MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

INTEROFFICE COMMUNICATION

TO: Sybil Kolon, Pall Life Science (PLS) Project Manager,
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Jackson District Office

FROM: Jim Coger, Geologist,
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Jackson District Office

DATE: June 15, 2009

SUBJECT: Review of the May 4, 2009, Comprehensive Remediation Plan (CRP) submitted by PLS.

My comments address the Proposed Modifications to Remedial Program (PMRP) Section of the CRP. The PMRP proposes to reduce the current seven remedial systems/cleanup objectives into two geographically specific cleanup programs. The area west of Wagner Road is described as the Western Area and the area east of Wagner Road is described as the Eastern Area in the PMRP.

Western Area:

PLS proposes to modify 6 elements of the cleanup program for the Western area. The 6 elements include 1) Mass Reduction, 2) Clear and Enforceable Cleanup Objectives, 3) Increased Wagner Road Extraction, 4) Performance Monitoring, 5) Termination Criteria, and 6) Institutional Controls.

The current monitoring well network west of Wagner Road, is not adequate for evaluating the Mass Reduction, Clear and Enforceable Cleanup Objectives, Performance Monitoring, Termination Criteria, and/or Institutional Control elements of the proposed modified cleanup program as discussed in further detail below.

The current monitor well network west of Wagner road was not installed with the explicit purpose of monitoring groundwater flow direction and contaminant concentrations relative to achieving a specific groundwater performance standard. The network is a patchwork of wells installed historically to evaluate the extent of contamination in various aquifers near the plant site. In order to monitor a revised remediation plan goal on the west side of Wagner Road, as stated (i.e. to prevent the areas impacted by contaminant concentrations of 85 micro grams per liter (ug/l) or greater from expanding

in directions that do not lead to the prohibition zone) it is first necessary to assure that the current extent of contamination, at concentrations greater than 85 ug/l throughout the saturated vertical thickness is understood so that a sufficient monitoring network consistent with 20118(10) can be designed and employed to assure that the extent does not expand from the established baseline.

Given the proposed change from the historical designation of aquifer units (e.g. C1, C2, C3, D1, D2, etc) to a single system with a single performance standard, it is even more critical that both parties understand and agree at the outset where the 85 ug/l isoconcentration line is to be established, both aerially and vertically. The Units C_3, D_2 and E, 1,4-Dioxane Isoconcentration Contour Maps, October 2008 – March 2009, included in the most recent PLS Quarterly Report, depicts different 85 ug/l isoconcentration lines for the shallow, intermediate and deep aquifers for the area west of Wagner Road. As PLS points out in the CRP, technical disputes associated with assessing compliance with cleanup objectives based on aquifer designation has resulted in diversion of scarce resources. PLS needs to clearly identify what monitoring wells will be used for compliance monitoring. If the performance standard is to prevent plume expansion, the performance monitoring well network must have the capability of monitoring the entire vertical extent of 1,4-Dioxane contamination at each compliance monitoring well location.

Mass Reduction and Increased Wagner Road Extraction: The proposed installation of an additional purge well at the MW-94s location will aid in the containment and removal of the significant levels of 1,4-Dioxane that continue to migrate eastward under this area of Wagner Road. As documented by the boring logs and vertical profiling data from purge well TW-18 and monitoring wells MW-95 and MW-106s/d, a thick hydraulically connected saturated interval was encountered from an elevation of approximately 840 feet above mean sea level (amsl), down to the bedrock at approximately 680 feet amsl. Significant levels of 1,4-Dioxane were detected throughout the aquifer.

The new proposed purge well(s) at the MW-94s location should be designed as a multi-level purge system, that when operated in conjunction with TW-18, has the capability of containing the entire vertical extent of contamination. Hydraulic containment of the vertical extent of contamination north of TW-18 is required pursuant to the source control requirements in Section 21018(2)(a) and (4), and shallow, intermediate and deep purging at this location will reduce the element of long-term uncertainty associated with contaminant migration into Evergreen, and transmission line capacity issues related to downgradient “leading edge” purging locations.

The monitoring well network west of Wagner Road is not adequate for assessing cleanup objectives. PLS proposes to terminate purging activities at four of the low-producing extraction wells west of Wagner Road, and at other purge locations when influent contaminant concentration levels drop below 500 micrograms per liter (ug/l) and PLS can establish that groundwater extraction is no longer necessary to prevent plume expansion.

PLS references EPA pump and treat guidance that notes that it is common for purge well influent contaminant levels to tail and/or become asymptotic during long term purging activities. The EPA guidance generally describes tailing as a phenomenon related to purge well efficiency, not an indication that cleanup objectives have been met.

The EPA Guidance Document, Methods for Monitoring Pump-and-Treat Performance June, 1994 notes that many factors can influence tailing or asymptotic behavior of influent data sets. The EPA document recommends that a performance monitoring well network should be installed within, at the perimeter, and downgradient of the containment zone to evaluate the performance of the purge system. PLS has not installed any performance monitoring wells in the areas proximal to Western area purge wells TW-11 or TW-17 for the purpose of assessing Unit E cleanup objectives.

Assumptions regarding dissolved phase contaminant levels, and/or the degree of cleanup achieved in the aquifer cannot be based solely on purge well influent data. Purge well influent data generally is not representative of contaminant levels in the aquifer due to the development of preferential flow paths and variability associated with contaminant flux through the aquifer matrix,(matrix diffusion/advective flushing).

Additional aquifer characterization, and installation of additional purge wells will be required to optimize contaminant mass reduction west of Wagner Road.

Clear and Enforceable Cleanup Objectives and Performance Monitoring: We agree that establishing a cleanup objective such as that proposed, i.e. to prevent the areas impacted by contaminant concentrations of 85 ppb or greater from expanding in directions that do not lead to the prohibition zone, is clear and enforceable. We disagree that the proposed monitoring plan is of sufficient scope and detail to assure that both parties will know a violation if/when we see one. The most significant deficiency in this portion of the proposal relates to monitor well spacing that causes the parties to have to extrapolate concentrations over large distances in a complex hydro geological regime. It is also unclear from a contaminant fate and transport perspective how PLS can conclude that the extent of the 85 ug/l plume will not expand when, as proposed, extraction wells are shut off with concentrations approaching 500 ug/l remaining in place.

The Unit E monitoring well network for the Western Area is not adequate for evaluating the proposed cleanup objective. The Western Area Unit E monitoring well network consists of MW-66, MW-64, MW-56d, MW-59d, MW-62d, and MW-63d, and the Wagner Road wells which include MW-94d, MW-96, MW-95, MW-105d, MW-65d, and MW-68.

Monitoring well MW-66 is located approximately 2700 feet west/southwest of MW-118/Wagner Road. There are no deep (Unit E) monitoring wells between MW-66 and Wagner Road. Unit E extraction well TW-11, located approximately 1200 feet east of MW-66, encountered 1,4-Dioxane contaminant levels exceeding 3000 ug/l's when it was installed in May 2002. PLS did not install additional monitoring wells north of TW-11 to define the vertical and horizontal extent of contamination in this area. The detection of 1,4-Dioxane at the TW -11 locations reflects that 1,4-Dioxane was migrating north, from the unknown source area, prior to initiation of purging activities.

MW-64 is located approximately 750 feet southeast of MW-66, and approximately 2000 feet west of Wagner Road. There are no deep monitoring wells between MW-64 and Wagner Road that establish/characterize the source of Unit E contamination. MW-64 detected 1,4-Dioxane exceeding 2000 ug/l when sampled in August 2001. The detection of 1,4-Dioxane at the MW-64 location indicates that contamination migrated westward, from a source area, prior to initiation of purging activities. PLS did not define the extent of contamination west of MW-64.

Monitoring wells MW-56d, MW-59d, MW-62d, and MW-63d are located approximately 4000 feet west of Wagner Road in the southwestern area of the facility (west/northwest of Third Sister Lake). There are no monitoring wells located between the southwest area and MW-64 or MW-66, (approximately 2000 feet), that define the western edge of deep contamination. PLS depicts the current western 85 ug/l isoconcentration contour for the Unit D_2 as being oriented from the southwest area to the northeast, between MW-56d and MW-118. Additional characterization of the full vertical thickness of the aquifer(s) , along the D_2 85 ug/l isoconcentration line, is required to establish that this contour location represents a clear and enforceable compliance boundary.

There are no deep monitoring wells located between MW-68 and MW-56d that define the extent of contamination south of the Core Area. PLS depicts Unit C_3 contamination extending south to the general area east, north, and northwest of Third Sister Lake. Deep and intermediate monitoring wells are required between MW-68 and MW-56 to establish the 85 ug/l compliance boundary.

Termination Criteria: The Western Area monitoring well network is not adequate for evaluating the performance of the remedial systems. It is not clear what criteria PLS will utilize to determine when groundwater extraction is no longer necessary. There are no monitoring wells in the Unit E source area, and/or west of Wagner Road that have the capability of determining how much contaminant mass remains in the Western area.

With distances exceeding 2000 feet between monitoring well locations, and an unknown amount of mass remaining in the Unit E source area, it is unclear how PLS can assume that 1,4-Dioxane, exceeding 85 ug/l will not expand beyond or back into, areas that were historically impacted prior to the initiation of purging activities.

Institutional Controls: PLS states on page 9 that "indeed the extent of the groundwater contamination above 85 ug/l is largely unchanged." PLS states on page 11 "Prior to terminating active remediation in the Western Area, PLS will evaluate the extent of any areas where contamination still exceed the DWC. PLS will obtain and record restrictive covenants that prevent unacceptable exposures to the groundwater on any affected properties." As noted above the source of Unit E contamination has not been identified and/or characterized. The PMRP does not propose a methodology or process for determining what properties need use restrictions under various purging or non-purging scenarios. The acknowledgement that the size of the western plume has generally not changed over time, combined with the proposal to potentially leave concentrations of significantly greater than 85 ppb west of Wagner Rd, make it difficult to understand why PLS must wait to "..evaluate the extent of any areas where contaminant concentrations still exceed the DWC" (drinking water criteria) to obtain and record restrictive covenants on affected properties

Eastern Area:

PLS proposes to modify 8 elements of the cleanup program for the Eastern Area. The 8 elements include 1) Elimination of Drinking Water Pathway by Expansion of Prohibition Zone, 2) Unified 2,800 ug/l Containment Cleanup Objective, 3) Continued Evergreen Groundwater Extraction, 4) Potential Installation of an Additional Extraction Well, 5) Installation of Pipeline to Connect the Maple Road and Evergreen Systems, 6) Maple Road Extraction Well, 7) Downgradient Monitoring, and 8) Termination Criteria.

The current monitoring well network in the southwestern, western and northern areas of the Evergreen Subdivision, are not adequate for evaluating the proposed remedial system modifications.

PLS states that the source of contamination migrating toward the DuPont Circle area is from the south, near the intersection of Rose and Valley Street. PLS has not installed any monitoring wells in this area. The orientation of the plume axis and extent of contamination migrating into the western area of the Evergreen has not been defined. Additional characterization is needed in the western area of Evergreen to demonstrate that contaminant levels exceeding 85 ug/l do not currently extend westward beyond the proposed prohibition boundary, and/or will not expand westward or to the northeast under reduced purging scenarios.

Until the extent and concentration levels of contamination migrating into the western area of Evergreen subdivision are better understood, it cannot be established that a decrease of extraction from the LB-1, LB-3 and AE-3 purge system will not result in migration of contamination greater than 85 ppb outside of the proposed expanded PZ.

PLS did not install the nested monitoring well requested by RRD, at Sequoia Parkway and Maple Road. Additional monitoring locations are needed in this area to calculate/calibrate the groundwater elevation data, submitted by PLS in the March 20, 2009 Evergreen System Report.

The vertical and horizontal extent of 1,4-Dioxane contamination upgradient of Maple Road and purge well TW-19, has not been sufficiently characterized to determine what purge rate will be required to prevent/contain contamination exceeding 2,800 ug/l from migrating east under Maple Road.

The characterization of the extent of contamination migrating into the Evergreen subdivision and Maple Road, and validation of groundwater elevation data for the northern PZ area, must be accomplished before modifications to the Eastern Area Remedial Systems can be considered.

Recommendations:

Western Area:

The Units C_3, D_2, and E 1,4-Dioxane isoconcentration Contour Maps, included the most recent PLS Quarterly Report, depicts significant levels (i.e. greater than 1000 ug/l) of 1,4-Dioxane contamination remaining in the shallow, intermediate, and deep aquifer systems in the Western Area. The isoconcentration contouring reflects that the C_3, D_2 and Unit E plumes overlay each other at some locations proximal to the Core Area, but apparently have different migration patterns south, west, and north of the Core area.

The C_3 plume extends to the south into the area east, north, and northwest of Third Sister Lake. The D_2 extends to the southwest and west beyond the C_3 and Unit E plumes. The monitoring well network in the general area north of the core area, between Jackson Plaza, Nancy Drive, and April Drive is not adequate for determining where the compliance boundary should be established.

As noted above, the establishment of a clear and enforceable cleanup objective requires installation of a monitoring well network that defines the extent of contamination, and demonstrates containment of 1,4-Dioxane above 85 ug/l throughout the saturated interval, at each compliance monitoring location.

As seen in Figure 1. there are only two deep (Unit E) monitoring wells (MW64 and MW-66) between monitoring wells MW-56s/d and MW-118, a distance of approximately 4800 feet. As noted above, PLS depicts a Unit D_2 85 ug/l isoconcentration contour between the MW-56s/d and MW-118/Wagner Road locations. PLS appears to utilize data from a combination of Unit C_3 and D_2 monitoring wells as a basis for this 85 ug/l boundary. Additional characterization of the deeper intervals and permanent monitoring wells are needed at the MW-39s/d, MW-34s/d, MW-36, MW-33, MW-11s/i/d, MW-13, Nancy Drive (PLS08-07), and MW-14d locations to define the extent of contamination, and to establish the basis for compliance monitoring.

A minimum of four monitoring wells should be installed between MW-68 and MW-56d. These wells should be screened at appropriate intervals to demonstrate that 1,4-Dioxane above 85 ug/l, will not migrate south or southwest beyond the compliance boundary. See Figure 2 for our suggested locations.

Pursuant to the source control requirements of Section 20118(8) of Part 201, and the source identification and evaluation element of Rule R299.5528(3)(g) a minimum of six well clusters, at 500 foot well spacing, should be installed on a north – south axis, through the core area, Figure 2. These wells should be vertically profiled to bedrock. The transect of monitoring wells should be installed from the area near technical boring PLS 98-01, south to the area immediately west of MW-68. These wells are necessary because there are no Unit E monitoring wells west of Wagner Road that establish where the source of Unit E contamination originates from, and/or provides an estimate of how much contaminant mass remains in the Unit E source area.

These wells should be installed utilizing Rotosonic drilling methods. Rotosonic methods, where an outer casing is advanced with the drill string, will minimize the potential for “drag down” and or introduction of contamination into areas that may not be impacted. Setting temporary well screens at ten foot intervals, and purging until representative formation water is encountered, will ensure that the vertical profiling data

represents actual aquifer contaminant levels throughout the saturated interval. This data should then be used to determine well screen elevations, and for contaminant mass calculations for future purge system optimization.

Eastern Area:

The Unit E Isoconcentration Map, included in PLS's October 2008 through March 2009 Quarterly Report depicts a Unit E plume migrating from the south, into the western area of the Evergreen Subdivision. The 1,4-Dioxane isoconcentration contours stop at the existing southern Evergreen prohibition zone boundary. The vertical and horizontal extent of contamination migrating into Evergreen from the west, southwest and south has not been defined.

To be consistent with Rule 528(3)(l), and Section 20118, additional wells are needed at the following locations (see Figure 2):

A nested well should be installed at the PLS former technical boring location GSI96-01. A well is needed in this area to define the vertical distribution of 1,4-Dioxane contamination, and to evaluate plume geometry and flow paths into the Evergreen subdivision.

An additional well, west of the GSI96-01 location, (Columbus Dr./I-94 area?) will be needed to define the western extent of contamination. The western well should also have the capability (>85 ug/l) of serving as a PZ compliance monitoring well.

Additional monitoring wells be required midway between the Columbus Dr./I-94 well, and monitoring well MW-121. The distance between I-94 and MW-121 appears to be approximately 1400 feet. These well(s) are needed to define the western extent of contamination and to establish that the source of contamination in DuPont Circle is not from and area west of, or outside of the proposed expanded PZ.

PLS should install the three additional monitoring wells proposed in the June 3, 2009 Evergreen Verification Plan. Additional hydraulic head elevations specific to the northern Evergreen area will be needed to determine well spacing requirements for a northern PZ performance monitoring well network, should PLS choose to pursue that option. The number and location of additional PZ wells will be contingent on review of hydraulic head and chemical data from the three new and existing monitoring wells.

LB system purge rates. Approval for any permanent purge rate reduction for the LB system should be contingent on PLS resolving the characterization and monitoring issues referenced above, and review of at least four quarters of monitoring data (at the proposed reduced purge rates) for the Evergreen performance monitoring well network.

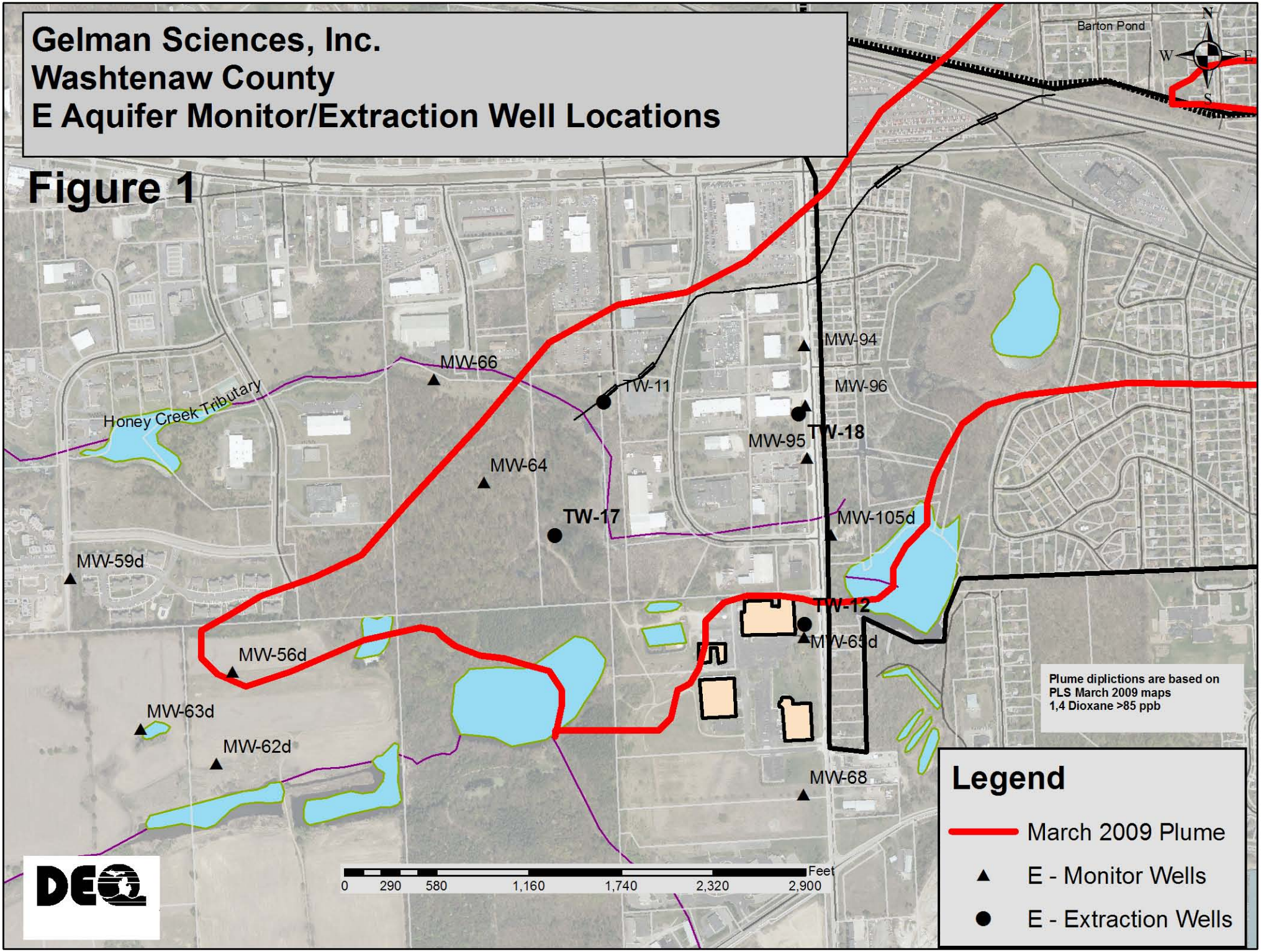
Maple Village: A minimum of one additional monitoring well nest is needed south of MW-72. A well location south of MW-72 is needed to define the width the 1,4-Dioxane plume, upgradient from the Maple Village Shopping Center (purge well TW-19), and to demonstrate that contamination exceeding 85 ug/l does not extend south beyond the PZ boundary. The third (northern) performance monitoring well should be installed in Vet's Park. The RRD and PLS previously agreed that the northern location was needed for performance monitoring.

If you have any questions or comments, please let me know.

cc: Mr. Mitchell Adelman, DEQ

Gelman Sciences, Inc.
Washtenaw County
E Aquifer Monitor/Extraction Well Locations

Figure 1



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DEQ Suggested Monitor Well Locations

Figure 2