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March 28, 2012

Mr. Christopher Black
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Corrective Action Section 2
Remediation and Reuse Branch, LU-9J
77 West Jackson Boulevard
Chicago, IL 60604-3590

RE: First 2011 Semiannual Monitoring Report, Chevron Cincinnati Facility, Hooven, Ohio

Dear Mr. Black:

Chevron Environmental Management Company (Chevron) is submitting the above referenced document to the United States Environmental Protection Agency (USEPA) in accordance with the November 1, 2006 Administrative Order on Consent between Chevron and USEPA and the December 13, 2007 *Operation, Maintenance, and Monitoring Plan for Final Groundwater Remedy, Chevron Cincinnati Facility (OMM Plan)*. This report summarizes the results of routine monitoring completed as part of final groundwater corrective measures implementation at the Chevron Cincinnati Facility for the period from January 1 through June 30, 2011. The following bullets provide a brief outline and summary of the findings in the attached report:

- Section 1.0 describes the purpose of the report and updates to the site conceptual model for the former refinery and off-site properties, including the processes acting to deplete the smear zone.
- Section 2.0 provides a summary of the infrastructure, methods, and results of monitoring activities conducted during the first semiannual monitoring period in 2011.
- Section 3.0 presents the qualitative and quantitative lines of evidence supporting the efficacy of natural attenuation mechanisms to degrade petroleum hydrocarbons across the smear zone. Data collected during the first semiannual monitoring period continue to demonstrate that the intrinsic processes in the saturated zone are degrading petroleum hydrocarbons. These same processes are reducing dissolved hydrocarbons to levels that are protective of sensitive receptors at the point of compliance boundaries.

Finally, this report summarizes the results of additional groundwater monitoring performed in the Southwest Quad. Localized changes in dissolved phase conditions were identified at the point of compliance boundary in the Southwest Quad in November 2008 with benzene reported in groundwater samples collected from sentinel monitoring well MW-35 and point of compliance well MW-133. These changes have been associated with alternate sources in the Southwest Quad that are unrelated to the former refinery. During groundwater monitoring performed in March and May 2011, low level

detections (parts per billion range) of benzene, ethylbenzene, and xylene were reported in groundwater samples collected from sentinel wells MW-35 and MW-131 as well as point of compliance well MW-120. Groundwater flow directions during these monitoring events were primarily from the west to the east following flood events, which is perpendicular to the typical flow direction, providing additional evidence that the source of the dissolved phase constituents in the sentinel and point of compliance wells is unrelated to releases from the former refinery. The smear zone and associated dissolved phase constituents attributable to releases from the refinery remain stable and there has not been redistribution of constituents following termination of continuous hydraulic control (i.e., year round pumping) following execution of the 2006 AOC.

If you have any questions regarding the enclosed documents, please contact me at (713) 432-2631 or Matt Mitchell at (513) 353-1323, ext. 23.

Sincerely,



Gene Choquette – Site Manager
Chevron Cincinnati Facility
Chevron Environmental Management Company

500-020-094

cc: Matt Mitchell, Trihydro

FIRST 2011 SEMIANNUAL MONITORING REPORT
CHEVRON CINCINNATI FACILITY
HOOVEN, OHIO

March 28, 2012

Project #: 500-020-094

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EXECUTIVE SUMMARY

This report presents results of the routine monitoring conducted by Chevron Environmental Management Company (Chevron) between January 1, 2011 and June 30, 2011 at the former Gulf Oil refinery situated approximately 20 miles west of Cincinnati, Ohio. Monitoring during this semiannual period was performed following the methods described in the *Remedy Implementation Plan for Final Groundwater Remedy, Chevron Cincinnati Facility (RIP, Trihydro 2007a)* and the *Operation, Maintenance, and Monitoring Plan for Final Groundwater Remedy, Chevron Cincinnati Facility (OMM Plan, Trihydro 2007b)*, in fulfillment of requirements provided in the 2006 Administrative Order on Consent (2006 AOC, Docket No. RCRA-05-2007-0001). Monitoring that was performed during the first 2011 semiannual period include:

- Fluid level gauging including continuous monitoring using pressure transducers as well as weekly, monthly, and bimonthly manual measurements to track hydraulic gradients and light non-aqueous phase liquid (LNAPL) occurrence
- Groundwater sampling to demonstrate dissolved phase plume stability and efficacy of monitored natural attenuation
- Lysimeter monitoring to collect data regarding precipitation infiltrate to assist in understanding electron acceptor flux into the upper portions of the saturated zone
- Rapid Optical Screening Technology (ROST) monitoring to confirm stability of the LNAPL at the lateral edge of the smear zone
- River monitoring to evaluate groundwater and surface water quality adjacent to, beneath, and within the Great Miami River

Monitoring results continue to demonstrate that the final groundwater remedy at the former refinery is progressing as anticipated and will meet remedial goals while ensuring that sensitive receptors remain protected. The United States Environmental Protection Agency (USEPA) has established performance monitoring criteria for remedies incorporating intrinsic natural attenuation processes (USEPA 1999, USEPA 2003). These performance monitoring criteria have been used to evaluate the progress of the final groundwater remedy at the Chevron Cincinnati Facility. Specifically the data collected at the Chevron Cincinnati Facility demonstrate the following:



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1. Dissolved phase natural attenuation indicators continue to demonstrate that intrinsic biodegradation is occurring within the saturated zone at the facility and off-site properties including Gulf Park. Nested vapor monitoring was not performed in Hooven or on the facility during the first semiannual period in 2011, in accordance with the schedule provided within the *OMM Plan* (Trihydro 2007b). Evidence of natural attenuation processes occurring in the vadose zone have been provided within previous semiannual reports, as well as the *Five-Year Groundwater Corrective Measures Implementation Review, Chevron Cincinnati Facility, Hooven, Ohio (Five-Year Review, Trihydro 2011b)*. Additional data demonstrating biodegradation processes within the vadose zone will be presented in the second semiannual report for 2011.
2. Dissolved phase data collected during the first half of 2011 continue to demonstrate that the concentrations of constituents of concern in groundwater are decreasing over time. Soil vapor, LNAPL, and soil core analytical results collected from the facility prior to 2011 also show a continued decrease in the smear zone mass and petroleum hydrocarbon concentrations over time.
3. Decreasing dissolved phase constituent trends are more pronounced at the margins of the smear zone compared to the interior portion of the plume. At its margins, the smear zone is thinner and LNAPL saturations are lower. In addition, groundwater enriched in electron acceptors intercepts the smear zone north of the facility and again to the southeast of the Buried Valley Aquifer-bedrock interface in Hooven creating a situation whereby petroleum hydrocarbons including benzene are attenuated more quickly along the margins than within the interior of the smear zone. These observations are consistent with the expectation of outside-in attenuation of petroleum hydrocarbons within the smear zone.
4. ROST and dissolved phase monitoring results verify that the LNAPL and dissolved phase plume were stable beneath the Southwest Quad and on the facility. Localized changes in dissolved phase conditions were identified at the point of compliance boundary in the Southwest Quad in November 2008 with benzene reported in groundwater samples collected from sentinel monitoring well MW-35 and point of compliance well MW-133. These changes have been associated with a localized release(s) in the Southwest Quad. Fluid level and groundwater monitoring results collected in the first half of 2010 confirm that constituents from the plume are not migrating to the point of compliance boundary. In March 2010, long-term operations and monitoring were reverted to the schedule outlined in the *OMM Plan* (Trihydro 2007b) following six months of monitoring with no additional detections of benzene in groundwater samples collected from wells MW-35 and MW-133. During groundwater monitoring performed in March and May 2011, low level detections (parts per billion range) of benzene, ethylbenzene, and xylene were reported in groundwater samples collected from sentinel wells MW-35 and MW-131 as well as point of compliance well MW-120. Groundwater flow directions during these monitoring events were primarily from the west to the east, which is perpendicular to the typical flow direction. Based on monitoring performed in the Southwest Quad, it is reasonable to conclude that the dissolved phase plume is stable

and there has not been redistribution of constituents following termination of continuous hydraulic control (i.e., year round pumping) following execution of the 2006 AOC.

5. Dissolved phase monitoring conducted along the west bank of the Great Miami River showed that constituents of concern present in the smear zone are not migrating beneath the partial penetrating barrier wall. The surface water screening standards were not exceeded in any of the hyporheic or surface water samples collected during the first half of 2011 and sensitive receptors along the river bank remain protected.

1.0 INTRODUCTION

Chevron is performing final groundwater corrective measures implementation and monitoring of the remedy performance at the former Gulf Refinery located approximately 20 miles west of Cincinnati, Ohio, near the intersection of Ohio State Route 128 and US Highway 50 as shown on Figure 1-1. The groundwater remedy was designed to be protective of human health and the environment, with the long-term objective of reducing dissolved phase hydrocarbon concentrations to meet groundwater cleanup standards. Achieving this objective was estimated to take up to 42 years; therefore, the following interim objectives have been adopted for the groundwater remedy:

- Monitor soil vapor concentrations and prevent migration of volatile petroleum hydrocarbons into indoor air above risk based limits
- Measure the stability of LNAPL and dissolved phase petroleum hydrocarbons
- Remove recoverable LNAPL to agreed upon end-points
- Stabilize the west bank of the Great Miami River to prevent erosion of soils containing petroleum hydrocarbons

Groundwater remediation and monitoring efforts are being conducted in accordance with the 2006 AOC between Chevron and the USEPA (Docket No. RCRA-05-2007-0001). The primary components of the groundwater remedy specified in the 2006 AOC include:

- Re-establishment of natural hydraulic conditions beneath the facility, Hooven, and off-site properties to the southwest (commonly referred to as the Southwest Quad) through discontinuance of year round groundwater recovery (although, as subsequently discussed, hydraulic containment via groundwater extraction from the production wells situated along the facilities eastern boundary were performed from March 2009 until March 2010)
- Focused LNAPL removal during periods of extreme low water table conditions through high-grade pumping over the next decade
- Combined operation of the horizontal soil vapor extraction (HSVE) system beneath Hooven with high-grade recovery (though the USEPA ordered discontinuance of the HSVE system between December 2007 and October 2009 while soil vapor monitoring was conducted by the USEPA Superfund Technical Assessment & Response Team)
- Continued seasonal operation of the Gulf Park biovent system during low water table conditions

- Engineered stabilization of the bank of the Great Miami River at the former refinery and Gulf Park to prevent erosion of soil containing petroleum hydrocarbons
- Long-term monitoring of natural source zone attenuation including dissolved and vapor phase biodegradation

A fundamental concept of the final groundwater remedy is the continued stability of the LNAPL and dissolved phase petroleum hydrocarbons. The majority of recoverable LNAPL has been removed beneath the former refinery and off-site properties over the past two decades. This is especially true in the upper and middle reaches of the smear zone, where LNAPL saturations are low. High-grade recovery is intended to focus on remaining LNAPL removal within the lower reaches of the smear zone and portions of the smear zone with the highest remaining LNAPL saturations. However, it is understood that the long-term remedy objective will be accomplished primarily through natural attenuation processes that drive contaminant degradation and removal over time.

A detailed discussion of the objectives and activities to be conducted to achieve the groundwater remedy goals are described in the documents titled *RIP* (Trihydro 2007a) and the *OMM Plan* (Trihydro 2007b).

1.1 SUMMARY OF SITE CONCEPTUAL MODEL

A detailed site conceptual model (SCM) for groundwater was presented in the *Five-Year Review* (Trihydro 2011b). A summary of the SCM is provided herein including updates made using assessment and routine monitoring results collected during the first half of 2011. Figure 1-2 shows a diagrammatic SCM for the facility, Hooven, and Southwest Quad.

Refinery operations at the former Gulf Oil refinery began in 1931. Chevron acquired Gulf Oil Company in 1985 and that same year, an oily sheen was observed on the Great Miami River along the southeast portion of the facility. Hydraulic containment measures were implemented to minimize migration of petroleum hydrocarbons off-site. The refinery ceased production in 1986 and the refinery infrastructure was subsequently dismantled. Interim measures performed at the facility since early 1985 focused on hydraulic control of LNAPL and dissolved phase petroleum hydrocarbons by continuously extracting groundwater and creating inward hydraulic gradients. These measures were expanded to include excavation of refinery related wastes; soil vapor extraction and six-phase heating beneath the Islands; bioventing beneath Gulf Park; and operation of the HSVE system designed to remove hydrocarbons beneath State Route 128 and Hooven. Remediation activities have recovered more than four million gallons of LNAPL.

1.1.1 SETTING

The former refinery is situated in a glacial valley incised into Ordovician-age shale and partially filled with glacial outwash and fluvial deposits of the Great Miami River (Spieker and Durrell 1961, Spieker 1968, Watkins and Spieker 1971). The fluvio-glacial aquifer ranges from approximately 20 to 100 feet thick, is composed of dominantly coarse sediment, and is referred to as the Great Miami Buried Valley Aquifer. An upward fining sequence is present in areas along the riverbank and flood plain on the former refinery. In addition, a clayey-silt layer is exposed at the ground surface in the western portion of Hooven with a thickness of at least 10 feet along the western edge of town. This layer serves as an apparent aquiclude with runoff flowing eastward over the shallow aquiclude before descending towards the groundwater table and joining regional flow.

The Buried Valley Aquifer pinches out beneath the western portions of Hooven (west of monitoring wells MW-113 and MW-129). Saturated sediments were not observed during installation of monitoring well MW-130 despite there being a high water table present when this well was installed in the spring of 2005. This soil boring was installed approximately two feet within the weathered portions of the Ordovician-age shale bedrock at a total depth of 65 feet below ground surface. Monitoring well MW-130 is located approximately 325 feet west of well MW-129.

Groundwater within the Buried Valley Aquifer generally flows from north to south, although episodic flooding tends to result in redirection of the flow to the east for periods ranging from days to weeks dependent on the magnitude of the flood event. This redirection of flow can affect dissolved phase concentrations measured in the point of compliance and sentinel monitoring wells in the Southwest Quad. Dissolved phase constituents associated with alternate sources in the Southwest Quad that are typically down- and cross-gradient, have been measured in groundwater samples collected from these wells following seasonal flooding events, when flow conditions are redirected.

A partially penetrating sheet pile wall was installed at the facility as part of the riverbank stabilization measures between September and December 2008. The partial penetrating wall does not affect horizontal flow conditions (i.e. flow direction primarily parallel to the river bank) within the Buried Valley Aquifer under ambient conditions. However, as designed, communication between groundwater and surface water has been dampened locally near the barrier wall during periods of increasing or decreasing discharge within the Great Miami River.

1.1.2 SOURCE

Refinery operations terminated in 1986, and the distribution of LNAPL stabilized as gravity and capillary forces approached equilibrium. Vertical smearing of the LNAPL occurred over time as a result of seasonal fluctuation of the water table, leaving some LNAPL within the pore spaces below and above the water table. The top and bottom of the

“smear zone” are roughly coincident with the historic high and low groundwater elevation. Therefore, some smear zone is exposed above the water table, even during periods of seasonal high groundwater, although the maximum exposure of LNAPL occurs during low water table events. The thickness of the smear zone generally increases from inches at the plume periphery, to as much as 20 feet in locations of the production wells. The depth to the top of the smear zone varies across the site, from as little as 10 feet near the Great Miami River, to approximately 30 feet across most of the former process areas and tank farms, 40 feet beneath the Southwest Quad, and up to 60 feet under the town of Hooven.

Petroleum hydrocarbon liquids are a mixture of individual constituents from many families, including aliphatics, aromatics, paraffins, isoparaffins, olefins, and naphthalenes. Each constituent has somewhat different physical, chemical, and toxicological properties. Some of these constituents are sufficiently toxic to pose a potential human health risk via dermal contact, ingestion, and inhalation if present at sufficient concentration. In the area adjacent to the distribution of LNAPL, some hydrocarbons dissolve in groundwater and migrate as solutes in the aqueous phase. Volatilization from LNAPL or dissolved phase hydrocarbons can produce vapors in the unsaturated zone immediately above the water table.

1.1.3 PLUME STABILITY

A fundamental concept of the final groundwater remedy is the continued stability of LNAPL and dissolved phase petroleum hydrocarbons. The majority of recoverable LNAPL has been removed from beneath the former refinery and off-site properties over the past two decades. This is especially true in the upper and middle reaches of the smear zone, where LNAPL saturations are low. High-grade recovery is intended to focus on removal of LNAPL within the lower reaches of the smear zone and portions of the plume with the highest remaining LNAPL saturations. However, it is understood that the long-term remedy objective will be accomplished primarily through natural processes that drive contaminant degradation and removal over time.

The LNAPL and dissolved phase plume boundaries are generally coincident at the up-gradient and lateral edges of the smear zone (i.e., western limit in Hooven and eastern limit along the Great Miami River), where dissolved phase petroleum hydrocarbons are generally indicative of LNAPL within the smear zone. Whereas, in the primary flow direction towards the south, a dissolved phase “halo” extends approximately 100 to 200 feet down-gradient from the LNAPL plume boundary.

Dissolved phase plume stability is expected to continue over the long-term, however, it was anticipated that some re-distribution of dissolved phase hydrocarbons would occur at the down-gradient edge of the plume after discontinuance

of hydraulic pumping that was performed as part of the interim measures for more than two decades. Dissolved phase plume stability was expected to become re-established during the first few years after pumping was discontinued.

Detections of dissolved phase benzene in samples collected from the sentinel well MW-35 and point of compliance well MW-133 were observed in 2008 and 2009. Dissolved phase benzene was not measured in any of the monthly groundwater samples collected from these two wells from September 2009 through the end of 2010. The detections of benzene in groundwater are not believed to be associated with re-distribution of the dissolved phase hydrocarbons associated with the former refinery at the southern limits of the plume. The benzene detected in these two wells was likely derived from an alternate source in the Southwest Quad, as the measured dissolved phase concentrations did not follow trends that would be expected if constituents were migrating down-gradient from the smear zone limits to the point of compliance well. Subsequent detections of dissolved phase constituents within the sentinel and point of compliance network have been attributed to alternate sources in the Southwest Quad as a result of redirection of hydraulic gradients following seasonal flooding of the Great Miami River.

The primary driver for plume stability is believed to be active biodegradation along the boundaries of the smear zone (i.e., up- and down-gradient limits of the smear zone, lower reaches of the smear zone within the saturated zone, and upper contact of the smear zone within the unsaturated zone). Most petroleum hydrocarbons are readily degradable by soil microorganisms in the presence of oxygen (O_2), a process referred to as aerobic biodegradation. Petroleum hydrocarbons are also degraded by soil microorganisms in the absence of O_2 via anaerobic respiration, but generally at a slower rate compared with aerobic degradation.

The pathway for migration of petroleum hydrocarbons in soil vapor into structures located in Hooven and the Southwest Quad is considered incomplete. Soils within the vadose zone to the west of the refinery are predominantly sand and gravel, which allow water to drain relatively freely; therefore, the pore-spaces are mostly air-filled, which provides a pathway for vapor migration. The migration of hydrocarbon vapors from the vapor source at depth is retarded by biological degradation where soil microbes metabolize hydrocarbon vapors as a source of energy. Beneath Hooven, where the vadose zone is nearly 60 feet thick, the hydrocarbon vapors are generally reduced through aerobic biodegradation, where O_2 in the atmosphere diffuses down into the unsaturated zone and is reduced along with the petroleum hydrocarbon vapors. Alternate sources are present in the vadose zone from surface releases of petroleum and non-petroleum related constituents in the Southwest Quad and Hooven. These releases affect the vertical profile of constituents of concern and fixed gases through utilization of O_2 and mixing of vapors within the shallow and intermediate portions of the vadose zone.

Microbiological degradation can also occur in the absence of O₂, where secondary oxidizers such as iron, manganese, sulfate, nitrates, and carbon dioxide (CO₂) are reduced, with the reduction of CO₂ resulting in the production of methane (CH₄). The CH₄ will subsequently diffuse upward and is generally degraded at shallower intervals where O₂ concentrations are sufficient. Anaerobic degradation is typically observed in the deeper intervals above the LNAPL and dissolved phase plume; however, anaerobic conditions can persist in the intermediate portions of the vadose zone during seasonally low water table conditions if alternate sources of petroleum hydrocarbons are present in the shallow subsurface and are utilizing available O₂.

Biodegradation is a primary driver not only for stability of vapor and dissolved phase petroleum hydrocarbons, but also for hydrocarbon mass reduction throughout the smear zone. Aerobic and anaerobic processes reduce petroleum hydrocarbon mass and concentrations in the dissolved and vapor phase. Whenever O₂ is available, aerobic biodegradation processes predominate. Aerobic degradation processes are the dominant mechanism for reductions in petroleum hydrocarbon concentrations in the plume periphery. Within the interior portions of the plume where atmospheric and dissolved O₂ is depleted, anaerobic biodegradation processes will tend to dominate. These anaerobic processes are expected to continue in portions of the smear zone where secondary oxidizers are available, given the relatively consistent supply of petroleum hydrocarbons (i.e., source of carbon) from the smear zone.

1.1.4 RECEPTOR

Receptors that have the potential to be affected by LNAPL and dissolved phase petroleum hydrocarbons include residents within Hooven, commercial workers in businesses situated in Hooven and the Southwest Quad, sensitive ecological communities along the Great Miami River, visitors and workers employed in remedy support and redevelopment activities on the former refinery, and trespassers coming onto the facility property. As the groundwater beneath the facility, Hooven, or Southwest Quad is not used for drinking purposes or secondary uses (e.g., irrigation, bathing, etc.) ingestion and dermal contact with dissolved phase petroleum hydrocarbons associated with the former refinery will not occur. Administrative and engineering controls, as well as personal protective equipment, will be used as appropriate to prevent site workers and visitors from potential unacceptable levels of exposure to LNAPL or dissolved phase petroleum hydrocarbons during subsurface disturbance associated with future redevelopment on the former refinery. Bank stabilization measures along the Great Miami River prevent soil containing petroleum hydrocarbons from eroding into the river or the discharge of dissolved phase petroleum hydrocarbons to surface water.

With respect to vapor intrusion, the receptor would be any occupant of a building on the former refinery, in Hooven, or to the southwest if vapors coming from the smear zone or dissolve phase plume entered that building at concentrations that pose a potential health risk. If soil vapors diffuse within the “zone of influence” of a structure without degrading,

they will become available to be transported into the structure via advection and convection through drains, cracks, utility entrances, sumps, or other permeable discontinuities in the building floor or basement walls. Wind load on the side of a building, barometric pressure changes, HVAC system operation, or temperature differences can all contribute to building depressurization that can drive advection. Most of these processes are reversible, so gases generally flow into and out of buildings under varying conditions. Atmospheric air also enters buildings through doors, windows, and small openings. The rate of air exchange in buildings typically reduces soil vapor concentrations by a factor of 100 to 10,000 (Johnson 1999), depending on building design, construction, use, maintenance, soil conditions, weather conditions and other factors.

The vapor intrusion pathway in Hooven was demonstrated to be incomplete during the subsurface investigation completed in 2005, through characterization of the petroleum hydrocarbon source, soil vapor, and migration pathway (Trihydro and GeoSyntec 2005). In addition, soil vapor data collected from the nested monitoring wells from 1997 to 1999 and following the 2005 investigation have also indicated vapors from the plume are not migrating from the smear zone to indoor air within the residences, businesses, or former elementary school at concentrations sufficient to pose an unacceptable excess health risk (Trihydro and GeoSyntec 2008). It should be noted that the Hooven Elementary School was closed prior to the start of the 2011-2012 academic year and converted into a community resource center. In portions of the Southwest Quad overlying the smear zone, commercial structures were constructed with a passive vapor barrier beneath the slab as a protective measure for inhibiting migration of vapors into the building, if present. Two independent investigations performed between 2008 and 2009 by the USEPA and Chevron confirmed that the vapor intrusion pathway is incomplete beneath Hooven and the Southwest Quad even under worst-case conditions (i.e., high-grade recovery exposing the lower portions of the smear zone without operation of the HSVE system), and there is not a health risk to any occupants within homes, businesses, or the former school associated with the smear zone or dissolved phase constituents beneath the community (Trihydro and GeoSyntec 2010).

1.1.5 ALTERNATE SOURCES

There are multiple potential alternate sources of LNAPL, vapor phase, and dissolved phase petroleum hydrocarbons within proximity of the former refinery. These include a former service station (currently a non-commercial automotive service center) located directly north of the facility, former operations at the Dravo Corporation sand and gravel quarry including diesel and gasoline underground storage tanks removed in 1991, the Kroger gasoline and diesel service station, underground storage tanks removed at the Hooven Elementary School and Hooven Fire Station, dry wells installed in the Southwest Quad, the Whitewater Reclamation (formerly Golsch) construction and demolition landfill, an asphalt production plant, a gravel quarry, railroad operations, surface releases associated with vehicles travelling on Ohio State Route 128 and United States Highway 50, surface releases from vehicles located in parking

lots across the Southwest Quad, commercial businesses (e.g., automotive repair, long-haul trucking, and construction lay down yards) located within Hooven and the Southwest Quad, as well as local point sources associated with residential, municipal and commercial activities in the Southwest Quad and Hooven. In addition, each of the residences and other occupied structures in Hooven maintained an individual septic system to treat wastewater prior to extension of a municipal sanitary sewer system into the community in 2006. Several studies including DeWalle et al. (1985) and Conn and Seigrist (2009) have documented releases of volatile petroleum related constituents from septic systems.

Volatile petroleum hydrocarbons are ubiquitous in indoor and outdoor air from many sources, including industrial and commercial operations, automobiles, combustion sources (e.g., gasoline, fuel oil, natural gas, etc.), combustion byproducts (e.g., diesel, wood, coal, candles, etc.), water treatment chemicals and byproducts, a variety of different consumer products, small power tools, tobacco smoke, glues, household cleaners, carpeting, and furniture. Indoor air often contains measurable concentrations of volatile and semivolatile constituents from household activities, consumer products, building materials, furnishings, and outdoor air sources. Volatile petroleum and non-petroleum related constituents associated with ambient sources unrelated to the former refinery have been measured in outdoor air samples collected during routine monitoring in Hooven and on the former refinery since 2004. Residential and commercial areas can also have shallow releases of hydrocarbons to the subsurface from sources similar to those described above. Therefore, hydrocarbon vapors are present in the vadose zone and indoor air in Hooven and the Southwest Quad associated with alternate sources.

1.2 PURPOSE

The primary purpose of this report is to provide a summary of the operations and monitoring conducted in accordance with the 2006 AOC, *RIP* (Trihydro 2007a), and *OMM Plan* (Trihydro 2007b) from January 1, 2011 to June 30, 2011. This report will also provide a summary of additional assessment and operational activities performed during the first half of 2011. The *Second 2010 Semiannual Monitoring Report, Chevron Cincinnati Facility, Hooven Ohio* (*Second 2010 Semiannual Monitoring Report*, Trihydro 2011a) provided the results of high-grade recovery operation completed between July 2010 and February 2011 including performance of the HSVE systems during the event. The *Second 2010 Semiannual Monitoring Report* also described the results of the biovent system operations conducted in Gulf Park during the first quarter of 2011. A summary of remedial systems operation and monitoring performed in the first half of 2011 are not included herein since these data have already been provided to the USEPA. The remainder of this report is organized into the following sections:

- Section 2.0 – Describes the infrastructure, methods, and results of monitoring activities conducted during the first semiannual reporting period in 2011.
- Section 3.0 – Presents the preliminary qualitative and quantitative lines of evidence supporting the efficacy of natural attenuation mechanisms to degrade petroleum hydrocarbons within the smear zone.

2.0 MONITORING NETWORK AND RESULTS

The primary component of the final groundwater corrective measures program is routine monitoring to evaluate the progress towards meeting the interim and long term remedy objectives. The monitoring network has been established to meet multiple performance and compliance monitoring criteria including collection of data to support remedial system operation; confirmation of high-grade pumping and HSVE system effectiveness; determination of compliance at boundaries where sensitive receptors are present; and evaluation of natural attenuation mechanisms. For the purpose of this report, monitoring has been divided into the following activities:

- Fluid level gauging including continuous monitoring using pressure transducers as well as weekly, monthly, and bimonthly manual measurements
- Groundwater sampling to demonstrate dissolved phase plume stability, protection of sensitive receptors, and efficacy of monitored natural attenuation
- Lysimeter monitoring to collect data regarding precipitation infiltrate to assist in understanding electron acceptor flux into the upper plane of the smear zone
- ROST monitoring to confirm stability of the LNAPL plume at the lateral edge of the smear zone
- River monitoring to evaluate groundwater and surface water quality adjacent to, beneath, and within the Great Miami River

The following sections describe the results of monitoring conducted to support the groundwater remedy between January 1 and June 30, 2011. A description of the methods used for installation, monitoring, and analysis have been previously described within the *RIP* (Trihydro 2007a) and *OMM Plan* (Trihydro 2007b). Additional information pertinent to these activities is described herein when deviations from these plans was necessary.

2.1 FLUID LEVEL MONITORING

Pressure transducers are generally deployed across the monitoring well network listed on Figure 2-1 to evaluate rapid fluctuations in hydraulic conditions across the facility. The pressure transducers are relocated as the goals of short term monitoring change such as during flood events or high-grade recovery. Transducers log groundwater elevations on a daily or more frequent basis. Groundwater elevation data recorded using pressure transducers are provided in Appendix A.

Pressure transducers were deployed during a portion or all of the first semiannual monitoring period in an expanded network (including wells MW-17, MW-20S, MW-21, MW-26R, MW-35, MW-44S, MW-56, MW-62, MW-81S,

MW-88, MW-94S, MW-96S, MW-98S, MW-112, and RBGP-44) across the site, Hooven, and Southwest Quad. Transducers were relocated in March 2011, as groundwater elevations rebounded above trigger elevations at the end of high-grade pumping event and as various production wells were shut-down. Pressure transducers were cleaned and reset within monitoring wells MW-19, MW-20S, MW-26R, MW-35, MW-44S, MW-48S, MW-79, MW-94S, MW-96S, MW-104S, MW-112, MW-131, MW-132, and RBGP-44.

Manual fluid level gauging is conducted on a bimonthly basis in each of the shallow monitoring wells located on the facility, Hooven, Southwest Quad, and Gulf Park. In addition, fluid levels are gauged weekly in select groundwater monitoring wells and river bank gauging point RBGP-44 located along the west bank of the river. Weekly gauging in these wells is conducted to supplement the bimonthly fluid level measurements in tracking trends in river and groundwater table elevations, as wells as LNAPL thickness.

Appendix B provides manual fluid level gauging data collected during the first half of 2011. Potentiometric surface maps for January, March, and May 2011 generated using data collected during bimonthly monitoring are provided as Figures 2-2 through 2-4. As shown on the January 2011 potentiometric surface map, groundwater flow was predominantly towards production well PROD_25 during high-grade recovery within the central portion of the facility. In contrast, groundwater flow during March was primarily from the west to the east, which is perpendicular to the typical flow direction, with some component of flow from the south to the north. There was an approximate 10-foot decrease in groundwater elevations observed across the Southwest Quad in the days preceding the March bimonthly fluid level gauging event. This rapid reduction in the groundwater elevations and redirection of groundwater flow towards the east was attributed to a return to ambient conditions following flooding events in early March 2011. Groundwater flow in the Buried Valley Aquifer was generally to the south to southeast during the May 31, 2011 bimonthly gauging event.

2.2 DISSOLVED PHASE MONITORING

Dissolved phase monitoring is conducted at the facility, Hooven, and Southwest Quad to assess plume stability, evaluate natural attenuation within the saturated portions of the smear zone, and measure performance of the final groundwater remedy. Groundwater samples are analyzed for the constituents of concern including benzene, ethylbenzene, toluene, total xylenes, chlorobenzene, arsenic, and lead. Benzene is the constituent most frequently reported in groundwater samples above remedial objectives, with historic concentrations as high as 13 milligrams per liter (mg/L); therefore many of the analyses conducted as part of the final remedy monitoring focus upon benzene depletion within the smear zone. Dissolved phase benzene is not generally detected more than 200 feet outside the LNAPL smear zone due to intrinsic biodegradation at the plume periphery.

Groundwater samples are also collected from selected wells for analysis of natural attenuation indicators including alkalinity, total calcium, total chloride, chemical oxygen demand, ferric iron (Fe^{3+}), ferrous iron (Fe^{2+}), total iron, dissolved manganese, total manganese, CH_4 , nitrogen, nitrogen as ammonia, nitrate, nitrite, total potassium, total sodium, sulfate, sulfide, and total organic carbon.

Field forms for groundwater samples collected between January and June 2011 are included in Appendix C. Laboratory analytical reports for groundwater samples collected during the first 2011 semiannual monitoring period are provided in Appendix D-1. Data validation reports for each of the analytical packages provided by the laboratory are provided in Appendix D-2. It should be noted that, Analytical Laboratory Services (ALS) located in Cincinnati, Ohio began analyzing groundwater and soil samples collected at the Chevron Cincinnati Facility beginning in 2011, following approval from the USEPA. The analytical summary reports provided by ALS and included in Appendix D-1, reference the laboratory reporting limits rather than the method detection limits. The method detection limits have been referenced on the summary tables and figures included within previous semiannual monitoring reports and remain so herein. Both the laboratory reporting limits (as listed on the analytical summary reports) and the method detection limits (included in the electronic data deliverable as well as the summary tables and figures) are below remedial goals for this project (USEPA MCLs).

The following subsections present the results of dissolved phase monitoring conducted between January and June 2011.

2.2.1 SENTINEL AND POINT OF COMPLIANCE MONITORING

There are three sentinel wells (MW-35, MW-131, and MW-132) and four point of compliance monitoring wells (MW-37, MW-120, MW-133, and MW-134) located at the down-gradient edge of the dissolved phase plume in the Southwest Quad. The sentinel and point of compliance monitoring networks are presented on Figure 2-5.

Groundwater samples were collected from the sentinel and point of compliance monitoring wells during May 2011, as part of semiannual monitoring activities in accordance with the schedule described in the *OMM Plan* (Trihydro 2007b).

Groundwater analytical results for the dissolved phase constituents of concern are provided on Table 2-1 and Figure 2-6. Groundwater samples collected in March from wells MW-35 and MW-120 had low detections (less than 2.0 parts per billion) of ethylbenzene and xylene well below the USEPA Maximum Contaminant Levels (MCLs). In addition, benzene was reported at 7.8 parts per billion in the groundwater sample collected from sentinel well MW-131 on May 16, 2011. Benzene was not reported above the detection limit within the groundwater sample collected from the corresponding point of compliance monitoring well MW-37. In accordance with the 2006 AOC and corresponding *OMM Plan* (Trihydro 2007b), groundwater samples were re-collected from the sentinel well MW-131 and the down-

gradient point of compliance wells MW-37 on June 1 and June 2, 2011, respectively. Benzene was not detected above laboratory reporting limits in the groundwater samples collected in June from the sentinel well MW-131 or point of compliance well MW-37.

Dissolved arsenic was detected in samples collected from sentinel well MW-131 during the June 2011 resampling at a concentration of 0.020 mg/L. As reported in the *Evaluation of Background Metal Concentrations in Ohio Soils* (Cox-Colvin & Associates, Inc. 1996) and the *Closure Plan Review Guidance for RCRA Facilities* (OEPA 1999), several metals including arsenic and lead are naturally occurring in soils across Ohio and the United States. Arsenic and lead have been sporadically detected in groundwater collected from monitoring wells located throughout the Southwest Quad over the more than two decades of monitoring.

The groundwater flow direction when samples were collected in March and May 2011 monitoring events were primarily from the west to the east, which is perpendicular to the typical flow direction, with some component of flow from the south to the north. There was an approximate 10-foot decrease in groundwater elevations observed across the Southwest Quad in the days preceding groundwater sample collection. This rapid reduction in the groundwater elevations and redirection of groundwater flow towards the east was attributed to a return to ambient conditions following flooding events in March and May 2011. Appendix F presents potentiometric surface maps and hydrographs showing the flow conditions in the Southwest Quad before and after collection of groundwater samples when these low levels of dissolved phase constituents of concern were detected in the samples from the sentinel and point of compliance wells.

Groundwater samples collected during the March and May 2011 events were not measuring dissolved phase constituent flux from the smear zone, which is located to the north-northeast but instead were measuring groundwater conditions to the west, where the smear zone attributed to releases from the former Gulf refinery is not present. Other sources of petroleum hydrocarbons are present west of these monitoring wells. It is likely that dissolved phase benzene measured in sentinel well MW-35 and point of compliance well MW-133 between November 2008 and August 2009 are also associated with flux from alternate sources when flow conditions were altered by periodic flooding and rapid re-equilibration of the water table. Based on monitoring performed in the Southwest Quad over the past five years it is reasonable to conclude that the dissolved phase plume is stable and there has not been redistribution of constituents following termination of continuous hydraulic control.

2.2.2 PERIMETER, INTERIOR, AND SUPPLEMENTAL MONITORING

As discussed in the SCM presented in Section 1.0 and supported by data collected to date, the LNAPL and dissolved phase petroleum hydrocarbons are laterally stable and degrading over time. Remaining LNAPL in the smear zone is gradually depleted through several mass loss mechanisms including dissolution into groundwater and subsequent dispersion and biodegradation, as well as volatilization and degradation within the vadose zone. As such, groundwater samples were collected from three groups of monitoring wells for evaluation of natural attenuation mechanisms within the saturated zone: perimeter, interior plume, and supplemental monitoring wells.

- Perimeter groundwater monitoring wells include those wells situated at the margins of the smear zone but not considered to be compliance boundaries for dissolved phase petroleum hydrocarbons in the saturated zone. Monitoring wells that are included in this network include MW-26R, MW-33, MW-48S, MW-85S, MW-94S, MW-95S, MW-100S, MW-104S, and MW-115S.
- Interior plume monitoring wells are those wells located within the smear zone that will be tracked on a consistent basis over the course of the remedy and include eleven wells: MW-10, MW-17, MW-18R, MW-20S, MW-22, MW-58S, MW-81S, MW-85D, MW-88, MW-93S, and MW-96S. A groundwater sample could not be collected from monitoring well MW-58S and MW-88 during the first 2011 semiannual monitoring period due to the presence of LNAPL within the well.
- Supplemental monitoring wells include additional wells that will be targeted for sampling to support evaluation of natural attenuation over the long-term remedy. The supplemental well network may be modified based upon data gaps identified during previous monitoring periods. Supplemental monitoring wells sampled during the first semiannual monitoring period in 2011 include wells L-1RR, L-3R, MW-21, MW-51, MW-64, MW-80, and MW-99.

Groundwater analytical results for the dissolved phase constituents of concern reported in samples collected from the perimeter, interior plume, and supplemental monitoring wells are provided on Table 2-2.

Groundwater samples were also collected from 12 monitoring wells for analysis of natural attenuation indicators during the first semiannual monitoring period including wells L-1RR, MW-18R, MW-20S, MW-33, MW-35, MW-38, MW-51, MW-81S, MW-85S, MW-96S, MW-100S, MW-112, MW-114, and MW-115S. Groundwater analytical results for the dissolved phase natural attenuation indicators are included on Table 2-3.

2.3 LYSIMETERS

Two soil moisture lysimeters were constructed at the grouped media locations near wells MW-18, MW-20, MW-21, and MW-93, in accordance with details presented in the *RIP* (Trihydro 2007a). The lysimeters are used to measure the makeup of recharge water (particularly oxidizers) from infiltrating precipitation and evaluate the contribution of the makeup water to biodegradation within the upper limits of the saturated zone. A shallow and deep lysimeter were installed at each grouped media location, the first set at a depth well above the smear zone and the second set at an elevation within or near the upper smear zone limit. Placement of each lysimeter was a function of the elevation of the top of the smear zone.

In accordance with the *OMM Plan* (Trihydro 2007b), a vacuum was applied to the shallow and deep lysimeters on June 1, 2011. Subsequently, on June 16, 2011, the rainwater infiltrate was collected from the shallow lysimeters. Samples were not collected from the deep lysimeter at each location due to sufficient recovery in the shallow lysimeter. Infiltrating precipitation collected from the lysimeters was analyzed for dissolved O₂ and oxidation-reduction potential (ORP) in the field prior to preserving the samples and submitting them for laboratory analysis of CH₄, nitrate, sulfate, as well as dissolved and total iron and manganese.

Field forms for samples collected from the lysimeters in June 2011 are included in Appendix C. Laboratory analytical reports for the lysimeter samples are provided in Appendix D-1 and data validation reports for each of the analytical packages provided by the laboratory are included in Appendix D-2. The lysimeter analytical results from the first half of 2011, along with historical results are presented in Table 2-4.

2.4 ROST MONITORING

Three ROST monitoring transects (RT-1 through RT-3) are in place perpendicular to the leading edge of the LNAPL plume, as shown in Figure 2-5. ROST technology was identified as the preferred tool for monitoring the potential for LNAPL migration at the leading edge of the plume because it is designed to provide real-time analysis of the physical and chemical characteristics of the distribution of petroleum hydrocarbons to distinguish between soils containing LNAPL and those outside of the smear zone.

The ROST monitoring transects consist of blank polyvinyl chloride (PVC) casing above the smear at three locations within each transect: an interior location (I) situated at the approximate lateral limit of the smear zone, an intermediate location (M) located 20-feet from the approximate lateral limit of the smear zone, and an outer location (O) installed 40-feet from the approximate lateral limit of the smear zone. ROST technology and installation methodology is presented in greater detail in the *RIP* (Trihydro 2007a).

ROST monitoring was completed within the three ROST transects on June 13 and 14, 2011. The tool was advanced from approximately 5 feet above the water table to approximately 5 feet below the water table in each of the monitoring location. ROST monitoring results are provided in Appendix E. Data collected during the June 2011 event indicate

that the smear zone is stable as there was not an indication of the presence of LNAPL within any of the intermediate or outer ROST monitoring wells based on laser induced fluorescence measurements in the three transects.

2.5 RIVER MONITORING

A partially penetrating sheet pile barrier wall and bank stabilization measures were installed along the west bank of the Great Miami River between September and December 2008. As part of these bank stabilization measures, a barrier wall performance monitoring network was installed along the restored river bank in accordance with the *Performance Monitoring Plan, Sheet Pile Barrier Along Great Miami River, Chevron Cincinnati Facility, Hooven, Ohio* (Trihydro 2007c). This work plan specified measures to characterize baseline conditions and monitor performance of the partially penetrating sheet pile wall during implementation of the final corrective measures for groundwater. The performance of the sheet pile wall is monitored by observing the hydraulic gradients in groundwater and surface water, as well as evaluating groundwater, hyporheic water, and surface water quality over time.

The barrier monitoring network is comprised of three monitoring transects along the northern, central, and southern portions of the barrier wall as illustrated on Figure 2-7. Each transect includes a groundwater monitoring nest (shallow, intermediate, and deep wells) situated inboard of the sheet pile wall and a groundwater monitoring nest located on the outboard side of the wall. In addition, a hyporheic/surface water monitoring well was also constructed outboard of the wall at each monitoring transect. A description of the installation and construction details for the sheet pile wall, stabilization measures, and performance monitoring network is provided in the *Second 2008 Semiannual Monitoring Report, Chevron Cincinnati Facility, Hooven, Ohio* (Trihydro 2009b).

2.5.1 FLUID LEVEL MONITORING

Pressure transducers were deployed on December 1, 2009 in the groundwater and surface water monitoring wells in the northern and southern monitoring transects to evaluate horizontal and vertical gradients across the partial penetrating barrier wall. Transducers are programmed to record groundwater and surface water elevations at a four-hour frequency. High frequency groundwater elevation data recorded using the pressure transducers are provided in Appendix A. Manual fluid level gauging was also conducted on January 27 and May 31, 2011 to supplement the transducer data and measure LNAPL gradients (if present) within the inboard portions of the barrier wall. LNAPL was

not detected in any of the monitoring wells situated on the west bank of the river during this gauging event. Manual fluid level measurements are included in Appendix B.

Transducer data from select monitoring wells was used to illustrate vertical hydraulic gradients on the interior and exterior of the barrier wall at the north and south monitoring transects (Figure 2-8 and Figure 2-9). Along the northern transect (shown on Figure 2-8), the groundwater elevation on the interior of the wall was generally lower than the surface water elevation from January to the beginning of March 2011, which corresponds to the peak of a flood event. Following this flood event, the groundwater elevation on the interior of the wall was generally higher than the surface water elevation. There is a consistent downward gradient on outside of the wall leading up to the early-March flood event. Following the flood event, there is generally a downward gradient on the inside of the wall and a corresponding upward gradient observed on the outboard side of the wall through June 2011. These results indicate that rapid and large fluctuations to surface water elevations can alter gradients and flow paths along the barrier. In addition, following flood events groundwater may continue to discharge back into the river for several months. The pathway for groundwater discharging back into the river has been altered as designed by installation of the barrier wall. Groundwater discharging into the river must first travel beneath the partially penetrating wall before making its way back into the river.

At the southern transect (shown on Figure 2-9), groundwater elevations are generally higher than surface water elevations with brief reversals during rapid rises in river stage. Generally, there is an upward gradient observed on the outboard side of the partially penetrating sheet pile wall that briefly reverses during river stage increases. On the interior portions of the wall there was a small vertical gradient that is basically the inverse of the outboard gradient observed during the first 2011 semiannual monitoring period. The data collected during the first half of 2011 show that groundwater is typically discharging to surface water beneath the barrier well except during episodic flood events when the gradient reverses and surface water discharges into the aquifer. It should be noted that vertical groundwater and surface flow beneath the wall makes up a small component of the overall flow within the aquifer, as the primary flow direction for groundwater and surface water is generally parallel to the riverbank.

2.5.2 GROUNDWATER, HYPORHEIC, AND SURFACE WATER MONITORING

The groundwater, hyporheic, and surface water monitoring wells were purged and sampled using a low flow methodology to prevent potential disturbance of the water quality. An inflatable packer system was used within the hyporheic/surface water zone monitoring wells to isolate a one foot interval within the uppermost portion of the water column to collect the surface water sample, and then to isolate a portion of the screen at the surface water/groundwater interface to collect the hyporheic water sample. Samples collected from the barrier monitoring network during May

and June 2011 were analyzed for the dissolved phase constituents of concern. Field forms from this monitoring event are provided in Appendix C. Groundwater, hyporheic zone, and surface water analytical reports and data validation reports are included in Appendix D.

Groundwater samples have also been collected and analyzed semiannually for monitored natural attenuation indicators during the June 2009, December 2009, May 2010, and November/December 2010 monitoring events. Samples have been collected from the inboard and outboard groundwater monitoring wells and hyporheic zone wells installed in the southern-most and middle monitoring transects (wells BMW-2S, BMW-2I, BMW-2D, BSW-2D, BMW-3S, BMW-3I, BMW-3D, and BSW-3D). The intent of the natural attenuation monitoring program along the barrier wall was to collect data to define baseline conditions and then to make adjustments as warranted based on these initial results.

Quarterly dissolved phase analytical results demonstrate that there is not a dissolved phase LNAPL source near the inboard or outboard portions of the barrier wall. Without the presence of a dissolved phase or LNAPL source it is not expected that there will be any significant changes to the natural attenuation indicators.

A previous request to discontinue sampling and analysis for monitored natural attenuation indicators from the barrier wall network was sent to the United States Environmental Protection Agency (USEPA) via correspondence dated October 27, 2010. The USEPA requested additional groundwater samples be analyzed for the monitored natural attenuation indicators over a range of hydraulic conditions including during high-grade pumping from the facility groundwater production wells. Groundwater samples have been collected over a range of hydraulic conditions at the barrier monitoring network, ranging from 462.9 feet above mean sea level (ft-amsl) in September 2009 to 469.1 ft-amsl in March 2010. Additional samples were collected in December 2010 and analyzed for constituents of concern and monitored natural attenuation indicators during high-grade pumping. Based on these analytical results, there does not appear to be a dissolved phase or LNAPL source near the inboard or outboard portions of the barrier wall. Without the presence of a dissolved phase or LNAPL source it is not expected that there will be any significant changes to the natural attenuation indicators as petrophyllitic bacteria require a hydrocarbon source to proliferate and cause alterations to groundwater geochemistry. On June 13, 2011 Chevron proposed to continue monitoring for the dissolved phase constituents of concern according to the schedule described in the *Performance Monitoring Plan, Sheet Pile Barrier Along Great Miami River, Chevron Cincinnati Facility, Hooven, Ohio* (Trihydro 2007c).

Samples will be collected and analyzed on a semiannual basis for the next two years, annually for the following ten years, and biennially thereafter. Groundwater samples will not be collected or analyzed for natural attenuation indicators until one or more organic constituents are detected above the laboratory reporting limit at an inboard monitoring well on a consistent basis (two or more successive sampling events). Once this occurs, sampling and

analysis for natural attenuation indicators will be resumed within the monitoring transect where dissolved phase constituents of concern were measured in accordance with the schedule described above. Chevron received approval for this strategy on December 1, 2011.

A summary of the groundwater results for constituents of concern are provided on Table 2-5. During the May and June 2011 monitoring events, there was a low level, concentration of toluene measured in a sample collected from inboard well MW-137S as well as an estimated dissolved phase arsenic concentration measured in sample MW-136S. A detection of benzene was present in inboard monitoring well MW-135D at 0.0015 mg/L with a corresponding detection of benzene in outboard wells BMW-1I and BMW-1D at 0.0012 and 0.0022 mg/L, respectively. Concentrations of benzene were greater in the outboard monitoring wells, without any detections within the shallow or intermediate depths on the interior of the wall, suggesting that constituents of concern present in the smear zone along the west bank of the river are not migrating beneath the barrier wall. Analytical results from this transect will continue to be evaluated during future events. It should be noted that the surface water screening standards were not exceeded in any of the hyporheic or surface water samples collected during the first half of 2011.

3.0 INTERPRETATION

Data collected during the first half of 2011 and included herein continue to demonstrate that the intrinsic processes are degrading petroleum hydrocarbons in the smear zone. In general, natural attenuation occurs as constituents present in the smear zone partition to groundwater and soil vapor, where they are biodegraded via aerobic and anaerobic processes. There are two general lines of evidence provided herein to support the efficacy of natural attenuation processes to degrade petroleum hydrocarbons at a rate that will achieve remedial goals for groundwater (i.e., USEPA MCLs) in a timeframe comparable to active remedial measures. The primary lines of evidence demonstrate the stability of petroleum hydrocarbons in the smear zone beneath the site and protectiveness of sensitive receptors (Section 3.1); as well as meaningful trends of decreasing constituent concentrations over time (Section 3.2). The secondary lines of evidence (Section 3.3) demonstrate indirectly that natural attenuation mechanisms are acting to transform hydrocarbon constituents, reduce concentrations, and inhibit mobility of the LNAPL and dissolved phase impacts. Qualitative and quantitative lines of evidence demonstrating natural depletion of the smear zone over the first five years of groundwater corrective measures implementation were provided in the *Five-Year Review* (Trihydro 2011b). Updates to these lines of evidence for which data was collected during the first half of 2011 are included herein.

3.1 PLUME STABILITY AND PROTECTIVENESS OF SENSITIVE RECEPTORS

During execution of the final groundwater remedy at the site, Chevron must continue to demonstrate that the LNAPL and dissolved phase plumes are stable and that sensitive receptors remain protected (USEPA 1999). If the extent of the LNAPL, dissolved, or vapor phase petroleum hydrocarbons are determined to be mobile or impacting sensitive receptors above risk based limits, contingency measures would be employed as outlined in the *OMM Plan* (Trihydro 2007b).

3.1.1 LNAPL

As discussed in the Update to Site Conceptual Model and Summary of Remedial Decision Basis (Chevron Cincinnati Groundwater Task Force 2005) and outlined within the First 2008 Semiannual Monitoring Report, Chevron Cincinnati Facility, Hooven, Ohio (Trihydro 2009a), LNAPL within the smear zone is stable. This determination was made based on (1) the age of the release; (2) a decrease in LNAPL gradients, transmissivity, and saturations due to natural degradation and engineered recovery; (3) morphology of the smear zone with a “thicker” core, which thins at the lateral edges; (4) there having been no expansion of LNAPL beyond the originally defined limits of the smear zone; and (5) preferential depletion of petroleum related constituents within the LNAPL at the soil gas and groundwater interface (otherwise referred to as outside-in weathering of the plume).

Data collected during the first half of 2011 continue to support that the smear zone is stable based on the laser induced fluorescence measurements in the three ROST monitoring transects conducted between June 13 and 14, 2011. Additionally, LNAPL was not measured in any of the sentinel or point of compliance monitoring wells installed in the Southwest Quad. Fluid level gauging within the performance monitoring network installed along the west bank of the Great Miami River also confirmed the stability of the smear zone along the restored river bank.

Historical petrophysical tests on soil cores collected in the saturated portions of the smear zone indicate two-phase (water-oil) LNAPL residual saturation ranges from about 18 to 25%. Data collected from the facility show an exponential decrease in the ability of LNAPL to migrate at saturations below 20 to 25%. Field testing completed in the late 1990s indicates that the two-phase LNAPL saturations in the majority of the plume were below residual values (i.e., immobilized). Additionally, soil core samples were collected on the facility in November 2008 and soil saturations calculated using this data also demonstrated that LNAPL saturations within the upper, middle, and lower portions of the smear zone were below residual values. No soil cores or LNAPL samples were collected during the first half of 2011; therefore, an assessment of smear zone saturations will be provided upon collection of additional data during subsequent semiannual monitoring periods.

3.1.2 DISSOLVED PHASE

Dissolved phase constituents of concern (including benzene, toluene, ethylbenzene, xylene, chlorobenzene, dissolved arsenic, and dissolved lead) have not been measured within routine samples collected from the sentinel and point of compliance groundwater monitoring network with the exception of following flood events as described in Section 2.2.1. In addition, dissolved phase constituents have not measured in groundwater or surface water at concentrations exceeding remedial goals along the Great Miami River. Arsenic and lead have been sporadically detected in groundwater collected from monitoring wells located throughout the Southwest Quad and along the river bank over the more than two decades of monitoring and are generally indicative of background metals measured in soils in Ohio as reported in the *Evaluation of Background Metal Concentrations in Ohio Soils* (Cox-Colvin & Associates, Inc. 1996) and the *Closure Plan Review Guidance for RCRA Facilities* (OEPA 1999).

3.2 CONSTITUENT TRENDS

It is expected that the data collected over the course of the remedy will show a meaningful trend of decreasing hydrocarbon mass and/or constituent concentrations over time. Analyses that may be used in evaluating the progress of the long term remedy in meeting remedial goals include evaluation of temporal trends in contaminant concentrations, LNAPL mass, or LNAPL saturations; comparisons of observed contaminant distributions with predictions; as well as comparison of calculated attenuation rates with those necessary to meet remedial goals within the required time frame.

These analyses can be complicated as a result of variation in the petroleum hydrocarbon distribution across the site, temporal fluctuations related to seasonal and longer term trends, heterogeneity in the vadose and saturated zones across the plume footprint, along with measurement variability. These complications necessitate the use of multiple lines of evidence and expanded monitoring networks to reduce uncertainty.

3.2.1 DISSOLVED PHASE CONSTITUENT TRENDS

The distribution of total benzene, toluene, ethylbenzene, and xylenes (BTEX) in groundwater for samples collected during the first 2011 semiannual monitoring period are displayed on Figure 3-1. It is useful to evaluate the dissolved phase constituent trends in two ways. First, dissolved phase constituent trends within individual groundwater monitoring wells can be used to assess spatial variability in engineered mass removal and intrinsic biodegradation processes across the smear zone footprint and identify areas that are not behaving as predicted. Trend analyses should be conducted in monitoring locations situated throughout the distribution of petroleum hydrocarbons to assess the range of dominant intrinsic processes acting on the plume. Temporal trends in individual wells may also indicate changes in climatic, hydrogeochemical, hydrocarbon release, site reuse, or other conditions unrelated to attenuation processes and need to be evaluated in the context of other lines of evidence.

Second, groundwater quality trends can be averaged within areas of the smear zone (i.e., up-gradient, interior, down-gradient) to assess overall trends in natural attenuation processes. These area averages are less sensitive to variations within individual wells that can sometimes complicate temporal analyses and provide an understanding of natural attenuation processes affecting the smear zone as a whole. For discussion purposes, there are two areas up-gradient of the smear zone, one to the north of the facility property and the second to the west along the Buried Valley Aquifer-bedrock interface in Hooven.

Individual well and area-wide trend analyses performed using data collected from monitoring wells across the smear zone during previous semiannual monitoring events have demonstrated a first order degradation rate for benzene

associated with both natural attenuation and engineered mass removal, with preferential depletion along the smear zone margins (i.e., outside-in weathering).

3.2.1.1 TRENDS WITHIN INDIVIDUAL MONITORING WELLS

Historically, groundwater samples have not been collected from the interior plume monitoring wells due to the presence of LNAPL during sampling. For the purpose of this analysis, trends are inferred for wells that have viable groundwater data from at least three monitoring events spanning three separate years. Of the ten interior plume wells,

six monitoring wells (MW-10, MW-18R, MW-20S, MW-58S, MW-88, and MW-96S) do not have data that meet these criteria. Many of these wells have been sampled for at least three consecutive years but due to water table elevations, some of the data was excluded based on potential dilution during high water table elevations or potential for LNAPL during low water table elevations. Constituent of concern concentrations reported in the samples collected from interior monitoring well MW-85D were all reported below the remedial goals, which is expected as this well is screened in the deeper portions of the Buried Valley Aquifer, well below the vertical distribution of dissolved phase petroleum hydrocarbons. Dissolved phase trends for the four remaining interior plume monitoring wells (MW-17, MW-22, MW-81S and MW-93S) are provided on Figures 3-2 through 3-5. Monitoring well MW-17 is located in the interior of the smear zone, where dissolved phase benzene concentrations continue to be measured at concentrations above remedial goals. There is a slight decreasing trend in benzene concentrations over time. This decreasing trend may become more pronounced over time as the smear zone up-gradient of well MW-17 becomes depleted and attenuation continues from the “outside-in.” Monitoring well MW-22 is located north of well MW-17, closer to the up-gradient edge of the smear zone, and accordingly shows a stronger decreasing trend in benzene concentrations over time. Monitoring well MW-81S is situated in the southwest limit of Hooven adjacent to State Route 128 and MW-93S is located in the central portion of Hooven adjacent to the former elementary school. Dissolved phase constituent concentrations in these two wells show a clear decreasing trend between 1996 and 2011. This trend is likely pronounced by groundwater and LNAPL recovery as well as HSVE system operations.

Of the nine supplemental groundwater monitoring wells (L-1RR, L-3R, MW-21, MW-33, MW-38, MW-51, MW-64, MW-80, and MW-99S), only wells MW-51 and MW-80 do not have sufficient data (i.e., results from at least three monitoring events spanning more than three years) to complete trend analyses. The dissolved phase results for constituents of concern reported in samples collected from well MW-33 have remained below MCLs over time and therefore trend analyses for this well are not evaluated herein.

As presented on Figures 3-6 through 3-9, dissolved phase benzene concentrations reported in supplemental monitoring wells L-1RR, L-3R, MW-21, and MW-38 showed a first order degradation rate over time. These wells are generally located outside of the footprint of engineered remedial measures at the facility; therefore these decreasing trends are indicative of natural attenuation processes. The rate of decline in benzene concentrations is greater in well MW-21 compared to monitoring wells L-1RR, L-3R and MW-38, as this well is located along the up-gradient edge of the smear zone.

The dissolved phase benzene concentrations reported in samples collected from monitoring wells MW-64 (Figure 3-10) and MW-99S (Figure 3-11) also show decreasing trends over time. These two monitoring wells are located on the eastern and western edge of the smear zone, respectively, and also demonstrate preferential depletion of benzene along

the smear zone margins (i.e., outside-in weathering). Moreover, dissolved phase trends observed in monitoring well MW-99S reflect mass loss through engineered recovery like the other wells situated in Hooven.

Temporal analysis of the dissolved phase results can also be conducted for two additional monitoring wells (MW-85S and MW-115S) located within the distribution of hydrocarbons at the facility, as these wells have a sufficient monitoring history with concentrations above remedial goals. MW-115S (Figure 3-12) is located outside the influence of historical remedial efforts in the Southwest Quad. Dissolved phase benzene shows a decreasing trend over time within samples collected from this well, which can be considered indicative of natural attenuation processes.

Monitoring well MW-85S (Figure 3-13) has historically shown a decreasing trend, which was reversed beginning with groundwater monitoring conducted in 2008. It is possible that installation of the partially penetrating barrier wall along the west bank of the Great Miami River in 2008 has subsequently limited the transport of electron acceptors such as dissolved O₂ to this portion of the smear zone along the river. Future groundwater monitoring will help resolve short term and long term dissolved phase benzene trends in this well and other monitoring wells installed along the west bank of the river within the smear zone.

The average first order degradation rate estimated using the dissolved phase analytical results from eleven monitoring wells (L-1RR, L-3R, MW-17, MW-21, MW-38, MW-22, MW-64, MW-81S, MW-93S, MW-99S, and MW-115S) was approximately 6.91×10^{-4} per year. Attenuation rates will be compared over time within individual wells installed across the plume and progress towards meeting the remedial goals will be further considered.

3.2.1.2 AVERAGE TRENDS ACROSS SMEAR ZONE

The average dissolved phase constituent and total petroleum hydrocarbon concentrations are indicative of ongoing natural smear zone depletion processes, with preferential LNAPL depletion at the smear zone boundaries. Other than the detections discussed in Section 2.2.1, dissolved phase benzene was not detected in samples collected from monitoring wells up-gradient and down-gradient of the smear zone. This indicates that attenuation processes such as dispersion, sorption, and biodegradation reduce the dissolved phase concentration, reduce mobility of the plume, and/or transform constituents of concern as groundwater exits the smear zone.

The average dissolved phase benzene concentration trends for selected monitoring wells located in the up-gradient (MW-21 and MW-22), interior (L-1RR, L-3R, MW-17, and MW-18R), and down-gradient (MW-48S, MW-94S, and MW-115S) portions of the smear zone are presented on Figure 3-14. Dissolved phase concentrations reported during monitoring conducted in 2002, 2004, 2008, 2009, 2010, and 2011 are averaged for the up-gradient, interior, and down-

gradient wells. Irrespective of the well locations, there is a decreasing trend in the dissolved phase benzene concentration reported between 2002 and 2011, indicative of benzene depletion from the smear zone. These decreasing trends are more pronounced at the margins of the smear zone compared to the interior portion of the plume. At its margins, the smear zone is thinner and LNAPL saturations are lower.

As the up-gradient portion of the smear zone is depleted of petroleum hydrocarbons, the benzene removal rates from the interior portion of the smear zone will increase as outside-in weathering continues. It is anticipated that the dissolved phase benzene concentrations reported in monitoring wells L-1RR and MW-17 will show trends similar to those currently observed in wells MW-21 and MW-22. This may then be followed by a similar transition in the dissolved phase benzene trends observed in monitoring wells L-3R and MW-18R. Over time, benzene concentrations in groundwater will continue to decrease across the smear zone, eventually reaching remedial goals.

3.3 HYDROGEOCHEMICAL INDICATORS OF NATURAL ATTENUATION

Characterization of geochemical variations in the vadose and saturated zones provides evidence of the types of biodegradation processes that are thought to be attenuating petroleum hydrocarbons in the smear zone. Many of the processes attenuating hydrocarbons in the smear zone cannot be measured directly (e.g., biological transformation of constituents). However, the processes may cause changes in geochemical parameters, leaving an observable "footprint" that can be related qualitatively and quantitatively to the natural attenuation processes (National Research Council 2000). In general, naturally occurring inorganic geochemical species serve as electron acceptors and are reduced during microbial degradation (i.e., oxidation) of petroleum hydrocarbons.

3.3.1 DISSOLVED PHASE CONSTITUENTS

During microbial degradation of petroleum impacts, dissolved O₂ concentrations steadily decrease until anaerobic conditions prevail. Once anaerobic conditions exist and multiple potential electron acceptors (i.e., oxidizers) are available, microorganisms preferentially use the electron acceptor that is thermodynamically most favorable. In other words, petrophylic bacteria that utilize the electron acceptor that offers the most energy during consumption of the petroleum hydrocarbon source will proliferate over other bacteria until they exhaust that electron acceptor and then other bacteria that use the next most favorable electron acceptor (based on availability in groundwater) thrive. The general order of preference for anaerobic hydrocarbon biodegradation based on the Gibb's energy of the reaction is:

- Denitrification (reduction of nitrate), with the eventual production of molecular nitrogen
- Reduction of manganese from Mn⁴⁺ to Mn²⁺
- Reduction of ferric iron (Fe³⁺) to ferrous iron (Fe²⁺)

- Sulfate reduction, with eventual production of sulfide
- Reduction of CO₂ and generation of CH₄

These microbial processes generally segregate into distinct zones dominated by O₂, nitrate, ferric iron, sulfate, and CO₂ reduction. Furthermore, given the different electron acceptors consumed and final by-products, it is theoretically possible to differentiate the "zones" of microbial processes across the smear zone. When applied at a field scale this differentiation of microbial zones must be framed in general terms which accommodate uncertainties, as several of the by-products of microbial metabolism (such as ferric iron, hydrogen sulfide, and CH₄) are readily transported down-gradient.

The spatial distribution of electron acceptors measured during the first 2011 semiannual monitoring period is displayed on Figure 3-15. Nitrate and sulfate concentrations were higher up-gradient of the smear zone compared to within the smear zone. Specifically, the average nitrate and sulfate concentrations in up-gradient groundwater, as provided in Table 3-1, were 4.4 and 60.0 mg/L, respectively. Sulfate and nitrate enriched water enters the smear zone with groundwater flowing from the north of the facility and bedrock-aquifer interface in the western portions of Hooven. The average nitrate and sulfate concentrations within the smear zone were 0.16 and 18.1 mg/L, respectively. Nitrate and sulfate concentrations showed a slight rebound in the down-gradient portions of the smear zone possibly the result of the supply of hydrocarbons in groundwater being exhausted by biodegradation processes.

The spatial distribution of reduced species and attenuation by-products including dissolved iron, manganese, and CH₄ are depicted on Figure 3-16. The concentration of each of these oxidation by-products was higher within the smear zone compared to up-gradient and down-gradient conditions. As reported in Table 3-1, the average dissolved iron, manganese, and CH₄ concentrations up-gradient of the smear zone were 0.0005, 0.0001, and 0.004 mg/L, respectively. Average dissolved iron, manganese, and CH₄ concentrations within the smear zone were 13.6, 0.86, and 5.3 mg/L, respectively. The increase in the concentration of these biodegradation by-products indicates iron and manganese reduction, as well as methanogenic processes, are degrading petroleum hydrocarbons. Down-gradient of the smear zone, dissolved iron, manganese, and CH₄ concentrations decrease to 0.00049, 0.5 and 0.092 mg/L, respectively.

A summary of hydrogeochemical indicator concentrations versus distance for monitoring conducted during the first half of 2011, along with historical results, is displayed on Figure 3-17. Select hydrogeochemical concentrations are compared to the dissolved phase benzene concentrations through the centerline of the smear zone. Iron and sulfate reduction primarily occurs within 2,000 feet down-gradient of the smear zone boundary where available electron receptors are fully reduced. There is a rapid increase in benzene, CH₄, and dissolved iron concentrations with an

associated decrease in sulfate. Methanogenesis is then the dominant process degrading hydrocarbons through the central portions of the smear zone. These trends reverse toward the down-gradient edge of the smear zone. The concentration versus distance plots further support that outside-in weathering of the smear zone is occurring.

3.3.2 HYDROGEOCHEMICAL FLUX WITH RAINWATER INFILTRATE

During the first half of 2011, the concentrations of electron acceptors measured in the rainwater infiltrate collected from lysimeter L-21S (northernmost location) and lysimeter L-18S (central portion of the smear zone) were generally low or not detected. Reduced byproducts including dissolved manganese and CH₄ were elevated within the samples collected from these locations. This is an indication of ongoing attenuation of petroleum hydrocarbons, and subsequent partitioning of CH₄ and volatile petroleum hydrocarbons from soil vapor to pore water within the vadose zone.

In the southern portions of the smear zone, the pore water generally contains higher levels of electron acceptors including elevated sulfate and nitrate concentrations measured in lysimeter L-20S and L-93S. Reduced by-products were reported at relatively low concentrations in the infiltrate samples collected from these two lysimeters. Based on these results it appears that there is a higher flux of electron acceptors into the saturated portions of the smear zone along the southern portion of the site.

Precipitation and subsequent infiltration comprise an important component of the aquifer budget. Much of this infiltrating water contains electron acceptors that are used by microorganisms in the smear zone to destroy hydrocarbons. The lysimeter data are useful in understanding this process, as demonstrated by an analysis of the assimilative capacity. Figure 3-18 presents a summary bar graph of pore water assimilative capacity measured during the first half of 2011 along with results from previous monitoring events conducted over the past five years. The assimilative capacity is estimated by summing the concentrations of electron acceptors and subtracting reduction-oxidation byproducts, scaled to stoichiometric coefficients for attenuation of hydrocarbons. As shown on this figure, pore water in the northern and central portion of the smear zone (as evaluated using lysimeters L-21S and L-18S) has a low or negative assimilative capacity, indicating that precipitation infiltrate at these locations does not have the potential to further degrade hydrocarbons within the saturated zone. On the other hand, the assimilative capacity of infiltrate in the southern portions of the smear zone (assessed using lysimeters L-20S and L-93S) is much higher.

3.4 SUMMARY OF LINES OF EVIDENCE SUPPORTING NATURAL ATTENUATION

Performance monitoring for any corrective measures program is necessary to demonstrate that the remedy is progressing as anticipated and will meet remedial goals while ensuring that sensitive receptors remain protected. The USEPA has established additional performance monitoring criteria for remedies incorporating intrinsic natural

attenuation processes for degradation of residual impacts (USEPA 1999, USEPA 2003). Performance monitoring programs in these cases must be designed to:

1. Demonstrate that natural attenuation is occurring according to expectations
2. Detect changes in environmental conditions (e.g., hydrogeologic, geochemical, microbiological, or other changes) that may reduce the efficacy of any of the natural attenuation processes
3. Identify any potentially toxic and/or mobile transformation products such as methane within the vadose zone
4. Verify that the LNAPL or dissolved phase plume is not expanding down-gradient
5. Verify no unacceptable impact to down-gradient receptors
6. Detect new releases of contaminants to the environment that could impact the effectiveness of the natural attenuation remedy

These performance monitoring criteria have been achieved during this first semiannual monitoring period based upon the qualitative and quantitative lines of evidence used to demonstrate the stability of petroleum hydrocarbons in the smear zone, protectiveness of sensitive receptors, transformation of petroleum hydrocarbon constituents via intrinsic processes, as well as decreasing petroleum hydrocarbon constituent concentrations and mass over time.

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TABLES

**TABLE 2-1. SOUTHWEST QUAD DISSOLVED PHASE ANALYTICAL RESULTS SUMMARY (NOVEMBER 2008 TO JUNE 2011)
FIRST 2011 SEMIANNUAL MONITORING PERIOD
CHEVRON CINCINNATI FACILITY, HOOVEN, OHIO**

Location ID	Date Sampled	Benzene (mg/L)	Chlorobenzene (mg/L)	Ethylbenzene (mg/L)	Toluene (mg/L)	Xylenes, Total (mg/L)	Arsenic, Dissolved (mg/L)	Lead, Dissolved (mg/L)
MW-26R	11/25/08	0.003 J	ND(0.0008)	ND(0.0008)	ND(0.0007)	0.0008 J	ND(0.01)	ND(0.0069)
	3/27/09	0.007	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.01)	ND(0.0069)
	11/12/09	ND(0.0005)	ND(0.0008) J	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0072)	ND(0.0069)
	5/11/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0072)	ND(0.0069)
	10/21/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0098)	ND(0.0069)
	5/18/11	ND(0.00051)	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00024)	ND(0.0012) J
MW-35	11/19/08	0.13	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.01)	ND(0.0069)
	Dup 11/19/08	0.13	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.01)	ND(0.0069)
	2/17/09	0.021	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.01)	ND(0.0069)
	4/3/09	0.021	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.01)	ND(0.0069)
	Dup 4/3/09	0.021	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.01)	ND(0.0069)
	4/28/09	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	--	--
	5/27/09	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	--	--
	6/29/09	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0072)	ND(0.0069)
	7/21/09	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0072)	ND(0.0069)
	8/11/09	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0072)	ND(0.0069)
	9/14/09	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0072)	ND(0.0069)
	10/12/09	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0072)	ND(0.0069)
	Dup 10/12/09	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0072)	ND(0.0069)
	11/17/09	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	--	--
	12/11/09	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	--	--
	1/12/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	--	--
	2/23/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0072)	ND(0.0069)
	3/29/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0072)	ND(0.0069)
	4/21/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0072)	ND(0.0069)
	5/4/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0072)	ND(0.0069)
Dup 5/4/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0072)	ND(0.0069)	
6/15/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0098)	ND(0.0069)	
7/14/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0098)	ND(0.0069)	

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FIRST 2011 SEMIANNUAL MONITORING PERIOD
CHEVRON CINCINNATI FACILITY, HOOVEN, OHIO**

Location ID	Date Sampled	Benzene (mg/L)	Chlorobenzene (mg/L)	Ethylbenzene (mg/L)	Toluene (mg/L)	Xylenes, Total (mg/L)	Arsenic, Dissolved (mg/L)	Lead, Dissolved (mg/L)
MW-35	8/25/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0098)	ND(0.0069)
	9/28/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0098)	ND(0.0069)
	10/20/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0098)	ND(0.0069)
	3/22/11	ND(0.00051)	ND(0.00051)	0.0012	ND(0.00048)	ND(0.00073)	ND(0.00024)	ND(0.0012)
	5/11/11	ND(0.00051)	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00024)	ND(0.0012)
MW-37	11/18/08	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.01)	ND(0.0069)
	4/2/09	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.01)	ND(0.0069)
	10/20/09	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	0.003 JB	ND(0.0069)
	5/5/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	0.0086 J	ND(0.0069)
	10/20/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0098)	ND(0.0069)
	5/16/11	ND(0.00051)	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00024)	ND(0.0012)
	6/2/11	ND(0.00051)	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00024)	ND(0.0012)
	Dup 6/2/11	ND(0.00051)	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00024)	ND(0.0012)
MW-94S	12/8/08	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.01)	ND(0.0069)
	Dup 12/8/08	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.01)	ND(0.0069)
	4/2/09	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.01)	ND(0.0069)
	5/6/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	0.0166J/ND(0.0166)U*	ND(0.0069)
	10/19/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0098)	ND(0.0069)
	5/17/11	ND(0.00051)	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00024)	ND(0.0012)
MW-115S	12/9/08	ND(0.0005)	ND(0.0008)	0.0008 J	ND(0.0007)	ND(0.0008)	ND(0.01)	ND(0.0069)
	4/3/09	0.009	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.01)	ND(0.0069)
	10/12/09	0.0008 J	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	0.0109 J	ND(0.0069)
	5/5/10	0.011	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	0.0185 J	ND(0.0069)
	10/20/10	0.003 J	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	0.0142 J	ND(0.0069)
	5/11/11	0.01	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	0.011 JB	ND(0.0012)

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Location ID	Date Sampled	Benzene (mg/L)	Chlorobenzene (mg/L)	Ethylbenzene (mg/L)	Toluene (mg/L)	Xylenes, Total (mg/L)	Arsenic, Dissolved (mg/L)	Lead, Dissolved (mg/L)
MW-120	11/18/08	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.01)	ND(0.0069)
	4/1/09	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.01)	ND(0.0069)
	10/7/09	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0072)	ND(0.0069)
	3/29/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0072)	ND(0.0069)
	Dup 3/29/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0072)	ND(0.0069)
	4/20/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0072)	ND(0.0069)
	5/5/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0072)	ND(0.0069)
	6/14/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0098)	ND(0.0069)
	Dup 6/14/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0098)	ND(0.0069)
	7/13/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0098)	ND(0.0069)
	8/24/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0098)	ND(0.0069)
	9/29/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0098)	ND(0.0069)
	10/19/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0098)	ND(0.0069)
	3/22/11	ND(0.00051)	ND(0.00051)	0.0016	ND(0.00048)	0.0014	ND(0.00024)	ND(0.0012)
	5/17/11	ND(0.00051)	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00024)	ND(0.0012)
MW-131	11/21/08	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	0.0155 J	0.0225
	2/18/09	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	0.0144 J	ND(0.0069)
	4/2/09	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.01)	ND(0.0069)
	7/23/09	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	0.01 J	ND(0.0069)
	10/20/09	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	0.0266/ND(0.0266)U*	ND(0.0069)
	5/6/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	0.0252 JB	ND(0.0069)
	Dup 5/6/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	0.0174J/ND(0.0174)U*	ND(0.0069)
	10/20/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	0.0147 J	ND(0.0069)
	5/16/11	0.0078	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00024)	ND(0.0012)
	6/1/11	ND(0.00051)	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	0.02 JB	ND(0.0012)
	11/17/08	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.01)	ND(0.0069)
	2/19/09	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.01)	ND(0.0069)
	3/30/09	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.01)	ND(0.0069)

**TABLE 2-1. SOUTHWEST QUAD DISSOLVED PHASE ANALYTICAL RESULTS SUMMARY (NOVEMBER 2008 TO JUNE 2011)
FIRST 2011 SEMIANNUAL MONITORING PERIOD
CHEVRON CINCINNATI FACILITY, HOOVEN, OHIO**

Location ID	Date Sampled	Benzene (mg/L)	Chlorobenzene (mg/L)	Ethylbenzene (mg/L)	Toluene (mg/L)	Xylenes, Total (mg/L)	Arsenic, Dissolved (mg/L)	Lead, Dissolved (mg/L)
MW-132	7/20/09	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0072)	ND(0.0069)
Dup	7/20/09	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0072)	ND(0.0069)
	10/5/09	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0072)	ND(0.0069)
	5/5/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0072)	ND(0.0069)
Dup	5/5/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0072)	ND(0.0069)
	10/19/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0098)	ND(0.0069)
	5/17/11	ND(0.00051)	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00024)	ND(0.0012)
MW-133	11/18/08	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.01)	ND(0.0069)
	2/17/09	0.003 J	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.01)	ND(0.0069)
	4/1/09	0.11	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.01)	ND(0.0069)
	4/28/09	0.036	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	--	--
	5/26/09	0.032	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	--	--
	6/29/09	0.11	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0072)	ND(0.0069)
	7/21/09	0.051	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0072)	ND(0.0069)
	8/11/09	0.031	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0072)	ND(0.0069)
	9/14/09	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0072)	ND(0.0069)
	10/8/09	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0072)	ND(0.0069)
	11/17/09	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	--	--
	12/11/09	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	--	--
	1/12/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	--	--
	2/23/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0072)	ND(0.0069)
	3/29/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0072)	ND(0.0069)
	4/20/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0072)	ND(0.0069)
	5/4/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0072)	ND(0.0069)
	6/14/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0098)	ND(0.0069)
	7/13/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0098)	ND(0.0069)
Dup	7/13/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0098)	ND(0.0069)
	8/24/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0098)	ND(0.0069)
	9/27/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0098)	ND(0.0069)

**TABLE 2-1. SOUTHWEST QUAD DISSOLVED PHASE ANALYTICAL RESULTS SUMMARY (NOVEMBER 2008 TO JUNE 2011)
FIRST 2011 SEMIANNUAL MONITORING PERIOD
CHEVRON CINCINNATI FACILITY, HOOVEN, OHIO**

Location ID	Date Sampled	Benzene (mg/L)	Chlorobenzene (mg/L)	Ethylbenzene (mg/L)	Toluene (mg/L)	Xylenes, Total (mg/L)	Arsenic, Dissolved (mg/L)	Lead, Dissolved (mg/L)
MW-133 Dup	10/20/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0098)	ND(0.0069)
	10/20/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0098)	ND(0.0069)
	3/22/11	ND(0.00051)	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00024)	ND(0.0012)
	5/17/11	ND(0.00051)	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00024)	ND(0.0012)
MW-134	11/17/08	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.01)	ND(0.0069)
	2/19/09	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.01)	ND(0.0069)
	3/30/09	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.01)	ND(0.0069)
	7/20/09	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0072)	ND(0.0069)
	10/5/09	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0072)	ND(0.0069)
	5/5/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	0.0104 J	ND(0.0069)
	10/19/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0098)	ND(0.0069)
	5/17/11	ND(0.00051)	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00024)	ND(0.0012)
MW-138	3/31/09	0.005 J	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.01)	ND(0.0069)
	4/28/09	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	--	--
	5/28/09	0.002 J	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	--	--
	6/29/09	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0072)	ND(0.0069)
	7/21/09	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0072)	ND(0.0069)
	8/12/09	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0072)	ND(0.0069)
	9/15/09	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0072)	ND(0.0069)
	10/7/09	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0072)	ND(0.0069)
	11/18/09	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	--	--
	12/14/09	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	--	--
	1/13/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	--	--
	2/23/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0072)	ND(0.0069)
	3/30/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0072)	ND(0.0069)
	4/21/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0072)	ND(0.0069)
	5/4/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0072)	ND(0.0069)
6/14/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0098)	ND(0.0069)	

**TABLE 2-1. SOUTHWEST QUAD DISSOLVED PHASE ANALYTICAL RESULTS SUMMARY (NOVEMBER 2008 TO JUNE 2011)
FIRST 2011 SEMIANNUAL MONITORING PERIOD
CHEVRON CINCINNATI FACILITY, HOOVEN, OHIO**

Location ID	Date Sampled	Benzene (mg/L)	Chlorobenzene (mg/L)	Ethylbenzene (mg/L)	Toluene (mg/L)	Xylenes, Total (mg/L)	Arsenic, Dissolved (mg/L)	Lead, Dissolved (mg/L)
MW-138	7/14/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0098)	ND(0.0069)
	8/25/10	0.001 J	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0098)	ND(0.0069)
	9/28/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0098)	ND(0.0069)
	10/20/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0098)	ND(0.0069)
	3/23/11	ND(0.00051)	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00024)	ND(0.0012)
	5/18/11	ND(0.00051)	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00024)	ND(0.0012) J
MW-139	3/31/09	0.15	ND(0.0008)	ND(0.0008)	0.005 J	0.005 J	0.0122 J	ND(0.0069)
	4/28/09	0.019	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	--	--
	4/28/09	0.098	ND(0.0008)	ND(0.0008)	0.003 J	0.003 J	--	--
	5/28/09	0.085	ND(0.0008)	ND(0.0008)	0.003 J	0.003 J	--	--
	6/30/09	0.11	ND(0.0008)	0.0009 J	0.005 J	0.004 J	0.0126 J	ND(0.0069)
	7/21/09	0.12	ND(0.0008)	0.001 J	0.006	0.005 J	0.0175 J	ND(0.0069)
	8/12/09	0.12	ND(0.0008)	ND(0.0008)	0.006	0.005 J	0.0164 J	ND(0.0069)
	9/15/09	0.048	ND(0.0008)	ND(0.0008)	0.002 J	0.0009 J	0.0097 J	ND(0.0069)
	10/7/09	0.017	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	0.0131 J	ND(0.0069)
	11/18/09	0.002 J	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	--	--
	12/14/09	0.004 J	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	--	--
	1/13/10	0.0009 J	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	--	--
	2/24/10	ND(0.0005)	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	0.0095 J	ND(0.0069)
	3/30/10	0.004 J	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0072)	ND(0.0069)
	4/21/10	0.007	ND(0.0008)	0.001 J	ND(0.0007)	ND(0.0008)	ND(0.0072)	ND(0.0069)
	5/4/10	0.009	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	0.0117 J	ND(0.0069)
	6/14/10	0.002 J	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	ND(0.0098)	ND(0.0069)
	7/14/10	0.026	ND(0.0008)	0.003 J	0.002 J	0.004 J	0.0104 J	ND(0.0069)
	8/25/10	0.05	ND(0.0008)	ND(0.0008)	0.003 J	0.003 J	0.0177 J	ND(0.0069)
	9/28/10	0.023	ND(0.0008)	ND(0.0008)	0.001 J	0.001 J	0.0242	ND(0.0069)
Dup 9/28/10	0.024	ND(0.0008)	ND(0.0008)	0.001 J	0.001 J	0.0241	ND(0.0069)	
10/20/10	0.009	ND(0.0008)	ND(0.0008)	ND(0.0007)	ND(0.0008)	0.0212	ND(0.0069)	

**TABLE 2-1. SOUTHWEST QUAD DISSOLVED PHASE ANALYTICAL RESULTS SUMMARY (NOVEMBER 2008 TO JUNE 2011)
FIRST 2011 SEMIANNUAL MONITORING PERIOD
CHEVRON CINCINNATI FACILITY, HOOVEN, OHIO**

Location ID	Date Sampled	Benzene (mg/L)	Chlorobenzene (mg/L)	Ethylbenzene (mg/L)	Toluene (mg/L)	Xylenes, Total (mg/L)	Arsenic, Dissolved (mg/L)	Lead, Dissolved (mg/L)
MW-139	3/23/11	ND(0.00051)	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00024)	ND(0.0012)
Dup	3/23/11	ND(0.00051)	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00024)	ND(0.0012)
	5/18/11	0.013	ND(0.00051)	0.0031	0.0017	0.0037	0.01 J	0.0085 J
MW-140	3/27/09	0.35	ND(0.002)	0.43	0.041	0.55	ND(0.01)	ND(0.0069)
	7/10/09	33 J	ND(2) J	2000 J	30 J	--	--	--
	6/15/10	0.12	ND(0.0008)	0.013	0.004 J	0.033	ND(0.0098)	ND(0.0069)
	3/23/11	0.033	ND(0.00051)	0.016	0.0054	0.024	0.007	ND(0.0012) J
MW-141	4/1/09	0.51	ND(0.002)	0.06	0.013	0.039	ND(0.01)	ND(0.0069)
Dup	4/1/09	0.52	ND(0.002)	0.062	0.013	0.042	ND(0.01)	ND(0.0069)
	7/23/09	0.4	ND(0.0008)	0.017	0.011	0.016	ND(0.0072)	ND(0.0069)
	10/13/09	0.29	ND(0.0008)	0.045	0.01	0.032	0.0131 J	ND(0.0069)
	2/24/10	0.19	ND(0.0008)	0.014	0.006	0.015	ND(0.0072)	ND(0.0069)
Dup	2/24/10	0.18	ND(0.0008)	0.014	0.006	0.015	ND(0.0072)	ND(0.0069)
	5/5/10	0.14	ND(0.0008)	0.019	0.008	0.024	0.0094 J	ND(0.0069)
	8/26/10	0.13	ND(0.002)	0.009 J	0.005 J	0.008 J	ND(0.0098)	ND(0.0069)
	3/23/11	0.0071	ND(0.00051)	ND(0.00068)	ND(0.00048)	0.0018	ND(0.00024)	ND(0.0012) J
	5/19/11	ND(0.00051)	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00024)	0.0072 J
MW-142	3/31/09	0.13	ND(0.002)	0.39	0.028	0.35	0.0166 J	ND(0.0069)
	5/28/09	0.12	ND(0.0008)	0.53	0.025	0.31	--	--
	6/30/09	0.31	ND(0.0008)	0.023	0.014	0.056	0.0212	ND(0.0069)
	7/23/09	0.27	ND(0.0008)	0.045	0.015	0.061	0.0254	ND(0.0069)
	8/12/09	0.21	ND(0.002)	0.31	0.022	0.21	0.0172 J	ND(0.0069)
	9/15/09	0.15	ND(0.0008)	0.15	0.019	0.13	0.0219	ND(0.0069)
	10/13/09	0.11	ND(0.0008)	0.19	0.021	0.17	0.0211	ND(0.0069)
	11/18/09	0.043	ND(0.002)	0.052	0.011 JB	0.058	--	--
	12/14/09	0.035	ND(0.0008)	0.12	0.013	0.13	--	--

**TABLE 2-1. SOUTHWEST QUAD DISSOLVED PHASE ANALYTICAL RESULTS SUMMARY (NOVEMBER 2008 TO JUNE 2011)
FIRST 2011 SEMIANNUAL MONITORING PERIOD
CHEVRON CINCINNATI FACILITY, HOOVEN, OHIO**

Location ID	Date Sampled	Benzene (mg/L)	Chlorobenzene (mg/L)	Ethylbenzene (mg/L)	Toluene (mg/L)	Xylenes, Total (mg/L)	Arsenic, Dissolved (mg/L)	Lead, Dissolved (mg/L)
MW-142	1/13/10	0.084	ND(0.002)	0.023	0.006 J	0.027	--	--
Dup	1/13/10	0.085	ND(0.002)	0.023	0.006 J	0.027	--	--
	2/24/10	0.09	ND(0.0008)	0.2	0.017	0.11	0.0211	ND(0.0069)
	3/30/10	0.066	ND(0.0008)	0.039	0.009	0.042	0.0194 J	ND(0.0069)
	4/20/10	0.13	ND(0.0008)	0.061	0.014	0.073	0.0267	ND(0.0069)
Dup	4/20/10	0.13	ND(0.0008)	0.061	0.013	0.074	0.0249	ND(0.0069)
	5/4/10	0.12	ND(0.002)	0.18	0.016	0.15	0.0203	ND(0.0069)
	6/15/10	0.16	ND(0.0008)	0.036	0.013	0.062	0.0192 J	ND(0.0069)
	7/13/10	0.16	ND(0.0008)	0.037	0.011	0.061	0.023	ND(0.0069)
	8/26/10	0.1	ND(0.002)	0.004 J	0.008 J	0.031	0.0211	ND(0.0069)
Dup	8/26/10	0.1	ND(0.002)	0.004 J	0.008 J	0.031	0.0201	ND(0.0069)
	9/28/10	0.11	ND(0.0008)	0.024	0.012	0.047	0.0212	ND(0.0069)
	10/20/10	0.15	ND(0.0008)	0.072	0.014	0.07	0.0226	ND(0.0069)
Dup	10/20/10	0.16	ND(0.0008)	0.074	0.015	0.073	0.0243	ND(0.0069)
	3/23/11	0.02	ND(0.00051)	0.052	0.0053	0.033	0.012	ND(0.0012)
	5/18/11	0.067	ND(0.00051)	0.11	0.0098	0.048	0.013	0.012 J
Dup	5/18/11	0.067	ND(0.00051)	0.11	0.0098	0.047	0.014	0.012 J

NOTES:

The method detection limit was used as the reporting limit.

-- - Not analyzed

Dup - Duplicate sample

J - Estimated concentration

JB - Estimated concentration due to detection of analyte within the method blank.

mg/L - milligram per liter

ND - Not detected at the indicated laboratory reporting limit or the method detection limit.

U* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration during validation due to detection of the analyte within the method blank.

**TABLE 2-2. PERIMETER, INTERIOR, AND SUPPLEMENTAL WELL GROUNDWATER ANALYTICAL RESULTS SUMMARY
FIRST 2011 SEMIANNUAL MONITORING PERIOD
CHEVRON CINCINNATI FACILITY, HOOVEN, OHIO**

Location ID	Date Sampled	Benzene (mg/L)	Ethylbenzene (mg/L)	Toluene (mg/L)	Xylenes, Total (mg/L)	Chlorobenzene (mg/L)	Arsenic, Dissolved (mg/L)	Lead, Dissolved (mg/L)
L-1RR	5/16/11	2.1	1.5	0.33	7.4	ND(0.00051)	0.053	0.029
L-3R	5/16/11	2.2	0.96	0.09	0.29	ND(0.00051)	0.022	0.0085
MW-10	5/18/11	0.0013	0.0016	ND(0.00048)	ND(0.00073)	ND(0.00051)	ND(0.00024)	0.0088 J
MW-17	5/19/11	3.2	0.38	0.066	0.12	ND(0.00051)	0.03	0.01 J
MW-18R	5/10/11	0.62	1.5	0.074	2	ND(0.00051)	0.023	0.024
MW-20S	5/10/11	0.57	0.97	0.055	1.3	ND(0.00051)	0.041	0.025
MW-21 Dup	5/05/11	0.094	1.7	0.058	0.77	ND(0.00051)	ND(0.00024)	ND(0.0012)
MW-21	5/05/11	0.094	1.9	0.057	0.83	ND(0.00051)	ND(0.00024)	ND(0.0012)
MW-22	5/16/11	0.0065	0.035	0.0046	0.052	ND(0.00051)	0.013	ND(0.0012)
MW-26R	5/18/11	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00051)	ND(0.00024)	ND(0.0012) J
MW-33	5/11/11	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00051)	ND(0.00024)	ND(0.0012)
MW-48S	5/19/11	ND(0.00051)	0.31	ND(0.00048)	1.3	ND(0.00051)	0.02	0.011 J
MW-51	5/09/11	ND(0.00051)	ND(0.00068) J	ND(0.00048)	ND(0.00073)	ND(0.00051)	ND(0.00024)	0.0092
MW-64	5/17/11	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00051)	ND(0.00024)	ND(0.0012)
MW-80 Dup	5/17/11	0.86	0.0013	0.012	0.013	ND(0.00051)	0.017	ND(0.0012)
MW-80	5/17/11	0.83	0.0013	0.012	0.013	ND(0.00051)	0.018	ND(0.0012)
MW-81S	5/12/11	0.43	0.027	0.0068	0.032	ND(0.00051)	0.007 JB	ND(0.0012)
MW-85D	5/18/11	ND(0.00051)	ND(0.00068)	0.0019	ND(0.00073)	ND(0.00051)	ND(0.00024)	ND(0.0012) J
MW-85S	5/10/11	0.055	0.021	0.005	0.02	ND(0.00051)	0.013	0.018
MW-93S Dup	6/06/11	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00051)	ND(0.00024)	ND(0.0012)
MW-93S	6/06/11	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00051)	ND(0.00024)	ND(0.0012)
MW-94S	5/17/11	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00051)	ND(0.00024)	ND(0.0012)
MW-95S	5/12/11	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00051)	ND(0.00024)	ND(0.0012)
MW-96S	5/12/11	0.28	0.17	0.0094	0.51	ND(0.00051)	0.022	0.017
MW-99S	5/17/11	ND(0.00051)	0.014	ND(0.00048)	0.012	ND(0.00051)	0.02	0.012 JB
MW-100S	5/12/11	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00051)	ND(0.00024)	ND(0.0012)
MW-104S	5/19/11	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00051)	ND(0.00024)	ND(0.0012) J
MW-115S	5/11/11	0.01	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00051)	0.011 JB	ND(0.0012)

Notes:

-- Not analyzed

J - Estimated concentration

JB - Estimated concentration due to detection of analyte within the method blank

mg/L - milligram per liter

ND - Not detected at the indicated laboratory reporting limit or method detection limit.

The method detection limit (MDL) was used as the reporting limit.

**TABLE 2-3. DISSOLVED PHASE NATURAL ATTENUATION ANALYTICAL RESULTS SUMMARY
FIRST 2011 SEMIANNUAL MONITORING PERIOD
CHEVRON CINCINNATI FACILITY, HOOVEN, OHIO**

Location ID	Date Sampled	Alkalinity (mg/L)	Calcium, Total (mg/L)	Chemical Oxygen Demand (mg/L)	Chloride (mg/L)	Iron, Ferric (mg/L)	Iron, Dissolved (mg/L)
L-1RR	5/16/11	160	130	110	40	1.6	11
MW-18R	5/10/11	460	130	83	38	ND(0.00097) J	22
MW-20S	5/10/11	620	180	110	30	0.48	18
MW-33	5/11/11	410	120	12	12	ND(0.00097)	1.3
MW-35	5/11/11	430	110	ND(5)	80	ND(0.00097)	ND(0.00097)
MW-38	5/11/11	570	160	18	120	ND(0.00097)	11
MW-51	5/09/11	480	140	ND(5)	25	ND(0.00097)	ND(0.00097)
MW-81S	5/12/11	600	150	36	100	ND(0.00097) J	15
MW-85S	5/10/11	530	150	58	20	0.46	28
MW-96S	5/12/11	620	180	180	180	ND(0.00097) J	14
MW-100S	5/12/11	340	110	ND(5)	110	ND(0.00097)	ND(0.00097)
MW-112	5/10/11	580	190	55	28	ND(0.00097) J	8.1
MW-114	5/16/11	500	120	ND(5)	180	ND(0.00097)	ND(0.00097)
MW-115S	5/11/11	450	110	7.9	52	ND(0.00097) J	7.9

Notes:
 -- Not analyzed
 J - Estimated concentration
 ND - Not detected
 mg/L - milligram per liter

The method detection limit (MDL) was used as the reporting limit.

**TABLE 2-3. DISSOLVED PHASE NATURAL ATTENUATION ANALYTICAL RESULTS SUMMARY
FIRST 2011 SEMIANNUAL MONITORING PERIOD
CHEVRON CINCINNATI FACILITY, HOOVEN, OHIO**

Location ID	Date Sampled	Manganese, Total (mg/L)	Manganese, Dissolved (mg/L)	Methane (mg/L)	Nitrogen, Nitrate (mg/L)	Nitrogen, Nitrite (mg/L)	Ammonia (mg/L)
L-1RR	5/16/11	0.48	0.42	11	ND(0.0045)	ND(0.0061)	0.1
MW-18R	5/10/11	0.49	0.49	6	ND(0.0045)	ND(0.0061)	1
MW-20S	5/10/11	0.34	0.33	6.4	ND(0.0045)	ND(0.0061)	0.97
MW-33	5/11/11	1.2	1.2	0.8	ND(0.0045)	ND(0.0061)	0.18
MW-35	5/11/11	0.53	0.5	0.092	0.39	ND(0.0061)	ND(0.007)
MW-38	5/11/11	0.83	0.8	2.9	ND(0.0045)	ND(0.0061)	0.55
MW-51	5/09/11	ND(0.00023)	ND(0.00023)	ND(0.00083)	0.64	ND(0.006)	ND(0.007)
MW-81S	5/12/11	0.23	0.24	5.9	ND(0.0045)	ND(0.0061)	0.098
MW-85S	5/10/11	1.7	1.7	6.7	ND(0.0045)	ND(0.0061)	0.88
MW-96S	5/12/11	1.1	1.1	8.6	0.38	ND(0.0061)	0.7
MW-100S	5/12/11	ND(0.00023)	ND(0.00023)	0.012	6	ND(0.0061)	ND(0.007)
MW-112	5/10/11	1.1	1.1	3.1	1.2	ND(0.0061)	1.7
MW-114	5/16/11	ND(0.00023)	ND(0.00023)	ND(0.00083)	6.4	ND(0.0061)	ND(0.007)
MW-115S	5/11/11	1.1	1.2	2	ND(0.0045)	ND(0.0061)	0.13

Notes:
 -- Not analyzed
 J - Estimated concentration
 ND - Not detected
 mg/L - milligram per liter

The method detection limit (MDL) was used as the reporting limit.

**TABLE 2-3. DISSOLVED PHASE NATURAL ATTENUATION ANALYTICAL RESULTS SUMMARY
FIRST 2011 SEMIANNUAL MONITORING PERIOD
CHEVRON CINCINNATI FACILITY, HOOVEN, OHIO**

Location ID	Date Sampled	Nitrogen, Kjeldahl (mg/L)	Potassium, Total (mg/L)	Sodium, Total (mg/L)	Sulfate (mg/L)	Total Sulfide (mg/L)	Total Organic Carbon (mg/L)
L-1RR	5/16/11	ND(0.3)	3	25	ND(0.02)	1.5	5.9
MW-18R	5/10/11	3.4	3.3	40	15	1.4	11
MW-20S	5/10/11	3.7	3.5	30	5	1.2	22
MW-33	5/11/11	ND(0.3)	1.1	7.8	13	ND(0.78)	2.3
MW-35	5/11/11	ND(0.3)	5.1	50	19	ND(0.78)	1.1
MW-38	5/11/11	1.7	4.2	88	34	ND(0.78)	3.5
MW-51	5/09/11	ND(0.3)	2.5	22	25 J	ND(0.78)	1.7
MW-81S	5/12/11	1.4	3.8	57	2.5	ND(0.78)	7.8
MW-85S	5/10/11	3.1	2	24	3.4	1.1	11
MW-96S	5/12/11	7	5.6	120	32	ND(0.78)	51
MW-100S	5/12/11	ND(0.3)	5.9	74	55	ND(0.78)	0.77
MW-112	5/10/11	5	4.8	24	76	ND(0.78)	15
MW-114	5/16/11	ND(0.3)	4.4	110	65	ND(0.78)	0.72
MW-115S	5/11/11	ND(0.3)	2.2	25	ND(0.02)	ND(0.78)	2.6

Notes:
 -- Not analyzed
 J - Estimated concentration
 ND - Not detected
 mg/L - milligram per liter

The method detection limit (MDL) was used as the reporting limit.

**TABLE 2-4. LYSIMETER ANALYTICAL RESULTS SUMMARY
FIRST 2011 SEMIANNUAL MONITORING PERIOD
CHEVRON CINCINNATI FACILITY, HOOVEN, OHIO**

Location ID	Date Sampled	Dissolved Oxygen ¹ (mg/L)	ORP ¹	Methane (mg/L)	Manganese Total (mg/L)	Manganese Dissolved (mg/L)	Iron Total (mg/L)	Nitrogen Nitrate (mg/L)	Sulfate (mg/L)	Iron Dissolved (mg/L)	Assimilative Capacity (mg hydrocarbon/L)
L-18S	5/14/09	4.2	189	1.9	0.362	0.357	0.319	ND(0.25)	1.8 J	ND(0.0522)	-0.500
	12/09/09	2.8	148	1.4	0.257	0.26	1.36	ND(0.25)	ND(1.5)	ND(0.0522)	-0.231
	6/03/10	2.0	45	2.7	0.256	0.259	2.38	ND(0.25)	ND(1.5)	ND(0.0522)	-2.268
	12/20/10	1.0	23	2.4	0.134	0.131	8.39	ND(0.25)	ND(1.5)	ND(0.0522)	-1.842
	6/16/11	2.0	-24	3.0	1.1	1.0	12	ND(0.0045)	ND(0.02)	7.2	-3.096
L-20S	5/14/09	2.6	208	ND(0.014)U	0.637	0.66	0.268	ND(0.25)	156	ND(0.0522)	15.000
	12/09/09	4.0	164	ND(0.01)	0.0978	0.0089	1	10.7	169	ND(0.0522)	35.290
	6/03/10	2.0	86	0.011 J	1.99	1.92	1.15	ND(0.25)	59.6	ND(0.0522)	11.734
	12/20/10	2.0	116	ND(0.005)	0.0518	0.0181	0.351	2.5	126 J	ND(0.0522)	24.981
	6/16/11	2.8	142	0.0024	0.13	0.11	ND(0.00097)	5.0	46	ND(0.00097)	10.490
L-21S	5/14/09	3.0	211	0.27	0.197	0.187	1.21	ND(0.25)	1.6 J	ND(0.0522)	0.900
	12/09/09	5.0	189	0.34	0.155	0.157	0.41	ND(0.25)	ND(1.5)	ND(0.0522)	1.581
	6/03/10	6.0	67	2.2	0.148	0.145	1.02	ND(0.25)	ND(1.5)	ND(0.0522)	-0.548
	12/20/10	3.0	82	0.95	0.12	0.117	3.87	ND(0.25)	ND(1.5)	ND(0.0522)	0.334
	6/16/11	2.0	69	0.74	0.17	0.17	1.8	ND(0.0045)	ND(0.02)	ND(0.00097)	-0.246
L-93S	5/14/09	6.0	173	ND(0.005)	0.0039 J	0.0034 J	ND(0.0522)	14.4	124	ND(0.0522)	19.800
	12/09/09	6.0	84	ND(0.01)	0.0034 J	0.0035 J	ND(0.0522)	1.3	155	ND(0.0522)	31.424
	6/03/10	6.0	101	ND(0.005)	0.0036 J	0.0014 J	0.0813 J	14.6	45.5	ND(0.0522)	13.155
	12/20/10	6.0	116	ND(0.005)	0.0041 J	0.0034 J	0.106 J	25.3	32.9 J	ND(0.0522)	12.785
	6/16/11	2.8	72	ND(0.00083)	ND(0.00023)	ND(0.00023)	ND(0.00097)	15	60	ND(0.00097)	15.062

NOTES:

¹ - ORP and DO measured in the field using titration kits

The method detection limit was used as the reporting limit

J - Estimated concentration

mg/L - milligram per liter

mg hydrocarbon/L - milligrams of petroleum hydrocarbons per liter

ND - Not detected at the indicated laboratory reporting limit or the method detection limit

ND(0.014)U - The result was evaluated to be undetected at the reported concentration during validation due to detection of the analyte within the method blank

**TABLE 2-5. BARRIER WALL PERFORMANCE MONITORING ANALYTICAL RESULTS SUMMARY
FIRST 2011 SEMIANNUAL MONITORING PERIOD
CHEVRON CINCINNATI FACILITY, HOOVEN, OHIO**

Location ID	Date Sampled	Benzene (mg/L)	Ethyl- benzene (mg/L)	Toluene (mg/L)	Xylenes, Total (mg/L)	Chlorobenzene (mg/L)	Arsenic, Dissolved (mg/L)	Lead, Dissolved (mg/L)
MW-135D	5/24/11	0.0015	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00051)	ND(0.00024)	0.0086 J
MW-135I	5/25/11	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00051)	ND(0.00024)	ND(0.0012)
MW-135S	5/25/11	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00051)	ND(0.00024)	0.0082 J
BMW-1D	5/25/11	0.0022	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00051)	ND(0.00024)	ND(0.0012)
BMW-1I	6/01/11	0.0012	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00051)	ND(0.00024)	ND(0.0012)
BMW-1S	6/01/11	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00051)	ND(0.00024)	ND(0.0012)
BSW-1D	6/09/11	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00051)	ND(0.00024)	ND(0.0012)
BSW-1S	6/09/11	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00051)	ND(0.00024)	ND(0.0012)
MW-136D Dup	5/26/11	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00051)	ND(0.00024)	ND(0.0012)
MW-136D	5/26/11	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00051)	ND(0.00024)	ND(0.0012)
MW-136I	5/26/11	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00051)	ND(0.00024)	ND(0.0012)
MW-136S	6/01/11	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00051)	0.014 JB	ND(0.0012)
BMW-2D	6/07/11	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00051)	ND(0.00024)	ND(0.0012)
BMW-2I	6/07/11	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00051)	ND(0.00024)	ND(0.0012)
BMW-2S	6/07/11	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00051)	ND(0.00024)	ND(0.0012)
BSW-2D	6/09/11	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00051)	ND(0.00024)	ND(0.0012)
BSW-2S	6/09/11	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00051)	ND(0.00024)	ND(0.0012)
MW-137D Dup	6/07/11	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00051)	ND(0.00024)	ND(0.0012)
MW-137D	6/07/11	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00051)	ND(0.00024)	ND(0.0012)
MW-137I	6/07/11	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00051)	ND(0.00024)	ND(0.0012)
MW-137S	6/07/11	ND(0.00051)	ND(0.00068)	0.0036	ND(0.00073)	ND(0.00051)	ND(0.00024)	ND(0.0012)
BMW-3D	6/02/11	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00051)	ND(0.00024)	ND(0.0012)
BMW-3I	6/02/11	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00051)	ND(0.00024)	ND(0.0012)
BMW-3S	6/09/11	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00051)	ND(0.00024)	ND(0.0012)
BSW-3D	6/08/11	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00051)	ND(0.00024)	ND(0.0012)
BSW-3S	6/08/11	ND(0.00051)	ND(0.00068)	ND(0.00048)	ND(0.00073)	ND(0.00051)	ND(0.00024)	ND(0.0012)

Notes:

- Not analyzed
- J - Estimated concentration
- JB - Estimated concentration due to detection of analyte within the method blank
- mg/L - milligram per liter
- ND - Not detected at the indicated laboratory reporting limit or method detection limit.

The method detection limit (MDL) was used as the reporting limit.

**TABLE 3-1. DISTRIBUTION OF DISSOLVED PHASE CONSTITUENTS
FIRST 2011 SEMIANNUAL MONITORING PERIOD
CHEVRON CINCINNATI FACILITY, HOOVEN, OHIO**

Constituent	Up-Gradient of Smear Zone ¹	Within Smear Zone ²	Down-Gradient of Smear Zone ³
Average TPH Concentration	0.086	7.3	--
Average BTEX Concentration	0.0003	0.3	0.0006
Average Benzene Concentration	0.0003	0.36	0.0012
Average Nitrate Concentration	4.4	0.160	0.39
Average Sulfate Concentration	60.0	18.1	19
Average Ferrous Iron Concentration	0.0005	13.6	0.00049
Average Dissolved Manganese Concentration	0.0001	0.86	0.5
Average Methane Concentration	0.004	5.3	0.092

NOTES:

Concentrations reported in milligrams per liter

Average values estimated assuming non-detect concentrations equal one half the detection limit, or average of detection limits when all constituents are non-detect

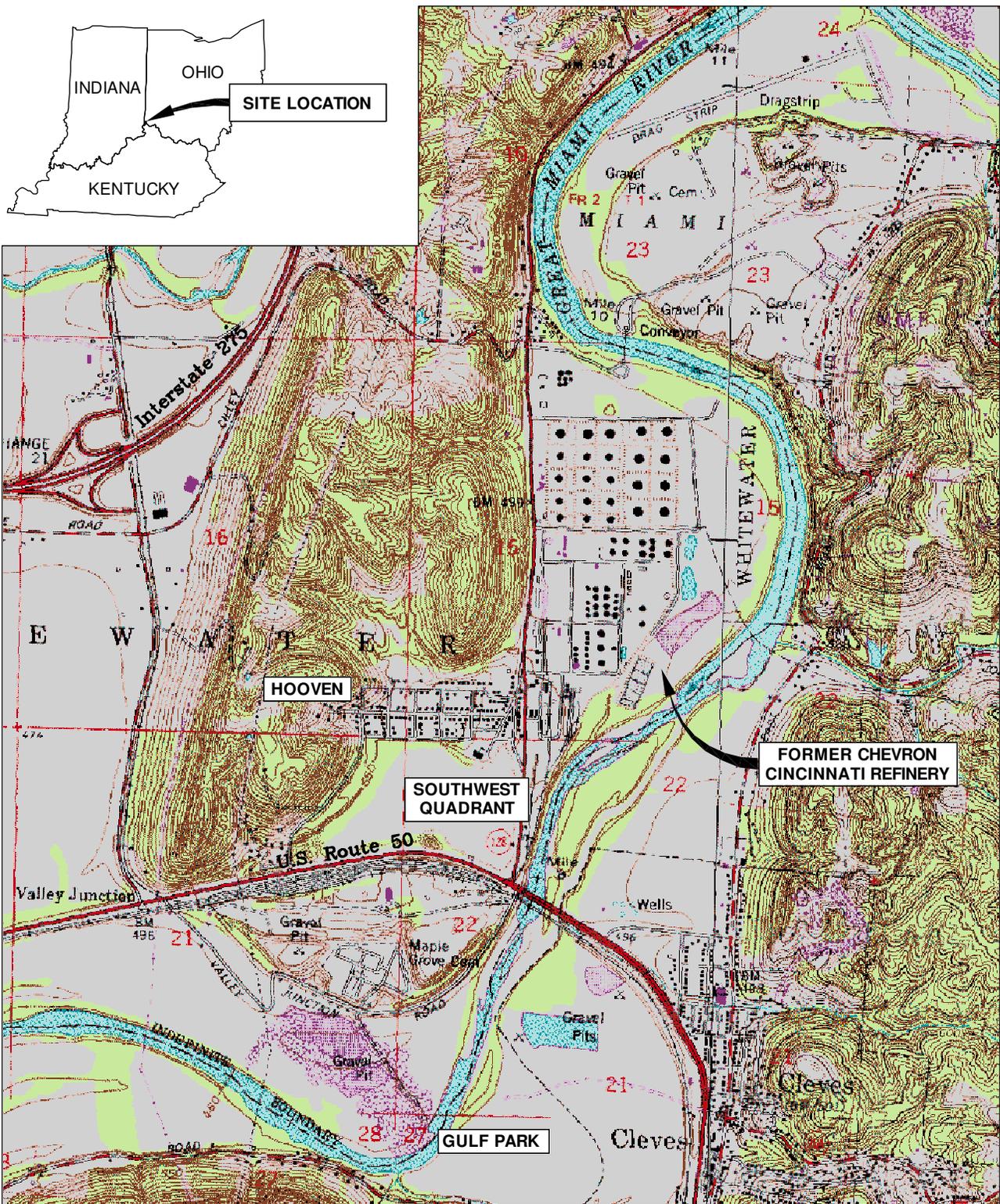
-- Not analyzed

¹ - Wells Upgradient of Smear Zone include MW-51, MW-95S, MW-100S, MW-113, MW-114, and MW-129

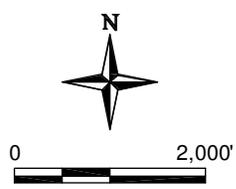
² - Wells within Smear Zone include L-1RR, MW-10, MW-17, MW-18R, MW-20S, MW-21, MW-22, MW-26R, MW-33, MW-38, MW-48S, MW-52, MW-64, MW-80, MW-81S, MW-85S, MW-93S, MW-94S, MW-96S, MW-104S, MW-112, MW-115S, MW-124, MW-139, MW-141, and MW-142

³ - Wells Downgradient of Smear Zone include MW-35, MW-37, MW-120, MW-131, MW-132, MW-133, MW-134, and MW-138

FIGURES

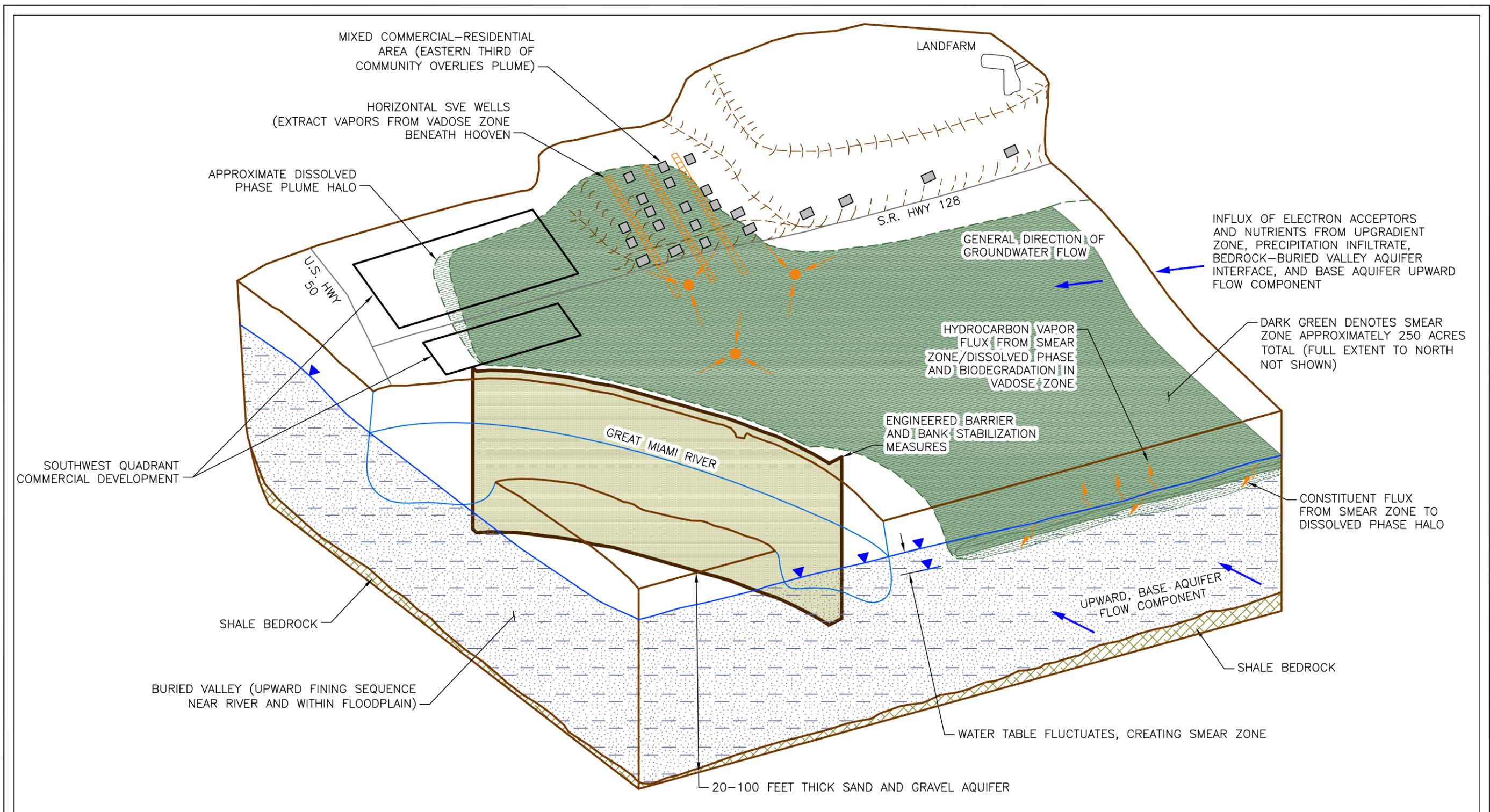


Basemap: U.S.G.S 7.5' Quadrangles, Hooven and Addyston, Ohio, 1996



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FIGURE 1-1			
SITE LOCATION MAP			
FIRST 2011 SEMIANNUAL MONITORING PERIOD			
CHEVRON CINCINNATI FACILITY			
HOOVEN, OHIO			
Drawn By: REP	Checked By: JP	Scale: 1" = 2,000'	Date: 1/13/2011
File: 500USGSSITE201011			



Source: Provided by Chevron Cincinnati.

EXPLANATION

-  HIGH-GRADE PUMPING TARGETED AREAS WITH HIGHEST RESIDUAL LNAPL SATURATION.
-  WATER LEVEL
-  DISSOLVED PHASE PLUME EXTENT
-  SMEAR ZONE EXTENT

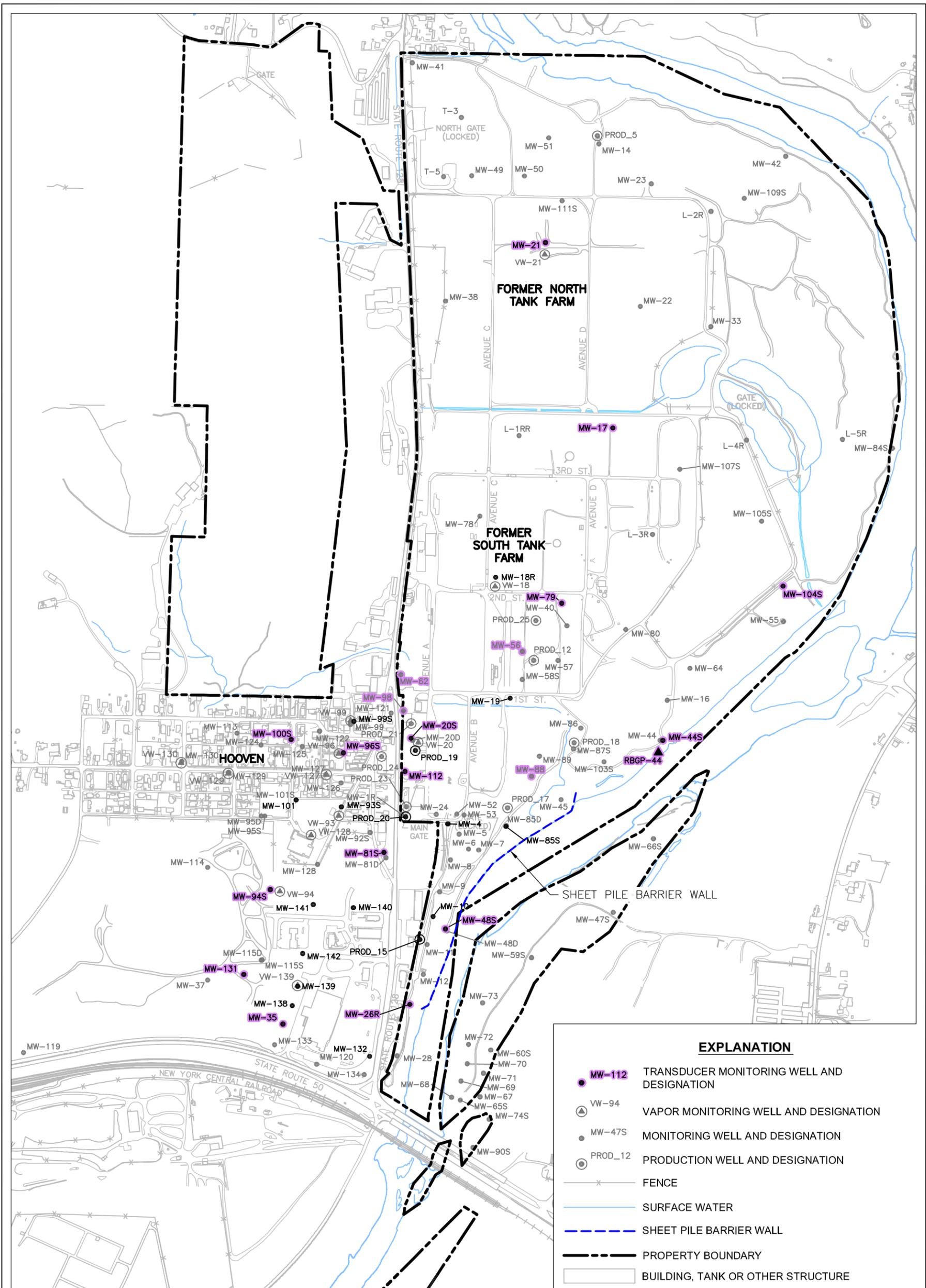


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FIGURE 1-2

GROUNDWATER CONCEPTUAL SITE MODEL
FIRST 2011 SEMIANNUAL MONITORING PERIOD
CHEVRON CINCINNATI FACILITY
HOOVEN, OHIO

Drawn By: REP | Checked By: JP | Scale: NONE | Date: 11/19/2010 | File: 500GWCONCMODEL-201011



EXPLANATION

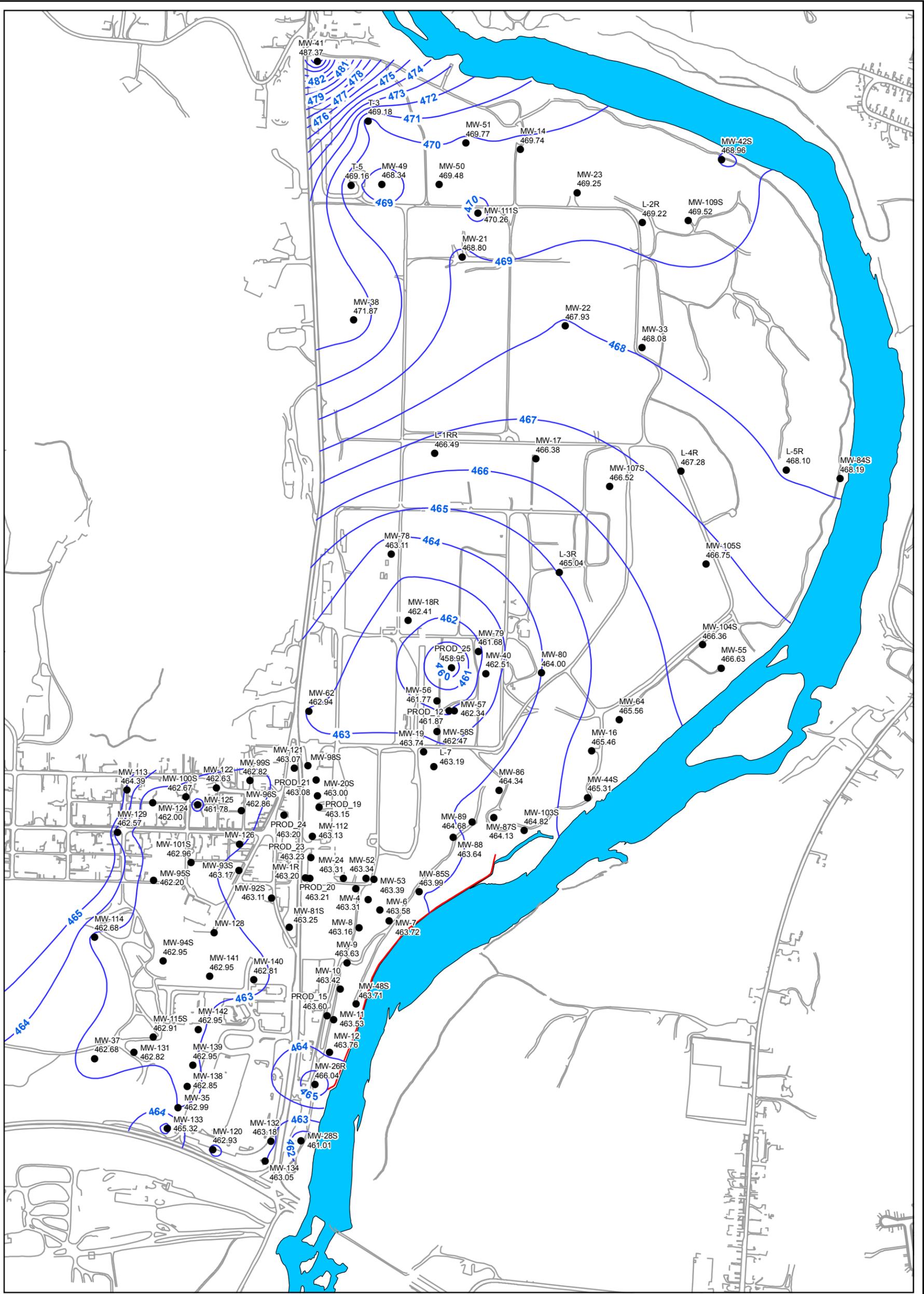
- MW-112 TRANSDUCER MONITORING WELL AND DESIGNATION
- ▲ VW-94 VAPOR MONITORING WELL AND DESIGNATION
- MW-47S MONITORING WELL AND DESIGNATION
- ⊙ PROD_12 PRODUCTION WELL AND DESIGNATION
- FENCE
- SURFACE WATER
- SHEET PILE BARRIER WALL
- PROPERTY BOUNDARY
- ▭ BUILDING, TANK OR OTHER STRUCTURE

FIGURE 2-1

TRANSDUCER MONITORING WELLS

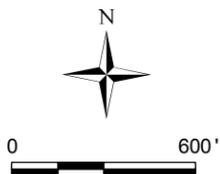
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EXPLANATION

 EQUIPOTENTIAL CONTOUR LINE
 Elevation In Feet Above Mean Sea Level
 Contour Interval is 1.0 feet
 (Line dashed where approximate)

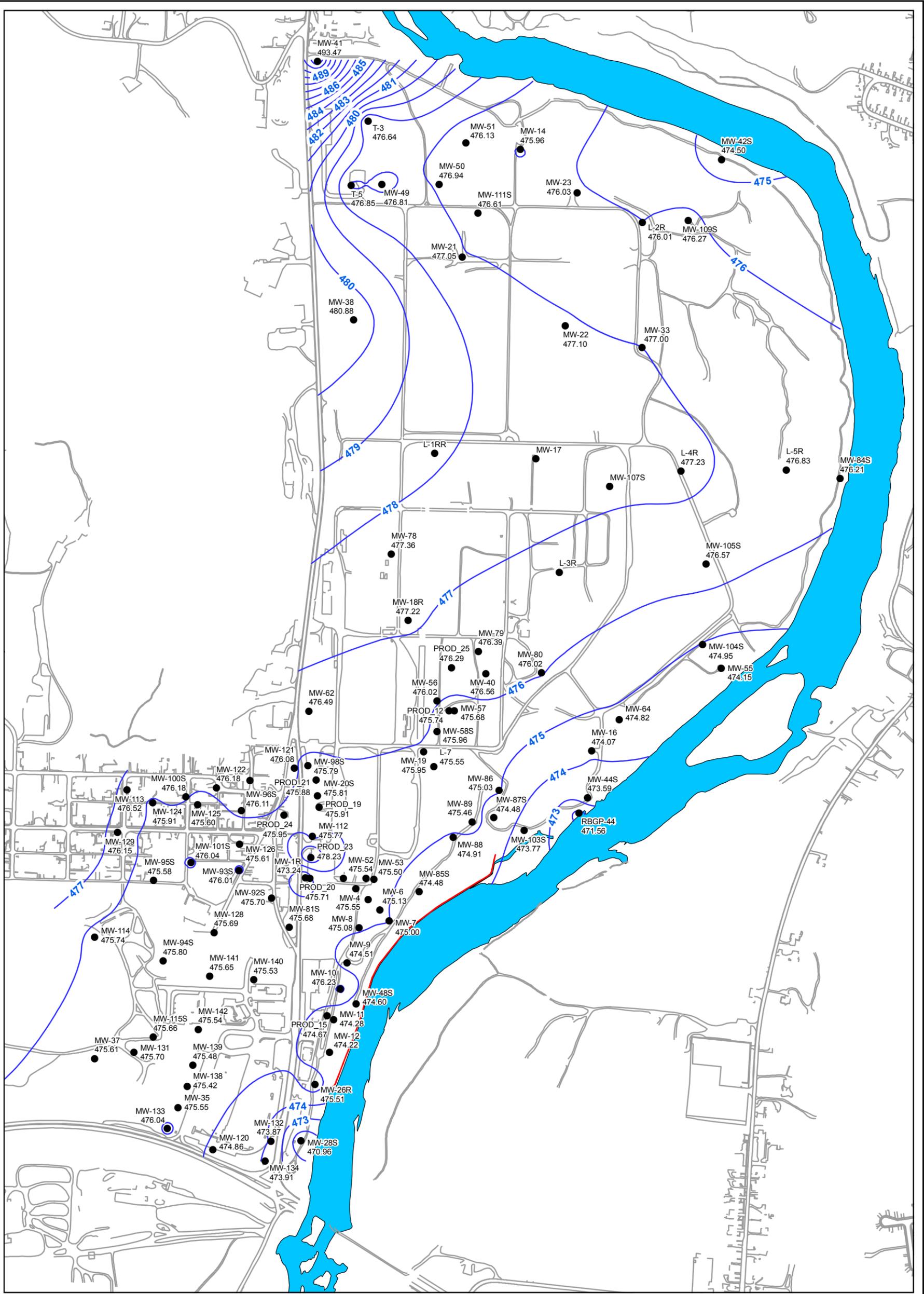



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FIGURE 2-2

**POTENTIOMETRIC SURFACE MAP
JANUARY 27, 2011**

**FIRST 2011 SEMIANNUAL MONITORING PERIOD
CHEVRON CINCINNATI FACILITY
HOOVEN, OHIO**



EXPLANATION

— EQUIPOTENTIAL CONTOUR LINE
 Elevation In Feet Above Mean Sea Level
 Contour Interval is 1.0 feet
 (Line dashed where approximate)



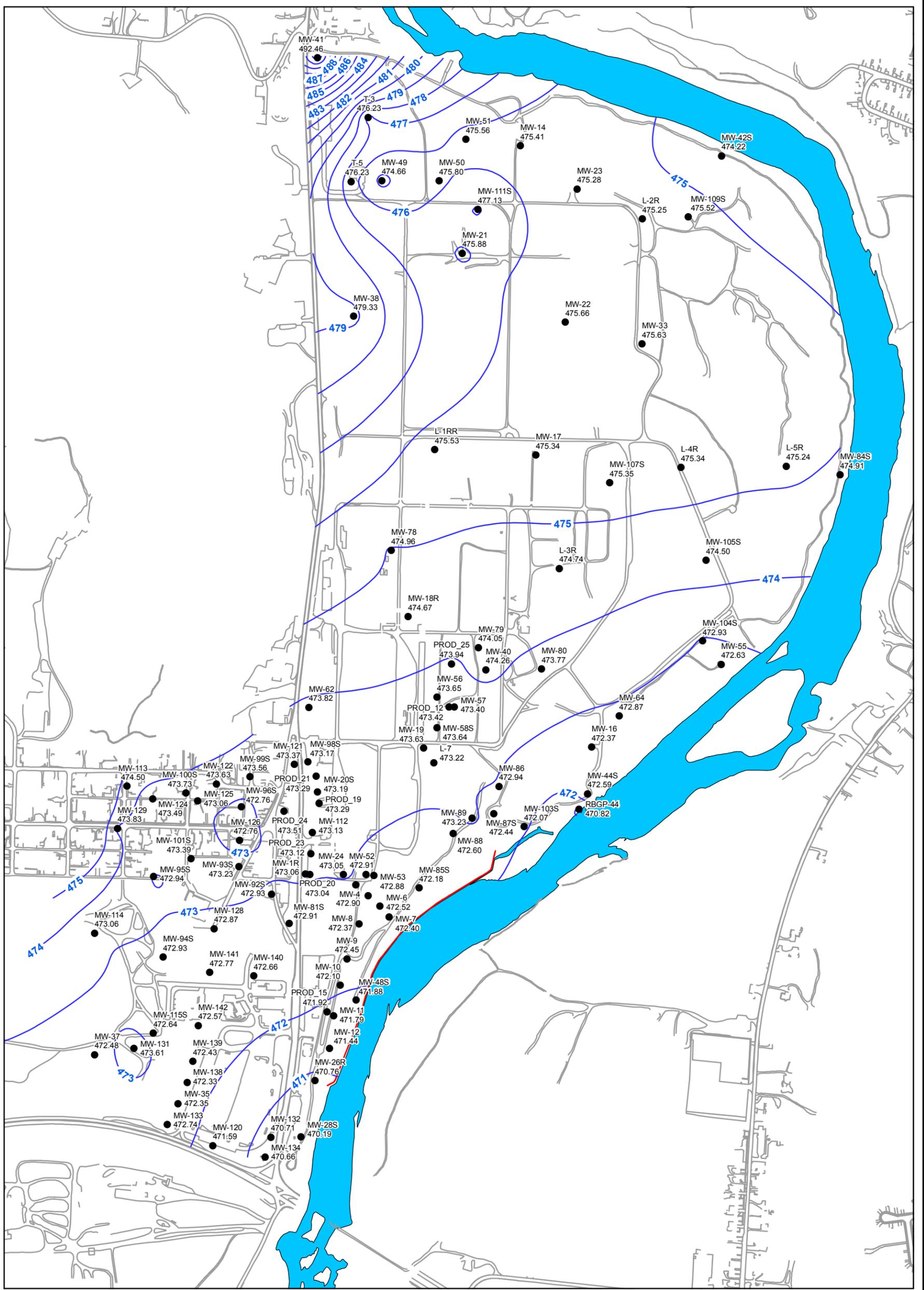
0 600'

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FIGURE 2-3

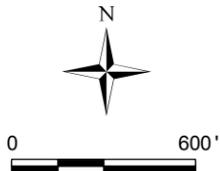
**POTENTIOMETRIC SURFACE MAP
 MARCH 18, 2011**

**FIRST 2011 SEMIANNUAL MONITORING PERIOD
 CHEVRON CINCINNATI FACILITY
 HOOVEN, OHIO**



EXPLANATION

— EQUIPOTENTIAL CONTOUR LINE
 Elevation In Feet Above Mean Sea Level
 Contour Interval is 1.0 feet
 (Line dashed where approximate)

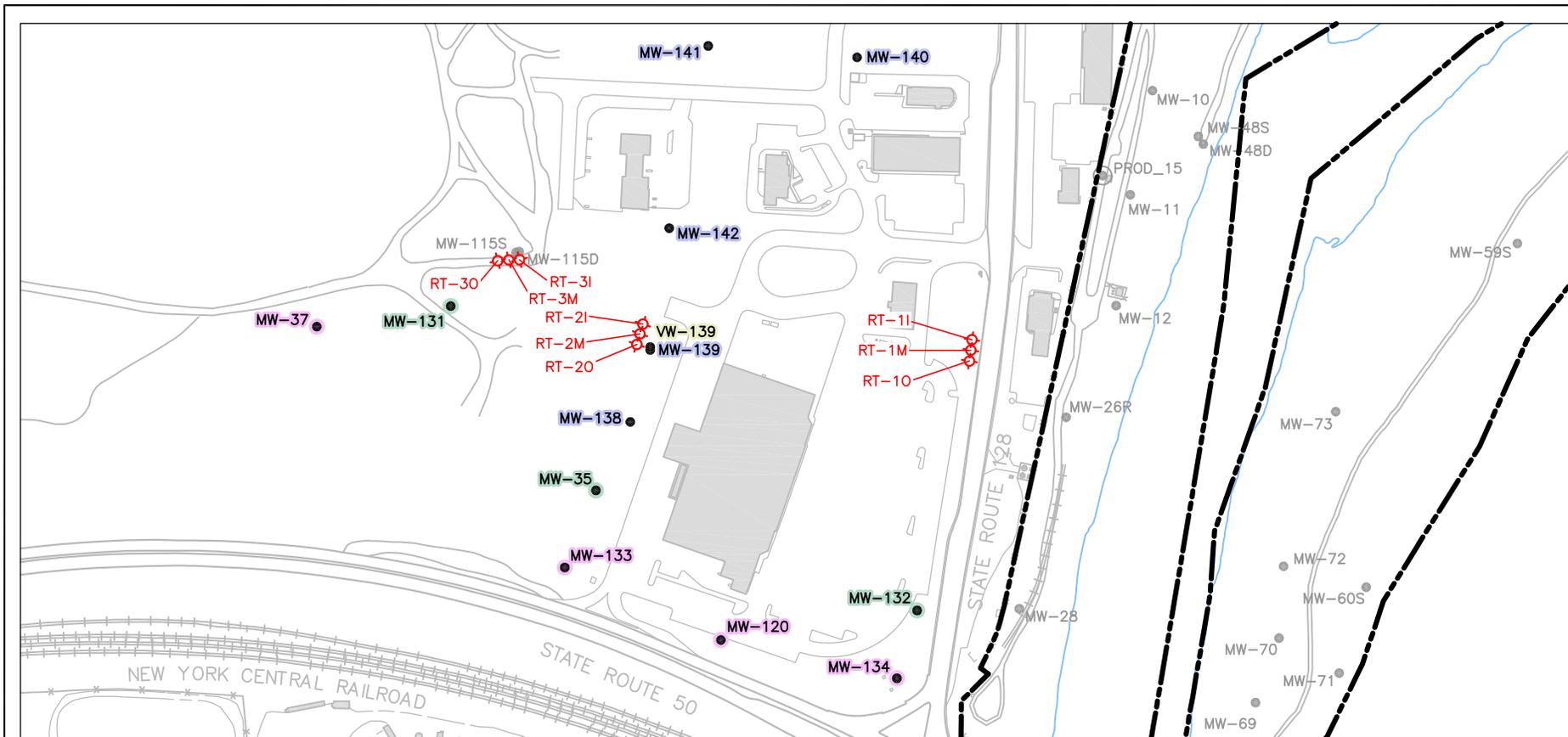


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FIGURE 2-4

**POTENTIOMETRIC SURFACE MAP
 MAY 31, 2011**

**FIRST 2011 SEMIANNUAL MONITORING PERIOD
 CHEVRON CINCINNATI FACILITY
 HOOVEN, OHIO**



EXPLANATION



PERMANENT ROST TRANSECT AND DESIGNATION
(I-INNER, M-MIDDLE, O-OUTER)

— SURFACE WATER

--- PROPERTY BOUNDARY

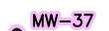
■ BUILDING, TANK OR OTHER STRUCTURE



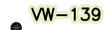
MONITORING WELL AND DESIGNATION
(INSTALLED MARCH 2009)



SENTINEL MONITORING WELL AND DESIGNATION



POINT OF COMPLIANCE MONITORING WELL
AND DESIGNATION



NESTED VAPOR WELL AND DESIGNATION



MONITORING WELL AND DESIGNATION



PRODUCTION WELL AND DESIGNATION



0 300'



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FIGURE 2-5

**SENTINEL, POINT OF COMPLIANCE, AND ROST
MONITORING NETWORK**

**FIRST 2011 SEMIANNUAL MONITORING PERIOD
CHEVRON CINCINNATI FACILITY
HOOVEN, OHIO**

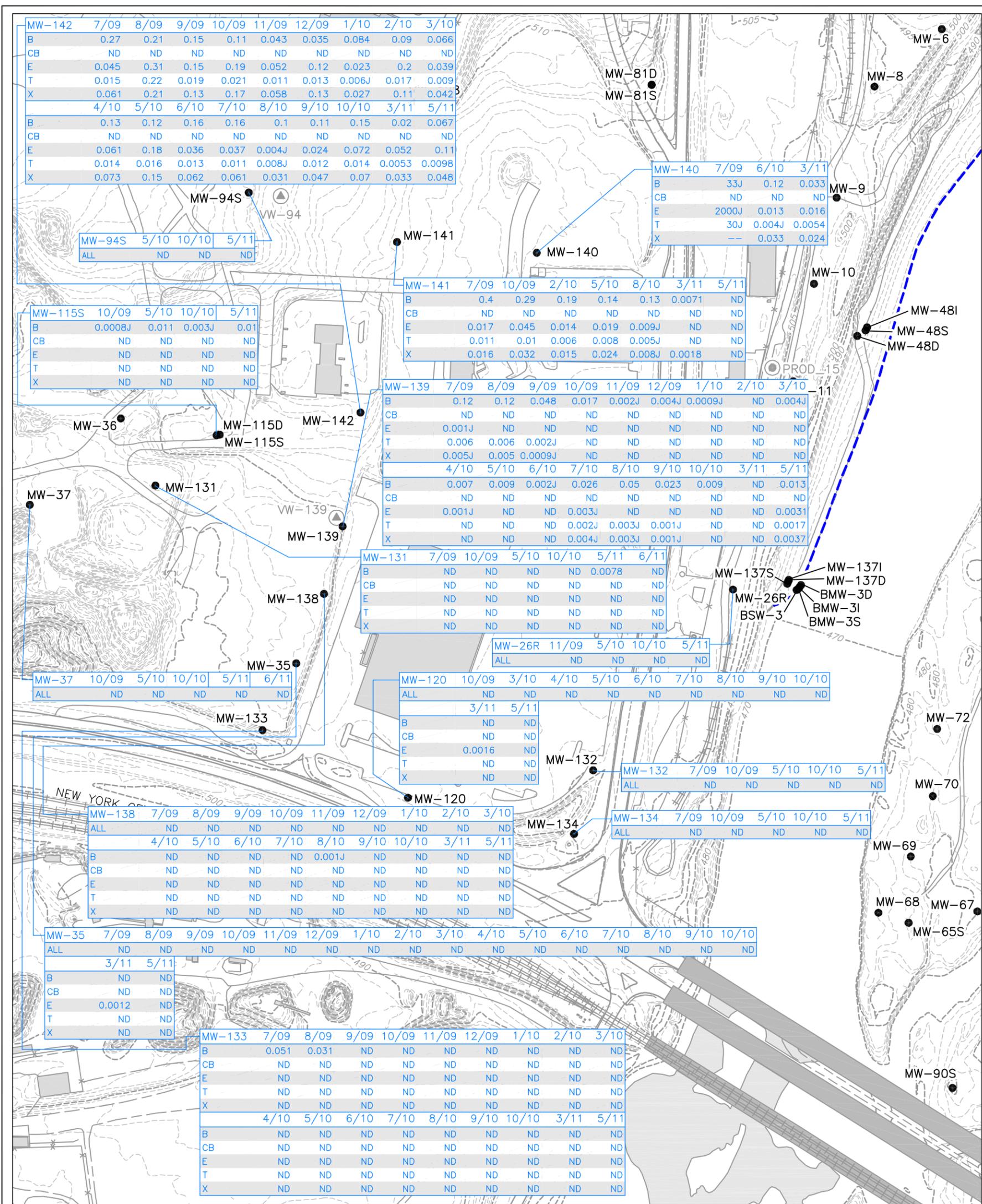
Drawn By: REP

Checked By: JP

Scale: 1"=300'

Date: 11/19/2010

File: 500ROST-TRANSECTS201011



EXPLANATION

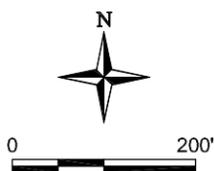
CONSTITUENT TABLE EXPLANATION

- BSW-3D BARRIER MONITORING WELL AND DESIGNATION
- MW-27 MONITORING WELL AND DESIGNATION
- ▲ VW-94 NESTED SOIL VAPOR MONITORING WELL AND DESIGNATION
- PROD_15 PRODUCTION WELL AND DESIGNATION
- SHEET PILE BARRIER WALL
- FENCE
- BUILDING, TANK OR OTHER STRUCTURE
- GROUND SURFACE CONTOURS (INTERVAL= 5')

WELL DESIGNATION	→	MW-133	3/10	←	SAMPLE DATE
Benzene	→	B	0.5		
Chlorobenzene	→	CB	0.8		
Ethylbenzene	→	E	0.8		
Toluene	→	T	0.7		
Xylenes, Total	→	X	0.8		

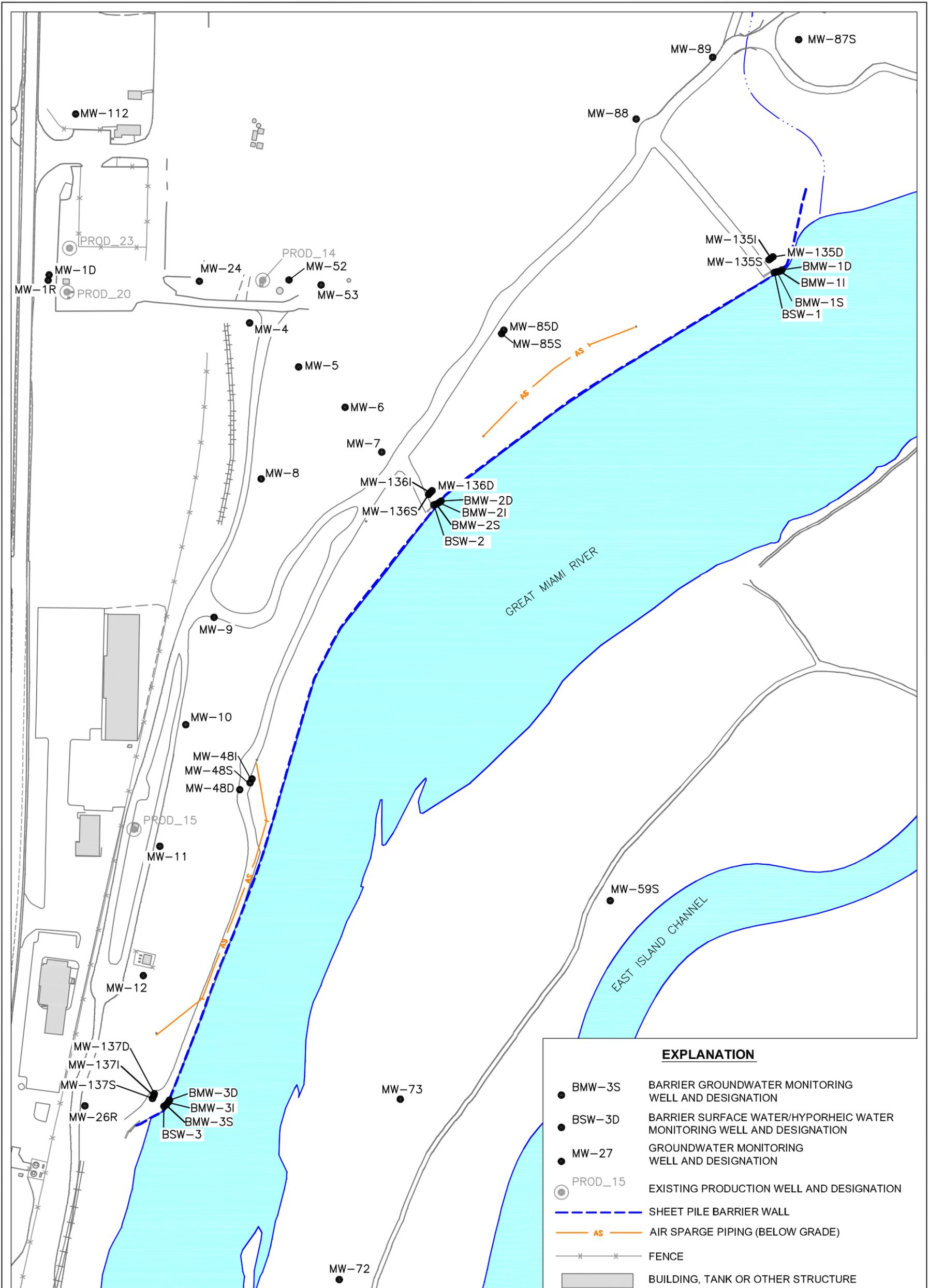
NOTES:

1. ALL VALUES ARE IN MILLIGRAMS PER LITER (mg/L)
2. J = ESTIMATED CONCENTRATION
3. -- = NOT MEASURED



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FIGURE 2-6
SOUTHWEST QUAD DISSOLVED PHASE
RESULTS SUMMARY
(JULY 2009 THROUGH JUNE 2011)
FIRST 2011 SEMIANNUAL MONITORING PERIOD
CHEVRON CINCINNATI FACILITY
HOOVEN, OHIO



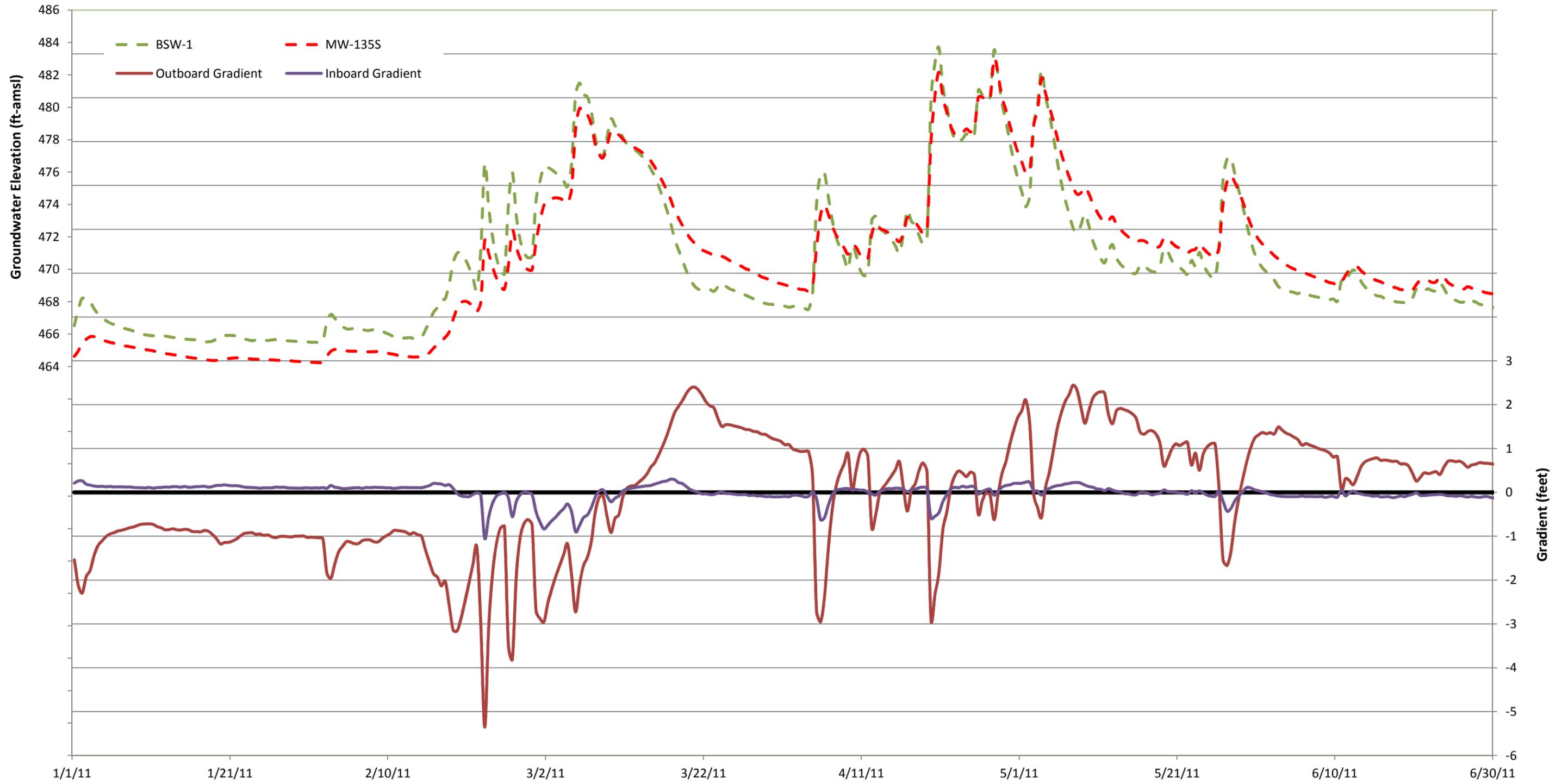
EXPLANATION	
● BMW-3S	BARRIER GROUNDWATER MONITORING WELL AND DESIGNATION
● BSW-3D	BARRIER SURFACE WATER/HYPORHEIC WATER MONITORING WELL AND DESIGNATION
● MW-27	GROUNDWATER MONITORING WELL AND DESIGNATION
○ PROD_15	EXISTING PRODUCTION WELL AND DESIGNATION
---	SHEET PILE BARRIER WALL
— AS —	AIR SPARGE PIPING (BELOW GRADE)
— x —	FENCE
■	BUILDING, TANK OR OTHER STRUCTURE



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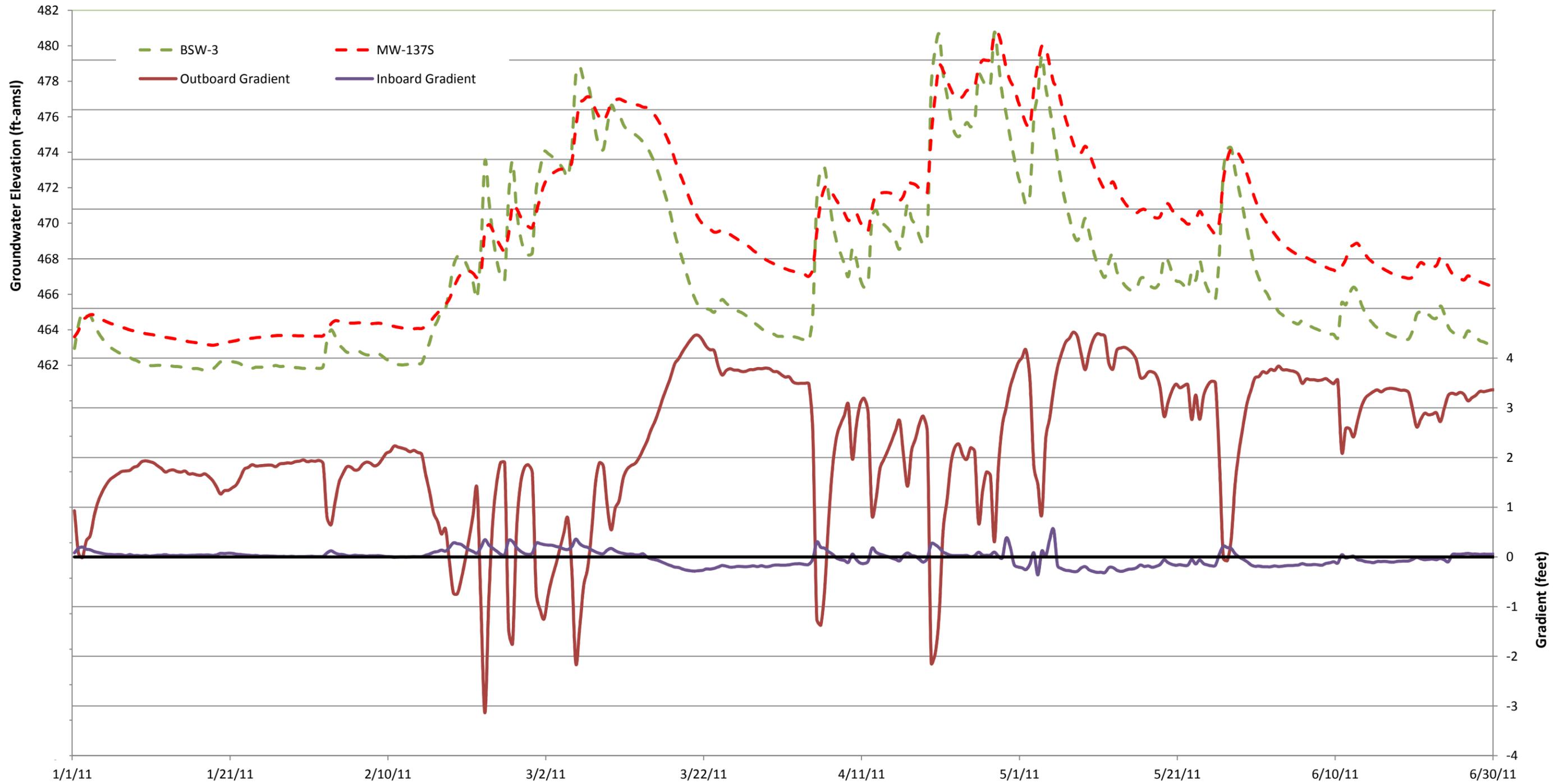
FIGURE 2-7
BARRIER PERFORMANCE AIR SPARGE AND MONITORING WELL NETWORK
FIRST 2011 SEMIANNUAL MONITORING PERIOD
CHEVRON CINCINNATI FACILITY
HOOVEN, OHIO

FIGURE 2-8. BARRIER WALL NORTH TRANSECT VERTICAL GRADIENTS
 FIRST 2011 SEMIANNUAL MONITORING PERIOD
 CHEVRON CINCINNATI FACILITY, HOOVEN, OHIO



EXPLANATION
 Outboard Gradient - Groundwater elevation at BMW-1D minus the surface water elevation at BSW-1.
 Inboard Gradient - Groundwater elevation at MW-135D minus the groundwater elevation at MW-135S.
 Upward vertical gradient shown as positive values, downward vertical gradient shown as negative values.

FIGURE 2-9. BARRIER WALL SOUTH TRANSECT VERTICAL GRADIENTS
 FIRST 2011 SEMIANNUAL MONITORING PERIOD
 CHEVRON CINCINNATI FACILITY, HOOVEN, OHIO



EXPLANATION

Outboard Gradient - Groundwater elevation at BMW-3D minus the surface water elevation at BSW-3.
 Inboard Gradient - Groundwater elevation at MW-137D minus the groundwater elevation at MW-137S.
 Upward vertical gradient shown as positive values, downward vertical gradient shown as negative values

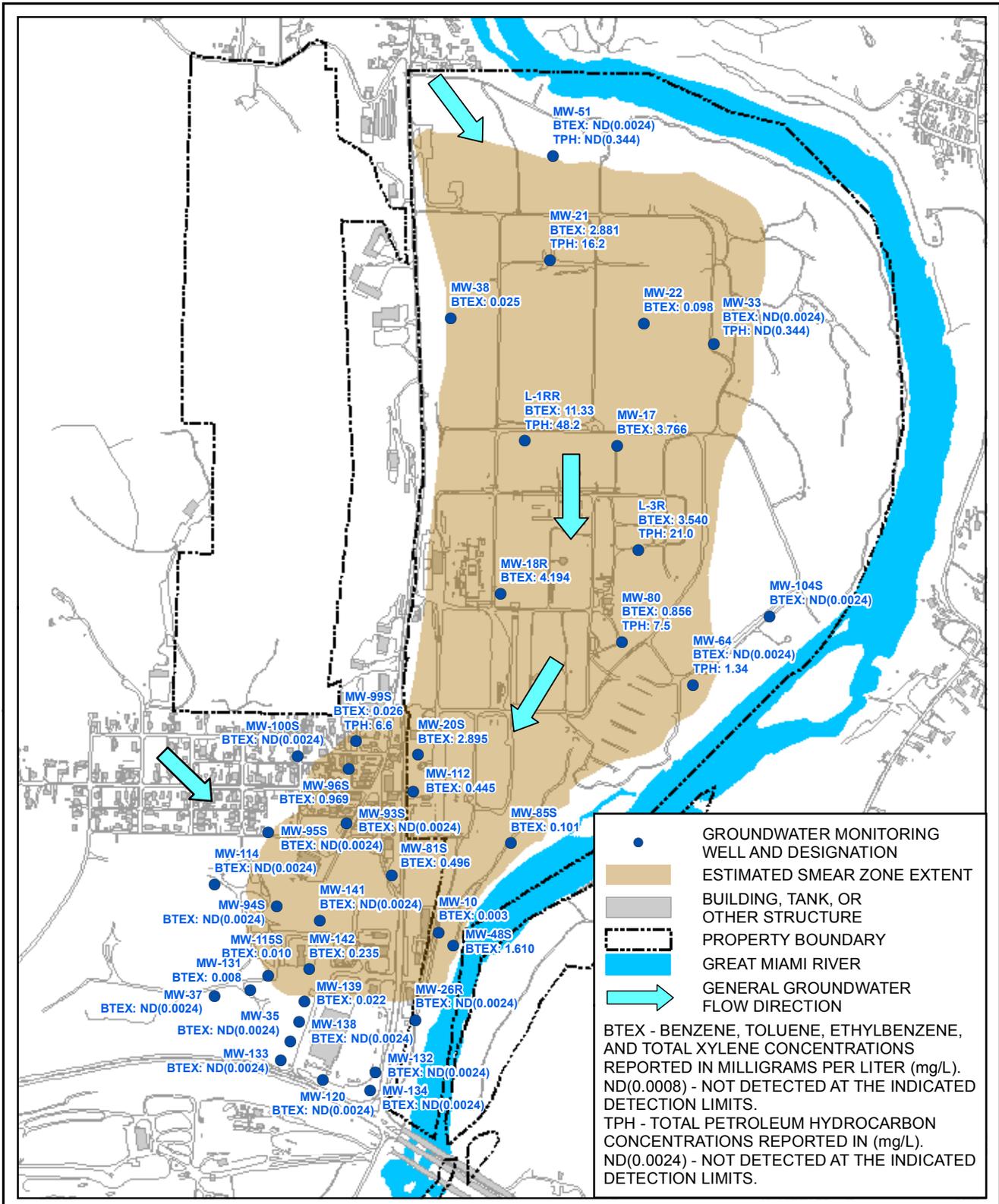
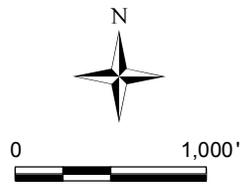


FIGURE 3-1

DISSOLVED PHASE CONSTITUENT CONCENTRATIONS

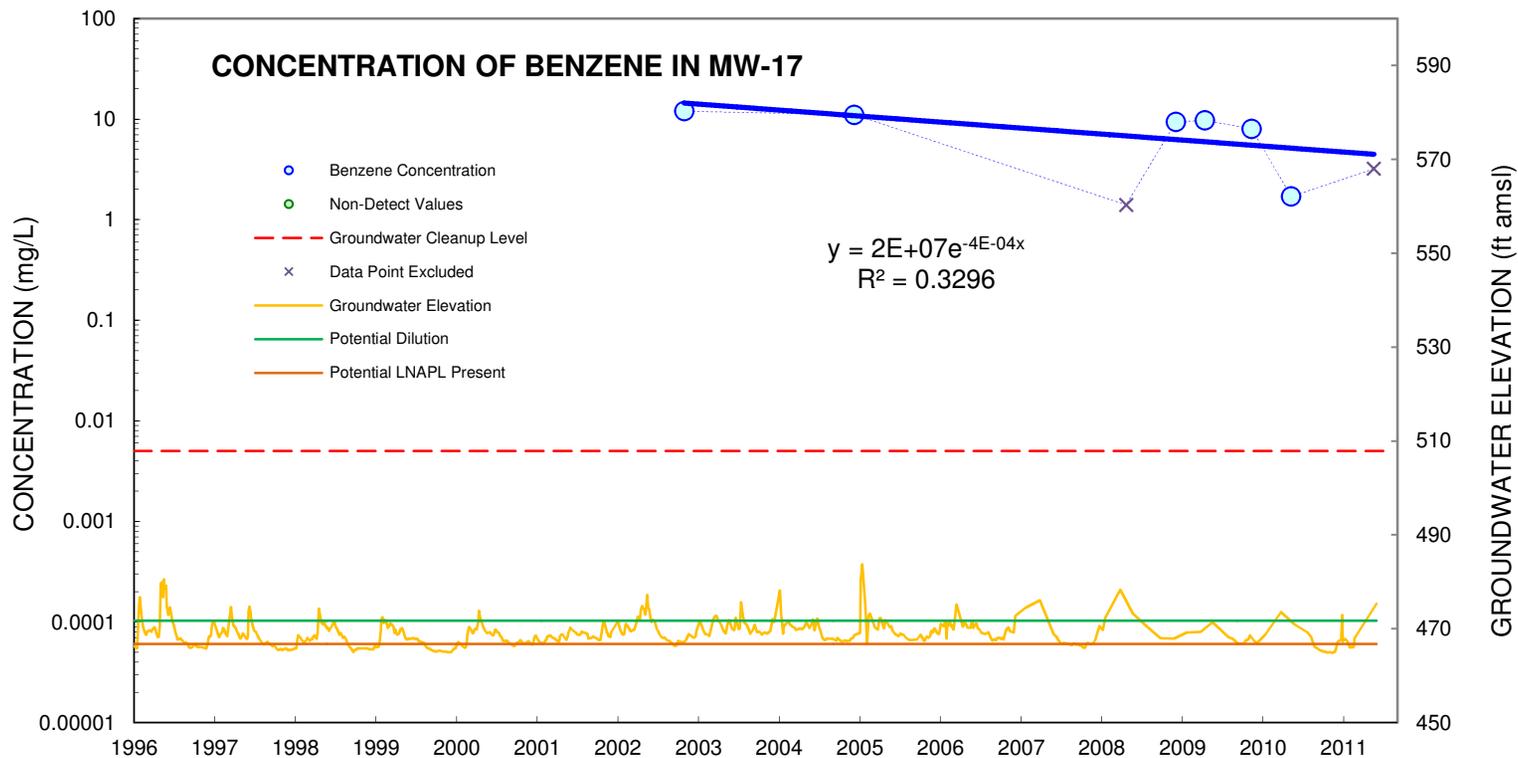
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Drawn By: BR	Checked By: JP	Scale: 1" = 1000'	Date: 2/6/12	File: 201112_QL_TPHtrends.mxd
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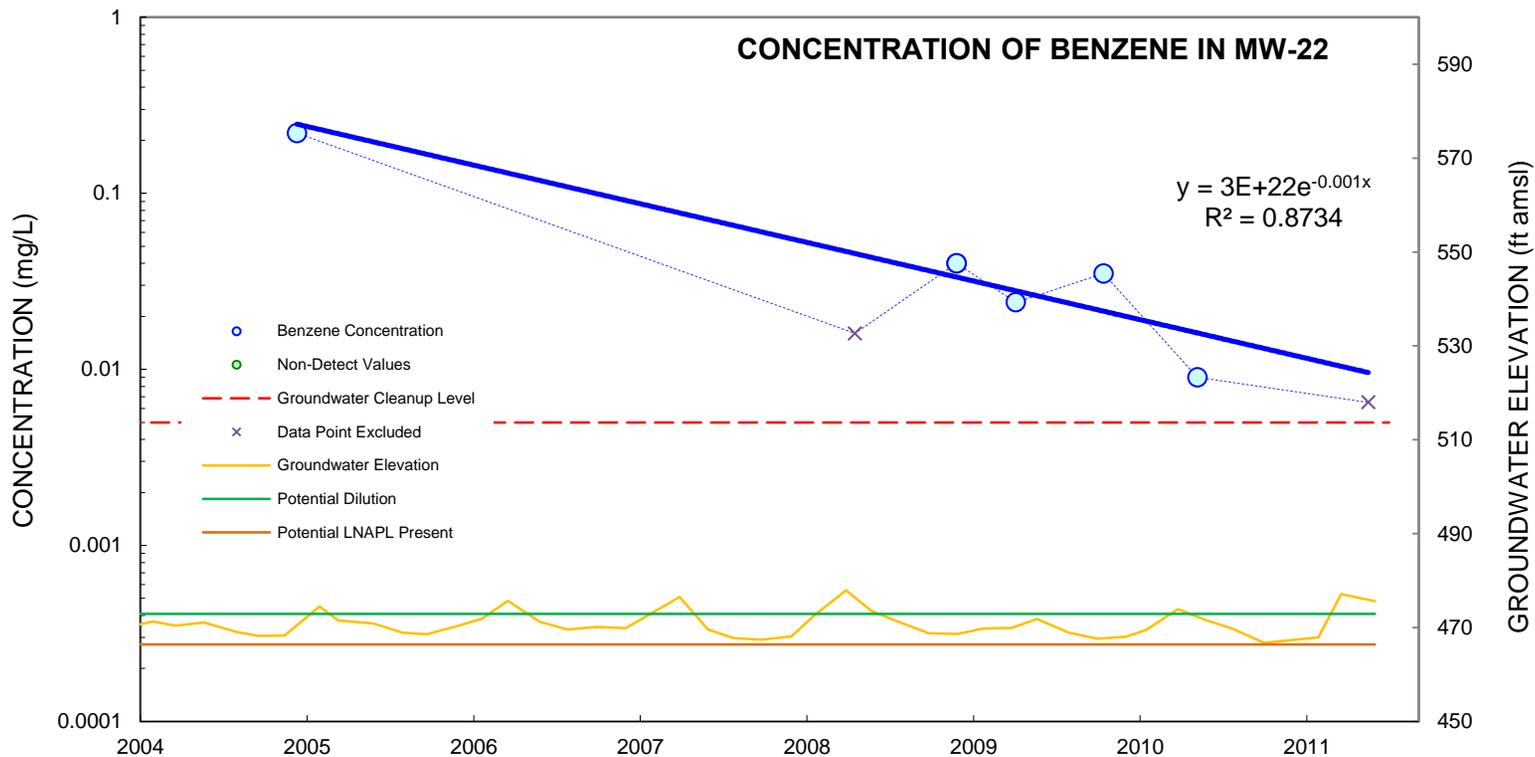
**FIGURE 3-2. GROUNDWATER CONSTITUENT CONCENTRATIONS VERSUS TIME, MONITORING WELL MW-17
FIRST 2011 SEMIANNUAL MONITORING PERIOD
CHEVRON CINCINNATI FACILITY, HOOVEN, OHIO**



EXPLANATION

WATER LEVELS PRESENTED FOR POSSIBLE EXCLUSION OF DATA POINTS BASED ON POTENTIAL DILUTION OR PRESENCE OF LNAPL.
 TWO DATA POINTS EXCLUDED (4/23/08 and 5/19/11)
 FT AMSL - FEET ABOVE MEAN SEA LEVEL
 mg/L - MILLIGRAMS PER LITER

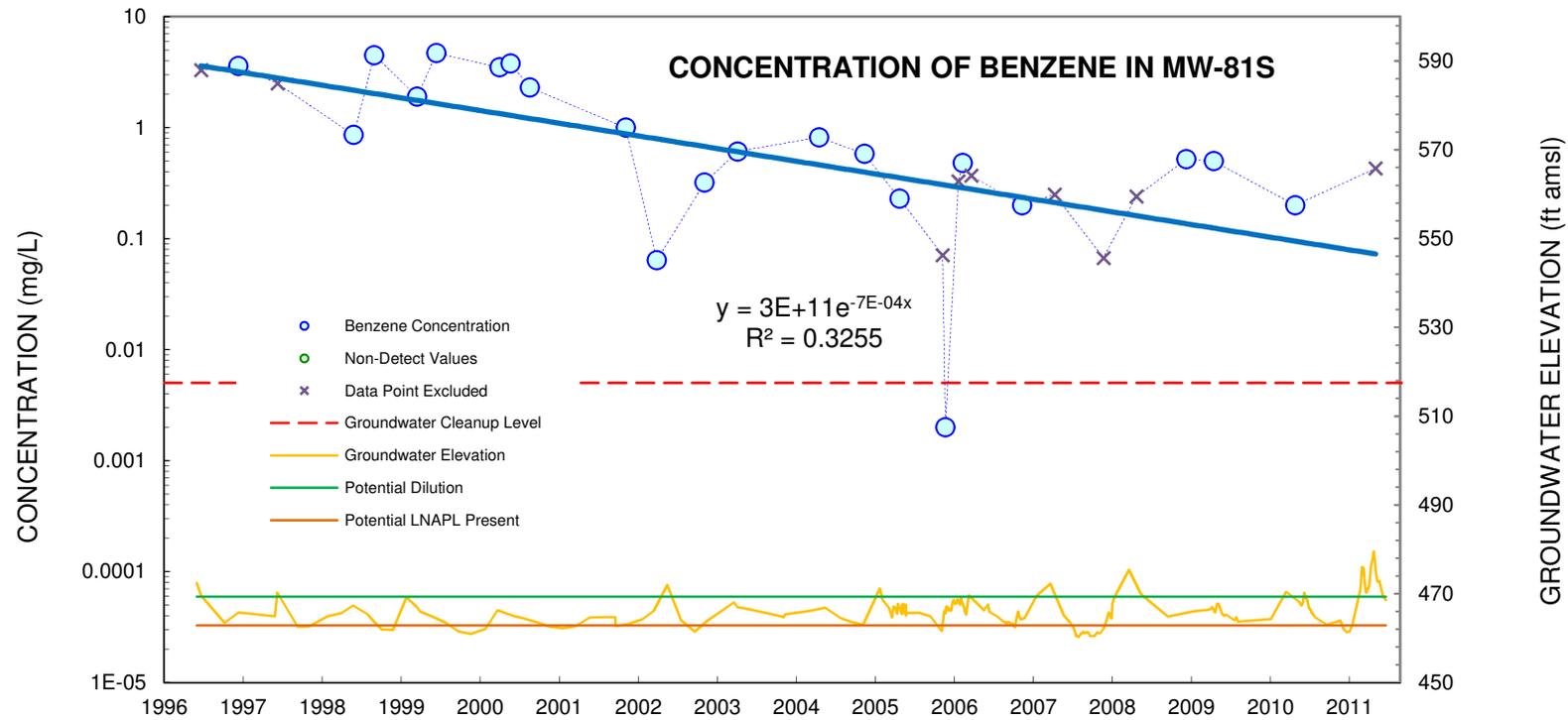
**FIGURE 3-3. GROUNDWATER CONSTITUENT CONCENTRATIONS VERSUS TIME, MONITORING WELL MW-22
FIRST 2011 SEMIANNUAL MONITORING PERIOD
CHEVRON CINCINNATI FACILITY, HOOVEN, OHIO**



EXPLANATION

WATER LEVELS PRESENTED FOR POSSIBLE EXCLUSION OF DATA POINTS BASED ON POTENTIAL DILUTION OR PRESENCE OF LNAPL.
TWO DATA POINTS EXCLUDED (4/16/08 and 5/16/11)
FT AMSL - FEET ABOVE MEAN SEA LEVEL
mg/L - MILLIGRAMS PER LITER

**FIGURE 3-4. GROUNDWATER CONSTITUENT CONCENTRATIONS VERSUS TIME, MONITORING WELL MW-81S
FIRST 2011 SEMI-ANNUAL MONITORING PERIOD
CHEVRON CINCINNATI FACILITY, HOOVEN, OHIO**



EXPLANATION

WATER LEVELS PRESENTED FOR POSSIBLE EXCLUSION OF DATA POINTS BASED ON POTENTIAL DILUTION OR PRESENCE OF LNAPL.

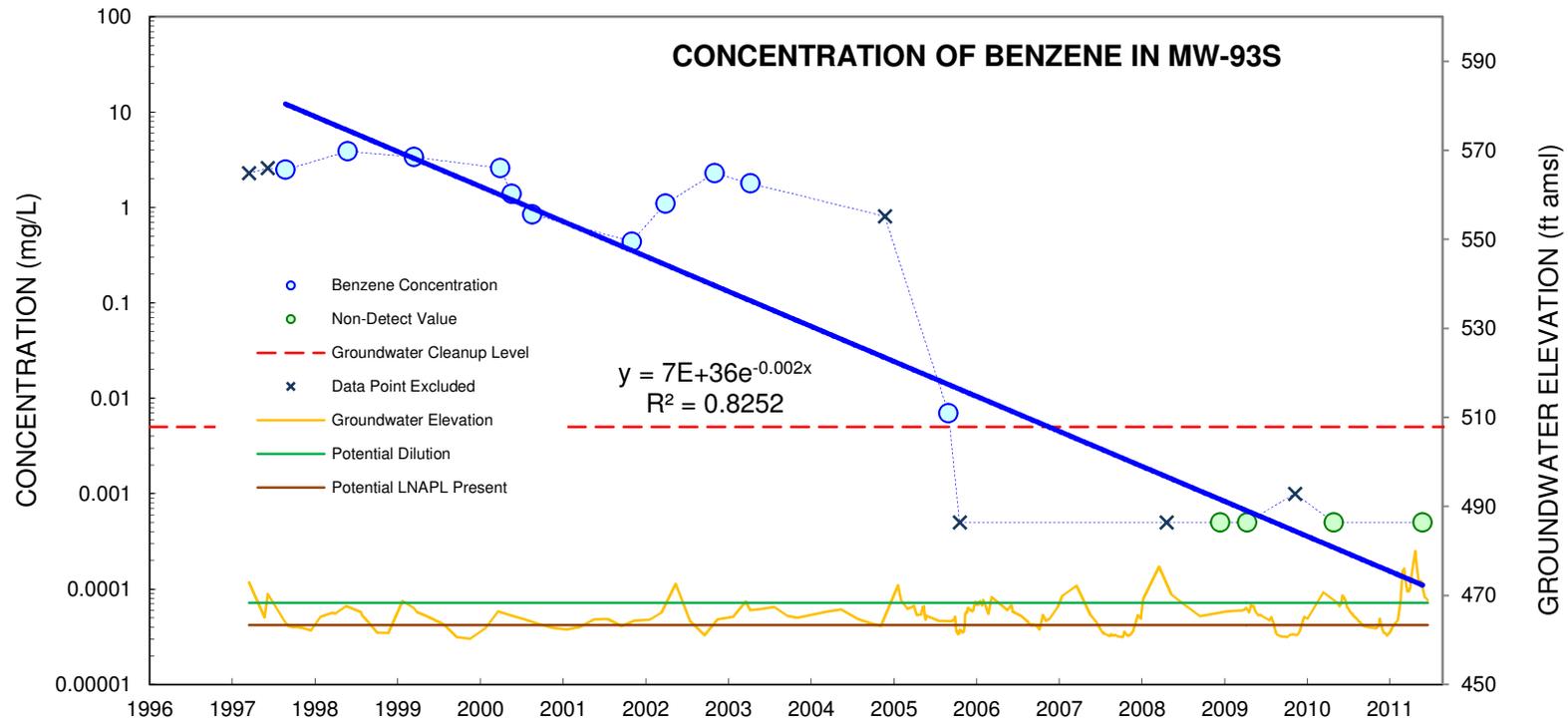
NO ANALYTICAL DATA AVAILABLE FOR FALL 2009 BECAUSE LNAPL WAS PRESENT IN THE WELL.

NINE DATA POINTS EXCLUDED (6/20/96, 6/9/97, 11/15/05, 1/27/06, 3/27/06, 4/17/07, 11/30/07, 4/30/08 and 5/12/11)

FT AMSL - FEET ABOVE MEAN SEA LEVEL

mg/L - MILLIGRAMS PER LITER

**FIGURE 3-5. GROUNDWATER CONSTITUENT CONCENTRATIONS VERSUS TIME, MONITORING WELL MW-93S
FIRST 2011 SEMIANNUAL MONITORING PERIOD
CHEVRON CINCINNATI FACILITY, HOOVEN, OHIO**



EXPLANATION

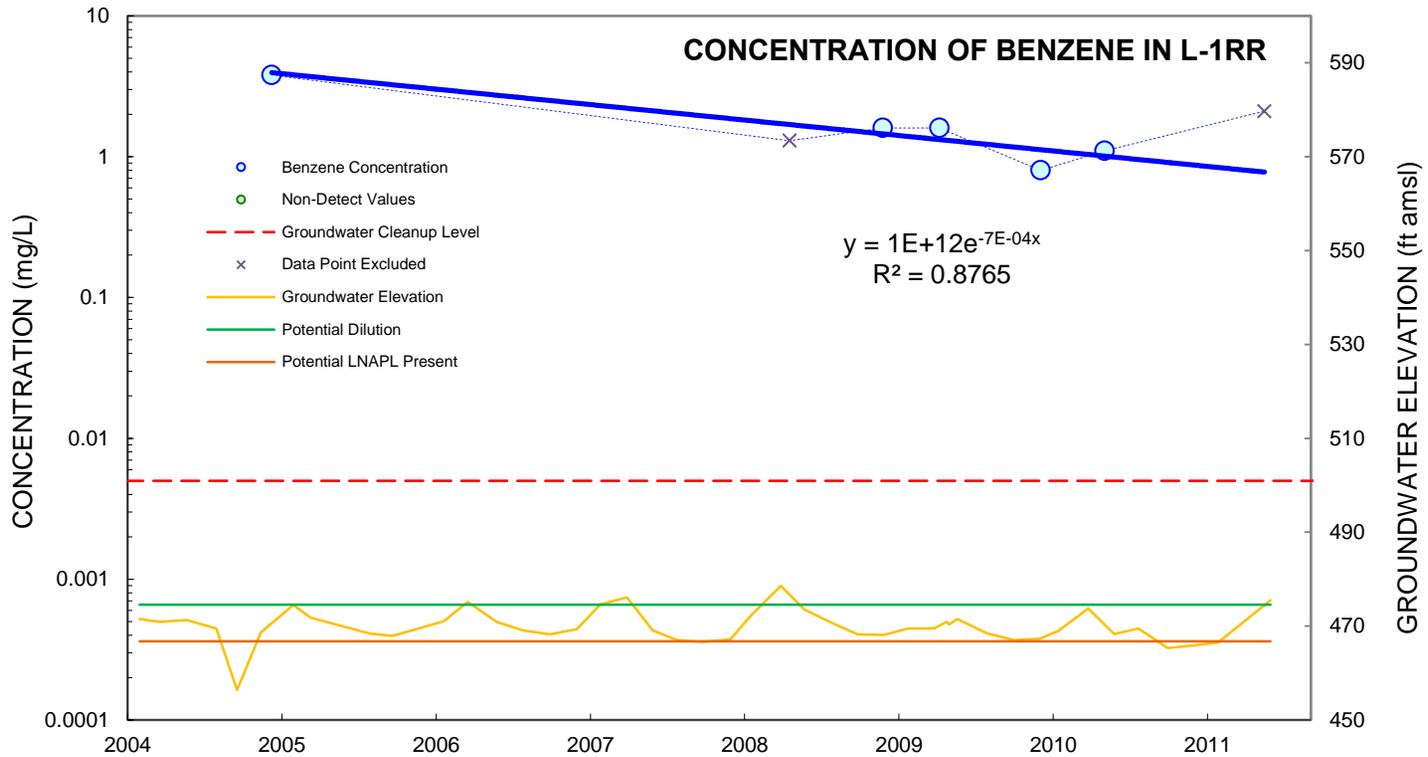
WATER LEVELS PRESENTED FOR POSSIBLE EXCLUSION OF DATA POINTS BASED ON POTENTIAL DILUTION OR PRESENCE OF LNAPL.

SIX DATA POINTS EXCLUDED (3/18/97, 6/9/97, 11/30/04, 10/27/05, 4/30/08, and 11/19/09)

FT AMSL - FEET ABOVE MEAN SEA LEVEL

mg/L - MILLIGRAMS PER LITER

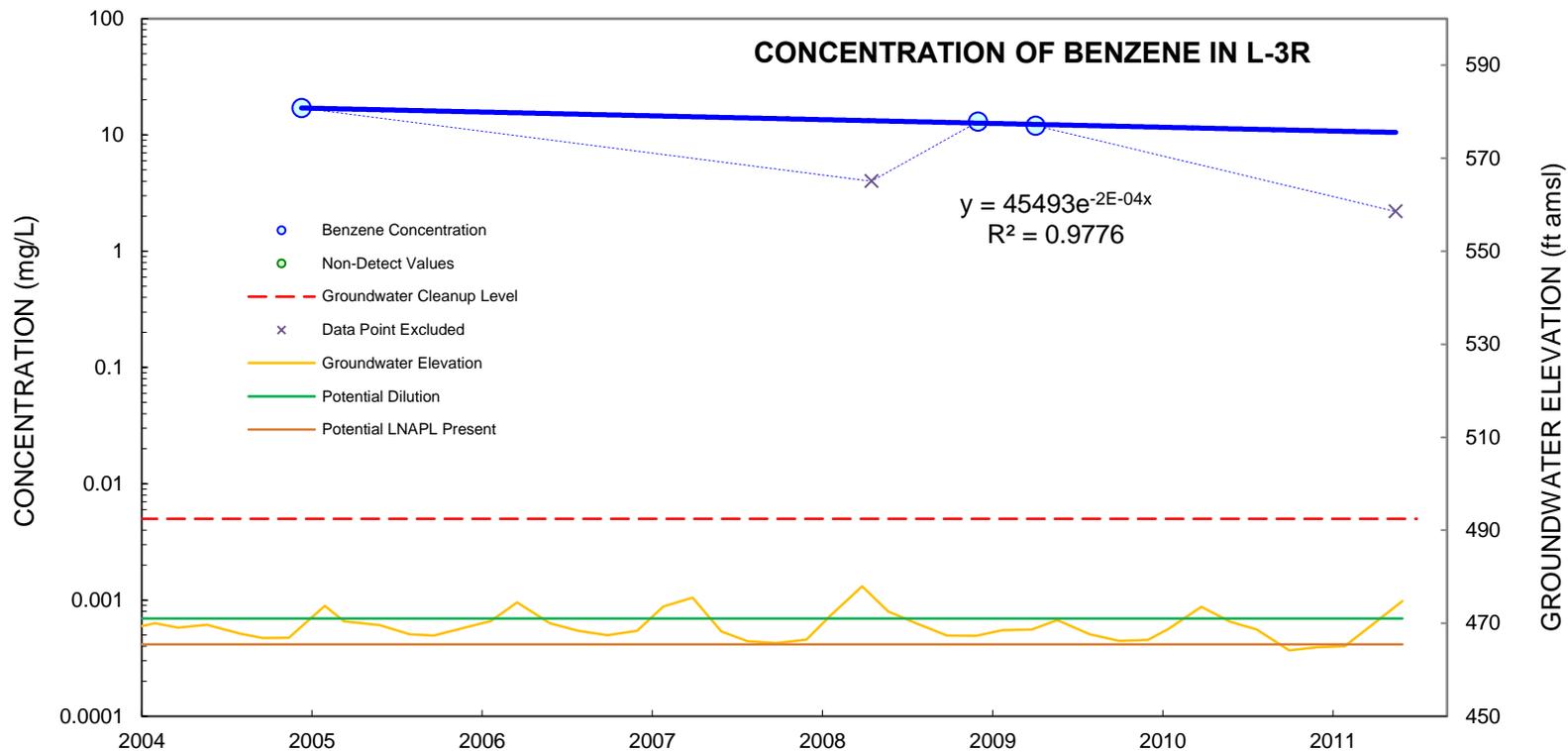
**FIGURE 3-6. GROUNDWATER CONSTITUENT CONCENTRATIONS VERSUS TIME, MONITORING WELL L-1RR
FIRST 2011 SEMIANNUAL MONITORING PERIOD
CHEVRON CINCINNATI FACILITY, HOOVEN, OHIO**



EXPLANATION

WATER LEVELS PRESENTED FOR POSSIBLE EXCLUSION OF DATA POINTS BASED ON POTENTIAL DILUTION.
 TWO DATA POINTS EXCLUDED (4/17/08 and 5/16/11)
 FT AMSL - FEET ABOVE MEAN SEA LEVEL
 mg/L - MILLIGRAMS PER LITER

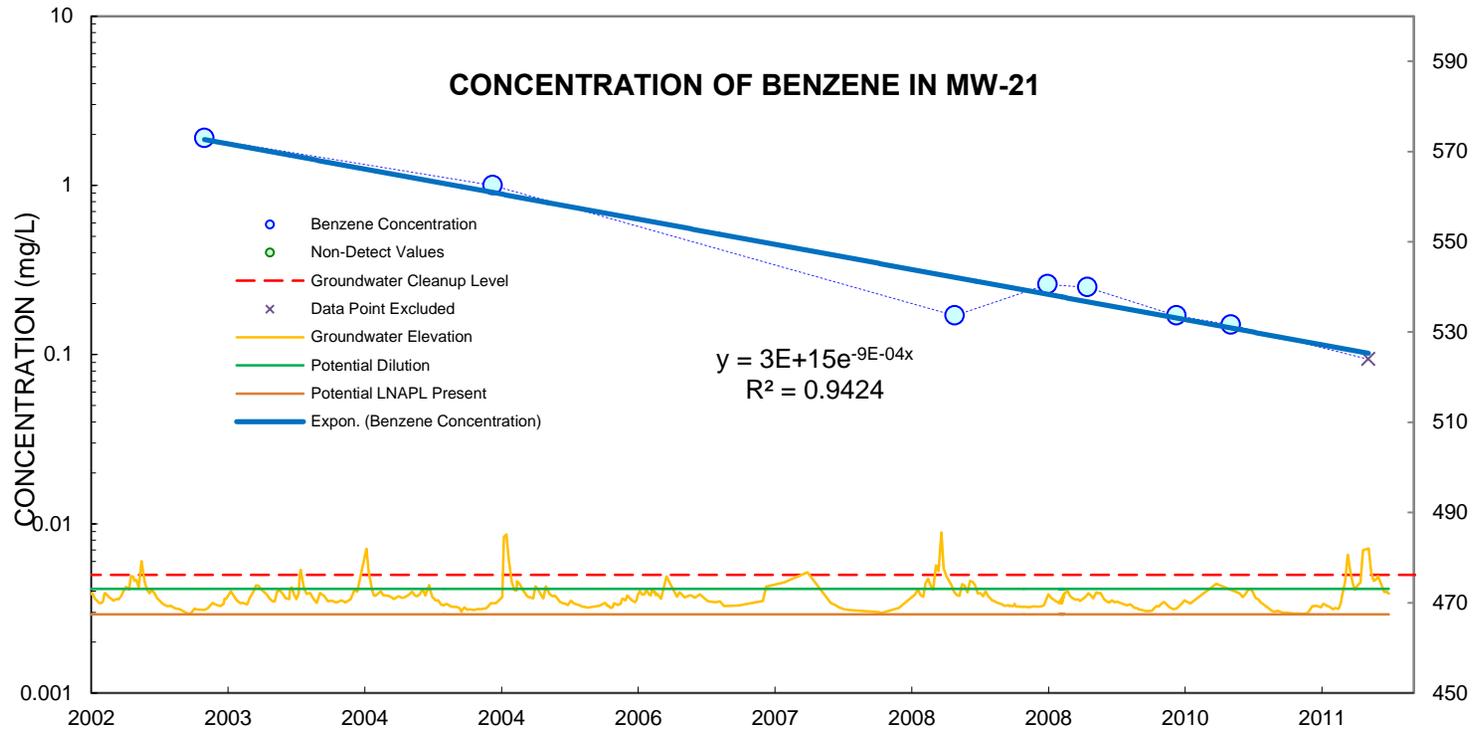
**FIGURE 3-7. GROUNDWATER CONSTITUENT CONCENTRATIONS VERSUS TIME, MONITORING WELL L-3R
FIRST 2011 SEMIANNUAL MONITORING PERIOD
CHEVRON CINCINNATI FACILITY, HOOVEN, OHIO**



EXPLANATION

WATER LEVELS PRESENTED FOR POSSIBLE EXCLUSION OF DATA POINTS BASED ON POTENTIAL DILUTION OR PRESENCE OF LNAPL.
 NO ANALYTICAL DATA AVAILABLE FOR FALL 2009 OR SPRING 2010 DUE TO LNAPL PRESENCE IN WELL.
 TWO DATA POINTS EXCLUDED (4/16/08 and 5/16/11)
 FT AMSL - FEET ABOVE MEAN SEA LEVEL
 mg/L - MILLIGRAMS PER LITER

**FIGURE 3-8. GROUNDWATER CONSTITUENT CONCENTRATIONS VERSUS TIME, MONITORING WELL MW-21
FIRST 2011 SEMIANNUAL MONITORING PERIOD
CHEVRON CINCINNATI FACILITY, HOOVEN, OHIO**



EXPLANATION

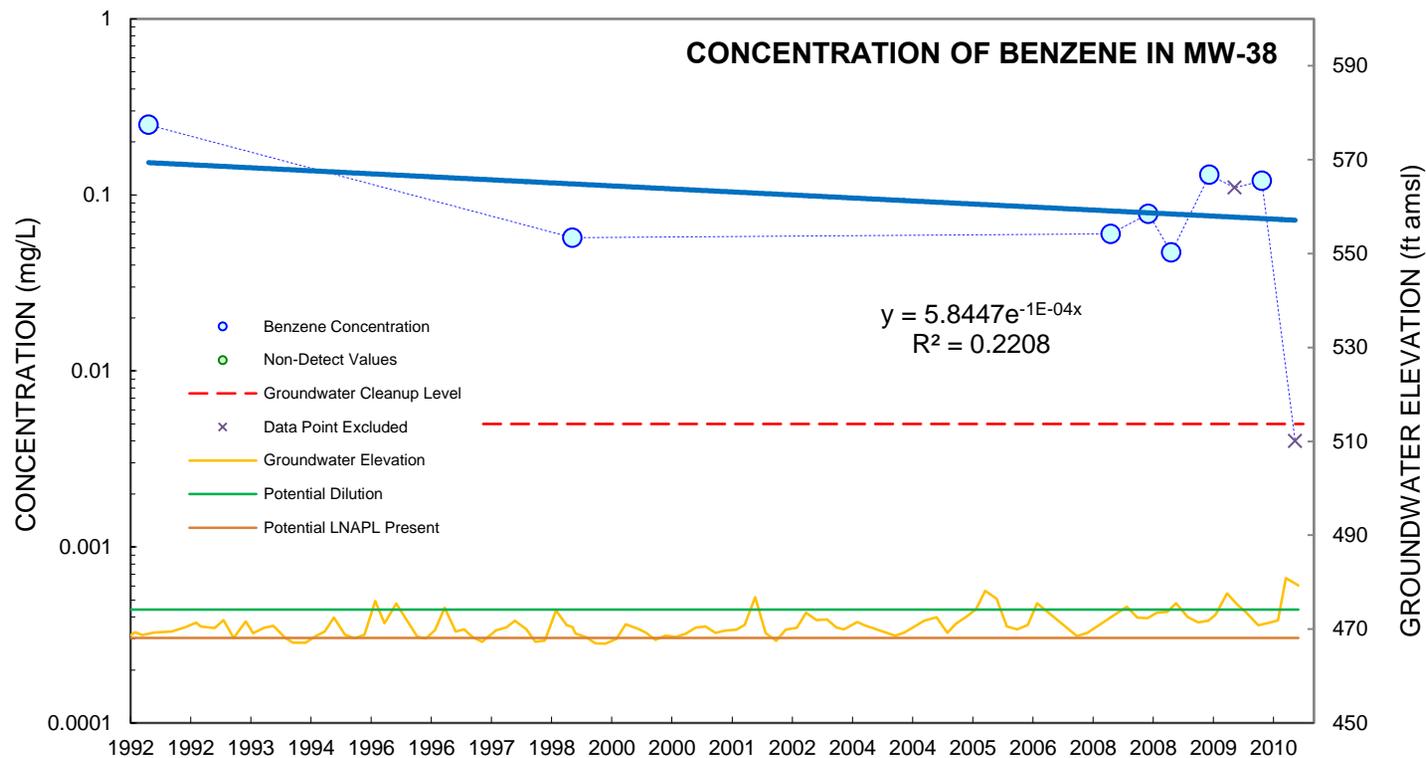
WATER LEVELS PRESENTED FOR POSSIBLE EXCLUSION OF DATA POINTS BASED ON POTENTIAL DILUTION OR PRESENCE OF LNAPL.

ONE DATA POINT EXCLUDED (5/5/11)

FT AMSL - FEET ABOVE MEAN SEA LEVEL

mg/L - MILLIGRAMS PER LITER

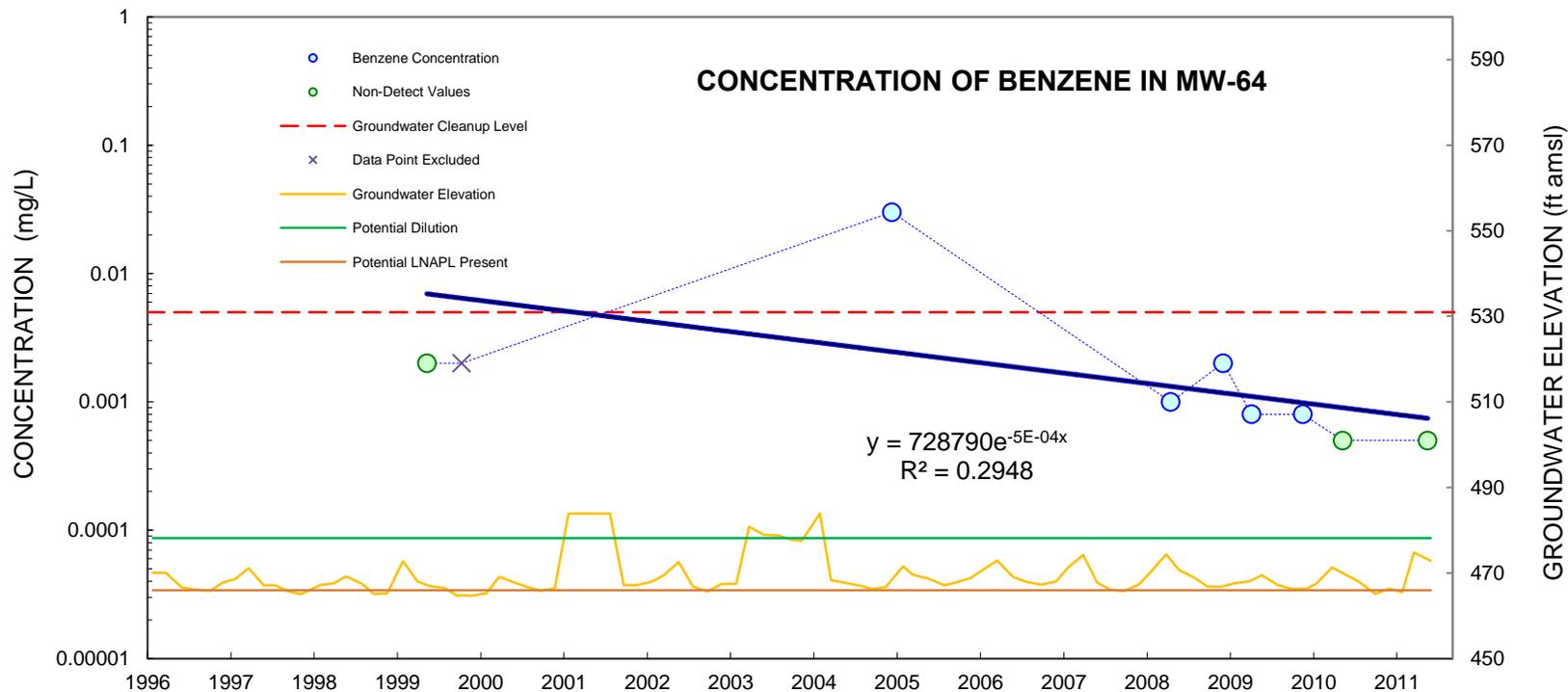
**FIGURE 3-9. GROUNDWATER CONSTITUENT CONCENTRATIONS VERSUS TIME, MONITORING WELL MW-38
FIRST 2011 SEMIANNUAL MONITORING PERIOD
CHEVRON CINCINNATI FACILITY, HOOVEN, OHIO**



EXPLANATION

WATER LEVELS PRESENTED FOR POSSIBLE EXCLUSION OF DATA POINTS BASED ON POTENTIAL DILUTION OR PRESENCE OF LNAPL.
TWO DATA POINTS EXCLUDED (5/10/10 and 5/11/11)
FT AMSL - FEET ABOVE MEAN SEA LEVEL
mg/L - MILLIGRAMS PER LITER

**FIGURE 3-10. GROUNDWATER CONSTITUENT CONCENTRATIONS VERSUS TIME, MONITORING WELL MW-64
FIRST 2011 SEMIANNUAL MONITORING PERIOD
CHEVRON CINCINNATI FACILITY, HOOVEN, OHIO**



EXPLANATION

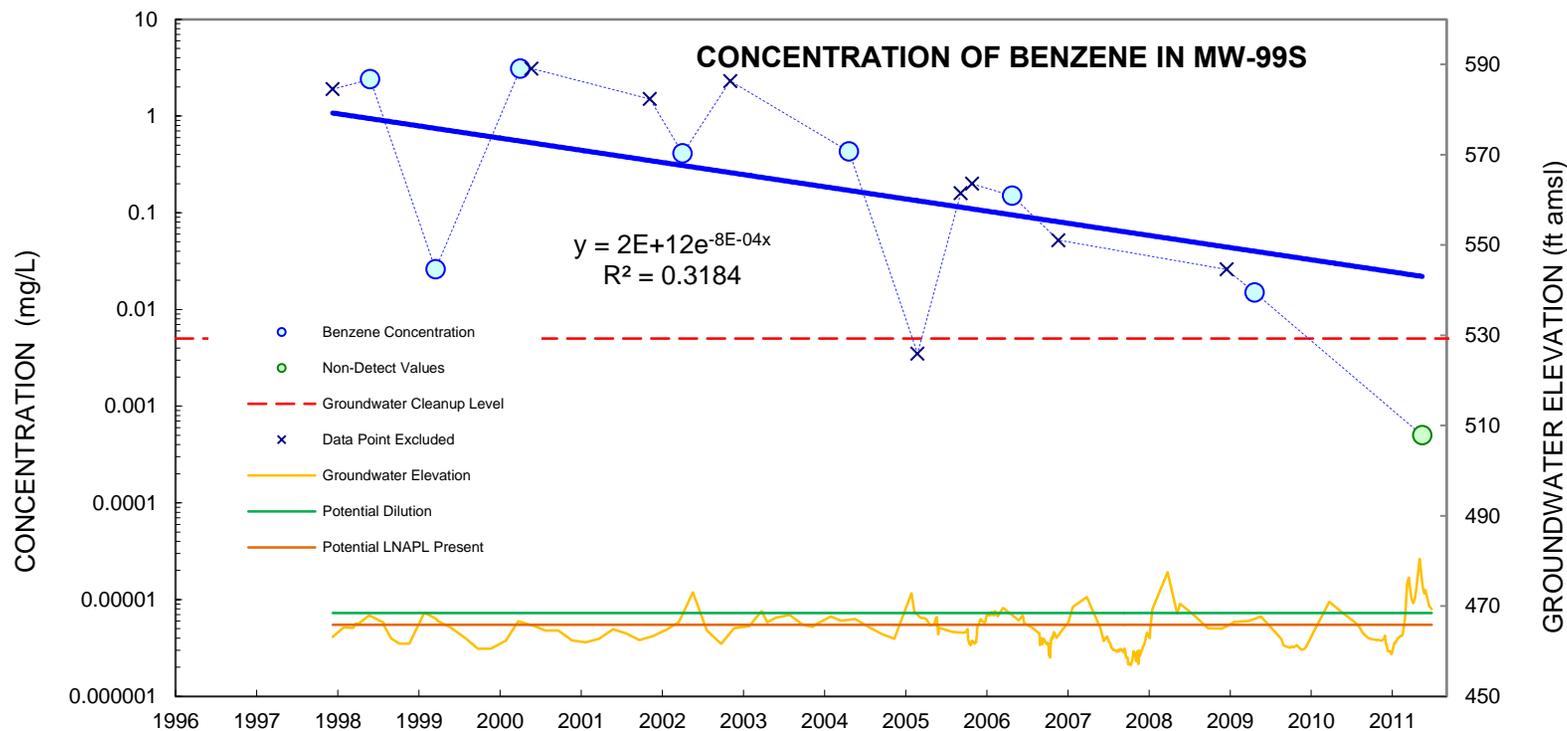
WATER LEVELS PRESENTED FOR POSSIBLE EXCLUSION OF DATA POINTS BASED ON POTENTIAL DILUTION OR PRESENCE OF LNAPL.

ONE DATA POINT EXCLUDED (10/12/99)

FT AMSL - FEET ABOVE MEAN SEA LEVEL

mg/L - MILLIGRAMS PER LITER

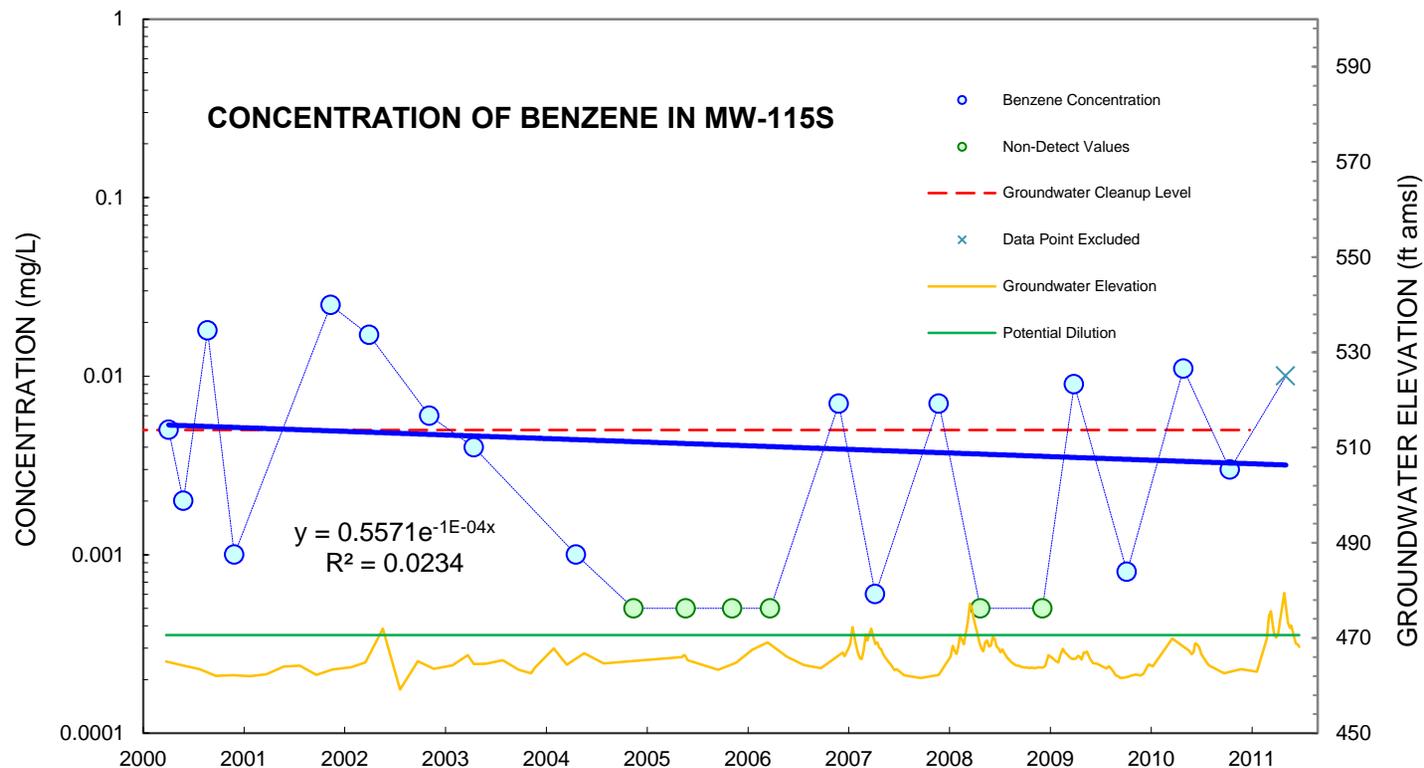
**FIGURE 3-11. GROUNDWATER CONSTITUENT CONCENTRATIONS VERSUS TIME, MONITORING WELL MW-99S
FIRST 2011 SEMIANNUAL MONITORING PERIOD
CHEVRON CINCINNATI FACILITY, HOOVEN, OHIO**



EXPLANATION:

WATER LEVELS PRESENTED FOR POSSIBLE EXCLUSION OF DATA POINTS BASED ON POTENTIAL DILUTION OR PRESENCE OF LNAPL. NINE DATA POINTS EXCLUDED (12/10/97, 4/3/00, 5/23/00, 11/7/01, 11/4/02, 2/24/05, 9/7/05, 10/28/05, and 11/20/06). WELL NOT SAMPLED IN SPRING 2010 DUE TO LNAPL PRESENCE IN WELL. FT AMSL - FEET ABOVE MEAN SEA LEVEL mg/L - MILLIGRAMS PER LITER

**FIGURE 3-12. GROUNDWATER CONSTITUENT CONCENTRATIONS VERSUS TIME, MONITORING WELL MW-115S
FIRST 2011 SEMIANNUAL MONITORING PERIOD
CHEVRON CINCINNATI FACILITY, HOOVEN, OHIO**



EXPLANATION

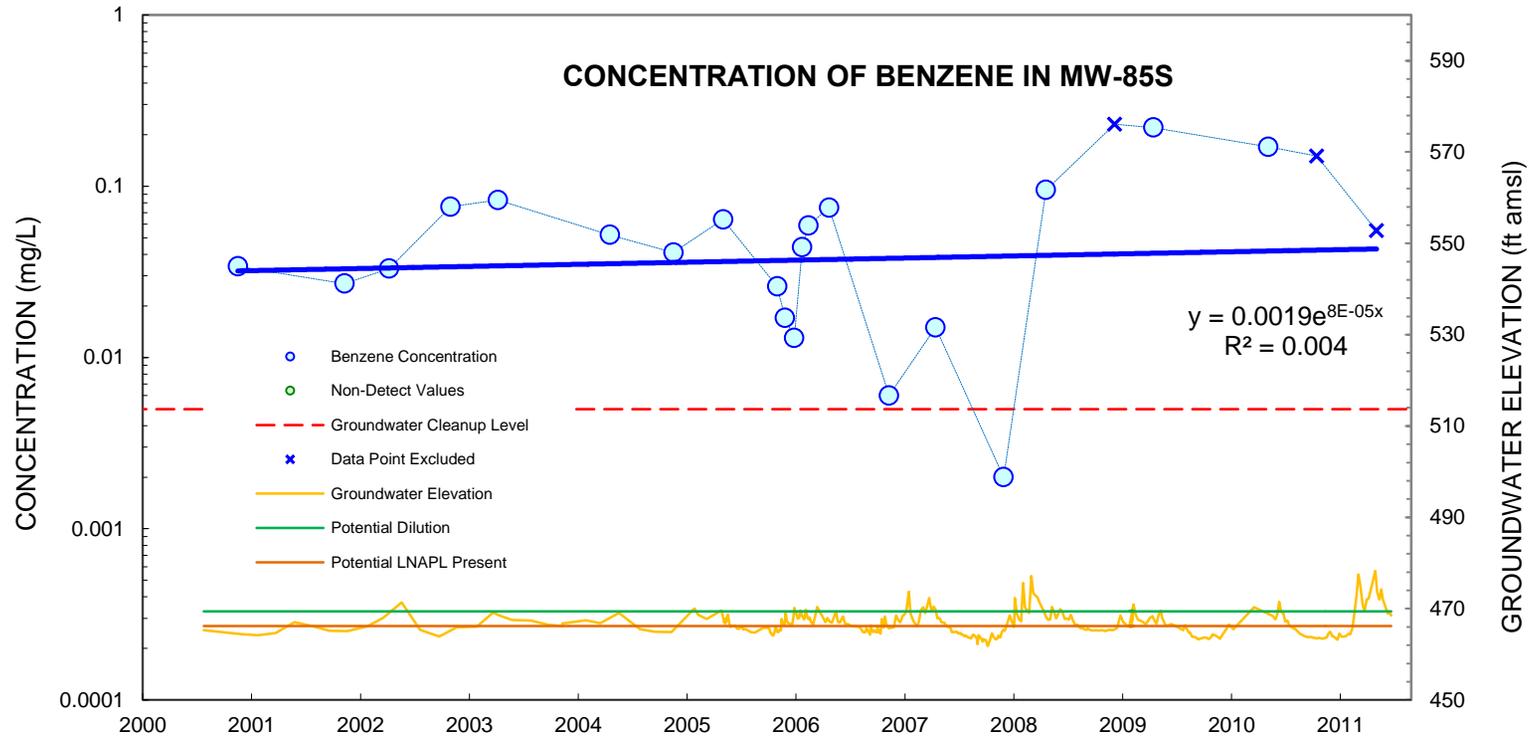
WATER LEVELS PRESENTED FOR POSSIBLE EXCLUSION OF DATA POINTS BASED ON POTENTIAL DILUTION.

ONE DATA POINTS EXCLUDED (5/11/11)

FT AMSL - FEET ABOVE MEAN SEA LEVEL

mg/L - MILLIGRAMS PER LITER

**FIGURE 3-13. GROUNDWATER CONSTITUENT CONCENTRATIONS VERSUS TIME, MONITORING WELL MW-85S
FIRST 2011 SEMIANNUAL MONITORING PERIOD
CHEVRON CINCINNATI FACILITY, HOOVEN, OHIO**



EXPLANATION

WATER LEVELS PRESENTED FOR POSSIBLE EXCLUSION OF DATA POINTS BASED ON POTENTIAL DILUTION OR PRESENCE OF LNAPL.
 THREE DATA POINTS EXCLUDED (12/11/08, 10/21/10, and 5/10/11)
 FT AMSL - FEET ABOVE MEAN SEA LEVEL
 mg/L - MILLIGRAMS PER LITER

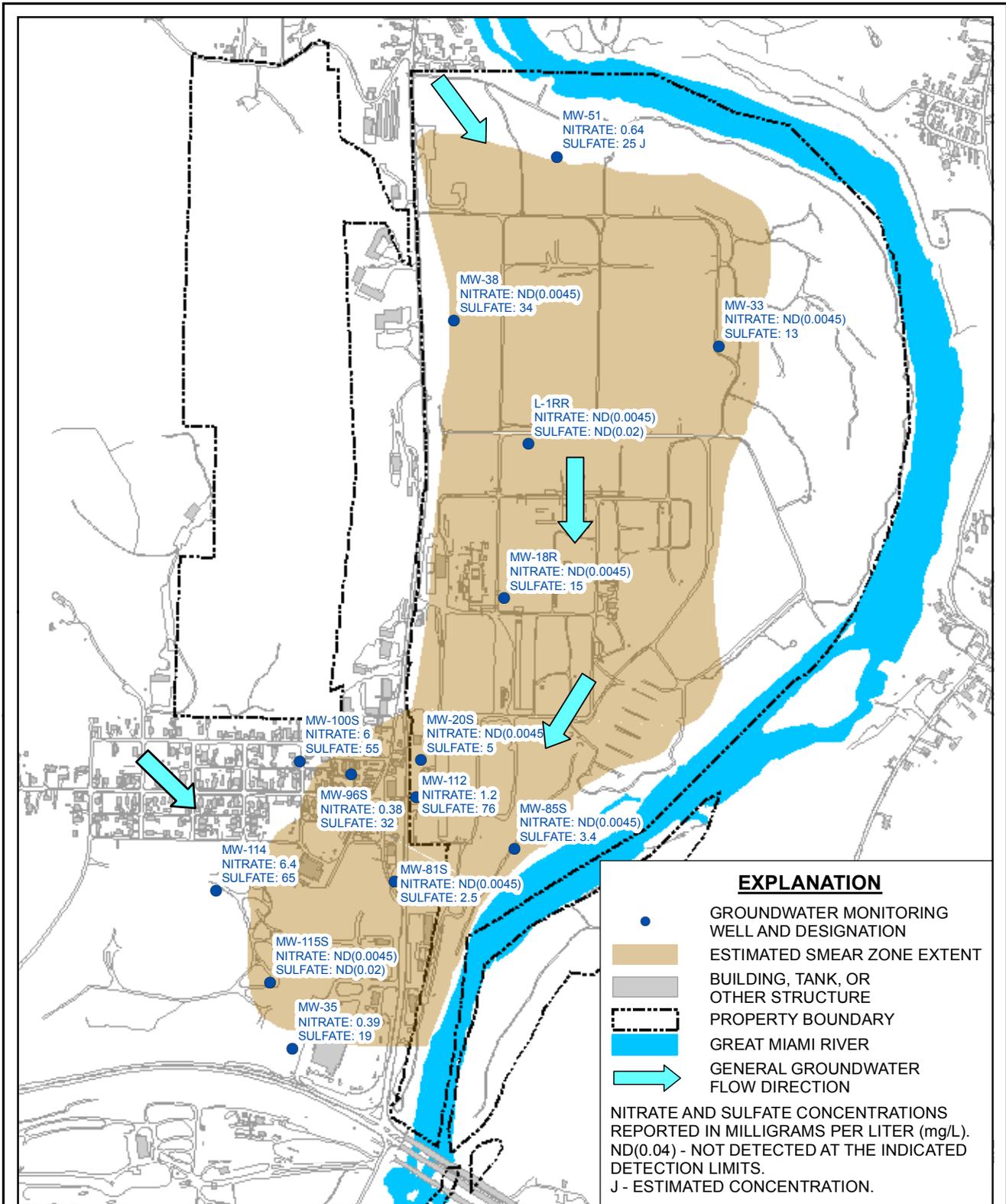
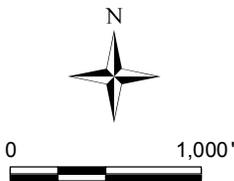


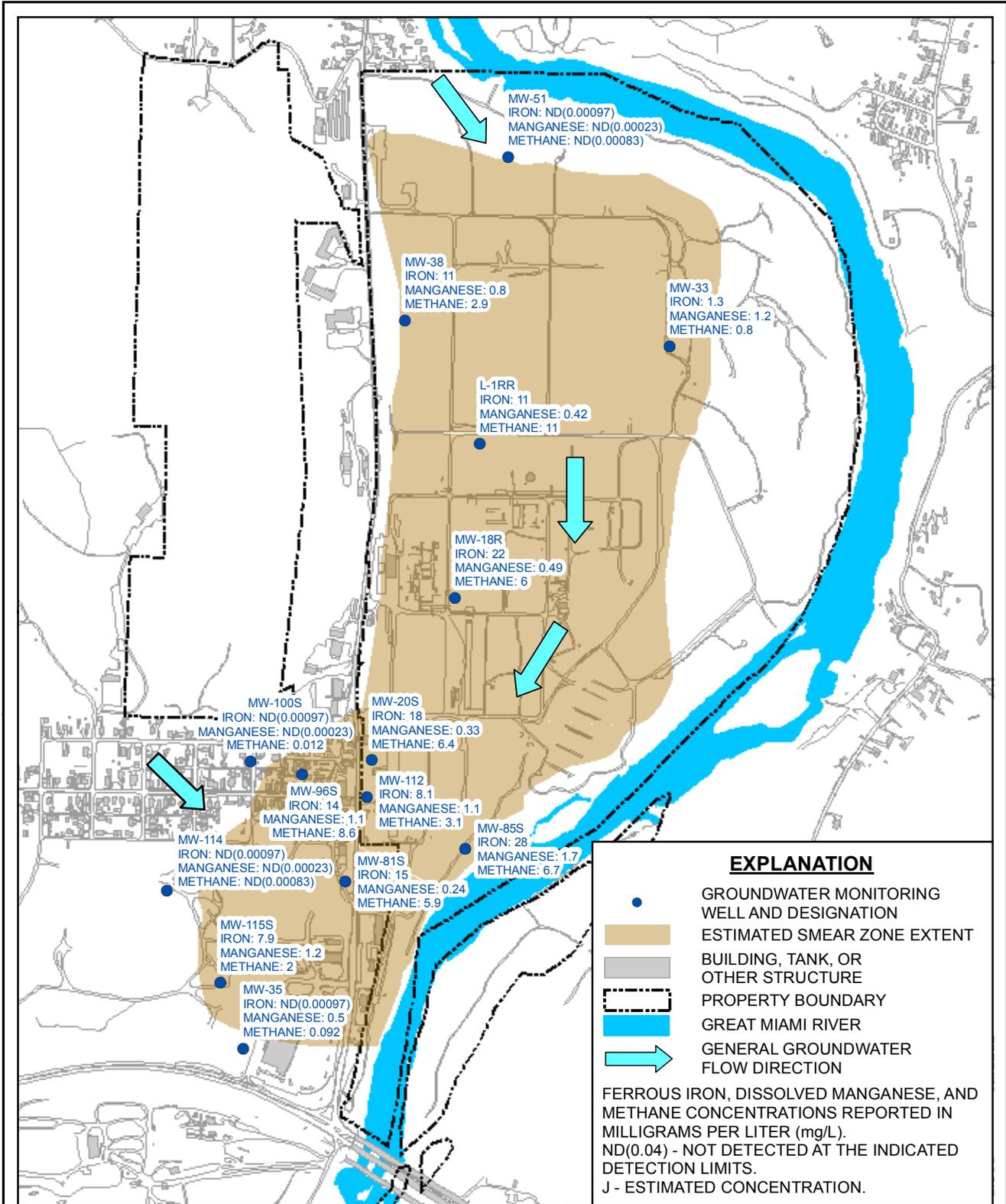
FIGURE 3-15

DISSOLVED PHASE NITRATE AND SULFATE CONCENTRATIONS

**FIRST 2011 SEMIANNUAL MONITORING PERIOD
 CHEVRON CINCINNATI FACILITY
 HOOVEN, OHIO**



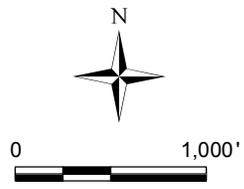
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EXPLANATION

- GROUNDWATER MONITORING WELL AND DESIGNATION
- ESTIMATED SMEAR ZONE EXTENT
- BUILDING, TANK, OR OTHER STRUCTURE
- ⋯ PROPERTY BOUNDARY
- GREAT MIAMI RIVER
- ➡ GENERAL GROUNDWATER FLOW DIRECTION

FERROUS IRON, DISSOLVED MANGANESE, AND METHANE CONCENTRATIONS REPORTED IN MILLIGRAMS PER LITER (mg/L).
 ND(0.04) - NOT DETECTED AT THE INDICATED DETECTION LIMITS.
 J - ESTIMATED CONCENTRATION.



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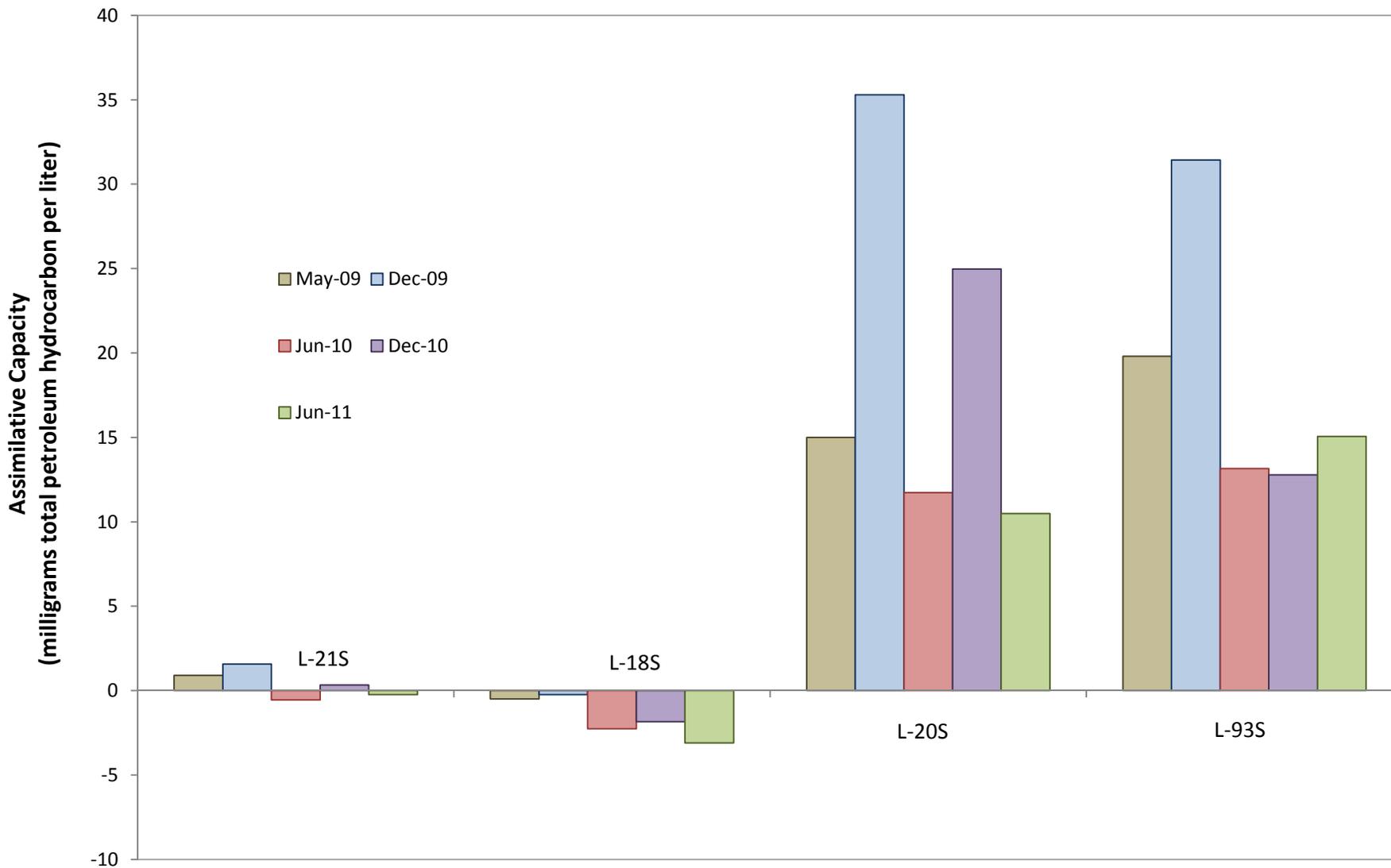
FIGURE 3-16
DISSOLVED PHASE IRON, MANGANESE, AND AND METHANE CONCENTRATIONS
FIRST 2011 SEMIANNUAL MONITORING PERIOD
CHEVRON CINCINNATI FACILITY
HOOVEN, OHIO

**FIGURE 3-17. DISSOLVED PHASE BENZENE AND HYDROGEOCHEMICAL SUMMARY VERSUS DISTANCE
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US EPA ARCHIVE DOCUMENT

**FIGURE 3-18. PORE WATER ASSIMILATIVE CAPACITY OVER TIME
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APPENDICES A THROUGH F

(PLEASE SEE ATTACHED CD)