Groundwater Monitoring System
Summary Report

DTE Electric Company
Monroe Power Plant Fly Ash Basin
Coal Combustion Residual Unit

7955 East Dunbar Road
Monroe, Michigan

October 2017

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Prepared For
DTE Electric Company

Graham Crockford, C.P.G.
Senior Project Geologist

David B. McKenzie, P.E.
Senior Project Engineer

1540 Eisenhower Place, Ann Arbor, MI 48108 ● 734.971.7080 Phone ● 734.971.9022 Fax
www.TRCsolutions.com

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Section 1
Introduction

1.1 Background and Objective

The United States Environmental Protection Agency (U.S. EPA) established a comprehensive set of requirements for management and disposal of coal combustion residuals (CCR) in landfills and surface impoundments in the Final Rule: Disposal of CCR from Electric Utilities (CCR Rule) on April 17, 2015. The DTE Electric Company (DTE Electric) Monroe Power Plant (MONPP) Fly Ash Basin (FAB) CCR unit is subject to the CCR Rule.

The objective of this report is to document and certify that the CCR Groundwater Monitoring System for the MONPP FAB CCR unit has been designed and constructed to meet the requirements of Title 40 Code of Federal Regulations (CFR) §257.91 (a)(1) and (2) of the CCR Rule. TRC Engineers Michigan, Inc. (TRC) was retained by DTE Electric to provide this report documenting the construction of the CCR groundwater monitoring system for the MONPP BAB.

1.2 Site Location

The MONPP is located in Section 16, Township 7 South, Range 9 East, at 7955 East Dunbar Road, Monroe in Monroe County, Michigan (**Figure 1**). The MONPP FAB is located about one mile southwest of the MONPP at latitude 41° 53' 03" North and longitude 83° 22' 31" West. The MONPP FAB is bounded by Dunbar Road and Plum Creek to the north and northeast, Interstate 75 to the northwest, a 200-acre peninsula into Lake Erie to the east and southeast, Lake Erie to the south and a large open field to the southwest (**Figure 2**).

1.3 Description of CCR Unit

The property has been used continuously for the operation of the MONPP FAB since approximately 1975 and is constructed over a natural clay-rich soil base. The MONPP FAB and landfill is a Type III solid waste disposal facility owned by DTE Electric, which currently accepts coal ash from DTE Electric's MONPP. The MONPP FAB is operated in accordance with Michigan Part 115 rules and the current operating license number 9393.

The MONPP FAB CCR unit is approximately 410-acres with an original design storage capacity of 18,500 acre-feet at a maximum elevation of 614 feet relative to the National Geodetic Vertical Datum of 1929 (NGVD 29)[1] (**Figure 2**). The FAB consists of an earthfill clay-rich soil

[1] GZA Geo Environmental, Inc., 2011, Round 7 Dam Assessment, DTE Energy Monroe Power Plant, Fly Ash Basin and Bottom Ash Stormwater Pond

embankment (raised surface impoundment) with a crest perimeter length of approximately 18,200 feet and a general height (from the lowest toe elevation to the top of embankment) of approximately 40 feet, with a maximum height of 44 feet. A road along the top of the crest has a width of approximately 15 feet and an elevation of approximately 614 feet NGVD 29 with the typical water operational level being 610 feet NGVD 29[1].

The FAB base is keyed into the existing natural clay-rich soil ground surface at an elevation of 563.4 feet. This natural low permeability clay-rich soil base serves as an underlying hydraulic barrier, forming a natural liner of at least 23 feet of natural clay-rich soil below the base of the FAB. Under Michigan Part 115 rules, the MONPP FAB CCR unit is not required to monitor units beneath the clay-rich soil base confining unit due to its thickness, continuity and low hydraulic conductivity.

The Fly Ash Basin has a structural height of approximately 50.6 feet. The outer slope of the embankment has a slope generally ranging from approximately 1.8 horizontal to 1 vertical (1.8H:1V) to 2.5H:1. The inner slope of the embankment where the coal ash slurry is stored has a slope of approximately 2H:1V. CCRs are placed into the FAB by use of a "wet" (sluiced) disposal method. In 2015, DTE Electric added a 79-acre "dry" disposal area vertical extension landfill located on top of a portion of the FAB that had been filled to approximate final grade with CCR[2].

[2] Geosyntec Consultants, 2015, 2015 Annual Inspection Report, Vertical Extension Landfill, Monroe Power Plant, Monroe, Michigan

Section 2
Hydrogeology

2.1 Regional Hydrogeologic Setting

The geology of Monroe County consists of primarily unconsolidated alluvium and glacial deposits overlying bedrock. The unconsolidated material consists of shallow/surficial alluvium deposits (sand and gravel) on top of clay-rich glacial till with some sporadic glaciofluvial deposits that range from not present to more than 150 feet thick, with an average thickness of about 50 feet[3]. Bedrock in Monroe County is predominantly Devonian and Silurian-aged carbonates and includes the Antrim Shale, Traverse Group, Dundee Formation (limestone and some dolostone), Detroit River Group, Sylvania Sandstone, Bass Islands Group, and Salina Group. There is a potential for uppermost aquifers to be within the overlying alluvium (4%); however, the majority of drinking water wells in the county (91%) are installed in bedrock[3]. The bedrock surface is highest in the central and southwestern portion of the county and dips to the southeast and northwest due to erosion. Monroe County's eastern boundary is Lake Erie, and in general, regional groundwater flow is to the east towards Lake Erie[3]. Much of the carbonate bedrock aquifer in Monroe County is generally confined and naturally artesian.

2.2 MONPP FAB Hydrogeology

The subsurface site geology presented in this report is primarily based on historical MONPP design borings advanced in the 1970s, in addition to the recent soil data collected from around the FAB during the groundwater monitoring system installation detailed in Section 3. Soil borings from the groundwater monitoring system installation are included in Appendix A and generalized geologic cross sections are provided in **Figures 3 through 5**.

Historical borings advanced when designing the MONPP FAB in the 1970s and recent work performed to install monitoring wells MW-16-01 through MW-16-07 documented that the MONPP FAB overlies more than 35 feet of unconsolidated clay-rich glacial till and/or lacustrine deposits with saturated limestone of the Bass Islands Group bedrock generally encountered from 37 to 53.5 feet below ground surface (feet-bgs) (**Figures 3 through 5**). The Bass Island Group can be as thick as 350 feet in Monroe County[4]. Two modes of groundwater movement through the carbonate bedrock are recognized: (i) through pore spaces in the rock (primary porosity),

[3] Beth A. Apple and Howard W. Reeves, 2007, Summary of Hydrogeologic Conditions by County for the State of Michigan. U.S. Geological Survey Open-File Report 2007-1236, 78 p.
[4] Reeves, H.W., Wright, KV and Nicholas, J.R., 2004, Hydrogeology and Simulation of Regional Ground-Water-Level Declines in Monroe County, Michigan, Water-Resources Investigations Report 03-4312, U.S. Department of the Interior, U.S. Geological Survey, Lansing, Michigan, 69 p.

and (ii) along an intersecting system of fractures, joints, and bedding planes, collectively referred to as secondary porosity[4]. Groundwater flow in the carbonate bedrock aquifer in Monroe County is primarily through secondary porosity consisting of fractures often evident along bedding-plane partings.

The limestone aquifer encountered at the site is generally artesian except in the area of monitoring well MW-16-01. Monitoring well MW-16-01 is located within several hundred feet of several off-site domestic residential water supply wells located to the north along Dunbar Road adjacent to Plum Creek that likely lower the hydraulic head in the area of MW-16-01.

Surface water bodies present in the area of the MONPP FAB include the Plum Creek a wide shallow creek (as close as 200 feet north and northeast of the MONPP FAB), Lake Erie (immediately adjacent to a portion of the MONPP FAB to the south) and the LaPlaisance Creek (approximately 2,000 feet south of the MONPP FAB).

2.2.1 Uppermost Aquifer

Definition

The 40 CFR §257.53 definitions of an aquifer and uppermost aquifer are as follows:

- *Aquifer* means a geologic formation, group of formations, or portion of a formation capable of yielding useable quantities of groundwater to wells or springs.
- *Uppermost aquifer* means the geologic formation nearest the natural ground surface that is an aquifer, as well as the lower aquifers that are hydraulically interconnected with this aquifer within the facility's property boundary. Upper limit is measured at a point nearest to the natural ground surface to which the aquifer rises during the wet season.

Site Uppermost Aquifer

As described above, the MONPP FAB CCR unit uppermost aquifer as defined in 40 CFR §257.53 consists of saturated limestone present beneath at least 37 feet and up to 53.5 feet of thick contiguous silty clay-rich soil that serves as a natural confining hydraulic barrier that isolates the underlying uppermost aquifer (**Figures 3 through 5**). The overlying low permeability silty clay-rich soil consistently has a hydraulic conductivity on the order of 1 to 2 x 10^{-8} cm/s as found in soil testing performed during the CCR monitoring well installation and no higher than 6.5 x 10^{-8} cm/s in historical site clay-rich soil testing[5].

[5] Detroit Edison, 1995, MONPP – Effectiveness of the Underlying Clay Soil as a Natural Barrier On-Site Ash Disposal Basin, Technical Report 242

The limestone bedrock aquifer is artesian in every location except MW-16-01, where static water level was approximately 1 to 2 feet-bgs. As mentioned above, it is likely that the hydraulic head in the area of monitoring well MW-16-01 is lower due to groundwater pumping from several water supply wells in the area. Soil boring and well logs for the CCR monitoring wells are included in Appendix A.

2.2.2 Groundwater Flow

Groundwater Flow Direction

TRC installed the groundwater monitoring wells included in the CCR monitoring well system which were completed in April 2016. TRC was also retained to collect water samples and to measure groundwater level data from these wells. Based on data collected by TRC, the general flow potential within the uppermost aquifer at the site is to the northeast towards Plum Creek. **Figure 6** provides a representative groundwater potentiometric surface map from January 2017. Wells located hydraulically upgradient of the CCR unit include MW-16-03, MW-16-04 and MW-16-05 on the southwestern and southern part of the FAB CCR. These wells exhibit potentiometric elevations (generally 10 to 15 feet above ground surface) resulting in flowing conditions. Downgradient monitoring wells MW-16-01, MW-16-05 and MW-16-06 are slightly artesian to not artesian.

The potentiometric groundwater elevations collected in 2016 and 2017 suggest that there is horizontal groundwater flow potential within the upper aquifer unit generally to the northeast towards Plum Creek. The average hydraulic gradient to the northeast ranges from 0.002 to 0.0025 foot/foot along the eastern part of the FAB to 0.004 to 0.005 foot/foot in the center and northwestern part of the FAB, with an overall mean of 0.004 foot/foot.

The surface water elevation within the FAB raised surface impoundment is at least 5 to more than 30 feet above the potentiometric surface elevations in the uppermost aquifer limestone, and more than 60 feet above the base of the underlying clay-rich confining unit that isolates groundwater within the limestone aquifer. Therefore, flow potential from the CCR unit to the surrounding area would be radially outward from the FAB. However, there is no hydraulic communication between the uppermost aquifer and the FAB due to the continuous silty clay-rich confining unit beneath the MONPP FAB. Based on the artesian conditions, the low permeability of the underlying natural soils, and the calculated time of travel for groundwater to flow vertically from the FAB to the uppermost aquifer, it is not possible for the uppermost aquifer to have been affected by CCR from FAB operations that began in 1975.

Uppermost Aquifer Hydraulic Conductivity

A mean hydraulic conductivity of approximately 4.3 feet/day was measured from one of the CCR monitoring wells using single well hydraulic conductivity tests (e.g., slug tests) performed in 2016. This result is consistent with other sources (5 feet/day) for the hydraulic conductivity of the Bass Island Group[4].

Horizontal Time of Travel

Using the groundwater potentiometric surface elevations measured at the MONPP FAB unit in 2016 and 2017, the horizontal gradient has varied from approximately 0.002 to 0.005 with an average gradient approximately 0.004 foot/foot to the northeast. Assuming an average porosity of 0.1 for the limestone in the uppermost aquifer, a mean hydraulic conductivity of 5 feet/day, and a hydraulic gradient of 0.004 for the limestone aquifer the potential horizontal groundwater flow rate to the northeast is approximately 0.2 feet/day or 73 feet/year.

Vertical Time of Travel

The MONPP FAB CCR unit was constructed in an area that consists of a naturally occurring silty-clay rich soil. This naturally deposited soil barrier has been verified by numerous historical soil borings[5], and also confirmed by TRC during completion of the seven soil borings installed as part of the CCR monitoring well installation program. Consequently, the geology and hydrogeology of the site provides a very high level of environmental protection of the uppermost aquifer. Based on the site geology and hydrogeology, there is extremely low potential for the landfill to affect the off-site uppermost aquifer groundwater in the future. Groundwater occurring in the deep confined uppermost limestone aquifer is protected from CCR constituents by the thick clay-rich aquitard with low hydraulic conductivity. In addition, under Michigan Part 115 rules, the MONPP FAB CCR unit is not required to monitor units beneath the clay-rich confining unit due to its thickness, continuity and low hydraulic conductivity.

Using the hydrogeologic information for the site, the time of travel for water from the base-grade elevation of the MONPP FAB down to the uppermost aquifer has previously been calculated to be 308 years assuming a maximum silty-clay hydraulic conductivity of 6.5×10^{-8} cm/s and 23 feet of silty-clay present between the bottom of the MONPP FAB CCR unit and the limestone bedrock surface[5]. Therefore, given that the MONPP FAB operations began in 1975, approximately 42-years ago, there is no potential for the uppermost aquifer CCR groundwater monitoring system wells to be affected from the MONPP FAB CCR unit.

Section 3
Groundwater Monitoring System

3.1 Groundwater Monitoring System Installation

During February to April 2016, TRC, on behalf of DTE oversaw the installation and development of the groundwater monitoring system in accordance with the 40 CFR §257.91. Seven monitoring wells (MW-16-01 through MW-16-07) were installed by a Michigan-licensed well driller at the MONPP FAB in order to establish the groundwater monitoring system as described below:

3.1.1 Soil Boring Advancement

In February through April 2016, seven soil borings were advanced to evaluate the subsurface geology and to allow monitoring well installation using sonic drilling techniques with 4-inch and 6-inch tooling along the perimeter of the MONPP FAB CCR unit. Soil samples were collected continuously in ten-foot sections from the ground surface to the termination of the soil boring. A TRC geologist was present to log each boring and describe the soil samples in accordance with the Unified Soil Classification System (USCS).

The soil borings were advanced to depths ranging from approximately 40 to 60 ft-bgs to within the top of the limestone bedrock. In most cases (at every location except MW-16-01), artesian conditions were encountered at the terminus of the soil borings. The variability in boring depth is related to the variable thickness of the overlying silty clay-rich soil (ranging from 37 to 53.5 feet) that overlies and confines the uppermost portion of the limestone uppermost aquifer and the distance to top of bedrock at each location.

3.1.2 Monitoring Well Installation

Based on the depths to the uppermost aquifer in each soil boring location, CCR monitoring wells MW-16-01 through MW-16-07 were screened within the uppermost portion of the limestone uppermost aquifer (along the clay/bedrock interface). Screened intervals in these monitoring wells range from 35 to 40 feet-bgs to 53 to 58 feet-bgs in the seven locations around the MONPP FAB perimeter (Figure 2). Given the presence of the natural clay-rich hydraulic barrier and the observed artesian conditions within the uppermost aquifer, the horizontal spacing of the wells is adequate to detect constituents from the CCR unit.

Monitoring wells were constructed within each borehole using 2-inch-diameter, Schedule 40 PVC casing and 5-foot long screens with 0.010-inch factory cut slots. Monitoring well construction diagrams from the installed monitoring wells accompany the soil boring logs in Appendix A. Following well installation, the cement grout and bentonite seal materials were allowed to stabilize for more than 24-hours before monitoring well development began.

3.1.3 Monitoring Well Development and Surveying

Following installation, each CCR monitoring well was developed by air lifting methods or by allowing it to develop naturally through artesian flow. In addition, a Michigan-licensed surveyor horizontally located each monitoring well utilizing the Michigan State Plane South Zone-2113, North American Datum 1983 (NAD 83), International feet. Vertical elevations of the ground surface at each soil boring and monitoring well location and the top of casing for each monitoring well were also surveyed in feet relative to the North American Vertical Datum of 1988 (NAVD 88). Monitoring well coordinates, elevations, screened intervals, and other monitoring well details are included in Table 1.

3.1.4 Detection Monitoring

The MONPP FAB CCR unit groundwater monitoring system, as shown on Figure 2, will serve as the detection monitoring locations pursuant to Title 40 CFR §257.93 and §257.94 of the CCR Rule. The MONPP FAB CCR unit will use intra-well statistical methods because the saturated unit being monitored is isolated by a laterally contiguous silty-clay unit which significantly impedes vertical groundwater flow thus preventing the monitored saturated zone from potentially being affected by CCR. In addition, the flow potential of liquid within the FAB is radially outward relative to the uppermost aquifer due to the elevation water is maintained within the FAB CCR unit. Based on these hydrogeologic conditions, intra-well statistical approaches are likely a more appropriate method to evaluate groundwater data statistically. Consequently, intra-well statistical tests will be evaluated for use during detection monitoring. Using the data collected from the monitoring well system, a statistical evaluation plan is being developed to evaluate compliance with the CCR Rule.

Section 4
Groundwater Monitoring System Certification

Groundwater Monitoring System Certification per 40 CFR §257.91(f)
Monroe Power Plant Fly Ash Basin
Monroe, Michigan

The U.S. EPA's Disposal of Coal Combustion Residuals from Electric Utilities Final Rule Title 40 CFR Part 257, §257.91, requires that the owner or operator of an existing CCR unit install a groundwater monitoring system. The owner or operator must obtain a certification from a qualified professional engineer stating that the groundwater monitoring system has been designed and constructed to meet the requirements of Title 40 CFR §257.91.

CERTIFICATION

I hereby certify that the groundwater monitoring system presented within this document for the MONPP FAB CCR unit has been designed and constructed to meet the requirements of Title 40 CFR §257.91 of the Federal CCR Rule. This document is accurate and has been prepared in accordance with good engineering practices, including the consideration of applicable industry standards, and with the requirements of Title 40 CFR §257.91.

Name	Expiration Date	
David B. McKenzie, P.E.	October 31, 2017	
Company	Date	
TRC Engineers Michigan, Inc.	October 13, 2017	Stamp

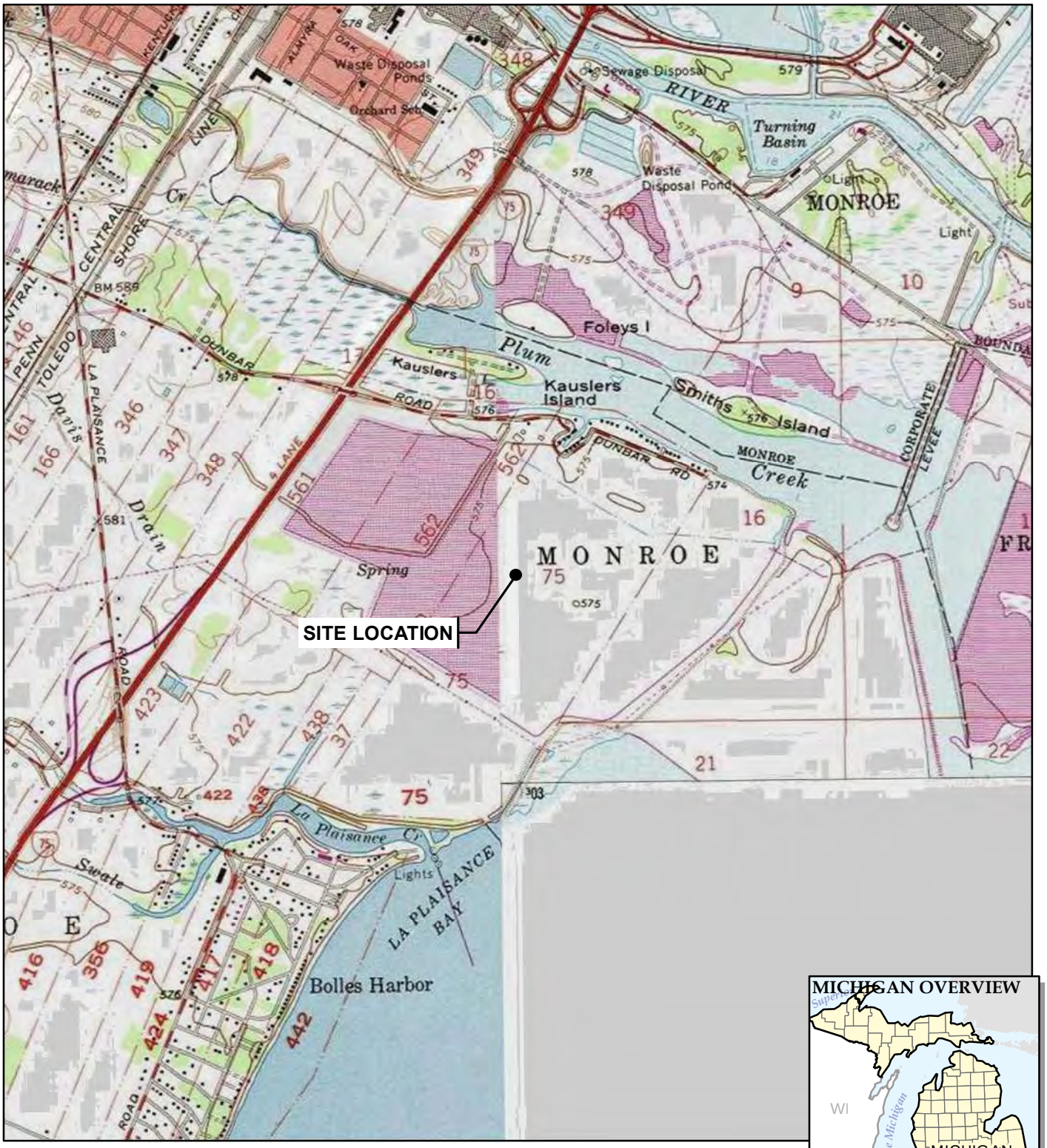
Tables

Table 1
Monitoring Well Information Summary
DTE Electric Company – Monroe Power Plant Fly Ash Basin
Monroe, Michigan

Well Location	Date Installed	Northing	Easting	Ground Surface Elevation (ft AMSL)	TOC Elevation (ft AMSL)	Geologic Unit of Screen Interval	Well Construction	Screen Interval Depth (ft BGS)	Screen Interval Elevation (ft AMSL)	Borehole Terminus Depth (ft BGS)	Borehole Terminus Elevation (ft AMSL)
Monroe Fly Ash Basin											
MW-16-01	2/17/2016	143121.86	13394675.84	578.91	581.74	Silty Clay at 48-50 ft bgs, Limestone bedrock at 50-53 ft bgs	2" PVC	48.0 to 53.0	530.9 to 525.9	55.0	523.9
MW-16-02	2/18/2016	140938.78	13396986.03	579.44	581.81	Silty Clay at 53-53.5 ft bgs, Limestone bedrock at 53.5-58 ft bgs	2" PVC	53.0 to 58.0	526.4 to 521.4	60.0	519.4
MW-16-03	2/16/2016	139040.68	13395136.56	577.29	579.95	Sand at 37.5-39 ft bgs, Silty Clay at 39-40 ft bgs, Limestone bedrock 40-42 ft bgs	2" PVC	37.0 to 42.0	540.3 to 535.3	50.0	527.3
MW-16-04	2/15/2016	140704.67	13390758.97	582.64	585.54	Silty Gravel at 41-42.5, Silty Sand at 42.5-44, Silt at 44-46 ft bgs, Limestone bedrock at 46 ft bgs	2" PVC	41.0 to 46.0	541.6 to 536.6	50.0	532.6
MW-16-05	4/13/2016	139537.00	13392809.68	580.51	583.25	Limestone bedrock	2" PVC	40.0 to 45.0	540.5 to 535.5	50.0	530.5
MW-16-06	4/13/2016	142566.72	13396398.37	579.20	581.94	Gravel and Cobbles	2" PVC	45.0 to 50.0	534.2 to 529.2	50.0	529.2
MW-16-07	4/14/2016	143408.82	13392311.01	575.41	578.40	Sandy Silt with Clay at 35-37 ft bgs, Limestone bedrock at 37-40 ft bgs.	2" PVC	35.0 to 40.0	540.4 to 535.4	40.0	535.4

Notes:
Coordinates are Michigan State Plane South Zone-2113, International Feet.
Elevation in feet above NAVD88.
TOC: Top of well casing.
ft AMSL: Feet above mean sea level.
ft BGS: Feet below ground surface.

Figures



BASE MAP FROM USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE SERIES.

N

1 " = 2,000 '
1:24,000

0 2,000 4,000
FEET

TRC
1540 Eisenhower Place
Ann Arbor, MI 48108-3284
Phone: 734.971.7080
TRC - GIS

PROJECT:
DTE ELECTRIC COMPANY
MONROE POWER PLANT
7955 EAST DUNBAR ROAD
MONROE, MICHIGAN

TITLE:
SITE LOCATION MAP

DRAWN BY:	J. PAPEZ
CHECKED BY:	S HOLMSTROM
APPROVED BY:	V. BUENING
DATE:	OCTOBER 2017
PROJ. NO.:	265996.0001
FILE:	265996-SLMMB.mxd

FIGURE 1

E:\DTE\CCR_Sites\2017_265996\265996-SLMMB.mxd -- Saved By: BDEEGAN on 10/9/2017, 14:49:39 PM

LEGEND

- MONITORING WELLS
- APPROXIMATE BOUNDARY OF FLY ASH

NOTES

1. BASE MAP IMAGERY FROM ESRI/MICROSOFT, "WORLD IMAGERY", WEB BASEMAP SERVICE LAYER.
2. WELL LOCATIONS SURVEYED BY BMJ ENGINEERS AND SURVEYORS INC. IN MARCH AND MAY 2016.

N

0 600 1,200 Feet

1 " = 600 '

1:7,200

PROJECT:

DTE ELECTRIC COMPANY
MONROE POWER PLANT FLY ASH BASIN
7955 EAST DUNBAR ROAD
MONROE, MICHIGAN

TITLE:

MONITORING NETWORK AND SITE PLAN

DRAWN BY:	J. PAPEZ	PROJ NO.:	265996.0001
CHECKED BY:	S. HOLMSTROM		
APPROVED BY:	V. BUENING		**FIGURE 1**
DATE:	OCTOBER 2017		

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1540 Eisenhower Place
Ann Arbor, MI 48108-3284
Phone: 734.971.7080
www.trcsolutions.com

FILE NO.: 265996-0001-000.mxd

TRC - GIS
Coordinate System: NAD 1983 UTM Zone 17N (Meter)
Map Rotation: 0
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Path: E:\DTE\CCR_Sites\2017_265996\265996-0001-000.mxd

LEGEND

- MONITORING WELLS
- APPROXIMATE BOUNDARY OF FLY ASH
- CROSS SECTIONS

NOTES

1. BASE MAP IMAGERY FROM ESRI/MICROSOFT, "WORLD IMAGERY", WEB BASEMAP SERVICE LAYER.
2. WELL LOCATIONS SURVEYED BY BMJ ENGINEERS AND SURVEYORS INC. IN MARCH AND MAY 2016.

0 600 1,200 Feet

1 " = 600 '

1:7,200

PROJECT:

DTE ELECTRIC COMPANY
MONROE POWER PLANT FLY ASH BASIN
7955 EAST DUNBAR ROAD
MONROE, MICHIGAN

TITLE:

CROSS SECTION LOCATOR MAP

DRAWN BY:	J. PAPEZ	PROJ NO.:	265996.0001
CHECKED BY:	S. HOLMSTROM		**FIGURE 3**
APPROVED BY:	V. BUENING		
DATE:	OCTOBER 2017		

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Phone: 734.971.7080
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FILE NO.: 265996-0001-008.mxd

TRC - GIS

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Map Rotation: 0

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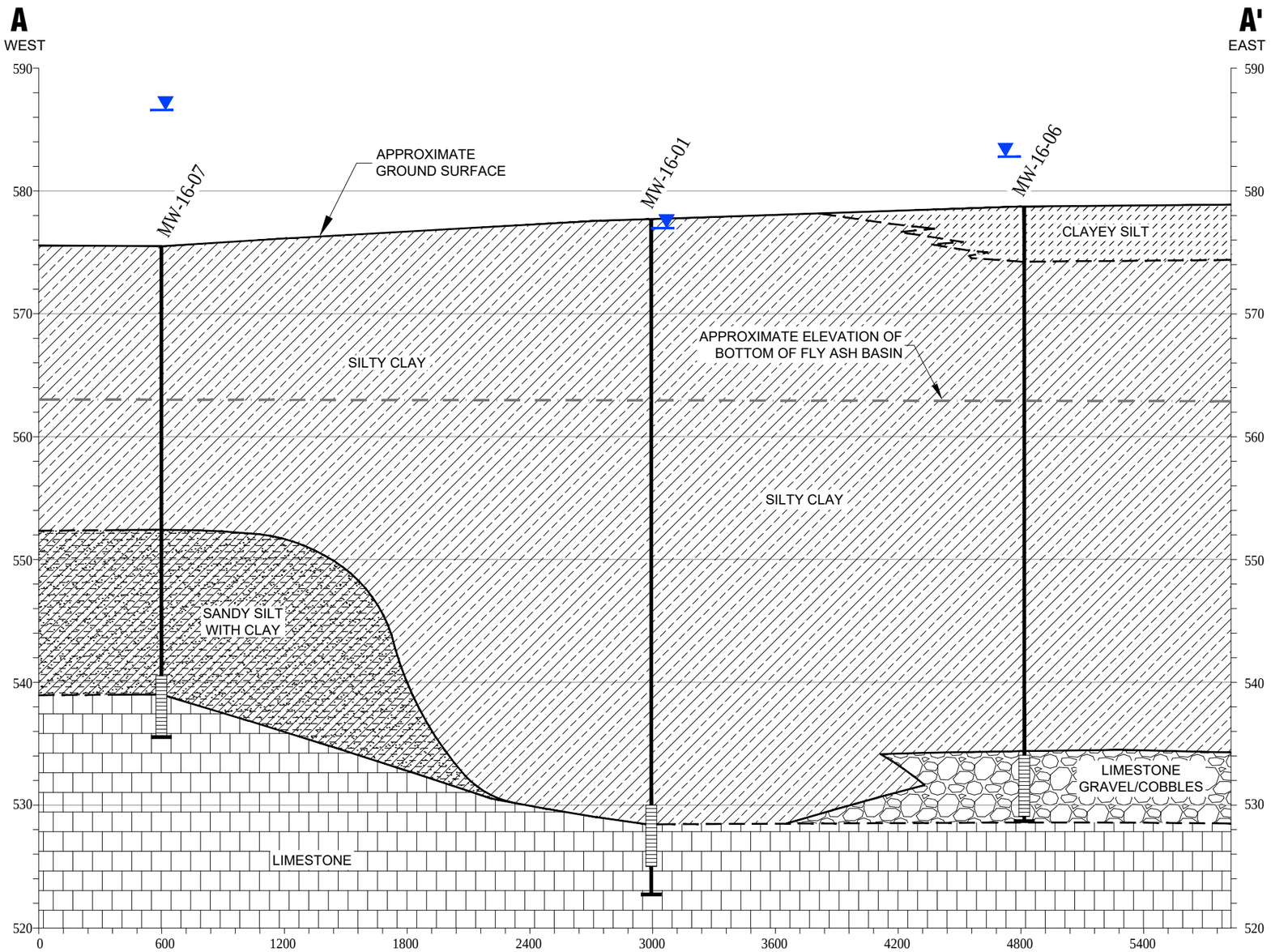
Path: E:\DTE\CCR_Sites\2017_265996\265996-0001-008.mxd

GENERALIZED GEOLOGIC CROSS-SECTION A-A'



LEGEND

- STRATEGRAPHIC BOUNDARY (DASHED WHERE INFERRED)
- GROUNDWATER ELEVATION (COLLECTED ON 03/06/2017)
- SOIL BORING
- WELL SCREEN INTERVAL
- END OF BORING

Lithology Key

- CLAYEY SILT
- SILTY CLAY
- SANDY SILT WITH CLAY
- LIMESTONE GRAVEL / COBBLES
- LIMESTONE BEDROCK

SCALE IN FEET
VERTICAL: 10 / 0
HORIZONTAL: 0 / 600

PROJECT:
DTE ELECTRIC COMPANY
MONROE POWER PLANT - FLY ASH BASIN
MONROE, MICHIGAN

TITLE:
GENERALIZED GEOLOGIC CROSS-SECTION A-A'

DRAWN BY:	D.STEHLE	PROJ NO.:	265996.0001.01
CHECKED BY:	S.HOLMSTROM		
APPROVED BY:	V.BUENING		**FIGURE 4**
DATE:	SEPTEMBER 2017		

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1540 Eisenhower Place
Ann Arbor, MI 48108
Phone: 734.971.7080
www.trcsolutions.com

FILE NO.: 265996.0001.01.01.04-05.dwg

GENERALIZED GEOLOGIC CROSS-SECTION B-B'

B SOUTH — **B'** NORTH

ACCESS ROAD

APPROXIMATE GROUND SURFACE

FLY ASH BASIN OPEN WATER

OPERATION WATER LEVEL ~609'

DEEPEST ASH ~570.2'

MINIMUM ASH THICKNESS ~7'

BOTTOM OF BASIN ~563'

MW-16-05

MW-16-01

Plum Creek

SILTY CLAY

LIMESTONE

620 610 600 590 580 570 560 550 540 530 520

0 600 1200 1800 2400 3000 3600 4200 4800 5400

LEGEND

- STRATEGRAPHIC BOUNDARY (DASHED WHERE INFERRED)
- GROUNDWATER ELEVATION (COLLECTED 03/06/2017)
- SOIL BORING
- WELL SCREEN INTERVAL
- END OF BORING

Lithology Key

- SILTY CLAY
- LIMESTONE BEDROCK

SCALE IN FEET

VERTICAL 10 0

HORIZONTAL 0 600

PROJECT:
DTE ELECTRIC COMPANY
MONROE POWER PLANT - FLY ASH BASIN
MONROE, MICHIGAN

TITLE:
GENERALIZED GEOLOGIC CROSS-SECTION B-B'

DRAWN BY:	D.Stehle	PROJ NO.:	265996.0001.01.01
CHECKED BY:	S.HOLMSTROM		
APPROVED BY:	V.BUENING		**FIGURE 5**
DATE:	MAY 2017		

TRC
1540 Eisenhower Place
Ann Arbor, MI 48108
Phone: 734.971.7080
www.trcsolutions.com

FILE NO.: 265996.0001.01.01.04-05.dwg

LEGEND

- MONITORING WELL
- APPROXIMATE BOUNDARY OF FLY ASH BASIN
- GROUNDWATER FLOW DIRECTION
- POTENTIOMETRIC SURFACE CONTOUR LINE (DASHED WHERE INFERRED)
- 582.69 STATIC WATER ELEVATION IN FEET (NGVD, 1988)

NOTES

1. BASE MAP IMAGERY FROM ESRI/MICROSOFT, "WORLD IMAGERY", WEB BASEMAP SERVICE LAYER.
2. GROUNDWATER MEASUREMENTS FROM 5/5/2016.
3. WELL LOCATIONS SURVEYED BY BMJ ENGINEERS AND SURVEYORS INC. IN MARCH AND MAY 2016.

0 600 1,200 Feet

1 " = 600 '

1:7,200

PROJECT:
DTE ELECTRIC COMPANY
MONROE POWER PLANT FLY ASH BASIN
7955 EAST DUNBAR ROAD
MONROE, MICHIGAN

TITLE:
GROUNDWATER POTENTIOMETRIC SURFACE MAP
JANUARY 2017

DRAWN BY:	B. DEEGAN	PROJ NO.:	265996.0001
CHECKED BY:	S. HOLMSTROM		FIGURE 6
APPROVED BY:	V. BUENING		
DATE:	OCTOBER 2017		

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1540 Eisenhower Place
Ann Arbor, MI 48108-3284
Phone: 734.971.7080
www.trcsolutions.com

FILE NO.: 265996-0001-009.mxd

TRC - GIS
Coordinate System: NAD 1983 UTM Zone 17N (Meter)
Map Rotation: 0
Plot Date: 10/9/2017, 14:58:49 PM by BDEEGAN -- LAYOUT: ANSI B (11"x17")
Path: E:\DTE\CCR_Sites\2017_265996\265996-0001-009.mxd

Appendix A
Soil Boring and Monitoring Well Installation Logs

WELL CONSTRUCTION LOG

WELL NO. MW-16-01

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
DTE EC: Monroe FAB	2/17/16	2/17/16	231828.0001.0000

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Stock Drilling	Sonic	578.91	581.74	60.0	6

Boring Location: SW of fly ash basin. N: 143121.86 E: 13394675.84	Personnel: Logged By - Jennifer Reed; Driller - Austin Goldsmith	Drilling Equipment: TerraSonic

Civil Town/City/or Village:	County:	State:	Water Level Observations: While Drilling: Date/Time; After Drilling: Date/Time 3/17/16 08:45	Depth (ft bgs): Depth (ft bgs) 2.00
Monroe, MI	Monroe	Michigan		

SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	WELL DIAGRAM	COMMENTS
1 CS	65		0	**SILTY CLAY** mostly clay, some silt, low plasticity, very dark gray (7.5YR 3/1), no odor, moist, medium stiff, high organic content, roots and grass. Change to no roots at 3.5 feet. Change to hard at 5.0 feet. Change to medium stiff at 5.5 feet. Change to trace to few gravel at 6.0 feet.				
2 CS	95		10	Change to medium plasticity, dark gray (10YR 4/1) mottled with yellowish brown (10YR 5/6), at 12.5 feet. Change to dark gray (10YR 4/1), very stiff at 17.5 feet.				
3 ST	60		20		CL-ML			
4 CS	100		30	Change to weathered limestone appearance, light gray (10YR 7/1), slight odor, stiff at 32.5 feet.				
5 CS	100		40	Change to not cohesive at 42.5 feet. Change to little silt, few coarse sand at 43.5 feet. Change to some silt, trace coarse sand at 45.0 feet. Grades to wet from 40 to 48 feet. Change to bedrock fragments encountered, wet at 48.0 feet.				
6 CS	95		50	**LIMESTONE** very weathered, light gray (10YR 7/1), moist, medium dense, similar to silt.				
7 CS	100			End of boring at 55.0 feet below ground surface.				

SOIL BORING WELL CONSTRUCTION LOG 231828.0001.GPJ TRC_CORP.GDT 231828.0001.0000 5/16/16

Signature: Jreed

Firm: TRC Environmental Corporation 734-971-7080
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WELL CONSTRUCTION LOG

WELL NO. MW-16-02

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
DTE EC: Monroe FAB	2/18/16	2/18/16	231828.0001.0000

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Stock Drilling	Sonic	579.44	581.81	55.0	6

Boring Location: S of fly ash basin. N: 140938.78 E: 13396986.03	Personnel: Logged By - Jennifer Reed; Driller - Austin Goldsmith	Drilling Equipment: TerraSonic

Civil Town/City/or Village:	County:	State:	Water Level Observations:
Monroe, MI	Monroe	Michigan	While Drilling: Date/Time — Depth (ft bgs) After Drilling: Date/Time 3/17/16 09:30 — Depth (ft bgs) -4.82

SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	WELL DIAGRAM	COMMENTS
1 CS	90		0	**SILTY CLAY** mostly clay, some silt, trace to few sand, trace to few gravel, low plasticity, dark brown (10YR 3/3), no odor, moist, hard. Change to dry at 3.25 feet. Change to dark gray (10YR 4/1) at 5.0 feet.				Artesian well conditions present.
2 CS	95		10	Change to moist at 9.5 feet Change to very stiff at 10.5 feet. Change to dark gray (10YR 4/1), mottled with light reddish brown (5YR 6/3) at 12.0 feet.				
3 ST	65		20		CL-ML			
4 CS	100			Change to no mottling at 25.0 feet.				
5 ST	95		30					
6 CS	100							
7 CS	100		40	**SILTY CLAY WITH SAND** mostly clay, some silt, little fine to coarse sand, low plasticity, dark gray (10YR 4/1), no odor, moist, very stiff. Change to light gray (10YR 7/1), slight odor at 42.5 feet.	CL-ML			
8 CS	100		50	**SILTY CLAY** mostly clay, some silt, few gravel, very low plasticity, light gray (10YR 7/1), slight odor, moist, hard. Change to dry, not cohesive at 51.5 feet.	CL-ML			
				LIMESTONE weathered, slight odor, saturated.				
			60	End of boring at 60.0 feet below ground surface.				

SOIL BORING WELL CONSTRUCTION LOG 231828.0001.GPJ TRC_CORP.GDT 231828.0001.0000 5/16/16

Signature: Reed

Firm: TRC Environmental Corporation
1540 Eisenhower Place Ann Arbor, Michigan
734-971-7080
Fax 734-971-9022

WELL CONSTRUCTION LOG

WELL NO. MW-16-03

Page 1 of 1

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
DTE EC: Monroe FAB	2/16/16	2/16/16	231828.0001.0000

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Stock Drilling	Sonic	577.29	579.95	50.0	6

Boring Location: E of fly ash basin. N: 139040.68 E: 13395136.56	Personnel: Logged By - Chris Scieszka; Driller - Austin Goldsmith	Drilling Equipment: TerraSonic

Civil Town/City/or Village:	County:	State:	Water Level Observations: While Drilling: Date/Time; After Drilling: Date/Time 3/17/16 09:25	Depth (ft bgs) Depth (ft bgs) -13.95
Monroe, MI	Monroe	Michigan		

SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	WELL DIAGRAM	COMMENTS
1 CS	70		0	**SILTY CLAY** mostly clay, some silt, low plasticity, very dark brown (10YR 2/2), no odor, moist, medium stiff (2.0 tsf), high organics, roots. Change to no roots, trace fine gravel at 2.5 feet. Change to wood fragments present at 8.0 feet.				Artesian well conditions present.
2 CS	60		10	Change to medium to high plasticity, dark gray (10YR 4/1), mottled with yellowish brown (10YR 5/6) and light reddish brown (5YR 6/3), no organics at 10.0 feet. Change to trace to few fine to coarse sand, trace to few fine gravel low plasticity, yellowish brown (10YR 5/4), at 12.0 feet. Change to dark gray (10YR 4/1), very stiff (3.0 tsf) at 17.0 feet.	CL-ML			
3 ST	100		20					
4 CS	100							
5 CS	100		30	Change to hard (>4.0 tsf) at 30.0 feet.				
				SAND mostly fine to coarse sand, trace to few silt, very dark gray (10YR 3/1), no odor, moist, loose.	SP			
6 CS	100		40	**SILTY CLAY** mostly clay, some silt, low plasticity, dark gray (10YR 4/1), no odor, moist, very stiff (3.0 tsf). **LIMESTONE** light gray (10YR 7/1), slight odor, weathered, saturated. Change to very weathered, moist at 41.0 feet. Change to competent, dry.	CL-ML			
			50	End of boring at 50.0 feet below ground surface.				

SOIL BORING WELL CONSTRUCTION LOG 231828.0001.GPJ TRC_CORP.GDT 231828.0001.0000 5/16/16

Signature:

Firm: TRC Environmental Corporation 734-971-7080
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WELL CONSTRUCTION LOG

WELL NO. MW-16-04

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
DTE EC: Monroe FAB	2/15/16	2/15/16	231828.0001.0000

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Stock Drilling	Sonic	582.64	585.54	50.0	6

Boring Location: N of fly ash basin.	Personnel	Drilling Equipment:
N: 140704.67 E: 13390758.97	Logged By - Chris Scieszka Driller - Austin Goldsmith	TerraSonic

Civil Town/City/or Village:	County:	State:	Water Level Observations:
Monroe, MI	Monroe	Michigan	While Drilling: Date/Time — Depth (ft bgs) After Drilling: Date/Time 3/17/16 10:15 — Depth (ft bgs) -19.40

SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	WELL DIAGRAM	COMMENTS
1 CS	20			**SILTY CLAY** mostly clay, little to some silt, trace to few fine to coarse sand, trace to few fine to coarse gravel, low plasticity, dark brown (10YR 3/3), no odor, dry, hard (>4.0 tsf).				Artesian well conditions present.
2 CS	100		10	Change to soft (0.5 tsf) at 10.0 feet.				
				Change to very stiff (3 to 4 tsf) at 15.0 feet.				
3 ST	80		20	Change to dark gray (10YR 4/1) at 19.0 feet.	CL-ML			
4 CS	100			Change to very stiff to hard (3 to >4 tsf) at 22.0 feet.				
5 CS	100		30	Change to cobble present at 29.5 feet. Change to hard (>4.0 tsf) at 31.0 feet.				
6 CS	80		40	**SILTY GRAVEL** mostly fine to coarse gravel, little to some silt, few fine to coarse sand, gray (10YR 5/1), no odor, saturated, medium dense to dense.	GM			
				SILTY SAND mostly fine to medium sand, little to some silt, gray (10YR 5/1), no odor, moist to saturated, dense to very dense.	SM ML			
			50	**SILT** mostly silt, trace to few fine sand, no plasticity, dark grayish brown (10YR 4/2), no odor, dry, very dense.				
				LIMESTONE gray (10YR 5/1) to dark gray (10 R 4/1), dry, competent but fractured.				
				End of boring at 50.0 feet below ground surface.				

SOIL BORING WELL CONSTRUCTION LOG 231828.0001.GPJ TRC_CORP.GDT 231828.0001.0000 5/16/16

Signature:

Firm: TRC Environmental Corporation
1540 Eisenhower Place Ann Arbor, Michigan
734-971-7080
Fax 734-971-9022

WELL CONSTRUCTION LOG

WELL NO. MW-16-05

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
DTE EC: Monroe FAB	4/12/16	4/13/16	231828.0001.0000

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Stock Drilling	Sonic	580.51	583.25	50.0	6

Boring Location: S edge of fly ash basin, along farm field edge. N: 139537.14 E: 13392810.51	Personnel: Logged By - Jennifer Reed; Driller - Austin Goldsmith	Drilling Equipment: TerraSonic

Civil Town/City/or Village:	County:	State:	Water Level Observations: While Drilling: Date/Time; After Drilling: Date/Time 5/5/16 12:47	Depth (ft bgs); Depth (ft bgs) -16.70
Monroe, MI	Monroe	Michigan		

SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	WELL DIAGRAM	COMMENTS
1 CS	75		0	**SILTY CLAY** mostly clay, little to some silt, low plasticity, very dark brown (10YR 2/2), no odor, moist, medium stiff, organic material present, roots and grass. Change to few to little fine to coarse sand at 2.5 feet. Change to brown (10YR 5/3), very stiff, no organic material at 5.0 feet. Change to trace to few gravel, gray (10YR 5/1) at 7.5 feet.	CL-ML			Artesian well conditions present.
2 CS	100		10					
3 CS	100		20					
4 CS	100		30	Change to no to trace fine to medium sand, no gravel, dark gray (10YR 4/1), hard at 30 feet.				
5 CS	100		40	**LIMESTONE** weathered, light gray (10YR 7/1), slight odor, moist to dry. Change to competent at 46.5 feet.				
			50	End of boring at 50.0 feet below ground surface.				

SOIL BORING WELL CONSTRUCTION LOG 231828.0001.GPJ TRC_CORP.GDT 231828.0001.0000 5/16/16

Signature:

Firm: TRC Environmental Corporation
1540 Eisenhower Place Ann Arbor, Michigan
734-971-7080
Fax 734-971-9022

WELL CONSTRUCTION LOG

WELL NO. MW-16-06

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
DTE EC: Monroe FAB	4/13/16	4/13/16	231828.0001.0000

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Stock Drilling	Sonic	579.20	581.94	50.0	6

Boring Location: NE of fly ash basin, along the river's edge. N: 142566.72 E: 13396398.37	Personnel: Logged By - Jennifer Reed; Driller - Austin Goldsmith	Drilling Equipment: TerraSonic

Civil Town/City/or Village:	County:	State:	Water Level Observations: While Drilling: Date/Time; After Drilling: Date/Time 5/5/16 09:30	Depth (ft bgs) -3.45
Monroe, MI	Monroe	Michigan		

SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	WELL DIAGRAM	COMMENTS
1 CS	98		0	**CLAYEY SILT WITH SAND** mostly silt, few to little fine to coarse sand, few to little clay, black (10YR 2/1), no odor, moist, medium stiff, high organic content, roots and grass. Change to very dark gray (10YR 3/1) at 2.5 feet.	ML-CL			Artesian well conditions present.
				SILTY CLAY mostly clay, some silt, few to little fine to coarse sand, light yellowish brown (10YR 6/4), moist, medium stiff. Change to brown (10YR 5/3), very stiff to hard at 7.0 feet.				
2 CS	100		10	Change to dark gray (10YR 4/1), hard at 11.5 feet. Change to no to trace sand at 15.0 feet.	CL-ML			
3 CS	100		20	**SILTY CLAY WITH SAND** mostly clay, some silt, little fine to coarse sand, dark gray (10YR 4/1), moist, hard.				
4 CS	100		30		CL-ML			
5 CS	100		40					
				GRAVEL AND COBBLES large broken limestone boulders, and cobbles, saturated.	GP			
			50	End of boring at 50.0 feet below ground surface.				

SOIL BORING WELL CONSTRUCTION LOG 231828.0001.GPJ TRC_CORP.GDT 231828.0001.0000 5/19/16

Signature: Reed

Firm: TRC Environmental Corporation
1540 Eisenhower Place Ann Arbor, Michigan
734-971-7080
Fax 734-971-9022

WELL CONSTRUCTION LOG

TRC

WELL NO. MW-16-07

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
DTE EC: Monroe FAB	4/14/16	4/14/16	231828.0001.0000

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Stock Drilling	Sonic	575.41	578.40	40.0	6

Boring Location: N of fly ash basin, S of E Dunbar Road, W of main gate.	Personnel	Drilling Equipment:
N: 143408.82 E: 13392311.01	Logged By - Jennifer Reed Driller - Austin Goldsmith	TerraSonic

Civil Town/City/or Village:	County:	State:	Water Level Observations:
Monroe, MI	Monroe	Michigan	While Drilling: Date/Time Depth (ft bgs) After Drilling: Date/Time 5/5/16 10:44 Depth (ft bgs)

SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	WELL DIAGRAM	COMMENTS
			0	**TOPSOIL**				Artesian well conditions present.
1 CS	95			**SILTY CLAY** mostly clay, some silt, few to little sand, brown (10YR 5/3) to gray (10YR 5/1), no odor, moist, medium stiff.				
			10	Change to dark gray (10YR 4/1) at 9.5 feet.	CL-ML			
2 CS	100							
			20					
3 CS	100			**SANDY SILT WITH CLAY** mostly silt, little sand, little clay, dark gray (10YR 4/1), moist, medium to very stiff. Change to little to some sand at 25.0 feet.				
			30	Change to gray (GLEY1 5/N), crumbly at 28.5 feet.	ML-CL			
4 CS	100			Change to wet at 35.0 feet.				
				LIMESTONE weathered, light gray (10YR 7/1), slight odor, wet.				
			40	Change to saturated at 39.5 feet.				
				End of boring at 40.0 feet below ground surface.				
			50					

SOIL BORING WELL CONSTRUCTION LOG 231828.0001.GPJ TRC_CORP.GDT 231828.0001.0000 6/6/16

Signature: Austin Smith for J Reed

Firm: TRC Environmental Corporation
1540 Eisenhower Place Ann Arbor, Michigan
734-971-7080
Fax 734-971-9022

WELL CONSTRUCTION DIAGRAM

PROJ. NAME: DTE EC: MFAB CCR MW Installation		WELL ID:	**MW-16-01**
PROJ. NO: 231828.0001	DATE INSTALLED: 2/17/2016 INSTALLED BY: J. REED		CHECKED BY: C. Scieszka

ELEVATION (BENCHMARK: USGS)	DEPTH BELOW OR ABOVE GROUND SURFACE (FEET)	
581.74	2.8	TOP OF CASING
578.91	0.0	GROUND SURFACE
	1.0	CEMENT SURFACE PLUG
		GROUT/BACKFILL MATERIAL: GROUT SLURRY
		GROUT/BACKFILL METHOD: TREMIE
50.8		RISER PIPE LENGTH
	39.5	GROUT
		BENTONITE SEAL MATERIAL: PELLETS
	44.0	BENTONITE SEAL
530.9	48.0	TOP OF SCREEN
5.0		SCREEN LENGTH
		FILTER PACK MATERIAL: MEDIUM, WASHED SAND
525.9	53.0	BOTTOM OF SCREEN
	53.0	BOTTOM OF FILTER PACK
	NA	BENTONITE PLUG
		BACKFILL MATERIAL: WASHED SAND
523.91	55.0	HOLE BOTTOM

NOTES:

CASING AND SCREEN DETAILS

TYPE OF RISER: 2-INCH PVC

PIPE SCHEDULE: 40

PIPE JOINTS: THREADED O-RINGS

SCREEN TYPE: 2-INCH PVC

SCR. SLOT SIZE: 0.01-INCH

BOREHOLE DIAMETER: 6 IN. FROM 0 TO 55 FT.
____ IN. FROM ____ TO ____ FT.

SURF. CASING DIAMETER: ____ IN. FROM ____ TO ____ FT.
____ IN. FROM ____ TO ____ FT.

WELL DEVELOPMENT

DEVELOPMENT METHOD: SURGE AND PUMP

TIME DEVELOPING: 50 MINUTES

WATER REMOVED: 100 GALLONS

WATER ADDED: 0 GALLONS

WATER CLARITY BEFORE / AFTER DEVELOPMENT

CLARITY BEFORE: VERY TURBID

COLOR BEFORE: DARK GRAY

CLARITY AFTER: CLEAR

COLOR AFTER: NONE

ODOR (IF PRESENT): NONE

WATER LEVEL SUMMARY

MEASUREMENT (FEET)			DATE	TIME
DTB BEFORE DEVELOPING:	--	T/PVC	--	--
DTB AFTER DEVELOPING:	57.30	T/PVC	2/19/2016	11:00
SWL BEFORE DEVELOPING:	4.69	T/PVC	2/19/2016	10:00
SWL AFTER DEVELOPING:	4.80	T/PVC	3/17/2016	8:45
OTHER SWL:		T/PVC		
OTHER SWL:		T/PVC		

PROTECTIVE CASING DETAILS

PERMANENT, LEGIBLE WELL LABEL ADDED? ☑ YES ☐ NO

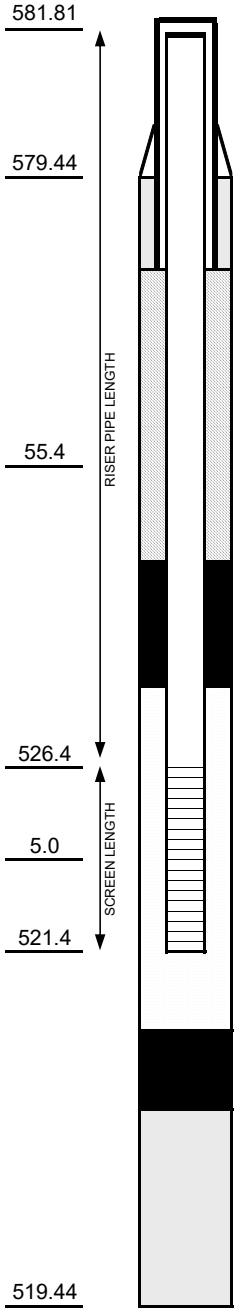
PROTECTIVE COVER AND LOCK INSTALLED? ☑ YES ☐ NO

LOCK KEY NUMBER: 3120

WELL CONSTRUCTION DIAGRAM

PROJ. NAME: DTE EC: MFAB CCR MW Installation		WELL ID:	**MW-16-02**
PROJ. NO: 231828.0001	DATE INSTALLED: 2/18/2016 INSTALLED BY: J. REED		CHECKED BY: C. Scieszka

ELEVATION (BENCHMARK: USGS)	DEPTH BELOW OR ABOVE GROUND SURFACE (FEET)	
581.81	2.4	TOP OF CASING
579.44	0.0	GROUND SURFACE
	1.0	CEMENT SURFACE PLUG
		GROUT/BACKFILL MATERIAL: CEMENT/GROUT SLURRY
		GROUT/BACKFILL METHOD: TREMIE
55.4		RISER PIPE LENGTH
	40.0	GROUT
		BENTONITE SEAL MATERIAL: PELLETS
	44.0	BENTONITE SEAL
526.4	53.0	TOP OF SCREEN
5.0		SCREEN LENGTH
		FILTER PACK MATERIAL: MEDIUM, WASHED SAND
521.4	58.0	BOTTOM OF SCREEN
	60.0	BOTTOM OF FILTER PACK
	NA	BENTONITE PLUG
		BACKFILL MATERIAL: WASHED SAND
519.44	60.0	HOLE BOTTOM



NOTES:
ARTESIAN MONITORING WELL

CASING AND SCREEN DETAILS

TYPE OF RISER: 2-INCH PVC

PIPE SCHEDULE: 40

PIPE JOINTS: THREADED O-RINGS

SCREEN TYPE: 2-INCH PVC

SCR. SLOT SIZE: 0.01-INCH

BOREHOLE DIAMETER: 6 IN. FROM 0 TO 60 FT.
____ IN. FROM ____ TO ____ FT.

SURF. CASING DIAMETER: ____ IN. FROM ____ TO ____ FT.
____ IN. FROM ____ TO ____ FT.

WELL DEVELOPMENT

DEVELOPMENT METHOD: ARTESIAN WELL

TIME DEVELOPING: 24 HOURS

WATER REMOVED: 2,880 GALLONS

WATER ADDED: 0 GALLONS

WATER CLARITY BEFORE / AFTER DEVELOPMENT

CLARITY BEFORE: SLIGHTLY CLOUDY TO CLOUDY

COLOR BEFORE: LIGHT GRAY

CLARITY AFTER: CLEAR

COLOR AFTER: NONE

ODOR (IF PRESENT): NONE

WATER LEVEL SUMMARY

MEASUREMENT (FEET)			DATE	TIME
DTB BEFORE DEVELOPING:	--	T/PVC	--	--
DTB AFTER DEVELOPING:	61.03	T/PVC	3/17/2016	9:30
SWL BEFORE DEVELOPING:	--	T/PVC	--	--
SWL AFTER DEVELOPING:	2.42	ATOC	3/17/2016	9:30
OTHER SWL:		T/PVC		
OTHER SWL:		T/PVC		

PROTECTIVE CASING DETAILS

PERMANENT, LEGIBLE WELL LABEL ADDED? ☑ YES ☐ NO

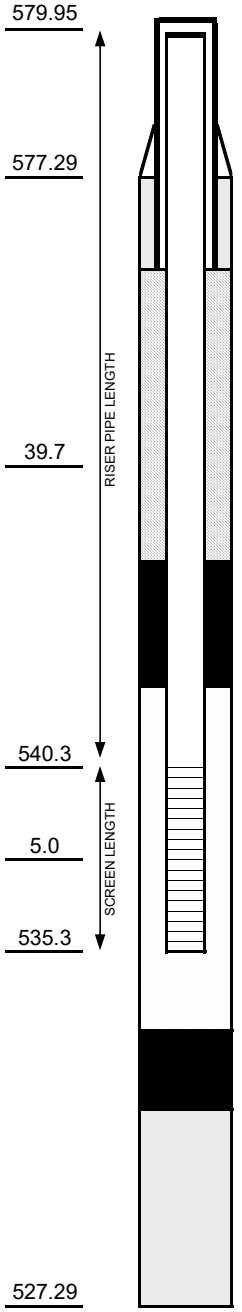
PROTECTIVE COVER AND LOCK INSTALLED? ☑ YES ☐ NO

LOCK KEY NUMBER: 3120

WELL CONSTRUCTION DIAGRAM

PROJ. NAME: DTE EC: MFAB CCR MW Installation		WELL ID:	**MW-16-03**
PROJ. NO: 231828.0001	DATE INSTALLED: 2/16/2016 INSTALLED BY: J. REED		CHECKED BY: C. Scieszka

ELEVATION (BENCHMARK: USGS)	DEPTH BELOW OR ABOVE GROUND SURFACE (FEET)
579.95	2.7 TOP OF CASING
577.29	0.0 GROUND SURFACE
	1.0 CEMENT SURFACE PLUG
	GROUT/BACKFILL MATERIAL: CEMENT/GROUT SLURRY
	GROUT/BACKFILL METHOD: TREMIE
39.7	
	28.0 GROUT
	BENTONITE SEAL MATERIAL: PELLETS
	32.0 BENTONITE SEAL
540.3	37.0 TOP OF SCREEN
	FILTER PACK MATERIAL: PEA STONE
5.0	
535.3	42.0 BOTTOM OF SCREEN
	50.0 BOTTOM OF FILTER PACK
	NA BENTONITE PLUG
	BACKFILL MATERIAL: WASHED SAND
527.29	50.0 HOLE BOTTOM



NOTES:
ARTESIAN MONITORING WELL

CASING AND SCREEN DETAILS

TYPE OF RISER: 2-INCH PVC

PIPE SCHEDULE: 40

PIPE JOINTS: THREADED O-RINGS

SCREEN TYPE: 2-INCH PVC

SCR. SLOT SIZE: 0.01-INCH

BOREHOLE DIAMETER: 6 IN. FROM 0 TO 50 FT.
____ IN. FROM ____ TO ____ FT.

SURF. CASING DIAMETER: ____ IN. FROM ____ TO ____ FT.
____ IN. FROM ____ TO ____ FT.

WELL DEVELOPMENT

DEVELOPMENT METHOD: ARTESIAN WELL

TIME DEVELOPING: 16 HOURS

WATER REMOVED: 7,200 GALLONS

WATER ADDED: 0 GALLONS

WATER CLARITY BEFORE / AFTER DEVELOPMENT

CLARITY BEFORE: VERY TURBID

COLOR BEFORE: DARK GRAY

CLARITY AFTER: CLEAR

COLOR AFTER: NONE

ODOR (IF PRESENT): SULFUR

WATER LEVEL SUMMARY

MEASUREMENT (FEET)			DATE	TIME
DTB BEFORE DEVELOPING:	--	T/PVC	--	--
DTB AFTER DEVELOPING:	44.65	T/PVC	3/17/2016	9:25
SWL BEFORE DEVELOPING:	--	T/PVC	--	--
SWL AFTER DEVELOPING:	11.20	ATOC	3/17/2016	9:25
OTHER SWL:		T/PVC		
OTHER SWL:		T/PVC		

PROTECTIVE CASING DETAILS

PERMANENT, LEGIBLE WELL LABEL ADDED? ☑ YES ☐ NO

PROTECTIVE COVER AND LOCK INSTALLED? ☑ YES ☐ NO

LOCK KEY NUMBER: 3120

WELL CONSTRUCTION DIAGRAM

PROJ. NAME: DTE EC: MFAB CCR MW Installation		WELL ID:	**MW-16-04**
PROJ. NO: 231828.0001	DATE INSTALLED: 2/15/2016 INSTALLED BY: C. Scieszka		CHECKED BY: C. Scieszka

ELEVATION (BENCHMARK: USGS)	DEPTH BELOW OR ABOVE GROUND SURFACE (FEET)	
585.54	2.9	TOP OF CASING
582.64	0.0	GROUND SURFACE
	1.0	CEMENT SURFACE PLUG
		GROUT/BACKFILL MATERIAL: CEMENT/GROUT SLURRY
		GROUT/BACKFILL METHOD: TREMIE
43.9		RISER PIPE LENGTH
	32.0	GROUT
		BENTONITE SEAL MATERIAL: PELLETS
	36.0	BENTONITE SEAL
541.6	41.0	TOP OF SCREEN
5.0		SCREEN LENGTH
		FILTER PACK MATERIAL: PEA STONE
536.6	46.0	BOTTOM OF SCREEN
	50.0	BOTTOM OF FILTER PACK
	NA	BENTONITE PLUG
		BACKFILL MATERIAL: WASHED SAND
532.64	50.0	HOLE BOTTOM

NOTES:
ARTESIAN MONITORING WELL

CASING AND SCREEN DETAILS

TYPE OF RISER: 2-INCH PVC

PIPE SCHEDULE: 40

PIPE JOINTS: THREADED O-RINGS

SCREEN TYPE: 2-INCH PVC

SCR. SLOT SIZE: 0.01-INCH

BOREHOLE DIAMETER: 6 IN. FROM 0 TO 50 FT.
____ IN. FROM ____ TO ____ FT.

SURF. CASING DIAMETER: ____ IN. FROM ____ TO ____ FT.
____ IN. FROM ____ TO ____ FT.

WELL DEVELOPMENT

DEVELOPMENT METHOD: ARTESIAN WELL

TIME DEVELOPING: 16 HOURS

WATER REMOVED: 28,900 GALLONS

WATER ADDED: 0 GALLONS

WATER CLARITY BEFORE / AFTER DEVELOPMENT

CLARITY BEFORE: VERY TURBID

COLOR BEFORE: DARK GRAY

CLARITY AFTER: CLEAR

COLOR AFTER: NONE

ODOR (IF PRESENT): SULFUR

WATER LEVEL SUMMARY

MEASUREMENT (FEET)			DATE	TIME
DTB BEFORE DEVELOPING:	--	T/PVC	--	--
DTB AFTER DEVELOPING:	49.45	T/PVC	3/17/2016	10:15
SWL BEFORE DEVELOPING:	--	T/PVC	--	--
SWL AFTER DEVELOPING:	16.50	ATOC	3/17/2016	10:15
OTHER SWL:		T/PVC		
OTHER SWL:		T/PVC		

PROTECTIVE CASING DETAILS

PERMANENT, LEGIBLE WELL LABEL ADDED? ☑ YES ☐ NO

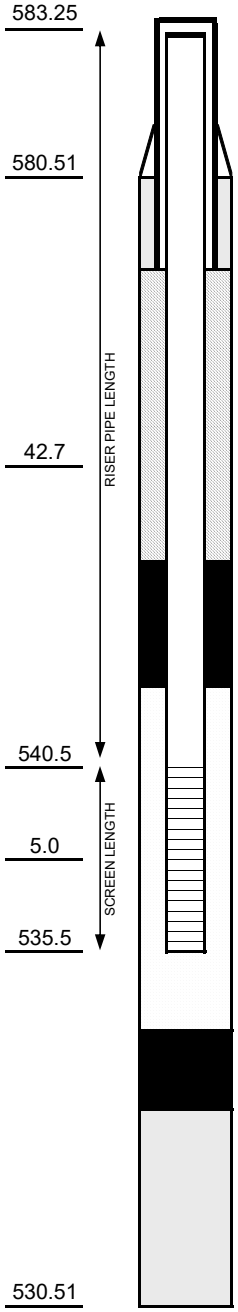
PROTECTIVE COVER AND LOCK INSTALLED? ☑ YES ☐ NO

LOCK KEY NUMBER: 3120

WELL CONSTRUCTION DIAGRAM

PROJ. NAME: DTE EC: MFAB CCR MW Installation		WELL ID:	**MW-16-05**
PROJ. NO: 231828.0001	DATE INSTALLED: 4/13/2016 INSTALLED BY: J. REED		CHECKED BY: C. Scieszka

ELEVATION (BENCHMARK: USGS)	DEPTH BELOW OR ABOVE GROUND SURFACE (FEET)	
583.25	2.7	TOP OF CASING
580.51	0.0	GROUND SURFACE
	1.0	CEMENT SURFACE PLUG
		GROUT/BACKFILL MATERIAL: CEMENT/GROUT SLURRY
		GROUT/BACKFILL METHOD: TREMIE
42.7		RISER PIPE LENGTH
	33.0	GROUT
		BENTONITE SEAL MATERIAL: PELLETS
	35.0	BENTONITE SEAL
540.5	40.0	TOP OF SCREEN
5.0		SCREEN LENGTH
		FILTER PACK MATERIAL: PEA STONE
535.5	45.0	BOTTOM OF SCREEN
	45.0	BOTTOM OF FILTER PACK
	NA	BENTONITE PLUG
		BACKFILL MATERIAL: PEA STONE
530.51	50.0	HOLE BOTTOM



NOTES:

CASING AND SCREEN DETAILS

TYPE OF RISER: 2-INCH PVC

PIPE SCHEDULE: 40

PIPE JOINTS: THREADED O-RINGS

SCREEN TYPE: 2-INCH PVC

SCR. SLOT SIZE: 0.01-INCH

BOREHOLE DIAMETER: 6 IN. FROM 0 TO 50 FT.
____ IN. FROM ____ TO ____ FT.

SURF. CASING DIAMETER: ____ IN. FROM ____ TO ____ FT.
____ IN. FROM ____ TO ____ FT.

WELL DEVELOPMENT

DEVELOPMENT METHOD: ARTESIAN WELL

TIME DEVELOPING: 12 HOURS

WATER REMOVED: 120 GALLONS

WATER ADDED: 0 GALLONS

WATER CLARITY BEFORE / AFTER DEVELOPMENT

CLARITY BEFORE: SLIGHTLY CLOUDY

COLOR BEFORE: VERY LIGHT GRAY

CLARITY AFTER: CLEAR

COLOR AFTER: NONE

ODOR (IF PRESENT): VERY SLIGHT TO NONE SULFUR

WATER LEVEL SUMMARY

MEASUREMENT (FEET)			DATE	TIME
DTB BEFORE DEVELOPING:	--	T/PVC	--	--
DTB AFTER DEVELOPING:	--	T/PVC	--	--
SWL BEFORE DEVELOPING:	--	T/PVC	--	--
SWL AFTER DEVELOPING:	14.00	ATOC	5/5/2016	12:47
OTHER SWL:		T/PVC		
OTHER SWL:		T/PVC		

PROTECTIVE CASING DETAILS

PERMANENT, LEGIBLE WELL LABEL ADDED? ☑ YES ☐ NO

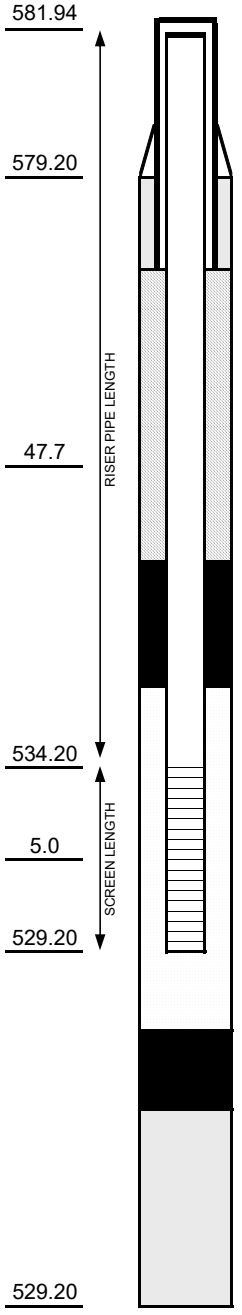
PROTECTIVE COVER AND LOCK INSTALLED? ☑ YES ☐ NO

LOCK KEY NUMBER: 3120

WELL CONSTRUCTION DIAGRAM

PROJ. NAME: DTE EC: MFAB CCR MW Installation		WELL ID:	**MW-16-06**
PROJ. NO: 231828.0001	DATE INSTALLED: 4/13/2016 INSTALLED BY: J. REED	CHECKED BY:	C. Scieszka

ELEVATION (BENCHMARK: USGS)	DEPTH BELOW OR ABOVE GROUND SURFACE (FEET)	
581.94	2.7	TOP OF CASING
579.20	0.0	GROUND SURFACE
	1.0	CEMENT SURFACE PLUG
		GROUT/BACKFILL MATERIAL: CEMENT/GROUT SLURRY
		GROUT/BACKFILL METHOD: TREMIE
47.7		RISER PIPE LENGTH
	38.0	GROUT
		BENTONITE SEAL MATERIAL: PELLETS
	40.0	BENTONITE SEAL
534.20	45.0	TOP OF SCREEN
5.0		SCREEN LENGTH
		FILTER PACK MATERIAL: PEA STONE
529.20	50.0	BOTTOM OF SCREEN
	50.0	BOTTOM OF FILTER PACK
	NA	BENTONITE PLUG
		BACKFILL MATERIAL: NA
529.20	50.0	HOLE BOTTOM



NOTES:

CASING AND SCREEN DETAILS

TYPE OF RISER: 2-INCH PVC

PIPE SCHEDULE: 40

PIPE JOINTS: THREADED O-RINGS

SCREEN TYPE: 2-INCH PVC

SCR. SLOT SIZE: 0.01-INCH

BOREHOLE DIAMETER: 6 IN. FROM 0 TO 50 FT.
____ IN. FROM ____ TO ____ FT.

SURF. CASING DIAMETER: ____ IN. FROM ____ TO ____ FT.
____ IN. FROM ____ TO ____ FT.

WELL DEVELOPMENT

DEVELOPMENT METHOD: ARTESIAN WELL

TIME DEVELOPING: 24 HOURS

WATER REMOVED: 240-250 GALLONS

WATER ADDED: 0 GALLONS

WATER CLARITY BEFORE / AFTER DEVELOPMENT

CLARITY BEFORE: SLIGHTLY CLOUDY

COLOR BEFORE: SLIGHTLY LIGHT GRAY

CLARITY AFTER: CLEAR

COLOR AFTER: NONE

ODOR (IF PRESENT): NONE

WATER LEVEL SUMMARY

MEASUREMENT (FEET)			DATE	TIME
DTB BEFORE DEVELOPING:	--	T/PVC	--	--
DTB AFTER DEVELOPING:	--	T/PVC	--	--
SWL BEFORE DEVELOPING:	--	T/PVC	--	--
SWL AFTER DEVELOPING:	0.75	ATOC	5/5/2016	9:30
OTHER SWL:		T/PVC		
OTHER SWL:		T/PVC		

PROTECTIVE CASING DETAILS

PERMANENT, LEGIBLE WELL LABEL ADDED? ☑ YES ☐ NO

PROTECTIVE COVER AND LOCK INSTALLED? ☑ YES ☐ NO

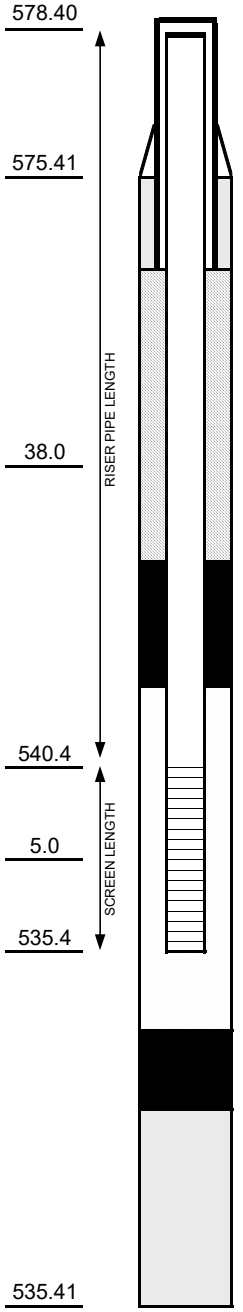
LOCK KEY NUMBER: 3120

REVISED 11/2013

WELL CONSTRUCTION DIAGRAM

PROJ. NAME: DTE EC: MFAB CCR MW Installation		WELL ID:	**MW-16-07**
PROJ. NO: 231828.0001	DATE INSTALLED: 4/14/2016 INSTALLED BY: J. REED		CHECKED BY: C. Scieszka

ELEVATION (BENCHMARK: USGS)	DEPTH BELOW OR ABOVE GROUND SURFACE (FEET)
578.40	3.0 TOP OF CASING
575.41	0.0 GROUND SURFACE
	1.0 CEMENT SURFACE PLUG
	GROUT/BACKFILL MATERIAL: CEMENT/GROUT SLURRY
	GROUT/BACKFILL METHOD: TREMIE
38.0	27.0 GROUT
	BENTONITE SEAL MATERIAL: PELLETS
	30.0 BENTONITE SEAL
540.4	35.0 TOP OF SCREEN
5.0	FILTER PACK MATERIAL: PEA STONE
535.4	40.0 BOTTOM OF SCREEN
	40.0 BOTTOM OF FILTER PACK
	NA BENTONITE PLUG
	BACKFILL MATERIAL: NA
535.41	40.0 HOLE BOTTOM



NOTES:

CASING AND SCREEN DETAILS

TYPE OF RISER: 2-INCH PVC

PIPE SCHEDULE: 40

PIPE JOINTS: THREADED O-RINGS

SCREEN TYPE: 2-INCH PVC

SCR. SLOT SIZE: 0.01-INCH

BOREHOLE DIAMETER: 6 IN. FROM 0 TO 40 FT.
____ IN. FROM ____ TO ____ FT.

SURF. CASING DIAMETER: ____ IN. FROM ____ TO ____ FT.
____ IN. FROM ____ TO ____ FT.

WELL DEVELOPMENT

DEVELOPMENT METHOD: ARTESIAN WELL

TIME DEVELOPING: 24 HOURS

WATER REMOVED: 240 GALLONS

WATER ADDED: 0 GALLONS

WATER CLARITY BEFORE / AFTER DEVELOPMENT

CLARITY BEFORE: SLIGHTLY CLOUDY

COLOR BEFORE: SLIGHTLY LIGHT GRAY

CLARITY AFTER: CLEAR

COLOR AFTER: NONE

ODOR (IF PRESENT): NONE

WATER LEVEL SUMMARY

MEASUREMENT (FEET)			DATE	TIME
DTB BEFORE DEVELOPING:	--	T/PVC	--	--
DTB AFTER DEVELOPING:	--	T/PVC	--	--
SWL BEFORE DEVELOPING:	--	T/PVC	--	--
SWL AFTER DEVELOPING:	8.80	ATOC	5/5/2016	10:44
OTHER SWL:	.	T/PVC		
OTHER SWL:		T/PVC		

PROTECTIVE CASING DETAILS

PERMANENT, LEGIBLE WELL LABEL ADDED? ☑ YES ☐ NO

PROTECTIVE COVER AND LOCK INSTALLED? ☑ YES ☐ NO

LOCK KEY NUMBER: 3120