds of concern that would otherwise be transferred to another medium (i.e., carbon) and require disposal;
- The minimal nutrients required by the biomass could be injected on a continual basis, offsetting most minor changes in operating conditions; and,
- Minimal operation and maintenance is required for a properly running bioreactor.

The potential disadvantages associated with biological treatment include:

- Partial or total destruction of the biomass can occur if a highly concentrated slug enters the biological reactor or if the influent water chemistry fluctuates greatly. This would require reseeding of the bioreactor;
- Monitoring of the influent water characteristics may be necessary to maintain normal operation; and
- A more highly trained operating staff is required and the system requires more continuous supervision and monitoring.

4.1.2.3 Air Sparging

As previously described, this option involves installing new air-sparging wells along the levee that would not only act as a barrier to plume migration, as described above, but also provide treatment for lesser impacted groundwater before leaving the site. This barrier would consist of a series of sparge wells placed along the river side of the levee wall. The air sparge system would act to strip volatile hydrocarbons from the groundwater migrating through the sparge barrier and act as a backup measure for the groundwater treatment if a recovery well failed. For this evaluation, sparging wells placed on 30 foot centers have been assumed to provide adequate coverage.

The final selection and design of the groundwater treatment system will be influenced by results of groundwater quality data, permitting requirements, the method of control and containment selected, and additional parameters defined in the selection process described below.

4.1.3 U.S Army Corps of Engineers Impacts

The USACE plans to extensively modify the levee adjacent to the Walnut River. These plans could potentially impact the installation of the physical barrier system, both fully and partially penetrating types, an air sparging barrier and treatment system and any control systems that require placement of physical facilities into the planned "footprint" of the USACE levee improvement plans. Any facilities placed within this zone will eventually be disrupted by USACE activities and may require placement behind the levee system further from the river.

4.2 LTU Corrective Action Analysis

The corrective action alternatives described above address containment and treatment of impacted groundwater at the downgradient edge of the WMA and the facility property boundary. It does not address impacts at the downgradient edge of the LTU. The impacts observed in the groundwater downgradient of the LTU indicates a need for additional corrective action at the LTU. This section identifies the additional corrective action alternative for the LTU groundwater impacts.

As discussed previously, groundwater trigger values have been exceeded in monitoring wells at the northwest, north and northeast sides of the LTU as shown on Table 1-2. Free phase petroleum hydrocarbons have been detected in monitoring well WN-8B at the northwest corner of the LTU. Elevated concentrations of dissolved BTEX and naphthalene have been detected in the groundwater at monitoring wells WN-7B and WN-8B at the northwest corner of the LTU as illustrated on Plates 3 through 7.

Borehole lithologic logs for these monitoring wells describe encountering stained soils and soils that produce hydrocarbon odor. Organic vapor analyzers used during the monitoring well borehole drilling detected vapors at concentrations of 100 to 180 part per million in the soils near the water table. Figure 4-1 presents a geologic cross-section along a portion of the LTU from the WN-7A/B well nest north along the edge of the LTU to WN-7A/B. This cross-section shows the lithology observed in the boreholes, range in groundwater level fluctuation, and the contact between the shallow clay alluvial deposit and the deeper sand and gravel deposits.

The water table fluctuates across a seven-foot interval in the sand and gravel alluvial deposits at the LTU. The lithology is fairly uniform across the area. Figure 4-1 also shows the maximum groundwater level that was observed following the flood in November 1998.

The objective of the corrective action at the LTU is to treat impacted groundwater flowing beneath the unit and demonstrate the corrective action is working at the point of compliance. The point of compliance will be at the downgradient edge of the LTU. A discussion of the point of compliance is presented in Section 6 of this document.

To achieve the objective stated above, the groundwater must be treated at the LTU and the source of the contamination should be removed. The source for the groundwater impacts consists of the free phase petroleum hydrocarbons floating on top of the water table, and occurring as residual contamination and vapors in the unsaturated zone above the water table. A source for the free product impacts observed at the northwest corner of the LTU was recently discovered. In-ground concrete sumps, possibly used to separate oil and water were discovered north of monitoring wells WN-8A/B. These sumps possibly date back to the early 1930s. TPI has been inspecting these sumps and during these inspections, water with a product sheen was encountered at the bottom. These sumps appear to be the source for the free product observed in monitoring well WN-8B.

The corrective action for the LTU has been considered with respect to the constituents of concern, the media in which they exist and available technologies. A groundwater hydraulic barrier containment system is in operation downgradient of the LTU, along the facility property boundary, by the Walnut River.

The groundwater impacts at the LTU are indicated by the results of groundwater sampling. However, the impacts exist in the groundwater and the unsaturated soils above the water table. Solely pumping the impacted groundwater will take many years to remove the hydrocarbons from the soils. A technology that treats the groundwater and the unsaturated soil will be the technology of choice.

In-situ treatment of the soils and groundwater in place can be accomplished using a combination of soil vapor extraction and air sparging (SVE-AS). These technologies while once considered innovative technologies by the USEPA, are now considered established technologies. Used in permeable soils, the SVE-AS technology has been used successfully to remediate petroleum hydrocarbon impacts at numerous sites across the United States, both cost-effectively and relatively quickly. Significant reductions in petroleum hydrocarbon contaminant concentrations have been observed in as short a time as 18 months.

SVE-AS systems will have to be monitored closely and operated for a sufficient time to avoid groundwater constituent concentrations from rebounding after the system is shut down.

The SVE technology can affect removal of thin layers of free phase petroleum hydrocarbons. This technology appears to be sufficient to address the free phase present near the northeast corner of the LTU. Conventional product recovery using skimming pumps are also available, however, these systems require a great deal of oversight and adjustment.

SVE-AS Technology Description

A soil vapor extraction-air sparging system consists of a network of air injection ("sparging") wells installed into the saturated zone and a network of vapor extraction wells ("vent") installed into the vadose (unsaturated zone). The sparge and vent wells are spaced with overlapping zones of influence. With air sparging, VOCs and some SVOCs dissolved in the groundwater and sorbed on the soil partition into the advective gaseous phase, effectively simulating an in-situ, saturated zone air stripping system. The stripped constituents are transported in the gaseous phase to the unsaturated zone, within the radius of influence of the SVE system. The constituents are drawn through the unsaturated zone to the vent wells, removed, and treated as necessary. Pulsed operation of the sparge wells improves performance by mixing the groundwater. Similarly, contaminants in the unsaturated zone occurring in the vapor phase, liquid phase and adsorbed phase are removed by mass transfer and drawn to the vent wells, removed and treated. During later stages of remediation, contaminant removal is more a result of biodegradation of less volatile, more strongly adsorbed contaminants.

If vapor treatment is required, the vent wells will be connected to an above ground treatment system. Vapor treatment is required more frequently in the initial stages of the remediation while the vapor phase in the unsaturated zone is treated. Air emissions may be controlled within regulatory limits by adjusting the rate of air injection and extraction.

The advantage of this option include:

- Works best in homogeneous permeable soils;
- Demonstrated success with remediation of petroleum hydrocarbons;
- Air sparging treats contamination in the capillary fringe (smear zone);
- Low operation and maintenance requirements;

- Does not require groundwater extraction and surface treatment;

The disadvantages of this option include:

- Does not work well in fine grained, low permeability soils;
- Low permeability soils (clay) above at the water table will prevent volatilized vapors migrating from the groundwater to be effectively captured by the vent wells;
- Depths to groundwater less than five feet below ground surface or where the saturated thickness is small may require a prohibitive number of wells to ensure full coverage of the area of concern;
- Careful design/control of the system is necessary to prevent off-site vapor migration;
- Iron precipitation may cause aquifer clogging or plugging.

4.3 Summary of Preliminary Analysis Selection and Corrective Action Recommendation

Based on the discussions given above it is apparent that the most viable boundary containment and groundwater treatment alternative is the use of the groundwater barrier for groundwater containment and recovery and biological degradation for groundwater treatment. The SVE-AS technology will be used at the LTU with focussed free product recovery as necessary. As a contingency for the occurrence of free phase product in monitoring well WN-8B, a product recovery system will be installed in the vicinity of the recently discovered sumps at the LTU, if it is determined that the SVE component of the corrective action technology is not sufficient to remove the product layer.

The ICM alternative chosen is to use the five existing wells (RW-40, RW-50, RW-60, RW-70 and RW-80A) to intercept groundwater downgradient of the LTU. The combined pumping rate of the five wells is predicted to be approximately 700-800 gallons per minute. The recommended pumping rate will produce a groundwater gradient reversal back from the river. The bioreactor treatment system already exists at the facility and is suitable to treat the collected groundwater providing compliance with the NPDES permit. Recovered PSH will be transferred and contained in a separate holding tank (tank 7132) and removed for recycling.

At the LTU, an SVE-AS system will be installed to treat dissolved and adsorbed phase constituents in the groundwater, and vapor phase, adsorbed phase, and liquid phase constituents in the unsaturated zone soils above the groundwater. The air sparge component of the system will provide an air sparge curtain that groundwater must flow through. The air injected into the groundwater will flow downgradient with the groundwater promoting biodegradation in the groundwater downgradient of the LTU.

5.0 ENGINEERING FEASIBILITY ANALYSIS

The purpose of this section is twofold. First to review the actual design and operation of the enhanced ICM System and to assess if this system can contain, recover and treat the contaminated groundwater plume from the WMA and, secondly, to provide a conceptual design for the SVE-AS corrective action at the LTU.

5.1 WMA ICM System

The existing ICM System represents a corrective action measure to control the groundwater within the WMA that will be protective of public health and environment. Contaminant source identification and remediation are the essential components in improving the groundwater quality in the WMA. Source control associated with the LTU area is addressed in the closure plan submitted with the RCRA Part B Permit Renewal (Earth Tech, 1998) and within this section of this document. The solid waste management units, which include areas near the LTU and the ICM system, will be addressed in the Phase II RCRA Facility Investigation (RFI). The Phase II RFI report was submitted to the USEPA on June 5, 2000.

TPI implemented an extensive groundwater investigation in December 1998. The groundwater investigation involved collection of groundwater samples from 16 additional monitoring wells while the routine (28 monitoring wells) quarterly groundwater sampling occurred. Forty-four monitoring wells were sampled in December 1998. Nine of the additional wells sampled are downgradient of the LTU, between the LTU and the closed surface impoundments. One of the additional monitoring (well number 72) wells was upgradient of monitoring wells WN-7A/B and WN-8A/B. Monitoring well RCRA-4 downgradient of the LTU and near the Walnut River downstream of the NPDES outfall was also sampled. The remaining wells are west and north of the LTU area. The location of the monitoring wells and the results of selected compounds are presented on Plates 3 through 7. The results of the groundwater analyses are included in Appendix A. The groundwater potentiometric surface contour map for December 1998 is presented on Plate 8. Plate 8 also illustrates the extent of phase separated hydrocarbons floating on top of the water table. Plate 1 also illustrates the extent of phase separated hydrocarbons floating on top of the water table during June 1999 along with the groundwater potentiometric surface contours.

Plate 2 presents the locations of pipelines and reported releases between 1983 and 1998. The location of reported releases on Plate 2 coincide with elevated concentrations of BTEX and naphthalene in the groundwater and are considered contributing sources for the groundwater impacts observed between the LTU and the closed surface impoundments. TPI recently discovered an additional source area at the northwest corner of the LTU; in-ground sumps possibly dating from the 1930s were discovered. These sumps contain sediment and upon investigation it was discovered that there was water in the bottom of the sumps with a light hydrocarbon sheen. These sumps are considered a potential source for the elevated concentrations of dissolved petroleum hydrocarbon constituents in monitoring well WN-8B and the occurrence of phase separated hydrocarbons in this well. These sumps have been added to the RFI and are identified as SWMU 53. The Phase II RFI soil sampling was conducted during September and October 1999. Each tank west of the LTU was also the subject of shallow soil sampling for TPH and lead analyses during the Phase II RFI.

5.1.1 ICM Design and Operation Assessment

The focus of this assessment will be on the ICM recovery wells, RW-40, RW-50, RW-60, RW-70 and RW-80A. These five recovery wells will be identified as the WMA ICM wells in this assessment. These recovery wells are adjacent to the property boundary, downgradient of the WMA. It will be shown that the recovery wells will intercept impacted groundwater that flows beneath the WMA. This section discusses the critical components of the groundwater recovery well system including the design, operation and maintenance of the containment, recovery and treatment processes. A general discussion about the system components is provided followed by an assessment. This assessment evaluates the WMA ICM System's ability to capture and treat the groundwater flowing beneath the WMA. Many factors used for engineering assessment are referenced from USEPA guidance documents such as RCRA Corrective Action Plan (USEPA, 1994) and General Methods for Remedial Operations Performance Evaluations (USEPA, 1992).

The components that will be discussed in this engineering feasibility section are as follows:

- General Description of the ICM System
- Groundwater Recovery System
- Modflow Computer Modeling
- Groundwater Containment
- Groundwater Treatment System

- ICM Performance Monitoring
- Operation and Maintenance Program

5.1.1.1 General Description of the ICM System

The ICM System was constructed and initially operated in 1995 to address groundwater contamination resulting from the releases of petroleum products at the refinery. The contaminants of concern include phase separated hydrocarbons (i.e., free-floating product) and elevated concentrations of benzene, toluene, ethylbenzene, xylene, and naphthalene dissolved in the groundwater. These chemical constituents are also found in the groundwater downgradient of the LTU (see Section 3). The ICM system was originally developed to prevent phase separated hydrocarbons (PSH) on the groundwater from migrating beyond the boundary of the facility and the recovery and treatment of impacted groundwater.

Figures 5-1a and 5-1b illustrate the general layout of the ICM System. The five original WMA ICM groundwater recovery wells (RW-40, RW-50, RW-60, RW-70 and RW-80A) are constructed to fully penetrate the alluvial aquifer. That is, the top of the screened interval extends above the water table and the bottom of the screened interval is at the top of the bedrock. The screened intervals in recovery wells RW-40 and RW-50 contain a blank section that was placed adjacent to a clay zone in the alluvium. This clay zone does not transmit groundwater due to the low hydraulic conductivity estimated to be 10^{-6} cm/sec. The clay zone was cased off as a precaution to prevent the clay from potentially entering the well and impeding the performance of the pump. Recovery wells RW-40, -50, -60 and -70 are constructed from 8-inch diameter steel casing with stainless steel screen. Recovery well RW-80A is constructed from 10-inch diameter steel casing with galvanized steel screen. In December, 2000, a sixth recovery well, RW-35 was constructed to enhance the capture of groundwater at the downgradient boundary of the WMA. This well is constructed from 10 inch diameter casing and well screen. The well screen fully penetrates the alluvial aquifer.

The submersible pumps within these recovery wells operate between 50 and 260 gpm. The groundwater recovery system collects both the dissolved constituents and the phase separated hydrocarbons (PSH) by submersible well pumps and product recovery pumps, respectively. Underground conveyance piping exists for both the collected PSH and the groundwater containing the dissolved phase. The recovered groundwater is pumped from the wells into bioreactor tank R-7101, one of two bioreactor tanks (Tank

#R-7101 and Tank #R-7102) for treatment. The recovered PSH is pumped to Tank 7132. Tank 7131 was used to contain recovered groundwater before the bioreactor treatment system was constructed. The tank is still connected to the treatment system in case the storage capacity is needed, however, it is isolated from the system with valves during normal operation. The collected PSH is collected on a periodic basis by the facility and recycled. After treatment in the bioreactor system, the effluent gravity flows to the oxidation pond system for aeration and further treatment and then discharged through a permitted NPDES discharge point before entering the Walnut River.

5.1.1.2 Groundwater Recovery System

As discussed above, there are five LTU ICM groundwater recovery wells (RW-40, RW-50, RW-60, RW-70 and RW-80A) at the eastern portion of the facility to capture and recover impacted groundwater. These wells were constructed in 1995 (RW-80A was constructed in 1998) to prevent PSH from migrating beyond the facility and into the Walnut River. Figures 5-2 through 5-6 illustrate the recovery well construction details for recovery wells RW-40, RW-50, RW-60, RW-70 and RW-80A. In December, 2000, a sixth recovery well, RW-35 was constructed to enhance the capture of groundwater at the downgradient boundary of the WMA. The well construction diagram for RW-35 is presented on Figure 6-1-1. This well is constructed from 10 inch diameter casing and well screen. The well screen fully penetrates the alluvial aquifer.

Recovery wells RW-40 and RW-50 have two screened intervals separated by a short length of blank casing to prevent fine grained sediments from entering the well and interfering with the operation of the submersible pump. Recovery wells RW-35, RW-60, RW-70 and RW-80A are screened across the entire saturated interval. Installing screen above the water table allows the collection of both PSH and dissolved constituent fractions.

Both dissolved constituents and PSH are collected by the groundwater recovery system. Product recovery pumps are installed in WMA ICM recovery wells RW-35, RW-40, RW-50, and RW-80A. The collected PSH is pumped to TK-7132 and recycled. The impacted groundwater is recovered using electric submersible pumps at an operational flow rate between 50-260 gpm per pump. The water treatment process flow diagram is provided on Figure 5-7 (TPI, 1997).

The groundwater recovery well locations are shown in Figures 5-1a and 5-1b. The well spacing are based upon the results of groundwater flow simulations using a 2-D finite element groundwater flow model. A detailed discussion of this modeling is presented in Appendix A of the Interim Corrective Measures Report (EnecoTech, 1994). The placement of the ICM wells involved the evaluation of the groundwater gradient and direction of groundwater flow, proximity of buildings, overhead and underground utilities, roads, access and the flood control levee.

Conveyance piping used for the collected groundwater is 6- inch HPDE piping going from the well heads to the bioreactor tanks. The piping is buried to a depth of three feet that is protective of freezing conditions (frost depth is approximately 18 inches). Flow meters are placed at each recovery wells and the influent to the bioreactor tank to determine groundwater flow rates and to assess and manage the system operation. Figure 5-8 shows the groundwater recovery process flow diagram. Figure 5-9 shows typical well head construction details for recovery wells RW-35, RW-40, RW-50, RW-60, RW-70 and RW-80A.

5.1.2 Groundwater Recovery System Assessment

There are two major elements to the design of the groundwater recovery system. First, the location of the wells, including well spacing and second, the pumping rate. The well location criterion is the wells must be able to intercept all of the groundwater flowing beneath the LTU. A flow net can be constructed to demonstrate the ability of the LTU ICM system to intercept the groundwater flowing beneath the LTU. A flow net consists of groundwater equipotential lines (potentiometric surface contours) and flowlines. The flowlines are perpendicular to the equipotential lines. Construction of flowlines from the northwest and southeast corners of the LTU on the June 1999 groundwater potentiometric surface contour map (Plate 1) indicates the groundwater between the flow lines is intercepted between recovery wells RW-50 and RW-70. Constructing flowlines in reverse from recovery wells RW-40 and RW-80A indicates an upgradient capture zone approximately three times the width of the groundwater zone beneath the LTU. This information is illustrated with the results of the groundwater modeling discussed in Section 5.3.

The second criterion is the ability of the system to pump the necessary amount of groundwater to capture the groundwater flowing from beneath the LTU. Recovery wells RW-40 through RW-80A are capable of pumping an average of approximately 800 gallons per minute. Groundwater flow from beneath the LTU toward the recovery well system can be calculated using the Darcy flow equation as follows:

$$Q = -KAI$$

Where: Q = bulk groundwater flow rate

K = hydraulic conductivity

A = cross section area of the aquifer

I = hydraulic gradient

Using the June 1999 groundwater potentiometric surface contour map, the hydraulic gradient measured from upgradient of the LTU to the upgradient edge of the No. 3B Aerated Lagoon is calculated to be 0.003 ft/ft. The cross section area of the aquifer between the northwest and southeast corners of the LTU is the 750-foot length of the cross section, times the 31-foot saturated thickness of the cross section or 23,250 ft^2. Using a conservative hydraulic conductivity of 620 ft/day, the flow through the cross sectional area is calculated at 224 gpm. The Darcy flow across the entire upgradient capture zone of recovery wells RW-40 through RW-80A is calculated to be 550 gpm. With an average pumping rate of approximately 800 gpm, the groundwater recovery system (RW-40 to RW-80A) is pumping 500 gpm from the refinery and 300 gpm from groundwater on the river side of the recovery wells.

The combined pumping from the five LTU ICM recovery wells will create a groundwater capture zone between the recovery wells that will extend to a stagnation zone between the recovery wells and the Walnut River. The size of the stagnation zone is a function of the groundwater hydraulic gradient. As the hydraulic gradient approaches 0 ft/ft the size of the capture zone approaches the cone of depression of the pumping well. Short-term pumping tests conducted in April 2000 demonstrate the radius of influence of the recovery wells extends beyond the compliance monitoring wells toward the Walnut River and beyond adjacent recovery wells. The groundwater capture zone is demonstrated by constructing groundwater flow lines perpendicular to the groundwater potentiometric surface equipotentials. The constructed groundwater flow lines describe groundwater flow from the upgradient contributing source area captured by the recovery wells.

The construction of the LTU ICM recovery wells and the associated conveyance system is adequate to contain the groundwater flowing beneath the LTU. The depth of the recovery wells and the screened intervals are adequate to capture the dissolved constituents in the alluvial aquifer. The use of both the product and groundwater pumps within each recovery well is a proven approach for the groundwater stabilization. The LTU area groundwater does not contain any constituents that would damage or cause an incompatibility problem to the well casings, pumps or the conveyance system piping.

5.1.3 Modflow Computer Modeling of Existing ICM System

Groundwater flow in response to the operation of the existing ICM system was simulated using Visual

Modflow version 2.61 as part of the "Groundwater Review and Preliminary Evaluation of the Existing Interim Corrective Measure System" (EnecoTech Inc., March 13, 1998). Since that report was completed, ICM recovery wells RW-40, RW-50, RW-60 and RW-70, have been upgraded, and a new recovery well was installed adjacent to RW-80. The new recovery well replaces RW-80 and it is designated as RW-80A. The upgrades to the ICM well enable a substantial increase in the pumping rates. The LTU ICM recovery system pumps approximately 600 to 800 gpm. The piezometer installation described in the March 13, 1998 evaluation report was implemented in April 1998 near the Oxidation Ponds and the LTU ICM recovery wells. Groundwater levels in the piezometers installed around the oxidation ponds are monitored monthly with the other monitoring wells and used to construct groundwater potentiometric surface contour maps. These maps are used to measure the groundwater gradient and thickness of the alluvial aquifer.

5.1.3.1 Model Input

The model grid is oriented SW-NE, extending roughly from the (upgradient) Arkansas River to the (downgradient) Walnut River. Both of the rivers are treated as constant head boundaries. The other two sides of the model domain are parallel to the direction of groundwater flow, and are modeled as no-flow boundaries. The aquifer is modeled as a single layer with a saturated thickness of 38 feet at the upgradient edge of the model to 28 feet at the downgradient edge of the model, and a uniform hydraulic conductivity of 620 ft/day. These input values are considered conservative and the saturated thickness values used exceed field measurements. Groundwater level measurements indicate the thickness of the alluvial aquifer in the upgradient model area is about approximately 30 feet. The hydraulic conductivity of the alluvial aquifer ranges between 40 ft/day and 620 ft/day. The 620 ft/day hydraulic conductivity used in the modeling is representative of unconsolidated deposits of sand and gravel.

In the vicinity of the recovery wells, the grid cells are 20 by 20 feet. In the upgradient portion of the model, the grid cells are 20 by 100 feet. The modeled hydraulic gradient is 0.0034 ft/ft. Pumping rates for RW-10 through RW-80A represent achievable pumping rates. The pumping rates are included on Figure 5-10. The model was run at steady state.

Data from the additional piezometers installed to monitor groundwater levels next to the Oxidation Ponds and the 3B Aeration Lagoon do not support the assumption of significant recharge from these sources. Therefore, recharge from these ponds was set to zero.

5.1.3.2 Model Results and Assessment

The groundwater modeling results indicate complete capture of the groundwater flowing beneath the LTU and downgradient of the closed surface impoundments, as illustrated with the flowlines on Figure 5-10. The combined groundwater pumping rate for recovery wells RW-40, RW-50, RW-60, RW-70 and RW-80A is 850 gpm. Figure 5-10 shows the modeled groundwater pathlines and the groundwater potentiometric surface contours. The modeled groundwater contour interval has been decreased to 0.1 feet near the recovery wells to more clearly illustrate the groundwater flow direction. The simulated boundary conditions represent the high water table, which is the most difficult scenario for achieving groundwater capture.

5.1.4 Groundwater Containment

Recovered groundwater is directed from the recovery wells to bioreactor tank R-7101 directly from the recovery wells. The need for the oil/water separator to separate the free floating oil from the collected groundwater before treatment is not needed due to the efficiency of the product recovery pumps inside the recovery wells. The previous oil/water separator tanks (TK-7111 and TK-7112) are used as backup containment of collected groundwater in case of a bioreactor system failure. These oil/water separator tanks each hold approximately 1 million gallons (Earth Tech, 1998).

5.1.4.1 Groundwater Containment Assessment

There would be no impact on the backup groundwater containment systems, even if an entire bioreactor system upset condition occurred. The two emergency containment tanks can store recovered groundwater for approximately 30-35 hours.

5.1.5 Groundwater Treatment System

As previously mentioned, the collected groundwater is discharged directly into bioreactor tank R7101. The bioreactor tanks were originally constructed to treat wastewater streams generated from the various processes related to refinery production. Since the shut down of the facility in 1996, one of the bioreactors has been idled while the other is used to treat process wastewater, stormwater and recovered groundwater from the ICM System. The two bioreactors are designed to operate in parallel, which provides additional backup capabilities in case one bioreactor becomes upset or is in need of maintenance.

The bioreactors each have capacities of 1.66 million gallons. With an influent flow rate of 850 gpm, the cycle time for the groundwater through a single bioreactor tank is approximately 32 hours.

The bioreactors use microorganisms to degrade dissolve organic compounds in the collected groundwater. These microorganisms can use many types of organic chemicals as an energy source thus degrading them to a nontoxic compound. There are some critical factors in the operation of the bioreactor to facilitate degradation. The chemical composition and associated concentrations in the bioreactor influent must be within a range tolerated by the microorganism in order for them to thrive and reproduce. Slug flows of high chemical concentrations into the bioreactor can kill off the microorganisms or affect their reproduction thus causing an upset condition and allowing influent to pass through the reactor without treatment. Monitoring the bioreactor influent and effluent water stream is critical in optimizing the system control parameters.

The bioreactor that is being used to treat collected groundwater is operating below design treatment/hydraulic capacity (Earth Tech, 1997). Based upon a 14-day study performed on the existing treatment system in November 1997 (Earth Tech, 1997) it has been shown that the bioreactor is treating chemicals whose performance is measured by gross analytical tests such as BOD, COD, dissolved oxygen, and nutrients.

Groundwater samples collected at the bioreactor influent and effluent on September 17, 1998 were tested for BTEX analysis by USEPA SW-846 method 8021. Benzene and ethylbenzene were detected in the influent water at concentrations of 788 and 81.5 ug/L respectively. Toluene and xylenes (total) were not detected in the influent samples. The practical quantitation limit for this sample was 50 ug/L. There were no detections of any of the BTEX compounds in the effluent water sample. The practical quantitation limit for the effluent sample was 5.0 ug/L for each of the constituents. The removal rate for the benzene treated in one bioreactor was greater than 99 percent.

The effluent from the bioreactor tank gravity flows into oxidation pond system where it is again aerated in several cells before it discharges into Walnut River through the NPDES permitted discharge point.

5.1.5.1 Groundwater Treatment System Assessment

Based upon the review of operational data from the facility, the following outlines the assessment of the waste treatment system.

The analytical data show good removal efficiency (greater than 99%) for benzene and ethylbenzene in the bioreactor treatment system. Toluene and xylenes (total) were not detected in the influent groundwater stream. Based upon the available information provided, the existing treatment system can effectively degrade the constituents of interest.

The bioreactors are operating at a lower hydraulic and chemical loading condition than used during the operation of the refinery. Individually the bioreactors provide more than adequate capacity for the groundwater treatment.

5.1.6 Operation and Maintenance Program

TPI is responsible for the operation and maintenance (O&M) of the groundwater recovery wells, the conveyance piping, the product and groundwater containment systems and the groundwater treatment system. An Operation and Maintenance Plan for the ICM system has been prepared to assist the system operators in operating, monitoring and maintaining the groundwater recovery and treatment system (EnecoTech, 2000).

The ICM O&M program includes monitoring the groundwater recovery well pumps and the product recovery pumps. A master control panel located in the motor control center next to the bioreactor tanks controls the groundwater and product recovery pumps. These controls monitor current draw by the pumps, operation up times, groundwater pumping rates and product pump cycles. The facility personnel inspect the well heads and the control panels daily during the workweek.

A spare groundwater pump and motor will be stored at the facility in the event one of the pumps fails. The submersible pumps and electric motors are off the shelf items and can usually be overnight delivered to the refinery from almost anywhere in the country. Typically, the downhole pump can be changed out within a single shift.

Kansas Gas and Electric (KGE) has three electric feeds into the site. One electric feed is required to provide electricity to the site. A telephone call to KG&E in Wichita will energize either of the two additional feeds into the site. This can generally be accomplished within one hour. Site personnel can switch the electric feed to re-energize the ICM system.

A 75-horsepower air blower is used for the bioreactor tanks. Two additional blowers are installed and plumbed into the bioreactor and can be switched on should the primary blower be shut off for maintenance. The evaluation of the wastewater treatment system (Earth Tech, 1998) indicates a 75-hp blower is necessary to operate the bioreactor tank.

5.1.7 Engineering Feasibility Analysis Conclusions

The purpose of the engineering feasibility analysis was to review the design and operation of the existing ICM System and to assess if this system can contain, recover and treat the contaminated groundwater plume from the LTU area. The facility source identification (solid waste management units), which includes the areas near the LTU and the ICM system, will be addressed in the Phase II RFI under the RCRA corrective action process. The focus of this assessment is on the WMA ICM recovery wells, RW-40, RW-50, RW-60, RW-70 and RW-80A. The following summarizes the conclusions:

<u>Recovery Well System</u>

- Recovery wells RW-35, RW-60, RW-70 and RW-80A are screened across the entire saturated interval. The screening intervals allow the collection of both PSH and dissolved constituent fractions;
- Both dissolved constituents and PSH are collected by the groundwater recovery system;
- The recovered groundwater is pumped from the wells into one of the two bioreactor tanks (Tank #R-7101) for treatment;
- The spacing of the wells was based upon the use of a 2-D finite element numerical groundwater flow model and confirmed with recent modeling using the USGS 2-D finite difference groundwater flow model (Modflow);
- The depth of the recovery wells and the screened intervals are appropriate to capture the dissolved constituents in the alluvial aquifer; and,
- Groundwater modeling simulations indicate that groundwater capture occurs at a pumping rate of approximately 700 gpm.

Treatment System

There would be no impact on the back up groundwater containment systems if an entire bioreactor system upset condition occurred. The two emergency containment tanks can store recovered groundwater for approximately 30-35 hours.

Groundwater samples collected at the bioreactor influent and effluent on September 17, 1998 were tested for BTEX analysis by USEPA SW-846 method 8021. Benzene and ethylbenzene were detected in the influent water at concentrations of 788 and 81.5 ug/L respectively. Toluene and xylenes (total) were not detected. The practical quantitation limit for this sample was 50 ug/L. There were no detections of any of the BTEX compounds in the effluent water sample. The practical quantitation limit for the effluent sample was 5.0 ug/L for each of the constituents. The removal rate for the benzene in the bioreactor was greater than 99 percent.

Operation and Maintenance

TPI is responsible for the operation and maintenance of the groundwater recovery wells, the conveyance piping, the product and groundwater containment systems and the groundwater treatment system. An operations manual has been prepared for use by the TPI maintenance (EnecoTech, 2000). This document provides a detail explanation on the operation of the groundwater recovery and treatment system.

In conclusion, the data indicate the recently upgraded LTU ICM system can capture the impacted groundwater using the recovery wells and treat it in the bioreactor treatment system. The treated groundwater is discharged to the Walnut River through the NPDES permitted discharge point.

5.2 LTU Corrective Action

As discussed in Section 4.3, an SVE-AS is recommended to address groundwater and unsaturated zone impacts at the LTU that contribute to the observed groundwater contamination. In April 1999, TPI installed a series of pilot test wells at the LTU to examine the feasibility of soil vapor extraction and air sparge system. The pilot test wells were installed in a line between monitoring wells WN-3A/B and WN-6A/B. The SVE wells were constructed from 2-inch diameter schedule 40 blank PVC casing and schedule 40 PVC casing with 0.020-inch machined slots. The SVE wells were screened from approximately one foot below the water table to about nine feet above the water table. The air sparge test well was installed to approximately 45 feet below the ground surface. The sparge well was completed with an 18-inch long KVA Sparge Point at the bottom of the well casing. The pilot testing consisted of conducting three tests. An SVE test was conducted, followed by an AS test, and then a combination SVE and AS test was conducted. Air flow, vacuum, dissolved oxygen, groundwater level and effluent vapors were monitored during the tests.

The data produced during the tests were evaluated to determine the effective radius of influence (ROI) for the SVE and AS wells. The results of the tests at the LTU indicate that the air sparge effective ROI is approximately 20 feet and the effective ROI for the SVE wells is 27 feet. The test data showed the dissolved oxygen levels in the groundwater increased during the sparging. The effluent gas from the SVE well increased in the combination SVE and AS test compared with the SVE only test indicating air stripping of volatile hydrocarbons in the groundwater was occurring. An effluent air sample was collected at the end of the combination SVE-AS test. The sample was analyzed for BTEX and total volatile petroleum hydrocarbons (TVPH). The initial emissions rate calculated for BTEX compounds were 0.13, 0.02, 0.01 and 0.01 tons per year per well respectively. The TVPH emissions rate was 2.22 tons per year per SVE well. The initial emission rate for the constructed system was expected to be slightly higher due to higher concentrations of dissolved constituents in the groundwater.

Based on the pilot test results, a full-scale system was designed and constructed. Startup of the new SVE-AS system was performed during October 22-24, 2002.

5.2.1 System Design

The as-built drawings for the system presented on Figures 5-11, 5-12 and 5-13. Figure 5-11 presents the layout of the SVE and AS wells. The SVE well spacing is 48 feet. This spacing corresponds to a 24-foot ROI that is slightly less than the calculated ROI and provides overlap. The AS well spacing is 24 feet, corresponding to a 12-foot ROI. The calculated ROI for the AS wells was 20 feet. The design provides an additional factor of safety by reducing the air sparge well spacing. The well layout shown on Figure 5-11 contains alternating combination SVE and AS well pair locations alternating with AS only wells. The ROI for the SVE and AS wells are shown on Figure 5-11. The SVE ROI is greater than the AS ROI providing for capture of all vapors stripped from the groundwater by the SVE wells. The closer spacing of the AS wells will shorten the cleanup time and reduce the risk of needing additional AS wells. As discussed in Section 4, this layout of SVE and AS wells are designed to remediate the groundwater contamination at the source.

While the primary mechanism to treat the groundwater is in-situ vapor stripping, the increased dissolved oxygen levels will propagate downgradient and promote biodegradation of the petroleum hydrocarbons dissolved in the groundwater. The well designs discussed below were based upon seasonal groundwater level elevation fluctuations.

The air sparge well as-built completion details are presented on Figure 5-12. The completed well consists of 2-inch diameter PVC casing with a KVA Spargepoint on the bottom. The well is designed to penetrate the upper half of the alluvial aquifer. Figure 4-1 illustrates the depth of the sparge well relative to the high and low observed groundwater levels. As indicated by the lithologic logs for the monitoring wells on the cross section, the lithology in which the AS wells have been completed contains sands and gravelly sands, an ideal medium for this technology.

The SVE well as-built completion details are presented on Figure 5-13. Figure 4-1 illustrates the vertical location of a typical SVE well relative to the water table. The SVE wells have been constructed to extend into the groundwater during low and high groundwater levels, and always extend above the groundwater, even during normal high groundwater level conditions. Figure 4-1 shows the low and high groundwater levels observed at this location, as well as the maximum groundwater level observed during the November 1998 flood event. The system is not designed to operate during unusual and short duration conditions as encountered during the flood in November 1998.

The SVE and-AS wells were completed using a 4.25-inch hollow stem auger drilling technique.

The wellhead details for the AS and the SVE wells are provided on Figures 5-12 and 5-13 respectively. The AS piping above the ground surface has been constructed from schedule 40 steel. The SVE piping has been constructed from schedule 40 PVC. The SVE wells are equipped with tee-connections with valves to attach equipment to monitor vapor concentrations at each well. All the SVE and AS wells have removable caps on the top of the casing to allow groundwater sampling or water level monitoring. The AS and SVE headers are buried in a trench below frost line.

The SVE system is designed to operate continuously, 24-hours per day, 7-days per week. Individual wells will be monitored periodically and may be valved out of the system if they are drawing contaminant free air to increase vacuum to the other wells upon notifying KDHE. Wells that are isolated in this way will be periodically monitored to verify that there has been no rebound effect. A liquid knockout tank has been installed inline between the SVE wells and the vacuum blower to collect any entrained water or condensed vapors.

There is strong research evidence that pulsed operation improves performance by mixing the groundwater. The AS wells are being operated in a pulsed fashion. The AS well groups are cycled on and off at half-hour intervals. KDHE will be notified if the routine operating interval is changed for reasons other than system maintenance.

An air compressor capable of delivering 85 standard cubic feet per minute (scfm) at 22 pounds per square inch gauge (psig) pressure is being used to drive the AS component of the system. A blower capable of pulling 330 scfm at 10 inches of mercury vacuum is being used to drive the SVE component of the system. 460-volt, 3-phase power is available in the immediate area and is being used to power the treatment systems.

5.2.2 Permitting

A construction permit application for the SVE-AS system was submitted to the KDHE Bureau of Air and Radiation (BAR). The KDHE-BAR has indicated by means of an official response (dated June 13, 2002) that no air permits were required for the construction or operation of the treatment system.

For the air sparge component of the system, an Underground Injection Control (UIC) Permit application was submitted to the KDHE Bureau of Water (BOW). In a response dated June 6, 2002, the BOW stated that it did "not intend to issue formal permits for this type of well as this time." No further permit action was undertaken.

5.2.3 SVE-AS System Monitoring

The emissions from the SVE system will be monitored as required by the KDHE Bureau of Air and Radiation. Individual SVE wells will be monitored periodically using either an organic vapor analyzer equipped with a photoionization detector (PID) or an explosimeter (i.e., %LEL meter). Air samples will be periodically collected from the SVE system for analysis of TVPH and BETX. Details of the monitoring are presented in Section 6 of this document.

5.2.4 Operation and Maintenance and Safety

An O&M manual has been prepared for the SVE-AS system. The SVE-AS system O&M procedures are based around the manufacturers' recommendations for upkeep of the various equipment items. Water and condensate recovered from the system will be managed in the wastewater treatment system on site. Safety issues are not detailed in the manual specifically. Instead, the facility safety guidelines are incorporated by reference. TPI will update the O&M manual as needed to facilitate changes either in equipment or in the facility safety policies.

6.0 CORRECTIVE ACTION MONITORING PROGRAM

Two corrective action systems have been selected for the facility. The WMA ICM groundwater corrective action near the downgradient boundary of the waste management area and the LTU SVE-AS system at the edge of the LTU. This section describes the monitoring programs for these two systems.

6.1 LTU ICM Groundwater Corrective Action Monitoring Program

Groundwater monitoring will consist of two phases, corrective action monitoring and compliance monitoring. The corrective action monitoring program (CAMP) is designed to meet the requirements of CFR 264.100 and to verify the effectiveness of the corrective action and to monitor the progress of the cleanup effort towards achieving the cleanup goals within the designated waste management area. This will be done by monitoring groundwater quality within the waste management area and by evaluating the capture zone of the LTU ICM groundwater recovery system. The water quality testing will be used to monitor the progress and effectiveness of the corrective action, and the capture zone monitoring will be used to demonstrate there is no discharge of hazardous constituents to the Walnut River.

The corrective action groundwater quality monitoring described in this section involves the use of indicator compounds. During the course of the corrective action, TPI may increase the number of analytical constituents tested to include the entire list of the GWPS. Testing of the GWPS constituents will provide an indication of when the transition to groundwater compliance monitoring should be recommended.

Once the groundwater analyses conducted in the CAMP demonstrate the water quality within the plume meets the GWPS, TPI will submit a request to KDHE to begin the compliance monitoring program as a Class I permit modification. Upon receiving KDHE approval, TPI shall implement the compliance monitoring program. The groundwater sampling and analysis plan (SAP) for the corrective action and compliance monitoring programs is included in Appendix P of the RCRA Part B Permit Application. This section of the Engineering Feasibility Plan describes the various elements of the corrective action monitoring program including the groundwater sampling and the capture zone monitoring.

6.1.1 Waste Management Area

As allowed by Sections 264.95(b)(2) and 264.97(b), the four regulated units have been incorporated into one waste management area. The waste management area is defined as the area encompassing the land treatment unit (LTU) to the west and the former surface impoundments #1, #2, and #3A to the east extending to the point of compliance near the Walnut river boundary. The groundwater modeling presented in this Engineering Feasibility Plan shows the groundwater flow direction and supports the definition of the waste management area boundaries.

6.1.2 Corrective Action Monitoring Well Network

The progress of the groundwater corrective action will be monitored using a monitoring well network that meets the requirements of Section 264.97(a). The monitoring well network is comprised of two upgradient wells, eight corrective action performance monitoring wells and two supplemental wells listed on Table 6-1. Figure 6-1 shows the corrective action groundwater monitoring well network and the four point of compliance wells. In addition, the groundwater pumped from the LTU ICM groundwater recovery wells will be sampled prior to entering the groundwater treatment system and the effluent from the treatment system will be sampled. This information will describe the quality of the groundwater at the recovery wells, the contaminant mass removal, and the performance of the groundwater treatment system. The groundwater corrective action monitoring wells are designed to monitor groundwater quality in the uppermost (alluvial aquifer) groundwater zone upgradient, within, and downgradient of the waste management area. The groundwater compliance monitoring wells will be used to measure the groundwater level elevation during the corrective action monitoring phase of the permit for the groundwater capture zone evaluation.

6.1.3 Groundwater Corrective Action Monitoring

The corrective action monitoring wells listed in Table 6-1 will be sampled according to the procedures presented in the SAP presented in Appendix P of the RCRA Part B permit application.

6.1.3.1 Groundwater Quality Monitoring

Groundwater corrective action samples, including the bioreactor influent and effluent water, will be analyzed for indicator compounds to monitor the performance and progress of the corrective actions. The sampling of the bioreactor influent will provide a composite representation of water quality conditions at the ICM recovery system. Monitoring the bioreactor effluent will provide information on mass removal rate and provide data to assess the treatment process.

The BTEX compounds were selected as the indicator compounds because of their high frequency of detection, mobility in the groundwater and elevated concentrations. These indicator compounds will be analyzed in the laboratory using USEPA SW-846 Method 8260B or currently promulgated version. The corrective action monitoring wells and the bioreactor influent and effluent streams will be monitored semiannually. The water samples will be analyzed by a KDHE certified laboratory.

Corrective Action Groundwater Quality Criteria

The purpose of the groundwater quality monitoring is to determine the progress of the groundwater corrective action. The concentrations of the indicator compounds will be monitored over time to determine trends. The criterion for the indicator compound monitoring is that the trend in the concentrations is decreasing over time. No two adjacent monitoring events can be used to describe a trend. Trends will be monitored over the period of three or more years and take into account seasonality and corrective action operations.

6.1.3.2 Capture Zone Monitoring

The groundwater levels will be monitored at four pairs of wells to determine the groundwater flow direction. These well pairs are: CMW-1 and RCRA-7, CMW-2 and 113, CMW-3 and 118, and, CMW-4 and MW-1002. The well locations are shown on Figure 6-2. Groundwater levels will be measured using an oil/water interface probe. The depth to free product (if present) and the oil/water or air/water interface will be measured to the nearest 0.01 feet and recorded in a bound field logbook. Density corrections for free product will be used to calculate a corrected groundwater level. The groundwater level elevation will be calculated by subtracting the corrected depth to water from the surveyed measuring point elevation. The groundwater capture zone monitoring will be performed on a quarterly schedule.

Capture Zone Demonstration Criteria

The groundwater capture zone between the LTU ICM recovery wells and the Walnut River will be created by continuous groundwater pumping from the 10 LTU ICM recovery wells (RW-35, RW-40, RW-45, RW-50, RW-55, RW-60, RW-65, RW-70, RW-75 and RW-80A). The combined pumping rate from these wells should average approximately 1000-1300 gpm. The groundwater pumping rate and hours of operation will be monitored and recorded. The capture zone will be monitored using the eight capture zone monitoring wells described previously. The criteria for the capture zone is a flat or a reversed hydraulic gradient between the recovery wells and the river. The capture zone evaluation monitoring will be conducted quarterly. There will be no groundwater discharge to the Walnut River if the gradient is flat or reversed. This criterion will be demonstrated by comparison of the groundwater level elevations in the capture zone monitoring well pairs listed on Table 6-1.

If free product is present on top of the water table, the groundwater elevation will be calculated using a density correction to account for the free product. The formula for calculating the corrected groundwater elevation in the presence of free product is:

CWL = (PT x D) + IE

Where:

CWL = corrected water level elevation (feet above mean sea level)

PT = product thickness (feet, measured in well)

D = density of free product

IE = oil-water interface elevation (feet above mean sea level) = well casing measuring point elevation – depth to oil-water interface

If the groundwater level elevation measurement data indicates there is flow toward the river the groundwater levels will be re-measured within seven days. The facility may elect to re-survey the measuring point elevations of the capture zone monitoring wells to verify they have not changed due to damage to the well during high river levels or frost heaving etc. Simultaneously, the recovery well performance will be evaluated and corrective actions taken if necessary. Corrective actions may include replacement of worn pumps, recovery well redevelopment, and well replacement.

An alternate compliance criteria to demonstrating containment of groundwater from the refinery will be the groundwater quality in the groundwater compliance wells (CMW-1, -2, -3 and -4). If gradient control can not be demonstrated using groundwater level measurements during a particular monitoring event, groundwater samples will be collected within 30 days of re-measuring the water levels and analyzed for the BTEX indicator compounds. The BTEX analysis will be performed using USEPA SW-846 Method 8260B. Concentrations of BTEX below the groundwater protection standards listed in the RCRA Part B Permit Application will demonstrate compliance with the requirement to contain the groundwater from the waste management area. Groundwater samples will be collected only in the compliance monitoring well(s) in the vicinity of the location where gradient control has not been achieved.

Based upon a conservative groundwater flow velocity of 7 feet per day (Section 2.1.10.4) it will take approximately 14 days for groundwater at RW-80A to reach the Walnut River and 24 to 30 days between recovery wells RW-35 and RW-70. These travel times are based on a non-operating groundwater recovery well. However, if a recovery well(s) is not operating, the groundwater hydraulic gradient will be less and the groundwater travel times will increase.

6.1.4 Reporting

Corrective action monitoring reports will be submitted to KDHE on a semiannual schedule. Semiannual reports containing both capture zone and groundwater quality monitoring data will be submitted to KDHE on March 1 and September 1 for the previous six month period (July through December information will be reported on March 1 and January through June information will be reported on September 1). The reports will include the following data:

- field forms for water level monitoring and groundwater sampling;
- summary table presenting the results of the laboratory analyses ;
- laboratory analytical results – summary forms ;
- chain-of-custody forms ;
- discussion of the sampling event and any variance from the groundwater sampling plan ;
- discussion of any laboratory quality control issues and recommended corrective action ;
- groundwater pumping rate and percentage of time in operation; and,
- groundwater treatment system influent and effluent samples analyses.

The March 1 monitoring report will serve as the annual groundwater monitoring report. This report will provide additional analyses including presentation of time versus concentration graphs to show trends in groundwater quality. These graphs will present data from the start of the corrective action. The annual report will include a summary of the operations for the previous year and recommendations on the operation of the corrective action system for the following year.

6.2 LTU SVE-AS Corrective Action Monitoring Program

The LTU SVE-AS system consists of a network of soil vapor extraction and air sparge wells and an air sparge blower and a SVE blower. The KDHE Bureau of Air and Radiation will establish the compliance monitoring requirements in the construction permit for the system. TPI will comply with requirements specified by the KDHE Bureau of Air and Radiation for this system.

6.2.1 Operational Monitoring

Operational data will be collected during the operation of the system as outlined below.

Air Sparge System

- Air flow rate at individual sparge wells (quarterly)
- Air flow rate and temperature at the blower (weekly)
- Cumulative operating time in hours (weekly)

Soil Vapor Extraction System

- Air temperature (weekly)
- Air velocity and flow (weekly)
- Vacuum (weekly)
- LEL (weekly)

Air samples will be collected from the SVE outlet on a quarterly basis. The air sample will be analyzed for total petroleum hydrocarbons, gasoline range (TPHgro) and BTEX. This data will be used to monitor the performance of the SVE-AS system.

6.2.2 Operational Reporting

Semiannual reports will be submitted to KDHE on March 1 and September 1 for the previous six month period (July through December information will be reported on March 1 and January through June information will be reported on September 1). The reports will contain a narrative summary description of the operation of the system during the previous six months. The report will include a tabulation of the operational monitoring information described in Section 6.2.1

6.3 Corrective Action Contingency Plan

As discussed previously, the corrective action system for the groundwater at the property boundary downgradient of the LTU and the closed surface impoundments is the LTU ICM groundwater recovery and treatment system. If it is determined that impacted groundwater is migrating off-site based upon groundwater level measurements and groundwater quality data, corrective action contingencies will be implemented.

Initially, the contingency will be to verify that the release is real. The facility will prepare and submit an assessment plan to KDHE for approval. The assessment plan will review the current monitoring network and assess whether it is still appropriate. The assessment plan will recommend a focussed evaluation of the groundwater gradient and flow direction and the groundwater quality providing recommendations and if necessary design modifications to the system including contingency corrective action measures.

The additional corrective action may be in the form of additional groundwater recovery wells or construction and operation of an SVE-AS system between the recovery wells and the Walnut River.

Additional recovery wells will be constructed with 10-inch diameter or larger casing and well screen. The pumps will be plumbed into the bioreactor treatment system. This system is capable of handling at a minimum an additional 1000 gpm on top of the current 950 gpm flow rate.

However, if it is determined SVE-AS technology would be more appropriate to apply, then SVE-AS wells would be designed like the SVE-AS wells for the LTU corrective action as depicted on Figures 5-13 and 5-14. SVE-AS pilot testing conducted in the vicinity of the bioreactor tanks indicate that the effective ROI for the SVE wells in this area is 53 feet and the AS ROI is estimated to be 17 feet. An SVE well spacing of 60 feet (30-foot radius) and an AS well spacing of 30 feet (15-foot radius) is considered appropriate for this area. As with the LTU design, the well spacing is conservative, however, the closer spacing will reduce the cleanup time.

The contingency technologies if necessary would be implemented within 180 days of the determination of their need and with the approval of KDHE.

Corrective action monitoring will continue through the permit period as required by the RCRA permit. If during the operation of the contingency corrective action the monitoring results indicate the contingency action is no longer necessary, TPI will request that operation of the contingency corrective action system be terminated. Corrective action monitoring will resume as described in Sections 6.1.

7.0 REFERENCES

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TABLES

Table 1-1 RCRA LTU Permit Groundwater Protection Standards

PARAMETER	STANDARD (ug/L)
Arsenic	50
Barium	1000
Cadmium	10
Chromium	50
Lead	50
Benzene	25
Ethylbenzene	25
Toluene	25
Xylene	25
1-Methylnaphthalene	25
Di(n)octylphthalate	25
Naphthalene	25
Phenanthrene	25

Table 1-2 1998 Groundwater Results Exceeding Trigger Values

Well I.D.	Date Sampled	Parameter	Conc (ug/L)	Code	Trigger (ug/L)
LAND TREATMENT UNIT					
First Quarter Sampling Event					
WN-2A	3/29/98	Benzene	51.8		25
WN-2B	3/29/98	Barium	1000		1000
		Benzene	639		25
		1-Methylnaphthalene	38.7		25
WN-3B	3/29/98	Barium	1600		1000
		Benzene	92.3		25
		Ethylbenzene	29.8		25
		1-Methylnaphthalene	44.3		25
WN-5B	3/29/98	1-Methylnaphthalene	53.9		25
WN-7B	3/29/98	Benzene	629		25
		Xylenes (Total)	41.9		25
		1-Methylnaphthalene	27.1		25
WN-8B	3/29/98	Benzene	66.8		25
		1-Methylnaphthalene	49.1		25
Second Quarter Sampling Event					
WN-1A	6/18/98	Chromium	240		50
		Nickel	70		50
WN-1B	6/18/98	Chromium	58		50
WN-3B	6/17/98	Barium	1800		1000
		Xylenes (Total)	44.5		25
		1-Methylnaphthalene	45.9		25
WN-5B	6/18/98	1-Methylnaphthalene	45.6		25
WN-6B	6/17/98	Benzene	108		25
WN-7B	6/18/98	Benzene	4780		25
		Ethylbenzene	248		25
		Toluene	28.6		25
		Xylenes (Total)	70.2		25
		1-Methylnaphthalene	44.3		25
		Naphthalene	62.9		25
WN-8B	6/18/98	Barium	1080		1000
		Benzene	236		25
		1-Methylnaphthalene	26.1		25

Table 1-2 1998 Groundwater Results Exceeding Trigger Values

Well I.D.	Date Sampled	Parameter	Conc (ug/L)	Code	Trigger (ug/L)
LAND TREATMENT UNIT					
Third Quarter Sampling Event					
WN-1B	9/17/98	Chromium	83		50
WN-2A	9/18/98	Benzene	58		25
WN-3A	9/18/98	Benzene	40		25
WN-3B	9/18/98	Barium	1960		1000
		Benzene	120		25
		1-Methylnaphthalene	45		25
WN-5B	9/17/98	Barium	1140		1000
		Benzene	38		25
		1-Methylnaphthalene	55		25
WN-6B	9/25/98	1-Methylnaphthalene	29		25
WN-7B	9/18/98	Benzene	1200	D	25
		Ethylbenzene	40		25
		1-Methylnaphthalene	61		25
		Naphthalene	41		25
WN-8B	9/18/98	Barium	1150		1000
		Benzene	200		25
		1-Methylnaphthalene	34		25
Fourth Quarter Sampling Event					
WN-2A	12/9/98	Benzene	78		25
WN-3A	12/9/98	Barium	1100		1000
		Benzene	26		25
WN-6A	12/9/98	Benzene	42		25
WN-6B	12/9/98	Barium	1160		1000
		Benzene	75		25
		1-Methylnaphthalene	26		25
WN-7A	12/9/98	Benzene	50		25
WN-7B	12/9/98	Barium	1040		1000
		Benzene	570	D	25
		Xylenes (Total)	62		25
		1-Methylnaphthalene	60		25
		Naphthalene	130	D	25
WN-8A	12/9/98	Benzene	59		25

Table 1-2 1998 Groundwater Results Exceeding Trigger Values

Well I.D.	Date Sampled	Parameter	Conc (ug/L)	Code	Trigger (ug/L)
LAND TREATMENT UNIT					
<u>Fourth Quarter Sampling Event</u>					
WN-8B	12/9/98	Benzene	580	D	25
		1-Methylnaphthalene	51		25

Table 1-2 1998 Groundwater Results Exceeding Trigger Values

Well I.D.	Date Sampled	Parameter	Conc (ug/L)	Code	Trigger (ug/L)
1 & 2 CLOSED IMPOUNDMENTS					
First Quarter Sampling Event					
MW-3	3/29/98	Barium	1900		1000
		Benzene	3350		25
		Xylenes (Total)	36.3		25
		1-Methylnaphthalene	106		25
MW-4	3/29/98	Barium	1300		1000
		Benzene	3180		25
		Xylenes (Total)	54.6		25
		1-Methylnaphthalene	91.6		25
MW-5	3/30/98	Barium	1300		1000
		Benzene	5450		25
		Ethylbenzene	131		25
		Toluene	35.7		25
		Xylenes (Total)	231		25
		1-Methylnaphthalene	149		25
		Naphthalene	65.5		25
MW-6	3/29/98	Benzene	2220		25
		Xylenes (Total)	93		25
		1-Methylnaphthalene	95.3		25
MW-10	3/29/98	Barium	1800		1000
		1-Methylnaphthalene	59		25
MW-11	3/29/98	Barium	1800		1000
		1-Methylnaphthalene	37		25
Second Quarter Sampling Event					
MW-3	6/19/98	Barium	1080		1000
		Benzene	2650		25
		Xylenes (Total)	43.4		25
		1-Methylnaphthalene	88.6		25
MW-4	6/19/98	Barium	1300		1000
		Benzene	889		25
		Xylenes (Total)	62.3		25
		1-Methylnaphthalene	103		25
MW-5	6/19/98	Barium	1300		1000
		Benzene	3500		25
		Xylenes (Total)	107		25
		1-Methylnaphthalene	78		25
		Naphthalene	40.6		25

Table 1-2 1998 Groundwater Results Exceeding Trigger Values

Well I.D.	Date Sampled	Parameter	Conc (ug/L)	Code	Trigger (ug/L)
1 & 2 CLOSED IMPOUNDMENTS					
Second Quarter Sampling Event					
MW-6	6/19/98	Benzene	3230		25
		Toluene	196		25
		Xylenes (Total)	347		25
		1-Methylnaphthalene	78.9		25
MW-10	6/19/98	Barium	1600		1000
MW-11	6/24/98	Barium	2200		1000
		Benzene	995		25
		1-Methylnaphthalene	316		25
Duplicate #1 (MW-	6/19/98	Barium	1300		1000
		Benzene	2900		25
		Xylenes (Total)	43.6		25
		1-Methylnaphthalene	119		25
Duplicate #2 (MW-	6/19/98	Benzene	4090		25
		Toluene	360		25
		Xylenes (Total)	512		25
		1-Methylnaphthalene	94.8		25
Third Quarter Sampling Event					
MW-4	9/30/98	Barium	2310		1000
		Benzene	9300	D	25
		Ethylbenzene	1100	D	25
		Toluene	82		25
		Xylenes (Total)	920	D	25
		1-Methylnaphthalene	710	D	25
		Naphthalene	410	D	25
		Phenanthrene	280	D	25
MW-10	9/25/98	Benzene	50		25
MW-11	9/25/98	Barium	1860		1000
		Benzene	1400		25
		Toluene	31	J	25
		Xylenes (Total)	44	J	25
		1-Methylnaphthalene	70		25

Table 1-2 1998 Groundwater Results Exceeding Trigger Values

Well I.D.	Date Sampled	Parameter	Conc (ug/L)	Code	Trigger (ug/L)
1 & 2 CLOSED IMPOUNDMENTS					
Fourth Quarter Sampling Event					
MW-3	12/10/98	Barium	1890		1000
		Benzene	3200	D	25
		Toluene	36		25
		Xylenes (Total)	190		25
		1-Methylnaphthalene	75		25
MW-4	12/10/98	Barium	1560		1000
		Benzene	9400	D	25
		Ethylbenzene	550	D	25
		Toluene	88		25
		Xylenes (Total)	1000	D	25
		1-Methylnaphthalene	120	D	25
		Naphthalene	180	D	25
MW-5	12/10/98	Barium	1310		1000
		Benzene	12000	D	25
		Ethylbenzene	940	D	25
		Toluene	240	E	25
		Xylenes (Total)	1600	D	25
		1-Methylnaphthalene	54		25
		Naphthalene	180		25
MW-6	12/10/98	Benzene	1400	D	25
		Ethylbenzene	27		25
		Toluene	150		25
		Xylenes (Total)	170		25
MW-10	12/10/98	Benzene	380	D	25
MW-11	12/10/98	Benzene	150	D	25
		1-Methylnaphthalene	28		25
MW-12	12/10/98	Benzene	26		25
RCRA-MW-5(MW	12/10/98	Benzene	32		25

Table 1-2 1998 Groundwater Results Exceeding Trigger Values

Well I.D.	Date Sampled	Parameter	Conc (ug/L)	Code	Trigger (ug/L)
3A AERATED LAGOON					
First Quarter Sampling Event					
RCRA-MW-1	3/30/98	Benzene	1390		25
		Xylenes (Total)	43.5		25
RCRA-MW-2	3/30/98	Benzene	3320		25
		1-Methylnaphthalene	68.1		25
RCRA-MW-3	3/30/98	Benzene	2920		25
		1-Methylnaphthalene	45.8		25
RCRA-MW-4	3/30/98	Benzene	3840		25
Dup #2 (RCRA-M	3/30/98	Benzene	638		25
		Xylenes (Total)	27.7		25
Second Quarter Sampling Event					
RCRA-MW-1	6/17/98	Benzene	1880		25
RCRA-MW-2	6/18/98	Barium	1040		1000
		Lead	58		50
		Benzene	4450		25
		Xylenes (Total)	63.3		25
		1-Methylnaphthalene	113		25
		Naphthalene	56.8		25
RCRA-MW-3	6/17/98	Barium	1060		1000
		Benzene	3050		25
		Xylenes (Total)	175		25
		1-Methylnaphthalene	34.9		25
RCRA-MW-4	6/18/98	Benzene	594		25
Third Quarter Sampling Event					
RCRA-MW-1	9/30/98	Benzene	3200	D	25
		Ethylbenzene	130	D	25
		Toluene	56		25
		Xylenes (Total)	77	JD	25
		1-Methylnaphthalene	180	D	25
		Naphthalene	180	D	25
		Phenanthrene	28		25

Table 1-2 1998 Groundwater Results Exceeding Trigger Values

Well I.D.	Date Sampled	Parameter	Conc (ug/L)	Code	Trigger (ug/L)
3A AERATED LAGOON					
<u>Third Quarter Sampling Event</u>					
RCRA-MW-2	9/30/98	Benzene	3300	D	25
		Ethylbenzene	470	D	25
		Toluene	50		25
		Xylenes (Total)	550	D	25
		1-Methylnaphthalene	160	E	25
		Naphthalene	180	E	25
		Phenanthrene	40		25
RCRA-MW-3	9/30/98	Barium	1400		1000
		Benzene	7700	D	25
		Ethylbenzene	430	D	25
		Toluene	540	D	25
		Xylenes (Total)	1160	D	25
		1-Methylnaphthalene	400	D	25
		Naphthalene	470	D	25
		Phenanthrene	91		25
<u>Fourth Quarter Sampling Event</u>					
RCRA-MW-1	12/10/98	Benzene	2600	D	25
		Ethylbenzene	440	D	25
		Toluene	36		25
		Xylenes (Total)	630	D	25
		1-Methylnaphthalene	65		25
		Naphthalene	120	D	25
RCRA-MW-2	12/10/98	Benzene	6500	D	25
		Ethylbenzene	760	D	25
		Toluene	97		25
		Xylenes (Total)	2100	D	25
		1-Methylnaphthalene	90		25
		Naphthalene	140	D	25
RCRA-MW-3	12/10/98	Barium	1110		1000
		Benzene	12000	D	25
		Ethylbenzene	1600	D	25
		Toluene	1200	D	25
		Xylenes (Total)	6200	D	25
		1-Methylnaphthalene	75		25
		Naphthalene	280	D	25

Table 1-2 1998 Groundwater Results Exceeding Trigger Values

Well I.D.	Date Sampled	Parameter	Conc (ug/L)	Code	Trigger (ug/L)
3A AERATED LAGOON					
Fourth Quarter Sampling Event					
RCRA-MW-4	12/10/98	Benzene	2200	D	25
		Ethylbenzene	250	D	25
		Toluene	45		25
		Xylenes (Total)	820	D	25
		1-Methylnaphthalene	33		25
		Naphthalene	51		25

Codes: J: Indicates an estimated value. Used primarily when the compound was detected below the practical quantitation limit (PQL).

D: Identifies all compounds identified in an analysis at a secondary dilution factor.

E: Identifies compounds whose concentrations exceed the calibration of the instrument for that specific analysis, or where the reported value is estimated because of the presence of interference.

Table 2-1 Summary of Walnut River Surface Water Analyses

Constituent		KDHE Surface Water Quality Criteria (Food Procurement)	SW-1 10/07/99	SW-1 10/27/99	SW-1 11/08/99	SW-2 10/07/99	SW-2 10/27/99	SW-2 11/08/99	SW-3 10/07/99	SW-3 10/27/99	SW-3 11/08/99
1,1,1-Trichloroethane	mg/L	173.077	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
1,1-Dichloroethene	mg/L	0.00185	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
1,2,4-Trimethylbenzene	mg/L		< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
1,2-Dibromoethane	mg/L	a	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
1,2-Dichloroethane	mg/L	b	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
1,3,5-Trimethylbenzene	mg/L		< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
1,4-Dioxane	mg/L	a	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
2-Butanone	mg/L	a	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.002 J	< 0.005
Benzene	mg/L	0.040	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Carbon disulfide	mg/L	a	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Chlorobenzene	mg/L	21	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Chloroform	mg/L	0.0157	< 0.005	< 0.005	0.06	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Ethylbenzene	mg/L	28.718	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Styrene	mg/L	a	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Tetrachloroethene	mg/L	0.00885	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Toluene	mg/L	b	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Trichloroethene	mg/L	0.0807	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.003 J	< 0.005	< 0.005
Xylene (total)	mg/L	a	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
1,2-Dichlorobenzene	mg/L		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
1,4-Dichlorobenzene	mg/L		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
1-Methylnaphthalene	mg/L		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
2,4-Dimethylphenol	mg/L	2.300	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
2,4-Dinitrotoluene	mg/L	0.0091	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
2-Methylnaphthalene	mg/L		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
2-Methylphenol	mg/L		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
4-Methylphenol	mg/L		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
7,12-Dimethylbenz(a)anthracene	mg/L	a	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthene	mg/L	a	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Anthracene	mg/L	0.0000311	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)anthracene	mg/L	0.0000311	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)pyrene	mg/L	0.0000311	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(b)fluoranthene	mg/L	0.0000311	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
bis(2-Ethylhexyl)phthalate	mg/L	a	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Butyl benzyl phthalate	mg/L	5.2	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Chrysene	mg/L	0.0000311	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Di-n-butyl phthalate	mg/L	b	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Di-n-octyl phthalate	mg/L	a	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Dibenz(a,h)anthracene	mg/L	0.0000311	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Fluoranthene	mg/L	b	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

Table 2-1 Summary of Walnut River Surface Water Analyses

Constituent		KDHE Surface Water Quality Criteria (Food Procurement)	SW-1 10/07/99	SW-1 10/27/99	SW-1 11/08/99	SW-2 10/07/99	SW-2 10/27/99	SW-2 11/08/99	SW-3 10/07/99	SW-3 10/27/99	SW-3 11/08/99
Fluorene	mg/L	0.0000311	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Indeno(1,2,3-cd)pyrene	mg/L	0.0000311	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Naphthalene	mg/L	a	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Nitrobenzene	mg/L	1.90	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Phenanthrene	mg/L	0.0000311	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Phenol	mg/L	4,600	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Pyrene	mg/L	na	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Pyridine	mg/L		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Antimony	mg/L	4.300	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Arsenic	mg/L	0.0205	< 0.003	< 0.003	**0.0048 J**	**0.0054 J**	< 0.003	**0.0041 J**	**0.0045 J**	**0.0045 J**	**0.0041 J**
Barium	mg/L	a	0.166	**0.1560**	**0.1850**	**0.1460**	**0.1490**	**0.2030**	**0.1650**	**0.2340**	**0.1880**
Beryllium	mg/L	0.00013	**0.0003 J**	**0.0005 J**	< 0.0003	**0.0007 J**	**0.0005 J**	< 0.0003	< 0.0003	**0.0009 J**	< 0.0003
Cadmium	mg/L	0.170	**0.0004 J**	**0.0016 J**	< 0.0003	< 0.0003	< 0.0003	**0.0003 J**	**0.0004 J**	**0.0014 J**	**0.0003 J**
Chromium	mg/L	a	0.009 J	**0.0007 J**	**0.0012 J**	**0.0081 J**	< 0.001	**0.0009 J**	**0.0088 J**	**0.0069 J**	**0.0014 J**
Lead	mg/L	a	< 0.010	**0.0028 J**	< 0.002	< 0.009	< 0.002	< 0.002	< 0.008	**0.0092**	< 0.002
Mercury	mg/L	0.000146	**0.0001 J**	**0.0002 J**	< 0.0001	**0.0004 J**	**0.0002**	< 0.0001	< 0.0001	**0.0001 J**	< 0.0001
Nickel	mg/L	0.100	**0.0085 J**	**0.0039 J**	**0.0036 J**	**0.0136 J**	**0.0026 J**	**0.0034 J**	**0.0078 J**	**0.0090 J**	**0.0038 J**
Selenium	mg/L	6.800	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003
Silver	mg/L	a	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Vanadium	mg/L	a	**0.0188 J**	**0.0072 J**	**0.0071 J**	**0.0173 J**	**0.0064 J**	**0.0065 J**	**0.0179 J**	**0.0194 J**	**0.0073 J**
Zinc	mg/L	a	0.114	**0.0307**	**0.0129 J**	< 0.065	**0.0206**	**0.0124 J**	< 0.068	**0.0411**	**0.0096 J**
Cyanide	mg/L	220	< 0.001	< 0.001	**0.0022 J**	**0.0015 J**	< 0.001	**0.0012 J**	< 0.001	< 0.001	**0.0014 J**

NOTES:

mg/L - Milligrams per liter

a - criterion not available

b - US EPA has promulgated criterion for Kansas under the Code of Federal Regulations, Title 40, Part 131.36.

< -value less then detectable limits

0.002 -detected value

J -detected, estimated value

[shaded] -meets or exceeds the KDHE Surface Water Quality Criteria for Food Procurement

Table 2-2 Properties of Selected Petroleum Products

Chemical	*Density* (g/cm3)	*Dynamlc Viscosity (cp)*	*Water Solubility (mg/l)*	*Vapor* Pressure *(mm Hg)*	*Henry's Law Constant* (atm-m3/mol)
Benzene	0.8765	0.6468	1.78 E+03	76	5.43 E-03 (1)
Ethylbenzene	0.867	0.678	1.52 E+02	7	7.9 E-03 (1)
Toluene	0.8669	0.58	5.15 E+02	22	6.61 E-03 (1)
m-Xylene	0.8642(1)	0.608	2 E+02	9	6.91 E-03 (1)
o-Xylene	0.880(1)	0.802	1.7 E+02	7	4.94 E-03 (1)
p-Xylene	0.8610(1)	0.635	1.98 E+02	9	7.01 E-03 (1)
Water	0.998 (6)	1.14 (6)	----	----	---
gasoline	0.72-0.76 (3)	0.36-0.49 (3)	----	----	---
#2 Fuel Oil	0.87-0.95	1.15-1.97 (5)	----	----	---
#6 Fuel Oil	0.87-0.95	14.5-493.5 (4)	----	----	---
Jet Fuel (JP-4)	0.75	0.83(5)	----	----	---

t Values are given at 20°C unless noted. (1) Value is at 25°C.
(2) Value is at unknown temperature but is assumed to be 20o- 30°C.
(3) Value is at 15.6°C.
(4) Value is at 38°C.
(5) Value is at 21°C.
(6) Value is at 15°C.

(Lyman and Noonan, 1990)

Table 2-3 Groundwater Compliance Monitoring Well Water Quality - December 1999

Parameter (units)	CMW-1 (RFI2-5C) 12/7/99	CMW-2 12/7/99	CMW-3 12/7/99	CMW-4 12/7/99
	Monitoring Well Name / Sample Date			
Inorganics				
Antimony (ug/l)	5 U	5 U	5 U	5 U
Arsenic (ug/l)	19.7	10.2	51.9	21.6
Barium (ug/l)	713	835	563	294
Beryllium (ug/l)	0.3 U	0.3 U	0.71 J	0.3 U
Cadmium (ug/l)	0.3 U	0.44 J	0.94 J	0.97 J
Chromium (ug/l)	4.2 J	3.7 J	21	2 U
Cyanide (ug/l)	1.4 UJ	1.8 UJ	3.3 UJ	8
Lead (ug/l)	2.1 U	2.1 U	8.8 U	2.1 U
Mercury (ug/l)	0.1 U	0.1 U	0.1 U	0.1 U
Nickel (ug/l)	4.8 J	3.5 J	19.1 J	4.7 J
Selenium (ug/l)	2.9 U	2.9 U	2.9 U	2.9 U
Vanadium (ug/l)	6.2 J	6.3 J	36.5	2.3 J
Silver (ug/l)	2 U	2 U	2 U	2 U
Zinc (ug/l)	12.6 U	18.1 U	54.2 U	11.2 J
Volatile Organic Compounds				
Benzene (UG/L)	5 U	5 U	2 J	5 U
2-Butanone (UG/L)	5 U	5 U	5 U	5 U
Carbon Disulfide (UG/L)	5 UJ	5 UJ	5 UJ	5 UJ
Chlorobenzene (UG/L)	5 U	5 U	5 U	5 U
Chloroform (UG/L)	5 U	5 U	5 U	5 U
1,2-Dibromoethane (UG/L)	5 U	5 U	5 U	5 U
1,2-Dichloroethane (UG/L)	5 U	5 U	5 U	5 U
1,1-Dichloroethene (UG/L)	5 U	5 U	5 U	5 U
1,4-Dioxane (UG/L)	500 U	500 U	500 U	500 U
Ethylbenzene (UG/L)	5 U	1 J	12	5 U
Styrene (UG/L)	5 U	1 J	15	5 U
Tetrachloroethene (UG/L)	5 U	5 U	5 U	5 U
Toluene (UG/L)	5 U	5 U	1 J	5 U
1,1,1-Trichloroethane (UG/L)	5 U	5 U	5 U	5 U
1,2,4-Trimethylbenzene (UG/L)	5 U	5 U	13	5 U
1,3,5-Trimethylbenzene (UG/L)	5 U	5 U	3 J	5 U
Trichloroethene (UG/L)	5 U	5 U	5 U	2 J
Xylenes (Total) (UG/L)	5 U	5 U	10	5 U

Table 2-3 Groundwater Compliance Monitoring Well Water Quality - December 1999

Parameter (units)	CMW-1 (RFI2-5C) 12/7/99	CMW-2 12/7/99	CMW-3 12/7/99	CMW-4 12/7/99
SemiVolatile Organic Compounds				
Acenaphthene (UG/L)	10 U	10 U	10 U	10 U
Anthracene (UG/L)	10 U	10 U	10 U	10 U
Benzo(a)anthracene (UG/L)	10 U	10 U	10 U	10 U
Benzo(a)pyrene (UG/L)	10 U	10 U	10 U	10 U
Benzo(b)fluoranthene (UG/L)	10 U	10 U	10 U	10 U
bis(2-ethylhexyl)phthalate (UG/L)	11 U	10 U	10 U	10 U
Butyl benzyl phthalate (UG/L)	10 U	10 U	10 U	10 U
Chrysene (UG/L)	10 U	10 U	10 U	10 U
Di-n-butyl phthalate (UG/L)	1 J	10 U	1 J	1 J
Di-n-octyl phthalate (UG/L)	10 U	10 U	10 U	10 U
Dibenz(a,h)anthracene (UG/L)	10 U	10 U	10 U	10 U
1,2-Dichlorobenzene (UG/L)	10 U	10 U	10 U	10 U
1,4-Dichlorobenzene (UG/L)	10 U	10 U	10 U	10 U
2,4-Dimethylphenol (ug/l)	10 U	10 U	10 U	10 U
2,4-Dinitrotoluene (UG/L)	10 U	10 U	10 U	10 U
7,12-Dimethylbenz(a)anthracene (UG/L)	10 U	10 U	10 U	10 U
Fluoranthene (UG/L)	10 U	10 U	10 U	10 U
Fluorene (UG/L)	1 J	10 U	10 U	10 U
Indeno(1,2,3-cd)pyrene (UG/L)	10 U	10 U	10 U	10 U
1-Methylnaphthalene (UG/L)	10 U	10 U	1 J	10 U
2-Methylnaphthalene (UG/L)	10 U	1 J	2 J	10 U
2-Methylphenol (UG/L)	10 U	10 U	10 U	10 U
4-Methylphenol (UG/L)	10 U	10 U	10 U	10 U
Naphthalene (UG/L)	10 U	10 U	2 J	10 U
Nitrobenzene (UG/L)	10 U	10 U	10 U	10 U
Phenanthrene (UG/L)	10 U	10 U	10 U	10 U
Phenol (UG/L)	10 U	10 U	10 U	10 U
Pyrene (UG/L)	10 U	10 U	10 U	10 U
Pyridine (UG/L)	10 U	10 U	10 U	10 U

Monitoring Well Name / Sample Date

Notes (Codes and Qualifiers):
NA-Not Analyzed
RA-Reanalyzed
RE-Reextracted
DL-Dilution
U-Not Detected
J-Estimated value and/or below PQL.
B-Also detected in assoc'd blank (Organics)
E-Concentration exceeds instrument calibration (Organics)
N-Spike not within control limits (Inorganics)
*-Duplicate not within control limits (Inorganics)

Table 2-4 Groundwater Compliance Monitoring Well Water Quality - March 2000

Parameter (units)	CMW-1 (RFI2-5C) 3/22/00	CMW-2 3/22/00	CMW-3 3/22/00	CMW-4 3/22/00
	Monitoring Well Name / Sample Date			
Inorganics				
Antimony (ug/l)	2.6 U	2.6 U	2.6 U	2.6 U
Arsenic (ug/L)	22.5	17.6	56.2	24.4
Barium (ug/L)	697	1110	1580	670
Beryllium (ug/l)	0.4 U	0.75 B	2 B	0.87 B
Cadmium (ug/L)	0.7 U	1.5 B	2.7 B	1.1 B
Chromium (ug/L)	3 U	12	28.3	11.2
Lead (ug/L)	8.9	16.9	32.6	15.5
Mercury (ug/l)	0.1 U	0.1 U	0.1 U	0.1 U
Nickel (ug/L)	9 U	13.9 B	40.9	21.2 B
Selenium (ug/l)	2.9 U	2.9 U	3.3 B	2.9 U
Vanadium (ug/l)	15.9 B	38.1	88.6	45.1
Silver (ug/L)	2.7 U	2.7 U	2.7 U	2.7 U
Zinc (ug/l)	18.2 B	78	145	72.3
Volatile Organic Compounds				
Benzene (ug/L)	2 J	5 U	5 U	5 U
2-Butanone (ug/L)	5 U	5 U	5 U	5 U
Carbon Disulfide (ug/L)	5 U	5 U	5 U	5 U
Chlorobenzene (ug/L)	5 U	5 U	5 U	5 U
Chloroform (ug/L)	5 U	5 U	5 U	5 U
1,2-Dibromoethane (ug/L)	5 U	5 U	5 U	5 U
1,2-Dichloroethane (ug/L)	5 U	5 U	5 U	5 U
1,1-Dichloroethene (ug/L)	5 U	5 U	5 U	5 U
1,4-Dioxane (ug/l)	500 U	500 U	500 U	500 U
Ethylbenzene (ug/L)	5 U	5 U	5 U	5 U
Styrene (ug/L)	5 U	5 U	5 U	5 U
Tetrachloroethene (ug/L)	5 U	5 U	5 U	5 U
Toluene (ug/L)	5 U	5 U	5 U	5 U
1,1,1-Trichloroethane (ug/L)	5 U	5 U	5 U	5 U
1,2,4-Trimethylbenzene (ug/L)	5 U	5 U	5 U	5 U
1,3,5-Trimethylbenzene (ug/L)	5 U	5 U	5 U	5 U
Trichloroethene (ug/L)	5 U	5 U	5 U	5 U
Xylenes (Total) (ug/L)	5 U	5 U	5 U	5 U

Table 2-4 Groundwater Compliance Monitoring Well Water Quality - March 2000

Parameter (units)	CMW-1 (RFI2-5C) 3/22/00	CMW-2 3/22/00	CMW-3 3/22/00	CMW-4 3/22/00
	Monitoring Well Name Sample Date			
SemiVolatile Organic Compounds				
Acenaphthene (ug/L)	10 U	10 U	1 J	10 U
Anthracene (ug/L)	10 U	10 U	10 U	10 U
Benzo(a)anthracene (ug/L)	10 U	10 U	10 U	10 U
Benzo(a)pyrene (ug/L)	10 U	10 U	10 U	10 U
Benzo(b)fluoranthene (ug/L)	10 U	10 U	10 U	10 U
bis(2-ethylhexyl)phthalate (ug/L)	21 B	28 B	4 JB	4 JB
Butyl benzyl phthalate (ug/L)	10 U	2 J	10 U	10 U
Chrysene (ug/L)	10 U	10 U	10 U	10 U
Di-n-butyl phthalate (ug/L)	1 J	1 J	1 J	1 J
Di-n-octyl phthalate (ug/L)	10 U	10 U	10 U	10 U
Dibenz(a,h)anthracene (ug/L)	10 U	10 U	10 U	10 U
1,2-Dichlorobenzene (ug/L)	10 U	10 U	10 U	10 U
1,4-Dichlorobenzene (ug/L)	10 U	10 U	1 J	10 U
2,4-Dimethylphenol (ug/L)	10 U	10 U	10 U	10 U
2,4-Dinitrotoluene (ug/L)	10 U	10 U	10 U	10 U
7,12-Dimethylbenz(a)anthracene (ug/L)	10 U	10 U	10 U	10 U
Fluoranthene (ug/L)	10 U	10 U	10 U	10 U
Fluorene (ug/L)	10 U	10 U	10 U	10 U
Indeno(1,2,3-cd)pyrene (ug/L)	10 U	10 U	10 U	10 U
1-Methylnaphthalene (ug/L)	10 U	10 U	10 U	10 U
2-Methylnaphthalene (ug/L)	10 U	10 U	10 U	10 U
2-Methylphenol (ug/L)	10 U	10 U	10 U	10 U
4-Methylphenol (ug/L)	10 U	3 J	10 U	10 U
Naphthalene (ug/L)	10 U	10 U	10 U	10 U
Nitrobenzene (ug/L)	10 U	10 U	10 U	10 U
Phenanthrene (ug/L)	10 U	10 U	10 U	10 U
Phenol (ug/L)	10 U	10 U	10 U	10 U
Pyrene (ug/L)	1 J	10 U	1 J	10 U
Pyridine (ug/L)	10 U	10 U	10 U	10 U

Notes
(Codes and Qualifiers): NA-Not Analyzed, RA-Reanalyzed, RE-Reextracted, DL-Dilution
U-Not Detected
J-Estimated value and/or below PQL.
B-Also detected in assoc'd blank (Organics)
E-Concentration exceeds instrument calibration (Organics)
N-Spike not within control limits (Inorganics)
*-Duplicate not within control limits (Inorganics)

Table 2-5 Summary of Water Wells and Surface Water Users Within Three Miles of the Refinery

Map Number	Location	Owner/Tenant	Depth of Well Feet BGL	Diameter of Well (inches)	Geological Source	Use of Water**	Data Source
	T34S R3E						
1	SW SW SW/SECTION 24	---	34.0	---	---	IR	1
2	SW SW SW/SECTION 24	---	44.0	---	---	IR	1
3	SE SE SE/SECTION 24	---	44.0	---	---	IR	1
4	SW SW SW/SECTION 24	---	35.0	---	---	LA	1
5	SW SW SW/SECTION 24	HOFFINES	38.0	---	---	LA	1
6	SW SE SW/SECTION 24	D.V. BACH	44.0	---	---	LA	1
7	SW SE NE/SECTION 24	SANFORD ELECTRIC	50.0	---	---	LA	1
8	SW SW SE/SECTION 24	SWEETWOOD	52.0	---	---	LA	1
9	SE SE NW/SECTION 25	PARMAN	100.0	---	---	LA	1
10	SW SW NE/SECTION 25	LONG	50.0	---	---	LA	1
11	SW SW NE/SECTION 25	CUPPLES	45.0	---	---	LA	1
12	SE SW SE/SECTION 26	CITY OF ARKANSAS CITY	35.0	---	---	PU	1
13	NE SW SE/SECTION 26	CITY OF ARKANSAS CITY	38.0	---	---	PU	1
14	SE SW SE/SECTION 26	CITY OF ARKANSAS CITY	40.0	18.00	TERRACE DEPOSITS	PU	1
15	NE SW SE/SECTION 26	CITY OF ARKANSAS CITY	38.0	---	---	PU	1
16	SE NW NW/SECTION 35	---	---	---	---	PU	1
17	SE SE SW/SECTION 36	BARTON	---	---	---	LA	1
37	NE SE NW/SECTION 26	CITY OF ARKANSAS CITY	35.0	18.00	TERRACE DEPOSITS	PU	2
38	NE NW SE/SECTION 26	CITY OF ARKANSAS CITY	---	---	---	NR	2
39	SE SE NW/SECTION 26	CITY OF ARKANSAS CITY	---	---	---	NR	2
40	N/2 E/2 SE NW/SECTION 26	J & S, NEISES	---	---	---	NR	2
41	SE SE SW/SECTION 25	PARMAN	100.0	---	---	IR	2

Table 2-5 Summary of Water Wells and Surface Water Users Within Three Miles of the Refinery

Map Number	Location	Owner/Tenant	Depth of Well Feet BGL	Diameter of Well (inches)	Geological Source	Use of Water**	Data Source
	T34S R4E						
18	SE SE SE/SECTION 31	---	30.0	---	---	DE	1
19	SE SE SE/SECTION 31	---	37.0	---	---	DE	1
20	SE SE SE/SECTION 31	TOTAL PETROLEUM	31.0	---	---	IN	1
21	SE SE SE/SECTION 31	TOTAL PETROLEUM	28.0	---	---	IN	1
22	NE SW NE/SECTION 19	---	30.0	---	---	DO	1
23	NW WN SW/SECTION 20	KANSAS DEPT OF TRANS	48.0	---	---	DO	1
24	NW WN SW/SECTION 20	KANSAS DEPT OF TRANS	23.0	---	---	DO	1
25	SE SE NE/SECTION 21	KANSAS DEPT OF TRANS	57.0	---	---	DO	1
26	NE NE SE/SECTION 29	DICK VALYER	45.0	---	---	LA	1
31	NW NW NW/SECTION 34	---	50.0	---	---	IR	1
42	SW NW NE/SECTION 20	R. BIRDSELL	34.0	72.00	TERRACE DEPOSITS	IR	2
43	SW SW SE/SECTION 21	A.L. PARKER	41.0	6.00	TERRACE DEPOSITS	DO	2
44	NE NW NE/SECTION 28	A. MILLER	242.0	8.00	BARNESTON-LIMESTON	DO	2
45	SE SE SE/SECTION 33	E. BUZZI	16.0	1.25	TERRACE DEPOSITS	DO	2
46	SE SE SE/SECTION 34	A. GILSTRAP	22.0	1.25	TERRACE DEPOSITS	DO	2
48	NE SE SE/SECTION 29	D. VALYER	45.0	---	---	IR	2
61	SE SE SE/SECTION 30	---	---	---	---	SU	3
	T35S R4E						
27	NW SW NW/SECTION 5	---	33.0	---	---	IN	1
28	SE SE NW/SECTION 5	MEADOWS	27.0	---	---	DO	1
29	SE SW NE/SECTION 6	RWD #1	---	---	---	PS	1
30	SW SE NE/SECTION 6	RWD #1	37.0	---	---	PS	1

Table 2-5 Summary of Water Wells and Surface Water Users Within Three Miles of the Refinery

Map Number	Location	Owner/Tenant	Depth of Well Feet BGL	Diameter of Well (inches)	Geological Source	Use of Water**	Data Source
32	NE NE NW/SECTION 3	KF&G COMM	38.0	---	---	OT	1
49	SW NE NW/SECTION 4	A. DENTON	33.0	18.00	TERRACE DEPOSITS	IR	2
50	NW NW NW/SECTION 6	MAUER NEUR PACKING CO	48.0	18.00	ALLUVIUM	IN	2
51	SW SE NW/SECTION 6	BOLTON TWP COOPERATIVI	52.0	12.00	TERRACE DEPOSITS	PU	2
52	NE NE NE/SECTION 7	E. BROWN	210.0	6.00	BARNESTON-LIMESTON	NR	2
53	N/2 NE NW SE/SECTION 6	RWD #1	---	---	---	NR	2
54	N/2 SE SE NW/SECTION6	RWD #1	---	---	---	NR	2
	T35S R4E, CONT..						
55	3500'N, 3300'W OF SE CORNER OF SECTION 6	T. O. MORTON	---	---	---	NR	2
56	3766'N, 3360'W OF SE CORNER OF SECTION 8	T. O. MORTON	---	---	---	NR	2
57	N/2 NE NW/SECTION 4	KANSAS DEPT. OF WILDLIFE AND PARKS	---	---	---	NR	2
33	SW SW NE/SECTION 3	HARPER	80.0	---	---	DO	1
58	5000'N, 3000'W OF SE CORNER OF SECTION 3	KANSAS DEPT. OF WILDLIFE AND PARKS	---	---	---	---	2
59	SE NW/SECTION 5	ROBERT B. MEADOWS	---	---	---	DO	2
60	SE SW NE/SECTION 6	COWLEY CO, RWD #1	40.0	---	---	PS	1

Table 2-5 Summary of Water Wells and Surface Water Users Within Three Miles of the Refinery

Map Number	Location	Owner/Tenant	Depth of Well Feet BGL	Diameter of Well (inches)	Geological Source	Use of Water**	Data Source

NOTES:

1. BG = BELOW GROUND SURFACE
2. T = TOWNSHIP
3. R = RANGE
4. RWD = RUAL WATER DISTRICT
5. **USE OF WATER:

   DO: DOMESTIC
   IN: INDUSTRIAL
   IR: IRRIGATION
   OT: OTHER
   LA:LAWN AND GARDEN
   DE:DEWATERING
   NR:UNKNOWN
   SU:SURFACE WATER INTAKE
   OB: OBSERVATION
   PU: PUBLIC SUPPLY
6. --- NO DATA AVAILABLE

SOURCE:

1. KANSAS DEPARTMENT OF HEALTH AND ENVIRONMENT
2. ROBERT/SCHORNICK AND ASSOCIATES
3. KANSAS DEPARTMENT OF HEALTH AND ENVIRONMENT AND KANSAS DEPARTMENT OF AGRICULTURE.

Table 3-1 Summary of Wastes Applied to the LTU

Year	Pounds [1]
1997	574,000
1996	371,348
1995	25,280
1994	621,510
1993	1,084,831
1992	1,452,800
1991	389,852
1990	4,895,229

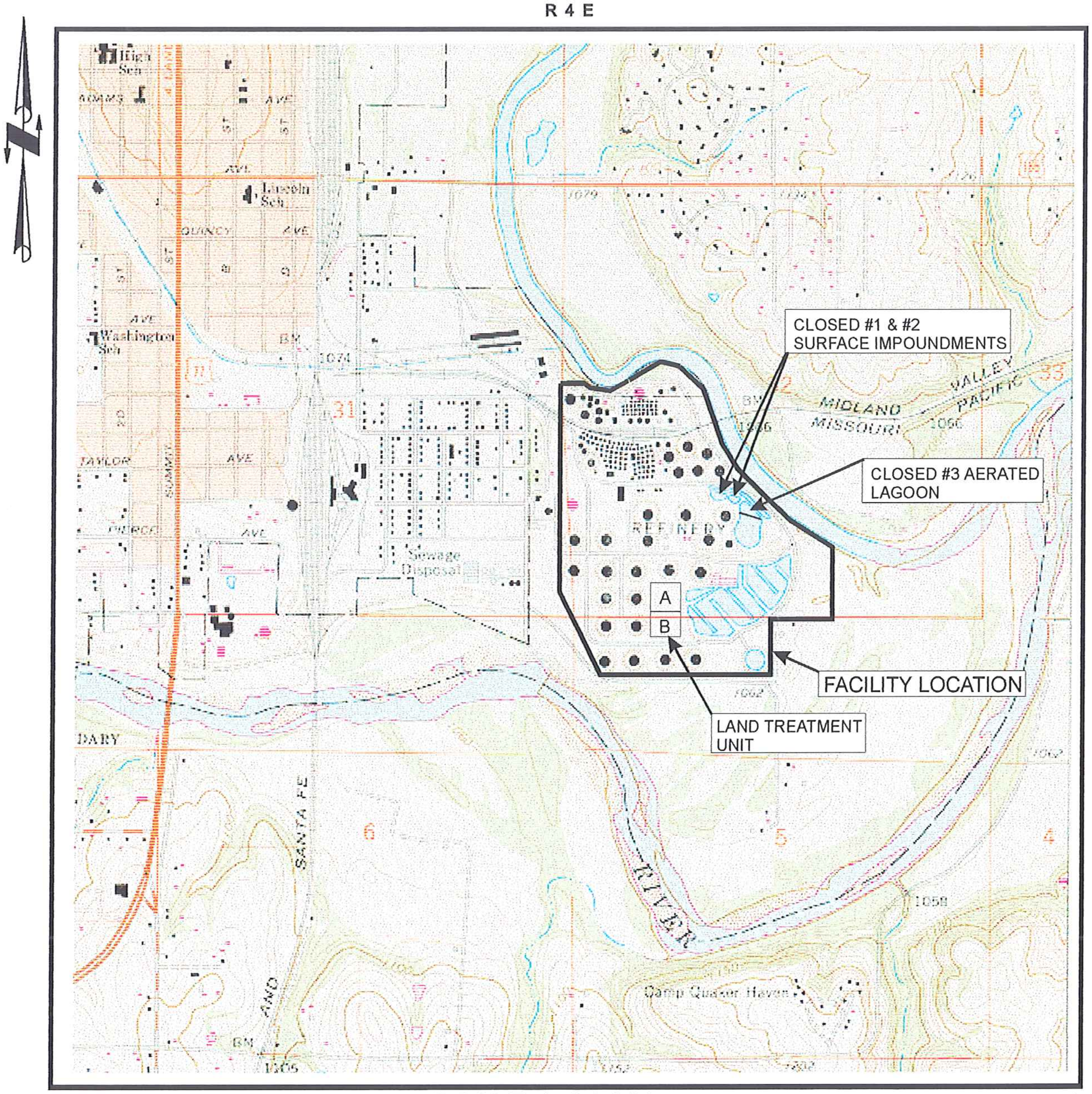
(1) = Pounds of waste determined from operation records (Earth Tech, 1998).

Table 6-1 Groundwater Corrective Action Monitoring Well Network

Water Quality Monitoring			Water Level Monitoring
Upgradient Monitoring Wells	**Performance Monitoring Wells**	**Supplemental Monitoring Wells**	**Capture Zone Monitoring Well Pairs**
WN-1A	WN-7B	MW-12	CMW-2 & 113
WN-1B	WN-8B	RCRA-4	CMW-3 & 118
	WN-6A		CMW-4 & MW-1002
	WN-6B		CMW-1 & RCRA-7
	MW-6		
	MW-13		
	MW-17		
	WN-5B		

FIGURES

R 4 E



T 34 S

T 35 S

SCALE 1: 24,000

1 1/2 0 1 MILE

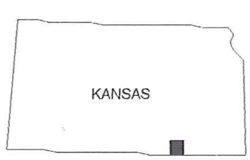
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

0 .5 0 1 KILOMETER

CONTOUR INTERVAL: 10 FEET

NATIONAL GEODETIC VERTICAL DATUM OF 1929

ARKANSAS CITY, KANS.
N3700-W9700/7.5
1965
PHOTOREVISED 1979
AMS 6558 II SE-SERIES V878



QUADRANGLE LOCATION

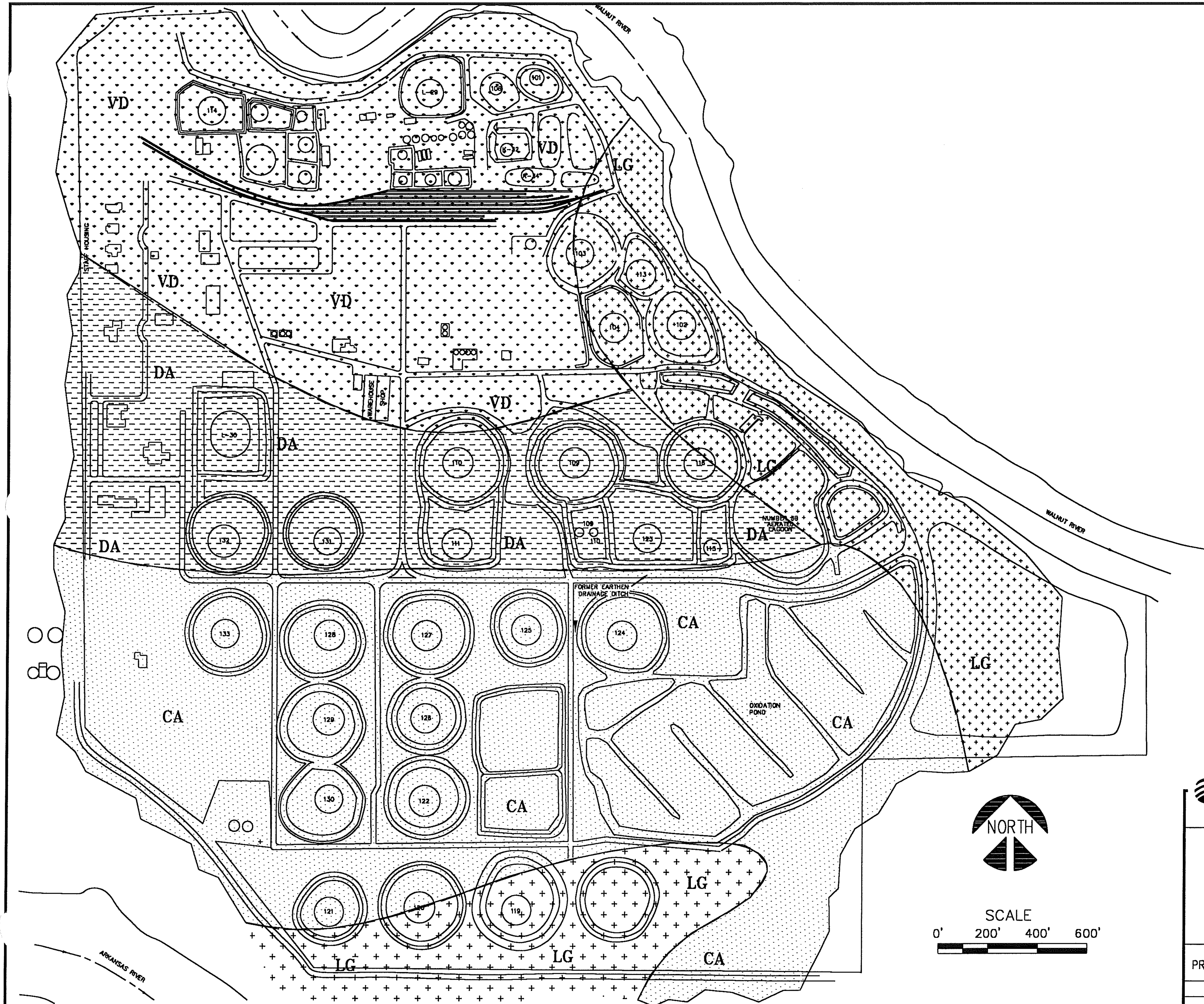
EnecoTech® ENVIRONMENTAL CONSULTANTS

FIGURE: 1-1

SITE LOCATION MAP

PROJECT: TPI PETROLEUM INC. - ARKANSAS CITY REFINERY

138R-011	DESIGNED BY:	J F M	APPROVED BY:		
138R11F1.CDR	DRAWN BY:	L K B	DATE:	2/25/97	REV:



LEGEND

- VD – VERDIGRIS SILT LOAM
- LG – LINCOLN-TIVOLI COMPLEX (FINE SANDY LOAM)
- DA – DALE SILT LOAM
- CA – CANADIAN FINE SANDY LOAM
- APPROXIMATE BOUNDARY OF SOIL TYPE

SOURCE: ROBERTS/SCHORNICK & ASSOCIATES, INC. 1992

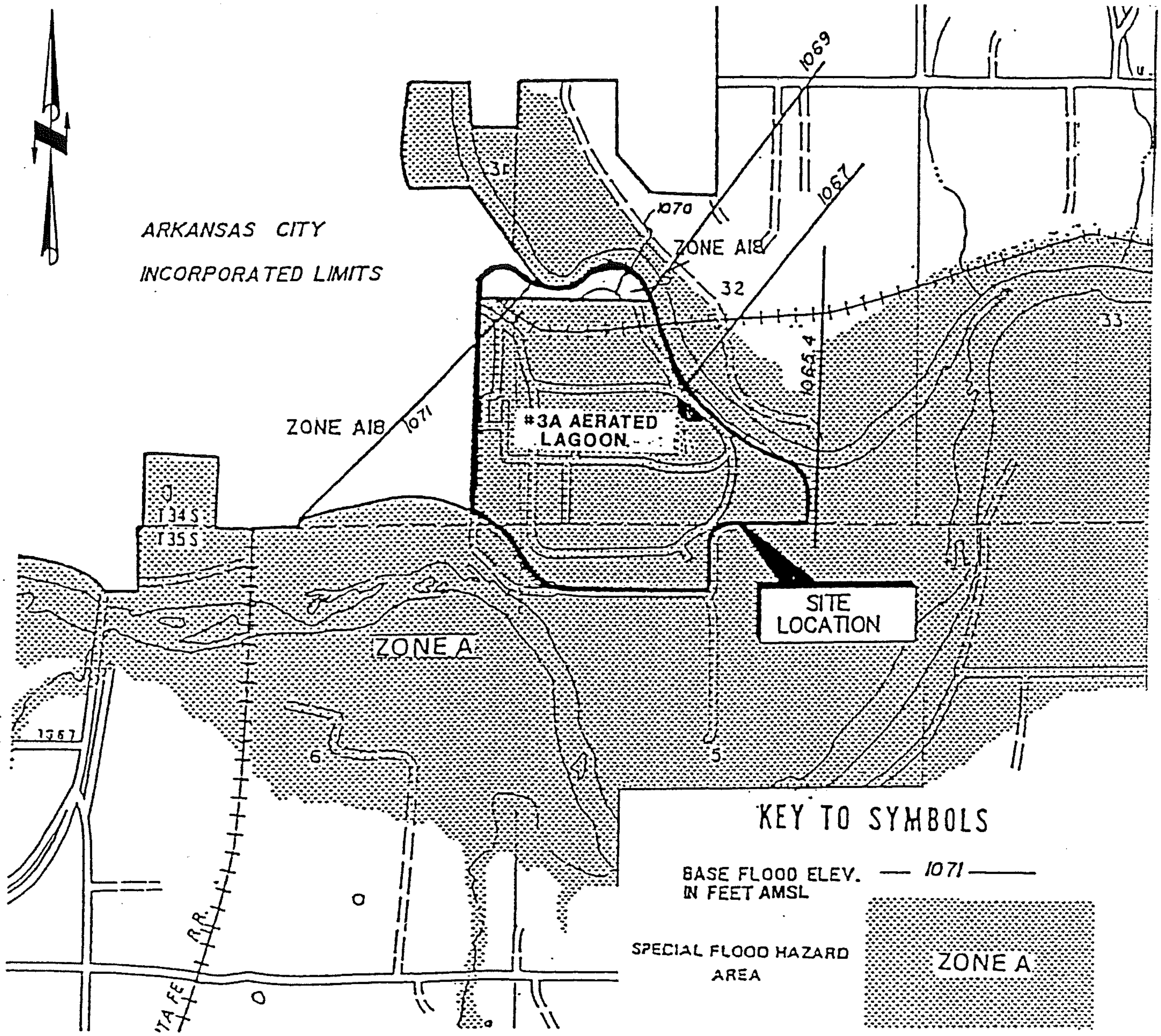
EnecoTech® ENVIRONMENTAL CONSULTANTS

Figure: 2-1

SURFACE SOIL TYPE MAP

PROJECT: TOTAL – ARKANSAS CITY REFINERY

01-0138R-014	DESIGNED BY: JFM	APPROVED BY:	
138R014V	DRAWN BY: GWT	DATE: 3/5/98	REV: 3/05/98

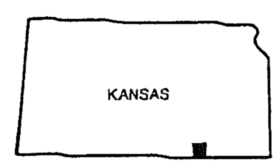


FLOOD HAZARD BOUNDARY MAP 7/19/77 FEMA 200563 0010A

NOTE: SOME OF THE INFORMATION LISTED ON
THE MAP OBTAINED FROM FLOOD INSURACE
RATE MAP, EFFECTIVE DATE: MAY 15, 1985
PANELS: 200070 0004 B
200070 0005 B

SCALE

0 1000' 2000'



QUADRANGLE LOCATION

EnecoTech
ENVIRONMENTAL CONSULTANTS

Figure: 2–2

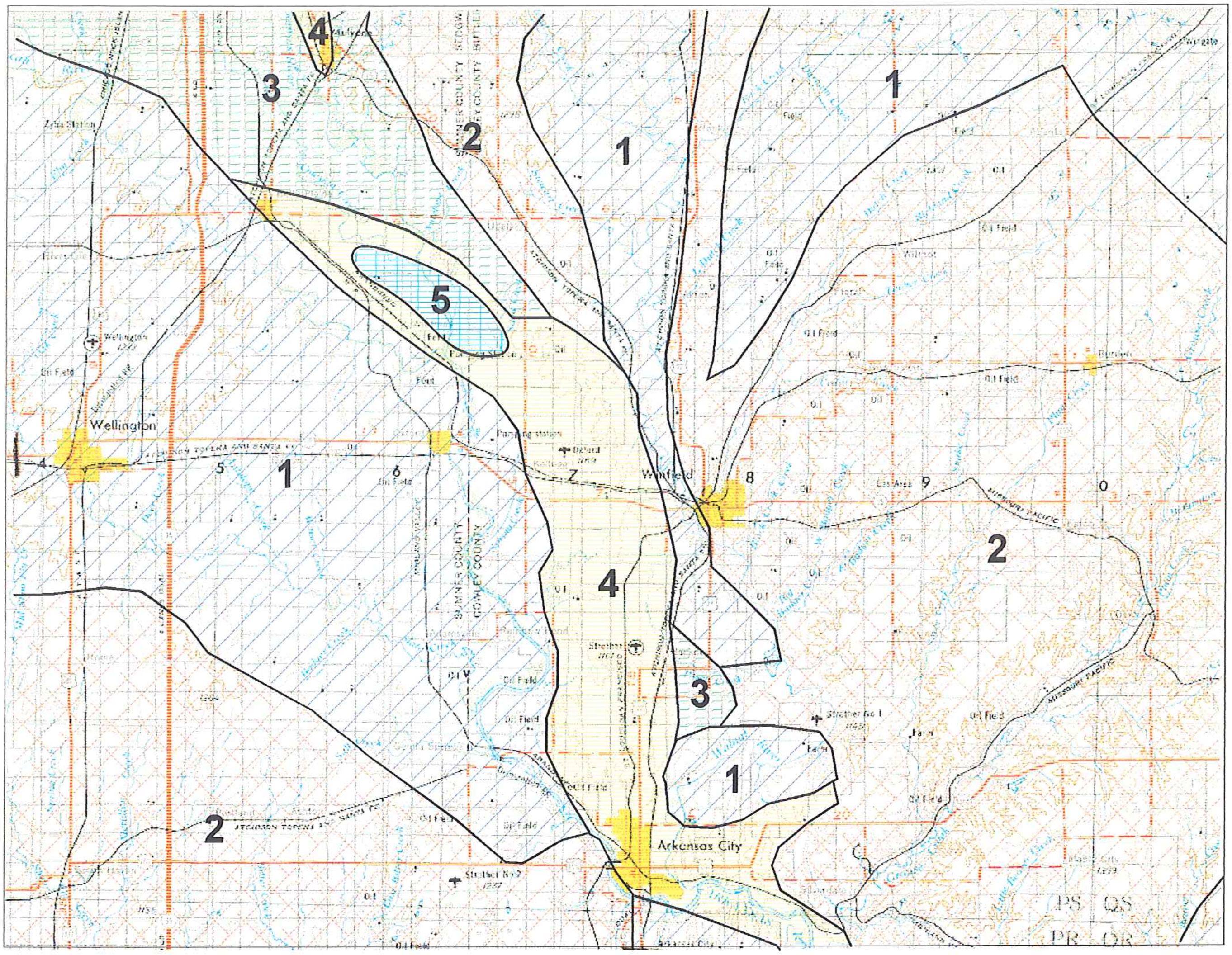
FLOOD HAZARD AREA MAP

TOTAL PETROLEUM, INC.
ARKANSAS CITY, KANSAS

PROJECT: TOTAL PETROLEUM, INC.

138R-014	DESIGNED BY JFM	APPROVED BY
138R014FCDR	DRAWN BY GWT	DATE 3/4/98 REV

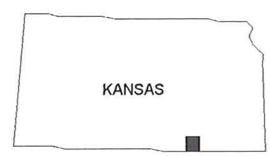
SOURCE: ROBERTS/SCHORNICK
& ASSOCIATES, INC. 1992



EXPLANATION

QUANTITY OF GROUND WATER GENERALLY AVAILABLE PER WELL, IN GALLONS PER MINUTE.

1	LESS THAN 10
2	10 TO 100
3	100 TO 500
4	500 TO 1000
5	GREATER THAN 1000



QUADRANGLE LOCATION

SOURCE: ROBERTS/SCHORNICK & ASSOCIATES, INC. 1992

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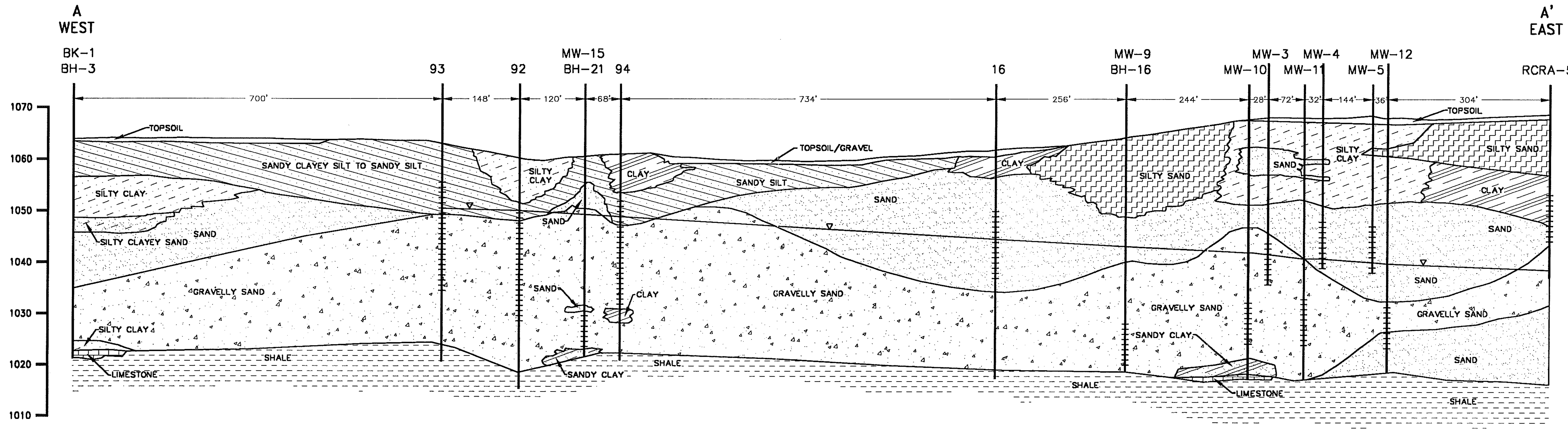
FIGURE: 2-3

MAP SHOWING AVAILABILITY OF GROUND WATER

TPI PETROLEUM, INC.
ARKANSAS CITY REFINERY

PROJECT: TPI PETROLEUM, INC.

138R-014	DESIGNED BY:	JFM	APPROVED BY:		
138R14F3.CDR	DRAWN BY:	LKB	DATE:	3/11/98	REV.



LEGEND

MONITOR WELL SCREENED INTERVAL

LITHOLOGY INTERPOLATED BETWEEN BORINGS

SCALE:
HORIZONTAL – 1"=200'
VERTICAL – 1"=20'

▽ GROUNDWATER POTENTIOMETRIC SURFACE JUNE 8-9, 1999

- TOPSOIL
- SILTY CLAY
- SILTY SANDY CLAY
- SANDY CLAY
- SANDY SILTY CLAY
- CLAY
- CLAYEY SANDY SILT
- SANDY SILT
- SILTY SAND
- GRAVELLY SAND
- SAND
- LIMESTONE
- SHALE

SOURCE: RSA 1992

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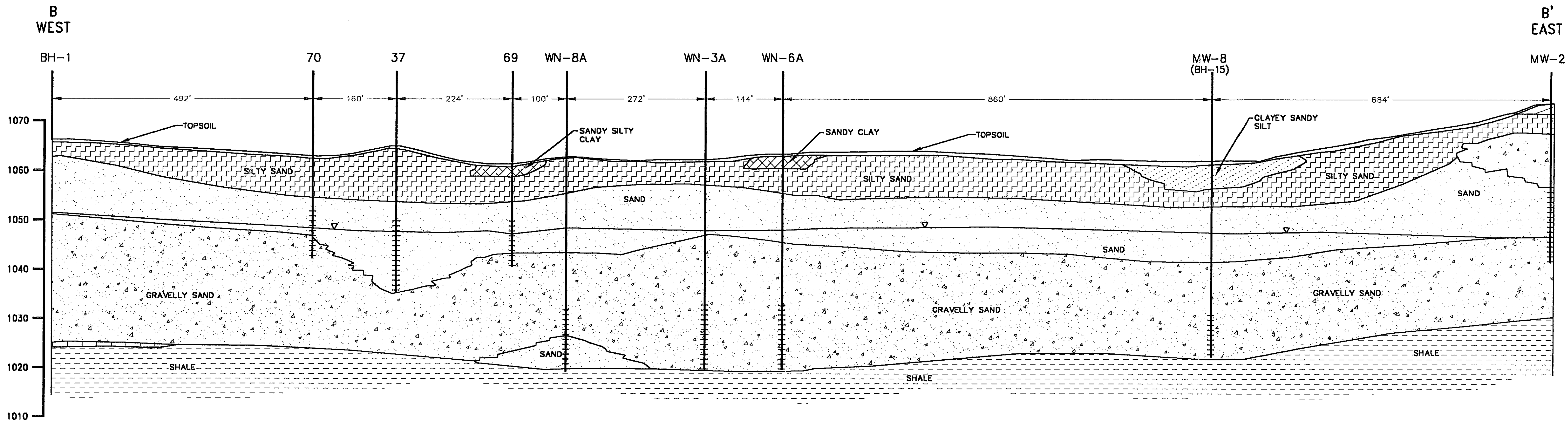
Figure: 2-4

GEOLOGICAL CROSS-SECTION A–A'

PROJECT: ARKANSAS CITY REFINERY – TPI PETROLEUM, INC.

13BR-014	DESIGNED BY: JFM	APPROVED BY:	
13BR014A	DRAWN BY: LKB	DATE: 7/2/99	REV:



LEGEND

MONITOR WELL SCREENED INTERVAL

LITHOLOGY INTERPOLATED BETWEEN BORINGS

SCALE:
HORIZONTAL – 1"=200'
VERTICAL – 1"=20'

▽ GROUNDWATER POTENTIOMETRIC SURFACE JUNE 8-9, 1999

TOPSOIL
SILTY CLAY
SILTY SANDY CLAY
SANDY SILTY CLAY
CLAY
CLAYEY SANDY SILT
SANDY SILT
SILTY SAND
GRAVELLY SAND
SAND
LIMESTONE
SHALE

SOURCE: RSA 1992

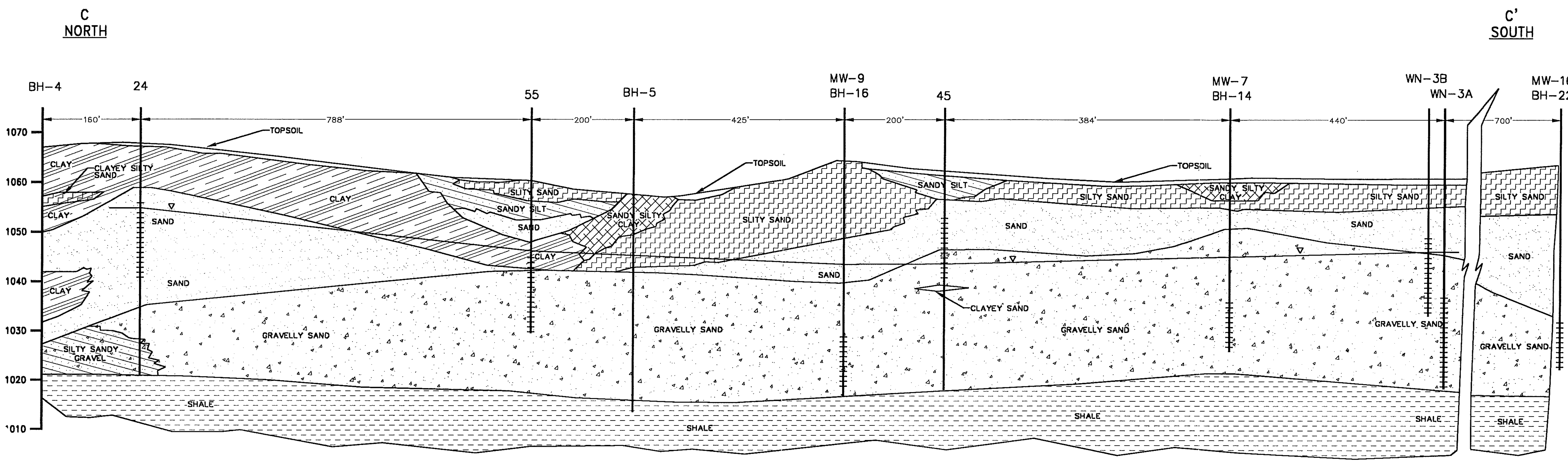
EnecoTech
ENVIRONMENTAL CONSULTANTS

Figure: 2-5

GEOLOGICAL CROSS-SECTION B-B'

PROJECT: ARKANSAS CITY REFINERY – TPI PETROLEUM, INC.

138R-014	DESIGNED BY: JFM	APPROVED BY:
138R0148	DRAWN BY: LKB	DATE: 7/2/99 REV:



LEGEND

MONITOR WELL
SCREENED INTERVAL

LITHOLOGY INTERPOLATED BETWEEN BORINGS

SCALE:
HORIZONTAL – 1"=200'
VERTICAL – 1"=20'

▽ GROUNDWATER POTENTIOMETRIC SURFACE JUNE 8-9, 1999

TOPSOIL
SILTY CLAY
SILTY SANDY CLAY
SANDY SILTY CLAY
CLAY
CLAYEY SANDY SILT
SANDY SILT
SILTY SAND
GRAVELLY SAND
SAND
LIMESTONE
SHALE

SOURCE: RSA 1992

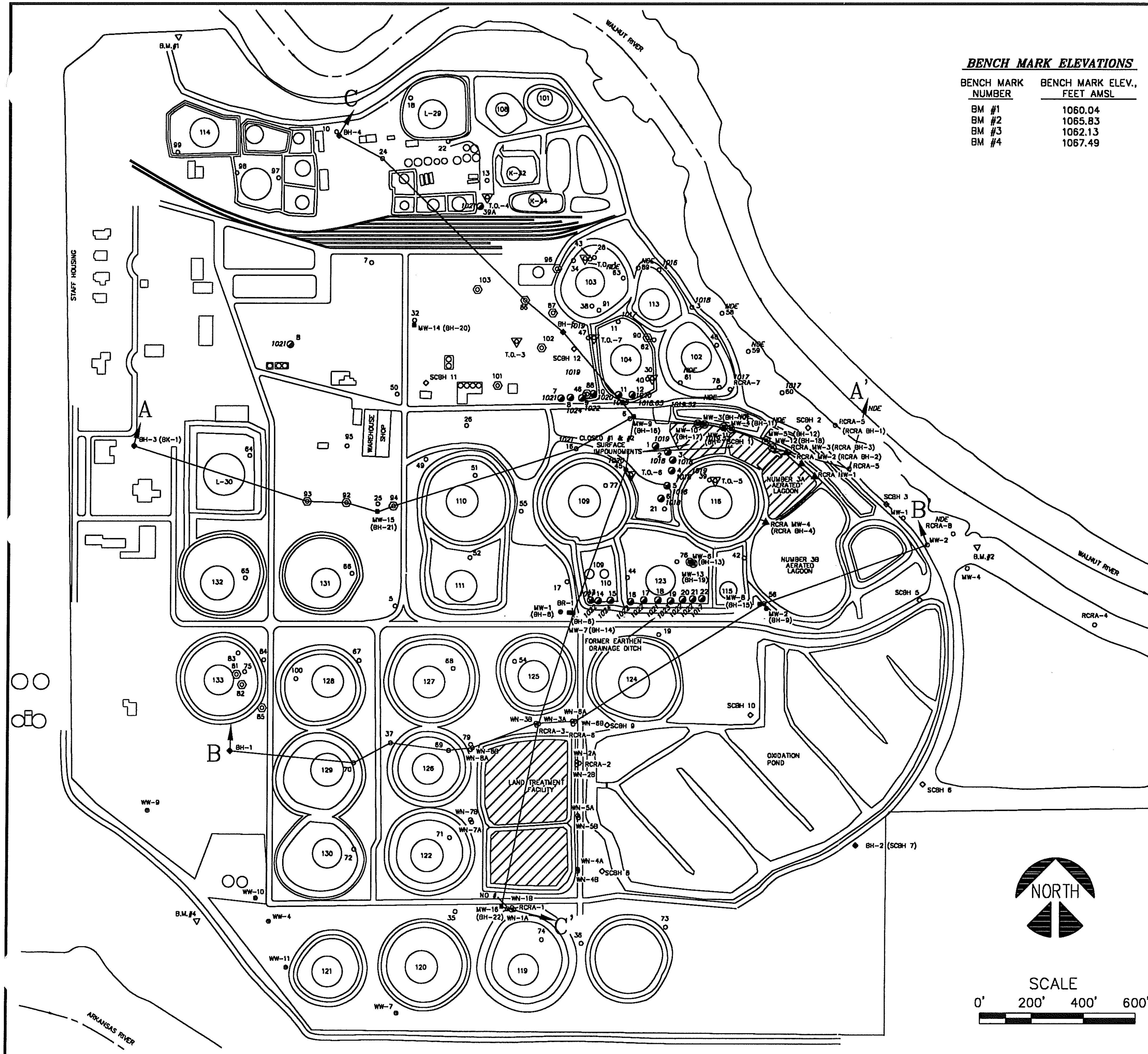
EnecoTech
ENVIRONMENTAL CONSULTANTS

Figure: 2-6

GEOLOGICAL CROSS-SECTION C-C'

PROJECT: ARKANSAS CITY REFINERY – TPI PETROLEUM, INC.

13BR-014	DESIGNED BY: JFM	APPROVED BY:
13BR014C	DRAWN BY: MJZ	DATE: 7/14/99 REV:



BENCH MARK ELEVATIONS

BENCH MARK NUMBER	BENCH MARK ELEV., FEET AMSL
BM #1	1060.04
BM #2	1065.83
BM #3	1062.13
BM #4	1067.49

MONITOR WELL DATA
(SHORT-TERM GROUNDWATER MONITORING INVESTIGATION)

WELL NUMBER	TOP CASING ELEV., FEET AMSL	GROUND ELEV., FEET AMSL
MW-1 (BH-8)	1064.58	1061.28
MW-2 (BH-9, SCBH-4)	1063.29	1060.03
MW-3 (BH-10)	1072.65	1068.47
MW-4 (BH-11)	1072.65	1068.64
MW-5 (BH-12)	1071.08	1067.40
MW-6 (BH-13)	1062.41	1060.34
MW-7 (BH-14)	1064.51	1061.41
MW-8 (BH-15)	1063.05	1060.16
MW-9 (BH-16)	1068.93	1065.15
MW-10 (BH-17)	1072.62	1068.82
MW-11 (BH-7, SCBH-1)	1071.93	1068.58
MW-12 (BH-18)	1070.83	1067.51
MW-13 (BH-19)	1063.02	1060.24
MW-14 (BH-20)	1064.35	1061.67
MW-15 (BH-21)	1063.38	1060.82
MW-16 (BH-22)	1068.10	1064.94
BR-1 (BH-6)	1064.76	1061.40

LEGEND

- MW-6 — STAINLESS STEEL RCRA SURFACE IMPOUNDMENT CLOSURE MONITORING WELL-SHALLOW ALLUVIAL AQUIFER
- MW-13 — STAINLESS STEEL RCRA SURFACE IMPOUNDMENT CLOSURE MONITORING WELL-DEEP ALLUVIAL AQUIFER
- MW-2 — PVC MONITORING WELL-SHALLOW ALLUVIAL AQUIFER
- MW-16 — PVC MONITORING WELL-DEEP ALLUVIAL AQUIFER
- BR-1 — PVC MONITORING WELL-BEDROCK
- BH-4 — SOIL BORING FOR LITHOLOGIC CHARACTERIZATION
- SCBH 5 — SOIL BORING DRILLED AS PART OF RFI SOIL CHARACTERIZATION
- 89 — EXISTING MONITORING WELL (INSTALLED BY OTHERS)
- RCRA MW-1 (RCRA BH-1) — NUMBER 3A AERATED LAGOON RCRA MONITORING WELL
- 85 — RECOVERY WELL (ONE PUMP)
- T.O.-3 — RECOVERY WELL (TWO PUMP)
- 2 — APPROXIMATE LOCATION OF ABANDONED BOREHOLE/WELL
- WW-11 — WATER SUPPLY WELL
- BM#4 — BENCH MARK SURVEYED AND REFERENCED TO AN OFF-SITE BENCH MARK
- 115 — ABOVE-GROUND PRODUCT STORAGE TANK
- APPROXIMATE PROPERTY LINE
- GEOLOGICAL CROSS-SECTION LINE

NOTE: THIS PLAN IS NOT A PLAT OF SURVEY.

NOTE: PREPARED BASED ON DATA FROM RSA, EEI, AND WOODWARD CLYDE INVESTIGATIONS.

SOURCE: ROBERTS/SCHORNICK & ASSOCIATES, INC. 1992

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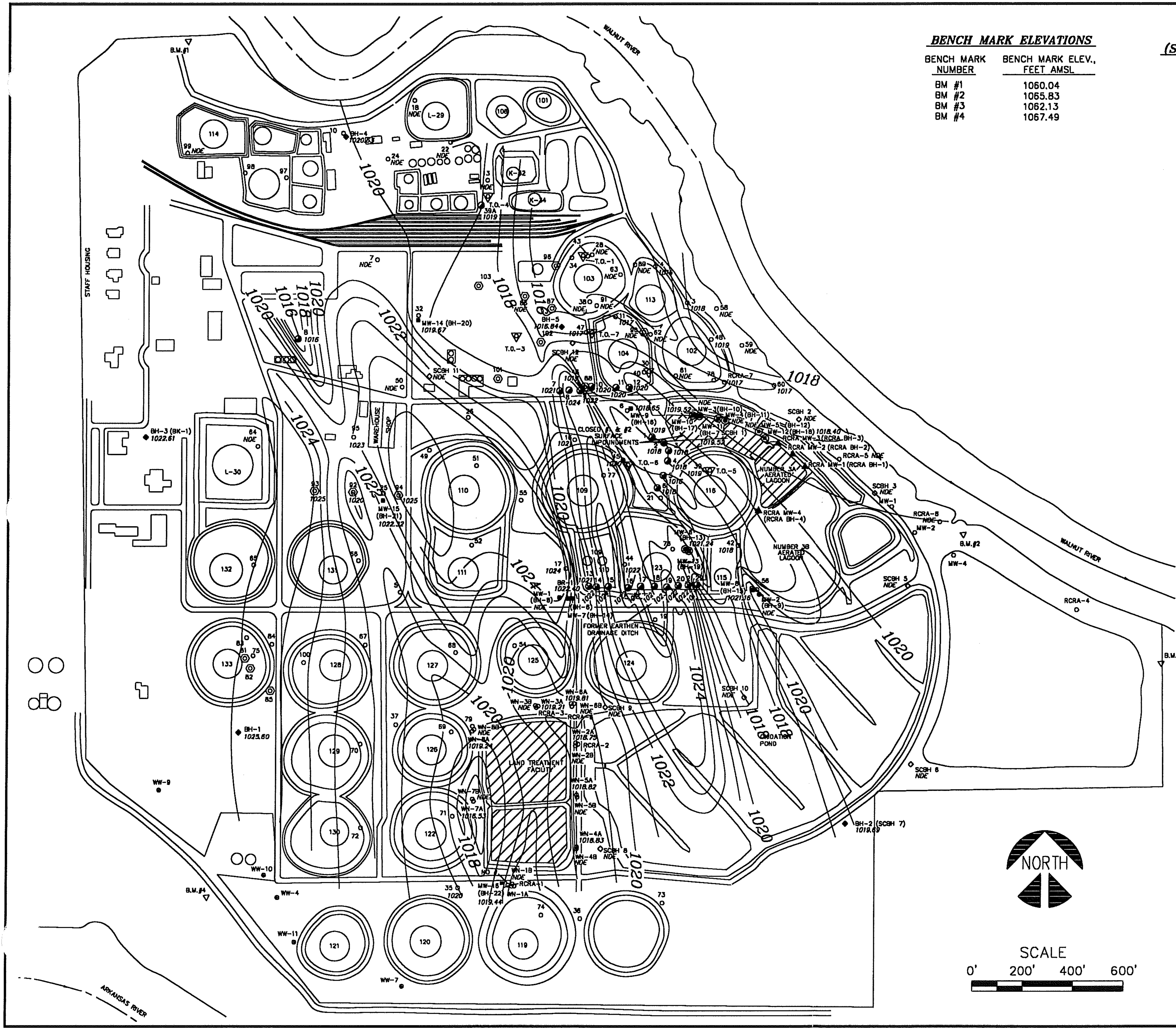
Figure: 2-7

FACILITY LAYOUT AND GEOLOGIC CROSS-SECTION LINES

PROJECT: TOTAL - ARKANSAS CITY REFINERY

01-0138R-014	DESIGNED BY: JFM	APPROVED BY:	
138014Z	DRAWN BY: GWT	DATE: 11/16/96	REV: 3/05/98



BENCH MARK ELEVATIONS

BENCH MARK NUMBER	BENCH MARK ELEV., FEET AMSL
BM #1	1060.04
BM #2	1065.83
BM #3	1062.13
BM #4	1067.49

MONITOR WELL DATA (SHORT-TERM GROUNDWATER MONITORING INVESTIGATION)

WELL NUMBER	TOP CASING ELEV., FEET AMSL	GROUND ELEV., FEET AMSL
MW-1 (BH-8)	1064.58	1061.28
MW-2 (BH-9, SCBH-4)	1063.29	1060.03
MW-3 (BH-10)	1072.65	1068.47
MW-4 (BH-11)	1072.65	1068.64
MW-5 (BH-12)	1071.08	1067.40
MW-6 (BH-13)	1062.41	1060.34
MW-7 (BH-14)	1064.51	1061.41
MW-8 (BH-15)	1063.05	1060.16
MW-9 (BH-16)	1068.93	1065.15
MW-10 (BH-17)	1072.62	1068.82
MW-11 (BH-7, SCBH-1)	1071.93	1068.58
MW-12 (BH-18)	1070.83	1067.51
MW-13 (BH-19)	1063.02	1060.24
MW-14 (BH-20)	1064.35	1061.67
MW-15 (BH-21)	1063.38	1060.82
MW-16 (BH-22)	1068.10	1064.94
BR-1 (BH-6)	1064.76	1061.40

LEGEND

Symbol	Description
MW-6	STAINLESS STEEL RCRA SURFACE IMPOUNDMENT CLOSURE MONITORING WELL-SHALLOW ALLUVIAL AQUIFER
MW-13	STAINLESS STEEL RCRA SURFACE IMPOUNDMENT CLOSURE MONITORING WELL-DEEP ALLUVIAL AQUIFER
MW-2	PVC MONITORING WELL-SHALLOW ALLUVIAL AQUIFER
MW-16	PVC MONITORING WELL-DEEP ALLUVIAL AQUIFER
BR-1	PVC MONITORING WELL-BEDROCK
BH-4	SOIL BORING FOR LITHOLOGIC CHARACTERIZATION
SCBH 6	SOIL BORING DRILLED AS PART OF RFI SOIL CHARACTERIZATION
89	EXISTING MONITORING WELL (INSTALLED BY OTHERS)
RCRA MW-1 (RCRA BH-1)	NUMBER 3A AERATED LAGOON RCRA MONITORING WELL
85	RECOVERY WELL (ONE PUMP)
T.O.-3	RECOVERY WELL (TWO PUMP)
2	APPROXIMATE LOCATION OF ABANDONED BOREHOLE/WELL
WW-11	WATER SUPPLY WELL
BM#4	BENCH MARK SURVEYED AND REFERENCED TO AN OFF-SITE BENCH MARK
115	ABOVE-GROUND PRODUCT STORAGE TANK
	APPROXIMATE PROPERTY LINE
1022	STRUCTURE CONTOUR, BEDROCK SURFACE, FEET AMSL CONTOUR INTERVAL = 2 FEET
1022.40	BEDROCK SURFACE ELEVATION, FEET AMSL
NDE	NOT DEEP ENOUGH

NOTE: THIS PLAN IS NOT A PLAT OF SURVEY.

NOTE: PREPARED BASED ON DATA FROM RSA, EEI, AND WOODWARD CLYDE INVESTIGATIONS.

SOURCE: ROBERTS/SCHORNICK & ASSOCIATES, INC. 1992

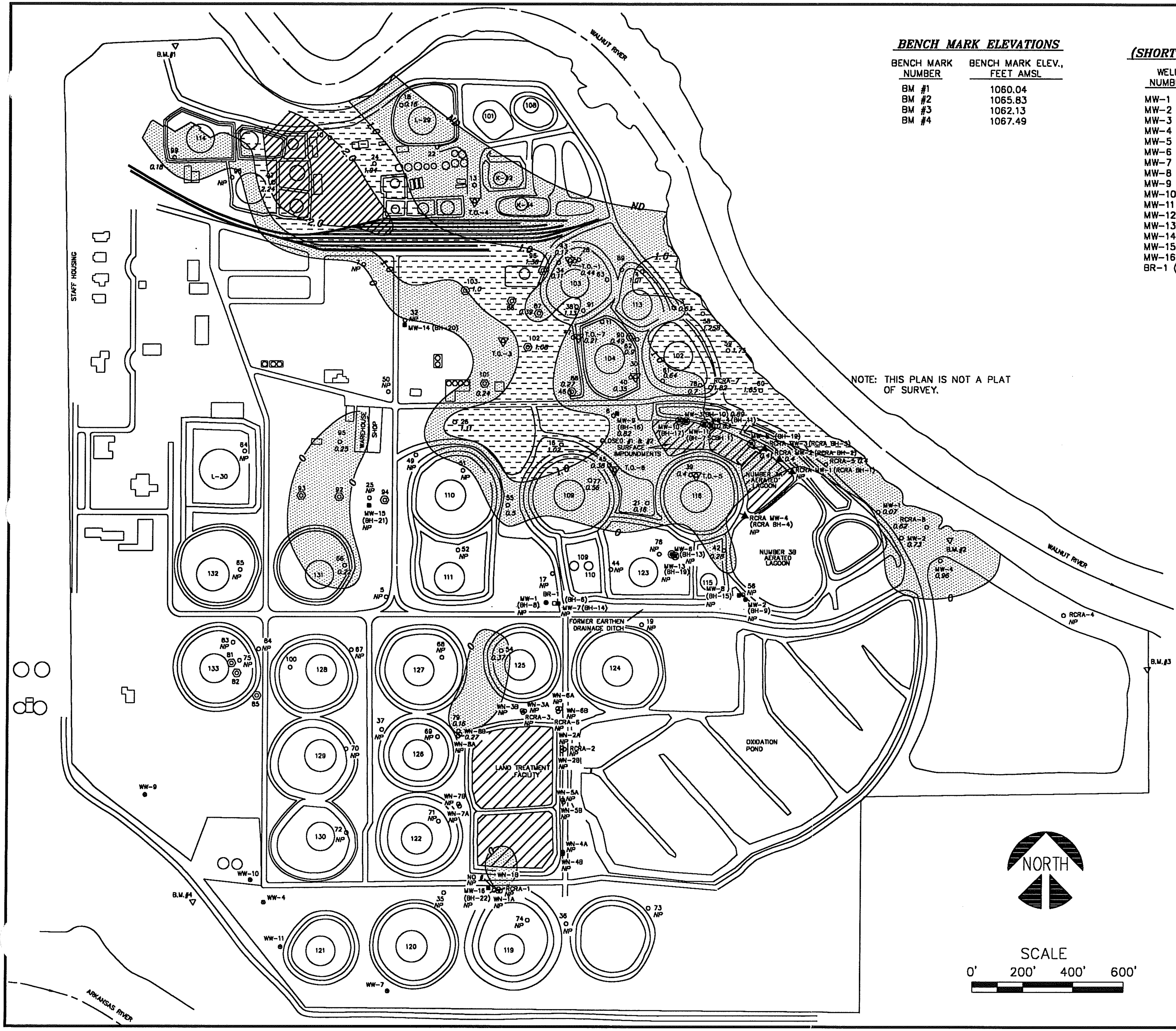
EnecoTech® ENVIRONMENTAL CONSULTANTS

Figure: 2-8

STRUCTURE CONTOUR MAP OF BEDROCK SURFACE, FEET AMSL

PROJECT: TOTAL - ARKANSAS CITY REFINERY

01-0138R-014	DESIGNED BY: JFM	APPROVED BY:
138R014X	DRAWN BY: GWT	DATE: 3/5/98 REV: 3/05/98



BENCH MARK ELEVATIONS

BENCH MARK NUMBER	BENCH MARK ELEV., FEET AMSL
BM #1	1060.04
BM #2	1065.83
BM #3	1062.13
BM #4	1067.49

MONITOR WELL DATA (SHORT-TERM GROUNDWATER MONITORING INVESTIGATION)

WELL NUMBER	TOP CASING ELEV., FEET AMSL	GROUND ELEV., FEET AMSL
MW-1 (BH-8)	1064.58	1061.28
MW-2 (BH-9, SCBH-4)	1063.29	1060.03
MW-3 (BH-10)	1072.65	1068.47
MW-4 (BH-11)	1072.65	1068.64
MW-5 (BH-12)	1071.08	1067.40
MW-6 (BH-13)	1062.41	1060.34
MW-7 (BH-14)	1064.51	1061.41
MW-8 (BH-15)	1063.05	1060.16
MW-9 (BH-16)	1068.93	1065.15
MW-10 (BH-17)	1072.62	1068.82
MW-11 (BH-7, SCBH-1)	1071.93	1068.58
MW-12 (BH-18)	1070.83	1067.51
MW-13 (BH-19)	1063.02	1060.24
MW-14 (BH-20)	1064.35	1061.67
MW-15 (BH-21)	1063.38	1060.82
MW-16 (BH-22)	1068.10	1064.94
BR-1 (BH-6)	1064.76	1061.40

NOTE: THIS PLAN IS NOT A PLAT OF SURVEY.

LEGEND

- MW-8 — STAINLESS STEEL RCRA SURFACE IMPOUNDMENT CLOSURE MONITORING WELL-SHALLOW ALLUVIAL AQUIFER
- MW-13 — STAINLESS STEEL RCRA SURFACE IMPOUNDMENT CLOSURE MONITORING WELL-DEEP ALLUVIAL AQUIFER
- MW-2 — PVC MONITORING WELL-SHALLOW ALLUVIAL AQUIFER
- MW-16 — PVC MONITORING WELL-DEEP ALLUVIAL AQUIFER
- BR-1 — PVC MONITORING WELL-BEDROCK
- 119 — EXISTING MONITORING WELL (INSTALLED BY OTHERS)
- RCRA MW-1 (RCRA BH-1) — NUMBER 3A AERATED LAGOON RCRA MONITORING WELL-SHALLOW ALLUVIAL AQUIFER
- 85 — RECOVERY WELL (ONE PUMP)
- T.O.-3 — RECOVERY WELL (TWO PUMP)
- WW-11 — WATER SUPPLY WELL
- BM#4 — BENCH MARK SURVEYED AND REFERENCED TO AN OFF-SITE BENCH MARK
- (115) — ABOVE-GROUND PRODUCT STORAGE TANK
- APPROXIMATE PROPERTY LINE
- 1.2 — FLOATING HYDROCARBON THICKNESS IN MONITOR WELL, FEET, 7/21/92
- FLOATING HYDROCARBON THICKNESS = 0 OR NO DATA AVAILABLE
- FLOATING HYDROCARBON THICKNESS > 0.0 FEET AND < 1.0 FEET
- FLOATING HYDROCARBON THICKNESS > 1.0 FEET AND < 2.0 FEET
- FLOATING HYDROCARBON THICKNESS > 2.0 FEET AND < 3.0 FEET
- ND — NO DATA
- NP — FLOATING HYDROCARBON NOT PRESENT

SOURCE: ROBERTS/SCHORNICK & ASSOCIATES, INC. 1992

EnecoTech® ENVIRONMENTAL CONSULTANTS

Figure: 2-9

ISOPACH OF FLOATING HYDROCARBON THICKNESS, FEET 7/21/92

PROJECT: TOTAL - ARKANSAS CITY REFINERY

01-0138R-014	DESIGNED BY: JFM	APPROVED BY:
138R014U	DRAWN BY: GWT	DATE: 3/5/98 REV: 3/05/98

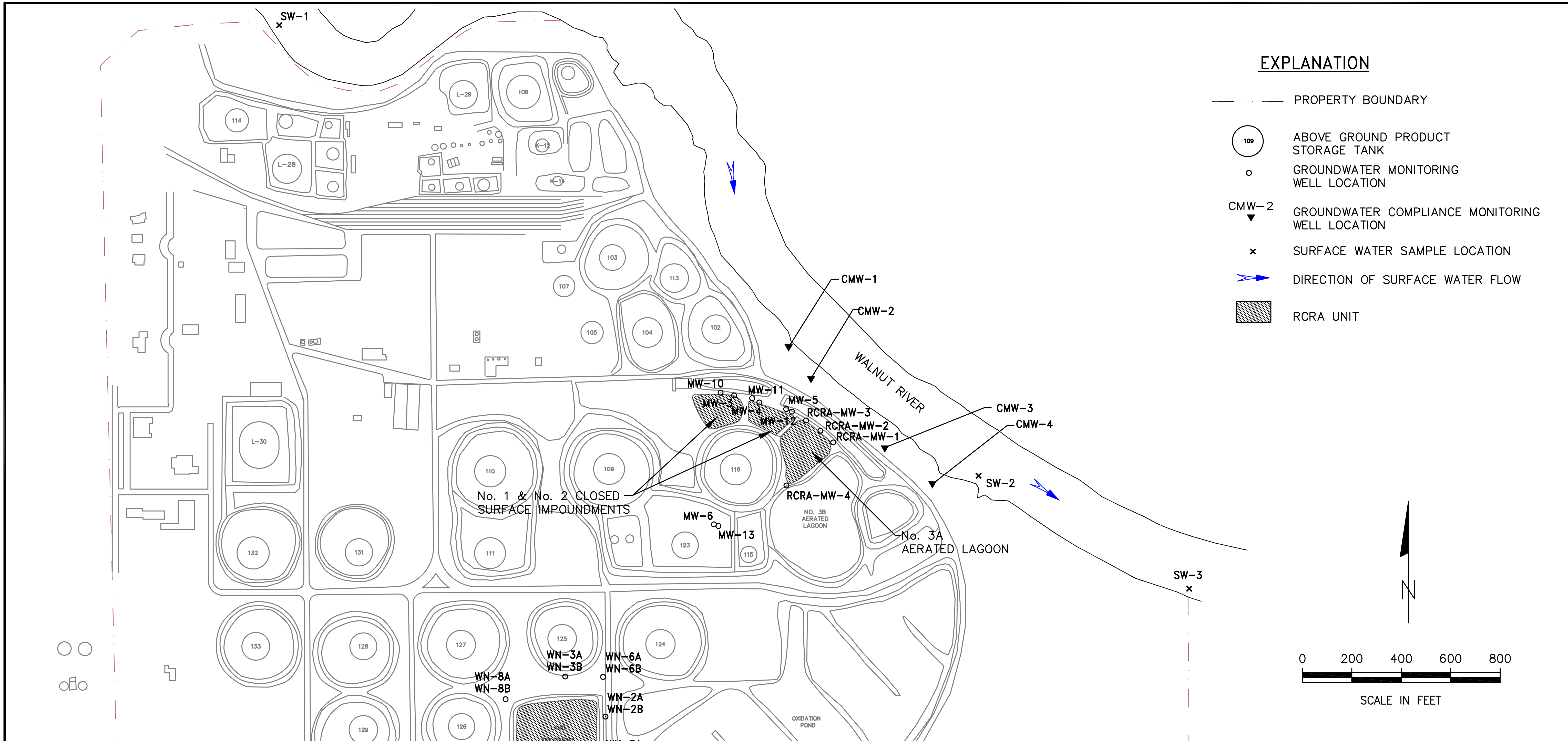


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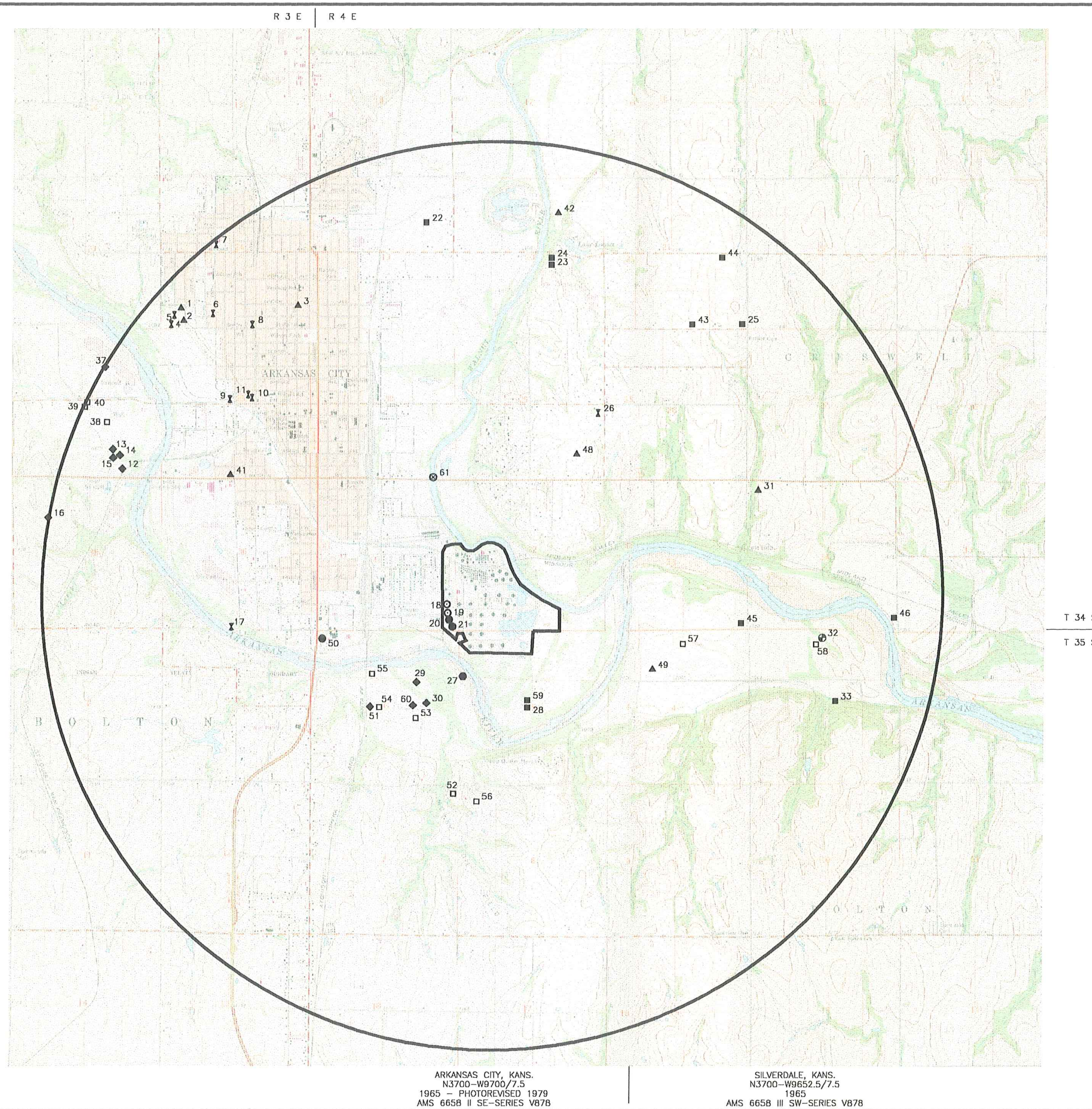
FIGURE: 2-10

MONITORING WELL AND SURFACE WATER SAMPLE LOCATION MAP

PROJECT: TPI ARKANSAS CITY REFINERY

01-0138R-016	DESIGNED BY: JFM	APPROVED BY: JFM	
138R014J	DRAWN BY: LKB	DATE: 11/15/94	REV: 7/31/00



EXPLANATION

MAP NO.	USE
▲	IRRIGATION WELL
⧗	LAWN/GARDEN WELL
■	DOMESTIC OR STOCK WELL
◆	PUBLIC WATER SUPPLY WELL
⊙	DEWATERING WELL
●	INDUSTRIAL WELL
⊘	OTHER
□	NOT REPORTED
⊗	SURFACE WATER INTAKE

SEE TABLE 15–1 FOR OWNWESHIP AND CONSTRUCTION INFORMATION

INFORMATION PRESENTED ON THIS FIGURE WAS OBTAINED FROM THE FOLLOWING SOURCES

1) KANSAS DEPARTMENT OF HEALTH AND ENVIRONMENT – PUBLIC WATER SUPPLY
2) KANSAS DEPARTMENT OF HEALTH AND ENVIRONMENT – BUREAU OF WATER
3) KANSAS DEPARTMENT OF HEALTH AND ENVIRONMENT – WATER RESOURCES DIVISION

N

FEET

0 2000 4000 6000 8000

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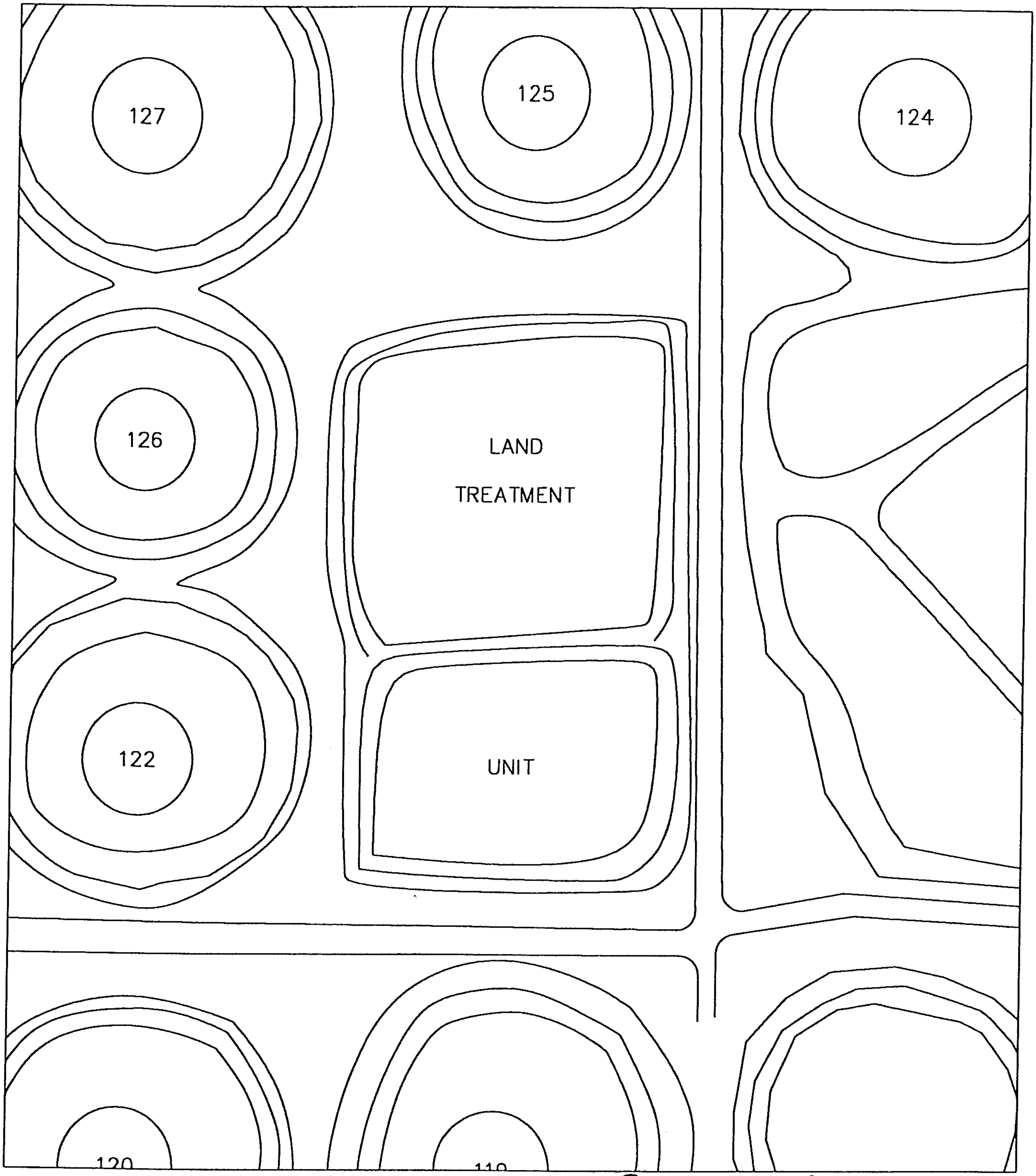
Figure: 2–11

WATER WELLS AND SURFACE WATER USERS WITHIN A THREE MILE RADIUS

PROJECT: TPI PETROLEUM, INC. – ARKANSAS CITY REFINERY

01–0138R–014	DESIGNED BY: JFM	APPROVED BY:	
OJT_WELL	DRAWN BY: LKB	DATE: 11/16/96	REV: 7/16/99



EXPLANATION

ABOVE GROUND PRODUCT
STORAGE TANK

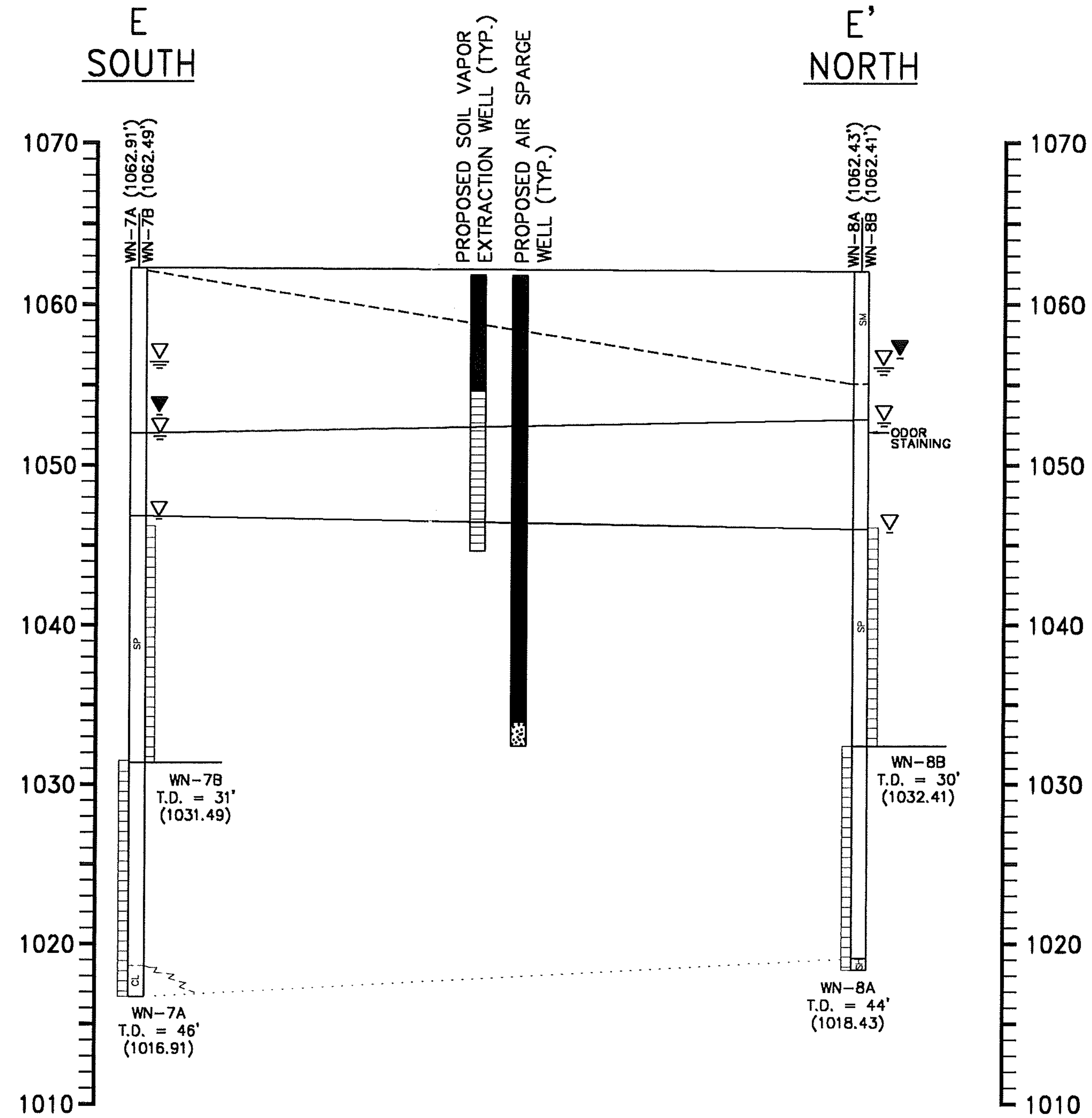
EnecoTech
ENVIRONMENTAL CONSULTANTS

Figure No.: 3-1

LAND TREATMENT UNIT

PROJECT: TPI PETROLEUM INC. - ARKANSAS CITY REFINERY

138R-014	DESIGNED BY: JFM	APPROVED BY: JFM	
138R014Y	DRAWN BY: LKB	DATE: 9/24/98	REV:



EXPLANATION

MONITOR WELL SCREENED INTERVAL

USCS SYMBOL/DESCRIPTION

SP – POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES

SM – SILTY-SANDS, SAND/SILT MIXTURES

GP – POORLY-GRADED GRAVELS, GRAVEL/SAND MIXTURES, LITTLE OR NO SAND

CL – INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS

SH – SHALE

▽ MAX WATER – MAXIMUM GROUND WATER LEVEL OBSERVED DURING NOVEMBER 1998 FLOOD

▽ HIGH WATER – NORMAL (NON FLOOD)MAXIMUM OBSERVED GROUND WATER LEVEL ELEVATION

▽ LOW WATER – LOWEST OBSERVED GROUND WATER LEVEL ELEVATION

▼ MAX PRODUCT – INDICATES HIGHEST ELEVATION OF FREE PRODUCT OBSERVED FLOATING ON TOP OF THE WATERTABLE.

------- CONTACT BETWEEN FINE(CLAY) SEDIMENTS AND SANDS & GRAVELS

SCALE:
HORIZONTAL – 1" = 60'
VERTICAL – 1" = 10'
VERTICAL EXAGGERATION = 6X
ELEVATIONS IN FEET ABOVE MEAN SEA LEVEL

10 / 0 / 60

LITHOLOGY INTERPOLATED BETWEEN BORINGS

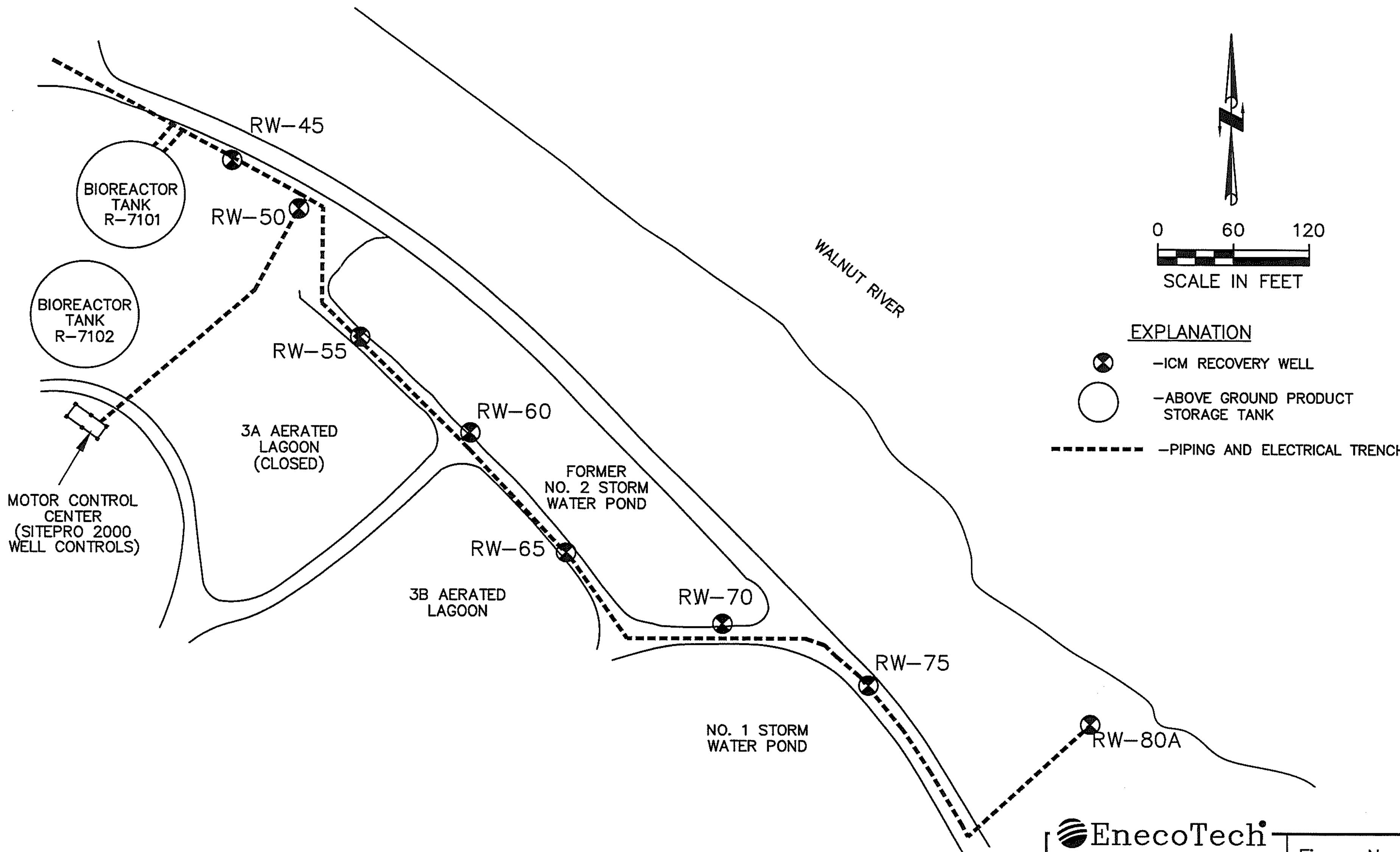
EnecoTech
ENVIRONMENTAL CONSULTANTS

Figure: 4-1

GEOLOGICAL CROSS-SECTION
LAND TREATMENT UNIT

PROJECT: ARKANSAS CITY REFINERY – TPI PETROLEUM, INC.

138R-014	DESIGNED BY: JFM	APPROVED BY:	
138R014F	DRAWN BY: LKB	DATE: 7/13/99	REV:



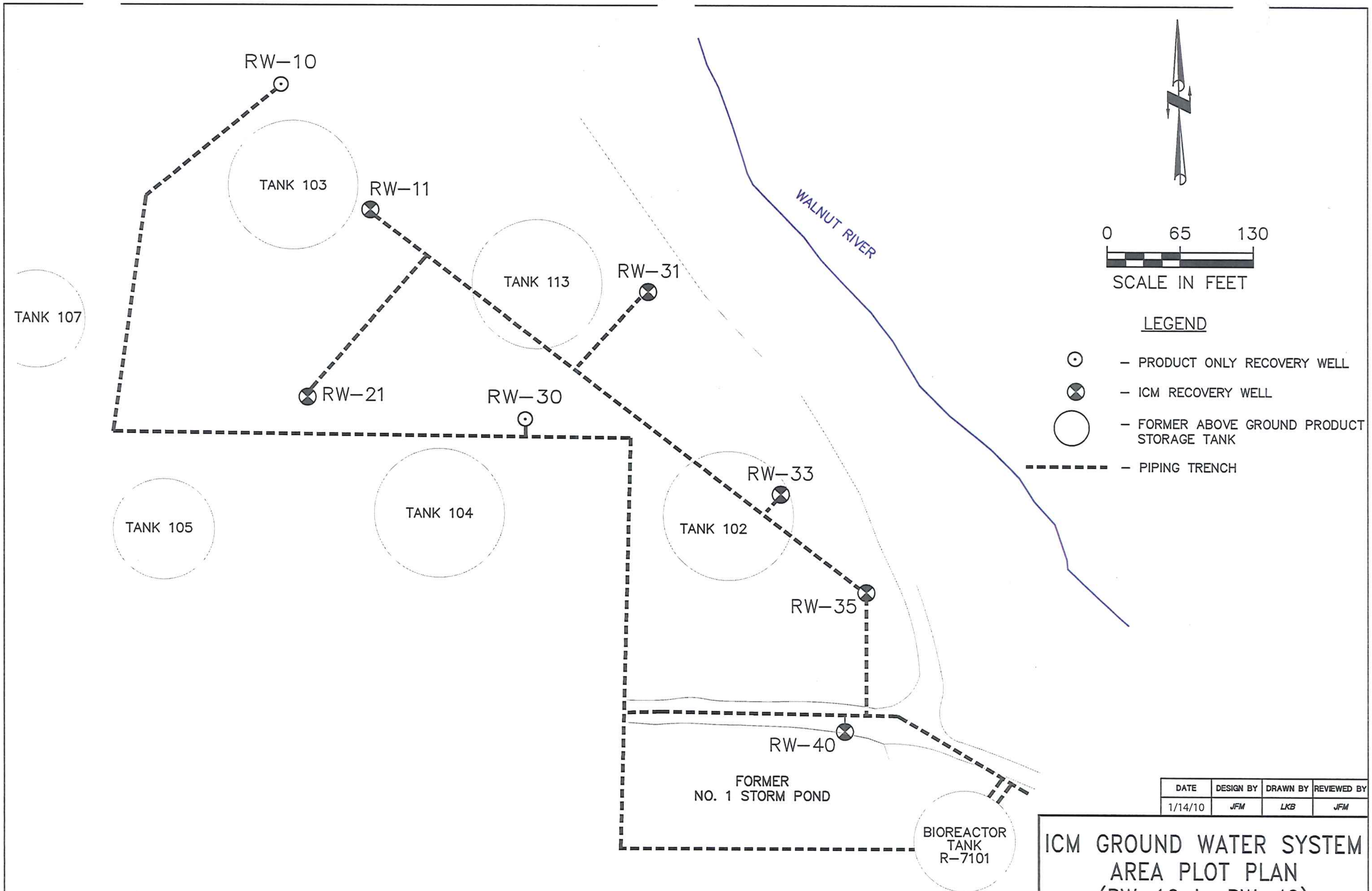
EnecoTech
ENVIRONMENTAL CONSULTANTS

Figure No.: 5–1a

ICM GROUND WATER SYSTEM AREA PLOT PLAN (RW–45 TO RW–80A)

PROJECT: TPI PETROLEUM INC. – ARKANSAS CITY REFINERY

138R–014	DESIGNED BY: JFM	APPROVED BY: JFM
\rev1\fig 5–1a	DRAWN BY: LKB	DATE: 9/24/98 REV: 8/2/00



DATE	DESIGN BY	DRAWN BY	REVIEWED BY
1/14/10	JFM	LKB	JFM

ICM GROUND WATER SYSTEM
AREA PLOT PLAN
(RW-10 to RW-40)

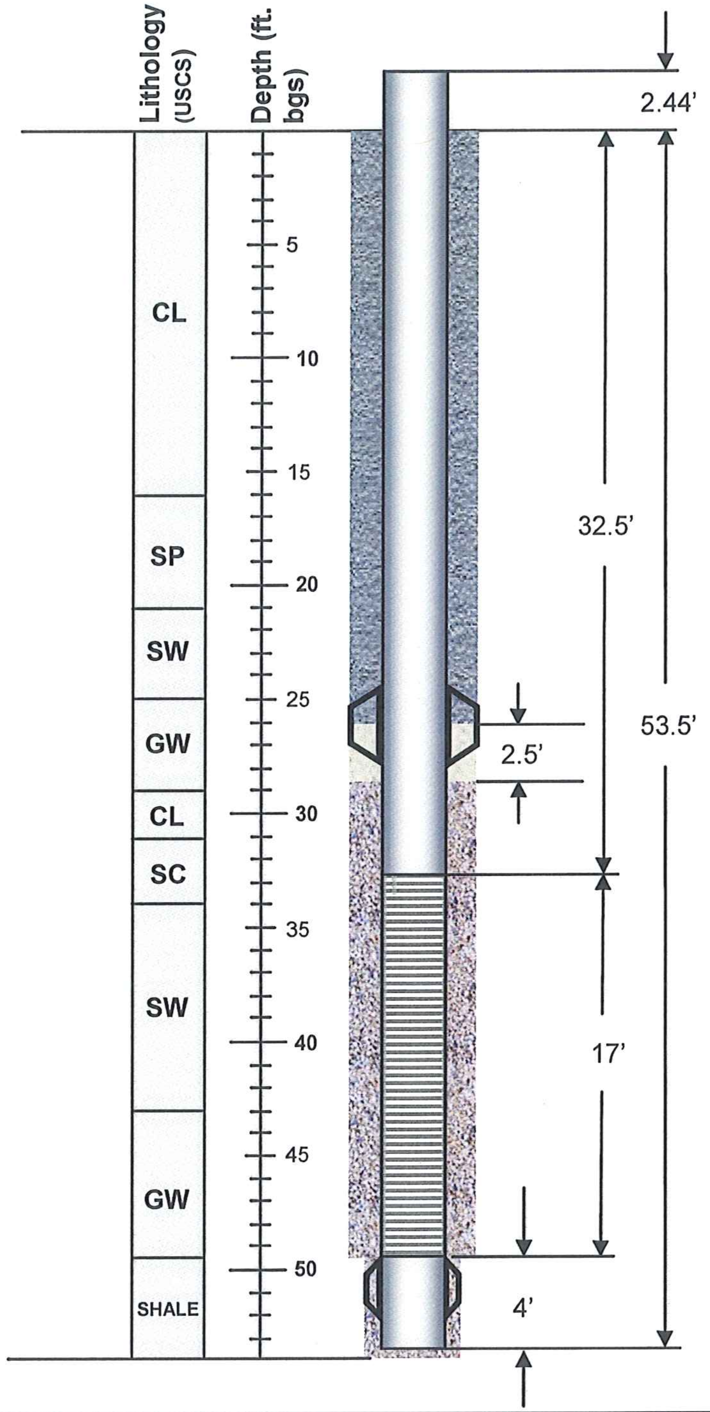
PROJECT: ARKANSAS CITY, KANSAS
MICHIGAN REUTILIZATION, LLC.

MWH

Figure No.: 5-1bR

AutoCAD FILE: Fig 5-1b REV
PROJECT NUMBER: 1005197

WELL CONSTRUCTION DIAGRAM



BOREHOLE:
Diameter: 24" (0-49.5'), 16" (49.5-54')

SURFACE SEAL:
Material: Cement Grout
Length: 26' (0-26')

BENTONITE SEAL:
Material: Bentonite Chips
Length: 2.5' (26-28.5')

FILTER PACK:
Material: 3-12 Silica Sand
Length: 25' (28.5-53.5')

WELL CASING:
Material: Certa-lok™ Sch. 40 PVC 12" Dia.
Length: 32.5' bgs

WELL SCREEN:
Material: Stainless Steel 12" Dia. 40 Slot
Length: 17' (32.5-49.5')

BOTTOM SUMP:
Material: Stainless Steel 12 " Dia.
Length: 4' (49.5-53.5')

STATIC WATER LEVEL: 31.8' (3/12/07) **ft bgs**

DATE STARTED: 3/8/07 **FINISH:** 3/12/07

LOGGED BY: Jason Garnsey

DRILLING CONTRACTOR: Layne Western

DRILLER: Kevin Holub

DRILLING METHOD: Reverse Circulation

DRILLING FLUID: Water

WELL DEVELOPMENT METHOD:
Bail, swab, overpump

SURVEY (site coordinates):

Top of Casing Elevation: 1071.34 **ft amsl**

Ground Surface Elevation: 1068.9 **ft amsl**

Northing: -749.309 **Easting:** 2076.840

EXPLANATION

The stratification lines on the borehole log represent the approximate boundary between soil and rock types. The transition between these boundaries may be more gradual than depicted on this log.

WELL CONSTRUCTION

- Cement Grout (surface seal)
- Bentonite Seal
- Filter Pack
- Well Screen
- Well Casing
- Casing Centralizer

LITHOLOGY

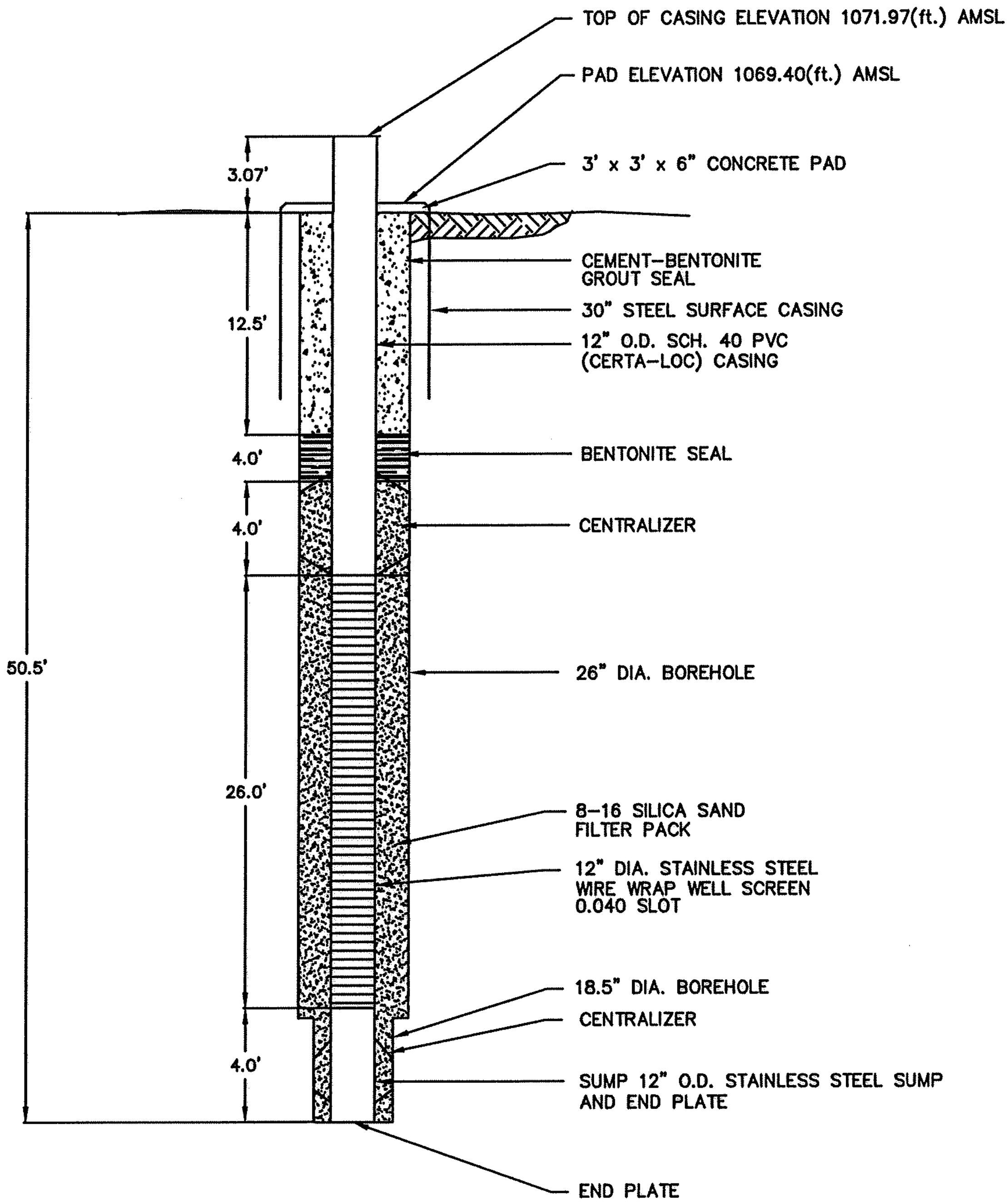
GW	Well-graded gravels, gravel-sand mixtures, little or no fines
SW	Well-graded sands, gravelly sands, little or no fines
SP	Poorly graded sands, gravelly sands, little or no fines
SC	Clayey sands, sand-clay mixtures
CL	Inorganic clays of low to med. plasticity, gravelly clays, sandy clays, silty clays, lean clays
SHALE	Shale Bedrock

RECOVERY WELL RW-40 CONSTRUCTION DIAGRAM

PROJECT:
MICHIGAN REUTILIZATION, LLC ARKANSAS CITY, KANSAS

MWH

Figure No.: 5-2



BUILT BY: LAYNE–WESTERN
DATE COMPLETED: 9/1/04

SECTION
NOT TO SCALE

MWH

Figure No.: 5-3

RECOVERY WELL RW–50
CONSTRUCTION DIAGRAM

PROJECT: TPI PETROLEUM INC. – ARKANSAS CITY REFINERY

4270189	DESIGNED BY: JFM	APPROVED BY: JFM
RW–50_101904	DRAWN BY: LKB	DATE: 9/30/04 REV:

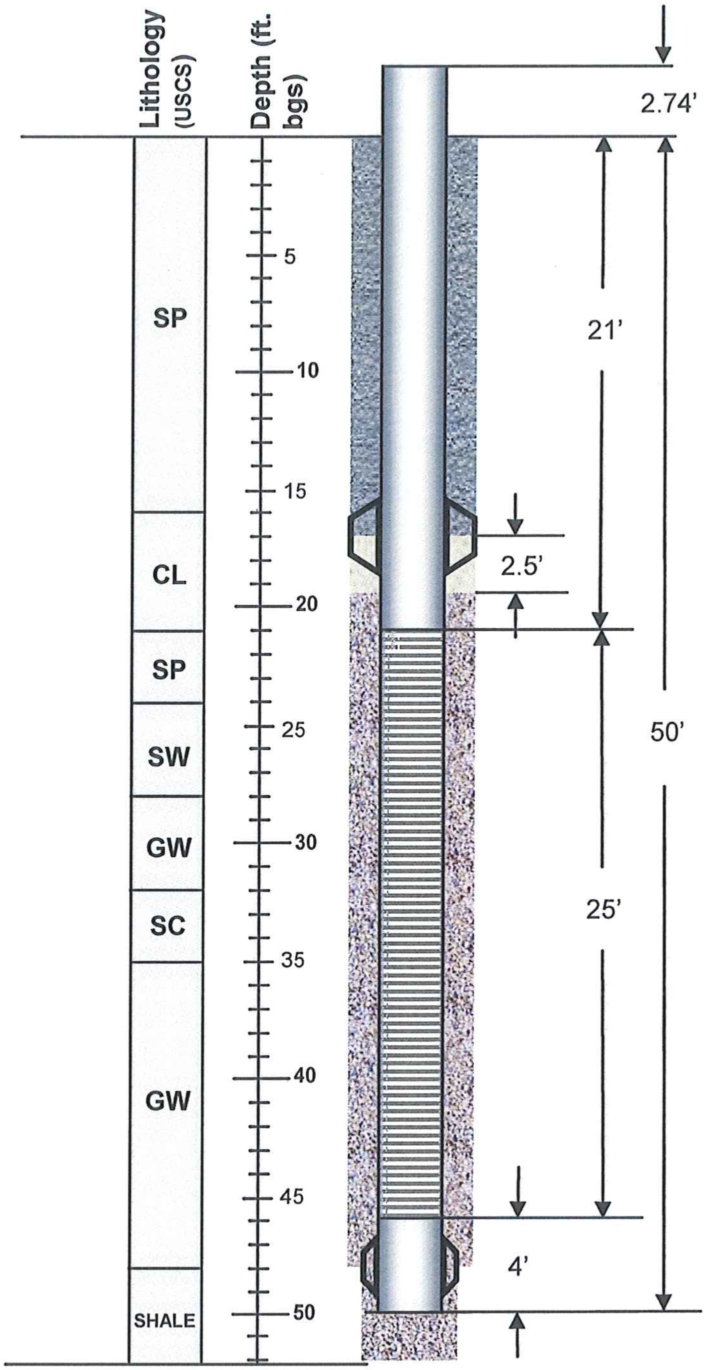
LOCATION (Plant Coordinates)

NORTHING –834.49(ft.)
EASTING 2248.23(ft.)

ELEVATIONS IN FEET ABOVE MEAN SEA LEVEL (AMSL)

FILENAME: Well Const Log rev2 DATE: 5/25/2007

WELL CONSTRUCTION DIAGRAM



BOREHOLE:
Diameter: 24" (0-46'), 16" (46-52')

SURFACE SEAL:
Material: Cement Grout
Length: 17' (0-17')

BENTONITE SEAL:
Material: Bentonite Chips
Length: 2.5' (17-19.5')

FILTER PACK:
Material: 3-12 Silica Sand
Length: 30.5' (19.5-50')

WELL CASING:
Material: Certa-lok™ Sch. 40 PVC 12" Dia.
Length: 21' bgs

WELL SCREEN:
Material: Stainless Steel 12" Dia. 50 Slot
Length: 25' (21-46')

BOTTOM SUMP:
Material: Stainless Steel 12 " Dia.
Length: 4' (46-50')

STATIC WATER LEVEL: 30.5 (3/2/07) **ft bgs**

DATE STARTED: 2/22/07 **FINISH:** 3/5/07

LOGGED BY: Jason Garnsey

DRILLING CONTRACTOR: Layne Western

DRILLER: Kevin Holub

DRILLING METHOD: Reverse Circulation

DRILLING FLUID: Water

WELL DEVELOPMENT METHOD:
Bail, swab, overpump

SURVEY (site coordinates):

Top of Casing Elevation: 1072.01 **ft amsl**

Ground Surface Elevation: 1069.27 **ft amsl**

Northing: -1019.172 **Easting:** 2403.951

EXPLANATION

The stratification lines on the borehole log represent the approximate boundary between soil and rock types. The transition between these boundaries may be more gradual than depicted on this log.

WELL CONSTRUCTION

- Cement Grout (surface seal)
- Bentonite Seal
- Filter Pack
- Well Screen
- Well Casing
- Casing Centralizer

LITHOLOGY

GW	Well-graded gravels, gravel-sand mixtures, little or no fines
SW	Well-graded sands, gravelly sands, little or no fines
SP	Poorly graded sands, gravelly sands, little or no fines
SC	Clayey sands, sand-clay mixtures
CL	Inorganic clays of low to med. plasticity, gravelly clays, sandy clays, silty clays, lean clays
SHALE	Shale Bedrock

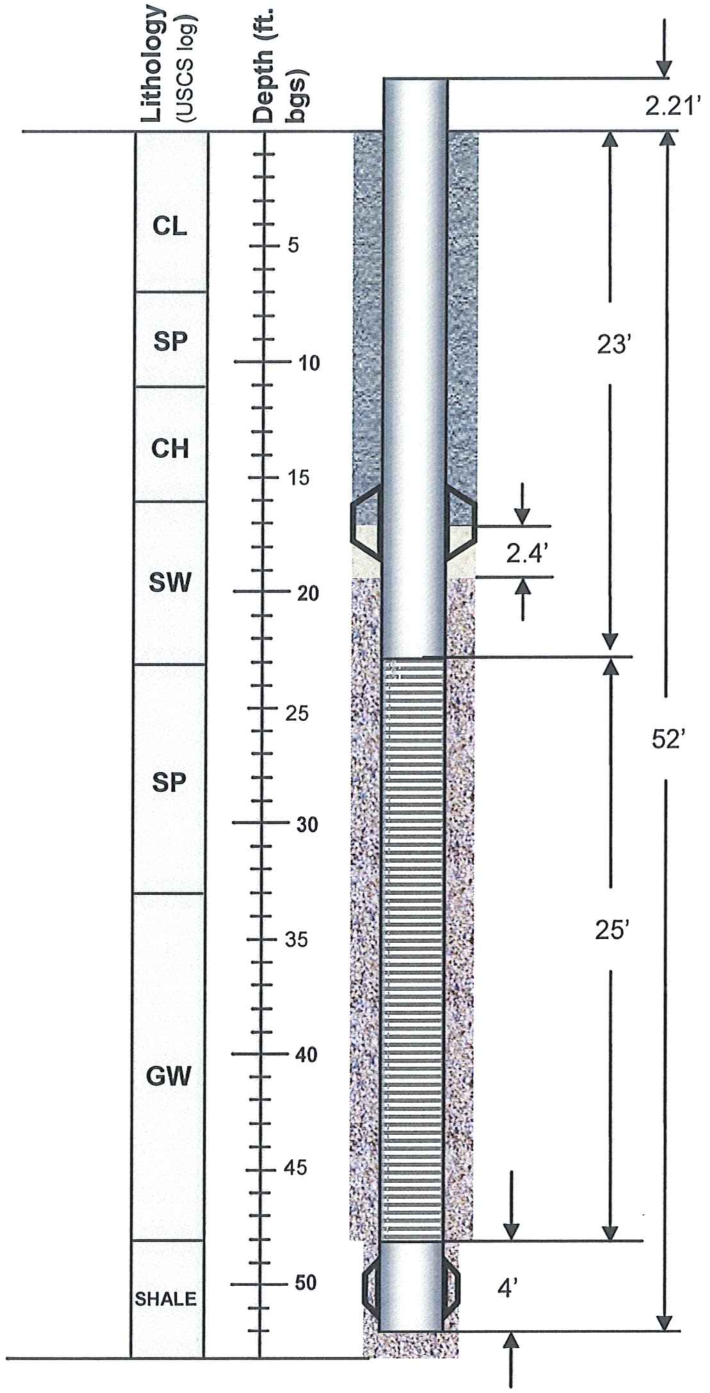
RECOVERY WELL RW-60 CONSTRUCTION DIAGRAM

PROJECT:
MICHIGAN REUTILIZATION, LLC
ARKANSAS CITY, KANSAS

MWH

Figure No.: 5-4

WELL CONSTRUCTION DIAGRAM



BOREHOLE:
Diameter: 24" (0-48'), 16" (48-55.5')

SURFACE SEAL:
Material: Cement Grout
Length: 17' (0-17')

BENTONITE SEAL:
Material: Bentonite Chips
Length: 2.4' (17-19.4')

FILTER PACK:
Material: 3-12 Silica Sand
Length: 32.6' (19.4-52')

WELL CASING:
Material: Certa-lok™ Sch. 40 PVC 12" Dia.
Length: 23' bgs

WELL SCREEN:
Material: Stainless Steel 12" Dia. 40 Slot
Length: 25' (23-48')

BOTTOM SUMP:
Material: Stainless Steel 12 " Dia.
Length: 4' (48-52')

STATIC WATER LEVEL: 29.15 (3/3/07) **ft bgs**

DATE STARTED: 3/2/07 **FINISH:** 3/6/07

LOGGED BY: Jason Garnsey

DRILLING CONTRACTOR: Layne Western

DRILLER: Kevin Holub

DRILLING METHOD: Reverse Circulation

DRILLING FLUID: Water

WELL DEVELOPMENT METHOD:
Bail, swab, overpump

SURVEY (site coordinates):

Top of Casing Elevation: 1071.52 **ft amsl**

Ground Surface Elevation: 1069.31 **ft amsl**

Northing: -1144.458 **Easting:** 2652.055

EXPLANATION

The stratification lines on the borehole log represent the approximate boundary between soil and rock types. The transition between these boundaries may be more gradual than depicted on this log.

WELL CONSTRUCTION

- Cement Grout (surface seal)
- Bentonite Seal
- Filter Pack
- Well Screen
- Well Casing
- Casing Centralizer

LITHOLOGY

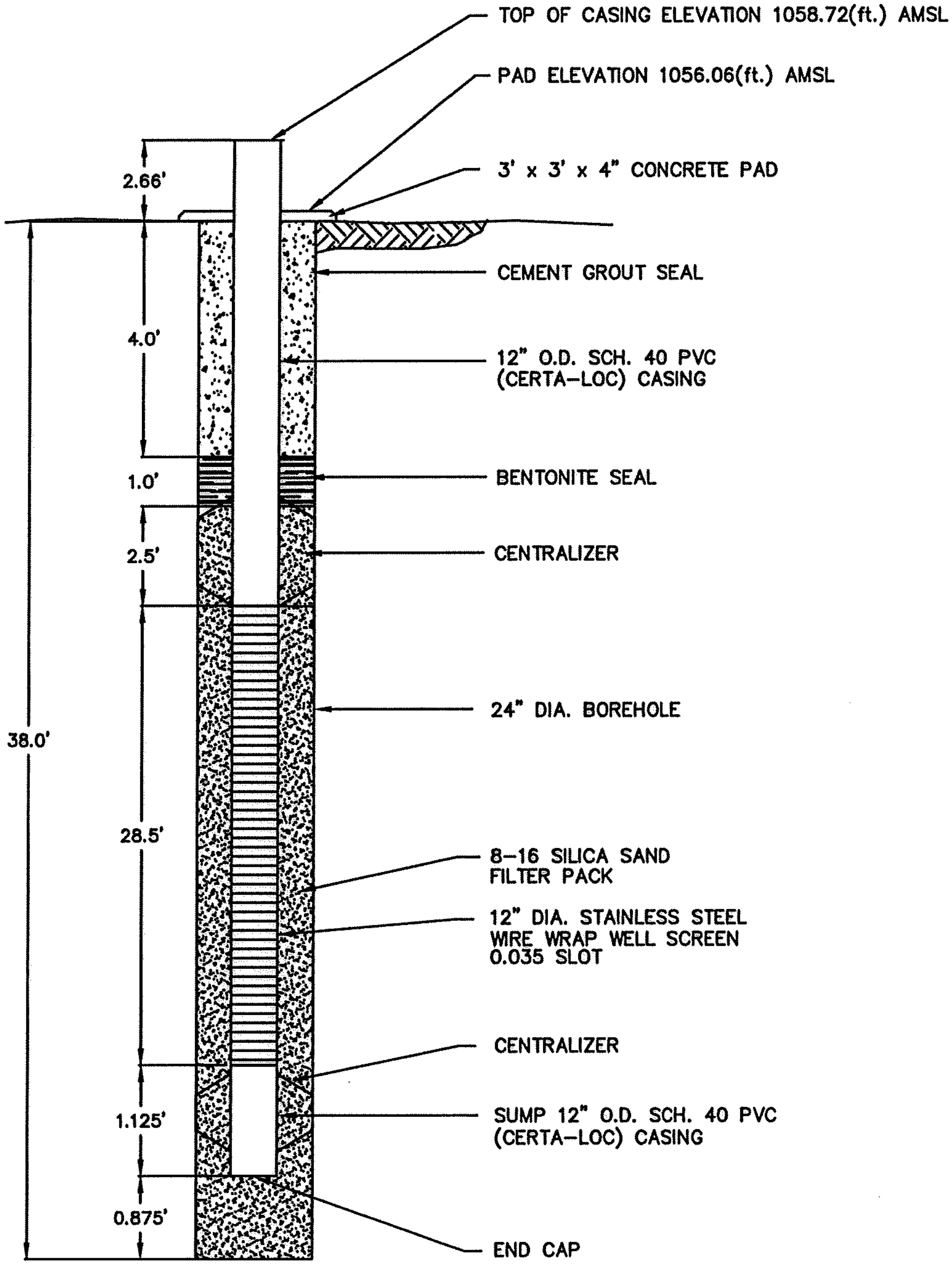
GW	Well-graded gravels, gravel-sand mixtures, little or no fines
SW	Well-graded sands, gravelly sands, little or no fines
SP	Poorly graded sands, gravelly sands, little or no fines
SC	Clayey sands, sand-clay mixtures
CL	Inorganic clays of low to med. plasticity, gravelly clays, sandy clays, silty clays, lean clays
SHALE	Shale Bedrock

RECOVERY WELL
RW-70
CONSTRUCTION DIAGRAM

PROJECT:
MICHIGAN REUTILIZATION, LLC
ARKANSAS CITY, KANSAS

MWH

Figure No.: 5-5



SECTION
NOT TO SCALE

BUILT BY: LAYNE-WESTERN
DATE DRILLED: 7/31/02
SURVEY DATE: 10/4/02

LOCATION (Plant Coordinates)

NORTHING -1170.33(ft.)
EASTING 2861.30(ft.)

ELEVATIONS IN FEET ABOVE MEAN SEA LEVEL (AMSL)

EnecoTech
ENVIRONMENTAL CONSULTANTS

Figure No.: 5-6

RECOVERY WELL RW-80A
CONSTRUCTION DIAGRAM

PROJECT: TPI PETROLEUM INC. - ARKANSAS CITY REFINERY

136R-017	DESIGNED BY: JFM	APPROVED BY:	
RW-80A	DRAWN BY: LKB	DATE: 9/5/02	REV:

EnecoTech Inc.
1580 Lincoln Street, Suite 1000
Denver, Colorado 80203

Figure: 5-6-1

Well Number: **RW-35**

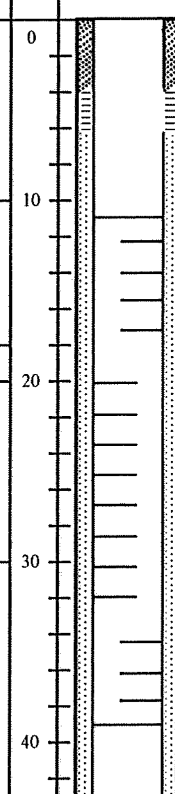
WELL CONSTRUCTION LOG

DATE DRILLED: **4/29/2003**	PROJECT NUMBER: **99-0138R-019**	DETECTOR: **PID OVM 580B**	CALIBRATED TO: **100 ppm Isobutylene**	BACKGROUND PID: **0 ppm**	
OWNER: **TPI PETROLEUM, INC.**	PROJECT NAME: **Arkansas City**	WELL TYPE: **Recovery Well**		NORTHING: **-594.96**	EASTING: **2032.12**
DRILLED BY: **Davis Environmental Drilling, L.L.C. State License # 607**	DRILLING METHOD: **Reverse Circulation**	SAMPLING METHOD: **Grab**	HOLE DIAMETER: **20"**	TOTAL WELL DEPTH: **43.44' BGS**	DEPTH TO LIQUID: **23.74' TOC**
LOGGED BY: **Scott Dixon, EnecoTech**	SEAL: **Gold Seal medium bentonite chips** / GRAVEL PACK: **8-12 mesh silica sand, 26.0 ft - 39.5 ft; Ritchie sand 6.5 ft -26.0 ft & 39.5 ft - 43.5 ft**		CEMENT: **0.0 ft - 4.0 ft**	DEPTH TO WATER: **24.21' TOC**	DATE MEASURED: **5/9/2003**
CASING TYPE: **Sch. 80 PVC**	DIAMETER: **12"**	LENGTH: **14.44' & 4'**	TOC ELEVATION: **1063.18**	GROUND ELEVATION: **1060.17**	CASING STICKUP **3.0'**
SCREEN TYPE: **Johnson Stainless Steel Wire Wrap**	SLOT: **0.040 inch**	DIAMETER: **12"**	LENGTH: **28'**	DEPTH TO TOP OF SCREEN: **11.44' BGS**	

LITHOLOGY/REMARKS
(The stratification lines on the borehole log represent the approximate boundary between soil and rock types. The transition between these boundaries may be more gradual than shown on this log.)

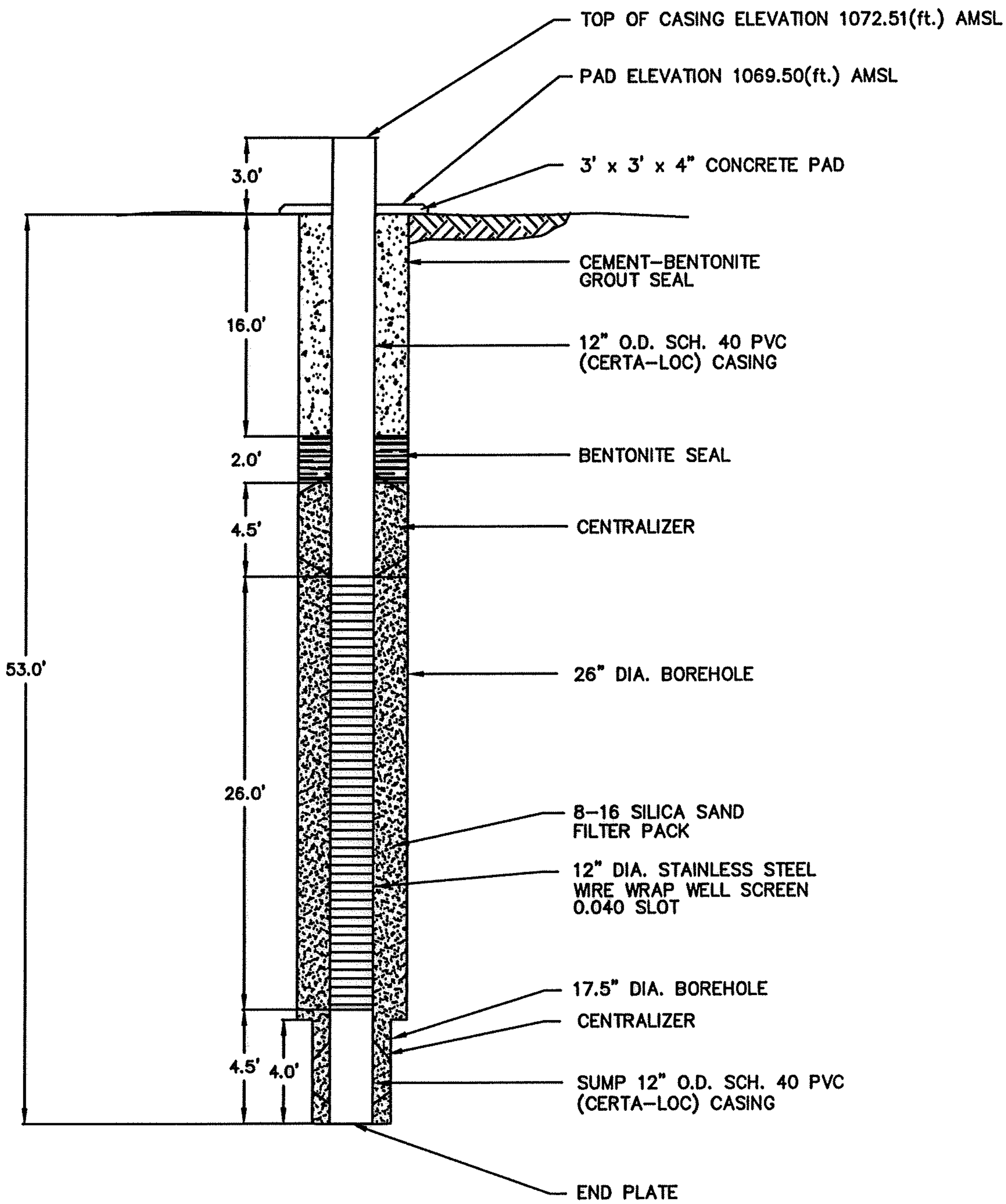
USCS CLASSIFICATION	PID READING (PPM)	DEPTH (FT BGS)	LITHOLOGY/REMARKS
SC	0	0	0.0'-4.0' Dk. Brown sandy sl. clayey loam, top soil
SP	35		4.0'-12.0' Tan-Brown fine-med. gr. sand, strong odor
CL		10	12.0'-13.0' Gray soft, sticky clay
SC			13.0'-19.0' Gray med-coarse gr. sandy clay with well rounded gravel up to 1/2"
CL			19.0'-20.0' Gray v. plastic, sticky clay
GW		20	20.0'-31.0' Various colored coarse sand with cobbles
CL		30	31.0'-34.0' Rusty-Tan mod. pl. sticky clay
GM			34.0'-39.5' Various colored gravel up to 1" and cobbles
CL		40	39.5'-40.0' Gray clay and soft shale
SH			40.0'-46.0' Gray hard shale bedrock
		50	

WELL COMPLETION



End of boring 46' BGS.

Sand Pack; Grout; D = Dry; M = Moist
Bentonite Chips; Cement; DP = Damp; SAT = Saturated



BUILT BY: LAYNE–WESTERN
DATE COMPLETED: 11/15/01

SECTION
NOT TO SCALE

LOCATION (Plant Coordinates)

NORTHING –791.301(ft.)
EASTING 2202.016(ft.)

ELEVATIONS IN FEET ABOVE MEAN SEA LEVEL (AMSL)

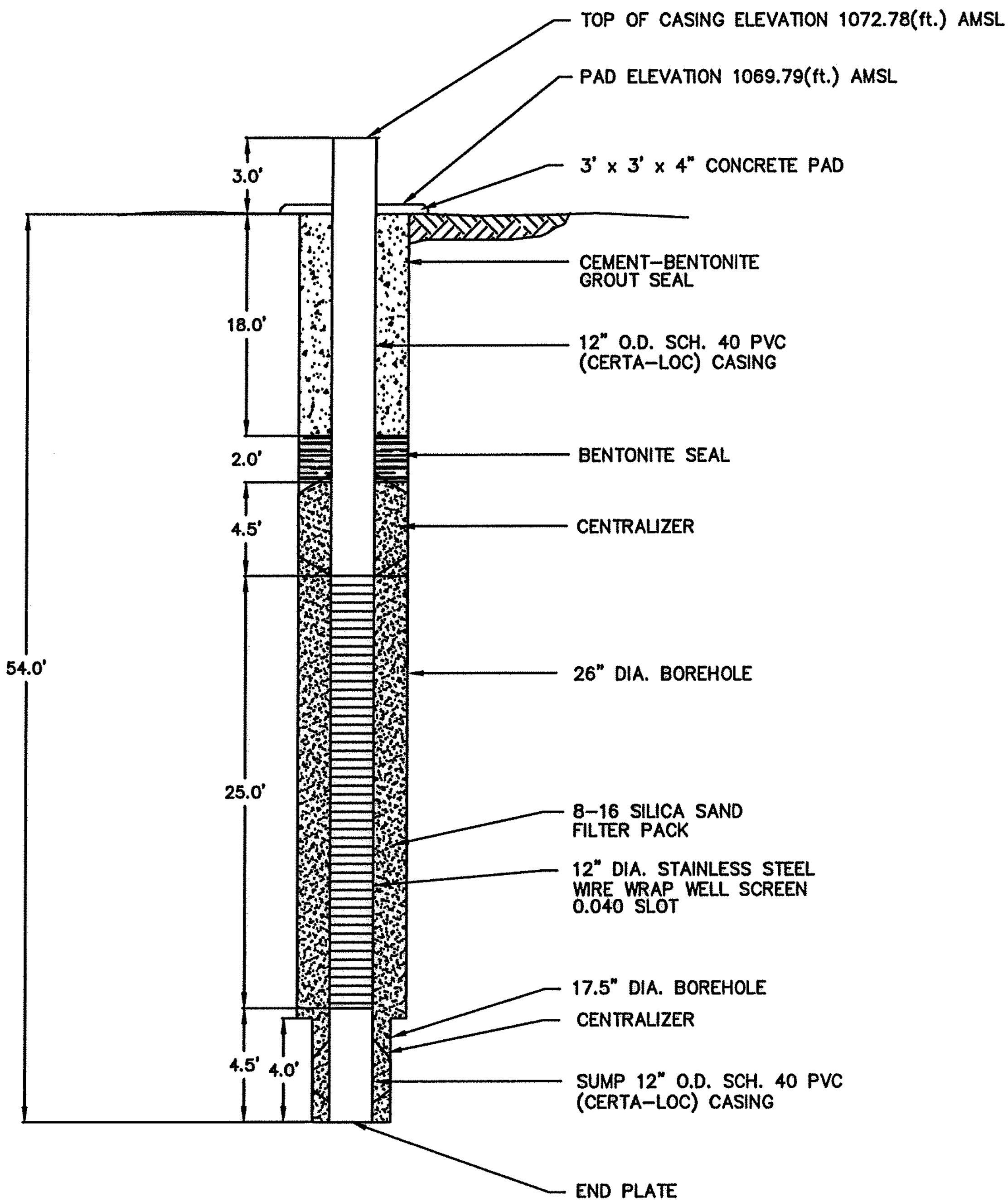
EnecoTech
ENVIRONMENTAL CONSULTANTS

Figure No.: 5-6-2

RECOVERY WELL RW–45
CONSTRUCTION DIAGRAM

PROJECT: TPI PETROLEUM INC. – ARKANSAS CITY REFINERY

138R–017	DESIGNED BY: JFM	APPROVED BY: JFM
18–45_OM	DRAWN BY: LKB	DATE: 1/17/02	REV:



BUILT BY: LAYNE–WESTERN
DATE COMPLETED: 11/17/01

SECTION
NOT TO SCALE

EnecoTech
ENVIRONMENTAL CONSULTANTS

Figure No.: 5-6-3

RECOVERY WELL RW–55
CONSTRUCTION DIAGRAM

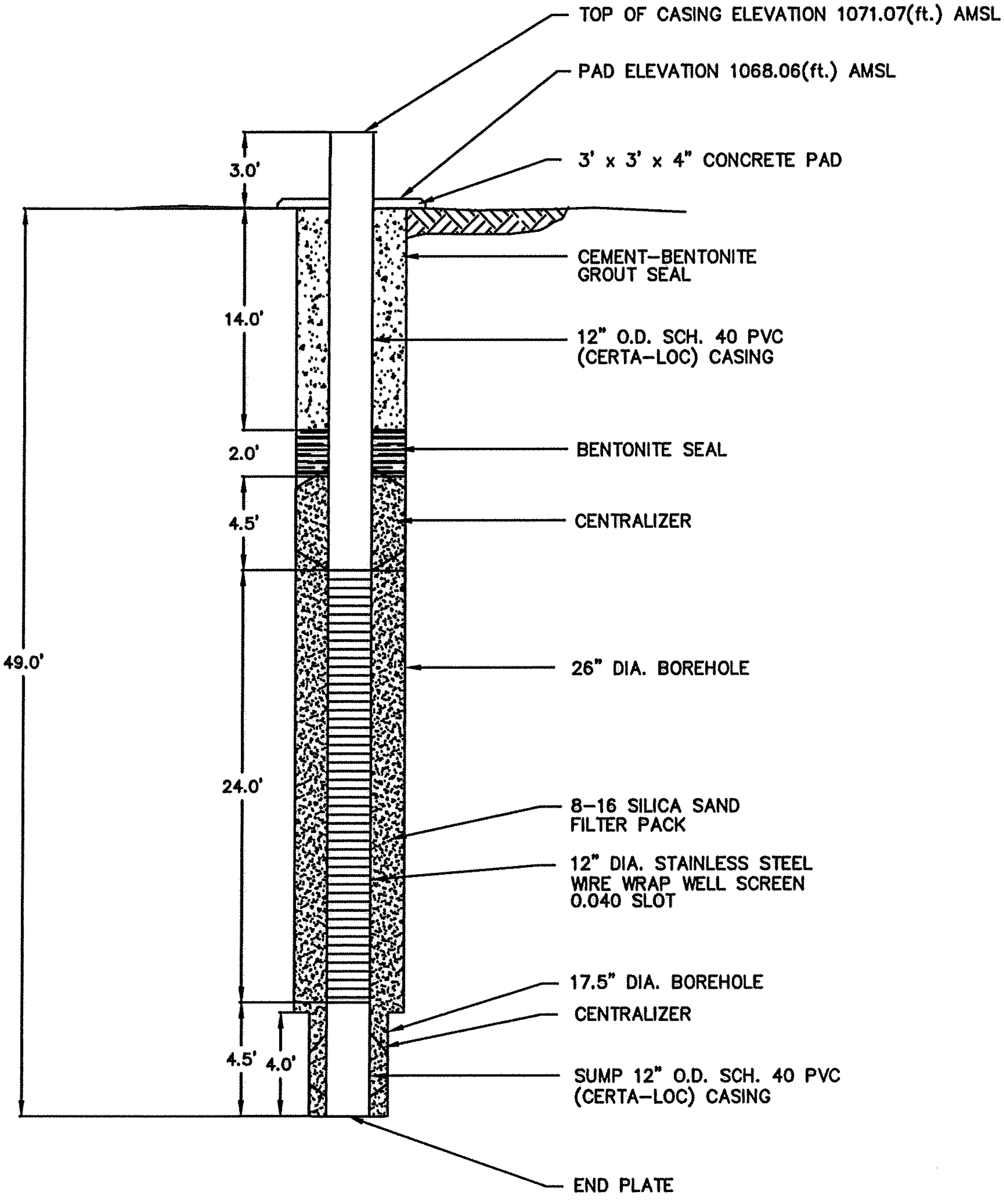
PROJECT: TPI PETROLEUM INC. – ARKANSAS CITY REFINERY

138R–017	DESIGNED BY: JFM	APPROVED BY: JFM	
18–55_OM	DRAWN BY: LKB	DATE: 1/17/02	REV:

LOCATION (Plant Coordinates)

NORTHING –936.245(ft.)
EASTING 2326.545(ft.)

ELEVATIONS IN FEET ABOVE MEAN SEA LEVEL (AMSL)



BUILT BY: LAYNE-WESTERN
DATE COMPLETED: 11/19/01

SECTION
NOT TO SCALE

LOCATION (Plant Coordinates)

NORTHING -1109.292(ft.)
EASTING 2493.427(ft.)

ELEVATIONS IN FEET ABOVE MEAN SEA LEVEL (AMSL)

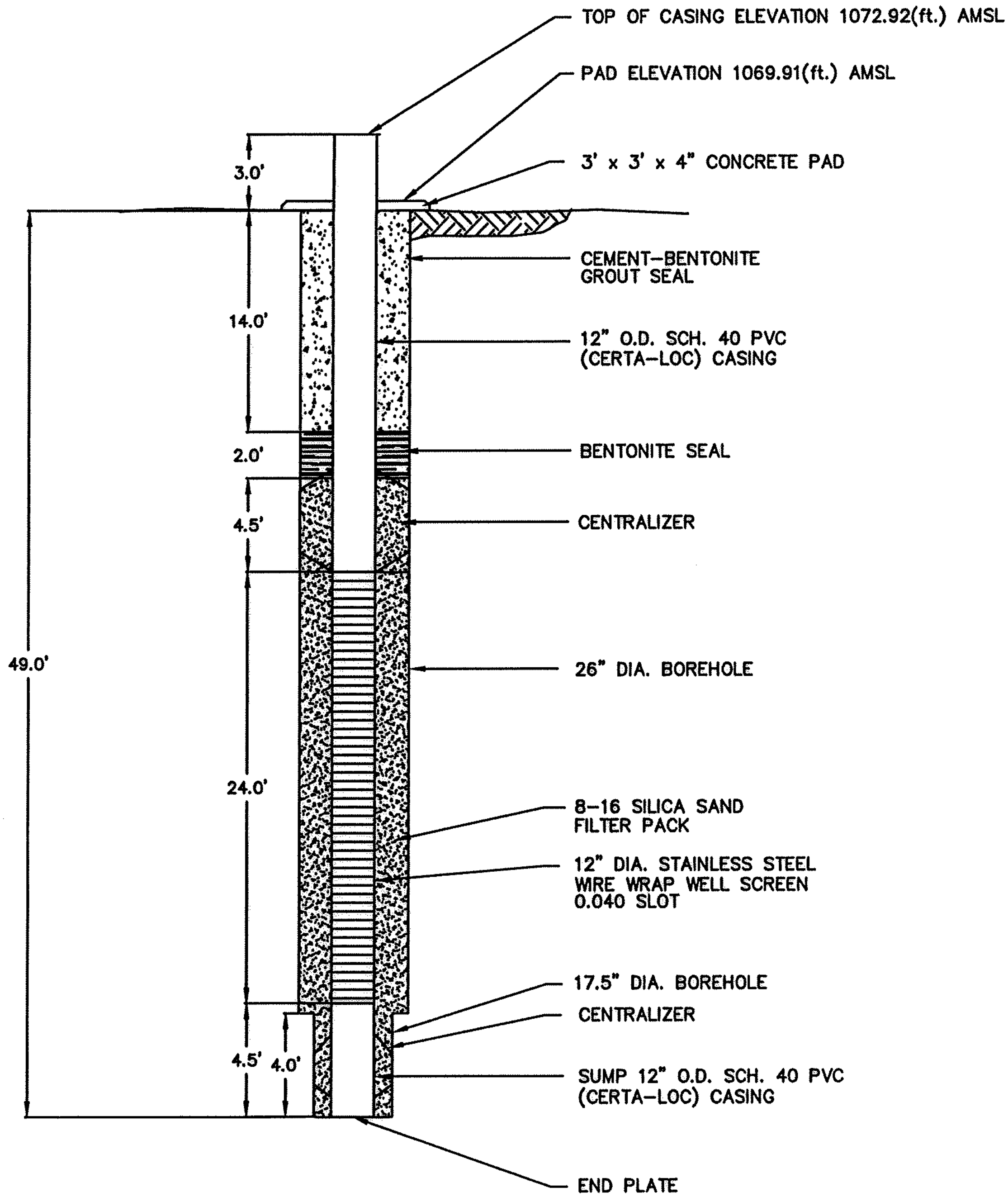
EnecoTech
ENVIRONMENTAL CONSULTANTS

Figure No.: 5-6-4

RECOVERY WELL RW-65
CONSTRUCTION DIAGRAM

PROJECT: TPI PETROLEUM INC. - ARKANSAS CITY REFINERY

138R-017	DESIGNED BY: JFM	APPROVED BY: JFM	
18-65_OM	DRAWN BY: LKB	DATE: 1/17/02	REV:



BUILT BY: LAYNE–WESTERN
DATE COMPLETED: 11/20/01

SECTION
NOT TO SCALE

LOCATION (Plant Coordinates)

NORTHING –1237.323(ft.)
EASTING 2758.073(ft.)

ELEVATIONS IN FEET ABOVE MEAN SEA LEVEL (AMSL)

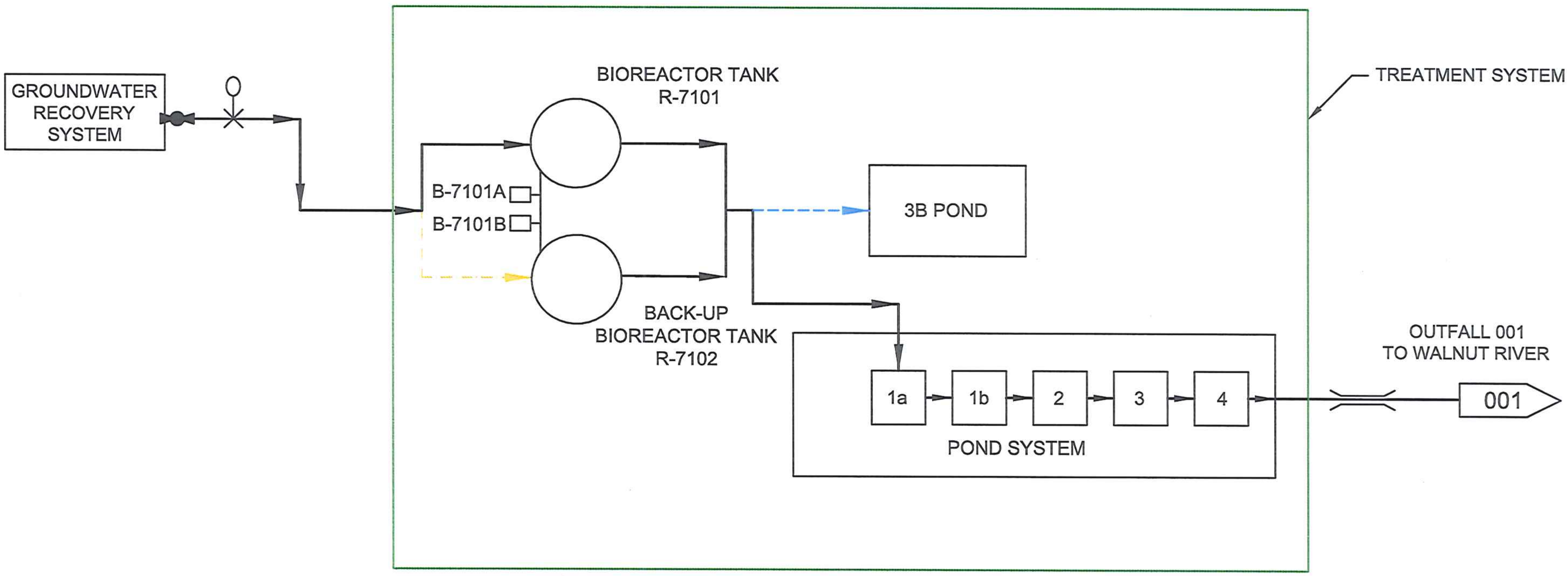
EnecoTech
ENVIRONMENTAL CONSULTANTS

Figure No.: 5-6-5

RECOVERY WELL RW–75
CONSTRUCTION DIAGRAM

PROJECT: TPI PETROLEUM INC. – ARKANSAS CITY REFINERY

136R–017	DESIGNED BY: JFM	APPROVED BY: JFM
18–75_OM	DRAWN BY: LKB	DATE: 1/17/02 REV:



EXPLANATION

- PRIMARY FLOW ROUTE
- ALTERNATE FLOW ROUTE
- RESERVE OVERFLOW ROUTE
- PARSHALL FLUME / OUTFALL MONITORING POINT
- FLOW METER
- PUMP
- AIR BLOWER

DATE	DESIGN BY	DRAWN BY	REVIEWED BY
08/11	JFM	CCL	JFM

WATER TREATMENT PROCESS

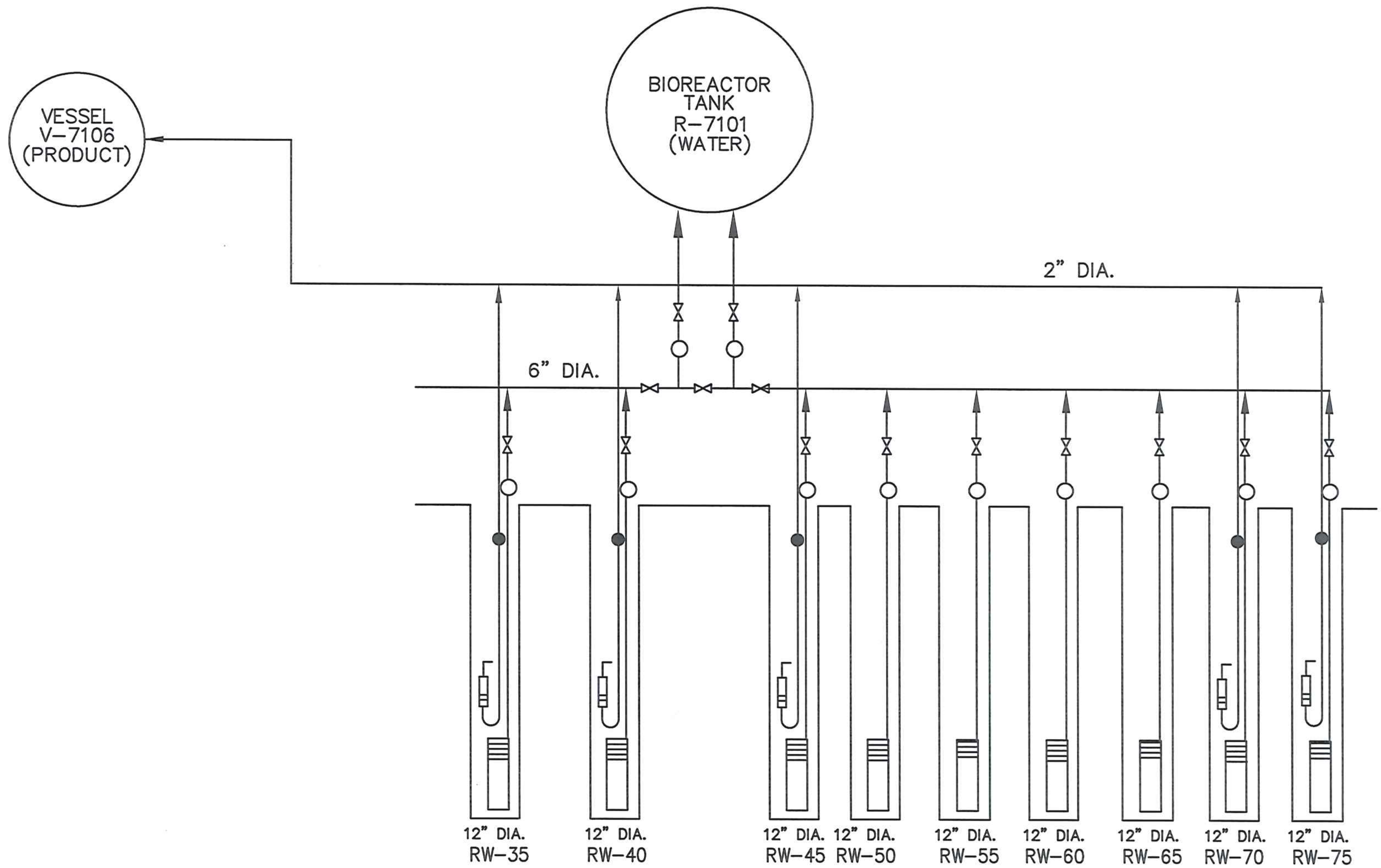
PROJECT:
MRP PROPERTIES COMPANY, LLC
ARKANSAS CITY, KANSAS

MWH

FIGURE
A2: 5-7

AutoCAD FILE: FIG_5-7_WATER TREATMENT PROCESS_REV 1.DWG

PROJECT NUMBER: 1010417



EXPLANATION

- ⋈ FLOW VALVE
- ○ FLOW METER
- ● PRODUCT METER
- PRODUCT PUMP
- ELECTRIC SUBMERSIBLE PUMP

DATE	DESIGN BY	DRAWN BY	REVIEWED BY
08/11	JFM	CCL	JFM

PROCESS FLOW DIAGRAM
GROUNDWATER RECOVERY

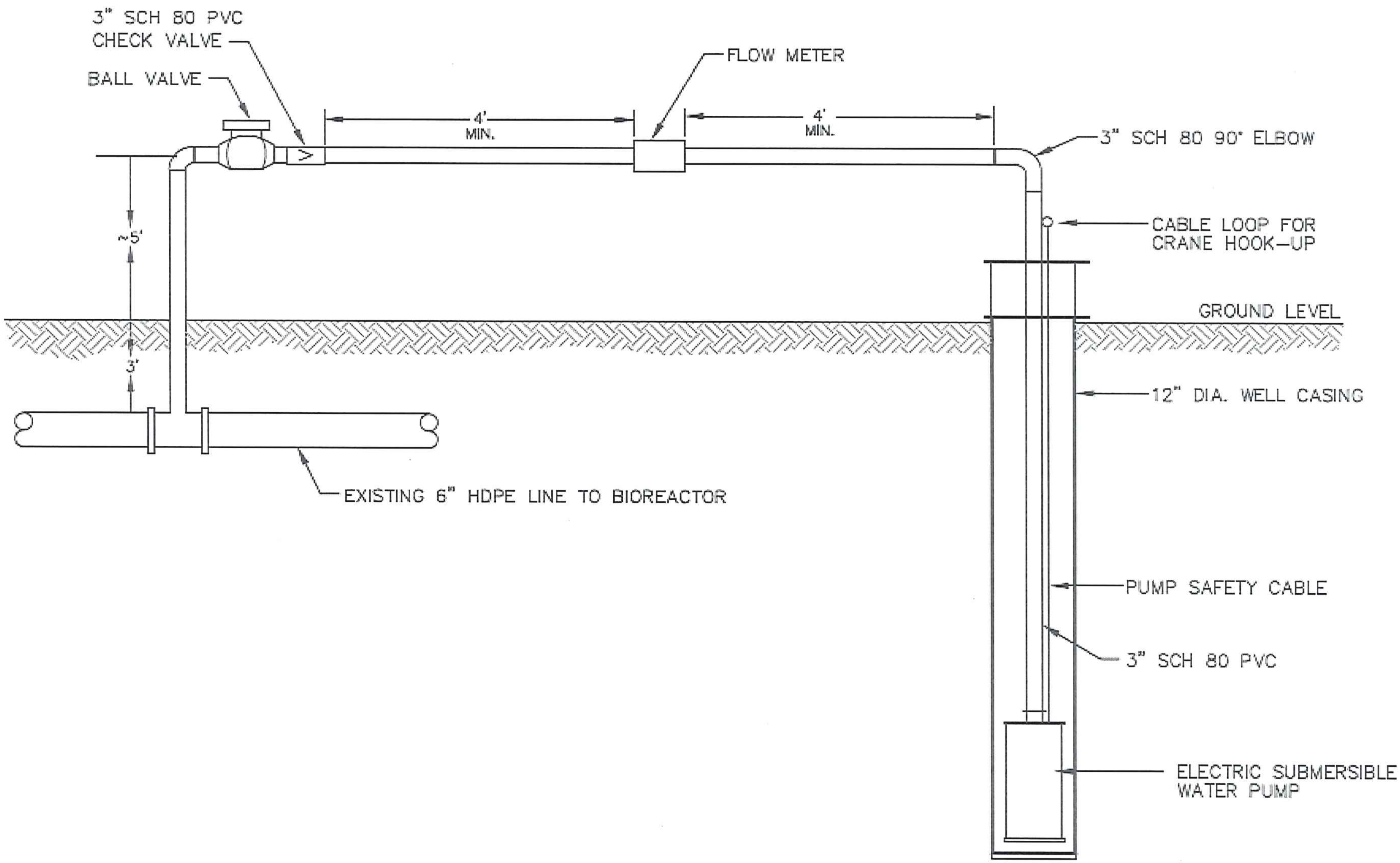
PROJECT:
MRP PROPERTIES COMPANY, LLC
ARKANSAS CITY, KANSAS

MWH

FIGURE
A2: 5-8

PROJECT NUMBER: 1010417

AutoCAD FILE: FIG_5-8_GW RECOVERY PROCESS FLOW.DWG



EXPLANATION

TITLE:

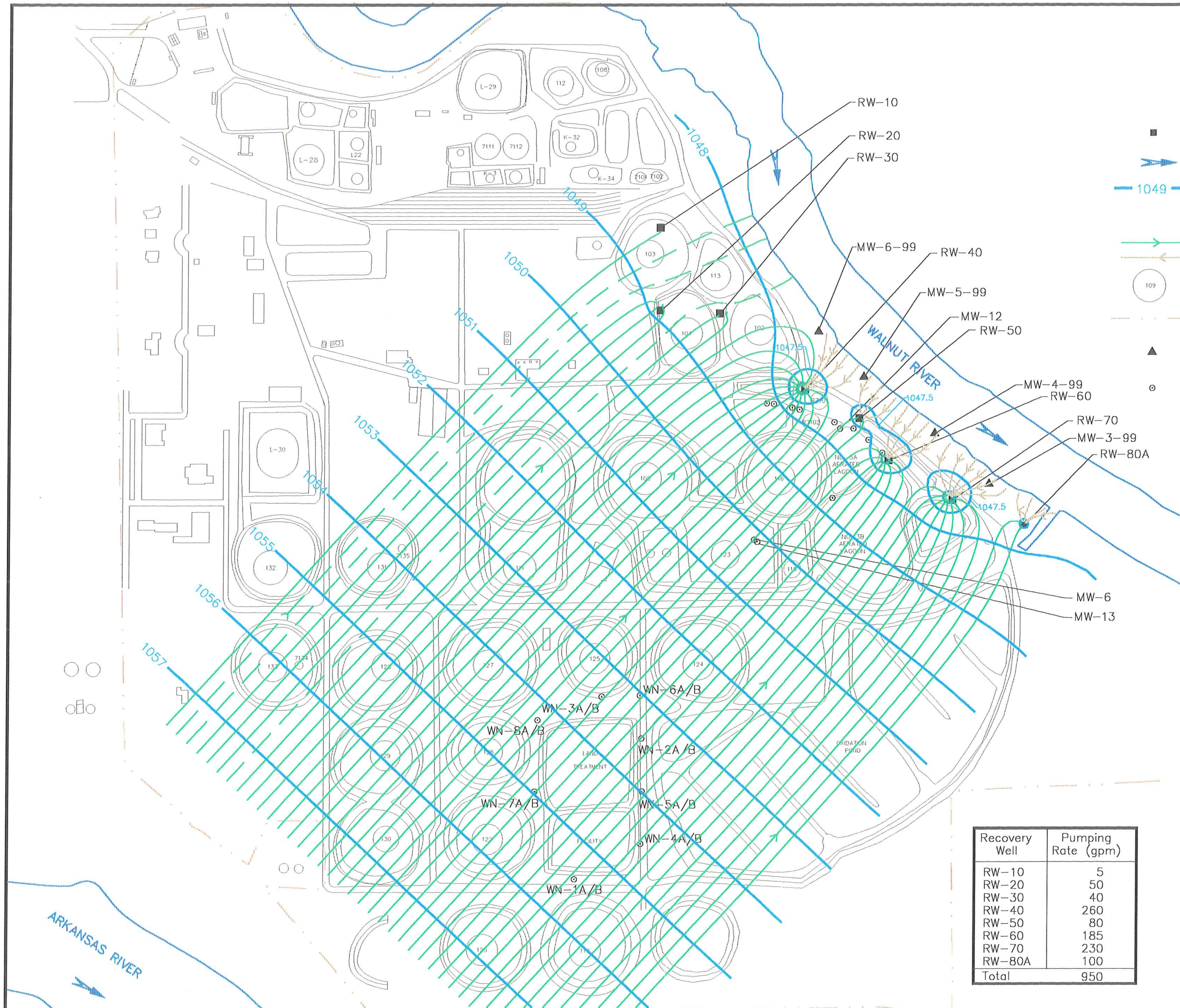
RECOVERY WELLHEAD PIPE LAYOUT

PROJECT:

MRP PROPERTIES COMPANY, LLC
ARKANSAS CITY, KANSAS

MWH

FIGURE No.: 5-9



N

FEET

0 200 400 600 800

EXPLANATION

- ■ ICM RECOVERY WELL
- DIRECTION OF SURFACE WATER FLOW
- 1049 — SIMULATED GROUNDWATER POTENTIOMETRIC SURFACE CONTOUR. CONTOUR INTERVAL 1 FOOT EXCEPT NEAR RECOVERY WELLS IT IS 0.5 FEET.
- GROUNDWATER FLOW PATHLINE & FLOW DIRECTION (DASHED WHERE NOT CAPTURED BY RECOVERY WELL)
- (109) ABOVE GROUND PRODUCT STORAGE TANK
- REFINERY PROPERTY BOUNDARY
- ▲ PROPOSED DOWNGRADIENT GROUNDWATER COMPLIANCE MONITORING WELL LOCATION
- ⊙ EXISTING GROUNDWATER MONITORING WELL LOCATION (1987 PERMIT & POST CLOSURE WELLS)

Recovery Well	Pumping Rate (gpm)
RW-10	5
RW-20	50
RW-30	40
RW-40	260
RW-50	80
RW-60	185
RW-70	230
RW-80A	100
Total	950

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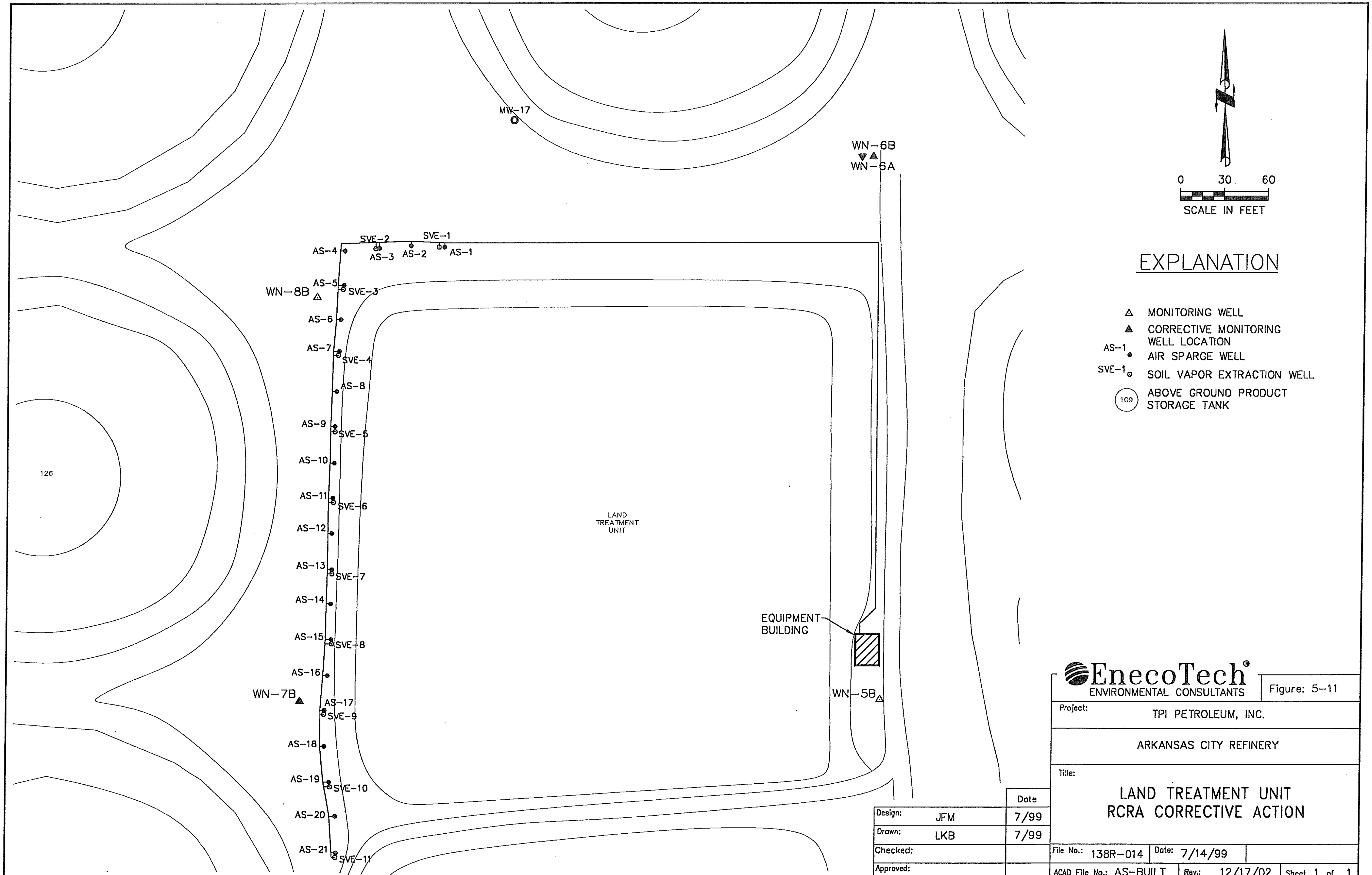
Figure: 5-10

MODELED GROUNDWATER FLOW AND PATHLINE ANALYSIS (PUMPING RATE 950 GPM)

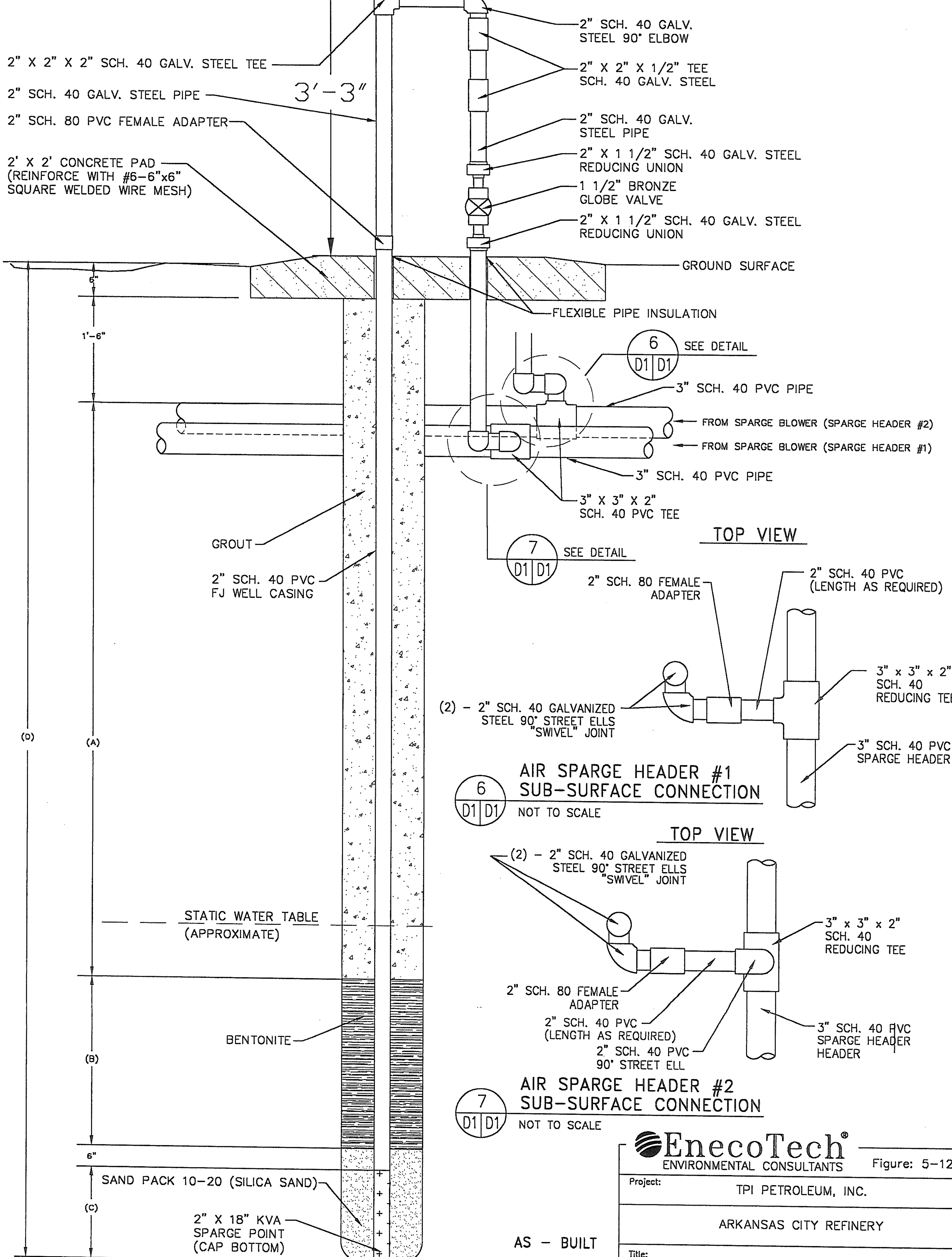
PROJECT: TPI PETROLEUM, INC. - ARKANSAS CITY REFINERY

01-0138R-014	DESIGNED BY: JFM	APPROVED BY:	
RWELL699	DRAWN BY: LKB	DATE: 11/16/96	REV: 11/18/98


MW-17
WN-6B
WN-6A
0 30 60
SCALE IN FEET
EXPLANATION
MONITORING WELL
CORRECTIVE MONITORING WELL LOCATION
AS-1 AIR SPARGE WELL
SVE-1 SOIL VAPOR EXTRACTION WELL
109 ABOVE GROUND PRODUCT STORAGE TANK
SVE-2
SVE-1
AS-4
AS-3
AS-2
AS-1
AS-5
WN-8B
SVE-3
AS-6
AS-7
SVE-4
AS-8
AS-9
SVE-5
AS-10
126
AS-11
SVE-6
AS-12
LAND TREATMENT UNIT
AS-13
SVE-7
AS-14
EQUIPMENT BUILDING
AS-15
SVE-8
AS-16
WN-7B
AS-17
SVE-9
WN-5B
AS-18
AS-19
SVE-10
AS-20
AS-21
SVE-11
EnecoTech
ENVIRONMENTAL CONSULTANTS
Figure: 5-11
Project: TPI PETROLEUM, INC.
ARKANSAS CITY REFINERY
Title: LAND TREATMENT UNIT RCRA CORRECTIVE ACTION
Date
Design: JFM 7/99
Drawn: LKB 7/99
Checked:
Approved:
File No.: 138R-014
Date: 7/14/99
ACAD File No.: AS-BUILT
Rev.: 12/17/02
Sheet 1 of 1

WELL SUMMARY

LOCATION	DEPTHS (A)	DEPTHS (B)	DEPTHS (C)	DEPTHS (D)	STATUS
LTU	22'-0"	2'-0"	1'-6"	28'-0"	CONSTRUCTED



TYPICAL ABOVE GRADE SPARGE WELL

NOT TO SCALE

AS - BUILT

		Date
Design:	JFM	7/99
Drawn:	LKB	7/99
Checked:		
Approved:		

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ENVIRONMENTAL CONSULTANTS

Figure: 5-12

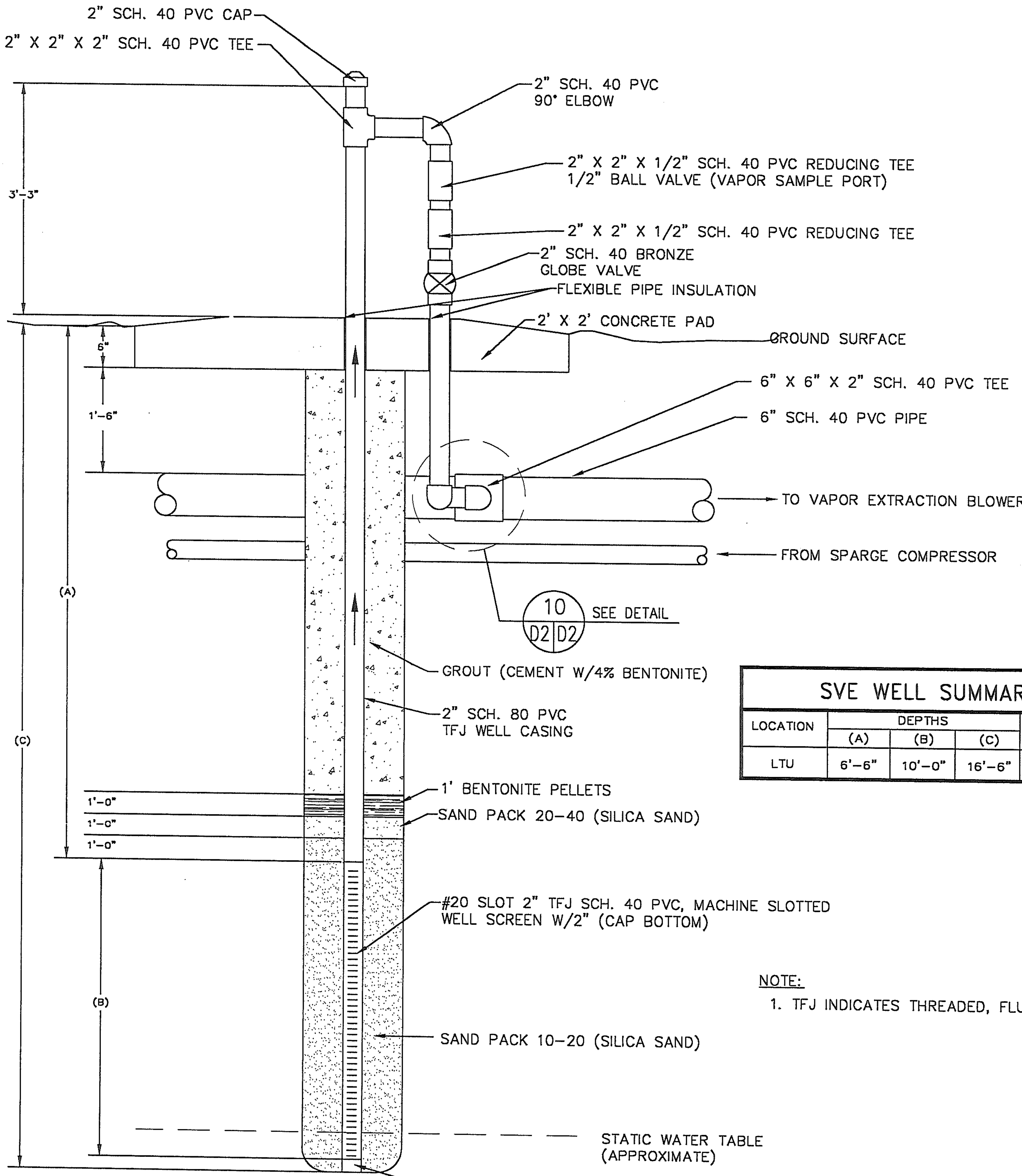
Project: TPI PETROLEUM, INC.

ARKANSAS CITY REFINERY

Title: LAND TREATMENT UNIT AIR SPARGE WELL COMPLETION DIAGRAM

File No.: 138R-014 | Date: 7/14/99

ACAD File No.: AS-BUILT | Rev.: 12/17/02 | Sheet 1 of 1



SVE WELL SUMMARY				
LOCATION	DEPTHS			STATUS
	(A)	(B)	(C)	
LTU	6'-6"	10'-0"	16'-6"	CONSTRUCTED

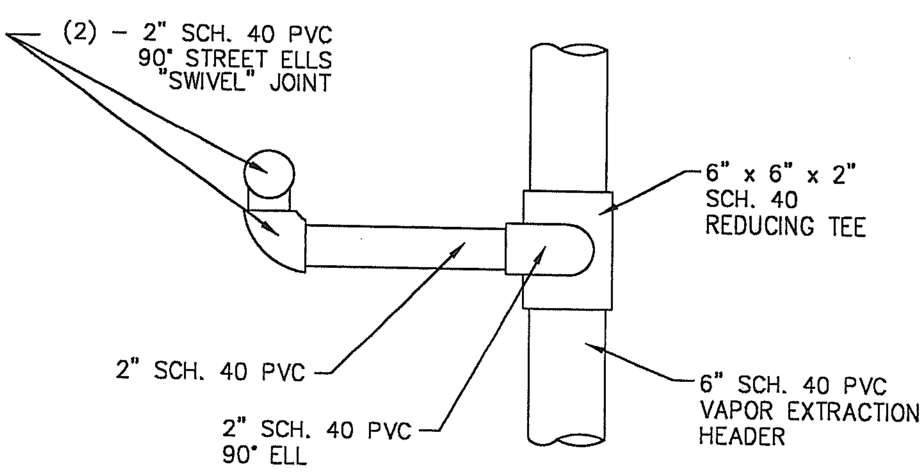
NOTE:

1. TFJ INDICATES THREADED, FLUSH JOINTED.

TYPICAL ABOVE GRADE SOIL VAPOR EXTRACTION WELL

NOT TO SCALE

TOP VIEW



10
D2 | D2

SOIL VAPOR EXTRACTION HEADER SUB-SURFACE CONNECTION

NOT TO SCALE

AS - BUILT

		Date
Design:	JFM	02/00
Drawn:	LKB	02/00
Checked:		
Approved:		

EnecoTech®
ENVIRONMENTAL CONSULTANTS

Figure: 5-13

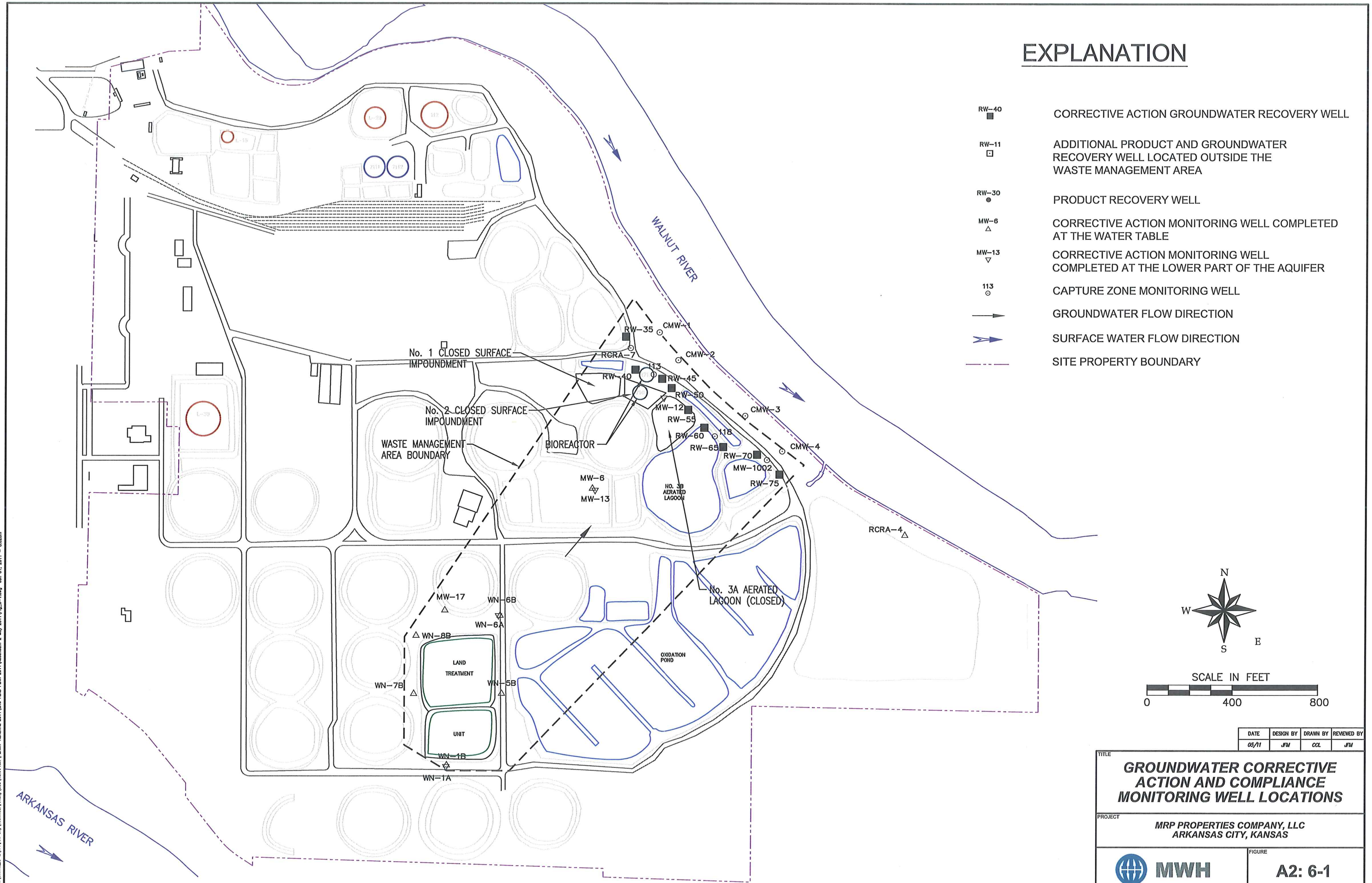
Project: TPI PETROLEUM, INC.

ARKANSAS CITY REFINERY

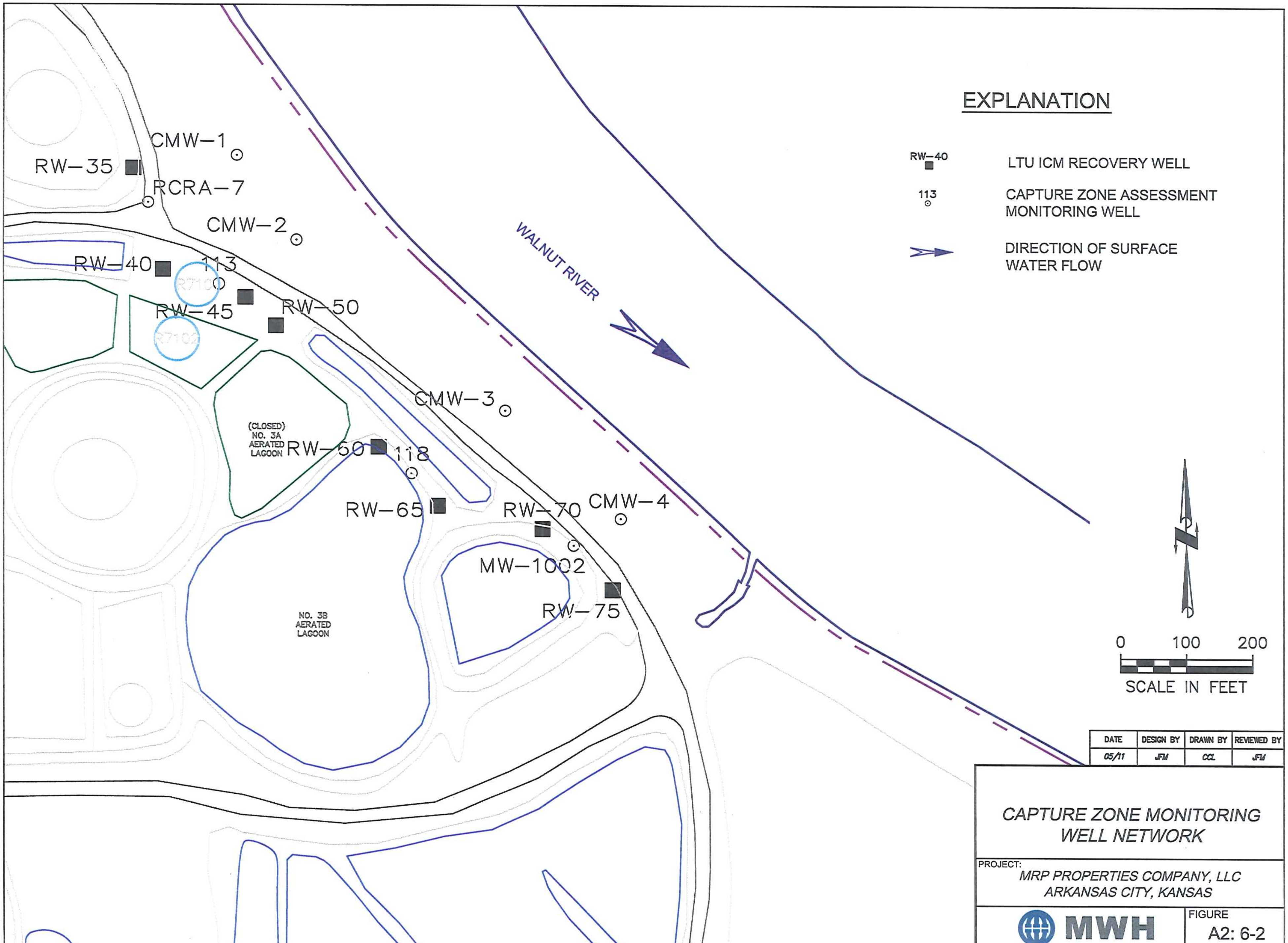
Title: LAND TREATMENT UNIT SOIL VAPOR EXTRACTION WELL COMPLETION DIAGRAM

File No.: 138R-014 | Date: 7/25/02

ACAD File No.: AS-BUILT | Rev.: 12/17/02 | Sheet 1 of 1



EXPLANATION
RW-40 CORRECTIVE ACTION GROUNDWATER RECOVERY WELL
RW-11 ADDITIONAL PRODUCT AND GROUNDWATER RECOVERY WELL LOCATED OUTSIDE THE WASTE MANAGEMENT AREA
RW-30 PRODUCT RECOVERY WELL
MW-6 CORRECTIVE ACTION MONITORING WELL COMPLETED AT THE WATER TABLE
MW-13 CORRECTIVE ACTION MONITORING WELL COMPLETED AT THE LOWER PART OF THE AQUIFER
113 CAPTURE ZONE MONITORING WELL
GROUNDWATER FLOW DIRECTION
SURFACE WATER FLOW DIRECTION
SITE PROPERTY BOUNDARY
WALNUT RIVER
ARKANSAS RIVER
No. 1 CLOSED SURFACE IMPOUNDMENT
No. 2 CLOSED SURFACE IMPOUNDMENT
WASTE MANAGEMENT AREA BOUNDARY
BIOREACTOR
No. 3B AERATED LAGOON
No. 3A AERATED LAGOON (CLOSED)
OXIDATION POND
LAND TREATMENT UNIT
RW-35
CMW-1
RCRA-7
CMW-2
113
RW-40
RW-45
RW-50
MW-12
RW-55
CMW-3
118
RW-60
RW-65
CMW-4
RW-70
MW-1002
RW-75
MW-6
MW-13
RCRA-4
MW-17
WN-6B
WN-6A
WN-8B
WN-7B
WN-5B
WN-1B
WN-1A
N
W
E
S
SCALE IN FEET
0
400
800
DATE 05/11
DESIGN BY JFM
DRAWN BY CCL
REVIEWED BY JFM
TITLE
GROUNDWATER CORRECTIVE ACTION AND COMPLIANCE MONITORING WELL LOCATIONS
PROJECT
MRP PROPERTIES COMPANY, LLC
ARKANSAS CITY, KANSAS
MWH
FIGURE
A2: 6-1



DATE	DESIGN BY	DRAWN BY	REVIEWED BY
05/11	JFM	CCL	JFM

CAPTURE ZONE MONITORING WELL NETWORK

PROJECT:
MRP PROPERTIES COMPANY, LLC
ARKANSAS CITY, KANSAS

MWH

FIGURE
A2: 6-2

PROJECT NUMBER: 1010417

AutoCAD FILE: FIG_6-2.DWG

APPENDIX A

Summary of December 1998 Groundwater Sample Analyses

Appendix A

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Conc.	Data Qual.	Units
WN-1A	Conductivity, Field	12/9/98	1309		umhos/cm
WN-1A	Corrected Water Elevation	12/9/98	1053.37		ftAMSL
WN-1A	pH, Field	12/9/98	7.27		std
WN-1A	Temperature, Field	12/9/98	57.5		DegF
WN-1A	Chloride	12/9/98	223		mg/l
WN-1A	Total Dissolved Solids	12/9/98	935		mg/l
WN-1A	Arsenic	12/9/98	2.9	U	ug/l
WN-1A	Barium	12/9/98	137		ug/l
WN-1A	Cadmium	12/9/98	0.3	U	ug/l
WN-1A	Chromium	12/9/98	4	B	ug/l
WN-1A	Lead	12/9/98	1.5	U	ug/l
WN-1A	Nickel	12/9/98	6.1	B	ug/l
WN-1A	Acetone	12/9/98	20		ug/L
WN-1A	Benzene	12/9/98	5	U	ug/L
WN-1A	2-Butanone	12/9/98	5	U	ug/L
WN-1A	Carbon Tetrachloride	12/9/98	5	U	ug/L
WN-1A	Chlorobenzene	12/9/98	5	U	ug/L
WN-1A	Chloroform	12/9/98	5	U	ug/L
WN-1A	1,1-Dichloroethene	12/9/98	5	U	ug/L
WN-1A	Ethylbenzene	12/9/98	5	U	ug/L
WN-1A	Toluene	12/9/98	5	U	ug/L
WN-1A	Trichloroethene	12/9/98	5	U	ug/L
WN-1A	Xylenes (Total)	12/9/98	5	U	ug/L
WN-1A	Acenaphthylene	12/9/98	10	U	ug/L
WN-1A	Anthracene	12/9/98	10	U	ug/L
WN-1A	Benzo(a)anthracene	12/9/98	10	U	ug/L
WN-1A	Benzo(a)pyrene	12/9/98	10	U	ug/L
WN-1A	Benzo(b)fluoranthene	12/9/98	10	U	ug/L
WN-1A	bis(2-ethylhexyl)phthalate	12/9/98	18	B	ug/L
WN-1A	Chrysene	12/9/98	10	U	ug/L
WN-1A	Di-n-octyl phthalate	12/9/98	10	U	ug/L
WN-1A	Dibenzofuran	12/9/98	10	U	ug/L
WN-1A	Dimethyl phthalate	12/9/98	10	U	ug/L
WN-1A	2,4-Dimethylphenol	12/9/98	10	U	ug/L
WN-1A	Fluoranthene	12/9/98	10	U	ug/L
WN-1A	Fluorene	12/9/98	10	U	ug/L
WN-1A	1-Methylnaphthalene	12/9/98	10	U	ug/L
WN-1A	2-Methylnaphthalene	12/9/98	10	U	ug/L
WN-1A	Naphthalene	12/9/98	10	U	ug/L
WN-1A	Phenanthrene	12/9/98	10	U	ug/L
WN-1A	Phenol	12/9/98	10	U	ug/L
WN-1A	Pyrene	12/9/98	10	U	ug/L

Note: See last page for explanation of codes.

Appendix A

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Conc.	Data Qual.	Units
WN-1B	Conductivity, Field	12/9/98	928		umhos/cm
WN-1B	Corrected Water Elevation	12/9/98	1053.41		ftAMSL
WN-1B	pH, Field	12/9/98	7.5		std
WN-1B	Temperature, Field	12/9/98	60.4		DegF
WN-1B	Chloride	12/9/98	145		mg/l
WN-1B	Total Dissolved Solids	12/9/98	604		mg/l
WN-1B	Arsenic	12/9/98	10.4		ug/l
WN-1B	Barium	12/9/98	284		ug/l
WN-1B	Cadmium	12/9/98	0.3	U	ug/l
WN-1B	Chromium	12/9/98	9.1		ug/l
WN-1B	Lead	12/9/98	16.1		ug/l
WN-1B	Nickel	12/9/98	20.8	B	ug/l
WN-1B	Acetone	12/9/98	20		ug/L
WN-1B	Benzene	12/9/98	5	U	ug/L
WN-1B	2-Butanone	12/9/98	5	U	ug/L
WN-1B	Carbon Tetrachloride	12/9/98	5	U	ug/L
WN-1B	Chlorobenzene	12/9/98	5	U	ug/L
WN-1B	Chloroform	12/9/98	5	U	ug/L
WN-1B	1,1-Dichloroethene	12/9/98	5	U	ug/L
WN-1B	Ethylbenzene	12/9/98	1	J	ug/L
WN-1B	Toluene	12/9/98	5	U	ug/L
WN-1B	Trichloroethene	12/9/98	5	U	ug/L
WN-1B	Xylenes (Total)	12/9/98	4	J	ug/L
WN-1B	Acenaphthylene	12/9/98	10	U	ug/L
WN-1B	Anthracene	12/9/98	10	U	ug/L
WN-1B	Benzo(a)anthracene	12/9/98	10	U	ug/L
WN-1B	Benzo(a)pyrene	12/9/98	10	U	ug/L
WN-1B	Benzo(b)fluoranthene	12/9/98	10	U	ug/L
WN-1B	bis(2-ethylhexyl)phthalate	12/9/98	5	JB	ug/L
WN-1B	Chrysene	12/9/98	10	U	ug/L
WN-1B	Di-n-octyl phthalate	12/9/98	10	U	ug/L
WN-1B	Dibenzofuran	12/9/98	10	U	ug/L
WN-1B	Dimethyl phthalate	12/9/98	10	U	ug/L
WN-1B	2,4-Dimethylphenol	12/9/98	10	U	ug/L
WN-1B	Fluoranthene	12/9/98	10	U	ug/L
WN-1B	Fluorene	12/9/98	10	U	ug/L
WN-1B	1-Methylnaphthalene	12/9/98	10	U	ug/L
WN-1B	2-Methylnaphthalene	12/9/98	10	U	ug/L
WN-1B	Naphthalene	12/9/98	10	U	ug/L
WN-1B	Phenanthrene	12/9/98	10	U	ug/L
WN-1B	Phenol	12/9/98	10	U	ug/L
WN-1B	Pyrene	12/9/98	10	U	ug/L

Note: See last page for explanation of codes.

Appendix A

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Data Conc.	Data Qual.	Units
WN-2A	Conductivity, Field	12/9/98	1073		umhos/cm
WN-2A	Corrected Water Elevation	12/9/98	1052.84		ftAMSL
WN-2A	pH, Field	12/9/98	6.47		std
WN-2A	Temperature, Field	12/9/98	60.4		DegF
WN-2A	Chloride	12/9/98	220		mg/l
WN-2A	Total Dissolved Solids	12/9/98	749		mg/l
WN-2A	Arsenic	12/9/98	3.6	B	ug/l
WN-2A	Barium	12/9/98	228		ug/l
WN-2A	Cadmium	12/9/98	0.3	U	ug/l
WN-2A	Chromium	12/9/98	1.2	B	ug/l
WN-2A	Lead	12/9/98	1.5	U	ug/l
WN-2A	Nickel	12/9/98	3.3	B	ug/l
WN-2A	Acetone	12/9/98	19		ug/L
WN-2A	Benzene	12/9/98	78		ug/L
WN-2A	2-Butanone	12/9/98	5	U	ug/L
WN-2A	Carbon Tetrachloride	12/9/98	5	U	ug/L
WN-2A	Chlorobenzene	12/9/98	5	U	ug/L
WN-2A	Chloroform	12/9/98	5	U	ug/L
WN-2A	1,1-Dichloroethene	12/9/98	5	U	ug/L
WN-2A	Ethylbenzene	12/9/98	5	U	ug/L
WN-2A	Toluene	12/9/98	5	U	ug/L
WN-2A	Trichloroethene	12/9/98	5	U	ug/L
WN-2A	Xylenes (Total)	12/9/98	5	U	ug/L
WN-2A	Acenaphthylene	12/9/98	10	U	ug/L
WN-2A	Anthracene	12/9/98	10	U	ug/L
WN-2A	Benzo(a)anthracene	12/9/98	10	U	ug/L
WN-2A	Benzo(a)pyrene	12/9/98	10	U	ug/L
WN-2A	Benzo(b)fluoranthene	12/9/98	10	U	ug/L
WN-2A	bis(2-ethylhexyl)phthalate	12/9/98	7	JB	ug/L
WN-2A	Chrysene	12/9/98	10	U	ug/L
WN-2A	Di-n-octyl phthalate	12/9/98	10	U	ug/L
WN-2A	Dibenzofuran	12/9/98	10	U	ug/L
WN-2A	Dimethyl phthalate	12/9/98	10	U	ug/L
WN-2A	2,4-Dimethylphenol	12/9/98	10	U	ug/L
WN-2A	Fluoranthene	12/9/98	10	U	ug/L
WN-2A	Fluorene	12/9/98	10	U	ug/L
WN-2A	1-Methylnaphthalene	12/9/98	10	U	ug/L
WN-2A	2-Methylnaphthalene	12/9/98	10	U	ug/L
WN-2A	Naphthalene	12/9/98	10	U	ug/L
WN-2A	Phenanthrene	12/9/98	10	U	ug/L
WN-2A	Phenol	12/9/98	10	U	ug/L
WN-2A	Pyrene	12/9/98	10	U	ug/L

Note: See last page for explanation of codes.

Appendix A

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Conc.	Data Qual.	Units
WN-2B	Conductivity, Field	12/9/98	1823		umhos/cm
WN-2B	Corrected Water Elevation	12/9/98	1052.88		ftAMSL
WN-2B	pH, Field	12/9/98	6.47		std
WN-2B	Temperature, Field	12/9/98	59.6		DegF
WN-2B	Chloride	12/9/98	33.1		mg/l
WN-2B	Total Dissolved Solids	12/9/98	1990		mg/l
WN-2B	Arsenic	12/9/98	5.1	B	ug/l
WN-2B	Barium	12/9/98	160		ug/l
WN-2B	Cadmium	12/9/98	0.58	B	ug/l
WN-2B	Chromium	12/9/98	1.5	B	ug/l
WN-2B	Lead	12/9/98	1.5	U	ug/l
WN-2B	Nickel	12/9/98	29.3	B	ug/l
WN-2B	Acetone	12/9/98	19		ug/L
WN-2B	Benzene	12/9/98	2	J	ug/L
WN-2B	2-Butanone	12/9/98	5	U	ug/L
WN-2B	Carbon Tetrachloride	12/9/98	5	U	ug/L
WN-2B	Chlorobenzene	12/9/98	5	U	ug/L
WN-2B	Chloroform	12/9/98	5	U	ug/L
WN-2B	1,1-Dichloroethene	12/9/98	5	U	ug/L
WN-2B	Ethylbenzene	12/9/98	5	U	ug/L
WN-2B	Toluene	12/9/98	5	U	ug/L
WN-2B	Trichloroethene	12/9/98	5	U	ug/L
WN-2B	Xylenes (Total)	12/9/98	5	U	ug/L
WN-2B	Acenaphthylene	12/9/98	10	U	ug/L
WN-2B	Anthracene	12/9/98	10	U	ug/L
WN-2B	Benzo(a)anthracene	12/9/98	10	U	ug/L
WN-2B	Benzo(a)pyrene	12/9/98	10	U	ug/L
WN-2B	Benzo(b)fluoranthene	12/9/98	10	U	ug/L
WN-2B	bis(2-ethylhexyl)phthalate	12/9/98	40	B	ug/L
WN-2B	Chrysene	12/9/98	10	U	ug/L
WN-2B	Di-n-octyl phthalate	12/9/98	10	U	ug/L
WN-2B	Dibenzofuran	12/9/98	10	U	ug/L
WN-2B	Dimethyl phthalate	12/9/98	10	U	ug/L
WN-2B	2,4-Dimethylphenol	12/9/98	10	U	ug/L
WN-2B	Fluoranthene	12/9/98	10	U	ug/L
WN-2B	Fluorene	12/9/98	10	U	ug/L
WN-2B	1-Methylnaphthalene	12/9/98	10	U	ug/L
WN-2B	2-Methylnaphthalene	12/9/98	10	U	ug/L
WN-2B	Naphthalene	12/9/98	10	U	ug/L
WN-2B	Phenanthrene	12/9/98	10	U	ug/L
WN-2B	Phenol	12/9/98	10	U	ug/L
WN-2B	Pyrene	12/9/98	10	U	ug/L

Note: See last page for explanation of codes.

Appendix A

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Data Conc.	Qual.	Units
WN-3A	Conductivity, Field	12/9/98	1375		umhos/cm
WN-3A	Corrected Water Elevation	12/9/98	1052.9		ftAMSL
WN-3A	pH, Field	12/9/98	7.3		std
WN-3A	Temperature, Field	12/9/98	62.1		DegF
WN-3A	Chloride	12/9/98	140		mg/l
WN-3A	Total Dissolved Solids	12/9/98	815		mg/l
WN-3A	Arsenic	12/9/98	17.5		ug/l
WN-3A	Barium	12/9/98	1100		ug/l
WN-3A	Cadmium	12/9/98	0.49	B	ug/l
WN-3A	Chromium	12/9/98	3.2	B	ug/l
WN-3A	Lead	12/9/98	9		ug/l
WN-3A	Nickel	12/9/98	6.5	B	ug/l
WN-3A	Acetone	12/9/98	5	U	ug/L
WN-3A	Benzene	12/9/98	26		ug/L
WN-3A	2-Butanone	12/9/98	5	U	ug/L
WN-3A	Carbon Tetrachloride	12/9/98	5	U	ug/L
WN-3A	Chlorobenzene	12/9/98	5	U	ug/L
WN-3A	Chloroform	12/9/98	5	U	ug/L
WN-3A	1,1-Dichloroethene	12/9/98	5	U	ug/L
WN-3A	Ethylbenzene	12/9/98	3	J	ug/L
WN-3A	Toluene	12/9/98	4	J	ug/L
WN-3A	Trichloroethene	12/9/98	5	U	ug/L
WN-3A	Xylenes (Total)	12/9/98	13		ug/L
WN-3A	Acenaphthylene	12/9/98	10	U	ug/L
WN-3A	Anthracene	12/9/98	10	U	ug/L
WN-3A	Benzo(a)anthracene	12/9/98	10	U	ug/L
WN-3A	Benzo(a)pyrene	12/9/98	10	U	ug/L
WN-3A	Benzo(b)fluoranthene	12/9/98	10	U	ug/L
WN-3A	bis(2-ethylhexyl)phthalate	12/9/98	4	JB	ug/L
WN-3A	Chrysene	12/9/98	10	U	ug/L
WN-3A	Di-n-octyl phthalate	12/9/98	10	U	ug/L
WN-3A	Dibenzofuran	12/9/98	10	U	ug/L
WN-3A	Dimethyl phthalate	12/9/98	10	U	ug/L
WN-3A	2,4-Dimethylphenol	12/9/98	10	U	ug/L
WN-3A	Fluoranthene	12/9/98	10	U	ug/L
WN-3A	Fluorene	12/9/98	1	J	ug/L
WN-3A	1-Methylnaphthalene	12/9/98	17		ug/L
WN-3A	2-Methylnaphthalene	12/9/98	10	U	ug/L
WN-3A	Naphthalene	12/9/98	10	U	ug/L
WN-3A	Phenanthrene	12/9/98	10	U	ug/L
WN-3A	Phenol	12/9/98	10	U	ug/L
WN-3A	Pyrene	12/9/98	10	U	ug/L

Note: See last page for explanation of codes.

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Conc.	Data Qual.	Units
WN-3B	Conductivity, Field	12/9/98	501		umhos/cm
WN-3B	Corrected Water Elevation	12/9/98	1052.92		ftAMSL
WN-3B	pH, Field	12/9/98	7.5		std
WN-3B	Temperature, Field	12/9/98	57.6		DegF
WN-3B	Chloride	12/9/98	8.9		mg/l
WN-3B	Total Dissolved Solids	12/9/98	632		mg/l
WN-3B	Arsenic	12/9/98	5.5	B	ug/l
WN-3B	Barium	12/9/98	230		ug/l
WN-3B	Cadmium	12/9/98	0.3	U	ug/l
WN-3B	Chromium	12/9/98	1.3	B	ug/l
WN-3B	Lead	12/9/98	1.5	U	ug/l
WN-3B	Nickel	12/9/98	1.3	B	ug/l
WN-3B	Acetone	12/9/98	18		ug/L
WN-3B	Benzene	12/9/98	22		ug/L
WN-3B	2-Butanone	12/9/98	5	U	ug/L
WN-3B	Carbon Tetrachloride	12/9/98	5	U	ug/L
WN-3B	Chlorobenzene	12/9/98	5	U	ug/L
WN-3B	Chloroform	12/9/98	5	U	ug/L
WN-3B	1,1-Dichloroethene	12/9/98	5	U	ug/L
WN-3B	Ethylbenzene	12/9/98	10		ug/L
WN-3B	Toluene	12/9/98	6		ug/L
WN-3B	Trichloroethene	12/9/98	5	U	ug/L
WN-3B	Xylenes (Total)	12/9/98	17		ug/L
WN-3B	Acenaphthylene	12/9/98	10	U	ug/L
WN-3B	Anthracene	12/9/98	10	U	ug/L
WN-3B	Benzo(a)anthracene	12/9/98	10	U	ug/L
WN-3B	Benzo(a)pyrene	12/9/98	10	U	ug/L
WN-3B	Benzo(b)fluoranthene	12/9/98	10	U	ug/L
WN-3B	bis(2-ethylhexyl)phthalate	12/9/98	5	JB	ug/L
WN-3B	Chrysene	12/9/98	10	U	ug/L
WN-3B	Di-n-octyl phthalate	12/9/98	10	U	ug/L
WN-3B	Dibenzofuran	12/9/98	10	U	ug/L
WN-3B	Dimethyl phthalate	12/9/98	10	U	ug/L
WN-3B	2,4-Dimethylphenol	12/9/98	10	U	ug/L
WN-3B	Fluoranthene	12/9/98	10	U	ug/L
WN-3B	Fluorene	12/9/98	10	U	ug/L
WN-3B	1-Methylnaphthalene	12/9/98	10	J	ug/L
WN-3B	2-Methylnaphthalene	12/9/98	1	J	ug/L
WN-3B	Naphthalene	12/9/98	3	J	ug/L
WN-3B	Phenanthrene	12/9/98	10	U	ug/L
WN-3B	Phenol	12/9/98	10	U	ug/L
WN-3B	Pyrene	12/9/98	10	U	ug/L

Note: See last page for explanation of codes.

Appendix A

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Data Conc.	Qual.	Units
WN-4A	Conductivity, Field	12/9/98	1184		umhos/cm
WN-4A	Corrected Water Elevation	12/9/98	1053.02		ftAMSL
WN-4A	pH, Field	12/9/98	7.56		std
WN-4A	Temperature, Field	12/9/98	57.6		DegF
WN-4A	Chloride	12/9/98	210		mg/l
WN-4A	Total Dissolved Solids	12/9/98	806		mg/l
WN-4A	Arsenic	12/9/98	3	B	ug/l
WN-4A	Barium	12/9/98	167		ug/l
WN-4A	Cadmium	12/9/98	0.3	U	ug/l
WN-4A	Chromium	12/9/98	5.1		ug/l
WN-4A	Lead	12/9/98	2.1	B	ug/l
WN-4A	Nickel	12/9/98	7.7	B	ug/l
WN-4A	Acetone	12/9/98	17		ug/L
WN-4A	Benzene	12/9/98	5	U	ug/L
WN-4A	2-Butanone	12/9/98	5	U	ug/L
WN-4A	Carbon Tetrachloride	12/9/98	5	U	ug/L
WN-4A	Chlorobenzene	12/9/98	5	U	ug/L
WN-4A	Chloroform	12/9/98	5	U	ug/L
WN-4A	1,1-Dichloroethene	12/9/98	5	U	ug/L
WN-4A	Ethylbenzene	12/9/98	5	U	ug/L
WN-4A	Toluene	12/9/98	5	U	ug/L
WN-4A	Trichloroethene	12/9/98	5	U	ug/L
WN-4A	Xylenes (Total)	12/9/98	5	U	ug/L
WN-4A	Acenaphthylene	12/9/98	10	U	ug/L
WN-4A	Anthracene	12/9/98	10	U	ug/L
WN-4A	Benzo(a)anthracene	12/9/98	10	U	ug/L
WN-4A	Benzo(a)pyrene	12/9/98	10	U	ug/L
WN-4A	Benzo(b)fluoranthene	12/9/98	10	U	ug/L
WN-4A	bis(2-ethylhexyl)phthalate	12/9/98	2	JB	ug/L
WN-4A	Chrysene	12/9/98	10	U	ug/L
WN-4A	Di-n-octyl phthalate	12/9/98	10	U	ug/L
WN-4A	Dibenzofuran	12/9/98	10	U	ug/L
WN-4A	Dimethyl phthalate	12/9/98	10	U	ug/L
WN-4A	2,4-Dimethylphenol	12/9/98	10	U	ug/L
WN-4A	Fluoranthene	12/9/98	10	U	ug/L
WN-4A	Fluorene	12/9/98	10	U	ug/L
WN-4A	1-Methylnaphthalene	12/9/98	10	U	ug/L
WN-4A	2-Methylnaphthalene	12/9/98	10	U	ug/L
WN-4A	Naphthalene	12/9/98	10	U	ug/L
WN-4A	Phenanthrene	12/9/98	10	U	ug/L
WN-4A	Phenol	12/9/98	10	U	ug/L
WN-4A	Pyrene	12/9/98	10	U	ug/L

Note: See last page for explanation of codes.

Appendix A

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Conc.	Data Qual.	Units
WN-4B	Conductivity, Field	12/9/98	1287		umhos/cm
WN-4B	Corrected Water Elevation	12/9/98	1053.01		ftAMSL
WN-4B	pH, Field	12/9/98	7.03		std
WN-4B	Temperature, Field	12/9/98	59.9		DegF
WN-4B	Chloride	12/9/98	54.1		mg/l
WN-4B	Total Dissolved Solids	12/9/98	1010		mg/l
WN-4B	Arsenic	12/9/98	3	B	ug/l
WN-4B	Barium	12/9/98	234		ug/l
WN-4B	Cadmium	12/9/98	0.3	U	ug/l
WN-4B	Chromium	12/9/98	0.7	U	ug/l
WN-4B	Lead	12/9/98	1.5	U	ug/l
WN-4B	Nickel	12/9/98	2	B	ug/l
WN-4B	Acetone	12/9/98	17		ug/L
WN-4B	Benzene	12/9/98	5	U	ug/L
WN-4B	2-Butanone	12/9/98	5	U	ug/L
WN-4B	Carbon Tetrachloride	12/9/98	5	U	ug/L
WN-4B	Chlorobenzene	12/9/98	5	U	ug/L
WN-4B	Chloroform	12/9/98	5	U	ug/L
WN-4B	1,1-Dichloroethene	12/9/98	5	U	ug/L
WN-4B	Ethylbenzene	12/9/98	5	U	ug/L
WN-4B	Toluene	12/9/98	5	U	ug/L
WN-4B	Trichloroethene	12/9/98	5	U	ug/L
WN-4B	Xylenes (Total)	12/9/98	5	U	ug/L
WN-4B	Acenaphthylene	12/9/98	10	U	ug/L
WN-4B	Anthracene	12/9/98	10	U	ug/L
WN-4B	Benzo(a)anthracene	12/9/98	10	U	ug/L
WN-4B	Benzo(a)pyrene	12/9/98	10	U	ug/L
WN-4B	Benzo(b)fluoranthene	12/9/98	10	U	ug/L
WN-4B	bis(2-ethylhexyl)phthalate	12/9/98	1	JB	ug/L
WN-4B	Chrysene	12/9/98	10	U	ug/L
WN-4B	Di-n-octyl phthalate	12/9/98	10	U	ug/L
WN-4B	Dibenzofuran	12/9/98	10	U	ug/L
WN-4B	Dimethyl phthalate	12/9/98	10	U	ug/L
WN-4B	2,4-Dimethylphenol	12/9/98	10	U	ug/L
WN-4B	Fluoranthene	12/9/98	10	U	ug/L
WN-4B	Fluorene	12/9/98	10	U	ug/L
WN-4B	1-Methylnaphthalene	12/9/98	4	J	ug/L
WN-4B	2-Methylnaphthalene	12/9/98	1	J	ug/L
WN-4B	Naphthalene	12/9/98	10	U	ug/L
WN-4B	Phenanthrene	12/9/98	10	U	ug/L
WN-4B	Phenol	12/9/98	10	U	ug/L
WN-4B	Pyrene	12/9/98	10	U	ug/L

Note: See last page for explanation of codes.

Appendix A

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Data Conc.	Qual.	Units
WN-5A	Conductivity, Field	12/9/98	1182		umhos/cm
WN-5A	Corrected Water Elevation	12/9/98	1052.93		ftAMSL
WN-5A	pH, Field	12/9/98	6.47		std
WN-5A	Temperature, Field	12/9/98	59.4		DegF
WN-5A	Chloride	12/9/98	230		mg/l
WN-5A	Total Dissolved Solids	12/9/98	800		mg/l
WN-5A	Arsenic	12/9/98	2.9	U	ug/l
WN-5A	Barium	12/9/98	128		ug/l
WN-5A	Cadmium	12/9/98	0.3	U	ug/l
WN-5A	Chromium	12/9/98	1.4	B	ug/l
WN-5A	Lead	12/9/98	1.5	U	ug/l
WN-5A	Nickel	12/9/98	3.5	B	ug/l
WN-5A	Acetone	12/9/98	5	U	ug/L
WN-5A	Benzene	12/9/98	5	U	ug/L
WN-5A	2-Butanone	12/9/98	5	U	ug/L
WN-5A	Carbon Tetrachloride	12/9/98	5	U	ug/L
WN-5A	Chlorobenzene	12/9/98	5	U	ug/L
WN-5A	Chloroform	12/9/98	5	U	ug/L
WN-5A	1,1-Dichloroethene	12/9/98	5	U	ug/L
WN-5A	Ethylbenzene	12/9/98	5	U	ug/L
WN-5A	Toluene	12/9/98	5	U	ug/L
WN-5A	Trichloroethene	12/9/98	5	U	ug/L
WN-5A	Xylenes (Total)	12/9/98	5	U	ug/L
WN-5A	Acenaphthylene	12/9/98	10	U	ug/L
WN-5A	Anthracene	12/9/98	10	U	ug/L
WN-5A	Benzo(a)anthracene	12/9/98	10	U	ug/L
WN-5A	Benzo(a)pyrene	12/9/98	10	U	ug/L
WN-5A	Benzo(b)fluoranthene	12/9/98	10	U	ug/L
WN-5A	bis(2-ethylhexyl)phthalate	12/9/98	2	JB	ug/L
WN-5A	Chrysene	12/9/98	10	U	ug/L
WN-5A	Di-n-octyl phthalate	12/9/98	10	U	ug/L
WN-5A	Dibenzofuran	12/9/98	10	U	ug/L
WN-5A	Dimethyl phthalate	12/9/98	10	U	ug/L
WN-5A	2,4-Dimethylphenol	12/9/98	10	U	ug/L
WN-5A	Fluoranthene	12/9/98	10	U	ug/L
WN-5A	Fluorene	12/9/98	10	U	ug/L
WN-5A	1-Methylnaphthalene	12/9/98	10	U	ug/L
WN-5A	2-Methylnaphthalene	12/9/98	10	U	ug/L
WN-5A	Naphthalene	12/9/98	10	U	ug/L
WN-5A	Phenanthrene	12/9/98	10	U	ug/L
WN-5A	Phenol	12/9/98	10	U	ug/L
WN-5A	Pyrene	12/9/98	10	U	ug/L

Note: See last page for explanation of codes.

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Conc.	Data Qual.	Units
WN-5B	Conductivity, Field	12/9/98	886		umhos/cm
WN-5B	Corrected Water Elevation	12/9/98	1052.97		ftAMSL
WN-5B	pH, Field	12/9/98	6.46		std
WN-5B	Temperature, Field	12/9/98	58.9		DegF
WN-5B	Chloride	12/9/98	66.3		mg/l
WN-5B	Total Dissolved Solids	12/9/98	578		mg/l
WN-5B	Arsenic	12/9/98	2.9	U	ug/l
WN-5B	Barium	12/9/98	424		ug/l
WN-5B	Cadmium	12/9/98	0.33	B	ug/l
WN-5B	Chromium	12/9/98	1.7	B	ug/l
WN-5B	Lead	12/9/98	3.2		ug/l
WN-5B	Nickel	12/9/98	8.1	B	ug/l
WN-5B	Acetone	12/9/98	23		ug/L
WN-5B	Benzene	12/9/98	24		ug/L
WN-5B	2-Butanone	12/9/98	5	U	ug/L
WN-5B	Carbon Tetrachloride	12/9/98	5	U	ug/L
WN-5B	Chlorobenzene	12/9/98	5	U	ug/L
WN-5B	Chloroform	12/9/98	5	U	ug/L
WN-5B	1,1-Dichloroethene	12/9/98	5	U	ug/L
WN-5B	Ethylbenzene	12/9/98	5	U	ug/L
WN-5B	Toluene	12/9/98	5	U	ug/L
WN-5B	Trichloroethene	12/9/98	5	U	ug/L
WN-5B	Xylenes (Total)	12/9/98	5	U	ug/L
WN-5B	Acenaphthylene	12/9/98	10	U	ug/L
WN-5B	Anthracene	12/9/98	10	U	ug/L
WN-5B	Benzo(a)anthracene	12/9/98	10	U	ug/L
WN-5B	Benzo(a)pyrene	12/9/98	10	U	ug/L
WN-5B	Benzo(b)fluoranthene	12/9/98	10	U	ug/L
WN-5B	bis(2-ethylhexyl)phthalate	12/9/98	1	JB	ug/L
WN-5B	Chrysene	12/9/98	10	U	ug/L
WN-5B	Di-n-octyl phthalate	12/9/98	10	U	ug/L
WN-5B	Dibenzofuran	12/9/98	10	U	ug/L
WN-5B	Dimethyl phthalate	12/9/98	10	U	ug/L
WN-5B	2,4-Dimethylphenol	12/9/98	10	U	ug/L
WN-5B	Fluoranthene	12/9/98	10	U	ug/L
WN-5B	Fluorene	12/9/98	10	U	ug/L
WN-5B	1-Methylnaphthalene	12/9/98	8	J	ug/L
WN-5B	2-Methylnaphthalene	12/9/98	3	J	ug/L
WN-5B	Naphthalene	12/9/98	10	U	ug/L
WN-5B	Phenanthrene	12/9/98	10	U	ug/L
WN-5B	Phenol	12/9/98	10	U	ug/L
WN-5B	Pyrene	12/9/98	10	U	ug/L

Note: See last page for explanation of codes.

Appendix A

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Conc.	Data Qual.	Units
WN-6A	Conductivity, Field	12/9/98	1042		umhos/cm
WN-6A	Corrected Water Elevation	12/9/98	1052.71		ftAMSL
WN-6A	pH, Field	12/9/98	7.2		std
WN-6A	Temperature, Field	12/9/98	63.3		DegF
WN-6A	Chloride	12/9/98	180		mg/l
WN-6A	Total Dissolved Solids	12/9/98	682		mg/l
WN-6A	Arsenic	12/9/98	9.6	B	ug/l
WN-6A	Barium	12/9/98	618		ug/l
WN-6A	Cadmium	12/9/98	0.33	B	ug/l
WN-6A	Chromium	12/9/98	1.7	B	ug/l
WN-6A	Lead	12/9/98	3.4		ug/l
WN-6A	Nickel	12/9/98	3.4	B	ug/l
WN-6A	Acetone	12/9/98	27		ug/L
WN-6A	Benzene	12/9/98	42		ug/L
WN-6A	2-Butanone	12/9/98	5	U	ug/L
WN-6A	Carbon Tetrachloride	12/9/98	5	U	ug/L
WN-6A	Chlorobenzene	12/9/98	5	U	ug/L
WN-6A	Chloroform	12/9/98	5	U	ug/L
WN-6A	1,1-Dichloroethene	12/9/98	5	U	ug/L
WN-6A	Ethylbenzene	12/9/98	5	U	ug/L
WN-6A	Toluene	12/9/98	2	J	ug/L
WN-6A	Trichloroethene	12/9/98	5	U	ug/L
WN-6A	Xylenes (Total)	12/9/98	4	J	ug/L
WN-6A	Acenaphthylene	12/9/98	10	U	ug/L
WN-6A	Anthracene	12/9/98	10	U	ug/L
WN-6A	Benzo(a)anthracene	12/9/98	10	U	ug/L
WN-6A	Benzo(a)pyrene	12/9/98	10	U	ug/L
WN-6A	Benzo(b)fluoranthene	12/9/98	10	U	ug/L
WN-6A	bis(2-ethylhexyl)phthalate	12/9/98	1	JB	ug/L
WN-6A	Chrysene	12/9/98	10	U	ug/L
WN-6A	Di-n-octyl phthalate	12/9/98	10	U	ug/L
WN-6A	Dibenzofuran	12/9/98	10	U	ug/L
WN-6A	Dimethyl phthalate	12/9/98	10	U	ug/L
WN-6A	2,4-Dimethylphenol	12/9/98	10	U	ug/L
WN-6A	Fluoranthene	12/9/98	10	U	ug/L
WN-6A	Fluorene	12/9/98	10	U	ug/L
WN-6A	1-Methylnaphthalene	12/9/98	11		ug/L
WN-6A	2-Methylnaphthalene	12/9/98	3	J	ug/L
WN-6A	Naphthalene	12/9/98	10	U	ug/L
WN-6A	Phenanthrene	12/9/98	10	U	ug/L
WN-6A	Phenol	12/9/98	10	U	ug/L
WN-6A	Pyrene	12/9/98	10	U	ug/L

Note: See last page for explanation of codes.

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Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Conc.	Data Qual.	Units
WN-6B	Conductivity, Field	12/9/98	958		umhos/cm
WN-6B	Corrected Water Elevation	12/9/98	1052.7		ftAMSL
WN-6B	pH, Field	12/9/98	6.9		std
WN-6B	Temperature, Field	12/9/98	62.9		DegF
WN-6B	Chloride	12/9/98	34.9		mg/l
WN-6B	Total Dissolved Solids	12/9/98	628		mg/l
WN-6B	Arsenic	12/9/98	6.5	B	ug/l
WN-6B	Barium	12/9/98	1160		ug/l
WN-6B	Cadmium	12/9/98	0.3	B	ug/l
WN-6B	Chromium	12/9/98	0.7	U	ug/l
WN-6B	Lead	12/9/98	1.5	U	ug/l
WN-6B	Nickel	12/9/98	1	U	ug/l
WN-6B	Acetone	12/9/98	57		ug/L
WN-6B	Benzene	12/9/98	75		ug/L
WN-6B	2-Butanone	12/9/98	5	U	ug/L
WN-6B	Carbon Tetrachloride	12/9/98	5	U	ug/L
WN-6B	Chlorobenzene	12/9/98	5	U	ug/L
WN-6B	Chloroform	12/9/98	5	U	ug/L
WN-6B	1,1-Dichloroethene	12/9/98	5	U	ug/L
WN-6B	Ethylbenzene	12/9/98	1	J	ug/L
WN-6B	Toluene	12/9/98	5	J	ug/L
WN-6B	Trichloroethene	12/9/98	5	U	ug/L
WN-6B	Xylenes (Total)	12/9/98	7		ug/L
WN-6B	Acenaphthylene	12/9/98	10	U	ug/L
WN-6B	Anthracene	12/9/98	10	U	ug/L
WN-6B	Benzo(a)anthracene	12/9/98	10	U	ug/L
WN-6B	Benzo(a)pyrene	12/9/98	10	U	ug/L
WN-6B	Benzo(b)fluoranthene	12/9/98	10	U	ug/L
WN-6B	bis(2-ethylhexyl)phthalate	12/9/98	2	JB	ug/L
WN-6B	Chrysene	12/9/98	10	U	ug/L
WN-6B	Di-n-octyl phthalate	12/9/98	10	U	ug/L
WN-6B	Dibenzofuran	12/9/98	10	U	ug/L
WN-6B	Dimethyl phthalate	12/9/98	10	U	ug/L
WN-6B	2,4-Dimethylphenol	12/9/98	10	U	ug/L
WN-6B	Fluoranthene	12/9/98	10	U	ug/L
WN-6B	Fluorene	12/9/98	1	J	ug/L
WN-6B	1-Methylnaphthalene	12/9/98	26		ug/L
WN-6B	2-Methylnaphthalene	12/9/98	4	J	ug/L
WN-6B	Naphthalene	12/9/98	10	U	ug/L
WN-6B	Phenanthrene	12/9/98	10	U	ug/L
WN-6B	Phenol	12/9/98	10	U	ug/L
WN-6B	Pyrene	12/9/98	10	U	ug/L

Note: See last page for explanation of codes.

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Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Conc.	Data Qual.	Units
WN-7A	Conductivity, Field	12/9/98	1448		umhos/cm
WN-7A	Corrected Water Elevation	12/9/98	1053.47		ftAMSL
WN-7A	pH, Field	12/9/98	7.6		std
WN-7A	Temperature, Field	12/9/98	60.9		DegF
WN-7A	Chloride	12/9/98	230		mg/l
WN-7A	Total Dissolved Solids	12/9/98	848		mg/l
WN-7A	Arsenic	12/9/98	4.9	B	ug/l
WN-7A	Barium	12/9/98	404		ug/l
WN-7A	Cadmium	12/9/98	0.49	B	ug/l
WN-7A	Chromium	12/9/98	14.2		ug/l
WN-7A	Lead	12/9/98	23.4		ug/l
WN-7A	Nickel	12/9/98	36.8	B	ug/l
WN-7A	Acetone	12/9/98	21		ug/L
WN-7A	Benzene	12/9/98	50		ug/L
WN-7A	2-Butanone	12/9/98	5	U	ug/L
WN-7A	Carbon Tetrachloride	12/9/98	5	U	ug/L
WN-7A	Chlorobenzene	12/9/98	5	U	ug/L
WN-7A	Chloroform	12/9/98	5	U	ug/L
WN-7A	1,1-Dichloroethene	12/9/98	5	U	ug/L
WN-7A	Ethylbenzene	12/9/98	5	U	ug/L
WN-7A	Toluene	12/9/98	5	U	ug/L
WN-7A	Trichloroethene	12/9/98	5	U	ug/L
WN-7A	Xylenes (Total)	12/9/98	5	U	ug/L
WN-7A	Acenaphthylene	12/9/98	10	U	ug/L
WN-7A	Anthracene	12/9/98	10	U	ug/L
WN-7A	Benzo(a)anthracene	12/9/98	10	U	ug/L
WN-7A	Benzo(a)pyrene	12/9/98	10	U	ug/L
WN-7A	Benzo(b)fluoranthene	12/9/98	10	U	ug/L
WN-7A	bis(2-ethylhexyl)phthalate	12/9/98	2	JB	ug/L
WN-7A	Chrysene	12/9/98	10	U	ug/L
WN-7A	Di-n-octyl phthalate	12/9/98	10	U	ug/L
WN-7A	Dibenzofuran	12/9/98	10	U	ug/L
WN-7A	Dimethyl phthalate	12/9/98	10	U	ug/L
WN-7A	2,4-Dimethylphenol	12/9/98	10	U	ug/L
WN-7A	Fluoranthene	12/9/98	10	U	ug/L
WN-7A	Fluorene	12/9/98	10	U	ug/L
WN-7A	1-Methylnaphthalene	12/9/98	1	J	ug/L
WN-7A	2-Methylnaphthalene	12/9/98	10	U	ug/L
WN-7A	Naphthalene	12/9/98	10	U	ug/L
WN-7A	Phenanthrene	12/9/98	10	U	ug/L
WN-7A	Phenol	12/9/98	10	U	ug/L
WN-7A	Pyrene	12/9/98	10	U	ug/L

Note: See last page for explanation of codes.

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Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Conc.	Data Qual.	Units
WN-7B	Conductivity, Field	12/9/98	829		umhos/cm
WN-7B	Corrected Water Elevation	12/9/98	1053.53		ftAMSL
WN-7B	pH, Field	12/9/98	7		std
WN-7B	Temperature, Field	12/9/98	60.1		DegF
WN-7B	Chloride	12/9/98	26.2		mg/l
WN-7B	Total Dissolved Solids	12/9/98	487		mg/l
WN-7B	Arsenic	12/9/98	26		ug/l
WN-7B	Barium	12/9/98	1040		ug/l
WN-7B	Cadmium	12/9/98	0.3	U	ug/l
WN-7B	Chromium	12/9/98	1.5	B	ug/l
WN-7B	Lead	12/9/98	9.3		ug/l
WN-7B	Nickel	12/9/98	2.2	B	ug/l
WN-7B	Acetone	12/9/98	5	U	ug/L
WN-7B	Benzene	12/9/98	570	D	ug/L
WN-7B	2-Butanone	12/9/98	5	U	ug/L
WN-7B	Carbon Tetrachloride	12/9/98	5	U	ug/L
WN-7B	Chlorobenzene	12/9/98	5	U	ug/L
WN-7B	Chloroform	12/9/98	5	U	ug/L
WN-7B	1,1-Dichloroethene	12/9/98	5	U	ug/L
WN-7B	Ethylbenzene	12/9/98	6		ug/L
WN-7B	Toluene	12/9/98	22		ug/L
WN-7B	Trichloroethene	12/9/98	5	U	ug/L
WN-7B	Xylenes (Total)	12/9/98	62		ug/L
WN-7B	Acenaphthylene	12/9/98	10	U	ug/L
WN-7B	Anthracene	12/9/98	10	U	ug/L
WN-7B	Benzo(a)anthracene	12/9/98	10	U	ug/L
WN-7B	Benzo(a)pyrene	12/9/98	10	U	ug/L
WN-7B	Benzo(b)fluoranthene	12/9/98	10	U	ug/L
WN-7B	bis(2-ethylhexyl)phthalate	12/9/98	1	JB	ug/L
WN-7B	Chrysene	12/9/98	10	U	ug/L
WN-7B	Di-n-octyl phthalate	12/9/98	10	U	ug/L
WN-7B	Dibenzofuran	12/9/98	10	U	ug/L
WN-7B	Dimethyl phthalate	12/9/98	10	U	ug/L
WN-7B	2,4-Dimethylphenol	12/9/98	10	U	ug/L
WN-7B	Fluoranthene	12/9/98	10	U	ug/L
WN-7B	Fluorene	12/9/98	1	J	ug/L
WN-7B	1-Methylnaphthalene	12/9/98	60		ug/L
WN-7B	2-Methylnaphthalene	12/9/98	47		ug/L
WN-7B	Naphthalene	12/9/98	130	D	ug/L
WN-7B	Phenanthrene	12/9/98	2	J	ug/L
WN-7B	Phenol	12/9/98	10	U	ug/L
WN-7B	Pyrene	12/9/98	10	U	ug/L

Note: See last page for explanation of codes.

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Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Conc.	Data Qual.	Units
WN-8A	Conductivity, Field	12/9/98	1260		umhos/cm
WN-8A	Corrected Water Elevation	12/9/98	1053.39		ftAMSL
WN-8A	pH, Field	12/9/98	7.1		std
WN-8A	Temperature, Field	12/9/98	55		DegF
WN-8A	Chloride	12/9/98	153		mg/l
WN-8A	Total Dissolved Solids	12/9/98	749		mg/l
WN-8A	Arsenic	12/9/98	4.3	B	ug/l
WN-8A	Barium	12/9/98	186		ug/l
WN-8A	Cadmium	12/9/98	0.3	U	ug/l
WN-8A	Chromium	12/9/98	0.86	B	ug/l
WN-8A	Lead	12/9/98	15.8		ug/l
WN-8A	Nickel	12/9/98	5.3	B	ug/l
WN-8A	Acetone	12/9/98	44		ug/L
WN-8A	Benzene	12/9/98	59		ug/L
WN-8A	2-Butanone	12/9/98	5	U	ug/L
WN-8A	Carbon Tetrachloride	12/9/98	5	U	ug/L
WN-8A	Chlorobenzene	12/9/98	5	U	ug/L
WN-8A	Chloroform	12/9/98	5	U	ug/L
WN-8A	1,1-Dichloroethene	12/9/98	5	U	ug/L
WN-8A	Ethylbenzene	12/9/98	2	J	ug/L
WN-8A	Toluene	12/9/98	13		ug/L
WN-8A	Trichloroethene	12/9/98	5	U	ug/L
WN-8A	Xylenes (Total)	12/9/98	7		ug/L
WN-8A	Acenaphthylene	12/9/98	10	U	ug/L
WN-8A	Anthracene	12/9/98	10	U	ug/L
WN-8A	Benzo(a)anthracene	12/9/98	10	U	ug/L
WN-8A	Benzo(a)pyrene	12/9/98	10	U	ug/L
WN-8A	Benzo(b)fluoranthene	12/9/98	10	U	ug/L
WN-8A	bis(2-ethylhexyl)phthalate	12/9/98	1	JB	ug/L
WN-8A	Chrysene	12/9/98	10	U	ug/L
WN-8A	Di-n-octyl phthalate	12/9/98	10	U	ug/L
WN-8A	Dibenzofuran	12/9/98	10	U	ug/L
WN-8A	Dimethyl phthalate	12/9/98	10	U	ug/L
WN-8A	2,4-Dimethylphenol	12/9/98	10	U	ug/L
WN-8A	Fluoranthene	12/9/98	10	U	ug/L
WN-8A	Fluorene	12/9/98	10	U	ug/L
WN-8A	1-Methylnaphthalene	12/9/98	21		ug/L
WN-8A	2-Methylnaphthalene	12/9/98	17		ug/L
WN-8A	Naphthalene	12/9/98	10	U	ug/L
WN-8A	Phenanthrene	12/9/98	10	U	ug/L
WN-8A	Phenol	12/9/98	10	U	ug/L
WN-8A	Pyrene	12/9/98	10	U	ug/L

Note: See last page for explanation of codes.

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Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Conc.	Data Qual.	Units
WN-8B	Conductivity, Field	12/9/98	856		umhos/cm
WN-8B	Corrected Water Elevation	12/9/98	1053.39		ftAMSL
WN-8B	pH, Field	12/9/98	7.1		std
WN-8B	Temperature, Field	12/9/98	57.2		DegF
WN-8B	Chloride	12/9/98	13.8		mg/l
WN-8B	Total Dissolved Solids	12/9/98	503		mg/l
WN-8B	Arsenic	12/9/98	21.9		ug/l
WN-8B	Barium	12/9/98	875		ug/l
WN-8B	Cadmium	12/9/98	0.3	U	ug/l
WN-8B	Chromium	12/9/98	1	B	ug/l
WN-8B	Lead	12/9/98	1.7	B	ug/l
WN-8B	Nickel	12/9/98	1.2	B	ug/l
WN-8B	Acetone	12/9/98	33		ug/L
WN-8B	Benzene	12/9/98	580	D	ug/L
WN-8B	2-Butanone	12/9/98	5	U	ug/L
WN-8B	Carbon Tetrachloride	12/9/98	5	U	ug/L
WN-8B	Chlorobenzene	12/9/98	5	U	ug/L
WN-8B	Chloroform	12/9/98	5	U	ug/L
WN-8B	1,1-Dichloroethene	12/9/98	5	U	ug/L
WN-8B	Ethylbenzene	12/9/98	15		ug/L
WN-8B	Toluene	12/9/98	18		ug/L
WN-8B	Trichloroethene	12/9/98	5	U	ug/L
WN-8B	Xylenes (Total)	12/9/98	24		ug/L
WN-8B	Acenaphthylene	12/9/98	10	U	ug/L
WN-8B	Anthracene	12/9/98	10	U	ug/L
WN-8B	Benzo(a)anthracene	12/9/98	10	U	ug/L
WN-8B	Benzo(a)pyrene	12/9/98	10	U	ug/L
WN-8B	Benzo(b)fluoranthene	12/9/98	10	U	ug/L
WN-8B	bis(2-ethylhexyl)phthalate	12/9/98	10	U	ug/L
WN-8B	Chrysene	12/9/98	10	U	ug/L
WN-8B	Di-n-octyl phthalate	12/9/98	10	U	ug/L
WN-8B	Dibenzofuran	12/9/98	2	J	ug/L
WN-8B	Dimethyl phthalate	12/9/98	10	U	ug/L
WN-8B	2,4-Dimethylphenol	12/9/98	10	U	ug/L
WN-8B	Fluoranthene	12/9/98	10	U	ug/L
WN-8B	Fluorene	12/9/98	3	J	ug/L
WN-8B	1-Methylnaphthalene	12/9/98	51		ug/L
WN-8B	2-Methylnaphthalene	12/9/98	11		ug/L
WN-8B	Naphthalene	12/9/98	10	U	ug/L
WN-8B	Phenanthrene	12/9/98	4	J	ug/L
WN-8B	Phenol	12/9/98	10	U	ug/L
WN-8B	Pyrene	12/9/98	10	U	ug/L

Note: See last page for explanation of codes.

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Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Conc.	Data Qual.	Units
MW-3	Conductivity, Field	12/10/98	1445		umhos/cm
MW-3	Corrected Water Elevation	12/10/98	1047.79		ftAMSL
MW-3	pH, Field	12/10/98	6.6		std
MW-3	Temperature, Field	12/10/98	62.1		DegC
MW-3	Chloride	12/10/98	61		mg/l
MW-3	Total Dissolved Solids	12/10/98	614		mg/l
MW-3	Arsenic	12/10/98	32.3		ug/l
MW-3	Barium	12/10/98	1890		ug/l
MW-3	Cadmium	12/10/98	0.97	B	ug/l
MW-3	Chromium	12/10/98	0.7	U	ug/l
MW-3	Lead	12/10/98	1.5	U	ug/l
MW-3	Nickel	12/10/98	1.9	B	ug/l
MW-3	Acetone	12/10/98	43		ug/L
MW-3	Benzene	12/10/98	3200	D	ug/L
MW-3	2-Butanone	12/10/98	5	U	ug/L
MW-3	Carbon Tetrachloride	12/10/98	5	U	ug/L
MW-3	Chlorobenzene	12/10/98	5	U	ug/L
MW-3	Chloroform	12/10/98	5	U	ug/L
MW-3	1,1-Dichloroethene	12/10/98	5	U	ug/L
MW-3	Ethylbenzene	12/10/98	23		ug/L
MW-3	Toluene	12/10/98	36		ug/L
MW-3	Trichloroethene	12/10/98	5	U	ug/L
MW-3	Xylenes (Total)	12/10/98	190		ug/L
MW-3	Acenaphthylene	12/10/98	10	U	ug/L
MW-3	Anthracene	12/10/98	10	U	ug/L
MW-3	Benzo(a)anthracene	12/10/98	10	U	ug/L
MW-3	Benzo(a)pyrene	12/10/98	10	U	ug/L
MW-3	Benzo(b)fluoranthene	12/10/98	10	U	ug/L
MW-3	bis(2-ethylhexyl)phthalate	12/10/98	2	JB	ug/L
MW-3	Chrysene	12/10/98	10	U	ug/L
MW-3	Di-n-octyl phthalate	12/10/98	10	U	ug/L
MW-3	Dibenzofuran	12/10/98	2	J	ug/L
MW-3	Dimethyl phthalate	12/10/98	10	U	ug/L
MW-3	2,4-Dimethylphenol	12/10/98	10	U	ug/L
MW-3	Fluoranthene	12/10/98	10	U	ug/L
MW-3	Fluorene	12/10/98	3	J	ug/L
MW-3	1-Methylnaphthalene	12/10/98	75		ug/L
MW-3	2-Methylnaphthalene	12/10/98	100	D	ug/L
MW-3	Naphthalene	12/10/98	13		ug/L
MW-3	Phenanthrene	12/10/98	8	J	ug/L
MW-3	Phenol	12/10/98	160	D	ug/L
MW-3	Pyrene	12/10/98	10	U	ug/L

Note: See last page for explanation of codes.

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Conc.	Data Qual.	Units
MW-4	Conductivity, Field	12/10/98	1553		umhos/cm
MW-4	Corrected Water Elevation	12/10/98	1046.94		ftAMSL
MW-4	pH, Field	12/10/98	6.5		std
MW-4	Temperature, Field	12/10/98	61.9		DegC
MW-4	Chloride	12/10/98	54.1		mg/l
MW-4	Total Dissolved Solids	12/10/98	678		mg/l
MW-4	Arsenic	12/10/98	24.5		ug/l
MW-4	Barium	12/10/98	1560		ug/l
MW-4	Cadmium	12/10/98	0.91	B	ug/l
MW-4	Chromium	12/10/98	0.7	U	ug/l
MW-4	Lead	12/10/98	1.5	U	ug/l
MW-4	Nickel	12/10/98	2.7	B	ug/l
MW-4	Acetone	12/10/98	330	E	ug/L
MW-4	Benzene	12/10/98	9400	D	ug/L
MW-4	2-Butanone	12/10/98	5	U	ug/L
MW-4	Carbon Tetrachloride	12/10/98	5	U	ug/L
MW-4	Chlorobenzene	12/10/98	5	U	ug/L
MW-4	Chloroform	12/10/98	5	U	ug/L
MW-4	1,1-Dichloroethene	12/10/98	5	U	ug/L
MW-4	Ethylbenzene	12/10/98	550	D	ug/L
MW-4	Toluene	12/10/98	88		ug/L
MW-4	Trichloroethene	12/10/98	5	U	ug/L
MW-4	Xylenes (Total)	12/10/98	1000	D	ug/L
MW-4	Acenaphthylene	12/10/98	10	U	ug/L
MW-4	Anthracene	12/10/98	1	J	ug/L
MW-4	Benzo(a)anthracene	12/10/98	10	U	ug/L
MW-4	Benzo(a)pyrene	12/10/98	10	U	ug/L
MW-4	Benzo(b)fluoranthene	12/10/98	10	U	ug/L
MW-4	bis(2-ethylhexyl)phthalate	12/10/98	10	U	ug/L
MW-4	Chrysene	12/10/98	10	U	ug/L
MW-4	Di-n-octyl phthalate	12/10/98	10	U	ug/L
MW-4	Dibenzofuran	12/10/98	2	J	ug/L
MW-4	Dimethyl phthalate	12/10/98	10	U	ug/L
MW-4	2,4-Dimethylphenol	12/10/98	5	J	ug/L
MW-4	Fluoranthene	12/10/98	10	U	ug/L
MW-4	Fluorene	12/10/98	4	J	ug/L
MW-4	1-Methylnaphthalene	12/10/98	120	D	ug/L
MW-4	2-Methylnaphthalene	12/10/98	230	D	ug/L
MW-4	Naphthalene	12/10/98	180	D	ug/L
MW-4	Phenanthrene	12/10/98	12		ug/L
MW-4	Phenol	12/10/98	74		ug/L
MW-4	Pyrene	12/10/98	1	J	ug/L

Note: See last page for explanation of codes.

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Conc.	Data Qual.	Units
MW-5	Conductivity, Field	12/10/98	1441		umhos/cm
MW-5	Corrected Water Elevation	12/10/98	1046.45		ftAMSL
MW-5	pH, Field	12/10/98	6.5		std
MW-5	Temperature, Field	12/10/98	62.6		DegC
MW-5	Chloride	12/10/98	117		mg/l
MW-5	Total Dissolved Solids	12/10/98	608		mg/l
MW-5	Arsenic	12/10/98	26.1		ug/l
MW-5	Barium	12/10/98	1310		ug/l
MW-5	Cadmium	12/10/98	0.83	B	ug/l
MW-5	Chromium	12/10/98	0.7	U	ug/l
MW-5	Lead	12/10/98	1.8	B	ug/l
MW-5	Nickel	12/10/98	1.9	B	ug/l
MW-5	Acetone	12/10/98	360	E	ug/L
MW-5	Benzene	12/10/98	12000	D	ug/L
MW-5	2-Butanone	12/10/98	5	U	ug/L
MW-5	Carbon Tetrachloride	12/10/98	5	U	ug/L
MW-5	Chlorobenzene	12/10/98	5	U	ug/L
MW-5	Chloroform	12/10/98	5	U	ug/L
MW-5	1,1-Dichloroethene	12/10/98	5	U	ug/L
MW-5	Ethylbenzene	12/10/98	940	D	ug/L
MW-5	Toluene	12/10/98	240	E	ug/L
MW-5	Trichloroethene	12/10/98	5	U	ug/L
MW-5	Xylenes (Total)	12/10/98	1600	D	ug/L
MW-5	Acenaphthylene	12/10/98	10	U	ug/L
MW-5	Anthracene	12/10/98	10	U	ug/L
MW-5	Benzo(a)anthracene	12/10/98	10	U	ug/L
MW-5	Benzo(a)pyrene	12/10/98	10	U	ug/L
MW-5	Benzo(b)fluoranthene	12/10/98	10	U	ug/L
MW-5	bis(2-ethylhexyl)phthalate	12/10/98	4	JB	ug/L
MW-5	Chrysene	12/10/98	10	U	ug/L
MW-5	Di-n-octyl phthalate	12/10/98	10	U	ug/L
MW-5	Dibenzofuran	12/10/98	10	U	ug/L
MW-5	Dimethyl phthalate	12/10/98	10	U	ug/L
MW-5	2,4-Dimethylphenol	12/10/98	4	J	ug/L
MW-5	Fluoranthene	12/10/98	10	U	ug/L
MW-5	Fluorene	12/10/98	1	J	ug/L
MW-5	1-Methylnaphthalene	12/10/98	54		ug/L
MW-5	2-Methylnaphthalene	12/10/98	90		ug/L
MW-5	Naphthalene	12/10/98	180	RE	ug/L
MW-5	Phenanthrene	12/10/98	4	J	ug/L
MW-5	Phenol	12/10/98	57		ug/L
MW-5	Pyrene	12/10/98	10	U	ug/L

Note: See last page for explanation of codes.

Appendix A

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Conc.	Data Qual.	Units
MW-6	Conductivity, Field	12/10/98	1051		umhos/cm
MW-6	Corrected Water Elevation	12/10/98	1050.08		ftAMSL
MW-6	pH, Field	12/10/98	6.1		std
MW-6	Temperature, Field	12/10/98	58.5		DegC
MW-6	Chloride	12/10/98	50.6		mg/l
MW-6	Total Dissolved Solids	12/10/98	529		mg/l
MW-6	Arsenic	12/10/98	22.4		ug/l
MW-6	Barium	12/10/98	625		ug/l
MW-6	Cadmium	12/10/98	0.32	B	ug/l
MW-6	Chromium	12/10/98	0.7	U	ug/l
MW-6	Lead	12/10/98	1.7	B	ug/l
MW-6	Nickel	12/10/98	2	B	ug/l
MW-6	Acetone	12/10/98	43		ug/L
MW-6	Benzene	12/10/98	1400	D	ug/L
MW-6	2-Butanone	12/10/98	5	U	ug/L
MW-6	Carbon Tetrachloride	12/10/98	5	U	ug/L
MW-6	Chlorobenzene	12/10/98	5	U	ug/L
MW-6	Chloroform	12/10/98	5	U	ug/L
MW-6	1,1-Dichloroethene	12/10/98	5	U	ug/L
MW-6	Ethylbenzene	12/10/98	27		ug/L
MW-6	Toluene	12/10/98	150		ug/L
MW-6	Trichloroethene	12/10/98	5	U	ug/L
MW-6	Xylenes (Total)	12/10/98	170		ug/L
MW-6	Acenaphthylene	12/10/98	10	U	ug/L
MW-6	Anthracene	12/10/98	10	U	ug/L
MW-6	Benzo(a)anthracene	12/10/98	10	U	ug/L
MW-6	Benzo(a)pyrene	12/10/98	10	U	ug/L
MW-6	Benzo(b)fluoranthene	12/10/98	10	U	ug/L
MW-6	bis(2-ethylhexyl)phthalate	12/10/98	2	JB	ug/L
MW-6	Chrysene	12/10/98	10	U	ug/L
MW-6	Di-n-octyl phthalate	12/10/98	10	U	ug/L
MW-6	Dibenzofuran	12/10/98	10	U	ug/L
MW-6	Dimethyl phthalate	12/10/98	10	U	ug/L
MW-6	2,4-Dimethylphenol	12/10/98	37		ug/L
MW-6	Fluoranthene	12/10/98	10	U	ug/L
MW-6	Fluorene	12/10/98	10	U	ug/L
MW-6	1-Methylnaphthalene	12/10/98	21		ug/L
MW-6	2-Methylnaphthalene	12/10/98	12		ug/L
MW-6	Naphthalene	12/10/98	6	J	ug/L
MW-6	Phenanthrene	12/10/98	2	J	ug/L
MW-6	Phenol	12/10/98	110	D	ug/L
MW-6	Pyrene	12/10/98	10	U	ug/L

Note: See last page for explanation of codes.

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Data Conc.	Qual.	Units
MW-10	Conductivity, Field	12/10/98	1616		umhos/cm
MW-10	Corrected Water Elevation	12/10/98	1048.07		ftAMSL
MW-10	pH, Field	12/10/98	7		std
MW-10	Temperature, Field	12/10/98	60.2		DegC
MW-10	Chloride	12/10/98	89		mg/l
MW-10	Total Dissolved Solids	12/10/98	804		mg/l
MW-10	Arsenic	12/10/98	5.7	B	ug/l
MW-10	Barium	12/10/98	245		ug/l
MW-10	Cadmium	12/10/98	0.3	U	ug/l
MW-10	Chromium	12/10/98	0.7	U	ug/l
MW-10	Lead	12/10/98	1.5	U	ug/l
MW-10	Nickel	12/10/98	1.9	B	ug/l
MW-10	Acetone	12/10/98	8		ug/L
MW-10	Benzene	12/10/98	380	D	ug/L
MW-10	2-Butanone	12/10/98	5	U	ug/L
MW-10	Carbon Tetrachloride	12/10/98	5	U	ug/L
MW-10	Chlorobenzene	12/10/98	5	U	ug/L
MW-10	Chloroform	12/10/98	5	U	ug/L
MW-10	1,1-Dichloroethene	12/10/98	5	U	ug/L
MW-10	Ethylbenzene	12/10/98	2	J	ug/L
MW-10	Toluene	12/10/98	5		ug/L
MW-10	Trichloroethene	12/10/98	5	U	ug/L
MW-10	Xylenes (Total)	12/10/98	2	J	ug/L
MW-10	Acenaphthylene	12/10/98	10	U	ug/L
MW-10	Anthracene	12/10/98	10	U	ug/L
MW-10	Benzo(a)anthracene	12/10/98	10	U	ug/L
MW-10	Benzo(a)pyrene	12/10/98	10	U	ug/L
MW-10	Benzo(b)fluoranthene	12/10/98	10	U	ug/L
MW-10	bis(2-ethylhexyl)phthalate	12/10/98	5	JB	ug/L
MW-10	Chrysene	12/10/98	10	U	ug/L
MW-10	Di-n-octyl phthalate	12/10/98	10	U	ug/L
MW-10	Dibenzofuran	12/10/98	10	U	ug/L
MW-10	Dimethyl phthalate	12/10/98	10	U	ug/L
MW-10	2,4-Dimethylphenol	12/10/98	2	J	ug/L
MW-10	Fluoranthene	12/10/98	10	U	ug/L
MW-10	Fluorene	12/10/98	10	U	ug/L
MW-10	1-Methylnaphthalene	12/10/98	1	J	ug/L
MW-10	2-Methylnaphthalene	12/10/98	1	J	ug/L
MW-10	Naphthalene	12/10/98	2	J	ug/L
MW-10	Phenanthrene	12/10/98	10	U	ug/L
MW-10	Phenol	12/10/98	10	U	ug/L
MW-10	Pyrene	12/10/98	10	U	ug/L

Note: See last page for explanation of codes.

Appendix A

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Conc.	Data Qual.	Units
MW-11	Conductivity, Field	12/10/98	859		umhos/cm
MW-11	Corrected Water Elevation	12/10/98	1047.06		ftAMSL
MW-11	pH, Field	12/10/98	7		std
MW-11	Temperature, Field	12/10/98	61.4		DegC
MW-11	Chloride	12/10/98	62.8		mg/l
MW-11	Total Dissolved Solids	12/10/98	392		mg/l
MW-11	Arsenic	12/10/98	18.7		ug/l
MW-11	Barium	12/10/98	904		ug/l
MW-11	Cadmium	12/10/98	0.3	U	ug/l
MW-11	Chromium	12/10/98	0.7	U	ug/l
MW-11	Lead	12/10/98	1.5	B	ug/l
MW-11	Nickel	12/10/98	1.2	B	ug/l
MW-11	Acetone	12/10/98	140		ug/L
MW-11	Benzene	12/10/98	150	D	ug/L
MW-11	2-Butanone	12/10/98	5	U	ug/L
MW-11	Carbon Tetrachloride	12/10/98	5	U	ug/L
MW-11	Chlorobenzene	12/10/98	5	U	ug/L
MW-11	Chloroform	12/10/98	5	U	ug/L
MW-11	1,1-Dichloroethene	12/10/98	5	U	ug/L
MW-11	Ethylbenzene	12/10/98	3	J	ug/L
MW-11	Toluene	12/10/98	6		ug/L
MW-11	Trichloroethene	12/10/98	5	U	ug/L
MW-11	Xylenes (Total)	12/10/98	6		ug/L
MW-11	Acenaphthylene	12/10/98	10	U	ug/L
MW-11	Anthracene	12/10/98	10	U	ug/L
MW-11	Benzo(a)anthracene	12/10/98	10	U	ug/L
MW-11	Benzo(a)pyrene	12/10/98	10	U	ug/L
MW-11	Benzo(b)fluoranthene	12/10/98	10	U	ug/L
MW-11	bis(2-ethylhexyl)phthalate	12/10/98	32	B	ug/L
MW-11	Chrysene	12/10/98	10	U	ug/L
MW-11	Di-n-octyl phthalate	12/10/98	10	U	ug/L
MW-11	Dibenzofuran	12/10/98	1	J	ug/L
MW-11	Dimethyl phthalate	12/10/98	10	U	ug/L
MW-11	2,4-Dimethylphenol	12/10/98	10	U	ug/L
MW-11	Fluoranthene	12/10/98	10	U	ug/L
MW-11	Fluorene	12/10/98	2	J	ug/L
MW-11	1-Methylnaphthalene	12/10/98	28		ug/L
MW-11	2-Methylnaphthalene	12/10/98	10	U	ug/L
MW-11	Naphthalene	12/10/98	10	U	ug/L
MW-11	Phenanthrene	12/10/98	5	J	ug/L
MW-11	Phenol	12/10/98	10	U	ug/L
MW-11	Pyrene	12/10/98	10	U	ug/L

Note: See last page for explanation of codes.

Appendix A

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Conc.	Data Qual.	Units
MW-12	Conductivity, Field	12/10/98	1363		umhos/cm
MW-12	Corrected Water Elevation	12/10/98	1046.26		ftAMSL
MW-12	pH, Field	12/10/98	7		std
MW-12	Temperature, Field	12/10/98	61.6		DegC
MW-12	Chloride	12/10/98	169		mg/l
MW-12	Total Dissolved Solids	12/10/98	603		mg/l
MW-12	Arsenic	12/10/98	12.3		ug/l
MW-12	Barium	12/10/98	675		ug/l
MW-12	Cadmium	12/10/98	0.34	B	ug/l
MW-12	Chromium	12/10/98	1.5	B	ug/l
MW-12	Lead	12/10/98	2.6	B	ug/l
MW-12	Nickel	12/10/98	5.3	B	ug/l
MW-12	Acetone	12/10/98	6		ug/L
MW-12	Benzene	12/10/98	26		ug/L
MW-12	2-Butanone	12/10/98	5	U	ug/L
MW-12	Carbon Tetrachloride	12/10/98	5	U	ug/L
MW-12	Chlorobenzene	12/10/98	5	U	ug/L
MW-12	Chloroform	12/10/98	5	U	ug/L
MW-12	1,1-Dichloroethene	12/10/98	5	U	ug/L
MW-12	Ethylbenzene	12/10/98	4	J	ug/L
MW-12	Toluene	12/10/98	5	U	ug/L
MW-12	Trichloroethene	12/10/98	5	U	ug/L
MW-12	Xylenes (Total)	12/10/98	4	J	ug/L
MW-12	Acenaphthylene	12/10/98	10	U	ug/L
MW-12	Anthracene	12/10/98	10	U	ug/L
MW-12	Benzo(a)anthracene	12/10/98	10	U	ug/L
MW-12	Benzo(a)pyrene	12/10/98	10	U	ug/L
MW-12	Benzo(b)fluoranthene	12/10/98	10	U	ug/L
MW-12	bis(2-ethylhexyl)phthalate	12/10/98	4	JB	ug/L
MW-12	Chrysene	12/10/98	10	U	ug/L
MW-12	Di-n-octyl phthalate	12/10/98	10	U	ug/L
MW-12	Dibenzofuran	12/10/98	10	U	ug/L
MW-12	Dimethyl phthalate	12/10/98	10	U	ug/L
MW-12	2,4-Dimethylphenol	12/10/98	10	U	ug/L
MW-12	Fluoranthene	12/10/98	10	U	ug/L
MW-12	Fluorene	12/10/98	10	U	ug/L
MW-12	1-Methylnaphthalene	12/10/98	10	U	ug/L
MW-12	2-Methylnaphthalene	12/10/98	10	U	ug/L
MW-12	Naphthalene	12/10/98	10	U	ug/L
MW-12	Phenanthrene	12/10/98	10	U	ug/L
MW-12	Phenol	12/10/98	10	U	ug/L
MW-12	Pyrene	12/10/98	10	U	ug/L

Note: See last page for explanation of codes.

Appendix A

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Conc.	Data Qual.	Units
MW-13	Conductivity, Field	12/10/98	1212		umhos/cm
MW-13	Corrected Water Elevation	12/10/98	1050.06		ftAMSL
MW-13	pH, Field	12/10/98	6.5		std
MW-13	Temperature, Field	12/10/98	58.9		DegC
MW-13	Chloride	12/10/98	155		mg/l
MW-13	Total Dissolved Solids	12/10/98	580		mg/l
MW-13	Arsenic	12/10/98	5.6	B	ug/l
MW-13	Barium	12/10/98	390		ug/l
MW-13	Cadmium	12/10/98	0.3	U	ug/l
MW-13	Chromium	12/10/98	0.7	U	ug/l
MW-13	Lead	12/10/98	1.5	U	ug/l
MW-13	Nickel	12/10/98	1	U	ug/l
MW-13	Acetone	12/10/98	5	U	ug/L
MW-13	Benzene	12/10/98	10		ug/L
MW-13	2-Butanone	12/10/98	5	U	ug/L
MW-13	Carbon Tetrachloride	12/10/98	5	U	ug/L
MW-13	Chlorobenzene	12/10/98	5	U	ug/L
MW-13	Chloroform	12/10/98	5	U	ug/L
MW-13	1,1-Dichloroethene	12/10/98	5	U	ug/L
MW-13	Ethylbenzene	12/10/98	3	J	ug/L
MW-13	Toluene	12/10/98	5	U	ug/L
MW-13	Trichloroethene	12/10/98	5	U	ug/L
MW-13	Xylenes (Total)	12/10/98	2	J	ug/L
MW-13	Acenaphthylene	12/10/98	10	U	ug/L
MW-13	Anthracene	12/10/98	10	U	ug/L
MW-13	Benzo(a)anthracene	12/10/98	10	U	ug/L
MW-13	Benzo(a)pyrene	12/10/98	10	U	ug/L
MW-13	Benzo(b)fluoranthene	12/10/98	10	U	ug/L
MW-13	bis(2-ethylhexyl)phthalate	12/10/98	4	JB	ug/L
MW-13	Chrysene	12/10/98	10	U	ug/L
MW-13	Di-n-octyl phthalate	12/10/98	10	U	ug/L
MW-13	Dibenzofuran	12/10/98	10	U	ug/L
MW-13	Dimethyl phthalate	12/10/98	10	U	ug/L
MW-13	2,4-Dimethylphenol	12/10/98	10	U	ug/L
MW-13	Fluoranthene	12/10/98	10	U	ug/L
MW-13	Fluorene	12/10/98	10	U	ug/L
MW-13	1-Methylnaphthalene	12/10/98	10	U	ug/L
MW-13	2-Methylnaphthalene	12/10/98	10	U	ug/L
MW-13	Naphthalene	12/10/98	10	U	ug/L
MW-13	Phenanthrene	12/10/98	10	U	ug/L
MW-13	Phenol	12/10/98	10	U	ug/L
MW-13	Pyrene	12/10/98	10	U	ug/L

Note: See last page for explanation of codes.

Appendix A

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Conc.	Data Qual.	Units
RCRA-MW-1	Conductivity, Field	12/10/98	1616		umhos/cm
RCRA-MW-1	Corrected Water Elevation	12/10/98	1045.61		ftAMSL
RCRA-MW-1	pH, Field	12/10/98	7.4		std
RCRA-MW-1	Temperature, Field	12/10/98	61.8		DegC
RCRA-MW-1	Chloride	12/10/98	159		mg/l
RCRA-MW-1	Total Dissolved Solids	12/10/98	914		mg/l
RCRA-MW-1	Arsenic	12/10/98	18		ug/l
RCRA-MW-1	Barium	12/10/98	757		ug/l
RCRA-MW-1	Cadmium	12/10/98	0.7	B	ug/l
RCRA-MW-1	Chromium	12/10/98	1.4	B	ug/l
RCRA-MW-1	Lead	12/10/98	4.1		ug/l
RCRA-MW-1	Nickel	12/10/98	3.1	B	ug/l
RCRA-MW-1	Acetone	12/10/98	190		ug/L
RCRA-MW-1	Benzene	12/10/98	2600	D	ug/L
RCRA-MW-1	2-Butanone	12/10/98	5	U	ug/L
RCRA-MW-1	Carbon Tetrachloride	12/10/98	5	U	ug/L
RCRA-MW-1	Chlorobenzene	12/10/98	5	U	ug/L
RCRA-MW-1	Chloroform	12/10/98	1	J	ug/L
RCRA-MW-1	1,1-Dichloroethene	12/10/98	5	U	ug/L
RCRA-MW-1	Ethylbenzene	12/10/98	440	D	ug/L
RCRA-MW-1	Toluene	12/10/98	36		ug/L
RCRA-MW-1	Trichloroethene	12/10/98	5	U	ug/L
RCRA-MW-1	Xylenes (Total)	12/10/98	630	D	ug/L
RCRA-MW-1	Acenaphthylene	12/10/98	10	U	ug/L
RCRA-MW-1	Anthracene	12/10/98	10	U	ug/L
RCRA-MW-1	Benzo(a)anthracene	12/10/98	10	U	ug/L
RCRA-MW-1	Benzo(a)pyrene	12/10/98	10	U	ug/L
RCRA-MW-1	Benzo(b)fluoranthene	12/10/98	6	J	ug/L
RCRA-MW-1	bis(2-ethylhexyl)phthalate	12/10/98	2	JB	ug/L
RCRA-MW-1	Chrysene	12/10/98	1	J	ug/L
RCRA-MW-1	Di-n-octyl phthalate	12/10/98	10	U	ug/L
RCRA-MW-1	Dibenzofuran	12/10/98	1	J	ug/L
RCRA-MW-1	Dimethyl phthalate	12/10/98	10	U	ug/L
RCRA-MW-1	2,4-Dimethylphenol	12/10/98	10	U	ug/L
RCRA-MW-1	Fluoranthene	12/10/98	10	U	ug/L
RCRA-MW-1	Fluorene	12/10/98	2	J	ug/L
RCRA-MW-1	1-Methylnaphthalene	12/10/98	65		ug/L
RCRA-MW-1	2-Methylnaphthalene	12/10/98	39		ug/L
RCRA-MW-1	Naphthalene	12/10/98	120	D	ug/L
RCRA-MW-1	Phenanthrene	12/10/98	7	J	ug/L
RCRA-MW-1	Phenol	12/10/98	22		ug/L
RCRA-MW-1	Pyrene	12/10/98	2	J	ug/L

Note: See last page for explanation of codes.

Appendix A

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Conc.	Data Qual.	Units
RCRA-MW-2	Conductivity, Field	12/10/98	1096		umhos/cm
RCRA-MW-2	Corrected Water Elevation	12/10/98	1045.79		ftAMSL
RCRA-MW-2	pH, Field	12/10/98	6.9		std
RCRA-MW-2	Temperature, Field	12/10/98	62		DegC
RCRA-MW-2	Chloride	12/10/98	59.3		mg/l
RCRA-MW-2	Total Dissolved Solids	12/10/98	604		mg/l
RCRA-MW-2	Arsenic	12/10/98	18.8		ug/l
RCRA-MW-2	Barium	12/10/98	905		ug/l
RCRA-MW-2	Cadmium	12/10/98	0.79	B	ug/l
RCRA-MW-2	Chromium	12/10/98	2.3	B	ug/l
RCRA-MW-2	Lead	12/10/98	25.2		ug/l
RCRA-MW-2	Nickel	12/10/98	7.8	B	ug/l
RCRA-MW-2	Acetone	12/10/98	180		ug/L
RCRA-MW-2	Benzene	12/10/98	6500	D	ug/L
RCRA-MW-2	2-Butanone	12/10/98	5	U	ug/L
RCRA-MW-2	Carbon Tetrachloride	12/10/98	5	U	ug/L
RCRA-MW-2	Chlorobenzene	12/10/98	5	U	ug/L
RCRA-MW-2	Chloroform	12/10/98	5	U	ug/L
RCRA-MW-2	1,1-Dichloroethene	12/10/98	5	U	ug/L
RCRA-MW-2	Ethylbenzene	12/10/98	760	D	ug/L
RCRA-MW-2	Toluene	12/10/98	97		ug/L
RCRA-MW-2	Trichloroethene	12/10/98	5	U	ug/L
RCRA-MW-2	Xylenes (Total)	12/10/98	2100	D	ug/L
RCRA-MW-2	Acenaphthylene	12/10/98	10	U	ug/L
RCRA-MW-2	Anthracene	12/10/98	1	J	ug/L
RCRA-MW-2	Benzo(a)anthracene	12/10/98	10	U	ug/L
RCRA-MW-2	Benzo(a)pyrene	12/10/98	10	U	ug/L
RCRA-MW-2	Benzo(b)fluoranthene	12/10/98	10	U	ug/L
RCRA-MW-2	bis(2-ethylhexyl)phthalate	12/10/98	4	JB	ug/L
RCRA-MW-2	Chrysene	12/10/98	2	J	ug/L
RCRA-MW-2	Di-n-octyl phthalate	12/10/98	1	J	ug/L
RCRA-MW-2	Dibenzofuran	12/10/98	1	J	ug/L
RCRA-MW-2	Dimethyl phthalate	12/10/98	10	U	ug/L
RCRA-MW-2	2,4-Dimethylphenol	12/10/98	5	J	ug/L
RCRA-MW-2	Fluoranthene	12/10/98	10	U	ug/L
RCRA-MW-2	Fluorene	12/10/98	2	J	ug/L
RCRA-MW-2	1-Methylnaphthalene	12/10/98	90		ug/L
RCRA-MW-2	2-Methylnaphthalene	12/10/98	79		ug/L
RCRA-MW-2	Naphthalene	12/10/98	140	D	ug/L
RCRA-MW-2	Phenanthrene	12/10/98	11		ug/L
RCRA-MW-2	Phenol	12/10/98	39		ug/L
RCRA-MW-2	Pyrene	12/10/98	4	J	ug/L

Note: See last page for explanation of codes.

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Conc.	Data Qual.	Units
RCRA-MW-3	Conductivity, Field	12/10/98	1126		umhos/cm
RCRA-MW-3	Corrected Water Elevation	12/10/98	1045.85		ftAMSL
RCRA-MW-3	pH, Field	12/10/98	6.6		std
RCRA-MW-3	Temperature, Field	12/10/98	63.6		DegC
RCRA-MW-3	Chloride	12/10/98	71.5		mg/l
RCRA-MW-3	Total Dissolved Solids	12/10/98	557		mg/l
RCRA-MW-3	Arsenic	12/10/98	32.3		ug/l
RCRA-MW-3	Barium	12/10/98	1110		ug/l
RCRA-MW-3	Cadmium	12/10/98	0.75	B	ug/l
RCRA-MW-3	Chromium	12/10/98	1.4	B	ug/l
RCRA-MW-3	Lead	12/10/98	5.7		ug/l
RCRA-MW-3	Nickel	12/10/98	1.6	B	ug/l
RCRA-MW-3	Acetone	12/10/98	200		ug/L
RCRA-MW-3	Benzene	12/10/98	12000	D	ug/L
RCRA-MW-3	2-Butanone	12/10/98	5	U	ug/L
RCRA-MW-3	Carbon Tetrachloride	12/10/98	5	U	ug/L
RCRA-MW-3	Chlorobenzene	12/10/98	5	U	ug/L
RCRA-MW-3	Chloroform	12/10/98	5	U	ug/L
RCRA-MW-3	1,1-Dichloroethene	12/10/98	5	U	ug/L
RCRA-MW-3	Ethylbenzene	12/10/98	1600	D	ug/L
RCRA-MW-3	Toluene	12/10/98	1200	D	ug/L
RCRA-MW-3	Trichloroethene	12/10/98	5	U	ug/L
RCRA-MW-3	Xylenes (Total)	12/10/98	6200	D	ug/L
RCRA-MW-3	Acenaphthylene	12/10/98	10	U	ug/L
RCRA-MW-3	Anthracene	12/10/98	10	U	ug/L
RCRA-MW-3	Benzo(a)anthracene	12/10/98	10	U	ug/L
RCRA-MW-3	Benzo(a)pyrene	12/10/98	10	U	ug/L
RCRA-MW-3	Benzo(b)fluoranthene	12/10/98	10	U	ug/L
RCRA-MW-3	bis(2-ethylhexyl)phthalate	12/10/98	10	B	ug/L
RCRA-MW-3	Chrysene	12/10/98	1	J	ug/L
RCRA-MW-3	Di-n-octyl phthalate	12/10/98	10	U	ug/L
RCRA-MW-3	Dibenzofuran	12/10/98	10	U	ug/L
RCRA-MW-3	Dimethyl phthalate	12/10/98	10	U	ug/L
RCRA-MW-3	2,4-Dimethylphenol	12/10/98	10		ug/L
RCRA-MW-3	Fluoranthene	12/10/98	10	U	ug/L
RCRA-MW-3	Fluorene	12/10/98	2	J	ug/L
RCRA-MW-3	1-Methylnaphthalene	12/10/98	75		ug/L
RCRA-MW-3	2-Methylnaphthalene	12/10/98	130	D	ug/L
RCRA-MW-3	Naphthalene	12/10/98	280	D	ug/L
RCRA-MW-3	Phenanthrene	12/10/98	6	J	ug/L
RCRA-MW-3	Phenol	12/10/98	39		ug/L
RCRA-MW-3	Pyrene	12/10/98	1	J	ug/L

Note: See last page for explanation of codes.

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Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Conc.	Data Qual.	Units
RCRA-MW-4	Conductivity, Field	12/10/98	1208		umhos/cm
RCRA-MW-4	Corrected Water Elevation	12/10/98	1048.02		ftAMSL
RCRA-MW-4	pH, Field	12/10/98	7.6		std
RCRA-MW-4	Temperature, Field	12/10/98	60.5		DegC
RCRA-MW-4	Chloride	12/10/98	120		mg/l
RCRA-MW-4	Total Dissolved Solids	12/10/98	677		mg/l
RCRA-MW-4	Arsenic	12/10/98	17.8		ug/l
RCRA-MW-4	Barium	12/10/98	750		ug/l
RCRA-MW-4	Cadmium	12/10/98	0.47	B	ug/l
RCRA-MW-4	Chromium	12/10/98	0.7	U	ug/l
RCRA-MW-4	Lead	12/10/98	3.5		ug/l
RCRA-MW-4	Nickel	12/10/98	3.3	B	ug/l
RCRA-MW-4	Acetone	12/10/98	100		ug/L
RCRA-MW-4	Benzene	12/10/98	2200	D	ug/L
RCRA-MW-4	2-Butanone	12/10/98	5	U	ug/L
RCRA-MW-4	Carbon Tetrachloride	12/10/98	5	U	ug/L
RCRA-MW-4	Chlorobenzene	12/10/98	5	U	ug/L
RCRA-MW-4	Chloroform	12/10/98	5	U	ug/L
RCRA-MW-4	1,1-Dichloroethene	12/10/98	5	U	ug/L
RCRA-MW-4	Ethylbenzene	12/10/98	250	D	ug/L
RCRA-MW-4	Toluene	12/10/98	45		ug/L
RCRA-MW-4	Trichloroethene	12/10/98	5	U	ug/L
RCRA-MW-4	Xylenes (Total)	12/10/98	820	D	ug/L
RCRA-MW-4	Acenaphthylene	12/10/98	10	U	ug/L
RCRA-MW-4	Anthracene	12/10/98	10	U	ug/L
RCRA-MW-4	Benzo(a)anthracene	12/10/98	10	U	ug/L
RCRA-MW-4	Benzo(a)pyrene	12/10/98	10	U	ug/L
RCRA-MW-4	Benzo(b)fluoranthene	12/10/98	10	U	ug/L
RCRA-MW-4	bis(2-ethylhexyl)phthalate	12/10/98	22	B	ug/L
RCRA-MW-4	Chrysene	12/10/98	10	U	ug/L
RCRA-MW-4	Di-n-octyl phthalate	12/10/98	10	U	ug/L
RCRA-MW-4	Dibenzofuran	12/10/98	10	U	ug/L
RCRA-MW-4	Dimethyl phthalate	12/10/98	10	U	ug/L
RCRA-MW-4	2,4-Dimethylphenol	12/10/98	4	J	ug/L
RCRA-MW-4	Fluoranthene	12/10/98	10	U	ug/L
RCRA-MW-4	Fluorene	12/10/98	1	J	ug/L
RCRA-MW-4	1-Methylnaphthalene	12/10/98	33		ug/L
RCRA-MW-4	2-Methylnaphthalene	12/10/98	27		ug/L
RCRA-MW-4	Naphthalene	12/10/98	51		ug/L
RCRA-MW-4	Phenanthrene	12/10/98	3	J	ug/L
RCRA-MW-4	Phenol	12/10/98	23		ug/L
RCRA-MW-4	Pyrene	12/10/98	1	J	ug/L

Note: See last page for explanation of codes.

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Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Data Conc.	Qual.	Units
19	Antimony	12/17/98	2.7	U	ug/l
19	Arsenic	12/17/98	39.5		ug/l
19	Barium	12/17/98	1120		ug/l
19	Beryllium	12/17/98	0.1	U	ug/l
19	Cadmium	12/17/98	1.4	B	ug/l
19	Chromium	12/17/98	0.7	U	ug/l
19	Lead	12/17/98	12.3		ug/l
19	Mercury	12/17/98	0.1	U	ug/l
19	Nickel	12/17/98	2.9	B	ug/l
19	Nickel	12/17/98	2.9	B	ug/l
19	Selenium	12/17/98	3.1	U	ug/l
19	Vanadium	12/17/98	4.6	B	ug/l
19	Zinc	12/17/98	14.6	B	ug/l
19	Benzene	12/17/98	4000	D	ug/L
19	2-Butanone	12/17/98	5	U	ug/L
19	Carbon Disulfide	12/17/98	5	U	ug/L
19	Chlorobenzene	12/17/98	5	U	ug/L
19	Chloroform	12/17/98	5	U	ug/L
19	1,2-Dibromoethane	12/17/98	5	U	ug/L
19	1,2-Dichloroethane	12/17/98	5	U	ug/L
19	1,1-Dichloroethene	12/17/98	5	U	ug/L
19	1,4-Dioxane	12/17/98	500	U	ug/l
19	Ethylbenzene	12/17/98	63	JD	ug/L
19	Styrene	12/17/98	5	U	ug/L
19	Tetrachloroethene	12/17/98	5	U	ug/L
19	Toluene	12/17/98	880	D	ug/L
19	1,1,1-Trichloroethane	12/17/98	5	U	ug/L
19	1,2,4-Trimethylbenzene	12/17/98	1000	E	ug/L
19	1,3,5-Trimethylbenzene	12/17/98	360	E	ug/L
19	Trichloroethene	12/17/98	5	U	ug/L
19	Xylenes (Total)	12/17/98	2900	D	ug/L
19	Acenaphthene	12/17/98	1	J	ug/L
19	Anthracene	12/17/98	10	U	ug/L
19	Benzo(a)anthracene	12/17/98	10	U	ug/L
19	Benzo(a)pyrene	12/17/98	10	U	ug/L
19	Benzo(b)fluoranthene	12/17/98	10	U	ug/L
19	bis(2-ethylhexyl)phthalate	12/17/98	10	U	ug/L
19	Butyl benzyl phthalate	12/17/98	10	U	ug/L
19	Chrysene	12/17/98	10	U	ug/L
19	Di-n-butyl phthalate	12/17/98	10	U	ug/L
19	Di-n-octyl phthalate	12/17/98	10	U	ug/L
19	Dibenz(a,h)anthracene	12/17/98	10	U	ug/L
19	1,2-Dichlorobenzene	12/17/98	10	U	ug/L

Note: See last page for explanation of codes.

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Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Data Conc. Qual.	Units
19	1,4-Dichlorobenzene	12/17/98	10 U	ug/L
19	2,4-Dimethylphenol	12/17/98	10	ug/L
19	2,4-Dinitrotoluene	12/17/98	10 U	ug/L
19	7,12-Dimethylbenz(a)anthracene	12/17/98	10 U	ug/L
19	Fluoranthene	12/17/98	10 U	ug/L
19	Fluorene	12/17/98	2 J	ug/L
19	Indeno(1,2,3-cd)pyrene	12/17/98	10 U	ug/L
19	1-Methylnaphthalene	12/17/98	68	ug/L
19	2-Methylnaphthalene	12/17/98	77	ug/L
19	2-Methylphenol	12/17/98	7 J	ug/L
19	4-Methylphenol	12/17/98	18	ug/L
19	Naphthalene	12/17/98	68	ug/L
19	Nitrobenzene	12/17/98	10 U	ug/L
19	Phenanthrene	12/17/98	2 J	ug/L
19	Phenol	12/17/98	21	ug/L
19	Pyrene	12/17/98	10 U	ug/L
19	Pyridine	12/17/98	10 U	ug/L

Note: See last page for explanation of codes.

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Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Data Conc.	Qual.	Units
24	Antimony	12/17/98	2.7	U	ug/l
24	Arsenic	12/17/98	64.1		ug/l
24	Barium	12/17/98	472		ug/l
24	Beryllium	12/17/98	0.1	U	ug/l
24	Cadmium	12/17/98	0.46	B	ug/l
24	Chromium	12/17/98	0.7	U	ug/l
24	Lead	12/17/98	7.9		ug/l
24	Mercury	12/17/98	0.1	U	ug/l
24	Nickel	12/17/98	4.4	B	ug/l
24	Nickel	12/17/98	4.4	B	ug/l
24	Selenium	12/17/98	3.1	U	ug/l
24	Vanadium	12/17/98	4.7	B	ug/l
24	Zinc	12/17/98	40.4		ug/l
24	Benzene	12/17/98	5	U	ug/L
24	2-Butanone	12/17/98	5	U	ug/L
24	Carbon Disulfide	12/17/98	5	U	ug/L
24	Chlorobenzene	12/17/98	5	U	ug/L
24	Chloroform	12/17/98	5	U	ug/L
24	1,2-Dibromoethane	12/17/98	5	U	ug/L
24	1,2-Dichloroethane	12/17/98	5	U	ug/L
24	1,1-Dichloroethene	12/17/98	5	U	ug/L
24	1,4-Dioxane	12/17/98	500	U	ug/l
24	Ethylbenzene	12/17/98	5	U	ug/L
24	Styrene	12/17/98	5	U	ug/L
24	Tetrachloroethene	12/17/98	5	U	ug/L
24	Toluene	12/17/98	5	U	ug/L
24	1,1,1-Trichloroethane	12/17/98	5	U	ug/L
24	1,2,4-Trimethylbenzene	12/17/98	5	U	ug/L
24	1,3,5-Trimethylbenzene	12/17/98	5	U	ug/L
24	Trichloroethene	12/17/98	5	U	ug/L
24	Xylenes (Total)	12/17/98	5	U	ug/L
24	Acenaphthene	12/17/98	10	U RE	ug/L
24	Anthracene	12/17/98	2	J RE	ug/L
24	Benzo(a)anthracene	12/17/98	2	J RE	ug/L
24	Benzo(a)pyrene	12/17/98	10	U RE	ug/L
24	Benzo(b)fluoranthene	12/17/98	10	U RE	ug/L
24	bis(2-ethylhexyl)phthalate	12/17/98	5	J RE	ug/L
24	Butyl benzyl phthalate	12/17/98	10	U RE	ug/L
24	Chrysene	12/17/98	2	J RE	ug/L
24	Di-n-butyl phthalate	12/17/98	10	U RE	ug/L
24	Di-n-octyl phthalate	12/17/98	10	U RE	ug/L
24	Dibenz(a,h)anthracene	12/17/98	10	U RE	ug/L
24	1,2-Dichlorobenzene	12/17/98	10	U RE	ug/L

Note: See last page for explanation of codes.

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Conc.	Data Qual.	Units
24	1,4-Dichlorobenzene	12/17/98	10	U RE	ug/L
24	2,4-Dimethylphenol	12/17/98	10	U RE	ug/L
24	2,4-Dinitrotoluene	12/17/98	10	U RE	ug/L
24	7,12-Dimethylbenz(a)anthracene	12/17/98	10	U RE	ug/L
24	Fluoranthene	12/17/98	10	U RE	ug/L
24	Fluorene	12/17/98	3	J RE	ug/L
24	Indeno(1,2,3-cd)pyrene	12/17/98	10	U RE	ug/L
24	1-Methylnaphthalene	12/17/98	45	RE	ug/L
24	2-Methylnaphthalene	12/17/98	46	RE	ug/L
24	2-Methylphenol	12/17/98	10	U RE	ug/L
24	4-Methylphenol	12/17/98	10	U RE	ug/L
24	Naphthalene	12/17/98	10	U RE	ug/L
24	Nitrobenzene	12/17/98	10	U RE	ug/L
24	Phenanthrene	12/17/98	20	RE	ug/L
24	Phenol	12/17/98	7	J RE	ug/L
24	Pyrene	12/17/98	12	RE	ug/L
24	Pyridine	12/17/98	10	U RE	ug/L

Note: See last page for explanation of codes.

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Data Conc.	Qual.	Units
32	Antimony	12/17/98	2.7	U	ug/l
32	Arsenic	12/17/98	2.9	U	ug/l
32	Barium	12/17/98	1050		ug/l
32	Beryllium	12/17/98	0.1	U	ug/l
32	Cadmium	12/17/98	0.77	B	ug/l
32	Chromium	12/17/98	1.1	B	ug/l
32	Lead	12/17/98	2.9	B	ug/l
32	Mercury	12/17/98	0.1	U	ug/l
32	Nickel	12/17/98	6.1	B	ug/l
32	Nickel	12/17/98	6.1	B	ug/l
32	Selenium	12/17/98	3.1	U	ug/l
32	Vanadium	12/17/98	11	B	ug/l
32	Zinc	12/17/98	44.9		ug/l
32	Benzene	12/17/98	870	D	ug/L
32	2-Butanone	12/17/98	5	U	ug/L
32	Carbon Disulfide	12/17/98	5	U	ug/L
32	Chlorobenzene	12/17/98	5	U	ug/L
32	Chloroform	12/17/98	5	U	ug/L
32	1,2-Dibromoethane	12/17/98	5	U	ug/L
32	1,2-Dichloroethane	12/17/98	5	U	ug/L
32	1,1-Dichloroethene	12/17/98	5	U	ug/L
32	1,4-Dioxane	12/17/98	500	U	ug/l
32	Ethylbenzene	12/17/98	5		ug/L
32	Styrene	12/17/98	5	U	ug/L
32	Tetrachloroethene	12/17/98	5	U	ug/L
32	Toluene	12/17/98	2	J	ug/L
32	1,1,1-Trichloroethane	12/17/98	5	U	ug/L
32	1,2,4-Trimethylbenzene	12/17/98	28		ug/L
32	1,3,5-Trimethylbenzene	12/17/98	3	J	ug/L
32	Trichloroethene	12/17/98	5	U	ug/L
32	Xylenes (Total)	12/17/98	6		ug/L
32	Acenaphthene	12/17/98	100	U	ug/L
32	Anthracene	12/17/98	25	J	ug/L
32	Benzo(a)anthracene	12/17/98	11	J	ug/L
32	Benzo(a)pyrene	12/17/98	100	U	ug/L
32	Benzo(b)fluoranthene	12/17/98	100	U	ug/L
32	bis(2-ethylhexyl)phthalate	12/17/98	100	U	ug/L
32	Butyl benzyl phthalate	12/17/98	100	U	ug/L
32	Chrysene	12/17/98	24	J	ug/L
32	Di-n-butyl phthalate	12/17/98	100	U	ug/L
32	Di-n-octyl phthalate	12/17/98	100	U	ug/L
32	Dibenz(a,h)anthracene	12/17/98	100	U	ug/L
32	1,2-Dichlorobenzene	12/17/98	100	U	ug/L

Note: See last page for explanation of codes.

Appendix A

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Conc.	Data Qual.	Units
32	1,4-Dichlorobenzene	12/17/98	100	U	ug/L
32	2,4-Dimethylphenol	12/17/98	100	U	ug/L
32	2,4-Dinitrotoluene	12/17/98	100	U	ug/L
32	7,12-Dimethylbenz(a)anthracene	12/17/98	100	U	ug/L
32	Fluoranthene	12/17/98	100	U	ug/L
32	Fluorene	12/17/98	55	J	ug/L
32	Indeno(1,2,3-cd)pyrene	12/17/98	100	U	ug/L
32	1-Methylnaphthalene	12/17/98	430		ug/L
32	2-Methylnaphthalene	12/17/98	710		ug/L
32	2-Methylphenol	12/17/98	100	U	ug/L
32	4-Methylphenol	12/17/98	100	U	ug/L
32	Naphthalene	12/17/98	100	U	ug/L
32	Nitrobenzene	12/17/98	100	U	ug/L
32	Phenanthrene	12/17/98	220		ug/L
32	Phenol	12/17/98	14	J	ug/L
32	Pyrene	12/17/98	110		ug/L
32	Pyridine	12/17/98	100	U	ug/L

Note: See last page for explanation of codes.

Appendix A

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Data Conc. Qual.	Units
51	Antimony	12/17/98	2.7 U	ug/l
51	Arsenic	12/17/98	6.5 B	ug/l
51	Barium	12/17/98	623	ug/l
51	Beryllium	12/17/98	0.1 U	ug/l
51	Cadmium	12/17/98	0.35 B	ug/l
51	Chromium	12/17/98	0.7 U	ug/l
51	Lead	12/17/98	5.9	ug/l
51	Mercury	12/17/98	0.1 U	ug/l
51	Nickel	12/17/98	5.3 B	ug/l
51	Nickel	12/17/98	5.3 B	ug/l
51	Selenium	12/17/98	3.1 U	ug/l
51	Vanadium	12/17/98	3.7 B	ug/l
51	Zinc	12/17/98	10.3 B	ug/l
51	Benzene	12/17/98	62	ug/L
51	2-Butanone	12/17/98	5 U	ug/L
51	Carbon Disulfide	12/17/98	5 U	ug/L
51	Chlorobenzene	12/17/98	5 U	ug/L
51	Chloroform	12/17/98	5 U	ug/L
51	1,2-Dibromoethane	12/17/98	5 U	ug/L
51	1,2-Dichloroethane	12/17/98	5 U	ug/L
51	1,1-Dichloroethene	12/17/98	5 U	ug/L
51	1,4-Dioxane	12/17/98	500 U	ug/l
51	Ethylbenzene	12/17/98	2 J	ug/L
51	Styrene	12/17/98	5 U	ug/L
51	Tetrachloroethene	12/17/98	5 U	ug/L
51	Toluene	12/17/98	4 J	ug/L
51	1,1,1-Trichloroethane	12/17/98	5 U	ug/L
51	1,2,4-Trimethylbenzene	12/17/98	5 U	ug/L
51	1,3,5-Trimethylbenzene	12/17/98	5 U	ug/L
51	Trichloroethene	12/17/98	5 U	ug/L
51	Xylenes (Total)	12/17/98	2 J	ug/L
51	Acenaphthene	12/17/98	7 J	ug/L
51	Anthracene	12/17/98	10	ug/L
51	Benzo(a)anthracene	12/17/98	4 J	ug/L
51	Benzo(a)pyrene	12/17/98	10 U	ug/L
51	Benzo(b)fluoranthene	12/17/98	10 U	ug/L
51	bis(2-ethylhexyl)phthalate	12/17/98	2 J	ug/L
51	Butyl benzyl phthalate	12/17/98	10 U	ug/L
51	Chrysene	12/17/98	7 J	ug/L
51	Di-n-butyl phthalate	12/17/98	10 U	ug/L
51	Di-n-octyl phthalate	12/17/98	10 U	ug/L
51	Dibenz(a,h)anthracene	12/17/98	10 U	ug/L
51	1,2-Dichlorobenzene	12/17/98	10 U	ug/L

Note: See last page for explanation of codes.

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Data Conc. Qual.	Units
51	1,4-Dichlorobenzene	12/17/98	10 U	ug/L
51	2,4-Dimethylphenol	12/17/98	10 U	ug/L
51	2,4-Dinitrotoluene	12/17/98	10 U	ug/L
51	7,12-Dimethylbenz(a)anthracene	12/17/98	10 U	ug/L
51	Fluoranthene	12/17/98	8 J	ug/L
51	Fluorene	12/17/98	8 J	ug/L
51	Indeno(1,2,3-cd)pyrene	12/17/98	10 U	ug/L
51	1-Methylnaphthalene	12/17/98	35	ug/L
51	2-Methylnaphthalene	12/17/98	16	ug/L
51	2-Methylphenol	12/17/98	10 U	ug/L
51	4-Methylphenol	12/17/98	2 J	ug/L
51	Naphthalene	12/17/98	7 J	ug/L
51	Nitrobenzene	12/17/98	10 U	ug/L
51	Phenanthrene	12/17/98	27	ug/L
51	Phenol	12/17/98	32	ug/L
51	Pyrene	12/17/98	37	ug/L
51	Pyridine	12/17/98	10 U	ug/L

Note: See last page for explanation of codes.

Appendix A

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Data Conc.	Qual.	Units
54	Antimony	12/17/98	2.7	U	ug/l
54	Arsenic	12/17/98	15		ug/l
54	Barium	12/17/98	1330		ug/l
54	Beryllium	12/17/98	0.1	U	ug/l
54	Cadmium	12/17/98	0.94	B	ug/l
54	Chromium	12/17/98	0.7	U	ug/l
54	Lead	12/17/98	6.4		ug/l
54	Mercury	12/17/98	0.1	U	ug/l
54	Nickel	12/17/98	1.4	B	ug/l
54	Nickel	12/17/98	1.4	B	ug/l
54	Selenium	12/17/98	3.1	U	ug/l
54	Vanadium	12/17/98	4	B	ug/l
54	Zinc	12/17/98	25.2		ug/l
54	Benzene	12/17/98	80		ug/L
54	2-Butanone	12/17/98	5	U	ug/L
54	Carbon Disulfide	12/17/98	5	U	ug/L
54	Chlorobenzene	12/17/98	5	U	ug/L
54	Chloroform	12/17/98	5	U	ug/L
54	1,2-Dibromoethane	12/17/98	5	U	ug/L
54	1,2-Dichloroethane	12/17/98	5	U	ug/L
54	1,1-Dichloroethene	12/17/98	5	U	ug/L
54	1,4-Dioxane	12/17/98	500	U	ug/l
54	Ethylbenzene	12/17/98	4	J	ug/L
54	Styrene	12/17/98	5	U	ug/L
54	Tetrachloroethene	12/17/98	5	U	ug/L
54	Toluene	12/17/98	8		ug/L
54	1,1,1-Trichloroethane	12/17/98	5	U	ug/L
54	1,2,4-Trimethylbenzene	12/17/98	23		ug/L
54	1,3,5-Trimethylbenzene	12/17/98	8		ug/L
54	Trichloroethene	12/17/98	5	U	ug/L
54	Xylenes (Total)	12/17/98	36		ug/L
54	Acenaphthene	12/17/98	2	J	ug/L
54	Anthracene	12/17/98	10	U	ug/L
54	Benzo(a)anthracene	12/17/98	10	U	ug/L
54	Benzo(a)pyrene	12/17/98	10	U	ug/L
54	Benzo(b)fluoranthene	12/17/98	10	U	ug/L
54	bis(2-ethylhexyl)phthalate	12/17/98	13		ug/L
54	Butyl benzyl phthalate	12/17/98	10	U	ug/L
54	Chrysene	12/17/98	2	J	ug/L
54	Di-n-butyl phthalate	12/17/98	10	U	ug/L
54	Di-n-octyl phthalate	12/17/98	10	U	ug/L
54	Dibenz(a,h)anthracene	12/17/98	10	U	ug/L
54	1,2-Dichlorobenzene	12/17/98	10	U	ug/L

Note: See last page for explanation of codes.

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Conc.	Data Qual.	Units
54	1,4-Dichlorobenzene	12/17/98	10	U	ug/L
54	2,4-Dimethylphenol	12/17/98	10	U	ug/L
54	2,4-Dinitrotoluene	12/17/98	10	U	ug/L
54	7,12-Dimethylbenz(a)anthracene	12/17/98	10	U	ug/L
54	Fluoranthene	12/17/98	10	U	ug/L
54	Fluorene	12/17/98	4	J	ug/L
54	Indeno(1,2,3-cd)pyrene	12/17/98	10	U	ug/L
54	1-Methylnaphthalene	12/17/98	58		ug/L
54	2-Methylnaphthalene	12/17/98	20		ug/L
54	2-Methylphenol	12/17/98	10	U	ug/L
54	4-Methylphenol	12/17/98	10	U	ug/L
54	Naphthalene	12/17/98	10	U	ug/L
54	Nitrobenzene	12/17/98	10	U	ug/L
54	Phenanthrene	12/17/98	7	J	ug/L
54	Phenol	12/17/98	4	J	ug/L
54	Pyrene	12/17/98	3	J	ug/L
54	Pyridine	12/17/98	10	U	ug/L

Note: See last page for explanation of codes.

Appendix A

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Data Conc.	Qual.	Units
56	Antimony	12/17/98	3.2	B	ug/l
56	Arsenic	12/17/98	23.7		ug/l
56	Barium	12/17/98	752		ug/l
56	Beryllium	12/17/98	0.22	B	ug/l
56	Cadmium	12/17/98	1.1	B	ug/l
56	Chromium	12/17/98	1.9	B	ug/l
56	Lead	12/17/98	14.8		ug/l
56	Mercury	12/17/98	0.1	U	ug/l
56	Nickel	12/17/98	4.2	B	ug/l
56	Nickel	12/17/98	4.2	B	ug/l
56	Selenium	12/17/98	3.1	U	ug/l
56	Vanadium	12/17/98	13.7	B	ug/l
56	Zinc	12/17/98	20.2		ug/l
56	Benzene	12/17/98	430	D	ug/L
56	2-Butanone	12/17/98	5	U	ug/L
56	Carbon Disulfide	12/17/98	5	U	ug/L
56	Chlorobenzene	12/17/98	5	U	ug/L
56	Chloroform	12/17/98	5	U	ug/L
56	1,2-Dibromoethane	12/17/98	5	U	ug/L
56	1,2-Dichloroethane	12/17/98	5	U	ug/L
56	1,1-Dichloroethene	12/17/98	5	U	ug/L
56	1,4-Dioxane	12/17/98	500	U	ug/l
56	Ethylbenzene	12/17/98	93	D	ug/L
56	Styrene	12/17/98	5	U	ug/L
56	Tetrachloroethene	12/17/98	5	U	ug/L
56	Toluene	12/17/98	6		ug/L
56	1,1,1-Trichloroethane	12/17/98	5	U	ug/L
56	1,2,4-Trimethylbenzene	12/17/98	150	D	ug/L
56	1,3,5-Trimethylbenzene	12/17/98	190		ug/L
56	Trichloroethene	12/17/98	5	U	ug/L
56	Xylenes (Total)	12/17/98	190	D	ug/L
56	Acenaphthene	12/17/98	10	U	ug/L
56	Anthracene	12/17/98	10	U	ug/L
56	Benzo(a)anthracene	12/17/98	2	J	ug/L
56	Benzo(a)pyrene	12/17/98	10	U	ug/L
56	Benzo(b)fluoranthene	12/17/98	10	U	ug/L
56	bis(2-ethylhexyl)phthalate	12/17/98	2	J	ug/L
56	Butyl benzyl phthalate	12/17/98	10	U	ug/L
56	Chrysene	12/17/98	3	J	ug/L
56	Di-n-butyl phthalate	12/17/98	10	U	ug/L
56	Di-n-octyl phthalate	12/17/98	10	U	ug/L
56	Dibenz(a,h)anthracene	12/17/98	10	U	ug/L
56	1,2-Dichlorobenzene	12/17/98	10	U	ug/L

Note: See last page for explanation of codes.

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Conc.	Data Qual.	Units
56	1,4-Dichlorobenzene	12/17/98	10	U	ug/L
56	2,4-Dimethylphenol	12/17/98	14		ug/L
56	2,4-Dinitrotoluene	12/17/98	10	U	ug/L
56	7,12-Dimethylbenz(a)anthracene	12/17/98	10	U	ug/L
56	Fluoranthene	12/17/98	10	U	ug/L
56	Fluorene	12/17/98	2	J	ug/L
56	Indeno(1,2,3-cd)pyrene	12/17/98	10	U	ug/L
56	1-Methylnaphthalene	12/17/98	36		ug/L
56	2-Methylnaphthalene	12/17/98	20		ug/L
56	2-Methylphenol	12/17/98	10	U	ug/L
56	4-Methylphenol	12/17/98	4	J	ug/L
56	Naphthalene	12/17/98	55		ug/L
56	Nitrobenzene	12/17/98	10	U	ug/L
56	Phenanthrene	12/17/98	3	J	ug/L
56	Phenol	12/17/98	13		ug/L
56	Pyrene	12/17/98	4	J	ug/L
56	Pyridine	12/17/98	10	U	ug/L

Note: See last page for explanation of codes.

Appendix A

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Conc.	Data Qual.	Units
72	Conductivity, Field	12/11/98	1248		umhos/cm
72	Corrected Water Elevation	12/11/98	1053.87		ftAMSL
72	pH, Field	12/11/98	7.4		std
72	Temperature, Field	12/11/98	60		DegC
72	Chloride	12/11/98	103		mg/l
72	Total Dissolved Solids	12/11/98	593		mg/l
72	Antimony	12/11/98	2.7	U	ug/l
72	Arsenic	12/11/98	2.9	U	ug/l
72	Barium	12/11/98	495		ug/l
72	Beryllium	12/11/98	0.37	B	ug/l
72	Cadmium	12/11/98	0.3	U	ug/l
72	Chromium	12/11/98	0.95	B	ug/l
72	Lead	12/11/98	31.4		ug/l
72	Mercury	12/11/98	0.1	U	ug/l
72	Nickel	12/11/98	2.6	B	ug/l
72	Nickel	12/11/98	2.6	B	ug/l
72	Selenium	12/11/98	3.1	U	ug/l
72	Vanadium	12/11/98	4.3	B	ug/l
72	Zinc	12/11/98	13	B	ug/l
72	Acetone	12/11/98	5	U	ug/L
72	Benzene	12/11/98	1	J	ug/L
72	2-Butanone	12/11/98	5	U	ug/L
72	Carbon Tetrachloride	12/11/98	5	U	ug/L
72	Chlorobenzene	12/11/98	5	U	ug/L
72	Chloroform	12/11/98	5	U	ug/L
72	1,1-Dichloroethene	12/11/98	5	U	ug/L
72	Ethylbenzene	12/11/98	5	U	ug/L
72	Toluene	12/11/98	5	U	ug/L
72	Trichloroethene	12/11/98	5	U	ug/L
72	Xylenes (Total)	12/11/98	5	U	ug/L
72	Acenaphthylene	12/11/98	10	U	ug/L
72	Anthracene	12/11/98	10	U	ug/L
72	Benzo(a)anthracene	12/11/98	10	U	ug/L
72	Benzo(a)pyrene	12/11/98	10	U	ug/L
72	Benzo(b)fluoranthene	12/11/98	10	U	ug/L
72	bis(2-ethylhexyl)phthalate	12/11/98	1	JB	ug/L
72	Chrysene	12/11/98	1	J	ug/L
72	Di-n-octyl phthalate	12/11/98	10	U	ug/L
72	Dibenzofuran	12/11/98	10	U	ug/L
72	Dimethyl phthalate	12/11/98	10	U	ug/L
72	2,4-Dimethylphenol	12/11/98	10	U	ug/L
72	Fluoranthene	12/11/98	10	U	ug/L
72	Fluorene	12/11/98	10	U	ug/L

Note: See last page for explanation of codes.

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Conc.	Data Qual.	Units
72	1-Methylnaphthalene	12/11/98	10	U	ug/L
72	2-Methylnaphthalene	12/11/98	10	U	ug/L
72	Naphthalene	12/11/98	10	U	ug/L
72	Phenanthrene	12/11/98	1	J	ug/L
72	Phenol	12/11/98	10	U	ug/L
72	Pyrene	12/11/98	10	U	ug/L

Note: See last page for explanation of codes.

Appendix A

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Data Conc.	Qual.	Units
75	Antimony	12/17/98	2.7	U	ug/l
75	Arsenic	12/17/98	8.6	B	ug/l
75	Barium	12/17/98	591		ug/l
75	Beryllium	12/17/98	0.1	U	ug/l
75	Cadmium	12/17/98	1.3	B	ug/l
75	Chromium	12/17/98	3.2	B	ug/l
75	Lead	12/17/98	39.1		ug/l
75	Mercury	12/17/98	1.1		ug/l
75	Nickel	12/17/98	8.4	B	ug/l
75	Nickel	12/17/98	8.4	B	ug/l
75	Selenium	12/17/98	3.1	U	ug/l
75	Vanadium	12/17/98	14.1	B	ug/l
75	Zinc	12/17/98	59		ug/l
75	Benzene	12/17/98	5700	D	ug/L
75	2-Butanone	12/17/98	5	U	ug/L
75	Carbon Disulfide	12/17/98	5	U	ug/L
75	Chlorobenzene	12/17/98	5	U	ug/L
75	Chloroform	12/17/98	5	U	ug/L
75	1,2-Dibromoethane	12/17/98	5	U	ug/L
75	1,2-Dichloroethane	12/17/98	5	U	ug/L
75	1,1-Dichloroethene	12/17/98	5	U	ug/L
75	1,4-Dioxane	12/17/98	500	U	ug/l
75	Ethylbenzene	12/17/98	800	D	ug/L
75	Styrene	12/17/98	5	U	ug/L
75	Tetrachloroethene	12/17/98	5	U	ug/L
75	Toluene	12/17/98	100		ug/L
75	1,1,1-Trichloroethane	12/17/98	5	U	ug/L
75	1,2,4-Trimethylbenzene	12/17/98	750	D	ug/L
75	1,3,5-Trimethylbenzene	12/17/98	410	D	ug/L
75	Trichloroethene	12/17/98	5	U	ug/L
75	Xylenes (Total)	12/17/98	2300	D	ug/L
75	Acenaphthene	12/17/98	2	J	ug/L
75	Anthracene	12/17/98	3	J	ug/L
75	Benzo(a)anthracene	12/17/98	5	J	ug/L
75	Benzo(a)pyrene	12/17/98	2	J	ug/L
75	Benzo(b)fluoranthene	12/17/98	2	J	ug/L
75	bis(2-ethylhexyl)phthalate	12/17/98	1	J	ug/L
75	Butyl benzyl phthalate	12/17/98	10	U	ug/L
75	Chrysene	12/17/98	11		ug/L
75	Di-n-butyl phthalate	12/17/98	10	U	ug/L
75	Di-n-octyl phthalate	12/17/98	10	U	ug/L
75	Dibenz(a,h)anthracene	12/17/98	1	J	ug/L
75	1,2-Dichlorobenzene	12/17/98	10	U	ug/L

Note: See last page for explanation of codes.

Appendix A

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Data Conc. Qual.	Units
75	1,4-Dichlorobenzene	12/17/98	10 U	ug/L
75	2,4-Dimethylphenol	12/17/98	31	ug/L
75	2,4-Dinitrotoluene	12/17/98	10 U	ug/L
75	7,12-Dimethylbenz(a)anthracene	12/17/98	10 U	ug/L
75	Fluoranthene	12/17/98	2 J	ug/L
75	Fluorene	12/17/98	3 J	ug/L
75	Indeno(1,2,3-cd)pyrene	12/17/98	10 U	ug/L
75	1-Methylnaphthalene	12/17/98	34	ug/L
75	2-Methylnaphthalene	12/17/98	47	ug/L
75	2-Methylphenol	12/17/98	4 J	ug/L
75	4-Methylphenol	12/17/98	2 J	ug/L
75	Naphthalene	12/17/98	92	ug/L
75	Nitrobenzene	12/17/98	10 U	ug/L
75	Phenanthrene	12/17/98	19	ug/L
75	Phenol	12/17/98	62	ug/L
75	Pyrene	12/17/98	10	ug/L
75	Pyridine	12/17/98	10 U	ug/L

Note: See last page for explanation of codes.

Appendix A

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Data Conc.	Qual.	Units
93	Antimony	12/17/98	2.7	U	ug/l
93	Arsenic	12/17/98	11.7		ug/l
93	Barium	12/17/98	727		ug/l
93	Beryllium	12/17/98	0.41	B	ug/l
93	Cadmium	12/17/98	1.5	B	ug/l
93	Chromium	12/17/98	0.9	B	ug/l
93	Lead	12/17/98	18.6		ug/l
93	Mercury	12/17/98	0.1	U	ug/l
93	Nickel	12/17/98	10	B	ug/l
93	Nickel	12/17/98	10	B	ug/l
93	Selenium	12/17/98	3.1	U	ug/l
93	Vanadium	12/17/98	18.5	B	ug/l
93	Zinc	12/17/98	61.6		ug/l
93	Benzene	12/17/98	5	U	ug/L
93	2-Butanone	12/17/98	5	U	ug/L
93	Carbon Disulfide	12/17/98	5	U	ug/L
93	Chlorobenzene	12/17/98	5	U	ug/L
93	Chloroform	12/17/98	5	U	ug/L
93	1,2-Dibromoethane	12/17/98	5	U	ug/L
93	1,2-Dichloroethane	12/17/98	5	U	ug/L
93	1,1-Dichloroethene	12/17/98	5	U	ug/L
93	1,4-Dioxane	12/17/98	500	U	ug/l
93	Ethylbenzene	12/17/98	5	U	ug/L
93	Styrene	12/17/98	5	U	ug/L
93	Tetrachloroethene	12/17/98	5	U	ug/L
93	Toluene	12/17/98	5	U	ug/L
93	1,1,1-Trichloroethane	12/17/98	5	U	ug/L
93	1,2,4-Trimethylbenzene	12/17/98	5	U	ug/L
93	1,3,5-Trimethylbenzene	12/17/98	5	U	ug/L
93	Trichloroethene	12/17/98	5	U	ug/L
93	Xylenes (Total)	12/17/98	5	U	ug/L
93	Acenaphthene	12/17/98	10	U	ug/L
93	Anthracene	12/17/98	10	U	ug/L
93	Benzo(a)anthracene	12/17/98	10	U	ug/L
93	Benzo(a)pyrene	12/17/98	10	U	ug/L
93	Benzo(b)fluoranthene	12/17/98	10	U	ug/L
93	bis(2-ethylhexyl)phthalate	12/17/98	1	J	ug/L
93	Butyl benzyl phthalate	12/17/98	10	U	ug/L
93	Chrysene	12/17/98	10	U	ug/L
93	Di-n-butyl phthalate	12/17/98	10	U	ug/L
93	Di-n-octyl phthalate	12/17/98	10	U	ug/L
93	Dibenz(a,h)anthracene	12/17/98	10	U	ug/L
93	1,2-Dichlorobenzene	12/17/98	10	U	ug/L

Note: See last page for explanation of codes.

Appendix A

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Conc.	Data Qual.	Units
93	1,4-Dichlorobenzene	12/17/98	10	U	ug/L
93	2,4-Dimethylphenol	12/17/98	10	U	ug/L
93	2,4-Dinitrotoluene	12/17/98	10	U	ug/L
93	7,12-Dimethylbenz(a)anthracene	12/17/98	10	U	ug/L
93	Fluoranthene	12/17/98	10	U	ug/L
93	Fluorene	12/17/98	2	J	ug/L
93	Indeno(1,2,3-cd)pyrene	12/17/98	10	U	ug/L
93	1-Methylnaphthalene	12/17/98	6	J	ug/L
93	2-Methylnaphthalene	12/17/98	5	J	ug/L
93	2-Methylphenol	12/17/98	10	U	ug/L
93	4-Methylphenol	12/17/98	60		ug/L
93	Naphthalene	12/17/98	10	U	ug/L
93	Nitrobenzene	12/17/98	10	U	ug/L
93	Phenanthrene	12/17/98	4	J	ug/L
93	Phenol	12/17/98	4	J	ug/L
93	Pyrene	12/17/98	10	U	ug/L
93	Pyridine	12/17/98	10	U	ug/L

Note: See last page for explanation of codes.

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Data Conc. Qual.	Units
98	Antimony	12/17/98	3.4 B	ug/l
98	Arsenic	12/17/98	19.6	ug/l
98	Barium	12/17/98	868	ug/l
98	Beryllium	12/17/98	0.1 U	ug/l
98	Cadmium	12/17/98	0.4 B	ug/l
98	Chromium	12/17/98	0.7 U	ug/l
98	Lead	12/17/98	6.4	ug/l
98	Mercury	12/17/98	0.1 U	ug/l
98	Nickel	12/17/98	1.4 B	ug/l
98	Nickel	12/17/98	1.4 B	ug/l
98	Selenium	12/17/98	3.1 U	ug/l
98	Vanadium	12/17/98	2.1 B	ug/l
98	Zinc	12/17/98	8.7 B	ug/l
98	Benzene	12/17/98	360 D	ug/L
98	2-Butanone	12/17/98	5 U	ug/L
98	Carbon Disulfide	12/17/98	5 U	ug/L
98	Chlorobenzene	12/17/98	5 U	ug/L
98	Chloroform	12/17/98	5 U	ug/L
98	1,2-Dibromoethane	12/17/98	5 U	ug/L
98	1,2-Dichloroethane	12/17/98	5 U	ug/L
98	1,1-Dichloroethene	12/17/98	5 U	ug/L
98	1,4-Dioxane	12/17/98	500 U	ug/l
98	Ethylbenzene	12/17/98	5 U	ug/L
98	Styrene	12/17/98	5 U	ug/L
98	Tetrachloroethene	12/17/98	5 U	ug/L
98	Toluene	12/17/98	6	ug/L
98	1,1,1-Trichloroethane	12/17/98	5 U	ug/L
98	1,2,4-Trimethylbenzene	12/17/98	5 U	ug/L
98	1,3,5-Trimethylbenzene	12/17/98	5 U	ug/L
98	Trichloroethene	12/17/98	5 U	ug/L
98	Xylenes (Total)	12/17/98	19	ug/L
98	Acenaphthene	12/17/98	10 U	ug/L
98	Anthracene	12/17/98	10 U	ug/L
98	Benzo(a)anthracene	12/17/98	10 U	ug/L
98	Benzo(a)pyrene	12/17/98	10 U	ug/L
98	Benzo(b)fluoranthene	12/17/98	10 U	ug/L
98	bis(2-ethylhexyl)phthalate	12/17/98	10 U	ug/L
98	Butyl benzyl phthalate	12/17/98	10 U	ug/L
98	Chrysene	12/17/98	10 U	ug/L
98	Di-n-butyl phthalate	12/17/98	10 U	ug/L
98	Di-n-octyl phthalate	12/17/98	10 U	ug/L
98	Dibenz(a,h)anthracene	12/17/98	10 U	ug/L
98	1,2-Dichlorobenzene	12/17/98	10 U	ug/L

Note: See last page for explanation of codes.

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Conc.	Data Qual.	Units
98	1,4-Dichlorobenzene	12/17/98	10	U	ug/L
98	2,4-Dimethylphenol	12/17/98	10	U	ug/L
98	2,4-Dinitrotoluene	12/17/98	10	U	ug/L
98	7,12-Dimethylbenz(a)anthracene	12/17/98	10	U	ug/L
98	Fluoranthene	12/17/98	10	U	ug/L
98	Fluorene	12/17/98	10	U	ug/L
98	Indeno(1,2,3-cd)pyrene	12/17/98	10	U	ug/L
98	1-Methylnaphthalene	12/17/98	8	J	ug/L
98	2-Methylnaphthalene	12/17/98	12		ug/L
98	2-Methylphenol	12/17/98	10	U	ug/L
98	4-Methylphenol	12/17/98	31		ug/L
98	Naphthalene	12/17/98	6	J	ug/L
98	Nitrobenzene	12/17/98	10	U	ug/L
98	Phenanthrene	12/17/98	1	J	ug/L
98	Phenol	12/17/98	7	J	ug/L
98	Pyrene	12/17/98	10	U	ug/L
98	Pyridine	12/17/98	10	U	ug/L

Note: See last page for explanation of codes.

Appendix A

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Data Conc.	Qual.	Units
109	Antimony	12/17/98	2.7	U	ug/l
109	Arsenic	12/17/98	5.5	B	ug/l
109	Barium	12/17/98	514		ug/l
109	Beryllium	12/17/98	0.21	B	ug/l
109	Cadmium	12/17/98	1	B	ug/l
109	Chromium	12/17/98	4.2	B	ug/l
109	Lead	12/17/98	5.3		ug/l
109	Mercury	12/17/98	0.1	U	ug/l
109	Nickel	12/17/98	9.3	B	ug/l
109	Nickel	12/17/98	9.3	B	ug/l
109	Selenium	12/17/98	3.6	B	ug/l
109	Vanadium	12/17/98	49.5		ug/l
109	Zinc	12/17/98	25.1		ug/l
109	Benzene	12/17/98	5	U	ug/L
109	2-Butanone	12/17/98	5	U	ug/L
109	Carbon Disulfide	12/17/98	5	U	ug/L
109	Chlorobenzene	12/17/98	5	U	ug/L
109	Chloroform	12/17/98	5	U	ug/L
109	1,2-Dibromoethane	12/17/98	5	U	ug/L
109	1,2-Dichloroethane	12/17/98	5	U	ug/L
109	1,1-Dichloroethene	12/17/98	5	U	ug/L
109	1,4-Dioxane	12/17/98	500	U	ug/l
109	Ethylbenzene	12/17/98	5	U	ug/L
109	Styrene	12/17/98	5	U	ug/L
109	Tetrachloroethene	12/17/98	5	U	ug/L
109	Toluene	12/17/98	5	U	ug/L
109	1,1,1-Trichloroethane	12/17/98	5	U	ug/L
109	1,2,4-Trimethylbenzene	12/17/98	5	U	ug/L
109	1,3,5-Trimethylbenzene	12/17/98	5	U	ug/L
109	Trichloroethene	12/17/98	5	U	ug/L
109	Xylenes (Total)	12/17/98	5	U	ug/L
109	Acenaphthene	12/17/98	2	J	ug/L
109	Anthracene	12/17/98	10	U	ug/L
109	Benzo(a)anthracene	12/17/98	10	U	ug/L
109	Benzo(a)pyrene	12/17/98	10	U	ug/L
109	Benzo(b)fluoranthene	12/17/98	10	U	ug/L
109	bis(2-ethylhexyl)phthalate	12/17/98	1	J	ug/L
109	Butyl benzyl phthalate	12/17/98	10	U	ug/L
109	Chrysene	12/17/98	1	J	ug/L
109	Di-n-butyl phthalate	12/17/98	10	U	ug/L
109	Di-n-octyl phthalate	12/17/98	10	U	ug/L
109	Dibenz(a,h)anthracene	12/17/98	10	U	ug/L
109	1,2-Dichlorobenzene	12/17/98	10	U	ug/L

Note: See last page for explanation of codes.

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Conc.	Data Qual.	Units
109	1,4-Dichlorobenzene	12/17/98	10	U	ug/L
109	2,4-Dimethylphenol	12/17/98	10	U	ug/L
109	2,4-Dinitrotoluene	12/17/98	10	U	ug/L
109	7,12-Dimethylbenz(a)anthracene	12/17/98	10	U	ug/L
109	Fluoranthene	12/17/98	10	U	ug/L
109	Fluorene	12/17/98	2	J	ug/L
109	Indeno(1,2,3-cd)pyrene	12/17/98	10	U	ug/L
109	1-Methylnaphthalene	12/17/98	37		ug/L
109	2-Methylnaphthalene	12/17/98	16		ug/L
109	2-Methylphenol	12/17/98	10	U	ug/L
109	4-Methylphenol	12/17/98	3	J	ug/L
109	Naphthalene	12/17/98	18		ug/L
109	Nitrobenzene	12/17/98	10	U	ug/L
109	Phenanthrene	12/17/98	5	J	ug/L
109	Phenol	12/17/98	3	J	ug/L
109	Pyrene	12/17/98	2	J	ug/L
109	Pyridine	12/17/98	10	U	ug/L

Note: See last page for explanation of codes.

Appendix A

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Data Conc.	Qual.	Units
129	Antimony	12/17/98	2.7	U	ug/l
129	Arsenic	12/17/98	43		ug/l
129	Barium	12/17/98	1180		ug/l
129	Beryllium	12/17/98	0.1	U	ug/l
129	Cadmium	12/17/98	1.5	B	ug/l
129	Chromium	12/17/98	0.7	U	ug/l
129	Lead	12/17/98	22.2		ug/l
129	Mercury	12/17/98	0.1	U	ug/l
129	Nickel	12/17/98	3.4	B	ug/l
129	Nickel	12/17/98	3.4	B	ug/l
129	Selenium	12/17/98	3.1	U	ug/l
129	Vanadium	12/17/98	7.3	B	ug/l
129	Zinc	12/17/98	39.5		ug/l
129	Benzene	12/17/98	4800	D	ug/L
129	2-Butanone	12/17/98	5	U	ug/L
129	Carbon Disulfide	12/17/98	5	U	ug/L
129	Chlorobenzene	12/17/98	5	U	ug/L
129	Chloroform	12/17/98	5	U	ug/L
129	1,2-Dibromoethane	12/17/98	5	U	ug/L
129	1,2-Dichloroethane	12/17/98	5	U	ug/L
129	1,1-Dichloroethene	12/17/98	5	U	ug/L
129	1,4-Dioxane	12/17/98	500	U	ug/l
129	Ethylbenzene	12/17/98	380	D	ug/L
129	Styrene	12/17/98	5	U	ug/L
129	Tetrachloroethene	12/17/98	5	U	ug/L
129	Toluene	12/17/98	1300	D	ug/L
129	1,1,1-Trichloroethane	12/17/98	5	U	ug/L
129	1,2,4-Trimethylbenzene	12/17/98	1000	D	ug/L
129	1,3,5-Trimethylbenzene	12/17/98	350	D	ug/L
129	Trichloroethene	12/17/98	5	U	ug/L
129	Xylenes (Total)	12/17/98	2700	D	ug/L
129	Acenaphthene	12/17/98	1	J	ug/L
129	Anthracene	12/17/98	10	U	ug/L
129	Benzo(a)anthracene	12/17/98	1	J	ug/L
129	Benzo(a)pyrene	12/17/98	10	U	ug/L
129	Benzo(b)fluoranthene	12/17/98	10	U	ug/L
129	bis(2-ethylhexyl)phthalate	12/17/98	2	J	ug/L
129	Butyl benzyl phthalate	12/17/98	10	U	ug/L
129	Chrysene	12/17/98	2	J	ug/L
129	Di-n-butyl phthalate	12/17/98	10	U	ug/L
129	Di-n-octyl phthalate	12/17/98	10	U	ug/L
129	Dibenz(a,h)anthracene	12/17/98	10	U	ug/L
129	1,2-Dichlorobenzene	12/17/98	10	U	ug/L

Note: See last page for explanation of codes.

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Conc.	Data Qual.	Units
129	1,4-Dichlorobenzene	12/17/98	10	U	ug/L
129	2,4-Dimethylphenol	12/17/98	12		ug/L
129	2,4-Dinitrotoluene	12/17/98	10	U	ug/L
129	7,12-Dimethylbenz(a)anthracene	12/17/98	10	U	ug/L
129	Fluoranthene	12/17/98	10	U	ug/L
129	Fluorene	12/17/98	2	J	ug/L
129	Indeno(1,2,3-cd)pyrene	12/17/98	10	U	ug/L
129	1-Methylnaphthalene	12/17/98	85		ug/L
129	2-Methylnaphthalene	12/17/98	110	D	ug/L
129	2-Methylphenol	12/17/98	9	J	ug/L
129	4-Methylphenol	12/17/98	23		ug/L
129	Naphthalene	12/17/98	94		ug/L
129	Nitrobenzene	12/17/98	10	U	ug/L
129	Phenanthrene	12/17/98	4	J	ug/L
129	Phenol	12/17/98	22		ug/L
129	Pyrene	12/17/98	3	J	ug/L
129	Pyridine	12/17/98	10	U	ug/L

Note: See last page for explanation of codes.

Appendix A

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Data Conc.	Qual.	Units
AP-1	Antimony	12/17/98	2.7	U	ug/l
AP-1	Arsenic	12/17/98	26.7		ug/l
AP-1	Barium	12/17/98	203		ug/l
AP-1	Beryllium	12/17/98	0.38	B	ug/l
AP-1	Cadmium	12/17/98	0.64	B	ug/l
AP-1	Chromium	12/17/98	0.97	B	ug/l
AP-1	Lead	12/17/98	10.5		ug/l
AP-1	Mercury	12/17/98	0.1	U	ug/l
AP-1	Nickel	12/17/98	5.3	B	ug/l
AP-1	Nickel	12/17/98	5.3	B	ug/l
AP-1	Selenium	12/17/98	3.1	U	ug/l
AP-1	Vanadium	12/17/98	17.7	B	ug/l
AP-1	Zinc	12/17/98	28.2		ug/l
AP-1	Benzene	12/17/98	47		ug/L
AP-1	2-Butanone	12/17/98	5	U	ug/L
AP-1	Carbon Disulfide	12/17/98	5	U	ug/L
AP-1	Chlorobenzene	12/17/98	5	U	ug/L
AP-1	Chloroform	12/17/98	5	U	ug/L
AP-1	1,2-Dibromoethane	12/17/98	5	U	ug/L
AP-1	1,2-Dichloroethane	12/17/98	5	U	ug/L
AP-1	1,1-Dichloroethene	12/17/98	5	U	ug/L
AP-1	1,4-Dioxane	12/17/98	500	U	ug/l
AP-1	Ethylbenzene	12/17/98	5	U	ug/L
AP-1	Styrene	12/17/98	5	U	ug/L
AP-1	Tetrachloroethene	12/17/98	5	U	ug/L
AP-1	Toluene	12/17/98	5	U	ug/L
AP-1	1,1,1-Trichloroethane	12/17/98	5	U	ug/L
AP-1	1,2,4-Trimethylbenzene	12/17/98	5	U	ug/L
AP-1	1,3,5-Trimethylbenzene	12/17/98	5	U	ug/L
AP-1	Trichloroethene	12/17/98	5	U	ug/L
AP-1	Xylenes (Total)	12/17/98	5	U	ug/L
AP-1	Acenaphthene	12/17/98	10	U	ug/L
AP-1	Anthracene	12/17/98	10	U	ug/L
AP-1	Benzo(a)anthracene	12/17/98	1	J	ug/L
AP-1	Benzo(a)pyrene	12/17/98	10	U	ug/L
AP-1	Benzo(b)fluoranthene	12/17/98	10	U	ug/L
AP-1	bis(2-ethylhexyl)phthalate	12/17/98	2	J	ug/L
AP-1	Butyl benzyl phthalate	12/17/98	10	U	ug/L
AP-1	Chrysene	12/17/98	2	J	ug/L
AP-1	Di-n-butyl phthalate	12/17/98	10	U	ug/L
AP-1	Di-n-octyl phthalate	12/17/98	10	U	ug/L
AP-1	Dibenz(a,h)anthracene	12/17/98	10	U	ug/L
AP-1	1,2-Dichlorobenzene	12/17/98	10	U	ug/L

Note: See last page for explanation of codes.

Appendix A

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Data Conc. Qual.	Units
AP-1	1,4-Dichlorobenzene	12/17/98	10 U	ug/L
AP-1	2,4-Dimethylphenol	12/17/98	10 U	ug/L
AP-1	2,4-Dinitrotoluene	12/17/98	10 U	ug/L
AP-1	7,12-Dimethylbenz(a)anthracene	12/17/98	10 U	ug/L
AP-1	Fluoranthene	12/17/98	10 U	ug/L
AP-1	Fluorene	12/17/98	1 J	ug/L
AP-1	Indeno(1,2,3-cd)pyrene	12/17/98	10 U	ug/L
AP-1	1-Methylnaphthalene	12/17/98	5 J	ug/L
AP-1	2-Methylnaphthalene	12/17/98	3 J	ug/L
AP-1	2-Methylphenol	12/17/98	10 U	ug/L
AP-1	4-Methylphenol	12/17/98	1 J	ug/L
AP-1	Naphthalene	12/17/98	10 U	ug/L
AP-1	Nitrobenzene	12/17/98	10 U	ug/L
AP-1	Phenanthrene	12/17/98	3 J	ug/L
AP-1	Phenol	12/17/98	2 J	ug/L
AP-1	Pyrene	12/17/98	3 J	ug/L
AP-1	Pyridine	12/17/98	10 U	ug/L

Note: See last page for explanation of codes.

Appendix A

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Data Conc.	Qual.	Units
AP-4	Antimony	12/17/98	2.7	U	ug/l
AP-4	Arsenic	12/17/98	44		ug/l
AP-4	Barium	12/17/98	1460		ug/l
AP-4	Beryllium	12/17/98	0.13	B	ug/l
AP-4	Cadmium	12/17/98	1.1	B	ug/l
AP-4	Chromium	12/17/98	1.1	B	ug/l
AP-4	Lead	12/17/98	4.6		ug/l
AP-4	Mercury	12/17/98	0.1	U	ug/l
AP-4	Nickel	12/17/98	4	B	ug/l
AP-4	Nickel	12/17/98	4	B	ug/l
AP-4	Selenium	12/17/98	3.1	U	ug/l
AP-4	Vanadium	12/17/98	12.9	B	ug/l
AP-4	Zinc	12/17/98	36.8		ug/l
AP-4	Benzene	12/17/98	430	D	ug/L
AP-4	2-Butanone	12/17/98	5	U	ug/L
AP-4	Carbon Disulfide	12/17/98	5	U	ug/L
AP-4	Chlorobenzene	12/17/98	5	U	ug/L
AP-4	Chloroform	12/17/98	5	U	ug/L
AP-4	1,2-Dibromoethane	12/17/98	5	U	ug/L
AP-4	1,2-Dichloroethane	12/17/98	5	U	ug/L
AP-4	1,1-Dichloroethene	12/17/98	5	U	ug/L
AP-4	1,4-Dioxane	12/17/98	500	U	ug/l
AP-4	Ethylbenzene	12/17/98	2	J	ug/L
AP-4	Styrene	12/17/98	5	U	ug/L
AP-4	Tetrachloroethene	12/17/98	5	U	ug/L
AP-4	Toluene	12/17/98	6		ug/L
AP-4	1,1,1-Trichloroethane	12/17/98	5	U	ug/L
AP-4	1,2,4-Trimethylbenzene	12/17/98	52		ug/L
AP-4	1,3,5-Trimethylbenzene	12/17/98	8		ug/L
AP-4	Trichloroethene	12/17/98	5	U	ug/L
AP-4	Xylenes (Total)	12/17/98	9		ug/L
AP-4	Acenaphthene	12/17/98	10	U RE	ug/L
AP-4	Anthracene	12/17/98	10	U RE	ug/L
AP-4	Benzo(a)anthracene	12/17/98	10	U RE	ug/L
AP-4	Benzo(a)pyrene	12/17/98	10	U RE	ug/L
AP-4	Benzo(b)fluoranthene	12/17/98	10	U RE	ug/L
AP-4	bis(2-ethylhexyl)phthalate	12/17/98	2	J RE	ug/L
AP-4	Butyl benzyl phthalate	12/17/98	10	U RE	ug/L
AP-4	Chrysene	12/17/98	1	J RE	ug/L
AP-4	Di-n-butyl phthalate	12/17/98	10	U RE	ug/L
AP-4	Di-n-octyl phthalate	12/17/98	10	U RE	ug/L
AP-4	Dibenz(a,h)anthracene	12/17/98	10	U RE	ug/L
AP-4	1,2-Dichlorobenzene	12/17/98	10	U RE	ug/L

Note: See last page for explanation of codes.

Appendix A

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Conc.	Data Qual.	Units
AP-4	1,4-Dichlorobenzene	12/17/98	10	U RE	ug/L
AP-4	2,4-Dimethylphenol	12/17/98	10	U RE	ug/L
AP-4	2,4-Dinitrotoluene	12/17/98	10	U RE	ug/L
AP-4	7,12-Dimethylbenz(a)anthracene	12/17/98	10	U RE	ug/L
AP-4	Fluoranthene	12/17/98	10	U RE	ug/L
AP-4	Fluorene	12/17/98	2	J RE	ug/L
AP-4	Indeno(1,2,3-cd)pyrene	12/17/98	10	U RE	ug/L
AP-4	1-Methylnaphthalene	12/17/98	86	RE	ug/L
AP-4	2-Methylnaphthalene	12/17/98	53	RE	ug/L
AP-4	2-Methylphenol	12/17/98	10	U RE	ug/L
AP-4	4-Methylphenol	12/17/98	15	RE	ug/L
AP-4	Naphthalene	12/17/98	10	U RE	ug/L
AP-4	Nitrobenzene	12/17/98	10	U RE	ug/L
AP-4	Phenanthrene	12/17/98	3	J RE	ug/L
AP-4	Phenol	12/17/98	5	J RE	ug/L
AP-4	Pyrene	12/17/98	1	J RE	ug/L
AP-4	Pyridine	12/17/98	10	U RE	ug/L

Note: See last page for explanation of codes.

Appendix A

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Data Conc.	Qual.	Units
ET-02	Antimony	12/17/98	2.7	U	ug/l
ET-02	Arsenic	12/17/98	26.5		ug/l
ET-02	Barium	12/17/98	1040		ug/l
ET-02	Beryllium	12/17/98	3.2	B	ug/l
ET-02	Cadmium	12/17/98	2.4	B	ug/l
ET-02	Chromium	12/17/98	5.1	B	ug/l
ET-02	Lead	12/17/98	32.8		ug/l
ET-02	Mercury	12/17/98	0.1	U	ug/l
ET-02	Nickel	12/17/98	28	B	ug/l
ET-02	Nickel	12/17/98	28	B	ug/l
ET-02	Selenium	12/17/98	4.1	B	ug/l
ET-02	Vanadium	12/17/98	85.7		ug/l
ET-02	Zinc	12/17/98	160		ug/l
ET-02	Benzene	12/17/98	17		ug/L
ET-02	2-Butanone	12/17/98	5	U	ug/L
ET-02	Carbon Disulfide	12/17/98	5	U	ug/L
ET-02	Chlorobenzene	12/17/98	5	U	ug/L
ET-02	Chloroform	12/17/98	5	U	ug/L
ET-02	1,2-Dibromoethane	12/17/98	5	U	ug/L
ET-02	1,2-Dichloroethane	12/17/98	5	U	ug/L
ET-02	1,1-Dichloroethene	12/17/98	5	U	ug/L
ET-02	1,4-Dioxane	12/17/98	500	U	ug/l
ET-02	Ethylbenzene	12/17/98	5	U	ug/L
ET-02	Styrene	12/17/98	5	U	ug/L
ET-02	Tetrachloroethene	12/17/98	5	U	ug/L
ET-02	Toluene	12/17/98	2	J	ug/L
ET-02	1,1,1-Trichloroethane	12/17/98	5	U	ug/L
ET-02	1,2,4-Trimethylbenzene	12/17/98	5	U	ug/L
ET-02	1,3,5-Trimethylbenzene	12/17/98	5	U	ug/L
ET-02	Trichloroethene	12/17/98	5	U	ug/L
ET-02	Xylenes (Total)	12/17/98	2	J	ug/L
ET-02	Acenaphthene	12/17/98	2	J	ug/L
ET-02	Anthracene	12/17/98	10	U	ug/L
ET-02	Benzo(a)anthracene	12/17/98	10	U	ug/L
ET-02	Benzo(a)pyrene	12/17/98	10	U	ug/L
ET-02	Benzo(b)fluoranthene	12/17/98	10	U	ug/L
ET-02	bis(2-ethylhexyl)phthalate	12/17/98	5	J	ug/L
ET-02	Butyl benzyl phthalate	12/17/98	10	U	ug/L
ET-02	Chrysene	12/17/98	10	U	ug/L
ET-02	Di-n-butyl phthalate	12/17/98	10	U	ug/L
ET-02	Di-n-octyl phthalate	12/17/98	10	U	ug/L
ET-02	Dibenz(a,h)anthracene	12/17/98	10	U	ug/L
ET-02	1,2-Dichlorobenzene	12/17/98	10	U	ug/L

Note: See last page for explanation of codes.

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Data Conc. Qual.	Units
ET-02	1,4-Dichlorobenzene	12/17/98	10 U	ug/L
ET-02	2,4-Dimethylphenol	12/17/98	10 U	ug/L
ET-02	2,4-Dinitrotoluene	12/17/98	10 U	ug/L
ET-02	7,12-Dimethylbenz(a)anthracene	12/17/98	10 U	ug/L
ET-02	Fluoranthene	12/17/98	10 U	ug/L
ET-02	Fluorene	12/17/98	4 J	ug/L
ET-02	Indeno(1,2,3-cd)pyrene	12/17/98	10 U	ug/L
ET-02	1-Methylnaphthalene	12/17/98	60	ug/L
ET-02	2-Methylnaphthalene	12/17/98	51	ug/L
ET-02	2-Methylphenol	12/17/98	10 U	ug/L
ET-02	4-Methylphenol	12/17/98	10 U	ug/L
ET-02	Naphthalene	12/17/98	16	ug/L
ET-02	Nitrobenzene	12/17/98	10 U	ug/L
ET-02	Phenanthrene	12/17/98	5 J	ug/L
ET-02	Phenol	12/17/98	10 U	ug/L
ET-02	Pyrene	12/17/98	1 J	ug/L
ET-02	Pyridine	12/17/98	10 U	ug/L

Note: See last page for explanation of codes.

Appendix A

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Data Conc. Qual.	Units
MW-1002	Antimony	12/17/98	2.7 U	ug/l
MW-1002	Arsenic	12/17/98	8.5 B	ug/l
MW-1002	Barium	12/17/98	621	ug/l
MW-1002	Beryllium	12/17/98	1.6 B	ug/l
MW-1002	Cadmium	12/17/98	1.4 B	ug/l
MW-1002	Chromium	12/17/98	7.6 B	ug/l
MW-1002	Lead	12/17/98	31.8	ug/l
MW-1002	Mercury	12/17/98	0.11 B	ug/l
MW-1002	Nickel	12/17/98	21.4 B	ug/l
MW-1002	Nickel	12/17/98	21.4 B	ug/l
MW-1002	Selenium	12/17/98	3.1 U	ug/l
MW-1002	Vanadium	12/17/98	45.1	ug/l
MW-1002	Zinc	12/17/98	136	ug/l
MW-1002	Benzene	12/17/98	5 U	ug/L
MW-1002	2-Butanone	12/17/98	5 U	ug/L
MW-1002	Carbon Disulfide	12/17/98	5 U	ug/L
MW-1002	Chlorobenzene	12/17/98	5 U	ug/L
MW-1002	Chloroform	12/17/98	5 U	ug/L
MW-1002	1,2-Dibromoethane	12/17/98	5 U	ug/L
MW-1002	1,2-Dichloroethane	12/17/98	5 U	ug/L
MW-1002	1,1-Dichloroethene	12/17/98	5 U	ug/L
MW-1002	1,4-Dioxane	12/17/98	500 U	ug/l
MW-1002	Ethylbenzene	12/17/98	5 U	ug/L
MW-1002	Styrene	12/17/98	5 U	ug/L
MW-1002	Tetrachloroethene	12/17/98	5 U	ug/L
MW-1002	Toluene	12/17/98	5 U	ug/L
MW-1002	1,1,1-Trichloroethane	12/17/98	5 U	ug/L
MW-1002	1,2,4-Trimethylbenzene	12/17/98	5 U	ug/L
MW-1002	1,3,5-Trimethylbenzene	12/17/98	5 U	ug/L
MW-1002	Trichloroethene	12/17/98	5 U	ug/L
MW-1002	Xylenes (Total)	12/17/98	5 U	ug/L
MW-1002	Acenaphthene	12/17/98	6 J	ug/L
MW-1002	Anthracene	12/17/98	16 J	ug/L
MW-1002	Benzo(a)anthracene	12/17/98	26 J	ug/L
MW-1002	Benzo(a)pyrene	12/17/98	8 J	ug/L
MW-1002	Benzo(b)fluoranthene	12/17/98	7 J	ug/L
MW-1002	bis(2-ethylhexyl)phthalate	12/17/98	50 U	ug/L
MW-1002	Butyl benzyl phthalate	12/17/98	50 U	ug/L
MW-1002	Chrysene	12/17/98	52	ug/L
MW-1002	Di-n-butyl phthalate	12/17/98	50 U	ug/L
MW-1002	Di-n-octyl phthalate	12/17/98	50 U	ug/L
MW-1002	Dibenz(a,h)anthracene	12/17/98	50 U	ug/L
MW-1002	1,2-Dichlorobenzene	12/17/98	50 U	ug/L

Note: See last page for explanation of codes.

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Conc.	Data Qual.	Units
MW-1002	1,4-Dichlorobenzene	12/17/98	50	U	ug/L
MW-1002	2,4-Dimethylphenol	12/17/98	50	U	ug/L
MW-1002	2,4-Dinitrotoluene	12/17/98	50	U	ug/L
MW-1002	7,12-Dimethylbenz(a)anthracene	12/17/98	50	U	ug/L
MW-1002	Fluoranthene	12/17/98	14	J	ug/L
MW-1002	Fluorene	12/17/98	19	J	ug/L
MW-1002	Indeno(1,2,3-cd)pyrene	12/17/98	50	U	ug/L
MW-1002	1-Methylnaphthalene	12/17/98	82		ug/L
MW-1002	2-Methylnaphthalene	12/17/98	50	U	ug/L
MW-1002	2-Methylphenol	12/17/98	50	U	ug/L
MW-1002	4-Methylphenol	12/17/98	6	J	ug/L
MW-1002	Naphthalene	12/17/98	50	U	ug/L
MW-1002	Nitrobenzene	12/17/98	50	U	ug/L
MW-1002	Phenanthrene	12/17/98	120		ug/L
MW-1002	Phenol	12/17/98	50	U	ug/L
MW-1002	Pyrene	12/17/98	63		ug/L
MW-1002	Pyridine	12/17/98	50	U	ug/L

Note: See last page for explanation of codes.

Appendix A

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Data Conc.	Data Qual.	Units
RCRA-4	Conductivity, Field	12/11/98	1273		umhos/cm
RCRA-4	Corrected Water Elevation	12/11/98	1047.84		ftAMSL
RCRA-4	pH, Field	12/11/98	7.4		std
RCRA-4	Temperature, Field	12/11/98	58.1		DegC
RCRA-4	Chloride	12/11/98	47.1		mg/l
RCRA-4	Total Dissolved Solids	12/11/98	708		mg/l
RCRA-4	Antimony	12/11/98	2.7	U	ug/l
RCRA-4	Arsenic	12/11/98	23.1		ug/l
RCRA-4	Barium	12/11/98	306		ug/l
RCRA-4	Beryllium	12/11/98	0.41	B	ug/l
RCRA-4	Cadmium	12/11/98	0.6	B	ug/l
RCRA-4	Chromium	12/11/98	2.4	B	ug/l
RCRA-4	Lead	12/11/98	11.5		ug/l
RCRA-4	Mercury	12/11/98	0.1	U	ug/l
RCRA-4	Nickel	12/11/98	5.9	B	ug/l
RCRA-4	Nickel	12/11/98	5.9	B	ug/l
RCRA-4	Selenium	12/11/98	3.1	U	ug/l
RCRA-4	Vanadium	12/11/98	10.7	B	ug/l
RCRA-4	Zinc	12/11/98	30.6		ug/l
RCRA-4	Acetone	12/11/98	5	U	ug/L
RCRA-4	Benzene	12/11/98	11		ug/L
RCRA-4	2-Butanone	12/11/98	5	U	ug/L
RCRA-4	Carbon Tetrachloride	12/11/98	5	U	ug/L
RCRA-4	Chlorobenzene	12/11/98	5	U	ug/L
RCRA-4	Chloroform	12/11/98	5	U	ug/L
RCRA-4	1,1-Dichloroethene	12/11/98	5	U	ug/L
RCRA-4	Ethylbenzene	12/11/98	3	J	ug/L
RCRA-4	Toluene	12/11/98	5	U	ug/L
RCRA-4	Trichloroethene	12/11/98	5	U	ug/L
RCRA-4	Xylenes (Total)	12/11/98	2	J	ug/L
RCRA-4	Acenaphthylene	12/11/98	10	U	ug/L
RCRA-4	Anthracene	12/11/98	10	U	ug/L
RCRA-4	Benzo(a)anthracene	12/11/98	10	U	ug/L
RCRA-4	Benzo(a)pyrene	12/11/98	10	U	ug/L
RCRA-4	Benzo(b)fluoranthene	12/11/98	10	U	ug/L
RCRA-4	bis(2-ethylhexyl)phthalate	12/11/98	1	JB	ug/L
RCRA-4	Chrysene	12/11/98	10	U	ug/L
RCRA-4	Di-n-octyl phthalate	12/11/98	10	U	ug/L
RCRA-4	Dibenzofuran	12/11/98	10	U	ug/L
RCRA-4	Dimethyl phthalate	12/11/98	10	U	ug/L
RCRA-4	2,4-Dimethylphenol	12/11/98	10	U	ug/L
RCRA-4	Fluoranthene	12/11/98	10	U	ug/L
RCRA-4	Fluorene	12/11/98	10	U	ug/L

Note: See last page for explanation of codes.

Appendix A

Fourth Quarter 1998 Groundwater Sampling Results

Well I. D.	Parameter	Sample Date	Conc.	Data Qual.	Units
RCRA-4	1-Methylnaphthalene	12/11/98	10	U	ug/L
RCRA-4	2-Methylnaphthalene	12/11/98	10	U	ug/L
RCRA-4	Naphthalene	12/11/98	10	U	ug/L
RCRA-4	Phenanthrene	12/11/98	10	U	ug/L
RCRA-4	Phenol	12/11/98	10	U	ug/L
RCRA-4	Pyrene	12/11/98	10	U	ug/L

Note: See last page for explanation of codes.

Appendix A

Summary of Qualifiers

Organic Qualifier Flags

U	Indicates compound was analyzed for but not detected.
J	Indicates an estimated value. Used primarily when the compound was detected below the practical quantitation limit (PQL).
B	This flag is used when the analyte is found in the associated blank as well as in the sample.
E	This flag identifies compounds whose concentrations exceed the calibration of the instrument for that specific analysis.
D	This flag identifies all compounds identified in an analysis at a secondary dilution factor.
RE	If a sample or compound has to be re-extracted and re-analyzed. Used primarily when the detected compounds concentration exceeds the calibration range of the instrument.

Inorganic Qualifier Flags

B	The reported value was obtained from a reading that was less than the practical quantitation limit (PQL).
E	The reported value is estimated because of the presence of interference.
N	Spike sample recovery not within control limits.
*	Duplicate analysis not within control limits.

APPENDIX B

Capture Zone Monitoring Well Logs

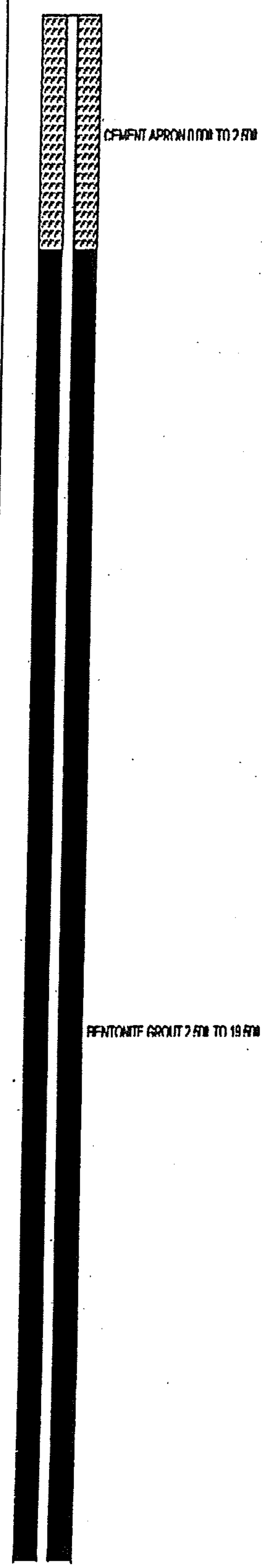
PROJECT: 01-01380-014

LOCATION: Arkansas City, KS

BOREHOLE RFI2-5C

BORING DATE: 11/19/99 DATUM: GROUND SURFACE LOGGED: Chuck Gay

DEPTH SCALE METRES	DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	DEPTH B.G.S. (ft)	Sample ID	USCS Symbol	Recovery (%)	MEASUREMENTS PID (PPM) 0 2k 4k 6k 8k 10k
0	0		GROUND SURFACE						
			Soil, dark brown, dry, organic.		0.0				
	2		Clay, brown, very firm, friable, dry, low plasticity, iron oxide mottles.		1.3		ML		
1	4								
	6		Clay, brown, friable, dry to moist at 6.5', sparse iron oxide mottles.		5.0		ML		
2	8								
			Sand, black to light brown, very fine to fine grained, subrounded, strong hydrocarbon odor and staining at 8.8-10.0', moist, 10% silt.		8.2		SM		
3	10								
	12		Sand, black turning to pale yellowish brown at 13.3-15.0', wet at 14.0', strong hydrocarbon odor and stain at 10.0-12.75', medium to coarse grain 11.5-13.0', turning very fine to fine grained, sub rounded.		10.0		SP		
4	14								
	16		Sand, pale yellowish brown, very fine to fine grained, faint hydrocarbon odor, wet.		15.0		SP		
5									



Continued on next page

DRAWN: JS CHECKED: JWH

BOREHOLE/MONITORING WELL NAME: CMW-1 (RFI2-5C)

LOCATION & ELEVATIONS

NORTHING:

EASTING:

COORDINATE SYSTEM: Plant Coords.

TOP OF CASING ELEV.: XXXX.XX ft.

GROUND ELEV.: XXXX.XX ft.

DRILLING SUMMARY

TOTAL WELL DEPTH: 29.00 ft bgs

SURFACE MOUNT: X STICKUP:

DATE DRILLED: 11/19/99

LOGGED BY: Chuck Gay EnecoTech

DRILLING CONTRACTOR:
Geocore Services, Inc., Salina, KS.

DRILLING RIG: CME-75
DRILLING METHOD: Hollow stem auger

BOREHOLE DIAMETER: 10"

HOLLOW STEM AUGER ID: 6.25"

WATER LEVEL (btoc): NA

WELL DESIGN AND MATERIALS

CASING: 2" ID sch. 40 PVC

SCREEN: 2" ID sch. 40 PVC 0.020" machine slot
SCREENED INTERVAL: 23.00-28.00 ft bg

FILTER PACK: 10-20 silica sand
FILTER PACK INTERVAL: 21.00-29.00 ft bgs

BENTONITE PELLETS: 2.50-19.50 ft bgs

GROUT INTERVAL 1: Benseal w/Aqua-Grout
GROUT INTERVAL 1: 19.50-21.00 ft bgs
GROUT INTERVAL 2: Cement
GROUT INTERVAL 2: 0.00-2.50 ft bgs

SAMPLING

WELL DEVELOPMENT

The wells were surged and pumped for approximately one hour until the water was sediment free.

COMMENTS

The stratification lines on the borehole log represent the approximate boundary between soil and rock types. The transition between these boundaries may be more gradual than depicted on this log.

Lithologic description from adjacent well RFI2-5A.

EnecoTech Inc.
1580 Lincoln Street, Suite 1000
Denver, Colorado 80203
(303) 861-2200

PROJECT: 61-0138R.014

LOCATION: Arkansas City, KS

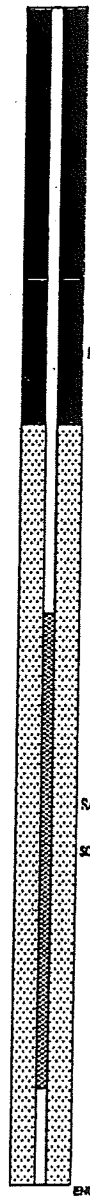
BOREHOLE RFI2-5C

BORING DATE: 11/19/99 DATUM: GROUND SURFACE LOGGED: Chuck Gay

DEPTH SCALE FEET	SOIL PROFILE DESCRIPTION	DEPTH B.G.S. (ft)	USCS Symbol
18	Sand, pale yellowish brown, very fine to fine grained, faint hydrocarbon odor, wet.		SP
	Clay, 30% silt, brown, firm, low plasticity,	18.2	
20	Sand, 20% silt, very pale yellowish brown, very fine to fine grained, wet.	18.6	SP
22, 24	Sand with 20% silt, pale yellowish brown, very fine to fine grained, wet.	20.0	SP
26, 28	Sand, pale yellowish brown, very fine to fine grained with 5% fine gravel.	25.0	SP
30, 32	END OF EXPLORATION @ 29.00ft	29.00	

Depth scale: Metres 6, 7, 8, 9, 10; Feet 18, 20, 22, 24, 26, 28, 30, 32

Column headings: METRES, FEET, BORING METHOD, DESCRIPTION, STRATA PLOT, DEPTH B.G.S. (ft), Sample ID, USCS Symbol, Recovery (%), MEASUREMENTS: PID (PPM) 0 2k 4k 6k 8k 10k



DRAWN: JS CHECKED: JWH

BOREHOLE/MONITORING WELL NAME: CMW-1 (RFI2-5C)

LOCATION & ELEVATIONS

NORTHING:

EASTING:

COORDINATE SYSTEM: Plant Coords.

TOP OF CASING ELEV.: XXXX.XX ft.

GROUND ELEV.: XXXX.XX ft.

DRILLING SUMMARY

TOTAL WELL DEPTH: 29.00 ft bgs

SURFACE MOUNT: X STICKUP:

DATE DRILLED: 11/19/99

LOGGED BY: Chuck Gay EnecoTech

DRILLING CONTRACTOR:
Geocore Services, Inc., Salina, KS.

DRILLING RIG: CME-75
DRILLING METHOD: Hollow stem auger

BOREHOLE DIAMETER: 10"

HOLLOW STEM AUGER ID: 6.25"

WATER LEVEL (btoc): NA

WELL DESIGN AND MATERIALS

CASING: 2" ID sch. 40 PVC

SCREEN: 2" ID sch. 40 PVC 0.020" machine slot
SCREENED INTERVAL: 23.00-28.00 ft bgs

FILTER PACK: 10-20 silica sand
FILTER PACK INTERVAL: 21.00-29.00 ft bgs

BENTONITE PELLETS: 2.50-19.50 ft bgs

GROUT INTERVAL 1: Benseal w/Aqua-Grout
GROUT INTERVAL 1: 19.50-21.00 ft bgs
GROUT INTERVAL 2: Cement
GROUT INTERVAL 2: 0.00-2.50 ft bgs

SAMPLING

WELL DEVELOPMENT

The wells were surged and pumped for approximately one hour until the water was sediment free.

COMMENTS

The stratification lines on the borehole log represent the approximate boundary between soil and rock types. The transition between these boundaries may be more gradual than depicted on this log.

Lithologic description from adjacent well RFI2-5A.

EnecoTech Inc.
1580 Lincoln Street, Suite 1000
Denver, Colorado 80203
(303) 861-2200

PROJECT: 01-0130R-014

LOCATION: Arkansas City, KS

BORING DATE: 11/19/99

DATUM: GROUND SURFACE

LOGGED: Chuck Gay

BOREHOLE CMW-2

DEPTH (ft)	SOIL PROFILE – DESCRIPTION	DEPTH B.G.S. (ft)	USCS Symbol	Recovery (%)
0	GROUND SURFACE			
0–4	Sand, yellowish orange, no odor or staining, well sorted, fine grained.	0.0	SP	100
4–5	Sand, light gray, strong hydrocarbon odor, heavy staining, well sorted, fine grained.	4.0	SP	100
5–10	Sand, olive gray, strong hydrocarbon odor, heavy staing, well sorted, fine grained.	5.0	SP	100
10–13	Sand, olive gray, strong hydrocarbon odor, heavy staining, well sorted, fine grained.	10.0	SP	50
13–14	Sand, olive gray, strong hydrocarbon odor, heavy staining, well sorted, medium	13.0	SP	50
14–15	Sand, olive gray, strong hydrocarbon odor, heavy staining, fine grained, well sorted.	14.00	SP	50
15–16	Sand, olive gray, strong hydrocarbon odor, heavy staining, fine grained, well sorted.	15.0	SP	80
16–18	Sand, olive gray, water at approximately 17.0', heavily stained, free product present, strong hydrocarbon odor, medium grained, poorly sorted.	16.0	SP	80
18–20	Sand, olive gray, strong hydrocarbon odor, free product present, fine grained, well sorted.	18.0	SW	80
20–25	Sand, olive gray, moderate hydrocarbon odor and staing, fine grained, well sorted.	20.0	SW	80
25–30	Sand, olive gray, slight odor and staining, fine grained, well sorted.	25.0	SW	50
30–	Sand, olive gray, fine grained, well sorted, slight hydrocarbon odor and staining.	30.0	SW	40

MEASUREMENTS: PID (PPM) 0 200 400 600 800 1000

CEMENT APRON 0.00ft TO 2.50ft

BENTONITE GROUT 2.50ft TO 22.50ft

17.00ft, 11/19/99

BENTONITE SEAL 22.50ft TO 24.50ft

SAND PACK (10-20 MESH) 24.50ft TO

SCREEN 26.50ft TO 31.50ft

Continued on next page

DRAWN: JS

CHECKED: JWH

BOREHOLE/MONITORING WELL NAME: CMW-2

LOCATION & ELEVATIONS

NORTHING:

EASTING:

COORDINATE SYSTEM: Plant Coords.

TOP OF CASING ELEV.: XXXX.XX ft.

GROUND ELEV.: XXXX.XX ft.

DRILLING SUMMARY

TOTAL WELL DEPTH: 32.50 ft bgs

SURFACE MOUNT: STICKUP:

DATE DRILLED: 11/19/99

LOGGED BY: Chuck Gay EnecoTech

DRILLING CONTRACTOR:
Geocore Services, Inc., Salina, KS.

DRILLING RIG: CME-75
DRILLING METHOD: Hollow stem auger

BOREHOLE DIAMETER: 10"

HOLLOW STEM AUGER ID:
PILOT BOREHOLE: 4.25"
REAMED BOREHOLE: 6.25"

WATER LEVEL (btoc): NA

WELL DESIGN AND MATERIALS

CASING: 2" ID sch. 40 PVC

SCREEN: 2" ID sch. 40 PVC 0.020" machine slot
SCREENED INTERVAL: 26.50-31.50 ft bg.

FILTER PACK: 10-20 silica sand
FILTER PACK INTERVAL: 24.50-32.50 ft bgs

BENTONITE PELLETS: 2.50-22.50 ft bgs

GROUT INTERVAL 1: Benseal w/Aqua-Grout
GROUT INTERVAL 1: 22.50-24.50 ft bgs
GROUT INTERVAL 2: Cement
GROUT INTERVAL 2: 0.00-2.50 ft bgs

SAMPLING

The borehole was sampled continuously with a 5-foot sampler. Percent recoveries and sample intervals are noted on the borehole log diagram.

WELL DEVELOPMENT

The wells were surged and pumped for approximately one hour until the water was sediment free.

COMMENTS

The stratification lines on the borehole log represent the approximate boundary between soil and rock types. The transition between these boundaries may be more gradual than depicted on this log.

Borehole below bottom of screen pugged with bentonite.

EnecoTech Inc.
1580 Lincoln Street, Suite 1000
Denver, Colorado 80203
(303) 861-2200

PROJECT: 01-0130R.014

LOCATION: Arkansas City, KS

BORING DATE: 11/19/99 DATUM: GROUND SURFACE LOGGED: Chuck Gay

BOREHOLE CMW-2

DESCRIPTION (Soil Profile)	Strata Plot	Depth B.G.S. (ft)	Sample ID	USCS Symbol	Recovery (%)	PID (PPM) 0 200 400 600 800 1000
Sand, olive gray, fine grained, well sorted, slight hydrocarbon odor and staining.				SW	40	
Sand, olive gray, fine grained, well sorted, very slight hydrocarbon odor.		35 ft		SW	20	
Sand, olive gray, medium grained, well sorted, very slight hydrocarbon odor.		38 ft		SW	20	
Shale.		39 ft				
END OF EXPLORATION @ 40.00ft		40 ft				

END OF EXPLORATION

DRAWN: JS CHECKED: JWH

BOREHOLE/MONITORING WELL NAME: CMW-2

LOCATION & ELEVATIONS

NORTHING:

EASTING:

COORDINATE SYSTEM: Plant Coords.

TOP OF CASING ELEV.: XXXX.XX ft.

GROUND ELEV.: XXXX.XX ft.

DRILLING SUMMARY

TOTAL WELL DEPTH: 32.50 ft bgs

SURFACE MOUNT: STICKUP:

DATE DRILLED: 11/19/99

LOGGED BY: Chuck Gay EnecoTech

DRILLING CONTRACTOR:
Geocore Services, Inc., Salina, KS.

DRILLING RIG: CME-75
DRILLING METHOD: Hollow stem auger

BOREHOLE DIAMETER: 10"

HOLLOW STEM AUGER ID:
PILOT BOREHOLE: 4.25"
REAMED BOREHOLE: 6.25"

WATER LEVEL (btoc): NA

WELL DESIGN AND MATERIALS

CASING: 2" ID sch. 40 PVC

SCREEN: 2" ID sch. 40 PVC 0.020" machine slot
SCREENED INTERVAL: 26.50-31.50 ft bgs

FILTER PACK: 10-20 silica sand
FILTER PACK INTERVAL: 24.50-32.50 ft bgs

BENTONITE PELLETS: 2.50-22.50 ft bgs

GROUT INTERVAL 1: Benseal w/Aqua-Grout
GROUT INTERVAL 1: 22.50-24.50 ft bgs
GROUT INTERVAL 2: Cement
GROUT INTERVAL 2: 0.00-2.50 ft bgs

SAMPLING

The borehole was sampled continuously with a 5-foot sampler. Percent recoveries and sample intervals are noted on the borehole log diagram.

WELL DEVELOPMENT

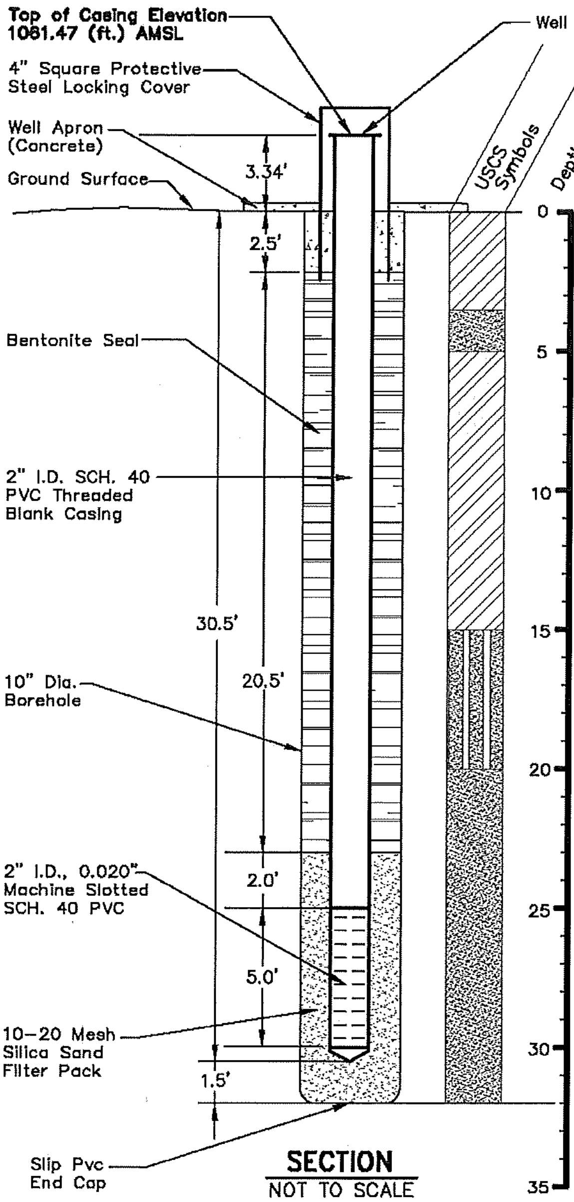
The wells were surged and pumped for approximately one hour until the water was sediment free.

COMMENTS

The stratification lines on the borehole log represent the approximate boundary between soil and rock types. The transition between these boundaries may be more gradual than depicted on this log.

Borehole below bottom of screen pugged with bentonite.

EnecoTech Inc.
1580 Lincoln Street, Suite 1000
Denver, Colorado 80203
(303) 861-2200



SECTION
NOT TO SCALE

COMMENTS

The stratification lines on the borehole log represent the approximate boundary between soil and rock types. The transition between these boundaries may be more gradual than depicted on this log.

PID Reading (ppm)	USCS Classification	Lithology/Remarks	
0	CL	0-3.5ft.	Clayey Silt, Dark Brown, Moist, Slight Plasticity, Some Fine Sand, No Odor
	SP	3.5-5.0ft.	Sand, Brown, Very Fine to Fine Grained, Moist, No Odor
0 0	CL	5.0- 15.0ft.	Silty Clay, Brown, Moist, Medium to High Plasticity, No Odor
0	SM	15.0-20.0ft.	Silty Sand, Dark Grayish Brown, Moist, Cohesive, Fine to Very Coarse Grained, Slight Weathered Hydrocarbon Odor
0 0	SP	20.0-32.0ft.	Sand, Brown, Some Silt, Medium to Very Coarse Grained with Small Gravel, Wet, Well Graded, Poorly Sorted, Subrounded to Angular, Weathered Hydrocarbon Odor to No Odor

End of Boring @ 32.0 ft. BGS

BUILT BY: GEOCORE SERVICES, INC.
DATE COMPLETED: 4/13/06

DATE	DESIGN BY	DRAWN BY	REVIEWED BY
04/06	JFM	LKB	JFM

MONITORING WELL CMW-03 CONSTRUCTION DIAGRAM

PROJECT: ARKANSAS CITY, KANSAS
MICHIGAN REUTILIZATION, LLC.

MWH

Figure No.:

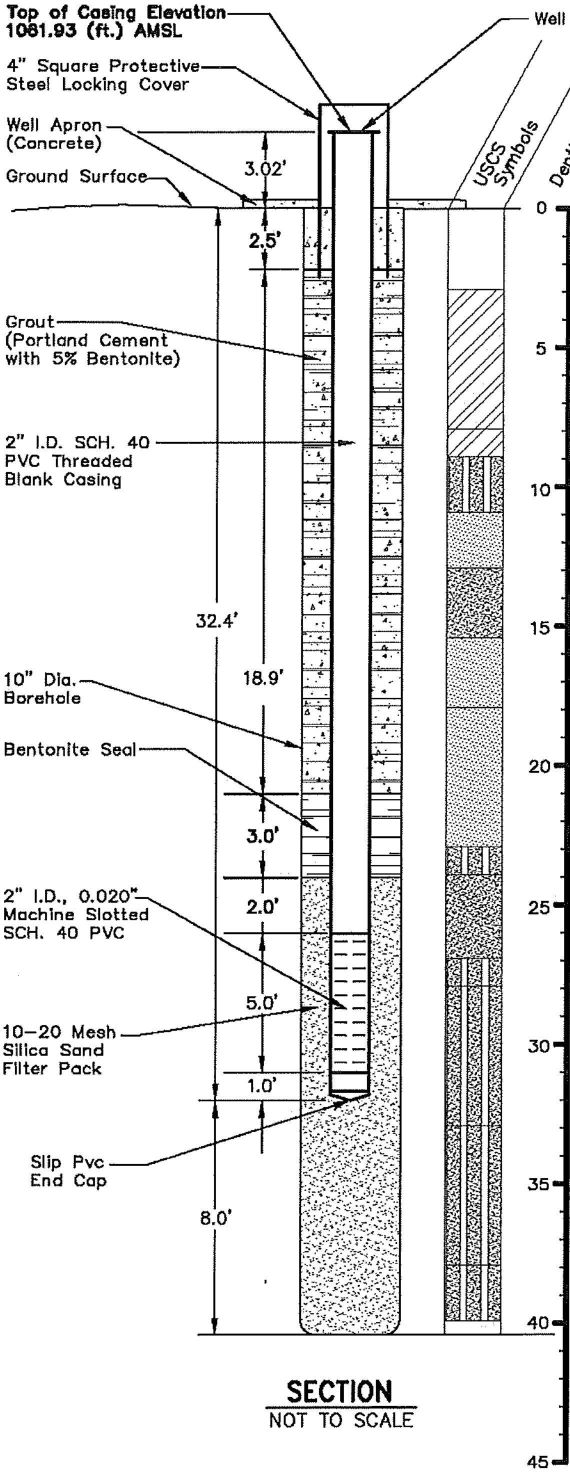
LOCATION (Plant Coordinates)

NORTHING -963.380 (ft.)
EASTING 2595.681 (ft.)

ELEVATIONS IN FEET ABOVE MEAN SEA LEVEL (AMSL)

NOTE: PVC CASING CONNECTIONS ARE THREADED AND FLUSH JOINTED

AutoCAD FILE: J/A CMW-3.DWG PROJECT NUMBER: 4270169



SECTION
NOT TO SCALE

COMMENTS

The stratification lines on the borehole log represent the approximate boundary between soil and rock types. The transition between these boundaries may be more gradual than depicted on this log.

PID Reading (ppm)	Classification USCS	Lithology/Remarks	
		0–2.9ft.	Fill
2	CL	2.9–7.9ft.	Silty Clay, Olive Gray, Low to Moderate Plasticity, No Hydrocarbon Odor or Staining
	CL	7.9–8.9ft.	Silty Clay, Olive Gray, Low to Moderate Plasticity, Soft, No Hydrocarbon Odor or Staining
0	SM	8.9–10.9ft.	Silty Sand, Dark Brown, No Hydrocarbon Odor or Staining, Very Fine to Fine Grained
0	SW	10.9–12.9ft.	Sand, Yellow Orange, Fine grained, Well Graded, No Hydrocarbon Odor or Staining
4 52	SP	12.9–15.4ft.	Sand, Light Brown, Poorly Sorted, Medium to Coarse Grained, Moderate Hydrocarbon Odor, No Apparent Staining
144	SW	15.4–17.9ft.	Sand, Olive Gray, Well Graded, Fine Graded, Strong Hydrocarbon Odor, Heavy Staining, Wet at Approximately 16.4'
455 130 141	SW	17.9–22.9ft.	Sand, Dark Gray, Well Graded, fine graded, Moderate Hydrocarbon Odor, Heavily Stained, Some Silt
120	SM	22.9–23.9ft.	Silty Sand, Dark Gray, Very Fine Grained to Fine Grained, Moderate Hydrocarbon Odor with Staining
54 62	SP	23.9–26.9ft.	Sand, Poorly Sorted, Fine to Coarse Grained, Moderate Hydrocarbon Odor with Heavy Staining
	SM	26.9–27.9ft.	Silty Sand, Dark Gray, Very Fine to Fine Grained, Moderate Hydrocarbon Odor with Heavy Staining
59 48 42	SM	27.9–32.9ft.	Silty Sand, Dark Gray, Very Fine to Fine Grained, Slight to Moderate Hydrocarbon Odor with Heavy Staining
49 29 25	SM	32.9–37.9ft.	Silty Sand, Dark Gray, Very Fine to Fine Grained, Slight Hydrocarbon Odor with Heavy Staining
20	SM	37.9–39.9ft.	Silty Sand, Dark Gray, Fine to Medium Grained, Slight Hydrocarbon Odor with Heavy Staining
		39.9–40.4ft.	Shale Bedrock

End of Boring @ 40.4 ft. BGS

BUILT BY: GEOCORE SERVICES, INC.
DATE COMPLETED: 4/13/08

DATE	DESIGN BY	DRAWN BY	REVIEWED BY
04/08	JFM	LKB	JFM

MONITORING WELL CMW-04 CONSTRUCTION DIAGRAM

PROJECT: ARKANSAS CITY, KANSAS
MICHIGAN REUTILIZATION, LLC.

MWH

Figure No.:

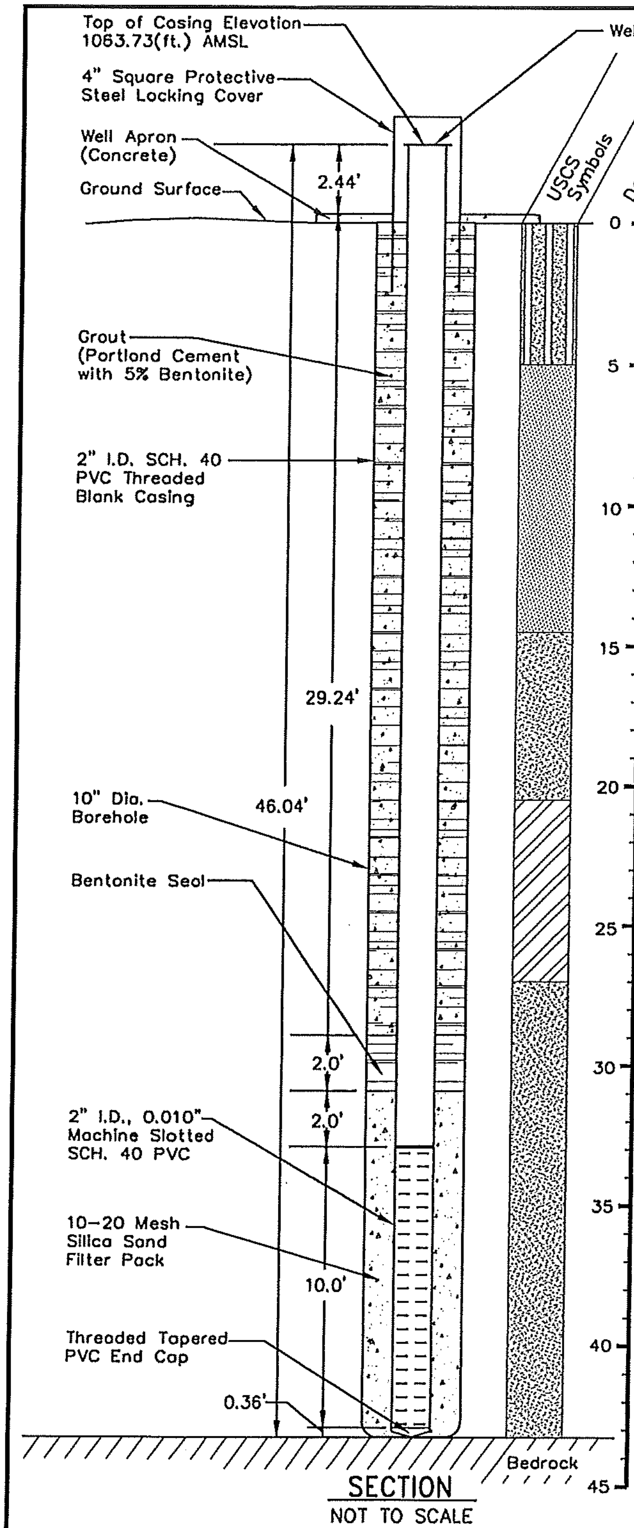
LOCATION (Plant Coordinates)

NORTHING -1128.715 (ft.)
EASTING 2770.582 (ft.)

ELEVATIONS IN FEET ABOVE MEAN SEA LEVEL (AMSL)

NOTE: PVC CASING CONNECTIONS ARE THREADED AND FLUSH JOINTED

AutoCAD FILE: DIA_CMW-4.Dwg PROJECT NUMBER: 4270169



COMMENTS
The stratification lines on the borehole log represent the approximate boundary between soil and rock types. The transition between these boundaries may be more gradual than depicted on this log.

PID Reading (ppm)	USCS Classification	Depth	Lithology/Remarks
	SM	0–5ft.	Dark Brown Very Slightly Clayey Silty Sand – Mod. Dry (Very Slightly Moist), 10% Fines, Crumbly with Organics, Blocky Structure
438, 29, 151, 92	SW	5–14.5ft.	Light Gray Brown Sand – Very Slightly Moist, Loose to Slightly Dense, Strong Odor, Staining Present, Subangular Grains, Medium Grained, Fining @ 9ft. to Approximately 12ft., Medium Grained at 12ft., Coarsening at 14.5ft., Strong Odor and Slight Staining Present
41, 450, 583, 567	SP	14.5–20.5ft.	Medium to Coarse Tan Gray Sand, Loose to Slightly Compact Subangular to Subrounded, Strong Odor, Slight Staining, Slight Flowing Dark Gray (Stained) to Light Black Color at 17.5ft., Very Strong Odor Saturated with Product at 20–20.5ft.
27.5, 30.5, 26	CL	20.5–27ft.	Water Table @ 24ft. BGS Free Product @ 20ft. Gray Clay, Mod. Dense, Very Plastic, Stained, Odor, Very Moist to Saturated, Strong Odor
4.2, 3.5	SP	27–43.2ft.	Coarse Sand, Subangular, Saturated, Loose, Medium Gray Color, (1) 4" Cobble @ 29.0ft. Bedrock @ 43.2ft. BGS.

BUILT BY: GEOCORE SERVICES, INC.
DATE COMPLETED: 10/30/01

EnecoTech
ENVIRONMENTAL CONSULTANTS

Figure No.:

MONITORING WELL RCRA-7 CONSTRUCTION DIAGRAM

PROJECT: TPI PETROLEUM INC. – ARKANSAS CITY REFINERY

138R-016	DESIGNED BY: JFM	APPROVED BY: JFM
18-RCRA_7R	DRAWN BY: LKB	DATE: 1/18/02 REV:

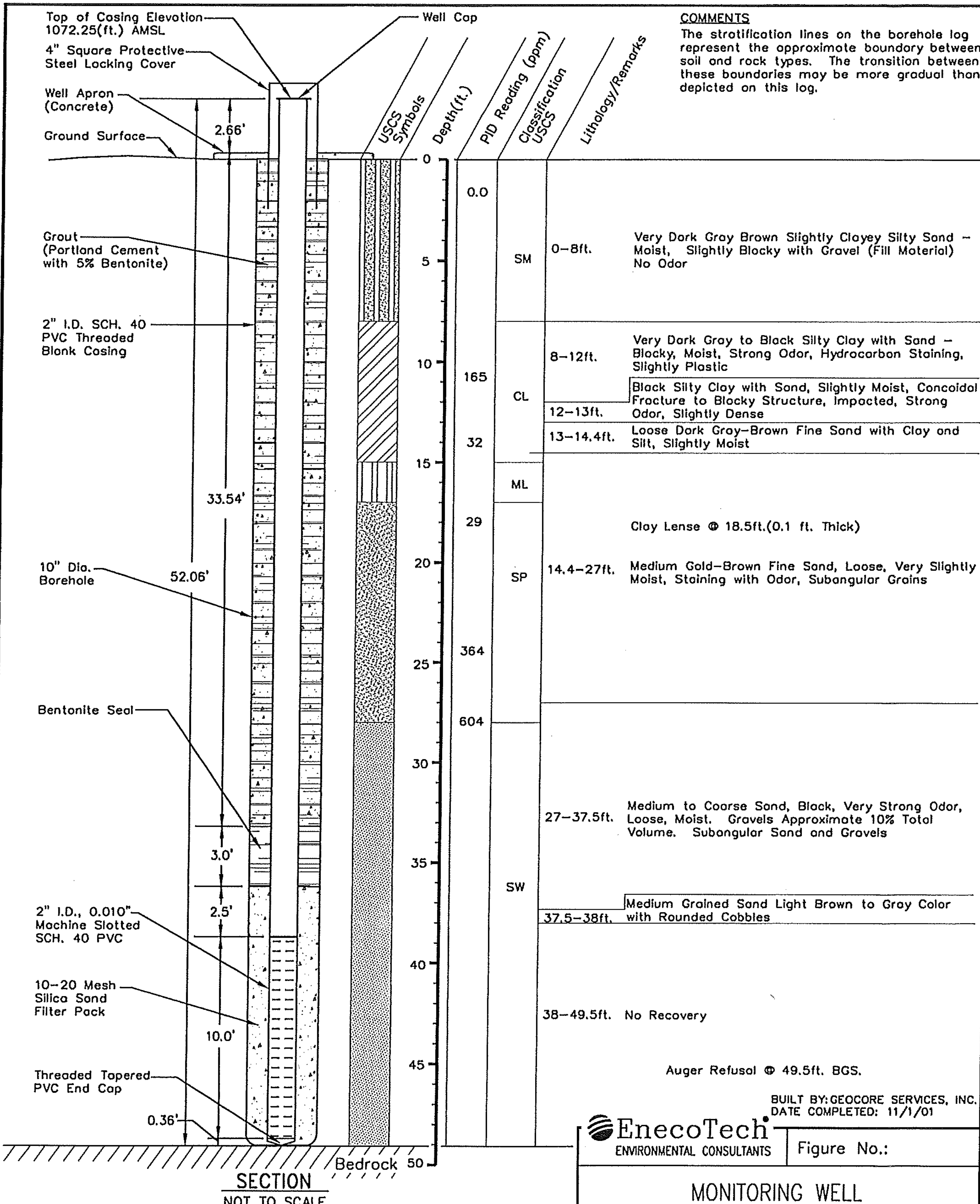
LOCATION (Plant Coordinates)

NORTHING –647.635(ft.)
EASTING 2054.371(ft.)

ELEVATIONS IN FEET ABOVE MEAN SEA LEVEL (AMSL)

NOTE: PVC CASING CONNECTIONS ARE THREADED AND FLUSH JOINTED

COMMENTS
The stratification lines on the borehole log represent the approximate boundary between soil and rock types. The transition between these boundaries may be more gradual than depicted on this log.



BUILT BY: GEOCORE SERVICES, INC.
DATE COMPLETED: 11/1/01

EnecoTech
ENVIRONMENTAL CONSULTANTS

Figure No.:

MONITORING WELL 113 CONSTRUCTION DIAGRAM

LOCATION (Plant Coordinates)

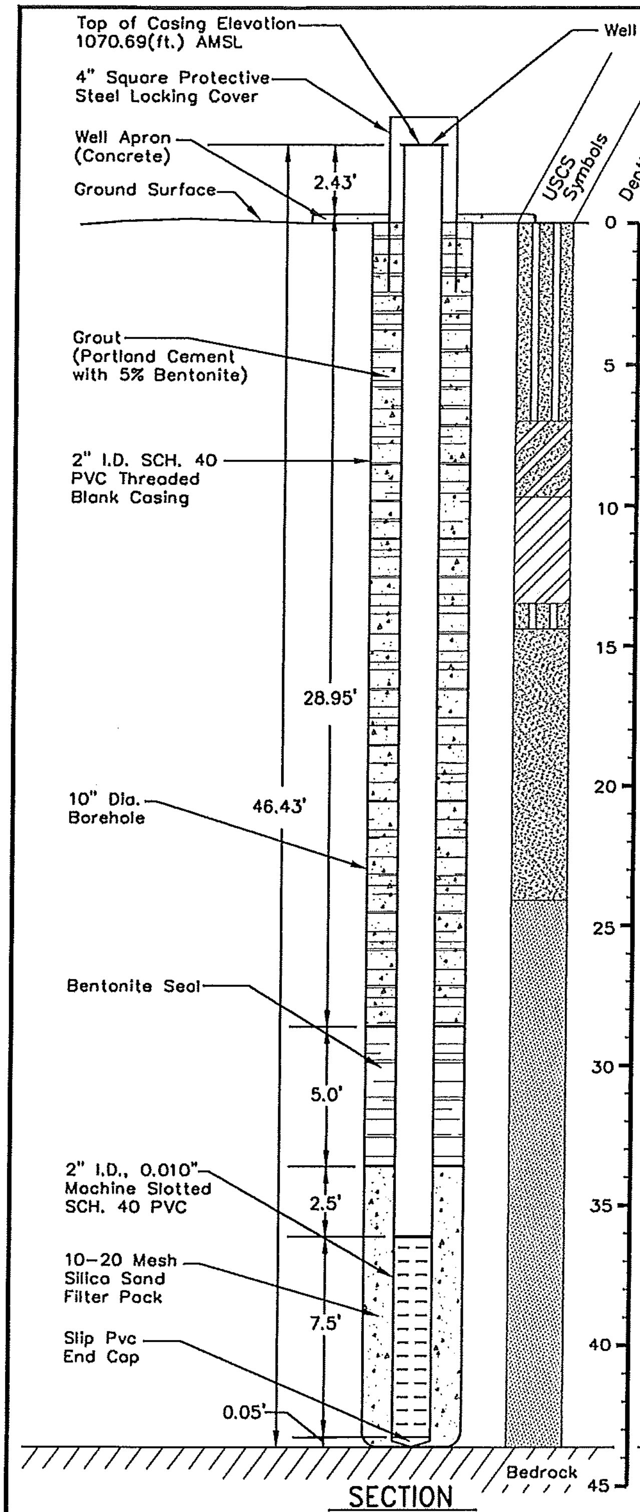
NORTHING -770.862(ft.)
EASTING 2162.007(ft.)

ELEVATIONS IN FEET ABOVE MEAN SEA LEVEL (AMSL)

NOTE: PVC CASING CONNECTIONS ARE THREADED AND FLUSH JOINTED

PROJECT: TPI PETROLEUM INC. - ARKANSAS CITY REFINERY

138R-016	DESIGNED BY: JFM	APPROVED BY: JFM
18-113	DRAWN BY: LKB	DATE: 1/18/02 REV:



SECTION
NOT TO SCALE

COMMENTS
The stratification lines on the borehole log represent the approximate boundary between soil and rock types. The transition between these boundaries may be more gradual than depicted on this log.

PID Reading (ppm)	USCS Classification	Lithology/Remarks	
BG, BG	SM	0–7ft.	Medium Gray–Brown Silty Sand, Slightly Moist, Blocky Structure with some Lamination Present below 4ft., 10% Clay, Rootlets and Red Oxidized Surfaces Present
5, 25	SC	7–8.5ft.	Very Dark Gray to Black Sandy Silt with Clay – Dense, Crumbly, Almost Vitreous Fracture Surfaces, Highly Stained
40		8.5–9.7ft.	Dark Gray Brown Clayey Silty Sand, Crumbly, Moist, Mod. Dense, some Staining, Very Slight Odor
50, 5, 5	CL	9.7–13.5ft.	Gray Silty Clay, Plastic, Moist, Blocky Structure
	SM	13.5–14.1ft.	Gray Silty Fine Sand, Crumbly, Mod. Dense, Moist
30, 119, 143, 220, 310	SP	14.1–23.8ft.	Tan–Gray Fine Sand, Poorly Graded, Very Slightly Dense, Moist, Odor but not Visually Stained, Grading to Fine to Medium Grained at 23 ft. BGS, Moist, Very Strong Hydrocarbon Odor
195, 195, 231	SW	23.8–44ft.	Medium Tan–Gray, Medium Sand, Mod. Well Graded, Subangular, Very Moist, Very Strong Odor, Loose "Salt & Pepper" Appearance, Coarsening with Depth to Coarse Sand at 28ft. BGS, Gray Color

Auger Refusal @ 44.0ft. BGS.

BUILT BY: GEOCORE SERVICES, INC.
DATE COMPLETED: 11/3/01

EnecoTech
ENVIRONMENTAL CONSULTANTS

Figure No.:

MONITORING WELL 118 CONSTRUCTION DIAGRAM

PROJECT: TPI PETROLEUM INC. – ARKANSAS CITY REFINERY

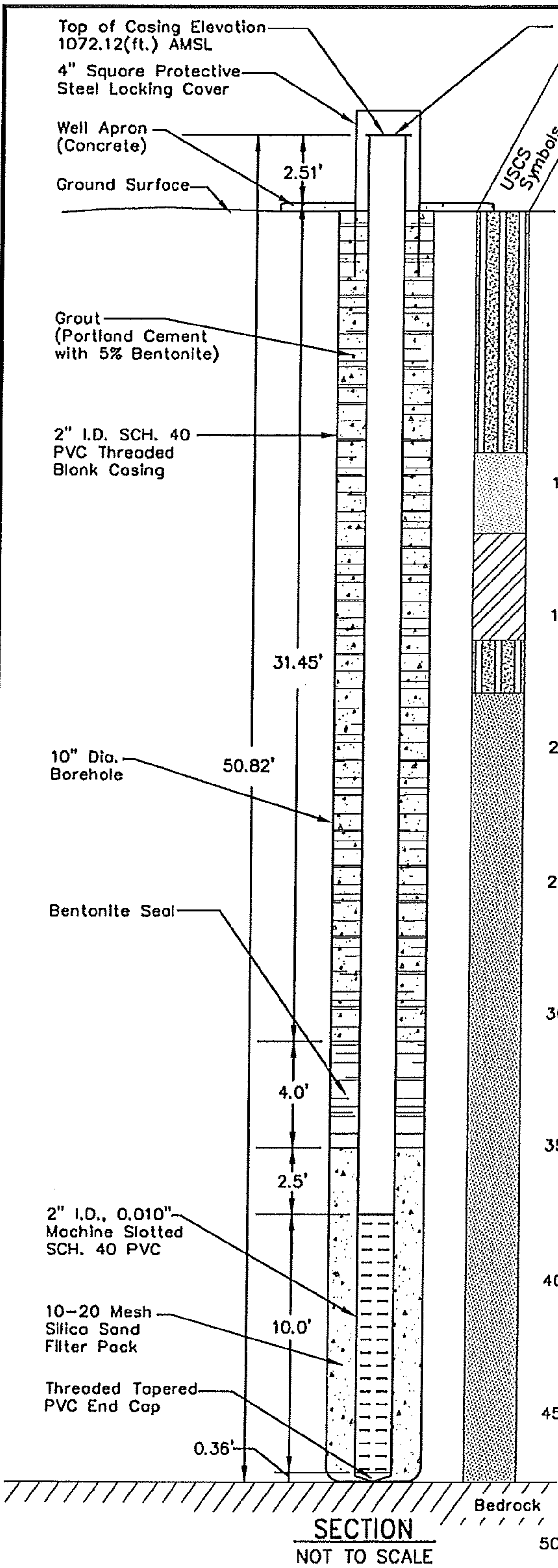
138R-016	DESIGNED BY: JFM	APPROVED BY: JFM
18-118R	DRAWN BY: LKB	DATE: 1/18/02	REV:

LOCATION (Plant Coordinates)

NORTHING −1059.369(ft.)
EASTING 2453.611(ft.)

ELEVATIONS IN FEET ABOVE MEAN SEA LEVEL (AMSL)

NOTE: PVC CASING CONNECTIONS ARE THREADED AND FLUSH JOINTED



COMMENTS
The stratification lines on the borehole log represent the approximate boundary between soil and rock types. The transition between these boundaries may be more gradual than depicted on this log.

Depth (ft.)	PID Reading (ppm)	USCS Classification	Lithology/Remarks
0–8ft.	1.6, 2.1, 1.7, 1.7	SM	Medium to Dark Brown Sandy Silt/Silty Fine Sand, Very Slightly Moist, Slightly Dense, Flaky Structure, Very Small amount of Clay, Dark Grayish Black at Approximately 2–3ft. BGS with Very Slight Odor
8–11.5ft.	7.5, 11.6	SW	Yellow-Brown Medium Sand, Loose to Very Slightly Compact, Slightly Moist Darkening to Gray Stained Appearance 11–11.5ft.
11.5–16ft.	14.7, 22	CL	Gray Clay, Plastic, Moist, Concoidal Fracture Surfaces with Wet Faces, Blocky Structure
16–16.8ft.	BG	SM	Medium Gray Silty Fine Sand, Laminated Structure, Slightly Moist
16.8–17.5ft.			Gray Fine Sand. Loose to Very Slightly Compact, Slightly Moist
17.5–22.5ft.	BG, BG	SW	Tan Medium Sand, Subangular, Mod. Well Graded, Loose, Slightly Moist Grading from Medium to Coarse Sand with Gray Color at 22.5ft.
22.5–46.5ft.	17.4, 74, 82, 137, 140, 165		Gray Medium Sand, Moist, Loose to Very Slightly Dense, Subangular with Black Grains

Auger Refusal @ 47.6ft. BGS.

BUILT BY: GEOCORE SERVICES, INC.
DATE COMPLETED: 11/2/01

EnecoTech
ENVIRONMENTAL CONSULTANTS

Figure No.:

MONITORING WELL MW-1002 CONSTRUCTION DIAGRAM

PROJECT: TPI PETROLEUM INC. – ARKANSAS CITY REFINERY

138R-016	DESIGNED BY: JFM	APPROVED BY: JFM	
18-MW_1002R	DRAWN BY: LKB	DATE: 1/18/02	REV:

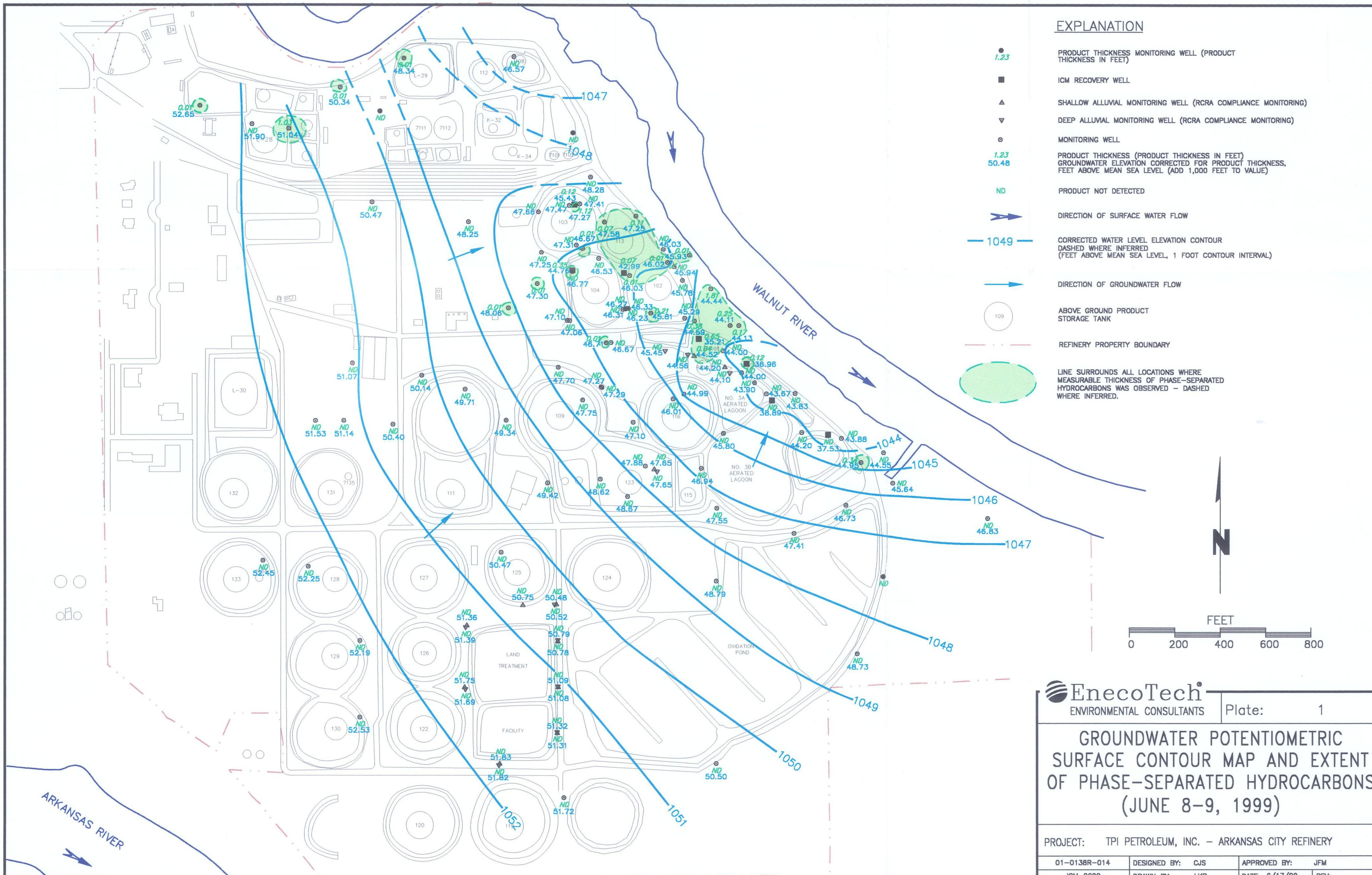
LOCATION (Plant Coordinates)

NORTHING −1169.513(ft.)
EASTING 2699.092(ft.)

ELEVATIONS IN FEET ABOVE MEAN SEA LEVEL (AMSL)

NOTE: PVC CASING CONNECTIONS ARE THREADED AND FLUSH JOINTED

PLATES



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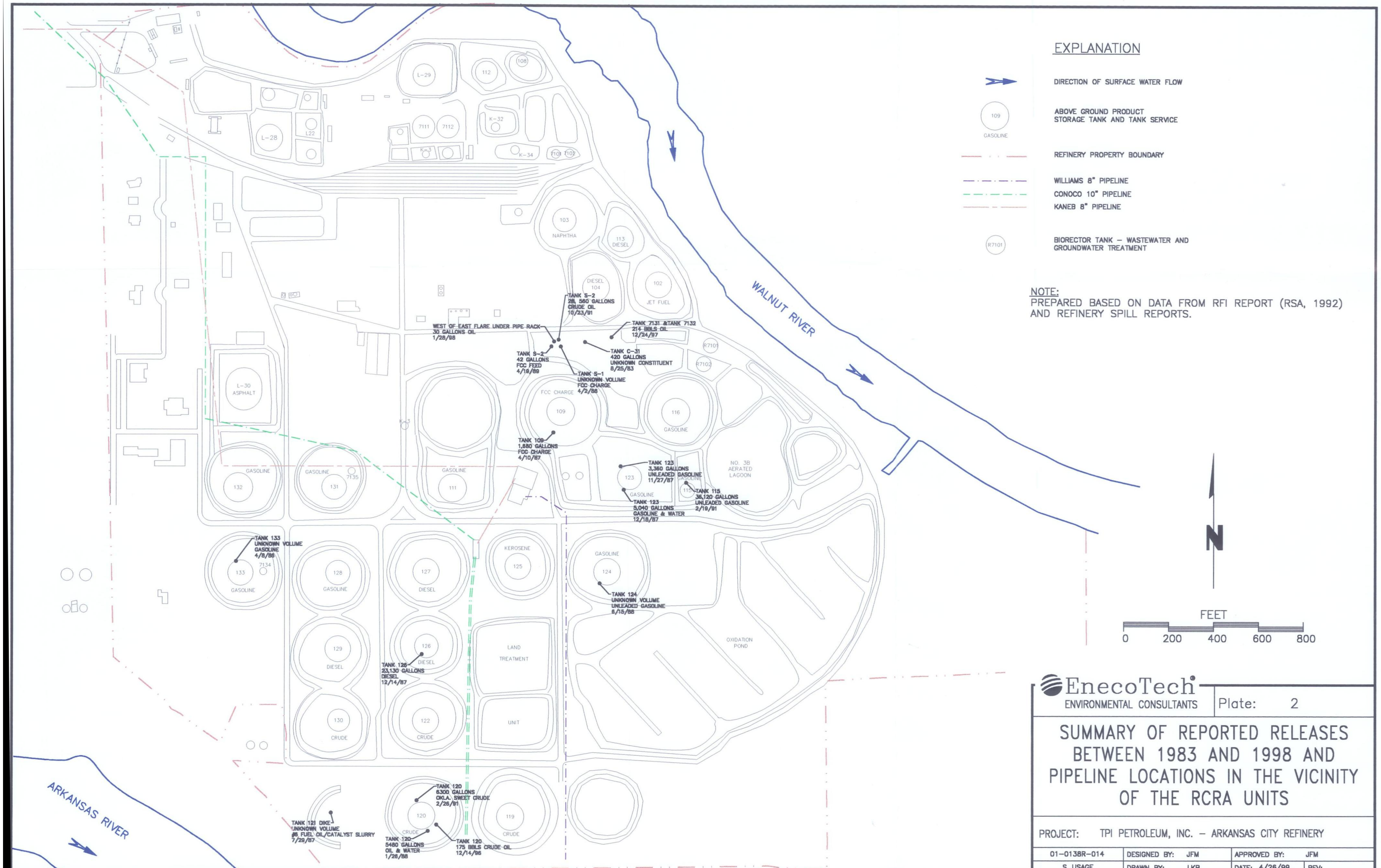
ENVIRONMENTAL CONSULTANTS

Plate: 1

GROUNDWATER POTENTIOMETRIC SURFACE CONTOUR MAP AND EXTENT OF PHASE-SEPARATED HYDROCARBONS (JUNE 8-9, 1999)

PROJECT: TPI PETROLEUM, INC. - ARKANSAS CITY REFINERY

01-0138R-014	DESIGNED BY: CJS	APPROVED BY: JFM	
ICM_0699	DRAWN BY: LKB	DATE: 6/17/99	REV:



EnecoTech
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Plate: 2

SUMMARY OF REPORTED RELEASES BETWEEN 1983 AND 1998 AND PIPELINE LOCATIONS IN THE VICINITY OF THE RCRA UNITS

PROJECT: TPI PETROLEUM, INC. – ARKANSAS CITY REFINERY

01-0138R-014	DESIGNED BY: JFM	APPROVED BY: JFM
S_USAGE	DRAWN BY: LKB	DATE: 4/26/99 REV:

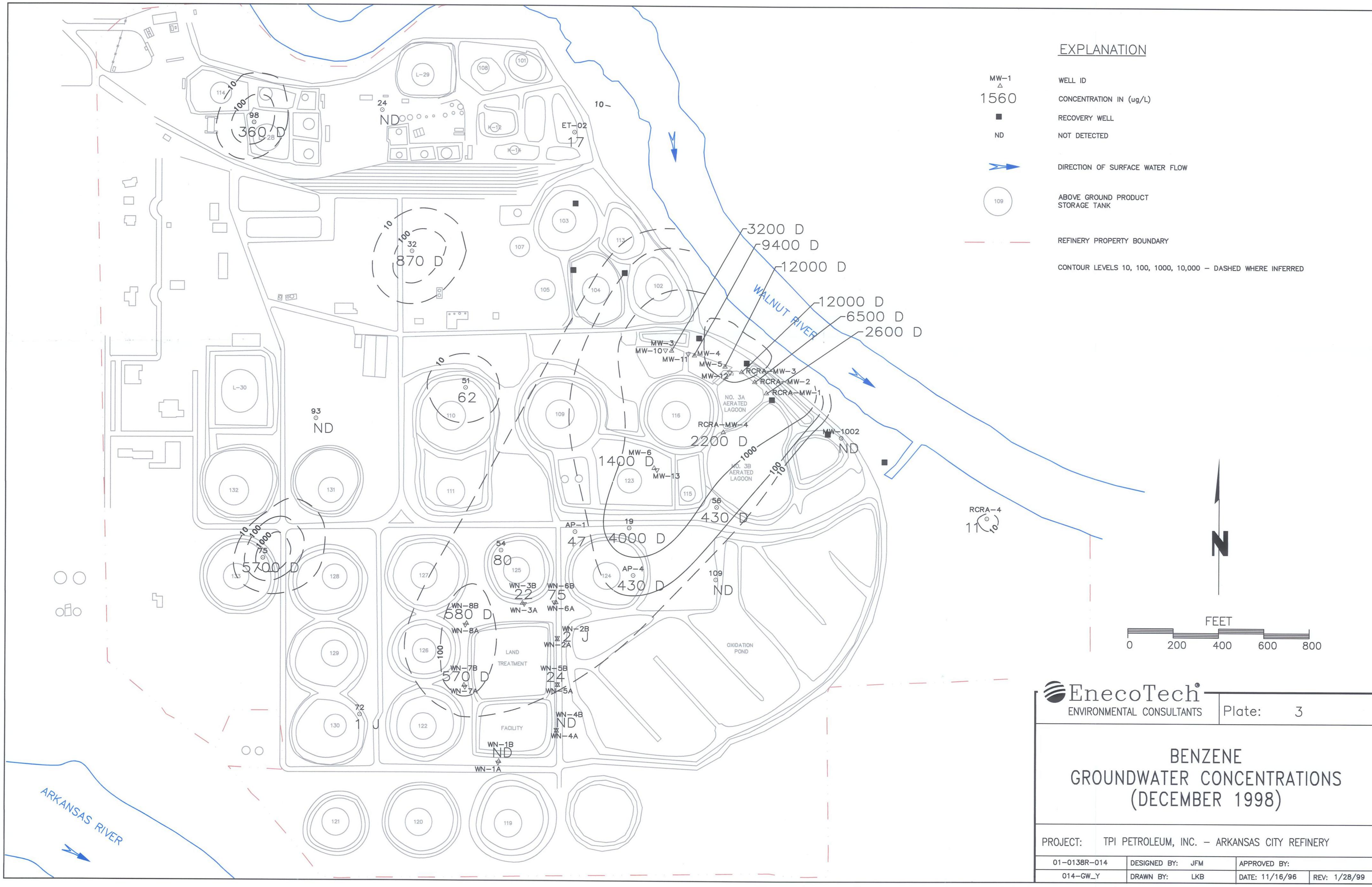

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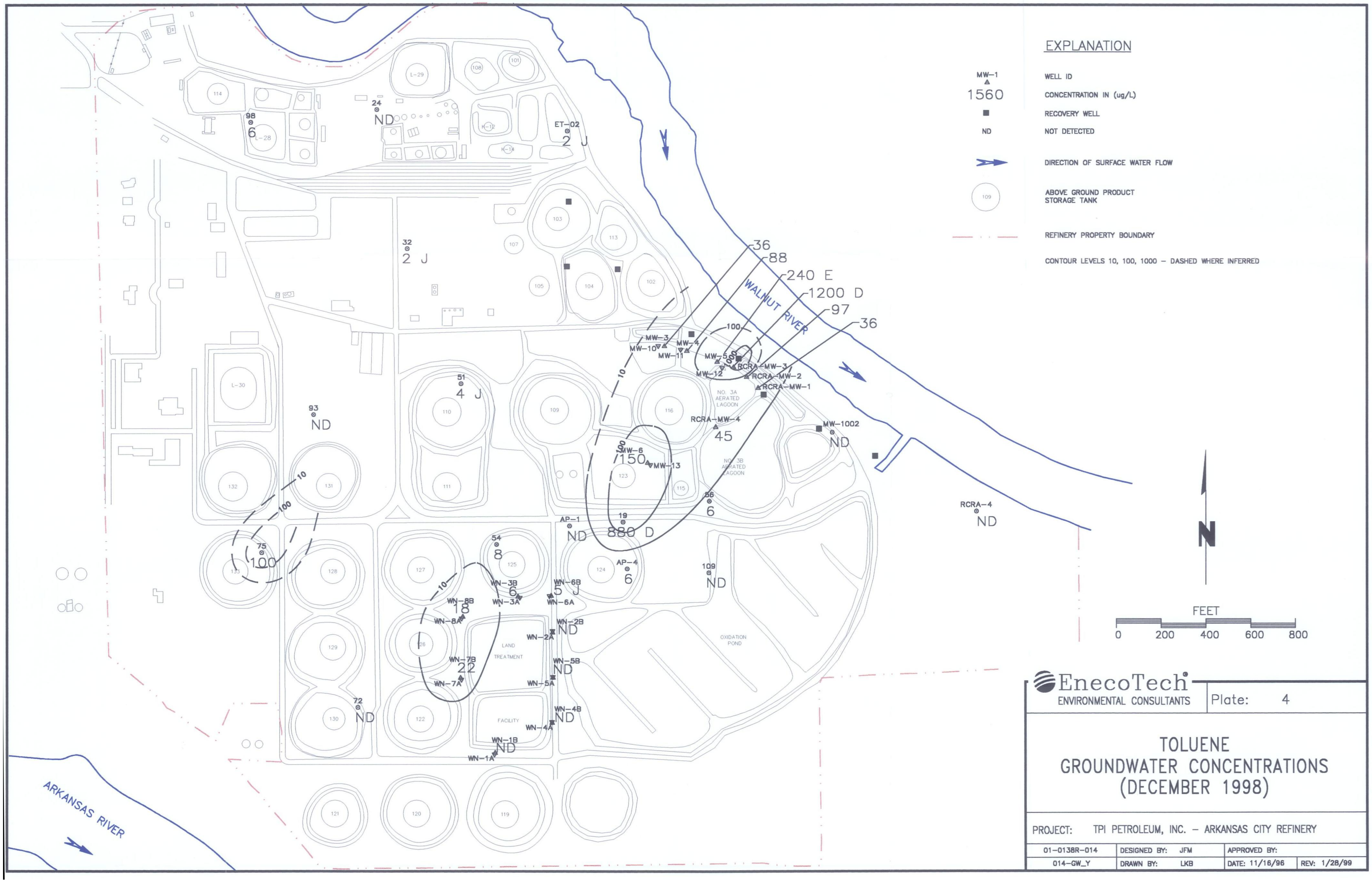
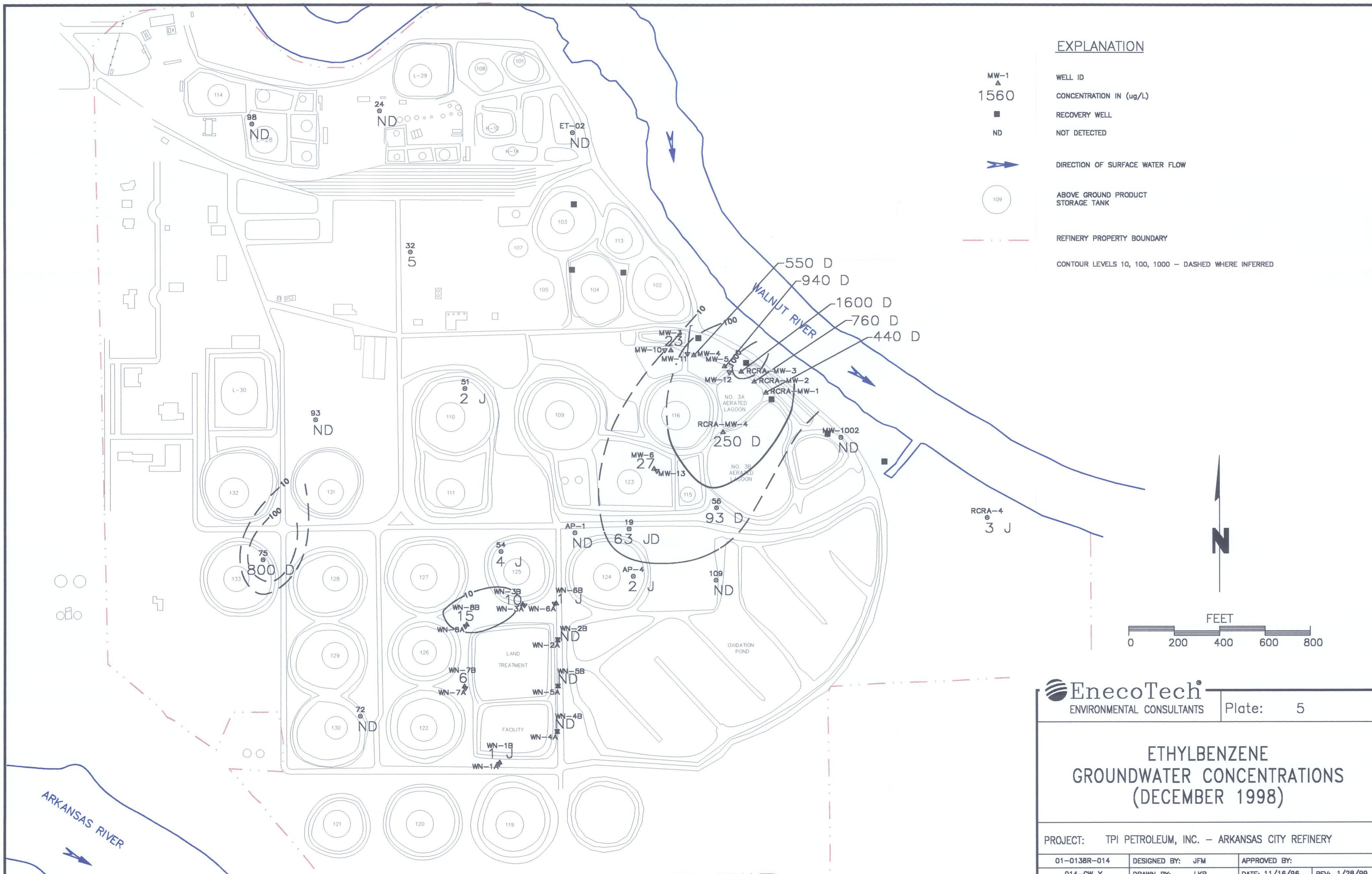
Plate: 3

BENZENE GROUNDWATER CONCENTRATIONS (DECEMBER 1998)

PROJECT: TPI PETROLEUM, INC. – ARKANSAS CITY REFINERY

01-0138R-014	DESIGNED BY: JFM	APPROVED BY:
014-GW_Y	DRAWN BY: LKB	DATE: 11/16/96 REV: 1/28/99


EXPLANATION
MW-1
1560
WELL ID
CONCENTRATION IN (ug/L)
RECOVERY WELL
ND
NOT DETECTED
DIRECTION OF SURFACE WATER FLOW
ABOVE GROUND PRODUCT STORAGE TANK
REFINERY PROPERTY BOUNDARY
CONTOUR LEVELS 10, 100, 1000 – DASHED WHERE INFERRED
WALNUT RIVER
ARKANSAS RIVER
NO. 3A AERATED LAGOON
NO. 3B AERATED LAGOON
OXIDATION POND
LAND TREATMENT FACILITY
MW-3
MW-4
MW-10
MW-11
MW-5
MW-12
RCRA-MW-3
RCRA-MW-2
RCRA-MW-1
RCRA-MW-4
45
MW-1002
ND
MW-6
150
MW-13
RCRA-4
ND
36
88
240 E
1200 D
97
36
ET-02
2 J
24
ND
98
6
32
2 J
51
4 J
93
ND
75
100
54
8
AP-1
ND
19
880 D
56
6
AP-4
6
109
ND
WN-3B
6
WN-3A
WN-6B
5 J
WN-6A
WN-8B
18
WN-8A
WN-2B
ND
WN-2A
WN-7B
22
WN-7A
WN-5B
ND
WN-5A
72
ND
WN-4B
ND
WN-4A
WN-1B
ND
WN-1A
N
FEET
0 200 400 600 800
EnecoTech
ENVIRONMENTAL CONSULTANTS
Plate: 4
TOLUENE
GROUNDWATER CONCENTRATIONS
(DECEMBER 1998)
PROJECT: TPI PETROLEUM, INC. – ARKANSAS CITY REFINERY
01-0138R-014
014-GW_Y
DESIGNED BY: JFM
DRAWN BY: LKB
APPROVED BY:
DATE: 11/16/96
REV: 1/28/99



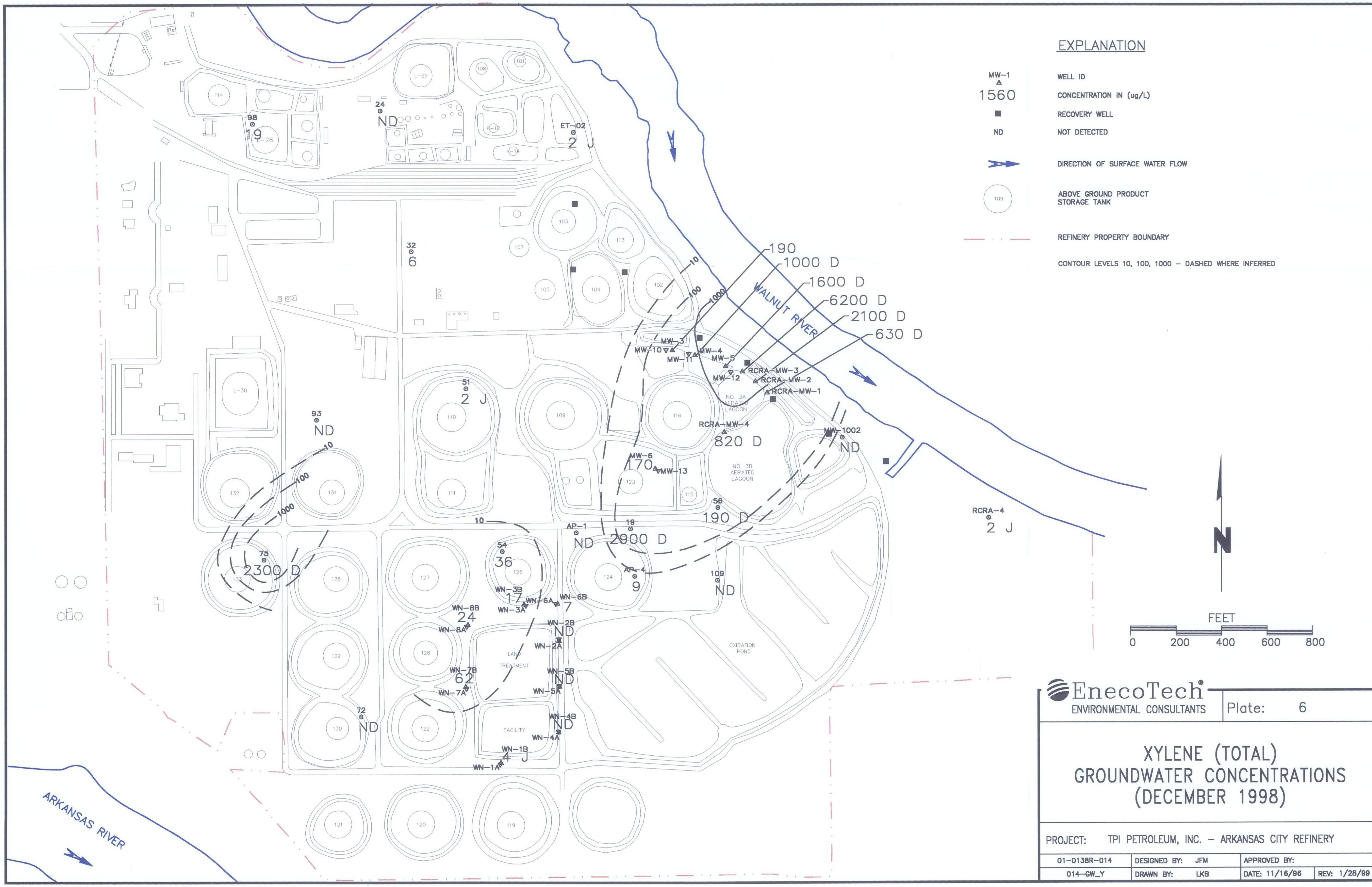
EnecoTech
ENVIRONMENTAL CONSULTANTS

Plate: 5

ETHYLBENZENE GROUNDWATER CONCENTRATIONS (DECEMBER 1998)

PROJECT: TPI PETROLEUM, INC. – ARKANSAS CITY REFINERY

01-0138R-014	DESIGNED BY: JFM	APPROVED BY:	
014-GW_Y	DRAWN BY: LKB	DATE: 11/16/96	REV: 1/28/99



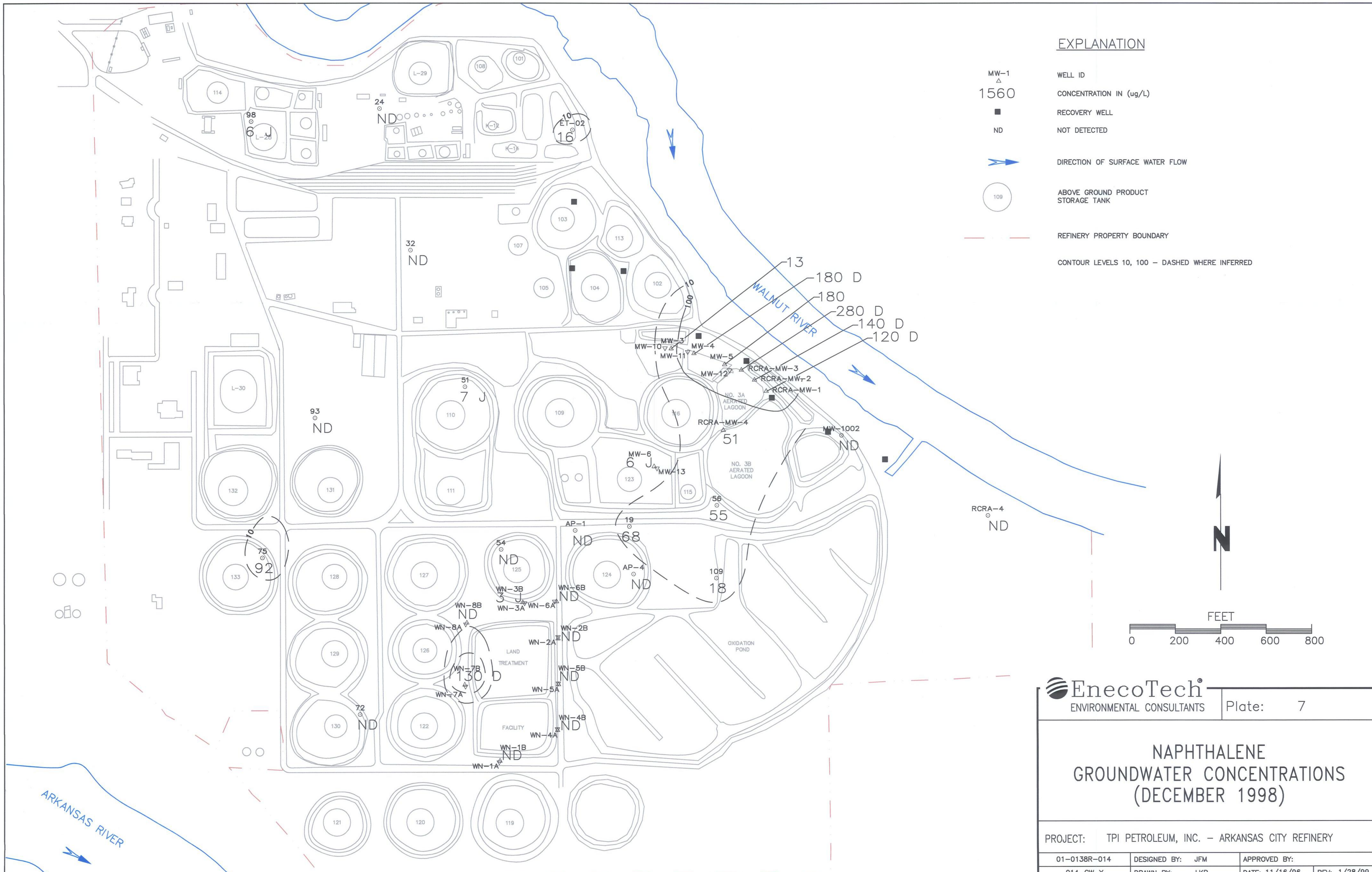
EnecoTech
ENVIRONMENTAL CONSULTANTS

Plate: 6

XYLENE (TOTAL) GROUNDWATER CONCENTRATIONS (DECEMBER 1998)

PROJECT: TPI PETROLEUM, INC. – ARKANSAS CITY REFINERY

01-0138R-014	DESIGNED BY: JFM	APPROVED BY:	
014-GW_Y	DRAWN BY: LKB	DATE: 11/16/96	REV: 1/28/99



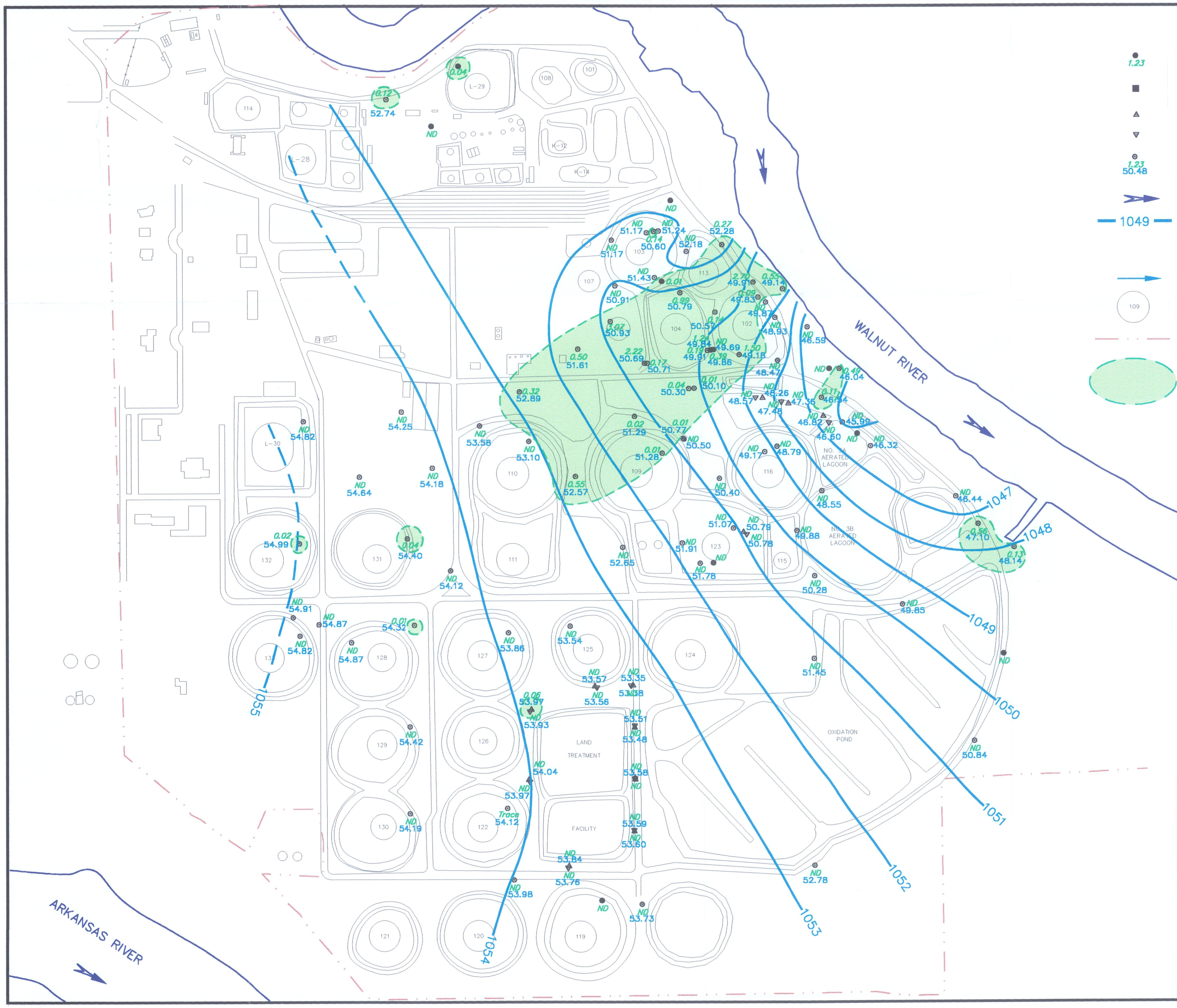
EnecoTech® ENVIRONMENTAL CONSULTANTS

Plate: 7

NAPHTHALENE GROUNDWATER CONCENTRATIONS (DECEMBER 1998)

PROJECT: TPI PETROLEUM, INC. – ARKANSAS CITY REFINERY

01-0138R-014	DESIGNED BY: JFM	APPROVED BY:
014-GW_Y	DRAWN BY: LKB	DATE: 11/16/96 REV: 1/28/99



EXPLANATION

Symbol	Description
1.23	PRODUCT THICKNESS MONITORING WELL (PRODUCT THICKNESS IN FEET)
■	ICM RECOVERY WELL
▲	SHALLOW ALLUVIAL MONITORING WELL (RCRA COMPLIANCE MONITORING)
▼	DEEP ALLUVIAL MONITORING WELL (RCRA COMPLIANCE MONITORING)
1.23 / 50.48	MONITORING WELL PRODUCT THICKNESS (PRODUCT THICKNESS IN FEET) (ND – PRODUCT NOT DETECTED) GROUNDWATER ELEVATION, FEET ABOVE MEAN SEA LEVEL (ADD 1,000 FEET TO VALUE)
➤➤	DIRECTION OF SURFACE WATER FLOW
— 1049 —	CORRECTED WATER LEVEL ELEVATION CONTOUR DASHED WHERE INFERRED (FEET ABOVE MEAN SEA LEVEL, 1 FOOT CONTOUR INTERVAL)
→	DIRECTION OF GROUNDWATER FLOW
109	ABOVE GROUND PRODUCT STORAGE TANK
– · –	REFINERY PROPERTY BOUNDARY
(green shaded area)	LINE SURROUNDS ALL LOCATIONS WHERE MEASURABLE THICKNESS OF PHASE-SEPARATED HYDROCARBONS WAS OBSERVED – DASHED WHERE INFERRED.

N

FEET
0 200 400 600 800

EnecoTech
ENVIRONMENTAL CONSULTANTS

Plate: 8

GROUNDWATER POTENTIOMETRIC SURFACE CONTOUR MAP AND EXTENT OF PHASE-SEPARATED HYDROCARBONS (DECEMBER 3-4, 1998)

PROJECT: TPI PETROLEUM, INC. – ARKANSAS CITY REFINERY

01-0138R-014	DESIGNED BY: JFM	APPROVED BY:	
ACBM1298	DRAWN BY: LKB	DATE: 11/16/96	REV: 9/09/98

ADDENDUM 1

ENGINEERING FEASIBILITY PLAN

MRP Properties Company, LLC

ARKANSAS CITY, KANSAS

U.S. EPA ID No.: KSD087418695

Prepared for:

MRP Properties Company, LLC
San Antonio, Texas

Prepared by:

EnecoTech Inc.
Denver, Colorado

Revision: 1, August 3, 2000
Revision: 2, October 20, 2000
Revision: 3, March 19, 2001
Revision: 4, April 23, 2002
Revision: 5, December 20, 2002
Revision: 6, January 25, 2010 (MWH)

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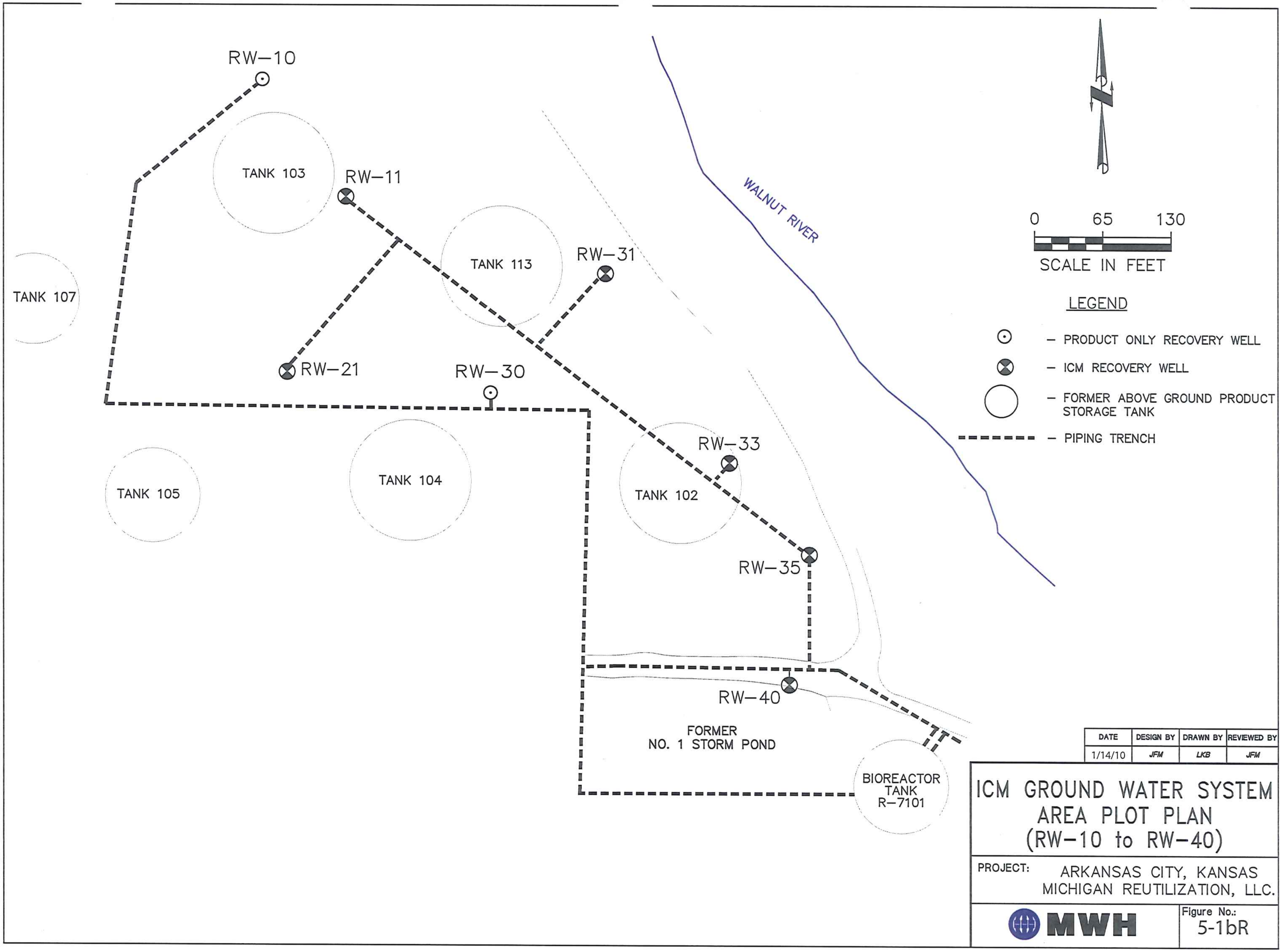
ADDENDUM 1

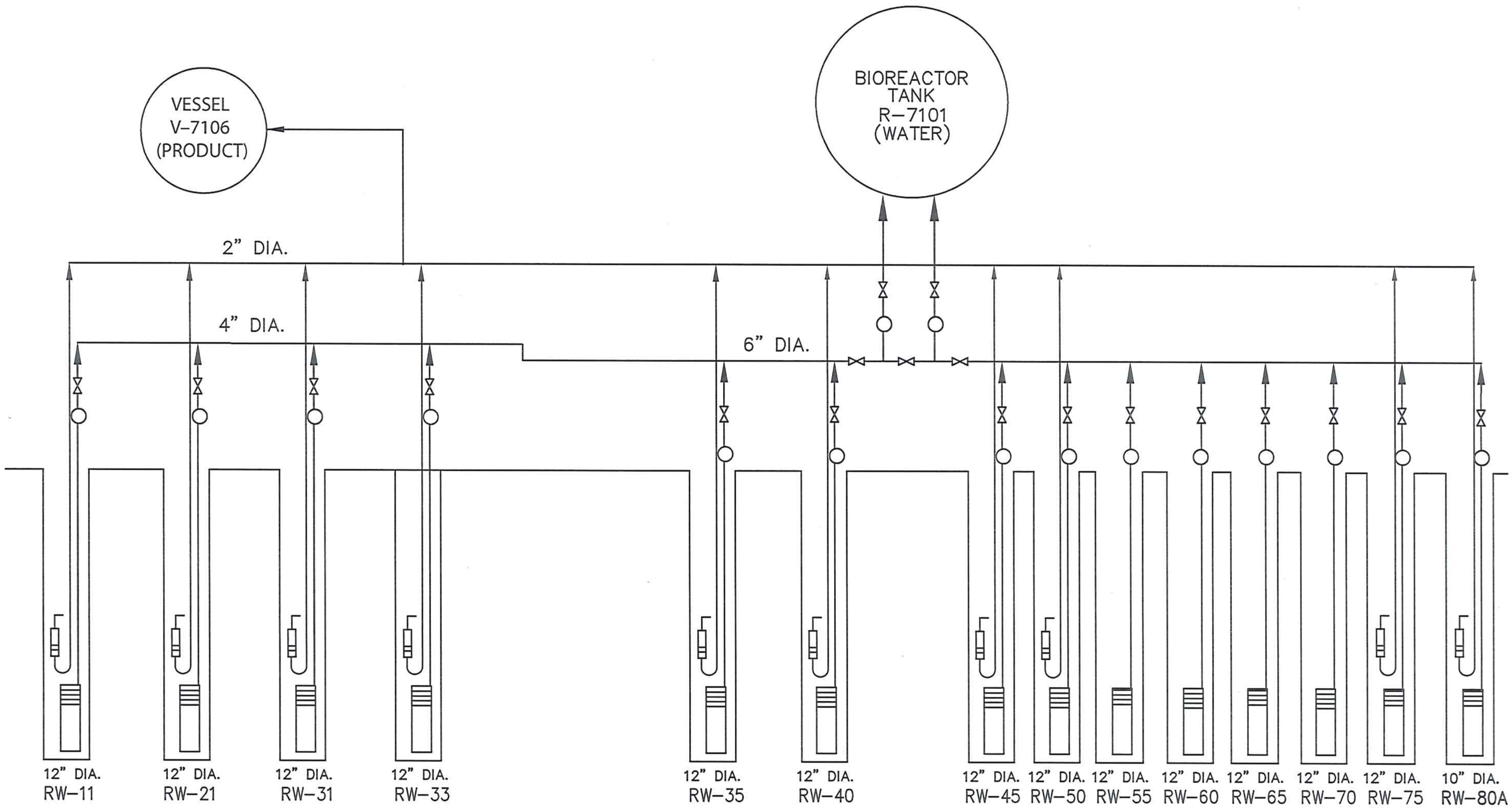
Class 1A Permit Modification

for the Replacement of Recovered Product Temporary Storage Tank 7132 with Vessel V-7106



PROJECT NUMBER: 1005197

AutoCAD FILE: Fig 5-1b REV



EXPLANATION

⋈ FLOW VALVE

○ FLOW METER

PRODUCT PUMP

ELECTRIC SUBMERSIBLE PUMP

DATE	DESIGN BY	DRAWN BY	REVIEWED BY
12/09	JFM	LKB	JFM

GROUNDWATER RECOVERY PROCESS FLOW DIAGRAM

PROJECT: ARKANSAS CITY, KANSAS
MRP PROPERTIES COMPANY, LLC

MWH

Figure No.: 5-8R

AutoCAD FILE: efpfig 5-8 PROJECT NUMBER: 1005197

ADDENDUM 2

ENGINEERING FEASIBILITY PLAN

MRP Properties Company, LLC

ARKANSAS CITY, KANSAS

U.S. EPA ID No.: KSD087418695

Prepared for:

MRP Properties Company, LLC
Arkansas City, Kansas

Prepared by:

EnecoTech Inc.
Denver, Colorado

Revision: 1, August 3, 2000
Revision: 2, October 20, 2000
Revision: 3, March 19, 2001
Revision: 4, April 23, 2002
Revision: 5, December 20, 2002
Revision: 6, January 25, 2010 (Addendum 1, MWH)
Revision: 7, August 29, 2011 (Addendum 2, MWH)

ENGINEERING FEASIBILITY PLAN

ADDENDUM 2

- Removal of Tanks TK-7111 and TK-7112;
- Removal of Recovery Well RW-80A from Groundwater Corrective Action; and
- Shut-Down of LTU Groundwater Corrective Action System.

A2.1.0 INTRODUCTION

This addendum describes three minor modifications to the current approved version of the Engineering Feasibility Plan (i.e., Version 6, approved by the KDHE on April 23, 2010).

1. Removal of the Emergency Containment Tanks (TK-7111 and TK-7112);
2. Removal of Recovery Well RW-80A from Groundwater Corrective Action; and
3. Shut-Down of LTU Groundwater Corrective Action System

Each plan modification is detailed below along with its justification. Modified figures are incorporated directly into this Addendum 2. These figures are numbered as before but with a prefix of "A2" to differentiate them from previous versions.

A2.1.1 Removal of Emergency Containment Tanks (TK-7111 and TK-7112)

Upon receiving KDHE approval, MRP will remove Tanks TK-7111 and TK-7112 from their previous service designation as emergency groundwater storage tanks (see Section 5.1.4.) These two tanks were included in the original EFP as a contingency in the event the Bioreactor system required maintenance or the pump in the Shell Trap malfunctioned. The capacity of these tanks is 818,160 gallons each. The combined capacity is 1,636,320 gallons. In its original configuration, the recovered groundwater was pumped to tank 7131, then pumped to the lift station adjacent to the two emergency containment tanks on the north side of the site. Subsequent modifications to the system provided for groundwater to be pumped directly to the bioreactor tank, bypassing tank 7131 and the lift station simplifying the operation and maintenance of the treatment system.

Since the groundwater corrective action was implemented under the 2001 hazardous waste management facility permit, several significant improvements were made to the water treatment system that essentially rendered the emergency containment tanks redundant. First, and most significantly, the effluent from the bioreactor tank was piped directed to the 1A pond, bypassing the 3B pond and the Shell Trap and the associated pumping system to the 1A pond. The 3B pond was subsequently drained providing 8.2 million gallons storage capacity, approximately five times the storage provided in the two emergency containment tanks. Removing the Shell Trap from the process eliminated the only pumping component downstream of the recovery wells. The other major improvement to the treatment system was the addition of a second blower to the bioreactor tanks. This second blower provides redundancy should the other blower need to be shut down for maintenance. Figure A2:5-7 contains the water treatment process diagram.

The result of these modifications to the water treatment system configuration is a significantly more robust system than the original system with five fold increase in the emergency storage capacity and 100 percent redundancy in the bioreactor blowers. The second bioreactor tank in reserve continues to provide redundancy in the treatment system.

A2.1.2 Removal of Recovery Well RW-80A from Groundwater Corrective Action

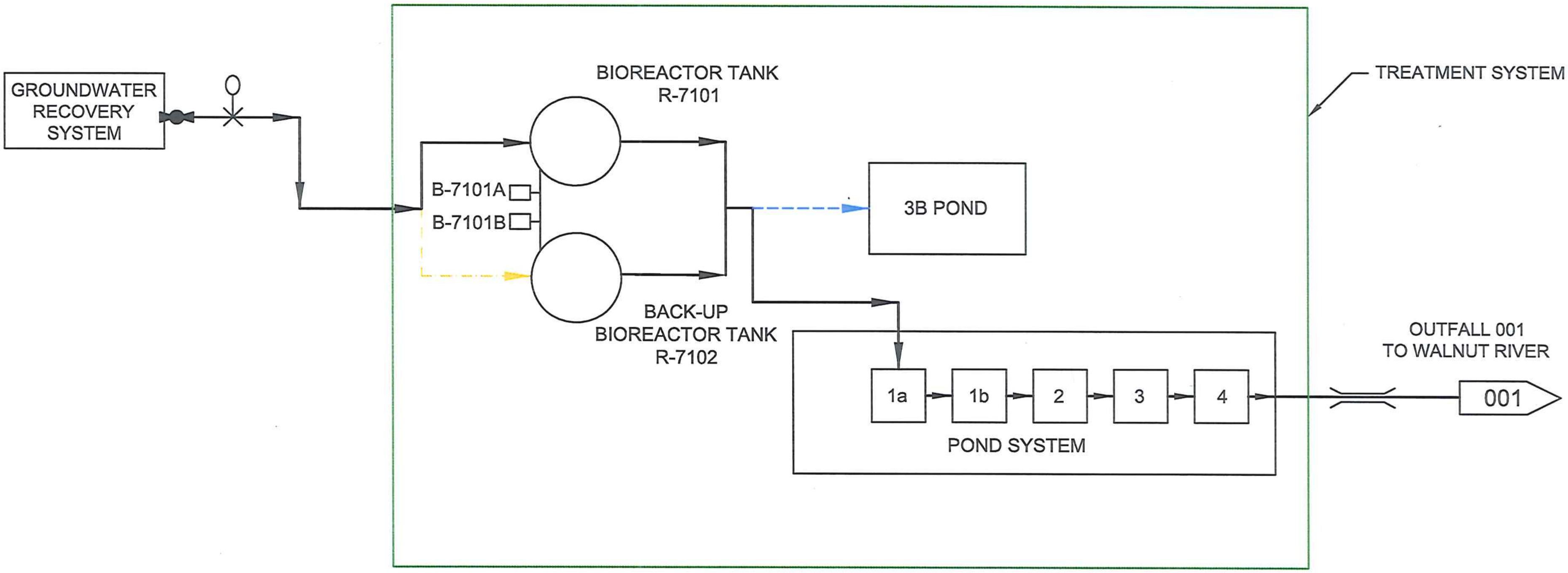
Upon approval from KDHE, MRP will remove recovery well RW-80A from the groundwater boundary containment system. Once removed from service, the well would be plugged and abandoned in accordance with KDHE requirements. This proposed change is based on two considerations. First, monitoring data indicating that RW-80A is not required for maintaining a reverse hydraulic gradient toward the Waste Management Area. In fact, due to its location, RW-80A locally produces a gradient toward the Walnut River. RW-80A's originally intended hydraulic capture function is currently achieved by the upgradient recovery well RW-75. Second, RW-80A is located on the river side of the levee and is periodically subjected both to inundation and collision with river debris. MRP would like to eliminate the risks associated with the groundwater corrective action system exposure to the river.

The shut down of recovery well RW-80A was field tested during a 180-day temporary authorization granted to MRP on November 4, 2008. RW-80A was shut down for a 180-day period between November 19, 2008 and May 18, 2009. The 180-day temporary authorization period spanned periods of low and high groundwater levels observed during the November to May period. During this time period, monthly capture zone monitoring indicated that the required 0.2-foot head difference was consistently achieved. MRP submitted the capture zone monitoring data to KDHE in correspondence dated June 8, 2009.

Figure A2:5-8R depicts the groundwater recovery system process flow diagram. Figures A2:6-1 and A2:6-2 shows the locations of the corrective action recovery wells and the capture zone monitoring well network.

A2.1.3 Shut-Down of LTU Groundwater Corrective Action System

MRP is proposing to cease operation of the LTU groundwater corrective action system. System monitoring data indicate that there are no additional corrective action benefits from continued operation of the system. In correspondence dated December 21, 2010 MRP requested a 180-day temporary authorization to discontinue system operation. The request was granted on January 4, 2011. Per the plan submitted with its request, MRP restarted the system on July 11, 2011 to make system observations and evaluate potential rebound in recovery of subsurface hydrocarbon impacts. MRP is submitting an evaluation of these data as a supplement to the current permit renewal application. Upon approval from KDHE, the LTU SVE-AS system will be shut down.



EXPLANATION

- PRIMARY FLOW ROUTE
- ALTERNATE FLOW ROUTE
- RESERVE OVERFLOW ROUTE
- PARSHALL FLUME / OUTFALL MONITORING POINT
- FLOW METER
- PUMP
- AIR BLOWER

DATE	DESIGN BY	DRAWN BY	REVIEWED BY
08/11	JFM	CCL	JFM

WATER TREATMENT PROCESS

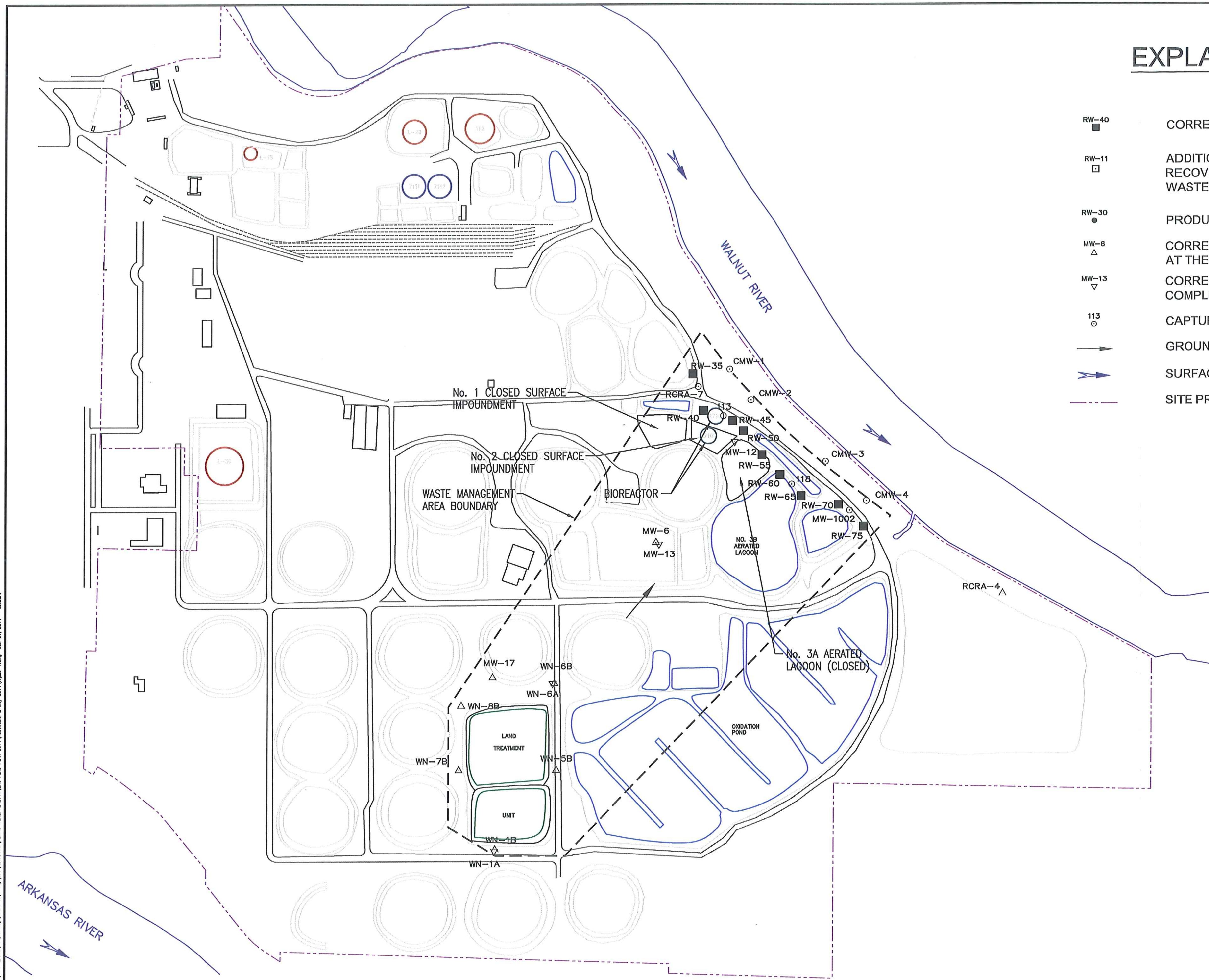
PROJECT:
MRP PROPERTIES COMPANY, LLC
ARKANSAS CITY, KANSAS

MWH

FIGURE
A2: 5-7

PROJECT NUMBER: 1010417

AutoCAD FILE: FIG_5-7_WATER TREATMENT PROCESS_REV 1.DWG



EXPLANATION

RW-40 ■	CORRECTIVE ACTION GROUNDWATER RECOVERY WELL
RW-11 ⊡	ADDITIONAL PRODUCT AND GROUNDWATER RECOVERY WELL LOCATED OUTSIDE THE WASTE MANAGEMENT AREA
RW-30 ●	PRODUCT RECOVERY WELL
MW-6 △	CORRECTIVE ACTION MONITORING WELL COMPLETED AT THE WATER TABLE
MW-13 ▽	CORRECTIVE ACTION MONITORING WELL COMPLETED AT THE LOWER PART OF THE AQUIFER
113 ⊙	CAPTURE ZONE MONITORING WELL
→	GROUNDWATER FLOW DIRECTION
➤➤	SURFACE WATER FLOW DIRECTION
-·-·-	SITE PROPERTY BOUNDARY

N W S E

SCALE IN FEET

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DATE	DESIGN BY	DRAWN BY	REVIEWED BY
05/11	JFM	CCL	JFM

TITLE

GROUNDWATER CORRECTIVE ACTION AND COMPLIANCE MONITORING WELL LOCATIONS

PROJECT

MRP PROPERTIES COMPANY, LLC
ARKANSAS CITY, KANSAS

MWH

FIGURE

A2: 6-1