September 19, 2013

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Midland, Michigan 48667
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Subject: WORK PLAN FOR LIMITED GROUNDWATER SAMPLING AND SCREENING
MIDLAND AREA SOILS
MID 000 724 724

As described in Section 5.3.1 of the *Interim Response Activity Plan Designed to Meet Criteria* (IRDC), approved by MDEQ on June 1, 2012, The Dow Chemical Company (Dow) is providing this Work Plan to supplement the Midland Area Soils Site-Specific Leachability Study conducted in 2012. The attached Work Plan provides the details of the limited groundwater sampling and screening to resolve the remaining constituents of interest (COIs), that have not yet been eliminated as a result of the 2012 study.

If you have any comments or questions related to the attached report, please contact me.

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Enclosure
mdc

WORK PLAN

MIDLAND AREA SOILS LIMITED GROUNDWATER SAMPLING AND SCREENING

Submitted by:

The Dow Chemical Company

Midland, Michigan

Revised: September 19, 2013
Prepared By URS Corporation

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1.0 INTRODUCTION

Recent work in 2010 and a previous study performed in 2005 and 2006 (CH2M Hill, 2007), have identified soil sample laboratory testing results above generic Michigan Department of Environmental Quality (MDEQ) Groundwater Drinking Water Protection and Groundwater Surface Water Interface Protection (GSI) criteria in soil samples in the Midland Area. These generic soil criteria are calculated based on generic assumptions that can be evaluated on a site-specific basis.

This Work Plan has been prepared for The Dow Chemical Company (Dow) to detail a groundwater study that will be conducted to verify and support the results of the leach study for constituents of interest (COIs) in soils in the Midland Area. The Study Area includes areas along the perimeter of the Midland Plant facility boundary. The data generated during this study will be used to support further evaluation of the list of constituents of interest (COI) for Midland Area Soils as described in Section 1.1.

1.1 BACKGROUND

Over 1,400 samples have been submitted from more than 400 locations for dioxin and furan analysis during work in 2010 and a previous study performed in 2005 and 2006 (CH2M Hill, 2007). A subset of the dioxin and furan data representing over 200 samples also includes VOCs, SVOCs, metals, pesticides, and PCBs to determine if concentrations are detectable in Midland Area Soils above generic MDEQ criteria. The existing VOC, SVOC, metals, pesticides and PCB data have been compiled and a preliminary screening evaluation has been conducted according to the COI screening flow chart in Appendix A. A summary of the COI screening of analytical results (2006 and 2010) is presented in Table 1. As shown in Table 1, a number of these analytes either have not been detected or are detected below generic MDEQ criteria or applicable default background levels, and therefore have been eliminated as COIs. Columns D5 and D6 from Table 1 show the results of the initial screening evaluation where one or more detected concentrations exceeded one or more MDEQ generic criteria. The spatial distribution and/or the level of detection of Column D5 and D6 analytes were evaluated further to determine if analytes could be eliminated or retained. Column E1 presents the list of analytes that were eliminated from the COI list, based on this evaluation.

Some analytes have been detected at concentrations above generic MDEQ Drinking Water and GSI protection criteria. These generic soil criteria are based on assumptions that can be investigated and/or modified on a site-specific basis. Additional leach testing was conducted for analytes with concentrations that exceeded applicable generic criteria to demonstrate compliance for soils (MDEQ, 2004). The June 1, 2012 Leachability Study Summary Report presented the results of the leach study. A review of the Leachability Study Summary Report findings was conducted during a meeting between MDEQ, EPA, Dow and URS on June 27, 2013. Column E2 in Table 1 presents the analytes that were eliminated as a COI based on the findings of the leach study (as discussed in June 27, 2013 meeting between MDEQ, EPA, Dow and URS).

During the June 27, 2013, the COIs that were not eliminated based on the findings of the leachability study were retained for further evaluation through groundwater screening. Table 2 presents a list of COIs that will be included for analysis in the groundwater sampling effort proposed in this Work Plan.

Table 2. COIs Retained for Groundwater Screening

COIs	Soil Minimum Detected Value (ug/kg)*	Soil Maximum Detected Value (ug/kg)	Res. DW Ground-water Criteria (ug/L)	GSI Ground-water Criteria (ug/L)
VOCs:				
Methylene Chloride	6	2,175	5.0	1,500
Toluene	4	7,010	790	270
Xylenes, Total	16	1,470	280	41
Total Cyanide	12	1,350	200	5.2
Metals:				
Arsenic	195	59,200	10	10
Chromium VI	863	4,610	100	11
Selenium	120	6,850	50	5
Chlorinated Herbicides:				
Pentachlorophenol	3	510	1.0	2.8

* - Minimum detected value does not include elevated “non-detect” reporting limits.

This Work Plan is intended to detail the sampling and testing of groundwater samples in support of the leachability study to determine if Midland Area Soils can be expected to leach at concentrations exceeding MDEQ generic residential drinking water and GSI criteria.

1.2 DATA QUALITY OBJECTIVES

The objective of this study is to determine if the substances identified in Table 2 are leaching into the shallow groundwater at concentrations above generic MDEQ Residential Drinking Water and Surface Water Interface (GSI) Cleanup Criteria. To achieve the objective, concentrations of the substances identified in Table 2 will be measured to develop a comprehensive and reliable measurement of groundwater quality from wells installed within the uppermost saturated soils. The measured groundwater concentrations will be used to evaluate the potential for presence of the COIs in Midland Area groundwater at levels greater than the generic MDEQ Residential Drinking Water and GSI Criteria.

Based on the evaluation described above, three conditions must be satisfied:

(1) Laboratory testing for the groundwater concentrations of COIs identified for study during this investigation must achieve a reliable level of detection equivalent to or less than the relevant groundwater criteria. These criteria are listed in Table 2.

(2) Wells sampled as part of this study shall have the screen intervals installed within the uppermost saturated soil unit.

(3) Wells sampled as part of this study shall be wells that have not been otherwise impacted by a known release.

MDEQ GSI groundwater criteria and GSI protection criteria for soils used in the screening process described in Section 1.1 are currently based on calculated cleanup criteria derived from site-specific pH data of approximately 7.7 standard units.

2.0 SAMPLING SCOPE

Groundwater samples will be collected from select locations and submitted for analysis for the list of COIs included in Table 2. The results of groundwater analysis will be compared to generic residential MDEQ drinking water and GSI criteria. The Site location is presented in Figure 1, and well locations are identified in Figure 2.

2.1 Approach

The proposed groundwater sampling will be conducted in both existing and new shallow wells where the groundwater is present and where there is no other known source present. A series of four new shallow wells were installed at the Southwest Plant Perimeter, along Poseyville Road and the southern boundary of Poseyville Landfill (see Figure 3). Existing wells proposed for sampling include shallow groundwater wells along the Northeast Plant Perimeter (Figure 4).

These areas include:

1) Locations that are representative of areas predominantly downwind from historic releases from the Midland Plant site; and

2) Locations closest to properties that use groundwater as a drinking water source.

The results will be compared to MDEQ generic Cleanup Criteria to determine the potential for these COIs to be present in shallow groundwater above the generic risk level.

2.2 Verification of Data Quality Assumptions

2.2.1 Reporting Limits

Analytical laboratory testing for the COIs must be capable of identifying their presence and concentration down to the level of the generic Cleanup Criteria. Laboratory reporting limits have been evaluated and standard methods capable of achieving those limits are summarized in Table 3.

Table 3. Reporting Limits and Cleanup Criteria for Groundwater COIs

COIs	Reporting Limit (ug/L)	Method	Res. DW Groundwater Criteria (ug/L)	GSI Groundwater Criteria (ug/L)
VOCs:				
Methylene Chloride	5.0		5.0	1,500
Toluene	1.0	SW-846 8260	790	270
Xylenes, Total	2.0		280	41
Total Cyanide	5.0	9012A	200	5.2
Chromium VI	1.0	218.7	100	5
Metals:				
Arsenic	1.0	SW-846 6020	10	10
Selenium	2.0		50	11
Chlorinated Herbicides:				
Pentachlorophenol	1.0	SW-846 8151	1.0	1.8

2.2.2 Appropriate Well Completion

Soil logs for each of the wells planned for the groundwater sampling event have been reviewed to verify that the open or slotted interval of each well is installed in the upper hydrogeologic unit, commonly referred to as the Surface Sand.

Table 4. Site Well Completion Depths

Well Number	Depth
Northeast Plant Perimeter	
4363	6.5 ft
6176	8.6 ft
MW-10 (MW-6175 Area)	6.0 ft
4355	13.0 ft
6177	14.0 ft
5385	10.5 ft

Well Number	Depth
Southwest Plant Perimeter	
8817	10.0 ft
8818	10.5 ft
8874	7.0 ft
8875	6.0 ft

The soils at well 4363 are sand to six feet, six inches, with a clay from three feet, three inches to five feet below ground level. The screened interval is three feet long, installed at six feet, six

inches below ground level. In this borehole, the upper three feet of sand and topsoil are isolated from the screen by the annular seal.

The soils at well 6176 are topsoil and fill to roughly four feet below the ground surface. Sandy soils are present to roughly eight feet, seven inches below ground surface. The screen is three feet long, installed at eight feet, seven inches below ground surface.

MW-10 in the 6175 Area is a sentinel groundwater monitoring well. The soils include sand fill and soils to five feet, six inches. The upper foot is clay fill. The screen is three feet long, installed at six feet below ground surface.

The soils at well 4355 are topsoil and sands to twelve feet 8 inches. The screen is installed at thirteen feet below ground level.

The soils at well 6177 consist of roughly eight feet of sandy loam to eight feet. Sandy soils are encountered to a depth of fourteen feet below ground surface. The screen is three feet long, installed at fourteen feet below ground surface.

The soils at well 5385 are sand fills and topsoil to nine feet below ground level, with a clay fill from one foot, eight inches to four feet, four inches below ground level. The screened interval is three feet long, installed at ten feet, six inches below ground level. In this borehole, the upper one foot, eight inches is isolated from the screen by the annular seal. A silty organic layer was observed from eight to nine feet at this location. This generally indicates where the former topsoil surface was prior to fill placement. This interval is included in the screened portion of the well.

The soils at well 8817 include two feet of loamy sand fill, with light brown sand to nine feet below ground surface. A silty clay lens was encountered just above six feet, and clay soils were encountered below the saturated sands to the bottom of the boring at ten feet below ground surface. The screen is five feet long, installed at ten feet below ground surface.

The soils at well 8818 include two feet of loamy sand fill, with roughly nine feet of silt and fine sands. Clay soils are encountered to the bottom of the boring at twelve feet below ground surface. The screen is five feet long, installed at ten feet six inches below ground surface.

The soils at well 8874 include roughly two feet of topsoil, followed by saturated sand to just under six feet below the ground surface. Clay soils were encountered to the bottom of the boring at seven feet below ground surface. The screen is four feet long, installed at eight feet below ground surface.

The soils at well 8875 include roughly one foot of topsoil, followed by sand, which becomes wet at two feet below ground surface. The sand is encountered to five feet below the ground surface. Clay soils were encountered to the bottom of the boring at six feet below ground surface. The screen is three feet long, installed at six feet below ground surface.

The soils at boring 8876 include light brown clay with varying fractions of silt and sand to the bottom of the boring at eight feet below ground surface, with one sand seam (<6 inches) at three feet six inches (3’6”) below ground surface. There were insufficient quantities of groundwater encountered or permeable soils to necessitate installation of a monitoring well at this location.

The soils at boring 8877 include light brown clay with varying fractions of silt and sand to the bottom of the boring at eight feet below ground surface. There were insufficient quantities of groundwater encountered or permeable soils to necessitate installation of a monitoring well at this location.

2.2.3 Appropriate Well Locations

Wells sampled as part of this study have not been otherwise impacted by a known release. New wells have been installed in areas where impacts are known not to be present from previous study. Existing wells have been determined not to have been impacted based on prior groundwater sampling. The existing wells were deemed to be un-impacted if organic contaminants identified in the general areas where these wells are located have not been detected previously at these specific wells.

3.0 FIELD METHODS

This Work Plan provides a strategy and scope of work to address key elements required to complete the sampling for the leach testing in the Study Area. The following section details the activities that will be performed in order to successfully complete the soil sampling activities.

3.1 SEQUENCE OF FIELD ACTIVITIES

3.1.1 Well Installation

Soil borings were made at the approximate locations shown in Figure 3. New wells were installed at locations where sufficient permeable soil and groundwater are encountered to effectively yield representative groundwater samples, in accordance with Appendix K, Section 3.3.2 of the Michigan Operations Facility Sampling and Analysis Plan (SAP). Soil borings were made with a hollow-step auger drilling rig. Soils were sampled continuously by split spoon samplers, inspected and described in the field by an experienced field geologist.

New wells are constructed of two-inch (2”) diameter schedule 40 PVC with flush joint threads. Screens are at least three feet (3’) long, with 10-slot openings. The borehole around the screen is filled with washed silica sand, with bentonite chips being used to fill the remaining annulus to grade. Wells are completed with a lockable surface casing, and secured with a padlock. Each well is labeled in the field to allow for a positive identification of the sample points.

If insufficient saturated surface soils were identified at borings 8876 and 8877, and those boreholes were abandoned by backfilling with bentonite chips, and hydrating with city water, in accordance with Appendix K, Section 2.3.2 of the Michigan Operations Facility SAP.

3.1.2 Well Development

Prior to conducting the sampling, new wells will be developed to improve the hydraulic connection with the formation and remove particles mobilized by the soil boring process. Development of new wells will be done by surging with a surge block to create alternating inward and outward movement of water through the well screen and filter pack. Aquifer materials that accumulate in the well are removed by overpumping (pumping at rates higher than

used during sampling). The well should be producing visually clear water free of visible aquifer materials before development is stopped.

3.2 GROUNDWATER SAMPLING

The following sections detail the field measurement and groundwater sampling procedures that will be utilized for the Midland Area Soils field activities related to the limited groundwater sampling in support of soil leaching evaluations.

Groundwater samples collected for analyses must be representative of the water moving in the aquifer, in the target zone where contaminants are expected to be located or to migrate (MDEQ, 2004). Sampling must proceed in a manner that assures the COI concentrations are representative of the natural groundwater and not the stagnant water in the well casings. There are two methods that will be utilized to verify samples are representative of the natural groundwater:

- Low flow sampling; and
- Fixed volume purging.

The sampling method will be selected on an individual basis, depending on the static water level and recharge rate.

3.2.1 Water Level Measurement

Static water level (SWL) readings will be obtained prior to purging to the nearest hundredth of a foot. A clean electric water level indicator will be used to determine the SWL. SWL indicators that are used in contaminated wells will not be used in this study. Prior to use, clean the SWL indicator with deionized water and a clean paper towel, followed by another water rinse. This prevents cross contamination between wells. Measure the SWL using the following steps:

1. Test the SWL indicator by turning it on and depressing the test button. There is an audible tone indicating the SWL indicator is working.
2. Lower the SWL indicator probe into the well casing slowly until the tone is audible. At this point, the SWL has been reached.

3. Static water level readings should be taken consistently from the same location at the top of the well casing, which could be done by permanently marking the casing via placement of a mark or notch.
4. The SWL indicator probe should be lifted at least a few inches above the water level and then lowered for another SWL reading. Continue this until a consistent SWL reading has been confirmed.
5. Record the SWL to the nearest hundredth of a foot on the field data sheet.
6. Slowly remove the indicator probe from the well, and remove any liquids using paper towels. Dispose of waste towels appropriately.
7. The SWL indicator shall be rinsed with deionized water and wiped dry between rinsings after every SWL reading.

3.2.2 Low Flow Purging Methodology

Low-flow sampling, commonly referred to as minimal drawdown or low stress purging is essentially a means of collecting a groundwater sample from a well that is the most representative of actual groundwater in the formation. This is effectively completed by removing water from the well slowly enough that the formation can re-charge the well at least as fast as the pumping rate, and monitoring water quality parameters to achieve stabilized readings.

To assure formation water is being pumped, the pump intake or inlet tubing shall be set within the lower half of the screen interval, and the pumping rate shall be adjusted so that the static water level readings eventually stabilize. This assures groundwater is recharging the well at an equivalent rate to pumping. Flow rate and static water level readings shall be recorded on the field data sheet.

While purging, the following water quality measurements are made within a flow-through cell:

- dissolved oxygen;
- temperature;
- specific conductivity;
- pH;

- RED/OX potential; and
- Turbidity.

At the point when these parameters are observed to stabilize, formation water is being obtained, and sampling may proceed. Generic criteria applied to the last three readings are as follows:

Table 5. Generic Stabilization Criteria

Parameter	Generic Stabilization Criteria
Dissolved Oxygen	+/- 10% or < 0.30 mg/L
Specific Conductivity	+/- 3%
pH	+/- 0.1 SU
REDOX potential	+/- 10 mV
Turbidity	< 20 NTU or +/- 10%

Knowledge of site geology, well installation, and sampling methodology is helpful in evaluating deviations from the generic stabilization criteria. Deviations from the generic criteria shall be noted on the field data sheet. Sampling may proceed after the point at which all parameters are stabilized, however the pumping rate during sampling must be consistent with purging rate (pump speed may not be increased).

Samples collected for inorganic analysis via the low-flow methodology described above shall not be filtered prior to preservation and analysis.

3.2.3 Fixed-Volume Purging Method

In locations where transmissivity of the unit limits the recharge rate to the well (either due to low hydraulic conductivity or limited saturated thickness), fixed-volume purging will be used. Historically, fixed-volume purging consisted of measuring the water volume in a well casing and purging three times that volume prior to sampling. In low-recovery wells, fixed volume purging is removing all of the water within the well casing, commonly referred to purging to dryness. Sampling will be done within 24 hours. Wells within sufficiently low transmissivity formations may require purging to dryness more than once.

For low recovery wells purged to dryness, groundwater samples subjected to inorganic analysis cannot be collected without adequately minimizing the influence of sampling disturbances, field filtering is necessary prior to preservation. Field filtration for inorganic analysis will be performed with an in-line 0.45 micron filter.

3.2.4 Equipment Calibration

Water quality measurements made using a flow-through cell are made using an In-Situ MP TROLL 9500 (or equivalent). The pH, conductivity, and RED/OX potential are calibrated at the beginning of each sample event, using what the manufacturer defines as a traditional calibration. The pH sensor is calibrated using a three point calibration; conductivity and RED/OX are single-point calibrations. Dissolved oxygen is calibrated every six months using a single-point calibration. During subsequent days within a sampling event, pH, conductivity, RED/OX potential may be calibrated with what the manufacturer defines as a quick calibration. Turbidity is bump-checked with a stock solution, and is calibrated using a single-point traditional calibration if it fails the daily bump check.

3.2.5 Sample Preservation

Preservation of the groundwater samples and blanks will be done according to the methods listed in Table 6.

Table 6. Sample Preservation Methods

Parameter	Bottle	Method	Preservation	Hold Time
VOCs	40 mL clear glass vial	SW-846 8260	0.25 mL Sulfuric or 0.5 mL HCL Store at 4°C	14 days
Chlorinated Herbicides	1000 mL amber glass	SW-846 8151	Store at 4°C	7/40 days (extract/analyze)
Total Cyanide	250 mL poly	9012A	2 mL NaOH Store at 4°C	14 days
Chromium VI	250 mL poly	218.7	2 mL NaOH Store at 4°C	14 days
Metals	250 mL poly	SW-846 6020	2 mL Nitric	6 months

3.2 SAMPLE DOCUMENTATION

Environmental soil samples will from four locations (PSW-1 through PSW-4) as shown on Figure 3.

3.2.1 Sample Identification and Labeling

Samples must be labeled to prevent mis-identification. Sample labels will be affixed to sample containers prior to or at the time of sampling. Sample labels will contain the following information:

- Sample number;
- Name or initials of sampler;
- Date and time of collection;
- Place of collection; and
- Analysis to be performed on the sample.

3.2.2 Chain of Custody

A person who has samples in custody must comply with these Chain-of-Custody Procedures. During collection, analysis and final disposition, a sample is considered to be under a person's custody when:

- The samples are in a person's physical possession;
- Are in view of the person after taking possession;
- Are secured by that person so that no one can tamper with it; or
- Are secured by that person in an area that is restricted to authorized personnel.

3.2.3 Field Data Sheets

Information pertinent to a field survey or sampling will be documented in the field data sheet, (example included in Appendix B). Field parameters shall be taken immediately prior to collecting the sample and documented in the field data sheet. It is essential that all samples be collected properly and that actual conditions during each sample collection are completely documented.

At a minimum, entries on the field data sheet will include the following:

- Location of sampling point;
- Sample number;
- Name or initials of the sampler;
- Date/time of purging and/or sampling;
- Number and volume of sample taken;
- Analyses to be performed on samples;
- Static Water Level (SWL) reading;
- Purge volume;
- Field parameters (such as temperature, pH, specific conductivity); and
- Additional field information determined by the sampler to be important (i.e. abnormal conditions, well damage, weather conditions, nearby construction/traffic).

Additional field documentation will include sufficient information to allow reconstruction of the sampling without reliance on the sampler's memory. A permanent writing instrument should be used to record all information on field data sheets. The proper correction technique is to draw one single line through the error and initial/date it at the point of error.

4.0 QUALITY ASSURANCE/QUALITY CONTROL

A number of quality assurance and quality control measures are incorporated into this study, including both field and laboratory stages, as described below.

4.1 Field Samples

4.1.1 Field Blanks

Field blanks will be collected to evaluate the potential for interference in the sampling process. A field blank will be collected for VOCs and Chlorinated Herbicides at the frequency of once per sampling event.

4.1.2 Field Duplicates

Field duplicates will be collected to evaluate the consistency of the sampling process. A field duplicate will be collected at the frequency of once per event for metals and cyanide.

4.2 Data Evaluation

4.2.1 Field Samples

Field Duplicates and Blanks will be reviewed to evaluate the potential for sampling variability and field contamination, respectively. Exceptions will be noted.

4.2.2 Field Operations

Field staff will be briefed on project requirements, and field documentation will be reviewed during and after each sampling event to verify completeness.

4.2.3 Laboratory Samples

Laboratory QA/QC samples, such as a Laboratory Control Sample (LCS) or Method Blank (MB) will be reviewed to evaluate the potential for laboratory contamination. Relative surrogate and matrix spike recovery amounts will be compared to laboratory performance criteria to verify recoveries are within appropriate ranges. Exceptions will be noted.

4.2.4 Reporting Limits

All laboratory Reporting Limits (RLs) will be reviewed. All elevated RLs will be noted. Elevated RLs for samples where constituents are not detected will result in flagging of the result, and corrective action which may involve re-sampling.

4.2.5 Adaptive Management

Findings that may affect the quality of samples will be addressed to ensure the data are useable for their intended purpose. Changes or corrective actions will be established if quality assurance issues are identified. Similarly, assumptions built into the project QA/QC measures should be validated during the data evaluation. For example, if VOCs are detected in wells, duplicates may be appropriate for VOCs in future sampling events.

4.3 SCHEDULE

Installation of new Monitoring Wells was completed August 5 and 6, 2013. The first round of groundwater sampling began on September 4, 2013. MDEQ were on-site to obtain sample splits. Groundwater sampling will proceed on a monthly schedule from September through November, 2013. MDEQ will be notified seven to ten calendar days in advance of each monthly sampling event to allow for sufficient time to schedule a sample split.

Results of sampling will be posted to the Midland Area Soils Project progress tracking tool (Sharepoint® Site) upon validation. In addition, September sampling event results will be provided in the third quarter Environmental Monitoring Report. October and November sampling results will be provided in the fourth quarter Environmental Monitoring Report.

The above schedule may vary based-on weather conditions, laboratory result issues, contractor availability, or other unforeseen circumstances and/or conditions, which may result in delays.

5.0 REFERENCES

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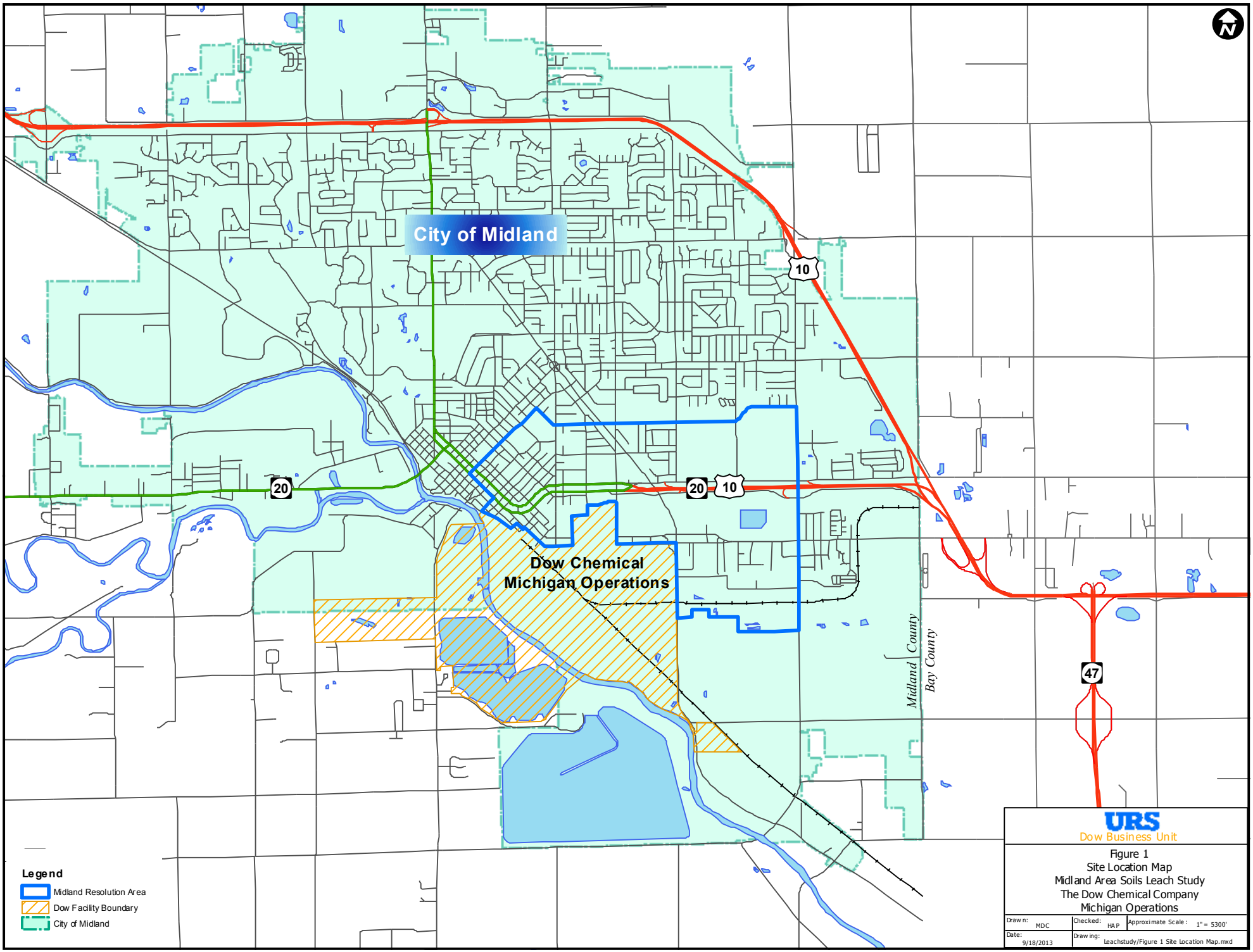
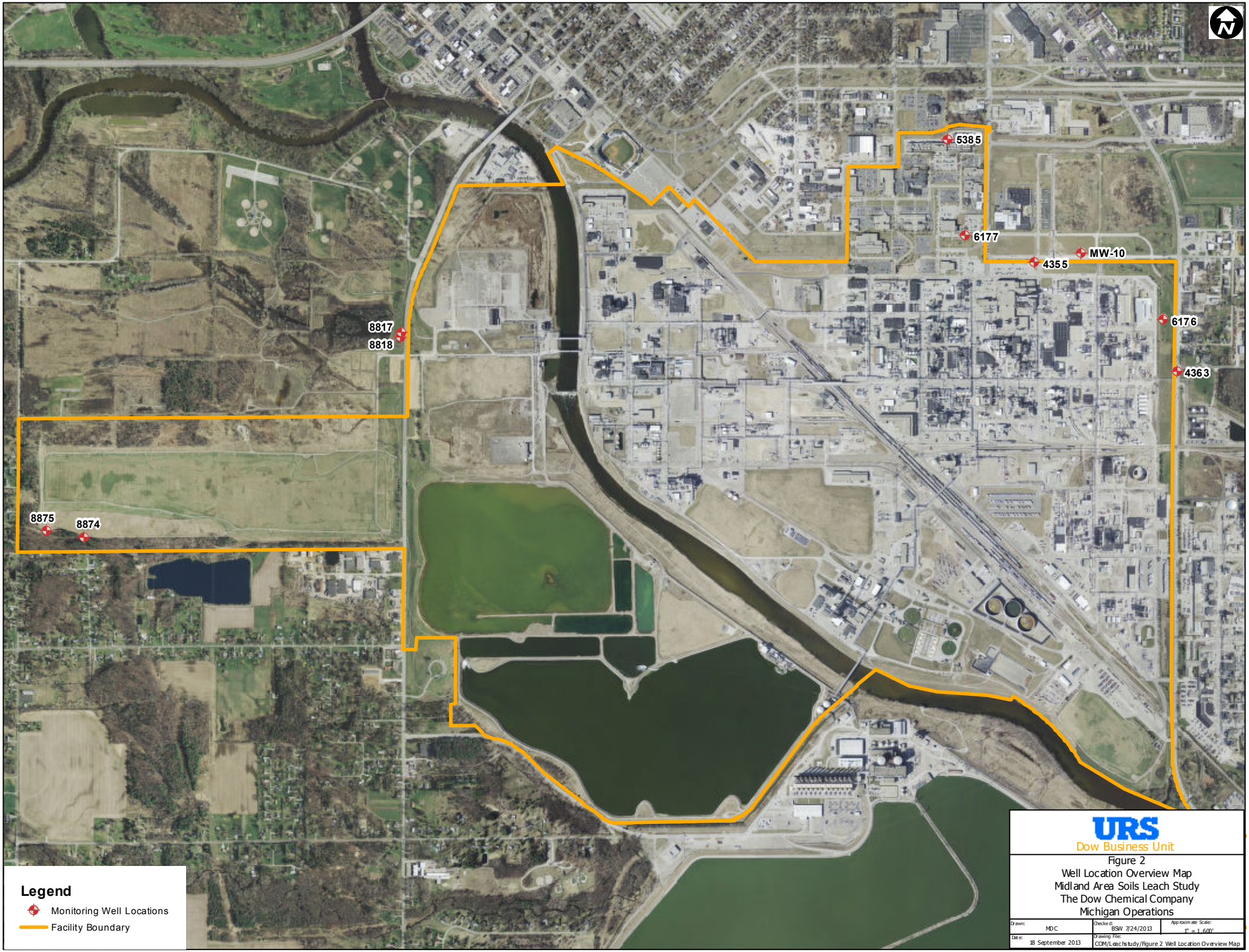
FIGURES

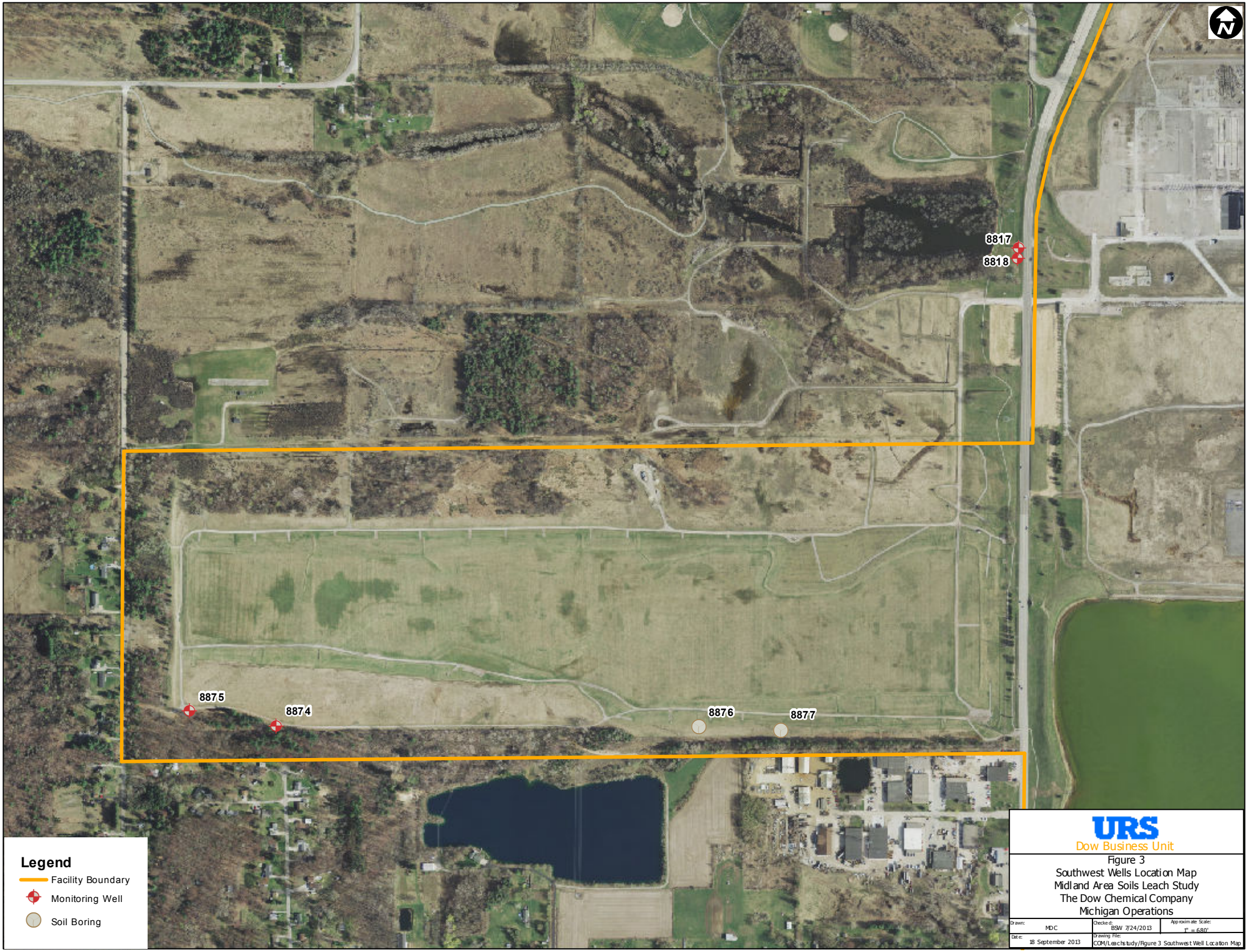

City of Midland
Dow Chemical
Michigan Operations
10
20
20
10
47
Midland County
Bay County
Legend
Midland Resolution Area
Dow Facility Boundary
City of Midland
URS
Dow Business Unit
Figure 1
Site Location Map
Midland Area Soils Leach Study
The Dow Chemical Company
Michigan Operations
Drawn: MDC
Checked: HAP
Approximate Scale: 1" = 5300'
Date: 9/18/2013
Drawing: Leachstudy/Figure 1 Site Location Map.mxd



URS
Dow Business Unit

Figure 2
Well Location Overview Map
Midland Area Soils Leach Study
The Dow Chemical Company
Michigan Operations

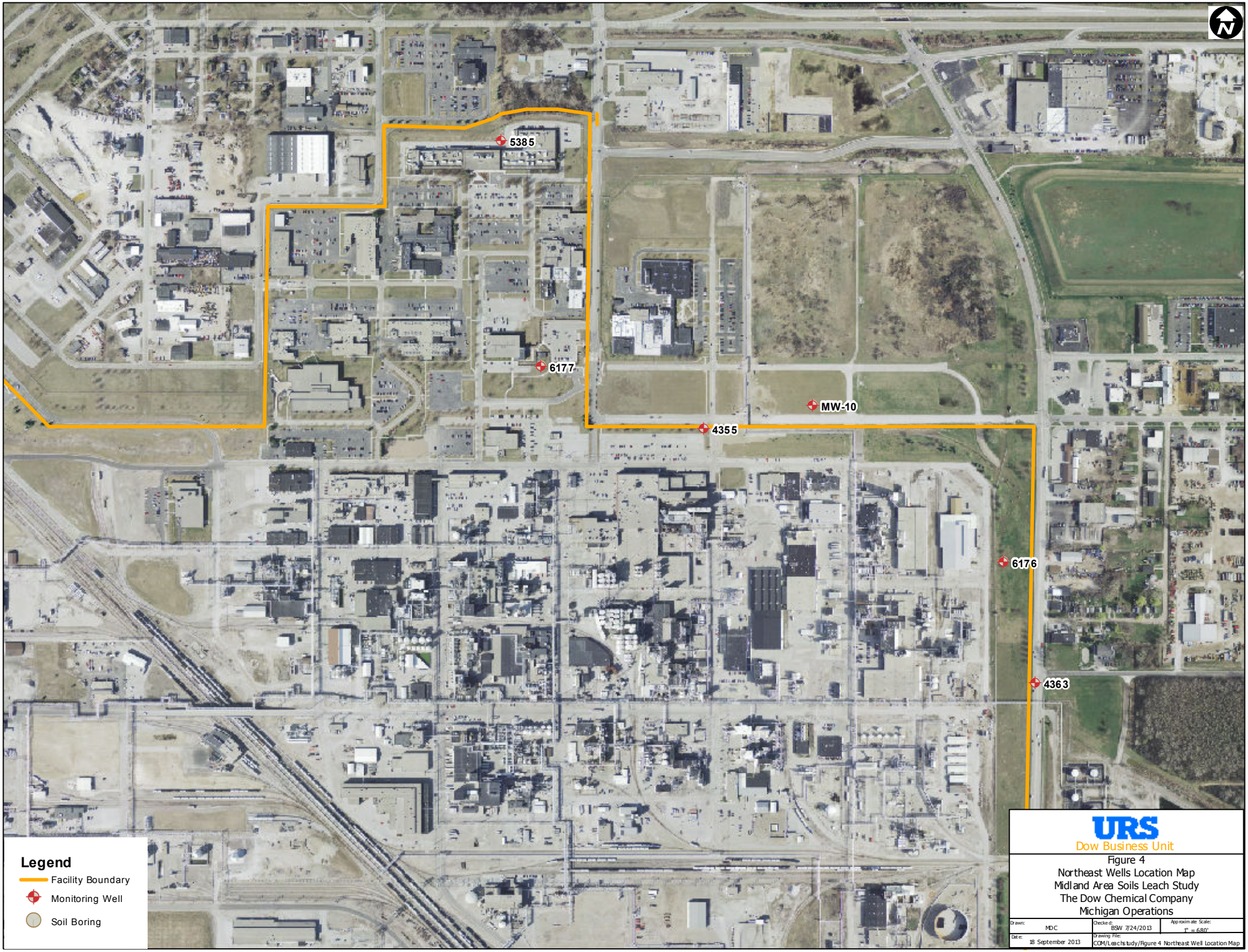
Drawn: MDC	Checked: BSW 7/24/2013	Approximate Scale: 1" = 1,600'
Date: 18 September 2013	Drawing File: COM/Leachstudy/Figure 2 Well Location Overview Map	



URS
Dow Business Unit

Figure 3
Southwest Wells Location Map
Midland Area Soils Leach Study
The Dow Chemical Company
Michigan Operations

Drawn: MDC	Checked: BSW 7/24/2013	Approximate Scale: 1" = 680'
Date: 18 September 2013	Drawing File: COM/Leachstudy/Figure 3 Southwest Well Location Map	



URS
Dow Business Unit

Figure 4
Northeast Wells Location Map
Midland Area Soils Leach Study
The Dow Chemical Company
Michigan Operations

Drawn: MDC	Checked: BSW 7/24/2013	Approximate Scale: 1" = 680'
Date: 18 September 2013	Drawing File: COM/Leachstudy/Figure 4 Northeast Well Location Map	

TABLE

Table 1
Summary of Non-dioxin Data Screening Results, The Dow Chemical Company, Midland, Michigan

A1 [1] Metals Screen-out by Statewide Default Background	A2 [1] Metals Screen-out by Regional Background Screening Levels	B1 [1] Screen-out by all NDs; RLs met MDEQ target detection levels	B2 [1] Screen-out by off-site NDs; RLs met MDEQ target detection levels	B3 [1] Screen-out by all NDs; all RLs ≤ all Part 201/EPA criteria	C1 [2] No criteria; detected ≤ 5%	C2 [2] No criteria; detected > 5%	D1 [1] Screen-out by other reasons	D2 [1] Detected ≤ 5%; screen-out by Part 201/EPA criteria	D3 [1] Detected > 5%; screen-out by Part 201/EPA criteria	D4 [2] Not detected above Part 201/EPA criteria; but have elevated RLs for NDs	D5 [2] Detected ≤ 5%; one or more detected concentrations > Part 201/EPA criteria	D6 [2] Detected > 5%; one or more detected concentrations > Part 201/EPA criteria	E1 [3] Eliminate through a review of spacial distribution	E2 Eliminate based on leach testing results	E3 Eliminate - Groundwater Screening (DW & GSI Pathways)	E4 Eliminate - analyte not sourced by Dow
(none)	Barium	Silvex (2,4,5-TP)	bis(2-Chloroisopropyl)ether	Endrin ketone	Delta BHC	Calcium	*(none)*	2,4,5-T (Trichlorophenoxyacetic Acid)	2,4-D (Dichlorophenoxyacetic Acid)	Thallium	alpha-BHC	Cyanide, Total	Delta BHC	Hexachlorobutadiene	***Pending***	***Pending***
	Cadmium	3,3'-Dichlorobenzidine	Hexabromobenzene	Heptachlor	Endrin aldehyde	Potassium		Endrin	Beryllium	PCBs, Total	Gamma BHC (Lindane)	Mercury	Endrin aldehyde	Lithium	***Analytes included in this screening***	
	Magnesium	4,4'-Methylene bis(2-chloroaniline)	Hexabromobiphenyl	(E)-alpha,beta-2,3,4,5,6-Heptachlorostyrene	4-Bromophenyl phenyl ether	Thorium		Mirex	Sodium	Aldrin	Hexachlorobutadiene	Aluminum	4-Bromophenyl phenyl ether	Fluoranthene	*Arsenic*	
	Manganese	2-Chloroethyl vinyl ether		(E)-beta-2,3,4,5,6-Hexachlorostyrene	4-Chlorophenyl phenyl ether	Titanium		1,2,4-Trichlorobenzene	Tin	Beta BHC	1,2-Dichlorobenzene	Antimony	4-Chlorophenyl phenyl ether	Zinc	*Methylene chloride*	
		Ethyl tert-Butyl Ether		(Z)-alpha,beta-2,3,4,5,6-Heptachlorostyrene	Octachlorostyrene	Endosulfan sulfate		2,4,5-Trichlorophenol	4,4'-DDD	Dieldrin	Acrylonitrile	Arsenic	Octachlorostyrene	Boron	*Pentachlorophenol*	
		Isopropyl Ether		(Z)-beta-2,3,4,5,6-Hexachlorostyrene	1,1-Dichloropropene	Sulfide		Azobenzene	4,4'-DDE	Toxaphene	Chlorobenzene	Boron	1,1-Dichloropropene	Strontium	*Total Cyanide*	
		Methyl-t-butyl ether		1,2,3-Trichlorobenzene	Propionitrile, Ethyl Cyanide	1,2,3,4-Tetrachlorobenzene		Benzyl alcohol	4,4'-DDT	Tris(2,3-dibromopropyl)phosphate	Tetrachloroethene	Chromium	Propionitrile, Ethyl Cyanide	Hexachlorobenzene	*Selenium*	
		t-Butanol		1,2,4,5-Tetrachlorobenzene		1,2,3-Trimethylbenzene		Dimethyl phthalate	Chlordane, Total	1,2-Diphenyl-hydrazine		Chromium VI	Calcium		*Toluene*	
		tert-Amyl Methyl Ether		1,4-Naphthoquinone		Methyl Iodide (Iodomethane)		Isophorone	Endosulfan, Total	1,3-Dinitrobenzene		Cobalt	Potassium		*Total Xylenes*	
		Vinyl acetate		1-Naphthylamine		p-Isopropyltoluene		n-Nitrosodiphenylamine	Heptachlor epoxide	2,2'-Oxybis(1-Chloropropane)		Copper	Thorium		*Chromium VI*	
				2,3,4,5,6-Pentachlorostyrene				Propachlor	Methoxychlor	2,4,6-Trichlorophenol		Iron	Titanium			
				2,4-Dimethylphenol				1,3,5-Trimethylbenzene	2,3,4,6-Tetrachlorophenol	2,4-Dichlorophenol		Lead	Endosulfan sulfate			
				2,6-Dichlorophenol				2-Chlorotoluene	2-Methylnaphthalene	2,4-Dinitrophenol		Lithium	Sulfide			
				2-Acetylaminofluorene				2-Hexanone	Acenaphthene	2,4-Dinitrotoluene		Molybdenum	1,2,3,4-Tetrachlorobenzene			
				2-Chloronaphthalene				Chloroform	Acenaphthylene	2,6-Dimethylphenol		Nickel	1,2,3-Trimethylbenzene			
				3-Nitroaniline				Chloromethane	Acetophenone	2,6-Dinitrotoluene		Selenium	Methyl Iodide (Iodomethane)			
				4-Nitrophenol				Cyclohexane	Anthracene	2-Chlorophenol		Silver	p-Isopropyltoluene			
				4-Nitroquinoline-1-oxide				Dichlorodifluoromethane	Benzo(a)anthracene	2-Naphthylamine		Strontium	Thallium			
				4-tert-Butylphenol				Methyl Ethyl Ketone (2-Butanone)	Benzo(b)fluoranthene	2-Nitroaniline		Vanadium	PCBs, Total			
				Alpha, Alpha Dimethylphenethylamine				Methyl Isobutyl Ketone (4-Methyl-2-Pentanone)	Benzo(g,h,i)perylene	2-Nitrophenol		Zinc	Aldrin			
				alpha-2,3,4,5,6-Hexachlorostyrene				n-Butylbenzene	Benzo(k)fluoranthene	3,3'-Dimethylbenzidine		Benzo[a]pyrene	Beta BHC			
				Benzyl dichloride				Styrene	Benzoic acid	3-Methylcholanthrene		Dibenzofuran	Dieldrin			
				beta,beta-2,3,4,5,6-Heptachlorostyrene				tert-Butylbenzene	Benzyl Butyl Phthalate	4,6-Dinitro-2-methylphenol		Fluoranthene	Toxaphene			
				Bisphenol-A					bis(2-ethylhexyl) phthalate	4-Aminobiphenyl		Hexachlorobenzene	Tris(2,3-dibromopropyl)phosphate			
				Caprolactam					Carbazole	4-Chloro-3-methylphenol		Pentachlorophenol	1,2-Diphenyl-hydrazine			
				cis-Nonachlor					Chrysene	4-Chloroaniline		Phenanthrene	1,3-Dinitrobenzene			
				Di-n-octylphthalate					Di-n-butyl phthalate	4-Nitroaniline		1,3-Dichlorobenzene	2,2'-Oxybis(1-Chloropropane)			
				Ethyl methanesulfonate					Fluorene	5-Nitro-o-toluidine		1,4-Dichlorobenzene	2,4,6-Trichlorophenol			
				Famphur					Indeno(1,2,3-c,d)Pyrene	7,12-Dimethylbenz(a)anthracene		Benzene	2,4-Dichlorophenol			
				Hexachlorocyclopentadiene					o-Phenylphenol	Aniline		Bromomethane	2,4-Dinitrophenol			
				Hexachlorophene					Phenol	Aramite (Total)		Methylene Chloride	2,4-Dinitrotoluene			
				Hexachloropropene					Pyrene	Benzidine		Naphthalene	2,6-Dimethylphenol			
				Isodrin					1,2,4-Trimethylbenzene	Bis(2-Chloroethoxy) methane		Toluene	2,6-Dinitrotoluene			
				Isosafrole					Acetone	Bis(2-Chloroethyl) ether		Xylenes, Total	2-Chlorophenol			
				Methapyrilene					Isopropylbenzene	Chlorobenzilate			2-Naphthylamine			
				Methyl chlorpyrifos					N-Propylbenzene	Chlorpyrifos			2-Nitroaniline			
				O,O,O-Triethyl Phosphorothioate					sec-Butylbenzene	Cresol, Total			2-Nitrophenol			
				O,O-Diethyl O-2-Pyrazinyl Phosphorothioate (Thionazin)					Tetrahydrofuran	Diallate (total of cis and trans isomers)			3,3'-Dimethylbenzidine			
				o,p'-DDD						Dibenz(a,h)anthracene			3-Methylcholanthrene			
				o-Toluidine						Diethyl phthalate			4,6-Dinitro-2-methylphenol			
				Parathion, Ethyl (Parathion)						Dimethoate			4-Aminobiphenyl			
				Pentachlorobenzene						Dinoseb			4-Chloro-3-methylphenol			

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				Pentachloronitrobenzene						Diphenylamine			4-Chloroaniline			
				p-Phenylenediamine						Disulfoton			4-Nitroaniline			
				Pronamide						Hexachloroethane			5-Nitro-o-toluidine			
				Ronnel						Kepone			7,12-Dimethylbenz(a)anthracene			
				Sym-Trinitrobenzene						Methyl methanesulfonate			Aniline			
				trans-Nonachlor						Nitrobenzene			Aramite (Total)			
				1,1,1,2-Tetrachloroethane						n-Nitrosodiethylamine			Benzidine			
				1,1,1-Trichloroethane						n-Nitrosodimethylamine			Bis(2-Chloroethoxy) methane			
				1,1-Dichloroethane						N-Nitroso-di-n-butylamine			Bis(2-Chloroethyl) ether			
				1,2,3-Trichloropropane						n-Nitrosodi-n-propylamine			Chlorobenzilate			
				2,2-Dichloropropane						n-Nitrosomethylethylamine			Chlorpyrifos			
				4-Chlorotoluene						n-Nitrosomorpholine			Cresol, Total			
				Bromobenzene						n-Nitrosopiperidine			Diallate (total of cis and trans isomers)			
				Bromodichloromethane						n-Nitrosopyrrolidine			Dibenz(a,h)anthracene			
				Bromoform						Parathion, Methyl			Diethyl phthalate			
				Carbon disulfide						p-Dimethylaminoazobenzene			Dimethoate			
				Chlorobromomethane						Pentochlorethane			Dinoseb			
				Chloroethane						Phenacetin			Diphenylamine			
				cis-1,2-Dichloroethene						Phorate			Disulfoton			
				cis-1,3-Dichloropropene						Pyridine			Hexachloroethane			
				Cyclohexanone						Safrole			Kepone			
				Dibromochloromethane						Tetraethyl Dithiopyrophosphate (Sulfotepp)			Methyl methanesulfonate			
				Dibromomethane						1,1,2,2-Tetrachloroethane			Nitrobenzene			
				Ethyl methacrylate						1,1,2-Trichloroethane			n-Nitrosodiethylamine			
				Isobutanol						1,1,2-Trichlorotrifluoroethane			n-Nitrosodimethylamine			
				n-Butanol						1,1-Dichloroethene			N-Nitroso-di-n-butylamine			
				trans-1,2-Dichloroethene						1,2-Dibromo-3-chloropropane			n-Nitrosodi-n-propylamine			
				trans-1,3-Dichloropropene						1,2-Dibromoethane (EDB)			n-Nitrosomethylethylamine			
				Trichlorofluoromethane						1,2-Dichloroethane			n-Nitrosomorpholine			
				Trihalomethanes, Total						1,2-Dichloropropane			n-Nitrosopiperidine			
										1,3-Dichloropropane			n-Nitrosopyrrolidine			
										1,3-Dichloropropene, Total			Parathion, Methyl			
										1,4-Dioxane			p-Dimethylaminoazobenzene			
										2-Propanol			Pentochlorethane			
										Acetonitrile			Phenacetin			
										Acrolein			Phorate			
										Allyl Chloride (3-Chloropropene)			Pyridine			
										Carbon tetrachloride			Safrole			
										Chloroprene (2-Chloro-1,3-Butadiene)			Tetraethyl Dithiopyrophosphate (Sulfotepp)			
										Ethyl Benzene			1,1,2,2-Tetrachloroethane			
										Ethyl ether			1,1,2-Trichloroethane			
										Ethylene oxide			1,1,2-Trichlorotrifluoroethane			
										Methyl methacrylate			1,1-Dichloroethene			
										Methylacrylonitrile			1,2-Dibromo-3-chloropropane			
										trans-1,4-Dichloro-2-butene			1,2-Dibromoethane (EDB)			
										Trichloroethene (TCE)			1,2-Dichloroethane			
										Vinyl chloride			1,2-Dichloropropane			
													1,3-Dichloropropane			
													1,3-Dichloropropene, Total			
													1,4-Dioxane			
													2-Propanol			
													Acetonitrile			
													Acrolein			
													Allyl Chloride (3-Chloropropene)			
													Carbon tetrachloride			
													Chloroprene (2-Chloro-1,3-Butadiene)			
													Ethyl Benzene			
													Ethyl ether			
													Ethylene oxide			
													Methyl methacrylate			

Table 1
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													Methylacrylonitrile			
													trans-1,4-Dichloro-2-butene			
													Trichloroethene (TCE)			
													Vinyl chloride			
													alpha-BHC			
													Gamma BHC (Lindane)			
													1,2-Dichlorobenzene			
													Acrylonitrile			
													Chlorobenzene			
													Tetrachloroethene			
													Cyanide, Total			
													Mercury			
													Aluminum			
													Antimony			
													Chromium			
													Cobalt			
													Copper			
													Iron			
													Lead			
													Molybdenum			
													Nickel			
													Selenium			
													Silver			
													Vanadium			
													Benzo[a]pyrene			
													Dibenzofuran			
													Fluoranthene			
													Phenanthrene			
													1,3-Dichlorobenzene			
													1,4-Dichlorobenzene			
													Benzene			
													Bromomethane			
													Methylene Chloride			
													Naphthalene			
													Toluene			
													Xylenes, Total			

Notes:
Figure 5-4 serves as a companion figure to this table.
Screen-out
Eliminate
May require additional evaluation
Requires additional evaluation
[1] Anayltes in categories A1, A2, B1. B2, B3, D1, D2, and D3 screened-out from further evaluation based on the screening category they were placed.
[2] Analytes in categories C1, C2, D4, D5, and D6 were initially retained and were each evaluated in a series of meetings and conference calls (held in May through July 2011) attended by MDEQ, EPA, and Dow staff
[3] Analytes from categories C1, C2, D4, D5, and D6 (shaded in gray) were placed in category E1 when the analyte was determined to be eliminated from further evaluation based on the results of the meetings and conference calls.

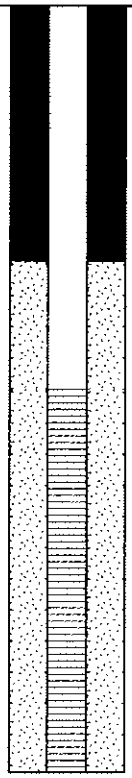
APPENDIX A

MW-10

North East Perimeter | Dow Chemical | Midland, MI

Coordinates: (x): 2915.41 Feet	(y): 1766.73 Feet	Drill Rig	CME-55
Geologist	Victoria Wetzel	Ground Elevation	625.44 TOC 628.42 Feet
Date Drilled	12-17-12	Total Depth of Borehole	10 Feet
Borehole Diameter	8" Inches	Depth to Water	3.8 Feet

Graphic Log	Description	Depth	Sample	PID	Recovery	Blow counts	Completion
	Clay fill, little silt, gravel and fine sand, moist, brown				20/24	2,2	
	Sand, fine, moist, orange					3,4	
	Sand, fine, moist, light brown				21/24	6,8	
						10,11	
	Sand, fine, wet, light brown				15/24	5,7	
		5					
	Clay, silty, moist, brown					3,5	
					24/24	2,4	
						7,10	
					23/24	5,6	
						10,13	



4355

LOG OF SOIL BORING NO. _____

McDOWELL & ASSOCIATES
Geotechnical Engineers

PROJECT: Piezometer Installation

JOB NO. 89-207

LOCATION: Dow Facilities

SURFACE ELEV. 633.7 DATE 5-09-89

Midland, Michigan

Sample & Type	Depth	Legend	SOIL DESCRIPTION	Penetration Blows For 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF.	Str. %
			SOD over sandy black TOPSOIL						
	1		0'10" Compact moist mixed SAND and TOPSOIL fill						
	2		2'0"						
	3		Extremely compact moist fine oxidized brown SAND						
	4								
A				13					
UL	5			19					
				21					
	6		6'3"						
	7		Medium compact moist to wet fine brown SAND, with slight trace of vegetation	2					
UL				3					
	8			4					
	9		9'0"						
	10		Very compact wet fine silty variegated SAND						
	11								
	12								
	13		12'8"						
	14		Very stiff moist silty blue CLAY						
	15								
	16								
	17								
	18								
	19								
	20								
	21								
	22								
	23		23'0"						
	24		Coordinates: 1659.0 N, 2241.5 E						
	25		Top fo casing at elevation 636.20						

TYPE OF SAMPLE
D. - DISTURBED
U L - UNDIST. LINER
S T. - SHELBY TUBE
S.S - SPLIT SPOON
R C - ROCK CORE
( ) - PENETROMETER

REMARKS:

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30"; Count Made At 6" Intervals

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT 6 FT. 8 INS.
G.W. ENCOUNTERED AT FT. INS
G.W. AFTER COMPLETION Set Piezometer FT. INS.
G.W. AFTER HRS FT. INS.
G.W. VOLUMES Heavy

McDOWELL & ASSOCIATES
Geotechnical Engineers
21355 Hatcher Avenue
Ferndale, Michigan 48220
Phone: (313) 399-2066

Boring No. 4355

Job No. 89-207 Well No. _____ Type PVC

Piezometer No. 4355

Type and Size of Auger 4" Flight From 0' To 23'

Type and Size of Casing H.S. Auger 4¼" I.D. From 0' To 13'

Wash Boring With --- Bit From --- To --

Size of Screen 2" x 5' Type #10 Slot Flush Joint

Bottom of Screen Set At 13'

Riser Pipe 2" x 10'3"

Filter 2 Bags of #3 Silica From 13' To 7'

Bentonite 2 Bags Hole Plug From 7' To Surface

Grout --- From --- To ---

Well Protector 5' x 6" with locking cap

Developed With _____

Remarks Dow lock #116A

Grade elevation = 633.7

Top of Pipe = 636.20

LOG OF SOIL BORING NO. 4363

McDOWELL & ASSOCIATES
Geotechnical Engineers

PROJECT Piezometer Installation

JOB NO. 89-207 LOCATION Dow Facilities

SURFACE ELEV. 628.3 DATE 5-11-89 Midland, Michigan

Sample & Type	Depth	Legend	SOIL DESCRIPTION	Penetration Blows For 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF	Str. %
	1		0'8" Moist brown sandy TOPSOIL and CLAY fill						
	2, 3		Moist fine oxidized brown SAND, with slight organic streaks						
	4, 5		3'3" Stiff moist silty oxidized brown CLAY, with a trace of organics						
	6		5'0" Wet fine brown SAND						
	7, 8		6'6" Stiff moist silty brown CLAY, with seams of silt						
	9, 10, 11, 12, 13, 14, 15, 16, 17		9'0" Stiff moist silty blue CLAY, with sand & pebbles						
	18, 19, 20, 21, 22, 23, 24, 25		17'0" Coordinates: 0161.9 N, 4139.4 E Top of casing at elevation 630.68						

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S - SPLIT SPOON
R.C - ROCK CORE
( ) - PENETROMETER

REMARKS:

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30". Count Made At 6" Intervals

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT 5 FT 0 INS.
G.W. ENCOUNTERED AT FT INS.
G.W. AFTER COMPLETION Set Piezometer INS.
G.W. AFTER HRS. FT INS.
G.W. VOLUMES Medium

McDOWELL & ASSOCIATES
Geotechnical Engineers
21355 Hatcher Avenue
Ferndale, Michigan 48220
Phone: (313) 399-2066

Boring No. 4363

Job No. 89-207 Well No. _____ Type PVC

Piezometer No. 4363

Type and Size of Auger 4" Flight From 0' To 17'0"

Type and Size of Casing H.S. Auger 4¼" I.D. From 0' To 6'6"

Wash Boring With --- Bit From --- To ---

Size of Screen 2" x 36" Type #10 Slot Flush Joint

Bottom of Screen Set At 6'6"

Riser Pipe 2" x 5'9"

Filter 1½ Bags #3 silica From 6'6" To 3'6"

Bentonite 1 Bag Hole Plug From 3'6" To Surface

Grout --- From --- To ---

Well Protector 5' x 6" with locking cap

Developed With _____

Remarks Dow Lock #116A

Grade elevation = 628.3

Top of Pipe = 630.68

LOG OF SOIL BORING NO. 5385

McDOWELL & ASSOCIATES
Geotechnical Engineers

PROJECT N.E. Perimeter Piezometers

JOB NO. 93-022

LOCATION Campus Area - Dow

SURFACE ELEV.

DATE 2-10-93

Midland, Michigan

Sample Type	Depth	Legend	SOIL DESCRIPTION	Penetration Blows For 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF.	Str. %
			0'5" Moist brown organic fine silty sandy TOPSOIL with vegetation, fill						
	1		1'8" Moist brown oxidized fine silty SAND, fill						
	2								
	3		Moist blue silty CLAY with some sandy lenses and streaks, sand and pebbles, fill						
	4		4'4"						
	5								
	6		Moist to wet brown fine silty SAND, fill						
	7								
	8		8'0" Moist dark brown silty sandy PEAT with vegetation, fill						
	9		9'0"						
	10		Moist blue silty CLAY with wet sandy seams or streaks						
	11		10'6"						
	12		Moist blue silty CLAY with some silt leanses						
	13		13'0"						
	14								
	15								
	16								
	17								
	18								
	19								
	20								
	21								
	22								
	23								
	24								
	25								

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
( ) - PENETROMETER

REMARKS:

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30"; Count Made At 6" Intervals

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT	6	FT.	9	INS.
G.W. ENCOUNTERED AT		FT.		INS.
G.W. AFTER COMPLETION	9	FT.	6	INS.
G.W. AFTER	HRS.	FT.		INS.

G.W. VOLUMES medium

McDOWELL & ASSOCIATES
21355 Hatcher Avenue
Ferndale, Michigan 48220

Phone: (313) 399-2066
Fax: (313) 399-2157

Job No. 93-022

Date _____

Boring No. 5385

Type 2" S.S.

Well No. _____

Elev. (Grade) _____

Piezo No. 5385

Elev. T/Casing _____

Coordinates _____

METHOD OF DRILLING

Type & Size of Auger 7" flight From 0' To 13'

Type & Size of Casing _____ From _____ To _____

Wash or Flush with _____ From _____ To _____

WELL CONSTRUCTION

Size of Screen 2" x 3' Slot Size 10 Type S.S. point

Bottom of Screen at 10'6"

Riser Pipe: Size 9' x 2" gal. with _____ Stick-up

Filter: #3 silica From 10' To 5'6"

Bentonite: hole plug From 5'5" To surface

Type of Grout: _____ From _____ To _____

Protector 6" flip top steel with Dow lock

Developed with _____ For _____ Hrs.

Remarks: _____

McDOWELL & ASSOCIATES
Geotechnical, Environmental, & Hydrogeologic Services
3730 James Savage Road • Midland, MI 48642
Phone: (989) 496-3610 • Fax: (989) 496-3196

LOG OF SOIL BORING NO. 6176

PROJECT Dow RCRA Investigations

JOB NO. 65092

LOCATION Midland, Michigan

SURFACE ELEV. _____ **DATE** 4-01-05

W of 872 Building

Sample & Type	Depth	Legend	SOIL DESCRIPTION	Penetration Blows for 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF.	Str. %
	1		Brown sandy TOPSOIL FILL						
	2		2'6"						
	3		Buried topsoil & silty SAND moist						
	4		4'0"						
S.S. A	5		Brownish Gray moist to wet silty SAND	Push					
	6								
	7								
S.S. B	8		8'7"	Push					
	9		Silty BLUE CLAY, soft, moist w/pebbles						
	10								
	11		12'0"						
	12		Note: 12'0" End of Boring						
	13								
	14								
	15								
	16								
	17								
	18								
	19								
	20								
	21								
	22								
	23								
	24								
	25								

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
( ) - PENETROMETER

REMARKS:

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30": Count Made at 6" Intervals

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT FT. INS.
G.W. ENCOUNTERED AT FT. INS.
G.W. AFTER COMPLETION FT. INS.
G.W. AFTER HRS. FT. INS.
G.W. VOLUMES MEDIUM

McDOWELL & ASSOCIATES
Geotechnical, Environmental, & Hydrogeologic Services
3730 James Savage Road • Midland, MI 48642
Phone: (989) 496-3610 • Fax: (989) 496-3196

LOG OF SOIL BORING NO. 6177

PROJECT Dow RCRA Investigations

JOB NO. 65092

LOCATION Midland, Michigan

SURFACE ELEV. _____ **DATE** 4-01-05

SE of 1790 Building

Sample & Type	Depth	Legend	SOIL DESCRIPTION	Penetration Blows for 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF.	Str. %
	1								
	2								
	3								
	4		Brown sandy TOPSOIL FILL						
	5								
	6								
	7								
			8'0"						
	8		Buried topsoil & silty SAND moist						
S.S. A	9		9'6"	Push					
	10								
	11		Brown moist to wet silty SAND						
D.S. B	12								
	13								
			14'0"						
	14								
	15		Gray sandy SILT, moist to wet						
	16								
			17'0"						
	17								
	18		Silty BLUE CLAY, soft, moist w/pebbles						
	19								
			20'0"						
	20								
	21		Note: 20'0" End of Boring						
	22								
	23								
	24								
	25								

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
( ) - PENETROMETER

REMARKS:

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30": Count Made at 6" Intervals

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT FT. INS.
G.W. ENCOUNTERED AT FT. INS.
G.W. AFTER COMPLETION FT. INS.
G.W. AFTER HRS. FT. INS.
G.W. VOLUMES MEDIUM

8817

CD-3 | Dow Chemical | Midland, MI

Coordinates: (x): –6417.19 Feet (y): 535.21 Feet		Drill Rig	CME-55
Geologist	Victoria Wetzel	Ground Elevation	605.79 TOC 608.85 Feet
Date Drilled	8-5-13	Total Depth of Borehole	10 Feet
Borehole Diameter	8 Inches	Depth to Water	6 Feet

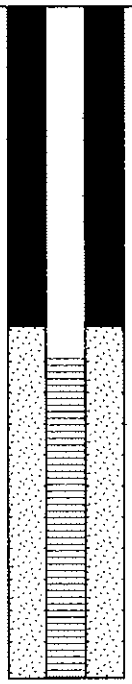
Graphic Log	Description	Depth	Sample	Undefined	Undefined	Undefined	Completion
	Fill						
	Sand, light brown, medium and fine grained, damp	5					
	Silty Clay, brown, stiff, moist						
	Sand, brown, medium and fine grained, wet						
	Clay, gray, little fine rounded gravel, some medium grained sand, hard, moist	10					
		15					

8818

CD-3 | Dow Chemical | Midland, MI

Coordinates: (x): -6413.49 Feet	(y): 688.50 Feet	Drill Rig	CME-55
Geologist	Victoria Wetzel	Ground Elevation	605.02 TOC 607.24 Feet
Date Drilled	8-5-13	Total Depth of Borehole	12 Feet
Borehole Diameter	8 Inches	Depth to Water	9 Feet

Graphic Log	Description	Depth	Sample	Undefined	Undefined	Undefined	Completion
	Fill						
	Sand, dark brown, medium grained, silty, moist						
	Silt, brown, little clay, moist -without clay	5					
	Sand, gray, medium grained, some organics, wet	10					
	Clay, brown, some medium grained sand, firm, damp						
		15					

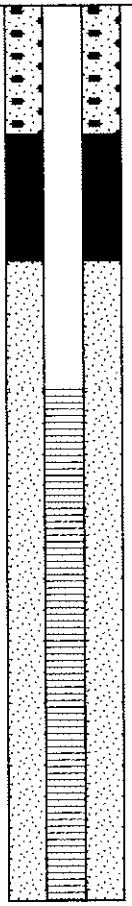


8874

Poseyville Landfill | Dow Chemical | Midland, Midland

Coordinates: (x): -11262.88 Feet (y): -1996.06 Feet		Drill Rig	CME-55
Geologist	Victoria Wetzel	Ground Elevation	629.54 TOC 632.91 Feet
Date Drilled	8-6-13	Total Depth of Borehole	7 Feet
Borehole Diameter	8 Inches	Depth to Water	2 Feet

Graphic Log	Description	Depth	Sample	Undefined	Undefined	Undefined	Completion
	Topsoil, dark brown, moist						
	Sand, light brown, fine to medium grained, wet	5					
	Clay, light brown, some silt, moist						

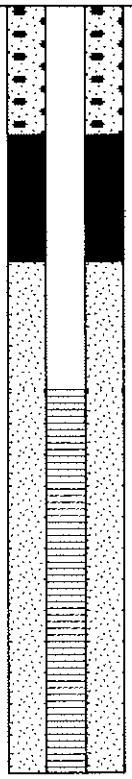


8875

Poseyville Landfill | Dow Chemical | Midland, Midland

Coordinates: (x): -10758.59 Feet (y): -2077.99 Feet		Drill Rig	CME-55
Geologist	Victoria Wetzel	Ground Elevation	628.61 TOC 631.85 Feet
Date Drilled	8-6-13	Total Depth of Borehole	6 Feet
Borehole Diameter	8 Inches	Depth to Water	2 Feet

Graphic Log	Description	Depth	Sample	Undefined	Undefined	Undefined	Completion
	Topsoil, dark brown, moist						
	Sand, brown, fine to medium grained, moist						
	-becoming wet						
	Clay, light brown, some silt, moist	5					



8876

Poseyville Landfill	Dow Chemical	Midland, Midland

Coordinates: (x): -8285.91 Feet	(y): -2092.883 Feet	Drill Rig	CME-55
Geologist	Victoria Wetzel	Ground Elevation	Feet
Date Drilled	8-6-13	Total Depth of Borehole	8 Feet
Borehole Diameter	8 Inches	Depth to Water	Feet

Graphic Log	Description	Depth	Sample	Undefined	Undefined	Undefined	Completion
	Clay, light brown, with fine and medium grained sand, little fine grained gravel, damp						
	Sand, dark brown, medium grained, dry						
	Clay, light brown, with fine and medium grained sand, little fine grained gravel, damp -becoming moist with silt						
		5					

URS Corporation

8877

Poseyville Landfill	Dow Chemical	Midland, Midland

Coordinates: (x): -7808.728 Feet (y): -2107.929 Feet		Drill Rig	CME-55
Geologist	Victoria Wetzel	Ground Elevation	Feet
Date Drilled	8-6-13	Total Depth of Borehole	8 Feet
Borehole Diameter	8 Inches	Depth to Water	Feet

Graphic Log	Description	Depth	Sample	Undefined	Undefined	Undefined	Completion
	Clay, light brown, some fine and medium grained sand, little silt, trace fine grained gravel and coarse sand, damp						
	-becoming soft and moist	5					

APPENDIX B

Field Data Sheet

Monitoring Well Purging and Sampling Form

Project: Facility SAP	**Well ID:**	**Sample Time:**	**Weather:** Ambient Temp: Wind (speed/direction):
Location:	**Well Depth:**	**Purge Start:**	
Field Personnel:	**Well Diameter:**	**Purging Device:**	General Weather Conditions:
Date:	***Well Volume:**	**Pump Intake Depth:**	
Initial SWL & Time:	****Purge Volume:**	**Pumped Dry (circle):** Y / N	Ground Conditions (circle): wet / dry / snow (amount) / ice
Well Type: (circle) Monitoring Well	Flowing Well	**Screen Interval:**	

Reading	Time (24HR)	Water Level (ft) (BTOC)	Volume Purged (L) or (gal)	Purge Rate (~mL/min)	pH (Units) (±0.1)	Specific Conductivity (µS/cm) (±3%)	ORP (mV) (±10mV)	D.O. (mg/L) (±10% if ≥0.3)	Turbidity (NTU) (±10% if ≥20)	Temp (ºC)	**Field Blank Collected (circle):** Y / N **Time:** **Duplicate Collected (circle):** Y / N **Time:** **Comments**
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

SAMPLE DESCRIPTION: Color: Odor: Y / N	**Bottle**	**Preservative**	**Required**	**Collected**	**Analyses/Method**	**Analytical Lab**
Clarity: Other Info:						
Calibration:						
Other Instrumentation Notes/Info:						
Other Info:						
Analytical Lab: **TA = Test America,** **D = Dow,** **O = Other**_____						

*** Well volume = (Well Depth - SWL) x (volume conversion factor)** ****Purge Volume = Well Volume x 3**

Well Diameter (in)	**1**	**1.5**	**2**	**3**	**4**	**6**	**8**	**10**
Volume conversion factor(gal/ft)	0.04	0.09	0.16	0.37	0.65	1.47	2.61	4.08
Volume conversion factor(L/ft)	0.15	0.35	0.61	1.40	2.46	5.56	9.88	15.44

Additional Notes on Back

Reading	Time (24HR)	Water Level (ft) (BTOC)	Volume Purged (L) or (gal)	Purge Rate (~mL/min)	pH (Units) (±0.1)	Specific Conductivity (µS/cm) (±3%)	ORP (mV) (±10mV)	D.O. (mg/L) (±10% if ≥0.3)	Turbidity (NTU) (±10% if ≥20)	Temp (ºC)	Comments
21											
22											
23											
24											
25											
26											
27											
28											
29											
30											
31											
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40											

Additional Notes: