Remediation Work Plan

Hannover Property /
Lot 2/B of the Former AM General/
LTV Missiles and Aerospace Facility
731 West Chippewa Avenue
South Bend, Indiana 46614

Prepared for:

Indiana Finance Authority – Indiana Brownfields Program &
Indiana Land Trust 731 GRN

Submitted by:

Quality Environmental Professionals, Inc.

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1.0 Introduction

Quality Environmental Professionals, Inc. (Qepi) is pleased to submit this Remediation Work Plan (RWP) report for the parcel commonly known as the Hannover Property, located at 731 West Chippewa Avenue in South Bend, Indiana. This RWP has been developed for the subject property, as well as the immediately adjacent properties to the north, west and northwest of the identified source area. This document has been prepared for the use of the property owner, Indiana Land Trust 731 GRN (ILT), the Indiana Brownfields Program (IBP) and the Indiana Department of Environmental Management (IDEM). A site location map is provided as Figure 1.

The source of impacts to soil and groundwater is believed to be historical usage of underground storage tanks (USTs) at the site prior to1989 when the USTs were removed from the site. Historic documentation has indicated that the site operated at least 37 USTs, beginning operation in the mid to late 1940's. These USTs have been identified as historically containing gasoline, diesel fuel, antifreeze, varnish, solvents, waste oils, transmission fluid, engine oil, and jet fuel.

IDEM Risk Integrated System of Closure (RISC) Industrial Default Cleanup Levels (IDCLs) are the most appropriate for on-site subsurface soil and groundwater impacts. Qepi has evaluated exposure pathways in the surrounding areas, and will consult with the IBP and IDEM after to implementation of remediation at the site to discuss amending the selected closure criteria with site specific closure goals.

Historic investigations at the subject site and immediately adjacent areas have documented total petroleum hydrocarbon (TPH) gasoline range organics (GRO) and extended range organics (ERO) impacts to soil and groundwater. Additionally, significant levels of light non-aqueous phase liquid (LNAPL) has been encountered in groundwater monitoring wells and piezometers at the subject property. Consultation with the IBP and IDEM has indicated that remediation of LNAPL should be the primary focus of remediation efforts.

Qepi performed three separate pilot tests at the site. A pump and treat pilot test was performed at the site in June 2009, a selective LNAPL recovery pilot test was performed in August 2009, and an MPE pilot test was performed in October 2009. Qepi also performed a product recovery test to estimate the volume of free phase product at the site. Procedures and results of these tests are included in Section 4.A.2.

Based on the technology analysis and the results of all three pilot tests, Qepi recommends that high-vacuum MPE supplemented with pump and treat be selected as the technology to remediate petroleum impacts at the site. Not only is MPE the most likely of the reviewed technologies to be successful in removing LNAPL, but it would have the added benefit of also treating impacts adsorbed to soil and dissolved impacts to groundwater. Historical groundwater and LNAPL level data indicate that increased product layers typically accompany lower groundwater levels. Supplementing the proposed MPE systems with pump and treat would slightly lower the groundwater elevation further and likely increase LNAPL recovery via the MPE systems. The proposed MPE systems are discussed in detail in Section 4.B.

System installation is anticipated to commence within 30 days of IDEM approval. Public and private utilities will be located prior to well installation or trenching. Remediation systems

typically take three to four months to construct. Upon completion, the remediation systems will be mobilized to the site and connected to the site extraction lines, flow lines, discharge lines, and electrical power. Qepi anticipates that the start-up process will take approximately one week to perform. Qepi personnel will be at the site on a daily basis during start up. Regular remediation system operation and maintenance will be performed by Qepi personnel twice per week thereafter.

It is anticipated that significant amounts of liquid-phase hydrocarbon (LPH) will be recovered using enhanced MPE at the site. Qepi anticipates that LPH recovery rates will be elevated upon start up, however the recovery rate will likely slow over time. If at any time the remediation systems stop recovering LPH, while it is still present in surrounding monitoring wells, a contingency plan may be used to help mobilize product toward the extraction wells. Injection of surfactant into the aquifer is likely the most effective method to mobilize LPH toward extraction wells. If deemed necessary, Qepi will install a series of injection wells at the site between extraction wells and inject a water-diluted surfactant solution into the aquifer. Surfactant is a substance that reduces surface tension in oil and water and helps LPH mobilize more readily. Another method that could be used to mobilize product in the groundwater is thermal treatment, however it is likely less cost effective.

If at any time it is deemed that the MPE system is ineffective, another treatment method will be used to address LPH impacts at the site. Alternative solutions include: permeable reactive barriers, oxygen injection, pump and treat, and selective LNAPL recovery. Qepi will consult with IBP personnel during system start-up activities and will provide regular updates to the IBP and IDEM on system progress. A Remediation Completion Report (RCR) will be submitted once the system has demonstrated that cleanup goals are achieved. A Remediation Work Plan Addendum will be submitted if additional on-site or off-site remediation becomes necessary.

1.A Project Identification

1.A.1 Facility Information

Name: ..... Hannover Property
Address: ..... 731 West Chippewa Avenue
South Bend, Indiana
IDEM Incident Number: ..... Not applicable
Brownfields ID Number: 4071121
Facility ID Number: ..... Not applicable
Telephone Number: ..... Not applicable

1.A.2 Present Owner/Operator

Site Owner: ..... Indiana Land Trust 731 GRN
Address: ..... 202 Lincolnway East

Suite 100
Mishawaka, Indiana 46544

1.A.3 Site Contact Person

Company:.....Indiana Land Trust 731 GRN
Contact:.....Mr. Joseph Grabill
Address:.....202 Lincolnway East
Suite 100
Mishawaka, Indiana 46544
Telephone No:..... (574) 532-6365

Company:..... Quality Environmental Professionals, Inc.
Contact:..... Mr. Nivas R. Vijay
Address:.....416 East Monroe Street
Suite 300
South Bend, Indiana 46601
Telephone No:..... (574) 234-1475

1.A.4 Historical Summary of Site Ownership and Operations

According to Quality Environmental Professional, Inc.'s *Phase I Environmental Site Assessment Report* dated October 30, 2007, the Hannover parcel was originally part of a 89-acre parcel developed by the Studebaker Corporation in 1941 for the manufacture of World War II-era B-17 Bomber jet engines and military off-terrain vehicles. The Hannover parcel was part of the original Studebaker plant, with the facilities on the site utilized for plant maintenance and utilities. The site was constructed to house the boilers, chillers and an electrical substation, as well as the water source for the plant.

After the completion of World War II, the property continued operation as a jet engine manufacturer and an automobile truck assembly plant. Beginning in the early 1950's, the facility operated primarily as a truck assembly plant for the Studebaker Corporation. The Studebaker Corporation merged operations with Packard and later with the Curtiss-Wright Corporation; however, the company continued operations under the Studebaker moniker. In 1964, the property was purchased by Kaiser Jeep Corporation, and continued operation as a military truck assembly plant.

The property continued operation as Kaiser Jeep until 1970, when the company began operations as American Motors General (AM General) Corporation. The property continued operation as AM General until 1989, when it was vacated. The site was vacant from 1989 until late 1991, when it was purchased by Realco South Bend. The property was redeveloped to house office spaces, warehousing and manufacturing operations. The site recommenced operation as AM

General in 1993, operating as a truck assembly and reconditioning facility. The property has operated as offices, warehousing and manufacturing from 1991 to present day.

In October 2001, the Hannover parcel was split from the original 89-acre parcel due to tax delinquency and obtained by Saint Joseph County. The site was acquired by Hannover, LLC in March 2002 and has operated as a vehicle maintenance and warehouse facility for Hannover, LLC from March 2002 to 2008, when it was acquired by Indiana Land Trust 731 GRN.

During its operations as the utility base for the manufacturing facility, the site operated at least 37 USTs, identified as historically containing gasoline, diesel fuel, antifreeze, varnish, solvents, waste oils, transmission fluid, engine oil and jet fuel. The northwest corner of the Hannover Property contained at least two large tank pits, housing at least thirty 15,000 to 25,000 gallon USTs containing petroleum products, primarily gasoline and jet fuel. These USTs were used to service operations within the former Studebaker Plant 2 building, located adjacent to the west (the current AM General building) and the former Studebaker Plant 8 building, located adjacent to the north (the current Green Tech Transfer and Recycling facility).

The Hannover property, as it is commonly referred to, is currently owned by Indiana Land Trust 731 GRN. The parcel historically served as the utility corridor for three neighboring parcels documented as having impacts to groundwater that have migrated from Hannover. The property to the east, commonly referred to as AM General, is owned by Indiana GRQ. The property to the northeast is a vacant parking area currently owned by AM General, Inc., and the property to the north, the former Studebaker Plant 8 facility, is currently the location of Green Tech Transfer and Recycling, owned by Mother Earth, LLC.

1.B Supporting Documents

1.B.1 Relevant Previous Reports, Documents and Data

Quality Environmental Professionals, Inc., *Phase I Environmental Site Assessment, Hannover Property / Lot2/B of Former AM General/LTV Missiles and Aerospace Facility*. October 30, 2007.

Quality Environmental Professionals, Inc., *Phase II Environmental Site Assessment, Hannover Property / Lot2/B of Former AM General/LTV Missiles and Aerospace Facility*. November 25, 2008.

Please note that the Phase I Environmental Site Assessment referenced above contains numerous documents relating to historic site investigations conducted at the subject property and the surrounding areas. Both the above referenced documents have been provided under separate cover to the IBP and IDEM and are not included as appendices to this RWP.

1.C Remedial Action Objectives

1.C.1 Remediation and Cleanup Objectives

IDEM RISC IDCLs have been chosen as closure goals for on-site impacts to subsurface soil and groundwater. As the site is currently located within a restricted use groundwater region in Saint Joseph County, no potable wells are located at the site. As such, IDEM site specific Non-Default Industrial Closure Levels (INDCLs) may be suitable, due to the lack of groundwater potable wells, the industrial use of the site, and the lack of exposure pathways, which is documented below.

IDEM RISC INDCLs have not been calculated for the site at this time. Qepi has consulted with the IBP and IDEM, and understands that the initial focus of remedial design should be to address the presence of LNAPLs in the groundwater. After the implementation of remediation at the site, Qepi will consult with the IBP and IDEM and will develop applicable closure goals based on the effectiveness of the selected remedial technology.

1.C.2 Work Items Planned

The selected remediation technology to be implemented at the site is high-vacuum multi-phase extraction (MPE) supplemented with pump and treat. The site has a plume consisting primarily of LNAPL and petroleum constituents originating from two former UST pit locations. The two potential source locations have been delineated through site investigation activities

To implement the MPE extraction and pump and treat system, Qepi will provide oversight for the installation of a network of 17 extraction wells across the site. Extraction wells are anticipated to be installed within 30 days of IDEM approval. Bid requests for system building and trenching along with bid requests for windmill pump construction will be sent out within 30 days of approval. Bid requests for trenching will include an additional bid request for the construction of an infiltration gallery. The site trenching and piping will be completed within 45 days of extraction well installation (weather permitting). Extraction wellhead completion will be performed during trenching activities. Public and private utilities will be located prior to well installation or trenching.

Remediation systems typically take three to four months to construct. Upon completion, the remediation systems will be mobilized to the site and connected to the site extraction lines, flow lines, discharge lines, and electrical power. Qepi anticipates that the start-up process will take approximately one week to perform. Qepi personnel will be at the site on a daily basis during start up. Regular remediation system operation and maintenance will be performed by Qepi personnel twice per week thereafter.

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System effluent air and influent, effluent, and mid-treatment samples will be collected on a monthly basis to determine system mass removal and confirm that system discharge meets regulatory standards. Specific sampling and monitoring schedule details are included in Section 4.C.1.

Qepi anticipates that the start-up process will take approximately one week to perform. Qepi personnel will be at the site on a daily basis during start up. Regular remediation system operation and maintenance will be performed by Qepi personnel twice per week thereafter. Qepi will consult with IBP personnel during system start-up activities and will provide regular updates to the IBP and IDEM on the systems.

At this time, no long term groundwater monitoring is planned for the site. Qepi will monitor groundwater drawdown in wells and free product levels on a monthly basis to document the effectiveness of the remedial system and will address groundwater monitoring after the initiation of remediation.

2.A Geographic Information

2.A.1 Political Geographic Data

The property is located on the United States Geological Survey (USGS) South Bend West Quadrangle topographic map in the SE ¼ of Section 23, Township 37 North, and Range 2 East. The geographic Universal transverse Mercator (UTM Zone 16 NAD 83) coordinates are 561928 Easting, 4610452 Northing. The latitude and longitude coordinates are 88° 15' 19.7" West, 41° 38' 31.1" North. A site location map is provided as Figure 1.

2.A.2 Physical Geographic Data

2.A.2.a Topography & Surface Water Flow

The site is relatively level, slightly sloping to the west. The topography of the site has an average elevation of 770 feet above mean sea level. Storm water from the facility grounds drains to storm water drains located throughout the properties. Regional surface water flow is likely west - northwest toward Bowman Creek. A site map showing an aerial view of the site and surrounding properties is included as Figure 2.

2.A.2.b Nearby Surface Waters, Wetlands & Drainage Ways

The nearest surface water body is Bowman Creek, located adjacent running northwest of the Hannover Property. Bowman Creek empties into a retention pond located approximately 1/8th mile north of the property. Bowman Creek eventually drains beyond this retention pond into the Saint Joseph River.

There were no indicators of wetlands observed at the site. Review of the 1990 United States Department of the Interior, Fish & Wildlife Service, National Wetlands Inventory Map did not identify designated wetlands on the site property. The nearest designated potential wetland is associated with Rum Village Park located approximately 0.50 miles west and southwest of the site. An area wetlands map is provided as Figure 3.

2.A.2.c Nearby Floodways & Flood Plains

Bowman Creek is located running adjacent to the site the northwest. Bowman Creek flows from the site north-northeast, eventually depositing into the Saint Joseph River, located approximately 2 miles from the site. According to the Indiana Geologic Survey (IGS) on-line GIS Atlas, the floodplain of the river is approximately 3 miles from the site.

2.B Geologic Information

2.B.1 Surficial & Unconsolidated Geology

The site is located in the St. Joseph River Basin (INDNR, 1987), and is characterized by alluvium, glacial outwash, and terraces. Surficial deposits are predominately sand and gravel. Most of the surficial material was deposited during the late Wisconsin Glaciation.

The predominant soil types in the project site area are Tyner-Oshtemo association soils consisting of deep, nearly level to strongly sloping, well drained and coarse textured and moderately coarse textured soils. These soils are developed on outwash plains and terraces (Benton, 1977). The Tyner series found at the site consists of deep, well-drained soils formed in sandy outwash. Permeability is rapid and it has a low available water capacity. Organic matter content is moderate in the surface layer. Runoff is slow or medium. Slope ranges from 0 to 6 percent (Benton, 1977). Unconsolidated deposits in the vicinity of the subject site are approximately 150 feet thick (Gray, 1983).

Based on field observations during the advancement of soil borings conducted at the site, the predominant soil consists of a 10YR 3/2 dark brown to 10YR 4/6 brown loamy sand to sandy fill material to depths ranging from the surface to 6 feet bgs. The fill material overlays 10YR 6/3 pale brown to 10YR 5/3 brown medium to coarse grained sand, which is present from approximately 6 feet bgs to 94 feet bgs. A 10YR 6/1 pale grayish brown clay layer is encountered at approximately 94 feet bgs. Geologic cross-section maps are provided as Figures 4A and 4B.

2.B.2 Bedrock Geology

According to the *Hydrogeologic Atlas of Aquifers in Indiana*, published by the USGS and the IDNR in 1994, the site is located in the Kankakee Outwash and Lacustrine Plain Physiographic Region. Underlying bedrock is the Devonian Ellsworth Group (Gray, Ault, and Keller, 1987). The lower part of the Ellsworth Group consists of alternating beds of gray-green shale and brownish-black shale. The upper part of the Ellsworth is grayish-green shale with light-greenish limestone or dolomite lenses. In some places, it contains a dark-gray, thinly laminated dolomite. (Shaver, et al, 1986).

2.B.3 Hydrogeology

2.B.3.a Regional Aquifer

The site is located in a regional aquifer consisting of buried sands and gravels, and interbedded shale and dolomite bedrock (USGS, 1994). The surficial aquifer consists of sands and gravels filling the Saint Joseph River valley. A review of the City of South Bend South municipal well field capacity logs indicates that the specific capacity of groundwater wells in the area of the subject site range from 46.8 to 80.7 gallons per minute. Municipal groundwater wells are installed at a depth ranging from 92 to 126 feet, and are generally installed above the first encountered clay aquitard unit, into medium to coarse grained sands and gravels.

Regional ground-water flow in the area of the site is to the north - northeast toward the natural discharge point, the Saint Joseph River (USGS, 1994). The ground-water flow in the thick sand

and gravel sequences is lateral flow that follows regional flow paths.

2.B.3.b Regional Depth to Groundwater & Seasonal Fluctuations

According to the *Hydrogeologic Atlas of Aquifers in Indiana*, the principal source of regional groundwater in this area is unconsolidated sand and gravel deposits, which average 80 - 100 feet in thickness. Based on historic groundwater sampling events, the average depth to water is approximately 16 feet bgs, and the seasonal groundwater fluctuation can vary from 2 feet to 8 feet.

2.C Ecological Information

2.C.1 Potentially Affected Species of Flora & Fauna

The site is located within an industrial complex south of downtown South Bend, Indiana. The majority of the area is covered with buildings or capped with asphalt and concrete, limiting ecological exposure to impacted soil and groundwater located on the site; however west and north of the site is a forested area housing a vehicle test track. This area has historically been operated by the owners of the subject property.

2.C.2 Potentially Affected Species of Endangered Flora & Fauna

Endangered, threatened, or rare species/areas have not been documented for the project area. The majority of the area is covered with buildings or capped with asphalt and concrete, limiting ecological exposure to impacted soil and groundwater located on the site.

2.C.3 Potential Effects on Vegetation & Wildlife Populations

The majority of the area is covered with buildings or capped with asphalt and concrete, limiting ecological exposure to impacted soil and groundwater located on the site. Wildlife has been documented in the forested areas west and north of the subjected site; however only limited wildlife has been documenting traversing the subject site. Care is taken to limit access of the industrial properties to wildlife and to keep wildlife restricted to the forested areas offsite.

2.D Site Investigation Activities

2.D.1 Potential Chemicals of Concern

The potential chemicals of concern (COCs) at the site have been identified as TPH (GRO), TPH (ERO), benzene, naphthalene and other petroleum hydrocarbon constituents, lead and cPAHs.

2.D.2 Sampling Rationale

The goals set forth for this phase of investigation activities at the site were to delineate the presence of free product in groundwater and to clearly identify the extent of the free product plume present. Historic site investigation activities documented the presence of free product and the concentrations of soil and groundwater impacts present at the site.

A total of 15 soil borings and 22 groundwater piezometers have been installed on the site and surrounding areas to delineate the LNAPL plume. Sets of nested pizeometers were initially installed in two areas where LNAPLs had historically been detected. The nested piezometers (PZ-1 through PZ-5 and PZ-6 through PZ-9) were installed with final depths separated by five foot increments and completed with 5-foot screens. These piezometers were installed as such to evaluate the zone where LNAPL product was initially encountered. After the gauging was completed of these nested piezometers, an additional 13 piezometers were installed along the perimeter of the suspected plume area and in a step out fashion to evaluate the horizontal extent of the free product plume. The locations of the piezometers and groundwater monitoring wells are shown on Figure 5.

2.D.3 Soil Sampling

Free product delineation and piezometer installation activities commenced on March 16, 2009. Earth Exploration, Inc. (EE) of South Bend, Indiana was contracted to advance soil borings B-100 and B-101 and install two series of nested piezometers. The nested piezometers were installed with the first set, PZ-1 through PZ-5, screened at incremented 5 foot depths to determine the vertical location of LNAPLs. PZ-1 was installed at a depth of 15.5 feet bgs, and each subsequent piezometer was installed 5 feet deeper, with PZ-5 installed to a depth of 35.5 feet bgs. Similarly, PZ-6 through PZ-9 were installed in a nested series, with PZ-6 installed to a depth of 18.5 feet bgs, and PZ-9 installed to a depth of 33.5 feet bgs. Each piezometer was installed with 5 foot of 1-inch PVC 0.010 slot screen, with 1-inch PVC solid riser to the top of the well. Each series of nested piezometers were installed within a 4 foot radius of one another. Soil boring B-100 was advanced to describe, screen and log soils correlating with the first nested series, and soil boring B-101 was advanced to correlate soils associated with the second piezometer set. Piezometers installed were advanced with a hollow stem auger, with soil samples collected via split-spoon technology.

From March 24 through March 31, 2009, EE was contracted to complete installation of 13 additional groundwater monitoring piezometers (PZ-10 through PZ-22). Piezometers were installed around the perimeter of the estimated LNAPL plume area, mapped during Phase II site investigation activities in November 2008. Additional piezometers were installed in a “step-out” or “step-in” fashion to delineate LNAPL presence or absence, if determined necessary by field screening. Prior to the installation of each piezometer, soil borings B-102 through B-114 were continuously logged. Soil samples were collected by split-spoon sampling through hollow-stem

augers. Soil boring and piezometer locations are depicted on Figure 5.

For each boring, subsurface soils were continuously logged in two-foot intervals and screened for volatile organic vapors using a pre-calibrated MSA photoionization detector (PID) equipped with a 10.2 eV lamp. In addition, the soils were inspected for evidence of impacts, such as staining or odors. The soil sample interval exhibiting the highest PID reading within the soil boring was submitted for laboratory analysis of TPH (GRO/ERO), volatile organic compounds (VOCs) and carcinogenic poly-aromatic hydrocarbons (cPAHs). Piezometer construction and soil boring logs are included in Appendix A. Geologic cross-sections are included as Figures 4A and 4B.

Soil samples collected were labeled and placed in a secured cooler (at four degrees Celsius) and submitted to ENVision Laboratories, Inc. (ENVision) for analysis of TPH (GRO/ERO) using United States Environmental Protection Agency (USEPA) SW-846 Method 8015, for VOCs using USEPA SW-846 Method 8260 and cPAHs using USEPA SW-846 Method 8270SIM.

2.D.4 Groundwater Sampling

Piezometers were installed throughout the subject site and the perimeter of the estimated LNAPL plume to further delineate the extent of the LNAPL plume and assist in the design of the remedial technology to be implemented at the site. Groundwater samples were not collected from any of the piezometers or groundwater monitoring wells at the site during this phase of the investigation.

2.D.5 Groundwater Elevation Calculation

Groundwater flow is believed to seasonally fluctuate at the site with the groundwater typically flowing to the northwest. From March 19 through July 31, 2009, Qepi conducted six separate groundwater gauging events of the 22 installed piezometers and numerous existing groundwater monitoring wells in the estimated area of impacts. Groundwater and LNAPL depths were gauged in each well utilizing a Solinst Oil/Water Interface meter. Groundwater and LNAPL gauging data is summarized in Table 1.

2.D.6 Soil Analytical Results

Impacts exceeding IDEM RISC IDCLs for TPH (GRO/ERO) were encountered in both B-100 and B-101. Furthermore, impacts of naphthalene were encountered exceeding IDEM RISC Residential Default Cleanup Levels (RDCLs).

Soil impacts have been delineated during the numerous phases of investigative activities conducted at the site and as such, only limited soil sampling was conducted during this phase of the investigation. The area of the LNAPL plume is impacted with TPH (GRO/ERO) and elevated naphthalene from approximately 18 feet bgs to approximately 34 feet bgs. This is based on

historic soil boring field screening and sampling results. Soil sample results from B-100 and B-101 are summarized on Tables 2 and 3. A copy of the laboratory analytical report is provided in Appendix B.

2.D.7 LNAPL Delineation Results

Based on the results of the LNAPL delineation, the plume of LNAPL extends from the Hannover Property, northwest onto the Indiana GRQ property and further northwest onto the former AM General parking lot, extending to Bowman Creek. The plume extends west into the landscaped former tank pit area located along the northern border of the Hannover Property, and south into the grassed secondary tank pit on the site. The plume additionally extends north and northeast into the Mother Earth, LLC property. A site map depicting the delineated LNAPL plume is included as Figure 6.

2.D.8 LNAPL Properties

In concert with the LNAPL delineation activities, Qepi collected one sample of LNAPL free product and submitted the sample to MicroBac Laboratories, Inc. for analysis of flammability, specific density and viscosity. Based on the results of the laboratory analytical, the specific density of the LNAPL was measured at 0.81 g/ml, the flammability/ignitibility of the material was measured at 120°F, and the viscosity was measured at 2.206 cST, with viscosity decreasing to 1.938 cST upon heating of the material to 90°F.

Based on these sampling results, the material's low viscosity makes it favorable to recover without the necessity to introduce additional implements to break down the LNAPL. The general flashpoint of the material is consistent with that of JP-2 and/or JP-6 jet fuel. A copy of the laboratory analytical report is provided in Appendix C.

2.D.9 Contaminants in Other Affected Media

No other impacted media (sediment, surface water, etc.) was encountered during site investigation activities.

2.E Preliminary Evaluation of Potentially Susceptible Areas

2.E.1 Drinking Water Sources & Wellhead Protection Areas

The site and surrounding area is provided water by the City of South Bend. A municipal well field, sporadically utilized by the City of South Bend, is located approximately ¾-mile southeast of the subject site. No water wells are located on the property. The nearest high capacity water well is located approximately 1 mile south of the site. The site is located within the Studebaker Commerce Center/Chippewa Administrative Control Area. This administrative control area was established by

the St. Joseph County Health Department in an area known or suspected to contain groundwater contamination. This area is subject to additional restrictions on use of groundwater.

Delineation activities have indicated that the plume of groundwater impacts is located within the boundaries of the subject sites, and does not migrate within ½-mile of the municipal well field. It does not appear the groundwater impacts on the property pose a threat to drinking water sources in the area, as the area is already within the designated administrative control area.

2.E.2 Geologically Susceptible Areas

According to the *Hydrogeologic Atlas of Aquifers in Indiana*, published by the USGS and the IDNR in 1994, the site is located in the Kankakee Outwash and Lacustrine Plain Physiographic Region. The site is located in the St. Joseph River Basin (INDNR, 1987). The area is characterized by alluvium, glacial outwash, and terraces. Surficial deposits are predominately sand and gravel. Most of the surficial material was deposited during the late Wisconsin Glaciation. The bedrock consists of shale and dolomite of the Devonian Ellsworth Group. There are no geologically susceptible areas in the vicinity of the site.

2.E.3 Socially Susceptible Areas

The site is located in an industrial complex south of downtown South Bend, Indiana. The delineated plume area is located entirely within the confines of the industrial corridor, bounded by Bowman Creek to the northwest, and the industrial grounds in all other directions. No residential developments are located in the vicinity of the impacted areas. An overview of the immediately surrounding areas is depicted on Figure 2.

2.E.4 Ecologically Susceptible Areas

There were no indicators of wetlands observed at the site. Review of the 1990 United States Department of the Interior, Fish & Wildlife Service, National Wetlands Inventory Map did not identify designated wetlands on the site property. The nearest wetlands were depicted approximately one-half mile north and northeast of the subject site, associated with Rum Village Park.

2.F Preliminary Evaluation of Possible Chemicals of Concern

2.F.1 Chemicals of Concern

The COCs at the site have been identified as TPH (GRO), TPH (ERO), benzene and naphthalene.

2.F.2 Suspected Chemicals of Concern based on Operational History

Based on the operation the COCs at the site have been identified as TPH (GRO), TPH (ERO),

benzene, naphthalene and other petroleum hydrocarbon constituents, lead, and cPAHs.

2.F.3 Description of Hazard Categories Present

Of the various chemicals in gasoline, naphthalene appears to have the greatest potential for adverse effects to human health and the environment because it is classified as a Class A carcinogen. Naphthalene is classified by the USEPA as a Class A carcinogen. This indicates that sufficient evidence exists from epidemiological studies to support a causal association between exposure and cancer. Site activities will be performed according to the Health and Safety Plan attached as Appendix D.

2.G Evaluation of Potential Contaminant Transport Mechanisms

2.G.1 Surface Water Runoff

A majority of the site is covered with asphalt or concrete. Some portions of the site are capped with grass or limited landscaping. Storm water surface drains are present on the Green Tech, GRQ and Hannover Property. Surface water flows into these drains, infiltrates into the soil in the grassed areas, or flows offsite into Bowman Creek.

2.G.2 Groundwater Flow

Regional groundwater flow in the vicinity of the site is north-northeast towards to Saint Joseph River.

2.G.3 Transport Mechanisms to Groundwater

Historic subsurface investigations conducted at the site have documented soil samples with impacts exceeding IDEM RISC IDCLs for TPH. Soil sample locations combined with field vapor screening results indicate that soil impacts are present in the zone approximately 3 to 5 feet below the first encountered groundwater saturated zone (approximately 18 to 20 feet), and extend to a depth of 34 to 38 feet bgs. Based on these analytical results, field screening, and the historic locations of USTs operated at the site, it is likely that soil impacts at the site are co-related to groundwater impacts, and are directly associated with the presence of USTs installed below the first encountered groundwater saturated zone. It does not appear that a continual unsaturated soil source of impacts to groundwater exists at the site.

2.G.4 Other Transport Mechanisms

During site investigation activities, no other transport mechanisms were identified on the site.

2.H Preliminary Evaluation of Potential Human Exposure Pathways

2.H.1 Inhalation Exposure Pathway

The site is covered with either an asphalt or concrete cap in a majority of the surface area, with small areas of grassed or landscaped areas within the identified plume region. Soil borings advanced in the impacted area indicate approximately 4 to 6 inches of asphalt or concrete present. This cap, coupled with the average depth of free product (approximately 18 to 20 feet) makes it unlikely that a potential inhalation exposure pathway is present.

2.H.2 Ingestion Exposure Pathway

The site is located within the Studebaker Commerce Center/Chippewa Administrative Control Area. This administrative control area was established by the St. Joseph County Health Department in an area known or suspected to contain groundwater contamination. This area is subject to additional restrictions on use of groundwater. No groundwater potable wells are located on the site.

2.H.3 Dermal Absorption Exposure Pathway

Dermal contact of impacted soil and/or water can be from fugitive dust in the air and site leaching of the soil to water. Groundwater impacts are present at the site; however no water supply wells are located on site. Furthermore, the site is located within the Studebaker Commerce Center/Chippewa Administrative Control Area, subjecting the area to additional restrictions on use of groundwater.

The potential exposure to impacted soils or groundwater via direct contact or through fugitive dust generation poses limited risk due to the lack of impacted unsaturated soils and the depth of impacted groundwater.

2.I Preliminary Evaluation of Potential Ecological Exposure Pathways

2.I.1 Potential Impacts to Aquatic Life

Due to the limited exposure pathways identified, adverse impacts to aquatic life are not likely.

2.I.2 Potential Impacts to Wildlife & Vegetation

Due to the limited exposure pathways identified, exposure to wildlife and vegetation species in the area is not likely.

2.J Identification of Existing Data Gaps

2.J.1 Hydrogeologic Information

The investigative activities conducted in the spring and summer of 2009 were completed to further delineate the extent of the free product plume and to assist in the final design of remedial technology at the site. As of the date of publishing of this RWP, no additional investigative activities have been deemed necessary at the site. Qepi does not believe any data gaps exist; however Qepi will continue to consult with the IBP and IDEM about the necessity of additional data collection.

2.J.2 Ecologic Information

Not applicable.

2.K Conceptual Site Model

Based on field observations during the advancement of soil borings conducted at the site, the predominant soil consists of a 10YR 3/2 dark brown to 10YR 4/6 brown loamy sand to sandy fill material to depths ranging from the surface to 6 feet bgs. The fill material overlays 10YR 6/3 pale brown to 10YR 5/3 brown medium to coarse grained sand ranging from approximately 6 feet bgs to 94 feet bgs. A 10YR 6/1 pale grayish brown clay layer is encountered at approximately 94 feet bgs. Groundwater is generally encountered at 13 to 16 feet bgs, with impacted groundwater and LNAPL generally encountered at 18 to 20 feet bgs. The groundwater flow direction is to the north-northeast. The cross sections provided as Figures 4A and 4B further provide a conceptual site model for the site.

2.L Other Impacted Media

No other impacted media (sediment, surface water, etc.) was encountered during site investigation activities.

2.M Summary of Horizontal and Vertical Extent of Contamination

Petroleum impacts to soil are present in soil below the first encountered saturated zone, beginning at approximately 18 feet bgs and extending to a depth of 34 to 38 feet bgs. Impacts are delineated horizontally and are mainly present from depths of 18 to 28 feet extending north and northeast into the Mother Earth, LLC property, northwest to the Indiana GRQ property, the former AM General parking lot area up to Bowman Creek, and east and south into the grassed former tank pit areas on the Hannover parcel.

LNAPL delineation has indicated that LNAPLs are encountered vertically at approximately 18 feet to approximately 25 feet bgs. No evidence or soil analytical results suggest the possible presence of dense non-aqueous phase liquid (DNAPL) which could lead to impacts deeper than 38 feet.

3.0 Summary of Potential Risks

3.A Long & Short-Term Human, Ecological & Environmental Risks

Based on the site investigation activities, free product petroleum is present in the soil and groundwater that, if exposed to, can cause direct threat to human health and the environment.

3.B Potential Human, Ecological & Environmental Receptors

Site workers should maintain caution and limit contact with free product recovered at the site. Free product at the site is present at a depth below the water table, at approximately 18 to 20 feet bgs.

3.C Current & Future Land-Use Issues

The site is currently being utilized for industrial purposes. Future land usage is expected to be similar and is unlikely to pose a potential risk at the site.

3.D Vapor Intrusion

The estimated plume area identified during the course of investigative activities has been identified as encompassing the southwestern corner of the high-bay area of the Green Tech Transfer and Recycling property, as well as being underneath two abandoned pump house buildings located on the Hannover property, and potentially migrating under the footprint of the AM General building. These buildings were constructed over several inches of concrete, as evidenced by historic soil borings conducted within both the AM General and the high-bay of the Green Tech building. Four to six inches of asphalt cover the drives of the four facilities.

Potential vapor intrusion issues do not appear to be of concern in the study area. No investigation of vapor intrusion issues has been deemed necessary at this time.

Should redevelopment activities in the mapped plume area include construction of buildings with commercial or residential use, Qepi will consult with the redevelopment partner, the IBP and IDEM to ensure proper construction standards are utilized to mitigate potential vapor intrusion issues.

4.A Evaluation of Remedial Alternatives

4.A.1 Identification of Remedial Alternatives

Based on the identified impacted media, extent and magnitude of COCs and the cleanup goals, candidate remediation technologies were evaluated to address the LNAPL source at the site. While the goal of the remediation is to remove the LNAPL source, technologies to remediate soil and dissolved groundwater impacts at the site were also considered.

The estimated extent of the LNAPL plume is shown on Figure 6. The plume is estimated to cover approximately 3.98 acres in area. The following potential corrective action alternatives were considered to address petroleum impacts at the site:

- **Air Sparge/Soil Vapor Extraction (AS/SVE) –** Although AS/SVE would likely work for soil impacts and dissolved impacts to groundwater, this technology is not typically used to remediate a free product source. The permeable soil found at the site would be amenable to AS/SVE, however it would not remove the free-phase hydrocarbon directly. AS could also have the negative possibility of pushing the LNAPL plume offsite.

- **Pump and Treat** – If not for the large fluctuations in groundwater elevations at the site, pump and treat would likely be very effective in removing LNAPL impacts to the site. Pump and treat technology would consist of a series of "explosion proof" pneumatically or mechanically driven down well pumps set in newly installed pumping wells across the LNAPL plume area. Recovered fluids would be transferred via underground piping to an on-site treatment facility where they would be treated by a moisture separator, oil/water separator, sediment filters, air stripper, and activated carbon polish. Treated water would likely be discharged to nearby Bowman Creek under a General National Pollutant Discharge Elimination System (NPDES) permit. Recovered oil would be recycled. Pilot test results indicate that accelerated oil recovery may be possible if the water table is depressed by a method such as pump and treat. If groundwater elevations were stable at the site, down well pumps could be set at the most efficient depth for product recovery. However, frequent fluctuation of the water table would require frequent adjustment of the down-well pump depths to make product recovery effective. While pump and treat may be effective for dissolved groundwater impacts at the site, it would likely have a limited effect on LNAPL recovery, and little to no influence on soil impacts. Pump and treat was selected as one of the technologies to pilot test.

- **Slurry Wall/Funnel and Gate** – Installing a slurry wall at the site could prevent further migration of the LNAPL plume. However, the potentiometric groundwater gradient is relatively stagnant at the site as evidenced by the LNAPL plume being roughly in the same vicinity as the former UST pit thought to be the source of the release approximately sixty years ago. Installing a limited permeable reactive section in a slurry wall (funnel and gate) could force the trapped LNAPL and groundwater impacts into a trench filled with media that could passively remediate or remove impacts. However, due to the relatively stagnant hydraulic gradient at the site, the

time it would take for the majority of the LNAPL to pass through the "gate" could take decades or centuries. Trenching for a slurry wall may also not be feasible in some areas due to the presence of buildings or underground conduits. Furthermore, the size of a slurry wall or funnel and gate system needed for the LNAPL plume area at the site would not likely be cost effective. Neither a slurry wall nor a funnel and gate system would treat impacts to soil at the site.

- **Monitored Natural Attenuation (MNA)** – Due to the presence of LNAPL at the site, MNA is not likely to reduce groundwater impacts to closure goals within any reasonable timeframe.

- **Selective LNAPL Recovery** – Selective LNAPL recovery would utilize a series of recovery wells similar to a pump and treat system. However, pneumatic down-well pumps would be fitted with a basin containing a hydrophobic membrane allowing only LNAPL to collect in the pump basin. The collected product would then be transferred to an on-site tank for storage and later recycled. Pumps would have to be installed within approximately one and a half feet of the hydraulic water level in each well to be effective, however the pump depths would be adjustable. Regardless, frequent groundwater level fluctuations would reduce the effectiveness of the technology. Selective LNAPL recovery would not address impacts to dissolved groundwater or soil. Selective LNAPL recovery was selected as one of the technologies to pilot test.

- **In-situ Oxygen Injection** – In-situ oxygen injection would consist of the addition of oxygen to the aquifer through either an oxygen-enriched air injection system or batch injections of an oxygen-releasing media such as ORC®. Although oxygen injection would likely work for dissolved impacts to groundwater, this technology is not typically used to remediate a free product source. The permeable soil found at the site would be amenable to in-situ oxygen injection, however it would not remove the free-phase hydrocarbon directly. While not as likely as AS to have a negative influence, in-situ oxygen injection could also have the possibility of pushing the LNAPL plume offsite. In-situ oxygen injection would not likely treat impacts to soil at the site.

- **Multi-Phase Extraction (MPE)** – MPE would be similar to pump and treat in that a series of extraction wells would be installed across the site and recovered fluids would travel through underground piping to an on-site treatment facility. However, MPE would apply a high vacuum, approximately 15 to 20 inches of mercury (Hg), to each extraction well using a vacuum pump. Area of influence would be similar to the pump and treat system, however MPE would pull in fluids from the top of the water column, greatly enhancing LNAPL recovery. MPE would also enhance LNAPL recovery by slightly depressing the water table within the plume area to some extent. This could be enhanced further with the installation of a few pneumatically or mechanically driven pumping wells to further depress the groundwater table at the site. While significant vacuum influence would be expected in the permeable soil at the site, MPE would have the added benefit of removing soil vapors and therefore treating unsaturated and seasonally saturated soils at the site. An MPE system

would be slightly more expensive than a pump and treat system, however MPE would have a significantly higher potential for LNAPL recovery. MPE was therefore selected as one of the technologies to pilot test.

4.A.2 Pilot Testing

Qepi performed three separate pilot tests at the site. A pump and treat pilot test was performed at the site in June 2009, a selective LNAPL recovery pilot test was performed in August 2009, and an MPE pilot test was performed in October 2009. Qepi also performed a product recovery test to estimate the volume of free phase product at the site. Procedures and results of these tests are included below.

4.A.2.a Pump and Treat Pilot Test

In late May, 2009, Qepi personnel along with Blackhawk Technology Company (Blackhawk) installed a down-well piston pump in recovery well RW-1. The pump was pneumatically powered by an air compressor which was in turn powered by an electric generator. "Explosion proof" pneumatically powered down-well pumps are preferred over electrically powered pumps because electrical currents could ignite flammable liquids or vapors that come into contact with them. Qepi also explored the possibility of a wind-powered piston pump, which would be driven by a windmill located above the well. While the wind-powered pumps had several advantages, a pneumatically driven pump was used for the pilot test to minimize costs.

The piston pump moves up and down vertically in the well in the motion of a piston. The range of the movement is three feet, therefore, the pump was set at a depth so that the well's hydraulic surface was at the midpoint of the pump's motion. Therefore the pump shaft would only reach into the top 1.5 feet of the water table and would be placed to recover the maximum amount of LNAPL. The pump used had the ability to maintain a three gallons per minute (gpm) flow rate under optimal conditions. Positive displacement piston pump details are included in Appendix E.

The pilot test commenced on June 1, 2009 and ended on June 23, 2009. The piston pump was set at a recovery rate of approximately 0.5 to 0.33 gpm. A total of 10,150 gallons of fluids were recovered from RW-1 over the 22 days of the pilot test. It is estimated that approximately 240-260 gallons of the recovered fluids were LNAPL. Upon completion of the pilot test, recovered fluids were properly disposed of by a certified waste removal contractor.

While the test was successful to a large extent, it produced lower than expected LNAPL recovery. This is possibly due to significant fluctuations in groundwater levels across the site. If the groundwater level rises more than 1.5 feet, the pump may only be able to recover groundwater since it will not be pumping from the surface. If the groundwater level drops more than 1.5 feet, the pump will not recover any fluids. The inability to handle fluctuations in groundwater levels was found to be the largest deficiency of the pump and treat pilot test. The low flow rate used for the pilot test may have also hindered the ability of the pump to depress the

groundwater level, and therefore the pump was not able to access as much of the surrounding LNAPL plume.

After analyzing the inconclusive results of the pump and treat pilot test, Qepi proposed an additional pilot test which was approved by the IFA and IDEM.

4.A.2.b Selective LNAPL Recovery Pilot Test

On August 4, 2009, Qepi along with Xitech Instruments, Inc. (Xitech) installed a product recovery skimmer pump in recovery well RW-1. The skimmer pump apparatus used an approximately three foot long slotted sump surrounded by a hydrophobic membrane that only allows LNAPL to enter. A pneumatically powered pump located within the down well skimmer was set up to pump out the sump every half hour. Recovered fluids were transferred to a 55-gallon drum stored at the surface. The pump was pneumatically powered by a tank of nitrogen gas. The skimmer apparatus was placed approximately half-way into the hydraulic surface of the groundwater to maximize product recovery.

The pilot test was commenced on August 4, 2009 and ended approximately two weeks later. Less than ten gallons of fluids (mostly LNAPL) were recovered during the course of the pilot test. Possible reasons for limited LNAPL recovery include significant groundwater level fluctuations, a highly selective hydrophobic membrane, or lack of drawdown. Regardless of the reason, the application was not successful, and Qepi proposed a third pilot test which was approved by the IFA and IDEM.

4.A.2.c MPE Pilot Test

Prior to beginning the MPE pilot test, Qepi installed one extraction well (EW-1) and two observation wells (OW-1 and OW-2). EW-1 was installed to a depth of 28 feet and was constructed of 4”-diameter, Schedule 40 PVC piping with the bottom 10 feet consisting of 0.020” slotted screen. Observation wells OW-1 and OW-2 were installed approximately 5 and 40 feet from EW-1, respectively. Both observation wells were constructed of 2”-diameter, Schedule 40 PVC piping along with 10-foot 0.010” slotted screen. Both observation wells were installed to and screened at the same depth as EW-1. All three pilot test wells were continuously logged and screened with a PID in two foot intervals. Boring logs for EW-1, OW-1, and OW-2 are included in Appendix A.

Qepi commenced pilot test activities on October 6, 2009. The pilot test was performed using a rental high-vacuum rotary claw pump and moisture separator. A high vacuum was applied to EW-1 using the vacuum pump via a 1-inch diameter flexible hose that was sealed to EW-1 using a flexible rubber reducing coupling. The vacuum hose was slowly lowered down the extraction well until it was near the top of the water column in order to maximize recovery of LPH. The vacuum pump was powered by a gasoline-powered generator for the duration of the pilot test. Recovered fluids and vapors were extracted from EW-1 and transferred to the moisture

separator. Effluent air was discharged directly to the atmosphere, while recovered fluids were transferred to the onsite 7,000 gallon tank for temporary storage pending proper disposal.

The pilot test was to be conducted for 5 days. However, due to the elevated fluid recovery rate from EW-1, the 7,000 gallon tank was filled to capacity approximately 19.5 hours after the start of the pilot test. Qepi then determined that enough data had been collected for the pilot test to be successfully evaluated, and the pump was not restarted.

Before, during, and after the pilot test, surrounding monitoring wells were monitored for vacuum and drawdown influence from EW-1. Wells were be monitored every half hour for the first hour of pilot testing and every hour subsequently until the completion of the pilot test. Surrounding wells monitored on an hourly basis included OW-1, OW-2, PZ-3, PZ-4, MW-327, and QW-8. Monitoring well MW-330, was also monitored intermittently as a water level fluctuation control. While, it is possible that MW-330 experienced drawdown from the pilot test activities, it is unlikely due to the distance from EW-1. Therefore, the drawdown observed in MW-330 was subtracted from the drawdown in the other monitored wells during data analysis. Observed vacuum data is included as Table 4. Water and product level gauging data is included as Table 5. Observation well drawdown over time is graphically represented in Figure 7.

Upon completion of the pilot test, Qepi analyzed the influence of both the vacuum created using the high vacuum pump and the water level drawdown at surrounding wells. The results of the pilot test indicated that while vacuum radius of influence (ROI) was limited during the pilot test, the surrounding wells showed a significant influence to drawdown that was still increasing at the time the pilot test was completed.

The three separate ROIs that were calculated for the pilot test include: 1% vacuum ROI, 10% drawdown ROI, and 5% drawdown ROI. 1% Vacuum ROI is defined as the distance away from the extraction well at which 1% of the applied vacuum is observed. Of all the wells monitored for vacuum, only wells MW-327 and OWP-1 exhibited vacuum influence. As shown in Figure 8, the 1% vacuum ROI for the pilot test was calculated to be 6.8 feet.

The 10% drawdown and 5% drawdown ROIs are defined as the distance from the extraction well at which 10% and 5% of the applied drawdown in the extraction well is observed. The 10% drawdown ROI was calculated to be 27.5 feet, while the 5% drawdown ROI was calculated to be 37 feet. Typically the 10% drawdown ROI is used for MPE system design, however based on site data, both ROIs could be biased low. The reason that the drawdown ROIs are considered to be conservative estimates are that background groundwater fluctuations were accounted for, and both ROIs were still increasing at the time the pilot test was stopped. If the pilot test were to be performed longer, both ROIs would likely be larger. Results of the 10% drawdown ROI analysis are shown on Figure 9, while the results of the 5% drawdown ROI analysis are shown on Figure 10.

4.A.2.d LNAPL Volume Estimate

On August 5, 2009, Qepi performed a product recovery test on monitoring well MW-327 in order to more accurately estimate the amount of LNAPL at the site. Monitoring MW-327 was chosen for the test because it has historically shown the largest layer of LPH of any of the wells at the site. The product recovery test was performed because LNAPL tends to collect in monitoring wells in disproportionate amounts compared to the surrounding water table due to capillary action and screen location (Blake and Hall, 1984). This can lead to artificially elevated estimates of LNAPL at the site. In order to determine an accurate thickness of the LPH in the aquifer using the Blake and Hall method, all LPH was selectively purged from the well using a Teflon-lined bailer. An oil/water interface probe was then used to immediately gauge depth to product and depth to water in MW-327. Additional product and water depths were gauged at specific timed intervals. Gauging data was collected from MW-327 in two minute intervals for the first 20 minutes of the recovery test. Intervals were later lengthened to 5, 10, and 60 minutes with the test ending after 180 minutes. Depth to product and depth to water gauging data and elevations are included in Table 6.

To determine the actual LPH thickness at MW-327, groundwater and LPH elevations were plotted on a graph together versus time (Figure 11). The “true” groundwater elevation of the aquifer is where the LPH and groundwater elevation lines diverge. Further readings show LNAPL depressing the “true” groundwater level. The length between the “true” groundwater elevation and the stabilized LPH elevation is the true thickness of the LPH within the aquifer. As shown in Figure 12, the “true” groundwater elevation was determined to be 83.71 feet, and the LPH elevation stabilized at 83.96 feet, therefore the actual thickness of the LNAPL in the aquifer at MW-327 is 0.25 feet.

The actual volume of LNAPL in the aquifer is then calculated using the following assumptions:

- MW-327 is located at the maximum thickness of the LPH plume
- LPH thickness decreases at a linear rate from MW-327 to the edges of the estimated plume shown in Figure 6.
- The estimated area of the LPH plume is 3.98 acres or 173,416 square feet
- Effective porosity of the soil at the site (well-sorted fine sand) is 35% (Fetter, 1994)

Using the modified formula for the volume of a cone:

$V = (1/3)(A)(h)(n_e)$ where: V = volume (cubic feet)
A = area (square feet)
h = height of product (feet)
n_e = effective porosity (unitless)

The calculated volume of the LNAPL plume is approximately 5,058 cubic feet or 37,834 gallons. This is believed to be a conservative (high) estimate considering site gauging data indicates that LPH thickness likely falls faster than at a linear rate away from MW-327.

4.B Selected Remediation Technology

4.B.1 Multi-Phase Extraction Supplemented with Pump and Treat

Based on the technology analysis and the results of all three pilot tests, Qepi recommends that high-vacuum MPE supplemented with pump and treat be selected as the technology to remediate petroleum impacts at the site. Not only is MPE the most likely of the reviewed technologies to be successful in removing LPH, but it would have the added benefit of also treating impacted soil and dissolved impacts to groundwater. Historical groundwater and LPH level data indicate that increased LPH layers typically accompany lower groundwater levels. Supplementing the MPE system with pump and treat would slightly lower the groundwater elevation further and likely increase LPH recovery via the MPE system.

4.B.2 Remediation Implementation

Qepi proposes to install a network of 17 MPE extraction wells located at the heart of the LPH plume with a contingency plan for up to 11 additional extraction wells to be installed near the extents of the LPH plume if necessary. The 5% drawdown ROI of 37 feet was used as the design ROI. The 10% drawdown ROI is typically used for extraction well placement, however drawdown ROI was still increasing at the time the pilot test was stopped. Therefore, true site-specific drawdown ROIs are likely larger than those measured by the pilot test. Proposed extraction well locations are shown on Figure 13.

Extraction wells will be constructed of 4-inch diameter, Schedule 40 PVC with 10 feet of 0.020-inch slotted screen. All extraction wells will be screened from 18 to 28 feet bgs and will be located in 2'x 2' vaults installed flush to the ground. Stinger tubes consisting of adjustable 1-inch diameter flexible hose will be installed in each extraction well and will be sealed to the well casing using a flexible rubber reducing coupling. Vacuum and flow will be controlled at each wellhead using a ball valve. Extraction well details are shown on Figure 14.

Recovered fluids and vapors will be extracted from the top of each extraction well using the 1-inch diameter stinger tubes to maximize LPH recovery. Fluids and vapors will be conducted underground to a remediation shed for treatment via 6-inch diameter Schedule 40 PVC piping. Pipes from different extraction wells will be combined before entering the remediation shed in two legs. Piping will be installed by trenching approximately four feet bgs to prevent water freezing in the lines during cold weather. Soil removed for trenching will be used to backfill the trenches in order to be cost effective. Excess soil that is not used for backfill will be stockpiled onsite or taken to a landfill for proper disposal. The top four inches of the trench will be

backfilled with gravel or asphalt in well trafficked areas. Qepi estimates that approximately 900 linear feet of trenching must be completed for remediation system installation.

MPE recovery will be supplemented with two pump and treat wells located in the part of the LPH plume with the highest thickness. Positive displacement piston pumps such as the one previously pilot tested will be installed in recovery wells RW-1 and RW-2. Recovered fluids from RW-1 will be conveyed back to the east system for treatment, while the west system will process recovered fluids from RW-2. Both piston pumps will be driven by windmills. Wind power provides many advantages at the site besides being a renewable energy source. An additional benefit is increased safety from the process being explosion proof. Renewable wind energy is also cost effective after the initial investment, requiring no utility costs and little maintenance. The areas where the windmill pumps are to be installed are open and amenable to wind power. Fluids recovered by the windmill pumps will be transferred back to the remediation systems via 1-inch diameter Schedule 40 PVC piping installed underground in a similar manner to the extraction well piping. Additional information on the windmill pumps is included as Appendix F.

Two separate but identical treatment systems will be installed at the site to treat recovered fluids. Both remediation sheds will be located on the Hannover property just south of the high-bay building. One system will control eight extraction wells in the western part of the plume, and the other will control nine extraction wells in the eastern part of the plume. Two separate systems are proposed instead of a single system to reach a higher treatment capacity in the event additional extraction wells are installed in the future. Each system will have two separate rooms. A smaller room will contain the electrical controls to the system, while the larger room will contain the treatment equipment. Equipment installed in the treatment room will be completely explosion proof for safety purposes.

Each system trailer will contain two high-vacuum rotary claw pumps that will be used to apply a high vacuum to the extraction lines. Both extraction well legs entering the trailer will be piped to dedicated moisture separators and pumps. Rotary claw pumps are recommended rather than liquid-ring pumps due to the sandy soil at the site. Higher air flow rates are typically observed in MPE systems installed in sandy soils compared to tighter formations. While rotary claw pumps operate at a slightly lower vacuum than liquid-ring pumps, they perform much better under high flow conditions and are more resistant to environmental wear. Rotary claw pumps are also less expensive to maintain than liquid-ring pumps and require less electrical power. The four pumps installed at the site will be or be the equivalent of the 15-horsepower (hp) Busch MI 1502 BV. The pump specified can move 300 cubic feet per minute (cfm) of air at 21 inches of Hg vacuum. Additional performance information about the Busch MI 1502 BV is included as Appendix G.

Pilot test data indicates that each extraction well will contribute approximately 60 cfm of air flow to the system at 21 inches of Hg. Due to flow restrictions, only five wells can be operated at a time on each leg, meaning the maximum combined treatment for both systems is 20 wells. If

additional wells are added, some wells may need to be cycled in order to operate the system at full capacity.

The MPE pilot test showed that EW-1 recovered fluids at a rate of approximately 6.0 gpm. Since the most wells that each system will be running is 10, and the maximum flow rate for the windmill pump is approximately 5 gpm, all fluid treatment components must have the capacity to handle a minimum 65 gpm flow rate.

In addition to two rotary claw pumps and moisture separators, each system will contain an equilibration tank where recovered fluids from both moisture separators along with the windmill pump will be combined before undergoing further treatment. Fluids will then pass through an oil/water separator. LPH that separates out in the oil/water separator will be recycled offsite. The remaining water will then enter into a series of sediment filters before undergoing further treatment using an air stripper and two activated carbon filters. A process flow diagram for one of the two identical systems is included as Figure 15.

Water will be discharged in an infiltration gallery located outside the LPH plume approximately 300 feet south of the systems. Treated water will be conveyed to the infiltration gallery via 6-inch diameter Schedule 40 PVC piping installed underground similar to the extraction well piping. Treated water will then be allowed to percolate back into the ground, further causing a mounding effect that will likely prevent LPH from migrating offsite to the south and push the LPH back toward the remediation system. Prior to the first discharge, Qepi will obtain proper discharge permits from the City of South Bend. The proposed infiltration gallery would be approximately 20 feet in length by 20 feet in width by 5 feet in depth. Side slopes would be at a ratio of 1:2 to minimize erosion and the pit would be lined with large gravel or rip-rap. The location of the proposed infiltration gallery is included on Figure 13.

Recovered vapors will be discharged directly to the atmosphere. Qepi will collect effluent air samples on a monthly basis to determine system progress and to confirm that the systems are meeting state and federal air regulations. If air sampling results indicate that effluent air emissions are in excess of allowable limits, additional air treatment such as a catalytic oxidizer or activated carbon filtration will be used to meet regulations.

4.B.3 Alternative Energy Considerations

Qepi has evaluated several options to pursue environmentally efficient remedial technology for the site. Qepi will install two windmill operated pump and treat wells at the property to mitigate energy use at the site. Qepi researched the applicability of solar powered energy for the site and has determined that utilizing solar technology to power any remedial system would not be cost effective for the short-term remedial goals at the site.

Any solar powered remedial alternative would require significant initial investment to begin operations. A review of the technology indicated that the system would require an operational

time of a minimum of 8 years before net cost savings in terms of energy use would be envisioned for the project. Qepi understands the budget constraints that will be present for the timeframe of this remediation and does not recommend that implementation of solar energy at this time.

Qepi anticipates recovering several thousand gallons of LNAPL free petroleum product during the course of remediation. Qepi has been in contact with several firms in Northern Indiana and anticipates being able to recycle all recovered petroleum product. This recycling of petroleum product will provide significant cost savings for the project, as no monies will need to be spent in the handling and disposal of recovered LNAPL. Qepi will document final usage of recovered and recycle LNAPL product during all site updates provided to the IBP and IDEM.

The use of windmill pump and treat technology and the recycling of recovered LNAPL free product will serve to mitigate costs incurred for remediation at the site and also provide an environmentally friendly option for site remediation. Qepi will continue to evaluate alternative, energy efficient design strategies at the site, including the potential reuse of recovered LNAPL petroleum onsite for purposes of energy generation, and will consult with the IBP as to their applicability at the site.

4.C Monitoring and Sampling Plan

4.C.1 Sampling Plan Details

System influent, effluent, and mid-treatment samples will be collected on a monthly basis to determine system mass recovery and to confirm that effluent concentrations are within the permissible regulatory limits. Samples will be analyzed using USEPA SW-846 Method 8015 for TPH GRO and TPH DRO.

In order to confirm that the systems are meeting state and federal air regulations and to determine system mass recovery, Qepi will collect an effluent air sample from the discharge side of each vacuum pump on a monthly basis. Air samples will be collected in 1-liter Tedlar bags and be analyzed for TPH using USEPA Method TO-15.

Qepi will gauge depth to groundwater and depth to product in the monitoring well and extraction well network with an oil/water interface probe on a quarterly basis. The collected depth to groundwater and product data will be used to focus the remediation system on the areas with the largest layers of LPH.

Qepi will consult with IBP and IDEM personnel throughout the course of operation of the groundwater remediation system to determine the most cost effective method to monitor the efficiency of the selected remedial technology in remediating soil and groundwater impacts. Qepi will explore the necessity of collecting groundwater samples from existing monitoring wells and/or advancing additional soil borings to monitor soil and groundwater conditions at a future date. Additional sampling will also be performed if requested by the IBP or IDEM.

4.C.2 Data Management Details

All sampling and reporting procedures will be performed in accordance with Qepi's Quality Assurance/Quality Control (QA/QC) procedures included as Appendix H.

4.D Projected Work Schedule

4.D.1 Projected Installation and Startup Schedule

Extraction wells are anticipated to be installed within 30 days of IDEM approval. Bid requests for system construction and trenching along with bid requests for windmill pump construction will be sent out within 30 days of approval. Bid request for trenching will include an additional bid request for the construction of an infiltration gallery. The site trenching and piping will be completed within 45 days of extraction well installation (weather permitting). Extraction wellhead completion will be performed during trenching activities. Public and private utilities will be located prior to well installation or trenching.

Remediation systems typically take three to four months to construct. Upon completion, the remediation systems will be mobilized to the site and connected to the site extraction lines, flow lines, discharge lines, and electrical power. Qepi anticipates that the start-up process will take approximately one week to perform. Qepi personnel will be at the site on a daily basis during start up. Regular remediation system operation and maintenance will be performed by Qepi personnel twice per week thereafter.

4.D.2 Sampling and Monitoring Schedule

System effluent air and influent, effluent, and mid-treatment samples will be collected on a monthly basis to determine system mass removal and confirm that system discharge meets regulatory standards. Specific sampling and monitoring schedule details are included in Section 4.C.1.

4.D.3 Expected Contaminant Removal and Treatment Rates

It is anticipated that significant amounts of LPH and petroleum mass will be recovered using enhanced MPE at the site. Qepi anticipates that LPH recovery rates will be elevated upon start up, however recovery rates should slow over time. If at any time the remediation systems stop recovering LPH, while it is still present in surrounding monitoring wells, a contingency plan may be used to help mobilize product toward the extraction wells. Injection of surfactant into the aquifer is likely the most effective method to mobilize LPH toward extraction wells. If deemed necessary, Qepi will install a series of injection wells at the site between extraction wells and

inject a water-diluted surfactant solution into the aquifer. Surfactant is a substance that reduces surface tension in oil and water and helps LPH mobilize more readily. Another method that could be used to mobilize product in the groundwater is thermal treatment, however it is likely less cost effective.

If at any time it is deemed that the MPE system is ineffective, another treatment method will be used to address LPH impacts at the site. Alternative solutions include: permeable reactive barriers, oxygen injection, pump and treat, and selective LNAPL recovery.

4.D.4 Operation and Maintenance Plan

Qepi anticipates that the start-up process will take approximately one week to perform. Qepi personnel will be at the site on a daily basis during start up. Regular remediation system operation and maintenance will be performed by Qepi personnel twice per week thereafter. Qepi will consult with IBP personnel during system start-up activities and will provide regular updates to the IBP and IDEM on the system.

5.0 Summary and Conclusions

Petroleum impacts to soil and groundwater including the presence of LNAPL have been discovered at the Hannover Property, located at 731 West Chippewa Avenue in South Bend, Indiana. The source of impacts to soil and groundwater is believed to be historical usage of underground storage tanks (USTs) at the site. A total of 37 former USTs have been identified as historically containing gasoline, diesel fuel, antifreeze, varnish, solvents, waste oils, transmission fluid, engine oil and jet fuel. Historic investigations at the subject site and immediately adjacent areas have documented TPH GRO and ERO impacts to soil and groundwater. Additionally, significant levels of free petroleum product have been encountered in groundwater monitoring wells and piezometers at the subject property. Consultation with the IBP and IDEM has indicated that remediation of LNAPL should be the primary focus of remediation efforts.

Qepi performed three separate pilot tests at the site. A pump and treat pilot test was performed at the site in June 2009, a selective LNAPL recovery pilot test was performed in August 2009, and an MPE pilot test was performed in October 2009. Qepi also performed a product recovery test to estimate the volume of free phase product at the site. Procedures and results of these tests are included in Section 4.A.2.

Based on the technology analysis and the results of all three pilot tests, Qepi recommends that high-vacuum MPE supplemented with pump and treat be selected as the technology to remediate petroleum impacts at the site. Not only is MPE the most likely of the reviewed technologies to be successful at removing LNAPL, but it would have the added benefit of also treating impacts to soil and dissolved impacts to groundwater. Historical groundwater and LNAPL level data indicate that increased product layers typically accompany lower groundwater levels. Supplementing the proposed MPE systems with pump and treat would slightly lower the groundwater elevation further and likely increase LNAPL recovery via the MPE systems. The proposed MPE systems are discussed in detail in Section 4.B.

System installation is anticipated to commence within 30 days of IDEM approval. Public and private utilities will be located prior to well installation or trenching. Remediation systems typically take three to four months to construct. Upon completion, the remediation systems will be mobilized to the site and connected to the site extraction lines, flow lines, discharge lines, and electrical power. Qepi anticipates that the start-up process will take approximately one week to perform. Qepi personnel will be at the site on a daily basis during start up. Regular remediation system operation and maintenance will be performed by Qepi personnel twice per week thereafter.

It is anticipated that significant amounts of liquid-phase hydrocarbon (LPH) will be recovered using enhanced MPE at the site. Qepi anticipates that LPH recovery rates will be elevated upon start up, however rates should slow over time. If at any time the remediation systems stop recovering LPH, while it is still present in surrounding monitoring wells, a contingency plan may be used to help mobilize product toward the extraction wells. Qepi will consult with IBP personnel during system start-up activities and will provide regular updates to the IBP and IDEM on system progress. A Remediation Completion Report (RCR) will be submitted once the system

has demonstrated that cleanup goals are achieved. A Remediation Work Plan Addendum will be submitted if additional on-site or off-site remediation becomes necessary.

6.A Community Relations Plan

No Community Relations Plan has been developed at this time. If at any time a plan is deemed necessary, one will be developed. It should be noted that the City of South Bend's Department of Community and Redevelopment has been working with the property owners to facilitate remedial activities. Qepi will regularly update the City of South Bend as to the status of the remediation, as requested.

6.B Public Meetings

No public meetings are scheduled at this time.

6.C Media Use

All formal documents submitted to the IBP or IDEM pertaining to this project are a matter of public record and will be included in IDEM's Virtual File Cabinet accessible through the IDEM website.

7.0 References

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U.S. Geological Survey, Hydrogeologic Atlas of Aquifers in Indiana, 1994.

8.0 Disclaimer

This RWP was prepared in accordance with generally accepted principles and practices in the environmental consulting field. Conclusions and recommendations expressed herein were developed from site evaluation and limited research, and we are not responsible for unrecorded data pertaining to this site. Qepi makes no warranties, expressed or implied, as to the fitness or merchantability of said property for any particular purpose, and we are not responsible for independent conclusions or opinions made by others based on this report.

This investigation was limited to the areas specified on the figures of this report. Qepi is not responsible for the identification of recognized environmental conditions that may be present outside this evaluated area, chemical parameters other than those specified by the City and IDEM, or at depths greater than that to which soil borings were advanced.

Any opinions and/or recommendations presented apply to site conditions existing at the time of performance of services. We are unable to report on or accurately predict events, which may impact the site, following performance of the described services, whether occurring naturally or caused by external forces. We assume no responsibility for conditions we are not authorized to investigate, or conditions not generally recognized as predictable at the time services are performed. Qepi makes no recommendations in regards to the sale, purchase, lease, construction, or other improvements on the subject property.

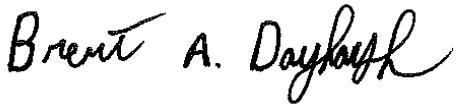
We are not responsible for changes in applicable regulatory standards, practices, or regulations following performance of services. Qepi prepared this RWP using the IDEM RISC Guidance Manual dated February 2001. Conclusions and recommendations expressed herein were developed from site evaluation and limited research, and we are not responsible for unrecorded data pertaining to this site. Qepi makes no warranties, expressed or implied, as to the fitness or merchantability of said property for any particular purpose, and we are not responsible for independent conclusions or opinions made by others on this report

9.0 Signature Page

This *Remediation Work Plan* was prepared by Mr. Nivas R. Vijay, Project Manager and Mr. Douglas J. Riggs, Project Manager and reviewed by Mr. Brent A. Dayharsh, Director of Technical Operations.

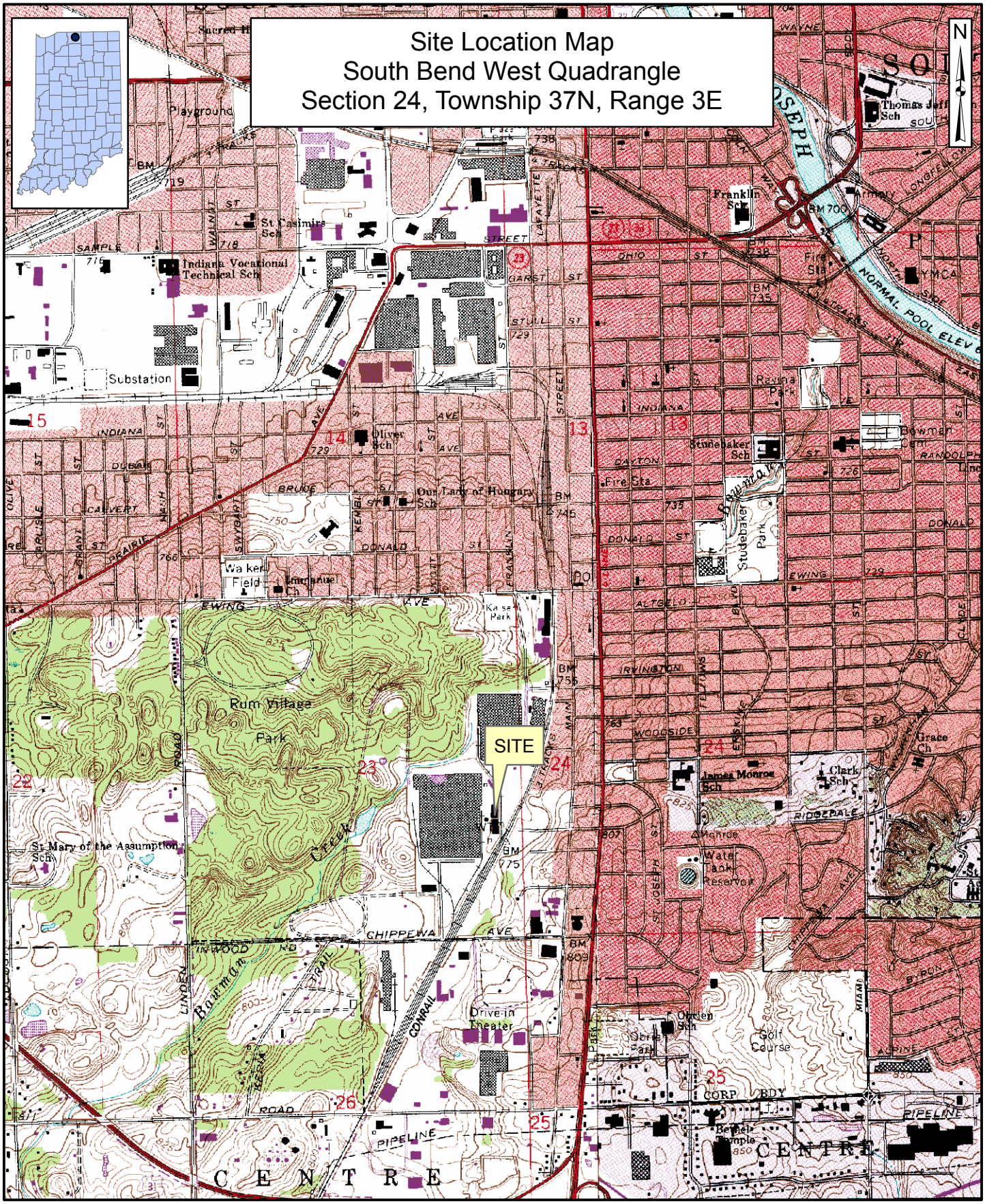
Nivas R. Vijay
Project Manager

Douglas J. Riggs, PE
Project Manager



Brent A. Dayharsh, LPG
Director of Technical Operations

Figures



Base Map: USGS 7.5 Minute DRG Quadrangle

QUALITY ENVIRONMENTAL PROFESSIONALS, INC.
1611 South Franklin Road
Indianapolis, Indiana 46239

FIGURE 1
SITE LOCATION MAP

HANNOVER PROPERTY
731 WEST CHIPPEWA AVENUE
SOUTH BEND, INDIANA

Project Number:	Date:
08-04-009	11/16/09
Drawn By:	Scale:
CWH	1"=200'
Checked By:	Sheet:
NRV	1

Base Map: 2008 National Agriculture Imagery Program

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FIGURE 2
SITE MAP

HANNOVER PROPERTY
731 WEST CHIPPEWA AVENUE
SOUTH BEND, INDIANA

Project Number:	Date:
08-03-009	11/16/09
Drawn By:	Scale:
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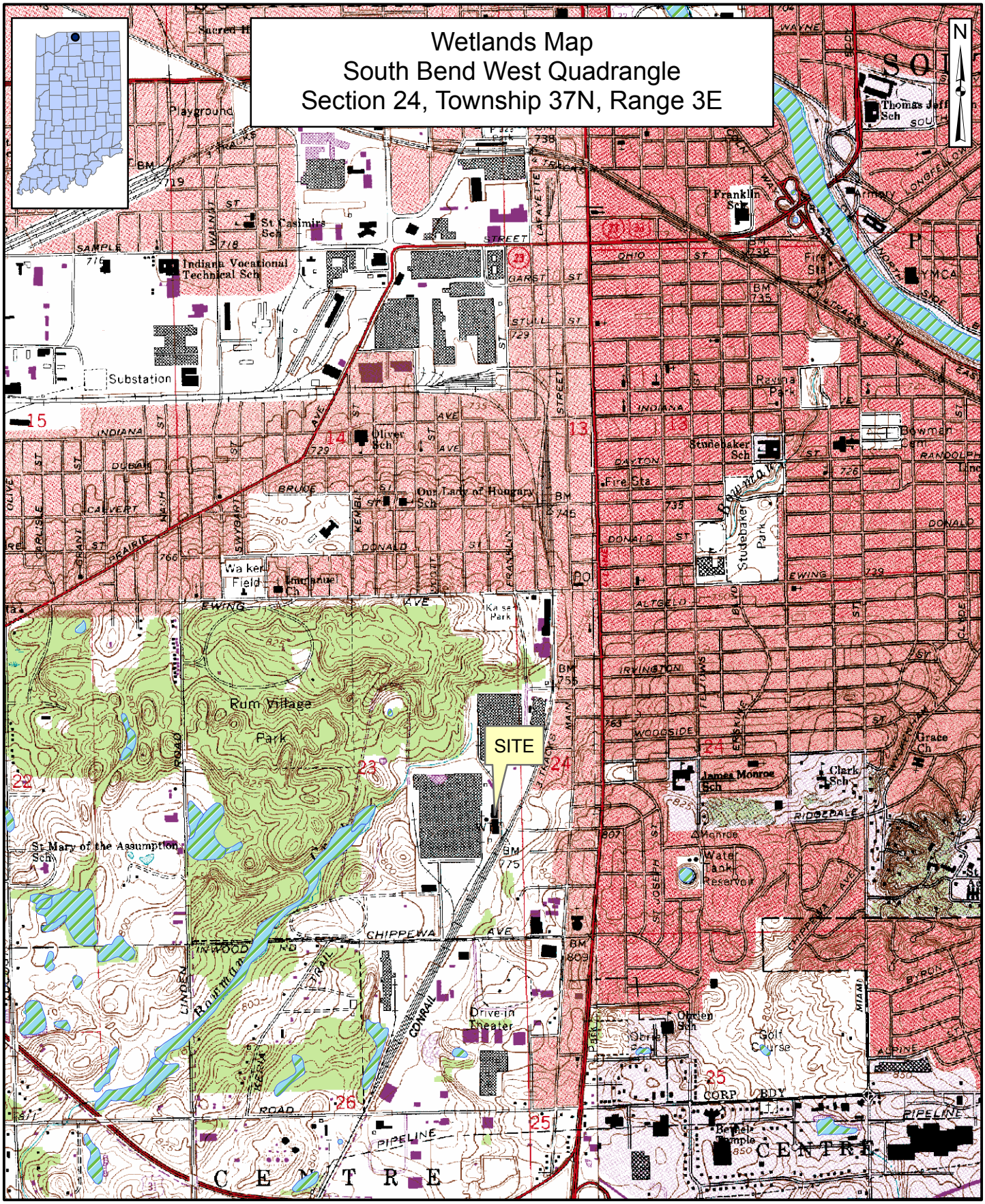

Base Map: USGS 7.5 Minute DRG Quadrangle

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FIGURE 3
WETLANDS MAP

HANNOVER PROPERTY
731 WEST CHIPPEWE
SOUTH BEND, INDIANA

Project Number:	Date:
08-04-009	11/16/09
Drawn By:	Scale:
CWH	1"=200'
Checked By:	Sheet:
NRV	1

SOUTH (A)

PZ-14
ESTIMATED ELEVATION

MW-330
ELE: 763.39'

MW-327
ELE: 765.55'

QW-7
ELE: 758.71'

PZ-19
ESTIMATED ELEVATION

PZ-10
ESTIMATED ELEVATION

SOUTH (A')

RELATIVE ELEVATION (FEET)

765'
760'
755'
745'
740'
735'

LEGEND

- SANDY CLAY LOAM
- SAND/SANDY LOAM
- SILT/SILT LOAM
- SCREEN
- DEPTH TO WATER (GUAGED 7/31/09)
- DEPTH TO PRODUCT
- AVERAGE FIRST ENCOUNTERED DEPTH TO WATER
- AVERAGE FIRST ENCOUNTERED DEPTH TO PRODUCT

5'
SCALE:
1"=5' VERTICAL
1"=50' HORIZONTAL
0'
50'

NOTES:
DEPTH TO WATER FOR QW-7 GAUGED ON 8/4/08.
DEPTH TO WATER FOR MW-330 GAUGED ON 8/7/08.
PIEZOMETERS NOT SURVEYED INTO GROUNDWATER NETWORK. ELEVATIONS BASED ON MONITORING WELL SURVEY DATA.

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HANNOVER PROPERTY
731 WEST CHIPPEWA
SOUTH BEND, INDIANA

FIGURE 4a
GEOLOGIC CROSS-SECTION
SOUTH (A) – NORTH (A')

PROJECT NO.	DATE
08-04-009	11/17/09
DRAWN BY	SCALE
CWH	AS NOTED
CHECKED BY	SHEET
NV	1

WEST (A)

EAST (B')

PZ-22 ESTIMATED ELEVATION

PZ-12 ESTIMATED ELEVATION

MW-333 ELE: 765.22'

MW-327 ELE: 765.55'

CW-8 ELE: 760.38'

MW-323 ELE: 761.14'

PZ-15 ESTIMATED ELEVATION

765'

760'

755'

745'

740'

735'

RELATIVE ELEVATION (FEET)

LEGEND

- SAND/SANDY LOAM
- SILT/SILT LOAM
- SCREEN
- DEPTH TO WATER (GAUGED 7/31/09)
- DEPTH TO PRODUCT
- AVERAGE FIRST ENCOUNTERED DEPTH TO WATER
- AVERAGE FIRST ENCOUNTERED DEPTH TO PRODUCT

5'

SCALE:
1"=5' VERTICAL
1"=40' HORIZONTAL

0' 40'

NOTES:
PIEZOMETERS NOT SURVEYED INTO GROUNDWATER NETWORK. ELEVATIONS BASED ON MONITORING WELL SURVEY DATA.

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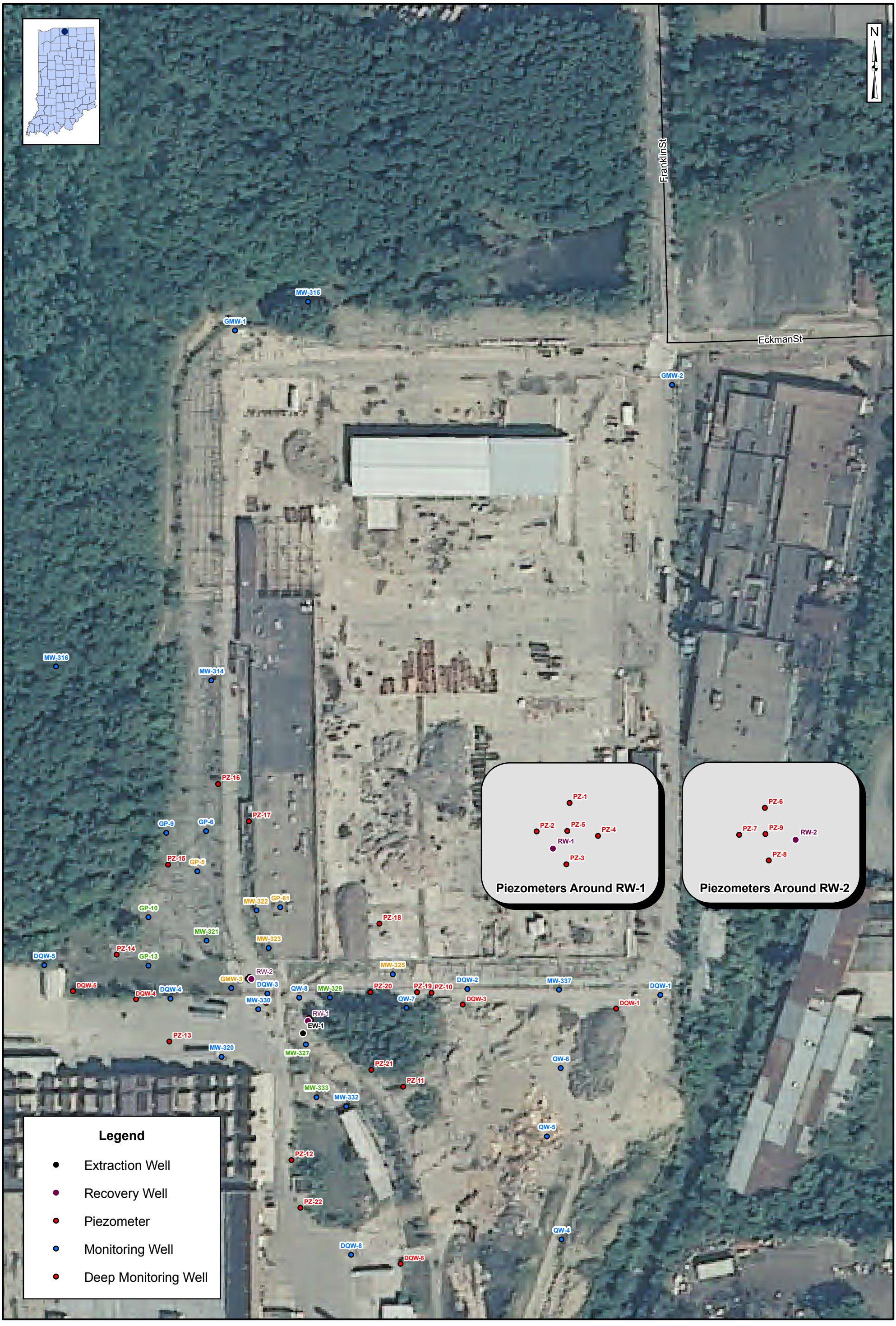
HANNOVER PROPERTY
731 WEST CHIPPEWA
SOUTH BEND, INDIANA

FIGURE 4b
GEOLOGIC CROSS-SECTION
WEST (B) – EAST (B')

PROJECT NO.	DATE
08-04-009	11/17/09
DRAWN BY	SCALE
CWH	AS NOTED
CHECKED BY	SHEET
NV	1



Base Map: 2008 National Agriculture Imagery Program

QUALITY ENVIRONMENTAL PROFESSIONALS, INC.
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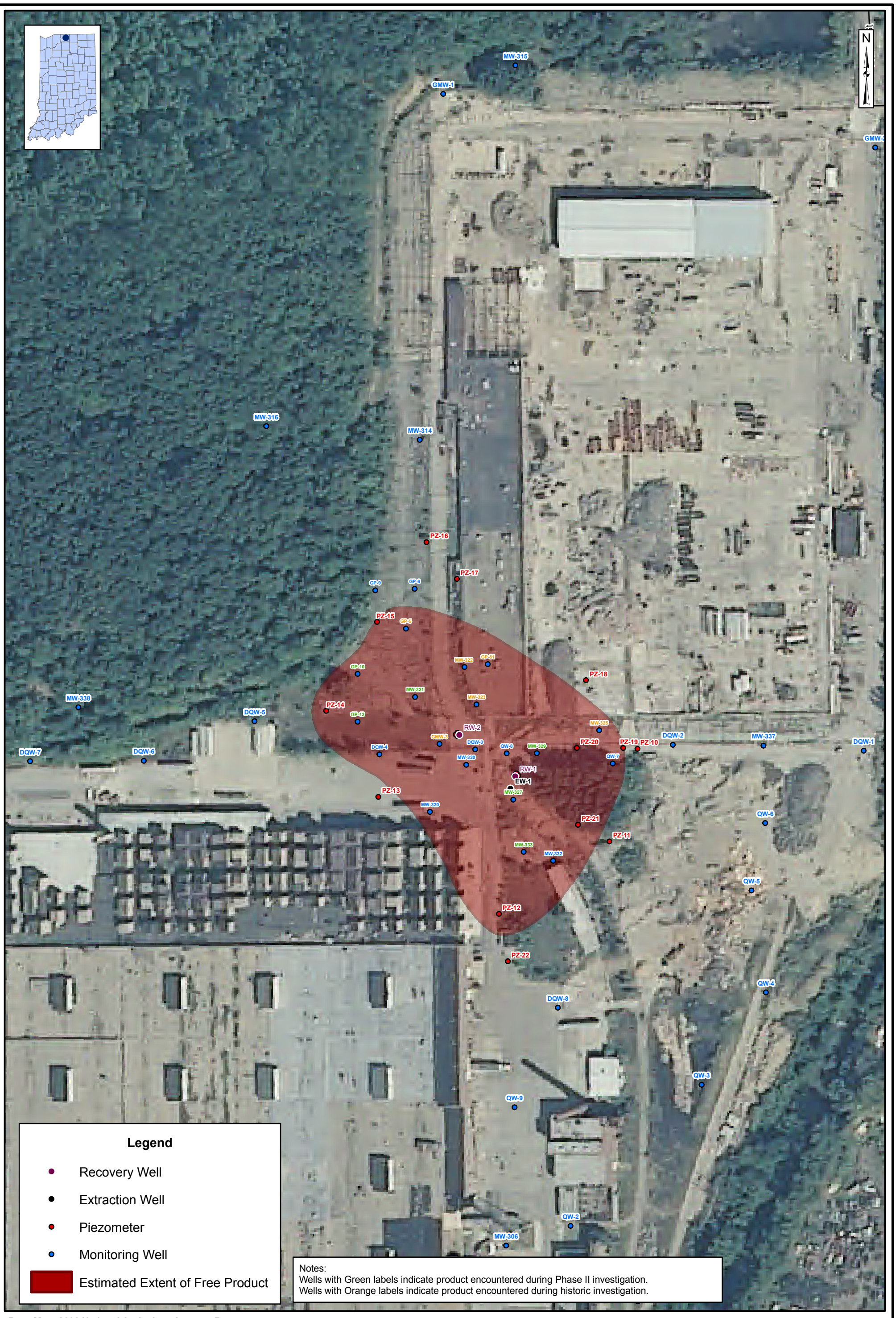
Indianapolis, Indiana 46239

FIGURE 5
SITE MAP WITH WELL AND BORINGS

HANNOVER PROPERTY
731 WEST CHIPPEWA AVENUE
SOUTH BEND, INDIANA

Project Number:	Date:
08-03-009	11/16/09
Drawn By:	Scale:
CWH	1"=150'
Checked By:	Sheet:
NRV	1



Base Map: 2008 National Agriculture Imagery Program

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FIGURE 6
ESTIMATED EXTENT OF FREE PRODUCT
SEPTEMBER 2009
HANNOVER PROPERTY
731 WEST CHIPPEWA AVENUE
SOUTH BEND, INDIANA

Project Number: 08-03-009	Date: 9/8/09
Drawn By: CWH	Scale: 1"=150'
Checked By: NRV	Sheet: 1

Figure 7: Water Level Drawdown During MPE Pilot Test

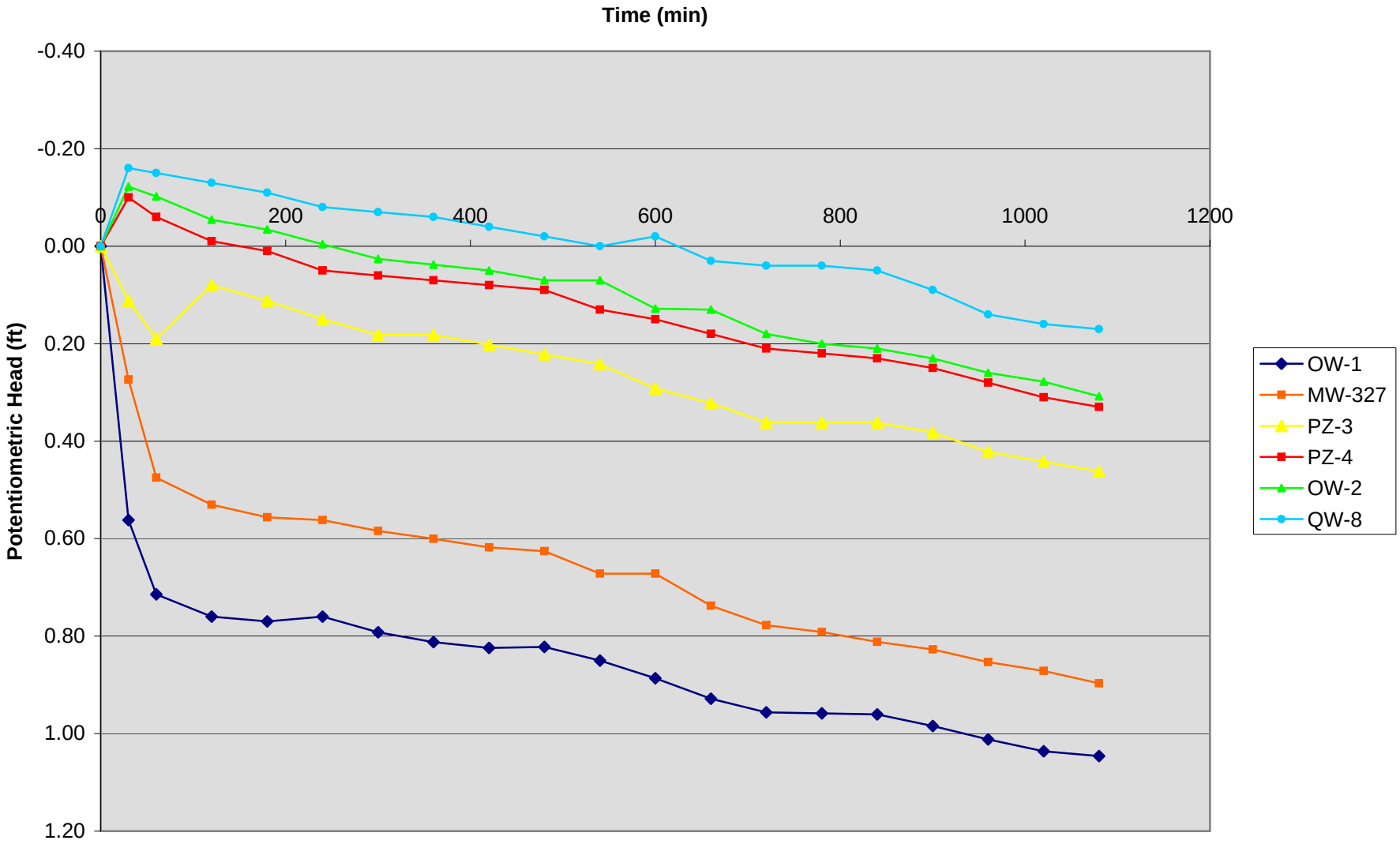


Figure 8
Normalized Vacuum vs. Radial Distance - October 6 and 7, 2009
Hannover Property
731 West Chippewa Avenue
South Bend, Indiana

Well ID	Distance from EW (ft)	Vacuum (" H2O)	Normalized Vacuum	ROI (ft)
EW-1	0.167	163.2	1	6.80
OW-1	5.0	0.2	0.0011	-
MW-327	15.0	0.16	0.0010	

ft: feet
" H2O: inches of water

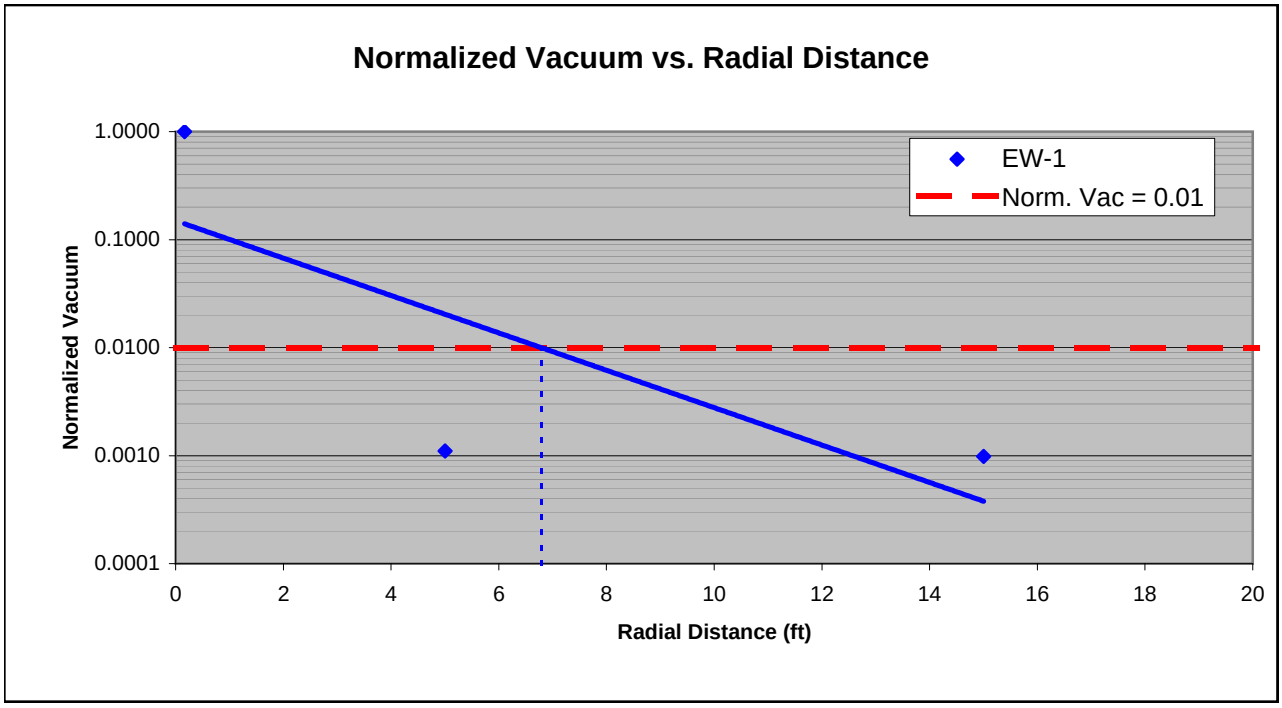


Figure 9
Potentiometric Drawdown vs. Radial Distance (10% ROI) - October 6 and 7, 2009
Hannover Property
731 West Chippewa Avenue
South Bend, Indiana

Well ID	Distance from EW (ft)	Drawdown (ft)	Normalized Drawdown	10% ROI (ft)
EW-1	0.167	2.87	1	27.5
OW-1	5	0.9	0.3053	
MW-327	15	0.7	0.2533	
PZ-3	25	0.3	0.1018	
PZ-4	35	0.2	0.0557	
QW-2	40	0.1	0.0480	

ft: feet
" H2O: inches of water

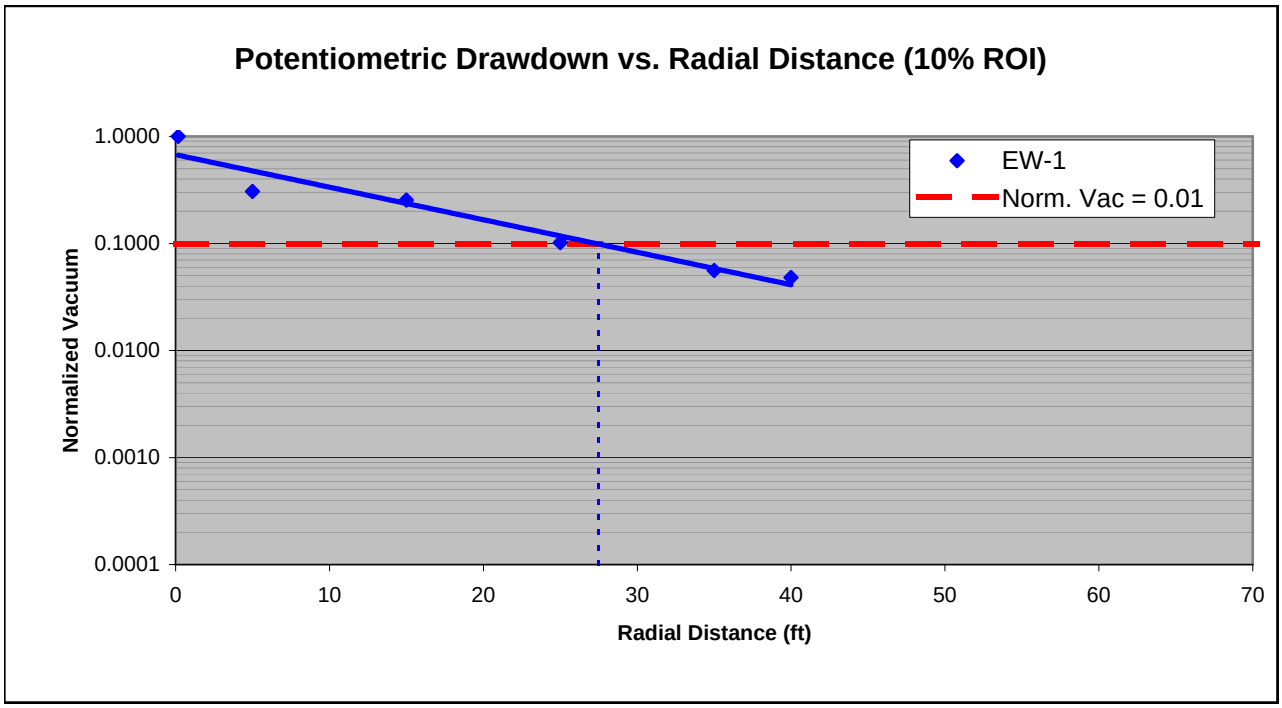


Figure 10
Potentiometric Drawdown vs. Radial Distance (5% ROI) - October 6 and 7, 2009
Hannover Property
731 West Chippewa Avenue
South Bend, Indiana

Well ID	Distance from EW (ft)	Drawdown (ft)	Normalized Drawdown	5% ROI (ft)
EW-1	0.167	2.83	1	37.0
OW-1	5	0.9	0.3096	
MW-327	15	0.7	0.2569	
PZ-3	25	0.3	0.1032	
PZ-4	35	0.2	0.0565	
OW-2	40	0.1	0.0487	

ft: feet
" H2O: inches of water

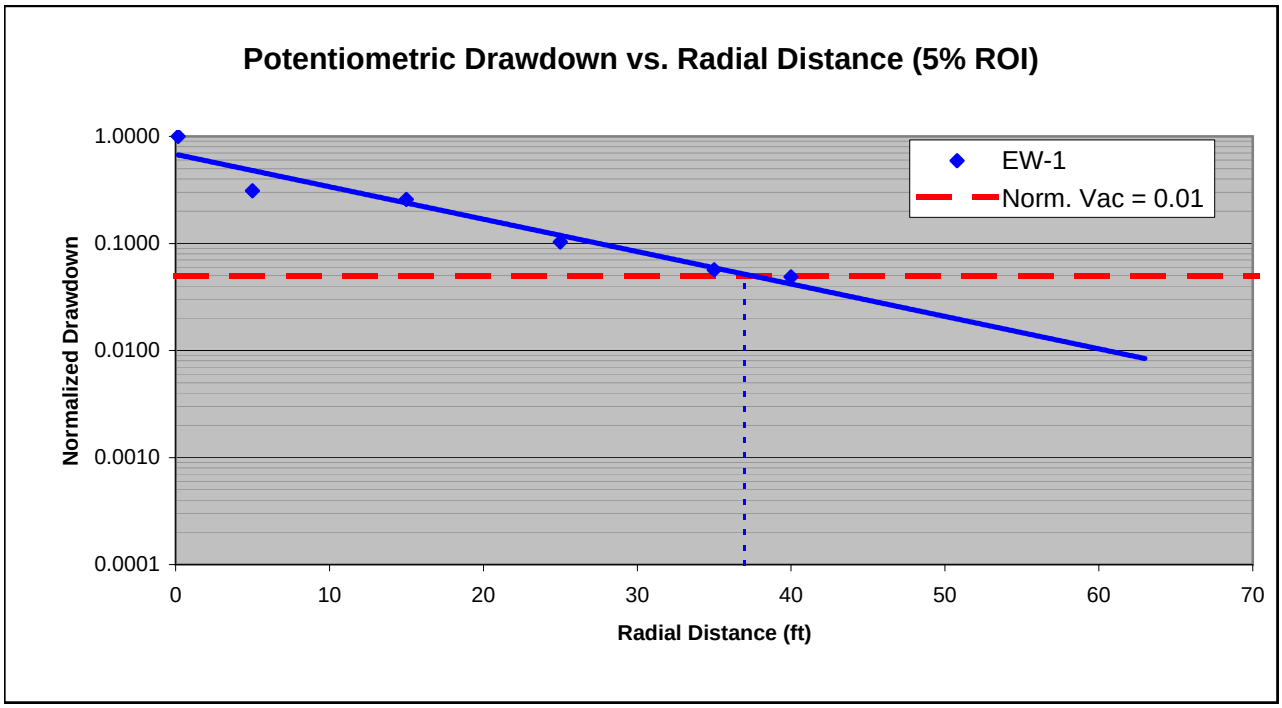


Figure 11: Product Recovery Test Results MW-327

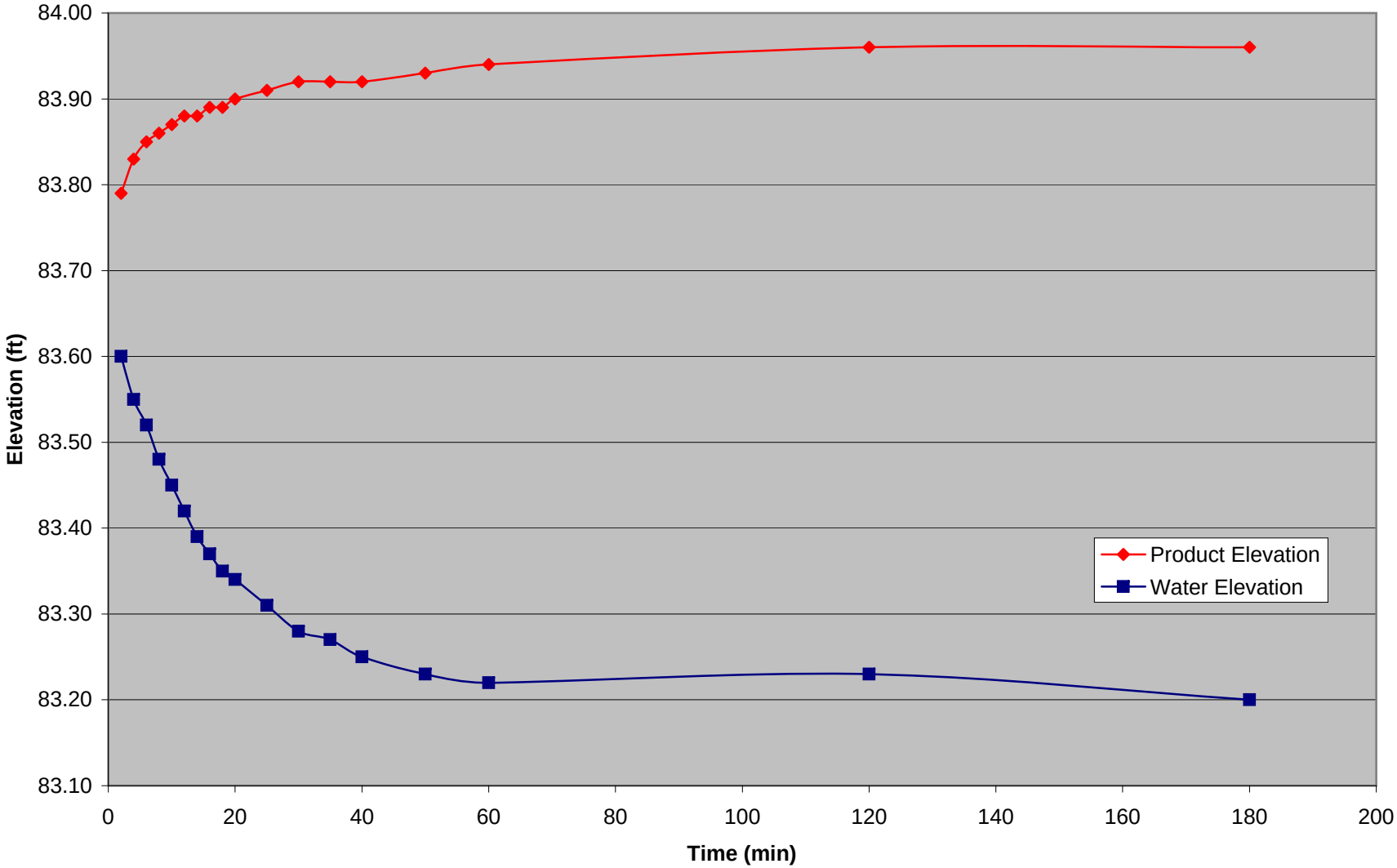
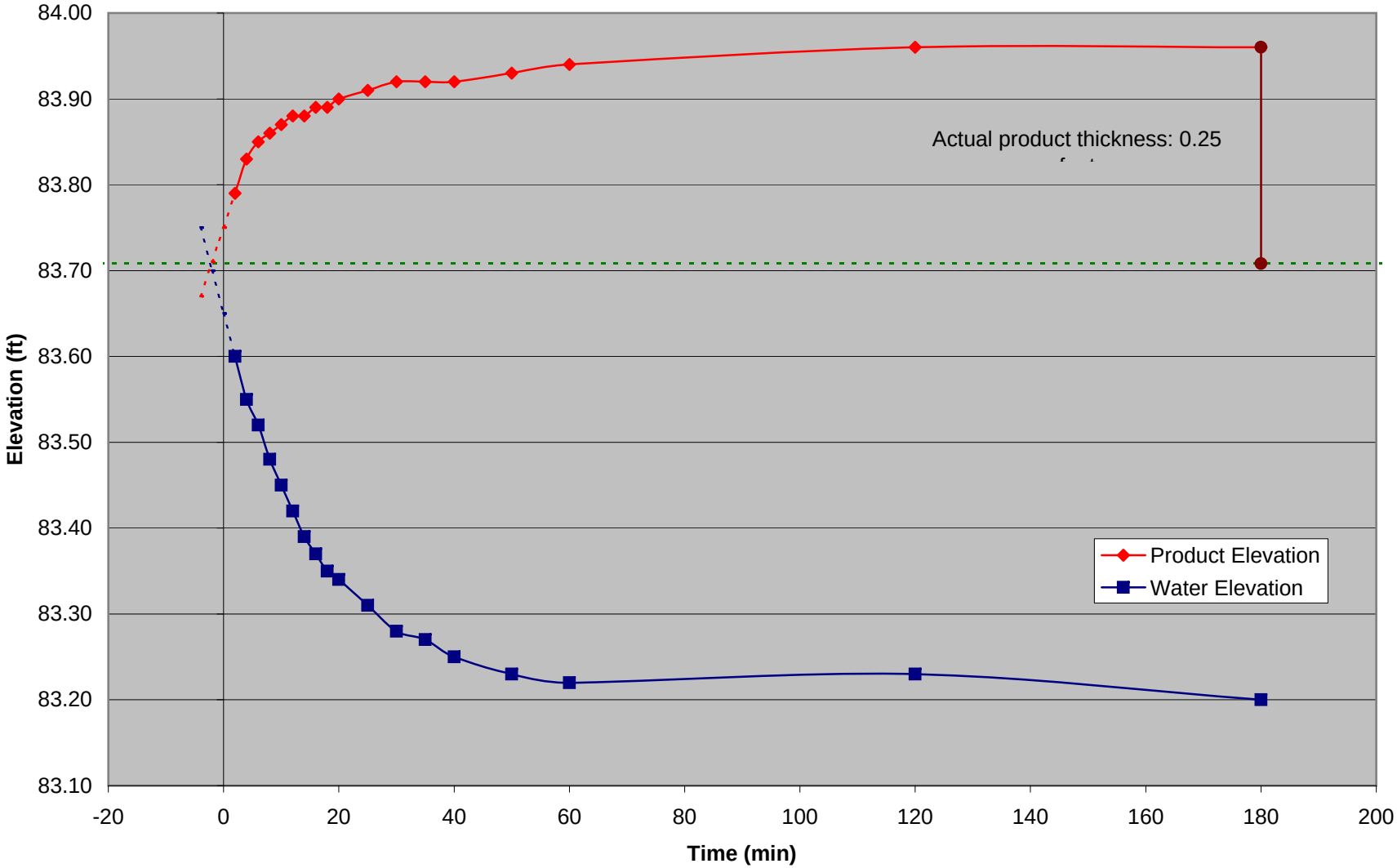
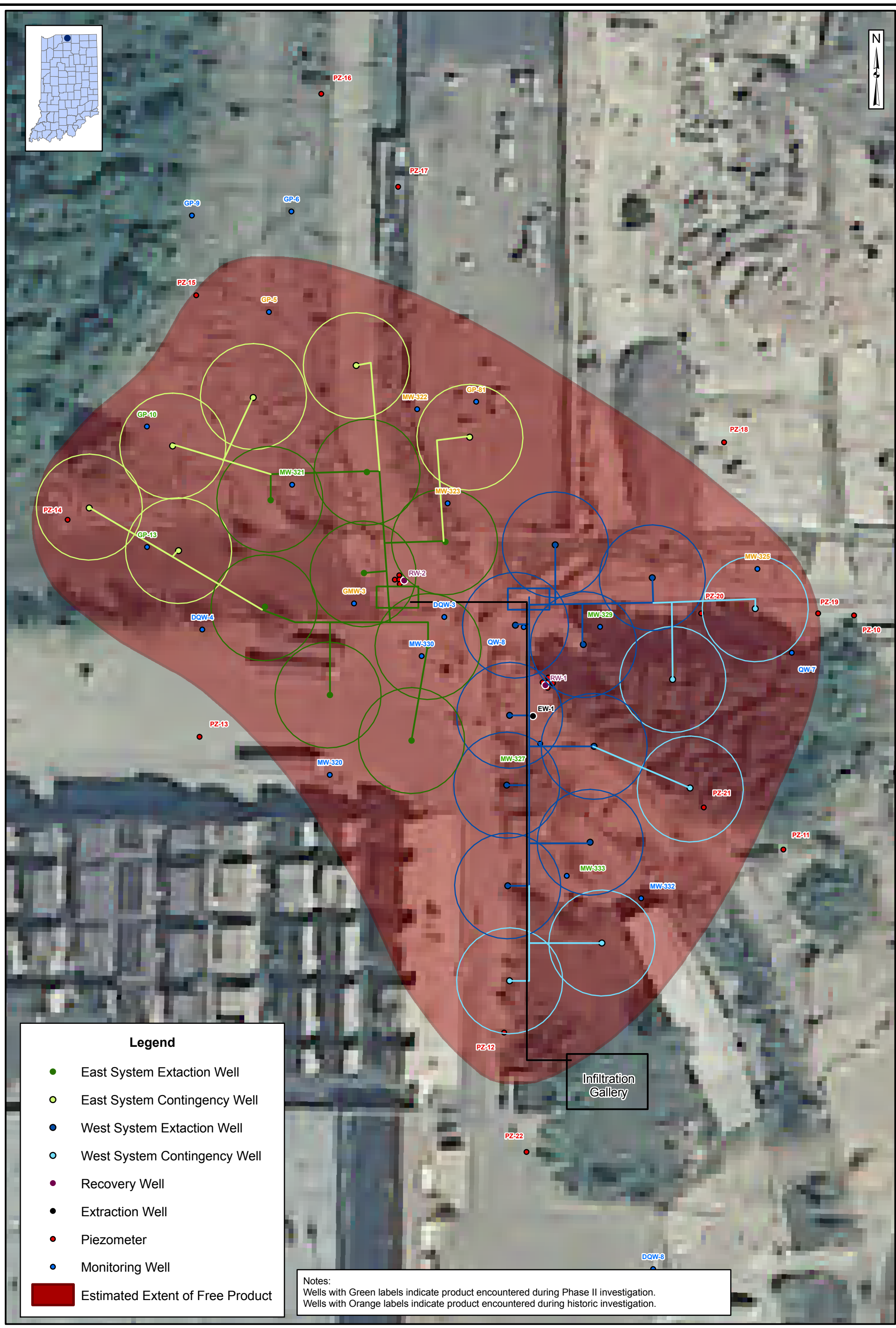


Figure 12: Actual Product Thickness in MW-327





Base Map: 2008 National Agriculture Imagery Program

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Indianapolis, Indiana 46239

FIGURE 13
PROPOSED REMEDIATION SYSTEM LAYOUT

HANNOVER PROPERTY
731 WEST CHIPPEWA AVENUE
SOUTH BEND, INDIANA

Project Number: 08-03-009	Date: 9/8/09
Drawn By: CWH	Scale: 1"=60'
Checked By: NRV	Sheet: 1

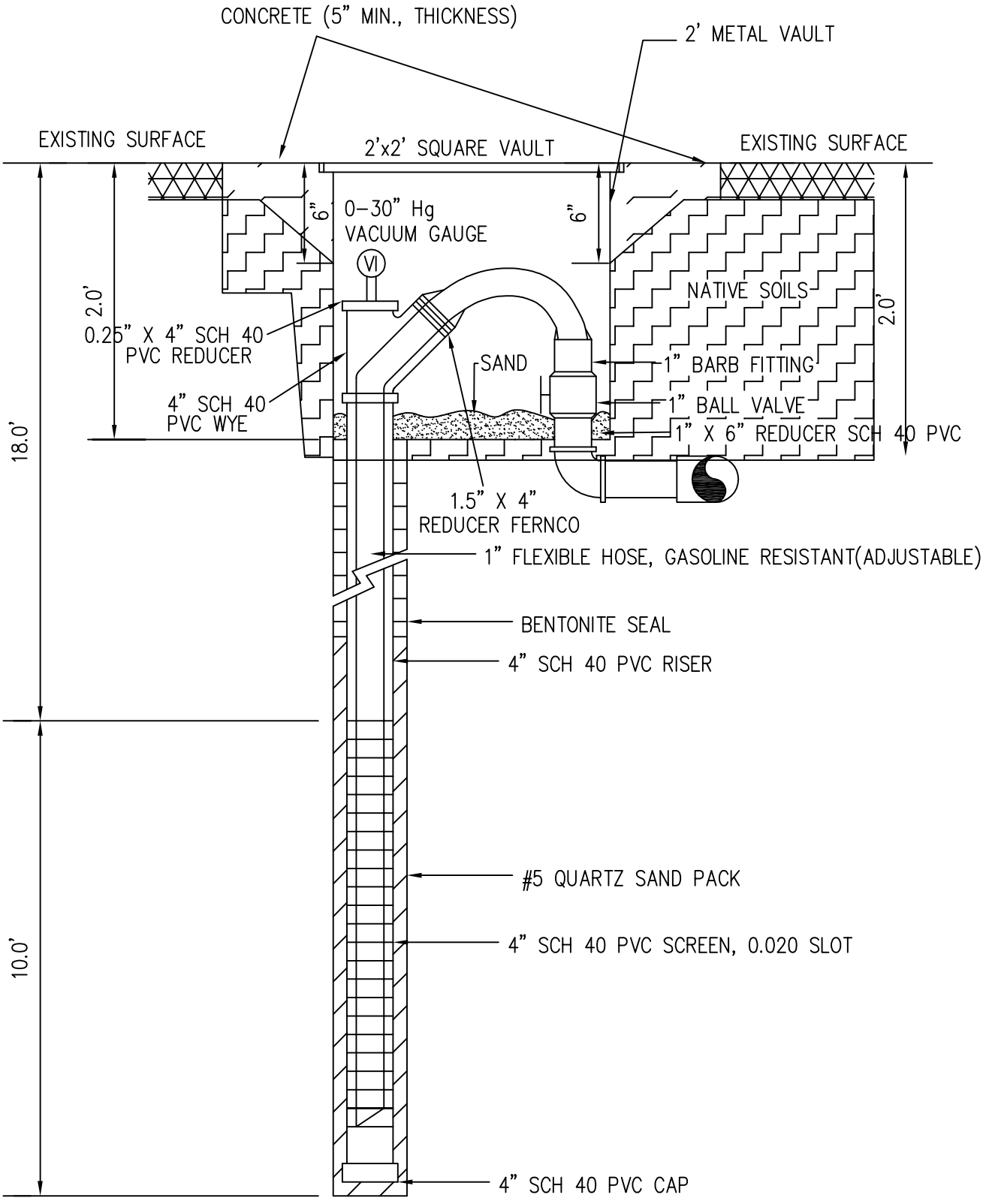

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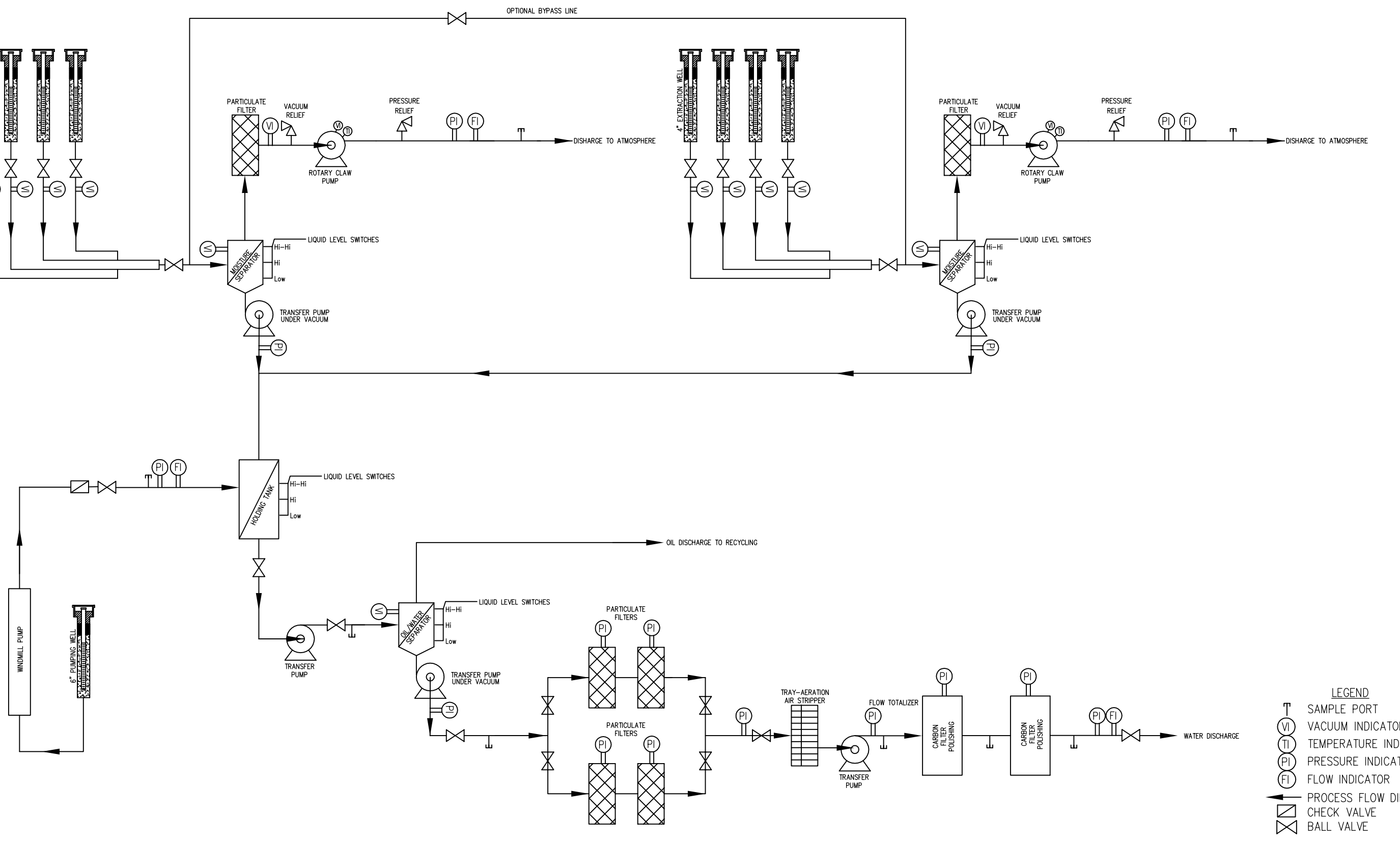
FIGURE 14
VERTICAL EXTRACTION WELL DETAIL

HANNOVER PROPERTY
731 WEST CHIPPEWE
SOUTH BEND, INDIANA

PROJECT NO.	DATE
08-04-009	11/11/09
DRAWN BY: CWH	SCALE: NONE
CHECKED BY: DJR	SHEET: 1



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Indianapolis, Indiana 46239

DRAWN BY:	PROJECT NO:	DATE:
CWH	08-04-009	11/9/09
CHECKED BY:	SCALE:	SHEET:
DJR	NTS	1

FIGURE 15
MPE/PUMP & TREAT PROCESS FLOW

HANNOVER PROPERTY
731 WEST CHIPPEWA
SOUTH BEND, INDIANA

Tables

Table 1
Potentiometric Gauging Data
Hannover Property
731 West Chippewa Avenue
South Bend, Indiana

Monitoring Well	Screen Length (ft)	Screened Interval	Total Depth of Well (ft)	Date	Depth to Product (ft)	Depth to Water (ft)
MW-323	15	9' - 24'	24.32	6/9/2009	-	11.21
				7/31/2009	-	12.04
MW-327	15	13' - 28'	28.22	3/31/2009	14.55	15.01
				5/19/2009	14.78	15.21
				6/9/2009	15.07	15.94
				7/31/2009	15.79	17.01
MW-333	?	-	29.49	7/31/2009	14.76	14.79
QW-8	10	15' - 25'	25.53	7/31/2009	11.08	11.11
RW-1	20	10' - 30'	29.60	3/31/2009	11.63	11.66
				5/19/2009	trace	11.11
				6/9/2009	Pump Installed	
				7/31/2009	12.16	12.21
RW-2	20	10' - 30'	29.64	7/31/2009	trace	12.29
PZ-1*	5	10' - 15'	15.02	3/19/2009	-	12.03
				3/23/2009	-	11.85
				3/31/2009	-	11.50
				5/19/2009	-	10.92
				6/9/2009	-	11.33
				7/31/2009	-	12.07
PZ-2*	5	15' - 20'	20.04	3/19/2009	12.53	12.55
				3/23/2009	12.32	12.35
				3/31/2009	12.01	12.04
				5/19/2009	-	11.49
				6/9/2009	11.84	11.87
				7/31/2009	trace	12.61
PZ-3*	5	20' - 25'	25.04	3/19/2009	12.52	12.55
				3/23/2009	12.31	12.40
				3/31/2009	12.01	12.07
				5/19/2009	11.50	11.55
				6/9/2009	11.88	11.95
				7/31/2009	12.62	12.69
PZ-4*	5	25' - 30'	29.81	3/19/2009	-	12.03
				3/23/2009	-	11.84
				3/31/2009	trace	11.52
				5/19/2009	-	10.98
				6/9/2009	-	11.36
				7/31/2009		12.12
PZ-5*	5	30' - 35'	35.06	3/19/2009	-	12.20
				3/23/2009	12.01	12.02
				3/31/2009	12.70	12.71
				5/19/2009	11.17	11.19
				6/9/2009	11.52	11.54
				7/31/2009	trace	12.31

Table 1
Potentiometric Gauging Data
Hannover Property
731 West Chippewa Avenue
South Bend, Indiana

Monitoring Well	Screen Length (ft)	Screened Interval	Total Depth of Well (ft)	Date	Depth to Product (ft)	Depth to Water (ft)
PZ-6**	5	13' - 18'	18.17	3/19/2009	-	12.45
				3/23/2009	-	12.45
				3/31/2009	-	12.19
				5/19/2009	trace	11.59
				6/9/2009	-	11.96
				7/31/2009	-	12.79
PZ-7**	5	18' - 23'	23.17	3/19/2009	-	12.95
				3/23/2009	-	12.72
				3/31/2009	-	12.46
				5/19/2009	-	11.88
				6/9/2009	-	12.24
				7/31/2009	-	13.08
PZ-8**	5	23' - 28'	28.22	3/19/2009	-	12.81
				3/23/2009	-	12.61
				3/31/2009	-	12.36
				5/19/2009	-	11.78
				6/9/2009	trace	12.11
				7/31/2009	trace	12.95
PZ-9**	5	28' - 33'	33.28	3/19/2009	-	12.79
				3/23/2009	-	12.58
				3/31/2009	-	12.34
				5/19/2009	trace	11.76
				6/9/2009	-	12.10
				7/31/2009	-	12.93
PZ-10	15	12' - 27'	26.66	3/31/2009	-	9.49
				5/19/2009	-	8.87
				6/9/2009	-	9.13
				7/31/2009	-	9.80
PZ-11	15	12' - 27'	26.62	3/31/2009	-	10.64
				5/19/2009	-	10.13
				6/9/2009	-	10.27
				7/31/2009	-	11.09
PZ-12	15	17' - 32	31.59	3/31/2009	14.97	14.99
				5/19/2009	trace	14.88
				6/9/2009	-	14.71
				7/31/2009	15.56	15.58
PZ-13	15	17' - 32'	31.61	3/31/2009	-	14.27
				5/19/2009	-	13.74
				6/9/2009	-	14.08
				7/31/2009	-	15.01
PZ-14	15	14' - 29'	28.61	3/31/2009	trace	13.85
				5/19/2009	-	13.30
				6/9/2009	-	13.46
				7/31/2009	-	14.62

Table 1
Potentiometric Gauging Data
Hannover Property
731 West Chippewa Avenue
South Bend, Indiana

Monitoring Well	Screen Length (ft)	Screened Interval	Total Depth of Well (ft)	Date	Depth to Product (ft)	Depth to Water (ft)
PZ-15	15	13' - 28	27.63	3/31/2009	-	10.81
				5/19/2009	-	10.17
				6/9/2009	-	10.56
				7/31/2009	-	11.41
PZ-16	15	12' - 27'	26.50	3/31/2009	-	10.60
				5/19/2009	-	9.95
				6/9/2009	-	10.32
				7/31/2009	-	11.12
PZ-17	15	13' - 28'	26.51	3/31/2009	-	11.60
				5/19/2009	-	10.99
				6/9/2009	-	11.34
				7/31/2009	-	12.12
PZ-18	20	10' - 30'	30.05	3/31/2009	-	6.53
				5/19/2009	-	5.91
				6/9/2009	Not Accessible	
				7/31/2009	Not Accessible	
PZ-19	20	10' - 30'	30.04	3/31/2009	-	9.45
				5/19/2009	-	8.83
				6/9/2009	-	9.10
				7/31/2009	-	9.78
PZ-20	20	9' - 29'	28.61	3/31/2009	trace	9.32
				5/19/2009	trace	8.67
				6/9/2009	-	8.99
				7/31/2009	-	9.73
PZ-21	15	12' - 27'	26.65	3/31/2009	trace	10.65
				5/19/2009	trace	10.17
				6/9/2009	-	10.45
				7/31/2009	-	11.19
PZ-22	15	15' - 30'	30.07	3/31/2009	-	13.76
				5/19/2009	-	13.69
				6/9/2009	-	13.94
				7/31/2009	-	14.82

*** - Nested Well Set**
**** - Nested Well Set**

Table 2
VOCs in Soil
Hannover Property
731 West Chippewa Avenue
South Bend, Indiana

Sample Location	Date Sampled	Sample Depth (feet)	Benzene	n-Butylbenzene	sec-Butylbenzene	tert-Butylbenzene	Carbon Tetrachloride	1,1-Dichloroethane	1,2-Dichloroethane	1,1-Dichloroethene	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	n-Hexane	Ethylbenzene	Isopropylbenzene (Cumene)	Methylene Chloride	Naphthalene	n-Propylbenzene	1,2,3-trichlorobenzene	1,2,4 Trimethylbenzene	1,3,5-Trimethylbenzene	Tetrachloroethene	Toluene	1,1,1-Trichloroethane	Trichloroethene	Vinyl Chloride	Xylenes	TPH-GRO	TPH-ERO
RISC Default Residential closure levels			**34**	**-**	**-**	**-**	**66**	**5,600**	**24**	**58**	**400**	**680**	**100,000**	**13,000**	**11,000**	**23**	**700**	**36,000**	**-**	**2500**	**610**	**58**	**12,000**	**1,900**	**57**	**13**	**170,000**	**120**	**230**
RISC Default Industrial closure levels			**350**	**-**	**-**	**-**	**290**	**58,000**	**150**	**42,000**	**5,800**	**14,000**	**-**	**-**	**42,000**	**1,800**	**170,000**	**300,000**	**-**	**170,000**	**68,000**	**640**	**96,000**	**280,000**	**350**	**27**	**170,000**	**1,500**	**2,300**
B-1	**03/16/09**	**22'-24'**	**< 42**	**2,230**	**1,890**	**1,750**	**< 600**	< 600	**< 600**	**< 600**	**< 600**	< 600	**< 1,100**	**864**	1,320	**< 600**	**23,110**	1,870	893	**21,440**	**3,610**	**< 600**	< 600	< 600	**< 600**	**< 200**	2,280	**2,130**	**8,691**
B-2	**03/17/09**	**24'-26'**	**< 42**	**1,830**	**1,270**	**< 600**	**< 600**	< 600	**< 600**	**< 600**	**< 600**	< 600	**< 1,200**	< 600	1,060	**< 600**	**2,300**	2,150	< 600	< 600	< 600	**< 600**	< 600	< 600	**< 600**	**< 200**	< 1,200	**540**	**3,587**

Notes: Values presented in parts per billion (ppb) or ug/kg except TPH in parts per million (ppm) or mg/kg
Constituents not listed were below the laboratory detection limit
Default Closure levels based on RISC Technical Users Guide, Updated 01/31/06. Amended August 2006 except TPH, Amended June 2009.
Bold cell denotes value exceeds RISC Default Residential closure level
Shaded cell denotes value exceeds RISC Default Industrial closure level

Table 3
SVOCs in Soil
Hannover Property
731 West Chippewa Avenue
South Bend, Indiana

Sample Location	Date Sampled	Sample Depth (feet)	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenzo(a,h)anthracene	Indeno(1,2,3-cd)pyrene	Naphthalene
RISC Default Residential Closure Levels			**5,000**	**500**	**5,000**	**16,000**	**50,000**	**500,000**	**500**	**5,000**	**700**
RISC Default Industrial Closure Levels			**15,000**	**1,500**	**15,000**	**16,000**	**150,000**	**1,500,000**	**1,500**	**15,000**	**170,000**
B-100	**03/16/09**	**22'-24'**	< 380	< 380	< 380	< 380	< 380	< 380	< 380	< 380	**19,560**
B-101	**03/17/09**	**24'-26**	< 390	< 390	< 390	< 390	< 390	< 390	< 390	< 390	**4,020**

Notes: Values presented in parts per billion (ppb) or ug/kg
Default Closure levels based on RISC Technical Users Guide, Updated 01/31/06. Amended August 2006.
Bold cell denotes value exceeds RISC Default Residential closure level
Shaded cell denotes value exceeds RISC Default Industrial closure level

Table 4
Multi-Phase Extraction Pilot Test Vacuum Results
October 6 and 7, 2009
Hannover Property
731 West Chippewa Avenue
South Bend, Indiana

Time	Time After (min)	Blower Vacuum ("Hg)	Blower Temp. (°F)	Blower Velocity (ft/min)	Air Flow Rate (cfm)	EW-1 Vacuum ("Hg)	EW-1 Vacuum ("H_2O)	OW-1 Vacuum ("H_2O)	MW-327 Vacuum ("H_2O)	PZ-3 Vacuum ("H_2O)	PZ-4 Vacuum ("H_2O)	OW-2 Vacuum ("H_2O)	QW-8 Vacuum ("H_2O)	MW-330 Vacuum ("H_2O)
14:00	0	0	115	0	0.0	0	0.0	0	0	0	0	0	0	0
14:30	30	22	225	2,800	23.9	5	68.0	4.6	0	0.02	0	0	0	-
15:00	60	22	248	3,900	33.2	5	68.0	0.1	0	0.01	0	0	0	-
16:00	120	22	250	4,600	39.2	5	68.0	0	0	0	0.02	0	0	-
17:00	180	22	248	5,100	43.5	9	122.4	0	0	0	0	0	0	0
18:00	240	22	250	6,200	52.8	9	122.4	0	0	0	0	0	0	-
19:00	300	22	251	6,300	53.7	9	122.4	0	0	0	0	0	0	-
20:00	360	22	247	5,900	50.3	9	122.4	0	0	0	0	0	0	0
21:00	420	22	249	6,350	54.1	10	136.0	0	0	0	0	0	0	-
22:00	480	22	251	6,200	52.8	10	136.0	0	0	0	0	0	0	-
23:00	540	22	257	8,100	69.0	11	149.6	0.1	0.02	0	0	0	0	0
0:00	600	22	256	8,000	68.2	10.5	142.8	0.1	0.08	0	0	0	0	-
1:00	660	22	241	6,100	52.0	11	149.6	0.04	0.06	0	0	0	0	-
2:00	720	22	244	7,200	61.4	11	149.6	0.02	0.01	0	0	0	0	0
3:00	780	22	241	5,600	47.7	11	149.6	0.03	0.06	0	0	0	0	-
4:00	840	22	241	5,500	46.9	11	149.6	0.02	0.08	0	0	0	0	-
5:00	900	22	244	4,900	41.8	11	149.6	0.1	0.01	0	0	0	0	0
6:00	960	22	240	6,700	57.1	11	149.6	0.22	0.08	0	0	0	0	-
7:00	1020	22	247	7,200	61.4	12.5	170.0	0.31	0.12	0	0	0	0	-
8:00	1080	22	245	7,000	59.7	12	163.2	0.18	0.16	0	0	0	0	0
9:30	1170	22	250	6,900	58.8	15	204.0	0.25	0.18	0	0	0	0	-

Table 5
Multi-Phase Extraction Pilot Test Drawdown Results
October 6 and 7, 2009
Hannover Property
731 West Chippewa Avenue
South Bend, Indiana

Time	Time After Start (min)	OW-1 DTP (ft)	OW-1 DTW (ft)	MW-327 DTP (ft)	MW-327 DTW (ft)	PZ-3 DTP (ft)	PZ-3 DTW (ft)	PZ-4 DTW (ft)	OW-2 DTP (ft)	OW-2 DTW (ft)	QW-8 DTW (ft)	MW-330 DTW (ft)
14:00	0	13.69	13.74	17.11	17.97	13.89	13.98	13.46	12.67	12.70	12.39	15.32
14:30	30	14.25	14.31	17.39	18.22	14.00	14.10	13.36	12.55	12.57	12.23	-
15:00	60	14.40	14.47	17.61	18.35	14.08	14.17	13.40	12.57	12.59	12.24	-
16:00	120	14.45	14.50	17.67	18.39	13.97	14.06	13.45	12.62	12.63	12.26	-
17:00	180	14.46	14.51	17.70	18.40	14.00	14.10	13.47	12.64	12.65	12.28	15.21
18:00	240	14.45	14.50	17.71	18.39	14.04	14.13	13.51	-	-	12.31	-
19:00	300	14.48	14.54	17.73	18.42	14.07	14.17	13.52	12.70	12.71	12.32	-
20:00	360	14.50	14.56	17.75	18.42	14.07	14.17	13.53	12.71	12.73	12.33	15.27
21:00	420	14.51	14.58	17.77	18.43	14.09	14.19	13.54	12.72	12.75	12.35	-
22:00	480	14.51	14.57	17.78	18.43	14.11	14.21	13.55	12.74	12.77	12.37	-
23:00	540	14.54	14.59	17.83	18.46	14.13	14.23	13.59	12.74	12.77	12.39	15.34
0:00	600	14.57	14.65	17.83	18.46	14.18	14.28	13.61	12.80	12.82	12.37	-
1:00	660	14.61	14.70	17.90	18.51	14.21	14.31	13.64	12.80	12.83	12.42	-
2:00	720	14.64	14.72	17.94	18.55	14.25	14.35	13.67	12.85	12.88	12.43	15.36
3:00	780	14.64	14.73	17.95	18.58	14.25	14.35	13.68	12.87	12.90	12.43	-
4:00	840	14.64	14.74	17.97	18.60	14.25	14.35	13.69	12.88	12.91	12.44	-
5:00	900	14.67	14.74	17.99	18.60	14.27	14.37	13.71	12.90	12.93	12.48	15.46
6:00	960	14.70	14.76	18.02	18.61	14.31	14.41	13.74	12.93	12.96	12.53	-
7:00	1020	14.72	14.80	18.04	18.62	14.33	14.43	13.77	12.95	12.97	12.55	-
8:00	1080	14.73	14.81	18.07	18.63	14.35	14.45	13.79	12.98	13.00	12.56	15.52
9:30	1170	14.48	14.56	17.83	18.21	14.35	14.45	13.79	12.99	13.01	12.57	-

Table 6
Product Recovery Test Results
Hannover Property
731 West Chippewa Avenue
South Bend, Indiana

Well ID	Depth to Product (ft)	Product Elevation (ft)	Depth to Water (ft)	Water Elevation (ft)	Product Thickness (ft)	Time (min)
MW-327	16.21	83.79	16.40	83.60	0.19	2
100.00	16.17	83.83	16.45	83.55	0.28	4
	16.15	83.85	16.48	83.52	0.33	6
	16.14	83.86	16.52	83.48	0.38	8
	16.13	83.87	16.55	83.45	0.42	10
	16.12	83.88	16.58	83.42	0.46	12
	16.12	83.88	16.61	83.39	0.49	14
	16.11	83.89	16.63	83.37	0.52	16
	16.11	83.89	16.65	83.35	0.54	18
	16.10	83.90	16.66	83.34	0.56	20
	16.09	83.91	16.69	83.31	0.60	25
	16.08	83.92	16.72	83.28	0.64	30
	16.08	83.92	16.73	83.27	0.65	35
	16.08	83.92	16.75	83.25	0.67	40
	16.07	83.93	16.77	83.23	0.70	50
	16.06	83.94	16.78	83.22	0.72	60
	16.04	83.96	16.77	83.23	0.73	120
	16.04	83.96	16.80	83.20	0.76	180

Appendix A

QUALITY ENVIRONMENTAL PROFESSIONALS, INC.
1611 South Franklin Road
Indianapolis, Indiana

LOG OF: **B-100** **(1 of 1)**

Project Number: **08-04-009**

Client:	**City of South Bend**	Drilling Method:	**Hollow Stem Auger**
Project:	**Hannover Property**	Sampling Method:	**Continuous**
Location:	**731 West Chippewa Avenue, South Bend, Indiana**	Weather:	**sunny, 45**
Logged By:	**NV**	Time Terminated:	**1145**
Drilling Company:	**Earth Exploration** Drillers: **Craig, Joe**	Completion Date:	**March 16, 2009**

Depth (feet)	SOIL DESCRIPTION	Sample	REMARKS	PID (ppm)	Depth (feet)
	Asphalt				
	10YR 3/2 very dark grayish brown, LOAMY SAND fill with gravel, asphalt debris, very moist			4.3	
				2.5	
5	10YR 4/2 dark grayish brown, medium grained SAND with gravel, very moist			8.7	5
	Coal scuttle and asphalt debris, 10YR 3/1 very dark gray mottled 10YR 4/2 dark grayish brown				
	10YR 4/1 dark gray, medium grained SAND, very moist, coal scuttle debris			4.8	
				6.0	
10	10YR 4/2 dark grayish brown, SANDY LOAM (50% sand, 30% silt, 20% clay) with gravel, very moist				10
	10YR 4/3 brown, medium to coarse grained SAND			4.2	
				9.1	
	Saturated at 13 feet, slight petroleum odor, mottled 10YR 4/2 dark grayish brown				
15	Strong petroleum odor			30.7	15
	10 YR 3/3 dark brown, medium to coarse SAND, saturated, very strong petroleum odor, slight sheen on soil			94.7	
	10YR 4/1 dark gray, medium to coarse grained SAND, very strong petroleum odor, sheen on soil			143.2	
20	Gravel				20
	10YR 4/1 dark gray, fine to medium grained SAND with gravel, saturated, very strong odor			171.7	
	very wet, very strong odor		Soil sampled from 22 to 24 feet bgs for TPH GRO, TPH ERO, VOCs, and cPAHs	310.5	
25	saturated, sheen in soil			253.6	25
				179.1	
				54.3	
30	10YR 4/3 brown, medium grained SAND with gravel, saturated, strong odor				30
				287.5	
	odorless			113.1	
	very light odor				
35				0.3	35
	Bottom of Boring at 36 ft				

QUALITY ENVIRONMENTAL PROFESSIONALS, INC.
1611 South Franklin Road
Indianapolis, Indiana

LOG OF: **B-101** **(1 of 1)**

Project Number: **08-04-009**

Client:	**City of South Bend**	Drilling Method:	**Hollow Stem Auger**
Project:	**Hannover Property**	Sampling Method:	**Continuous**
Location:	**731 West Chippewa Avenue, South Bend, Indiana**	Weather:	**sunny, 50**
Logged By:	**NV**	Time Terminated:	**1315**
Drilling Company:	**Earth Exploration** Drillers: **Craig, Joe**	Completion Date:	**March 17, 2009**

Depth (feet)	SOIL DESCRIPTION	Sample	REMARKS	PID (ppm)	Depth (feet)
	Asphalt				
	10YR 3/2 very dark grayish brown, LOAMY SAND fill with gravel, moist			2.2	
	10YR 4/2 dark grayish brown, SANDY LOAM (60% sand, 30% silt, 10% clay), moist, slightly foam, gravel			0.3	
5	10YR 4/1 dark gray mottled with 10YR 3/2 very dark grayish brown, fine to medium grained SAND, moist, slightly firm, gravel			1.7	5
	wet, debris and coal scuttle			0.6	
	10YR 4/2 dark grayish brown, SANDY CLAY LOAM (50% sand, 15% silt, 35% clay), wet, gravel, slightly firm, soft			0.7	
10	10YR 4/2 dark grayish brown, medium to coarse grained SAND with gravel, wet			4.3	10
	Poor Recovery			5.9	
15	10YR 4/1 dark gray, medium to coarse grained SAND with gravel, very wet			14.7	15
	Saturated at 16 feet			146.2	
	Slight odor			199.3	
20	very strong odor, sheen on soil, saturated			253.7	20
	very strong odor, sheen on soil			199.9	
	10YR 4/1 dark gray, fine to medium grained SAND with gravel, saturated, very strong odor, slight sheen on soil		Soil sampled from 24 to 26 feet bgs for TPH GRO, TPH ERO, VOCs, and cPAHs	324.1	
25	Subsiding odor			84.7	25
	10YR 4/1 dark gray, medium to coarse grained SAND with gravel, slight odor			47.2	
30	10YR 4/1 dark gray, fine to medium grained SAND, saturated			17.3	30
	10YR 4/3 brown, medium to coarse grained SAND with gravel, very wet			4.9	
35	Bottom of Boring at 34 ft				35

QUALITY ENVIRONMENTAL PROFESSIONALS, INC.
1611 South Franklin Road
Indianapolis, Indiana

LOG OF: B-102/PZ-10

Project Number: **08-04-009**

Client:	**City of South Bend**	Drilling Method:	**Direct Push**
Project:	**Hannover Property**	Sampling Method:	
Location:	**731 West Chippewa Avenue, South Bend, Indiana**	Weather:	**cloudy, 40's**
Logged By:	**ALS**	Time Terminated:	**1215**
Drilling Company:	**Earth Exploration** Drillers: **Sam, Carl**	Completion Date:	**March 24, 2009**

Depth (feet)	SOIL DESCRIPTION	Sample	REMARKS	PID (ppm)	Depth (feet)
	Asphalt				
	10YR 3/2 very dark grayish brown, SILT (90% silt, 10% clay), soft, slightly moist			0.0	
	Begin 10YR 5/6 yellowish brown mottling			1.0	
5	10YR 5/6 yellowish brown mottling, SILT LOAM (50% silt, 40% sand, 10% clay), soft, moist			0.0	5
	10YR 4/3 brown, poorly sorted, coarse SAND, moist			1.3	
				1.9	
10					10
	SAND becomes more compact			0.0	
	Saturated at 12 feet			0.0	
15				0.0	15
				0.0	
				0.0	
20				0.0	20
				0.0	
	No Recovery			-	
25					25
				0.0	
	Bottom of Boring at 28 ft				

QUALITY ENVIRONMENTAL PROFESSIONALS, INC.
1611 South Franklin Road
Indianapolis, Indiana

LOG OF: B-103/PZ-11

(1 of 1)

Project Number: **08-04-009**

Client:	**City of South Bend**	Drilling Method:	**Hollow Stem Auger**
Project:	**Hannover Property**	Sampling Method:	**Split Spoon**
Location:	**731 West Chippewa Avenue, South Bend, Indiana**	Weather:	**cloudy, 50's**
Logged By:	**ALS**	Time Terminated:	**1749**
Drilling Company:	**Earth Exploration** Drillers: **Craig, Joe**	Completion Date:	**March 24, 2009**

Depth (feet)	SOIL DESCRIPTION	Sample	REMARKS	PID (ppm)	Depth (feet)
	Asphalt				
	10YR 3/1 very dark gray, SILT LOAM (70% silt, 20% sand, 10% clay), soft, slightly moist			0.1	
	10YR 4/3 brown, LOAMY SAND (80% sand, 20% silt) with gravel, soft, slightly moist			2.7	
	10YR 3/1 very dark gray, SILT LOAM (70% silt, 20% sand, 10% clay), soft, slightly moist			0.0	
5	10YR 4/3 brown, LOAMY SAND (80% sand, 20% silt) with gravel, soft, slightly moist				5
	10YR 4/4 dark yellowish brown			0.0	
	2.5Y 5/1 gray			0.0	
	Begin 10YR 5/6 yellowish brown mottling			0.0	
	poorly sorted, coarse SAND with 2.5Y 5/1 gray mottling, slightly moist, soft				
10	10YR 3/6 dark yellowish brown, LOAMY SAND (90% sand, 10% silt), very moist			2.4	10
	poorly sorted, coarse SAND with 2.5Y 5/1 gray mottling, slightly moist, soft			0.6	
	Saturated at 12 feet				
15				1.4	15
	medium to fine grained SAND			0.7	
				0.2	
20	gravel				20
				0.0	
				0.1	
25				0.0	25
				0.2	
				0.2	
30					30
				0.0	
	Bottom of Boring at 32 ft				

QUALITY ENVIRONMENTAL PROFESSIONALS, INC.
1611 South Franklin Road
Indianapolis, Indiana

LOG OF: B-104/PZ-12

Project Number: **08-04-009**

Client:	**City of South Bend**	Drilling Method:	**Hollow Stem Auger**
Project:	**Hannover Property**	Sampling Method:	**Split Spoon**
Location:	**731 West Chippewa Avenue, South Bend, Indiana**	Weather:	**partly cloudy - 50's**
Logged By:	**ALS**	Time Terminated:	**1130**
Drilling Company:	**Earth Exploration** Drillers: **Craing, Joe**	Completion Date:	**March 25, 2009**

Depth (feet)	SOIL DESCRIPTION	Sample	REMARKS	PID (ppm)	Depth (feet)
	Gravel			0.0	
	10YR 4/6 dark yellowish brown, SANDY LOAM (40% silt, 60% sand) with gravel, moist, soft			0.1	
	10YR 4/3 brown, SAND with gravel, very moist, soft			0.0	5
5	10YR 5/3 brown, SANDY LOAM (70% sand, 20% silt, 10% clay), very moist, soft			0.0	
	10YR 4/3 brown, medium to coarse grained SAND, very moist, soft			0.0	
	10YR 5/3 brown, SANDY LOAM (70% sand, 20% silt, 10% clay), very moist, soft			0.0	
	No Recovery			0.0	
10	10YR 5/3 brown, SANDY LOAM (70% sand, 20% silt, 10% clay), very moist, soft			0.0	10
	10YR 2/1 black, SILT LOAM (70% silt, 10% sand, 20% clay), very soft, moist, organic matter			0.0	
	10YR 5/3 brown, SANDY LOAM (70% sand, 20% silt, 10% clay), very moist, soft			3.5	
15	10YR 2/1 black, SILT LOAM (70% silt, 10% sand, 20% clay), very soft, moist, organic matter			20.9	15
	10YR 4/4 dark yellowish brown, SANDY LOAM (70% sand 20% silt, 10% clay), very moist, soft			134.2	
	10YR 2/1 black, SILT LOAM (70% silt, 10% sand, 20% clay), very soft, moist, organic matter			64.9	
20	10YR 4/3 brown, medium to coarse grained SAND, very moist, soft			73.3	20
	10YR 2/1 black staining, strong odor			90.5	
	Saturated at 18 feet			103.0	
	stained 2.5Y 4/1 dark gray, strong odor			108.6	
25	Staining becomes 10YR 5/1 gray			99.7	25
				109.6	
				71.3	
30	10YR 6/2 light brownish gray			25.5	30
	gravel content increases				
35					35
	10YR 4/3 brown, staining stops, odor stops				
	Bottom of Boring at 38 ft				

QUALITY ENVIRONMENTAL PROFESSIONALS, INC.
1611 South Franklin Road
Indianapolis, Indiana

LOG OF: B-105/PZ-13

Project Number: **08-04-009**

Client:	**City of South Bend**	Drilling Method:	**Hollow Stem Auger**
Project:	**Hannover Property**	Sampling Method:	**Split Spoon**
Location:	**731 West Chippewa Avenue, South Bend, Indiana**	Weather:	**sunny, 60's**
Logged By:	**ALS**	Time Terminated:	**1452**
Drilling Company:	**Earth Exploration** Drillers: **Craig, Joe**	Completion Date:	**March 25, 2009**

Depth (feet)	SOIL DESCRIPTION	Sample	REMARKS	PID (ppm)	Depth (feet)
	Asphalt				
	10YR 3/6 dark yellowish brown, LOAM (50% sand, 30% silt, 20% clay), soft, slightly moist			0.0	
	10YR 2/1 black, SILTY CLAY LOAM (70% silt, 30% clay), stiff, slightly moist,			0.0	
5	10YR 3/6 dark yellowish brown, LOAM (50% sand, 30% silt, 20% clay), soft, slightly moist			0.0	5
	10YR 2/1 black, SILTY CLAY LOAM (70% silt, 30% clay), stiff, slightly moist,			0.0	
	10YR 4/3 brown, fine to medium grained SAND, very moist			0.0	
	10YR 2/1 black, SILTY CLAY LOAM (70% silt, 30% clay), stiff, slightly moist,			0.0	
	No Recovery				
10	10YR 3/6 dark yellowish brown, LOAM (50% sand, 30% silt, 20% clay), soft, slightly moist			0.0	10
	10YR 2/1 black, SILTY CLAY LOAM (70% silt, 30% clay), stiff, slightly moist,			1.7	
	10YR 3/6 dark yellowish brown, LOAM (50% sand, 30% silt, 20% clay), soft, slightly moist			0.0	
	10YR 4/3 brown, fine to medium grained SAND, very moist			0.0	
15	wet			0.0	15
	Saturated at 18 feet			0.0	
	medium to coarse grained SAND			0.0	
20				0.0	20
				47.3	
	10YR 5/1 gray staining, slight odor			74.1	
25	fine grained SAND			81.5	25
	coarse grained SAND				
	fine to medium grained SAND				
	medium to coarse grained SAND, odor stops			10.8	
30	staining stops			0.9	30
	Bottom of Boring at 34 ft				

QUALITY ENVIRONMENTAL PROFESSIONALS, INC.
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LOG OF: B-106/PZ-14

Project Number: **08-04-009**

Client:	**City of South Bend**	Drilling Method:	**Hollow Stem Auger**
Project:	**Hannover Property**	Sampling Method:	**Split Spoon**
Location:	**731 West Chippewa Avenue, South Bend, Indiana**	Weather:	**sunny, 45**
Logged By:	**NV**	Time Terminated:	**1800**
Drilling Company:	**Earth Exploration** Drillers: **Craig, Joe**	Completion Date:	**March 25, 2009**

Depth (feet)	SOIL DESCRIPTION	Sample	REMARKS	PID (ppm)	Depth (feet)
	Asphalt			0.0	
	10YR 3/3 dark brown, medium grained SAND fill with organics			0.0	
	10YR 4/3 brown, medium to coarse grained SAND fill with gravel, slightly moist			0.0	
5	10YR 4/2 dark grayish brown with 10YR 3/1 very dark gray mottling, SANDY CLAY LOAM (60% sand, 20% silt, 20% clay) with gravel, very moist, firm, plastic			0.0	5
				0.0	
	10YR 4/2 dark grayish brown, medium to coarse grained SAND with gravel, moist			0.1	
10	10YR 3/2 very dark grayish brown, SANDY CLAY LOAM (60% sand, 20% silt 20% clay) with gravel, very moist, firm, plastic			0.0	10
	wet at 11 feet bgs			0.0	
	10YR 4/1 dark gray, medium grained SAND with gravel, wet			0.0	
15	10YR 4/1 dark gray, medium to coarse grained SAND with gravel			0.0	15
	Saturated at 15 feet bgs			0.1	
				0.1	
20	10YR 4/3 brown, medium to coarse grained SAND with gravel, saturated			-	20
				-	
25	10YR 4/2 dark grayish brown, medium to coarse grained SAND with gravel, saturated			-	25
				-	
				-	
30	6 inch fine grained SAND seam at 29.5 feet bgs			-	30
	Bottom of Boring at 32 ft				

QUALITY ENVIRONMENTAL PROFESSIONALS, INC.
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LOG OF: B-107/PZ-15

Project Number: **08-04-009**

Client:	**City of South Bend**	Drilling Method:	**Hollow Stem Auger**
Project:	**Hannover Property**	Sampling Method:	**Split Spoon**
Location:	**731 West Chippewa Avenue, South Bend, Indiana**	Weather:	**p. cloudy, 40**
Logged By:	**NV**	Time Terminated:	**1050**
Drilling Company:	**Earth Exploration** Drillers: **Craig, Joe**	Completion Date:	**March 26, 2009**

Depth (feet)	SOIL DESCRIPTION	Sample	REMARKS	PID (ppm)	Depth (feet)
	Asphalt				
	10YR 3/1 very dark gray with 10YR 3/3 dark brown mottling, course grained SAND fill with gravel, moist			0.0	
	10YR 4/3 brown with 10YR 6/3 pale gray mottling, SANDY LOAM fill with gravel, debris, moist			0.0	
5	Brick debris at 5 feet bgs			10.2	5
	Coal debris at 7 feet bgs			14.9	
	10YR 3/3 dark brown, medium to coarse grained SAND, slightly moist, slight creosol odor			24.7	
10					10
	10YR 4/3 brown, medium grained SAND, very wet, slight creosol odor			53.8	
	10YR 4/3 brown, medium to coarse grained SAND with gravel			65.7	
	Saturated at 14 feet bgs				
15				49.7	15
	Slight creosol odor at 17 feet bgs			43.6	
				53.2	
20					20
	No odor at 17 feet bgs			50.0	
	10YR 6/2 light brownish gray, medium to coarse grained SAND with gravel, saturated			43.1	
25	Cobble at 25 feet bgs			21.1	25
	10YR 4/2 dark grayish brown, medium to coarse grained SAND with gravel, saturated			14.9	
	10YR 4/2, dark grayish brown, fine grained SAND with gravel, saturated			6.9	
30					30
				4.1	
	Bottom of Boring at 32 ft				

QUALITY ENVIRONMENTAL PROFESSIONALS, INC.
1611 South Franklin Road
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LOG OF: B-108/PZ-16
(1 of 1)

Project Number: **08-04-009**

Client:	**City of South Bend**	Drilling Method:	**Hollow Stem Auger**
Project:	**Hannover Property**	Sampling Method:	**Split Spoon**
Location:	**731 West Chippewa Avenue, South Bend, Indiana**	Weather:	**p. cloudy, 45**
Logged By:	**NV**	Time Terminated:	**1320**
Drilling Company:	**Earth Exploration** Drillers: **Craig, Joe**	Completion Date:	**March 26, 2009**

Depth (feet)	SOIL DESCRIPTION	Sample	REMARKS	PID (ppm)	Depth (feet)
	Asphalt				
	10YR 3/1 very dark gray with 10YR 4/1 dark gray mottling, SAND fill with debris			1.0	
	10YR 4/2 dark grayish brown, SAND fill with coal debris			1.3	
	10YR 3/1 very dark gray with 10YR 4/2 dark grayish brown mottling, SAND fill with coal debris and gravel, moist			0.7	
5	Wood debris at 6 feet bgs			0.7	5
	10YR 5/4 yellowish brown, medium to coarse grained SAND with gravel and debris, slightly moist			1.3	
	10YR 5/3 brown, medium to coarse grained SAND, wet, slight creosol odor			1.5	
10	Very wet at 12.5 feet bgs			1.5	10
	Saturated at 13.5 feet bgs, slight odor			2.8	
	10YR 4/2 dark grayish brown, medium to coarse grained SAND with gravel, saturated			1.9	
15	10YR 4/3 brown, medium to coarse grained SAND with gravel, saturated			25.	15
	10YR 4/2 dark grayish brown, medium grained SAND, saturated			2.8	
	medium to coarse grained SAND, gravel			2.2	
20	Cobble at 25 feet bgs			2.1	20
	10YR 4/1 dark gray, medium grained SAND with gravel, saturated			2.8	
25	10YR 4/3 brown, medium to coarse grained SAND with gravel, saturated			2.2	25
	Bottom of Boring at 34 ft			1.7	
30				1.0	30

BORING LOG 08-03-009 HANNOVER.GPJ BORING LOG.GDT 11/24/09

QUALITY ENVIRONMENTAL PROFESSIONALS, INC.
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Indianapolis, Indiana

LOG OF: B-109/PZ-17

Project Number: **08-04-009**

Client:	**City of South Bend**	Drilling Method:	**Hollow Stem Auger**
Project:	**Hannover Property**	Sampling Method:	**Split Spoon**
Location:	**731 West Chippewa Avenue, South Bend, Indiana**	Weather:	**p. sunny, 50**
Logged By:	**NV**	Time Terminated:	**1630**
Drilling Company:	**Earth Exploration** Drillers: **Craig, Joe**	Completion Date:	**March 26, 2009**

Depth (feet)	SOIL DESCRIPTION	Sample	REMARKS	PID (ppm)	Depth (feet)
	Asphalt				
	10YR 3/2 very dark grayish brown with 10YR 4/3 brown and 10YR 4/1 dark gray mottling, SANDY LOAM fill with gravel and debris, moist			0.1	
	Brick debris at 2.5 feet bgs			1.1	
	Coal debris at 3.5 feet bgs				
5				4.2	5
	10YR 3/3 dark brown with 10YR 4/2 dark grayish brown and 10YR 5/3 brown mottling, SAND fill with debris and gravel, very moist			2.2	
	10YR 3/3 dark brown, SANDY CLAY LOAM (55% sand, 35% clay, 10% silt) with gravel, firm, plastic, very moist			2.9	
10				0.6	10
	Slightly moist at 11 feet bgs				
	10YR 4/2 dark grayish brown with 10YR 3/3 dark brown mottling, medium grained SAND with gravel, very wet			0.9	
	Saturated at 14 feet bgs				
15	10YR 4/3 brown, medium to coarse grained SAND with gravel, saturated			0.5	15
				1.1	
				0.4	
20				0.1	20
	10YR 4/1 dark gray, medium grained SAND with gravel, saturated			0.5	
	Fine to medium grained SAND				
25				1.2	25
	Medium to coarse grained SAND with gravel			1.1	
				1.1	
30	10YR 4/2 dark grayish brown, medium to coarse grained SAND, saturated			-	30
	Bottom of Boring at 32 ft				

QUALITY ENVIRONMENTAL PROFESSIONALS, INC.
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Indianapolis, Indiana

LOG OF: **B-11/QW-2**
(1 of 1)

Project Number: **08-04-009**

Client:	**City of South Bend**	Drilling Method:	**Direct Push/Auger**
Project:	**Hannover Property**	Sampling Method:	**continuous**
Location:	**731 West Chippewa Avenue, South Bend, Indiana**	Weather:	**sunny, 70's**
Logged By:	**DWM**	Time Terminated:	**1000**
Drilling Company:	**Midway** Drillers: **Mark and Zach**	Completion Date:	**June 20, 2008**

Depth (feet)	SOIL DESCRIPTION	Sample	REMARKS	PID (ppm)	Depth (feet)
	fine grained SAND with gravel and coal, dry, 10 YR 3/1 very dark gray	1	soil sample taken between 0'-2' for laboratory analysis	0	
2	fine grained SAND with gravel, moist, 10 YR 4/3 brown	2		0	2
4		3		0	4
6		4		0	6
8	fine grained SAND, wet to very wet, 10 YR 4/3 brown	5		0	8
10		6	soil sample taken between 10'-12' for laboratory analysis	0	10
12	fine grained SAND, saturated at 12 feet, 10 YR 4/3 brown	7		0	12
14		8		0	14
16		9		0	16
18	Bottom of Boring at 18 ft				18

QUALITY ENVIRONMENTAL PROFESSIONALS, INC.
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Indianapolis, Indiana

LOG OF: B-110/PZ-18

Project Number: **08-04-009**

Client:	**City of South Bend**	Drilling Method:	**Hollow Stem Auger**
Project:	**Hannover Property**	Sampling Method:	**Split Spoon**
Location:	**731 West Chippewa Avenue, South Bend, Indiana**	Weather:	**p. sunny, 35**
Logged By:	**NV**	Time Terminated:	
Drilling Company:	**Earth Exploration** Drillers: **Craig, Joe**	Completion Date:	**March 27, 2009**

Depth (feet)	SOIL DESCRIPTION	Sample	REMARKS	PID (ppm)	Depth (feet)
	Concrete				
	10YR 3/3 dark brown, coarse grained SAND fill with gravel and debris			0.9	
	10YR 4/3 brown, medium to coarse grained SAND fill with gravel and debris, moist			2.1	
	10YR 3/3 brown, SANDY CLAY LOAM (55% sand, 35% clay, 10% sand) with gravel, firm, plastic, moist			2.7	5
5	10YR 4/2 dark grayish brown mottled with 10YR 3/2 very dark grayish brown, medium to coarse grained SAND with gravel, moist			8.4	
	10YR 6/2 light brownish gray, medium to coarse grained SAND with gravel, wet			11.4	
10	10YR 4/1 dark gray, medium to coarse grained, SAND with gravel, saturated at 9 feet bgs			12.5	10
	10YR 4/3 brown mottling at 13 feet bgs			15.6	
15	Cobble at 16 feet bgs			4.3	15
				4.2	
				2.2	
20	10YR 6/1 gray, medium to coarse grained SAND with gravel, saturated, slight odor			18.6	20
				15.0	
	Cobble at 24 feet bgs				
25	10YR 4/1 dark gray, fine to medium grained SAND with gravel, saturated, very slight odor			4.2	25
				2.5	
	10YR 4/4 dark yellowish brown, fine to medium grained SAND, saturated			2.3	
30	10YR 5/4 yellowish brown, SANDY LOAM with gravel, saturated			-	30
	Bottom of Boring at 32 ft				

QUALITY ENVIRONMENTAL PROFESSIONALS, INC.
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Indianapolis, Indiana

LOG OF: B-111/PZ-19

Project Number: **08-04-009**

Client:	**City of South Bend**	Drilling Method:	**Hollow Stem Auger**
Project:	**Hannover Property**	Sampling Method:	**Split Spoon**
Location:	**731 West Chippewa Avenue, South Bend, Indiana**	Weather:	**p. sunny, 40**
Logged By:	**NV**	Time Terminated:	
Drilling Company:	**Earth Exploration** Drillers: **Craig, Joe**	Completion Date:	**March 26, 2009**

Depth (feet)	SOIL DESCRIPTION	Sample	REMARKS	PID (ppm)	Depth (feet)
	Asphalt				
	10YR 3/3 dark brown with 10YR 4/2 dark grayish brown mottling, gravelly SAND fill, moist			1.9	
	Coal debris at 3 feet bgs			8.0	
	Wood debris at 4 feet bgs				
5	10YR 5/6 yellowish brown, medium to coarse grained SAND fill with gravel, very moist			12.6	5
	10YR 5/4 yellowish brown, SANDY CLAY LOAM (55% sand, 35% clay, 10% silt) with gravel, firm, plastic, very moist			0.3	
	10YR 5/4 yellowish brown with 10YR 4/1 dark gray mottling, medium to coarse grained SAND with gravel, wet			0.4	
10				0.3	10
	Saturated at 11.5 feet bgs			0.7	
15				0.7	15
	10YR 4/1 dark gray with 10YR 4/4 dark yellowish brown mottling, medium to coarse grained SAND with gravel, saturated			1.1	
				1.0	
20	10YR 4/3 brown with 10YR 4/2 dark grayish brown mottling, medium to coarse grained SAND with gravel, saturated			4.0	20
				2.9	
25	10YR 4/3 brown, fine to medium grained SAND, saturated			0.7	25
	10YR 4/3 brown, very coarse grained SAND with gravel, saturated			0.9	
	Cobble at 28 feet bgs			1.1	
30	10YR 4/3 brown, medium to coarse grained SAND with gravel, saturated			0.4	30
	10YR 4/3 brown, SANDY LOAM with gravel, saturated			-	
	Bottom of Boring at 34 ft				

QUALITY ENVIRONMENTAL PROFESSIONALS, INC.
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Indianapolis, Indiana

LOG OF: B-112/PZ-20

Project Number: **08-04-009**

Client:	**City of South Bend**	Drilling Method:	**Hollow Stem Auger**
Project:	**Hannover Property**	Sampling Method:	**Split Spoon**
Location:	**731 West Chippewa Avenue, South Bend, Indiana**	Weather:	**sunny, 45**
Logged By:	**NV**	Time Terminated:	**1540**
Drilling Company:	**Earth Exploration** Drillers: **Craig, Joe**	Completion Date:	**March 27, 2009**

Depth (feet)	SOIL DESCRIPTION	Sample	REMARKS	PID (ppm)	Depth (feet)
	Asphalt				
	10YR 3/2 very dark grayish brown, gravelly SAND fill, debris			0.0	
	10YR 3/3 dark brown, medium grained SAND fill, debris, moist			0.1	
	Brick debris at 3 feet bgs				
5	10YR 4/4 dark yellowish brown, SANDY CLAY LOAM (60% sand, 25% clay, 15% silt) with gravel, firm, plastic, moist			0.1	5
				0.0	
				0.4	
10	10YR 3/2 very dark grayish brown, medium to coarse grained SAND fill with gravel, moist				10
	10YR 4/2 dark grayish brown, medium grained SAND with gravel, wet			0.0	
	10YR 4/2 dark grayish brown, medium to coarse grained SAND with gravel, saturated at 13 feet bgs			0.2	
15				0.3	15
	10YR 3/2 very dark grayish brown mottling			1.1	
	10YR 4/1 dark gray, medium grained SAND, saturated			4.7	
20	10YR 3/1 very dark gray, medium to coarse grained SAND, saturated				20
	10YR 4/1 dark gray with 10YR 3/2 very dark grayish brown mottling, fine to medium grained SAND with gravel, saturated			6.9	
				18.7	
25	10YR 4/1 dark gray, medium to coarse grained SAND with gravel, saturated, petroleum odor			37.6	25
				14.3	
	10YR 4/1 dark gray, fine to medium grained SAND with gravel, saturated, very slight odor				
	10YR 4/3 brown, with 10YR 4/2 dark grayish brown mottling, SANDY LOAM with gravel, saturated, no odor			3.9	
30				1.0	30
	Bottom of Boring at 32 ft				

QUALITY ENVIRONMENTAL PROFESSIONALS, INC.
1611 South Franklin Road
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LOG OF: B-113/PZ-21

(1 of 1)

Project Number: **08-04-009**

Client:	**City of South Bend**	Drilling Method:	**Hollow Stem Auger**
Project:	**Hannover Property**	Sampling Method:	**Split Spoon**
Location:	**731 West Chippewa Avenue, South Bend, Indiana**	Weather:	**sunny, 50**
Logged By:	**NV**	Time Terminated:	**1625**
Drilling Company:	**Earth Exploration** Drillers: **Craig, Joe**	Completion Date:	**March 30, 2009**

Depth (feet)	SOIL DESCRIPTION	Sample	REMARKS	PID (ppm)	Depth (feet)
	Asphalt				
	10YR 3/3 dark brown with 10YR 5/4 yellowish brown mottling, coarse grained SAND fill with gravel and debris, slightly moist			0.4	
	Poor Recovery			-	
5				1.1	5
	Concrete at 6 feet bgs				
	Concrete debris at 7 feet bgs, moist			10.4	
	10YR 4/2 dark grayish brown at 9 feet bgs			13.7	
10	Brick debris at 10 feet bgs				10
	10YR 4/2 dark grayish brown with 10YR 3/2 very dark grayish brown mottling, coarse grained SAND with gravel, very wet			19.2	
	10YR 4/2 dark grayish brown, medium to coarse grained SAND with gravel, very wet			29.7	
15	10YR 4/4 dark yellowish brown with 10YR 4/1 dark gray mottling, medium to coarse grained SAND, saturated at 13 feet bgs			41.4	15
	10YR 4/2 dark grayish brown, medium to coarse grained SAND with gravel, saturated			58.7	
	10YR 4/3 brown, medium to coarse grained SAND with gravel, saturated			88.6	
20				89.6	20
	10YR 4/1 dark gray, fine to medium grained SAND with gravel, saturated, light sheen on soil, slight odor			121.7	
25	10YR 4/3 brown, medium to coarse grained SAND with gravel, saturated			77.5	25
	Cobble at 26 feet bgs			37.1	
	10YR 4/3 brown, fine to medium grained SAND with gravel, saturated			14.8	
30				-	30
	Bottom of Boring at 32 ft				

QUALITY ENVIRONMENTAL PROFESSIONALS, INC.
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Indianapolis, Indiana

LOG OF: B-114/PZ-22

Project Number: **08-04-009**

Client:	**City of South Bend**	Drilling Method:	**Hollow Stem Auger**
Project:	**Hannover Property**	Sampling Method:	**Split Spoon**
Location:	**731 West Chippewa Avenue, South Bend, Indiana**	Weather:	**p. cloudy, 45**
Logged By:	**NV**	Time Terminated:	**930**
Drilling Company:	**Earth Exploration** Drillers: **Craig, Joe**	Completion Date:	**March 31, 2009**

Depth (feet)	SOIL DESCRIPTION	Sample	REMARKS	PID (ppm)	Depth (feet)
	Asphalt				
	10YR 3/3 dark brown, coarse grained SAND fill with gravel, debris, moist			0.0	
	10YR 4/3 brown, medium grained SAND fill with gravel, moist			0.0	
	10YR 3/3 dark brown, SANDY LOAM fill with debris, slag, very moist			0.1	
5	10YR 4/3 brown, medium to coarse grained SAND with gravel, moist			0.0	5
	10YR 3/1 very dark gray with 10YR 3/3 dark brown mottling, fine to medium grained SAND, debris, moist			0.0	
	slag debris at 9.5 feet bgs			0.0	
10	10YR 5/6 yellowish brown, medium to coarse grained SAND with gravel, very moist			0.0	10
				0.0	
				0.2	
15	10YR 6/1 gray, medium to coarse grained SAND, very wet			0.1	15
	10YR 4/2 dark grayish brown, medium to coarse grained SAND with gravel, saturated at 16 feet bgs			0.1	
	10YR 4/3 brown mottling begins at 19 feet bgs			0.2	
20					20
	10YR 4/3 brown, medium to coarse grained SAND with gravel, saturated			0.1	
	Cobble at 25 feet bgs			0.0	
25	10YR 6/3 pale brown, medium to coarse grained with gravel, saturated			0.0	25
				-	
30	Bottom of Boring at 30 ft				30

QUALITY ENVIRONMENTAL PROFESSIONALS, INC.
1611 South Franklin Road
Indianapolis, Indiana

LOG OF B-115/EW-1/OW-1

Project Number: **08-04-009**

Client:	**City of South Bend**	Drilling Method:	**Hollow Stem Auger**
Project:	**Hannover Property**	Sampling Method:	**Split Spoon**
Location:	**731 West Chippewa Avenue, South Bend, Indiana**	Weather:	**65°F, cloudy**
Logged By:	**NV**	Time Terminated:	**13:15**
Drilling Company:	**Earth Exploration** Drillers: **Craig, Joe**	Completion Date:	**September 21, 2009**

Depth (feet)	SOIL DESCRIPTION	Sample	REMARKS	PID (ppm)	Depth (feet)
	6" of Asphalt				
	10YR 4/3 brown, FILL SAND, coarse grained, with gravel			0.0	
	10YR 3/3 dark brown, FILL SAND, medium grained, with gravel, moist			0.0	
	10YR 4/2 dark grayish brown, FILL SAND, with dark brown mottles, medium grained, with gravel, moist			0.1	
5	coal debris at 5.5'			0.0	5
	clay at 7'			0.0	
	10YR 4/2 dark grayish brown, SANDY CLAY LOAM, with gravel, wet			0.0	
10	slight odor at 9'			0.0	10
	10YR 4/1 dark gray, SAND, medium to coarse grained, with gravel, very wet, slight petroleum odor			0.0	
	10YR 4/1 dark gray, SAND, medium to coarse grained, with gravel, very wet, petroleum odor			0.2	
15	10YR 4/1 dark gray, SAND, with brown mottles, medium to coarse grained, with gravel, saturated at 14', heavy odor			0.1	15
	slight sheen on soil at 19', saturated			0.1	
				0.2	
20	gravel and cobbles at 21', heavy odor, sheen on soil , saturated			0.1	20
	10YR 6/2 light brownish gray, SAND, with gray mottles, medium to coarse grained, with gravel, very wet, heavy odor			0.0	
25	10YR 6/2 light brownish gray, SAND, medium to coarse grained, saturated, petroleum odor			0.0	25
	10YR 4/3 brown, SAND, with dark grayish brown mottles, medium to coarse grained, with gravel, saturated, slight odor			-	
30	Bottom of Boring at 30 ft				30

QUALITY ENVIRONMENTAL PROFESSIONALS, INC.
1611 South Franklin Road
Indianapolis, Indiana

LOG OF: B-116/OW-2

(1 of 1)

Project Number: **08-04-009**

Client:	**City of South Bend**	Drilling Method:	**Hollow Stem Auger**
Project:	**Hannover Property**	Sampling Method:	**Split Spoon**
Location:	**731 West Chippewa Avenue, South Bend, Indiana**	Weather:	**60°F, cloudy**
Logged By:	**NV**	Time Terminated:	**9:25**
Drilling Company:	**Earth Exploration** Drillers: **Craig, Joe**	Completion Date:	**September 21, 2009**

Depth (feet)	SOIL DESCRIPTION	Sample	REMARKS	PID (ppm)	Depth (feet)
	Asphalt				
	10YR 3/3 dark brown, FILL SAND, with dark grayish brown mottles, medium to coarse grained, with debris, slight odor			0.0	
	10YR 4/2 dark grayish brown, FILL SAND, medium to coarse grained, with debris, slightly moist			0.0	
5	brick debris at 5'			0.1	5
	10YR 3/2 very dark grayish brown, FILL SAND, fine to medium grained, very moist			0.0	
	10YR 3/2 very dark grayish brown, SANDY CLAY LOAM, with gravel, slightly firm, very moist			0.0	
10	concrete debris at 10'			0.0	10
	10YR 4/2 dark grayish brown, SAND, with gravel, very moist			0.0	
	saturated at 14'			0.0	
15	very dark grayish brown mottles at 15', petroleum odor			0.2	15
	slight sheen on soil at 18'			0.1	
	10YR 6/2 light brownish gray, SAND, with dark grayish brown mottles, medium to coarse grained, with gravel, saturated, petroleum odor			0.1	
20	sheen on soil at 21', heavy odor			0.2	20
				0.1	
25				0.0	25
	petroleum odor subsiding slightly at 27'			0.0	
				-	
30	Bottom of Boring at 30 ft				30

BORING LOG 08-03-009 HANNOVER.GPJ BORING LOG.GDT 11/24/09

Appendix B

ENVision Laboratories, Inc.
1439 Sadlier Circle West Drive
Indianapolis, IN 46239
Tel: 317.351.8632
Fax: 317.351.8639
www.envisionlaboratories.com

Mr. Nivas Vijay
QEPI
1611 South Franklin Road
Indianapolis, IN 46239

April 13, 2009

ENVision Project Number: 2009-553
Client Project Name: 08-04-009/Hannover

Dear Mr. Vijay,

Please find the attached analytical report for the samples received March 20, 2009. All test methods performed were fully compliant with local, state, and federal EPA methods unless otherwise noted. The project was analyzed as requested on the enclosed chain of custody record. Please review the comments section for additional information about your results or Quality Control data.

Feel free to contact me if you have any questions or comments regarding your analytical report or service.

Thank you for your business. ENVision Laboratories looks forward to working with you on your next project.

Yours Sincerely,

David Norris

Client Services Manager
ENVision Laboratories, Inc.

IL ELAP / NELAC Accreditation # 100454

ENVision Laboratories, Inc.
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Analytical Report

Client Name: QEPI

Project ID: Hannover / 08-04-009

Client Project Manager: Nivas Vijay

ENVision Project Number: 2009-553

Analytical Method: 8260
Prep Method: 5035A
Analytical Batch: 032709VS

Client Sample ID: B-100 (22-24')
Envision Sample Number: 9-3604
Sample Matrix: soil

Sample Collection Date/Time: 3/16/09 11:45
Sample Received Date/Time: 3/20/09 08:38

Compounds	Sample Results (ug/kg)	Rep. Limit (ug/kg)	Flags
Acetone	< 11400	11400	3
Acrolein	< 11400	11400	3
Acrylonitrile	< 11400	11400	3
Benzene	< 42	600	3,5
Bromobenzene	< 600	600	3
Bromochloromethane	< 600	600	3
Bromodichloromethane	< 600	600	3
Bromoform	< 600	600	3
Bromomethane	< 600	600	3
n-Butanol	< 5700	5700	3
2-Butanone (MEK)	< 1100	1100	3
n-Butylbenzene	**2230**	600	3
sec-Butylbenzene	**1890**	600	3
tert-Butylbenzene	**1750**	600	3
Carbon Disulfide	< 600	600	3
Carbon Tetrachloride	< 600	600	3
Chlorobenzene	< 600	600	3
Chloroethane	< 600	600	3
2-Chloroethylvinylether	< 5700	5700	3
Chloroform	< 600	600	3
Chloromethane	< 600	600	3
2-Chlorotoluene	< 600	600	3
4-Chlorotoluene	< 600	600	3
1,2-Dibromo-3-chloropropane	< 600	600	3
Dibromochloromethane	< 600	600	3
1,2-Dibromoethane (EDB)	< 600	600	3
Dibromomethane	< 600	600	3
1,2-Dichlorobenzene	< 600	600	3
1,3-Dichlorobenzene	< 600	600	3
1,4-Dichlorobenzene	< 600	600	3
trans-1,4-Dichloro-2-butene	< 114000	114000	3
Dichlorodifluoromethane	< 600	600	3
1,1-Dichloroethane	< 600	600	3
1,2-Dichloroethane	< 600	600	3
1,1-Dichloroethene	< 600	600	3

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Analytical Report

8260 continued…

Compounds	Sample Results (ug/kg)	Rep. Limit (ug/kg)	Flags
cis-1,2-Dichloroethene	< 600	600	3
trans-1,2-Dichloroethene	< 600	600	3
1,2-Dichloropropane	< 600	600	3
1,3-Dichloropropane	< 600	600	3
2,2-Dichloropropane	< 600	600	3
1,1-Dichloropropene	< 600	600	3
cis-1,3-Dichloropropene	< 600	600	3
trans-1,3-Dichloropropene	< 600	600	3
Ethylbenzene	**864**	600	3
Ethyl methacrylate	< 11400	11400	3
Hexachloro-1,3-butadiene	< 600	600	3
n-Hexane	< 1100	1100	3
2-Hexanone	< 1100	1100	3
Iodomethane	< 1100	1100	3
Isopropylbenzene (Cumene)	**1320**	600	3
p-Isopropyltoluene	< 600	600	3
Methylene chloride	< 2300	2300	3
4-Methyl-2-pentanone (MIBK)	< 1100	1100	3
Methyl-tert-butyl-ether	< 180	600	3,5
Naphthalene	**23110**	600	3
n-Propylbenzene	**1870**	600	3
Styrene	< 600	600	3
1,1,1,2-Tetrachloroethane	< 600	600	3
1,1,2,2-Tetrachloroethane	< 600	600	3
Tetrachloroethene	< 600	600	3
Toluene	< 600	600	3
1,2,3-Trichlorobenzene	**893**	600	3
1,2,4-Trichlorobenzene	< 600	600	3
1,1,1-Trichloroethane	< 600	600	3
1,1,2-Trichloroethane	< 600	600	3
Trichloroethene	< 600	600	3
Trichlorofluoromethane	< 600	600	3
1,2,3-Trichloropropane	< 600	600	3
1,2,4-Trimethylbenzene	**21440**	600	3
1,3,5-Trimethylbenzene	**3610**	600	3
Vinyl acetate	< 1100	1100	3
Vinyl chloride	< 200	200	3
Xylene, M&P	**2280**	600	3
Xylene, 0rtho	< 600	600	3
Xylene, Total	**2280**	1200	
Dibromofluoromethane (surrogate)	98%		
1,2-Dichloroethane-d4 (surrogate)	81%		
Toluene-d8 (surrogate)	94%		
4-bromofluorobenzene (surrogate)	77%		
Analysis Date/Time:	3/27/09 / 20:32		
Analyst Initials	tjg		
Percent Solids:	88%		

All results reported on dry weight basis.

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Analytical Report

Client Name: QEPI

Project ID: Hannover / 08-04-009

Client Project Manager: Nivas Vijay

ENVision Project Number: 2009-553

Analytical Method: 8270 SVOC
Prep Method: 3550B
Analytical Batch: 033109B

Client Sample ID: B-100 (22-24')
Envision Sample Number: 9-3604
Sample Matrix: soil

Sample Collection Date/Time: 3/16/09 11:45
Sample Received Date/Time: 3/20/09 08:38

Compounds	Sample Results (mg/kg)	Rep. Limit (mg/kg)	Flags
Benzo(a)anthracene	< 0.38	0.38	
Benzo(a)pyrene	< 0.38	0.38	
Benzo(b)fluoranthene	< 0.38	0.38	
Benzo(k)fluoranthene	< 0.38	0.38	
Chrysene	< 0.38	0.38	
Dibenzo(a,h)anthracene	< 0.38	0.38	
Indeno(1,2,3-cd)pyrene	< 0.38	0.38	
Naphthalene	**19.56**	0.38	2
Nitrobenzene-d5 (surrogate)	82%		
2-Fluorobiphenyl (surrogate)	99%		
p-Terphenyl-d14 (surrogate)	107%		
Analysis Date/Time:	03-31-09/19:16		
Analyst Initials:	gjd		
Date Extracted:	3/23/2009		
Initial Sample Weight:	30 g		
Final Volume:	1.0 mL		
Percent Solids	88%		

All results reported on dry weight basis.

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Analytical Report

Client Name: QEPI

Project ID: Hannover / 08-04-009

Client Project Manager: Nivas Vijay

ENVision Project Number: 2009-553

Analytical Method: 8015 TPH Gasoline Range
Prep Method: 5035A
Analytical Batch: 032709GS

Client Sample ID: B-100 (22-24')
Envision Sample Number: 9-3604
Sample Matrix: soil

Sample Collection Date/Time: 3/16/09 11:45
Sample Received Date/Time: 3/20/09 08:38

Compounds	Sample Results (mg/kg)	Reporting Limit (mg/kg)	Flags
TPH-Gasoline	**2130**	70.0	3
4-bromofluorobenzene (surrogate)	112%		
Analysis Date/Time:	3/27/09 / 23:35		
Analyst Initials	tjg		
Percent Solids	88%		

All results reported on dry weight basis.

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Analytical Report

Client Name: QEPI

Project ID: Hannover / 08-04-009

Client Project Manager: Nivas Vijay

ENVision Project Number: 2009-553

Analytical Method: 8015 TPH Extended C8-C36
Prep Method: 3550B
Analytical Batch: 032809E

Client Sample ID: B-100 (22-24')
Envision Sample Number: 9-3604
Sample Matrix: soil

Sample Collection Date/Time: 3/16/09 11:45
Sample Received Date/Time: 3/20/09 08:38

Compounds	Sample Results (mg/kg)	Reporting Limit (mg/kg)	Flags
TPH--Extended C8-C36	**8,691**	23	1, 2
o-Terphenyl (surrogate)	196%		
Analysis Date/Time:	03-29-09/18:47		
Analyst Initials:	LLL		
Date Extracted:	3/25/2009		
Initial Sample Weight:	30 g		
Final Volume:	3.0 mL		
Percent Solids	88%		

All results reported on dry weight basis.

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Analytical Report

Client Name: QEPI

Project ID: Hannover / 08-04-009

Client Project Manager: Nivas Vijay

ENVision Project Number: 2009-553

Client Sample ID: B-100 (22-24')
Envision Sample Number: 9-3604
Sample Matrix: soil

Sample Collection Date/Time: 3/16/09 11:45
Sample Received Date/Time: 3/20/09 08:38

Analyte	Sample Results	Flags	Method
Percent Moisture	12.0%		1684
Percent Solids	88.0%		1684
Analysis Date:	3/23/09		
Analyst Initials	cac		

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Analytical Report

Client Name: QEPI

Project ID: Hannover / 08-04-009

Client Project Manager: Nivas Vijay

ENVision Project Number: 2009-553

Analytical Method: 8260
Prep Method: 5035A
Analytical Batch: 032709GS

Client Sample ID: B-101 (24-26')
Envision Sample Number: 9-3605
Sample Matrix: soil

Sample Collection Date/Time: 3/17/09 13:00
Sample Received Date/Time: 3/20/09 08:38

Compounds	Sample Results (ug/kg)	Rep. Limit (ug/kg)	Flags
Acetone	< 11800	11800	3
Acrolein	< 11800	11800	3
Acrylonitrile	< 11800	11800	3
Benzene	< 42	600	3,4
Bromobenzene	< 600	600	3
Bromochloromethane	< 600	600	3
Bromodichloromethane	< 600	600	3
Bromoform	< 600	600	3
Bromomethane	< 600	600	3
n-Butanol	< 5900	5900	3
2-Butanone (MEK)	< 1200	1200	3
n-Butylbenzene	**1830**	600	3
sec-Butylbenzene	**1270**	600	3
tert-Butylbenzene	< 600	600	3
Carbon Disulfide	< 600	600	3
Carbon Tetrachloride	< 600	600	3
Chlorobenzene	< 600	600	3
Chloroethane	< 600	600	3
2-Chloroethylvinylether	< 5900	5900	3
Chloroform	< 600	600	3
Chloromethane	< 600	600	3
2-Chlorotoluene	< 600	600	3
4-Chlorotoluene	< 600	600	3
1,2-Dibromo-3-chloropropane	< 600	600	3
Dibromochloromethane	< 600	600	3
1,2-Dibromoethane (EDB)	< 600	600	3
Dibromomethane	< 600	600	3
1,2-Dichlorobenzene	< 600	600	3
1,3-Dichlorobenzene	< 600	600	3
1,4-Dichlorobenzene	< 600	600	3
trans-1,4-Dichloro-2-butene	< 11800	11800	3
Dichlorodifluoromethane	< 600	600	3
1,1-Dichloroethane	< 600	600	3
1,2-Dichloroethane	< 600	600	3
1,1-Dichloroethene	< 600	600	3

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Analytical Report

8260 continued…

Compounds	Sample Results (ug/kg)	Rep. Limit (ug/kg)	Flags
cis-1,2-Dichloroethene	< 600	600	3
trans-1,2-Dichloroethene	< 600	600	3
1,2-Dichloropropane	< 600	600	3
1,3-Dichloropropane	< 600	600	3
2,2-Dichloropropane	< 600	600	3
1,1-Dichloropropene	< 600	600	3
cis-1,3-Dichloropropene	< 600	600	3
trans-1,3-Dichloropropene	< 600	600	3
Ethylbenzene	< 600	600	3
Ethyl methacrylate	< 11800	11800	3
Hexachloro-1,3-butadiene	< 600	600	3
n-Hexane	< 1200	1200	3
2-Hexanone	< 1200	1200	3
Iodomethane	< 1200	1200	3
Isopropylbenzene (Cumene)	**1060**	600	3
p-Isopropyltoluene	< 600	600	3
Methylene chloride	< 2400	2400	3
4-Methyl-2-pentanone (MIBK)	< 1200	1200	3
Methyl-tert-butyl-ether	< 180	600	3,5
Naphthalene	**2300**	600	3
n-Propylbenzene	**2150**	600	3
Styrene	< 600	600	3
1,1,1,2-Tetrachloroethane	< 600	600	3
1,1,2,2-Tetrachloroethane	< 600	600	3
Tetrachloroethene	< 600	600	3
Toluene	< 600	600	3
1,2,3-Trichlorobenzene	< 600	600	3
1,2,4-Trichlorobenzene	< 600	600	3
1,1,1-Trichloroethane	< 600	600	3
1,1,2-Trichloroethane	< 600	600	3
Trichloroethene	< 600	600	3
Trichlorofluoromethane	< 600	600	3
1,2,3-Trichloropropane	< 600	600	3
1,2,4-Trimethylbenzene	< 600	600	3
1,3,5-Trimethylbenzene	< 600	600	3
Vinyl acetate	< 1200	1200	3
Vinyl chloride	< 200	200	3
Xylene, M&P	< 600	600	3
Xylene, 0rtho	< 600	600	3
Xylene, Total	< 1200	1200	
Dibromofluoromethane (surrogate)	84%		
1,2-Dichloroethane-d4 (surrogate)	85%		
Toluene-d8 (surrogate)	85%		
4-bromofluorobenzene (surrogate)	92%		
Analysis Date/Time:	3/27/09 / 20:54		
Analyst Initials	tjg		
Percent Solids:	85%		

All results reported on dry weight basis.

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Indianapolis, IN 46239
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Analytical Report

Client Name: QEPI

Project ID: Hannover / 08-04-009

Client Project Manager: Nivas Vijay

ENVision Project Number: 2009-553

Analytical Method: 8270 SVOC
Prep Method: 3550B
Analytical Batch: 033109B

Client Sample ID: B-101 (24-26')
Envision Sample Number: 9-3605
Sample Matrix: soil

Sample Collection Date/Time: 3/17/09 13:00
Sample Received Date/Time: 3/20/09 08:38

Compounds	Sample Results (mg/kg)	Rep. Limit (mg/kg)	Flags
Benzo(a)anthracene	< 0.39	0.39	
Benzo(a)pyrene	< 0.39	0.39	
Benzo(b)fluoranthene	< 0.39	0.39	
Benzo(k)fluoranthene	< 0.39	0.39	
Chrysene	< 0.39	0.39	
Dibenzo(a,h)anthracene	< 0.39	0.39	
Indeno(1,2,3-cd)pyrene	< 0.39	0.39	
Naphthalene	**4.02**	0.39	
Nitrobenzene-d5 (surrogate)	91%		
2-Fluorobiphenyl (surrogate)	83%		
p-Terphenyl-d14 (surrogate)	91%		
Analysis Date/Time:	03-31-09/19:45		
Analyst Initials:	gjd		
Date Extracted:	3/23/2009		
Initial Sample Weight:	30 g		
Final Volume:	1.0 mL		
Percent Solids	85%		

All results reported on dry weight basis.

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Analytical Report

Client Name: QEPI

Project ID: Hannover / 08-04-009

Client Project Manager: Nivas Vijay

ENVision Project Number: 2009-553

Analytical Method: 8015 TPH Gasoline Range
Prep Method: 5035A
Analytical Batch: 032709GS

Client Sample ID: B-101 (24-26')
Envision Sample Number: 9-3605
Sample Matrix: soil

Sample Collection Date/Time: 3/17/09 13:00
Sample Received Date/Time: 3/20/09 08:38

Compounds	Sample Results (mg/kg)	Reporting Limit (mg/kg)	Flags
TPH-Gasoline	**548**	35.0	4
4-bromofluorobenzene (surrogate)	94%		
Analysis Date/Time:	3/27/09 / 00:01		
Analyst Initials	tjg		
Percent Solids	85%		

All results reported on dry weight basis.

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Analytical Report

Client Name: QEPI

Project ID: Hannover / 08-04-009

Client Project Manager: Nivas Vijay

ENVision Project Number: 2009-553

Analytical Method: 8015 TPH Extended C8-C36
Prep Method: 3550B
Analytical Batch: 032809E

Client Sample ID: B-101 (24-26')
Envision Sample Number: 9-3605
Sample Matrix: soil

Sample Collection Date/Time: 3/17/09 13:00
Sample Received Date/Time: 3/20/09 08:38

Compounds	Sample Results (mg/kg)	Reporting Limit (mg/kg)	Flags
TPH--Extended C8-C36	**3,587**	24	1, 2
o-Terphenyl (surrogate)	162%		
Analysis Date/Time:	03-29-09/20:16		
Analyst Initials:	LLL		
Date Extracted:	3/25/2009		
Initial Sample Weight:	30 g		
Final Volume:	3.0 mL		
Percent Solids	85%		

All results reported on dry weight basis.

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Analytical Report

Client Name: QEPI

Project ID: Hannover / 08-04-009

Client Project Manager: Nivas Vijay

ENVision Project Number: 2009-553

Client Sample ID:	B-101 (24-26')	**Sample Collection Date/Time:**	3/17/09 13:00
Envision Sample Number:	9-3605	**Sample Received Date/Time:**	3/20/09 08:38
Sample Matrix:	soil		

Analyte	Sample Results	Flags	Method
Percent Moisture	15.0%		1684
Percent Solids	85.0%		1684
Analysis Date:	3/23/09		
Analyst Initials	cac		

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8260 Quality Control Data

ENVision Batch Number: 032709VS

Method Blank (MB):	MB Results (ug/kg)	Rep Lim (ug/kg)	Flag
Acetone	< 100	100	
Acrolein	< 100	100	
Acrylonitrile	< 100	100	
Benzene	< 5	5	
Bromobenzene	< 5	5	
Bromochloromethane	< 5	5	
Bromodichloromethane	< 5	5	
Bromoform	< 5	5	
Bromomethane	< 5	5	
n-Butanol	< 50	50	
2-Butanone (MEK)	< 10	10	
n-Butylbenzene	< 5	5	
sec-Butylbenzene	< 5	5	
tert-Butylbenzene	< 5	5	
Carbon Disulfide	< 5	5	
Carbon Tetrachloride	< 5	5	
Chlorobenzene	< 5	5	
Chloroethane	< 5	5	
2-Chloroethylvinylether	< 50	50	
Chloroform	< 5	5	
Chloromethane	< 5	5	
2-Chlorotoluene	< 5	5	
4-Chlorotoluene	< 5	5	
1,2-Dibromo-3-chloropropane	< 5	5	
Dibromochloromethane	< 5	5	
1,2-Dibromoethane (EDB)	< 5	5	
Dibromomethane	< 5	5	
1,2-Dichlorobenzene	< 5	5	
1,3-Dichlorobenzene	< 5	5	
1,4-Dichlorobenzene	< 5	5	
trans-1,4-Dichloro-2-butene	< 100	100	
Dichlorodifluoromethane	< 5	5	
1,1-Dichloroethane	< 5	5	
1,2-Dichloroethane	< 5	5	
1,1-Dichloroethene	< 5	5	
cis-1,2-Dichloroethene	< 5	5	
trans-1,2-Dichloroethene	< 5	5	
1,2-Dichloropropane	< 5	5	
1,3-Dichloropropane	< 5	5	
2,2-Dichloropropane	< 5	5	
1,1-Dichloropropene	< 5	5	
cis-1,3-Dichloropropene	< 5	5	
trans-1,3-Dichloropropene	< 5	5	
Ethylbenzene	< 5	5	
Ethyl methacrylate	< 100	100	

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8260 QC Continued…

	MB Results (ug/kg)	Rep Lim (ug/kg)	Flag
Hexachloro-1,3-butadiene	< 5	5	
2-Hexanone	< 10	10	
n-Hexane	< 10	10	
Iodomethane	< 10	10	
Isopropylbenzene (Cumene)	< 5	5	
p-Isopropyltoluene	< 5	5	
Methylene chloride	< 5	5	
4-Methyl-2-pentanone (MIBK)	< 10	10	
Methyl-tert-butyl-ether	< 5	5	
Naphthalene	< 5	5	
n-Propylbenzene	< 5	5	
Styrene	< 5	5	
1,1,1,2-Tetrachloroethane	< 5	5	
1,1,2,2-Tetrachloroethane	< 5	5	
Tetrachloroethene	< 5	5	
Toluene	< 5	5	
1,2,3-Trichlorobenzene	< 5	5	
1,2,4-Trichlorobenzene	< 5	5	
1,1,1-Trichloroethane	< 5	5	
1,1,2-Trichloroethane	< 5	5	
Trichloroethene	< 5	5	
Trichlorofluoromethane	< 5	5	
1,2,3-Trichloropropane	< 5	5	
1,2,4-Trimethylbenzene	< 5	5	
1,3,5-Trimethylbenzene	< 5	5	
Vinyl acetate	< 10	10	
Vinyl chloride	< 2	2	
Xylene, M&P	< 5	5	
Xylene, 0rtho	< 5	5	
Xylenes, Total	<10	10	
Dibromofluoromethane (surrogate)	88%		
1,2-Dichloroethane-d4 (surrogate)	101%		
Toluene-d8 (surrogate)	85%		
4-bromofluorobenzene (surrogate)	97%		
Analysis Date/Time:	3/27/09 / 19:06		
Analyst Initials	tjg		

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1439 Sadlier Circle West Drive
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8260 QC Continued…

Laboratory Control Standard (LCS):	LCS Results (ug/kg)	LCS Conc(ug/kg)	% Rec	Flag
Vinyl Chloride	**57.4**	50	115%	
1,1-Dichloroethene	59.4	50	119%	
trans-1,2-Dichloroethene	53.6	50	107%	
Methyl-tert-butyl ether	49.4	50	99%	
1,1-dichloroethane	42.3	50	85%	
cis-1,2-Dichloroethene	48.3	50	97%	
Chloroform	46.7	50	93%	
1,1,1-Trichloroethane	40.7	50	81%	
Benzene	47.8	50	96%	
Trichloroethene	44.4	50	89%	
Toluene	44.8	50	90%	
1,1,1,2-Tetrachloroethane	66.2	50	132%	
Chlorobenzene	55.3	50	111%	
Ethylbenzene	45.1	50	90%	
O-Xylene	51.8	50	104%	
N-propylbenzene	40.0	50	80%	
Dibromofluoromethane (surrogate)	108%			
1,2-Dichloroethane-d4 (surrogate)	94%			
Toluene-d8 (surrogate)	102%			
4-bromofluorobenzene (surrogate)	112%			
Analysis Date/Time:	3/27/09 / 18:23			
Analyst Initials	tjg			

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8270 PAH Quality Control Data

ENVision Batch Number: 032309BS

Method Blank (MB):	Method Blank Results (mg/kg)	Reporting Limit (mg/kg)	Flag
Acenaphthene	< 0.33	0.33	
Acenaphthylene	< 0.33	0.33	
Anthracene	< 0.33	0.33	
Benzo(a)anthracene	< 0.33	0.33	
Benzo(a)pyrene	< 0.33	0.33	
Benzo(b)fluoranthene	< 0.33	0.33	
Benzo(g,h,i)perylene	< 0.33	0.33	
Benzo(k)fluoranthene	< 0.33	0.33	
Chrysene	< 0.33	0.33	
Dibenzo(a,h)anthracene	< 0.33	0.33	
Fluoranthene	< 0.33	0.33	
Fluorene	< 0.33	0.33	
Indeno(1,2,3-cd)pyrene	< 0.33	0.33	
2-methylnaphthalene	< 0.33	0.33	
Naphthalene	< 0.33	0.33	
Phenanthrene	< 0.30	0.30	
Pyrene	< 0.33	0.33	
Nitrobenzene-d5 (surrogate)	77%		
2-Fluorobiphenyl (surrogate)	80%		
p-Terphenyl-d14 (surrogate)	110%		
Analysis Date/Time	03-27-09/08:32		
Analyst Initials	gjd		
Date Extracted	3/23/2009		
Initial Sample Weight:	30 g		
Final Volume	1.0 mL		

LCS/LCSD	LCS Results	LCS Concentration	LCSD Results	LCS Recovery	LCSD Recovery	RPD	Flag
Acenaphthene	38.27	50	38.48	76.5%	77.0%	0.5%	
Acenaphthylene	36.93	50	35.42	73.9%	70.8%	4.2%	
Anthracene	47.89	50	45.34	95.8%	90.7%	5.5%	
Benzo(a)anthracene	42.56	50	42.12	85.1%	84.2%	1.0%	
Benzo(a)pyrene	45.52	50	44.05	91.0%	88.1%	3.3%	
Benzo(b)fluoranthene	48.51	50	45.00	97.0%	90.0%	7.5%	
Benzo(g,h,i)perylene	42.11	50	42.92	84.2%	85.8%	1.9%	
Benzo(k)fluoranthene	48.95	50	49.54	97.9%	99.1%	1.2%	
Chrysene	48.36	50	46.98	96.7%	94.0%	2.9%	
Dibenzo(a,h)anthracene	41.79	50	41.08	83.6%	82.2%	1.7%	
Fluoranthene	54.10	50	52.20	108.2%	104.4%	3.6%	
Fluorene	40.74	50	40.13	81.5%	80.3%	1.5%	
Indeno(1,2,3-cd)pyrene	44.06	50	44.00	88.1%	88.0%	0.1%	
2-methylnaphthalene	36.16	50	34.75	72.3%	69.5%	4.0%	
Naphthalene	33.12	50	32.01	66.2%	64.0%	3.4%	
Phenanthrene	43.87	50	42.11	87.7%	84.2%	4.1%	
Pyrene	42.83	50	42.42	85.7%	84.8%	1.0%	

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8270 QC Continued...

Nitrobenzene-d5 (surrogate)	95%	89%
2-Fluorobiphenyl (surrogate)	88%	86%
p-Terphenyl-d14 (surrogate)	97%	94%
Analysis Date/Time:	03-27-09/09:01	03-27-09/09:30
Analyst Initials:	gjd	gjd
Date Extracted:	3/23/2009	3/23/2009
Initial Sample Weight:	30 g	30 g
Final Volume:	1.0 mL	1.0 mL

MS/MSD	Sample Result	MS Result	MSD Result	Spike Conc.	MS Recovery	MSD Recovery	RPD	Flag
Acenaphthene	0.00	37.78	37.43	50	75.6%	74.9%	0.9%	
Acenaphthylene	0.00	36.98	35.56	50	74.0%	71.1%	3.9%	
Anthracene	0.00	41.52	42.11	50	83.0%	84.2%	1.4%	
Benzo(a)anthracene	0.00	40.74	43.01	50	81.5%	86.0%	5.4%	
Benzo(a)pyrene	0.00	42.25	42.48	50	84.5%	85.0%	0.5%	
Benzo(b)fluoranthene	0.00	49.90	48.29	50	99.8%	96.6%	3.3%	
Benzo(g,h,i)perylene	0.00	36.08	35.44	50	72.2%	70.9%	1.8%	
Benzo(k)fluoranthene	0.00	41.50	43.62	50	83.0%	87.2%	5.0%	
Chrysene	0.00	41.22	42.33	50	82.4%	84.7%	2.7%	
Dibenzo(a,h)anthracene	0.00	40.35	39.08	50	80.7%	78.2%	3.2%	
Fluoranthene	0.00	48.91	48.18	50	97.8%	96.4%	1.5%	
Fluorene	0.00	37.57	36.63	50	75.1%	73.3%	2.5%	
Indeno(1,2,3-cd)pyrene	0.00	40.54	40.24	50	81.1%	80.5%	0.7%	
2-methylnaphthalene	0.00	32.07	30.49	50	64.1%	61.0%	5.1%	
Naphthalene	0.00	31.72	33.57	50	63.4%	67.1%	5.7%	
Phenanthrene	0.00	42.13	44.27	50	84.3%	88.5%	5.0%	
Pyrene	0.00	38.80	40.93	50	77.6%	81.9%	5.3%	
Nitrobenzene-d5 (surrogate)	88%	98%	91%					
2-Fluorobiphenyl (surrogate)	90%	82%	81%					
p-Terphenyl-d14 (surrogate)	93%	81%	80%					
Analysis Date/Time:	03-27-09/14:45	03-27-09/15:13	03-27-09/15:42					
Analyst Initials:	gjd	gjd	gjd					
Date Extracted:	3/23/2009	3/23/2009	3/23/2009					
Initial Sample Weight:	30 g	30 g	30 g					
Final Volume:	1.0 mL	1.0 mL	1.0 mL					
Original Sample Number Spiked:	9-3472							

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8015 TPH-Gasoline Quality Control Data

ENVision Batch Number: 032709GS

Method Blank (MB):	MB Results (mg/kg)	Rep Lim (mg/kg)	Flag
TPH-Gasoline	< 15	15	
4-bromofluorobenzene (surrogate)	108%		
Analysis Date/Time:	3/27/09 / 22:44		
Analyst Initials:	tjg		

Laboratory Control Standard (LCS):	LCS Results (mg/kg)	LCS Conc (mg/kg)	% Rec	Flag
TPH-Gasoline	11.2	10	112	
4-bromofluorobenzene (surrogate)	113%			
Analysis Date/Time:	3/27/09 / 23:09			
Analyst Initials:	tjg			

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8015 TPH-Extended Range Quality Control Data

ENVision Batch Number: 032809E

Method Blank (MB):	MB Results (mg/kg)	Reporting Limit (mg/kg)	Flag
TPH-Extended Range	< 20	20	
o-Terphenyl (surrogate)	73%		
Analysis Date/Time:	03-29-09/11:19		
Analyst Initials:	LLL		
Date Extracted:	3/25/2009		
Initial Sample Weight:	30 g		
Final Volume:	3.0 mL		

LCS/LCSD	LCS Result (mg/kg)	LCS/LCSD Conc. (mg/kg)	LCSD Result (mg/kg)	LCS Rec.	LCSD Rec.	RPD	Flag
TPH-Extended Range	81.14	100	89.44	81.1%	89.4%	9.7%	
o-Terphenyl (surrogate)	85%		90%				
Analysis Date/Time:	03-29-09/11:49		03-29-09/12:19				
Analyst Initials:	LLL		LLL				
Date Extracted:	3/25/2009		3/25/2009				
Initial Sample Weight:	30 g		30 g				
Final Volume:	3.0 mL		3.0 mL				

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Flag Number	Comments
1	Surrogate recovery is biased high due to matrix interference. LLL 03-31-09
2	The reported value is estimated due to linear range exceedence. LLL/GJD 03-31-09
3	Reported value is from a 100 X dilution. TJG 4-10-09
4	Reported value is from a 50 X dilution. TJG 4-10-09
5	Reported value is below the reporting limit but above the MDL. TJG 4-10-09

2009-553

QUALITY ENVIRONMENTAL PROFESSIONALS, INC.

CHAIN OF CUSTODY RECORD

3/19

Project Name:	Hannover
Laboratory:	ENVision
Job #:	09-04-009
Sampled By:	Nivas Vijay

Report To:

Quality Environmental Professionals, Inc.
1611 South Franklin Road • PHONE 317.351.4255
Indianapolis, IN 46239 • FAX 317.351.4265

Attention: Nivas Vijay

Sample Description	Date	Time	Comp	Grab	Sample (Matrix)	Analyses Requested: TPH (GRO (8015) / DRO)	VOCs 8260	cPAHs 8270 SIM									
B-100 (22'-24')	3/16/09	1145		X	S	X	X	X							3	6	0 4
B-101 (24'-26')	3/17/09	1300		X	S	X	X	X							3	6	0 5

Date Results Requested By: Standard

✓ Please return original copy of **Chain Of Custody Record** to QEPI

✓ We request that you submit chromatographs with all laboratory results, plus QA/QC documentation.

Remarks

4 oz jars

Relinquished By: (Signature)	Date/Time: 3/19/09 1245	Received By: (Signature)	Date/Time 3/19/09 1245
Relinquished By: (Signature)	Date/Time: 3/20/09 831	Received By: (Signature) Andrew Stracke	Date/Time 3/20/09 831
Relinquished By: (Signature) Andrew Stracke	Date/Time: 3/20/09 838	Received For Lab By: (Signature) Cheryl Simon	Date/Time 3/20/09 8:38

Temperature When Shipped	Total # of Containers: 6
Remarks	
Temperature Upon Arrival at Lab: 4°C	

McDP

Appendix C

July 27, 2009

Nivas Vijay
Quality Environmental Professionals, Inc.
1611 S. Franklin Road
Indianapolis, IN 46239

Work Order No.: ME0907742

RE: Hanover

Dear Nivas Vijay:

Microbac Laboratories, Inc. received 1 sample on 7/16/2009 2:45:00 PM for the analyses presented in the following report.

The enclosed results were obtained from and are applicable to the sample(s) as received at the laboratory. All sample results are reported on an "as received" basis unless otherwise noted.

All data included in this report have been reviewed and meet the applicable project specific and certification specific requirements, unless otherwise noted. A qualifications page is included in this report and lists the programs under which Microbac maintains certification.

This report has been paginated in its entirety and shall not be reproduced except in full, without the written approval of Microbac Laboratories.

We appreciate the opportunity to service your analytical needs. If you have any questions, please feel free to contact us.

Sincerely,
Microbac Laboratories, Inc.

Deborah Griffiths
Senior Project Manager

Enclosures

WORK ORDER SAMPLE SUMMARY

Date: *Monday, July 27, 2009*

CLIENT: Quality Environmental Professionals, Inc.
Project: Hanover
Lab Order: ME0907742

Lab Sample ID	Client Sample ID	Tag Number	Collection Date	Date Received
ME0907742-01A	FP-1		7/1/2009 9:30:00 AM	7/16/2009

Microbac®

ANALYTICAL RESULTS

Date: *Monday, July 27, 2009*

Client:	Quality Environmental Professionals, Inc.		
Client Project:	Hanover		
Client Sample ID:	FP-1	**Work Order / ID:**	ME0907742-01A
Sample Description:		**Collection Date:**	07/01/09 09:30
Sample Matrix:	Liquid	**Date Received:**	07/16/09 14:45

Analyses	ST	Result	RL	Qual	Units	DF	Analyzed
KINEMATIC VISCOSITY @ 77 F	Method: **D445**			Prep Date/Time:			Analyst: **GJM**
Viscosity	A	***2.206***			cSt	1	07/21/09 00:00
DENSITY	Method: **CALCULATED**			Prep Date/Time:			Analyst: **RPL**
Density	A	***0.81***	0.10		g/ml	1	07/21/09 16:44
IGNITABILITY (CLOSED CUP)	Method: **SW1010**			Prep Date/Time:			Analyst: **TMG**
Ignitability	A	***120***	30		ºF	1	07/22/09 08:37
DYNAMIC VISCOSITY	Method: **D978**			Prep Date/Time:			Analyst: **GJM**
Viscosity	A	***1.938***			cSt @ 90	1	07/21/09 00:00

FLAGS, FOOTNOTES AND ABBREVIATIONS (as needed)

NA	=	Not Analyzed	N/A	=	Not Applicable			
mg/L	=	Milligrams per Liter (ppm)	ug/L	=	Micrograms per Liter (ppb)	cfu	=	Colony Forming Unit
mg/Kg	=	Milligrams per Kilogram (ppm)	ug/Kg	=	Micrograms per Kilogram (ppb)	ng/L	=	Nanograms per Liter (ppt)

U = Undetected

J = Analyte concentration detected between RL and MDL (Metals / Organics)

j = Analyte concentration detected betweeen 1/2 PQL and PQL (for TIC analytes only)

B = Detected in the associated Method Blank at a concentration above the routine PQL/RL

b = Detected in the associated Method Blank at a concentration above the Method Detection Limit but less than the routine PQL/RL

D = Surrogate recoveries are not calculated due to sample dilution

ND = Not Detected at the Reporting Limit (or the Method Detection Limit, if listed)

E = Value above quantitation range

H = Analyte was prepared and/or analyzed outside of the analytical method holding time

I = Matrix Interference

R = RPD outside accepted recovery limits

S = Spike recovery outside recovery limits

Surr = Surrogate

DF = Dilution Factor RL = Reporting Limit ST = Sample Type MDL = Method Detection Limit

SAMPLE TYPES

A = Analyte

I = Internal Standard

S = Surrogate

T = Tentatively Identified Compound (TIC, concentration estimated)

QC SAMPLE IDENTIFICATIONS

MBLK	=	Method Blank	ICSA	=	Interference Check Standard "A"	OPR	=	Ongoing Precision and Recovery Standard
DUP	=	Method Duplicate	ICSAB	=	Interference Check Standard "AB"			
LCS	=	Laboratory Control Sample	LCSD	=	Laboratory Control Sample Duplicate			
MS	=	Matrix Spike	MSD	=	Matrix Spike Duplicate			
ICB	=	Initial Calibration Blank	CCB	=	Continuing Calibration Blank			
ICV	=	Initial Calibration Verification	CCV	=	Continuing Calibration Verification			
PDS	=	Post Digestion Spike	SD	=	Serial Dilution			

CERTIFICATIONS

Below is a list of certifications maintained by the Microbac Merrillville Laboratory. All data included in this report has been reviewed for and meets all project specific and quality control requirements of the applicable accreditation, unless otherwise noted. Complete lists of individual analytes pursuant to each certification below are available upon request.

- Illinois EPA for the analysis wastewater and solid waste in accordance with the requirements of the National Environmental Laboratory Accreditation Program [NELAP] (accreditation #100435)
- Illinois Department of Public Health for the microbiological analysis of drinking water (registry #1755266)
- Indiana DEM approved support laboratory for solid waste and wastewater analyses
- Indiana SDH for the chemical analysis of drinking water (lab #C-45-03)
- Indiana SDH for the microbiological analysis of drinking water (lab #M-45-8)
- Kentucky DEP for the chemical analysis of drinking water (lab #90147)
- Kentucky EPPC for the analysis of samples applicable to the Underground Storage Tank program (lab #75)
- New York SDH for the chemical analysis of air and emissions (lab #11909)
- North Carolina DENR for the environmental analysis for NPDES effluent, surface water, groundwater, and pretreatment regulations (certificate #597)
- Tennessee DEC for the chemical analysis of drinking water (lab #04017)
- Wisconsin DNR for the chemical analysis of wastewater and solid waste (lab #998036710)

MICROBAC LOCATIONS, SERVICE CENTERS (SC) AND SATELLITE OFFICES (Sat)

Baltimore Division - Baltimore, MD
Camp Hill Division - Camp Hill, PA
Camp Hill Division (SC) - Pittston, PA
Chicagoland Division - Merrillville, IN
Chicagoland Division (SC) - Indianapolis, IN
Southern California Division - Corona, CA
Erie Division - Erie, PA
Fayetteville Division - Fayetteville, NC
Hauser Division - Boulder, CO
Kentucky Division - Louisville, KY
Kentucky Division (Sat) - Evansville, IN
Kentucky Division (Sat) - Lexington, KY
Kentucky Division (Sat) - Paducah, KY
Knoxville Division - Maryville, TN
Massachusetts Division - Worchester, MA
Microbac Corporate Office - Pittsburgh, PA
Microbac NY - Cortland Office - Cortland, NY
Microbac NY - Waverly Office - Waverly, NY
Ohio Valley Division - Marietta, OH
Pittsburgh Division - Warrendale, PA
Richmond Division - Richmond, VA
South Carolina Division - New Ellenton, SC
South Jersey Division - Laurel Springs, NJ
Southern Headquarters - Poquoson, VA
Southern Testing Division - Wilson, NC
Southern Testing Division (Sat) - Greensboro, NC
Venice Division - Venice, FL

COOLER INSPECTION

Date: Monday, July 27, 2009

Client Name ***Quality Environmental Professi*** Date / Time Received: ***7/16/2009 2:45:00 PM***

Work Order Number ***ME0907742*** Received by: DEB

Checklist completed by DPP 7/17/2009 9:14:03 AM Reviewed by DDG 7/20/2009 7:58:31 AM

Carrier name: Client Delivered

After-Hour Arrival?	Yes ☐	No ☑	
Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on shippping container/cooler?	Yes ☐	No ☐	Not Present ☑
Custody seals intact on sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☑	No ☐	
Chain of custody included sufficient client identification?	Yes ☑	No ☐	
Chain of custody included sufficient sample collector information?	Yes ☐	No ☑	
Chain of custody included a sample description?	Yes ☑	No ☐	
Chain of custody agrees with sample labels?	Yes ☑	No ☐	
Chain of custody identified the appropriate matrix?	Yes ☑	No ☐	
Chain of custody included date of collection?	Yes ☑	No ☐	
Chain of custody included time of collection?	Yes ☑	No ☐	
Chain of custody identified the appropriate number of containers?	Yes ☑	No ☐	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time?	Yes ☑	No ☐	
If samples are preserved, are the preservatives identified?	Yes ☑	No ☐	
Samples properly preserved?	Yes ☑	No ☐	

If No, adjusted by? _____ Date/Time _____

Chain of custody included the requested analyses?	Yes ☑	No ☐
Chain of custody signed when relinquished and received?	Yes ☑	No ☐
Samples received on ice?	Yes ☐	No ☑

Container/Temp Blank temperatures

VOA vials for aqueous samples have zero headspace? No VOA vials submitted ☑ Yes ☐ No ☐

ANY "NO" EVALUATION (excluding After-Hour Receipt) REQUIRES CLIENT NOTIFICATION.

General Comments:

Sample ID	Client Sample ID	Comments
ME0907742-01A	FP-1	Per client please analyze at 77 and 90 degrees for Viscosity

QUALITY ENVIRONMENTAL PROFESSIONALS, INC.

CHAIN OF CUSTODY RECORD

P 1 of 1

RUSH

ject Name: Hannover

oratory:

#: 08-04-009.02 Sampled By: Nivas Vijay

ort To:

Quality Environmental Professionals, Inc.
1611 South Franklin Road • PHONE 317.351.4255
Indianapolis, IN 46239 • FAX 317.351.4265

ation: Nivas Vijay

Date Results Requested By: Standard - 3 day

- ✓ Please return original copy of **Chain Of Custody Record** to QEPI
- ✓ We request that you submit chromatographs with all laboratory results, plus QA/QC documentation.

Remarks

Sample of free product for requested analysis

e-mail results to:

nvijay@qepi.com

3-day turn

Sample Description	Date	Time	Comp	Grab	Sample (Matrix)	Analyses Requested: Viscosity	Flammability (Flash Point)	Specific Density										0907742
FP-1	7/1/09	0930		X		X	X	X										01

Relinquished By: (Signature)	Date/Time:	Received By: (Signature)	Date/Time	Temperature When Shipped	Total # of Containers
	7/16/09 1445				2
Relinquished By: (Signature)	Date/Time:	Received By: (Signature)	Date/Time	Remarks	
Relinquished By: (Signature)	Date/Time:	Received For Lab By: (Signature)	Date/Time	Temperature Upon Arrival at Lab:	
			7/16/09 1445		

McDP

Appendix D

Health & Safety Plan

Hannover Property /
Lot 2/B of the Former AM General/
LTV Missiles and Aerospace Facility
731 West Chippewa Avenue
South Bend, Indiana 46614

Prepared For:
Indiana Finance Authority – Indiana Brownfields Program &
Indiana Land Trust 731 GRN

Submitted by:

Quality Environmental Professionals, Inc.

November 6, 2009

Table of Contents

List of Attachments

Quality Environmental Professionals, Inc

Site Health & Safety Plan

1.0 General Information

1.1. Project Name

Hannover Property

1.2. Project Number

08-04-009

1.3. Location

The site is located at 731 West Chippewa Avenue in South Bend, Indiana.

1.4. Client

Indiana Land Trust 731 GRN and the Indiana Finance Authority – Indiana Brownfields Program

1.5. Plan Prepared By

Nivas R. Vijay

1.6. Plan Approved By

Brent A. Dayharsh, LPG

2.0 Site Description

2.1. General Site Description

The Hannover parcel was originally part of a 89-acre parcel developed by the Studebaker Corporation in 1941 for the manufacture of World War II-era B-17 Bomber jet engines and military off-terrain vehicles. The Hannover parcel was part of the original Studebaker plant, with the facilities on the site utilized for plant maintenance and utilities. The site was constructed to house the boilers, chillers and an electrical substation, as well as the water source for the plant.

During its operations as the utility base for the manufacturing facility, the site operated at least 37 USTs, identified as historically containing gasoline, diesel fuel, antifreeze, varnish, solvents, waste oils, transmission fluid, engine oil and jet fuel. The northwest corner of the Hannover Property, contained at least two large tank pits, housing at least 30-15,000 to 25,000 gallon USTs containing petroleum products, primarily gasoline and jet fuel. These USTs were used to service operations

within the former Studebaker Plant 2 building, located adjacent to the west (the current AM General building) and the former Studebaker Plant 8 building, located adjacent to the north (the current Green Tech Transfer and Recycling facility).

The Hannover property, as it is commonly referred to, is currently owned by Indiana Land Trust 731 GRN. The parcel historically served as the utility corridor for three neighboring parcels documented as having impacts to groundwater migrated from Hannover. The property to the east, commonly referred to as AM General, is owned by Indiana GRQ. The property to the northeast is a vacant parking area currently owned by AM General, Inc., and the property to the north, the former Studebaker Plant 8 facility, is currently the location of Green Tech Transfer and Recycling, owned by Mother Earth, LLC.

3.0 Project Objectives(s)

3.1. Description of Work Area Activities Planned

The scope of work for this project will be focused around the former UST pits in the northwestern corner of the Hannover Property and the delineated LNAPL plume, extending to the north, west, and south. Work activities will include advancing soil borings and installing wells using a hollow stem auger drill rig or a directional drilling rig, and the collection of soil and groundwater samples. The corrective action phase will include a remediation system with pump and treat and multi-phase extraction equipment.

4.0 Project Organization

Table 1

Team Member	Responsibility
Brent A. Dayharsh	Director of Technical Operations
Nivas R. Vijay	Project Manager/Site Supervisor
Doug J. Riggs	Project Manager/Site Supervisor
Travis Erny	Health and Safety Officer
H. David Smith	Senior Technician/Site Personnel
Daniel Melvin	Site Personnel
All personnel allowed on site will have current Health & Safety Training as required by 29 CFR 1910.120.	

4.1. Responsibilities

4.1.1. Senior Project Manager/Project Manager

The Project Manager will be responsible for preparation of the site work plan, provide adequate personnel, time, and resources to conduct on-site activities. The Project Manager will also be responsible for the project schedule and on-time completion of the project. The Project Manager is also responsible for overall site safety.

4.1.2. Health and Safety Officer

The Health and Safety Officer (HSO) will advise the Project Manager of all on-site health and safety issues. The HSO will develop or assist in development of this site-specific health and safety plan and is responsible for making sure that the procedures outlined in this plan are properly implemented. The safety officer shall be notified of any emergencies. The safety officer will be available to evaluate changes in site conditions or site operations that may potentially warrant changes in the site safety plan.

4.1.3. Site Supervisor

The Site Supervisor will be responsible for field team operations and safety. The Site Supervisor will manage daily site operations. The Site Supervisor will conduct daily on-site safety briefings and make sure proper safety procedures and policies are being conducted.

4.1.4. Site Personnel

Site personnel will be required to follow safety policies and procedures outlined and set forth in this document. Each individual conducting operations at the site will be required to read and sign the safety plan.

4.1.5. Subcontractors

Subcontractors involved with site operations will be required to have current 24 or 40-hour training under 29 CFR 1910.120. Qepi will inform subcontractors of potential site hazards and each subcontractor will be required to develop their own site-specific plan. Each subcontractor will be required to maintain a high level of safety while conducting operations.

4.1.6. Notes

- Any violations of the safety plan may result in disciplinary action against the individual.
- The safety plan may be changed at any time by the project manager due to changes in scope of work or site conditions. The project manager will be immediately notified of the changes.
- All on-site staff will review the safety plan with the senior project manager/project manager before entry onto the site.

5.0 Hazard Analysis

The chemical and physical hazards that may be present are discussed in the following subsections.

5.1. Chemical Hazards

The primary impacts encountered at the site are related the petroleum constituents. TPH (GRO/ERO), benzene and naphthalene have been encountered in elevated concentrations at the site. The chemical-specific Occupational Safety and Health Administration (OSHA) permissible exposure limits (PELs) and chemical and physical properties are shown in the following table.

Table 2

Principal Contaminant(s)	PEL ppm	IDLH ppm	Incompatibilities & Reactivities	Symptoms/Effects of ACWE Exposure
Naphthalene	15	ND	Oxidizers. May form explosives peroxides on standing	Eyes and skin irritant, dizziness
Benzene	1	ND	Strong oxidizers, fluorides, perchlorates, and nitric acid	Eye, skin, nose, respiratory system irritant, giddiness, headache and nausea
Toluene	200	500	Strong oxidizers	Eye and nose irritant, fatigue, weakness, euphoria, dizziness and headache
Ethylbenzene	100	800	Strong oxidizers	Eyes, skin and mucous membrane irritant, and headache
Xylenes(o,m,p)	100	900	Strong oxidizers and acids	Eyes, skin, nose and throat irritant, dizziness, nausea, vomiting and abdominal pain
VOC's/SVOC's	-	-	Vary – Strong oxidizers	Eyes, nose and throat irritant, dizziness, headache, and nausea

ND: No Data Available
*: Represent potential on site exposures

5.1.1. Waste Type(s)

- Free Product – Yes, recovered LNAPL petroleum product from water table
- Liquid – Yes, water from soil borings and decontamination water
- Solid – Yes, soil cuttings from borings
- Sludge – No
- Gas – Possible, volatile organic vapors from constituents in table above

5.1.2. Waste Characteristics

- **Corrosive** – Unlikely, metals and SVOCs if present, but will present minimal hazard.
- **Flammable –** Some wastes may be flammable, but at concentrations expected and due to constituents mixed with soil or water, the material should pose a low flammability hazard. Free product petroleum is anticipated to be recovered at this site, with a potential to be flammable. Open flame equipment will not be used during this project. Employees may not smoke at the site. See also Section 5.2.7.
- **Reactive –** May react with strong oxidizers to form oxides and gases of carbon and hydrogen
- **Oxidizer –** No
- **Toxic –** Slightly, materials that may be present can be toxic in large quantities or high concentrations for what is expected during this phase of work. If levels of these chemicals reach the OSHA PELs, STELs, or IDLH, they could potentially be acutely toxic. This type of symptom would occur if a person inhaled a very large dose of these chemicals or ingested a large dose. Chronic or long-term exposure is most likely to occur in the human body when an exposure occurs in lower levels over an extended period of time. This may cause damage to internal organs weeks or years after the exposure. Exposure levels for constituents listed in the table above are anticipated to be well below the OSHA PEL-Time Weighted Average (TWA). Because the materials are in a soil or water mix, the toxicity level of the material is anticipated to be very low.

5E.1.3. Suspected Route of Exposure

- Ingestion – moderate; impacted soil particles from soil cuttings, but likely from improper sanitation after handling impacted soil or groundwater
- Inhalation – low; vapors from impacted soil or groundwater
- Skin Absorption – low; contact with impacted soil or groundwater.
- Is there potential for direct contact or splash? – Potentially, but unlikely with proper personal protective equipment (PPE). Employees must wear gloves when sampling soils or water.

5.1.4. Material Safety Data Sheets (MSDS)

The MSDS for each chemical listed in Table 2 is provided in Attachment A. Please refer to the MSDS for proper first aid and other relevant hazard information. Since the primary chemicals of concern are petroleum constituents, MSDS for these chemicals most likely to be present are included.

5.2. Physical Hazards

Physical hazards of major concern are trip hazards, heat and cold stress, equipment operations, system operations, and utilities. Each of these issues has been addressed in the following sections.

5.2.1. Heat Stress

This is not as great of concern for this phase of the project, since operations will be conducted during the winter months. The wearing of personal protective equipment puts a worker at considerable risks for heat stress. Results from over exposure to heat may include the following signs and symptoms.

Heat Rash results when moisture is held close to the skin when the body sweats, which prevents evaporation and clogs pores. Signs and symptoms include:

- Red rashes and
- Blotchy skin

Heat Cramps are caused by prolonged exposure to heat and sweating without adequate fluid and electrolyte replacement. Signs and symptoms include:

- Muscle spasms in the abdomen and muscled most heavily used, and
- Pain in the hands, feet and abdomen?

Heat Exhaustion occurs from increased stress on various body organs, including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Signs and symptoms include:

- Pale skin
- Heavy sweating
- Dizziness, fainting, blurred vision,and
- Low blood pressure and a rapid pulse

Heat Stroke is the most serious form of heat stress. Temperature regulation fails, and the body temperature rises to critical levels. Immediate action must be taken to cool the body before serious injury or death occurs. Competent medical help must be obtained immediately. Signs and symptoms include:

- Hot and unusually dry skin, red face
- Lack of or reduced perspiration
- Dizziness and confusion and

- Strong, rapid pulse, and coma?

To reduce the risk of heat exposure workers will drink 16 ounces of non-caffeinated fluid (preferably water or diluted drinks) before beginning work. Workers are urged to drink plenty of fluids throughout the work shift, as needed. A total of 1.6 gallons is recommended, but more may be necessary to maintain hydration. On-site medical monitoring will occur when ambient temperatures indicate the likelihood for heat stress to occur (i.e. Level A or B work).

Operations conducted wearing impermeable ensembles will follow the work/break schedule.

Table 3

Adjusted Temperature	Break Schedule
90 F or above	After 15 minutes of work
87.5 – 90 F	After 30 minutes of work
82.5-87.5 F	After 60 minutes of work
77.5-82.5 F	After 90 minutes of work
72.5-77.5 F	After 120 minutes of work

5.2.2. Cold Stress

Exposure to cold temperatures increases the likelihood and potential for worker disorders or conditions that could result in injury or illness. Strong wind accompanied by cold temperatures can exacerbate the occurrence of injury or illness. The two generally recognized cold disorders or conditions are frostbite and hypothermia. Contributing factors to these disorders or conditions are:

- Exposure to extremely cold air temperatures
- High winds (wind chill or equivalent chill temperature (ECT))
- Contact with liquids (groundwater)
- Inadequate clothing
- Poor worker health

Control measures to prevent cold stress include dressing in warm, layered clothing (insulated or water-impermeable clothing is best) and warming up as necessary by taking shelter or breaks. An outer shell of windproof material is essential to preventing cold stress in high wind conditions when the air temperature is below 39.2° F. Make sure to protect extremities, especially ears and hands. Skin should be kept dry to avoid additional opportunities for frostbite. Replace wet clothing immediately with warm dry clothing as needed.

5.2.3. Excessive Noise

Hearing protection must be utilized during noisy operations (i.e. when performing well installation activities) to conserve hearing. The drilling and sampling activities that will occur for this project should not require implementation of a hearing conservation program. If site operations indicate noise level TWAs above the OSHA Action Level of 85 dBA, then applicable regulations (29 CFR 1910.95, 29 CFR 1926.52 and 29 CFR 1926.101) will be followed for site operations with respect to hearing conservation.

5.2.4. Confined Space Entry

Not applicable for this project. Only Qepi personnel trained to enter areas determined to be a permit-required confined space should do so, if necessary.

5.2.5. Open Excavations

Some trenching is expected during the installation of the remedial system piping, requiring narrow open excavations.

All excavation area should be delineated by appropriate means, such as caution tape or fencing. Qepi employees will not enter the excavation if it is determined to be a confined space or until appropriate safety measures, such as benching, sloping or shielding, have been instituted. Excavation areas will be filled as soon as possible. In the event excavations must remain open the following precautions will be taken:

- Underground utilities will be marked appropriately;
- Excavations will be barricaded using caution tape and temporary fencing;
- The excavation will be inspected daily to assess soil conditions; and,
- Air monitoring will be conducted to monitor potential vapors from the pit.

5.2.6. Welding and/or Cutting

Welding is not expected for this project.

Qepi recommends that cold cutting or other similar method be utilized in lieu of hot welding/cutting operations whenever possible. Welding operations should be performed in accordance with the general requirements of 29 CFR 1910 Subpart Q and any specific requirements of that subpart which apply (i.e. oxygen fuel gas welding on tanks and cylinders). The basic general requirements must address fire prevention and protection during welding operations (including providing fire extinguishers and training for personnel who may use them), personal protection of welders and associated personnel, and ventilation in the welding areas. Air monitoring for lower explosive limits (LELs) shall be performed before and during welding

operations. If air monitoring data indicates that a LEL exists, all welding/cutting operations should be halted immediately until the hazard is eliminated.

5.2.7. Flammable Liquids

Impacted media are noncombustible in nature; however, petroleum LNAPL recovered may be flammable depending on concentration. Use caution when working with or near highly impacted medias, if found to be present on site. Flammable liquids used on site shall be handled, stored and marked properly. Flammable liquid containers will be OSHA-approved Safety Containers. Storage of flammable materials is not expected for this phase of work, but if containers will be stored at the site, they should be stored in a flammable storage cabinet or other appropriate secured location outside the exclusion zone. The area will be posted with NO SMOKING signs.

5.2.8. Equipment Operation/Tools

A drill rig will be used to advance extraction wells at the site. An excavator will be utilized to conduct trenching activities. Regular hand tools will be utilized during remedial system maintenance operations.

- ***Equipment***

  Each piece of equipment in operation at the site will be inspected before it can be used at the site. This will be the responsibility of the subcontractor. The equipment will be inspected to make sure that all safety devices are clearly labeled and functioning properly. This will include safety lights, emergency shut-off devices, and audio warning devices. Inspections of equipment will also be completed daily. The inspections will attempt to identify any worn parts and/or damaged safety equipment. If a safety issue is discovered, the piece of equipment will be tagged, and placed out of commission. The equipment will either be replaced or repaired. Daily inspection sheets will remain in the custody of the excavator. Each piece of heavy equipment will have a working fire extinguisher and first aid kit.

- ***Operators***

  Operators will be properly trained on each piece of equipment that they operate. This will be the responsibility of the subcontractor. Operators will have demonstrated competency in the operation of the equipment. Operators will inform other on-site staff of emergency shut-off switches and other safety devices that may be used during emergency situations.

- ***Site Personnel***

  Employees will not be allowed on or in the proximity of equipment until they have been properly trained and have received a safety briefing. The site supervisor or site personnel will keep a record of this briefing. Staff shall stay out of the operating range of any heavy equipment onsite. Entry into the operating zone is allowed only after the operator's attention has been gained and all buckets or extensions have been grounded.

5.2.9. Slip, Trip, Fall Hazards

The site should be cleared of slip, trip, and fall hazards. Tools and equipment will be stored appropriately, so as not to cause a slip or trip hazard, after decontamination. Any liquids will be contained immediately; areas with permanent walking hazards will be identified with marking paint or caution tape. The site supervisors will complete an assessment of general housekeeping at the site.

5.2.10. Presence of Underground Utilities

In order to eliminate hazards from underground utilities such as electric lines and natural gas supply lines, an underground utility marking service will be notified 48 hours in advance of any excavation activities. The typical color markings used are shown below:

- **Electric:** Marked by red paint.
- **Gas**: Marked by yellow paint,
- **Water**: Marked by blue paint.
- **Sewer**: Marked by green paint.
- **Telephone**: Marked by orange paint.
- **Specify exact location**: Blocks of residential lots.
- **Precautions to be taken**: Holey Moley will be contacted to mark all lines.

5.2.11. Presence of Overhead Utilities

Special precautions must be taken when using a drill rig or excavator onsite within the vicinity of electrical power lines and other utilities. Contact with live power lines may lead to shock, burns and even electrocution. Also, fires can potentially be started when power lines are contacted or downed.

Overhead utilities will be located, noted and emphasized in project work plans. Each overhead line must be considered dangerous and noted before mobilization of the drill rig. An inspection of the site prior to site operations will be conducted to assess overhead lines and their locations. Overhead

lines that are low or sagging must be noted, and the proper utility notified. No sagging or lowered lines are to be touched by site workers.

Areas where excavators are in operation must be inspected before operations occur. The minimum distance from any point or equipment extension to the nearest power lines should be determined when the extension is raised or being raised. The extension should not be raised or equipment operated if the distance is less than 20 feet. This is due to the potential of arcing and the movement of lines in the wind.

5.2.12. Traffic

Traffic hazards are prevalent at this industrial facility. Before leaving for a site, make sure necessary traffic control equipment, cones, caution tape, and warning flags have been loaded into the field vehicle. Warning vests suitable based on visibility must be warn when on-site. Be sure to note traffic concerns, even when wearing vests and utilizing the following demarcation systems.

- Sampling a groundwater monitoring well – Use a 3-cone (28" or 36") system with attached warning flags. Set-up the cone system before beginning work and remove them upon completion of work tasks (cones can be moved to each well and then back).

- Installing a well or advancing a soil boring – Use an appropriate number of cones and flags to demarcate the work zone. Cordon off the cone boundary with caution tape. Set-up the cone system before beginning work and take away upon completion of work tasks.

Excavations - Use an appropriate number of cones and flags to demarcate the work zone. Cordon off the cone boundary with caution tape. If excavation will remain open overnight, the project manager will determine if fencing and/or other barricades will be needed at the site.

5.2.13. Weather

As remedial system operation will be year round, proper care should be taken to understand the daily seasonal weather conditions prior to working onsite. Please refer to the sections on heat and cold stress above. If rain and/or snow is found on the ground at the site, then special caution must be taken with regard to work processes and drilling. Site personnel should exercise caution while walking or carrying equipment or other items on snow. Prior to drilling, remove snow in a radius of at least 5 feet from the point to drill to check for utility mark-outs.

5.2.14.Animals/Insects

The site has wooded areas in the vicinity. When entering wooded areas, examine the areas and create noise prior to entry to attempt to scare off any animals present. Survey the areas where work will be performed for signs of insects, such as bee's nests, and use an insect repellant if necessary. If ticks or other attaching insects are prevalent, then site personnel should inspect themselves prior

to leaving the site. Be aware of any larger animals (deer, wild turkey, etc.) that may be present and avoid these animals.

5.2.15. Other Hazards: System Safety/Electrical Safety

This phase of the project does not involve system installation.

Employees may perform certain functions as outlined in this section in order to maintain routine operation of these systems. When working on or around these systems, employees should be aware of piping and other protruding equipment associated with the systems, as they present a trip hazard. Employees may enter the systems to check gauges and oil and pressure levels. When performing these tasks, employees should be sure to wear heavy-duty gloves to prevent inadvertent burns from contact with adjacent hot surfaces, as well as hard hats and safety glasses. Employees may also access the control panel face to turn off power or check power supply to the systems.

Employees are not to access the control circuitry unless they have been trained in Qepi's specific lockout program for performing system functions that require lockout, such as adding oil to any remedial system implements or removal of any guard. If an employee is unsure of whether a function requires lockout of the system of a particular piece of equipment, then they should call the project manager to determine if lockout is necessary.

6.0 Site Control

6.1. Site Access

Site access and security has been agreed upon between Qepi, Mother Earth, LLC and Indiana Land Trust 731 GRN, via Mr. Mike Morris, owner of Mother Earth, LLC and Mr. Joseph Grabill, owner of Indiana Land Trust 731 GRN. Mr. Morris' phone number can be found in the Emergency Phone Numbers page found in Attachment C. No personnel other than Qepi staff or subcontractors who are 40-hr or 24-hr trained will be allowed onto the site to perform the activities outlined in the Scope of Work for this project. Otherwise, site control will be maintained by on site personnel. A sign in sheet or this health and safety plan will be utilized to keep records of the workers entering and exiting the site. Qepi will place safety cones and caution tape, if necessary, around areas where drilling and sampling activities are being conducted. A site personnel must check at the Green Tech Transfer and Recycling facility's office prior to the start of any onsite work.

Work will be conducted at various locations at the site. Area-specific exclusion zones should be set-up by the contractor performing the work at that location. Workers entering these areas will sign in and out to keep track of personnel. Personnel entering these areas will be required to be in level C, or modified C PPE gear, depending on the air monitoring results.

If an outside agency, comes onto the site, the following procedures should be followed:

- Ask to see the representatives credentials and record pertinent information (name, agency, ID #, etc.) in the field book
- Request that any persons entering the exclusion zone be outfitted in the proper PPE

- ***Exclusion Zones***

  Exclusion zones will be limited to the areas where the remediation system trailer and remedial system operated wells are present. Personnel entering this area must be in Level D PPE and may be required to be in level C, or modified C PPE, depending on air monitoring results. Employees are not allowed to smoke, eat, drink, or apply cosmetics or sunscreen in the exclusion zone.

- ***Contamination Reduction Zone***

  This area is located outside of the exclusion zone, but will likely be adjacent to the soil borings. No impacted personnel, PPE, or heavy equipment will be allowed leave the exclusion zone without being properly decontaminated. Specific decontamination procedures are outlined in Section 9.0 of this plan.

- ***Support Zone***

  The support zone will be considered the remaining area of the facility not included in the exclusion zone or the contamination reduction zone. This area will not contain any contaminated material of personnel. Personnel in this area will be required to have level D PPE.

7.0 Personal Protective Equipment (PPE)

Based on the evaluation of potential hazards, the following levels of personal protection have been designated for site activities. Each contractor must make a hazard assessment in determining the proper PPE required for the activities they will perform. The assessment should include air monitoring and possibly analytical data in order to make the proper PPE determination. Determination of the proper PPE includes decisions on the type of respirator, protective clothing (chemical resistant suits and gloves) and other protective gear, such as hard hats. Site personnel must have successfully passed a qualitative fit test in a respirator present for site use, if needed. Additionally, site personnel must be trained in the use of the equipment utilized on site.

7.1. Level A

Not applicable

7.2. Level B

Not applicable

7.3. Level C

If site air monitoring or sampling results reveal elevated levels warranting respiratory protection, site personal will use level C protection will include the following:

- Poly-coated tyvek suit;
- Inner glove;
- Nitrile outer glove;
- Inner boot;
- Hard hat;
- Outer boot; and,
- Full-face respirator.

Modified C PPE will be used when no inhalation hazards exist, but where there is a small potential for contact with contamination. Modified C PPE includes the following items:

- Poly-coated tyvek;
- Inner glove;
- Nitrile outer glove;
- Inner boot;
- Outer boot;
- Hearing protection;
- Hard hat; and,
- Safety glasses

7.4. Level D

Level D equipment will include the following equipment:

- Hard hat;
- Safety glasses;
- Steel-toed shoes; and
- Long sleeve shirt with traffic safety vest

Level C PPE will be required only if air monitoring data suggests the upgrade in PPE. PPE may be down graded to modified level C, if daily air-monitoring operations have been conducted and results indicate that respiratory protection is not necessary.

Onsite personnel conducting remedial system operation and maintenance activities will be required to wear level D PPE when at the site.

8.0 Medical Surveillance

To safeguard the health of field personnel, a medical monitoring program will be implemented. Those Qepi employees and any contractors performing hazardous waste work on-site should be included in the Medical Surveillance Program as highlighted below:

- Any employees who are exposed to hazardous substances above the published exposure limits, without the use of a respirator, for thirty days or more per year.
- Any employee who wears a respirator for 30 days or more per year.
- Any employee who develop symptoms due to overexposure to hazardous substances, become ill, or who are injured due to overexposure to hazardous substances.
- Member of HAZMAT teams.

If Qepi employees and contractors fall into any of the above categories, a baseline medical examination should include the following based on job task:

- Medical and work history
- Physical examination performed by a local licensed physician
- Eye exam
- pulmonary function test
- X-ray (chest)
- EKG
- Audiogram
- Urinalysis
- Blood chemistry
- Heavy metals
- Other tests as deemed necessary

All employees working on-site will provide proof of a baseline examination. Periodic medical monitoring every 12 or at a minimum of 24 months is required. Personnel medical records will be

maintained according to 29 CFR 1910.120(f)(8). Access to the records will be consistent with 29 CFR 1910.20. Any unexpected exposures will be reported to the safety officer.

9.0 Decontamination

All decontamination procedures will follow Qepi's SOPs. All equipment, machinery, trucks, and personnel shall be properly decontaminated prior to exiting the area. Decontamination of equipment will include washing with both Isopropyl alcohol, Liquinox soap water and a de-ionized water rinse.

9.1. Personnel Decontamination Procedures

All personnel entering the exclusion zone will undergo decontamination prior to leaving the site. Personnel will proceed through the following Level C decontamination stations:

9.1.1. Station 1

- Thorough wash of all equipment (hand tools, monitoring equipment, etc.)
- Disposal of gloves and disposable coveralls
- Equipment Required: Disposal containers, liquid collection facilities

9.1.2. Station 2

- Thorough wash of boots, respirator, and other equipment that is not disposable
- Equipment Required: Alconox and water

9.1.3. Station 3

- Storage facilities for decontaminated PPE and tools.
- Equipment Required: storage shelves

9.1.4. Heavy Equipment Decontamination

Inspection of heavy equipment and vehicles for gross contamination will be conducted prior to leaving the exclusion zone. The equipment will then be placed into a decontamination pad in the contamination reduction zone. A power washer and brushes will be used to remove contaminated material; residual material will be collected and containerized for proper disposal.

9.2. Decontamination Waste Water

Collection: Collect all wastewater on-site in a labeled 55-gallon drum pending analysis.

Disposal: Solid and liquid material will be evaluated and sent for proper waste disposal offsite.

10.0 Air Monitoring

Air monitoring will be conducted by site personnel trained in the use and calibration of the equipment utilized at the site. Calibration of air monitoring equipment should be conducted in the field and recorded in the log book. Monitoring should be conducted at a minimum as follows: 1) prior to initiating work, 2) when work conditions change, or 3) when conditions dictate that continuous monitoring is necessary.

10.1 Personal Air Monitoring

In accordance with 29 CFR 1910.120, each contractor and subcontractor, as applicable and according to their respective SOPs, will conduct personal air monitoring for their employees. Personal sampling should be performed for those workers in worst-case or high-risk situations. Documentation of sampling and results must be made available, if requested.

10.2 Perimeter/Area Monitoring

Photo-ionization detectors (PIDs) will be used to monitor for elevated levels of contaminants and determine if upgrades in the level of PPE will be necessary. Air monitoring may also be conducted for LELs and oxygen levels in the atmosphere near the drilling operation using a combustible gas indicator (CGI). If an LEL is detected, operations will be stopped to determine the reason for the reading occurring and if and how the hazardous condition will be eliminated. If oxygen levels are detected below 19.5% or above 23.5%, work will also be stopped to determine the reason for those readings.

Calibration of all equipment will be conducted in accordance with manufacturer's specifications. All documentation of calibration of equipment and sampling results must be available from each contractor and subcontractor upon request.

11.0 Contingency Plan

11.1. Emergency Communication Signal(s)

Emergency communication between Qepi personnel will be direct, if possible. If visual contact cannot be maintained, hand-held radios will be used when and if necessary. Hand signals should be used when necessary as follows:

Signal	**Message**
Hand gripping throat	Can't breathe

Grip partners wrist(s)	Leave area immediately
Hands on top of head	Need assistance
Thumbs up	I'm OK/I understand
Thumbs down	No/negative

11.2. Emergency Escape Route(s)

In case of an emergency, all site personnel will be directed north of the site, into the field office of the Green Tech Transfer and Recycling facility. If it is found that airborne hazards are being carried to this location, then an alternate location should be selected based on weather conditions (i.e. wind direction).

11.3. Emergency Equipment on Site

Each contractor and subcontractor should supply the proper emergency equipment necessary based on the respective job tasks at the site. The Qepi H&SO will be responsible for making sure contractors and subcontractors have the necessary minimum emergency equipment and coordinate the use, if necessary, of these items between subcontractors.

- First Aid Kit: Yes, in field vehicles
- Fire Extinguisher: Yes, in field vehicles
- Telephone: Mobile phone with on site personnel
- Eye Wash/Safety Shower: Eyewash in field vehicles

11.4. Hazards on Site

The on-site safety hazards include the previously mentioned chemical hazards and physical hazards.

11.5. Re-entry to the Exclusion Zone

Re-entry to the Exclusion Zone following an on-site emergency shall not be permitted until the following conditions are satisfied:

- The conditions resulting in an emergency have been corrected.
- Appropriate personnel have received medical attention, if applicable.
- The hazards have been re-evaluated.
- The Site Safety Plan has been reviewed and determined adequate for the hazards encountered.
- All site personnel have been instructed in any new hazards and changes to the Site Safety Plan.

12.0 Emergency Response Plan

12.1. Pre-Emergency Planning

All personnel shall read the Health & Safety Plan (HASP) and sign the signature page. Emergency procedures outlined in this plan should be discussed with on site personnel and followed when appropriate. Should an emergency occur, a safety meeting must be held and documented and relevant personnel outlined in this plan contacted. Site personnel should follow the chain-of-command outlined in this plan with the senior Qepi personnel relinquishing authority to the LEPC when on site. All small, non-life threatening operations will be controlled by site personnel. This will include small releases less than reportable quantities, small equipment fires, or non-emergency first aid issues.

In the case of large emergencies or life-threatening situations, efforts will be focused on the removal of site workers from the hazardous situation. Emergency contact will be made immediately, including all necessary state, local, Federal, and Qepi personnel.

12.2. Lines of Authority

Qepi's Project Manager.....Nivas R. Vijay

Qepi's Health & Safety Officer .....Travis Erny

Qepi's Phone No.: .....(574) 360-0961 or (317) 440-8946

12.3. Hazard Analysis

Refer to Part E of this Health & Safety Plan

12.4. Safe Distances & Refuge

In the event of an evacuation, personnel will meet at a pre-determined designated location upwind of the site. Information will be gathered and relayed to the first emergency responder at the scene. The location of the meeting place will be determined by the onsite supervisor, due to the fact that operations maybe from various areas at the site.

12.4.1. Air Monitoring

In the event of emergency, Qepi will use real time air monitoring to determine a safe distance.

12.4.2. Refuge

Refuge may be sought in a location pre-determined by the site supervisor. If this area is not considered safe, then the company support vehicles will be used to transport site personnel to a safe distance. The support vehicle should be placed at safe distance from site activity and upwind, if possible.

12.5. Site Control & Security

Qepi will assist emergency responders in maintaining site security.

12.6. Evacuation Procedures

Staff will be instructed to move to a safe location or meeting point to make emergency calls and further evaluate the emergency situation.

12.7. Emergency Decontamination

Emergency decontamination will consist of removal of protective suit, disposable gloves and boot covers by workers adequately protected in an environment where the victim will not be re-contaminated.

12.8. Emergencies

Emergencies will be made known to the property owners through the line authority. An evaluation of the situation will dictate whether additional emergency equipment/personnel are necessary to mitigate the problem. Medical treatment for minor problems may be obtained from on site first aid kits. Major medical problems may be addressed at Memorial Hospital, located at 615 North Michigan Street in South Bend. Directions to the hospital are included in Attachment B. Emergency phone numbers can be found in Attachment B. When notifying any authority or responder of a chemical emergency, also inform them of the chemical hazards involved.

13.0 Emergency Response

See Attachment A for the MSDS sheets. Attachment B includes a general map of the site with relocation areas. Attachment C includes emergency phone numbers and a map with directions to the nearest hospital.

14.0 Signature Page

All personnel have read the above plan and are familiar with its provisions. All personnel have received medical surveillance and training in compliance with the health and & safety policies outlined in this plan, including all applicable Federal, state and local regulations. Qepi personnel may stop work at the site if it is not performed in accordance with this plan or OSHA regulations. In addition, subcontractors shall provide and make available a site safety plan at least as stringent as this plan. Qepi reserves the right to review any subcontractors plan and determine its authority.

All on-site personnel, subcontractor personnel, and any visitors within the confines of the work area are required to sign the following agreement prior to conducting work at the site.

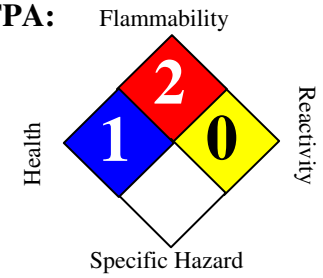
1. I have read and fully understand this Site Health and Safety Plan.
2. I agree to abide by the provisions and my responsibilities outlined in this Site Health and Safety Plan.

Name (Company)	Signature

Attachment A

Material Safety Data Sheet
Jet Fuel

NFPA:



HMIS III:

HEALTH	1
FLAMMABILITY	2
PHYSICAL	0

0 = Insignificant, 1 = Slight, 2 = Moderate, 3 = High, 4 = Extreme

SECTION 1. PRODUCT AND COMPANY IDENTIFICATION

Product name : Jet Fuel

Synonyms : Jet Fuel - A, B, A-I, A-50, High Sulfur, Military, Jet A & B Aviation Turbine Fuel, Jet A-I, Jet A; Avjet For Blending; Jet Q Turbine Fuel, Aviation Fuel; Turbine Fuel; JP-4; JP-5; JP-8, Avjet for Blending, 888100004452

MSDS Number : 888100004452 **Version** : 2.6

Product Use Description : Fuel

Company : For: Tesoro Refining & Marketing Co.
300 Concord Plaza Drive, San Antonio, TX 78216-6999

Tesoro Call Center : (877) 783-7676 **Chemtrec (Emergency Contact)** : (800) 424-9300

SECTION 2. HAZARDS IDENTIFICATION

Emergency Overview

Regulatory status : This material is considered hazardous by the Occupational Safety and Health Administration (OSHA) Hazard Communication Standard (29 CFR 1910.1200).

Signal Word : WARNING

Hazard Summary : Harmful or fatal if swallowed. Harmful by inhalation. Irritating to eyes, respiratory system and skin. Affects central nervous system. Flammable.

Potential Health Effects

Eyes : Severe eye irritant. Contact may cause stinging, watering, redness, swelling, and eye damage.

Skin : Prolonged or repeated skin contact with liquid may cause defatting resulting in drying, redness and possible blistering. Practically non-toxic if absorbed following acute (single) exposure. Liquid may be absorbed through the skin in toxic amounts if large areas of skin are repeatedly exposed.

Ingestion : Ingestion may cause gastrointestinal disturbances, including irritation, nausea, vomiting and diarrhea, and central nervous (brain) effects similar to alcohol intoxication. In severe cases, tremors, convulsions, loss of consciousness, coma, respiratory arrest and death may occur.

Inhalation : Inhalation of fumes or mist may result in respiratory tract irritation and central nervous system (brain) effects may include headache, dizziness, loss of balance and coordination, unconsciousness, coma, respiratory failure, and death. WARNING: the burning of any hydrocarbon as a fuel in an area without

adequate ventilation may result in hazardous levels of combustion products, including carbon monoxide, and inadequate oxygen levels, which may cause unconsciousness, suffocation, and death.

Chronic Exposure : Similar products produced skin cancer and systemic toxicity in laboratory animals following repeated applications. The significance of these results to human exposures has not been determined - see Section 11 Toxicological Information.

Target Organs : Eyes, Skin, Respiratory system, Irritation from skin exposure may aggravate existing open wounds, skin disorders, and dermatitis (rash)

SECTION 3. COMPOSITION/INFORMATION ON INGREDIENTS

Component	CAS-No.	Weight %
Kerosene (petroleum)	8008-20-6	100%
Naphthalene	91-20-3	0 to 3%
Ethyl Benzene	100-41-4	0 to 1%
Trimethy Benzene	95-63-6	0 to 1%
Ethyl Benzene	100-41-4	0 to 1%
Diethylene Glycol Monomethyl Ether	111-77-3	0 to 0.15%
Alkyl Dithiothiadiazole	N/A	0 to 15%

SECTION 4. FIRST AID MEASURES

Inhalation : If inhaled, remove to fresh air. If not breathing, give artificial respiration. If necessary, provide additional oxygen once breathing is restored if trained to do so. Seek medical attention immediately.

Skin contact : Take off all contaminated clothing immediately. Wash off immediately with soap and plenty of water. Wash contaminated clothing before re-use. If skin irritation persists, seek medical attention.

Eye contact : In case of eye contact, remove contact lens and rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Seek medical attention immediately.

Ingestion : Do NOT induce vomiting. Do not give liquids. Seek medical attention immediately. If vomiting does occur naturally, keep head below the hips to reduce the risks of aspiration. Monitor for breathing difficulties. Small amounts of material which enter the mouth should be rinsed out until the taste is dissipated.

Notes to physician : Symptoms: Aspiration may cause pulmonary edema and pneumonitis. Treatment: Do not induce vomiting, use gastric lavage only. Remove from further exposure and treat symptomatically.

SECTION 5. FIRE-FIGHTING MEASURES

Form : Liquid

Flash point	:	38 °C (100 °F)
Auto Ignition temperature	:	210 °C (410 °F)
Lower explosive limit	:	0.7 %(V)
Upper explosive limit	:	4.0 %(V)
Suitable extinguishing media	:	Carbon dioxide (CO2), Water spray, Dry chemical, Foam, Keep containers and surroundings cool with water spray., Do not use a solid water stream as it may scatter and spread fire., Water may be ineffective for fighting the fire, but may be used to cool fire-exposed containers.
Specific hazards during fire fighting	:	Fire Hazard. Do not use a solid water stream as it may scatter and spread fire. Cool closed containers exposed to fire with water spray. Sealed containers may rupture when heated. Above the flash point, explosive vapor-air mixtures may be formed. Vapors can flow along surfaces to distant ignition source and flash back.
Special protective equipment for fire-fighters	:	Firefighting activities that may result in potential exposure to high heat, smoke or toxic by-products of combustion should require NIOSH/MSHA- approved pressure-demand self-contained breathing apparatus with full facepiece and full protective clothing.
Further information	:	Exposure to decomposition products may be a hazard to health. Standard procedure for chemical fires.

SECTION 6. ACCIDENTAL RELEASE MEASURES

Personal precautions	:	ACTIVATE FACILITY'S SPILL CONTINGENCY OR EMERGENCY RESPONSE PLAN if applicable. Evacuate nonessential personnel and remove or secure all ignition sources. Consider wind direction; stay upwind and uphill, if possible. Evaluate the direction of product travel, diking, sewers, etc. to contain spill areas. Spills may infiltrate subsurface soil and groundwater; professional assistance may be necessary to determine the extent of subsurface impact.
Environmental precautions	:	Carefully contain and stop the source of the spill, if safe to do so. Protect bodies of water by diking, absorbents, or absorbent boom, if possible. Do not flush down sewer or drainage systems, unless system is designed and permitted to handle such material. The use of fire fighting foam may be useful in certain situations to reduce vapors. The proper use of water spray may effectively disperse product vapors or the liquid itself, preventing contact with ignition sources or areas/equipment that require protection.
Methods for cleaning up	:	Take up with sand or oil absorbing materials. Carefully shovel, scoop or sweep up into a waste container for reclamation or disposal - caution, flammable vapors may accumulate in closed containers. Response and clean-up crews must be properly trained and must utilize proper protective equipment (see Section 8).

CERCLA Hazardous substances and corresponding RQs :

Naphthalene	91-20-3	100 lbs
Ethylbenzene	100-41-4	1,000 lbs

SECTION 7. HANDLING AND STORAGE

Handling	:	Keep away from fire, sparks and heated surfaces. No smoking near areas where material is stored or handled. The product should only be stored and handled in areas with intrinsically safe electrical classification.

Advice on protection against fire and explosion : Hydrocarbon liquids including this product can act as a non-conductive flammable liquid (or static accumulators), and may form ignitable vapor-air mixtures in storage tanks or other containers. Precautions to prevent static-initated fire or explosion during transfer, storage or handling, include but are not limited to these examples:

(1) Ground and bond containers during product transfers. Grounding and bonding may not be adequate protection to prevent ignition or explosion of hydrocarbon liquids and vapors that are static accumulators.

(2) Special slow load procedures for "switch loading" must be followed to avoid the static ignition hazard that can exist when higher flash point material (such as fuel oil or diesel) is loaded into tanks previously containing low flash point products (such gasoline or naphtha).

(3) Storage tank level floats must be effectively bonded.

For more information on precautions to prevent static-initated fire or explosion, see NFPA 77, Recommended Practice on Static Electricity (2007), and API Recommended Practice 2003, Protection Against Ignitions Arising Out of Static, Lightning, and Stray Currents (2008).

Dust explosion class : Not applicable

Requirements for storage areas and containers : Keep away from flame, sparks, excessive temperatures and open flame. Use approved containers. Keep containers closed and clearly labeled. Empty or partially full product containers or vessels may contain explosive vapors. Do not pressurize, cut, heat, weld or expose containers to sources of ignition. Store in a well-ventilated area. The storage area should comply with NFPA 30 "Flammable and Combustible Liquid Code". The cleaning of tanks previously containing this product should follow API Recommended Practice (RP) 2013 "Cleaning Mobile Tanks In Flammable and Combustible Liquid Service" and API RP 2015 "Cleaning Petroleum Storage Tanks".

Advice on common storage : Keep away from food, drink and animal feed. Incompatible with oxidizing agents. Incompatible with acids.

Other data : Emergency eye wash capability should be available in the near proximity to operations presenting a potential splash exposure.

SECTION 8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Exposure Guidelines

List	Components	CAS-No.	Type:	Value
OSHA Z1	Naphthalene	91-20-3	PEL	10 ppm 50 mg/m3
	Ethyl Benzene	100-41-4	PEL	100 ppm 435 mg/m3
ACGIH	Naphthalene	91-20-3	TWA	10 ppm
		91-20-3	STEL	15 ppm
	Kerosene (petroleum)	8008-20-6	TWA	200 mg/m3
	Ethyl Benzene	100-41-4	TWA	100 ppm 434 mg/m3
			STEL	125 ppm 543 mg/m3

Protective measures : Keep out of reach of children.

Engineering measures : Use only intrinsically safe electrical equipment approved for use in classified areas. Emergency eye wash capability should be available in the vicinity of any potential splash exposure.

Eye protection	:	Goggles and face shield as needed to prevent eye and face contact.
Hand protection	:	Gloves constructed of nitrile, neoprene, or PVC are recommended.
Skin and body protection	:	Chemical protective clothing such as DuPont TyChem ®, Barricade or equivalent, recommended based on degree of exposure. Consult manufacturer specifications for further information.
Respiratory protection	:	NIOSH/MSHA approved positive-pressure self-contained breathing apparatus (SCBA) or Type C positive-pressure supplied air with escape bottle must be used for gas concentrations above occupational exposure limits, for potential of uncontrolled release, if exposure levels are not known, or in an oxygen-deficient atmosphere.
Work / Hygiene practices	:	Emergency eye wash capability should be available in the near proximity to operations presenting a potential splash exposure. Use good personal hygiene practices. Avoid repeated and/or prolonged skin exposure. Wash hands before eating, drinking, smoking, or using toilet facilities. Do not use as a cleaning solvent on the skin. Do not use solvents or harsh abrasive skin cleaners for washing this product from exposed skin areas. Waterless hand cleaners are effective. Promptly remove contaminated clothing and launder before reuse. Use care when laundering to prevent the formation of flammable vapors which could ignite via washer or dryer. Consider the need to discard contaminated leather shoes and gloves.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

Form	:	Liquid
Appearance	:	Light yellow to white
Odor	:	Characteristic Petroleum distillate
Flash point	:	38 °C (100 °F)
Auto Ignition temperature	:	210 °C (410 °F)
Thermal decomposition	:	No decomposition if stored and applied as directed.
Lower explosive limit	:	0.7 %(V)
Upper explosive limit	:	4.0 %(V)
pH	:	Not applicable
Specific gravity	:	0.8 (H20=1)
Freezing point	:	-55 °C (-67 °F)
Boiling point	:	160 - 300 °C(320 - 572 °F)
Vapor Pressure	:	6.9 hPa at 20 °C (68 °F)
Relative Vapor Density	:	4.5
Density	:	0.8 g/cm3
Water solubility	:	Insoluble
Viscosity, kinematic	:	1.6 mm2/s at 40 °C (104 °F)

Percent Volatiles	:	100 %
Conductivity (conductivity can be reduced by environmental factors such as a decrease in temperature)		Diesel Fuel Oils at terminal load rack: At least 25 pS/m Ultra Low Sulfur Diesel (ULSD) without conductivity additive: 0 pS/m to 5 pS/m ULSD at terminal load rack with conductivity additive: At least 50 pS/m but conductivity may decrease from environmental factors such as temperature drop. JP-8 at terminal load rack: 150 pS/m to 600 pS/m

SECTION 10. STABILITY AND REACTIVITY

Conditions to avoid	:	Avoid high temperatures, open flames, sparks, welding, smoking and other ignition sources. Keep away from strong oxidizers.
Materials to avoid	:	Keep away from strong oxidizers such as nitric and sulfuric acids.
Hazardous decomposition products	:	Risk of explosion. In case of fire hazardous decomposition products may be produced such as: Smoke. Hydrocarbons. Carbon Monoxide and Carbon Dioxide.
Thermal decomposition	:	No decomposition if stored and applied as directed.
Hazardous reactions	:	Stable under normal conditions of use; however, incompatible with strong acids and strong oxidizers.

SECTION 11. TOXICOLOGICAL INFORMATION

Carcinogenicity

NTP	:	Naphthalene (CAS-No.: 91-20-3)
IARC	:	Kerosene is not listed as carcinogenic by NTP, OSHA, and ACGIH. IARC has listed kerosene as a probable human carcinogen. naphthalene (CAS-No.: 91-20-3) Kerosene (petroleum) (CAS-No.: 8008-20-6)
CA Prop 65	:	WARNING! This product contains a chemical known to the State of California to cause cancer. Naphthalene (CAS-No.: 91-20-3)
Skin irritation	:	Irritating to skin.
Eye irritation	:	Irritating to eyes.
Further information	:	Kerosene does not have a measurable effect on human reproduction or development. Kerosene is not listed as carcinogenic by NTP, OSHA, and ACGIH. IARC has listed kerosene as a probable human carcinogen. Some petroleum distillates have been found to cause adverse reproductive effects in laboratory animals. Acute and chronic exposure to kerosene may result in CNS effects including irritability, restlessness, ataxia, drowsiness, convulsions, coma and death. The most common health effect associated with chronic kerosene exposure is dermatitis.

Component:

Kerosene (petroleum)	8008-20-6	Acute oral toxicity: LD50 rat Dose: 5 mg/kg Acute dermal toxicity: LD50 rabbit Dose: 2,001 mg/kg

		Acute inhalation toxicity: LC50 rat Dose: 5.28 mg/l Exposure time: 4 h Skin irritation: Classification: Irritating to skin. Result: Skin irritation
Naphthalene	91-20-3	Acute oral toxicity: LD50 rat Dose: 2,001 mg/kg Acute dermal toxicity: LD50 rat Dose: 2,501 mg/kg Acute inhalation toxicity: LC50 rat Dose: 101 mg/l Exposure time: 4 h Skin irritation: Classification: Irritating to skin. Result: Mild skin irritation Eye irritation: Classification: Irritating to eyes. Result: Mild eye irritation Carcinogenicity: N11.00422130

SECTION 12. ECOLOGICAL INFORMATION

Additional ecological information : Release of this product should be prevented from contaminating soil and water and from entering drainage and sewer systems. U.S.A. regulations require reporting spills of this material that could reach any surface waters. The toll free number for the U.S. Coast Guard National Response Center is (800) 424-8802. Naphthalene (91-20-3) one of the ingredients in this mixture is classified as a Marine Pollutant.

Component:

Naphthalene	91-20-3	Toxicity to algae: EC50 Species: Dose: 33 mg/l Exposure time: 24 h

SECTION 13. DISPOSAL CONSIDERATIONS

Disposal : Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved waste facility.
Processing, use or contamination of this product may change the waste management options.
State and local disposal regulations may differ from federal disposal regulations.
Dispose of container and unused contents in accordance with federal, state and local requirements.

SECTION 14. TRANSPORT INFORMATION

CFR

Proper shipping name	: Fuel, aviation, turbine engine
UN-No.	: 1863
Class	: 3
Packing group	: III

TDG

Proper shipping name	: Fuel, aviation, turbine engine
UN-No.	: UN1863
Class	: 3
Packing group	: III

IATA Cargo Transport

UN UN-No.	: UN1863
Description of the goods	: Fuel, aviation, turbine engine
Class	: 3
Packaging group	: III
ICAO-Labels	: 3
Packing instruction (cargo aircraft)	: 310
Packing instruction (cargo aircraft)	: Y309

IATA Passenger Transport

UN UN-No.	: UN1863
Description of the goods	: Fuel, aviation, turbine engine
Class	: 3
Packaging group	: III
ICAO-Labels	: 3
Packing instruction (passenger aircraft)	: 309
Packing instruction (passenger aircraft)	: Y309

IMDG-Code

UN-No.	: UN 1863
Description of the goods	: Fuel, aviation, turbine engine
Class	: 3
Packaging group	: III
IMDG-Labels	: 3
EmS Number	: F-E S-E
Marine pollutant	: Yes

SECTION 15. REGULATORY INFORMATION

OSHA Hazards	: Toxic by inhalation. Highly toxic by ingestion Moderate skin irritant Severe eye irritant Combustible
TSCA Status	: On TSCA Inventory
DSL Status	: All components of this product are on the Canadian DSL list.
SARA 311/312 Hazards	: Acute Health Hazard Chronic Health Hazard Fire Hazard
California Prop. 65	: WARNING! This product contains a chemical known to the State of California to

cause cancer.

Naphthalene	91-20-3

SECTION 16. OTHER INFORMATION

Further information

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

Prepared by : GWU mbH
Birlenbacher Str. 18
D-57078 Siegen

Germany

Telephone: +49-(0)271-88072-0

Revision Date : 05/04/2009

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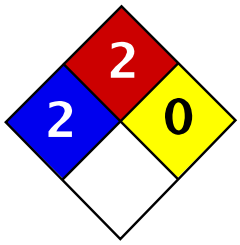

Health	2
Fire	2
Reactivity	0
Personal Protection	E

Material Safety Data Sheet
Naphthalene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Naphthalene

Catalog Codes: SLN1789, SLN2401

CAS#: 91-20-3

RTECS: QJ0525000

TSCA: TSCA 8(b) inventory: Naphthalene

CI#: Not available.

Synonym:

Chemical Name: Not available.

Chemical Formula: C10H8

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Naphthalene	91-20-3	100

Toxicological Data on Ingredients: Naphthalene: ORAL (LD50): Acute: 490 mg/kg [Rat]. 533 mg/kg [Mouse]. 1200 mg/kg [Guinea pig]. DERMAL (LD50): Acute: 20001 mg/kg [Rabbit]. VAPOR (LC50): Acute: 170 ppm 4 hour(s) [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of ingestion. Hazardous in case of eye contact (irritant), of inhalation. Slightly hazardous in case of skin contact (irritant, permeator). Severe over-exposure can result in death.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: A4 (Not classifiable for human or animal.) by ACGIH.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Classified Development toxin [POSSIBLE].
The substance is toxic to blood, kidneys, the nervous system, the reproductive system, liver, mucous membranes, gastrointestinal tract, upper respiratory tract, central nervous system (CNS).
Repeated or prolonged exposure to the substance can produce target organs damage. Repeated exposure to an highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Do not use an eye ointment. Seek medical attention.

Skin Contact:
After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact: Not available.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:
Do not induce vomiting. Examine the lips and mouth to ascertain whether the tissues are damaged, a possible indication that the toxic material was ingested; the absence of such signs, however, is not conclusive. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 567°C (1052.6°F)

Flash Points: CLOSED CUP: 88°C (190.4°F). OPEN CUP: 79°C (174.2°F).

Flammable Limits: LOWER: 0.9% UPPER: 5.9%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances: Not available.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
Flammable solid.
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Use appropriate tools to put the spilled solid in a convenient waste disposal container.

Large Spill:
Flammable solid.
Stop leak if without risk. Do not touch spilled material. Use water spray curtain to divert vapor drift. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe dust. Avoid contact with eyes Wear suitable protective clothing In case of insufficient ventilation, wear suitable respiratory equipment If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as oxidizing agents.

Storage:
Flammable materials should be stored in a separate safety storage cabinet or room. Keep away from heat. Keep away from sources of ignition. Keep container tightly closed. Keep in a cool, well-ventilated place. Ground all equipment containing material. Keep container dry. Keep in a cool place.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection:
Splash goggles. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
Israel: TWA: 10 (ppm)
TWA: 10 STEL: 15 (ppm) from ACGIH (TLV) [1995]
TWA: 52 STEL: 79 (mg/m3) from ACGIH [1995]
Australia: STEL: 15 (ppm)
Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Crystalline solid.)

Odor: Aromatic.

Taste: Not available.

Molecular Weight: 128.19 g/mole

Color: White.

pH (1% soln/water): Not available.

Boiling Point: 218°C (424.4°F)

Melting Point: 80.2°C (176.4°F)

Critical Temperature: Not available.

Specific Gravity: 1.162 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: 4.4 (Air = 1)

Volatility: Not available.

Odor Threshold: 0.038 ppm

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties:
Partially dispersed in hot water, methanol, n-octanol.
Very slightly dispersed in cold water.
See solubility in methanol, n-octanol.

Solubility:
Partially soluble in methanol, n-octanol.
Very slightly soluble in cold water, hot water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Highly reactive with oxidizing agents.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: May attack some forms of rubber and plastic

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE.
Acute oral toxicity (LD50): 490 mg/kg [Rat].
Acute dermal toxicity (LD50): 20001 mg/kg [Rabbit].
Acute toxicity of the vapor (LC50): 170 ppm 4 hour(s) [Rat].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: A4 (Not classifiable for human or animal.) by ACGIH.

DEVELOPMENTAL TOXICITY: Classified Development toxin [POSSIBLE].
The substance is toxic to blood, kidneys, the nervous system, the reproductive system, liver, mucous membranes, gastrointestinal tract, upper respiratory tract, central nervous system (CNS).

Other Toxic Effects on Humans:
Very hazardous in case of ingestion.
Hazardous in case of inhalation.
Slightly hazardous in case of skin contact (irritant, permeator).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Ecotoxicity in water (LC50): 305.2 ppm 96 hour(s) [Trout].

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are more toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: CLASS 4.1: Flammable solid.

Identification: : Naphthalene, refined : UN1334 PG: III

Special Provisions for Transport: Marine Pollutant

Section 15: Other Regulatory Information

Federal and State Regulations:
Rhode Island RTK hazardous substances: Naphthalene
Pennsylvania RTK: Naphthalene
Florida: Naphthalene
Minnesota: Naphthalene
Massachusetts RTK: Naphthalene
TSCA 8(b) inventory: Naphthalene
TSCA 8(a) PAIR: Naphthalene
TSCA 8(d) H and S data reporting: Naphthalene: 06/01/87
SARA 313 toxic chemical notification and release reporting: Naphthalene: 1%
CERCLA: Hazardous substances.: Naphthalene: 100 lbs. (45.36 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS B-4: Flammable solid.
CLASS D-1B: Material causing immediate and serious toxic effects (TOXIC).
CLASS D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC):
R36- Irritating to eyes.
R40- Possible risks of irreversible effects.
R48/22- Harmful: danger of serious damage to health by prolonged exposure if swallowed.
R48/23- Toxic: danger of serious damage to health by prolonged exposure through inhalation.
R63- Possible risk of harm to the unborn child.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 2

Reactivity: 0

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 2

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/11/2005 01:30 PM

Last Updated: 10/11/2005 01:30 PM

1. MATERIAL AND COMPANY IDENTIFICATION

Material Name	:	**Benzene**
Uses	:	Raw material for use in the chemical industry
Product Code	:	Q9121, Q9112
Company	:	**Shell Chemical LP** PO Box 2463 HOUSTON TX 77252-2463 USA
MSDS Request	:	1-800-240-6737
Customer Service	:	1-800-872-7435

Emergency Telephone Number

Chemtrec Domestic (24 hr)	:	1-800-424-9300
Chemtrec International (24 hr)	:	1-703-527-3887

2. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Name	CAS No.	Concentration
Benzene	71-43-2	100 00 %

3. HAZARDS IDENTIFICATION

Emergency Overview

Appearance and Odour	:	Colourless Liquid Aromatic
Health Hazards	:	Vapours may cause drowsiness and dizziness Irritating to skin Irritating to eyes Harmful: may cause lung damage if swallowed May cause cancer
Safety Hazards	:	Extremely flammable Vapours are heavier than air Vapours may travel across the ground and reach remote ignition sources causing a flashback fire danger Electrostatic charges may be generated during pumping Electrostatic discharge may cause fire
Environmental Hazards	:	Toxic to aquatic organisms

Health Hazards

Inhalation	:	Slightly irritating to respiratory system Vapours may cause drowsiness and dizziness
Skin Contact	:	Irritating to skin
Eye Contact	:	Irritating to eyes
Ingestion	:	Harmful: may cause lung damage if swallowed
Other Information	:	Possibility of organ or organ system damage from prolonged exposure; see Chapter 11 for details Target organ(s): Cardiovascular system Blood

Blood-forming organs
Immune system
Possible risk of irreversible (genetic) effects May cause cancer
May cause leukaemia (AML - acute myelogenous leukaemia)

Signs and Symptoms : Eye irritation signs and symptoms may include a burning sensation, redness, swelling, and/or blurred vision Skin irritation signs and symptoms may include a burning sensation, redness, swelling, and/or blisters If material enters lungs, signs and symptoms may include coughing, choking, wheezing, difficulty in breathing, chest congestion, shortness of breath, and/or fever The onset of respiratory symptoms may be delayed for several hours after exposure Breathing of high vapour concentrations may cause central nervous system (CNS) depression resulting in dizziness, light-headedness, headache, nausea and loss of coordination Continued inhalation may result in unconsciousness and death Damage to blood-forming organs may be evidenced by: a) fatigue and anaemia (RBC), b) decreased resistance to infection, and/or excessive bruising and bleeding (platelet effect). Heart damage may be evidenced by shortness of breath and, in severe cases, by collapse (cardiac arrest)

Environmental Hazards : Toxic to aquatic organisms

4. FIRST AID MEASURES

General Information : Keep victim calm Obtain medical treatment immediately

Inhalation : DO NOT DELAY Remove to fresh air If rapid recovery does not occur, transport to nearest medical facility for additional treatment

Skin Contact : Remove contaminated clothing Immediately flush skin with large amounts of water for at least 15 minutes, and follow by washing with soap and water if available If redness, swelling, pain and/or blisters occur, transport to the nearest medical facility for additional treatment

Eye Contact : Immediately flush eyes with large amounts of water for at least 15 minutes while holding eyelids open Transport to the nearest medical facility for additional treatment.

Ingestion : If swallowed, do not induce vomiting: transport to nearest medical facility for additional treatment If vomiting occurs spontaneously, keep head below hips to prevent aspiration

Advice to Physician : Potential for chemical pneumonitis Consider: gastric lavage with protected airway, administration of activated charcoal Potential for cardiac sensitisation, particularly in abuse situations Hypoxia or negative inotropes may enhance these effects Consider: oxygen therapy

5. FIRE FIGHTING MEASURES

Clear fire area of all non-emergency personnel

Flash point : -11 °C / 12 °F (Abel)

Explosion / Flammability : 1 4 - 7 1 %(V)

limits in air		
Auto ignition temperature	:	562 °C / 1,044 °F
Specific Hazards	:	The vapour is heavier than air, spreads along the ground and distant ignition is possible Will float and can be reignited on surface water Carbon monoxide may be evolved if incomplete combustion occurs
Extinguishing Media	:	Foam, water spray or fog Dry chemical powder, carbon dioxide, sand or earth may be used for small fires only
Unsuitable Extinguishing Media	:	Do not use water in a jet
Protective Equipment for Firefighters	:	Wear full protective clothing and self-contained breathing apparatus
Additional Advice	:	Keep adjacent containers cool by spraying with water

6. ACCIDENTAL RELEASE MEASURES

Avoid contact with spilled or released material Immediately remove all contaminated clothing. For guidance on selection of personal protective equipment see Chapter 8 of this Material Safety Data Sheet For guidance on disposal of spilled material see Chapter 13 of this Material Safety Data Sheet Observe all relevant local and international regulations

Protective measures	:	Isolate hazard area and deny entry to unnecessary or unprotected personnel Stay upwind and keep out of low areas Shut off leaks, if possible without personal risks Remove all possible sources of ignition in the surrounding area Use appropriate containment to avoid environmental contamination Prevent from spreading or entering drains, ditches or rivers by using sand, earth, or other appropriate barriers Attempt to disperse the vapour or to direct its flow to a safe location for example by using fog sprays Take precautionary measures against static discharge Ensure electrical continuity by bonding and grounding (earthing) all equipment Ventilate contaminated area thoroughly
Clean Up Methods	:	For large liquid spills (> 1 drum), transfer by mechanical means such as vacuum truck to a salvage tank for recovery or safe disposal Do not flush away residues with water Retain as contaminated waste Allow residues to evaporate or soak up with an appropriate absorbent material and dispose of safely Remove contaminated soil and dispose of safely For small liquid spills (< 1 drum), transfer by mechanical means to a labelled, sealable container for product recovery or safe disposal Allow residues to evaporate or soak up with an appropriate absorbent material and dispose of safely Remove contaminated soil and dispose of safely
Additional Advice	:	Notify authorities if any exposure to the general public or the environment occurs or is likely to occur Local authorities should be advised if significant spillages cannot be contained The vapour is heavier than air, spreads along the ground and distant ignition is possible Vapour may form an explosive mixture with air U S regulations may require reporting releases of this material to the environment which exceed the reportable quantity (refer to Chapter 15) to the National

7. HANDLING AND STORAGE

General Precautions : Avoid breathing of or contact with material Only use in well ventilated areas Wash thoroughly after handling For guidance on selection of personal protective equipment see Chapter 8 of this Material Safety Data Sheet Use the information in this data sheet as input to a risk assessment of local circumstances to help determine appropriate controls for safe handling, storage and disposal of this material

Handling : Avoid inhaling vapour and/or mists Avoid contact with skin, eyes, and clothing Avoid exposure Obtain special instructions before use Extinguish any naked flames Do Not smoke. Remove ignition sources Avoid sparks Electrostatic charges may be generated during pumping Electrostatic discharge may cause fire Ensure electrical continuity by bonding and grounding (earthing) all equipment Restrict line velocity during pumping in order to avoid generation of electrostatic discharge (<= 1 m/sec until fill pipe submerged to twice its diameter, then <= 7 m/sec) Avoid splash filling Do NOT use compressed air for filling, discharging, or handling operations

Storage : Vapours from tanks should not be released to atmosphere Breathing losses during storage should be controlled by a suitable vapour treatment system Bulk storage tanks should be diked (bunded) The vapour is heavier than air Beware of accumulation in pits and confined spaces

Product Transfer : Electrostatic charges may be generated during pumping Electrostatic discharge may cause fire Ensure electrical continuity by bonding and grounding (earthing) all equipment Restrict line velocity during pumping in order to avoid generation of electrostatic discharge (<= 1 m/sec until fill pipe submerged to twice its diameter, then <= 7 m/sec) Avoid splash filling Do NOT use compressed air for filling, discharging, or handling operations

Recommended Materials : For containers, or container linings use mild steel, stainless steel

Unsuitable Materials : Natural, butyl, neoprene or nitrile rubbers

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Occupational Exposure Limits

Material	Source	Type	ppm	mg/m3	Notation
Benzene	ACGIH	TWA	0.5 ppm		
	ACGIH	STEL	2.5 ppm		
	ACGIH	SKIN			Can be absorbed through the skin
	OSHA	TWA	1 ppm		
	OSHA	STEL	5 ppm		
	OSHA	ACTION	0.5 ppm		

	OSHA Z1A	TWA	1 ppm		
	OSHA Z1A	STEL	5 ppm		

Additional Information : Skin notation means that significant exposure can also occur by absorption of liquid through the skin and of vapour through the eyes or mucous membranes Shell has adopted as Interim Standards, the OSHA PELs that were established in 1989 and later rescinded

Exposure Controls : The level of protection and types of controls necessary will vary depending upon potential exposure conditions Select controls based on a risk assessment of local circumstances Appropriate measures include: Use sealed systems as far as possible Adequate ventilation to control airborne concentrations below the exposure guidelines/limits Adequate explosion-proof ventilation to control airborne concentrations Firewater monitors and deluge systems are recommended Eye washes and showers for emergency use

Personal Protective Equipment : Personal protective equipment (PPE) should meet recommended national standards Check with PPE suppliers

Respiratory Protection : If engineering controls do not maintain airborne concentrations to a level which is adequate to protect worker health, select respiratory protection equipment suitable for the specific conditions of use and meeting relevant legislation Check with respiratory protective equipment suppliers Where air-filtering respirators are suitable, select an appropriate combination of mask and filter Select a filter suitable for organic gases and vapours [boiling point >65 °C (149 °F)] Where respiratory protective equipment is required, use a full-face mask Where air-filtering respirators are unsuitable (e g , airborne concentrations are high, risk of oxygen deficiency, confined space) use appropriate positive pressure breathing apparatus Respirator selection, use and maintenance should be in accordance with the requirements of the OSHA Respiratory Protection Standard, 29 CFR 1920.134

Hand Protection : Where hand contact with the product may occur the use of gloves approved to relevant standards (e g Europe: EN374, US: F739) made from the following materials may provide suitable chemical protection: Longer term protection: Viton Incidental contact/Splash protection: Nitrile rubber Suitability and durability of a glove is dependent on usage, e.g frequency and duration of contact, chemical resistance of glove material, glove thickness, dexterity Always seek advice from glove suppliers Contaminated gloves should be replaced

Eye Protection : Chemical splash goggles (chemical monogoggles)

Protective Clothing : Chemical resistant gloves/gauntlets, boots, and apron Where risk of splashing or in spillage clean up, use chemical resistant one-piece overall with integral hood

Environmental Exposure Controls : Local guidelines on emission limits for volatile substances must be observed for the discharge of exhaust air containing vapour

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	:	Colourless Liquid
Odour	:	Aromatic
Odour threshold	:	2 7 ppm
Boiling point	:	80.1 °C / 176 2 °F
Freezing Point	:	5 6 °C / 42 0 °F
Flash point	:	-11 °C / 12 °F (Abel)
Explosion / Flammability limits in air	:	1 4 - 7 1 %(V)
Auto-ignition temperature	:	562 °C / 1,044 °F
Vapour pressure	:	10 kPa at 20 °C / 68 °F
Specific gravity	:	0 8787 at 20 °C / 68 °F
Density	:	885 kg/m3 at 15 °C / 59 °F
Water solubility	:	0 1 g/l Negligible 1 8 kg/m3 at 25 °C / 77 °F
n-octanol/water partition coefficient (log Pow)	:	1 95 - 2 13
Kinematic viscosity	:	0 65 mm2/s at 20 °C / 68 °F
Vapour density (air=1)	:	2 7 at 15 °C / 59 °F
Electrical conductivity	:	< 50 pS/m at 20 °C / 68 °F
Saturated Vapour concentration (in air)	:	99000 PPM_M at 20 °C / 68 °F
Evaporation rate (nBuAc=1)	:	2 8
Surface tension	:	0 03 N/m
Molecular weight	:	78 g/mol

10. STABILITY AND REACTIVITY

Stability	:	Stable under normal conditions of use Reacts violently with strong oxidising agents
Conditions to Avoid	:	Avoid heat, sparks, open flames and other ignition sources Prevent vapour accumulation
Materials to Avoid	:	Strong oxidising agents
Hazardous Decomposition Products	:	Thermal decomposition is highly dependent on conditions A complex mixture of airborne solids, liquids and gases, including carbon monoxide, carbon dioxide and other organic compounds will be evolved when this material undergoes combustion or thermal or oxidative degradation

11. TOXICOLOGICAL INFORMATION

Basis for Assessment	:	Information given is based on product testing
Acute Oral Toxicity	:	Low toxicity: LD50 >2000 mg/kg , Rat (Benzene) Aspiration into the lungs when swallowed or vomited may cause chemical pneumonitis which can be fatal
Acute Dermal Toxicity	:	Low toxicity: LD50 >2000 mg/kg , Rabbit
Acute Inhalation Toxicity	:	Low toxicity: LC50>5000 ppm / 1 hours, Rat High concentrations may cause central nervous system depression resulting in headaches, dizziness and nausea;

continued inhalation may result in unconsciousness and/or death

Skin Irritation : Irritating to skin
Eye Irritation : Irritating to eyes
Respiratory Irritation : Inhalation of vapours or mists may cause irritation to the respiratory system
Sensitisation : Not expected to be a skin sensitiser
Repeated Dose Toxicity : Blood-forming organs: repeated exposure affects the bone marrow
Blood: may cause haemolysis of red blood cells and/or anaemia
Cardiovascular system: chronic abuse of similar materials has been associated with irregular heart rhythms and cardiac arrest
Immune System: animal studies on this material or its components have demonstrated immunotoxicity.
Mutagenicity : Mutagenic; positive in in-vivo and in-vitro assays
Carcinogenicity : Known human carcinogen
May cause leukaemia (AML - acute myelogenous leukaemia)

Material	:	Carcinogenicity Classification
Benzene	:	ACGIH Group A1: Confirmed human carcinogen.
Benzene	:	NTP: Known carcinogen.
Benzene	:	IARC 1: Human carcinogen.
Benzene	:	OSHASP: Cancer hazard.

Reproductive and Developmental Toxicity : Causes foetotoxicity in animals at doses which are maternally toxic
Does not impair fertility

12. ECOLOGICAL INFORMATION

Acute Toxicity :
Fish : Toxic: 1 < LC/EC/IC50 <= 10 mg/l
Aquatic Invertebrates : Harmful: 10 < LC/EC/IC50 <= 100 mg/l
Algae : Harmful: 10 < LC/EC/IC50 <= 100 mg/l
Microorganisms : Harmful: 10 < LC/EC/IC50 <= 100 mg/l

Mobility : Floats on water
If product enters soil, it will be highly mobile and may contaminate groundwater
Persistence/degradability : Readily biodegradable meeting the 10 day window criterion.
Bioaccumulation : Does not bioaccumulate significantly
Other Adverse Effects : In view of the high rate of loss from solution, the product is unlikely to pose a significant hazard to aquatic life

13. DISPOSAL CONSIDERATIONS

Material Disposal : Recover or recycle if possible It is the responsibility of the waste generator to determine the toxicity and physical properties of the material generated to determine the proper waste classification and disposal methods in compliance with

		applicable regulations
Local Legislation	:	Disposal should be in accordance with applicable regional, national, and local laws and regulations

14. TRANSPORT INFORMATION

US Department of Transportation Classification (49CFR)

Identification number	UN 1114
Proper shipping name	Benzene
Class / Division	3
Packing group	II
Hazardous subst /material RQ:	BENZENE/10 00 LB
Emergency Response Guide	130

IMDG

Identification number	UN 1114
Proper shipping name	BENZENE
Class / Division	3
Packing group	II
Marine pollutant:	No

IATA (Country variations may apply)

Identification number	UN 1114
Proper shipping name	Benzene
Class / Division	3
Packing group	II

15. REGULATORY INFORMATION

The regulatory information is not intended to be comprehensive. Other regulations may apply to this material

Federal Regulatory Status

Notification Status

AICS	Listed	
DSL	Listed	
INV (CN)	Listed	
ENCS (JP)	Listed	(3)-1
TSCA	Listed	
EINECS	Listed	200-753-7
KECI (KR)	Listed	97-1-99
KECI (KR)	Listed	KE-02150
PICCS (PH)	Listed	

Comprehensive Environmental Release, Compensation & Liability Act (CERCLA)

Benzene (71-43-2)	Reportable quantity: 10 lbs
Benzene (71-43-2)	Reportable quantity: 10 lbs

Clean Water Act (CWA) Section 311

Benzene (71-43-2)	Reportable quantity: 10 lbs
Benzene (71-43-2)	Reportable quantity: 10 lbs

SARA Hazard Categories (311/312)

Immediate (Acute) Health Hazard Delayed (Chronic) Health Hazard Fire Hazard

SARA Toxic Release Inventory (TRI) (313)

Benzene (71-43-2)	100 00%

State Regulatory Status

California Safe Drinking Water and Toxic Enforcement Act (Proposition 65)

Known to the State of California to cause birth defects or other reproductive harm
Known to the state of California to cause cancer

Benzene (71-43-2) 100 00%	Carcinogenic Developmental toxin Male reproductive toxin

New Jersey Right-To-Know Chemical List

Benzene (71-43-2) 100 00%

Pennsylvannia Right-To-Know Chemical List

Benzene (71-43-2) 100 00%	Special hazard Environmental hazards Listed

16. OTHER INFORMATION

HMIS Rating (Health, Fire, Reactivity)	:	2, 3, 0
NFPA Rating (Health, Fire, Reactivity)	:	2, 3, 0
MSDS Version Number	:	23
MSDS Effective Date	:	06/30/2003
MSDS Revisions	:	A vertical bar (|) in the left margin indicates an amendment from the previous version

MSDS Regulation	:	The content and format of this MSDS is in accordance with the OSHA Hazard Communication Standard, 29 CFR 1910 1200
Uses and Restrictions	:	Raw material for use in the chemical industry
MSDS Distribution	:	The information in this document should be made available to all who may handle the product
Disclaimer	:	The information contained herein is based on our current knowledge of the underlying data and is intended to describe the product for the purpose of health, safety and environmental requirements only No warranty or guarantee is expressed or implied regarding the accuracy of these data or the results to be obtained from the use of the product

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND COMPANY/UNDERTAKING

Material Name	:	**Ethylbenzene**
Uses	:	Intermediate in styrene monomer manufacture
Product Code	:	Q9217
Manufacturer/Supplier	:	**Shell Chemicals Europe B.V.** PO Box 8610 3009 AP Rotterdam Netherlands
Local Contact	:	Shell Chemicals UK
Telephone	:	+44 (0)1244 685000
Fax	:	+44 (0)1244 685010
Emergency Telephone Number	:	+44 (0)151 350 4595

2. COMPOSITION/INFORMATION ON INGREDIENTS

Material Formal Name	:	Ethyl benzene
Synonyms	:	phenyl ethane EB
CAS No.	:	100-41-4
INDEX No.	:	601-023-00-4
EINECS No.	:	202-849-4

3. HAZARDS IDENTIFICATION

Health Hazards	:	Harmful by inhalation. May cause moderate irritation to skin Moderately irritating to eyes Possibility of organ or organ system damage from prolonged exposure; see Chapter 11 for details Target organ(s): Central nervous system (CNS) Kidney Liver Reproductive system
Safety Hazards	:	Vapours are heavier than air Vapours may travel across the ground and reach remote ignition sources causing a flashback fire danger Highly flammable. The vapour is heavier than air, spreads along the ground and distant ignition is possible May form flammable/explosive vapour-air mixture.
Environmental Hazards	:	Toxic to aquatic organisms

4. FIRST AID MEASURES

General Information	:	Take appropriate steps to avoid fire, explosion and inhalation hazards DO NOT DELAY
Inhalation	:	Remove to fresh air Do not attempt to rescue the victim unless proper respiratory protection is worn If the victim has difficulty breathing or tightness of the chest, is dizzy, vomiting, or unresponsive, give 100% oxygen with rescue breathing or CPR

as required and transport to the nearest medical facility

Skin Contact	:	DO NOT DELAY Remove contaminated clothing Immediately flush skin with large amounts of water for at least 15 minutes, and follow by washing with soap and water if available. If redness, swelling, pain and/or blisters occur, transport to the nearest medical facility for additional treatment.
Eye Contact	:	Immediately flush eyes with large amounts of water for at least 15 minutes while holding eyelids open Transport to the nearest medical facility for additional treatment
Ingestion	:	If swallowed, do not induce vomiting: transport to nearest medical facility for additional treatment If vomiting occurs spontaneously, keep head below hips to prevent aspiration Give nothing by mouth
Advice to Physician	:	Potential for chemical pneumonitis Consider: gastric lavage with protected airway, administration of activated charcoal.

5. FIRE FIGHTING MEASURES

Clear fire area of all non-emergency personnel

Specific Hazards	:	Will float and can be reignited on surface water The vapour is heavier than air, spreads along the ground and distant ignition is possible Hazardous combustion products may include: Carbon monoxide formaldehyde
Extinguishing Media	:	Foam Dry chemical powder, carbon dioxide, sand or earth may be used for small fires only
Protective Equipment for Firefighters	:	Proper protective equipment including breathing apparatus must be worn when approaching a fire in a confined space Wear full protective clothing and self-contained breathing apparatus
Additional Advice	:	All storage areas should be provided with adequate fire fighting facilities. Evacuate the area of all non-essential personnel Keep adjacent containers cool by spraying with water

6. ACCIDENTAL RELEASE MEASURES

Protective measures	:	Avoid contact with spilled or released material. For guidance on selection of personal protective equipment see Chapter 8 of this Material Safety Data Sheet. Avoid inhaling vapour and/or mists Stay upwind and keep out of low areas Avoid contact with the skin Avoid contact with spilled or released material Immediately remove all contaminated clothing For guidance on selection of personal protective equipment see Chapter 8 of this Material Safety Data Sheet For guidance on disposal of spilled material see Chapter 13 of this Material Safety Data Sheet Isolate hazard area and deny entry to unnecessary or unprotected personnel Extinguish any naked flames Do Not smoke. Remove ignition sources. Avoid sparks. Remove all possible sources of ignition in the surrounding area Use appropriate containment to avoid environmental contamination Prevent from spreading or entering drains, ditches or rivers by using sand, earth, or other appropriate barriers Attempt to disperse the vapour or to direct its flow to a safe location for

		example by using fog sprays Take precautionary measures against static discharge Ensure electrical continuity by bonding and grounding (earthing) all equipment Use appropriate containment to avoid environmental contamination Ventilate contaminated area thoroughly
Clean Up Methods	:	Soak up residue with an absorbent such as clay, sand or other suitable material and dispose of properly Shovel into a suitable clearly marked container for disposal or reclamation in accordance with local regulations Flush contaminated area with plenty of water Do not flush away residues with water Retain as contaminated waste For small liquid spills (< 1 drum), transfer by mechanical means to a labelled, sealable container for product recovery or safe disposal. Allow residues to evaporate or soak up with an appropriate absorbent material and dispose of safely Remove contaminated soil and dispose of safely
Additional Advice	:	Proper disposal should be evaluated based on regulatory status of this material (refer to Section 13), potential contamination from subsequent use and spillage, and regulations governing disposal in the local area Local authorities should be advised if significant spillages cannot be contained Observe all relevant local regulations Notify authorities if any exposure to the general public or the environment occurs or is likely to occur Vapour may form an explosive mixture with air The vapour is heavier than air, spreads along the ground and distant ignition is possible

7. HANDLING AND STORAGE

Handling	:	Ambient Extinguish any naked flames Do Not smoke Remove ignition sources. Avoid sparks Avoid breathing of or contact with material Only use in well ventilated areas Wash thoroughly after handling For guidance on selection of personal protective equipment see Chapter 8 of this Material Safety Data Sheet Local exhaust ventilation is recommended In accordance with good industrial hygiene practices, precautions should be taken to avoid breathing of material
Storage	:	Must be stored in a well-ventilated area, away from sunlight, ignition sources and other sources of heat
Product Transfer	:	Ensure electrical continuity by bonding and grounding (earthing) all equipment Restrict line velocity during pumping in order to avoid generation of electrostatic discharge (<= 1 m/sec until fill pipe submerged to twice its diameter, then <= 7 m/sec) Avoid splash filling Do NOT use compressed air for filling, discharging, or handling operations
Recommended Materials	:	Epoxy resins For containers, or container linings use mild steel, stainless steel.
Unsuitable Materials	:	Most plastics ; Natural, butyl, neoprene or nitrile rubbers

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Occupational Exposure Limits

Material	Source	Type	ppm	mg/m3	Notation
Ethylbenzene	EH40 OES	TWA	100 ppm	441 mg/m3	
	EH40 OES	STEL	125 ppm	552 mg/m3	
	EH40 OES	SKIN			Can be absorbed through the skin

Additional Information : Wash hands before eating, drinking, smoking and using the toilet. Launder contaminated clothing before re-use

Exposure Controls : Local guidelines on emission limits for volatile substances must be observed for the discharge of exhaust air containing vapour The level of protection and types of controls necessary will vary depending upon potential exposure conditions Select controls based on a risk assessment of local circumstances Appropriate measures include: Use sealed systems as far as possible Where material is heated, sprayed or mist formed, there is greater potential for airborne concentrations to be generated Adequate ventilation to control airborne concentrations below the exposure guidelines/limits Exhaust emission systems should be designed in accordance with local conditions; the air should always be moved away from the source of vapour generation and the person working at this point Provide adequate ventilation in storage areas Eye washes and showers for emergency use

Personal Protective Equipment : Personal protective equipment (PPE) should meet recommended national standards Check with PPE suppliers

Respiratory Protection : Select a filter suitable for combined particulate/organic gases and vapours [boiling point >65 °C (149 °F)] meeting EN141 Respiratory protective devices - Compressed air line breathing apparatus for use with a full face mask, half mask or a mouthpiece assembly - Requirements, testing, marking - Amendment 1

Hand Protection : Where hand contact with the product may occur the use of gloves approved to relevant standards (e g Europe: EN374, US: F739) made from the following materials may provide suitable chemical protection: Longer term protection: Suitability and durability of a glove is dependent on usage, e g frequency and duration of contact, chemical resistance of glove material, glove thickness, dexterity Always seek advice from glove suppliers Contaminated gloves should be replaced Neoprene rubber Nitrile rubber Viton

Eye Protection : Chemical splash goggles (chemical monogoggles)

Protective Clothing : Chemical resistant gloves/gauntlets, boots, and apron Where risk of splashing or in spillage clean up, use chemical resistant one-piece overall with integral hood and chemical resistant gloves Otherwise use chemical resistant apron and gauntlets

Monitoring Methods : Monitoring of the concentration of substances in the breathing zone of workers or in the general workplace may be required to confirm compliance with an OEL and adequacy of exposure controls For some substances biological monitoring may also be appropriate Examples of sources of recommended air monitoring methods are given below or contact supplier

Further national methods may be available National Institute of Occupational Safety and Health (NIOSH), USA: Manual of analytical Methods http://www cdc gov/niosh/nmam/nmammenu html Occupational Safety and Health Administration (OSHA), USA: Sampling and Analytical Methods http://www.osha-slc gov/dts/sltc/methods/toc.html Health and Safety Executive (HSE), UK: Methods for the Determination of Hazardous Substances http://www hsl gov uk/search htm Berufsgenossenschaftliches Institut für Arbeitssicherheit (BIA), Germany http://www hvbg de/d/bia/pub/grl/grle htm L'Institut National de Recherche et de Securité, (INRS), France http://www inrs fr/indexnosdoss html

9. PHYSICAL AND CHEMICAL PROPERTIES

Boiling point	:	136 2 °C / 277.2 °F
Melting / freezing point	:	-95 °C / -139 °F
Flash point	:	21 °C / 70 °F (Abel)
Explosion / Flammability limits in air	:	1 2 - 8 %(V)
Auto-ignition temperature	:	428 - 435 °C / 802 - 815 °F
Vapour pressure	:	500 Pa at 10 °C / 50 °F 950 Pa at 20 °C / 68 °F 7,400 Pa at 60 °C / 140 °F 47,000 Pa at 110 °C / 230 °F
Density	:	868 kg/m3 at 20 °C / 68 °F
Water solubility	:	0 17 kg/m3
n-octanol/water partition coefficient (log Pow)	:	3 15
Dynamic viscosity	:	0 78 mPa s at 10 °C / 50 °F 0 43 mPa s at 60 °C / 140 °F 0 28 mPa s at 110 °C / 230 °F
Kinematic viscosity	:	0.32 mm2/s at 110 °C / 230 °F 0 5 mm2/s at 60 °C / 140 °F 0 9 mm2/s at 10 °C / 50 °F
Vapour density (air=1)	:	3.7
Electrical conductivity	:	123 pS/m
Koc	:	165000 ml/kg
Thermal conductivity		0 137 W/m °C at 10 °C / 50 °F 0 117 W/m °C at 60 °C / 140 °F 0 101 W/m °C at 110 °C / 230 °F
Surface tension	:	30 mN/m
Molecular weight	:	106 16 g/mol

10. STABILITY AND REACTIVITY

Stability	:	Stable under normal conditions of use Reacts violently with strong oxidising agents
Conditions to Avoid	:	Heat, flames, and sparks Exposure to sunlight
Materials to Avoid	:	Copper alloys Strong oxidising agents
Hazardous Decomposition Products	:	Hazardous decomposition products are not expected to form during normal storage

11. TOXICOLOGICAL INFORMATION

Basis for Assessment	:	Information given is based on product testing
Acute Oral Toxicity	:	Low toxicity: LD50 >2000 mg/kg , Rat Aspiration into the lungs when swallowed or vomited may cause chemical pneumonitis which can be fatal
Acute Dermal Toxicity	:	Low toxicity: LD50 >2000 mg/kg , Rat
Acute Inhalation Toxicity	:	Moderately toxic: LC50 >2 - 20 mg/l / 4 hours, Rat
Skin Irritation	:	May cause moderate skin irritation (but insufficient to classify)
Eye Irritation	:	Expected to be moderately irritating to eyes (but insufficient to classify)
Sensitisation	:	Not expected to be a skin sensitiser
Repeated Dose Toxicity	:	Kidney: can cause kidney damage Liver: can cause liver damage Central nervous system: repeated exposure affects the nervous system
Mutagenicity	:	Not mutagenic
Carcinogenicity	:	Limited evidence of carcinogenic effect
Reproductive and Developmental Toxicity	:	Repeated inhalation of Ethyl Benzene for 186 days at levels well exceeding the TLV caused degeneration of the germinal epithelium in the testes of rabbits and monkeys but not of rats Causes slight foetotoxicity

12. ECOLOGICAL INFORMATION

Acute Toxicity	:	
Fish	:	Toxic: 1 < LC/EC/IC50 <= 10 mg/l
Aquatic Invertebrates	:	Toxic: 1 < LC/EC/IC50 <= 10 mg/l
Algae	:	Toxic: 1 < LC/EC/IC50 <= 10 mg/l
Microorganisms	:	Toxic: 1 < LC/EC/IC50 <= 10 mg/l
Mobility	:	Floats on water If product enters soil, it will be highly mobile and may contaminate groundwater
Persistence/degradability	:	Readily biodegradable Oxidises rapidly by photo-chemical reactions in air
Bioaccumulation	:	Does not bioaccumulate significantly
Other Adverse Effects	:	In view of the high rate of loss from solution, the product is unlikely to pose a significant hazard to aquatic life

13. DISPOSAL CONSIDERATIONS

Material Disposal	:	Dispose in accordance with prevailing regulations, preferably to a recognised collector or contractor The competence of the collector or contractor should be established beforehand Recover or recycle if possible Otherwise: Incineration Comply with any local recovery or waste disposal regulations Waste arising from a spillage or tank cleaning should be disposed of in accordance with prevailing regulations, preferably to a recognised collector or contractor The competence of the collector or contractor should be established beforehand
Container Disposal	:	Refer to Section 7 before handling the product or containers. Remove all packaging for recovery or waste disposal Dispose

		in accordance with prevailing regulations, preferably to a recognised collector or contractor The competence of the collector or contractor should be established beforehand Recover or recycle if possible Otherwise: Incineration Residues may cause an explosion hazard Do not puncture, cut or weld uncleaned drums
Local Legislation	:	Local regulations may be more stringent than regional or national requirements and must be complied with

14. TRANSPORT INFORMATION

ADR

Class	:	3
Packing group	:	II
Hazard indentification no.	:	33
UN No	:	1175
Danger label (primary risk)	:	3
Proper shipping name	:	ETHYLBENZENE

RID

Class	:	3
Packing group	:	II
Hazard indentification no	:	33
UN No	:	1175
Danger label (primary risk)	:	3
Proper shipping name	:	ETHYLBENZENE

IMDG

Identification number	UN 1175
Proper shipping name	ETHYLBENZENE
Class / Division	3
Packing group	II
Marine pollutant:	No

IATA (Country variations may apply)

UN No	:	1175
Proper shipping name	:	Ethylbenzene
Class / Division	:	3
Packing group	:	II

15. REGULATORY INFORMATION

The regulatory information is not intended to be comprehensive Other regulations may apply to this material

EC Label Name	:	ETHYL BENZENE
EC label/EC Number	:	202-849-4
EC Classification	:	Highly flammable Harmful
EC Annex I Number	:	601-023-00-4

EC Symbols	:	F Highly flammable Xn Harmful	
EC Risk Phrases	:	R11 Highly flammable R20 Harmful by inhalation	
EC Safety Phrases	:	S16 Keep away from sources of ignition - No smoking S24/25 Avoid contact with skin and eyes S29 Do not empty into drains	
AICS	:	Listed	
DSL	:	Listed	
INV (CN)	:	Listed	
ENCS (JP)	:	Listed	(3)-28
TSCA	:	Listed	
EINECS	:	Listed	202-849-4
KECI (KR)	:	Listed	KE-13532
PICCS (PH)	:	Listed	
National Legislation			
OECD HPV	:	Listed	

16. OTHER INFORMATION

R-phrase(s)

R11	Highly flammable.
R20	Harmful by inhalation

MSDS Version Number	:	1
MSDS Effective Date	:	10 07 2003
MSDS Revisions	:	A vertical bar (|) in the left margin indicates an amendment from the previous version.
MSDS Regulation	:	The content and format of this safety data sheet is in accordance with Commission Directive 2001/58/EC of 27 July 2001, amending for the second time Commission Directive 91/155/EEC.
Uses and Restrictions	:	Intermediate in styrene monomer manufacture
MSDS Distribution	:	The information in this document should be made available to all who may handle the product
Disclaimer	:	This information is based on our current knowledge and is intended to describe the product for the purposes of health, safety and environmental requirements only. It should not therefore be construed as guaranteeing any specific property of the product

1. IDENTIFICATION OF THE SUBSTANCE / PREPARATION AND COMPANY / UNDERTAKING

Product name	:	Toluene
Product code	:	T1402 Q9131
Product type	:	Base chemical
Use of substance/preparation	:	Raw material for use in the chemical industry.
Supplier	:	Shell Chemicals Europe B V P.O Box 8610 3009 AP Rotterdam NL
Contact numbers	:	+31 (0)10 231 7000 Fax: +31 (0)10 231 7180
Emergency telephone number	:	+31 (0)10 431 3233

2. COMPOSITION/INFORMATION ON INGREDIENTS

Substance formal name	:	Benzene, methyl
Substance chemical family	:	Aromatic hydrocarbon
Synonyms	:	Methyl benzol Phenyl methane Toluol Methyl benzene
EINECS	:	203-625-9
CAS-No	:	108-88-3

3. HAZARDS IDENTIFICATION

Human health hazards	:	Harmful by inhalation. Narcotic at high vapour concentrations. Aspiration into the lungs may cause chemical pneumonitis which can be fatal Repeated exposure may cause skin dryness or cracking
Safety hazards	:	Highly flammable Extreme risk of vapour ignition at normal handling temperatures. Electrostatic charges may be generated during handling
Environmental hazards	:	No specific hazards

4. FIRST AID MEASURES

Symptoms and effects	:	Irritation of the skin, eyes and respiratory tract - headache - nausea - dizziness - narcosis
First Aid - Inhalation	:	Remove to fresh air If rapid recovery does not occur, obtain medical attention
First Aid - Skin	:	Remove contaminated clothing Wash skin with water using soap if available If persistent irritation occurs, obtain medical attention
First Aid - Eye	:	Flush eye with water If persistent irritation occurs, obtain medical attention
First Aid - Ingestion	:	Do not induce vomiting Give nothing by mouth If rapid recovery does not occur, obtain medical attention
Advice to physicians	:	Dermatitis may result from prolonged or repeated exposure Aspiration into the lungs may cause chemical pneumonitis Causes central nervous system depression Severe exposure may cause blurred vision, tremors, shallow and rapid breathing, delerium and unconsciousness

5. FIRE-FIGHTING MEASURES

Specific hazards	:	Carbon monoxide may be evolved if incomplete combustion occurs Will float and can be reignited on surface water The vapour is heavier than air, spreads along the ground and distant ignition is possible
Extinguishing media	:	Foam Dry chemical powder, carbon dioxide, sand or earth may be used for small fires only
Unsuitable extinguishing media	:	Water in a jet
Protective equipment	:	Full protective clothing and self-contained breathing apparatus
Other information	:	Keep adjacent containers cool by spraying with water

6. ACCIDENTAL RELEASE MEASURES

Protective measures	:	Avoid contact with skin, eyes, clothing Do not breathe vapour Ventilate contaminated area thoroughly Extinguish naked flames Remove ignition sources No smoking Avoid sparks Evacuate the area of all non-essential personnel Shut off leaks, if possible without personal risk Take precautionary measures against static discharge Wear gloves and one-piece suit Viton offers good resistance, other materials may be less suitable Check with equipment supplier to determine if level of protection is adequate Wear safety shoes or boots - chemical resistant. For guidance on respiratory protection see Section 8
Environmental precautions	:	Prevent contamination of soil and water Prevent from spreading or entering into drains, ditches or rivers by using sand, earth, or other appropriate barriers
Clean-up methods	:	Large spillage: Transfer to a labelled, sealable container for product recovery or safe disposal. Treat residues as for small spillage Small spillage: Absorb or contain liquid with sand, earth or spill control material Shovel up and place in a labelled, sealable container for subsequent safe disposal Put leaking containers in a labelled drum or overdrum Scrub contaminated surfaces with detergent solution. Retain washings as contaminated waste
Other information	:	Risk of explosion Inform the emergency services if liquid enters surface water drains Vapour may form an explosive mixture with air See Section 13 for information on disposal

7. HANDLING AND STORAGE

Handling	:	Avoid contact with skin, eyes and clothing. Do not breathe vapour Extinguish any naked flames Remove ignition sources Avoid sparks. Do not smoke. Take precautionary measures against static discharges Earth all equipment Use local exhaust extraction Do not empty into drains Handling temperatures: Ambient
Storage	:	Keep away from direct sunlight and other sources of heat or ignition Do not smoke in storage areas Keep container tightly closed and in a well-ventilated place. Storage temperatures: Ambient
Product transfer	:	Take precautionary measures against static discharge. Earth all equipment Avoid splash filling Do not use compressed air for filling, discharging or handling If positive displacement pumps are used, these must be fitted with a non-integral

pressure relief valve. Restrict line velocity during pumping in order to avoid generation of electrostatic discharge Refer to supplier for further product transfer instructions if required

Recommended materials : For containers or container linings, use mild steel, stainless steel For container paints, use zinc silicate, epoxy resins

Unsuitable materials : PVC; natural, butyl or neoprene rubbers

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Toluene

TLV/ACGIH : TWA (8 h) = 50 ppm
TWA (8 h) = 188 mg/m3
(Sk) Skin notation means that significant exposure can also occur by absorption of liquid through the skin and of vapour through the eyes or mucous membranes

Hygiene measures : Launder contaminated clothing before re-use

Respiratory protection : If engineering controls do not maintain airborne concentrations to a level which is adequate to protect worker health, select Respiratory Protective Equipment suitable for the specific conditions of use and meeting relevant legislation Check with Respiratory Protective Equipment suppliers Where air-filtering respirators are unsuitable (e g airborne concentrations are high, risk of oxygen deficiency, confined space) use appropriate positive pressure Breathing Apparatus

Hand protection : Where hand contact with the product may occur the use of gloves approved to relevant standards (e g Europe: EN374, US: F739) made from the following materials may provide suitable chemical protection: Longer term protection - Viton Incidental contact/Splash protection - nitrile rubber gloves Suitability and durability of a glove is dependent on usage, e g frequency and duration of contact, chemical resistance of glove material, glove thickness, dexterity Always seek advice from glove suppliers Contaminated gloves should be replaced

Eye protection : monogoggles (EN166)

Body protection : standard issue work clothes
safety shoes or boots - chemical resistant
If splashes are likely to occur, wear:
long sleeve overall
Check with equipment supplier to determine if level of protection is adequate

Other information : Skin notation means that significant exposure can also occur by absorption of liquid through the skin and of vapour through the eyes or mucous membranes.

Monitoring methods : Monitoring of the concentration of substances in the breathing zone of workers or in the general workplace may be required to confirm compliance with an OEL and adequacy of exposure controls For some substances biological monitoring may also be appropriate Examples of sources of recommended air monitoring methods are given below. Further national methods may be available National Institute of Occupational Safety and Health (NIOSH), USA: Manual of analytical Methods http://www.cdc gov/niosh/nmam/nmammenu.html Occupational Safety and Health Administration (OSHA), USA: Sampling and Analytical Methods http://www osha-slc.gov/dts/sltc/methods/toc html Health and Safety Executive (HSE), UK: Methods for the Determination of Hazardous Substances http://www hsl gov uk/search htm Berufsgenossenschaftliches Institut für Arbeitssicherheit (BIA), Germany http://www hvbg de/d/bia/pub/grl/grle htm L'Institut

National de Recherche et de Securité, (INRS), France
http://www inrs fr/indexnosdoss html

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical state	:	Liquid
Colour	:	Colourless
Odour	:	Aromatic
Boiling point	:	Typical 110 4 - 110 8 °C
Melting / freezing point	:	Typical -95 °C
Flash point	:	4 °C (Abel)
Auto-ignition temperature	:	535 °C (ASTM E-659)
Explosion / flammability limits in air	:	1 2 - 8 %(V)
Vapour pressure	:	Typical 12 kPa @ 50 °C Typical 1 kPa @ 0 °C Typical 3 kPa @ 20 °C
Relative evaporation rate	:	2 (ASTM D 3539, nBuAc=1) 6 1 (DIN 53170 di-ethyl ether=1)
Density	:	Typical 871 kg/m3 @ 15 °C
Vapour density (air=1)	:	3 1
Solubility in water	:	0 515 kg/m3
n-octanol/water partition coefficient (log Pow)	:	2 65
Kinematic viscosity	:	0 63 mm2/s @ 25 °C
Odour threshold	:	1 74 ppm
Surface tension	:	Typical 28 5 mN/m @ 20 °C (ASTM D-971)
Electrical conductivity	:	Typical 8 pS/m @ 20 °C (ASTM D-4308)
Molecular mass	:	92 g/mol

10. STABILITY/REACTIVITY

Stability	:	Stable under normal use conditions Reacts with strong oxidising agents Reacts with strong acids
Conditions to avoid	:	Heat, flames and sparks
Materials to avoid	:	Strong acids. Strong oxidising agents
Hazardous decomposition products	:	None known

11. TOXICOLOGICAL INFORMATION

Basis for assessment	:	Information given is based on product data
Acute toxicity - oral	:	Low toxicity, LD50 > 2000 mg/kg
Acute toxicity - dermal	:	Low toxicity, LD50 > 2000 mg/kg
Acute toxicity - inhalation	:	Low toxicity, LC50 > 5 mg/l Classified as harmful under EC criteria
Eye irritation	:	Irritant
Skin irritation	:	Irritant
Skin sensitisation	:	Not a skin sensitiser
Repeated dose toxicity	:	Repeated exposure affects the nervous system , Repeated exposure affects the respiratory system , Effects were seen at high doses only
Carcinogenicity	:	Not a carcinogen.
Mutagenicity	:	Not mutagenic.
Fertility impairment	:	Does not impair fertility
Development toxicity	:	Causes foetotoxicity at doses which are maternally toxic
Human effects	:	See Section 4 for information regarding acute effects to humans , Prolonged/repeated contact may cause defatting of the skin which can lead to dermatitis , High exposures can

cause drowsiness and dizziness , Aspiration into the lungs may cause chemical pneumonitis which can be fatal

12. ECOLOGICAL INFORMATION

Basis for assessment	:	Information given is based on product data
Mobility	:	Floats on water Evaporates within a day from water or soil surfaces Product remaining on soil surface evaporates within a day If product enters soil, it will be mobile and may contaminate groundwater
Persistence/degradability	:	Readily biodegradable meeting the 10 day window criterion Oxidises rapidly by photo-chemical reactions in air Integrated environmental half-life expected to be 1 - < 10 days Dominant loss process - photolysis Poses a significant risk of oxygen depletion in aquatic systems
Bioaccumulation	:	Does not bioaccumulate significantly
Acute toxicity - fish	:	Toxic, 1 < LC/EC/IC 50 <= 10 mg/l
Acute toxicity - algae	:	Practically non toxic, 100 < LC/EC/IC 50 <= 1000 mg/l .
Acute toxicity - bacteria	:	Practically non toxic, 100 < LC/EC/IC 50 <= 1000 mg/l
Acute toxicity - invertebrates	:	Slightly toxic, 10 < LC/EC/IC 50 <= 100 mg/l
Other information	:	Other information In view of the high rate of loss from solution, the product is unlikely to pose a significant hazard to aquatic life Sewage treatment Practically non toxic, 100 < LC/EC/IC 50 <= 1000 mg/l

13. DISPOSAL CONSIDERATIONS

Product disposal	:	Recover or recycle if possible Otherwise: Incineration
Waste disposal	:	Recover or recycle if possible Otherwise: Incineration
Local legislation	:	The recommendations given are considered appropriate for safe disposal However, local regulations may be more stringent and these must be complied with.

14. TRANSPORT INFORMATION

ADR

Class	:	3
Packing group	:	II
Kemler number	:	33
UN No	:	1294
Hazard symbol	:	3
Proper shipping name	:	TOLUENE

RID

Class	:	3
Packing group	:	II
Kemler number	:	33
UN No	:	1294
Hazard symbol	:	3
Proper shipping name	:	TOLUENE

IMDG

Class	:	3
Packing group	:	II
UN No	:	1294
Hazard symbol	:	3
Proper shipping name	:	TOLUENE

IATA

Class	:	3
Packing group	:	II
UN No	:	1294
Hazard symbol	:	3
Proper shipping name	:	Toluene

15. REGULATORY INFORMATION

EC Label name	:	TOLUENE
EC label/EC number	:	203-625-9
EC classification	:	Highly flammable Harmful
EC Annex I number	:	601-021-00-3
EC symbols	:	F Highly flammable Xn Harmful
EC Risk Phrases	:	R20 Harmful by inhalation R11 Highly flammable
EC Safety Phrases	:	S16 Keep away from sources of ignition - No smoking S25 Avoid contact with eyes S29 Do not empty into drains S33 Take precautionary measures against static discharges
AICS (Australia)	:	Listed
DSL (Canada)	:	Listed
EINECS/ELINCS (EC)	:	Listed
EINECS	:	203-625-9
MITI (Japan)	:	3-2
TCCL (Korea)	:	3-2725
TSCA (USA)	:	Listed
BAG T/EDV Nr	:	G-2953

16. OTHER INFORMATION

Uses and restrictions	:	Raw material for use in the chemical industry Persistent abuse involving repeated and prolonged exposures to high concentrations of vapour ('sniffing') has been reported to result in central nervous system damage and eventually death
Other information	:	MSDS distribution The information in this document should be made available to all who may handle the product Reference The content and format of this safety data sheet is in accordance with Commission Directive 2001/58/EC of 27 July 2001, amending for the second time Commission Directive 91/155/EEC

EC Risk Phrases

R11	Highly flammable
R20	Harmful by inhalation

A vertical bar (|) in the left margin indicates an amendment from the previous version

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Disclaimer
This information is based on our current knowledge and is intended to describe the product for the purposes of health, safety and environmental requirements only It should not therefore be construed as guaranteeing any specific property of the product

1. MATERIAL AND COMPANY IDENTIFICATION

Material Name	:	**Xylene**
Uses	:	Solvent Raw material for use in the chemical industry
Product Code	:	Q9151, T1404, Q9156, Q5891
Company	:	**Shell Chemical LP** PO Box 2463 HOUSTON TX 77252-2463 USA
MSDS Request	:	1-800-240-6737
Customer Service	:	1-800-872-7435

Emergency Telephone Number

Chemtrec Domestic (24 hr)	:	1-800-424-9300
Chemtrec International (24 hr)	:	1-703-527-3887

2. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Name	CAS No.	Concentration
Xylene, Mixed Isomers	1330-20-7	100 00 %

Contains Ethylbenzene, CAS # 100-41-4

3. HAZARDS IDENTIFICATION

Emergency Overview

Appearance and Odour	:	Colourless Liquid Aromatic
Health Hazards	:	Vapours may cause drowsiness and dizziness Irritating to skin Harmful: may cause lung damage if swallowed
Safety Hazards	:	Flammable Vapours are heavier than air Vapours may travel across the ground and reach remote ignition sources causing a flashback fire danger Electrostatic charges may be generated during pumping Electrostatic discharge may cause fire
Environmental Hazards	:	Toxic to aquatic organisms

Health Hazards

Inhalation	:	Slightly irritating to respiratory system. Vapours may cause drowsiness and dizziness
Skin Contact	:	Irritating to skin
Eye Contact	:	Moderately irritating to eyes
Ingestion	:	Harmful: may cause lung damage if swallowed
Other Information	:	Possibility of organ or organ system damage from prolonged exposure; see Chapter 11 for details Target organ(s): Auditory system Kidney Liver

Central nervous system (CNS)
Cardiovascular system

Signs and Symptoms : Eye irritation signs and symptoms may include a burning sensation, redness, swelling, and/or blurred vision Skin irritation signs and symptoms may include a burning sensation, redness, swelling, and/or blisters If material enters lungs, signs and symptoms may include coughing, choking, wheezing, difficulty in breathing, chest congestion, shortness of breath, and/or fever The onset of respiratory symptoms may be delayed for several hours after exposure Breathing of high vapour concentrations may cause central nervous system (CNS) depression resulting in dizziness, light-headedness, headache, nausea and loss of coordination Continued inhalation may result in unconsciousness and death

Aggravated Medical Condition : Pre-existing medical conditions of the following organ(s) or organ system(s) may be aggravated by exposure to this material: Auditory system Cardiovascular system Central nervous system (CNS) Kidney Liver Skin

4. FIRST AID MEASURES

General Information : Keep victim calm Obtain medical treatment immediately

Inhalation : DO NOT DELAY Remove to fresh air If rapid recovery does not occur, transport to nearest medical facility for additional treatment

Skin Contact : Remove contaminated clothing Immediately flush skin with large amounts of water for at least 15 minutes, and follow by washing with soap and water if available If redness, swelling, pain and/or blisters occur, transport to the nearest medical facility for additional treatment

Eye Contact : Immediately flush eyes with large amounts of water for at least 15 minutes while holding eyelids open Transport to the nearest medical facility for additional treatment.

Ingestion : If swallowed, do not induce vomiting: transport to nearest medical facility for additional treatment If vomiting occurs spontaneously, keep head below hips to prevent aspiration

Advice to Physician : Potential for chemical pneumonitis Consider: gastric lavage with protected airway, administration of activated charcoal. Potential for cardiac sensitisation, particularly in abuse situations Hypoxia or negative inotropes may enhance these effects Consider: oxygen therapy

5. FIRE FIGHTING MEASURES

Clear fire area of all non-emergency personnel

Flash point : Typical 21 - 27 °C / 70 - 81 °F (Abel)

Explosion / Flammability limits in air : 1 - 7.1 %(V)

Auto ignition temperature : 432 - 530 °C / 810 - 986 °F (ASTM E-659)

Specific Hazards : The vapour is heavier than air, spreads along the ground and

		distant ignition is possible Will float and can be reignited on surface water Carbon monoxide may be evolved if incomplete combustion occurs
Extinguishing Media	:	Foam, water spray or fog Dry chemical powder, carbon dioxide, sand or earth may be used for small fires only
Unsuitable Extinguishing Media	:	Do not use water in a jet
Protective Equipment for Firefighters	:	Wear full protective clothing and self-contained breathing apparatus.
Additional Advice	:	Keep adjacent containers cool by spraying with water

6. ACCIDENTAL RELEASE MEASURES

Avoid contact with spilled or released material Immediately remove all contaminated clothing For guidance on selection of personal protective equipment see Chapter 8 of this Material Safety Data Sheet For guidance on disposal of spilled material see Chapter 13 of this Material Safety Data Sheet Observe all relevant local and international regulations

Protective measures	:	Isolate hazard area and deny entry to unnecessary or unprotected personnel. Stay upwind and keep out of low areas. Shut off leaks, if possible without personal risks Remove all possible sources of ignition in the surrounding area Use appropriate containment to avoid environmental contamination Prevent from spreading or entering drains, ditches or rivers by using sand, earth, or other appropriate barriers. Attempt to disperse the vapour or to direct its flow to a safe location for example by using fog sprays Take precautionary measures against static discharge Ensure electrical continuity by bonding and grounding (earthing) all equipment Ventilate contaminated area thoroughly
Clean Up Methods	:	For large liquid spills (> 1 drum), transfer by mechanical means such as vacuum truck to a salvage tank for recovery or safe disposal Do not flush away residues with water. Retain as contaminated waste Allow residues to evaporate or soak up with an appropriate absorbent material and dispose of safely Remove contaminated soil and dispose of safely For small liquid spills (< 1 drum), transfer by mechanical means to a labelled, sealable container for product recovery or safe disposal Allow residues to evaporate or soak up with an appropriate absorbent material and dispose of safely Remove contaminated soil and dispose of safely
Additional Advice	:	Notify authorities if any exposure to the general public or the environment occurs or is likely to occur Local authorities should be advised if significant spillages cannot be contained The vapour is heavier than air, spreads along the ground and distant ignition is possible Vapour may form an explosive mixture with air See Chapter 13 for information on disposal U S regulations may require reporting releases of this material to the environment which exceed the reportable quantity (refer to Chapter 15) to the National Response Centre at (800) 424-8802. Notify authorities if any exposure to the general public or the environment occurs or is likely to occur

7. HANDLING AND STORAGE

General Precautions	:	Avoid breathing of or contact with material Only use in well ventilated areas Wash thoroughly after handling For guidance on selection of personal protective equipment see Chapter 8 of this Material Safety Data Sheet Use the information in this data sheet as input to a risk assessment of local circumstances to help determine appropriate controls for safe handling, storage and disposal of this material
Handling	:	Avoid inhaling vapour and/or mists Avoid contact with skin, eyes, and clothing Extinguish any naked flames Do Not smoke Remove ignition sources Avoid sparks Electrostatic charges may be generated during pumping Electrostatic discharge may cause fire Ensure electrical continuity by bonding and grounding (earthing) all equipment Restrict line velocity during pumping in order to avoid generation of electrostatic discharge (<= 1 m/sec until fill pipe submerged to twice its diameter, then <= 7 m/sec) Avoid splash filling Do NOT use compressed air for filling, discharging, or handling operations Handling Temperature: Ambient
Storage	:	Bulk storage tanks should be diked (bunded) Vapours from tanks should not be released to atmosphere Breathing losses during storage should be controlled by a suitable vapour treatment system Must be stored in a diked (bunded) well-ventilated area, away from sunlight, ignition sources and other sources of heat Keep away from aerosols, flammables, oxidizing agents, corrosives and from other flammable products which are not harmful or toxic to man or to the environment The vapour is heavier than air Beware of accumulation in pits and confined spaces Storage Temperature: Ambient
Product Transfer	:	Electrostatic charges may be generated during pumping Electrostatic discharge may cause fire. Ensure electrical continuity by bonding and grounding (earthing) all equipment Restrict line velocity during pumping in order to avoid generation of electrostatic discharge (<= 1 m/sec until fill pipe submerged to twice its diameter, then <= 7 m/sec) Avoid splash filling Do NOT use compressed air for filling, discharging, or handling operations Keep containers closed when not in use Do not use compressed air for filling, discharging or handling
Recommended Materials	:	For containers, or container linings use mild steel, stainless steel
Unsuitable Materials	:	Natural, butyl, neoprene or nitrile rubbers
Container Advice	:	Containers, even those that have been emptied, can contain explosive vapours Do not cut, drill, grind, weld or perform similar operations on or near containers
Additional Information	:	Ensure that all local regulations regarding handling and storage facilities are followed

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Occupational Exposure Limits

Material	Source	Type	ppm	mg/m3	Notation
Ethylbenzene	ACGIH	TWA	100 ppm		
	ACGIH	STEL	125 ppm		
	OSHA Z1	PEL	100 ppm	435 mg/m3	
	OSHA Z1A	TWA	100 ppm	435 mg/m3	
	OSHA Z1A	STEL	125 ppm	545 mg/m3	
Xylene, Mixed Isomers	ACGIH	TWA	100 ppm		
	ACGIH	STEL	150 ppm		
	OSHA Z1	PEL	100 ppm	435 mg/m3	
	OSHA Z1A	TWA	100 ppm	435 mg/m3	
	OSHA Z1A	STEL	150 ppm	655 mg/m3	

Additional Information : Shell has adopted as Interim Standards, the OSHA PELs that were established in 1989 and later rescinded

Exposure Controls : The level of protection and types of controls necessary will vary depending upon potential exposure conditions. Select controls based on a risk assessment of local circumstances Appropriate measures include: Use sealed systems as far as possible Adequate explosion-proof ventilation to control airborne concentrations below the exposure guidelines/limits Local exhaust ventilation is recommended Firewater monitors and deluge systems are recommended Eye washes and showers for emergency use

Personal Protective Equipment : Personal protective equipment (PPE) should meet recommended national standards Check with PPE suppliers

Respiratory Protection : If engineering controls do not maintain airborne concentrations to a level which is adequate to protect worker health, select respiratory protection equipment suitable for the specific conditions of use and meeting relevant legislation Check with respiratory protective equipment suppliers Where air-filtering respirators are suitable, select an appropriate combination of mask and filter Where respiratory protective equipment is required, use a full-face mask Select a filter suitable for organic gases and vapours [boiling point >65 °C (149 °F)] Where air-filtering respirators are unsuitable (e g , airborne concentrations are high, risk of oxygen deficiency, confined space) use appropriate positive pressure breathing apparatus Respirator selection, use and maintenance should be in accordance with the requirements of the OSHA Respiratory Protection Standard, 29 CFR 1920 134

Hand Protection : Where hand contact with the product may occur the use of

		gloves approved to relevant standards (e g Europe: EN374, US: F739) made from the following materials may provide suitable chemical protection: Longer term protection: Viton Incidental contact/Splash protection: Nitrile rubber Suitability and durability of a glove is dependent on usage, e g frequency and duration of contact, chemical resistance of glove material, glove thickness, dexterity Always seek advice from glove suppliers. Contaminated gloves should be replaced
Eye Protection	:	Chemical splash goggles (chemical monogoggles)
Protective Clothing	:	Chemical resistant gloves/gauntlets, boots, and apron Where risk of splashing or in spillage clean up, use chemical resistant one-piece overall with integral hood.
Environmental Exposure Controls	:	Local guidelines on emission limits for volatile substances must be observed for the discharge of exhaust air containing vapour

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	:	Colourless Liquid
Odour	:	Aromatic
Odour threshold	:	0 27 ppm
Boiling point	:	Typical 136 - 145 °C / 277 - 293 °F
Flash point	:	Typical 21 - 27 °C / 70 - 81 °F (Abel)
Explosion / Flammability limits in air	:	1 - 7 1 %(V)
Auto-ignition temperature	:	432 - 530 °C / 810 - 986 °F (ASTM E-659)
Vapour pressure	:	Typical 4 5 kPa at 50 °C / 122 °F Typical 0 8 - 1 2 kPa at 20 °C / 68 °F Typical 0 2 kPa at 0 °C / 32 °F
Density	:	Typical 870 kg/m3 at 15 °C / 59 °F (ASTM D-1298)
Water solubility	:	0 175 kg/m3
Solubility in other solvents	:	Miscible
n-octanol/water partition coefficient (log Pow)	:	3 12 - 3 2
Kinematic viscosity	:	< 0 9 mm2/s at 20 °C / 68 °F
Vapour density (air=1)	:	3 7
Dielectric constant	:	Typical 2 6
Evaporation rate (nBuAc=1)	:	13 5 (DIN 53170, di-ethyl ether=1) 0.76 (ASTM D 3539, nBuAc=1)
Surface tension	:	Typical 28 7 mN/m at 20 °C / 68 °F (ASTM D-971)
Molecular weight	:	106 g/mol

10. STABILITY AND REACTIVITY

Stability	:	Stable under normal conditions of use Reacts violently with strong oxidising agents
Conditions to Avoid	:	Avoid heat, sparks, open flames and other ignition sources Prevent vapour accumulation
Materials to Avoid	:	Strong oxidising agents
Hazardous Decomposition Products	:	Thermal decomposition is highly dependent on conditions A complex mixture of airborne solids, liquids and gases, including carbon monoxide, carbon dioxide and other organic compounds will be evolved when this material undergoes combustion or

thermal or oxidative degradation

11. TOXICOLOGICAL INFORMATION

Basis for Assessment : Information given is based on product testing

Acute Oral Toxicity : Low toxicity: LD50 >2000 mg/kg , Rat
Aspiration into the lungs when swallowed or vomited may cause chemical pneumonitis which can be fatal.

Acute Dermal Toxicity : Low toxicity: LD50 >2000 mg/kg , Rabbit

Acute Inhalation Toxicity : Low toxicity: LC50>5000 ppm / 1 hours, Rat
High concentrations may cause central nervous system depression resulting in headaches, dizziness and nausea; continued inhalation may result in unconsciousness and/or death

Skin Irritation : Irritating to skin

Eye Irritation : Moderately irritating to eyes

Respiratory Irritation : Inhalation of vapours or mists may cause irritation to the respiratory system

Repeated Dose Toxicity : Liver: can cause liver damage
Kidney: can cause kidney damage
Central nervous system: repeated exposure affects the nervous system
Auditory system: prolonged and repeated exposures to high concentrations have resulted in hearing loss in rats Solvent abuse and noise interaction in the work environment may cause hearing loss
Cardiovascular system: chronic abuse of similar materials has been associated with irregular heart rhythms and cardiac arrest

Mutagenicity : Not mutagenic

Carcinogenicity : Not carcinogenic in animal studies (Xylene, Mixed Isomers)
Limited evidence of carcinogenic effect (Ethylbenzene)

Material	:	Carcinogenicity Classification
Xylene, Mixed Isomers	:	ACGIH Group A4: Not classifiable as a human carcinogen.
Xylene, Mixed Isomers	:	IARC 3: Classification not possible from current data.
Ethylbenzene	:	ACGIH Group A3: Confirmed animal carcinogen with unknown relevance to humans.
Ethylbenzene	:	IARC 2B: Possible carcinogen.

Reproductive and Developmental Toxicity : Does not impair fertility. (Xylene, Mixed Isomers)

Repeated inhalation of Ethyl Benzene for 186 days at levels well exceeding the TLV caused degeneration of the germinal epithelium in the testes of rabbits and monkeys but not of rats
Causes foetotoxicity in animals at doses which are maternally toxic (Xylene, Mixed Isomers)
In developmental toxicity studies conducted in laboratory animals, there is no evidence of teratogenicity following inhalation exposure to xylene, but delayed development and some behavioural impairments have been observed in offspring

Additional Information : Over exposures of humans to xylene or xylene solvent mixtures produced predominately central nervous system (CNS) effects with less common effects reported to the lung, gastrointestinal tract, liver, kidney and heart

12. ECOLOGICAL INFORMATION

Acute Toxicity

Fish	:	Toxic: 1 < LC/EC/IC50 <= 10 mg/l
Aquatic Invertebrates	:	Toxic: 1 < LC/EC/IC50 <= 10 mg/l
Algae	:	Toxic: 1 < LC/EC/IC50 <= 10 mg/l
Mobility	:	If product enters soil, it will be highly mobile and may contaminate groundwater Floats on water
Persistence/degradability	:	Readily biodegradable Oxidises rapidly by photo-chemical reactions in air
Bioaccumulation	:	Does not bioaccumulate significantly
Other Adverse Effects	:	In view of the high rate of loss from solution, the product is unlikely to pose a significant hazard to aquatic life

13. DISPOSAL CONSIDERATIONS

Material Disposal	:	Recover or recycle if possible It is the responsibility of the waste generator to determine the toxicity and physical properties of the material generated to determine the proper waste classification and disposal methods in compliance with applicable regulations
Container Disposal	:	Drain container thoroughly After draining, vent in a safe place away from sparks and fire Residues may cause an explosion hazard Do not, puncture, cut, or weld uncleaned drums Send to drum recoverer or metal reclaimer
Local Legislation	:	Disposal should be in accordance with applicable regional, national, and local laws and regulations

14. TRANSPORT INFORMATION

US Department of Transportation Classification (49CFR)

Identification number	UN 1307
Proper shipping name	Xylenes
Class / Division	3
Packing group	III
Hazardous subst /material RQ:	ETHYLBENZENE/6,060 LB XYLENE/100 00 LB
Emergency Response Guide	130
No	

IMDG

Identification number	UN 1307
Proper shipping name	XYLENES
Class / Division	3
Packing group	III
Marine pollutant:	No

IATA (Country variations may apply)

Identification number	UN 1307
Proper shipping name	Xylenes
Class / Division	3
Packing group	III

15. REGULATORY INFORMATION

The regulatory information is not intended to be comprehensive. Other regulations may apply to this material.

Federal Regulatory Status

Notification Status

AICS	Listed	
DSL	Listed	
INV (CN)	Listed	
ENCS (JP)	Listed.	(3)-3
TSCA	Listed	
EINECS	Listed	215-535-7
KECI (KR)	Listed	97-1-275
KECI (KR)	Listed	KE-35427
PICCS (PH)	Listed	

Comprehensive Environmental Release, Compensation & Liability Act (CERCLA)

Xylene (1330-20-7)	Reportable quantity: 100 lbs
Xylene, Mixed Isomers (1330-20-7)	Reportable quantity: 100 lbs
Ethylbenzene (100-41-4)	Reportable quantity: 1,000 lbs
Benzene (71-43-2)	Reportable quantity: 10 lbs

Clean Water Act (CWA) Section 311

Xylene (1330-20-7)	Reportable quantity: 100 lbs
Xylene, Mixed Isomers (1330-20-7)	Reportable quantity: 100 lbs
Ethylbenzene (100-41-4)	Reportable quantity: 1,000 lbs
Benzene (71-43-2)	Reportable quantity: 10 lbs

SARA Hazard Categories (311/312)

Immediate (Acute) Health Hazard Delayed (Chronic) Health Hazard Fire Hazard

SARA Toxic Release Inventory (TRI) (313)

Xylene, Mixed Isomers (1330-20-7)	100 00%
Ethylbenzene (100-41-4)	25 00%

Benzene (71-43-2) 0 02%

State Regulatory Status

California Safe Drinking Water and Toxic Enforcement Act (Proposition 65)

Known to the State of California to cause birth defects or other reproductive harm
Known to the state of California to cause cancer

Benzene (71-43-2) 0 02%	Carcinogenic Developmental toxin Male reproductive toxin

New Jersey Right-To-Know Chemical List

Xylene, Mixed Isomers (1330-20-7) 100 00%
Ethylbenzene (100-41-4) 25 00%
Benzene (71-43-2) 0 02%

Pennsylvannia Right-To-Know Chemical List

Xylene, Mixed Isomers (1330-20-7) 100 00%	Environmental hazard Listed
Ethylbenzene (100-41-4) 25 00%	Environmental hazard Listed.
Benzene (71-43-2) 0 02%	Special hazard Environmental hazard Listed

16. OTHER INFORMATION

MSDS Version Number	:	25 1
MSDS Effective Date	:	12/29/2003
MSDS Revisions	:	A vertical bar (|) in the left margin indicates an amendment from the previous version
MSDS Regulation	:	The content and format of this MSDS is in accordance with the OSHA Hazard Communication Standard, 29 CFR 1910 1200
Uses and Restrictions	:	Solvent Raw material for use in the chemical industry
MSDS Distribution	:	The information in this document should be made available to all who may handle the product
Disclaimer	:	The information contained herein is based on our current knowledge of the underlying data and is intended to describe the product for the purpose of health, safety and environmental requirements only No warranty or guarantee is expressed or

implied regarding the accuracy of these data or the results to be obtained from the use of the product

AMERADA HESS CORPORATION

NFPA 704 (Section 16)

MATERIAL SAFETY DATA SHEET

Methyl tert-Butyl Ether (MTBE) **MSDS No. 9922**

1. CHEMICAL PRODUCT and COMPANY INFORMATION (rev. Apr-98)

Amerada Hess Corporation
1 Hess Plaza
Woodbridge, NJ 07095-0961

EMERGENCY TELEPHONE NUMBER (24 hrs): **CHEMTREC (800) 424-9300**
COMPANY CONTACT (business hours): Corporate Safety (732) 750-6000

SYNONYMS: 2-methoxy-2-methyl propane; Methyl t-butyl ether; MTBE; t-butyl methyl ether

See Section 16 for abbreviations and acronyms

2. COMPOSITION and INFORMATION ON INGREDIENTS (rev. Sep-94)

INGREDIENT NAME	EXPOSURE LIMITS	CONCENTRATION PERCENT BY WEIGHT
Methyl-tertiary butyl ether (MTBE) CAS NUMBER: 1634-04-4	OSHA PEL-TWA/STEL: None established ACGIH TLV-TWA: 40 ppm, A3	> 97%

MTBE ($C_5H_{12}O$) is used as an octane booster and oxygenate for unleaded gasoline

3. HAZARDS IDENTIFICATION (rev. Apr-98; Tox-98)

EMERGENCY OVERVIEW

DANGER!

EXTREMELY FLAMMABLE - EYE AND MUCOUS MEMBRANE IRRITANT - EFFECTS CENTRAL NERVOUS SYSTEM - HARMFUL OR FATAL IF SWALLOWED - ASPIRATION HAZARD

High fire hazard Keep away from heat, spark, open flame, and other ignition sources

Contact may cause eye, skin and mucous membrane irritation Avoid prolonged breathing of vapors or mists Inhalation may cause irritation, anesthetic effects (dizziness, nausea, headache, intoxication), and respiratory system effects

If ingested, do NOT induce vomiting, as this may cause chemical pneumonia (fluid in the lungs)

EYES

Contact with the eye may cause slight to mild irritation.

SKIN

Practically non-toxic if absorbed following acute (single) exposure. May cause skin irritation with prolonged or repeated contact Liquid may be absorbed through the skin in toxic amounts if large areas of skin are exposed repeatedly

INGESTION

The major health threat of ingestion occurs from the danger of aspiration (breathing) of liquid drops into the lungs, particularly from vomiting Aspiration may result in chemical pneumonia (fluid in the lungs), severe lung damage, respiratory failure and even death

Ingestion may cause gastrointestinal disturbances, including irritation, nausea, vomiting, and diarrhea, and central nervous system (brain) effects similar to alcohol intoxication. In severe cases, tremors, convulsions, loss of consciousness, coma, respiratory arrest and death may occur

INHALATION

Excessive exposure may cause irritation to the nose, throat, lungs and respiratory tract Central nervous system (brain) effects may include headache, dizziness, loss of balance and coordination, unconsciousness, coma, respiratory failure, and death

WARNING: the burning of any hydrocarbon as a fuel in an area without adequate ventilation may result in hazardous levels of combustion products, including carbon monoxide, and inadequate oxygen levels, which may cause unconsciousness, suffocation, and death

CHRONIC EFFECTS and CARCINOGENICITY

This product has produced cancer, developmental and systemic toxicity in laboratory animals following repeated exposure The significance of these results to human exposures has not been determined – see Section 11, Toxicological Information.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE

Irritation from skin exposure may aggravate existing open wounds, skin disorders, and dermatitis (rash) conditions. Chronic respiratory disease, or pre-existing central nervous system disorders may be aggravated by exposure

4. FIRST AID MEASURES (rev. Apr-98; Tox-98)

EYES

In case of contact with eyes, immediately flush with clean, low-pressure water for at least 15 min Hold eyelids open to ensure adequate flushing Seek medical attention.

SKIN

Remove contaminated clothing Wash contaminated areas thoroughly with soap and water or waterless hand cleanser Obtain medical attention if irritation or redness develops

INGESTION

DO NOT INDUCE VOMITING Do not give liquids Obtain immediate medical attention If spontaneous vomiting occurs, lean victim forward to reduce the risk of aspiration Small amounts of material which enter the mouth should be rinsed out until the taste is dissipated

INHALATION

Remove person to fresh air If person is not breathing, ensure an open airway and provide artificial respiration. If necessary, provide additional oxygen once breathing is restored if trained to do so Seek medical attention immediately

5. FIRE FIGHTING MEASURES (rev. Nov-96)

FLAMMABLE PROPERTIES:

FLASH POINT:	-14 °F (-25 °C)
AUTOIGNITION TEMPERATURE:	AP 815 °F (435 °C)
OSHA/NFPA FLAMMABILITY CLASS:	1B (flammable liquid)
LOWER EXPLOSIVE LIMIT (%):	1 6
UPPER EXPLOSIVE LIMIT (%):	8 4

FIRE AND EXPLOSION HAZARDS

Vapors may be ignited rapidly when exposed to heat, spark, open flame or other source of ignition Flowing product may be ignited by self-generated static electricity. When mixed with air and exposed to an ignition source, flammable vapors can burn in the open or explode in confined spaces Being heavier than air, vapors may travel long distances to an ignition source and flash back Runoff to sewer may cause fire or explosion hazard

This product burns with a blue flame which is often less visible than gasoline or other petroleum hydrocarbons flames

EXTINGUISHING MEDIA

SMALL FIRES: Any extinguisher suitable for Class B fires, dry chemical, CO2, water spray, fire fighting foam, or Halon

LARGE FIRES: Water spray, fog or fire fighting foam suitable for polar solvents Water may be ineffective for fighting the fire, but may be used to cool fire-exposed containers

Firefighting foam suitable for polar solvents is recommended - refer to NFPA 11 "Low Expansion Foam ."

FIRE FIGHTING INSTRUCTIONS
Small fires in the incipient (beginning) stage may typically be extinguished using handheld portable fire extinguishers and other fire fighting equipment

Firefighting activities that may result in potential exposure to high heat, smoke or toxic by-products of combustion should require NIOSH/MSHA- approved pressure-demand self-contained breathing apparatus with full facepiece and full protective clothing

Isolate area around container involved in fire Cool tanks, shells, and containers exposed to fire and excessive heat with water For massive fires the use of unmanned hose holders or monitor nozzles may be advantageous to further minimize personnel exposure Major fires may require withdrawal, allowing the tank to burn Large storage tank fires typically require specially trained personnel and equipment to extinguish the fire, often including the need for properly applied fire fighting foam

See Section 16 for the NFPA 704 Hazard Rating

6. ACCIDENTAL RELEASE MEASURES (rev. Apr-98)

ACTIVATE FACILITY SPILL CONTINGENCY or EMERGENCY PLAN

Evacuate nonessential personnel and remove or secure all ignition sources Consider wind direction; stay upwind and uphill, if possible Evaluate the direction of product travel, diking, sewers, etc to confirm spill areas Spills may infiltrate subsurface soil and groundwater; professional assistance may be necessary to determine the extent of subsurface impact

Carefully contain and stop the source of the spill, if safe to do so Protect bodies of water by diking, absorbents, or absorbent boom, if possible Do not flush down sewer or drainage systems, unless system is designed and permitted to handle such material The use of fire fighting foam may be useful in certain situations to reduce vapors The proper use of water spray may effectively disperse product vapors or the liquid itself, preventing contact with ignition sources or areas/equipment that require protection.

Take up with sand or other oil absorbing materials. Carefully shovel, scoop or sweep up into a waste container for reclamation or disposal - caution, flammable vapors may accumulate in closed containers Response and clean-up crews must be properly trained and must utilize proper protective equipment (see Section 8)

7. HANDLING and STORAGE (rev. Apr-98)

HANDLING PRECAUTIONS
Handle as a flammable liquid Keep away from heat, sparks, and open flame! Electrical equipment should be approved for classified area Bond and ground containers during product transfer to reduce the possibility of static-initiated fire or explosion

Special slow load procedures for "switch loading" must be followed to avoid the static ignition hazard that can exist when higher flash point material (such as fuel oil) is loaded into tanks previously containing low flash point products (such as this product) - see API Publication 2003, "Protection Against Ignitions Arising Out Of Static, Lightning and Stray Currents

STORAGE PRECAUTIONS
Keep away from flame, sparks, excessive temperatures and open flame Use approved vented containers. Keep containers closed and clearly labeled Empty product containers or vessels may contain explosive vapors Do not pressurize, cut, heat, weld or expose such containers to sources of ignition

Store in a well-ventilated area This storage area should comply with NFPA 30 "Flammable and Combustible Liquid Code" Avoid storage near incompatible materials The cleaning of tanks previously containing this product should follow API Recommended Practice (RP) 2013 "Cleaning Mobile Tanks In Flammable and Combustible Liquid Service" and API RP 2015 "Cleaning Petroleum Storage Tanks".

WORK/HYGIENIC PRACTICES

Emergency eye wash capability should be available in the near proximity to operations presenting a potential splash exposure Use good personal hygiene practices Avoid repeated and/or prolonged skin exposure. Wash hands before eating, drinking, smoking, or using toilet facilities Do not use as a cleaning solvent on the skin Do not use solvents or harsh abrasive skin cleaners for washing this product from exposed skin areas Waterless hand cleaners are effective Promptly remove contaminated clothing and launder before reuse Use care when laundering to prevent the formation of flammable vapors which could ignite via washer or dryer Consider the need to discard contaminated leather shoes and gloves

8. EXPOSURE CONTROLS and PERSONAL PROTECTION (rev. Nov-96)

ENGINEERING CONTROLS

Use adequate ventilation to keep vapor concentrations of this product below occupational exposure and flammability limits, particularly in confined spaces

EYE/FACE PROTECTION

Safety glasses or goggles are recommended where there is a possibility of splashing or spraying

SKIN PROTECTION

Gloves constructed of nitrile or neoprene are recommended Chemical protective clothing such as of E I DuPont Tychem ®, Barricade ®, or equivalent recommended based on degree of exposure Note: The resistance of specific material may vary from product to product as well as with degree of exposure Consult manufacturer specifications for further information

RESPIRATORY PROTECTION

A NIOSH/MSHA-approved air-purifying respirator with organic vapor cartridges or canister may be permissible under certain circumstances where airborne concentrations are or may be expected to exceed exposure limits or for odor or irritation Protection provided by air-purifying respirators is limited Use a positive pressure, air-supplied respirator if there is a potential for uncontrolled release, exposure levels are not known, in oxygen-deficient atmospheres, or any other circumstance where an air-purifying respirator may not provide adequate protection

Refer to OSHA 29 CFR 1910 134, ANSI Z88 2-1992, NIOSH Respirator Decision Logic, and the manufacturer for additional guidance on respiratory protection selection

9. PHYSICAL and CHEMICAL PROPERTIES (rev. Sep-94)

APPEARANCE

A clear, water-like liquid

ODOR

A sweet, ether-like odor

ODOR THRESHOLD

Odor detectable at 0 05 ppm and recognizable at 0 13 ppm Highly odorous

BASIC PHYSICAL PROPERTIES

BOILING POINT:	131 °F (55 °C)
VAPOR PRESSURE:	7 8 PSI @ 100 °F (38 °C)
VAPOR DENSITY (air = 1):	3 1
SPECIFIC GRAVITY (H_2O = 1):	0 74
EVAPORATION RATE:	ND - probably high
PERCENT VOLATILES:	100 %
SOLUBILITY (H_2O):	AP 5% @ 68 °F (20 °C)

10. STABILITY and REACTIVITY (rev. Sep-94)

STABILITY: Stable Hazardous polymerization will not occur

CONDITIONS TO AVOID
Avoid high temperatures, open flames, sparks, welding, smoking and other ignition sources

INCOMPATIBLE MATERIALS
Keep away from strong oxidizers

HAZARDOUS DECOMPOSITION PRODUCTS
Carbon monoxide, carbon dioxide, non-combusted hydrocarbons (smoke), irritating aldehydes and ketones, and other toxic vapors

11. TOXICOLOGICAL PROPERTIES (rev. Apr-98)

ACUTE EFFECTS

Acute Dermal:	LD50 (rabbit): >10 g/kg	Eye Irritation (rabbits):	mild to moderate
Acute Inhalation:	LC50 (rat): 35,000 ppm	Dermal irritation (rabbit):	slight
Acute Oral:	LD50 (rat): 4 0 ml/kg	Dermal Sensitization:	negative

CHRONIC EFFECTS AND CARCINOGENICITY
Carcinogenic: **IARC:** NO **NTP:** NO **OSHA:** NO **ACGIH:** A3 (animal carcinogen)
MTBE has demonstrated some evidence of developmental toxicity in animal models

MUTAGENICITY (genetic effects)
MTBE was positive in a single mutagenicity study following activation

12. ECOLOGICAL INFORMATION (rev. Apr-98)

Keep out of sewers, drainage and waterways Report spills and releases, as applicable, under Federal and State regulations If released, MTBE will be expected to exhibit fairly high mobility in soil, and therefore may leach into groundwater Refer to API Publication 4497, "Cost-Effective, Alternative Treatment Technologies For Reducing the Concentrations of Ethers and Alcohols in Groundwater"

13. DISPOSAL CONSIDERATIONS (rev. Apr-98)

Consult federal, state and local waste regulations to determine appropriate disposal options

14. TRANSPORTATION INFORMATION (rev. Sep-94)

PROPER SHIPPING NAME:	Methyl tert-butyl ether
HAZARD CLASS AND PACKING GROUP:	3, PG II
DOT IDENTIFICATION NUMBER:	UN 2398
DOT SHIPPING LABEL:	FLAMMABLE LIQUID

15. REGULATORY INFORMATION (rev. Nov-96)

U.S. FEDERAL, STATE, and LOCAL REGULATORY INFORMATION
This product and its constituents listed herein are on the EPA TSCA Inventory Any spill or uncontrolled release of this product, including any substantial threat of release, may be subject to federal, to state and/or local reporting requirements This product and/or its constituents may also be subject to other regulations at the federal, state and/or local level Consult those regulations applicable to your facility / operation. Consult those regulations applicable to your facility/operation

CLEAN WATER ACT (OIL SPILLS)
Any spill or release of this product to "navigable waters" (essentially any surface water, including certain wetlands) or adjoining shorelines sufficient to cause a visible sheen or deposit of a sludge or emulsion must be reported immediately to the National Response Center (1-800-424-8802) or, if not practical, the U S Coast Guard with follow-up to the National Response Center, as required by U S Federal Law Also contact appropriate state and local regulatory agencies as required

CERCLA SECTION 103 and SARA SECTION 304 (RELEASE TO THE ENVIRONMENT)
MTBE is a CERCLA hazardous substance and as such is subject to CERCLA and SARA federal reporting requirements Reportable Quantity (pounds): 1000

SARA SECTION 311/312 - HAZARD CLASSES

ACUTE HEALTH	CHRONIC HEALTH	FIRE	SUDDEN RELEASE OF PRESSURE	REACTIVE
X	X	X	---	---

SARA SECTION 313 - SUPPLIER NOTIFICATION

This product contains the following toxic chemicals subject to the reporting requirements of section 313 of the Emergency Planning and Community Right-To-Know Act (EPCRA) of 1986 and of 40 CFR 372:

INGREDIENT NAME	CONCENTRATION PERCENT BY WEIGHT
Methyl-tertiary butyl ether (MTBE) CAS NUMBER: 1634-04-4	> 97

CANADIAN REGULATORY INFORMATION (WHMIS)

Class B, Division 2 (Flammable Liquid)
Class D, Division 2, Subdivision B (Toxic by other means)

16. OTHER INFORMATION (rev. Nov-96)

NFPA® HAZARD RATING	HEALTH:	1	Slight
	FIRE:	3	High
	REACTIVITY:	0	Negligible
HMIS® HAZARD RATING	HEALTH:	1*	Slight
	FIRE:	3	Serious
	REACTIVITY:	0	Negligible
			* Chronic

SUPERSEDES MSDS DATED: 11/21/96

ABBREVIATIONS:

AP = Approximately < = Less than > = Greater than
N/A = Not Applicable N/D = Not Determined ppm = parts per million

ACRONYMS:

ACGIH	American Conference of Governmental Industrial Hygienists
AIHA	American Industrial Hygiene Association
ANSI	American National Standards Institute (212)642-4900
API	American Petroleum Institute 202)682-8000
CERCLA	Comprehensive Emergency Response, Compensation, and Liability Act
DOT	U S Department of Transportation [General Info: (800)467-4922]
EPA	U S Environmental Protection Agency
HMIS	Hazardous Materials Information System
IARC	International Agency For Research On Cancer
MSHA	Mine Safety and Health Administration
NFPA	National Fire Protection Association (617)770-3000
NIOSH	National Institute of Occupational Safety and Health
NOIC	Notice of Intended Change (proposed change to ACGIH TLV)
NTP	National Toxicology Program
OPA	Oil Pollution Act of 1990
OSHA	U S Occupational Safety & Health Administration
PEL	Permissible Exposure Limit (OSHA)
RCRA	Resource Conservation and Recovery Act
REL	Recommended Exposure Limit (NIOSH)
SARA	Superfund Amendments and Reauthorization Act of 1986 Title III
SCBA	Self-Contained Breathing Apparatus
SPCC	Spill Prevention, Control, and Countermeasures
STEL	Short-Term Exposure Limit (generally 15 minutes)
TLV	Threshold Limit Value (ACGIH)
TSCA	Toxic Substances Control Act
TWA	Time Weighted Average (8 hr)
WEEL	Workplace Environmental Exposure Level (AIHA)
WHMIS	Canadian Workplace Hazardous Materials Information System

DISCLAIMER OF EXPRESSED AND IMPLIED WARRANTIES

Information presented herein has been compiled from sources considered to be dependable and is accurate and reliable to the best of our knowledge and belief but is not guaranteed to be so Since conditions of use are beyond our control, we make no warranties, expressed or implied. except those that may be contained in our written contract of sale or acknowledgment

Vendor assumes no responsibility for injury to vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet Additionally, vendor assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material. even if reasonable safety procedures are followed Furthermore, vendee assumes the risk in their use of the material

Attachment B

Base Map: 2008 National Agriculture Imagery Program

QUALITY ENVIRONMENTAL PROFESSIONALS, INC.
1611 South Franklin Road
Indianapolis, Indiana 46239

FIGURE 2
SITE MAP

HANNOVER PROPERTY
731 WEST CHIPPEWA AVENUE
SOUTH BEND, INDIANA

Project Number:	Date:
08-03-009	11/16/09
Drawn By:	Scale:
CWH	1"=150'
Checked By:	Sheet:
NRV	1

Attachment C

Emergency Phone Numbers

Post in Full View

Qepi Director of Health & Safety (Office)..... (317) 351-4255

Qepi Director of Health & Safety (Cell) ..... (317) 440-8946 or (574) 360-0961

US EPA Region V Emergency Response Center ..... (312) 886-2395

ATF Explosives Hotline..... (800) 283-2662

Centers for Disease Control Emergency Response Hotline ..... (770) 488-7100

National Response Center (HazMat Spills/Pipeline Leaks) ..... (800) 424-8802

IDEM – Emergency Response..... (888) 233-7745

CHEMTREC ..... (800) 262-8200

Hospital*.....*911 or (574) 647-1000

Name: *Memorial Hospital and Health Center*

Address: *615 North Michigan Street, South Bend*

Travel Time: *5-10 minutes*

Directions: *Head North from site on Michigan Street into downtown South Bend*

Map Attached: *No*

Site Control (*Bob Heslop or Nivas R. Vijay*)..... (574) 232-6000 or (574) 360-0961

Paramedics*..... *911

Fire Department*..... *911

Local Police*..... *911

Appendix E

BLACKHAWK TECHNOLOGY COMPANY

ANY LIQUID, AT ANY DEPTH,* IN ANY ENVIRONMENT.

ANCHOR ELECTRIC PISTON PUMP®

Patented Top-Head-Drive Piston Pump

Patented, Electric Top-Head Drive Motor

Customizable Downhole Pump

DESCRIPTION

The Anchor Electric Piston Pump Model 101E is powered by electricity. The control motor is located at surface grade for easy installation and maintenance. Power to the pump is direct from grade through the sucker rod assembly. The pump removes water and product (e.g. oil, solvents, leachate) from a two (2) inch (4.85 cm) diameter well casing or greater to depths of 804 feet (245 meters) with a 1 hp motor. The fluid inlet is located at the bottom of the pump intake cylinder and removes water or product to 0 submergence depth.

TECHNICAL SPECIFICATIONS

MODEL 101E

FLOW RANGE
0-1.35 US GPM
5.1 LPM

OPERATIONAL DEPTH
804 Ft.
245 M
with 1 hp motor

WELL CASING SIZE
Minimum 2 In.
4.85 CM

PERFORMANCE AND TECHNICAL DATA

PERFORMANCE

Operational Depth	804’
Flow Range	0 to 1.35 US GPM/ 5.1 LPM 1,900 US GPD/ 7,300 LPD
Discharge per Stroke	.05 US Gallons per stroke Note: flow does not vary with depth
Motor	1/2 or 1 hp
Power Supply	120 or 230 Volt Single Phase or 230 or 460 Volt Three Phase
Maximum Discharge Pressure	348 PSI
Maximum Lift	804 feet of water or 348 PSIG Variable speed (stroke) control adjusts to well conditions; liquid drawn down to top of strainer.

TECHNICAL

Stroke Length	12” (30.48 cm)
Maximum External Diameter	2.9” (7.37 cm)
Total Cylinder Length	30” (76.2 cm)
Connection of Riser Pipe	1-1/4” (3.18 cm)
Connection to Sucker Rod	7/16” - 20
Recommended Internal Diameter of Bore Hole	2-3” (4.85 - 7.62 cm) or greater diameter
Weight of Cylinder	8 lbs.
Discharge Size	2” NPT
Installation	Unit can be installed vertically or horizontally
Driver Weight	40 lbs.
Driver Rod Weight	12 lbs./100’
Foot Valve Assembly Weight	8 lbs.
Minimum Well Casing Size	2”

* Up to 1000 feet.

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www.blackhawkco.com

ANCHOR ELECTRIC PISTON PUMP®
MODEL 101E

TECHNICAL SPECIFICATIONS

MATERIALS OF CONSTRUCTION
(Materials of construction can be modified to meet specific applications)

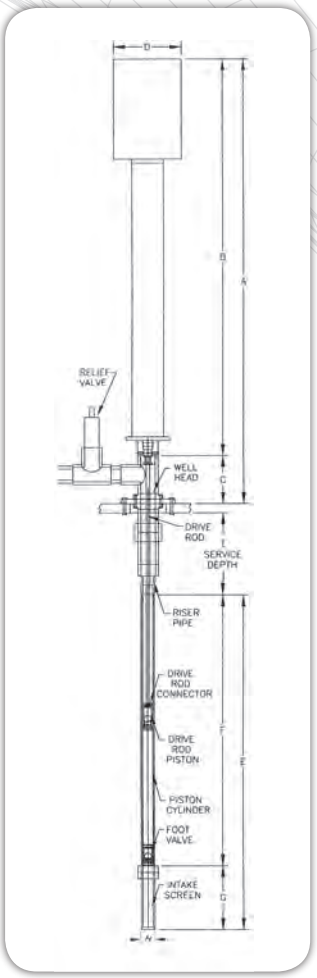
ABOVE GROUND

Drive Motor	Stainless Steel/ Aluminum
Seal Plate	Delrin®
Seal Plate Seals	Nitrile/Viton
Relief Valve	Stainless Steel
Discharge Tee	Stainless Steel
Well Head	Steel

DOWNHOLE

Drive Rod	Fiberglass
Drive Rod Connector	Stainless Steel
Drive Piston Seal	Nitrile/Viton
Drive Piston Check Ball	Stainless Steel
Drive Piston	Delrin®
Piston Cylinder	Stainless Steel/PVC
Foot Valve Check Ball	Stainless Steel
Foot Valve	Delrin® with Stainless seat
Intake Screen	Stainless Steel/PVC

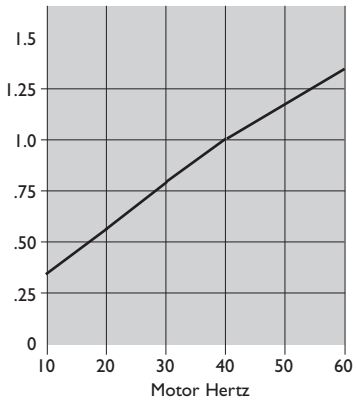
PUMP DIMENSIONS



AVAILABLE OPTIONS

- ✓ Level Control Systems
- ✓ Hazardous Duty Components
- ✓ Metered Flow Control
- ✓ Flow Measurement
- ✓ Variable Frequency Drive
- ✓ SCADA Capability

ANCHOR 101E ELECTRIC PUMP FLOW PERFORMANCE



DIMENSIONS (IN INCHES)

A	Above Well Height	48.5
B	Driver Height	43
C	Discharge Tee & Well Seal Height	5.5
D	Driver Diameter	8
E	Foot Valve Assembly Length	38
F	Foot Valve Length	30
G	Intake Screen Length	8
H	Downhole Diameter	1.9

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Appendix F

BLACKHAWK TECHNOLOGY COMPANY

ANY LIQUID, AT ANY DEPTH*, IN ANY ENVIRONMENT.

BLACKHAWK WINDMILL PUMP

GO GREEN.

Windmill pumps eliminate the need for electric or pneumatic power. And in addition to free wind power, your state may offer green tax credits when you use windmill pumps in your landfill.

Combine the traditional advantages of windmill power with today's pump technology. And get the permanent, low flow pumping you need without providing power to remote sites.

FEATURES	BENEFITS
Space age materials of construction	• Continuous fiberglass rods provide strength, lightweight, and flexibility, and eliminate cumbersome jointed steel lift rods. • Delrin drive pistons replace heavier, less efficient brass pistons • Nitrile or Viton u-cups replace traditional leather for greater compatibility with landfill liquids. • Stainless steel foot valves and stainless steel check balls provide longer service life than brass parts. • New materials offer compatibility with a wide range of chemicals. • Today's proven materials are lighter, easier to use, and long lasting.
Eliminates power requirements	• Eliminates cost of supplying power to remote sites • Eliminates maintenance costs associated with other power sources • Ideal for closed remediation and landfill sites
Compatible with full range of Blackhawk pumps	• Combines wind power with the piston pump that matches your application • Offers a range of downhole and windmill combinations • Provides an aesthetically pleasing power option

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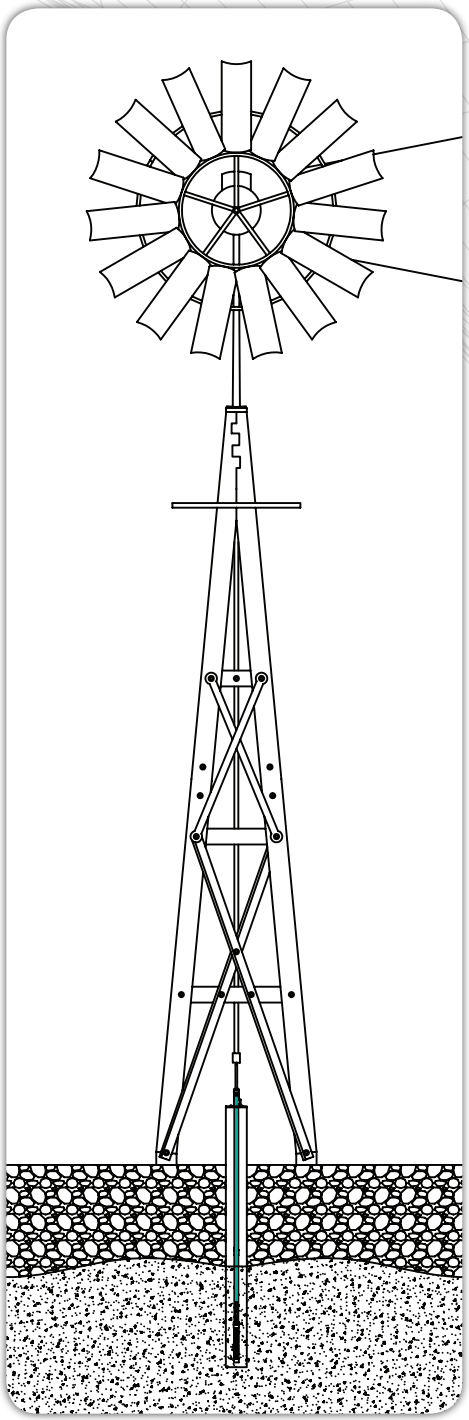
www.blackhawkco.com

BLACKHAWK WINDMILL PUMP

FEATURES	BENEFITS
Strong, adjustable windmill construction	• Available in 14-foot stub tower or 21-foot full tower designs • Strong, heavy anchor and cross bracing provide tower strength and rigidity. • Adjustable pump stroke provides either added power or delivers greater volume. • Balanced load construction minimizes wear. • Positive oiling systems and removable bearings simplify maintenance.



WINDMILL SPECIFICATIONS

MODEL 802	MILL SIZE (WHEEL DIA. IN FT.)	STROKE (INCHES)	NUMBER OF SAILS	SHIPPING WEIGHT (LBS.)
X	6	5 and 3.75	18	200
A	8	7.125 and 5.5	18	350
B	10	9.25 and 7.25	18	640
D	12	11.5 and 8.25	18	1090
E	14	13.5 and 9.75	18	1735
F	16	1.875 and 1.375	18	2410

ABOUT BLACKHAWK TECHNOLOGY COMPANY

Founded in 1990, Blackhawk Technology Company manufactures the industry's most comprehensive line of electric, pneumatic, and windmill top-head-drive positive displacement piston pumps designed to withstand the harshest outdoor environments and the most rigorous downhole pumping conditions. The Company originated landfill and groundwater remediation piston pumps, and no one offers more real world experience in landfills, petrochemical facilities, and remediation sites.

To learn more, see our customer testimonials and case histories at www.blackhawkco.com.

Contact us for a sample landfill application specification.

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www.blackhawkco.com

Appendix G

Mink

Mink MI 1502 BV/BP

MI 1502 BV

Description

The Busch Mink MI 1502 is a single-stage, dry rotary claw-type, positive displacement pump designed for either pressure or vacuum applications.

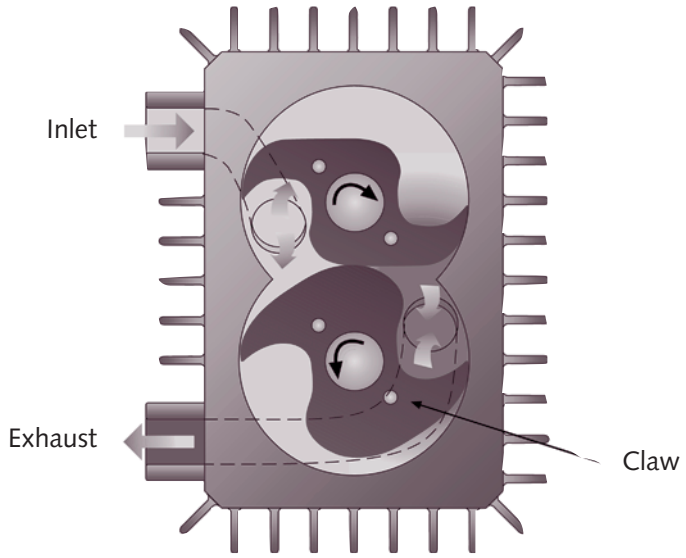
Vacuum or pressure is produced by two non-contacting rotors in an oil-free pumping chamber. The dry, non-contacting design makes the Mink ideal for pneumatic conveying, printing, soil remediation, and any application where dust particles may be present. Wearing parts are separated from the pumping chamber which leads to a longer pump life with low maintenance.

Features

- Non-contacting design
- Dry (oil-free) pumping chamber
- Air-cooled
- Low maintenance – no wear in pumping chamber
- Simple, modular construction
- Suitable for variable speed applications
- Discharge silencer on vacuum model; inlet silencer on pressure model
- Frame rails
- Suitable for dusty environments
- Integral relief valve
- Inlet filter on pressure model

Dry Rotary Claw Pressure or Vacuum Pumps

Operating Principle



Operating Principle

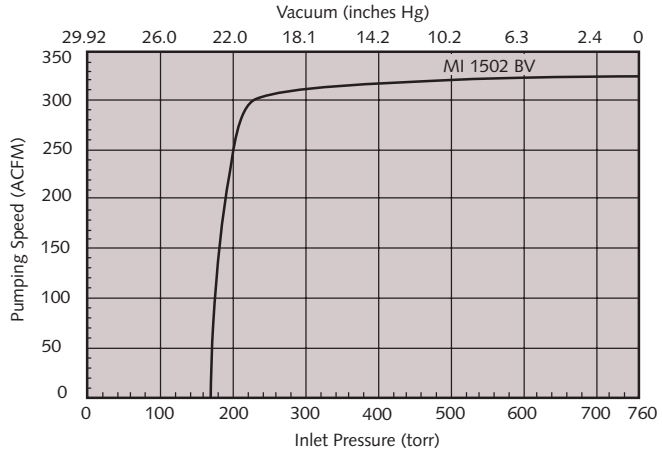
Inside the pump housing, two claw shaped rotors take in air as they rotate in opposite directions. The air is compressed by the rotors, then discharged through a silencer to atmosphere. The non-return valve incorporated into the inlet flange prevents air from back flowing into the pumping chamber when the pump is turned off. Mink MI dry rotary claw direct drive pumps are driven by a C-face motor, and the two rotors are synchronized by gears. A wide range of accessories allows optimum adaptation to many applications.

Applications

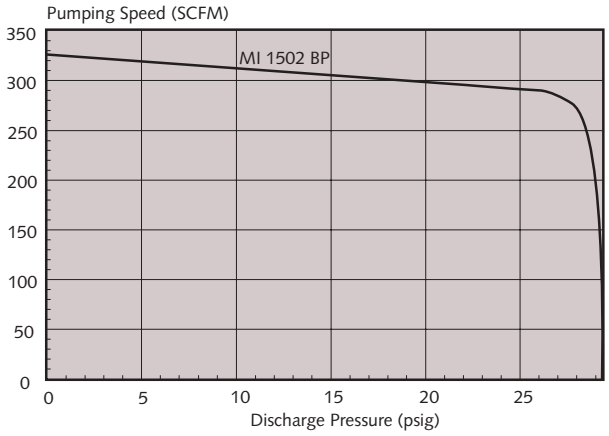
- Wood Industry
- Pneumatic conveying
- Transport and lifting systems
- Medical technology
- Central vacuum systems
- Packaging industry
- Plastics industry
- Food industry
- Printing industry
- Ceramics and brick industry
- Environmental technology
- Vacuum sewage
- Textile industry
- Paper industry
- Beverage industry

Technical Data

Pumping Speed vs.Inlet Pressure



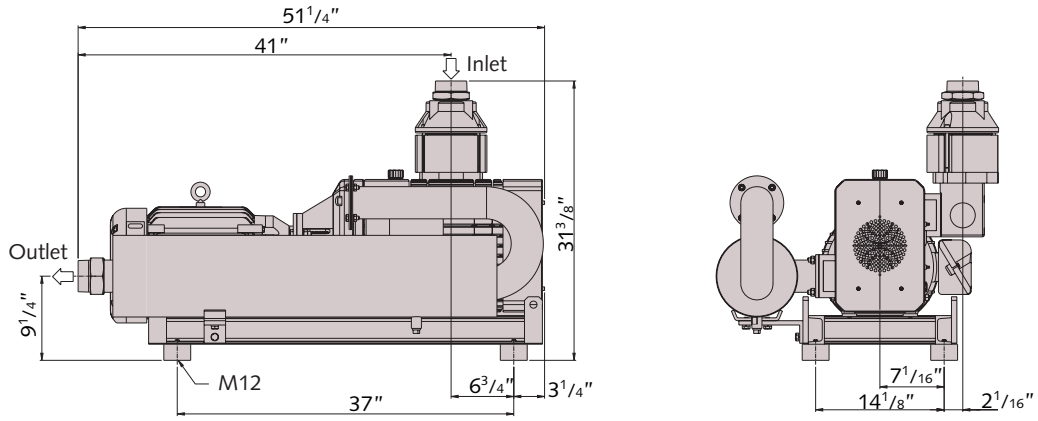
Pumping Speed vs. Discharge Pressure



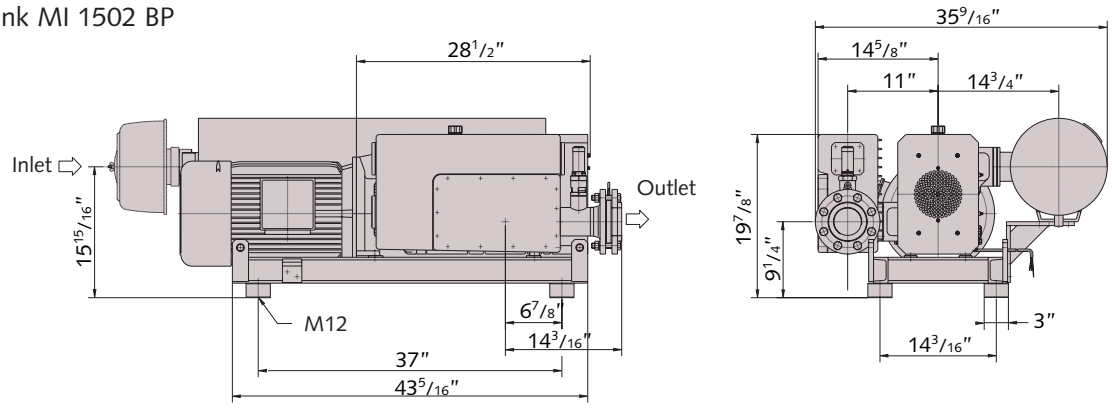
Technical Data Model MI		1502 BV	1502 BP
Nominal pumping speed	ACFM	325	-
Nominal pumping speed	SCFM	-	325
Free air displacement	CFM	376	376
End vacuum	"Hg	23.4	-
End vacuum	torr	165	-
Maximum Pressure	psig	-	29.4
Motor rating	HP	15	40
Motor speed	RPM	3600	3600
Approx. weight	Lbs	950	1350
Inlet pipe connection	Inches	3	3
Discharge pipe connection	Inches	3	3
Sound rating	dBA	85	87

Dimensions

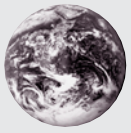
Mink MI 1502 BV



Mink MI 1502 BP



All dimensions in inches unless otherwise noted.



Busch - all over the world in industry

ISO 9001-2000 Registered Company

Busch, Inc. 516 Viking Drive Virginia Beach, VA 23452
Phone (757) 463-7800 FAX (757) 463-7407

www.buschpump.com
1-800-USA-PUMP

Amsterdam Barcelona Birmingham Basel Brussels Dublin Göteborg Helsinki Istanbul Copenhagen Kuala Lumpur Milan Maulburg Melbourne Montreal Moscow New York New Plymouth Oslo Paris San Jose São Paulo Seoul Singapore Taipei Tokyo Vienna

Appendix H

Abbreviated

Quality Assurance/Quality Control (QA/QC) Procedures (Indiana)

Quality Environmental Professionals, Inc.

1611 South Franklin Road
Indianapolis, IN 46239
Phone: 317.351.4255
FAX: 317.351.4265
800.400.9047
www.Qepi.com

Quality Environmental Professionals, Inc.

Abbreviated (QA/QC) Procedures

Table of Contents

Table of Contents

(Continued)

Quality Environmental Professionals, Inc.

Quality Assurance/Quality Control (QA/QC) Procedures

1. Field Preparation

1.a. Proper Field Note Procedures

Each project has an assigned, dedicated field book. The field book will contain the following information:

1. Name of the facility,
2. Address,
3. Telephone number,
4. Contact's name and phone number,
5. County in which the site is located,
6. Township,
7. Facilities SIC# or EPA# if applicable,
8. Name, address and phone number of the nearest hospital.

The index page will be in the front section of the field book. The index will include the page number and field work date along with a key word that describes the reason for the field work, such as, groundwater sampling, separate phase product removal, tank yank, well gauging, etc.

The procedure for taking field notes will be as follows:

- Each page must be numbered at the bottom center of the page

At the top of each page for each new field day will include the following information:

1. Date
2. Job #
3. Project/Client name
4. Time on site
5. Qepi personnel on site
6. Other personnel on site/time
7. Weather conditions:
   a. Wind direction,
   b. Cloud cover,
   c. Temperature, in °Fahrenheit
   d. Snowy,
   e. Rainy,
   f. Humid, etc.

Qepi personnel will log in all necessary information. Additionally Qepi's field notes will include:

1. What tasks were performed,
2. What was noticed,
3. Any problems and how any problems were rectified,
4. Who was on site and for what purposes.
5. When the Health and Safety Plan (HASP) was reviewed and by whom.
6. Correspondences and the reason for the correspondences.
7. Emergencies and/or accidents on site.

Qepi personnel will make sure that all boring log data will be entered in the field book. The following is the protocol for logging borings. The following information will be recorded:

- Boring #
- Soil type
- Location of boring
- Moisture
- Depth
- Munsell Color Code
- Blow counts
- % Clay content
- HNu reading

The depth at which groundwater is encountered will be recorded.

When taking field notes involving static water levels and/or conducting groundwater sampling, Qepi personnel will include the following information in the field book:

- Well Number
- pH
- Location of the well
- Electrical conductivity & temperature
- Static water level
- Well diameter
- Measuring point on well casing
- Well volumes purged
- Presence of any separate-phase product and thickness of product
- Recovery rate
- Dissolved Oxygen (DO)
- Surface elevation, if known

Qepi personnel understand the importance of taking detailed notes. No empty spaces will be left in the field book. If empty space is left for the purpose of logging additional information at a later time, as a result of extreme weather conditions or time restraints, Qepi personnel will record the pertinent information in the field book as soon as possible (same day). If additional lines are not utilized, our staff will cross through these blank lines and write "intentionally not used" followed by the individual's name.

- The bottom of each page will be signed and dated.
- All photos taken on site will be entered in the field book in the photo legend.

2. Proper Decontamination Procedures

Qepi uses the following decontamination (decon) processes when using a Teflon or stainless steel bailer at the site. The bailer will be washed in a Liquinox/water solution, rinsed with tap water; and followed by a final rinse with DI water. Since disposable bailers will generally be utilized by Qepi, the aforementioned decon will only be used for the pH probe, DO meters, and oil/water interface probes.

Qepi's decon kit includes the following:

- Several gallons of tap H_20
- Several gallons of DI H_20
- Liquinox soap
- 3 plastic 5-gallon buckets
- Scrub brushes, spray bottles, paper towels, visqueen,
- Isopropanol Alcohol
- DOT-approved 55 gallon, clean, labeled drums

2.a. Equipment Decontamination Protocol for Organics

1. Wash equipment with Liquinox soap
2. Rinse equipment with tap water
3. Rinse equipment with DI water

2.b. Equipment Decontamination Protocol for Inorganics

1. Wash equipment with Liquinox soap
2. Rinse equipment with tap water
3. Rinse equipment with dilute (0.1N) hydrochloric or nitric acid

4. Rinse equipment with reagent water

2.c. Decontamination Solutions for other Constituents

1. PCBs, PCP, pesticides, phenols (Methanol)
2. Oils, base neutrals, pesticides (Methylene Chloride)
3. Xylenes, PCBs, Chlorinated compounds (hexane)
4. Phenols, PCBs (acetone)
5. Oils, fatty materials (carbon tetrachloride)
6. Metals (nitric acid)
7. For other constituents, see site-specific Sampling & Analysis Plan (SAP)

All drilling and sampling equipment will be decontaminated between each boring to prevent cross-contamination. A decon pad will be constructed in a contamination free area. The ground will be lined with visqueen plastic sheeting.

A power sprayer, using potable water will be used to wash and clean the drill equipment (the augers and sampler barrels). All rinseate water generated will be collected in the decon pad sump area and pumped to 55-gallon drums, unless otherwise directed by the client.

Additionally, the continuous sampler barrels will be hand-scrubbed using Liquinox and water and rinsed first using potable tap water followed by a rinse of distilled, deionized water.

3. Soils Classification/Soil Sampling

3.a. Soil Field Classification System

The field classification system will allow Qepi's project person to determine the subsurface soil type. Qepi personnel will use matrix percentages as per the United States Department of Agriculture (USDA) for soil classification.

When classifying sands, particle size and shape will be noted for permeability application. This information will further assist in describing leaching/percolation.

During soil classification, Qepi personnel will note any staining or odors. Qepi personnel will field screen the soil for determination of total photo-ionizable vapors (TPV), (soil headspace gas). This information will be noted on Qepi's soil boring logs.

Soil boring investigations will be performed utilizing the best site-specific technology to complete

the investigation in a timely and efficient manner. All sampling activities, at a minimum, follow United States Environmental Protection Agency (USEPA), SW 846 Test Methods for Evaluating Solid Wastes, Physical and Chemical Methods, 3rd Edition; the ASTM Standards D2487-93 or D2488-93 Standard Test Methods for Classification of Soils for Engineering Purposes or Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).

3.b. Soil Sampling Methodology

Qepi uses the following equipment to auger soil borings and to collect soil samples.

- Hand Auger or Power Auger
- Soil Probe
- Geoprobe®
- Drill Rig

For shallow investigations in silts, silt loams, and clays (less than seven feet), a stainless steel hand auger, soil probe or power auger will be utilized to collect soil samples in one-foot intervals. For soil samples at depths greater than seven feet, a truck-mounted Geoprobe® and/or a drill rig will be utilized to collect the soil samples.

3.c. Shallow Soil Samples using Hand Auger or Soil Probe

The soil samples will be collected continuously with a stainless steel hand auger and/or a soil probe if the sampling depths are less than 10 feet. If the sampling depth is less than 10 feet, and the site has fine sands, a hand auger and/or soil probe may not be appropriate. If a hand auger/soil probe is used the soil sample will be collected using a bucket auger for the hand auger or a plastic liner for the soil probe. The soil will be obtained in one-foot intervals, with split samples for laboratory and/or field classification/screening activities. All soil will be classified as per the aforementioned protocol.

Soil samples will be field screened for soil headspace gas using a pre-calibrated HNu photo-ionization detector (PID) equipped with a 10.2 eV lamp. If a contaminant has an ionization potential outside the specified ranges, an 11.7 eV lamp can be substituted and/or an alternate detector, such as an Organic Vapor Analyzer (OVA) will be selected for a specific project. The protocol for soil sampling will be discussed below in the development of soil grids. These sampling activities will be supervised by a professional hydrogeologist as recommended by the USEPA Technical Environmental Guidance Document (TEGD).

3.d. Soil Boring Log

All surface and subsurface investigation activities will involve the preparation of Qepi boring logs. The following information will be entered on this log when classifying soils:

- Munsell Color Code
- Qepi field classification including:
  - ✓ Density
  - ✓ Relative Proportion
  - ✓ Particle size
  - ✓ Consistency (for clay or silty/sandy clays)
  - ✓ Plasticity (for clay or silty/sandy clays)
- Moisture
- If groundwater was encountered in the boring, and at what depth
- Any documentation of color changes or unusual odors (petroleum, solvent, etc.)
- Sample of Soil Description:
  - ✓ 10YR4/3brown, very fine, sub-rounded sand, trace of gravel, some silt, glacial in origin/outwash material, moist.
  - ✓ Using the Munsell Color Chart validates color consistently.

This information will be logged into the dedicated field book, and transferred to a boring log.

3.e. Soil Sampling

Proper soil sampling methodology will be used when collecting soil samples with a stainless steel spade, shovel, post hole digger, spatula, hand auger, or a driller's split spoon.

When using any of these tools, Qepi will decontaminate the equipment prior to field use. Qepi will document all decontamination activities. Qepi personnel will follow decontamination procedures described in Section 2.

Prior to initiation of sampling, Qepi personnel will wear the appropriate disposable gloves and auger down to the first sampling interval. When sampling the first five feet, Qepi will sample in one foot intervals. Qepi personnel will decon after each collected sample. Qepi will change gloves with each sample interval. Qepi personnel will place the soil obtained from each sample interval into labeled sample jars and secure the sample with a Teflon lid. The remainder of the sample will

be placed in a labeled, ziplock bag. Qepi will allow the collected sample to settle (approximately 15 minutes in spring, summer and fall) so that soil headspace gas can form, then the contents in the bag will be mixed by shaking. Next, the bag will be opened and a probe will be inserted to obtain a headspace reading. Qepi will log this information in the field book and on the boring log in parts per million vapor (ppmv). If sampling in the winter, Qepi will take headspace readings in a heated environment, and allow 45 - 60 minutes for sample bags to warm up.

An adequate number of soil borings will be augered to allow for the preparation of a minimum of two cross sections and/or a fence diagram per study area. IDEM requires that on each site at least three (3) borings must be continuously sampled to prepare cross-sections, IDEM requires that two (2) soil samples for borings less than 15 feet must be submitted for analysis. These samples will be the highest TPV reading, the one above the water table and/or the bottom of the boring.

The number and spacing between soil borings will be dependent upon the hydrogeological conditions encountered at the site. The cross sections will illustrate; surface and subsurface features, depths to water-bearing units and lithology. Standard geological terms and symbols will be used to describe the characteristics of the geological materials encountered.

3.f. Soil Screening Methodology

Soil samples presumed to be impacted with volatile organic compounds (VOCs) will be field screened for photo-ionizable vapors (TPVs) using a pre-calibrated HNu photo-ionization detector (PID) equipped with a 10.2 eV lamp. If a known contaminant has an ionization potential outside the specified ranges, an 11.7 eV lamp will be substituted and/or an alternate detector such as an OVA will be used.

Qepi will evaluate background ambient air readings and record these values as the background reference values for calibration checks. If the ambient background air readings should fluctuate more than 0.5 ppm, the instrument will be re-calibrated. Upon collection of a soil sample, the sample will be split and a portion of the sample will be immediately placed into a pre-cleaned jar with a Teflon-lined lid. The second portion of the soil sample will be placed into a "ziplock" type plastic bag for field screening purposes. The temperature of the soil sample inside the ziplock bag will be allowed to equilibrate with the ambient temperature and the sample will be screened with a pre-calibrated HNu or similar field screening instrument and recorded in ppmv in the field book and on the boring log. The soil vapor screening will assist in determining which samples should be submitted for laboratory analysis.

3.g. Soil Geotechnical Sampling

Soil samples obtained for geotechnical tests will include, but are not limited to: grain size distribution analysis, Atterberg Limits, hydrometer analysis, permeability, porosity, and bulk density readings.

3.h. Soil Sampling via Drill Rig

When soil borings are advanced using a truck-mounted drill rig, Qepi personnel will make sure that the driller's rig and all equipment are clean prior to the initiation of drilling operations. At least three borings on site will be continuously sampled using split spoon samplers, continuous sample barrels and shelby tubes. Standard split-spoon samplers will probably be used 90% of the time.

Once receiving the split spoon, Qepi personnel will open and screen the soil while its still in the split spoon. If soil headspace readings obtained are elevated above the background level, then Qepi will split the soil sample in half with one half being placed immediately in a Teflon jar and stored on ice under Qepi's chain of custody (C-O-C) procedure. The second half will be placed into a labeled zip-lock bag and be utilized for soil classification and soil headspace screening.

When calculating percentage of recovery, Qepi will never use the first six to nine inches of the soil in the sample barrel. This six to nine inches generally represents (trash) soil from the previous sampling interval. Qepi will obtain soil from the end of the spoon where the basket is for evaluation. If there is no observable HNu reading and no visible staining, Qepi will place all the soil in zip-lock baggies. Grab soil samples may be obtained for lab analysis at the ground surface.

After the soil is transferred to the laboratory jar, the samples will be placed inside a cooler containing ice for storage until transport to the analytical laboratory. Once received by the lab, the samples will be stored inside the lab's refrigerator under their COC.

3.i. Soil Disposal

Soil cuttings and fines generated during investigations will be placed into 55-gallon DOT-approved steel drums pending receipt of analytical results. Qepi will determine, via laboratory analytical results, whether the cuttings are special, generic or hazardous in nature. After receipt of analytical results, Qepi will coordinate the appropriate removal and disposal of all cuttings/fines generated.

4. Sediment Sampling Protocol

4.a Scope of Sediment Sampling

Sediments are those mineral and organic materials situated beneath an aqueous layer. The aqueous layer may either be static, such as lakes, ponds, or other impoundments, or in flowing water bodies such as rivers and streams. Sediment samples are collected to determine whether concentrations of specific contaminants exceed established threshold limits or if concentrations present a risk to human health or the environment.

4.b Sediment Sampling Methodology

Qepi uses the following equipment to collect sediment samples.

- Shovel
- Trowel
- Auger
- Ponar Grab

4.c Sample Collection of a Surface Sediment Beneath a Shallow Layer

Qepi collects surface sediment from beneath a shallow stream/pond using tools such as a spade, shovel, auger, and trowels or scoops. Once the material is removed from depth, Qepi personnel will utilize a stainless steel or plastic scoop to collect the sample. Qepi personnel will transfer the sample into the appropriate sample container.

4.d Sample Collection of a Deep Sediment Beneath a Shallow Layer

Qepi collects deep sediments from beneath a shallow stream/pond by using an auger and a tube sampler. Qepi personnel will auger boreholes to a desired sampling depth. The auger is then withdrawn and the auger tip is replaced with a tube core sampler. The tube sampler is lowered into the bore hole and driven into the sediment at the completion depth. The core is withdrawn and the sample within the core is collected.

4.e Sampling Surface Sediments Beneath a Deep Aqueous Layer

Qepi collects sediments beneath a deep aqueous layer by lowering a Ponar Dredge or Ekman Dredge with rope or cable. Qepi personnel lower the sampling device into the water body until sediment is encountered. The mechanism on the dredge is triggered and the device entraps sediment in the spring-loaded jaws. Once the sediment is encased in the dredge, Qepi personnel will raise the sampling device to the surface, allowing any free liquid to slowly decant through the top of the sampler. The sediments in the sampler will be transferred to a stainless steel or plastic bucket. Qepi personnel continue to repeat the ponar dredging process until the desired amount of sediment is collected. The sediment in the bucket is thoroughly mixed and the sediment sample is transferred in the appropriate container. If Qepi personnel are collecting a sediment sample for VOCs, the sample will be obtained directly from the bucket prior to

mixing the sediment.

4.f Sampling Subsurface Sediments from Beneath a Deep Aqueous Layer

Qepi collects subsurface sediment sample beneath a deep aqueous layer, using a sample coring device such as an auger. When the desired depth is reached, the sediment material is placed into a stainless steel or plastic bucket and mixed thoroughly. The sediment sample is obtained from this mixture and placed into the appropriate container.

5. Field Screening Protocol

5.a. Soil Gas Survey

In order to address data quality concerns at some sites, data collection procedures will be established prior to initiation of the survey. The use of either a pre-calibrated HNu PID or a pre-calibrated OVA will be the analytical device used to monitor any soil vapors encountered. The use of a gas chromatograph (GC) will be specified. A soil grid will be developed to minimize bias and to provide complete coverage of the site. The spacing of the grid will be site-specific although generally on a 25 foot by 25 foot grid and/or up to 100 foot by 100 foot grid. Several points outside the grid area will be sampled to establish background readings of soil vapors in ppmv. Some variance from the grid will be permitted where existing structures prevent sampling at specific grid points.

To make sure that a high level of precision is obtained using the Qepi methodology, a "calibration point" will be tested at regular intervals during the survey. The theory behind the calibration point is that the actual contaminant concentration at this point is constant and that variations in the daily soil vapor concentrations are due to variations in the environment, in the sampling procedure, and in the analytical instrument.

Qepi will use the following survey protocol to evaluate TPVs:

- Utilities will be screened at all sites.
- A specially designed clay tip will be used to auger the bore hole. If the power auger is used, then a reading will be taken every two feet.
- A retractable tip will be inserted into the borehole and driven an additional two inches to seat the tip in the ground.
- The probe shaft will be pulled back slightly (1 to 2 inches) to expose the slots in the retractable tip.
- After the retractable tip is in place, a pump will be connected to the probe shaft and the

system purged for a period of seven minutes. The system will be allowed to return to atmospheric pressure prior to recording any vapor concentrations.

- The pumping system is then removed and the TPVs are determined by obtaining an HNu-PID and/or OVA reading measurement from inside the probe shaft, with the highest measurement being recorded.
- If high TPVs are encountered, the probe will be advanced an additional three feet and another reading obtained.
- Finally, the probe system is removed from the ground and decontaminated using the appropriate decon protocol. The system is allowed to air dry and then tested with the HNu-PID and/or OVA prior to initiation of additional sample points.

6. Environmental Media Documentation

6.a. Chain of Custody

Qepi's C-O-C Form #158, must be submitted with all samples that are submitted for laboratory analysis. The form requests that the laboratory return the original C-O-C back to Qepi for documentation. The following information will be included on the C-O-C:

- Qepi personnel to receive the analytical results,
- The required date of analytical results,
- Qepi's job number,
- Project Name - i.e. Remediation Efforts
- The environmental program applicable to the site,
- Qepi's sampling representative,
- Sample ID number,
  - ✓ Date of sample
  - ✓ Time of sample
  - ✓ Composite sample (soil sample only)
  - ✓ Grab sample
  - ✓ Sample description
  - ✓ Groundwater
  - ✓ Stormwater

- ✓ Wastewater
- ✓ PCBs
- ✓ Soil
- ✓ Air

- Number of containers
- Analysis requested
- Remarks, (i.e. only could retrieve eight ounces of this sample. Run both BTEX and VOCs from the same vial).
- Upon relinquishing the samples to the laboratory, the temperature of the cooler and the date and time of the change of possession will be recorded in the appropriate sections of the COC. The laboratory representative will sign, date, time and record the cooler temperature upon acceptance.
- Qepi personnel will make sure that all information will be received by the date specified.

6.b. Sample Labeling

All samples will be identified by proper labeling to facilitate sample collection, changes in custody, and appropriate analysis. Each sample will be identified by affixing a pressure-sensitive gummed label on the sample container. The following information will be written on each label with a permanent black marker:

- Date
- Time of sample
- Sampler initials
- Description
- Sample number
- Analysis required
- Project number

When filling the laboratory sample bottles, the container will be filled to the top and every effort will be made to prevent trapping air at the top and exposure to the atmosphere will be minimized during sampling. The container cap will be screwed on tightly immediately after filling the sample container. Samples for VOCs will be checked to make sure that no headspace (air bubbles) are present in the sample container.

If on a CERCLA or RCRA site, Qepi will make sure that the top of each bottle will be sealed with Teflon tape, followed by a signed and dated custody seal. Waterproof tape will be placed over the sample labels. The properly labeled samples will be stored and transported to the approved laboratory at approximately 4° Celsius in iced coolers or other storage devices capable of maintaining this temperature.

6.c. Instrument Field Calibration

Field Quality Assurance Procedures will always include test instrumentation calibration as an essential part of the standard operation procedures. All field analytical procedures shall be conducted in duplicate, normally one in 20 samples. A record of these duplicate analyses will result in re-calibration of the instrument used or re-examination of the sampling location.

All field analyses must be traceable to the specific individual performing the analyses and to the specific equipment utilized. This information will be entered into the field logbooks for all field analyses performed by the sampling team.

7. Groundwater Purging/Sampling

7.a. Purging the monitoring well

Generally at least three well volumes will be removed during purging. However, checking the chemical properties of the water, such as specific conductivity and pH may reveal that purging is complete at less or more that three well volumes. Some sites can be sampled using the no-purge method.

If purging is required, place purge water in a labeled drum on-site pending analysis for proper disposal purposes. If the purge water from the monitoring well comes up silty, make a note to redevelop the well prior to the next sampling event.

The purging process is to make sure that all stagnant water is replaced by fresh formation water. The procedure for well purging depends on the hydraulic yield characteristics of the well. When evacuating low-yield wells (wells that are incapable of yielding three casing volumes such as silts and clays) it may be necessary to bail the wells dry. As soon as the well recovers sufficiently, the first sample will be tested for pH, temperature, dissolved oxygen and specific conductance. Samples will then be collected and containerized in the order of the sample's volatilization sensitivity. The well will be retested for pH, temperature, and specific conductance after sampling as a measure of the purging efficiency and as a check on the stability of the water samples over time. Whenever full recovery exceeds two hours, the sample will be collected as soon as sufficient volume is available for a sample.

Pumps can be used for purging the wells if sufficient time is allowed to let the water stabilize prior to sampling. Prior to removing any water, static water levels will be measured. Next, at least one or two bailers of water will be removed to check the pH, specific conductance and dissolved oxygen. All equipment will be deconned between each well, to prevent contamination. The appropriate gloves will be worn when sampling at each sampling site (well). Measures will be taken to prevent solids from coming in contact with the purging equipment and lines, which in turn could introduce contaminants to the well. Purged water will be collected and screened with an Hnu PID or an OVA, pH, temperature, and conductivity meters. If these parameters suggest that the water is contaminated, it must be drummed and properly disposed.

7.b. Obtaining Groundwater Samples

After the wells are purged, a disposable bailer will be lowered into the well slowly to retrieve a water sample. Qepi will place this sample into a clean glass jar and retest the pH and conductivity to make sure that well stabilization has occurred. When stabilization has occurred, Qepi personnel will collect all samples in properly labeled and sealed clean sample containers. Sample containers will be placed into an iced secured container. The temperature in the cooler will be between 1° -6° C and the cooler's temperature will be recorded in the field book at two hour intervals. Qepi personnel will include an extra one liter sample per well, in case of breakage of bottles in the field, or during transport to the laboratory.

When sampling for VOCs and benzene, toluene, ethylbenzene, xylene/methyl tertiary butyl ether (BTEX/MTBE) Qepi will be extra careful not to overfill and lose the preservative in the vials. These samples will not have any air bubbles present after filling the vial. Once filling the 40 ml vials, Qepi personnel will check for headspace by turning the vials upside down after filling to determine if any air bubbles are present. VOCs and BTEX/MTBE will be the first samples collected.

RCRA guidelines for groundwater sampling eliminates the need to field-filter groundwater samples for metals.

8. Lake & Surface Water Samples

8.a. Scope & Application

Water samples are obtained rivers, lakes, ponds, lagoons, and surface impoundments. They include samples collected from depth as well as sampling from the surface. Prior to collecting the surface water sample, Qepi personnel will determine the hydrology and morphometrics of the surface water body to be sampled in order to develop appropriate sample locations in relation to the flow patterns. Water quality data will be collected for dissolved oxygen, pH, and temperature to determine if stratification is present.

8.b Sampling Methodology

Qepi utilizes the following equipment to obtain surface water samples.

- Kemmerer bottle
- Bacon bomb sampler
- Dip sampler
- Direct Method
- Peristalic Pump

8.c Surface Water Sample Collection

Qepi personnel will collect surface water samples with sample devices constructed of glass, stainless steel, PVC or Teflon. The type of sample device is contingent upon the analysis required for the sample.

8.d Surface Water Sample Collection with Kemmerer Bottle and Bacon Bomb Sampler

Surface water collection with a Kemmerer bottle and Bacon bomb sampler are used when site access is from a boat or structure such as a bridge or pier and when samples at depth are required. The preset sampling device is lowered in the surface water body to the predetermined depth so as not to disturb the bottom sediment. Once the sampling depth is achieved, the sampling device is opened and closed. The sampler is brought to the surface and the first 10 to 20 mL are discharged to clear any potential contamination on the valve and the remaining water is transferred to the appropriate sample container.

8.e Surface Water Collection with a Dip Sampler

Qepi personnel will utilize a dip sampler for surface water samples when a sample is to be recovered from an outfall pipe along a lagoon bank where direct access is limited. The sampling device is extended to the sample location where the sample is to be obtained. The collected water sample is then transferred to the appropriate sample container.

8.f Surface Water Sample Collection Using the Direct Method

Qepi will use this method to obtain samples from streams, rivers, lakes, and other surface waters. The water sample will be collected by placing the sample container under the water with the sample container pointing upstream. Qepi will take precaution not to disturb

the substrate. The water will be collected by avoiding surface debris and boat wake, if applicable. During this sampling method, Qepi will utilize non-preserved sample bottles due to the dilution factor of preserved bottles when using this method.

8.g Surface Water Sample Collection Using the Peristaltic Pump

Qepi will utilize a peristaltic pump for a wide range of applications including streams, ponds, and containers. Using a peristaltic pump will allow both a lateral reach of the sampler and sampling from depth. Qepi will allow several liters of sample to pass through the sampling system prior to obtaining the actual sample. The sample collection will be achieved by allowing the pump discharge to flow gently down the side of the bottle so as to minimize entry turbulence.

9. Sampling Plans

The establishment of a continuing QA/QC program is to make sure of the reliability and validity of field and analytical laboratory data gathered as part of the overall groundwater monitoring program, is Qepi's responsibility. A plan must be prepared describing the QA/QC procedures that will be used in the field and laboratory. Qepi will use only approved commercial laboratories to conduct analysis of ground-water samples. The laboratory must exercise a proper USEPA QA/QC protocol.

9.a. Field QA/QC

Qepi can determine that proper field QA/QC is being completed by collecting and analyzing trip blanks. Since disposable bailers will be used, field blanks will not be necessary. Each time a group of bottles is prepared for use in the field, one bottle of each type (e.g. glass, fluorocarbon resin, polyethylene) will be selected from the batch and filled with deionized water. The sample blank will be transported to the sampling location and returned to the laboratory in a manner identical to the handling procedure used for the samples. These trip blanks will be subjected to the same analysis as the groundwater. Any contaminants found in the trip blanks could be attributed to:

- interaction between the sample and the container,
- contaminated rinse water, or
- a handling procedure that alters the sample analysis results.

The concentration levels of any contaminants found in the trip blank will not be used to correct the groundwater data. The contamination levels will be noted, and if the levels are greater than an order of magnitude when compared to the field sample results, then resampling of the groundwater will occur.
The trip blank will be prepared by filling one of each type of sample bottle with deionized

water. The trip blank(s) will be handled with the other samples during the course of the sampling event and will be returned to the laboratory for analysis. One trip blank per sampling event is required.

An equipment blank will only be necessary if Teflon or stainless steel bailers are used.

All field equipment will be calibrated prior to field use and deconned in the field before measuring each sample. The SAP will describe a program for making sure that field equipment is properly calibrated. Other QA/QC practices such as sampling equipment, decontamination procedures, and C-O-C procedures will also be described in the SAP.

9.b. Laboratory QA/QC Program

The laboratory SOP will provide for the use of standards, laboratory blanks, duplicates, and spiked samples for calibration and identification of potential matrix interferences. The laboratory should use adequate statistical procedures (e.g. QC charts) to monitor and document performance and implement an effective program to resolve testing problems (e.g., instrument maintenance, operator training). Data from QC samples (e.g. blanks, spiked samples) should be used as a measure of performance or as an indicator of potential sources of cross-contamination, but should not be used to alter or correct analytical data. These data should be submitted to the agency with the groundwater monitoring sample results.

9.c. Quality Assurance Project Plan

Qepi's QAPP will be prepared in accordance with Quality Assurance Procedures for RREL (EPA 1989d), Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans (EPA 1980) and IDEM's SW846 Contract Laboratory Program Technical Specifications. Qepi's QAPP include the following quality assurance objectives:

- Precision
- Accuracy
- Representativeness
- Completeness
- Comparability

Qepi's QAPP will include the following sections:

- A project description of the intended uses of the data and the necessary level of precision and accuracy
- Identify the QA/QC director and the QA/QC team and describe project responsibilities

- Discuss the methods and procedures to be used to evaluate the precision, accuracy and completeness of the data.
- Discuss the rationale used to validate the accuracy and precision of the data as representative of a population parameter sampling point, such as:
  - ✓ environmental conditions at the time of sampling
  - ✓ number of sampling points
  - ✓ representativeness of selected media
  - ✓ the representativeness of the selected analytical parameters
- Sampling Procedures
- Analytical Procedures and Calibration
- Description of how data sets are comparable, such as:
  - ✓ How was the RD/RA data generated?
  - ✓ Was data generated by an outside laboratory?
  - ✓ If data was generated by outside lab, who validated the data?
  - ✓ Will Qepi's data validation have access to these reports?
- Calculation of Data Quality Indicators
- Will specify the schedule of Quality Assurance Report
- Quality Assurance Control Reports will be generated and forwarded to IDEM on a quarterly basis during the RD/RA phase. This Quality Assurance Control Reports will include the following information:
  - ✓ Assessment of measurement, data accuracy, precision, and completeness
  - ✓ Performance Audits and results
  - ✓ System Audits and results
  - ✓ Quality assurance problems and recommended solutions
  - ✓ How the problems were resolved
- The result of Category IV QAPP will assist Qepi with remedy-screening treatability studies.

9.d. Sample Analysis/Data Validation

Depending on the application, Qepi can prepare a SAP in accordance with the USEPA Characterization of Hazardous Waste Sites "A Methods Manual Volume I Site Investigation", EPA/600/4-84/07, April 1985, Test Methods for Evaluating Solid Waste (EPA 1986) and A

Compendium of Superfund Field Operations Methods (EPA 1987b).

9.e. Sample Analysis & Validation

All data generated during an investigation will be validated. Each package of data, including C-O-C forms, traffic reports or analytical request forms, sampling location information, and laboratory results including laboratory qualifiers are to be entered into the Integrated Site Information System (ISIS) for sample management and tracking purposes. Analytical data generated by USEPA CLP laboratories was validated by USEPA Region V Laboratory Scientific Support Section (LSSS) according to protocols and procedures outlined in the Functional Guidelines.

A data quality summary will be prepared for quality control purposes. The following checks will be made of all data:

- Laboratory flags compared with the data
- "Useability" qualifiers added as appropriate to clarify the laboratory qualifiers
- Field blanks, trip blanks, and duplicate analytical results assessed, and data flagged with necessary qualifiers

A summary of the useability evaluation will be written and data summary tables prepared.

9.f. Data Management

The field sampling activities (Field/Non-NCLP Analysis and NCLP Analysis) will be completed. A management database will serve as a central repository for all project data, samples, analytical data, well completion data, and water level measurements-except boring logs.

10. Monitoring Wells

10.a. Installation of Monitoring Wells

The installation of monitoring wells will allow for characterization of water-bearing units on-site. The number, location and depth installed for groundwater monitoring wells will be dependent upon the site-specific hydrogeology. Qepi personnel will provide oversight and supervision of all drilling operations and monitoring well installations. Qepi personnel in charge for drilling oversight will be required to understand the Indiana Department of Natural Resources (IDNR) Indiana Code 25-39-1.5, more specifically 310 IAC 16-8-3 entitled Monitoring Wells.

Section 310 IAC establishes standards for monitoring wells in relationship to drilling. Key points to understand about monitoring well installation are:

- Monitoring wells with a nominal diameter of 3/4 of an inch, can be installed for monitoring groundwater levels only.
- No monitoring well less than one (1) inches can be used for the purpose of monitoring the quality of groundwater.
- Monitoring well casing shall meet the American Society of Testing Materials (ASTM) standards in regards to construction material requirements. These requirements are that the well materials must be clear and free of rust, grease, oil or contaminants and the well material must be centered in the borehole.
- Monitoring well casings finished at an elevation below ground surface must be equipped with a watertight locking cap. The top of the well casing shall terminate at a depth no greater than one (1) foot below ground surface.
- Monitoring wells installed at ground surface or less than one (1) foot below ground surface shall have a flush mounted protective cover pipe.
- The protective well cover must have a nominal diameter at least four (4) inches greater than the diameter of the monitoring well. The lid shall be clearly marked with the words "monitoring well" and display the words "do not fill".
- Granular bentonite can only be used to grout a monitoring well if the diameter of the borehole is four (4) inches or larger than the well and if the monitoring well is less than 25 feet deep.
- The annulus of the monitoring well shall be pressure grouted with neat cement or bentonite slurry.

10.b. Monitoring Well Development Protocol

- Wells will be developed at least 24 hours after installation and grouting.
- Wells will be developed using a pump, bailer or surge block.
- Well volumes will be calculated prior to developing wells.
- The appearance of the water prior to developing the wells will be described.
- At least 10 well volumes of water will be removed. The well will be developed until the water is free of silt.
- All development water will be containerized for proper disposal.

Qepi personnel will describe the following sampling technique in the field book.

1. the technique used for development purposes,

2. how much water was removed,
3. the description of the water before and after development,
4. the static water levels before and after, and
5. how the development water was disposed.

10.c. Installation of Monitoring Wells in Unconsolidated Materials

Qepi personnel have been trained on installation of shallow monitoring wells. Qepi personnel when installing a monitoring well less than 30 feet, will document the following information:

- Where water was encountered in the borehole?
- What type of sediments are present?
- What is the well to be utilized for?

10.d. Piezometers

Piezometers can be used to determine the configuration of the potentiometric surface at sites having confined conditions. Qepi will oversee the installation of piezometers. The piezometers will be installed using a truck-mounted or ATV-mounted Geoprobe® and/or drill rig. The piezometers will be constructed using small-diameter well screen and riser pipe. The length of riser and screen will be site-specific, and based upon the thickness of the water-bearing zone. The type of well construction materials utilized for the piezometers will be selected based upon chemical compatibility with the contaminants of concern. The piezometers will have watertight locking caps and either be flush mounted with traffic grade metals lids or have a steel casing/protective cover extending two feet above ground surface surrounded by brightly colored posts. Qepi will have the ground elevation and the top of the casing of each piezometer surveyed.

In addition to obtaining potentiometric surface data, piezometers can be utilized to obtain information on horizontal direction of groundwater flow, if three (3) or more piezometers are installed. Vertical head differences can be obtained using piezometer nests, if the nested piezometers are spaced within 10 feet apart and set at different depths, at least one shallow and one deep. At sites having low-permeable units, such as clay units, 2-inch piezometers can be utilized for determining hydraulic conductivity of the formation.

10.e. Abandonment of Monitoring Wells

Qepi personnel will oversee the abandonment of monitoring wells.

- Plugging material must consist of a neat cement with not more than 5% bentonite additive,

- Bentonite slurry, or
- Pelletized, medium-grade or coarse-grade crushed bentonite.

If the well is plugged using slurry it will be pumped into place using a tremie pipe. If pelletized materials are used it must be added and measured to make sure bridging doesn't occur. The well casing will be cut at least two feet below the ground surface and a cement plug larger in diameter than the well bore, will be constructed over the well bore.

Well abandonments will be reported to the Indiana Department of Natural Resources (IDNR) in writing within 30 days after plugging is completed.