Site-Wide Groundwater Monitoring Plan

General Motors Corporation
Moraine, Ohio

December 2002

ARCADIS
Infrastructure, buildings, environment, communications

Table of Contents

Tables

Figures

Appendices

1. Introduction

This Site-Wide Groundwater Monitoring Plan (monitoring plan) was prepared to address groundwater monitoring activities at the following General Motors Corporation (GM) facilities located in Moraine, Ohio: Delphi Harrison Thermal Systems Moraine Plant (Delphi Thermal Moraine), former General Motors Powertrain Group, Moraine Engine Plant (former Moraine Engine), and General Motors Truck Group, Moraine Assembly Plant (Moraine Assembly). This monitoring plan will replace the current Resource Conservation and Recovery Act (RCRA) monitoring as outlined in the Revised Groundwater Quality Assessment Plan for the Harrison Radiator North Lagoon (Geraghty & Miller, Inc., 1989a), the Revised Groundwater Monitoring Detection Program for the Harrison Radiator South Lagoon (Geraghty & Miller, Inc., 1989b), and the Final Interim Measures Design Plans (Geraghty & Miller, Inc., 1995).

The objectives of conducting groundwater monitoring are as follows:

1. Monitor groundwater quality upgradient and downgradient of the closed North and South Settling Lagoons.

2. Monitor groundwater quality upgradient and downgradient of Landfills L1, L2, and L3.

3. Monitor the effectiveness of and the need for corrective measures groundwater capture systems in the upper and lower aquifers at the southern, downgradient property boundary.

4. Monitor the effectiveness of corrective measures remediation activities in Reactive Zones (RZ) RZ-1, RZ-2, and RZ-3, to address volatile organic compounds (VOCs) related to Area of Interest 7 (AOI 7).

5. Monitor an appropriate list of wells once corrective measures objectives (defined in the Draft Interim Measures/Corrective Measures Report [ARCADIS Geraghty & Miller, Inc. 2001]) have been met to verify that these objectives continue to be met without active measures.

While this monitoring plan differs from the existing plans (i.e., reduced frequency of sampling certain monitoring wells and eliminating monitoring at other wells), a more appropriate set of monitoring wells and parameters will be monitored at a larger set of

wells to provide a better overall understanding of improvements in groundwater conditions at the site.

1.1 Site Background

The former Moraine Engine and Moraine Assembly facilities occupy approximately 300 acres, while the adjacent Delphi Thermal Moraine facility occupies approximately 165 acres. The facilities are located in the City of Moraine in Montgomery County in southwestern Ohio. A small portion of the Moraine Assembly facility is located in the City of Kettering. Figure 1 presents the location of each facility, property boundaries, and site features.

The GM site has been used for industrial purposes since the property was acquired in the mid-1920's. Frigidaire (a division of GM) produced appliances from the late 1920's until 1979. GM announced the shut down of all Frigidaire operations in January 1979. During 1980 and 1981, the majority of the former Frigidaire Plant 2 was converted to the former Moraine Engine facility, and the former Frigidaire Plant 3 and the northeast corner of former Frigidaire Plant 2 were converted to the Moraine Assembly facility. Since 1981, former Moraine Engine operations have included the machining, painting (this operation was discontinued in September 1995), and assembly of diesel truck engines. Former Moraine Engine operations ceased in the fall of 2000. The plant building has undergone decommissioning and demolition. Since 1981, Moraine Assembly operations initially included the manufacture, assembly, and painting of small trucks, but currently Chevrolet TrailBlazers, GM Envoys, and Oldsmobile Bravadas are produced at this facility. Delphi Thermal Moraine's major operations, which began in 1941, are the machining and assembly of automotive air conditioning compressors, accumulator dehydrators, and miscellaneous air conditioning valves.

1.2 Site Regulatory History

Delphi Thermal Moraine contains North and South Settling Lagoons that are shown on Figure 2. GM filed a RCRA Part A Application with Ohio EPA for interim status in November 1980. GM began detection monitoring at the North and South Settling Lagoons in February 1981. In 1984, assessment monitoring began for the North Settling Lagoon. By October 1988, GM expanded the groundwater monitoring assessment plan network for the North Settling Lagoon and expanded the groundwater detection network in the South Settling Lagoon in accordance with an agreed consent

order with the State of Ohio. The assessment and detection monitoring well network for the upper and lower aquifers are shown on Figures 2 and 3, respectively.

Delphi Thermal Moraine submitted closure plans for the North and South Settling Lagoons to U.S. EPA and Ohio EPA in November 1985 and November 1989. Closure discussions between GM and Ohio EPA were deferred by mutual agreement to coordinate ultimate closure requirements with the corrective action requirements from the United States Environmental Protection Agency (U.S. EPA) Region V (the North and South Settling Lagoons were evaluated as solid waste management units [SWMUs] in the RCRA Facility Investigation [RFI] at Delphi Thermal Moraine). During the summer of 1999, GM met with the Ohio EPA to present and discuss a revised approach for closure of the lagoons. This approach was presented to Ohio EPA in the Lagoon Closure Plan, dated February 2000 (Conestoga-Rovers & Associates, 2000), and approved by Ohio EPA in a letter to GM dated August 24, 2000. Closure activities were initiated in September 2000 and completed in June 2001. GM submitted the Closure Certification Report to Ohio EPA on August 10, 2001 (Conestoga-Rovers & Associates 2001). Ohio EPA approved full closure of the North and South Settling Lagoons in a letter dated June 27, 2002 (Ohio EPA, 2002).

Delphi Thermal Moraine received an Administrative Order (Docket No. V-W-91R-2) from the U.S. EPA Region V, which became effective on January 30, 1991. The Administrative Order, issued under Section 3008(h) of RCRA, as amended, 42 U.S.C. 6928(h), required Delphi Thermal Moraine to implement a RCRA Corrective Action program at the Moraine facility consisting of the following: 1) conduct an RFI and 2) conduct a Corrective Measures Study (CMS), if necessary.

GM is currently meeting the requirements of the Administrative Order through the completed two-phased RFI investigation at the Delphi Thermal Moraine facility and by implementing capture zone interim measures. The initial Interim Measure was implemented per the Final Interim Measures Design Plans (Geraghty & Miller, Inc. 1995), which was approved by the U.S. EPA in a July 31, 1995 letter. The initial, on-going interim measures consist of controlling migration of VOCs in the shallow and deep aquifers at the southern property boundary through groundwater extraction at TW-2 and DN-13, respectively (Figure 2). The groundwater recovered by the upper aquifer recovery well TW-2 is treated using an air stripper tower and discharged through GM's National Pollutant Discharge Elimination System (NPDES) permitted outfall to the Great Miami River. Based on the first four years of operation, the system recovered and treated a total of 231,658,610 gallons at an average flowrate of 150 gallons per minute (ARCADIS Geraghty & Miller, 2000a). DN-13 is a deep aquifer

well that Montgomery County has been using in a Pump-to-Waste Program since March 1990. The interim measure consists of continued pumping of DN-13 at a rate of 2.663 million gallons per day.

The findings of the RFI for Delphi Thermal Moraine, including a Baseline Risk Assessment, were reported to the U.S. EPA and Ohio EPA in a draft RCRA Facility Investigation Final Report (Geraghty & Miller, Inc. 1996 and ENVIRON Corporation 1996 [these reports were approved by U.S. EPA in April 2000]). The RCRA Facility Investigation Final Report determined a CMS was not necessary for the SWMUs investigated in the RFI at Delphi Thermal Moraine, including the North Settling Lagoon and South Settling Lagoon. A summary of the Baseline Risk Assessment is presented in Appendix A.

The U.S. EPA issued an Amendment to the Administrative Order (Docket No. VW-R-002-91), effective on April 24, 1997, which included the former Moraine Engine and Moraine Assembly facilities in the Corrective Action program. This Amendment required GM to conduct a Supplemental RFI at the two additional facilities (6 AOIs were investigated). A multi-phased investigation was completed during the Supplemental RFI, which focused on AOI 7 - Former Oil House Area. The findings of the Supplemental RFI for former Moraine Engine and Moraine Assembly, including a Supplemental Baseline Risk Assessment, were reported to the U.S. EPA and Ohio EPA in a draft Supplemental RFI Report submitted to the U.S. EPA and Ohio EPA in June 1999 (ARCADIS Geraghty & Miller, Inc. 1999 and ENVIRON Corporation 1999 [these reports were approved by U.S. EPA in April 2000]). The Supplemental RFI Report determined that constituent concentrations in soils at the AOIs do not pose an unacceptable risk. However, GM recommended and implemented interim measures to address VOCs in groundwater associated with AOI 7. A Primary Groundwater Source Area (AOI 7) Interim Measures Work Plan was submitted to the U.S. EPA and Ohio EPA in June 1999 and was approved by the U.S. EPA in July 1999 (ARCADIS Geraghty & Miller, Inc. 1999). This Work Plan recommended a combination of in-situ technologies to address chlorinated VOCs in shallow groundwater (Figure 4). The recommended in-situ technologies were implemented between September 1999 and May 2000. The results of these AOI 7 Interim Measures were presented in the Draft Interim Measures/Corrective Measures Report submitted to the U.S. EPA and Ohio EPA in March 2001 (ARCADIS Geraghty & Miller, Inc. 2001).

To provide a basis for evaluating the performance of these AOI 7 Interim Measures, the Work Plan proposed that a comprehensive site-wide groundwater sampling event for VOCs be conducted to establish a baseline data set. This baseline sampling for

VOCs was completed in September 1999. Additionally, the first annual groundwater sampling event was completed between September and October 2000. During the 2000 sampling event, at the request of U.S. EPA, groundwater samples were analyzed for Appendix IX VOCs by Method 8260 and cis-1,2-dichloroethene, semi-volatile organic compounds (SVOCs) and metals to verify that current groundwater conditions were consistent with previous site conditions. The results of this one-time sampling event confirmed that VOCs were the only constituents of potential concern in groundwater at the site. SVOCs were not detected and metals were not detected above levels of concern during the 2000 sampling event. The analytical results from the 1999 baseline event and the 2000 first annual event are presented in the Interim Measures/Corrective Measures Report (ARCADIS Geraghty & Miller, Inc. 2001).

2. Site Conceptual Model

The site conceptual model is based on many years of lagoon monitoring and RFI investigations. Section 4.0 of the Supplemental RFI report presents the current site-wide groundwater conditions (ARCADIS Geraghty & Miller, Inc., 2000b). A summary of these conditions is presented below and serves as the basis for development of the site-wide groundwater monitoring plan discussed in the next section.

The site (Delphi Thermal Moraine, former Moraine Engine, Moraine Assembly) contains 56 upper aquifer monitoring wells (Figure 2), 18 lower aquifer monitoring wells (Figure 3), 6 injection wells for remediation purposes (Figure 5), 49 introduction wells for remediation purposes (Figures 5, 6, and 7), one upper and one lower aquifer capture zone extraction well (Figures 2 and 4, respectively), and several active production wells (Figure 4). The current groundwater sampling programs for the site monitoring well network are summarized on Table 1.

The site lies over the Great Miami River buried valley aquifer, which consists of valley fill deposits composed of sand and gravel outwash separated by locally discontinuous silt and clay units, referred to as till zones. Beneath the site, these glacial deposits have been divided into the following hydrogeologic units: the upper sand and gravel unit, the regional till zone, and the lower sand and gravel unit. The upper sand and gravel unit is generally 30, and in some areas, up to 70 feet thick and contains minor till lenses. The unit is considered a water-table aquifer. In addition, the upper aquifer beneath the AOI 7 area is divided into an upper and lower portion by the presence of an upper clay till. The upper clay till is continuous beneath the AOI 7 area at a depth ranging from approximately 25 feet to over 40 feet below land surface. The water table is located approximately 4 to 12 feet above the top of the upper clay till.

The regional till zone has a varied thickness and continuity, but appears to be discernible throughout the region; it ranges from being absent to being present in excess of 50 feet thick beneath the site. The regional till zone overlies at least 50, and in some areas, over 100 feet of sand and gravel that comprise the lower unit. This lower unit is a fully saturated, semi-confined aquifer throughout most of the Dayton area; however, there are locations where the regional till is thin or discontinuous. In areas where the regional till is absent, the upper and lower aquifers respond as one hydrogeologic unit. Consequently, aquifer parameters across the site vary with the thickness and distribution of the till layer. Additional information on site

hydrogeologic units is presented in the RFI Report (Geraghty & Miller, Inc. 2000) and the Supplemental Description of Current Conditions (Geraghty & Miller, Inc. 1997a).

Depth-to-water measurements and water-level elevations measured on December 3 and 4, 2001, for the upper aquifer are summarized in Table 2. The water-table surface on December 3 and 4, 2001 (Figure 8) shows flow in the upper aquifer is generally from north-northeast to south-southwest over the majority of the site. A groundwater capture zone, centered around Capture Well TW-2 located in the southwest corner of Landfill L1, is evident at the southern end of the Delphi Thermal Moraine facility. December 3 and 4, 2001 water-level measurements show the water level in Well TW-2 is lower than the water levels to the west in monitoring well GM-16, to the southwest in monitoring well GM-17, and to the south in monitoring well WSU-24, indicating a localized reversal of groundwater flow south/southwest of Capture Well TW-2. TW-2, screened in the upper aquifer, has been operating since January 31, 1996.

Hydraulic characteristics of the water-table aquifer were determined by evaluation of data from pumping tests conducted in 1985 and in 1989. The median hydraulic conductivity (K) value estimated from pumping test data was 1,650 feet per day (ft/day), and effective porosity was assumed to be 0.3 to 0.5. Using average hydraulic gradients for December 2001, groundwater flow velocities in the upper aquifer ranged from 2.29 ft/day to 3.82 ft/day.

Water-level elevations, presented on Table 2, were measured in the deep monitoring wells and production wells on December 3 and 4, 2001. The potentiometric surface on December 3 and 4, 2001 (Figure 9) shows groundwater flow in the lower aquifer to be generally from northeast to southwest, with a groundwater capture zone centered around County Well DN-13. County Well DN-13 is located south of the Delphi Thermal Moraine facility in the Dryden Road North Wellfield. The Pump-to-Waste Program at the Dryden Road North Wellfield, which began in 1990, was incorporated into interim measures and was in operation during the December 2001 baseline groundwater monitoring event. Groundwater flow velocity in the lower aquifer ranged between 0.50 ft/day and 0.83 ft/day.

VOCs present in upper and lower aquifer groundwater primarily associated with AOI 7 - Former Oil House Area are above their respective Safe Drinking Water Act, Maximum Contaminant Level (MCL). However, the upper aquifer is not a drinking water source or industrial water source on-site and is not reasonably expected to serve as either type of water source in the future. Further, there are no known users of groundwater from this upper water-table aquifer in the immediate vicinity of the site.

The lower aquifer is currently used as a nonpotable industrial water supply at the Moraine Engine and Moraine Assembly facilities and has the potential for use as an emergency drinking water supply downgradient of the facilities.

Based on the findings of the RFI and Supplemental RFI investigations, constituents of potential concern for the facilities are limited to chlorinated VOCs in groundwater from historic releases. As stated in the approved AOI 7 Interim Measures Work Plan (ARCADIS Geraghty & Miller, 1999b), data from the site-wide baseline sampling event completed in September 1999 (submitted to U.S. EPA and Ohio EPA under separate cover) was evaluated to establish a site-specific parameter list for site-wide groundwater monitoring. This list contains the eight chlorinated VOCs, that U.S. EPA and GM agreed to during the AOI 7 investigation. In addition, as stated in the Supplemental RFI report (Section 3.4.3.3), toluene would be added to the site parameter list based on detected concentrations in the AOI 7 area during November 1998. Benzene, toluene, ethylbenzene, and xylenes (BTEX) were all detected during the September 1999 baseline sampling event. While BTEX constituents were not identified as constituents of concern during the RFI, they have been added to the site-specific parameter list in order to monitor the effectiveness of the AOI 7 corrective measures and evaluate the total level of organic carbon at the site. The appropriateness of this site-specific parameter list was verified by the results of the one-time sampling event for VOCs, SVOCs and metals requested by the U.S. EPA in comments dated June 16, 2000 that was completed between September and October 2000. Based on GM's assessment of the September and October 2000 groundwater data, GM will add arsenic and barium to the site-specific parameter list used for the site-wide groundwater monitoring program, downgradient of the reactive zones (upper aquifer wells GM-28, ME-3, GM-32, and GM-21) and at the property boundary wells (upper aquifer wells GM-6, TW-2, 4S, and GM-2). These constituents will be included in the site-wide monitoring program until such time as a sufficient database has been developed to demonstrate that the random detection of these two metals does not pose a concern at this site. Once this has been demonstrated, only samples collected from the property boundary wells will be analyzed for arsenic and barium. Using this data, GM will evaluate if changes in the groundwater geochemistry are contributing to solubilizing the arsenic and barium and will modify the enhanced reductive dechlorination process as necessary.

This site-specific list includes the following parameters: benzene, 1,1-dichloroethane, 1,1-dichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, ethylbenzene, tetrachloroethene, toluene, 1,1,1-trichloroethane, trichloroethene, vinyl chloride, xylenes, arsenic, and barium.

3. Groundwater Monitoring Plan

In order to meet the objectives for groundwater monitoring presented in Section 1.0, a plan has been developed and is presented below. While this plan differs from the existing plans (i.e., reduced frequency of sampling certain monitoring wells and elimination of some wells), a more appropriate set of parameters will be monitored at a larger set of wells to give a better overall understanding of changes in groundwater quality at the site. The plan has been developed to meet the objectives of post-closure monitoring of the North and South Settling Lagoons and of monitoring effectiveness of the site-wide corrective measures. As discussed further in Appendix B, this plan is consistent with the intent of post-closure groundwater monitoring requirements for the closed lagoons, as specified in OAC 3745-54.

A summary of the monitoring plan is presented on Table 3. Figures 10 and 11 indicate the wells to be sampled for VOCs on a site-wide basis in the upper and lower aquifers, respectively. A schedule for the site-wide groundwater monitoring is presented on Figure 12.

3.1 North and South Settling Lagoons and Landfill Monitoring

The groundwater monitoring plan has been developed to meet the objectives of post-closure monitoring for the closed North and South Settling Lagoons. Groundwater quality in the upper-most aquifer downgradient of the closed North and South Settling Lagoons will be monitored on an annual basis for the site-specific list of VOCs. The monitoring well network will consist of three upper aquifer monitoring wells located at the downgradient point of compliance at each closed lagoon, as indicated on Table 3 and presented on Figure 10. Boring logs and well construction logs for these wells are presented in Appendix C. These monitoring wells are a subset of the existing site-wide monitoring well network:

- Closed North Settling Lagoon: W-2-N, W-3-N, and W-4-N.
- Closed South Settling Lagoon: W-2-S, W-3-S, and W-4-S.

VOC concentrations found in monitoring well HR-9, located upgradient from the site property, are similar to and sometimes higher than concentrations found in the monitoring wells directly downgradient of the closed North Settling Lagoon indicating other sources of VOCs are present upgradient from Delphi Thermal Moraine. VOC concentrations in the monitoring wells further downgradient (approximately 1,800

feet) are generally much higher than concentrations in monitoring wells directly downgradient of the North Settling Lagoon, suggesting that VOCs detected in those areas (located some distance from the North Settling Lagoon) are from other sources. These data coupled with the direction of groundwater flow suggests that other sources of these same VOC constituents exist east of the closed North Settling Lagoon at the Former Oil House. Therefore, only monitoring well data obtained from the downgradient point of compliance of the closed lagoons will be evaluated as part of this trend evaluation.

In addition, a subset of the existing monitoring wells located upgradient and downgradient of the landfills (Landfills L1, L2, and L3) will be monitored on an annual basis. The three landfill locations are shown on Figure 10 and the list of wells to be sampled are presented on Table 3.

3.2 Interim Measures Capture Zone Monitoring

GM has been operating a groundwater recovery and treatment system at Delphi Thermal Moraine since January 31, 1996, in order to control the off-site migration of upper aquifer groundwater that contains VOCs. Capture well TW-2, a component of this interim measures system, is located at the southern property boundary (Figure 2). In order to evaluate downgradient groundwater quality in the upper aquifer, a subset of the existing monitoring well network in the vicinity of TW-2 and downgradient of the site will be monitored on an annual basis, as presented on Table 3.

The Air Permit and NPDES Permit for the groundwater recovery and treatment system require periodic monitoring and reporting of water quality in the influent and effluent streams, and pumping flow rates. These activities will continue in accordance with the permit requirements presented in the Final Interim Measures Design Plans (Geraghty & Miller, Inc., 1995) and the new operational scheme presented in the October 1996 Monthly Technical Progress Report.

Interim measures also consist of continued pumping of Montgomery County Well DN-13 (Figure 4). In order to evaluate downgradient groundwater quality in the lower aquifer, a subset of the existing monitoring well network in the vicinity of DN-13 and downgradient of the site will be monitored on an annual basis, as presented on Table 3.

Continued interim measures pumping of groundwater at the downgradient property boundary at wells TW-2 and DN-13 to control migration of groundwater constituents

has been recommended as a part of the corrective measures for the site, as discussed in the Interim Measures/Corrective Measures Report.

3.3 AOI 7 Interim/Corrective Measures Remediation Zones Monitoring

As presented in the AOI 7 Interim Measures Work Plan, groundwater quality in select wells upgradient and downgradient of the oxidation areas and reactive zones (Figures 5, 6, and 7) will be monitored, as presented on Table 3. Oxidation Area 1 (OA-1) consists of three wells where chemicals (such as hydrogen peroxide, ferrous sulfate, and sulfuric acid) were injected into the upper aquifer above the upper clay till to create Fenton's Reagent and oxidize the VOCs. The OA-1 wells surround the GM-23/GM-27 well cluster. OA-2 consists of three wells which surround the former Moraine Engine Tank Farm. These wells will be used for remediation purposes. Reactive Zone 1 (RZ-1) is located at the southern boundary of AOI 7 and consists of nine introduction wells; RZ-2 is located as an intermediate downgradient treatment curtain south of AOI 7 in the ME well series area and consists of 4 introduction wells; and RZ-3 is located downgradient of the Delphi Thermal Moraine and the former Moraine Engine facilities and consists of 40 wells. Interim measures within the reactive zones involves the introduction of a carbon source (molasses and potable water mixture) into the upper aquifer to allow the microbial population to develop the reducing conditions necessary to support enhanced anaerobic biodegradation of the chlorinated VOCs.

Based on an evaluation of the AOI 7 Interim Measures discussed above, the corrective measures for the site were proposed in the Draft Interim Measures/Corrective Measures report, submitted to the U.S. EPA and Ohio EPA in March 2001 (ARCADIS Geraghty & Miller, 2001). The proposed AOI 7 corrective measures include continued operation of RZ-1, RZ-2, and RZ-3, with an expansion of RZ-1 through installation and use of additional carbon introduction wells along the western side of RZ-1 during proposed redevelopment activities in this area.

Monitoring frequency of the wells in the reactive zones will be quarterly for the first year, semi-annually for years two and three, and annually thereafter. Field parameters collected from wells within these zones will be monitored more frequently in order to assess performance of the mobile reactive zones.

3.4 Waste Pile/Staging Area Interim Measures

A supplemental investigation is currently being conducted in the Waste Pile/Staging Area at the Delphi Thermal Moraine facility. This focused investigation involves the advancement of soil borings for collection of soil samples for screening and analysis, and to allow the installation of monitoring wells. This investigation is focused at locations upgradient, within and downgradient of the Waste Pile/Staging Area in the upper aquifer, above the regional clay till. Monitoring well pairs have been installed upgradient (deep upper aquifer well GM-33 and shallow well GM-34) and downgradient (deep/shallow pairs GM-35/GM-36 and GM-37/38). These monitoring wells have been sampled for VOCs, SVOCs, metals and polychlorinated biphenyls. After this groundwater data is validated and reviewed, GM will propose to U.S. EPA and Ohio EPA the wells in this area to be added to the site-wide groundwater-monitoring network.

3.5 Field Methodologies

The following sections present a summary of the field procedures to be followed during the site-wide groundwater-monitoring program.

3.5.1 Groundwater Sampling

Groundwater samples will be collected using low-flow sampling procedures from selected upper aquifer monitoring wells presented on Table 3. Field parameters including pH, specific conductance, temperature, oxidation/reduction potential, and dissolved oxygen will be measured during purging of each upper aquifer well using a multi-parameter flow-through cell. Standard Operating Procedure (SOP) #21 will be followed when sampling upper aquifer wells (Geraghty & Miller, Inc., 1997b). A copy of this SOP, along with other SOP's related to groundwater sampling are presented in Appendix D.

Groundwater samples from the lower aquifer wells presented in Table 3 will be collected using a 2-inch submersible pump or a site-dedicated bailer. Once three well volumes are evacuated, field parameters (pH, specific conductance, and temperature) will be measured. SOP #3 will be followed when sampling lower aquifer wells (Appendix D). Groundwater samples from the production wells will be collected according to SOP #28. All groundwater samples will be collected, managed under standard chain-of-custody procedures, and validated in accordance with the approved

Supplemental RFI Work Plan and the RFI Quality Assurance Project Plan (Geraghty & Miller, Inc., 1997b).

3.5.2 Water-Level Measurements

Water levels will be measured contemporaneously in all accessible on-site wells and wells located east of the site and at the southern end of the site, within the Dryden Road North Wellfield, and within the Dryden Road South Wellfield on an annual basis. Specific wells where depth to water will be measured are included on Table 4. SOP #4 will be followed when taking water level measurements.

3.5.3 Laboratory Analytical Methods

All groundwater samples will be analyzed for the site-specific parameter list using SW 846 Method 8260 and Method 6010B. This parameter list was developed after evaluating data from the September 1999 baseline groundwater sampling event and the one-time sampling event conducted in September/October 2000 (which included analysis of Appendix IX VOCs and cis-1,2-dichloroethene, SVOCs and metals), conducted as part of the AOI 7 interim measures. The site-specific parameter list includes: benzene, 1,1-dichloroethane, 1,1-dichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, ethylbenzene, tetrachloroethene, toluene, 1,1,1-trichloroethane, trichloroethene, vinyl chloride, xylenes, arsenic, and barium. This site-specific list of VOCs may be modified, as necessary.

Select groundwater samples from upper aquifer monitoring wells will also be analyzed for the biogeochemical indicator parameters. Table 5 lists specific field, laboratory, and biogeochemical indicator parameters, and field and laboratory analytical methods. All samples will be submitted under appropriate chain-of-custody documentation to Severn Trent Laboratory in North Canton, Ohio (STL North Canton) and Microseeps in Pittsburgh, Pennsylvania.

4. Groundwater Data Evaluation

Water-level elevations measured from each well will be used to determine groundwater flow directions in the upper and lower aquifers and to determine the vertical gradients between the two aquifers. The cone of influence present around TW-2, DN-13, and any active production wells will be noted on the groundwater flow maps.

All analytical data collected for site-wide groundwater monitoring will be validated and reviewed in accordance with the Data Management Plan and the Quality Assurance Project Plan of the Supplemental RFI Work Plan (Geraghty & Miller, Inc., 1997b). As data are acquired, they will be interpreted to ensure that monitoring objectives outlined in Section 1.0 are met. In general, the data evaluation will be focused on two components: 1) continuing contributions, if any, from in-place waste management units, and 2) effectiveness of corrective measures activities. An outline of the general approach that will be used to evaluate data collected in the groundwater monitoring program is provided below; details regarding the data evaluation methodology are provided in the Interim Measures/Corrective Measures Report submitted by GM to U.S. EPA and Ohio EPA in March 2001 (ARCADIS Geraghty & Miller, 2001).

4.1 Program Objectives

4.1.1 Monitoring of In-Place Waste Management Units

One component of the groundwater monitoring program is monitoring of specific units that will continue to manage wastes in-place (i.e., the closed lagoons and landfills). Although the RFI and Supplemental RFI determined that the wastes at these units do not contribute constituents to groundwater at levels that would have any significant effect on current and reasonably expected future groundwater uses, the monitoring program includes monitoring wells that will be used to confirm these findings.

Objectives 1 and 2: Assessing contributions from the lagoons and landfills. The monitoring wells associated with the monitoring of the lagoons and landfills will be evaluated to determine whether these units are significantly affecting groundwater quality. In general, this evaluation would include a review of groundwater quality from monitoring wells upgradient and downgradient of these units to identify whether a particular unit is affecting groundwater quality. If a unit is determined to be affecting groundwater quality, the health significance to current and reasonably expected groundwater uses on-site and

off-site will be evaluated. This evaluation will follow the groundwater assessment methods used in the Supplemental RFI Baseline Risk Assessment, accounting for the goal of achieving the conditions outlined in Objective 3 below.

4.1.2 Effectiveness of Corrective Measures

As discussed in the Supplemental RFI Report, the supplemental baseline risk assessment determined that no unacceptable human exposures are currently occurring. However, constituents in groundwater at AOI 7 were determined to have a potential to migrate to an extent that reasonably expected future uses of groundwater might be affected. Accordingly, GM has continued the interim measures pumping of groundwater at the downgradient property boundary at wells TW-2 and DN-13 to control migration of groundwater constituents and has implemented additional interim remedial measures to provide in-situ remediation in AOI 7 and at on-site locations downgradient of AOI 7. These remedial measures have been recommended as the corrective measures for the site, as discussed in the Interim Measures/Corrective Measures Report. Therefore, the second component of the site-wide groundwater monitoring program described in this plan is the collection and evaluation of data for ongoing determination of the effectiveness of and the need for continuation of corrective measures controls and remedial measures.

Objective 3: Assessing the need for pumping of wells TW-2 and DN-13.
The need for continued operation of these wells will be determined based on achieving and maintaining the following conditions:

1. Upper Aquifer: Consistent with the criterion stated in the RCRA Corrective Action Environmental Indicator Determination – Migration of Contaminated Groundwater Under Control (CA 750), the condition to be met in the upper aquifer is no migration of VOCs at concentrations exceeding appropriately protective levels (i.e., "appropriate for the protection of the groundwater resource and its beneficial uses" as characterized in the RFI) beyond the "existing area of contaminated groundwater."

2. Lower Aquifer: Consistent with the goal to maintain a usable aquifer, including off-site drinking water use, the condition to be met in the lower aquifer is no VOC concentrations exceeding MCLs (or equivalent risk-based drinking water concentrations) in the lower aquifer beyond the "existing area of contaminated groundwater."

GM expects that achievement of these conditions will be determined by comparing groundwater quality data from on-site monitoring wells in the upper aquifer at the downgradient facility boundary to specific remediation target levels that have been established to ensure achieving the above-defined conditions when the corrective measures wells are turned-off. The remediation target levels were established using the groundwater assessment methods used in the Supplemental Baseline Risk Assessment, supplemented as appropriate with additional predictive models. Specific modeling methods for establishing the concentration limits and specific monitoring points are described in the Interim Measures/Corrective Measures Report.

Objective 4: Assessing the effectiveness of and the need for continuing remediation in RZs 1 and 3.

Monitoring wells located at and downgradient of AOI 7 and each RZ are included in the site-wide groundwater monitoring program to provide data that will be evaluated to determine whether active remediation at AOI 7 or a particular RZ is performing as expected or has reached the feasible limits of the technology. This evaluation may suggest adjustments or modifications to the remedial actions, including terminating remediation. The specifics of how the data will be evaluated to monitor performance is described in the Interim Measures/Corrective Measures Report.

In addition to the evaluation of technical performance, the data from these wells will also be evaluated to determine the extent to which active remediation at each RZ is contributing significantly to achievement of the conditions outlined above for Objective 3. Specific approaches for evaluating these data from this perspective has been developed in conjunction with the work described above for Objective 3 during completion of the Interim Measures/Corrective Measures Report.

Objective 5: Verify the effectiveness of completed corrective measures.

The monitoring program also is designed to provide data that will allow ongoing confirmation of the Supplemental RFI findings that groundwater at AOI 7 is the only significant source affecting site-wide groundwater quality. Therefore, certain elements of this groundwater monitoring program are to be continued for some period after the completion of active corrective measures controls and remedial measures to verify that the conditions defined for Objective 3 continue to be met without these active measures. The Interim Measures/Corrective Measures Report describes the verification monitoring procedure that will follow

shut-down of the active control measures and remedial measures, to ensure that groundwater quality remains acceptable.

4.1.3 Corrective Action Completion Strategy

GM's goal under its corrective action program is to reduce existing on-site and off-site groundwater concentrations to levels that are protective of reasonably expected future uses of groundwater. GM's approach for achieving this goal will be met through a combination of interim and corrective measures that achieve plume migration control, reduce existing plume concentrations, and monitor performance of these measures. Data will be acquired during the implementation of corrective measures to evaluate progress towards achieving this goal. Once on-site groundwater concentrations are reduced sufficiently by active corrective measures to ensure continued protection of reasonably expected groundwater uses, some or all of the active measures will be shut-off. Groundwater monitoring as described in this plan would continue to verify that groundwater conditions remain acceptable, and that ultimately, groundwater concentrations at the downgradient property boundary decline below appropriately protective levels (i.e., appropriate for the protection of the groundwater resource and its beneficial uses).

As discussed in Appendix A, supplemental baseline risk assessments determined that no unacceptable human exposures are currently occurring (Environ Corporation 2000). In particular, hazardous constituents present in soil/waste at the SWMUs and AOIs, including the land-based disposal units present at Delphi Thermal pose no unacceptable risk to groundwater under current and reasonably likely groundwater use conditions. However, constituents in groundwater at an unrelated area, AOI 7, were determined to have a potential to migrate to an extent that reasonably expected future uses of groundwater might be affected. As described in Section 1, at the request of U.S. EPA, GM implemented interim measures pumping of groundwater at the downgradient property boundary at wells TW-2 and DN-13 to control migration of groundwater constituents. GM has also implemented in-situ remediation at three on-site locations downgradient of AOI 7. In addition, GM has initiated a site-wide groundwater monitoring program to collect and evaluate data for its ongoing assessment of the effectiveness of these remedial measures in meeting the corrective measures objectives. The monitoring program includes monitoring for some period following termination of these remedial measures to ensure that groundwater quality remains acceptable, and that off-site contamination is reduced to below appropriately protective levels. In addition, the monitoring program includes provisions for identifying potentially significant contributions from the land-based units (i.e., landfills

and closed lagoons), if any, relative to the existing site-wide groundwater quality, to ensure continuation of corrective action as necessary to address these units.

4.2 Data Evaluation Methodology

4.2.1 Shut-Down of Remediation Components

The need for continued operation of the remedial measures will be determined based on achieving and maintaining the following conditions:

1. Upper aquifer: consistent with the criterion stated in the approved RCRA Corrective Action Environmental Indicator Determination – Migration of Contaminated Groundwater Under Control (CA 750), the condition to be met in the upper aquifer is no migration of VOCs at concentrations exceeding appropriately protective levels (i.e., appropriate for the protection of the groundwater resource and its beneficial uses as characterized in the RFI) beyond the existing area of contaminated groundwater. Based on the groundwater conditions established during the September 1999 baseline sampling event, GM proposed for a short-/intermediate-term goal to use existing well GM-26 (Figure 10) as the point of compliance (POC) for ensuring that this condition is maintained.

2. Lower aquifer: consistent with the goal to maintain a usable aquifer, including off-site drinking water use, the condition to be met in the lower aquifer is no VOC concentrations exceeding maximum contaminant levels (MCLs) or equivalent risk-based drinking water concentrations in the lower aquifer beyond the existing area of contaminated groundwater. Based on the groundwater conditions established during the September 1999 baseline sampling event, GM proposed for a short-/intermediate-term goal to use existing wells GM-15, GM-11, and GM-20D (Figure 11) as the POCs for ensuring that this condition is maintained.

Progress towards achieving these conditions will be evaluated by comparing groundwater quality data from on-site monitoring wells to calculated remediation performance target levels (RTLs) that ensure compliance with these conditions without active corrective measures (RTLs are presented on a table in Appendix B). As described in GM's draft Interim Measures/Corrective Measures Report, preliminary RTLs have been estimated using the groundwater assessment methods developed in the Supplemental Baseline Risk Assessment (see summary provided in

Appendix A), taking into consideration the current pumping conditions at and in the vicinity of the facility. Specifically, the modflow groundwater flow model (Geraghty & Miller, Inc. 1994) developed for Delphi Thermal Moraine and the surrounding region (including former Moraine Engine and Moraine Assembly) is being used to support the estimation of RTLs equal to concentrations in on-site groundwater at locations downgradient of AOI 7 that would not be expected to result in exceedances of the MCL at the designated POCs.

The calculated RTLs are presented in Appendix B of the Interim Measures/Corrective Measures Report and Appendix B of this plan. These preliminary RTLs will be reviewed and updated, as needed, as part of the annual assessment of the corrective measures performance to ensure that the basis on which they were estimated remains valid. For example, these preliminary RTLs will be revised as appropriate to reflect knowledge of groundwater pumping conditions at the time of each annual evaluation. Any changes to the RTLs or the methodology for deriving the RTLs will be reviewed with U.S. EPA prior to making a decision regarding termination of one or more remedial measures.

As part of the annual remediation performance monitoring evaluation, data collected from on-site and off-site monitoring wells will be compared to RTLs as a measure of the performance of each remedial measure; i.e., to determine the extent to which each remedial measure is contributing to achievement of the specific conditions outlined above for the upper and lower aquifers. In addition, as part of the annual performance monitoring evaluation, GM will review the groundwater pumping conditions at the facility and surrounding area to confirm that the basis for the RTLs remain valid. In the event that pumping conditions at or surrounding the facility changed during the monitoring period, then GM will update the RTLs prior to conducting the performance evaluation. Further, because the models used to develop the RTLs do not take into consideration attenuation of constituents during transport in the groundwater (e.g., retardation, degradation), and one of the primary components of the remedial measures is enhanced in-situ biodegradation, GM will also assess the extent to which these processes should be accounted for in applying the RTLs during the performance evaluation. Any changes to the methodology for deriving the RTLs will be reviewed with U.S. EPA prior to making a decision regarding termination of one or more remedial measures.

GM's intermediate-term goal is to reduce existing on-site and off-site groundwater concentrations within the existing plume boundary to levels that are protective of reasonably expected future uses of groundwater without the active operation of

corrective measures. Achievement of this goal will be determined by comparing groundwater quality data from monitoring wells to RTLs that are designed to ensure residual on-site concentrations will not result in off-site concentrations exceeding acceptable levels. For example, achieving the RTLs in areas downgradient of AOI 7 (e.g., downgradient of RZ-3) would indicate that the downgradient control measures (e.g., pumping TW-2) would no longer be necessary to meet the allowable POC concentration. However, in this example, if concentrations upgradient of RZ-3 remain above the target levels, the active measures at RZ-1, RZ-2, and/or RZ-3 would need to be maintained until upgradient concentrations are further reduced. Achieving RTLs in all of the on-site monitoring zones would indicate that the allowable POC concentrations would not be exceeded if all active measures were shut-off.

Once on-site groundwater concentrations are reduced sufficiently by active measures to be protective of reasonably expected future uses, some or all of these active measures will be shut-off. Following shut-down of any active measures, GM will continue its groundwater monitoring program to confirm that the conditions in the upper and lower aquifer continue to be met without these active measures. GM's long-term goal is to reduce the off-site groundwater concentrations to below appropriately protective levels so that the POC can be shifted to the downgradient facility boundary.

4.2.2 Assessment of Closed Lagoons

As previously described, this site-wide monitoring program provides for an equivalent monitoring of potentially significant contributions of hazardous waste constituents to existing groundwater quality. To determine if the closed lagoons may be significant contributors of hazardous waste constituents to existing groundwater concentrations, monitoring data collected from the designated post-closure monitoring wells located downgradient of each of the closed lagoons will be evaluated for temporal trends. The initial approach for evaluating trends in these data will be to apply straight line regression to the data and to determine if the regression line appears to show a strong positive correlation. This regression analysis will only be performed for wells and constituents where a sufficient percentage of analytical data are above detection limits to allow for a meaningful trend evaluation. In the event that the regression analysis shows a strong correlation, more rigorous statistical methods may be employed to determine the significance of the correlation. These more rigorous statistical methods may include the Sen's Test or the Mann-Kendall Test (Gibbons, 2001). If a statistically significant trend is identified, the degree to which the closed lagoons are affecting groundwater quality will be further evaluated relative to changes in site-wide groundwater quality that are unrelated to the close lagoons. The results of the

statistical trend analysis and any additional evaluation will be included in the annual groundwater monitoring report. Table 6 presents the first set of data to be included in the trend evaluation. This data was collected in November 2001 after the lagoons were closed.

If the closed lagoons are determined to be affecting groundwater quality, such effects will be evaluated as part of GM's comprehensive site-wide RCRA corrective action monitoring program. This evaluation will be conducted in lieu of a standard groundwater compliance program as described in OAC 3745-54-99 since it provides a more comprehensive assessment of the significance of groundwater concentrations attributed to the closed lagoons relative to potential site-specific human health impacts attributed to the existing groundwater conditions. Specifically, the health significance of concentrations downgradient of the closed lagoons will be evaluated using the assessment approach defined in the Supplemental Resource Conservation and Recovery Act Facility Investigation Report, Volume II Supplemental Baseline Risk Assessment ("Supplemental BRA"; ENVIRON 2000). The constituent concentrations in detection monitoring wells associated with a unit that are not attributable to an upgradient source(s) will be considered representative of the concentrations that are leaching from the unit, and used to confirm that the unit's contribution to existing groundwater concentrations do not represent levels that could adversely impact potential groundwater receptors.

In the event that one or both of the closed lagoons is determined to be contributing constituents to groundwater such that the site-wide corrective action objectives are not being met, then GM will consider the need for further action under the corrective action program with U.S. EPA. If U.S. EPA determines based on review of the monitoring results that one or both of the lagoons is contributing constituents to the groundwater, U.S. EPA will notify OEPA. OEPA reserves the right to make the determination as to whether or not further action is required with respect to addressing groundwater contamination potentially caused by releases from the closed lagoons.

4.2.3 Assessment of Other Land-Based Units

The monitoring program will also be used to evaluate potentially significant contributions from the other land-based units (i.e., landfills), if any, relative to the existing site-wide groundwater quality, to ensure that the groundwater conditions achieved by the remedial measures continue to be met. Consistent with the methodology specified for the closed lagoons, the significance of concentrations downgradient of the other land-based units will be evaluated using the assessment

approach defined in the Supplemental Baseline Risk Assessment. The constituent concentration in monitoring wells associated with a unit that is not attributable to an upgradient source(s) will be considered representative of the concentration that is leaching from the waste, and used as that unit's source term. The source term will then be multiplied with the source reduction factors defined for that unit under current conditions without interim measures to confirm that the unit's contribution to groundwater concentrations do not represent levels that could adversely impact potential groundwater receptors.

5. Groundwater Data Reporting

By March 1st of each year, a summary report will be prepared that contains a discussion of field activities (water-level measurements and groundwater sampling), an assessment of groundwater quality, flow rate, and direction, an evaluation of the validated analytical results (as presented in Section 4.0), a discussion of corrective measures, and a discussion of any problems encountered during sampling and analysis. The report will also contain tabulated analytical results, a summary table that includes construction and location information for the wells in the monitoring program, tabulated water-level elevations, a figure showing water-table surface groundwater elevations, groundwater sampling logs, a hard copy of the laboratory report, and an electronic database. This annual report will be designed to provide adequate information such that it will serve as the annual capture zone monitoring report and the post-closure monitoring report for the closed lagoons and only one annual monitoring report will be required for the site to address both U.S. EPA and Ohio EPA requirements. As part of the data evaluation and reporting, GM will determine if the closed settling lagoons are serving as a significant contributor to groundwater contamination. In the event this occurs, GM will notify both U.S. EPA and Ohio EPA, per the requirements of OAC 3745-54-98(G).

On an annual basis, the wells included in the site-wide groundwater monitoring program and the site-specific parameter list will be assessed to ensure the most appropriate program is implemented. All project files for the site-wide groundwater monitoring program, including field notes and laboratory reports, will be maintained per the requirements of the QAPP.

As shown on Figure 12, groundwater monitoring and reporting are proposed for the next 5 years; however, groundwater monitoring will be implemented for a minimum of 30 years, unless otherwise demonstrated that no further monitoring is warranted. At the end of the fifth year, this monitoring plan will be reevaluated and modifications proposed, if necessary. However, changes to the monitoring program may be proposed prior to the five year timeframe, if necessary.

6. References

ARCADIS Geraghty & Miller, Inc., 1999. Primary Groundwater Source Area (AOI 7) Interim Measures Work Plan, General Motors Corporation, Moraine, Ohio. June 1999.ARCADIS Geraghty & Miller, Inc., 2000a. Fourth Annual Interim Measures Capture Zone Report, Delphi Harrison Thermal Systems, Moraine, Ohio.

ARCADIS Geraghty & Miller, Inc., 2000b. Supplemental RFI - Volume I (Methodologies and Results) General Motors Powertrain Group Moraine Engine Plant and General Motors Truck Group Moraine Assembly Plant, Moraine, Ohio. April 2000.

ARCADIS Geraghty & Miller, Inc., 2001. Draft Interim Measures/Corrective Measures Report, General Motors Corporation, Moraine, Ohio. March 2001.

Conestoga-Rovers & Associates, 2000. Lagoon Closure Plan, General Motors, Harrison Radiator Division Facility, Moraine, Ohio. February 2000.

Conestoga-Rovers & Associates, 2001. Certification of Lagoon Closure Report, General Motors Harrison Radiator Division Facility, Moraine, Ohio. August 10, 2001.

ENVIRON Corporation, 1996. RCRA Facility Investigation Final Report Volume II (Baseline Risk Assessment), Delphi Harrison Thermal Systems, General Motors Corporation, Moraine, Ohio. February 1996.

ENVIRON Corporation, 2000. Supplemental Resource Conservation and Recovery Act Facility Investigation Report, Volume II Supplemental Baseline Risk Assessment, General Motors Powertrain Group Moraine Engine Plant and General Motors Truck Group Moraine Assembly Plant, Moraine, Ohio. April 2000.

Geraghty & Miller, Inc. 1989a. Revised Ground-water Quality Assessment Plan for the Harrison Radiator North Lagoon, Harrison Radiator Division, General Motors Corporation, Moraine, Ohio. June 1989.

Geraghty & Miller, Inc. 1989b. Revised Ground-water Monitoring Detection Program for the Harrison Radiator South Lagoon, Harrison Radiator Division, General Motors Corporation, Moraine, Ohio. June 1989.

Geraghty & Miller, Inc., 1994. Revised Three-Dimensional Steady-State Flow Model, Harrison Division - General Motors Corporation, Moraine, Ohio. May 1994.

Geraghty & Miller, Inc., 1995. Final Interim Measures Design Plans, Harrison Division - GM, Moraine, Ohio. April 1995.

Geraghty & Miller, Inc., 1997a. Supplemental DOCC for General Motors Powertrain Group Moraine Engine Plant and General Motors Truck Group Moraine Assembly Plant, Moraine, Ohio. July 1997.

Geraghty & Miller, Inc., 1997b. Supplemental RFI Work Plan for General Motors Powertrain Group Moraine Engine Plant and General Motors Truck Group Moraine Assembly Plant, Moraine, Ohio. July 1997.

Geraghty & Miller, Inc. 2000. RCRA Facility Investigation Final Report Volume I (Methodologies and Results) Delphi Harrison Thermal Systems, General Motors Corporation, Moraine, Ohio. April 2000.

Gibbons, Robert D. and David E. Coleman, 2001. Statistical Methods for Detection and Quantification of Environmental Contamination. John Wiley & Sons. June 2001.

Ohio Environmental Protection Agency (Ohio EPA), 2002. Letter to Ms. Jean Caufield, from Pamela S. Allen, Manager, Re: Delphi Harrison Thermal Systems-Moraine Surface Impoundments, Completion of Full Closure OHD000817 577. June 27, 2002.

Table 1. Current Groundwater Monitoring Programs Performed at General Motors Corporation, Moraine, Ohio.

Well	Quarterly Assessment Monitoring[1]	Semi-Annual Detection Monitoring[2]	Capture Zone Monitoring[3]
Upper Aquifer Wells			
HR-1	X[4]		
HR-2	X[4]		
HR-3	X[4]		
HR-4	X[4]		
HR-5	X[4]		
HR-6	X[4]		
HR-7	X[4]		
HR-8	X[4]		
HR-9	X[5]		
HR-11	X[5]		
HR-16		X[6,7]	
HR-17		X[6,7]	
W-1-N	X[4]		
W-2-N	X[4]		
W-3-N	X[5]		
W-4-N	X[5]		
W-2-S		X[6,7]	
W-3-S		X[6,7]	
W-4-S		X[6,7]	
4S			X[8]
GM-6			X[8]
GM-17			X[8]
GM-18			X[8]
TW-2			X[8]
Lower Aquifer Wells			
HR-10	X[5]		
HR-12	X[5]		
HR-13	X[4]		
HR-14	X[5]		
HR-15	X[5]		

VOCs	Volatile organic compounds.	SpC	Specific Conductance.
SVOC	Semivolatile Organic Compounds.	TOX	Total Organic Halogens.
TOC	Total Organic Carbon.	Fe	Iron.
Mn	Manganese.	Na	Sodium.

(1) The quarterly assessment monitoring is performed during March, June, September, and November.
(2) The semi-annual detection monitoring is performed during June and September.
(3) The capture zone monitoring is performed during July.
(4) Sampled quarterly for VOCs, SpC, pH.
(5) Sampled quarterly for VOCs, SpC, pH, SVOC, total cyanide, total metals, dissolved metals.
(6) Sampled second quarter for SpC, pH, TOX, TOC.
(7) Sampled fourth quarter for SpC, pH, TOX, TOC, phenol, chlorides, sulfates, total Fe, Mn, Na, dissolved Fe, Mn, Na.
(8) Sampled annually for VOCs.

Table 2. Water-Level Measurements During December 2001, General Motors Corporation, Moraine, Ohio.

Well	Measuring Point Elevation	Depth-to-Water (feet)	Water-Level Elevation
Shallow Aquifer Wells			
W-1-N	739.02	31.9	707.12
W-2-N	731.68	25.26	706.42
W-3-N	733.66	27.39	706.27
W-4-N	731.63	25.22	706.41
HR-1	732.71	28.09	704.62
HR-2	734.75	28.42	706.33
HR-3	736.75	30.47	706.28
HR-4	742.6	35.64	706.96
HR-5	734.27	28.46	705.81
HR-6	732.66	27.62	705.04
HR-7	731.73	25.85	705.88
HR-8	743.42	36.15	707.27
HR-9	743.51	36.68	707.83
HR-11	743.33	35.64	707.69
HR-16	727.01	22.65	704.36
HR-17	726.43	21.97	704.46
W-1-S	729.29	24.78	704.51
W-2-S	726.64	22.83	703.81
W-3-S	733.42	25.38	708.04*
W-4-S	727.68	23.93	703.75
GM-2	735.81	32.28	703.53
4S	731.36	NA	NA
GM-6	730.27	27.15	703.12
GM-8	735.17	31.79	703.38
GM-10	723.9	20.99	702.91
GM-16	725.3	22.09	703.21
GM-17	723.84	20.74	703.1
GM-18	723.8	22.07	701.73
GM-19S	730.85	26.86	703.99
EAST	730.98	26.75	704.23
WEST	731.08	26.84	704.24
WSU-24	725.1	21.53	703.57
WS-17	726.18	22.96	703.22
WS-18	733.52	31.63	701.89

Table 2. Water-Level Measurements During December 2001, General Motors Corporation, Moraine, Ohio.

Well	Measuring Point Elevation	Depth-to-Water (feet)	Water-Level Elevation
WS-19	726.62	23.25	703.37
TW-2	733.38	34.06	699.32
RW-10	728.53	24.44	704.09
RW-11	729.74	25.47	704.27
GM-21	724.2	21.2	703.81
GM-22	728.28	29.92	701.71
GM-23	730.99	26.2	704.8
GM-24	747.29	38.2	709.09
GM-25	746.17	40.16	706.01
GM-26	722.29	21.14	701.15
GM-27	730.59	24.12	706.45
GM-28	729.19	32.08	705.94
GM-29	730.78	27.26	703.52
GM-30	732.33	29.87	702.46
GM-31	728.20	31.78	703.45
GM-32	732.08	28.59	703.49
GM-33	729.77	25.49	704.28
GM-34	730.56	26.27	704.29
GM-35	731.27	28.84	702.43
GM-36	731.11	28.58	702.53
GM-37	730.05	26.03	704.02
GM-38	729.88	27.28	702.6
ME-2	728.4	**	NA
ME-3	728.09	29.5	703.09
ME-4	728.31	Dry	Dry
ME-6	728.34	32.73	703.18
Deep Aquifer Wells			
GM-1	735.74	32.38	703.36
GM-3	730.44	27.48	702.96
GM-4	731.46	28.51	702.95
GM-5	731.29	28.17	703.12
GM-7R	735.61	32.16	703.45
GM-9	724.07	21.55	702.52
GM-11	723.71	21.28	702.43
GM-13	723.82	21.84	701.98
GM-14	723.5	22.99	700.51
GM-15	725.23	23.35	701.88
GM-19D	730.25	26.68	703.57
GM-20D	727.26	23.81	703.45
HR-10	742.81	34.98	707.83

Table 2. Water-Level Measurements During December 2001, General Motors Corporation, Moraine, Ohio.

Well	Measuring Point Elevation	Depth-to-Water (feet)	Water-Level Elevation
HR-12	742.64	34.93	707.71
HR-13	735.03	28.66	706.37
HR-14	731.63	26.68	704.95
HR-15	733.74	27.49	706.25
M73C	716.55	15.87	700.68
MT68	746.45	41.26	705.19
MT69	722.71	20.38	702.33
MT576M	751.46	44.42	707.04
MT596M***	757.73	49.83	707.9
Production and Fire Wells			
11B	NS	On	NM
12A	742.35	On	NM
28	733.67	NM	NM
31	734.05	27.50	706.55
32	732.10	27.85	704.25
35	733.96	Dry	NM
37	731.24	NM	NM
39	732.07	On	NM
42	731.62	26.69	704.93
44	734.62	NM	NM
45	731.03	NM	NM
46	733.34	29.75	703.59
A	739.00	NM	NM
FW-1A	739.89	33.26	707.74
FW-2	737.48	31.74	705.74
FW-3	739.26	33.55	705.71
FW-4	731.62	27.57	704.05

Measuring point is to top of the PVC Casing.
Water-level elevations are reported in feet above mean sea level (msl).
Depth-to-water elevations were measured on December 3 and 4, 2001 using an electronic water level indicator.
Depth-to-water measurements are reported in feet below the measuring point.
NS - Not Surveyed.
NA - Not accessible because 4S still contains a submersible pump.
NM - Not measured.
*Well needs to be resurveyed.
** Well crushed but can be repaired.
***Measuring point is top of cement housing.

Table 3. Summary of Site-Wide Groundwater Monitoring Plan, General Motors Corporation, Moraine, Ohio.

Monitoring Wells	Reason for Monitoring	Monitoring Frequency	Parameter List
Upper Aquifer Wells			
HR-9	Monitoring groundwater quality upgradient of the site.	Annual	1st Annual[1], VOCs[2]
HR-11	Monitoring groundwater quality upgradient of the site.	Annual	1st Annual[1], VOCs[2]
HR-8	Monitoring of groundwater quality upgradient of the North Settling Lagoon and Landfills L2 and L3.	Annual	1st Annual[1], VOCs[2]
HR-4	Monitoring of groundwater quality upgradient of the North Settling Lagoon and downgradient of Landfill L3.	Annual	1st Annual[1], VOCs[2]
W-2-N	Monitoring of groundwater quality downgradient of the North Settling Lagoon.	Annual	1st Annual[1], VOCs[2]
W-3-N	Monitoring of groundwater quality downgradient of the North Settling Lagoon.	Annual	1st Annual[1], VOCs[2]
W-4-N	Monitoring of groundwater quality downgradient of the North Settling Lagoon and Landfills L2 and L3.	Annual	1st Annual[1], VOCs[2]
HR-2	Monitoring groundwater quality downgradient of Landfills L2 and L3.	Annual.	1st Annual[1], VOCs[2]
HR-5	Monitoring of groundwater quality downgradient of the North Settling Lagoon.	Annual	1st Annual[1], VOCs[2]
HR-3	Monitoring groundwater quality in the central portion of the site.	Annual	1st Annual[1], VOCs[2]
HR-1	Monitoring groundwater quality in the central portion of the site.	Annual	1st Annual[1], VOCs[2]
GM-30	Monitoring effectiveness of interim measures at AOI 7.	Quarterly for 1st year, semi-annually for years 2 and 3, and annually thereafter.	1st Annual[1], VOCs[2] Biogeochemical[3]

Table 3. Summary of Site-Wide Groundwater Monitoring Plan, General Motors Corporation, Moraine, Ohio.

Monitoring Wells	Reason for Monitoring	Monitoring Frequency	Parameter List
Upper Aquifer Wells			
GM-23	Monitoring effectiveness of interim measures at AOI 7.	Quarterly for 1st year, semi-annually for years 2 and 3, and annually thereafter.	1st Annual[1], VOCs[2] Biogeochemical[3]
GM-27	Monitoring effectiveness of interim measures at AOI 7 in lower portion of the upper aquifer.	Annual	1st Annual[1], VOCs[2]
GM-29	Monitoring effectiveness of interim measures upgradient of RZ-1.	Quarterly for 1st year, semi-annually for years 2 and 3, and annually thereafter.	1st Annual[1], VOCs[2] Biogeochemical[3]
GM-28	Monitoring effectiveness of interim measures downgradient of RZ-1.	Quarterly for 1st year, semi-annually for years 2 and 3, and annually thereafter.	1st Annual[1], VOCs[2] Biogeochemical[3], arsenic, barium
ME-6	Monitoring effectiveness of interim measures at the upgradient boundary of RZ-2.	Quarterly for 1st year, semi-annually for years 2 and 3, and annually thereafter.	1st Annual[1], VOCs[2] Biogeochemical[3]
GM-31	Monitoring effectiveness of interim measures within RZ-2.	Annual	1st Annual[1], VOCs[2] Biogeochemical[3]
ME-3	Monitoring effectiveness of interim measures at the downgradient boundary of RZ-2.	Quarterly for 1st year, semi-annually for years 2 and 3, and annually thereafter.	1st Annual[1], VOCs[2] Biogeochemical[3], arsenic, barium
GM-22	Monitoring effectiveness of interim measures upgradient of RZ-3.	Quarterly for 1st year, semi-annually for years 2 and 3, and annually thereafter.	1st Annual[1], VOCs[2] Biogeochemical[3]

Table 3. Summary of Site-Wide Groundwater Monitoring Plan, General Motors Corporation, Moraine, Ohio.

Monitoring Wells	Reason for Monitoring	Monitoring Frequency	Parameter List
Upper Aquifer Wells			
19S	Monitoring effectiveness of interim measures upgradient of RZ-3 and groundwater quality upgradient of Landfill L1.	Quarterly for 1st year, semi-annually for years 2 and 3, and annually thereafter.	1st Annual[1], VOCs[2] Biogeochemical[3]
EAST	Monitoring effectiveness of interim measures upgradient of RZ-3 and groundwater quality upgradient of Landfill L1.	Quarterly for 1st year, semi-annually for years 2 and 3, and annually thereafter.	1st Annual[1], VOCs[2] Biogeochemical[3]
GM-32	Monitoring effectiveness of interim measures downgradient of RZ-3 and groundwater quality upgradient of Landfill L1.	Quarterly for 1st year, semi-annually for years 2 and 3, and annually thereafter.	1st Annual[1], VOCs[2] Biogeochemical[3], arsenic, barium
GM-21	Monitoring effectiveness of interim measures downgradient of RZ-3.	Quarterly for 1st year, semi-annually for years 2 and 3, and annually thereafter.	1st Annual[1], VOCs[2] Biogeochemical[3], arsenic, barium
HR-17	Monitoring of groundwater quality upgradient of the South Settling Lagoon.	Annual	1st Annual[1], VOCs[2]
W-2-S	Monitoring of groundwater quality downgradient of the South Settling Lagoon.	Annual	1st Annual[1], VOCs[2]
W-3-S	Monitoring of groundwater quality downgradient of the South Settling Lagoon.	Annual	1st Annual[1], VOCs[2]
W-4-S	Monitoring of groundwater quality downgradient of the South Settling Lagoon.	Annual	1st Annual[1], VOCs[2]
GM-8	Monitoring groundwater quality downgradient of the site and within Landfill L1.	Annual	1st Annual[1], VOCs[2] bio

Table 3. Summary of Site-Wide Groundwater Monitoring Plan, General Motors Corporation, Moraine, Ohio.

Monitoring Wells	Reason for Monitoring	Monitoring Frequency	Parameter List
Upper Aquifer Wells			
GM-6	Monitoring groundwater quality downgradient of the site and Landfill L1.	Annual	1st Annual[1], VOCs[2], arsenic, barium
4S/TW-2	Monitoring groundwater quality downgradient of the site and Landfill L1.	Annual	1st Annual[1], VOCs[2], arsenic, barium
GM-2	Monitoring groundwater quality downgradient of the site.	Annual	1st Annual[1], VOCs[2], arsenic, barium
GM-16	Monitoring groundwater quality downgradient of the site.	Annual	1st Annual[1], VOCs[2]
GM-17	Monitoring groundwater quality downgradient of the site.	Annual	1st Annual[1], VOCs[2]
GM-18	Monitoring groundwater quality downgradient of the site.	Annual	1st Annual[1], VOCs[2]
WSU-24	Monitoring groundwater quality downgradient of the site.	Annual	1st Annual[1], VOCs[2]
GM-10	Monitoring groundwater quality downgradient of the site.	Annual	1st Annual[1], VOCs[2]
GM-26	Monitoring groundwater quality downgradient of the site.	Annual	1st Annual[1], VOCs[2]
Lower Aquifer Wells			
HR-10	Monitoring groundwater quality upgradient of the site.	Annual	1st Annual[1], VOCs[2]
HR-12	Monitoring groundwater quality upgradient of the site.	Annual	1st Annual[1], VOCs[2]
HR-15	Monitoring groundwater quality in the central portion of the site.	Annual	1st Annual[1], VOCs[2]
HR-13	Monitoring groundwater quality in the central portion of the site.	Annual	1st Annual[1], VOCs[2]
~~31~~ GM-39	Monitoring groundwater quality in the central portion of the site.	Annual	1st Annual[1], VOCs[2]
~~32~~ GM-42	Monitoring groundwater quality in the central portion of the site.	Annual	1st Annual[1], VOCs[2]

Table 3. Summary of Site-Wide Groundwater Monitoring Plan, General Motors Corporation, Moraine, Ohio.

Monitoring Wells	Reason for Monitoring	Monitoring Frequency	Parameter List
Lower Aquifer Wells			
~~42~~ GM-40	Monitoring groundwater quality in the central portion of the site.	Annual	1st Annual(1), VOCs(2)
~~28~~ GM-41	Monitoring groundwater quality in the central portion of the site.	Annual	1st Annual(1), VOCs(2)
GM-19D	Monitoring groundwater quality downgradient of the site.	Annual	1st Annual(1), VOCs(2)
GM-3	Monitoring groundwater quality downgradient of the site.	Annual	1st Annual(1), VOCs(2)
GM-1	Monitoring groundwater quality downgradient of the site.	Annual	1st Annual(1), VOCs(2)
GM-15	Monitoring groundwater quality downgradient of the site.	Annual	1st Annual(1), VOCs(2)
GM-11	Monitoring groundwater quality downgradient of the site.	Annual	1st Annual(1), VOCs(2)
GM-20D	Monitoring groundwater quality downgradient of the site.	Annual	1st Annual(1), VOCs(2)
DN-13	Monitoring groundwater quality downgradient of the site.	Annual	1st Annual(1), VOCs(2)
GM-9	Monitoring groundwater quality downgradient of the site.	Annual	1st Annual(1), VOCs(2)
MT-69	Monitoring groundwater quality downgradient of the site.	Annual	1st Annual(1), VOCs(2)

VOCs - Volatile organic compounds.
SVOCs – Semi-volatile organic compounds.

(1) The following parameters will be analyzed for the 1st annual sampling event: Appendix IX VOCs and cis-1,2-dichloroethene, Appendix IX SVOCs, and Appendix IX total and dissolved metals.
(2) The parameters for the remaining annual sampling events will include the site-specific list of VOCs: benzene, 1,1,-dichloroethane, 1,1-dichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, ethylbenzene, tetrachloroethene, toluene, 1,1,1-trichloroethane, trichloroethene, vinyl chloride, and xylenes.
(3) The biogeochemical list includes the field and laboratory parameters presented on Table 5.

Table 4. List of Wells to be Used for Water-Level Measurements, General Motors Corporation, Moraine, Ohio.

Upper Aquifer Monitoring Wells

W-1-N	HR-9	GM-10	GM-21	GM-33
W-2-N	HR-11	GM-16	GM-22	GM-34
W-3-N	HR-16	GM-17	GM-23	GM-35
W-4-N	HR-17	GM-18	GM-24	GM-36
HR-1	W-1-S	GM-19S	GM-25	GM-37
HR-2	W-2-S	EAST	GM-26	GM-38
HR-3	W-3-S	WEST	GM-27	ME-2
HR-4	W-4-S	TW-2	GM-28	ME-3
HR-5	GM-2	WSU-24	GM-29	ME-4
HR-6	4S	WS-17	GM-30	ME-6
HR-7	GM-6	WS-18	GM-31	
HR-8	GM-8	WS-19	GM-32	

Lower Aquifer Monitoring Wells

GM-1	GM-11	HR-12	MT-69
GM-3	GM-13	HR-13	MT576M
GM-4	GM-14	HR-14	MT68M
GM-5	GM-15	HR-15	MT596M
GM-7R	GM-19D	GM-20D	
GM-9	HR-10	M73C	

Lower Aquifer Production and Fire Wells (as accessible)

A	32	42	FW-1A
11B	35	44	FW-2
12A	37	45	FW-3
28	39	46	FW-4
31			

Table 5. Field and Laboratory Analytical Procedures for Groundwater, General Motors Corporation, Moraine, Ohio.

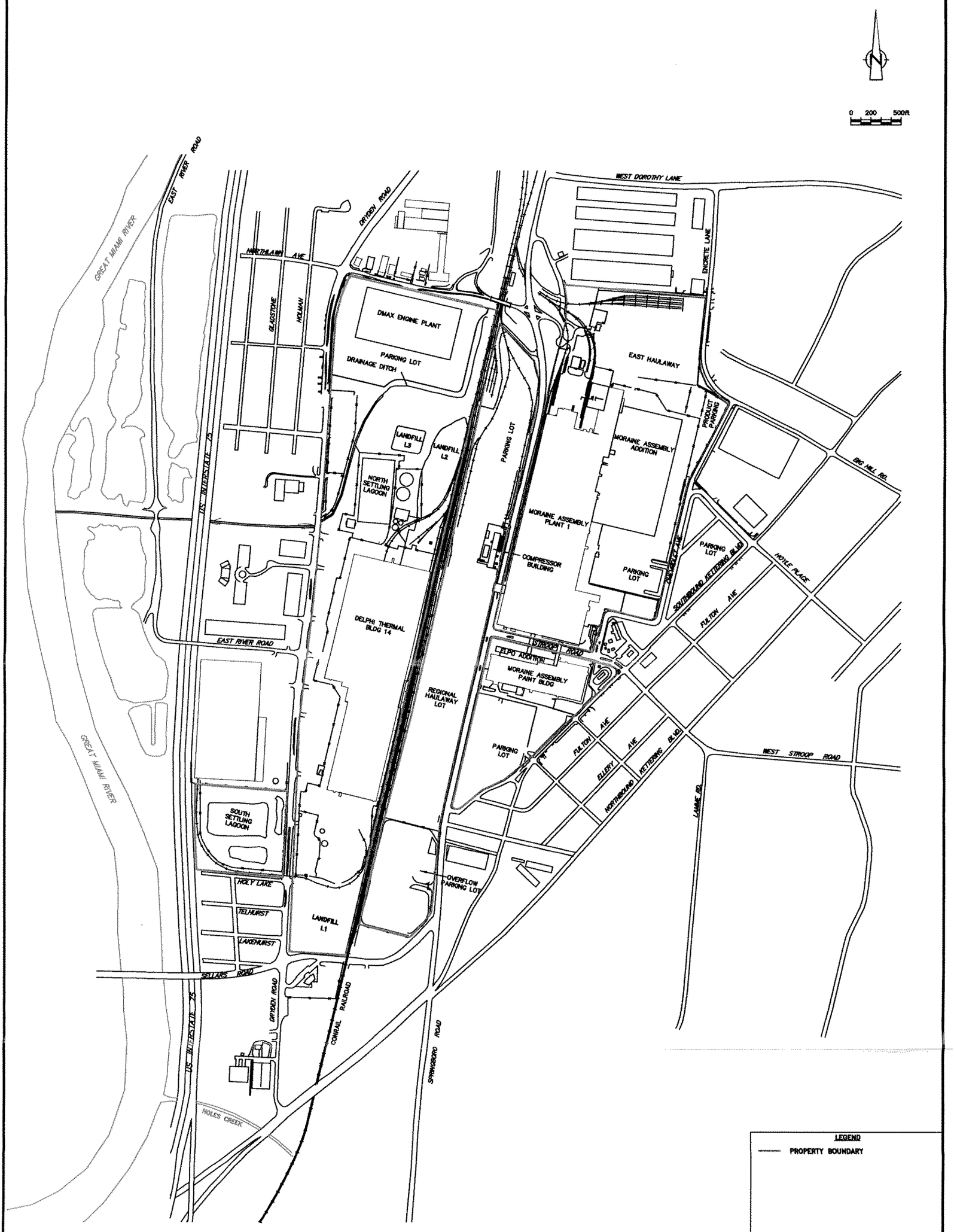
Parameters	Method Number	Procedure
Site-Specific List of VOCs[1]	Method 8260B	Laboratory
Arsenic, Barium (select wells only)	Method 6010B	Laboratory
Dissolved Oxygen	[2]	Field
Reduction/Oxidation Potential	[2]	Field
pH	[2]	Field
Specific Conductance	[2]	Field
Manganese (Total)	Method 6010B	Laboratory
Manganese (Dissolved)	Method 6010B	Laboratory
Iron (Total)	Method 6010B	Laboratory
Iron (Dissolved)	Method 6010B	Laboratory
Sulfate	SM 375.4	Laboratory
Sulfide	SM 376.1	Laboratory
Total Organic Carbon	SM 415.1	Laboratory
Chlorides	SM 325.2	Laboratory
Light Hydrocarbon Scan (Ethane, Ethene, Methane)	Method AM18G[3]	Laboratory

Method Refers to U.S. Environmental Protection Agency SW 846.
SM Standard Methods for the Evaluation of Water and Wastewater, 18th Edition, 1992.
VOCs Volatile organic compounds.
(1) Site-specific parameter list for VOCs includes: benzene, 1,1-dichloroethane, 1,1-dichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, ethylbenzene, tetrachloroethene, toluene, 1,1,1-trichloroethane, trichloroethene, vinyl chloride, and xylenes.
(2) Field parameters to be collected using a down-well or a flow-through meter.
(3) Method numbers are laboratory-specific and developed for monitoring natural attenuation projects.

Table 5. Field and Laboratory Analytical Procedures for Groundwater, General Motors Corporation, Moraine, Ohio.

Parameters	Method Number	Procedure
Site-Specific List of VOCs[1]	Method 8260B	Laboratory
Arsenic, Barium (select wells only)	Method 6010B	Laboratory
Dissolved Oxygen	[2]	Field
Reduction/Oxidation Potential	[2]	Field
pH	[2]	Field
Specific Conductance	[2]	Field
Manganese (Total)	Method 6010B	Laboratory
Manganese (Dissolved)	Method 6010B	Laboratory
Iron (Total)	Method 6010B	Laboratory
Iron (Dissolved)	Method 6010B	Laboratory
Sulfate	SM 375.4	Laboratory
Sulfide	SM 376.1	Laboratory
Total Organic Carbon	SM 415.1	Laboratory
Chlorides	SM 325.2	Laboratory
Light Hydrocarbon Scan (Ethane, Ethene, Methane)	Method AM18G[3]	Laboratory

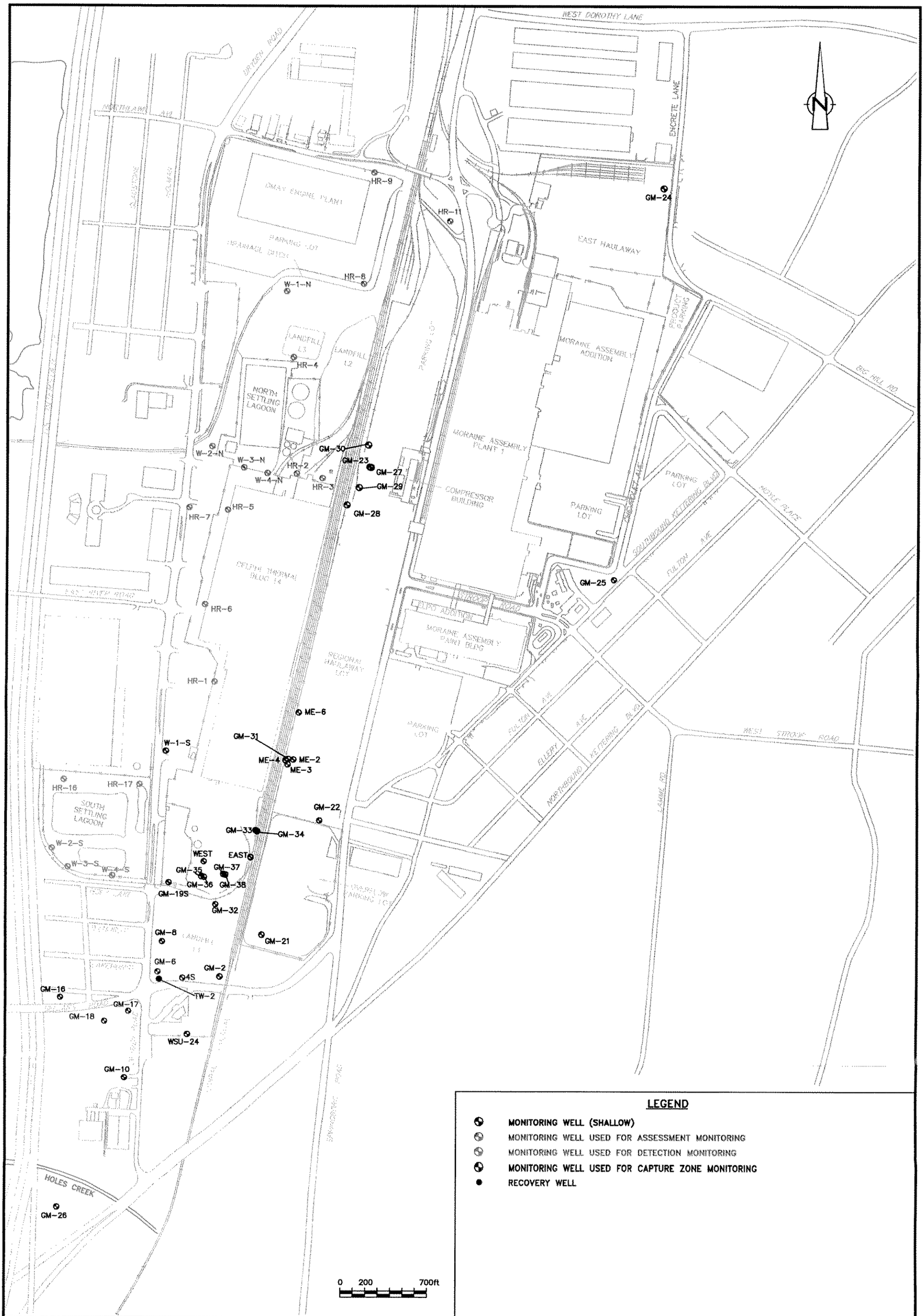
Method Refers to U.S. Environmental Protection Agency SW 846.
SM Standard Methods for the Evaluation of Water and Wastewater, 18th Edition, 1992.
VOCs Volatile organic compounds.
(1) Site-specific parameter list for VOCs includes: benzene, 1,1-dichloroethane, 1,1-dichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, ethylbenzene, tetrachloroethene, toluene, 1,1,1-trichloroethane, trichloroethene, vinyl chloride, and xylenes.
(2) Field parameters to be collected using a down-well or a flow-through meter.
(3) Method numbers are laboratory-specific and developed for monitoring natural attenuation projects.



ARCADIS
6397 Emerald Parkway
Suite 150, Dublin, OH 43016
Tel: 614/764-2310 Fax: 614/764-1270

SITE LAYOUT
FORMER MORAINE ENGINE, MORAINE ASSEMBLY AND DELPHI THERMAL FACILITIES
GENERAL MOTORS CORPORATION
MORAINE, OHIO

DATE 10/18/2002	PROJECT MANAGER N. GILLOTTI	DRAWING NAME CRA\GWM\GWMPLAN-00
DRAWN R. SMITH	LEAD DESIGN PROF. J. REID	CHECKED N. GILLOTTI
PROJECT NUMBER 0H000294.0005.0003		DRAWING NUMBER 1



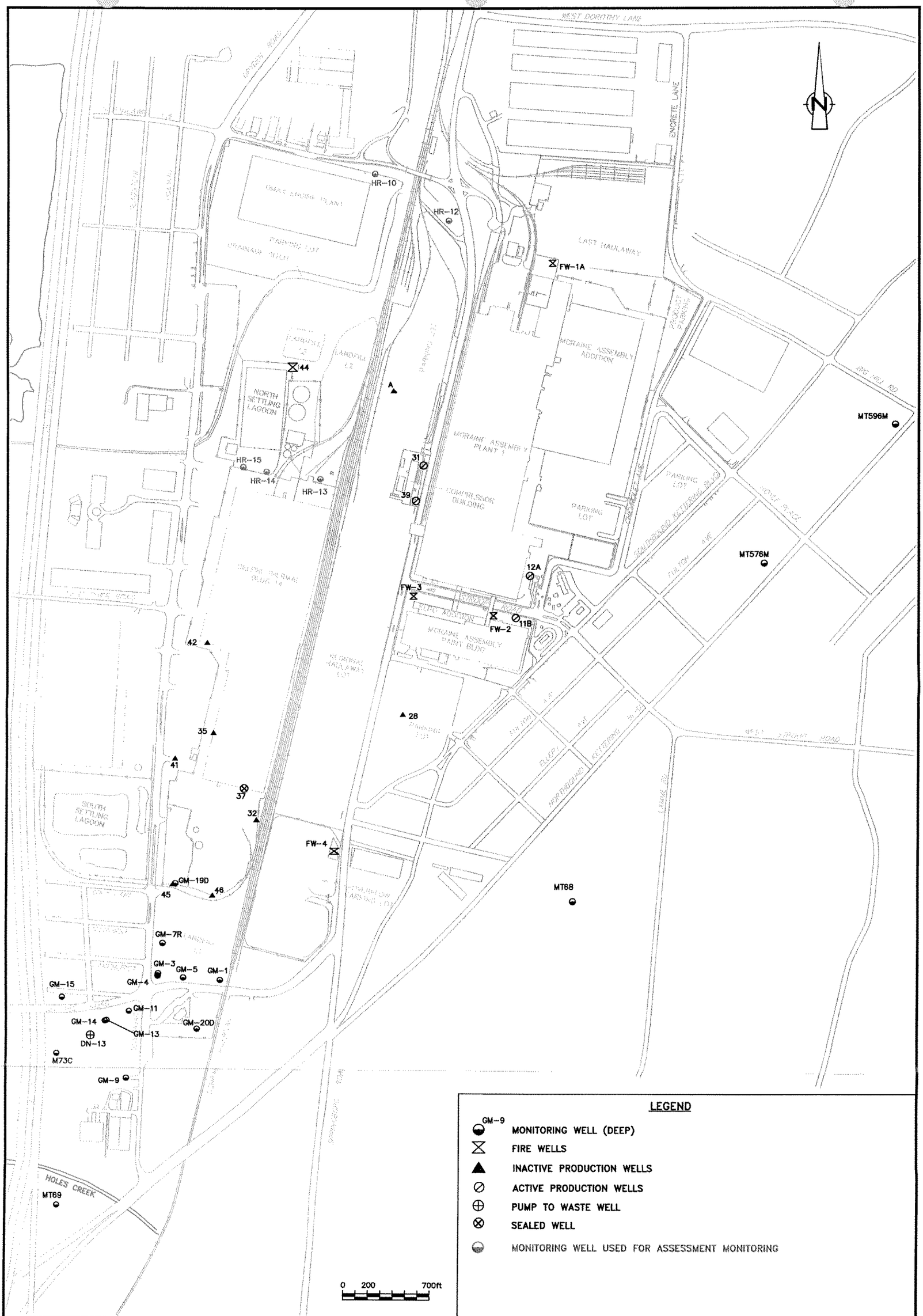
LEGEND

- MONITORING WELL (SHALLOW)
- MONITORING WELL USED FOR ASSESSMENT MONITORING
- MONITORING WELL USED FOR DETECTION MONITORING
- MONITORING WELL USED FOR CAPTURE ZONE MONITORING
- RECOVERY WELL

ARCADIS
6397 Emerald Parkway
Suite 150, Dublin, OH 43016
Tel: 614/764-2310 Fax: 614/764-1270

UPPER AQUIFER MONITORING WELL NETWORK GENERAL MOTORS CORPORATION MORAINE, OHIO

DATE	PROJECT MANAGER	DRAWING NAME
10/18/2002	N. GILLOTTI	CRA\GWP\GWMPLAN-01
DRAWN	LEAD DESIGN PROF.	CHECKED
R. SMITH	J. REID	N. GILLOTTI
PROJECT NUMBER		DRAWING NUMBER
0H000294.0005.0003		2



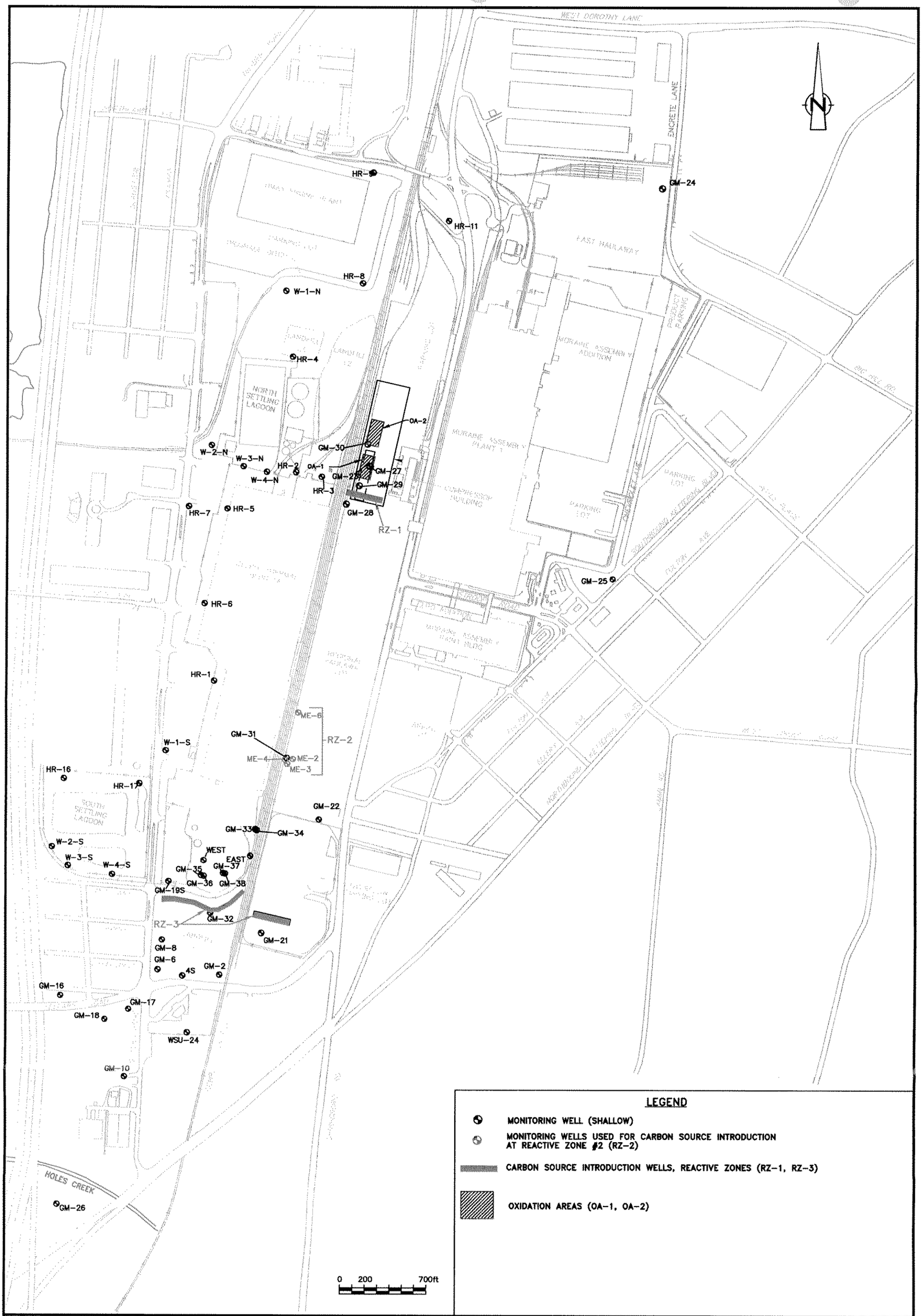
LEGEND

- GM-9 — MONITORING WELL (DEEP)
- FIRE WELLS
- INACTIVE PRODUCTION WELLS
- ACTIVE PRODUCTION WELLS
- PUMP TO WASTE WELL
- SEALED WELL
- MONITORING WELL USED FOR ASSESSMENT MONITORING

ARCADIS
6397 Emerald Parkway
Suite 150, Dublin, OH 43016
Tel: 614/764-2310 Fax: 614/764-1270

LOWER AQUIFER MONITORING WELL NETWORK GENERAL MOTORS CORPORATION MORAINE, OHIO

DATE	PROJECT MANAGER	DRAWING NAME
10/18/2002	N. GILLOTTI	CRA\GWP\GWMPLAN--02
DRAWN	LEAD DESIGN PROF.	CHECKED
R. SMITH	J. REID	N. GILLOTTI
PROJECT NUMBER		DRAWING NUMBER
OH000294.0005.0003		3



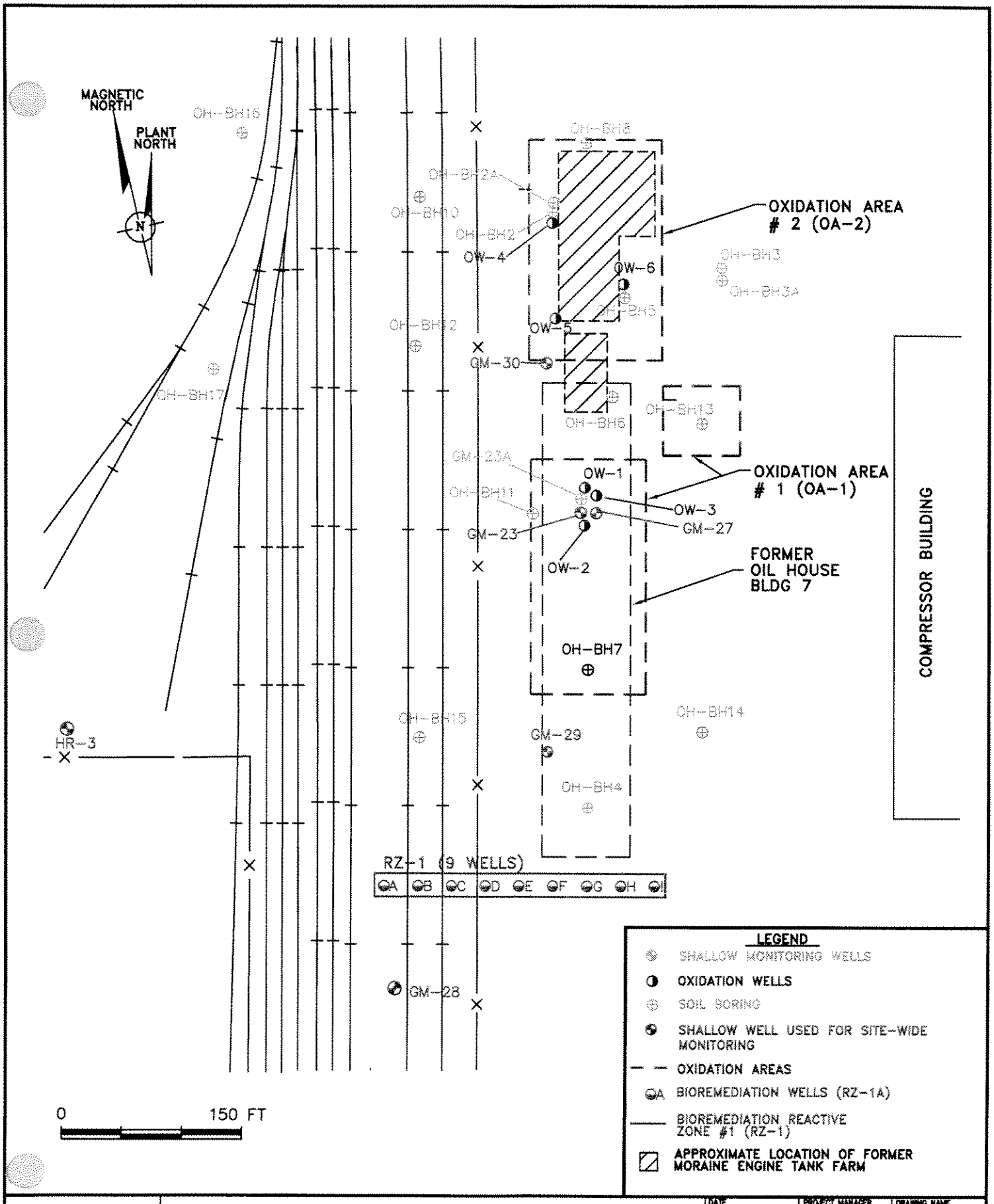
LEGEND

- MONITORING WELL (SHALLOW)
- MONITORING WELLS USED FOR CARBON SOURCE INTRODUCTION AT REACTIVE ZONE #2 (RZ-2)
- CARBON SOURCE INTRODUCTION WELLS, REACTIVE ZONES (RZ-1, RZ-3)
- OXIDATION AREAS (OA-1, OA-2)

ARCADIS
6397 Emerald Parkway
Suite 150, Dublin, OH 43016
Tel: 614/764-2310 Fax: 614/764-1270

AOI 7 CORRECTIVE MEASURES
GENERAL MOTORS CORPORATION
MORAINE, OHIO

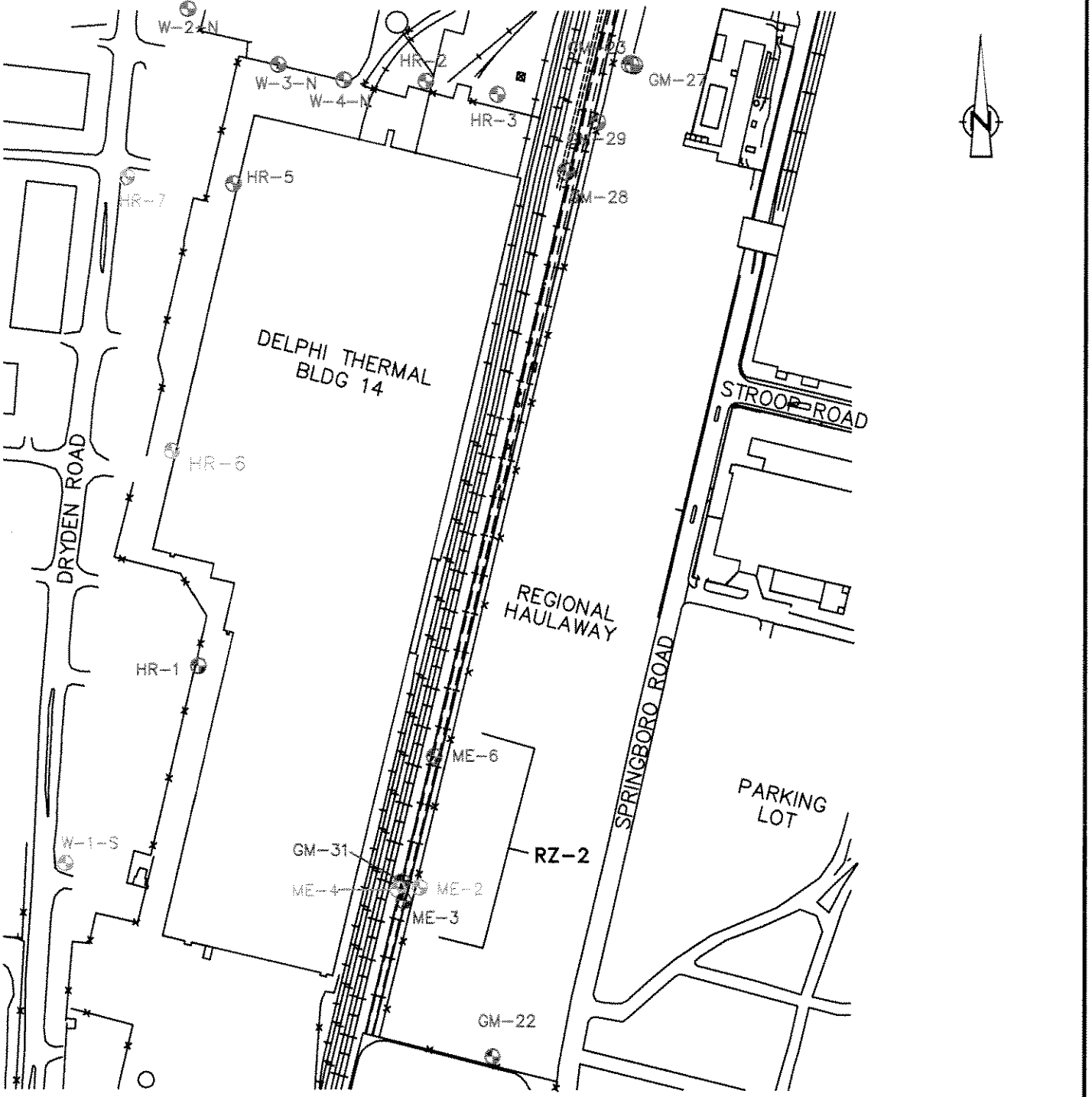
DATE	PROJECT MANAGER	DRAWING NAME
10/18/2002	N. GILLOTTI	CRA\GWP\GWMPLAN-05
DRAWN	LEAD DESIGN PROF.	CHECKED
R. SMITH	J. REID	N. GILLOTTI
PROJECT NUMBER		DRAWING NUMBER
OH000294.0005.0003		4



ARCADIS
6367 Emerald Parkway
Suite 150, Dublin, OH 43016
Tel: 614/764-2310 Fax: 614/764-1270

BIOREMEDIATION REACTIVE ZONE #1 AND OXIDATION AREAS GENERAL MOTORS CORPORATION MORAINE, OHIO

DATE	PROJECT MANAGER	DRAWING NAME
10/18/2002	N. GILLOTTI	CRA\GMM\GMMPLAN-08
DRAWN	LEAD DESIGN PROF.	CHECKED
R. SMITH	J. REID	N. GILLOTTI
PROJECT NUMBER		FIGURE NUMBER
0H000294.0005.0003		5



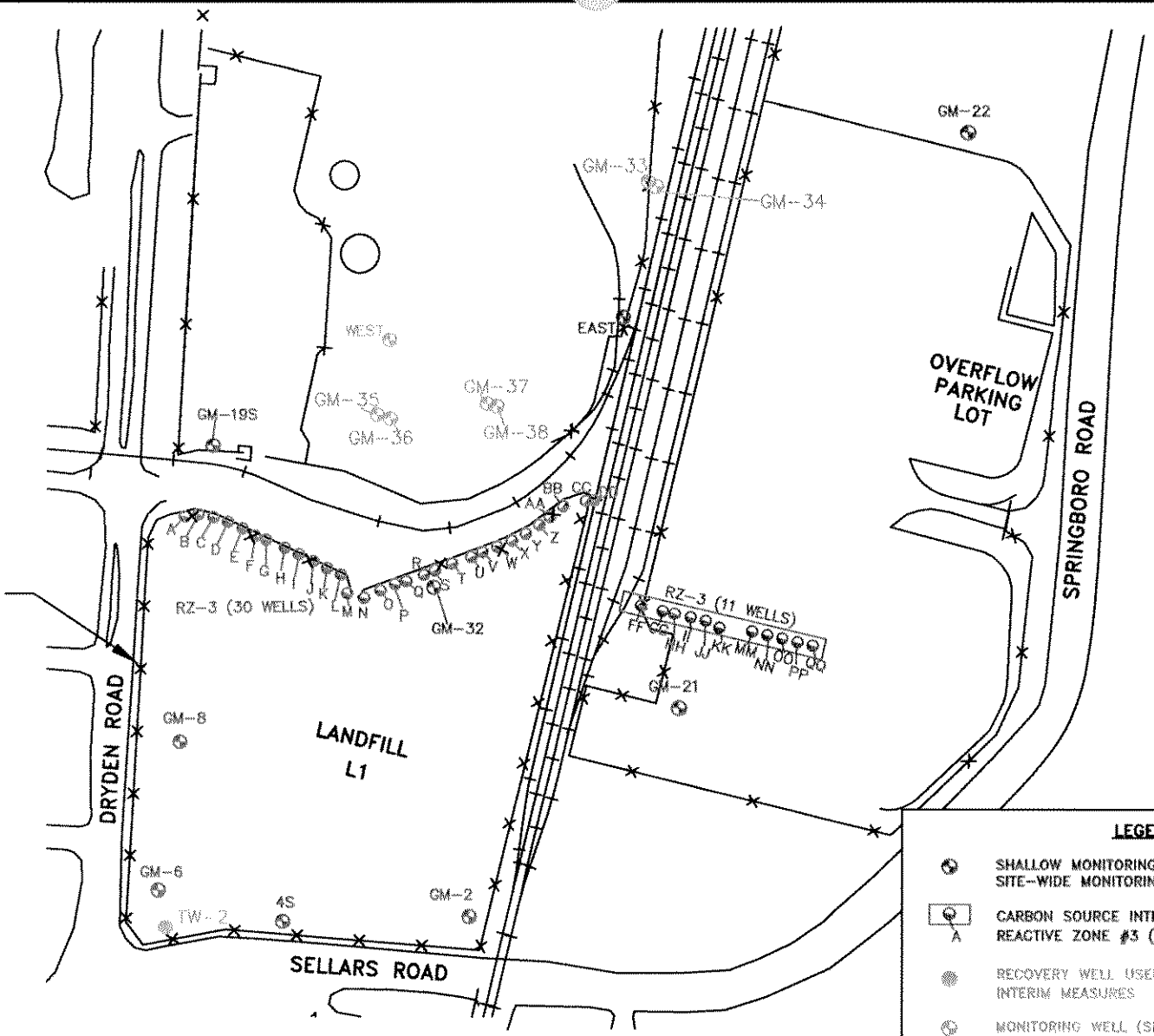
LEGEND

- MONITORING WELL (SHALLOW)
- MONITORING WELL USED FOR SITE-WIDE MONITORING

ARCADIS
6367 Emerald Parkway
Suite 150, Dublin, OH 43016
Tel: 614/764-2310 Fax: 614/764-1270

BIOREMEDIATION REACTIVE ZONE #2 GENERAL MOTORS CORPORATION MORAINE, OHIO

DATE	PROJECT MANAGER	DRAWING NAME
10/16/2002	N. GILLOTTI	CRA\GMM\GWMPLAN-10
DRAWN	LEAD DESIGN PROF.	CHECKED
R. SMITH	J. REID	N. GILLOTTI
PROJECT NUMBER		FIGURE NUMBER
OH000294.0005.0003		6



LEGEND

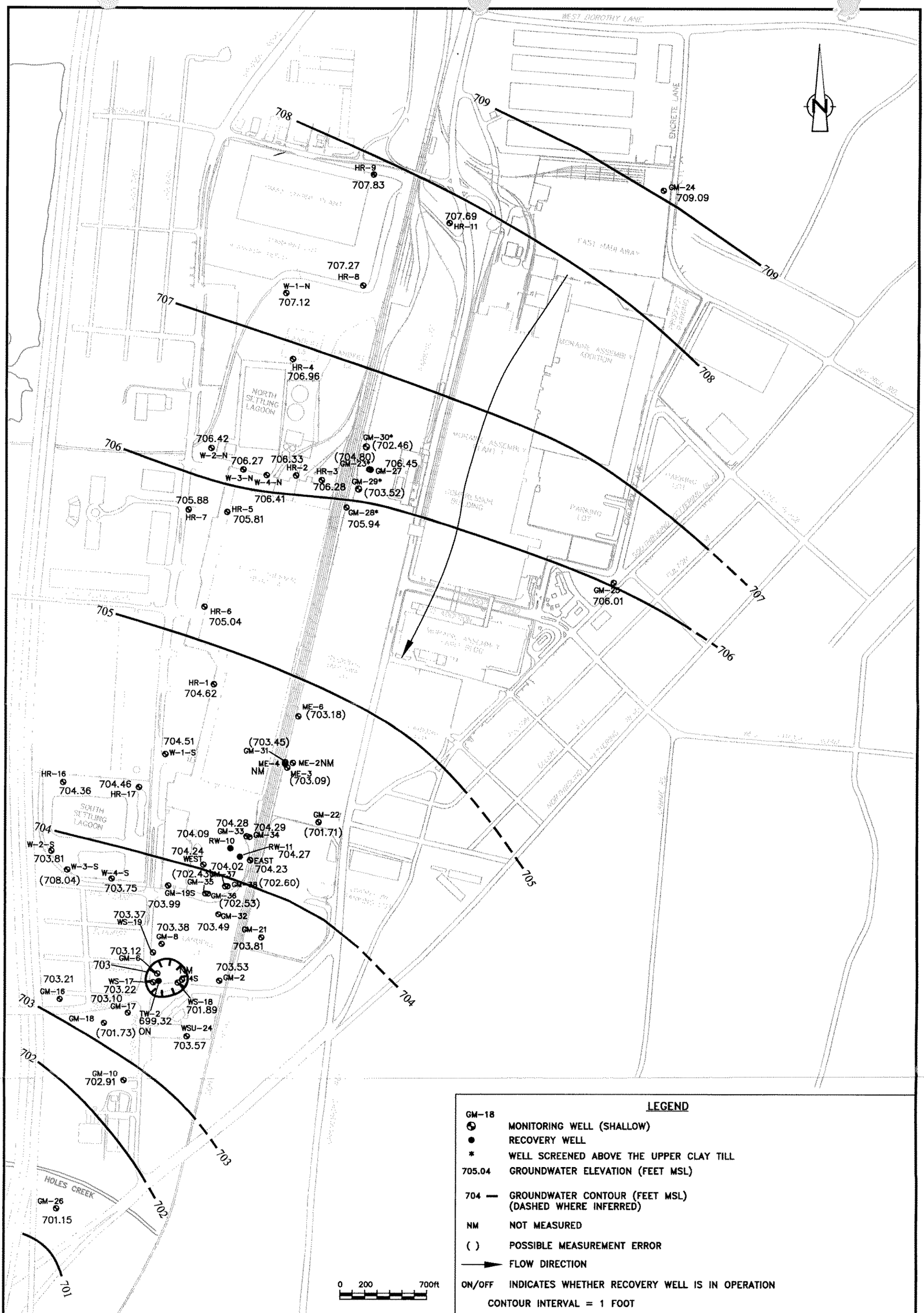
- SHALLOW MONITORING WELL USED FOR SITE-WIDE MONITORING
- CARBON SOURCE INTRODUCTION WELLS REACTIVE ZONE #3 (RZ-3A)
- RECOVERY WELL USED FOR THE CAPTURE ZONE INTERIM MEASURES
- MONITORING WELL (SHALLOW)

NOTE: INTRODUCTION WELL RZ-3LL WAS NOT INSTALLED DUE TO PRESENCE OF UNDERGROUND UTILITIES.

ARCADIS

BIOREMEDIATION REACTIVE ZONE #3
GENERAL MOTORS CORPORATION
MORAINE, OHIO

DATE 10/18/2002	PROJECT MANAGER N. GILLOTTI	DRAWING NAME CRA\GW\GWMPLAN-11
DRAWN R. SMITH	LEAD DESIGN PROF. J. REID	CHECKED N. GILLOTTI
PROJECT NUMBER 0H000294.0005.0003		FIGURE NUMBER 7



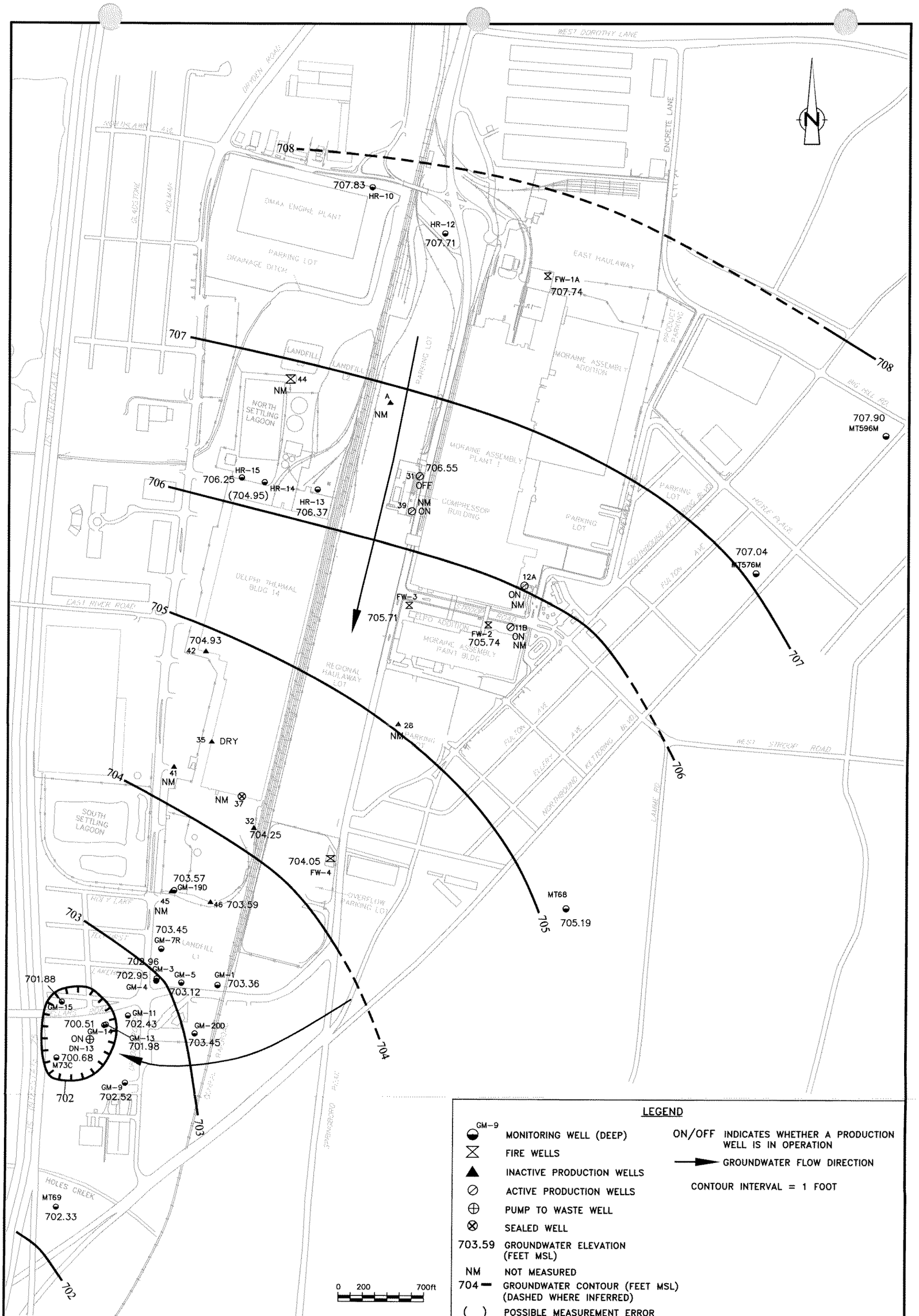
LEGEND

GM-18	MONITORING WELL (SHALLOW)
●	RECOVERY WELL
*	WELL SCREENED ABOVE THE UPPER CLAY TILL
705.04	GROUNDWATER ELEVATION (FEET MSL)
704 —	GROUNDWATER CONTOUR (FEET MSL) (DASHED WHERE INFERRED)
NM	NOT MEASURED
( )	POSSIBLE MEASUREMENT ERROR
→	FLOW DIRECTION
ON/OFF	INDICATES WHETHER RECOVERY WELL IS IN OPERATION
	CONTOUR INTERVAL = 1 FOOT

ARCADIS
6397 Emerald Parkway
Suite 150, Dublin, OH 43016
Tel: 614/764-2310 Fax: 614/764-1270

WATER TABLE SURFACE (UPPER AQUIFER) ON DECEMBER 3 AND 4, 2001 FORMER MORAINE ENGINE, MORAINE ASSEMBLY AND DELPHI THERMAL FACILITIES GENERAL MOTORS CORPORATION, MORAINE, OHIO

DATE 10/18/2002	PROJECT MANAGER N. GILLOTTI		DRAWING NAME CRA\GWP\GWMPLAN-06
DRAWN R. SMITH	LEAD DESIGN PROF. J. REID		CHECKED N. GILLOTTI
PROJECT NUMBER			DRAWING NUMBER
0H000294.0005.0003			8



LEGEND

- GM-9 — MONITORING WELL (DEEP)
- FIRE WELLS
- INACTIVE PRODUCTION WELLS
- ACTIVE PRODUCTION WELLS
- PUMP TO WASTE WELL
- SEALED WELL
- 703.59 — GROUNDWATER ELEVATION (FEET MSL)
- NM — NOT MEASURED
- 704 — GROUNDWATER CONTOUR (FEET MSL) (DASHED WHERE INFERRED)
- ( ) — POSSIBLE MEASUREMENT ERROR

ON/OFF INDICATES WHETHER A PRODUCTION WELL IS IN OPERATION

GROUNDWATER FLOW DIRECTION

CONTOUR INTERVAL = 1 FOOT

ARCADIS
6397 Emerald Parkway
Suite 150, Dublin, OH 43016
Tel: 614/764-2310 Fax: 614/764-1270

POTENTIOMETRIC SURFACE (LOWER AQUIFER) ON DECEMBER 3 AND 4, 2001 FORMER MORAINE ENGINE, MORAINE ASSEMBLY AND DELPHI THERMAL FACILITIES GENERAL MOTORS CORPORATION, MORAINE, OHIO

DATE	PROJECT MANAGER	DRAWING NAME
10/18/2002	N. GILLOTTI	CRA\GWP\GWMPLAN-07
DRAWN	LEAD DESIGN PROF.	CHECKED
R. SMITH	J. REID	N. GILLOTTI
PROJECT NUMBER		DRAWING NUMBER
OH000294.0005.0003		9

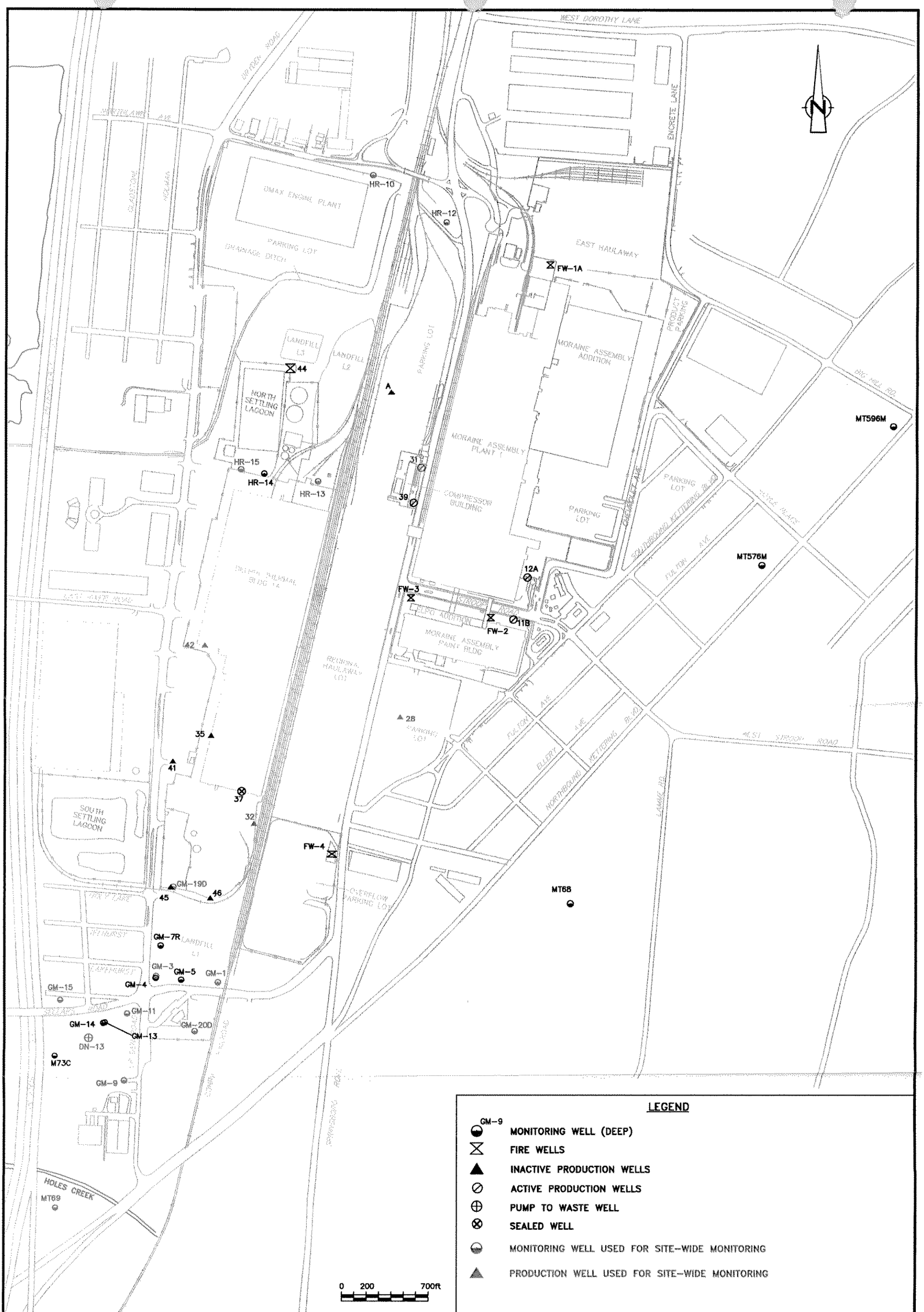
LEGEND

- MONITORING WELL (SHALLOW)
- MONITORING WELL USED FOR SITE-WIDE MONITORING
- RECOVERY WELL

ARCADIS
6397 Emerald Parkway
Suite 150, Dublin, OH 43016
Tel: 614/764-2310 Fax: 614/764-1270

UPPER AQUIFER MONITORING WELLS FOR SITE-WIDE GROUNDWATER MONITORING GENERAL MOTORS CORPORATION MORAINE, OHIO

DATE 10/18/2002	PROJECT MANAGER N. GILLOTTI	DRAWING NAME CRA\GWP\GWMPLAN-03
DRAWN R. SMITH	LEAD DESIGN PROF. J. REID	CHECKED N. GILLOTTI
PROJECT NUMBER 0H000294.0005.0003		DRAWING NUMBER 10



LEGEND

- GM-9 — MONITORING WELL (DEEP)
- FIRE WELLS
- INACTIVE PRODUCTION WELLS
- ACTIVE PRODUCTION WELLS
- PUMP TO WASTE WELL
- SEALED WELL
- MONITORING WELL USED FOR SITE-WIDE MONITORING
- PRODUCTION WELL USED FOR SITE-WIDE MONITORING

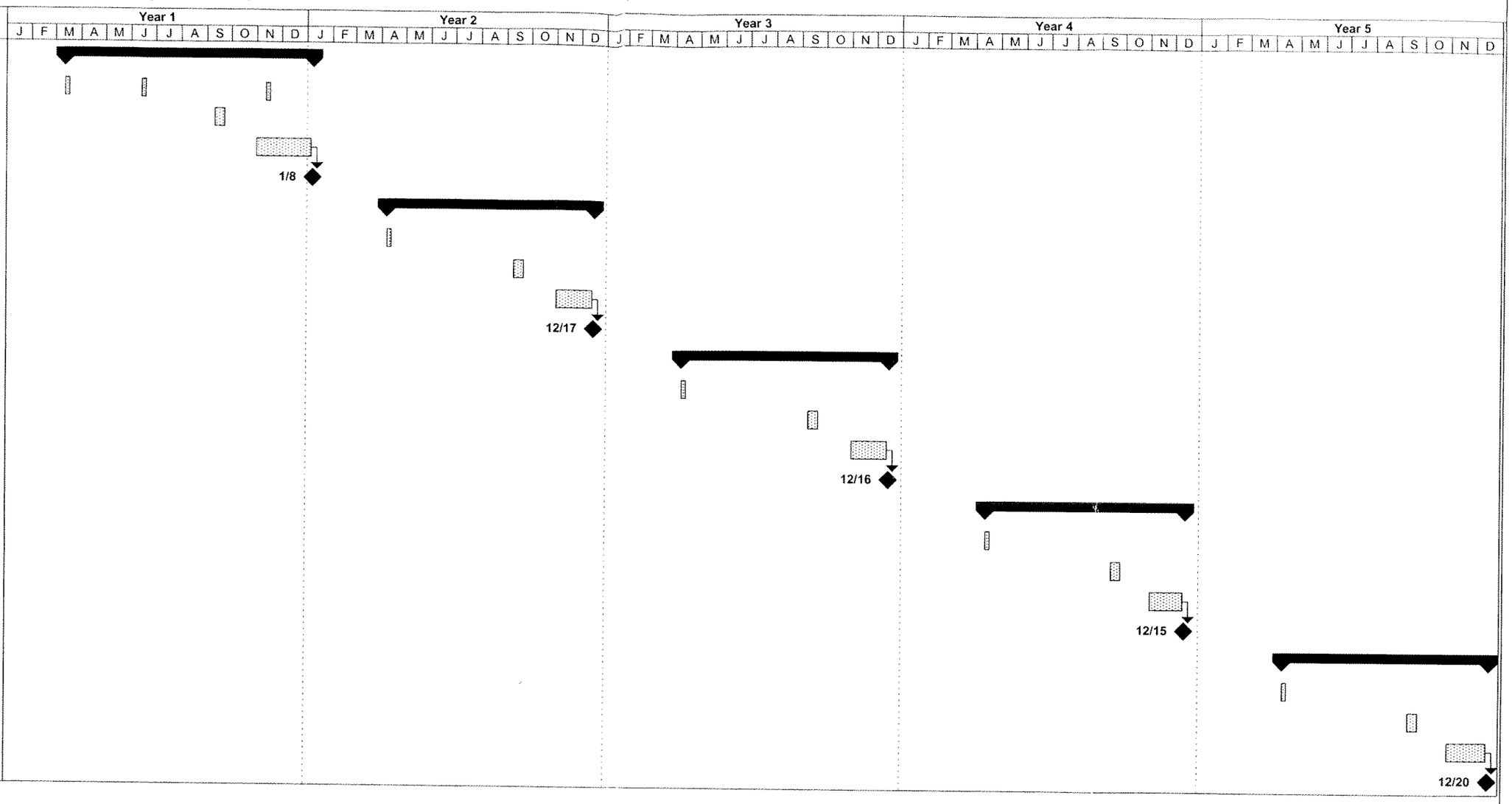
ARCADIS
6397 Emerald Parkway
Suite 150, Dublin, OH 43016
Tel: 614/764-2310 Fax: 614/764-1270

LOWER AQUIFER MONITORING WELLS FOR SITE-WIDE GROUNDWATER MONITORING GENERAL MOTORS CORPORATION MORAINE, OHIO

DATE	PROJECT MANAGER	DRAWING NAME
10/18/2002	N. GILLOTTI	CRA\GWP\GWMPLAN-04
DRAWN	LEAD DESIGN PROF.	CHECKED
R. SMITH	J. REID	N. GILLOTTI
PROJECT NUMBER		DRAWING NUMBER
0H000294.0005.0003		11

Figure 12. Site-Wide Groundwater Monitoring Schedule, General Motors Corporation, Moraine, Ohio.

ID	Task Name
1	**Monitoring Plan for Year 1**
2	Interim Measures Quarterly
3	Site-Wide Annual
4	Report Preparation
5	Report Submittal to EPA
6	**Monitoring Plan for Year 2**
7	Interim Measures Semi-Annual
8	Site-wide Annual
9	Report Preparation
10	Report Submittal to EPA
11	**Monitoring Plan for Year 3**
12	Interim Measures Semi-Annual
13	Site-wide Annual
14	Report Preparation
15	Report Submittal to EPA
16	**Monitoring Plan for Year 4**
17	Interim Measures Semi-Annual
18	Site-wide Annual
19	Report Preparation
20	Report Submittal to EPA
21	**Monitoring Plan for Year 5**
22	Interim Measures Semi-Annual
23	Site-wide Annual
24	Report Preparation
25	Report Submittal to EPA



Date: Fri 2/25/00 | Task | Milestone | Summary

Appendix A

Summary of Baseline Risk Assessment

Summary of RFI Baseline Risk Assessment
General Motors Corporation
Moraine, Ohio

1 Scope of RFI Risk Assessment

The Baseline Risk Assessment conducted during the RFI at the Delphi Thermal Moraine facility evaluated the potential risk to human health and the environment posed by releases of hazardous waste and constituents from the 14 solid waste management units (SWMUs) investigated in the RFI at Delphi Thermal, including SWMUs undergoing closure under Ohio EPA's RCRA program (i.e., the North and South Settling Lagoons). Potential exposures to constituents in soil/waste at the SWMUs via direct contact, airborne transport, and groundwater transport were evaluated to determine whether soil/waste at the SWMUs warrants corrective measures and to support identification of appropriate corrective measures alternatives by determining which potential exposure pathways, if any, pose a significant risk. This Baseline Risk Assessment was supplemented with a risk assessment performed for constituents detected in soils within the 6 AOIs investigated at the former Moraine Engine facility and the Moraine Assembly facility. In addition to evaluating potential groundwater exposures to constituents that may leach from soil/waste at the SWMUs and AOIs, the supplemental Baseline Risk Assessment also evaluated potential groundwater exposures to constituents already in groundwater at the former Oil House (AOI 7) associated with the former Moraine Engine facility.

2 Assessment of Groundwater Exposure Pathway

The conceptual site model for the baseline and supplemental Baseline Risk Assessments established the reasonably anticipated future land uses and groundwater uses at and around Delphi Thermal Moraine, Moraine Assembly and former Moraine Engine facilities, the potential exposure pathways associated with constituents in soil/waste at the 14 SWMUs and 6 AOIs, and the potentially exposed populations on-site and off-site.

With respect to the exposure assessment for the groundwater pathway, it was determined that groundwater in the lower aquifer in the region surrounding the three facilities is a drinking and industrial water source; but the groundwater in the upper aquifer underlying the facilities is not a drinking or industrial water source and is not reasonably expected to serve as either type of water source in the future. The groundwater in the upper aquifer, however, is a medium for potential transport of constituents from the SWMUs at Delphi Thermal Moraine and the AOIs at Moraine Assembly and former Moraine Engine to the lower aquifer and the Great Miami River. As such,

the Baseline Risk Assessments included an assessment of the extent to which the hydraulic interconnections could result in migration of constituents to the lower aquifer or to the River in concentrations of significance to human health.

The potential for drinking water exposure to groundwater was evaluated for current or potential drinking water use of groundwater extracted from the following municipal well fields:

- West Carrollton: as West Carrollton's drinking water supply
- Miami Shores: as Greater Moraine Water System (GMWS) of Montgomery County's primary emergency drinking water supply
- Dryden Road South: as GMWS's secondary emergency drinking water supply

Although the Dryden Road North well field is not expected to serve as a drinking water supply or as an emergency drinking water supply, the groundwater quality at this well field was also evaluated.

The Baseline Risk Assessment also evaluated the potential for exposures that may occur through current and potential nonpotable industrial use of groundwater extracted from industrial wells. Based on currently active production wells and potential operation of inactive production wells, potential exposures through nonpotable groundwater use was evaluated for the following on-site industrial wells:

- Delphi Thermal inactive production wells: as a potential industrial water supply
- Moraine Assembly active production wells: as an industrial water supply
- Moraine Engine active production wells: as an industrial water supply
- Moraine Engine inactive production well: as a potential industrial water supply

The significance of waste constituents potentially transported to the Great Miami River via groundwater flow from the upper aquifer was also evaluated.

3 Estimating Contributions To Groundwater Receptors

To estimate the magnitude of the potential exposures at the identified exposure points, mathematical models were used in combination with soil and groundwater monitoring data collected during the RFI and supplemental RFI. Based on the assessment of current and potential future groundwater pumping, 10 groundwater modeling scenarios were evaluated to predict

potential waste constituent migration from the SWMUs and AOIs at the three facilities to potential points of groundwater exposure under various groundwater pumping patterns in the region. Each modeling scenario was defined by (1) a groundwater use scenario, (2) a set of wells that are expected to be pumping under the groundwater use scenario, and (3) a set of associated groundwater exposure points that are evaluated in the risk assessment. As described on Table 3-4 of the Baseline Risk Assessment (a copy is included in this Appendix A), the 10 scenarios were divided into two groups of five scenarios. One group (Scenarios 6 through 10) included current interim measures (i.e., operation of wells TW-2 and DN-13 for hydraulic control) in each scenario and the other group did not include interim measures pumping (Scenarios 1 through 5). The first scenario (Scenario 1) was the baseline groundwater use scenario, which represents current groundwater use conditions.

The MODFLOW model (G&M 1994) developed to evaluate groundwater flow at the three facilities and in the region under various pumping conditions was used in this exposure assessment as the basis for approximating the transport of waste constituents from the SWMUs and AOIs to potential points of groundwater use for the 10 scenarios. The groundwater flow model facilitates the approximation of transport of constituents in groundwater by allowing the calculation of source reduction factors that account for the natural dilution of constituents as they move in groundwater from under the facilities to potential exposure points. The source reduction factors were calculated by using the MODFLOW model in combination with MODALL (Potter 1995), a complete-mix model designed to work with MODFLOW. The MODALL model uses the cell-by-cell flow terms computed by MODFLOW to calculate source reduction factors for a specified source within each downgradient cell or block in the finite difference domain of the MODFLOW model. The source reduction factors were computed for steady-state transport (without dispersion) with the following conservative assumptions:

- Each SWMU or AOI provides a continuous, steady-state flux of constituents into the upper aquifer.
- No degradation of constituents occurs during transport.
- No dispersion of constituents occurs during transport.

A source reduction factor was computed by setting the concentration of the groundwater beneath a source to a constant, unit concentration (or dimensionless concentration C/C_0), such that the calculated concentration at an exposure point ranges from zero to one. The concentration estimated at the potential exposure point for a unit source concentration is the source reduction factor for that source and exposure point combination. The estimated exposure concentration of

a constituent at an exposure point resulting from all SWMUs and AOIs was then obtained by multiplying the groundwater concentration at the SWMU or AOI with the source reduction factor and summing all the products.

With a few exceptions (e.g., the land based units), the groundwater concentrations at a SWMU or AOI were estimated using the maximum detected concentration in the soil/waste data. For the closed lagoons at Delphi Thermal Moraine, the maximum groundwater concentration of a constituent measured during the supplemental RFI (or the RFI, if no data were collected during the supplemental RFI) from monitoring wells associated with the lagoons was considered to be representative of the concentration that leaches from the lagoon waste, and was used as the source term, if the constituent was detected in the lagoon sludge or is a degradation product of constituents detected in the sludge. This approach may tend to overestimate the lagoon source concentration since it did not account for potential contributions from upgradient sources.

4 Conclusions for the Groundwater Pathway

The aggregate effect of these sources on the exposure point concentration was calculated by adding the concentration contributions from the individual SWMUs and AOIs. Potential groundwater and surface water exposures were then evaluated by comparison of exposure concentrations in groundwater and surface water at potential points of contact with maximum contaminant levels (MCLs) under the Safe Drinking Water Act, or similar risk-based drinking water concentrations for constituents without MCLs. For active nonpotable industrial water supply wells where predicted constituent concentrations are higher than MCLs or risk-based drinking water concentrations, their predicted constituent concentrations were further assessed based on the actual exposure setting and water usage.

With respect to the closed lagoons at the Delphi Thermal Moraine facility, based on the assessment of the combined contributions of hazardous constituents to groundwater from soil/waste present in the SWMUs at Delphi Thermal Moraine and the AOIs at the former Moraine Engine and Moraine Assembly, the supplemental Baseline Risk Assessment concluded that constituents in soil/waste at the closed lagoons, as represented by groundwater concentrations observed immediately downgradient of these two SWMUs, do not pose an unacceptable risk via groundwater transport under the 10 groundwater use scenarios evaluated. Specifically, under the current and hypothetical groundwater use conditions evaluated, with or without taking into account the current interim measures, potential leaching of constituents from soil/waste at the closed lagoons was not predicted to cause concentrations at points of groundwater use to exceed MCLs (or similar risk-based drinking water concentrations for constituents without MCLs).

In summary, the potential leaching of hazardous constituents in waste present in the closed lagoons was not predicted to result in unacceptable impacts to current or reasonably likely future groundwater uses. However, constituents in groundwater at AOI 7 were determined to have a potential to migrate to the extent that reasonably expected future uses of groundwater in the lower aquifer might be affected. As such, as described herein, GM is implementing corrective measures to remediate the source area contamination at AOI 7. The details of this corrective measure are presented in the Interim Measures/Corrective Measures Report.

Table 3-4: Ground Water Modeling Scenarios
Moraine Engine and Moraine Assembly Plants - GMC, Moraine, Ohio

Ground Water Use Scenario	Pumping Locations	Potential Exposure Points
Scenario 1: Baseline conditions	• Baseline wells[1]	• West Carrollton municipal well field • Moraine Assembly industrial wells (11A, 12A) • Moraine Engine industrial wells (31, 39)
Scenario 2: Potential use of Miami Shores in emergency	• Baseline wells • Miami Shores	• West Carrollton municipal well field • Moraine Assembly industrial wells (11A, 12A) • Moraine Engine industrial wells (31, 39) • Miami Shores well field
Scenario 3: Potential use of Miami Shores in emergency and redevelopment of Delphi Thermal wells and Well 28	• Baseline wells • Miami Shores • Delphi Thermal wells • Moraine Engine Well 28	• West Carrollton municipal well field • Moraine Assembly industrial wells (11A, 12A) • Moraine Engine industrial wells (31, 39) • Miami Shores well field • Delphi Thermal industrial wells (42, 44, 45) • Moraine Engine Well 28
Scenario 4: Potential use of Miami Shores with Dryden Rd South in severe emergency	• Baseline wells • Miami Shores • Dryden Rd South	• West Carrollton municipal well field • Moraine Assembly industrial wells (11A, 12A) • Moraine Engine industrial wells (31, 39) • Miami Shores well field • Dryden Rd South well field
Scenario 5: Potential use of Miami Shores with Dryden Rd South in severe emergency and redevelopment of Delphi Thermal wells and Well 28	• Baseline wells • Miami Shores • Dryden Rd South • Delphi Thermal wells • Moraine Engine Well 28	• West Carrollton municipal well field • Moraine Assembly industrial wells (11A, 12A) • Moraine Engine industrial wells (31, 39) • Miami Shores well field • Dryden Rd South well field • Delphi Thermal industrial wells (42, 44, 45) • Moraine Engine Well 28
Scenario 6: Same as Scenario 1 but with interim measures	• Same as Scenario 1 • TW2 and DN13	• Same as in Scenario 1
Scenario 7: Same as Scenario 2 but with interim measures	• Same as Scenario 2 • TW2 and DN13	• Same as in Scenario 2
Scenario 8: Same as Scenario 3 but with interim measures	• Same as Scenario 3 • TW2 and DN13	• Same as in Scenario 3
Scenario 9: Same as Scenario 4 but with interim measures	• Same as Scenario 4 • TW2 and DN13	• Same as in Scenario 4
Scenario 10: Same as Scenario 5 but with interim measures	• Same as Scenario 5 • TW2 and DN13	• Same as in Scenario 5

[1]Baseline wells include: Appleton Paper, Beerman Realty, Cains Mobile Home Park, Moraine Engine (31, 39), Moraine Assembly, Miami Paper, Moraine Country Club, NCR Country Club, Siebenthaler Nursery, City of West Carrollton, West Carrollton Parchment (G&M 1994)

[2] Well 44 is currently maintained for fire protection

Appendix B

Analysis of Post-Closure Monitoring Requirements for the Closed Lagoons

Consistency with Ohio EPA Post-Closure Monitoring Requirements for the Settling Lagoons
General Motors Corporation
Moraine, Ohio

1 Basis for Monitoring Plan

The proposed monitoring described in this Site-Wide Groundwater Monitoring Plan (monitoring plan) provides for long-term monitoring of ongoing corrective action activities, and monitoring upgradient and downgradient of the two lagoons closed in accordance with an Ohio EPA-approved closure plan (Conestoga-Rovers & Associates 2000). The overall goal of this monitoring plan is to implement a single performance-based program that addresses both the corrective measures requirements and the post-closure requirements for the two closed settling lagoons.

As described in Section 3 of this monitoring plan, the scope and approach for the proposed site-wide monitoring has been developed by taking into account the considerable knowledge gained through 18 years of investigation which has included a RCRA Facility Investigation (RFI), Supplemental RFI, two Interim Measures programs, and the existing RCRA groundwater monitoring programs established for the two surface impoundments (the closed North and South Settling Lagoons) located on the GM property leased by the Delphi Thermal Moraine facility. In particular, the selection of wells and monitoring parameters to be included in this program is largely based on the findings of the RFI activities which identified chlorinated VOCs as the only constituents of concern for these facilities. Further, GM's intent is to utilize the findings of the Baseline Risk Assessment conducted as part of the RFI tasks as a key basis for evaluating future monitoring data with respect to the need for further action at the closed lagoons, as well as determining when corrective measures are no longer necessary. The specific details regarding the approach for evaluating future monitoring data are summarized in Section 4 of this monitoring plan.

As described in this monitoring plan, the scope and approach for the site-wide monitoring program has been developed to meet multiple objectives, including post-closure monitoring of the closed lagoons and monitoring the effectiveness of remedial measures being implemented as part of GM's corrective action program. GM believes that this proposed approach which combines (1) the monitoring program for a facility subject to site-wide corrective action with (2) the monitoring program for units at the same facility subject to post-closure requirements is consistent with the holistic approach contemplated in USEPA's Post-Closure Permit

Requirement and Closure Process: Final Rule (63 FR 56710, October 22, 1998). Specifically, this rule provides flexibility to "harmonize the two sets of requirements by substituting corrective action requirements for regulated units set out in Part 264 (for permitted facilities) or Part 265 (for interim status facilities)"; in particular, this portion of the rule provides the USEPA and authorized states with the discretion to allow alternate but equivalent groundwater monitoring and closure and post-closure standards at facilities where a release of hazardous waste or hazardous constituents has occurred, and the regulated unit(s) are located downgradient of one or more SWMUs or AOIs that have likely contributed to the release (as is the case with the closed lagoons). The approach discussed in USEPA's rulemaking is particularly relevant to this facility where groundwater quality impacts upgradient (including from off-site sources) to the two closed lagoons have been documented in the RFI, and where the RFI determined that these closed lagoons do not contribute constituents to groundwater at levels that would have any human health significance under current and reasonably expected future groundwater uses. Moreover, this approach is consistent with the site history in coordinating the closure of the lagoons with the site-wide corrective action activity.

Further, this Final Rule indicates that requirements for a regulated unit may be modified if the alternative standards will protect human health and the environment. That is, USEPA is allowing facilities undergoing corrective action to use a site-specific performance-based groundwater monitoring program for a regulated unit (i.e., the closed lagoons) to ensure protection of human health and the environment. The performance-based monitoring can be used to integrate the requirements for the regulated unit into the requirements for SWMUs developed under site-wide corrective action authorities. This approach is also consistent with the strategy proposed under Ohio's Government Performance and Results Act (GPRA) for closure/post-closure facilities for determining if closure/post-closure controls are in-place. According to the Ohio Hazardous Waste Notifier (Ohio EPA, Fall 2000), an approved control could include having units located among SWMUs, and having the closure and post-closure obligations covered by a corrective action order.

2 Evaluation of Groundwater Monitoring Requirements

GM believes that this monitoring plan satisfies the substantive requirements of OAC 3745-54 for post-closure monitoring by providing for the identification of potentially significant contributions from the closed lagoons, if any, relative to the existing site-wide groundwater quality, as well as ensuring continuation of corrective action as necessary to address these units. An analysis of compliance of this monitoring plan with OAC 3745-54 Chapters 90 through 99 and 3745-55 Chapters 01 and 011 is provided in Table B-1.

Table B-1 presents a comparison of the monitoring plan to the requirements of OAC 3745-54 which demonstrates that this monitoring plan meets or exceeds the intent, if not the specific requirements for post-closure monitoring of the two closed lagoons. In addition, as detailed below, based on the past 18 years of groundwater monitoring conducted for the closed lagoons and the results of the Baseline Risk Assessments presented in the RFI and Supplemental RFI Reports (ENVIRON Corporation 2000), GM believes that sufficient information has been developed for the closed lagoons to demonstrate that a modification of certain groundwater monitoring requirements for these closed lagoons is appropriate. However, it should be recognized that while GM is seeking relief from specific monitoring requirements, GM is committed to implementing a comprehensive long-term monitoring program, including monitoring for the closed lagoons, which provides for the protection of human health and the environment.

GM believes that the site-specific groundwater conditions warrant modification of the standard monitoring requirements specified under OAC 3745-54-90 to 3745-54-99.

- The closed lagoons ceased receiving wastes approximately 15 years ago. Groundwater monitoring conducted at these units during the last 18 years, including sampling events conducted during the RFI and Supplemental RFI, have not identified releases from these units warranting corrective action. The assessment of potential risks posed by wastes present in the lagoons via direct exposures and migration to groundwater demonstrated that these residual wastes do not pose an unacceptable risk to human health or the environment.

- The closure of these lagoons includes waste solidification followed by backfilling with 10-feet of clean soil to bring the units to level grade with the surrounding area, thus significantly limiting the potential for direct contact with the solidified waste.

- Groundwater monitoring upgradient and downgradient of the closed lagoons is provided for under the monitoring plan developed by GM for its ongoing corrective action program. This plan includes provisions for assessing whether the closed lagoons are significantly affecting groundwater quality. As described in Section 4 of this monitoring plan, this evaluation will be based on data from upgradient and downgradient wells to identify whether the closed lagoons are affecting groundwater quality relative to existing effects from other sources. If the closed lagoons are determined to be affecting groundwater quality, the human health significance to current and reasonably expected

groundwater uses on-site and off-site will be evaluated using the methods in the approved Supplemental RFI Baseline Risk Assessment. Further, this assessment would consider the combined contributions from the closed lagoons and other sources, which is more protective of human health and the environment than if the contributions from the closed lagoons were assessed individually. The need for corrective measures to address the lagoons' incremental contributions will be implemented under GM's ongoing corrective action program.

In summary, the findings of the past 18 years of monitoring and the RFI and Supplemental RFI activities support a determination that a modification of certain monitoring requirements is appropriate because of the low potential for migration of hazardous waste or hazardous constituents from the lagoons to water supply wells or surface water. Specifically,

- Hazardous constituents to be monitored. According to OAC 3745-54-93(A), the hazardous constituents to be monitored are those identified in the appendix to OAC 3745-51-11 which have been detected in groundwater in the uppermost aquifer and that are reasonably expected to be in or derived from waste contained in the regulated unit. However, OAC 3745-54-93(B) specifies that constituents may be excluded from the monitoring program if it is found that the constituent is not capable of posing a substantial present or potential hazard to human health or the environment. As discussed above, the RFI completed by GM documented that the only constituents of concern identified in groundwater at the Facilities are chlorinated VOCs. Further, GM demonstrated in the Supplemental RFI Baseline Risk Assessment that no hazardous constituents of the wastes present in the lagoons (even before closure) would migrate to groundwater at levels that would pose a substantial present or potential hazard to human health or the environment.

- Point of compliance. According to OAC 3745-54-91(A), a compliance monitoring program is required whenever hazardous constituents are detected at the compliance point for the regulated unit, and a corrective action program is required when a statistically significant increase in concentrations is evidenced at the point of compliance (POC) or when a hazardous constituent exceeds concentration limits between the compliance point and the downgradient property boundary. In addition, OAC 3745-54-97(B) indicates that separate groundwater monitoring systems are not required at a Facility with more than one regulated unit where sampling of groundwater will enable detection of hazardous constituents from the multiple regulated units.

GM is currently implementing a corrective action program at the Facilities to address the presence of chlorinated VOCs in groundwater resulting from a release from an AOI located at the former Moraine Engine plant. Currently, the area of groundwater monitoring being addressed by GM encompasses the two closed lagoons and groundwater between these units and the downgradient property boundary. Further, GM has documented the presence of an upgradient off-site source which is contributing chlorinated VOCs to site groundwater.

GM's corrective action program is designed to address the combined effects of all sources of the existing groundwater contamination and the area of contaminated groundwater between these sources and the downgradient property boundary. Further, GM will monitor changes in groundwater quality over time to assess the performance of the ongoing corrective measures. Given the current groundwater conditions and GM's corrective action plans, GM believes that the locations downgradient of the closed lagoons defined as the POCs for the site-wide corrective action are appropriate POCs for the two closed lagoons (refer to Section 4.3 in the monitoring plan).

- Alternative Concentration Limits. According to OAC 3745-54-94, the facility will specify the concentration limits for hazardous constituents in groundwater. OAC 3745-54-94(B) provides for the use of an alternative concentration limit if it is found that the constituent will not pose a substantial present or potential hazard to human health or the environment.

  GM has developed risk-based remediation target concentrations that will be used to assess the performance of active corrective measures (i.e., in-situ remediation and active pumping at the downgradient property boundary). Specifically, these target concentrations will be defined as on-site groundwater concentrations that are protective of current and future groundwater uses, and must be achieved before the active corrective measures can be terminated. These target concentrations will also be used to identify other units that may be contributing hazardous constituents to groundwater at levels that prevent meeting these targets. Development of the remediation targets concentrations are based on the methodology presented in the Supplemental RFI Baseline Risk Assessment. GM expects that by using these remediation target concentrations to evaluate the performance of active corrective measures and implementing a data assessment plan that considers the combined contributions from all sources upgradient of the POCs defined for the site-wide corrective action, that these targets will be more protective of human health and the environment in comparison with alternative

concentration limits developed for each individual unit. The development of these risk-based remediation target concentrations is summarized in Section 4.3 of this monitoring plan.

- Identification of a significant evidence of contamination. OAC 3745-54-97(H) specifies that a statistical method must be used for identifying significant evidence of contamination. Further, it is specified that the test method shall be protective of human health and the environment. As documented in the *Evaluation of Groundwater Detection Monitoring Data* submitted to Ohio EPA on February 8, 2000, statistically significant increases could be interpreted to have occurred in the vicinity of the South Settling Lagoon. However, historical groundwater concentration trends demonstrate that these statistically significant increases are unrelated to a release from the South Settling Lagoon, and that changes in upgradient groundwater quality are causing statistically significant increases in both upgradient and downgradient monitoring wells. Thus, as a result of site-wide groundwater contamination from sources other than the lagoons, the standard approaches contemplated in OAC 3745-54-97(H) are not practical for assessing data from monitoring of these units. As an alternative, GM has developed risk-based remediation targets for assessing the human health and environmental significance of data collected during the long-term groundwater monitoring program.

In summary, GM believes that the site-specific groundwater conditions warrant modification of the standard monitoring requirements specified under OAC 3745-54-90 to 3745-54-99. In particular, the use of a site-specific constituent monitoring list, alternative point of compliance, and alternative compliance limits are warranted for this site. These site-specific considerations are incorporated in this monitoring plan. However, based on the findings of the RFI, the monitoring plan still provides a program that will be protective of human health and the environment.

3 Summary

This monitoring plan meets the substantive requirements for post-closure monitoring specified in OAC 3745-54 for the two closed lagoons. For those requirements that are not fully addressed by this monitoring plan, prior monitoring and risk assessment calculations demonstrated that this monitoring plan is fully protective of human health and environment such that a modification of certain requirements is reasonable and appropriate. Finally, the approach presented in the monitoring plan which combines the objectives for corrective action with those of post-closure lagoon monitoring is consistent with both USEPA and Ohio EPA regulations and guidance for

sites at which the regulated unit is located downgradient of one or more SWMUs or AOIs that have likely contributed to the release.

Table B-1. Analysis for Compliance with OAC 3745-54 Chapters 90 through 99 and 3745-55 Chapters 01 and 011, Site-Wide Groundwater Monitoring Program, General Motors Corporation, Moraine, Ohio.

Regulatory Citation	Regulation	Rationale for Applicability	Reference Document/Location Where Regulation is Addressed
OAC 3745-54 Standards for the Management of Hazardous Wastes			
3745-54-90 (A)	Groundwater Protection; Applicability Applies to owners/operators of facilities that treat, store, or dispose of hazardous waste. Owner or operator shall satisfy requirements of (A)(2) of this rule for all wastes contained in waste management units.	The NSL received industrial wastewater from 1972 to 1979, and the SSL received industrial wastewater from 1965 to 1979. The lagoons have been inactive since 1989 and are currently closed through solidification. Therefore, (A)(1) may be applicable, however, the GM facilities are under interim status and contain SWMUs/ AOIs regulated under a corrective action order, including the lagoons. This enforceable order could be applied in lieu of these regulations.	Closure Plan, Section 1.1 SDOCC, Section 1.3.16 DOCC, Section 3.3
(B)	Units are not subject to 3745-54-90 to 3745-54-99 and 3745-55-01 to 3745-55-02 of the OAC for releases into the uppermost aquifer if particular criteria are met.	Lagoons do not meet exception criteria during their operating life, however, as residual waste was solidified during closure, the potential for migration of liquid is eliminated. Further, the RFI determined that these lagoons did not serve as a significant source of groundwater contamination from a risk perspective.	Closure Plan, Section 2.0 SWGM Plan, Section 1.2 RFI Reports
(C)	Applies for units during the active life and the closure period. After closure, these regulations apply if certain criteria are met.	This regulation applies during the compliance period under 3745-54-96 if the owner or operator is conducting compliance monitoring under a corrective action program under 3745-55-01; GM will continue conducting groundwater monitoring to verify that groundwater conditions remain the same, or improve over time.	Closure Plan, Section 2.0 SWGM Plan, Section 1.2 IM/CM Report, Section 2.0
(D)	Applies to miscellaneous units, when necessary to comply with 3745-57-91 through 3745-57-93.	NA, as the lagoons are surface impoundments, not miscellaneous units.	NA
3745-54-91 (A)(1)	Required Programs Applies when hazardous constituents from a regulated unit are detected at the compliance point.	SSL constituents have never been detected in downgradient wells. NSL constituents have been detected in downgradient wells. Hazardous constituents from an AOI (which is not a regulated unit) have been detected downgradient of the AOI, as explained in the IM/CM report. The SWGM Plan addresses long-term monitoring of releases from the the major source of VOCs at the facility (AOI 7) and the monitoring of the lagoons and landfills. The downgradient point of compliance well is GM-26 for the site in the upper aquifer as presented in the IM/CM and SWGM reports.	RFI Reports SWGM Plan, Sections 1.2 and 3.0 IM/CM Report, Section 2.0

Table B-1. Analysis for Compliance with OAC 3745-54 Chapters 90 through 99 and 3745-55 Chapters 01 and 011, Site-Wide Groundwater Monitoring Program, General Motors Corporation, Moraine, Ohio.

Regulatory Citation	Regulation	Rationale for Applicability	Reference Document/Location Where Regulation is Addressed
(A)(2)	Applies when groundwater protection standards are exceeded at the compliance point.	The IM/CM and SWGM reports include a strategy for addressing exceedences in groundwater concentrations of VOCs from AOI 7 (which is not a regulated unit). No exceedences have occurred at the compliance point that are attributable to the lagoons.	IM/CM Report, Section 2.0 SWGM Plan, Sections 1.2 and 3.0
(A)(3)	Applies when hazardous constituents from a regulated unit are exceeded between the compliance point and the downgradient property boundary.	The IM/CM and SWGM reports include a strategy for addressing exceedences in groundwater concentrations of VOCs from AOI 7 (which is not a regulated unit). No exceedences have occurred at the compliance points or downgradient property boundary that are attributable to the lagoons.	IM/CM Report, Section 2.0 SWGM Plan, Sections 1.2 and 3.0
(A)(4)	Requirements for owner/operator to institute a detection monitoring plan under 3745-54-98	The site-wide groundwater monitoring will continue to assess if any significant contributions are occurring from the lagoons.	SWGM Plan, Section 1.0 BRA Report
(B)	Regional Administrator to specify in the facility permit the elements of the monitoring and response program.	The 3008(h) Order should serve as the "enforceable document" in lieu of "the permit" and the SWGM Plan should meet the monitoring elements necessary for compliance with the corrective action order or post-closure process. Additionally, the BRA concluded that the lagoons did not pose a significant risk to human health and the environment (with or without closure).	BRA Report, Section 5.0
3745-54-92	Groundwater Protection Standard Ensures that hazardous constituents under 3745-54-93 detected in the groundwater from a regulated unit do not exceed the concentration limits under 3745-54-94 in the uppermost aquifer underlying the waste management area beyond the point of compliance under 3745-54-95 during the compliance period under 3745-54-96.	The 3008(h) Order should serve as the "enforceable document" in lieu of "the permit". Site-specific risk-based standards and the groundwater flow model have been used to determine protective groundwater concentrations based on groundwater receptors and current use of the upper aquifer on a site-wide basis.	BRA Report, Section 3.0 IM/CM Report, Section 2.0
3745-54-93 (A)	Hazardous Constituents The permit will specify the hazardous constituents to which the groundwater protection standard of 3745-54-92 applies.	The approved RFI reports concluded that VOCs are the constituents of concern in groundwater. The SWGM Plan has been designed to address the site-specific constituents of concern, VOCs. Historic sampling of groundwater has determined that SVOCs, PCBs and metals are not of concern in groundwater.	SWGM Plan, Section 2.0 RFI Reports
(B)	A constituent listed in the appendix to rule 3745-51-11 will be excluded from the list of hazardous constituents specified in the permit, if it is found that the constituent is not capable of posing a risk.	Historic sampling of groundwater determined that SVOCs, PCBs, and metals are not of concern; therefore, is appropriate to exclude them from the monitoring parameters. The BRA concluded that estimates of risk from the constituents in the lagoon sludge were well below U.S. EPA-established acceptable levels.	BRA Report, Section 5.0 RFI Report, Sections 6.0 and 7.0 SWGM Plan, Section 2.0

Table B-1. Analysis for Compliance with OAC 3745-54 Chapters 90 through 99 and 3745-55 Chapters 01 and 011, Site-Wide Groundwater Monitoring Program, General Motors Corporation, Moraine, Ohio.

Regulatory Citation	Regulation	Rationale for Applicability	Reference Document/Location Where Regulation is Addressed
3745-54-94	Concentration Limits		
(A)	The permit will specify the concentration limits in the groundwater for hazardous constituents established under 3745-54-93.	Methods established in the approved BRA and the groundwater flow model have been used to determine protective groundwater concentrations (Remediation Target Levels [RTLs]) based on groundwater receptors and current use of the upper aquifer.	BRA Report, Section 3.0 IM/CM Report, Section 2.0
(B)	An alternate concentration limit may be established for a hazardous constituents.	Methods established in the approved BRA have been used to calculate groundwater protection standards (RTLs) for VOCs.	IM/CM Report, Section 2.0
3745-54-95	Point of Compliance		
(A)	The permit will specify the point of compliance at which groundwater protection standard of rule 3745-54-92 applies and at which monitoring must be conducted.	The facility compliance point is defined as GM-26 for the upper aquifer. This location is downgradient of the site, including the primary source area (AOI 7), landfills and lagoons. The site also contains remediation performance monitoring points as presented in the IM/CM and SWGM reports.	IM/CM Report, Section 2.0 SWGM Plan
(B)	Definition of a waste management area.	The waste management areas are defined and discussed in the RFI Reports. The plan covers AOI 7 and the land-based units. For the purpose of groundwater monitoring, the waste management area can be defined by the property boundary, including the upper aquifer.	RFI Reports SWGM Plan, Sections 1.0, 2.0, 3.0
3745-54-96	Compliance Period		
(A)	The permit will specify the compliance period during which the groundwater protection standard of rule 3745-54-92 applies.	The compliance period is defined as the length of time necessary to meet the RTLs and to verify that groundwater conditions remain acceptable for VOCs in the upper aquifer for some period of time thereafter. The length of this period of time will be evaluated on an annual basis.	IM/CM Report, Section 2.0
(B)	Compliance period begins when the owner/operator initiates a compliance monitoring program meeting 3745-54-99.	The site-wide groundwater monitoring program was initiated in the fall of 2000 in order to monitor corrective measures. During this period, RCRA monitoring of the former lagoons has been on-going, and will continue until the SWGM plan is approved.	SWGM Plan, Figure 12 IM/CM Report, Section 4.0
(C)	If owner/operator is engaged in corrective action, compliance period may be extended until groundwater protection standard 3745-54-92 is not exceeded for a period of three consecutive years.	Groundwater data will be continuously evaluated using risk-based strategies to determine the appropriate compliance period.	IM/CM Report, Section 2.0
3745-54-97	General Groundwater Monitoring Requirements		
(A)	Groundwater monitoring system must be representative of the uppermost aquifer and contain a sufficient number of wells.	The well network includes those wells that are upgradient/downgradient of the lagoons. These wells are screened in the upper aquifer.	SWGM Plan, Section 3.0

Table B-1. Analysis for Compliance with OAC 3745-54 Chapters 90 through 99 and 3745-55 Chapters 01 and 011, Site-Wide Groundwater Monitoring Program, General Motors Corporation, Moraine, Ohio.

Regulatory Citation	Regulation	Rationale for Applicability	Reference Document/Location Where Regulation is Addressed
(B)	Facilities that contain more than one regulated unit are not required to have separate groundwater monitoring systems.	One, comprehensive, site-wide monitoring plan is appropriate for this facility.	SWGM Plan, Section 3.0
(C)	All monitoring wells must be cased in a manner that maintains the integrity of the monitoring well bore hole.	The existing wells were installed with care to protect the integrity of the borehole. The existing wells are regularly sampled and inspected. These wells were installed following approved protocols.	RFI Work Plans
(D)	Groundwater monitoring program must include consistent sampling and analysis procedures.	The groundwater monitoring program will be conducted following approved protocols.	SWGM Plan, Section 3.0
(E)	Groundwater monitoring program must include appropriate sampling and analytical methods.	The groundwater monitoring program will be conducted following approved protocols and an approved laboratory.	SWGM Plan, Section 3.0
(F)	Groundwater monitoring program must include determination of groundwater surface elevation.	Water-level measurements will be collected at each sampling event and groundwater contour maps will be prepared on an annual basis.	SWGM Plan, Section 3.0
(G)	Requirements for establishing background concentrations of hazardous constituents in groundwater.	Background groundwater quality at the upgradient property boundary was established in the RFI, but will continue to be monitored on an annual basis as part of the site-wide program.	RFI Reports SWGM Plan, Section 3.0
(H)	Statistical methods to be used in evaluating groundwater monitoring data.	Groundwater data will be evaluated using risk-based strategies and the groundwater flow model.	IM/CM Report, Section 2.0
(I)	Performance standards for the statistical methods in 3745-54-97(H).	The use of the parameters called for in the regulations will not adequately evaluate potential releases and therefore, site specific VOC analysis will be conducted.	SWGM Plan, Sections 2.0
(J)	Groundwater monitoring data must be filed at the facility.	The facility will maintain copies of the groundwater monitoring data.	RFI Work Plans
3745-54-98	Detection Monitoring Program	The components of a detection monitoring program as defined in 3745-54 -98 paragraphs A through H, are not appropriate for the site. Groundwater quality and historical releases of hazardous constituents have been well documented in the approved RFI reports. With the implementation of groundwater corrective measures and lagoon closure, a site-wide groundwater monitoring program using the existing well network, monitoring the site-specific constituents of concern, and following a risk-based strategy is an appropriate approach for this site.	SWGM Plan, Sections 1.0, 2.0, 3.0 IM/CM Report, Section 2.0 RFI Reports

Table B-1. Analysis for Compliance with OAC 3745-54 Chapters 90 through 99 and 3745-55 Chapters 01 and 011, Site-Wide Groundwater Monitoring Program, General Motors Corporation, Moraine, Ohio.

Regulatory Citation	Regulation	Rationale for Applicability	Reference Document/Location Where Regulation is Addressed
(A)	Owner/operator must monitor for indicator parameters.	Based on the findings of the RFI, monitoring will be conducted for the site-specific VOCs, which are appropriate parameters for evaluating potential releases from the former lagoons; therefore, analysis of the indicator parameters is not applicable to these units.	SWGM Plan, Sections 1.0, 2.0, 3.0 IM/CM Report, Section 2.0
(B)	Owner/operator must install a groundwater monitoring system at the compliance point under 3745-54-95.	A sufficient number of properly installed groundwater monitoring wells have been and will continue to be monitored to provide the necessary compliance point monitoring, as defined in the IM/CM Report.	SWGM Plan, Sections 1.0, 2.0, 3.0 IM/CM Report, Section 2.0
(C)	Owner/operator must conduct a groundwater monitoring program for each chemical parameter and hazardous constituent specified in the permit.	The site-wide groundwater monitoring plan proposes monitoring for site-specific VOCs which are appropriate parameters for evaluating potential releases from the former lagoons.	SWGM Plan, Sections 1.0, 2.0, 3.0 IM/CM Report, Section 2.0
(D)	The permit will specify frequencies for collecting samples and conducting statistical tests.	The site-wide groundwater monitoring plan proposes the frequency necessary to adequately monitor for site-specific VOCs and the methods for evaluating this data are provided in the IM/CM Report. Based on the IM/CM report, monitoring will be conducted annually.	SWGM Plan, Sections 1.0, 2.0, 3.0 IM/CM Report, Section 2.0
(E)	Owner/operator must determine the groundwater flow rate and direction in the uppermost aquifer at least annually.	The site-wide groundwater monitoring plan proposes annual evaluation of the groundwater flow rate and direction in the uppermost aquifer.	SWGM Plan, Sections 1.0, 2.0, 3.0 IM/CM Report, Section 2.0
(F)	Owner/operator must determine whether there is statistically significant evidence of contamination.	Methods to be used for evaluating the site-specific VOC data are provided in the IM/CM Report. Additionally, GM will determine if there is a significant contribution to groundwater from the land-based units.	SWGM Plan, Sections 1.0, 2.0, 3.0 IM/CM Report, Section 2.0
(G)	Applies when there is statistically significant evidence of contamination.	An effective monitoring network is already in place. As part of the annual data evaluation/reporting, the SWGM Plan has provisions for notification, if GM determines that the lagoons are a significant contributor to groundwater contamination.	SWGM Plan, Sections 1.0, 2.0, 3.0 IM/CM Report, Section 2.0
(H)	Applies when owner/operator determines the detection monitoring program no longer satisfies the requirements of this section.	The site-wide groundwater monitoring plan proposes a monitoring program that will adequately satisfy the requirements of this section over time. As part of the annual data evaluation/reporting, GM will propose any necessary modifications to the SWGM Plan.	SWGM Plan, Sections 1.0, 2.0, 3.0 IM/CM Report, Section 2.0

Table B-1. Analysis for Compliance with OAC 3745-54 Chapters 90 through 99 and 3745-55 Chapters 01 and 011, Site-Wide Groundwater Monitoring Program, General Motors Corporation, Moraine, Ohio.

Regulatory Citation	Regulation	Rationale for Applicability	Reference Document/Location Where Regulation is Addressed
3745-54-99	Compliance Monitoring Program	The components of a compliance monitoring program as defined in 3745-54 -99 paragraphs A through J, are not appropriate for the site. Groundwater quality and historical releases of hazardous constituents have been well documented in the approved RFI reports. With the implementation of groundwater corrective measures and lagoon closure, a site-wide groundwater monitoring program using the existing well network, monitoring the site-specific constituents of concern, and following a risk-based strategy is an appropriate approach for the site.	SWGM Plan, Sections 1.0, 2.0, 3.0 IM/CM Report, Section 2.0 RFI Reports
(A)	Owner/operator must monitor groundwater to determine whether regulated units are in compliance with the groundwater protection standard under 3745-54-92.	The site-wide groundwater monitoring plan proposes the frequency necessary to adequately monitor for site-specific VOCs and the methods for evaluating this data are provided in the IM/CM Report. The monitoring includes wells upgradient and downgradient of the lagoons.	SWGM Plan, Sections 1.0, 2.0, 3.0 IM/CM Report, Section 2.0
(B)	Owner/operator must install a groundwater monitoring system at the compliance point under 3745-54-95.	A sufficient number of properly installed groundwater monitoring wells have been and will continue to be monitored to provide the necessary compliance point monitoring, as defined in the IM/CM Report.	SWGM Plan, Sections 1.0, 2.0, 3.0 IM/CM Report, Section 2.0
(C)	The director will specify sampling procedures and statistical methods.	The site-wide groundwater monitoring plan proposes the procedures necessary to adequately monitor for site-specific VOCs and the methods for evaluating this data are provided in the IM/CM Report. Sampling procedures specified in the SWGM Plan are consistent with previously approved RFI protocols.	SWGM Plan, Sections 1.0, 2.0, 3.0 IM/CM Report, Section 2.0
(D)	Owner/operator must determine whether there is statistically significant evidence of contamination.	The site-wide groundwater monitoring plan proposes the procedures necessary to adequately monitor for site-specific VOCs and the methods for evaluating this data are provided in the IM/CM Report. The monitoring program proposed in the SWGM Plan and the data evaluation approach proposed in the IM/CM Report specify the methodology to assess if the lagoons are having a significant contribution to groundwater contamination.	SWGM Plan, Sections 1.0, 2.0, 3.0 IM/CM Report, Section 2.0
(E)	Owner/operator must determine the groundwater flow rate and direction in the uppermost aquifer at least annually.	The site-wide groundwater monitoring plan proposes annual evaluation of the groundwater flow rate and direction in the uppermost aquifer.	SWGM Plan, Sections 1.0, 2.0, 3.0 IM/CM Report, Section 2.0

Table B-1. Analysis for Compliance with OAC 3745-54 Chapters 90 through 99 and 3745-55 Chapters 01 and 011, Site-Wide Groundwater Monitoring Program, General Motors Corporation, Moraine, Ohio.

Regulatory Citation	Regulation	Rationale for Applicability	Reference Document/Location Where Regulation is Addressed
(F)	The director will specify frequencies for collecting samples and conducting statistical tests.	The site-wide groundwater monitoring plan proposes the frequency necessary to adequately monitor for site-specific VOCs and the methods for evaluating this data are provided in the IM/CM Report.	SWGM Plan, Sections 1.0, 2.0, 3.0 IM/CM Report, Section 2.0
(G)	Owner/operator must analyze samples from all wells at the compliance point for all constituents at least annually.	The site-wide groundwater monitoring plan proposes annual evaluation of the site-wide groundwater quality, including the point of compliance.	SWGM Plan, Sections 1.0, 2.0, 3.0 IM/CM Report, Section 2.0
(H)	Owner/operator determines that any concentration limit are exceeded at any well at the point of compliance.	The SWGM program will assess whether there are exceedences of site-specific concentrations limits at the point of compliance on an annual basis. The SWGM Plan has provisions for notification, if GM determines that the lagoons are a significant contributor to groundwater contamination.	SWGM Plan, Sections 1.0, 2.0, 3.0 IM/CM Report, Section 2.0
(I)	Owner/operator determines that any concentration limit are exceeded at any well at the point of compliance and can demonstrate the presence of another source.	The site-wide groundwater monitoring plan proposes the frequency necessary to adequately monitor for site-specific VOCs and the methods for evaluating this data are provided in the IM/CM Report.	SWGM Plan, Sections 1.0, 2.0, 3.0 IM/CM Report, Section 2.0
(J)	Applies when owner/operator determines the compliance monitoring program no longer satisfies the requirements of this section.	The site-wide groundwater monitoring plan proposes a monitoring program that will adequately satisfy the requirements of this section over time. The SWGM Plan has provisions for notification, if GM determines that the lagoons are a significant contributor to groundwater contamination. As a part of the annual data evaluation/reporting, GM will propose any necessary modifications to the SWGM Plan.	SWGM Plan, Sections 1.0, 2.0, 3.0 IM/CM Report, Section 2.0
OAC 3745-55 Management of Hazardous Wastes: Closure and Post-Closure			
3745-55-01 (A)	Corrective Action Program Owner/operator must take corrective action to ensure that regulated units are in compliance with 3745-54-92.	GM will take a site-wide approach to monitor groundwater upgradient and downgradient of the primary source area (AOI 7), the reactive zones installed for remedial purposes and the land-based units (lagoons and landfills). GM will also monitor the capture zones. A comprehensive corrective action program has already been implemented at this site, which included the lagoons.	SWGM Plan, Sections 3.0
(B)	Owner/operator must implement a corrective action program that prevents hazardous constituents from exceeding their respective concentration limits.	GM is currently implementing corrective measures to address the AOI 7 source area and several areas downgradient of AOI 7.	SWGM Plan, Sections 1.0, 2.0 IM/CM Report, Section 5.0
(C)	Owner/operator must begin corrective action within a reasonable time period after the groundwater protection standard is exceeded.	GM has been implementing corrective measures over the last six years to address VOCs in the upper aquifer and will continue to do so until the groundwater RTLs are met.	IM/CM Report, Section 2.0

Table B-1. Analysis for Compliance with OAC 3745-54 Chapters 90 through 99 and 3745-55 Chapters 01 and 011, Site-Wide Groundwater Monitoring Program, General Motors Corporation, Moraine, Ohio.

Regulatory Citation	Regulation	Rationale for Applicability	Reference Document/Location Where Regulation is Addressed
(D)	Owner/operator must establish and implement a groundwater monitoring program to demonstrate effectiveness of the corrective action program.	The groundwater monitoring program is presented in the SWGM Plan.	SWGM Plan, Section 3.0
(E)	Owner/operator must conduct corrective action program to remove or treat in place any hazardous constituents that exceed concentration limits.	GM is addressing the primary source area (AOI 7) through the implementation of in-situ remediation technologies and is addressing hydraulic control through the implementation of the capture zones. These active measures will result in attenuation of the VOC concentrations in groundwater. The lagoons have been closed in place with the sludge being solidified.	SWGM Plan, Sections 1.0, 2.0, 3.0
(F)	Owner/operator must continue corrective action measures during the compliance period.	GM will implement corrective measures and site-wide groundwater monitoring until the site-wide objectives have been met.	IM/CM Report, Sections 1.0, 2.0
(G)	Owner/operator must report in writing to the director on the effectiveness of the corrective action program.	GM will continue implementing corrective measures and site-wide groundwater monitoring until the site-wide objectives have been met. The effectiveness of this program will be documented in an annual report.	SWGM Plan, Sections 1.0, 4.0, 5.0
(H)	Applies when owner/operator determines the corrective action program no longer satisfies the requirements of this section.	GM will continue implementing corrective measures and site-wide groundwater monitoring until the site-wide objectives have been met. GM will assess the program at least annually and identify/propose any necessary changes to the program to ensure that the objectives of the SWGM Plan continue to be met.	SWGM Plan, Section 1.0
(I)	The director may exempt any person disposing of hazardous wastes from any requirement of 3734-55.	NA	NA
3745-55-011	Corrective Action for Waste Management Units		
(A)	Owner/operator seeking a permit for the treatment, storage, or disposal of hazardous waste shall institute corrective action as necessary to protect human health and the environment for all releases of hazardous waste or constituents from any waste at the facility, regardless of the time at which waste was placed in such unit.	NA; GM is not seeking a permit for the treatment, storage, or disposal of hazardous waste.	NA
(B)	Corrective action will be specified in the permit in accordance with this rule and with rules 3745-57-72 and 3745-57-73. Permit will contain schedules of compliance for such corrective action and assurances of financial responsibility for completing such corrective action.	NA; GM is not seeking a permit for the treatment, storage, or disposal of hazardous waste.	NA
(C)	Owner/operator shall implement corrective actions beyond the facility property boundary, where necessary to protect human health and environment, unless the owner/operator demonstrates to the satisfaction of the director that, despite the owner's/operator's best efforts, the owner/operator was unable to obtain the necessary permission to undertake such actions.	GM is currently implementing a comprehensive corrective action program, which included the lagoons. In-situ remedial technologies are addressing the historical release from AOI 7 across the site and capture zone corrective measures are addressing hydraulic control in the upper and lower aquifers at the property boundary and downgradient of the property, respectively. Under the SWGM program, GM will evaluate on an annual basis if there are any significant contributions to	IM/CM Report SWGM Plan

Table B-1. Analysis for Compliance with OAC 3745-54 Chapters 90 through 99 and 3745-55 Chapters 01 and 011, Site-Wide Groundwater Monitoring Program, General Motors Corporation, Moraine, Ohio.

Regulatory Citation	Regulation	Rationale for Applicability	Reference Document/Location Where Regulation is Addressed
(C) Continued	The owner/operator is not relieved of all responsibility to clean up a release that has migrated beyond the facility boundary where off-site access is denied. On-site measures to address such releases will be determined on a case-by-case basis. Assurances of financial responsibility for such corrective action shall be provided.	groundwater contamination.	

References

Closure Plan — Conestoga-Rovers & Associates, 2000. Lagoon Closure Plan, General Motors, Harrison Radiator Division Facility, Moraine, Ohio. June 2000.

SDOCC — Geraghty & Miller, Inc., 1997. Supplemental DOCC for General Motors Powertrain Group Moraine Engine Plant and General Motors Truck Group Moraine Assembly Plant, Moraine, Ohio. July 1997.

DOCC — Geraghty & Miller, Inc., 1991. Description of Current Conditions, Task 1 for the RCRA Facility Investigation for Harrison Radiator Division - GMC, Moraine, Ohio. January 1991.

SWGM Plan — ARCADIS Geraghty & Miller, 2000. Draft Site-Wide Groundwater Monitoring Plan, General Motors Corporation, Moraine, Ohio. March 2000, revised September 2001.

RFI Report — ARCADIS Geraghty & Miller, 2000. RFI and Supplemental RFI Reports, General Motors Corporation, Moraine Ohio. April 2000.

IM/CM Report — ARCADIS Geraghty & Miller, 2001. Draft Interim Measures/Corrective Measures (IM/CM) Report, General Motors Corporation, Moraine, Ohio. March 2001.

BRA Report — ENVIRON Corporation, 2000. Baseline Risk Assessment, General Motors Corporation, Moraine, Ohio. April 2000.

RFI Work Plans — Geraghty & Miller, Inc., 1992. RCRA Facility Investigation Work Plan, Harrison Division-GMC, Moraine, Ohio. November 1992.

Geraghty & Miller, Inc., 1997. Supplemental RFI Work Plan for General Motors Powertrain Group Moraine Engine Plant and General Motors Truck Group Moraine Assembly Plant, Moraine, Ohio. July 1997.

Not Applicable — SSL - South Settling Lagoon

- North Settling Lagoon — RTLs - Remediation Target Levels

TABLE B-2: Preliminary Remediation Target Levels

Remediation Target Levels (mg/L) - Upper Aquifer								
			Constituent of Concern					
Point of Compliance *GM-26*			*PCE*	*TCE*	*1,1-DCE*	*cis-1,2-DCE*	*Vinyl Chloride*	monitoring wells
Allowable POC Concentration (mg/L):			*0.005*	*0.005*	*0.007*	*0.070*	*0.002*	
Estimated Remediation Target Level at AOI 7 (mg/L):			*1.667*	*1.667*	*2.333*	*23.333*	*0.667*	GM-23, GM-29 and GM-30
Distance from AOI 7 (monitoring zone)	Source Reduction Factor	Normalized Remediation Target	Remediation Target (mg/L)	Remediation Target (mg/L)	Remediation Target (mg/L)	Remediation Target (mg/L)	Remediation Target (mg/L)	
140 ft (Zone S1)	0.9	300	1.500	1.500	2.100	21.000	0.600	GM-28
1190 ft (Zone S1 to Zone S2)	0.7	233	1.167	1.167	1.633	16.333	0.467	GM-28, ME-6
2240 ft (Zone S2)	0.1	33	0.167	0.167	0.233	2.333	0.067	ME-6, ME-3, GM-31
2940 ft (Zone S2 to Zone S3)	0.04	13	0.067	0.067	0.093	0.933	0.027	ME-6, ME-3, GM-31, GM-22, GM-19S, and EAST
3640 ft (Zone S3)	0.03	10	0.050	0.050	0.070	0.700	0.020	GM-32, GM-21
4430 ft (Zone S3 to GM-10)	0.02	7	0.033	0.033	0.047	0.467	0.013	GM-32, GM-21, GM-8, GM-6, 4S, GM-2, GM-16, GM-17, GM-18, WSU-24, and GM-10
5215 ft (GM-10)	0.008	3	0.013	0.013	0.019	0.187	0.005	GM-10
6370 ft (POC)	0.003	1	0.005	0.005	0.007	0.070	0.002	GM-26

Remediation Target Level (mg/L) - Lower Aquifer								
			Constituent of Concern					
Point of Compliance *GM-11, GM-15 and GM-20D*			*PCE*	*TCE*	*1,1-DCE*	*cis-1,2-DCE*	*Vinyl Chloride*	monitoring wells
Allowable POC Concentration (mg/L):			*0.005*	*0.005*	*0.007*	*0.070*	*0.002*	
Estimated Remediation Target Level at AOI 7 (mg/L):			*0.556*	*0.556*	*0.778*	*7.778*	*0.222*	GM-23, GM-29 and GM-30
Distance from AOI 7 (monitoring zone)	Source Reduction Factor	Normalized Remediation Target	Remediation Target (mg/L)	Remediation Target (mg/L)	Remediation Target (mg/L)	Remediation Target (mg/L)	Remediation Target (mg/L)	
3250 ft (Zone D1)	0.03	3	0.017	0.017	0.023	0.233	0.007	GM-19 and Well 32
4250 ft (Zone D2)	0.02	2	0.011	0.011	0.016	0.156	0.004	GM-1 and GM-3
4900 ft (POC)	0.009	1	0.005	0.005	0.007	0.070	0.002	GM-11, GM-15 and GM-20D

Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97

02/01/01

Section 1. Ground Water Monitoring Applicability OAC rule 3745-54-90(A)		Y/N	NA	Vio	Def	Pg	Rmk
1-1	If the facility contains a surface impoundment, landfill, land treatment facility, or wastepile has a GWM program according to OAC rules 3745-54-90 to 99 and 55-01 to 55-02 been implemented? OAC rule 3745-54-90(A)(1)	Y				SWGM Plan Sec 1.0, 2.0 Lagoon Annual and Quarterly Reports Prior to closure of the lagoons, the north settling lagoon was in assessment monitoring (3745-65-93) and the south settling lagoon was in detection monitoring (3745-65-92), per the requirements of the Consent Decree.	
1-2	All waste management units must comply with OAC rule 3745-55-011 regardless of when waste was placed in the unit. Are all units in compliance? OAC rule 3745-54-90(A)(2)	Y				Closure Plan Yes, however, the facility does not have a permit. In lieu of a permit. the corrective action order serves as the enforceable document.	
Section 2. Exemptions from Ground Water Monitoring Requirements OAC rule 3745-54-90(B) These will not be allowed for Baseline Call Ins.		**Y/N**	**NA**	**Vio**	**Def**	**Pg**	**Rmk**
2-1	Was a waiver from OAC rules 3745-54-90 through 55-01 ground water monitoring requested?		√			Closure Plan Sec. 2.0 SWGM Plan, Sec. 1.2 Lagoon Annual and Quarterly Reports RFI and Baseline Risk Assessment Reports Lagoons do not meet the exception criteria during their operating life; however, as waste was solidified during closure, the potential for migration of liquid is eliminated. Further, the RFI determined that these lagoons did not serve as a significant source of groundwater contamination from a risk perspective. A long-term groundwater monitoring plan has been proposed for the closed lagoons.	
2-2	Did the owner/operator make a demonstration that the facility was exempted under OAC rule 3745-54-01 and 90(B)(1)?		√			Closure Plan Section 2.0 SWGM Plan, Sec. 1.2 Lagoon Annual and Quarterly Reports RFI and Baseline Risk Assessment Reports	
2-3	Did the owner/operator make a demonstration that a landfill was exempted due to engineering and secondary containment under OAC rule 3745-54-90(B)(2)?		√			Closure Plan Section 2.0 SWGM Plan, Sec. 1.2 Lagoon Annual and Quarterly Reports RFI and Baseline Risk Assessment Reports	
2-4	Did the owner/operator make a demonstration that the facility was exempted due to meeting the land treatment requirements under OAC rule 3745-54-90(B)(3)?		√			Closure Plan Section 2.0 SWGM Plan, Sec. 1.2 Lagoon Annual and Quarterly Reports RFI and Baseline Risk Assessment Reports	
2-5	Did the owner/operator demonstrate that there is not potential for migration of liquid from a regulated unit to the uppermost aquifer during the active life of the regulated unit (including the closure post-closure periods)? Predictions must be based on assumptions that maximize the rate of liquid migration. This demonstration must be certified by a qualified geologist or geotechnical engineer. OAC rule 3745-54-90(B)(4)		√			Closure Plan Section 2.0 SWGM Plan, Sec. 1.2 Lagoon Annual and Quarterly Reports RFI and Baseline Risk Assessment Reports	
2-6	Did the owner demonstrate that the waste pile is designed and operated in compliance with OAC rule 3745-56-50(C)? OAC rule 3745-54-90(B)(5)		√			Closure Plan Section 2.0 SWGM Plan, Sec. 1.2 Lagoon Annual and Quarterly Reports RFI and Baseline Risk Assessment Reports	

Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97

02/01/01

Section 2. Con't. Exemptions from Ground Water Monitoring Requirements OAC rule 3745-54-90(B) These will not be allowed for Baseline Call Ins.		**Y/N**	**NA**	**Vio**	**Def**	**Pg**	**Rmk**
2-7	Is the facility required to perform GWM during closure and post-closure periods? OAC rule 3745-54-90(C)		√			Closure Plan Section 2.0 SWGM Plan, Sec. 1.2 Lagoon Annual and Quarterly Reports RFI and Baseline Risk Assessment Reports	
2-8	Does the facility have a miscellaneous unit required to implement GWM according to OAC rules 3745-54-90 to 99 and 55-01 to 55-02?		√			Closure Plan Section 2.0 SWGM Plan, Sec. 1.2 Lagoon Annual and Quarterly Reports RFI and Baseline Risk Assessment Reports	
Section 3. Interim Status Ground Water Monitoring Data This section is required for a permit. If the facility has already been conducting ground water monitoring under the Interim Status regulations, Ohio EPA already has this data. **Therefore, it does not need to be submitted again.**		**Y/N**	**NA**	**Vio**	**Def**	**Pg**	**Rmk**
3-1	Did the owner/operator provide a summary of interim status ground water monitoring data? OAC rule 3745-50-44(B)(1)	Y				Lagoon Annual and Quarterly Reports Closure Plan	
3-2	Did it include a summary description of the wells according to OAC rule 3745-65-91 including: Location and identification of each well on a topographic map?	Y				Lagoon Annual and Quarterly Reports	
3-3	Which wells were upgradient and which wells were down gradient?	Y				Lagoon Annual and Quarterly Reports	
Section 3. Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97		**Y/N**	**NA**	**Vio**	**Def**	**Pg**	**Rmk**
3-4	Details of the design and construction of each monitoring well?	Y				Lagoon Annual and Quarterly Reports DOCC Reports RFI Reports	
3-5	Was a copy of the facility's SAP submitted and did it include all the necessary procedures required in OAC rule 3745-65-92(A) as listed in the SAP portion of this guidance in Section 10?	Y				Lagoon Sampling Plans for Assessment and Detection Monitoring Programs SWGM Plan	
3-6	Were all Interim Status sampling results required by OAC rules 3745-65-92 through 94 submitted including: Copies of each quarterly report from the first year of monitoring?	Y				Lagoon Annual and Quarterly Reports	
3-7	Copies of any subsequent (annual or semi-annual) analytical results for each well?	Y				RFI Reports	
3-8	Copies of any notifications of statistically significant changes reported to the Director pursuant to OAC rule 3745-65-93?	Y				Lagoon Annual Reports Correspondence to Ohio EPA	
3-9	Results of ground water surface elevations and evaluations for each sampling event?	Y				Lagoon Annual and Quarterly Reports RFI Reports	
3-10	Calculations of the initial background arithmetic mean and variance for each indicator parameter based on replicated measurements form upgradient well during the first year of sampling? OAC rule 3745-65-92(C)(2)	Y				Lagoon Annual and Quarterly Reports	
3-11	Was information related to statistical procedures provided, including: A description of statistical procedures used (if applicable) in processing the data submitted? OAC rule 3745-65-93(B)	Y				Lagoon Annual and Quarterly Reports	
3-12	Results of statistical comparisons between upgradient and downgradient sampling results and first year background values for each indicator parameter?	Y				Lagoon Annual and Quarterly Reports	

Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97

02/01/01

Section 3. Con't. Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97		Y/N	NA	Vio	Def	Pg	Rmk
3-13	If required, was an adequate Ground Water Quality Assessment Plan submitted? OAC rule 3745-65-93(D)(3)	Y				Lagoon Sampling Plan for the Assessment Monitoring Program	
3-14	Were the following results submitted and were the determinations adequately made to assess: Whether hazardous waste or hazardous waste constituents have entered the ground water?	Y				Lagoon Annual and Quarterly Reports	
3-15	Whether the rate, vertical and horizontal extent of ground water contamination has been fully determined according to OAC rule 3745-65-93(D)(4)(a)?	Y				Lagoon Annual and Quarterly Reports	
3-16	Whether the concentrations of hazardous waste or hazardous waste constituents in the ground water had been fully determined according to OAC rule 3745-65-93(D)(4)(b)?	Y				Lagoon Annual and Quarterly Reports	
Section 4. General Hydrogeologic Information - Guidance Checklist for OAC rules 3745-54-90 through 97		**Y/N**	**NA**	**Vio**	**Def**	**Pg**	**Rmk**
4-1	Were the uppermost aquifer and any hydraulically interconnected underlying aquifers correctly identified so that **representative** samples may be collected as required by OAC rule 3745-54-97?	Y				Lagoon Annual and Quarterly Reports DOCC Reports RFI Reports	
4-2	Was the full lateral and vertical extent of subsurface materials characterized correctly?	Y				Lagoon Annual and Quarterly Reports RFI Reports Closure Plan	
4-3	Were all geological influences that might control ground water flow (highly conductive zones, fault zones, fracture traces, buried stream deposits, etc.) adequately evaluated?	Y				Lagoon Annual and Quarterly Reports DOCC Reports RFI Reports	
4-4	Are there geological influences that may restrict ground water flow (e.g., confining layers, hydraulic barriers) to any stratigraphically lower water-bearing units?	Y				Lagoon Annual and Quarterly Reports DOCC Reports RFI Reports	
4-5	If there are any confining layers, are they laterally continuous across the entire site?	Y				DOCC Reports RFI Reports	
4-6	Was the ground water flow direction and rate correctly identified including the basis for those determinations?	Y				Lagoon Annual and Quarterly Reports DOCC Reports RFI Reports	
4-7	Were there any **Fluctuations** in static ground water levels?	Y				Lagoon Annual and Quarterly Reports DOCC Reports RFI Reports	
4-8	If yes, are the fluctuations caused by any of the following: Off site well pumping?	N				DOCC Reports RFI Reports Off-site pumping in the deep aquifer is continuous and does not result in fluctuations.	

Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97

02/01/01

Section 4. Con't. General Hydrogeologic Information - Guidance Checklist for OAC rules 3745-54-90 through 97		Y/N	NA	Vio	Def	Pg	Rmk
4-9	On site well pumping?	N				DOCC Reports RFI Reports On-site production well pumping in the deep aquifer is typically continuous and does not result in fluctuations. However, historic pumping did result in fluctuations.	
4-10	Off or On site construction or changing land-use patterns?	N				No current changes are proposed at the facility.	
4-11	Seasonal variations?	Y				Lagoon Annual and Quarterly Reports DOCC Reports RFI Reports	
4-12	Do the water level fluctuations alter the general ground water gradients and flow directions?	N				Lagoon Annual and Quarterly Reports DOCC Reports RFI Reports	
4-13	Were the **hydraulic conductivity** properties of the uppermost aquifer determined?	Y				Lagoon Annual and Quarterly Reports DOCC Reports RFI Reports	
4-14	Was the following information from hydrogeologic investigations submitted in a report written by a qualified hydrogeologist?	Y				Lagoon Annual and Quarterly Reports DOCC Reports RFI Reports	
4-15	Did the owner/operator address means for resolution of any information gaps of geologic data?	Y				Lagoon Annual and Quarterly Reports DOCC Reports RFI Reports	
4-16	Did the report include regional as well as site specific descriptions of the geology and hydrogeology including at a minimum, the depth to bedrock?	Y				DOCC Reports RFI Reports	
4-17	Characteristics of the major stratigraphic units?	Y				DOCC Reports RFI Reports	
4-18	Average yield of water wells within a one mile radius? (Logs should be submitted as well)	Y				DOCC Reports RFI and Baseline Risk Assessment Reports	
4-19	Identification and estimation of the amount of recharge and discharge?	Y				DOCC Reports RFI Reports	
4-20	Did the written description include an accurate classification and description of the **Site Specific** consolidated and unconsolidated materials from the ground surface down to the base of the lowest saturated zone of concern?	Y				DOCC Reports RFI Reports	
4-21	Did the narrative include a site-specific description of the **occurrence of ground water** at the site, including: Identification of saturated zones, including depth and lateral and vertical extent?	Y				DOCC Reports RFI Reports	
4-22	Description of the interconnection between saturated zones and surface water?	Y				DOCC Reports RFI Reports	

Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97

02/01/01

Section 4.	Con't. General Hydrogeologic Information - Guidance Checklist for OAC rules 3745-54-90 through 97	Y/N	NA	Vio	Def	Pg	Rmk
4-23	Were the results of this report supported by an adequate and complete set of raw data?	Y				DOCC Reports RFI Reports	
4-24	Were the **boring logs** complete technical records of conditions encountered including the results of the laboratory analyses?	Y				DOCC Reports RFI Reports	
4-25	Did the logs include: Site name and Site-specific coordinates?	Y				DOCC Reports RFI Reports	
4-26	Date started, completed, abandoned or converted into well?	Y				DOCC Reports RFI Reports	
4-27	Depth and reason for termination of borehole?	Y				DOCC Reports RFI Work Plans and Reports	
4-28	Sampling interval?	Y				DOCC Reports RFI Work Plans and Reports	
4-29	Surface elevation based on Mean Sea level (MSL) or fixed reference point?	Y				DOCC Reports RFI Reports	
4-30	Description and classification of unconsolidated materials? (Field and lab)	Y				DOCC Reports RFI Reports	
4-31	Description and classification of consolidated materials? (Field and lab)	Y				DOCC Reports RFI Reports	
4-32	Presence of structural features such as fractures, solution cavities, or bedding?		√			DOCC Reports RFI Reports These features are not present at the facility in the monitored unconsolidated zones.	
4-33	Depth to water, water-bearing zone(s) and vertical extent of each?	Y				DOCC Reports RFI Reports	
4-34	Depth and location of any color and/or stains (possible contamination) encountered in borehole?	Y				DOCC Reports RFI Reports	
4-35	Did the interval and depth of sample collection adequately reflect subsurface complexity?	Y				DOCC Reports RFI Reports	
4-36	Were **well construction logs** provided for all wells and piezometers?	Y				DOCC Reports RFI Reports	
4-37	Did the construction logs include: Date/time of start and completion of construction?	Y				DOCC Reports RFI Reports	
`8	Boring/well number?	Y				DOCC Reports RFI Reports	

Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97

02/01/01

Section 4. Con't. General Hydrogeologic Information - Guidance Checklist for OAC rules 3745-54-90 through 97		Y/N	NA	Vio	Def	Pg	Rmk
4-39	Drilling method and drilling fluid used?	Y				DOCC Reports RFI Reports	
4-40	Borehole diameter and well casing diameter?	Y				DOCC Reports RFI Reports	
4-41	Latitude and longitude?	Y				DOCC Reports RFI Reports	
4-42	Borehole depth?	Y				DOCC Reports RFI Reports	
4-43	Well depth?	Y				DOCC Reports RFI Reports	
4-44	Casing length and materials?	Y				DOCC Reports RFI Reports	
4-45	Screened interval?	Y				DOCC Reports RFI Reports	
4-46	Screen materials, length, design and slot size?	Y				DOCC Reports RFI Reports	
4-47	Casing and screen joint type?	Y				DOCC Reports RFI Reports	
4-48	Depth/elevation of top and bottom of screen?	Y				DOCC Reports RFI Reports	
4-49	Filter pack material/size, volume calculations, and placement method?	Y				DOCC Reports RFI Reports	
4-50	Depth/elevation to top and bottom of filter pack?	Y				DOCC Reports RFI Reports	
4-51	Annular seal composition, volume, and placement method?	Y				DOCC Reports RFI Reports	
4-52	Surface seal composition, placement method and volume?	Y				DOCC Reports RFI Reports	
4-53	Surface seal and well apron design/construction?	Y				DOCC Reports RFI Reports	
4-54	Depth/elevation of water?	Y				DOCC Reports RFI Reports	
4-55	Well development procedure and ground water turbidity?	Y				DOCC Reports RFI Reports	

Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97

02/01/01

Section 4. Con't. General Hydrogeologic Information - Guidance Checklist for OAC rules 3745-54-90 through 97		Y/N	NA	Vio	Def	Pg	Rmk
4-56	Type/design of protective casing?	Y				DOCC Reports RFI Reports	
4-57	Well cap and lock?	Y				DOCC Reports RFI Reports	
4-58	Ground surface elevation (+/- 0.01 ft)?	Y				DOCC Reports RFI Reports	
4-59	Surveyed reference point (+/- 0.01 ft) on well casing?	Y				DOCC Reports RFI Reports	
4-60	Water level after completion of well development?	Y				DOCC Reports RFI Reports	
4-61	Did the report include a description of field methods used and a summary of which data were collected by each method?	Y				DOCC Reports RFI Reports	
Section 5. Topographic Map Requirements - Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97 The owner/operators of facilities required to perform ground water monitoring shall include the following information on a topo map:		**Y/N**	**NA**	**Vio**	**Def**	**Pg**	**Rmk**
5-1	Do all maps include: Legend?	Y				Lagoon Annual and Quarterly Reports DOCC Reports RFI Reports	
5-2	Map scale and date?	Y				Lagoon Annual and Quarterly Reports DOCC Reports RFI Reports	
5-3	North arrow?	Y				Lagoon Annual and Quarterly Reports DOCC Reports RFI Reports	
5-4	Wind rose (prevailing wind speed and direction)?	N				A wind rose diagram has not been prepared for the GM Moraine facilities.	
5-5	A contour interval at a level of detail appropriate for the investigation?	Y				Lagoon Annual and Quarterly Reports DOCC Reports RFI Reports	
5-6	Anthropogenic features such as utility lines and buildings?	Y				Lagoon Annual and Quarterly Reports DOCC Reports RFI Reports	
5-7	Legal boundaries of the regulated facility?	Y				Lagoon Annual and Quarterly Reports DOCC Reports RFI Reports	

Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97

02/01/01

Section 5. Con't. Topo Map Requirements - Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97		Y/N	NA	Vio	Def	Pg	Rmk
5-23	Indication of ground water flow direction?	Y				Lagoon Annual and Quarterly Reports DOCC Reports RFI Reports	
5-24	Was an explanation for the flow direction and a justification of the extrapolation of flow outside the area defined by data points included?	Y				Lagoon Annual and Quarterly Reports DOCC Reports RFI Reports	
5-25	Were separate potentiometric maps submitted for each zone monitored?	Y				Lagoon Annual and Quarterly Reports DOCC Reports RFI Reports	
5-26	Location of any injection or withdrawal monitoring wells?	Y				RFI Reports SWGM Plan IM/CM Report	
Section 6.	**Contaminant Plume Description**	**Y/N**	**NA**	**Vio**	**Def**	**Pg**	**Rmk**
6-1	For existing facilities with contaminated ground water, did the owner/operator provide a description of any plume of contamination that has entered the ground water from a regulated unit at the time the plan/application is submitted?	Y				Lagoon Annual and Quarterly Reports SWGM Plan IM/CM Report RFI Reports	
6-2	Did the description include delineating the horizontal extent of any plume on the topographic map required above?	Y				IM/CM Report RFI Reports	
6-3	Did the owner/operator identify the concentration of each constituent listed in the Appendix to OAC rule 3745-54-98 throughout the plume or identify the maximum concentration of each of those constituents in the plume?	Y				Lagoon Annual and Quarterly Reports RFI Reports SWGM Plan During the RFI, the Appendix IX list was used and a site-specific parameter list is proposed in the SWGM Plan.	
6-4	Was the vertical extent of each plume delineated in cross section?	Y				Data Visualization	
Section 7.	**Correct GW Monitoring Program - Guidance Checklist for Monitoring under OAC rules 3745-54-90 through 97**	**Y/N**	**NA**	**Vio**	**Def**	**Pg**	**Rmk**
7-1	Is the facility operating under the correct GWM program?	Y				SWGM Plan	
7-2	If hazardous constituents under OAC rule 3745-54-93 have been detected in the ground water at the compliance point, was a compliance GWM program in accordance with OAC rule 3745-54-99 implemented? OAC rule 3745-54-91(A)(1)	N				Prior to closure of the lagoons, the North Settling Lagoon was in assessment monitoring (3745-65-93) and the South Settling Lagoon was in detection monitoring (3745-65-92), per the requirements of the Consent Decree. Hazardous constituents have also been detected from on-site and off-site sources.	

Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97

02/01/01

Section 7. Con't. Correct GW Monitoring Program - Guidance Checklist for Monitoring under OAC rules 3745-54-90 through 97		Y/N	NA	Vio	Def	Pg	Rmk
7-3	If the ground water protection standard under OAC rule 3745-54-92 was exceeded at the compliance point under OAC rule 3745-54-95, was a corrective action GWM program in accordance with OAC rule 3745-55-01 implemented? OAC rule 3745-54-91(A)(2)		√			Lagoon Annual and Quarterly Reports Consent Decree, October 26, 1988 SWGM Plan	
7-4	If hazardous constituents under OAC rule 3745-54-93 exceeded concentration limits as established under OAC 3745-54-94 in the ground water between the compliance point and the downgradient facility property boundary was a corrective action GWM program according to OAC rule 3745-55-01 implemented? OAC rule 3745-54-91(A)(3)		√			Lagoon Annual and Quarterly Reports Consent Decree, October 26, 1988 SWGM Plan	
7-5	Has a detection GWM program (capable of determining the facility's impact on the quality of ground water in the uppermost aquifer underlying the facility) been implemented? OAC rule 3745-54-91(A)(4)	Y				Lagoon Supplemental Annual Reports Consent Decree, October 26, 1988 A detection monitoring program was implemented for the south settling lagoon (3745-65-92). SWGM Plan	
7-6	Did the owner/operator submit an adequately detailed plan/ engineering report specify all the elements of the correct ground water monitoring program? OAC rule 3745-54-91(B)(1)	Y				SWGM Plan	
7-7	If required, is more than one GWM program presently in operation at the site? OAC rule 3745-54-91(B)(2)	Y				SWGM Plan	
Section 8. Ground Water Protection Standard OAC rules 3745-54-92 through 96		**Y/N**	**NA**	**Vio**	**Def**	**Pg**	**Rmk**
	If hazardous constituents have been detected in the ground water, has the ground water protection standard been established in the facility permit/closure or post-closure plan? OAC rule 3745-54-92	Y				SWGM Plan Sec. 4.0 IM/CM Report, Sec. 2.0 Remediation target levels that are risk-based and protective of human health are proposed.	
8-2	Will the ground water protection standard ensure that hazardous constituents detected in the ground water from a regulated unit will not exceed the concentration limits in the uppermost aquifer underlying the waste management area beyond the point of compliance during the compliance period? OAC rule 3745-54-92	Y				SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 A site-wide data evaluation that includes the closed lagoons and compliance points will be conducted.	
8-3	Does the **list of hazardous constituents** for ground water monitoring include any constituent listed in the appendix to OAC rule 3745-51-11 that have been detected in the ground water in the uppermost aquifer underlying a regulated unit and that are reasonably expected to be in or derived from waste contained in a regulated unit? OAC rule 3745-54-93(A)	Y				SWGM Plan, Sec. 2.0, 3.0, 4.0 RFI and Baseline Risk Assessment Reports IM/CM Report	
8-4	Have constituents been excluded from the parameter list due to their lack of adverse effects on ground water quality? OAC rule 3745-54-93(B)(1)	Y				SWGM Plan, Sec. 2.0, 3.0, 4.0 RFI and Baseline Risk Assessment Reports IM/CM Report	
8-5	Have any constituents been excluded from the parameter list due to their potentially adverse effects on hydraulically connected surface water quality? OAC rule 3745-54-93(B)(2)	N				RFI and Baseline Risk Assessment Reports Surface water was evaluated in the RFI and based on the conclusions in the Baseline Risk Assessment, there were no adverse impacts to the Drainage Ditch.	

Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97

02/01/01

Section 8. Con't. GW Protection Standard - Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97		Y/N	NA	Vio	Def	Pg	Rmk
8-6	Have the **concentration limits** been set in the permit/plan? OAC rule 3745-54-94(A)	N				SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Baseline Risk Assessment Remediation target levels are proposed in the SWGM Plan and a trend evaluation will be conducted for the lagoons.	
8-7	Were concentration limits set so as to not exceed background levels of that constituent in the ground water at the time the limit was specified in the permit? OAC rule 3745-54-94(A)(1)	N				SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Baseline Risk Assessment Remediation target levels were derived using methodologies in the baseline risk assessment.	
8-8	Were concentration limits set so as to not exceed the respective MCL value if the background level of the constituent is below the MCL? OAC rule 3745-54-94(A)	N				SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Baseline Risk Assessment Remediation target levels were derived using methodologies in the baseline risk assessment.	
8-9	Were concentration limits set so as to not exceed the alternate concentration limit (ACL) established in the permit? OAC rule 3745-54-94(A)(3)		√			The facility does not have a permit, in lieu of a permit, the corrective action order serves as the enforceable document.	
8-10	Have all potentially adverse effects on ground water quality been correctly considered when establishing the ACL? OAC rule 3745-54-94(B)(1)	Y				SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Baseline Risk Assessment Risk-based remediation target levels are proposed.	
8-11	Have all potentially adverse effects on hydraulically connected surface-water quality been correctly considered when establishing the ACL? OAC rule 3745-54-94(B)(2)	Y				SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Baseline Risk Assessment Surface water was evaluated in the RFI and based on the conclusions in the Baseline Risk Assessment, there were no adverse impacts to the Drainage Ditch.	
8-12	Does the permit/plan identify the **point of compliance** where the ground water protection standard applies? OAC rule 3745-54-95	Y				SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0	
8-13	Is ground water monitoring conducted at the vertical surface located at the hydraulically downgradient limit of the waste management area that extends down into the uppermost aquifer underlying the regulated units? OAC rule 3745-54-95(A)	Y				SWGM Plan, Sec. 3.0	
8-14	Is the waste management area correctly defined for the purposes of the point of compliance? OAC rule 3745-54-95(B)	Y				SWGM Plan, Sec. 3.0	

Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97

02/01/01

Section 8. Con't. GW Protection Standard - Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97		Y/N	NA	Vio	Def	Pg	Rmk
8-15	If the facility contains more than one regulated unit, does the point of compliance correctly circumscribe the regulated units? OAC rule 3745-54-95(B)(2)	N				SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 The lagoon point of compliance wells are located immediately downgradient of each closed lagoon.	
8-16	Has the permit/plan correctly specified the **compliance period** in the permit as the number of years equal to the active life of the waste management area? OAC rule 3745-54-96(A)	N				SWGM Plan, Sec. 5.0 Site-wide groundwater monitoring will be conducted for a minimum of 30 years, unless otherwise demonstrated that no further monitoring is warranted.	
8-17	Has the permit/plan correctly specified when the compliance monitoring period begins when the compliance monitoring program was initiated? OAC rule 3745-54-96(B)		√			SWGM Plan, Sec. 4.0 Consent Decree, October 26, 1988 The closed lagoons are not in a compliance monitoring program.	
8-18	Has it been necessary to extend the compliance period to demonstrate that the GW protection standard has not been exceeded for 3 consecutive years? OAC rule 3745-54-96(C)	N				SWGM Plan, Sec. 4.0 Consent Decree, October 26, 1988 The closed lagoons are not in a compliance monitoring program.	
Section 9. Wells for Part B Ground Water Monitoring OAC rules 3745-54-97(A-C)		**Y/N**	**NA**	**Vio**	**Def**	**Pg**	**Rmk**
9-1	Do the actual numbers, locations, and depths of the GWM wells and waste management areas agree with the data in the GWM Plan? Is the location and identification of each well on a topographic map?	Y				SWGM Plan, Sec. 3.0	
9-2	Is it clear which wells are upgradient and which wells are down gradient?	Y				SWGM Plan, Sec. 3.0	
9-3	Does the GWM system consist of a sufficient number of wells, installed at appropriate locations and depths to yield groundwater samples from the uppermost aquifer? OAC rule 3745-54-97(A)	Y				SWGM Plan, Sec. 3.0	
9-4	Will the GWM system produce samples that represent the quality of background water that has not been affected by leakage from the unit? OAC rule 3745-54-97(A)(1)	Y				RFI and Baseline Risk Assessment Reports SWGM Plan Sec. 3.0 Comparison of upgradient versus downgradient groundwater quality is not appropriate without evaluating site-wide conditions.	
9-5	If it cannot be determined what wells are hydraulically upgradient, does the GWM system correctly include sampling of wells that are not hydraulically upgradient of the waste management area? OAC rule 3745-54-97(A)(1)(a)(i)		√			SWGM Plan, Section 3.0 RFI Reports GM has determined which wells are hydraulically upgradient.	
9-6	Has sampling at other non-upgradient wells provided an indication of background GW quality that is as or more representative than monitoring upgradient wells? OAC rule 3745-54-97(A)(1)(a)(ii)		√			SWGM Plan, Sec. 3.0 RFI Reports GM has determined which wells are hydraulically upgradient.	

Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97

02/01/01

ction 9. Con't. Wells for Part B GWM - Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97		Y/N	NA	Vio	Def	Pg	Rmk
9-7	Is there upgradient contamination emanating from a source on-site?	Y				RFI and Baseline Risk Assessment Reports Lagoon Annual and Quarterly Reports	
9-8	Off-site?	Y				RFI and Baseline Risk Assessment Reports Lagoon Annual and Quarterly Reports	
9-9	Is the ground water flow direction variable (i.e., no location is clearly hydraulically upgradient under all conditions)?	N				DOCC Reports RFI Reports	
9-10	If representative upgradient groundwater quality is contaminated, has an additional upgradient well been installed to provide uncontaminated samples representative of the same stratigraphic unit as the downgradient wells?		√			SWGM Plan, Sec. 1.0, 2.0, 3.0 RFI Reports Groundwater quality upgradient of the site is contaminated from off-site sources.	
9-11	Are there background well(s) of sufficient number to account for any heterogeneity in background groundwater quality?	Y				SWGW Plan, Sec. 1.0, 2.0, 3.0 RFI Reports Lagoon Annual and Quarterly Reports	
9-12	Are the background well(s) screened in the same stratigraphic horizon(s) as the downgradient wells to ensure comparability of data?	Y				DOCC Reports, RFI Reports Lagoon Annual and Quarterly Reports	
9-13	Have sufficient monitoring wells been installed hydraulically downgradient to represent the quality of ground water passing the point of compliance? OAC rule 3745-54-97(A)(2)	Y				DOCC Reports RFI Reports SWGM Plan, Sec. 3.0 Lagoon Annual and Quarterly Reports	
9-14	Have sufficient monitoring wells been installed to allow for the immediate detection of contamination when hazardous waste or hazardous constituents have migrated from the waste management area to the uppermost aquifer? OAC rule 3745-54-97(A)(3)	Y				SWGM Plan, Sec. 3.0 Lagoon Annual and Quarterly Reports DOCC Reports RFI Reports	
9-15	If more than one hydrogeologic zone is monitored, are an adequate number of downgradient wells in each hydrogeologic zone?	Y				SWGM Plan, Sec. 3.0 DOCC Reports, RFI Reports	
9-16	In the case of a facility consisting of only one regulated unit, is the point of compliance described by the waste boundary or perimeter?		√			Lagoon Annual and Quarterly Reports RFI Reports The GM Moraine Facilities contain two closed lagoons.	
9-17	If the point of compliance circumscribes several regulated units, does the GWM system enable detection and measurement at the compliance point of hazardous constituents that have entered the uppermost aquifer? OAC rule 3745-54-97(B)	Y				SWGM Plan, Sec. 3.0 The lagoon point of compliance wells are located immediately downgradient of each closed lagoon. The point of compliance does not circumscribe the units.	
9-18	Has the owner/operator reported to Ohio EPA the well design, construction and installation information for all monitoring wells?	Y				RFI Work Plans and Reports, DOCC Reports Lagoon Annual and Quarterly Reports	

Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97

02/01/01

Section 9. Con't. Wells for Part B GWM - Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97		Y/N	NA	Vio	Def	Pg	Rmk
9-19	Is all monitoring well design, construction and installation information kept on-site as part of the operating record?	Y				RFI Work Plans Project files are maintained at the Moraine facility, GM headquarters in Troy, Michigan, and the ARCADIS Columbus, Ohio office. Historic files are kept in a secured off-site storage location.	
9-20	Are the monitoring well casing and screen materials such that they will be resistant to chemical and microbiological corrosion and degradation in contaminated and uncontaminated waters over their operating life?	Y				RFI Work Plan	
9-21	Are the monitoring wells and screens cased and installed properly to maintain an open passage to the aquifer materials?	Y				RFI Work Plan	
9-22	Does the owner/operator identify the well screen lengths of each monitoring well?	Y				RFI Work Plan	
9-23	Does the design and construction of the owner/operator's monitoring wells permit depth discrete groundwater samples to be taken?	Y				RFI Work Plan	
9-24	Was a filter pack installed?	Y				RFI Work Plan	
9-25	If yes, was the filter pack compatible with formation materials?(size and inertness)	Y				RFI Work Plan	
9-26	Was the length of the filter pack sufficient to encompass the entire screened interval?	Y				RFI Work Plan	
9-27	Was the filter pack installed properly? (If no, comment)	Y				RFI Work Plan	
9-28	Is the annular space above the sampling depth sealed with suitable to prevent vertical movement of water within the borehole and contamination of samples and the ground water by infiltration of surface water and contaminants?	Y				RFI Work Plan	
9-29	Are the sealant materials chemically inert to the highest anticipated concentration of constituents expected in the ground water?	Y				RFI Work Plan	
9-30	Will the wells produce samples representative of groundwater quality?	Y				RFI Work Plan and Reports	
9-31	Does the monitoring well's construction and design permit an accurate assessment of aquifer characteristics?	Y				RFI Work Plan and Reports	
9-32	Are the ground water samples free from turbidity?	N				RFI Work Plan Some samples are more turbid than others; however, low-flow sampling procedures should reduce the amount of turbidity in the sample. Based on 20 years of groundwater monitoring, turbidity has not been an issue.	
9-33	Were the wells properly developed?	Y				RFI Work Plan	
9-34	Was there evidence of siltation in the bottom of the well that could reduce representativeness of groundwater samples?	N				RFI Work Plan Siltation of the lagoon point of compliance wells has not occurred.	
9-35	Does the screened interval yield sufficient quantities of ground water for the collection of representative samples?	Y				RFI Work Plan and Reports	

Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97

02/01/01

Section 10. SAP OAC rules 3745-54-97(D through F)		Y/N	NA	Vio	Def	Pg	Rmk
10-1	Has a Sampling and Analysis Plan (SAP) been developed and implemented as written to ensure that monitoring results will provide a reliable indication of ground water quality below the waste management area? OAC rule 3745-54-97(D)	Y				Lagoon Work Plans for Assessment and Detection Monitoring Programs RFI Work Plan SWGM Plan	
10-2	Does the owner/operator keep a copy of the most recent SAP on-site?	Y				Project files are maintained at the Moraine facility. Historic files are kept in a secured off-site storage location.	
10-3	If the facility is abandoned and no operations are maintained on-site, was the SAP present for review during the site inspection? (It must be present during all sampling events.)		√			The GM Moraine facilities are still active.	
10-4	Does the plan include procedures and techniques for measuring ground water elevations as required by OAC rule 3745-54-97(D)(1) including: Taking all water level measurements within a 24 hour period?	Y				RFI Work Plan SWGM Plan	
10-5	Taking all water level measurements to an accuracy of +/-0.01 feet?	Y				RFI Work Plan SWGM Plan	
10-6	Taking all water level measurements prior to purging?	Y				RFI Work Plan SWGM Plan	
10-7	Were groundwater surface elevations determined at each monitoring well during each sampling event?	Y				RFI Work Plan SWGM Plan	
10-8	Are total well depths measured at least once a year?	Y				SWGM Plan	
10-9	Was a marked reference point established by a licensed surveyor used when measuring the water levels in each well?	Y				RFI Work Plan	
10-10	Was there proper decontamination of the measuring equipment between well locations to prevent cross contamination?	Y				RFI Work Plan SWGM Plan	
10-11	Were the measurements skewed by the presence of an immiscible layer?	N				RFI Work Plan SWGM Plan An immiscible layer is not present at the lagoon point of compliance wells.	
10-12	Were the measurements skewed by on or off-site pumping?	N				RFI Work Plan SWGM Plan	
10-13	If the detection of immiscible layers is applicable, were procedures for both dense and light phases included? OAC rule 3745-54-97(D)(2)	Y				RFI Work Plan There are several wells (not associated with the lagoons) that intermittently contain an immiscible layer.	
10-14	If applicable, are immiscible layers sampled separately prior to well evacuation?	N				A sufficient quantity of the immiscible layer is not present for sampling purposes.	
10-15	If applicable, are procedures to be used to minimize mixing the water soluble phases?	Y				RFI Work Plan	

Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97

02/01/01

Section 10. Con't. SAP - Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97		Y/N	NA	Vio	Def	Pg	Rmk
10-16	If procedures for immiscibles were not included, did the SAP provide a justification as to why immiscibles were not applicable?		√			There are several wells (not associated with the lagoons) that intermittently contain an immiscible layer.	
10-17	Did the SAP contain procedures and techniques for well evacuation as required by OAC rule 3745-54-97(D)(3)(a), including: whether low-yielding wells will be evacuated to dryness?	Y				RFI Work Plan SWGM Plan	
10-18	Evacuation of an adequate amount of water from high-yielding wells?	Y				RFI Work Plan SWGM Plan	
10-19	The correct formula to calculate well volumes?	Y				RFI Work Plan SWGM Plan	
10-20	The device used to evacuate the wells?	Y				RFI Work Plan SWGM Plan	
10-21	The use of micropurging techniques, if applicable?	Y				RFI Work Plan SWGM Plan	
10-22	Did the SAP contain procedures and techniques for sample withdrawal as required by OAC rule 3745-54-97(D)(3)(b), including: Proper decontamination of equipment between wells?	Y				RFI Work Plan SWGM Plan	
10-23	Sampling wells in order from least to most contaminated?	Y				RFI Work Plan SWGM Plan	
10-24	Sampling of parameters in order of sensitivity to volatilization?	Y				RFI Work Plan SWGM Plan	
10-25	Did the SAP contain procedures and techniques for sample equipment as required by OAC rule 3745-54-97(D)(3)(c), including: devices with sample-contacting parts of either fluorocarbon/resins or stainless steel?	Y				RFI Work Plan SWGM Plan	
10-26	Type of sampling device used?	Y				RFI Work Plan SWGM Plan	
10-27	Type of pump to be used?	Y				RFI Work Plan SWGM Plan	
10-28	Whether the sampling devices be dedicated?	Y				RFI Work Plan SWGM Plan	
10-29	Type of cord/wire used to raise and lower bailers?	Y				RFI Work Plan SWGM Plan	
10-30	Will bailers be lowered slowly?	Y				RFI Work Plan SWGM Plan	
10-31	If bladder pumps are to be used, will they be operated in a continuous manner to prevent aeration?		√			RFI Work Plan SWGM Plan Use of bladder pumps is not proposed in the groundwater sampling SOP.	

Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97

02/01/01

Section 10.	Con't. SAP - Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97	Y/N	NA	Vio	Def	Pg	Rmk
10-32	Will pumping rates remain below 100 ml/min?		√			RFI Work Plan SWGM Plan Groundwater pumping rates are discussed in the groundwater sampling SOP.	
10-33	Will care be taken to avoid placing clean sampling equipment on the ground or other contaminated surfaces prior to insertion into the well?	Y				RFI Work Plan SWGM Plan	
10-34	Did the SAP contain procedures and techniques for sample collection including sample containers as required by OAC rule 3745-54-97(D)(3)(d), including: whether samples would be transferred from the sampling device directly to their compatible containers?	Y				RFI Work Plan SWGM Plan	
10-35	Whether sample containers for metals (inorganics) analysis are polyethylene, Teflon, or glass with polypropylene-lined caps?	Y				RFI Work Plan SWGM Plan	
10-36	Whether sample containers for organic analysis were glass bottles with fluorocarbon resin-lined caps?	Y				RFI Work Plan SWGM Plan	
10-37	Whether sample bottles are pre-cleaned by the laboratory?	Y				RFI Work Plan SWGM Plan	
10-38	Whether if not pre-cleaned, prior to sampling will sample containers for metals analysis be cleaned using these sequential steps: Nonphosphate detergent wash, Potable water rinse, 10% hydrochloric or nitric acid rinse, and Distilled/deionized water rinse?		√			RFI Work Plan Sample containers are pre-cleaned by the laboratory.	
10-39	Whether if not pre-cleaned, will sample containers for organic analyses be cleaned using these sequential steps: Nonphosphate detergent/hot water wash, Potable water rinse, Solvent-pesticide grade isopropanol, acetone, methanol or hexane rinse, and Distilled/deionized water rinse?		√			RFI Work Plan Sample containers are pre-cleaned by the laboratory.	
10-40	If bailers are used, will contents be transferred to the sample container so that agitation and aeration are minimized?	Y				RFI Work Plan SWGM Plan	
10-41	Are samples for VOCs transferred to containers and capped in a timely manner to prevent aeration?	Y				RFI Work Plan SWGM Plan	
10-42	Was the container for organic analysis filled to form a meniscus?	Y				RFI Work Plan SWGM Plan	
10-43	Was the bottle checked for air after capping it?	Y				RFI Work Plan SWGM Plan	
10-44	Did the SAP contain procedures and techniques for sample preservation as required by OAC rule 3745-54-97(D)(3)(e), including whether: Samples for the following analysis are cooled to 4° C: Organic Analyses, PCBs, Chromium VI, Phenols, Sulfate, Nitrate/Nitrite, Coliform bacteria, Cyanide, Oil and Grease, Turbidity, Pesticides, and Specific Conductance?	Y				RFI Work Plan SWGM Plan QAPP	
10-45	Did the SAP contain procedures and techniques for sample filtration as required by OAC rule 3745-54-97(D)(3)(f)?	Y				RFI Work Plan SWGM Plan	

Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97

02/01/01

Section 10. Con't. SAP - Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97		Y/N	NA	Vio	Def	Pg	Rmk
10-46	Did the SAP contain procedures and techniques for sample preservation as required by OAC rule 3745-54-97(D)(3)(e), including whether samples for the following analyses are field acidified to pH <2 with HNO_3: Sodium, Total metals, Dissolved Metals, Mercury, Endrin, Lindane, Methoxychlor, Toxaphene, 2,4 D, 2,4,5 TP Silvex, Radium, Gross Alpha and Beta?	Y				RFI Work Plan SWGM Plan QAPP	
10-47	Did the SAP contain procedures and techniques for sample preservation as required by OAC rule 3745-54-97(D)(3)(e), including whether samples for the following analyses are field acidified to pH <2 with H_2SO_4? Phenols, Oil and grease, ammonia, Nitrate/Nitrite?	Y				RFI Work Plan SWGM Plan QAPP	
10-48	Did the SAP contain procedures and techniques for sample preservation as required by OAC rule 3745-54-97(D)(3)(e), including whether the sample for TOC analysis is field acidified to pH <2 with HCl ?	Y				RFI Work Plan SWGM Plan QAPP	
10-49	Did the SAP contain procedures and techniques for sample preservation as required by OAC rule 3745-54-97(D)(3)(e), including whether the sample for TOX analysis is preserved with 1 ml of 1.1 M sodium sulfite?	Y				RFI Work Plan SWGM Plan QAPP	
10-50	Did the SAP contain procedures and techniques for sample preservation as required by OAC rule 3745-54-97(D)(3)(e), including whether the sample for cyanide analysis is preserved with NaOH to pH >12?	Y				RFI Work Plan SWGM Plan QAPP	
10-51	Did the SAP contain procedures and techniques for sample shipment as required by OAC rule 3745-54-97(D)(3)(g)?	Y				RFI Work Plan SWGM Plan QAPP	
10-52	Did the SAP contain procedures and techniques for performing field analysis, including: Procedures and forms for recording raw data as required by OAC rule 3745-54-97(D)(4)(a), including: **Maintaining a field logbook** containing: Monitoring program?	Y				RFI Work Plan SWGM Plan QAPP	
10-53	Locations/identification numbers of well(s) monitored?	Y				RFI Work Plan SWGM Plan	
10-54	Total depth of each well?	Y				RFI Work Plan SWGM Plan	
10-55	Static water level depth and measurement technique?	Y				RFI Work Plan SWGM Plan	
10-56	Presence of immiscible layers and detection method?	Y				RFI Work Plan	
10-57	Collection method for immiscible layers and sample identification numbers?	N				RFI Work Plan Immiscible layers are not consistently present in any one well. Immiscible layers are not present in the lagoon point of compliance wells.	
10-58	Well purging procedures and requirements?	Y				RFI Work Plan SWGM Plan	

Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97

02/01/01

Section 10. Con't. SAP - Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97		Y/N	NA	Vio	Def	Pg	Rmk
10-59	Sample withdrawal procedure?	Y				RFI Work Plan SWGM Plan	
10-60	Date and time of sample collection?	Y				RFI Work Plan SWGM Plan	
10-61	Well sampling sequence?	Y				RFI Work Plan SWGM Plan	
10-62	Types of sample containers and sample identification number(s)?	Y				RFI Work Plan SWGM Plan QAPP	
10-63	Preservative(s) used?	Y				RFI Work Plan SWGM Plan QAPP	
10-64	Internal temperature of shipping containers?	Y				RFI Work Plan SWGM Plan QAPP	
10-65	Parameters requested?	Y				RFI Work Plan SWGM Plan QAPP	
10-66	Field analysis data and method(s)?	Y				RFI Work Plan SWGM Plan QAPP	
10-67	Sample distribution in containers and transporter?	Y				RFI Work Plan SWGM Plan QAPP	
10-68	Field Observations/ sample appearance?	Y				RFI Work Plan SWGM Plan QAPP	
10-69	Unusual well recharge rates?	Y				RFI Work Plan SWGM Plan	
10-70	Equipment malfunction(s)?	Y				RFI Work Plan SWGM Plan QAPP	
10-71	Possible sample contamination?	Y				RFI Work Plan SWGM Plan QAPP	

Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97

02/01/01

Section 10. Con't. SAP - Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97		Y/N	NA	Vio	Def	Pg	Rmk
10-72	Sampling rate?	Y				RFI Work Plan SWGM Plan QAPP	
10-73	Any deviations from the SAP and why modifications were necessary?	Y				RFI Work Plan SWGM Plan QAPP	
10-74	Field team members?	Y				RFI Work Plan SWGM Plan QAPP	
10-75	Climatic conditions?	Y				RFI Work Plan SWGM Plan	
10-76	Does a copy of the log remain on-site as part of the owner/operator's groundwater monitoring operating record?	Y				RFI Work Plan SWGM Plan QAPP Project files are maintained at the facility. Historic files are kept in a secured off-site storage location.	
	Does the SAP specify that the following chemically unstable parameters, if applicable, will be measured in the field: pH, temperature, specific conductivity, redox potential, chlorine, dissolved oxygen, and turbidity?	Y				RFI Work Plan SWGM Plan QAPP Chlorine and turbidity are not regularly monitored.	
10-78	Does the SAP specify that in-situ determinations are made after well evacuation and before sample removal?	Y				RFI Work Plan SWGM Plan	
10-79	Does the SAP specify whether in-situ samples are drawn from split portions?	N				RFI Work Plan SWGM Plan	
10-80	Does the SAP specify whether pH and specific conductivity were measured immediately upon collection?	Y				RFI Work Plan SWGM Plan	
10-81	Did the SAP contain procedures and techniques for calibration methods as required by OAC rule 3745-54-97(D)(4)(b), including: calibration of field instruments according to manufacturer's specifications?	Y				RFI Work Plan SWGM Plan QAPP	
10-82	Documentation of date, procedure, and maintenance for equipment calibration in the field logbook?	Y				RFI Work Plan SWGM Plan QAPP	
10-83	Did the SAP contain procedures and techniques for sample filtration as required by OAC rule 3745-54-97(D)(4)(c)) including: Handling of organic samples without filtering?	Y				RFI Work Plan SWGM Plan QAPP	

Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97

02/01/01

ion 10. Con't. SAP - Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97		Y/N	NA	Vio	Def	Pg	Rmk
10-84	Filtering the sample for dissolved metals through a 0.45 micron filter?	Y				RFI Work Plan SWGM Plan QAPP	
10-85	Did the SAP contain procedures and techniques for decontamination as required by OAC rule 3745-54-97(D)(5)) including: Decontamination to prevent cross-contamination during filtering?	Y				RFI Work Plan SWGM Plan QAPP	
10-86	Decontaminating the measuring equipment between well locations to prevent cross contamination?	Y				RFI Work Plan SWGM Plan QAPP	
10-87	Whether sampling equipment will be disassembled and thoroughly cleaned between sampling of individual wells?	Y				RFI Work Plan SWGM Plan QAPP	
10-88	Whether the cleaning procedure for inorganic analysis will include the following sequential steps: Nonphosphate detergent wash, potable water rinse, dilute 10% hydrochloric/nitric acid rinse, and deionized water rinse?	N				RFI Work Plan and QAPP SWGM Plan Sample containers are pre-cleaned by the laboratory. The equipment decontamination SOP will be followed.	
10-89	Whether the cleaning procedure for organic analysis will include: Nonphosphate detergent wash, potable water rinse, solvent-pesticide grade isopropanol, acetone, methanol or hexane rinse, and a distilled/deionized water rinse?	N				RFI Work Plan and QAPP SWGM Plan Sample containers are pre-cleaned by the laboratory. The equipment decontamination SOP will be followed.	
10-90	Whether the sampling equipment will be thoroughly dry before use?	Y				RFI Work Plan SWGM Plan	
10-91	Did the SAP contain procedures and techniques for disposal of purge water as required by OAC rule 3745-54-97(D)(6)?	Y				RFI Work Plan SWGM Plan	
10-92	Did the SAP contain procedures and techniques that the purge water be containerized until evaluated and disposed in an environmentally acceptable method according to the requirements of Ohio EPA?	N				RFI Work Plan SWGM Plan Purge water from the lagoon wells is not containerized because it does not require treatment. Purge water from the Former Oil House Area and the Waste Pile/Staging Area are treated at the on-site wastewater treatment plant.	
10-93	Did the SAP include discussions if normal detection monitoring indicates that the groundwater is not contaminated: whether the purge water will containerized?	Y				RFI Work Plan SWGM Plan Purge water from the lagoon wells is not containerized because it does not require treatment. Purge water from the Former Oil House Area and the Waste Pile/Staging Area are treated at the on-site wastewater treatment plant.	

Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97

02/01/01

Section 10.	Con't. SAP - Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97	Y/N	NA	Vio	Def	Pg	Rmk
10-94	Whether it will be disposed of properly?	Y				RFI Work Plan SWGM Plan QAPP Purge water from the lagoon wells is not containerized because it does not require treatment. Purge water from the Former Oil House Area and the Waste Pile/Staging Area are treated at the on-site wastewater treatment plant.	
10-95	If monitoring has indicated that the purged ground water exhibits constituent concentrations above ambient/natural quality did the SAP discuss whether it would be managed as a wastewater or hazardous waste?	Y				RFI Work Plan SWGM Plan QAPP Purge water from the lagoon wells is not containerized because it does not require treatment. Purge water from the Former Oil House Area and the Waste Pile/Staging Area are treated at the on-site wastewater treatment plant.	
10-96	If contaminated, did the SAP discuss whether the purge water would be stored, treated, and disposed of as though it were a hazardous waste?	Y	-			RFI Work Plan SWGM Plan QAPP Purge water from the lagoon wells is not containerized because it does not require treatment. Purge water from the Former Oil House Area and the Waste Pile/Staging Area are treated at the on-site wastewater treatment plant.	
10-97	Did the SAP include a discussion of the sample analysis including: A list of all site-specific applicable constituents associated with the facility as required by OAC rule 3745-54-97(D)(7)(a)?	Y				SWGM Plan RFI Work Plans and Reports	
10-98	The analytical method for each constituent as required by OAC rule 3745-54-97(D)(7)(b)?	Y				RFI Work Plan SWGM Plan QAPP	
10-99	Methods using the lowest detection limit as listed in the most recent SW-846?	Y				QAPP	
10-100	The detection limit for each parameter as required by OAC rule 3745-54-97(D)(7)(b)?	Y				QAPP	
10-101	Detection limits less than or equal to the MCL for each constituent?	Y				QAPP	
10-102	Sample holding times for each parameter as required by OAC rule 3745-54-97(D)(7)(c)?	Y				QAPP	
10-103	Did the SAP include discussions of Quality Assurance/Quality Control as required by OAC rule 3745-54-97(D)(8), including: Whether the generated data is ensured by a QA/QC program?	Y				QAPP	
10-104	Does the QA/QC program include documentation of any deviation from approved procedures?	Y				QAPP	

Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97

02/01/01

Section 10.	Con't. SAP - Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97	Y/N	NA	Vio	Def	Pg	Rmk
10-105	Did the SAP include discussions of the following under OAC rule 3745-54-97(D)(8)(a)): Equipment or field blanks?	Y				QAPP	
10-106	Trip blanks?	Y				QAPP	
10-107	Lab blanks?	Y				QAPP	
10-108	Are the correct number of the following to be taken? Equipment or field blanks? (one for each day)	N				QAPP Rinseate blanks are collected for every 10 analytical samples.	
10-109	Trip blanks? (one for each day)	Y				QAPP Trip blanks are collected one per cooler of VOCs.	
10-110	Lab blanks? (one for each run)	Y				QAPP	
10-111	Did the SAP include discussions of whether duplicate samples be taken as required by OAC rule 3745-54-97(D)(8)(b)?	Y				QAPP	
10-112	Did the SAP include discussions of whether standards will be run?	Y				QAPP	
10-113	Did the SAP include discussions of whether any spiked samples be required?	Y				QAPP	
10-114	Did the SAP include discussions of potential lab interferences as required by OAC rule 3745-54-97(D)(8)(c)?	Y				QAPP	
10-115	If the lab is unable to obtain an analytical measurement for any constituent or parameter did the owner/operator's SAP discuss procedures for sampling matrix interferences?	N				QAPP Matrix interference has not been an issue at the lagoon wells.	
10-116	Was a statement provided in the SAP that QA/QC samples will not be used to correct data?	N				QAPP Matrix interference has not been an issue at the lagoon wells.	
10-117	Was a statement provided in the SAP that that only approved statistical QA/QC methods be used?	Y				QAPP	
10-118	Did the SAP discuss how and who will be critically examining the data to ensure it has been properly calculated and reported?	Y				QAPP	
10-119	Did the SAP include discussions of Chain of Custody /Sample Analysis Request Sheet Procedures including: Standardized field tracking reporting forms to establish sample custody for the field prior to and during shipping as required by OAC rule 3745-54-97(D)(9)(a)?	Y				QAPP	
10-120	Did the SAP discuss whether the chain-of custody/sample analysis request sheet would be included with the sample?	Y				QAPP	
10-121	Did the SAP discuss whether the chain-of-custody/sample request sheet will include the following: Sample number?	Y				QAPP	
10-122	Signature of collector?	Y				QAPP	
10-123	Date and time of sample collection?	Y				QAPP	
10-124	Sample type?	Y				QAPP	
10-125	Well ID (or other sample location)?	Y				QAPP	

Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97

02/01/01

Section 10.	Con't. SAP - Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97	Y/N	NA	Vio	Def	Pg	Rmk
10-126	Identification of duplicates?	Y				QAPP	
10-127	Number of containers?	Y				QAPP	
10-128	Parameters requested?	Y				QAPP	
10-129	Preservatives used?	Y				QAPP	
10-130	Analysis to be performed?	Y				QAPP	
10-131	Signatures of persons involved in chain-of-custody?	Y				QAPP	
10-132	Inclusive dates and times of custody?	Y				QAPP	
10-133	Internal temperature of shipping container when samples were sealed?	N				QAPP	
10-134	Internal temperature of shipping container upon opening at laboratory?	Y				QAPP	
10-135	Did the SAP discuss whether sample seals will be placed on shipping containers to ensure samples are not altered?	Y				QAPP	
10-136	Did the SAP discuss how the chain-of-custody/sample request forms will help prevent: Misidentification of the samples?	Y				QAPP	
10-137	How they will allow easy tracking of possession?	Y				QAPP	
10-138	Did the SAP discuss whether the labels will contain all the information necessary for effective sample tracking as required by OAC rule 3745-54-97(D)(9)(b), including: Sample identification number?	Y				QAPP	
10-139	Name of collector?	Y				QAPP	
10-140	Date and time of collection?	Y				QAPP	
10-141	Place of collection (well or other location)?	Y				QAPP	
10-142	Parameter(s) requested?	Y				QAPP	
10-143	Preservative used?	Y				QAPP	
10-144	Did the SAP discuss whether the sample labels will remain legible even if wet?	Y				QAPP	
10-145	Does the ground water monitoring program include sampling and analytical methods that are appropriate for ground water sampling as required by OAC rule 3745-54-97(E)?	Y				RFI Work Plan SWGM Plan QAPP	
10-146	Does the ground water monitoring program include sampling and analytical methods that accurately measure hazardous constituents in the ground water as required by OAC rule 3745-54-97(E)?	Y				RFI Work Plan SWGM Plan QAPP	
10-147	Was the surface elevation measured each time ground water is sampled as required by OAC rule 3745-54-97(F)?	Y				RFI Work Plan SWGM Plan	

Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97

02/01/01

ion 11. Background Determinations OAC rule 3745-54-97(G)		Y/N	NA	Vio	Def	Pg	Rmk
11-1	Has data on each constituent specified in the permit/plan been collected from each background well and each well at the compliance point? OAC rule 3745-54-97(G)	Y				Lagoon Annual and Quarterly Reports RFI Reports SWGM Plan	
11-2	Are the number and kinds of samples collected to establish background appropriate for the form of statistical test employed, following generally accepted statistical principles? OAC rule 3745-54-97(G)	Y				Lagoon Annual and Quarterly Reports RFI and Baseline Risk Assessment Reports SWGM Plan, Sec. 4.0	
11-3	Is the sample size as large as necessary to ensure with reasonable confidence that a contaminant release to ground water from a facility will be detected? OAC rule 3745-54-97(G)	Y				Lagoon Annual and Quarterly Reports SWGM Plan, Sec. 3.0 and 4.0	
11-4	Has the owner/operator followed (as specified in the permit/plan) the appropriate sampling procedure and interval for each hazardous constituent listed in the facility permit? OAC rule 3745-54-97(G)		√			The facility does not have a permit, in lieu of a permit, the corrective action order serves as the enforceable document.	
11-5	Were at least four independent samples taken for each constituent from each well? OAC rule 3745-54-97(G)(1)	Y				Lagoon Annual and Quarterly Reports RFI Reports SWGM Plan, Sec. 2.0 and 3.0	
11-6	Has an alternate sampling procedure been proposed and approved in the permit/plan that takes into account the uppermost aquifer's effective porosity, hydraulic conductivity and hydraulic gradient and the fate and transport characteristics of the potential contaminants? OAC rule 3745-54-97(G)(2)	Y				Lagoon Annual and Quarterly Reports RFI Reports SWGM Plan, Sec. 2.0, 3.0, 4.0 IM/CM Report	
Section 12. Statistics for Part B GWM OAC rules 3745-54-97(H, I, & J)		**Y/N**	**NA**	**Vio**	**Def**	**Pg**	**Rmk**
12-1	For each constituent in each well, was a statistical method, protective of human health and the environment, followed as specified in the permit/plan? OAC rule 3745-54-97(H)	N				SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evaluated on a site-wide basis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	
12-2	Will the tests be conducted separately for each hazardous constituent in each well? OAC rule 3745-54-97(H)		√			SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evaluated on a site-wide basis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	

Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97

02/01/01

Section 12.	Con't. Statistics for Part B GWM OAC rules 3745-54-97(H, I, & J)	Y/N	NA	Vio	Def	Pg	Rmk
12-3	Were any PQLs proposed by the owner/operator and approved by the Director? OAC rule 3745-54-97(H)		√			SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evaluated on a site-wide basis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	
12-4	Do each of the chosen statistical methods comply with the performance standards listed in OAC rule 3745-54-97(I)?		√			SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evaluated on a site-wide basis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	
12-5	If a parametric ANOVA was used, did the method include estimation and testing of the contrasts between each compliance well's mean and the background mean levels for each constituent? OAC rule 3745-54-97(H)(1)		√			SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evaluated on a site-wide basis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	
12-6	If ANOVA based on ranks was used, did the method include estimation and testing of the contrasts between each compliance well's median and the background median levels for each constituent? OAC rule 3745-54-97(H)(2)		√			SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evaluated on a site-wide basis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	
12-7	If a tolerance/prediction intervals were used, was the interval based on the distribution of the background data and was the level of each constituent compared to the upper tolerance or prediction limit? OAC rule 3745-54-97(H)(3)		√			SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evaluated on a site-wide basis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	

Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97

02/01/01

Section 12.	Con't. Statistics for Part B GWM OAC rules 3745-54-97(H, I, & J)	Y/N	NA	Vio	Def	Pg	Rmk
12-8	If control charts were used, was a control limit set for each constituent? OAC rule 3745-54-97(H)(4)		√			SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evaluated on a site-wide basis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	
12-9	If another statistical test method was presented, was it approved by the Director? OAC rule 3745-54-97(H)(5)		√			SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evaluated on a site-wide basis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	
12-10	Were the statistical methods chosen appropriate for the distribution of each constituent? OAC rule 3745-54-97(I)(1)		√			SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evaluated on a site-wide basis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	
12-11	With the exception of tolerance, prediction intervals and control charts: Was the Type 1 experimentwise error (false positive) for individual well comparisons no less than .01 for each testing period? OAC rule 3745-54-97(I)(2)		√			SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evaluated on a site-wide basis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	
12-12	Was the Type 1 experimentwise error for multiple comparisons procedures no less than .05 per period? OAC rule 3745-54-97(I)(2)		√			SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evaluated on a site-wide basis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	

Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97

02/01/01

Section 12. Con't. Statistics for Part B GWM OAC rules 3745-54-97(H, I, & J)		Y/N	NA	Vio	Def	Pg	Rmk
12-18	Data distribution? OAC rule 3745-54-97(I)(4)		√			SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evaluated on a site-wide basis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	
12-19	Range of concentration values for each constituent of concern? OAC rule 3745-54-97(I)(4)		√			SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evaluated on a site-wide basis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	
12-20	Does the statistical method chosen for each parameter account for data below the detection limit? OAC rule 3745-54-97(I)(5)		√			SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evaluated on a site-wide basis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	
12-21	If a PQL is used, is it the lowest concentration level that could reliably be achieved during routine laboratory operating procedures? OAC rule 3745-54-97(I)(5)		√			SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evaluated on a site-wide basis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	
12-22	Were proper procedures employed, if necessary, to control or correct for: Seasonal variability? OAC rule 3745-54-97(I)(6)		√			SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evaluated on a site-wide basis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	

Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97

02/01/01

Section 12. Con't. Statistics for Part B GWM OAC rules 3745-54-97(H, I, & J)		Y/N	NA	Vio	Def	Pg	Rmk
12-23	Spatial variability? OAC rule 3745-54-97(I)(6)		√			SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evaluated on a site-wide basis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	
12-24	Temporal correlations? OAC rule 3745-54-97(I)(6)		√			SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evaluated on a site-wide basis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	
12-25	Is all ground water monitoring data maintained at the facility as part of the operating record? OAC rule 3745-54-97(J)	Y				RFI Work Plan Project files are maintained at the Moraine facility and historic files are kept in a secured off-site storage location.	
12-26	Has all data been submitted to the Agency for review per the permit/plan schedule? OAC rule 3745-54-97(J)	Y				RFI Reports IM/CM Report DOCC and Supplemental DOCC	

Section 13. General Operating Record Requirements OAC rules 3745-54-73 (A), (B)(5&6), and 74(A&B)		Y/N	NA	Vio	Def	Pg	Rmk
13-1	Does the plan specify that a written operating record is kept at the facility as required by OAC rule 3745-54-73(A)?	Y				RFI Work Plan QAPP Project files are maintained at the Moraine facility, GM headquarters in Troy, Michigan, and the ARCADIS Columbus, Ohio office. Historic files are kept in a secured off-site storage location.	
13-2	Will the operating record contain the results from the last three years of all inspections required under OAC rule 3745-54-15(D) as required by OAC rule 3745-54-73(B)(5)?	Y				RFI Work Plan QAPP Project files are maintained at the Moraine facility, GM headquarters in Troy, Michigan, and the ARCADIS Columbus, Ohio office. Historic files are kept in a secured off-site storage location.	

Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97

02/01/01

Section 13. Con't. General Operating Record Requirements OAC rules 3745-54-73 (A), (B)(5&6), and 74(A&B)		Y/N	NA	Vio	Def	Pg	Rmk
13-3	Will all records, including plans, be furnished upon request and made available at all reasonable times for inspection by Ohio EPA as required by OAC rule 3745-54-74(A)?	Y				Project files are maintained at the Moraine facility, GM headquarters in Troy, Michigan, and the ARCADIS Columbus, Ohio office. Historic files are kept in a secured off-site storage location. Records can be furnished upon request.	
13-4	If the facility has been sold and the new owner assumed responsibility for monitoring, will the records remain onsite?		√			The facility is owned by GM.	
13-5	If the facility is closed and no data storage areas are operational, will the information be available if requested for any inspection?		√			The GM Moraine facilities are active.	
13-6	Will all records for monitoring, corrective action, and all other records be kept until closure of the facility? OAC rule 3745-54-74(B)	Y				RFI Work Plan QAPP Project files are maintained at the Moraine facility, GM headquarters in Troy, Michigan, and the ARCADIS Columbus, Ohio office. Historic files are kept in a secured off-site storage location.	
13-7	Was the record retention period extended due to enforcement action? OAC rule 3745-54-74(B)		√			There have been no enforcement actions.	
13-8	Does the plan say that the following records will be available during inspections as required by OAC rule 3745-54-73(B)(6)? Results of sampling (including lab sheets) for all required parameters according to OAC rules 3745-55-02(A&B)(2)?	Y				RFI Work Plan QAPP Project files are maintained at the Moraine facility, GM headquarters in Troy, Michigan, and the ARCADIS Columbus, Ohio office. Historic files are kept in a secured off-site storage location.	
13-9	Results of annual Appendix IX sampling events as required by OAC rule 3745-55-02(B)(4)?	Y				RFI Work Plan QAPP Project files are maintained at the Moraine facility, GM headquarters in Troy, Michigan, and the ARCADIS Columbus, Ohio office. Historic files are kept in a secured off-site storage location.	
13-10	Groundwater surface elevations taken at the time of sampling for each well? OAC rule 3745-55-02(A&B)(1)	Y				RFI Work Plan QAPP Project files are maintained at the Moraine facility, GM headquarters in Troy, Michigan, and the ARCADIS Columbus, Ohio office. Historic files are kept in a secured off-site storage location.	

Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97

02/01/01

Section 13. Con't. General Operating Record Requirements OAC rules 3745-54-73 (A), (B)(5&6), and 74(A&B)		Y/N	NA	Vio	Def	Pg	Rmk
13-11	Annual determinations of groundwater flow rate and direction? OAC rule 3745-55-02(A)(3)	Y				RFI Work Plan QAPP Project files are maintained at the Moraine facility, GM headquarters in Troy, Michigan, and the ARCADIS Columbus, Ohio office. Historic files are kept in a secured off-site storage location.	
13-12	Evaluations of extent of contamination and effectiveness of corrective action? 55-01(D) or 55-02(B)(3)	Y				IM/CM Report SWGM Plan The site is not currently in corrective action per 3745-55-01 and 3745-55-02.	
13-13	All statistical comparisons for all parameters? OAC rule 3745-54-97(J) and 55-02(A)(4)	Y				IM/CM Report SWGM Plan A trend evaluation is proposed for the lagoons.	
13-14	Results of statistical comparisons for increased contamination? OAC rule 3745-55-02(B)(4)	Y				IM/CM Report SWGM Plan A trend evaluation is proposed for the lagoons.	
13-15	Results of statistical comparisons determining whether concentration limits have been exceeded? OAC rule 3745-55-02(B)(5)	Y				IM/CM Report SWGM Plan A trend evaluation is proposed for the lagoons.	
13-16	Any permit modifications related to establishing either a compliance or corrective action system that would include: Identification of any hazardous constituents identified in the ground water? OAC rule 3745-54-98(G)(4)		√			The facility does not have a permit, in lieu of a permit, the corrective action order serves as the enforceable document.	
13-17	Any proposed additions or changes to monitoring frequency, SAP procedures or methods, or statistics needed to establish either an assessment/compliance/corrective action ground water monitoring plan? OAC rule 3745-54-98(G)(4)(c)	Y				SWGM Plan Project files are maintained at the Moraine facility, GM headquarters in Troy, Michigan, and the ARCADIS Columbus, Ohio office. Historic files are kept in a secured off-site storage location.	
13-18	Any notices of intent to seek an ACL and any ACL demonstrations? OAC rule 3745-54-98(G)(4)(d)	Y				SWGM Plan Project files are maintained at the Moraine facility, GM headquarters in Troy, Michigan, and the ARCADIS Columbus, Ohio office. Historic files are kept in a secured off-site storage location.	

Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97

02/01/01

Section 13. Con't. General Operating Record Requirements OAC rules 3745-54-73 (A), (B)(5&6), and 74(A&B)		Y/N	NA	Vio	Def	Pg	Rmk
13-19	Notices of intent/demonstrations that a source other than the unit caused the contamination? OAC rule 3745-54-99(I)	Y				Interim Measures Work Plans IM/CM Report Project files are maintained at the Moraine facility, GM headquarters in Troy, Michigan, and the ARCADIS Columbus, Ohio office. Historic files are kept in a secured off-site storage location.	
13-20	Any engineering feasibility plans for corrective action programs? OAC rule 3745-54-99(H)(2)	Y				IM/CM Report Project files are maintained at the Moraine facility, GM headquarters in Troy, Michigan, and the ARCADIS Columbus, Ohio office. Historic files are kept in a secured off-site storage location.	
13-21	Current SAP? OAC rule 3745-54-97(D&E)	Y				SWGM Plan Project files are maintained at the Moraine facility, GM headquarters in Troy, Michigan, and the ARCADIS Columbus, Ohio office. Historic files are kept in a secured off-site storage location.	
13-22	Current Groundwater Monitoring Plan? OAC rule 3745-54-98, 99, 55-01	Y				SWGM Plan Project files are maintained at the Moraine facility, GM headquarters in Troy, Michigan, and the ARCADIS Columbus, Ohio office. Historic files are kept in a secured off-site storage location.	
13-23	A copy of the Ground Water Protection Standard?	Y				SWGM Plan Project files are maintained at the Moraine facility, GM headquarters in Troy, Michigan, and the ARCADIS Columbus, Ohio office. Historic files are kept in a secured off-site storage location.	
13-24	Copy of field logbook or notes? OAC rule 3745-54-97(D)(4)(a)	Y				SWGM Plan Project files are maintained at the Moraine facility, GM headquarters in Troy, Michigan, and the ARCADIS Columbus, Ohio office. Historic files are kept in a secured off-site storage location.	
13-25	Chain of Custody forms? OAC rule 3745-54-97(D)(9)(a)	Y				SWGM Plan Project files are maintained at the Moraine facility, GM headquarters in Troy, Michigan, and the ARCADIS Columbus, Ohio office. Historic files are kept in a secured off-site storage location.	

Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97

02/01/01

Section 14.	General Part B Reporting Requirements OAC rules 3745-54-75, 77(C), 90(A&B), and 55-02	Y/N	NA	Vio	Def	Pg	Rmk
14-1	Does the plan specify that the owner/operator will submit a copy of the annual report to the Director by March 1st?	Y				SWGM Plan, Sec. 5.0	
14-2	Will the owner/operator use the reporting form supplied by the Director?	Y				The supplemental groundwater form can be found on the OEPA web site.	
14-3	Will it contain a certification signed by the owner/operator that the report was accurate & complete? OAC 3745-54-75(J)	Y				SWGM Plan, Sec. 5.0	
14-4	Will it be complete as required by OAC rule 3745-54-75(F)?	Y				SWGM Plan, Sec. 5.0	
14-5	Does the plan specify that the 5 data files required will be accurate and complete: Facility dbf?	Y				SWGM Plan, Sec. 5.0	
14-6	Will the Wells dbf be accurate and complete?	Y				SWGM Plan, Sec. 5.0	
14-7	Will the Sampling dbf be accurate and complete?	Y				SWGM Plan, Sec. 5.0	
14-8	Will the Parameters dbf be accurate and complete?	Y				SWGM Plan, Sec. 5.0	
14-9	Will the GW Data dbf be accurate and complete?	Y				SWGM Plan, Sec. 5.0	
14-10	Will it include all the results of quarterly/semi-annual/annual sampling of indicator parameters, waste constituents or reaction products, or hazardous constituents specified in the ground water protection standard as specified in the permit/plan? OAC rule 3745-55-02(A&B)(2)	Y				SWGM Plan, Sec. 5.0	
14-11	Will it include all the results of annual Appendix IX sampling required under OAC rule 3745-54-99(H) for Compliance Monitoring? OAC rule 3745-55-02(B)(4)	Y				SWGM Plan, Sec. 5.0	
14-12	Were the statistics, if any, performed correctly?		√			SWGM Plan A trend evaluation is proposed for the lagoon wells.	
14-13	Does the plan specify that the report will include results of statistical tests determining whether a significant increase has occurred over the background values for any parameter or constituent specified in the permit/plan for Detection Monitoring? OAC rule 3745-55-02(A)(4)	Y				SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0	
14-14	Will it include results of statistical tests determining whether a significant increase has occurred over the concentration limit for any hazardous constituent specified in the permit/plan under OAC rule 3745-55-02(B)(5)?	Y				SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0	
14-15	Will Chain of Custody forms be included in the Annual Report?	Y				SWGM Plan, Sec. 5.0	
14-16	Will lab sheets be included in the submittal?	Y				SWGM Plan, Sec. 5.0	
14-17	Will dilution, spike, spike recovery % be included on the lab sheets?	Y				SWGM Plan, Sec. 5.0	
14-18	Will it include any data validation issues (qualifiers) such that the information provided may not be used for compliance requirements?	Y				SWGM Plan, Sec. 5.0	
14-19	Will method codes, detection limits and units of measurement be included in the report?	Y				SWGM Plan, Sec. 5.0	
14-20	Will all sample blanks and duplicates be identified?	Y				SWGM Plan, Sec. 5.0	
14-21	Will documentation be present of any parameter omissions during any sampling event?	Y				SWGM Plan, Sec. 5.0	

Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97

02/01/01

Section 14.	Con't. General Part B Reporting Requirements OAC rules 3745-54-75, 77(C), 90(A&B), and 55-02	Y/N	NA	Vio	Def	Pg	Rmk
14-22	Will the results of the evaluation of groundwater surface elevations be in map form including: Monitoring well locations in relation to the hazardous waste unit?	Y				SWGM Plan, Sec. 5.0	
14-23	Ground water surface elevations required under OAC rule 3745-54-97(F)? OAC rule 3745-55-02(A&B)	Y				SWGM Plan, Sec. 5.0	
14-24	Ground water flow rate and direction (with arrows) in the uppermost aquifer? OAC rule 3745-55-02(A&B)(3)	Y				SWGM Plan, Sec. 5.0	
14-25	Separate maps for separate zones monitored?	Y				SWGM Plan, Sec. 5.0	
14-26	A discussion of any response necessary to restore compliance with the up and downgradient monitoring well requirements?	Y				SWGM Plan, Sec. 5.0	
14-27	If ground water contamination has been determined: Were calculated or measured rates of migration included?	Y				SWGM Plan, Sec. 5.0 Baseline Risk Assessment	
14-28	Were supporting calculations submitted?	Y				SWGM Plan, Sec. 5.0	
14-29	Were there maps correctly delineating the extent of contamination?	Y				SWGM Plan, Sec. 5.0	
14-30	Were there separate maps for each zone monitored?	Y				SWGM Plan, Sec. 5.0	
14-31	Were there separate maps for each sampling event?	Y				SWGM Plan, Sec. 5.0	
14-32	Will all other reports otherwise required by OAC rules 3745-54-90 through 55-02 be submitted, complete and accurate, as required by OAC rule 3745-54-77(C)?	Y				SWGM Plan, Sec. 5.0	
14-33	Did the owner/operator submit an land treatment exemption request from GWM and demonstration due to OAC rule 3745-54-90(B)(3)?		√			GM did not submit an exemption request.	
14-34	Did the owner/operator submit an exemption request from GWM and demonstration due to no migration as specified in OAC rule 3745-54-90(B)(4)?		√			GM did not submit an exemption request.	
14-35	Did the owner/operator submit an exemption request from GWM and demonstration due to OAC rule 3745-54-90(B)(5)?		√			GM did not submit an exemption request.	
Section 15.	**Part B Operations & Maintenance Requirements (OAC rule 3745-54-15 & 54-33(B))**	**Y/N**	**NA**	**Vio**	**Def**	**Pg**	**Rmk**
15-1	Does the plan specify that the owner/operator will inspect the facility for malfunctions and deteriorations of monitoring equipment? OAC rule 3745-54-15(A)	Y				SWGM Plan, Sec. 5.0 RFI Work Plans	
15-2	Does the plan specify that these inspections will be conducted with such regularity as to be able to identify problems in time to correct them before such problems harm human health or the environment? OAC rule 3745-54-15(A)	Y				SWGM Plan, Sec. 5.0	
15-3	Does the plan include a written schedule for inspecting monitoring equipment? OAC rule 3745-54-15(B)(1)	Y				QAPP	
15-4	Does the written schedule contain an inventory of any facility-owned sampling and purging equipment including information on model/serial numbers used as part of the monitoring program? OAC rule 3745-54-15(B)(1)		√			The facility does not own the equipment. ARCADIS will maintain and inspect all equipment.	
15-5	Does the plan contain detailed operating, calibration, and maintenance procedures and schedules for each sampling device? OAC rule 3745-54-15(B)(1)	Y				QAPP	

Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97

02/01/01

Section 15. Con't. Part B Operations & Maintenance Requirements (OAC rule 3745-54-15 & 54-33(B))		Y/N	NA	Vio	Def	Pg	Rmk
15-6	Does the plan specify that the schedule will be kept at the facility and be available for review during the inspection? OAC rule 3745-54-15(B)(2)	Y				SWGM Plan, Sec. 5.0 QAPP	
15-7	Does the plan specify that the schedule will identify the types of problems (malfunctions or deterioration) to be looked for during the inspection? OAC rule 3745-54-15(B)(3)	Y				QAPP	
15-8	Is the frequency of the inspections based on possible equipment deterioration rates? OAC rule 3745-54-15(B)(4)	N				Regular equipment inspections will be conducted regardless of the age of the equipment.	
15-9	Does the plan include decision criteria to be used to replace or repair sampling equipment and/or monitoring wells? OAC rule 3745-54-15(B)(4)	Y				Only equipment that is in good working order will be brought to the site. Visual observations on monitoring well conditions will be made during each sampling event.	
15-10	Does the plan specify that the owner/operator will keep a log or summary of these inspections? OAC rule 3745-54-15(D)	Y				QAPP	
15-11	Does the plan specify that these logs will be kept for 3 years from the date of the inspection? OAC rule 3745-54-15(D)	Y				QAPP	
15-12	Does the plan specify that these logs will include: OAC rule 3745-54-15(D) and OAC rule 3745-54-33(B) Date and time of inspection?	Y				QAPP	
15-13	Name of the inspector? OAC rule 3745-54-15(D) and OAC rule 3745-54-33(B)	Y				QAPP	
15-14	Notation of observations? OAC rule 3745-54-15(D) and OAC rule 3745-54-33(B)	Y				QAPP	
15-15	Date and nature of any repairs or remedial actions? OAC rule 3745-54-15(D) and OAC rule 3745-54-33(B)	Y				QAPP	

SWGM Plan – Site-Wide Groundwater Monitoring Plan
IM/CM Report – Interim Measures/Corrective Measures Report
RFI Report – RCRA Facility Investigation Report
QAPP – Quality Assurance Project Plan
DOCC – Description of Current Condition
SOP – Standard Operating Procedures

Guidance Checklist for GW Monitoring under OAC rules 3745-54-90 through 97

02/01/01

Section 12.	Con't. Statistics for Part B GWM OAC rules 3745-54-97(H, I, & J)	Y/N	NA	Vio	Def	Pg	Rmk
12-13	If multiple well comparisons were used, were the individual well comparisons maintained at .01 experimentwise error for each testing period? OAC rule 3745-54-97(I)(2)		√			SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evaluated on a site-wide basis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	
12-14	If a control chart was used, was the specific type of control chart and its associated parameters specified in the permit/plan? OAC rule 3745-54-97(I)(3)		√			SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evaluated on a site-wide basis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	
12-15	If tolerance intervals were used, was the percentage of population contained in the interval protective of human health and the environment? OAC rule 3745-54-97(I)(3)		√			SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evaluated on a site-wide basis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	
12-16	If prediction intervals were used, were confidence levels protective of human health and the environment? OAC rule 3745-54-97(I)(4)		√			SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evaluated on a site-wide basis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	
12-17	Were the intervals based on: Number of samples in the background database? OAC rule 3745-54-97(I)(4)		√			SWGM Plan, Sec. 4.0 IM/CM Report, Sec. 2.0 Groundwater data will be evaluated on a site-wide basis with a trend evaluation performed on the downgradient lagoon wells. Approved methodologies in the baseline risk assessment will also be used to evaluate the data on a site-wide basis.	

Guidance Checklist for Detection GW Monitoring under OAC rule 3745-54-98

02/01/01

Guidance Checklist for Part B Detection Monitoring Program: OAC rule 3745-54-98							
ction 1. Parameters - OAC rule 3745-54-98(A)							
1-1	Does the plan indicate that the facility will be monitoring for all the indicator parameters, waste constituents and reaction products that will provide a reliable indication of the presence of hazardous constituents in the ground water based on: types/quantities/concentrations of constituents in wastes managed at the regulated unit? OAC rule 3745-54-98(A)(1)	Y				SWGM Plan Sec. 1.0, 2.0, 3.0, 4.0 IM/CM Report Sec. 2.0 RFI and Baseline Risk Assessment Reports Based on the findings of the RFI and Baseline Risk Assessment, monitoring will be conducted for the site-specific VOCs, which are appropriate parameters for evaluating potential releases on a site-wide basis.	
1-2	Mobility, stability, and persistence of waste constituents or their reaction products in the unsaturated zone beneath the waste management area? OAC rule 3745-54-98(A)(2)	Y				Closure Plan RFI and Baseline Risk Assessment Reports The waste is now solidified per the requirements of the Closure Plan.	
1-3	Detectability of indicator parameters/waste constituents/reaction products? OAC rule 3745-54-98(A)(3)	Y				SWGM Plan Sec. 1.0, 2.0, 3.0 IM/CM Report Sec. 2.0 RFI and Baseline Risk Assessment Reports The groundwater COCs have been fully delineated based on 18 years of lagoon monitoring and 10 years of corrective action monitoring. The COCs in groundwater are VOCs. The lagoon point of compliance wells are properly located to detect a release.	
1-4	Concentrations of values and coefficients of variation of proposed monitoring parameters or constituents in the ground water background? OAC rule 3745-54-98(A)(4)	Y				SWGM Plan Sec. 3.0 IM/CM Report Sec. 2.0 RFI and Baseline Risk Assessment Reports The site-specific parameter list appropriately includes VOCs as the upgradient COCs.	
1-5	Have all of these parameters been specified in the permit/plan? OAC rule 3745-54-98(A)	Y				SWGM Plan Sec. 1.0, 2.0, 3.0 IM/CM Report Sec. 2.0 The site-specific parameter list is defined in the SWGM Plan.	
Section 2. Wells OAC rule 3745-54-98(B)							
2-1	Does the plan include a monitoring system with wells installed at the compliance point?	Y				SWGM Plan Sec. 3.0 The wells include W-2-N, W-3-N, and W-4-N for the North Settling Lagoon and W-2-S, W-3-S, and W-4-S for the South Settling Lagoon.	

Guidance Checklist for Detection GW Monitoring under OAC rule 3745-54-98

02/01/01

Section 2. Con't. Wells OAC rule 3745-54-98(B)		Y/N	NA	Vio	Def	Pg	Rmk
2-2	Will the wells provide representative samples for water passing the compliance point?	Y				SWGM Plan IM/CM Report Sec. 2.0 RFI and Baseline Risk Assessment Reports Yes, if the data is evaluated on a site-wide basis.	
2-3	Does the plan specify how the wells will be properly maintained?	Y				SWGM Plan Sec. 3.0	
Section 3. Background Frequency of Sampling and Analysis OAC rule 3745-54-98(C&D)		**Y/N**	**NA**	**Vio**	**Def**	**Pg**	**Rmk**
3-1	Does the plan specify that records will be maintained of analytical/statistical/elevation data? OAC rule 3745-54-98(C)	Y				QAPP The site-wide QAPP details document holding times. Project files are maintained at the facility and historic files are kept in a secured off-site storage location.	
3-2	Does the permit/plan specify an appropriate ground water monitoring system be used to establish background values for each parameter including number and type of samples for each hazardous constituent appropriate for the statistical test employed? OAC rule 3745-54-98(D)	Y				SWGM Plan Sec. 3.0, 4.0 IM/CM Report Sec. 2.0 A trend evaluation is proposed for the lagoon wells.	
3-3	Does the permit/plan specify that a sequence of at least four samples from each well (background and compliance wells) must be collected at least semi-annually during detection monitoring? OAC rule 3745-54-98D	N				SWGM Plan Sec. 3.0, 4.0 IM/CM Report Sec. 2.0 The lagoon point of compliance wells will be sampled on an annual basis for the site-specific parameters.	
3-4	Or did the plan specify another sampling frequency to be approved by the Director? OAC rule 3745-54-98(D)	Y				SWGM Plan Sec. 3.0 IM/CM Report Sec. 2.0 Annual sampling is proposed.	
3-5	Does it specify that four samples will be collected at intervals assuring independence relative to the uppermost aquifer's effective porosity/hydraulic conductivity/gradient/fate/transport of contaminants? OAC rule 3745-54-98(D)	N				SWGM Plan Sec. 3.0 IM/CM Report Sec. 2.0 The lagoon point of compliance wells will be sampled on an annual basis for the site-specific parameters. However, historically data was collected quarterly for the North Settling Lagoon and semi-annually for the South Settling Lagoon.	
3-6	Does the plan specify the frequency for collection of all ground water samples? OAC rule 3745-54-98(D)	Y				SWGM Plan Sec. 3.0 IM/CM Report Sec. 2.0 Annual sampling is proposed.	
3-7	Does the plan specify the frequency for conducting statistical tests? OAC rule 3745-54-98(D)	Y				SWGM Plan Sec. 3.0, 4.0 IM/CM Report Sec. 2.0 A trend evaluation will be performed on the data on an annual basis.	

Guidance Checklist for Detection GW Monitoring under OAC rule 3745-54-98

02/01/01

Section 4. Sampling & Analysis Procedures OAC rules 3745-54-98(E&F)		Y/N	NA	Vio	Def	Pg	Rmk
4-1	Did the permit/plan include a documentation of proper sampling and analysis procedures including procedures and techniques for measuring ground water elevations according to OAC rule3745-54-97(D)?	Y				RFI Work Plans QAPP SWGM Plan Sec. 3.0 The groundwater monitoring program will be conducted following approved RFI protocols.	
4-2	Was the surface elevation to be measured each time ground water is sampled?	Y				SWGM Plan Sec. 3.0	
4-3	Did the permit/plan contain procedures for determining the ground water flow rate and direction at least annually in the uppermost aquifer? OAC rule 3745-54-98(E)	Y				SWGM Plan Sec. 3.0	
4-4	Did the plan specify that the ground water flow rate and direction in the uppermost aquifer would be determined at least annually? OAC rule 3745-54-98(E)	Y				SWGM Plan Sec. 3.0	
4-5	Did the permit/plan include methods for determining statistically significant increases for any monitored parameter specified in the permit/plan? OAC rule 3745-54-98(F)	N				SWGM Plan Sec. 4.0 IM/CM Report Sec. 2.0 A trend evaluation is proposed for the lagoon point of compliance wells.	
4-6	Did these methods compare data collected at the compliance point to the background well quality? OAC rule 3745-54-98(F)(1)	N				SWGM Plan Sec. 4.0 IM/CM Report Sec. 2.0 Comparison of upgradient versus downgradient groundwater quality is not appropriate without also evaluating site-wide conditions.	
4-7	Did the plan specify whether determinations of statistical significance are to be made within a reasonable period of time considering the complexity of the statistical test & the availability of labs to perform the analysis? OAC rule 3745-54-98(F)(2)	Y				SWGM Plan Sec. 4.0, 5.0 The trend evaluation will be completed in time to meet the March 1st deadline for the annual report.	
Section 5. Statistical Determinations and Response OAC rules 3745-54-98(E&F)		**Y/N**	**NA**	**Vio**	**Def**	**Pg**	**Rmk**
5-1	Does the plan specify what actions the owner/operator will take if hazardous constituents at any compliance point well show statistically significant evidence of contamination?	Y				SWGM Plan Sec. 4.0 IM/CM Report Sec. 2.0 If the closed lagoons are determined to be affecting groundwater quality, such effects will be evaluated as part of GM's comprehensive site-wide RCRA corrective action monitoring program on an annual basis. Consideration will be given to the need for further action for the lagoon(s) pursuant to OAC 3745-55-11 and - 011.	

Guidance Checklist for Detection GW Monitoring under OAC rule 3745-54-98

02/01/01

ection 5. Con't. Statistical Determinations and Response OAC rules 3745-54-98(E&F)		Y/N	NA	Vio	Def	Pg	Rmk
5-2	Does this include a written notice sent to the Director within seven days indicating which chemical parameter(s) or hazardous constituent(s)(s) have shown statistically significant evidence of contamination? OAC rule 3745-54-98(G)(1)	N				SWGM Plan Sec. 4.0, 5.0 IM/CM Report Sec. 2.0 Upon completion of data validation, the data evaluation will be conducted. If the data evaluation process concludes there is a concern, OEPA will be notified. Historical data at the lagoon point of compliance wells do not indicate this will be an issue.	
5-3	Does it include whether all wells will be immediately sampled for all Appendix IX constituents? OAC rule 3745-54-98(G)(2)	N				SWGM Plan Sec. 4.0, 5.0 IM/CM Report Sec. 2.0 Immediate resampling will be negotiated with OEPA after the data evaluation is complete.	
5-4	Does it include what the owner/operator will do if any compounds in Appendix IX are found during the resampling? OAC rule 3745-54-98(G)(3)	N				SWGM Plan Sec. 4.0, 5.0 IM/CM Report Sec. 2.0 The site-specific parameter list will be used for all groundwater sampling events.	
5-5	Does it include whether the owner/operator will resample those wells for those parameters within 1 month? OAC rule 3745-54-98(G)(3)	N				SWGM Plan Sec. 4.0, 5.0 IM/CM Report Sec. 2.0 Immediate resampling will be negotiated with OEPA after the data evaluation is complete.	
5-6	Does it include what actions the owner/operator will perform if the second analysis confirms the initial results?	N				SWGM Plan Sec. 4.0, 5.0 IM/CM Report Sec. 2.0 If the closed lagoons are determined to be affecting groundwater quality, such effects will be evaluated as part of GM's comprehensive site-wide RCRA corrective action monitoring program on an annual basis. Consideration will be given to the need for further action for the lagoon(s) pursuant to OAC 3745-55-11 and - 011.	
5-7	Does that plan specify that all of the confirmed Appendix IX parameters will be incorporated into the compliance monitoring parameter list? OAC rule 3745-54-98(G)(3)	N				SWGM Plan Sec. 4.0, 5.0 IM/CM Report Sec. 2.0 GM will assess the need to modify the number of wells that are sampled and the parameter list on an annual basis.	

Guidance Checklist for Detection GW Monitoring under OAC rule 3745-54-98

02/01/01

ection 5. Con't. Statistical Determinations and Response OAC rules 3745-54-98(E&F)		Y/N	NA	Vio	Def	Pg	Rmk
5-8	Does it also specify that if the owner/operator does not resample for Appendix IX parameters within 1 month, that the list of detected parameters from the first Appendix IX sampling will form the basis for the compliance ground water monitoring parameter list? OAC rule 3745-54-98(G)(3)	Y				SWGM Plan Sec. 4.0 and 5.0 IM/CM Report Sec. 2.0 The site-specific parameter list will be used for all groundwater sampling events. Additionally, GM will assess the need to modify the number of wells that are sampled and the parameter list on an annual basis.	
5-9	Does the plan specify that the owner/operator shall submit an application for a permit modification to the Director within 90 days of the original statistical trigger to establish a compliance ground water monitoring program? OAC rule 3745-54-98(G)(4)		√			The facility does not have a permit. In lieu of a permit, the enforceable document is the corrective action order.	
5-10	Does the plan specify that the permit modification application will include: Identification of the concentration of any constituent listed in Appendix IX detected in the ground water at each monitoring well at the compliance point? OAC rule 3745-54-98(G)(4)(a)		√			The facility does not have a permit. In lieu of a permit, the enforceable document is the corrective action order.	
5-11	Does the plan specify that the permit modification application will include any proposed changes to the ground water monitoring system necessary to meet the requirements a Compliance Ground Water Monitoring Program according to OAC rule 3745-54-99? OAC rule 3745-54-98(G)(4)(b)		√			The facility does not have a permit. In lieu of a permit, the enforceable document is the corrective action order.	
5-12	Does the plan specify that the permit modification application will include any proposed changes to the monitoring frequency, sampling, analysis procedures, or statistical method necessary to meet the requirements of a Compliance Monitoring Program according to OAC rule 3745-54-99? OAC rule 3745-54-98(G)(4)(c)		√			The facility does not have a permit. In lieu of a permit, the enforceable document is the corrective action order. GM will assess the need to modify the number of wells that are sampled and the parameter list on an annual basis.	
5-13	Does the plan specify that the permit modification application will include a proposed concentration limit (or notice of intent to seek an alternate concentration limit) for each hazardous constituent detected at the compliance point? OAC rule 3745-54-98(G)(4)(d)		√			The facility does not have a permit. In lieu of a permit, the enforceable document is the corrective action order. The corrective action completion strategy and remediation target levels are defined in the IM/CM Report and the SWGM Plan.	
5-14	Does the plan specify that within 180 days of the initial detection, the owner/operator will submit to the Director all data necessary to justify an ACL if one is to be sought? OAC rule 3745-54-98(G)(5)(a)	Y				SWGM Plan Sec. 5.0 Any proposed changes to the risk-based remediation target levels will be included in the annual report due on March 1st.	
5-15	Does the plan specify that if an ACL is to be sought whether each constituent that has an MCL has concentrations below that MCL? OAC rule 3745-54-98(G)(5)(b)(i)	N				SWGM Plan Sec. 4.0, 5.0 IM/CM Report Sec. 2.0 The corrective action completion strategy and risk-based remediation target levels are currently proposed.	
5-16	Does the plan specify if an ACL is to be sought whether the owner/operator applied for an ACL for every hazardous constituent identified during the Appendix IX sampling? OAC rule 3745-54-98(G)(5)(b)(ii)	N				SWGM Plan Sec. 5.0 IM/CM Report Sec. 2.0 Risk-based remediation target levels are proposed for the site-specific parameter list.	

Guidance Checklist for Detection GW Monitoring under OAC rule 3745-54-98

02/01/01

ction 5. Con't. Statistical Determinations and Response OAC rules 3745-54-98(E&F)		Y/N	NA	Vio	Def	Pg	Rmk
5-17	Does the plan specify that if either of the last two questions were answered "NO", that an engineering feasibility plan for corrective action shall be submitted within 180 days of the initial detection ? OAC rule 3745-54-98(G)(5)(b)	N				SWGM Plan Sec. 5.0 IM/CM Report Sec. 2.0 If the closed lagoons are determined to be affecting groundwater quality, such effects will be evaluated as part of GM's comprehensive site-wide RCRA corrective action monitoring program on an annual basis. Consideration will be given to the need for further action for the lagoon(s) pursuant to OAC 3745-55-11 and - 011.	
5-18	Does the plan specify that the owner/operator may chose to make a demonstration that a source other than the regulated unit caused the contamination or that the detection resulted from sampling, lab error, statistical evaluation or natural variation in the ground water? (Other Source Demonstration) OAC rule 3745-54-98(G)(6)	Y				SWGM Plan Sec. 4.0 IM/CM Report Sec. 2.0 The data will be assessed on a site-wide basis.	
5-19	Does the plan specify that the owner/operator may chose to make such a demonstration either in lieu of a permit modification or in addition to a permit modification? OAC rule 3745-54-98(G)(6)		√			The facility does not have a permit. In lieu of a permit, the enforceable document is the corrective action order.	
5-20	Does the plan specify that the Director will be notified that the owner/operator intends to make Another Source demonstration within 7 days of determining statistically significant evidence of contamination at the compliance point? OAC rule 3745-54-98(G)(6)(a)	N				SWGM Plan Sec. 4.0, 5.0 IM/CM Report Sec. 2.0 The annual sampling will be conducted in the fall and the data evaluation process completed in time to meet the March 1st deadline. This evaluation will include a site-wide assessment of groundwater quality and source areas.	
5-21	Does the plan specify that within 90 days of the confirmed statistical trigger, if the owner/operator intends to make Another Source demonstration he must submit a report to the Director demonstrating **successfully** that a source other than the regulated unit caused the contamination and that the demonstration may be based on an error in sampling? OAC rule 3745-54-98(G)(6)(b)	N				SWGM Plan Sec. 4.0, 5.0 IM/CM Report Sec. 2.0 The annual sampling will be conducted in the fall and the data evaluation process completed in time to meet the March 1st deadline. This evaluation will include a site-wide assessment of groundwater quality and source areas. A trend evaluation will be conducted on the lagoon point of compliance wells.	
5-22	Or error in lab analysis ? OAC rule 3745-54-98(G)(6)(b)	N				SWGM Plan Sec. 4.0, 5.0 QAPP Data validation will be performed on all data packages in accordance with the QAPP.	

Guidance Checklist for Detection GW Monitoring under OAC rule 3745-54-98

02/01/01

ction 5. Con't. Statistical Determinations and Response OAC rules 3745-54-98(E&F)		Y/N	NA	Vio	Def	Pg	Rmk
5-23	Or error in statistical evaluation? OAC rule 3745-54-98(G)(6)(b)	N				SWGM Plan Sec. 4.0, 5.0 IM/CM Report Sec. 2.0 The annual sampling will be conducted in the fall and the data evaluation process completed in time to meet the March 1st deadline. This evaluation will include a site-wide assessment of groundwater quality and source areas. A trend evaluation will be conducted on the lagoon point of compliance wells.	
5-24	Or natural variability in the ground water quality? OAC rule 3745-54-98(G)(6)(b)	N				SWGM Plan Sec. 4.0, 5.0 IM/CM Report Sec. 2.0 The annual sampling will be conducted in the fall and the data evaluation process completed in time to meet the March 1st deadline. This evaluation will include a site-wide assessment of groundwater quality and source areas. A trend evaluation will be conducted on the lagoon point of compliance wells.	
5-25	Does the plan specify that if the demonstration is not successful, a permit modification shall be submitted to make any changes in the Detection ground water monitoring program necessary to bring it back into compliance within the required 90 days? OAC rule 3745-54-98(G)(6)(c)		√			The facility does not have a permit. In lieu of a permit, the enforceable document is the corrective action order.	
5-26	Does the plan specify that throughout this period the owner/operator shall continue detection monitoring according to OAC rule 3745-54-98(G)(6)(d)?	Y				SWGM Plan Sec. 4.0, 5.0 IM/CM Report Sec. 2.0 Groundwater monitoring will be implemented for a minimum of 30 years, unless otherwise demonstrated that no further monitoring is warranted.	
5-27	Does the plan specify that if at any point the owner/operator determines that the detection monitoring program is not satisfying the regulations, that he/she will submit a permit modification to the Director within 90 days to make appropriate changes? OAC rule 3745-54-98(H)		√			The facility does not have a permit. In lieu of a permit, the enforceable document is the corrective action order.	
Section 6.	**Detection Reporting & Recordkeeping Requirements for Part B GWM OAC rules 3745-55-01(A&C)**	**Y/N**	**NA**	**Vio**	**Def**	**Pg**	**Rmk**
6-1	Does the plan specify that the owner/operator will keep records of the ground water monitoring information required by the detection monitoring program outlined in OAC rule 3745-54-98?	Y				SWGM Plan Sec. 5.0 QAPP Project files are maintained at the facility, GM headquarters in Troy, MI, and the ARCADIS Columbus, OH office. Historic files are kept in a secured off-site storage location.	
6-2	Will records be kept of: Ground water elevations under OAC rule 3745-54-97(F)? OAC rule 3745-55-02(A)(1)	Y				SWGM Plan Sec. 5.0 QAPP	
6-3	Semi-annual sampling results as required by OAC rule 3745-54-98(A)? OAC rule 3745-55-02(A)(2)	Y				SWGM Plan Sec. 5.0 QAPP	

Guidance Checklist for Detection GW Monitoring under OAC rule 3745-54-98

02/01/01

ction 6. Con't. Detection Reporting & Recordkeeping Requirements for Part B GWM OAC rules 3745-55-01(A&C)		Y/N	NA	Vio	Def	Pg	Rmk
6-4	Ground water flow rate & direction in the uppermost aquifer as required by OAC rule 3745-54-98(E)? OAC rule 3745-55-02(A)(3)	Y				SWGM Plan Sec. 5.0 QAPP	
6-5	Results of statistical tests as required by OAC rule 3745-54-98(G)? OAC rule 3745-55-02(A)(4)	Y				SWGM Plan Sec. 4.0, 5.0 IM/CM Report Sec. 2.0 QAPP	
6-6	Did the plan specify that an annual report would be submitted as required by OAC rule 3745-54-75 including all the above information in the form the Director makes available? OAC rule 3745-55-02(C)	Y				SWGM Plan Sec. 5.0	
6-7	Did the plan specify that the annual report would be submitted to the Director by March 1st of the following year? OAC rule 3745-54-75 & 3745-55-02(C)	Y				SWGM Plan Sec. 5.0	

SWGM Plan – Site-Wide Groundwater Monitoring Plan
IM/CM Report – Interim Measures/Corrective Measures Report
RFI Report – RCRA Facility Investigation Report
QAPP – Quality Assurance Project Plan

Appendix C

Boring Logs and Well Construction Logs for the Lagoon Wells

LOG OF BORING NO. W-2-N

GROUNDWATER MONITORING WELLS, HARRISON RADIATOR, DAYTON OPERATIONS, MORAINE, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 9-22-81

SURFACE ELEVATION: 729.68' **DATE COMPLETED:** 9-22-81

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
0.0'	(FILL) Asphalt and base				
1.0'	(FILL) Brown silt and sand, some gravel - moist				
7.0'	(ORIGINAL) Brown sand and gravel - moist				
10'					
20'					
30'	(Becomes wet at 32.0')				
40'					
50'					
60'	(continued on next page)				

METHOD: DRIVE CASING

TECHNICIAN: BARRETT

JOB NO.: 26418 (kab)

WATER OBSERVATIONS

INITIAL DEPTH: 32.0'

COMPLETION DEPTH: 32.0'

DEPTH AFTER: 24 HRS. 32.0'

TYPE SAMPLER:

____ A. SPLIT SPOON

____ B.

____ C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. W-2-N (second page)

GROUNDWATER MONITORING WELLS, HARRISON RADIATOR, DAYTON OPERATIONS, MORAINE, OHIO

BORING LOCATION As shown on boring location paln **DATE STARTED:** 9-22-81

SURFACE ELEVATION: 729.68' **DATE COMPLETED:** 9-22-81

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
60'	(continued)				
	Bottom of borin at 60.0'				
70'					
80'					
90'					
100'					
110'					
120'					

METHOD: DRIVE CASING

TECHNICIAN: BARRETT

JOB NO.: 26418 (kab)

WATER OBSERVATIONS

INITIAL DEPTH: 32.0'

COMPLETION DEPTH: 32.0'

DEPTH AFTER: 24 HRS. 32.0'

TYPE SAMPLER:

____ A. SPLIT SPOON

____ B.

____ C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF WELL NO. W-2-N

GROUNDWATER MONITORING WELLS, HARRISON RADIATOR,
DAYTON OPERATIONS, MORAINE, OHIO

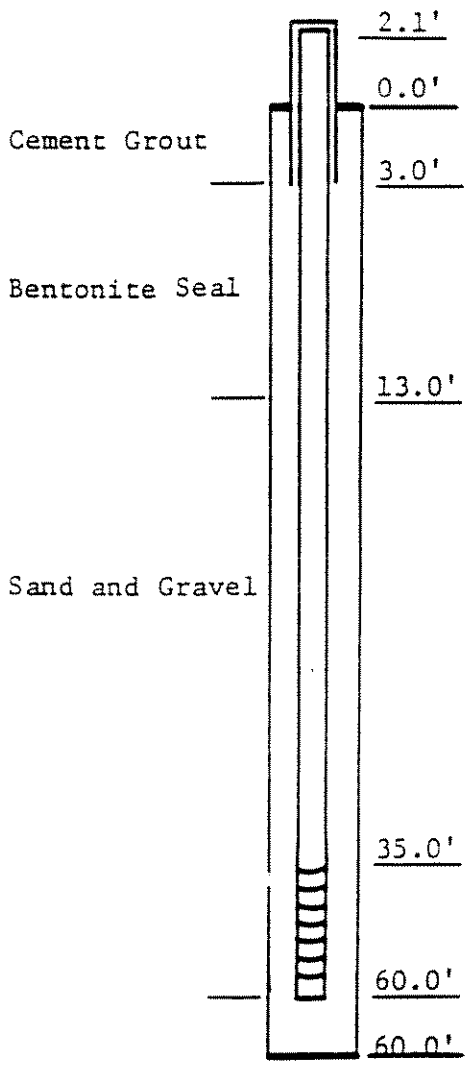
BORING LOCATION: As shown on boring location plan
DATE INSTALLED: 9-22-81

SURFACE ELEVATION: 729.68'
TOP OF PIPE ELEVATION: 731.77'*

TYPE OF PIEZOMETER: Monitoring Well - 4" Schedule 40 PVC Casing

DATE	WATER SURFACE DEPTH (FT.)	WATER SURFACE ELEV. (FT.)
9-28-81	32.0	697.7
10-5-81	32.7	697.0

INSTALLATION DESCRIPTION



TECHNICIAN BARRETT

JOB NO. 26418

NOTES: PVC screen length - 25 feet
Screen slot size - 0.010 inches
Guard pipe - 5" x 4' 2" black iron with locking cap
*Elevation given is top of guard pipe without cap

LOG OF BORING NO. W-3-N

GROUNDWATER MONITORING WELLS, HARRISON RADIATOR, DAYTON OPERATIONS, MORAINE, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 9-8-81

SURFACE ELEVATION: 731.98' **DATE COMPLETED:** 9-9-81

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
0.0'	Brown silt, trace of sand, trace of gravel - damp				
2.0'	Brown sand and gravel, trace of silt - damp				
10'					
20'					
	(Becomes wet at 25.5')				
30'					
40'					
50'					
60'	Bottom of boring at 57.0'				

METHOD: HOLLOW STEM AUGER

TECHNICIAN: CHRISTY

JOB NO.: 26418 (kab)

WATER OBSERVATIONS

INITIAL DEPTH: 25.5'

COMPLETION DEPTH: 25.5'

DEPTH AFTER 24 HRS. 26.0'

TYPE SAMPLER:

____ A. SPLIT SPOON

____ B.

____ C. SHELBY TUBE

BOWSER – MORNER

LOG OF WELL NO. W-3-N

GROUNDWATER MONITORING WELLS, HARRISON RADIATOR,
DAYTON OPERATIONS, MORAINE, OHIO

BORING LOCATION: As shown on boring location plan
DATE INSTALLED: 9-9-81

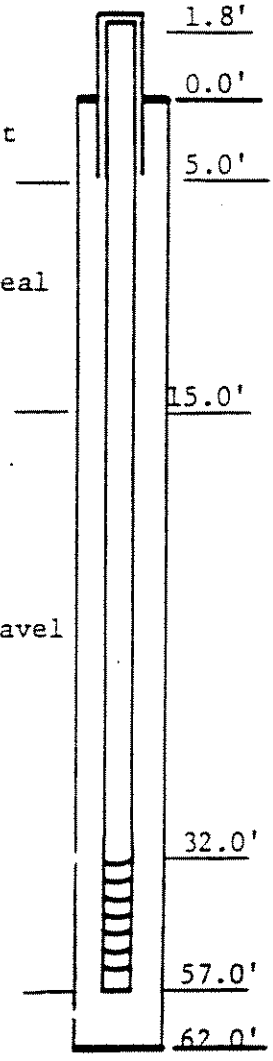
SURFACE ELEVATION: 731.98'
TOP OF PIPE ELEVATION: 733.82' *

TYPE OF PIEZOMETER:

DATE	WATER SURFACE DEPTH (FT.)	WATER SURFACE ELEV. (FT.)	
9-9-81	25.5	706.5	
9-10-81	26.0	706.0	
10-5-81	35.1	696.9	

INSTALLATION DESCRIPTION

DESCRIPTION	DEPTH (FT.)
	1.8'
	0.0'
Cement Grout	
	5.0'
Bentonite Seal	
	15.0'
Sand and Gravel	
	32.0'
	57.0'
	62.0'



TECHNICIAN CHRISTY

JOB NO. 26418

NOTES: PVC screen length - 25 feet
Screen slot size - 0.010 inches
Guard pipe - 5" x 4' 2" black iron with locking cap
*Elevation given in top of guard pipe without cap

LOG OF BORING NO. W-4-N

GROUNDWATER MONITORING WELLS, HARRISON RADIATOR, DAYTON OPERATIONS, MORAINE, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 9-10-81

SURFACE ELEVATION: 729.88' **DATE COMPLETED:** 9-10-81

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
0.0'	(FILL) Brown sand and gravel, some silt				
2.0'	(FILL) Brown clay, trace of sand, trace of gravel				
3.0'	(ORIGINAL) Brown sand and gravel, some cobbles, trace of silt				
10'					
20'					
30'	(Becomes wet at 32.0')				
40'					
50'					
60'	(continued on next page)				

METHOD: HOLLOW STEM AUGER

TECHNICIAN: CHRISTY

JOB NO.: 26418 (kab)

WATER OBSERVATIONS

INITIAL DEPTH: 32.0'

COMPLETION DEPTH: 26.5'

DEPTH AFTER: 24 **HRS.** 32.3'

TYPE SAMPLER:

____ A. SPLIT SPOON

____ B.

____ C. SHELBY TUBE

BOWSER – MORNER

LOG OF BORING NO. W-4-N (second page)

GROUNDWATER MONITORING WELLS, HARRISON RADIATOR, DAYTON OPERATIONS, MORAINE, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 9-10-81

SURFACE ELEVATION: 729.88' **DATE COMPLETED:** 9-10-81

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
60'	(continued)				
61.0'					
62.0'	Gray silt and clay - moist				
	Brown sand and gravel, trace of silt				
	Bottom of boring at 65.0'				
70'					
80'					
90'					
100'					
110'					
120'					

METHOD: HOLLOW STEM AUGER

TECHNICIAN: CHRISTY

JOB NO.: 26418 (kab)

WATER OBSERVATIONS

INITIAL DEPTH: 32.0'

COMPLETION DEPTH: 26.5'

DEPTH AFTER: 24 HRS. 32.3'

TYPE SAMPLER:

____ A. SPLIT SPOON

____ B.

____ C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF WELL NO. W-4-N

GROUNDWATER MONITORING WELLS, HARRISON RADIATOR,
DAYTON OPERATIONS, MORAINE, OHIO

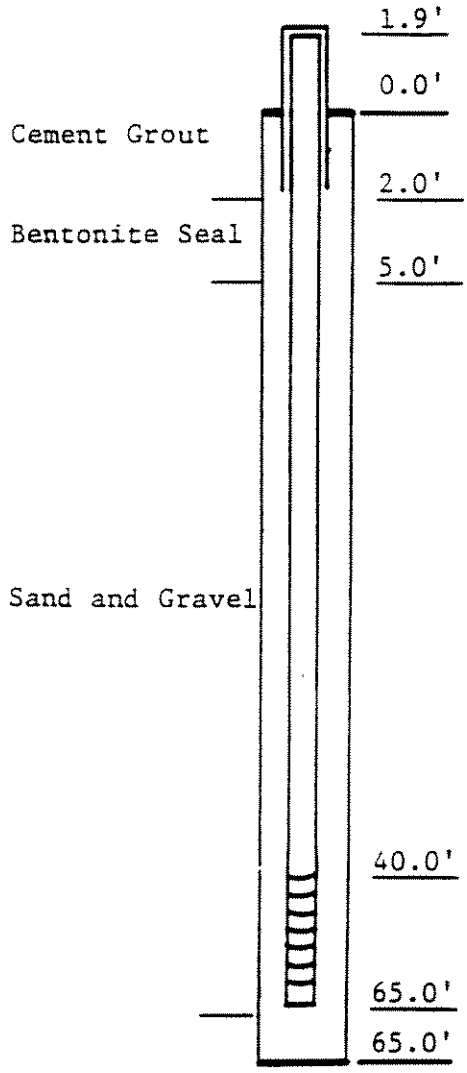
BORING LOCATION: As shown on boring location plan
DATE INSTALLED: 9-24-81

SURFACE ELEVATION: 729.88'
TOP OF PIPE ELEVATION: 731.78'*

TYPE OF PIEZOMETER: Monitor Well - 4" Schedule 40 PVC Casing

DATE	WATER SURFACE DEPTH (FT.)	WATER SURFACE ELEV. (FT.)
9-10-81	26.5	703.4
9-25-81	32.3	697.6
9-28-81	33.5	696.4
10-5-81	32.8	697.1

INSTALLATION DESCRIPTION



TECHNICIAN PATTERSON

JOB NO. 26418

NOTES: PVC screen length - 25 feet
Screen slot size - 0.010 inches
Guard pipe - 5" x 4' 2" black iron with locking cap
* Elevation given is top of guard pipe without cap

LOG OF BORING NO. W-2-S

GROUNDWATER MONITORING WELLS, HARRISON RADIATOR, DAYTON OPERATIONS, MORAINE, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 9-18-81

SURFACE ELEVATION: 725.01' **DATE COMPLETED:** 9-21-81

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
0.0'	Brown clay, trace of sand, trace of gravel				
3.0'	Brown sand and gravel - damp				
10'					
20'					
30'					
	(Becomes wet at 35.5')				
40'					
50'					
60'					
	(continued on next page)				

METHOD: DRIVE CASING

TECHNICIAN: PATTERSON

JOB NO.: 26418 (kab)

WATER OBSERVATIONS

INITIAL DEPTH: 35.0'

COMPLETION DEPTH: 34.5'

DEPTH AFTER: 24 HRS. 35.3'

TYPE SAMPLER:

____ A. SPLIT SPOON

____ B.

____ C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. W-2-S

GROUNDWATER MONITORING WELLS, HARRISON RADIATOR, DAYTON OPERATIONS, MORAINE, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 9-18-81

SURFACE ELEVATION: 725.01' **DATE COMPLETED:** 9-21-81

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
60'	(continued)				
63.0'	Gray silt, trace of clay - moist				
64.0'	Brown sand and gravel - wet				
	Bottom of boring at 65.0'				
70'					
80'					
90'					
100'					
110'					
120'					

METHOD: DRIVE CASING

TECHNICIAN: PATTERSON

JOB NO.: 26418 (kab)

WATER OBSERVATIONS

INITIAL DEPTH: 35.0'

COMPLETION DEPTH: 34.5'

DEPTH AFTER: 24 HRS. 35.3'

TYPE SAMPLER:

____ A. SPLIT SPOON

____ B.

____ C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF WELL NO. W-2-S

GROUNDWATER MONITORING WELLS, HARRISON RADIATOR,
DAYTON OPERATIONS, MORAINE, OHIO

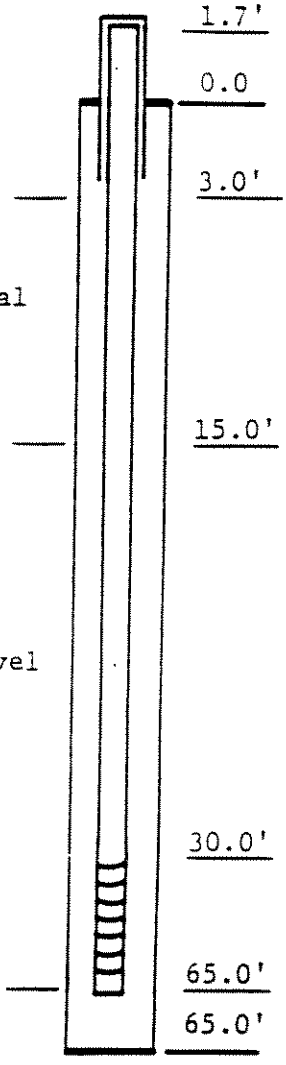
BORING LOCATION: As shown on boring location plan
DATE INSTALLED: 9-21-81
SURFACE ELEVATION: 725.01'
TOP OF PIPE ELEVATION: 726.75'*

TYPE OF PIEZOMETER: Monitor Well - 4" Schedule 40 PVC Casing

DATE	WATER SURFACE DEPTH (FT.)	WATER SURFACE ELEV. (FT.)
9-21-81	34.5	690.5
9-22-81	35.3	689.7
10-5-81	35.3	689.7

INSTALLATION DESCRIPTION

DESCRIPTION	DEPTH (FT.)
	1.7'
	0.0
Cement Grout	
	3.0'
Bentonite Seal	
	15.0'
Sand and Gravel	
	30.0'
	65.0'
	65.0'



TECHNICIAN PATTERSON

JOB NO. 26418

NOTES: PVC screen length - 35 feet
Screen slot size - 0.010 inches
Guard pipe - 5" x 4' 2" black iron with locking cap
* Elevation given is top of guard pipe without cap

LOG OF BORING NO. W-3-S

GROUNDWATER MONITORING WELLS, HARRISON RADIATOR, DAYTON OPERATIONS, MORAINE, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 9-23-81

SURFACE ELEVATION: 731.47' **DATE COMPLETED:** 9-23-81

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
0.0'	(FILL) Topsoil and sand and gravel - moist				
6.0'	(ORIGINAL) Brown sand and gravel - moist				
10'					
20'					
30'					
40'	(Becomes wet at 41.0')				
50'					
60'					

(continued on next page)

METHOD: DRIVE CASING

TECHNICIAN: PATTERSON

JOB NO.: 26418 (kab)

WATER OBSERVATIONS

INITIAL DEPTH: 41.0'

COMPLETION DEPTH: 41.0'

DEPTH AFTER: 24 HRS. 41.0'

TYPE SAMPLER:

____ A. SPLIT SPOON

____ B.

____ C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. W-3-S (second page)

GROUNDWATER MONITORING WELL, HARRISON RADIATOR, DAYTON OPERATIONS, MORAINE, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 9-23-81

SURFACE ELEVATION: 731.47' **DATE COMPLETED:** 9-23-81

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
60'	(continued)				
70'					
	Bottom of boring at 76.0'				
80'					
90'					
100'					
110'					
120'					

METHOD: DRIVE CASING

TECHNICIAN: PATTERSON

JOB NO.: 26418 (kab)

WATER OBSERVATIONS

INITIAL DEPTH: 41.0'

COMPLETION DEPTH: 41.0'

DEPTH AFTER: 24 HRS. 41.0'

TYPE SAMPLER:

____ A. SPLIT SPOON

____ B.

____ C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF WELL NO. W-3-S

GROUNDWATER MONITORING WELLS, HARRISON RADIATOR,
DAYTON OPERATIONS, MORAINE, OHIO

BORING LOCATION: As shown on boring location plan
DATE INSTALLED: 9-23-81

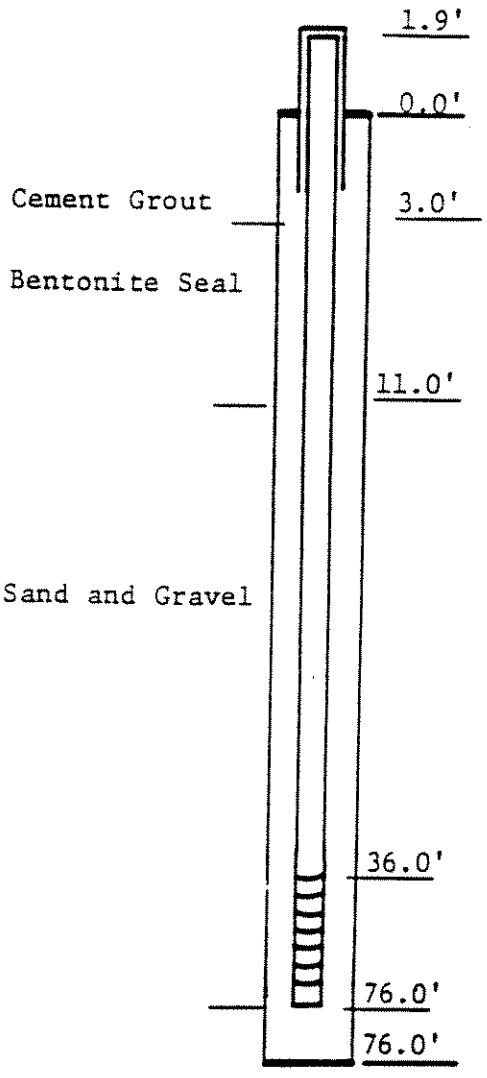
SURFACE ELEVATION: 731.47'
TOP OF PIPE ELEVATION: 733.39'*

TYPE OF PIEZOMETER: Monitoring Well - 4" Schedule 40 PVC Casing

DATE	WATER SURFACE DEPTH (FT.)	WATER SURFACE ELEV. (FT.)
9-23-81	41.0	690.5
9-24-81	41.0	690.5
10-5-81	42.0	689.5

INSTALLATION DESCRIPTION

DESCRIPTION	DEPTH (FT.)



TECHNICIAN PATTERSON

JOB NO. 26418

NOTES: PVC screen length - 40 feet
Screen slot size - 0.010 inches
Guard pipe - 5" x 4' 2" black iron with locking cap
*Elevation given is top of guard pipe without cap

LOG OF BORING NO. W-4-S

GROUNDWATER MONITORING WELLS, HARRISON RADIATOR, DAYTON OPERATIONS, MORAINE, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 9-25-81

SURFACE ELEVATION: 726.66' **DATE COMPLETED:** 9-28-81

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
0.0'	Brown sand and gravel, some silt, trace of cobbles				
10'					
20'					
30'					
	(Becomes wet at 37.5')				
40'					
50'					
60'					
	(continued on next page				

METHOD: DRIVE CASING

TECHNICIAN: PATTERSON

JOB NO.: 26418 (kab)

WATER OBSERVATIONS

INITIAL DEPTH: 37.5'

COMPLETION DEPTH: 37.5'

DEPTH AFTER: 24 HRS. 37.5'

TYPE SAMPLER:

____ A. SPLIT SPOON

____ B.

____ C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. W-4-S (second page)

GROUNDWATER MONITORING WELLS, HARRISON RADIATOR, DAYTON OPERATIONS, MORAINE, OHIO

BORING LOCATION: As shown on boring location plan

DATE STARTED: 9-25-81

SURFACE ELEVATION: 726.66'

DATE COMPLETED: 9-28-81

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
60'	(continued)				
70'	Bottom of boring at 70.0'				
80'					
90'					
100'					
110'					
120'					

METHOD: DRIVE CASING

TECHNICIAN: PATTERSON

JOB NO.: 26418 (kab)

WATER OBSERVATIONS

INITIAL DEPTH: 37.5'

COMPLETION DEPTH: 37.5'

DEPTH AFTER: 24 HRS. 37.5'

TYPE SAMPLER:

____ A. SPLIT SPOON

____ B.

____ C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF WELL NO. W-4-S

GROUNDWATER MONITORING WELLS, HARRISON RADIATOR,
DAYTON OPERATIONS, MORAINE, OHIO

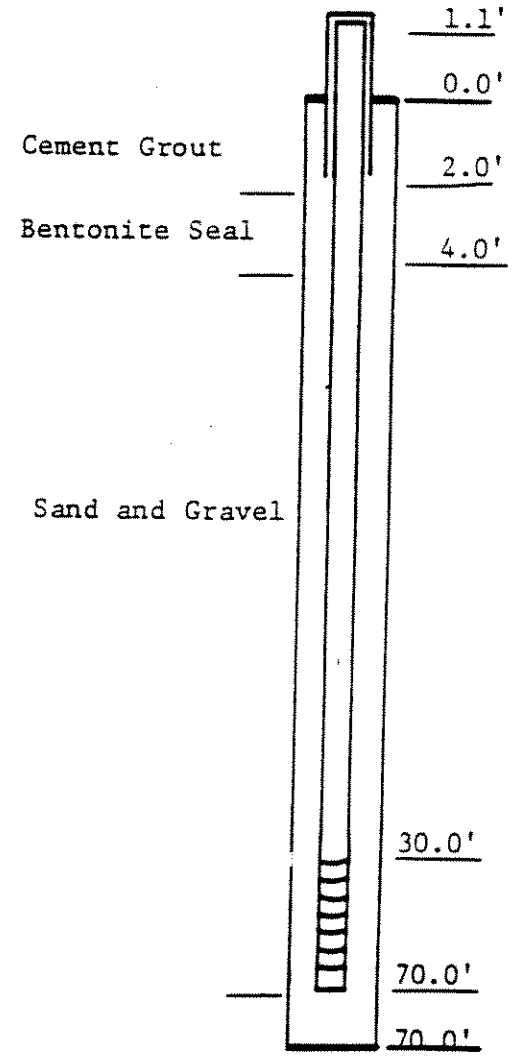
BORING LOCATION: As shown on boring location plan
DATE INSTALLED: 9-28-81

SURFACE ELEVATION: 726.66'
TOP OF PIPE ELEVATION: 727.80'*

TYPE OF PIEZOMETER: Monitoring Well - 4" Schedule 40 PVC Casing

DATE	WATER SURFACE DEPTH (FT.)	WATER SURFACE ELEV. (FT.)
9-28-81	37.6	689.1
9-29-81	37.6	689.1
10-5-81	37.3	689.4

INSTALLATION DESCRIPTION



TECHNICIAN PATTERSON

JOB NO. 26418

NOTES: PVC screen length - 40 feet
Screen slot size - 0.010 inches
Guard pipe - 5" x 4' 2" black iron with locking cap
* Elevation given is top of guard pipe without cap

ARCADIS

Appendix D

Standard Operating Procedures

ARCADIS

SOP #2 - Monitor Well Purging With A Bailer Or Pump

EQUIPMENT:

_____	PPE	_____	"Caution" tape and stakes
_____	Plastic sheeting	_____	Bailer
_____	Paperwork	_____	Rope
_____	Conductivity meter	_____	Thermometer
_____	PID	_____	M-scope
_____	Calculator		

PROCEDURES:

Prior to Well Sampling:

A. Acquire necessary equipment and paperwork.

At Sampling Location:

1. Don appropriate PPE (see Health and Safety Plan).
2. Establish exclusion zone.
3. Set up monitoring equipment (PID).
4. Place plastic sheeting near well and work area.
5. Unlock and remove well cap, note condition of well.
6. Measure water level and sound well (See SOP #4).
7. Calculate volume of water in the well using one of the following equations:

   a. 2-inch diameter well

   0.1632 gal/ft x____

   (linear ft of water in well) = 1 well volume

   b. 4-inch diameter well

   0.6528 gal/ft x____

   (linear ft of water in well) = 1 well volume

   Record the well volume on the water sampling log.

8. Insert pump/bailer into well. If using pump, connect clean length of tubing to pump. If using bailer, connect rope to bailer, allowing sufficient length to reach bottom of well.

9. Purge 3 well volumes of water; dispose of purge and excess sampling water at well site.

10. Record volume of water purged, clarity and all other pertinent information on Water Sampling Log.

11. Commence with sampling (See SOP #3).

ARCADIS

SOP #3 - Groundwater Sampling - Teflon Bailer

EQUIPMENT:

_____	PPE	_____	"Caution" tape and stakes
_____	Plastic sheeting	_____	Bailer
_____	Sample labels	_____	Rope
_____	Sample bottles	_____	Thermometer
_____	Cooler and ice	_____	pH meter
_____	Conductivity meter	_____	M-scope
_____	Pyrex™ cup	_____	Paperwork
_____	PID		

PROCEDURES:

Prior to Well Sampling:

A. Acquire necessary equipment and paperwork.

At Sampling Location:

1. Don appropriate PPE (see Health and Safety Plan).

2. Establish exclusion zone.

3. Set up monitoring equipment (PID).

4. Place plastic sheeting near well and work area.

5. Unlock and remove well cap, note condition of well.

6. Record sampling station number, sample identification, date, time, weather condition, and project number on Water Sampling Log.

7. Use M-Scope to determine depth-to-water and total depth of well (see SOP #4). Record on water sampling log.

8. Calculate volume of water in well and volume to be purged from well (three well volumes). Record on water sampling log (see SOP #2).

9. Remove decontaminated bailer from protective covering and attach cord, allowing enough length for bailer to reach bottom of well.

10. Lower bailer slowly to bottom of well with a minimum of surface disturbance.

11. Raise bailer to surface carefully, not allowing bailer cord to contact ground.

12. Continue bailing until appropriate volume has been purged. Record purged volume on water sampling log.

12A. Pour sample into a Pyrex™ cup. Measure temperature, pH, and conductivity (see SOPs #5 and #6). Record information on water sampling log.

13. Begin sampling well. The following order of sample collection must be followed: volatile organic compounds (VOCs), semivolatiles, and metals. Any remaining samples should be collected as soon as possible.

14. Remove the cap from the sample bottle, and tilt the bottle slightly.

15. Pour the sample slowly down the inside of the sample bottle. Avoid splashing of the sample. Assure that any suspended matter in the sample is transferred quantitatively to the sample bottle.

16. Leave adequate air space in the bottle to allow for expansion, except for volatile organic analysis (VOA) flasks. VOCs should be collected without head space or bubbles.

17. Label the bottle with the following information: sample ID, date, time of sampling, sampler's initials, and method of preservation. Enter all information accurately and legibly. Complete chain-of-custody forms (see SOP #11).

18. Pour sample into Pyrex™ cup. Measure temperature, pH, and conductivity again (see SOPs #5 and #6). Record information on water sampling log.

19. Samples should be placed in appropriate containers, and packed with ice in coolers as soon as practical.

20. Replace well cap and lock.

21. Decontaminate bailer and dispose of bailer rope (see SOP #9).

22. Personnel decontamination (see Health and Safety Plan).

After Sampling:

A. Ship samples to analytical laboratory with full Chain-of-Custody documentation.

B. Complete all necessary paperwork.

QA/QC REQUIREMENTS:

One rinseate blank and duplicate sample per ten investigative samples or per day, whichever is greater, must be collected by each ground-water sampling crew.

A trip blank must accompany each cooler of VOC samples that is shipped during the project.

ARCADIS

SOP #4 - Measuring Water-Levels With An M-Scope

EQUIPMENT:

_____ PPE
_____ M-scope
_____ Paperwork

PROCEDURES:

1. Check to see if there are any grossly contaminated wells requiring measurements made with separate M-Scopes; don appropriate PPE (see Health and Safety Plan).
2. Check that the M-Scope battery is functional.
3. Decontaminate the probe and tape with a distilled water rinse. Dry with a lint-free paper towel (see SOP #7).
4. Remove cap from well and check for the measuring point mark and for any sharp edges which may damage tape.
5. If the M-scope has metallic markers, check to see that they have not shifted.
6. Lower the probe into the center of the well until a contact with the water surface is indicated, either by audible alarm, light or meter deflection.
7. Mark and hold the tape at the measuring point (lip of 2-inch casing) and repeat the measurement.
8. Read off the measurement and record. If the tape has only five foot markers, measure the distance to the measured point with a folding ruler. Measurements should be made to the ± 0.01 feet.
9. Lower probe to bottom of well. Raise probe slowly until there is no slack in the tape. Gently "feel" the bottom of the well by slowly raising and lowering the probe.
10. Read off the measurement and record on Water Level Measurement field-data sheet or water sampling log.

After Field Work:

A. Complete all necessary paperwork.

QA/QC REQUIREMENTS:

One replicate water-level measurement must be made per five investigative measurements or one per day, whichever is greater.

ARCADIS

SOP #5 - pH Meter Standard Operating Procedures

EQUIPMENT:

_____ pH meter
_____ Paperwork
_____ Standard solutions (4, 7, and 10)

PROCEDURES:

1. Pour sample into Pyrex™ cup.
2. Place thermometer in sample.
3. Remove cap from pH probe and rinse with distilled water.
4. Place probe in sample and allow it to stabilize (10 to 20 seconds).
5. Adjust temperature control on pH meter to proper setting.
6. Take a pH reading and record value on sampling log.
7. Rinse probe with distilled water.
8. Repeat the above two steps four times to collect a quadruplicate measurement of pH.
9. Fill cap with distilled water and place on end of probe.

pH METER CALIBRATION:

EQUIPMENT:

_____ pH Standards (4, 7, and 10)
_____ Distilled water
_____ Thermometer

SOP #5 - pH Meter Standard Operating Procedures

Note: pH standards and distilled water should be stored in a similar location so temperature is the same.

PROCEDURES:

1. Place thermometer in standard solution.
2. Set temperature adjustment of pH meter to the temperature of the standard solution.
3. Remove cap from pH probe and rinse with distilled water.
4. Place pH probe in pH standard 7 and allow it to stabilize for 10 to 20 seconds.
5. Take a pH reading. If necessary, adjust "zero" control until reading is ± 0.1 of standard. Record readings on calibration log.
6. Remove pH probe from solution and rinse with distilled water.
7. Place pH probe in pH standard 4 or 10 and allow it to stabilize.
8. Take a pH reading. If necessary, adjust "slope" control until reading is ± 0.1 of standard. Record reading on calibration log.
9. Remove pH probe from solution and rinse with distilled water.
10. Place pH probe in remaining pH standard and allow it to stabilize.
11. Take a pH reading. If necessary, adjust "slope" control until reading is ± 0.1 of standard. Record reading on calibration log.
12. Repeat above process until all readings are ± 0.1 of standard.
13. Rinse probe with distilled water.
14. Fill cap for probe with distilled water (to keep probe moist) and place it on probe.
15. Record all calibration details on pH Meter Calibration Log sheet.

QA/QC REQUIREMENTS:

pH meter calibration should be checked with a 7-standard solution every four hours. If reading is greater than ± 0.1 of standard, repeat calibration process.

Standard solutions should be replaced every six months.

One replicate pH measurement per every five investigative measurements or one per day, whichever is greater must be made.

ARCADIS

SOP #6 - Specific Conductivity Meter Standard Operating Procedures

EQUIPMENT:

_____ Specific conductivity meter
_____ Standard solutions (1413 mmhos/cm)
_____ Paperwork

PROCEDURES:

1. Pour sample into Pyrex™ cup.
2. Place thermometer in sample.
3. Adjust temperature control on meter to the temperature of the sample.
4. Rinse probe with distilled water.
5. Insert conductivity probe into sample and allow it to stabilize (10 to 20 seconds).
6. Take a reading and record on sampling log.
7. Rinse probe with distilled water.
8. Repeat the above two steps four times to collect a quadruplicate measurement of specific conductance.

SPECIFIC CONDUCTIVITY METER CALIBRATION:

EQUIPMENT:

_____ Conductivity Standards (1413 mmhos/cm)
_____ Thermometer
_____ Small regular screwdriver
_____ Distilled water

Conductivity standards and distilled water should be stored in similar locations so temperature is the same.

SOP #6 - Specific Conductivity Meter Standard Operating Procedures

PROCEDURES:

1. Place thermometer in distilled water.
2. Set temperature adjustment of conductivity meter to the temperature of distilled water.
3. Rinse conductivity probe with distilled water.
4. Place probe in 1413 standard and allow it to stabilize for 10 to 20 seconds.
5. Take reading. If necessary, adjust calibration screw to ± 10 mmhos/cm. Record value on Specific Conductivity Meter Calibration Log.
6. Rinse probe with distilled water.
7. Record all calibration details on specific conductance meter calibration log sheet.

QA/QC REQUIREMENTS:

Specific conductivity calibration should be checked every four hours with a 1413 mmhos/cm standard. If reading is greater than ± 10 mmhos/cm of standard, repeat calibration.

Standard solutions should be replaced every six months.

One replicate specific conductance measurement should be made per every five investigative measurements or every day, whichever is greater.

ARCADIS

SOP #7 - Decontamination Of M-Scopes And Steel Tapes

EQUIPMENT:

_____ Distilled water
_____ Paper towels
_____ Paperwork

PROCEDURE:

1. Rinse entire device (probe and tape) with distilled water and dry with paper towels.
2. Wrap equipment in plastic to prevent contamination during long-term storage.
3. Record date, time and details of decontamination on Equipment Maintenance/Decontamination Log for that field meter.

ARCADIS

SOP #8 - Decontamination Of Submersible Pump

EQUIPMENT:

_____	Submersible pump	_____	Micro™ solution
_____	30 gallon trash can	_____	Distilled water
_____	Paper towels	_____	Paperwork

PROCEDURE:

1. Place pump in 30-gallon trash can, remove, and discard rope used to hang pump in well.
2. Wash pump thoroughly using Micro™ solution and distilled water and brushes or towels, if required.
3. Rinse pump repeatedly with distilled water and dry.
4. Pump should be wrapped in plastic to prevent contamination during storage or transit.
5. Record date, time and details of decontamination on Equipment Maintenance/Decontamination Log for the pump.

ARCADIS

SOP #9 - Decontamination Of Teflon Bailer

EQUIPMENT:

_____ Micro™ solution
_____ Distilled water
_____ Brush

PROCEDURE:

1. Wash bailer thoroughly with laboratory detergent (Micro™ solution) and distilled water using a brush to remove any particulate matter or surface film, if required.

2. Rinse bailer thoroughly with distilled water and allow to air dry as long as possible.

3. Wrap bailer with plastic to prevent contamination during long-term storage.

4. Record date, time and details of decontamination on an Equipment Maintenance/Decontamination Log.

SOP #11 - Chain-Of-Custody/Sample Shipment Procedures

PROCEDURE:

A Chain-of-Custody Record must be completed by the sampling team for all samples immediately upon collection. The Chain-of-Custody Record will be delivered to the analytical laboratory. A Chain-of-Custody Record is included in Appendix A. Information to be provided on this form includes:

- Project number and ID;
- Laboratory identification;
- Sampling personnel;
- Sample identification;
- Sample matrix;
- Sample container material;
- Sample preservation;
- Date and time of collection;
- Type of analysis to be performed; and
- Shipment method and carrier.

All suspected low concentration samples (less than 100 ppm based on field screening) should be packed in coolers by the sampling team with sufficient packaging to prevent damage to sample bottles during shipment. Frozen ice packs must be included in each sample cooler. (If the container is to be shipped, a Chain-of-Custody seal should be applied in such a manner so as to monitor tampering.) Sample coolers will then usually be hand-delivered each day to the analytical laboratory by the sampling team or designated personnel.

Upon change of possession, the record is to be signed and dated by both parties. The white (original) copy accompanies the shipment, the field sampler retains the yellow and pink copies. The analytical laboratory will be responsible for routing samples to the appropriate analytical section in a timely manner.

Based on existing data, all samples are expected to be low concentration samples. However, if VOC concentrations exceeding 100 ppm (see Note) are suspected in samples based on field screening, appropriate measures will be taken. Samples suspected of containing medium or high concentrations (greater than 100 ppm based on field screening) will be stored and shipped separate from suspected low concentration samples. Tertiary containment will be provided by placing the medium or high concentration samples in appropriate containers prior to placing them in shipping coolers.

NOTE:

"Medium level" concentrations = 100 x Average Upper Laboratory Calibration Limit (200 ppb) = 20,000 ppb.

HNU field screening measures a mixture of compounds with varying instrument response.

Assumption: Five VOCs present in mixture for field screening.

20,000 ppb x 5 = 100,000 ppb = 100 ppm.

ARCADIS

SOP #13 - Rinseate Blank Collection

EQUIPMENT:

_____ Distilled water
_____ Sample containers
_____ Water Sampling Log

PROCEDURE:

1. Decontaminate equipment (split-spoons, bailer, etc.) according to SOP #9 or #10.

2. Following the final distilled water rinse, rinse the sampling device with high purity distilled water this time washing the rinseate into sample containers for laboratory analysis.

3. All rinseate blanks must be handled and analyzed in the same manner as investigative samples. (See SOP #11 for Chain-of-Custody and Sample Shipment Procedures.) Record details of rinseate blank collection on a Water Sampling Log.

QA/QC REQUIREMENTS:

One rinseate blank per ten investigative samples or one per day, whichever is greater, must be collected by each sampling crew (i.e., each drill rig team is one sample crew, each ground-water sampling team is one crew, etc.).

ARCADIS

SOP #14 - Duplicate Sample Collection

EQUIPMENT:

_____ Sample containers _____ Paperwork

PROCEDURE:

1. Immediately following sample collection, fill a second set of sample containers using the same order of sample collection and procedures.

2. Label the sample with its duplicate sample identification.

3. All duplicate samples should be handled and analyzed in the same manner as investigative samples. (See SOP #11 for Chain-of-Custody and Sample Shipment Procedures.) Record details of duplicate sample collection on the appropriate sampling log.

QA/QC REQUIREMENTS:

One duplicate sample of ground water, surface water, sediment, soil or sludge must be collected per ten investigative samples or per day, whichever is greater by each sampling crew (i.e., each ground-water sampling team is a separate sampling crew, etc.).

ARCADIS

SOP #21 - Low-Flow Purging And Sampling Of Groundwater

EQUIPMENT:

- _______ Adjustable-rate, low-flow, positive-displacement pump, dedicated to the well
- _______ Generator (if needed)
- _______ Teflon-lined polyethylene tubing, dedicated to the well
- _______ Polyethylene sheeting
- _______ In-line, flow-through cell equipped with pH, Eh, dissolved oxygen (DO), specific conductivity, and temperature electrodes
- _______ Turbidity meter
- _______ Large, wide-mouth beakers
- _______ PID, or equivalent
- _______ Electronic water-level indicator or equivalent (marked in 0.01-foot increments)
- _______ Nylon stay-ties
- _______ Logbook
- _______ Sampling gloves

PROCEDURES:

1. Check the condition of the well and look for any damage or evidence of tampering and record.

2. Remove the well cap.

3. Measure well headspace with a PID and record the reading in the logbook.

4. Measure the depth to water with an electronic water-level device and record the measurement in the logbook. Do not measure the depth to the bottom of the well at this time (in order to avoid disturbing any accumulated sediment). Obtain depth to bottom information from well installation log. Calculate standing water volume as: depth of water column times cross-sectional area of the well.

5. Lay out the polyethylene sheeting and place all equipment on the sheeting. To avoid cross contamination, do not let any downhole equipment touch the ground surface.

6. Measure the depth to water in the well again. If the measurement has changed more than 1/100th of a foot, check and record the measurement again.

7. Attach and secure the polyethylene tubing to the low-flow pump. As the pump is slowly lowered into the well, secure the safety drop cable, tubing, and electronic lines to each other using nylon stay-ties.

8. The pump should be set at approximately the middle of the screen. Avoid placing the pump intake less than 2 feet above the bottom of the well as this may cause mobilization of any sediment present in the bottom of the well. Start purging the well. Avoid surging. Observe air bubbles displaced from discharge tube to assess progress of steady pumping until water arrives at the surface.

9. The water level in the well should be monitored during purging, and ideally, the purge rate should equal the well recharge rate so that there is little or no drawdown in the well. (The water level should stabilize for the specific purge rate.) There should be at least 1 foot of water over the pump intake so there is no risk of the pump suction being broken, or entrainment of air in the sample. Record adjustments in the purge rate and changes in depth to water in the logbook. Purge rates should, if needed, be decreased to the minimum capabilities of the pump to avoid affecting well drawdown. The well should not be purged dry. If the recharge rate of the well is so low that the well is purged dry, then wait until the well has recharged to a sufficient level and collect the appropriate volume of water for the sample with the pump.

10. During well purging, use the flow-through cell to monitor the field parameters frequently (every 3 to 5 minutes) until the parameters have stabilized to within 10 percent (plus or minus 5 percent) over a minimum of three readings. Repeatedly collect water in the beaker and assess turbidity. Turbidity and DO are typically the last parameters to stabilize. If turbidity readings fall below 7 NTUs, then the stabilization range can be amended to 20 percent (plus or minus 10 percent) over a minimum of three readings.

11. Once the field parameters have stabilized, collect the samples directly from the end of the discharge tube. Volatile organic compounds (VOCs) and analytes that degrade by aeration should be collected first. All sample bottles should be filled by allowing the water from the discharge tube to flow gently down the inside of the bottle with minimal turbulence. Cap each bottle as it is filled.

12. The pump assembly should be carefully removed from the well. The tubing should be dedicated to each well and should be placed in a large plastic garbage bag, sealed, and labeled with the appropriate well identification number.

13. Close and lock the well.

ARCADIS

SOP #28 - Purging and Sampling of Active Production Well

EQUIPMENT:

_____	PPE	_____	Cooler with ice
_____	Plastic sheeting	_____	5-gallon buckets
_____	Paperwork	_____	ACTAT probe
_____	PID	_____	Measuring cup
_____	Calculator	_____	pH meter, solutions
_____	Pens, etc.	_____	Conductivity meter, solutions
_____	Thermometer	_____	Parameter-measuring cup
_____	Sample Bottles	_____	Ziploc baggies

PROCEDURES:

Prior to Well Sampling:

A. Acquire necessary equipment, lab bottles, and paperwork (Daily notes and groundwater sampling log).

At Sampling Location:

1. Don appropriate PPE (see Health and Safety Plan).
2. Establish exclusion zone.
3. Set up monitoring equipment (PID).
4. Place plastic sheeting near well and work area.
5. Note condition of well and whether it is in operation.
6. Measure water level with ACTAT (if a measuring port exists) (See SOP #4).
7. Open the in-line valve or spigot.
8. Allow spigot to remain open at constant flow for a minimum of 5 minutes. If applicable, contain purge water in buckets for proper disposal.
9. Reduce the flow to approximately 100 mL per minute (when applicable), using measured cup.
10. Record volume of water purged (when applicable), clarity and all other pertinent information on Water Sampling Log.

11. Fill the appropriate sample containers. Ensure that VOC vials do not have headspace.

12. Label vials with sample name, date, time, analysis, sampler, etc.

13. Place sample bottles in ice-filled cooler.

14. Collect additional water in a parameter container. Measure pH, Specific Conductivity, and Temperature using 4 replicate measurements (see SOP #5 and SOP #6). Record results on sampling log.

15. Turn off spigot.

16. Pack up equipment, dispose of purge water according to work plan, and dispose of PPE.

17. Complete a Chain-of-Custody form for each cooler to establish the necessary documentation to track possession from time of collection to analysis. The Chain-of-Custody form must include the following information:

Project identification (REALM, Production Well Sampling)
AG&M project number and project manager
REALM laboratory P.O. number (R-I-00-11-01 for 2000)
Indicate Level III Data Package, Reports to Pam Stubbs, copy Nancy Gillotti.
Sampling personnel
Identity of samples
Description and number of sample containers
Date and time of sampling
Signatures of persons involved in the Chain-of-Custody and the dates and times of possession

18. Place the completed Chain-of-Custody form in a ziploc bag and place inside cooler. Deliver cooler in person to Test America - Dayton Division for analysis. After laboratory personnel signs the Chain-of-Custody, retain the pink copy.

19. Note on groundwater sampling log whether the production well is ON or OFF. If DN-13 is OFF contact the office immediately.