Date: October 17, 2017

To: Operating Record

From: Harold D. Register, Jr., P.E.

RE: Groundwater Monitoring System Certification, §257.91(f)
    JC Weadock Power Plant, JC Weadock Landfill

Introduction

According to Title 40 Code of Federal Regulations (40 CFR) Part 257, Subpart D, §257.91(f); the owner or operator of a Coal Combustion Residual (CCR) management unit must obtain a certification from a qualified professional engineer stating that the groundwater monitoring system at the CCR management unit has been designed and constructed to meet the requirements of §257.91. Additionally, §257.91(a) details a performance standard requiring the system monitor the uppermost aquifer and include a minimum of at least one upgradient and three downgradient monitoring wells, and that if the uppermost aquifer monitoring system includes the minimum number of wells, the basis supporting use of only the minimum.

Groundwater Monitoring System

A groundwater monitoring system has been established for the JC Weadock Landfill, which established the following locations for determining background groundwater quality and detection monitoring. The downgradient monitoring network accurately represents the quality of groundwater passing the waste boundary and ensures detection of groundwater contamination in the uppermost aquifer based on the preferred flow path as a result of the construction of a soil-bentonite slurry wall completed in 2008 (drawings attached). The certified construction quality assurance report verifies that the wall achieves a minimum 1E-07 cm/sec hydraulic conductivity with a mean value of 3E-08 cm/sec. The downgradient groundwater monitoring system has been established within the 1,600 linear foot portion of the perimeter embankment dike that lacks the slurry wall construction.

Background:

<table>
<thead>
<tr>
<th>MW-15002</th>
<th>MW-15008</th>
</tr>
</thead>
<tbody>
<tr>
<td>MW-15016</td>
<td>MW-15019</td>
</tr>
</tbody>
</table>

Downgradient:

| JCW-MW-15011 | JCW-MW-15012 | JCW-MW-15023 |
Provided herein, as required by §257.91(f), is certification from a qualified professional engineer that the groundwater monitoring system at Consumers Energy JC Weadock Landfill meets the requirements of §257.91.

CERTIFICATION

Professional Engineer Certification Statement [40 CFR 257.91]

I hereby certify that, having reviewed the attached documentation and being familiar with the provisions of Title 40 of the Code of Federal Regulations §257.91 (40 CFR Part 257.91), I attest that this Groundwater Monitoring System has been designed and constructed to meet the requirements of 40 CFR 257.91. The report is accurate and has been prepared in accordance with good engineering practices, including the consideration of applicable industry standards, and with the requirements of 40 CFR Part 257.91.

Signature

October 17, 2017
Date of Certification

Harold D. Register, Jr., P.E.
Name

6201056266
Professional Engineer Certification Number

ENCLOSURES


Consumers Energy Company

SUMMARY OF MONITORING WELL DESIGN, INSTALLATION, AND DEVELOPMENT – LANDFILL UNIT

J.C. Weadock Electric Generation Facility – Essexville, Michigan

May 13, 2016
J.C. WEADOCK MONITORING WELL DESIGN, INSTALLATION, AND DEVELOPMENT

Gregory E. Zellmer, P.G.
Certified Project Manager/Senior Geologist

Mark Robert Klemmer, PE
Printed Name of Registered Professional Engineer

Signature of Registered Professional Engineer
Registration Number: 62010-49167 State: MI

Date: 5/13/16

Summary of Monitoring Well Design, Installation, and Development – Landfill Unit

J.C. Weadock Electric Generation Facility
– Essexville, MI

Prepared for:
Consumers Energy Company
Jackson, Michigan

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Our Ref.:
DE000722.0001.00006

Date: May 13, 2016

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Drawing SG-22354 – JC Weadock Monitoring Wells, CCR Monitoring

APPENDICES

Appendix A – Soil Boring and Monitoring Well Construction Logs
Appendix B – Photgraphic Logs
Appendix C – Hydraulic Test Results
INTRODUCTION

Arcadis has prepared this Summary of Monitoring Well Design, Installation, and Development (Report) to summarize monitoring well installation activities for the landfill unit at the J.C. Weadock electric generation facility (JCW), located in Essexville, Michigan (Site). Monitoring wells were installed to achieve compliance under the recently published 40 CFR Part 257, Subpart D – Standards for the Disposal of Coal Combustion Residuals (CCR) from Electric Utilities (specifically Section 257.91(e)(1)). This Report summarizes the groundwater monitoring well installation activities, including drilling procedures, well locations, well construction details, development activities, and hydraulic testing results. The methodology used in the field activities conforms to federal and state guidance and industry standards.

Arcadis also evaluated the existing monitoring well network to determine if any existing well could be utilized as part of the CCR monitoring program. The following well was determined to be appropriately constructed and will be included in the landfill unit monitoring program and designated as follows for the CCR monitoring program:

<table>
<thead>
<tr>
<th>Historical Well Name</th>
<th>RCRA Well Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>MW-116A</td>
<td>MW-15027</td>
</tr>
</tbody>
</table>

OBJECTIVES

The objectives of this report are to document the work completed at the Site, including:

- Advancement of soil borings
- Monitoring well installation
- Monitoring well development
- Hydraulic testing

The following section describes each of these elements in more detail.

FIELD ACTIVITIES

3.1 Soil Borings

Fourteen (14) soil borings were completed using rotosonic-drilling methods operated by Stock Drilling, Inc. of Ida, Michigan with oversight provided by an Arcadis geologist. Rotosonic drilling uses powered equipment to collect subsurface-soil samples. The rotosonic drill rig advances a length of pipe into the ground through a combination of hydraulic force and high-frequency vibration. The high-frequency vibrations allow the pipe to advance through various types of soil and bedrock producing a high-quality, continuous soil core within
the pipe. Each length of pipe was extracted from the ground and emptied into a clear plastic liner for logging. This process was repeated until the total depth of the boring was reached.

Continuous soil cores were collected during drilling to provide detailed lithological and stratigraphic data. An on-site geologist inspected each core, classified the contents, and recorded the observations on an Arcadis boring log field sheet (Appendix A). A photographic log showing the general soil types observed at the Site is included as Appendix B. Four soil borings were not completed as monitoring wells because they did not meet the minimum requirements of the CCR regulation for first usable aquifer due to the soils encountered at the boring locations. Details of monitoring well installation are provided in the following section.

3.2 Monitoring Well Installation

Of the fourteen (14) soil borings that were completed, ten (10) of the soil boring locations were converted into permanent monitoring wells. The four (4) soil borings not converted to monitoring wells (Soil Borings SB-15004, SB-15005, SB-15013 and SB-15017) were backfilled with soil cuttings. Once the total depth of the soil boring was reached, permanent monitoring wells were installed in the uppermost aquifer unit for completion of monitoring wells. Monitoring wells were installed through the rotosonic drill rig piping allowing the driller to construct the monitoring well, while simultaneously removing the drill piping. Monitoring wells were constructed with 2-inch inside diameter Schedule 40, polyvinyl chloride (PVC) screens and PVC risers. The well screens have a slot size of 0.010 inch. The length of the monitoring well screens at the Site varied from 3.5 to 10 feet, and the length of the screen intervals was determined based on observations of each location during the soil boring activities. A medium-grained sand pack was placed around each well screen to a height 0.5 to 3 feet above the top of the well screen. Approximately 1 to 11.7 feet of bentonite pellets were placed on top of the sand pack. The remainder of the annular space was finished to ground surface with soil cuttings or concrete.

The wells were finished at the surface using a 3-foot long, locking, stickup well cover set in a 24 inch by 24 inch concrete pad. Well construction logs are included in Appendix A; well construction is summarized in Table 1; well locations are shown on Drawing SG-22354. Wells were labeled according to Consumers Energy’s site-specific nomenclature provided to Arcadis. The CE construction manager supplied keyed-alike locks for each well that match the existing well keys.

3.3 Monitoring Well Development

Newly installed monitoring wells were allowed to set for a minimum of 48 hours, after which the wells were developed. Well development was completed by surging and evacuated water from the monitoring wells using a submersible pump. A “flow-thru cell” and a turbidity meter were utilized to monitor indicator parameters (turbidity, pH, temperature, oxidation-reduction potential (ORP), and conductivity) to determine if groundwater parameters had appropriately stabilized during the development activities at each monitoring well. The stabilization parameters are provided below in Table 2. Indicator parameters were recorded in field notes and the development process continued until development water was free of visible sediment, stabilization of the field parameters, and below 10 Nephelometric Turbidity Units (NTUs). The volume of groundwater removed during development and its appearance was recorded in the field logbook. If drilling fluids were utilized during well installation, the volume of fluids used was recorded in the field logbook. This
volume was removed in addition to the volume required for standard development. Monitoring well development details are included in Table 1.

Table 2. Groundwater Parameter Stabilization Criteria

<table>
<thead>
<tr>
<th>Groundwater Parameter</th>
<th>Stabilization Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>3 readings within +/- 0.1 Standard Units</td>
</tr>
<tr>
<td>Specific Conductance (SpC)</td>
<td>3 readings within +/- 3% mS/cms</td>
</tr>
<tr>
<td>Temperature</td>
<td>3 readings within +/- 3%</td>
</tr>
<tr>
<td>Oxidation-Reduction Potential (ORP)</td>
<td>3 readings within +/- 10 mV</td>
</tr>
<tr>
<td>Turbidity</td>
<td>3 readings within +/- 10% or &lt;1 when &lt; 10 NTU</td>
</tr>
<tr>
<td>Dissolved Oxygen (DO)</td>
<td>3 readings within +/- 0.3 mg/L</td>
</tr>
</tbody>
</table>

3.4 Hydraulic Testing

On November 11 and 12, 2015, Arcadis conducted hydraulic tests (slug tests) at seven (7) monitoring wells (MW-15008, JCW MW-15009, JCW MW-15010, JCW MW-15011, MW-15020, JCW MW-15023 and MW-15024) at the Site. Well construction logs are included in Appendix A; well construction details are summarized in Table 1.

During the slug testing activities, three tests were completed at each of the monitoring wells. The slug tests at the seven wells were completed to estimate hydraulic conductivity (K) by introducing a water table displacement by removing a known volume of water or depressing the water level by compressed air and measuring the rate of recovery. The tests at all monitoring wells were completed using a disposable bailer to remove a known volume of water. The bailer used was 1.5-inches in diameter and 36-inches long. All wells have casing and screen diameters of 2-inches and filter pack diameter of 6-inches. Monitoring wells JCW MW-15010 and JCW MW-15023 are screened in a sand layer that is confined by 9 and 4.5 feet thick clay. Monitoring well JCW MW-15009 was screened in unconfined sand across the water table at the time of hydraulic testing. The remaining wells were screened in unconfined sand approximately 1 to 2.8 feet below the water table at the time of hydraulic testing. At all the monitoring wells, a pressure transducer was set to record at 0.5 second intervals to measure pre-test static head, displacement and recovery data.

All tests at the seven monitoring wells reached full recovery within approximately 30 to 900 seconds. Recovery data collected from the wells were analyzed using the applicable analytical solution with AQTESOLV® for Windows©. Based on diagnostic analyses, the solution utilized at the recovery data from four of the wells (MW-15008, JCW MW-15009, JCW MW-15010, and MW-15020) was the confined or the unconfined KGS model (1994) that accounts for partial penetration effects. The recovery data of JCW MW-15010 was fit to the confined KGS model (1994) and the recovery data from monitoring wells MW-15008, JCW MW-15009, and MW-15020 were fit to the unconfined KGS model (1994). The confined Cooper et al.
(1967) solution was utilized for recovery data at monitoring wells JCW MW-15011, JCW MW-15023 and MW-15024. The results indicated an estimated hydraulic conductivity range from 7.7 to 30 feet per day (ft/d) with an average of 17 ft/d and a geometric mean of 16 ft/d. The results of this test seem to be a reasonable fit for the very fine to coarse sand formation. The monitoring well locations where slug tests were conducted are shown on Drawing SG-22354 and the results of the hydraulic conductivity tests are presented in Table 3 and Appendix C.
TABLES
<table>
<thead>
<tr>
<th>MW ID</th>
<th>Former MW ID</th>
<th>Northing</th>
<th>Easting</th>
<th>Ground Surface Elevation (ft above msl)</th>
<th>TOC Elevation (ft above msl)</th>
<th>Date Installed</th>
<th>Geologic Unit of Screen Interval</th>
<th>Well Construction</th>
<th>Well Screen Length (ft)</th>
<th>Static DTW (ft below TOC)</th>
<th>Total Depth</th>
<th>Pumping DTW (ft below TOC)</th>
<th>Gallons Removed</th>
<th>Final Turbidity (NTU)</th>
</tr>
</thead>
</table>
| Background Monitoring Well
| MW-15002    | --           | 777890.3 | 1326294.1 | 582.7 | 585.36 | 9/24/2015 | Sand | 2" PVC, 10 slot | 10 | 4 - 14 | 7.8 | 16.9 | NR | 150 | 15.7 |
| MW-15016    | --           | 777566.2 | 1326394.1 | 583.7 | 586.49 | 9/30/2015 | Sand | 2" PVC, 10 slot | 3.5 | 5.9 | 4.33 | 8.03 | 8.00 | 51 | 5.1 |
| MW-15018    | --           | 777892.4 | 1326393.8 | 583.6 | 586.42 | 10/1/2015 | Sand | 2" PVC, 10 slot | 4 | 3.8 | 6.26 | 10.03 | 10.00 | 62 | 2.07 |
| MW-15019    | --           | 777804.1 | 1326354.9 | 583.5 | 586.17 | 10/1/2015 | Sand | 2" PVC, 10 slot | 14 | 4 - 14 | 6.02 | 16.00 | 16.17 | 280 | 0.94 |
| MW-15020    | --           | 777808.4 | 1326307.7 | 582.5 | 585.95 | 10/1/2015 | Sand | 2" PVC, 10 slot | 10 | 4 - 14 | 5.41 | 17.03 | 5.95 | 135 | 6.1 |
| MW-15024    | --           | 778249.1 | 1326334.9 | 583.7 | 586.56 | 10/8/2015 | Sand | 2" PVC, 10 slot | 10 | 4 - 14 | 6.40 | 17.11 | 11.37 | 200 | 2.6 |
| MW-15027    | --           | 778661.3 | 1326319.3 | 583.2 | 586.25 | 4/26/2005 | Sand | NR | 10 | 5 - 15 | 5.73 | 18.29 | 4.45 | 110 | 1.51 |

| Landfill Monitoring Well
| JCW MW-15011 | -- | 780807.4 | 1326513.1 | 594.9 | 597.07 | 9/29/2015 | Sand | 2" PVC, 10 slot | 3.5 | 12.5 - 16 | 12.58 | 18.25 | 17.3 | 160 | 5.32 |
| JCW MW-15012 | -- | 780995.6 | 1326567.2 | 592.2 | 595.07 | 9/29/2015 | Sand (10.8-15) / Clay (15.8-15) | 2" PVC, 10 slot | 5 | 10.8 - 15.8 | 14.29 | 18.75 | NR | 330 | 1.3 |
| JCW MW-15023 | -- | 780840.7 | 1326527.5 | 592.7 | 595.32 | 10/8/2015 | Sand | 2" PVC, 10 slot | 5 | 13 - 18 | 11.95 | 20.85 | 15.85 | 100 | 0.81 |

| Hydraulic Testing Wells
| JW MW-15008 | -- | 780880.3 | 1326234.1 | 582.7 | 585.36 | 9/24/2015 | Sand | 2" PVC, 10 slot | 10 | 4 - 14 | 4.78 | 17.46 | 5.76 | 110 | 2.94 |
| JW MW-15009 | -- | 780481.4 | 1326225.9 | 586.9 | 589.64 | 9/24/2015 | Sand | 2" PVC, 10 slot | 5 | 5 - 10 | 8.78 | 12.78 | 12.7 | 65 | 1.46 |
| JW MW-15010 | -- | 780809.7 | 1326341.0 | 595.2 | 597.76 | 9/24/2015 | Sand | 2" PVC, 10 slot | 1.5 | 15.5 - 17.5 | 15.51 | 19.45 | NA | 23 | 2.55 |
| JW MW-15011 | -- | 780807.4 | 1326513.3 | 594.9 | 597.07 | 9/29/2015 | Sand | 2" PVC, 10 slot | 3.5 | 12.5 - 16 | 12.58 | 18.25 | 17.3 | 160 | 5.32 |
| JW MW-15020 | -- | 778708.4 | 1326307.7 | 582.5 | 585.95 | 10/1/2015 | Sand | 2" PVC, 10 slot | 10 | 4 - 14 | 5.41 | 17.03 | 5.95 | 135 | 6.1 |
| JW MW-15023 | -- | 780840.7 | 1326527.9 | 592.7 | 595.32 | 10/8/2015 | Sand | 2" PVC, 10 slot | 10 | 13 - 18 | 11.95 | 20.85 | 15.85 | 100 | 0.81 |
| JW MW-15024 | -- | 778249.1 | 1326334.9 | 583.7 | 586.56 | 10/8/2015 | Sand | 2" PVC, 10 slot | 10 | 4 - 14 | 6.40 | 17.11 | 11.37 | 200 | 2.6 |

Notes:
DTW: Depth to water
ft = feet
bgs = below ground surface
TOC = Top of casing elevation
TBD: Pending survey data
NR = Not recorded
### Table 3
Estimated Hydraulic Conductivity (K) Values
Consumers Energy Co.
J.C. Weadock Generating Facility
Essexville, Michigan

<table>
<thead>
<tr>
<th>Well ID</th>
<th>Test</th>
<th>Initial Displacement (ft)</th>
<th>Expected (Calculated) Displacement (ft)</th>
<th>K (ft/d)</th>
<th>K (cm/sec)</th>
<th>Slug Test Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>MW-15008</td>
<td>2</td>
<td>0.847</td>
<td>0.844</td>
<td>30</td>
<td>1.06E-02</td>
<td>KGS Model (Hyder et. al., 1994)</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>1.433</td>
<td>1.69</td>
<td>26</td>
<td>9.17E-03</td>
<td>KGS Model (Hyder et. al., 1994)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Average</td>
<td></td>
<td>28</td>
<td>9.88E-03</td>
<td></td>
</tr>
<tr>
<td>JCW MW-15009</td>
<td>1</td>
<td>0.838</td>
<td>0.844</td>
<td>8.0</td>
<td>2.82E-03</td>
<td>KGS Model (Hyder et. al., 1994)</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>1.613</td>
<td>1.69</td>
<td>7.7</td>
<td>2.72E-03</td>
<td>KGS Model (Hyder et. al., 1994)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Average</td>
<td></td>
<td>7.9</td>
<td>2.77E-03</td>
<td></td>
</tr>
<tr>
<td>JCW MW-15010</td>
<td>3</td>
<td>1.678</td>
<td>1.69</td>
<td>13</td>
<td>4.59E-03</td>
<td>KGS Model (Hyder et. al., 1994)</td>
</tr>
<tr>
<td>JCW MW-15011</td>
<td>2</td>
<td>0.793</td>
<td>0.844</td>
<td>14</td>
<td>4.93E-03</td>
<td>Cooper et al. (1967)</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>1.487</td>
<td>1.69</td>
<td>16</td>
<td>5.78E-03</td>
<td>Cooper et al. (1967)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Average</td>
<td></td>
<td>15</td>
<td>5.35E-03</td>
<td></td>
</tr>
<tr>
<td>MW-15020</td>
<td>1</td>
<td>0.82</td>
<td>0.844</td>
<td>21</td>
<td>7.41E-03</td>
<td>KGS Model (Hyder et. al., 1994)</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>0.768</td>
<td>0.844</td>
<td>21</td>
<td>7.41E-03</td>
<td>KGS Model (Hyder et. al., 1994)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Average</td>
<td></td>
<td>21</td>
<td>7.41E-03</td>
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<tr>
<td>JCW MW-15023</td>
<td>2</td>
<td>0.805</td>
<td>0.844</td>
<td>21</td>
<td>7.35E-03</td>
<td>Cooper et al. (1967)</td>
</tr>
<tr>
<td>MW-15024</td>
<td>3</td>
<td>1.438</td>
<td>1.69</td>
<td>11</td>
<td>3.78E-03</td>
<td>Cooper et al. (1967)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Over all Average</td>
<td></td>
<td>17</td>
<td>6.05E-03</td>
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<tr>
<td></td>
<td></td>
<td>Over all Geometric mean</td>
<td></td>
<td>16</td>
<td>5.53E-03</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Minimum</td>
<td></td>
<td>7.7</td>
<td>2.72E-03</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maximum</td>
<td></td>
<td>30</td>
<td>1.06E-02</td>
<td></td>
</tr>
</tbody>
</table>

Note:

- cm/sec = centimeters per second
- ft = feet
- ft/d = feet per day

References

FIGURES
Date Start: 09/17/15
Date Finish: 09/17/15
Drilling Company: Stock Drilling
Driller's Name: Austin Goldsmith
Drilling Method: Hydrovac/Sonic
Sampling Method: Continuous
Rig Type: Sonic
Water Level Start (ft. bgs.): NA
Water Level Finish (ft. btoc.): 7.8

Well/Boring ID: MW-15002
Client: Consumers Energy
Location: JC Weadock Facility
2742 Weadock Highway
Essexville, MI 48732
Weather Conditions: 72 F Sunny

Sample/Int/Type	 ELEVATION	 Recovery (feet)	 PID Headspace (ppm)	 Analytical Sample	 Geologic Column

DEPT (feet bgs.)	 Sample Run Number	 Sample/Int/Type	 Recovery (feet)	 PID Headspace (ppm)	 Analytical Sample	 Geologic Column

585
1 0.0- 6.0' 	 6.0 	 NA 	

580
2 6.0- 10.0' 	 2.5 	 NA 	

575
3 10.0- 15.0' 	 4.7 	 NA 	

570

TOC Elevation = 587.71 (ft. above msl)
Concrete (0.0- 1.0' bgs)
2" PVC Well Casing (3.0- 4.0' bgs)
Bentonite Pellets (1.0-2.0' bgs)

Sand Pack K&E WP00 (2.0- 15.0' bgs)
2" PVC 10 Slot Well Screen (4.0-14.0' bgs)

(0.0 - 6.0') Hydrovac no lithology recorded.
(6.0 - 8.0') SAND, very fine to medium; little organics; trace silt; trace clay; trace granule, subrounded to subangular; moist to wet; very dark brown (10YR 2/2).
(8.0 - 14.0') SAND, fine to coarse; little very coarse; trace granule to medium pebbles, subrounded to subangular; poorly sorted; moist; very dark grayish brown (10YR 3/2).

End of boring 15.0' bgs.

NOTE: trace small pebbles to small cobbles, subrounded to subangular from 12.0 to 14.0' bgs.
(14.0 - 15.0') CLAY, low to medium plasticity; little silt; little granule to small cobbles, subrounded to subangular; dry; stiff; dark grayish brown (10YR 4/2).

Remarks: bgs = below ground surface	 btoc = below top of casing

Hydrovac to 6.0' bgs.
Groundwater not encountered during drilling.
Water level at development was 7.8' btoc.
No odor or staining observed.
Groundwater elevation measured on December 8, 2015 was 580.49 feet above mean sea level.
**Table: Sample/Int/Type and Elevation**

<table>
<thead>
<tr>
<th>Sample Run Number</th>
<th>Sample Type</th>
<th>Recovery (feet)</th>
<th>PID Headspace (ppm)</th>
<th>Analytical Sample</th>
<th>Geologic Column</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0-6.0'</td>
<td>1</td>
<td>0.0</td>
<td>NA</td>
<td></td>
<td>(0.0 - 6.0') Hydrovac no lithology recorded.</td>
</tr>
<tr>
<td>6.0-9.0'</td>
<td>2</td>
<td>3.2</td>
<td>NA</td>
<td></td>
<td>(6.0 - 8.0') SAND, very fine to fine; trace medium to coarse sand; well sorted; wet; trace organics; very dark gray (10YR 3/1). NOTE: Sluff.</td>
</tr>
<tr>
<td>9.0-19.0'</td>
<td>3</td>
<td>9.4</td>
<td>NA</td>
<td></td>
<td>(8.0 - 8.5') CLAY, low plasticity; trace granule to small pebbles, subrounded to subangular; dry; stiff; dark yellowish brown (10YR 4/4).</td>
</tr>
<tr>
<td>9.0-19.0'</td>
<td>3</td>
<td>9.4</td>
<td>NA</td>
<td></td>
<td>(8.5 - 19.0') SAND, very fine to medium; trace coarse to very coarse sand; trace granule, subrounded to subangular; well sorted; wet; very dark gray (10YR 3/1).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NOTE: little medium to very coarse sand; trace granule, subrounded to subangular; color change to dark grayish brown (10YR 4/2) at 16.5' bgs.</td>
</tr>
<tr>
<td>19.0-33.0'</td>
<td>4</td>
<td>10.0</td>
<td>NA</td>
<td></td>
<td>(19.0 - 33.0') SAND, very fine to fine; trace medium to coarse sand; trace clay; well sorted; moist; dark grayish brown (10YR 4/2).</td>
</tr>
<tr>
<td>29.0-39.0'</td>
<td>5</td>
<td>8.7</td>
<td>NA</td>
<td></td>
<td>(33.0 - 39.0') SILT and CLAY, medium to high plasticity, slow dilatancy; trace organics; moist; soft; olive brown (2.5Y 4/3).</td>
</tr>
</tbody>
</table>

**Stratigraphic Description**

- **(0.0 - 6.0')** Hydrovac no lithology recorded.
- **(6.0 - 8.0')** SAND, very fine to fine; trace medium to coarse sand; well sorted; wet; trace organics; very dark gray (10YR 3/1). NOTE: Sluff.
- **(6.0 - 8.5')** CLAY, low plasticity; trace granule to small pebbles, subrounded to subangular; dry; stiff; dark yellowish brown (10YR 4/4).
- **(8.5 - 19.0')** SAND, very fine to medium; trace coarse to very coarse sand; trace granule, subrounded to subangular; well sorted; wet; very dark gray (10YR 3/1).
- **(19.0 - 33.0')** SAND, very fine to fine; trace medium to coarse sand; trace clay; well sorted; moist; dark grayish brown (10YR 4/2).
- **(33.0 - 39.0')** SILT and CLAY, medium to high plasticity, slow dilatancy; trace organics; moist; soft; olive brown (2.5Y 4/3).

**Remarks:**

- *bgs = below ground surface, btoc = below top of casing*

Hydrovac to 6.0' bgs.
Groundwater encountered at 2.0' bgs during drilling.
Water level at development was 4.78' btoc.
No odor or staining observed.
Groundwater elevation measured on December 8, 2015 was 580.68 feet above mean sea level.
**Date Start:** 09/24/15  
**Date Finish:** 09/24/15  
**Drilling Company:** Stock Drilling  
**Driller’s Name:** Austin Goldsmith  
**Drilling Method:** Hydrovac/Sonic  
**Sampling Method:** Continuous  
**Rig Type:** Sonic  
**Water Level Start (ft. bgs.):** 5.0  
**Water Level Finish (ft. btoc.):** 8.80  
**Client:** Consumers Energy  
**Location:** JC Weadock Facility  
2742 Weadock Highway  
Essexville, MI  48732  
**Weather Conditions:** 70 F Sunny  

**Well/Boring ID:** JCW MW-15009  
**Data File:** JCW MW-15009.dat  
**Created/Edited by:** C. Jeffers  

### DEPTH (feet bgs.)  |  Sample Run Number  |  Sample/Int/Type  |  Recovery (feet)  |  PID Headspace (ppm)  |  Analytical Sample  |  Geologic Column  |  Water Level (ft. bgs.)  |  Remarks  |  Weather Conditions  
--- | --- | --- | --- | --- | --- | --- | --- | --- | --- 
590 | | | | | | | | |  
585 | 1 | 0.0 - 6.0' | 0.0 | NA | | (6.0 - 6.0') Hydrovac; no lithology recorded. | | |  
580 | 2 | 6.0 - 10.0' | 5.0 | NA | | (6.0 - 7.0') SAND, very fine to fine; little organics, roots; little silt and clay; poorly sorted; moist; dark gray (10YR 4/1).  
(7.0 - 10.0') SAND, very fine to fine; little medium sand; trace coarse sand to granule, subrounded to subangular; trace organics; well sorted; dry to moist; dark gray (10YR 4/1). | |  
575 | | | | | | End of boring 10.0' bgs. | |  

**Remarks:**  
- bgs = below ground surface  
- btoc = below top of casing  
- Hydrovac to 6.0' bgs.  
- Groundwater encountered at 5.0' bgs during drilling.  
- Water level at development was 8.80' btoc.  
- No odor or staining observed.  
- Groundwater elevation measured on December 8, 2015 was 580.84 feet above mean sea level.
**Stratigraphic Description**

**Well/Boring Construction**

**Casing Elevation:**
- Easting: 13263418
- Casing Elevation: 597.76

**Borehole Depth (ft. bgs.):** 19.0

**Surface Elevation:** 585.2

**Well/Boring ID:** JCW MW-15010

**Client:** Consumers Energy

**Location:** JC Weadock Facility
- 2742 Weadock Highway
- Essexville, MI 48732

**Weather Conditions:** 70 F Sunny

---

<table>
<thead>
<tr>
<th>DEPTH (ft bgs.)</th>
<th>ELEVATION</th>
<th>Sample Run Number</th>
<th>Sampling Int/Type</th>
<th>Recovery (feet)</th>
<th>PID Headspace (ppm)</th>
<th>Analytical Sample</th>
<th>Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.0</td>
<td>1</td>
<td>0.0</td>
<td>0.0</td>
<td>NA</td>
<td>0.0</td>
<td>(0.0 - 6.0') Hydrovac no lithology recorded.</td>
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<tr>
<td>5</td>
<td>5.95</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(6.0 - 9.0') CLAY, little fine sand to small pebbles; trace medium pebbles; subrounded to subangular; dry; stiff; dark yellowish brown (10YR 4/4). NOTE: Fill.</td>
</tr>
<tr>
<td>10</td>
<td>5.90</td>
<td>2</td>
<td>6.0</td>
<td>4.6</td>
<td>NA</td>
<td>4.6</td>
<td>(9.0 - 10.5') SAND, very fine to fine; well sorted; dry; grayish brown (10YR 5/2).</td>
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<tr>
<td>15</td>
<td>5.85</td>
<td></td>
<td></td>
<td>10.0</td>
<td>NA</td>
<td>10.0</td>
<td>(10.5 - 14.0') ASH, fly ash, very fine; wet. NOTE: Fill material.</td>
</tr>
<tr>
<td>20</td>
<td>5.80</td>
<td>3</td>
<td>9.0</td>
<td>14.0</td>
<td>NA</td>
<td>14.0</td>
<td>(14.0 - 15.0') FILL, roots and organics; trace ash.</td>
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<tr>
<td></td>
<td>5.75</td>
<td></td>
<td></td>
<td>15.0</td>
<td>NA</td>
<td>15.0</td>
<td>(15.0 - 17.0') SAND, very fine to medium; trace coarse to very coarse, subrounded to subangular; trace organics, roots and shells; moist to wet; poorly sorted; dark grayish brown (10YR 4/2).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>17.0</td>
<td>NA</td>
<td>17.0</td>
<td>(17.0 - 19.0') CLAY, medium to high plasticity; little sand, very fine to medium; little organics, roots; trace silt; dry; medium stiff; light brownish gray (2.5Y 6/2).</td>
</tr>
</tbody>
</table>

**Remarks:** bgs = below ground surface  btoc = below top of casing

- Hydrovac to 6.0' bgs.
- Groundwater encountered at 10.5' bgs during drilling.
- Water level at development was 15.75' btoc.
- No odor or staining observed.
- Groundwater elevation measured on December 8, 2015 was 582.01 feet above mean sea level.
Hydrovac to 6.0' bgs.
Groundwater encountered at 10.0' bgs during drilling.
Water level at development was 12.67' btoc.
No odor or staining observed.
Groundwater elevation measured on December 8, 2015 was 584.4 feet above mean sea level.

**Stratigraphic Description**
(0.0 - 6.0') Hydrovac no lithology recorded.
(6.0 - 8.0') SAND, very fine to fine; trace medium to very coarse, subrounded to subangular; trace clay; well sorted; dry; dark gray (10YR 4/1). NOTE: Fill material.
(8.0 - 9.0') SAND, very fine to coarse; trace granule, subrounded to subangular; little clay; dry; brownish yellow (10YR 6/8).
(9.0 - 10.0') CLAY, medium plasticity; trace very fine to medium sand; trace granule, subrounded to subangular; dry; medium stiff; dark grayish brown (10YR 4/2).
(10.0 - 11.5') ASH; wet; black (10YR 2/1). NOTE: Fill material.
(11.5 - 16.0') SAND, fine to coarse; trace very coarse sand to granule, subrounded to subangular; trace organics, shells, roots; well sorted; moist to wet; very dark grayish brown (10YR 3/2).

NOTE: color change to black (10YR 2/1) from 15.0-16.0' bgs.
(16.0 - 18.0') CLAY, low plasticity; trace fine sand to large pebbles, subrounded to subangular; trace roots; moist; medium stiff; dark grayish brown (10YR 4/2).

End of boring 18.0' bgs.

**Remarks:**

bgs = below ground surface  
btoc = below top of casing

Hydrovac to 6.0' bgs.
Groundwater encountered at 10.0' bgs during drilling.
Water level at development was 12.67' btoc.
No odor or staining observed.
Groundwater elevation measured on December 8, 2015 was 584.4 feet above mean sea level.
Stratigraphic Description

Well/Boring Construction

ToC Elevation = 595.07 (ft. above msl)

Concrete (0.0-1.5' bgs)

2" PVC Well Casing (-2.8-10.8' bgs)

Cement/Bentonite Grout (1.5-6.8' bgs)

Bentonite Pellets (6.8-7.8' bgs)

Sand Pack K&E WP00 (7.8-19.0' bgs)

2" PVC 10 Slot Well Screen (10.8-15.8' bgs)

**Remarks:**

bgs = below ground surface

btoc = below top of casing

Hydrovac to 6.0' bgs.

Groundwater encountered at 13.0' bgs during drilling.

Water level at development was 14.53' btoc.

No odor or staining observed.

Groundwater elevation measured on December 8, 2015 was 592.2 feet above mean sea level.
Date Start: 09/28/15  
Date Finish: 09/30/15  
Drilling Company: Stock Drilling  
Driller's Name: Austin Goldsmith  
Drilling Method: Hand Auger/Sonic  
Sampling Method: Continuous  
Rig Type: Sonic  
Water Level Start (ft. bgs.): 2.5  
Water Level Finish (ft. btoc.): 4.33  

Noting: 777566.2  
Easting: 13263941.7  
Casing Elevation: 586.49  
Borehole Depth (ft. bgs.): 9.0  
Surface Elevation: 583.7  
Descriptions By: L. Rogers  

Well/Boring ID: MW-15016  
Client: Consumers Energy  
Location: JC Weadock Facility  
2742 Weadock Highway  
Essexville, MI 48732  
Weather Conditions: 55 F Cloudy

**Sample/Int/Type**

<table>
<thead>
<tr>
<th>DEPTH (ft. bgs.)</th>
<th>Sample Run Number</th>
<th>Sample Int/Type</th>
<th>Recovery (feet)</th>
<th>PID Headspace (ppm)</th>
<th>Analytical Sample</th>
<th>Geologic Column</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-6.0'</td>
<td>1</td>
<td>NA</td>
<td>6.0</td>
<td>NA</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>6.0-9.0'</td>
<td>2</td>
<td>NA</td>
<td>6.0</td>
<td>NA</td>
<td>NA</td>
<td></td>
</tr>
</tbody>
</table>

**Stratigraphic Description**

- **0.0 - 0.1'** GRASS and TOPSOIL.
- **0.1 - 4.0'** SAND, very fine to coarse; little granule; trace small pebbles, subrounded to subangular; poorly sorted; dry; gray (10YR 4/1).
- NOTE: Trace clay at 2.0' bgs.
- NOTE: Wet at 2.5' bgs.
- NOTE: Trace organics, roots from 3.0 to 4.0' bgs.

- **4.0 - 5.5'** SAND, very fine to fine; trace medium sand; trace organics, shell fragments; well sorted; wet; very dark gray (10YR 3/1).
- **5.5 - 9.0'** CLAY, trace silt, medium plasticity; trace very fine to medium sand; trace organics, roots; moist to dry; medium stiff to stiff; gray (10YR 5/1).
- NOTE: Loose trace organics at 6.0' bgs; little granule to small cobbles, subrounded to subangular from 6.0' to 9.0' bgs.

**Remarks:** bgs = below ground surface     btoc = below top of casing

Hand Auger to 6.0' bgs.
Groundwater encountered at 2.5' bgs during drilling.
Water level at development was 4.33' btoc.
No odor or staining observed.
Groundwater elevation measured on December 8, 2015 was 582.73 feet above mean sea level.
Stratigraphic Description

Well/Boring Construction

Casing Elevation: 586.42
Well/Boring ID: MW-15018
Client: Consumers Energy

Location: JC Weadock Facility
2742 Weadock Highway
Essexville, MI 48732

Weather Conditions: 54 F

Date Start: 09/28/15
Date Finish: 10/01/15
Drilling Company: Stock Drilling
Driller's Name: Austin Goldsmith
Drilling Method: Hand Auger/Sonic
Sampling Method: Continuous
Rig Type: Sonic

Water Level Start (ft. bgs.): 3.0
Water Level Finish (ft. btoc.): 6.26

Remarks: bgs = below ground surface          btoc = below top of casing
Hand Auger to 6.0' bgs.
Groundwater encountered at 3.0' bgs during drilling.
Water level at development was 6.26' btoc.
No odor or staining observed.
Groundwater elevation measured on December 8, 2015 was 580.5 feet above mean sea level.

Sample Run Number

ELEVATION

Sample/Int/Type

Recovery (feet)

PID Headspace (ppm)

Analytical Sample

Geologic Column

Water Level Start (ft. bgs.): 3.0
Water Level Finish (ft. btoc.): 6.26

Drilling Method: Hand Auger/Sonic
Sampling Method: Continuous
Rig Type: Sonic

Sample/Int/Type

ELEVATION

Recovery (feet)

PID Headspace (ppm)

Analytical Sample

Geologic Column

Water Level Start (ft. bgs.): 3.0
Water Level Finish (ft. btoc.): 6.26

NOTE: Moist at 2.0' bgs.
NOTE: Wet at 3.0' bgs.
NOTE: Little peat and organics at 5.5' to 6.0' bgs.
NOTE: Loose peat at 6.0' bgs.

(7.0 - 9.0') CLAY, medium plasticity; little granule to small pebbles, subrounded to subangular; trace silt; dry stiff; dark gray (10YR 4/1).
End of boring 9.0' bgs.

TOC Elevation = 586.42 (ft. above msl)
Concrete (0.0-0.5' bgs)
Bentonite Pellets (0.5-2.0' bgs)
2" PVC Well Casing (-3.0-3.0' bgs)
Sand Pack K&E WP00 (2.0-9.0' bgs)
2" PVC 10 Slot Well Screen (3.0-7.0' bgs)

1 6.0
2 3.0
1 0.0
2 6.0

0.0-6.0' bgs
6.0-9.0' bgs
(0.0 - 0.2') GRASS and TOPSOIL.
(0.2 - 7.0') SAND, very fine to medium; trace coarse sand to granule, subrounded to subangular; dry; well sorted; dark yellowish brown (10YR 3/4).

NOTE: Moist at 2.0' bgs.
NOTE: Wet at 3.0' bgs.
NOTE: Little peat and organics at 5.5' to 6.0' bgs.
NOTE: Loose peat at 6.0' bgs.

(7.0 - 9.0') CLAY, medium plasticity; little granule to small pebbles, subrounded to subangular; trace silt; dry stiff; dark gray (10YR 4/1).
End of boring 9.0' bgs.

Remarks: bgs = below ground surface          btoc = below top of casing
Hand Auger to 6.0' bgs.
Groundwater encountered at 3.0' bgs during drilling.
Water level at development was 6.26' btoc.
No odor or staining observed.
Groundwater elevation measured on December 8, 2015 was 580.5 feet above mean sea level.

NOTE:  Moist at 2.0' bgs.
NOTE:  Wet at 3.0' bgs.
NOTE:  Little peat and organics at 5.5' to 6.0' bgs.
NOTE:  Loose peat at 6.0' bgs.

(7.0 - 9.0') CLAY, medium plasticity; little granule to small pebbles, subrounded to subangular; trace silt; dry stiff; dark gray (10YR 4/1).
End of boring 9.0' bgs.

Remarks: bgs = below ground surface          btoc = below top of casing
Hand Auger to 6.0' bgs.
Groundwater encountered at 3.0' bgs during drilling.
Water level at development was 6.26' btoc.
No odor or staining observed.
Groundwater elevation measured on December 8, 2015 was 580.5 feet above mean sea level.

NOTE:  Moist at 2.0' bgs.
NOTE:  Wet at 3.0' bgs.
NOTE:  Little peat and organics at 5.5' to 6.0' bgs.
NOTE:  Loose peat at 6.0' bgs.

(7.0 - 9.0') CLAY, medium plasticity; little granule to small pebbles, subrounded to subangular; trace silt; dry stiff; dark gray (10YR 4/1).
End of boring 9.0' bgs.
**Stratigraphic Description**

<table>
<thead>
<tr>
<th>DEPTH (feet bgs.)</th>
<th>Sample Run Number</th>
<th>Sample Int/Type</th>
<th>Recovery (feet)</th>
<th>PID Headspace (ppm)</th>
<th>Analytical Sample</th>
<th>Geologic Column</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0 - 6.0'</td>
<td>1</td>
<td>0.0-6.0'</td>
<td>6.0</td>
<td>NA</td>
<td></td>
<td>(0.0 - 0.2') GRASS and TOPSOIL.</td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>(0.2 - 2.0') SAND, fine to medium; little coarse to very coarse sand; trace granule to small pebbles, subrounded to subangular; dry; well sorted; dark brown (10YR 3/3).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(2.0 - 7.5') SAND, very fine to medium; trace coarse sand; moist; well sorted; very dark brown (10YR 2/2).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NOTE: Wet at 3.0' bgs.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NOTE: Little coarse sand to granule, subrounded to subangular starting at 4.0' bgs.</td>
</tr>
<tr>
<td>6.0 - 9.0'</td>
<td>2</td>
<td>6.0-9.0'</td>
<td>NA</td>
<td>NA</td>
<td></td>
<td>(7.5 - 14.5') SAND and CLAY, very fine to fine, high plasticity; trace medium sand; trace silt; moist to wet; well sorted; dark gray (10YR 4/1).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.0 - 19.0'</td>
<td>3</td>
<td>9.0-19.0'</td>
<td>9.5</td>
<td>NA</td>
<td></td>
<td>(14.5 - 16.5') SAND, fine to coarse; little very coarse sand to granule; trace small pebbles, subrounded to subangular; well sorted; wet; dark gray (10YR 4/1).</td>
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<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19.0'</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(16.5 - 19.0') SAND, very fine to fine; some clay; trace medium sand; well sorted; wet; dark gray (10YR 4/1).</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td>End of boring 19.0' bgs.</td>
</tr>
</tbody>
</table>

**Remarks:**
- bgs = below ground surface
- btoc = below top of casing

- Hand Auger to 6.0' bgs.
- Groundwater encountered at 3.0' bgs during drilling.
- Water level at development was 6.02' btoc.
- No odor or staining observed.
- Groundwater elevation measured on December 8, 2015 was 580.39 feet above mean sea level.
**Stratigraphic Description**

<table>
<thead>
<tr>
<th>DEPTH (feet bgs.)</th>
<th>Sample/Int/Type</th>
<th>Recovery (feet)</th>
<th>PID Headspace (ppm)</th>
<th>Analytical Sample</th>
<th>Geologic Column</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0-6.0'</td>
<td>1</td>
<td>6.0</td>
<td>NA</td>
<td></td>
<td>(0.0 - 0.2') GRASS, TOPSOIL, and FRAGMITES.</td>
</tr>
<tr>
<td>6.0-9.0'</td>
<td>2</td>
<td>3.5</td>
<td>NA</td>
<td></td>
<td>(0.2 - 1.0') SAND, very fine to medium; trace coarse sand to granule, subrounded to subangular; trace roots; poorly sorted; moist; dark grayish brown (10YR 4/2).</td>
</tr>
<tr>
<td>9.0-19.0'</td>
<td>3</td>
<td>9.6</td>
<td>NA</td>
<td></td>
<td>(1.0 - 19.0') SAND, very fine to fine; trace medium sand; well sorted; moist; dark yellowish brown (10YR 4/4).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NOTE: Color change to gray (10YR 5/1) at 2.0' bgs.</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
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<td>NOTE: Trace coarse sand; color change to very dark brown (10YR 2/2) at 4.0' bgs.</td>
</tr>
<tr>
<td></td>
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<td>NOTE: Trace organics, shells; wet at 5.0' bgs.</td>
</tr>
<tr>
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<td></td>
<td></td>
<td>NOTE: Loose trace shells; color change to dark gray (10YR 4/1) at 6.0' bgs.</td>
</tr>
</tbody>
</table>

**Remarks:**
- bgs = below ground surface
- btoc = below top of casing

Hand Auger to 6.0' bgs.
Groundwater encountered at 5.0' bgs during drilling.
Water level at development was 5.41' btoc.
No odor or staining observed.
Groundwater elevation measured on December 8, 2015 was 580.61 feet above mean sea level.
## Stratigraphic Description

**Well/Boring: **
- **Construction:**
  - **Casing Elevation:**
  - **Easting:**
  - **Surface Elevation:**

**Well/Boring ID:**
- **Client:** Consumers Energy

**Location:**
- JC Weadock Facility
  - 2742 Weadock Highway
  - Essexville, MI 48732

**Weather Conditions:**
- 43 F Partly Sunny

### Geological Column

<table>
<thead>
<tr>
<th>DEPTH (feet bgs.)</th>
<th>ELEVATION</th>
<th>Sample Run Number</th>
<th>Sample/Int/Type</th>
<th>Recovery (feet)</th>
<th>PID Headspace (ppm)</th>
<th>Analytical Sample</th>
<th>Geologic Column</th>
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**Remarks:**
- bgs = below ground surface  
- btoc = below top of casing

Hydrovac to 6.0' bgs.
Groundwater encountered at 6.0' bgs during drilling.
Water level at development was 11.05' btoc.
No odor or staining observed.
Groundwater elevation measured on December 8, 2015 was 584.17 feet above mean sea level.
**Stratigraphic Description**

**Sample/Int/Type** | **ELEVATION** | **Recovery (feet)** | **PID Headspace (ppm)** | **Analytical Sample** | **Geologic Column**
--- | --- | --- | --- | --- | ---
NA | NA | NA | NA | NA | NA

**Date Start:** 10/08/15  
**Date Finish:** 10/08/15  
**Drilling Company:** Stock Drilling  
**Driller's Name:** Austin Goldsmith  
**Drilling Method:** Hand Auger/Sonic  
**Sampling Method:** Continuous  
**Rig Type:** Sonic

**Well Level Start (ft. bgs.):** 5.0  
**Well Level Finish (ft. btoc):** 6.4

**Well/Boring ID:** MW-15024  
**Client:** Consumers Energy  
**Location:** JC Weadock Facility  
2742 Weadock Highway  
Essexville, MI  48732  
**Weather Conditions:** 61 F Cloudy

**Groundwater encountered at 5.0' bgs during drilling.**
**Water level at development was 6.4' btoc.**
**No odor or staining observed.**
**Groundwater elevation measured on December 8, 2015 was 580.27 feet above mean sea level.**

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**Remarks:**  
*bgs = below ground surface  
btoc = below top of casing*
**Well/Boring Data**

**Date Start:** 04/26/2005  
**Date Finish:** 04/26/2005  
**Drilling Company:** Rau Drilling  
**Driller's Name:** Greg Compeau  
**Drilling Method:** Hollow Stem Auger  
**Sampling Method:** Continuous  
**Rig Type:** Auger  
**Water Level Start (ft. bgs.):** 2.0  
**Water Level Finish (ft. btoc.):** NA

**Casing Elevation:**  
**Easting:** 13263139  
**Surface Elevation:** 584.1  
**Borehole Depth (ft. bgs.):** 15.5  
**Descriptions By:** B Hennings (NRT, Inc.)

**Well/Boring ID:** MW-15027  
**Client:** Consumers Energy  
**Location:** JC Weadock Facility  
2742 Weadock Highway  
Essexville, MI 48732

**Weather Conditions:** NA

<table>
<thead>
<tr>
<th>DEPTH (feet bgs.)</th>
<th>ELEVATION</th>
<th>Sample Run Number</th>
<th>Sample/Int/Type</th>
<th>Recovery (feet)</th>
<th>PID Headspace (ppm)</th>
<th>Analytical Sample</th>
<th>Geologic Column</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0 - 1.0'</td>
<td>585</td>
<td>1</td>
<td>NA</td>
<td></td>
<td></td>
<td></td>
<td>(0.0 - 1.0') CLAY, tan low plasticity lean clay, trace gravel and organics.</td>
</tr>
<tr>
<td>1.0 - 2.0'</td>
<td>580</td>
<td>2</td>
<td>NA</td>
<td></td>
<td></td>
<td></td>
<td>(1.0 - 2.0') SAND, brown medium grained sand, trace fine gravel.</td>
</tr>
<tr>
<td>2.0 - 4.0'</td>
<td>575</td>
<td>3</td>
<td>1.6</td>
<td>NA</td>
<td></td>
<td></td>
<td>(2.0 - 15.5') SAND, well graded, tan, wet, fine to coarse grained, sub-rounded sand composed of 90% quartz and 10% other lithic grains, trace shell fragments, mottled red-orange.</td>
</tr>
<tr>
<td>4.0 - 6.0'</td>
<td>570</td>
<td>4</td>
<td>1.5</td>
<td>NA</td>
<td></td>
<td></td>
<td>NOTE: Sand becomes gray, no mottling.</td>
</tr>
<tr>
<td>6.0 - 8.0'</td>
<td>565</td>
<td>5</td>
<td>1.5</td>
<td>NA</td>
<td></td>
<td></td>
<td>NOTE: Sand becomes medium grained, well graded with trace coarse sand.</td>
</tr>
<tr>
<td>8.0 - 10.0'</td>
<td>560</td>
<td>6</td>
<td>1.7</td>
<td>NA</td>
<td></td>
<td></td>
<td>NOTE: Sand becomes brown (10YR 5/3), 5% shell fragments, trace roots.</td>
</tr>
<tr>
<td>10.0 - 12.0'</td>
<td>555</td>
<td>7</td>
<td>1.7</td>
<td>NA</td>
<td></td>
<td></td>
<td>NOTE: Sand becomes well-graded medium to coarse grained, 5% shell fragments, no roots.</td>
</tr>
<tr>
<td>12.0 - 14.0'</td>
<td>550</td>
<td>8</td>
<td>1.7</td>
<td>NA</td>
<td></td>
<td></td>
<td>End of boring 15.5' bgs.</td>
</tr>
</tbody>
</table>

**Remarks:** bgs = below ground surface  
btoc = below top of casing

Groundwater encountered at 2.0' bgs during drilling.  
No odor or staining observed.
**Date Start:** 09/21/15  
**Date Finish:** 09/21/15  
**Drilling Company:** Stock Drilling  
**Driller's Name:** Austin Goldsmith  
**Drilling Method:** Hydrovac/Sonic  
**Sampling Method:** Continuous  
**Rig Type:** Sonic  
**Well Level Start (ft. bgs.):** NA  
**Water Level Finish (ft. bgs.):** NA  

**Well/Boring ID:** SB-15004  
**Client:** Consumers Energy  
**Location:** JC Weadock Facility  
2742 Weadock Highway  
Essexville, MI 48732  
**Weather Conditions:** 74 F Sunny

### Sample Run Number

<table>
<thead>
<tr>
<th>DEPTH (feet bgs.)</th>
<th>ELEVATION</th>
<th>Sample Run Number</th>
<th>Sample/Int/Type</th>
<th>Recovery (feet)</th>
<th>PID Headspace (ppm)</th>
<th>Analytical Sample</th>
<th>Geologic Column</th>
<th>Stratigraphic Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(0.0 - 0.6')</td>
<td>0.0</td>
<td>6-1</td>
<td>0.0</td>
<td>NA</td>
<td></td>
<td></td>
<td></td>
<td>(6.0 - 0.6') Hydrovac; no lithology recorded.</td>
</tr>
<tr>
<td>(6.0 - 6.5')</td>
<td>6.0</td>
<td>6-2</td>
<td>7.5</td>
<td>NA</td>
<td></td>
<td></td>
<td></td>
<td>(6.0 - 6.5') Bottom ASH. NOTE: Fill material.</td>
</tr>
<tr>
<td>(6.5 - 20.0')</td>
<td>10.0</td>
<td>6-3</td>
<td>7.5</td>
<td>NA</td>
<td></td>
<td></td>
<td></td>
<td>(6.5 - 20.0') CLAY, medium plasticity, no dilatancy; trace very fine to fine sand; trace granule to small cobble, subrounded to subangular; dry; stiff to very stiff; dark yellowish brown (10YR 4/6).</td>
</tr>
<tr>
<td>(10.0 - 15.0')</td>
<td>15.0</td>
<td>6-4</td>
<td>9.0</td>
<td>NA</td>
<td></td>
<td></td>
<td></td>
<td>NOTE: color change to dark gray (10YR 4/1) at 13.5' bgs.</td>
</tr>
</tbody>
</table>

**Borehole backfilled with soil cuttings.**

**Remarks:**  
*bgs = below ground surface  
btoc = below top of casing*

Hydrovac to 6.0' bgs.  
Groundwater not encountered during drilling.  
No odor or staining observed.
**Stratigraphic Description**

<table>
<thead>
<tr>
<th>DEPTH (feet bgs.)</th>
<th>Sample Run Number</th>
<th>Depth (feet)</th>
<th>Recovery (feet)</th>
<th>PID Headspace (ppm)</th>
<th>Analytical Sample</th>
<th>Stratigraphic Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>1</td>
<td>0.0 - 6.0'</td>
<td>0.0</td>
<td>NA</td>
<td>NA</td>
<td>(0.0 - 6.0') Hydrovac; no lithology recorded.</td>
</tr>
<tr>
<td>5.0</td>
<td></td>
<td>6.0 - 10.0'</td>
<td>5.0</td>
<td>NA</td>
<td>NA</td>
<td>(6.0 - 20.0') CLAY, medium plasticity, no dilatancy; trace very fine to fine sand; trace granule to small cobble, subrounded to subangular; dry; stiff to very stiff; dark yellowish brown (10YR 4/6).</td>
</tr>
<tr>
<td>10.0</td>
<td></td>
<td>10.0 - 15.0'</td>
<td>7.0</td>
<td>NA</td>
<td>NA</td>
<td>NOTE: color change to dark gray (10YR 4/1) at 13.0' bgs.</td>
</tr>
<tr>
<td>15.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>End of boring 20.0' bgs.</td>
</tr>
</tbody>
</table>

**Well/Boring Construction**

- **Borehole** backfilled with soil cuttings.

**Remarks:**

- bgs = below ground surface
- btoc = below top of casing

Hydrovac to 6.0' bgs.

Groundwater not encountered during drilling.

No odor or staining observed.
### Stratigraphic Description

**Well/Boring ID:** JCW SB-15013  
**Client:** Consumers Energy  
**Location:** JC Weadock Facility  
2742 Weadock Highway  
Essexville, MI 48732  
**Weather Conditions:** 55 F Cloudy

<table>
<thead>
<tr>
<th>Elevation</th>
<th>Sample Run Number</th>
<th>Sample/Hole Type</th>
<th>Recovery (feet)</th>
<th>PID Headspace (ppm)</th>
<th>Analytical Sample</th>
<th>Geologic Column</th>
<th>Stratigraphic Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0 - 6.0'</td>
<td>1</td>
<td>0.0</td>
<td>0.0</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>(0.0 - 6.0') Hydrovac; no lithology recorded.</td>
</tr>
<tr>
<td>6.0 - 9.0'</td>
<td>2</td>
<td>6.0</td>
<td>2.4</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>(6.0 - 11.0') CLAY, medium to low plasticity; little fine to coarse sand; trace silt; trace granule to large pebbles, subrounded to subangular; dry; stiff; dark gray (10YR 4/1).</td>
</tr>
<tr>
<td>9.0 - 19.0'</td>
<td>3</td>
<td>9.0</td>
<td>9.5</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>(11.0 - 16.5') Fly ASH and Clay mixture; moist; very soft; balck (10YR 2/1). Strike: N20&lt;sup&gt;°&lt;/sup&gt; E Dip: 95&lt;sup&gt;°&lt;/sup&gt;</td>
</tr>
<tr>
<td>16.5 - 19.0'</td>
<td>3</td>
<td>16.5</td>
<td>19.0</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>(16.5 - 19.0') CLAY, trace very fine to medium sand; trace granule to very large pebbles, subrounded to subangular; dry; very stiff to hard; dark gray (10YR 4/1).</td>
</tr>
</tbody>
</table>

**Remarks:** bgs = below ground surface

Hydrovac to 6.0' bgs.  
Groundwater not encountered.  
No odor or staining observed.
**Well/Boring ID:** SB-15017  
**Client:** Consumers Energy  
**Location:** JC Weadock Facility  
2742 Weadock Highway  
Essexville, MI 48732  
**Weather Conditions:** 51 F Cloudy, windy

### Stratigraphic Description

<table>
<thead>
<tr>
<th>DEPTH (feet bgs.)</th>
<th>ELEVATION</th>
<th>Sample/Int/Type</th>
<th>Recovery (feet)</th>
<th>PID Headspace (ppm)</th>
<th>Analytical Sample</th>
<th>Geologic Column</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0.0 - 6.0'</td>
<td>NA</td>
<td>6.0</td>
<td>(0.0 - 0.1') TOPSOIL, GRASS and road GRAVEL.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.1 - 1.0') SAND and ASH, very fine to medium pebbles, subrounded to subangular; poorly sorted; dry; dark brown (10YR 3/3). NOTE: Fill.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.0 - 6.0'</td>
<td></td>
<td>6.0</td>
<td>(1.0 - 5.0') CLAY, medium plasticity; little very fine to medium sand; trace coarse sand to small pebbles, subrounded to subangular; trace silt; trace ash; dry; medium stiff; brown (10YR 4/3).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>6.0 - 9.0'</td>
<td>NA</td>
<td>3.0</td>
<td>NOTE: Lose trace ash, clay becomes stiff; wet; dark grayish brown (10YR 4/2) at 3.0' bgs.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6.0</td>
<td>(5.0 - 6.0') PEAT; black (10YR 2/1).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6.0 - 9.0'</td>
<td>NA</td>
<td></td>
<td>(6.0 - 9.0') CLAY, medium to low plasticity; little granule to small pebbles, subrounded to subangular; dry; stiff; dark grayish brown (10YR 4/2).</td>
</tr>
</tbody>
</table>

End of boring 9.0' bgs.  
*Borehole backfilled with soil cuttings.*

### Remarks:

- **bgs =** below ground surface  
- **btoc =** below top of casing  

Hydrovac to 6.0' bgs.  
Groundwater encountered at 3.0' bgs during drilling.  
No odor or staining observed.
# Soil Description

<table>
<thead>
<tr>
<th>Udden-Wentworth Scale</th>
<th>Modified ARCADIS, 2008</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Size Class</strong></td>
<td><strong>Millimeters</strong></td>
</tr>
<tr>
<td>Boulder</td>
<td>256 – 4096</td>
</tr>
<tr>
<td>Large cobble</td>
<td>128 – 256</td>
</tr>
<tr>
<td>Small cobble</td>
<td>64 – 128</td>
</tr>
<tr>
<td>Very large pebble</td>
<td>32 – 64</td>
</tr>
<tr>
<td>Large pebble</td>
<td>16 – 32</td>
</tr>
<tr>
<td>Medium pebble</td>
<td>8 – 16</td>
</tr>
<tr>
<td>Small pebble</td>
<td>4 – 8</td>
</tr>
<tr>
<td>Granule</td>
<td>2 – 4</td>
</tr>
<tr>
<td>Very coarse sand</td>
<td>1 – 2</td>
</tr>
<tr>
<td>Coarse sand</td>
<td>½ – 1</td>
</tr>
<tr>
<td>Medium sand</td>
<td>¼ – ½</td>
</tr>
<tr>
<td>Fine sand</td>
<td>1/8 – ¼</td>
</tr>
<tr>
<td>Very fine sand</td>
<td>1/16 – 1/8</td>
</tr>
<tr>
<td>Silt (subgroups not included)</td>
<td>1/256 – 1/16</td>
</tr>
<tr>
<td>Clay (subgroups not included)</td>
<td>1/2048 – 1/256</td>
</tr>
</tbody>
</table>

### Fine-grained soil – Consistency

<table>
<thead>
<tr>
<th>Description</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very soft</td>
<td>N-value &lt; 2 or easily penetrated several inches by thumb.</td>
</tr>
<tr>
<td>Soft</td>
<td>N-value 2-4 or easily penetrated one inch by thumb.</td>
</tr>
<tr>
<td>Medium stiff</td>
<td>N-value 9-15 or indented about ¼ inch by thumb with great effort.</td>
</tr>
<tr>
<td>Very stiff</td>
<td>N-value 16-30 or readily indented by thumb nail.</td>
</tr>
<tr>
<td>Hard</td>
<td>N-value &gt; 30 or indented by thumbnail with difficulty.</td>
</tr>
</tbody>
</table>

### Coarse-grained soil – Density

<table>
<thead>
<tr>
<th>Description</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very loose</td>
<td>N-value 1-4,松软</td>
</tr>
<tr>
<td>Loose</td>
<td>N-value 5-10,松软</td>
</tr>
<tr>
<td>Medium dense</td>
<td>N-value 11-30,中等密度</td>
</tr>
<tr>
<td>Dense</td>
<td>N-value 31-50,密实</td>
</tr>
<tr>
<td>Very dense</td>
<td>N-value &gt;50,坚硬</td>
</tr>
</tbody>
</table>

### Plasticity

<table>
<thead>
<tr>
<th>Modifier</th>
<th>Percent of Total Sample (by volume)</th>
</tr>
</thead>
<tbody>
<tr>
<td>and</td>
<td>36 – 50,粘性大</td>
</tr>
<tr>
<td>some</td>
<td>21 – 35,粘性中</td>
</tr>
<tr>
<td>little</td>
<td>10 – 20,粘性小</td>
</tr>
<tr>
<td>trace</td>
<td>&lt;10,非常粘性</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Description</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonplastic</td>
<td>A ⅛ inch (3 mm) thread cannot be rolled at any water content.</td>
</tr>
<tr>
<td>Low</td>
<td>The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.</td>
</tr>
<tr>
<td>Medium</td>
<td>The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.</td>
</tr>
<tr>
<td>High</td>
<td>It takes considerable time rolling and inverting to reach the plastic limit. The thread can be rolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.</td>
</tr>
</tbody>
</table>

### Texture

<table>
<thead>
<tr>
<th>Description</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry</td>
<td>Absence of moisture, dry to touch, dusty.</td>
</tr>
<tr>
<td>Moist</td>
<td>Damp but no visible water.</td>
</tr>
<tr>
<td>Wet (Saturated)</td>
<td>Visible free water, soil is usually below the water table.</td>
</tr>
</tbody>
</table>

### Angular

- **Particles have sharp edges and relatively plane sides with unpolished surfaces.**

### Subangular

- **Particles are similar to angular description but have rounded edges.**

### Subrounded

- **Particles have nearly plane sides but have well-rounded corners and edges.**

### Rounded

- **Particles have smoothly curved sides and no edges.**
APPENDIX B

Photographic Logs
<table>
<thead>
<tr>
<th>Photograph #1</th>
<th>Photograph #2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description of Photograph:</strong> View of the various soil types encountered during the monitoring well installation activities at the Site.</td>
<td><strong>Description of Photograph:</strong> View of the various soil types encountered during the monitoring well installation activities at the Site.</td>
</tr>
<tr>
<td><strong>Site Location:</strong> Consumers Energy Co. JC Weadock Generating Facility Essexville, Michigan</td>
<td>Consumers Energy Co. JC Weadock Generating Facility Essexville, Michigan</td>
</tr>
<tr>
<td><strong>Photograph Taken By:</strong> Lance Rogers</td>
<td><strong>Photograph Taken By:</strong> Lance Rogers</td>
</tr>
<tr>
<td><strong>Date of Photograph:</strong> September 21, 2015</td>
<td><strong>Date of Photograph:</strong> October 8, 2015</td>
</tr>
</tbody>
</table>
Photograph #1

**Description of Photograph:**
View of the various soil types encountered during the monitoring well installation activities at the Site.

**Site Location:**
Consumers Energy Co.  
JC Weadock Generating Facility  
Essexville, Michigan

**Photograph Taken By:**
Lance Rogers

**Date of Photograph:**
September 21, 2015

---

Photograph #2

**Description of Photograph:**
View of the various soil types encountered during the monitoring well installation activities at the Site.

Consumers Energy Co.  
JC Weadock Generating Facility  
Essexville, Michigan

**Photograph Taken By:**
Lance Rogers

**Date of Photograph:**
October 8, 2015
APPENDIX C
Hydraulic Test Logs
Slug Test Analysis Results for JCW MW-15008 -Test 2

Prepared By: Arcadis
Prepared For: Consumer Energy
Project: Essexville, MI

**SOLUTION**

Aquifer Model: Unconfined
Solution Method: KGS Model

\[
\begin{align*}
Kr &= 30. \text{ ft/day} \\
Ss &= 5.2E-5 \text{ ft}^{-1} \\
Kz/Kr &= 1
\end{align*}
\]

**AQUIFER DATA**

Saturated Thickness: 27 ft

**WELL DATA (JCW MW-15008)**

Initial Displacement: 0.847 ft
Static Water Column Height: 12.81 ft
Total Well Penetration Depth: 12.81 ft
Screen Length: 10. ft
Casing Radius: 0.083 ft
Well Radius: 0.25 ft
Slug Test Analysis Results for JCW MW-15008 -Test 3

Prepared By: Arcadis
Prepared For: Consumer Energy

Project: Essexville, MI

**SOLUTION**

Aquifer Model: Unconfined
Solution Method: KGS Model

\[
\begin{align*}
Kr &= 26. \text{ ft/day} \\
Kz/Kr &= 1 \\
Ss &= 2.2E-13 \text{ ft}^{-1}
\end{align*}
\]

**AQUIFER DATA**

Saturated Thickness: 27 ft

**WELL DATA (JCW MW-15008)**

Initial Displacement: 1.433 ft
Static Water Column Height: 12.81 ft
Total Well Penetration Depth: 12.81 ft
Screen Length: 10 ft
Casing Radius: 0.083 ft
Well Radius: 0.25 ft
Slug Test Analysis Results for JCW MW-15009 -Test 1

Prepared By: Arcadis
Prepared For: Consumer Energy

Project: Location:
Essexville, MI

SOLUTION
Aquifer Model: Unconfined
Solution Method: KGS Model

\[
\begin{align*}
Kr &= 8. \text{ ft/day} \\
Kz/Kr &= 1. \\
Ss &= 0.00013 \text{ ft}^{-1}
\end{align*}
\]

AQUIFER DATA
Saturated Thickness: 22.46 ft

WELL DATA (JCW MW-15009)
Initial Displacement: 0.838 ft
Static Water Column Height: 4.46 ft
Total Well Penetration Depth: 4.46 ft
Screen Length: 4.46 ft
Casing Radius: 0.083 ft
Well Radius: 0.25 ft
Slug Test Analysis Results for JCW MW-15009 - Test 3

Prepared By: Arcadis
Prepared For: Consumer Energy
Project: Essexville, MI

SOLUTION
Aquifer Model: Unconfined
Solution Method: KGS Model

\[ Kr = 7.7 \text{ ft/day} \]
\[ Kz/Kr = 1. \]
\[ Ss = 3.4\times10^{-5} \text{ ft}^{-1} \]

AQUIFER DATA
Saturated Thickness: 22.46 ft

WELL DATA (JCW MW-15009)
Initial Displacement: 1.613 ft
Static Water Column Height: 4.46 ft
Total Well Penetration Depth: 4.46 ft
Screen Length: 4.46 ft
Casing Radius: 0.083 ft
Well Radius: 0.25 ft
Slug Test Analysis Results for JCW MW-15010 -Test 3

Prepared By: Arcadis
Prepared For: Consumer Energy
Project: Essexville, MI

SOLUTION
Aquifer Model: Confined
Solution Method: KGS Model
Kr = 13. ft/day
Kz/Kr = 1.

AQUIFER DATA
Saturated Thickness: 2 ft

WELL DATA (JCW MW-15010)
Initial Displacement: 1.678 ft
Static Water Column Height: 4.02 ft
Total Well Penetration Depth: 2 ft
Screen Length: 1.5 ft
Casing Radius: 0.083 ft
Well Radius: 0.25 ft
Slug Test Analysis Results for JCW MW-15011 -Test 2

Prepared By: Arcadis  Prepared For: Consumer Energy

Project: Essexville, MI

SOLUTION
Aquifer Model: Confined
Solution Method: Cooper-Bredhoeft-Papadopulos

\[ T = 49. \text{ ft}^2/\text{day} \]

\[ S = 0.0047 \]

AQUIFER DATA
Saturated Thickness: 5.83 ft

WELL DATA (JCW MW-15011)
Initial Displacement: 0.793 ft
Static Water Column Height: 5.83 ft
Total Well Penetration Depth: 5.83 ft
Screen Length: 3.5 ft
Casing Radius: 0.083 ft
Well Radius: 0.25 ft
Slug Test Analysis Results for J CW MW-15011 -Test 3

Prepared By: Arcadis

Prepared For: Consumer Energy

Project: Location:

Essexville, MI

SOLUTION

Aquifer Model: Confined
Solution Method: Cooper-Bredhoeft-Papadopulos
T = 57. ft²/day  S = 0.00098

AQUIFER DATA

Saturated Thickness: 5.83 ft

WELL DATA (J CW MW-15011)

Initial Displacement: 1.487 ft
Static Water Column Height: 5.83 ft
Total Well Penetration Depth: 5.83 ft
Screen Length: 3.5 ft
Casing Radius: 0.083 ft
Well Radius: 0.25 ft
Slug Test Analysis Results for JCW MW-15020 - Test 1

Prepared By: Arcadis
Prepared For: Consumer Energy
Project: Location: Essexville, MI

**SOLUTION**
- Aquifer Model: Unconfined
- Solution Method: KGS Model
- $Kr = 21.0$ ft/day
- $Ss = 2.6E-6$ ft$^{-1}$
- $Kz/Kr = 1.0$

**Aquifer Data**
- Saturated Thickness: 29.55 ft
- **Well Data (JCW MW-15020)**
  - Initial Displacement: 0.82 ft
  - Static Water Column Height: 12.05 ft
  - Total Well Penetration Depth: 12.05 ft
  - Screen Length: 10.0 ft
  - Casing Radius: 0.083 ft
  - Well Radius: 0.25 ft
Slug Test Analysis Results for JCW MW-15020 -Test 2

Prepared By: Arcadis
Prepared For: Consumer Energy

Project: Location: Essexville, MI

SOLUTION
Aquifer Model: Unconfined
Solution Method: KGS Model

\[ Kr = 21. \text{ ft/day} \]
\[ S_s = 2.5 \times 10^{-5} \text{ ft}^{-1} \]
\[ K_z/K_r = 1 \]

AQUIFER DATA
Saturated Thickness: 29.55 ft

WELL DATA (JCW MW-15020)
Initial Displacement: 0.768 ft
Static Water Column Height: 12.05 ft
Total Well Penetration Depth: 12.05 ft
Screen Length: 10 ft
Casing Radius: 0.083 ft
Well Radius: 0.25 ft
Slug Test Analysis Results for JCW MW-15023 - Test 2

Prepared By: Arcadis  |  Prepared For: Consumer Energy
Project:  |  Location: Essexville, MI

<table>
<thead>
<tr>
<th>SOLUTION</th>
<th>AQUIFER DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aquifer Model: Confined</td>
<td>Saturated Thickness: 6.5 ft</td>
</tr>
<tr>
<td>Solution Method: Cooper-Bredhoeft-Papadopulos</td>
<td>WELL DATA (JGW MW-15023)</td>
</tr>
<tr>
<td>T = 104. ft²/day</td>
<td>Initial Displacement: 0.805 ft</td>
</tr>
<tr>
<td>S = 2.5E-5</td>
<td>Static Water Column Height: 9.48 ft</td>
</tr>
</tbody>
</table>

Diagram of normalized head vs. time (sec)
Slug Test Analysis Results for JCW MW-15024 -Test 3

Prepared By: Arcadis
Prepared For: Consumer Energy
Project: Location:
Essexville, MI

SOLUTION
Aquifer Model: Confined
Solution Method: Cooper-Bredhoefft-Papadopulos
T = 107. ft²/day
S = 8.5E-5

AQUIFER DATA
Saturated Thickness: 28.5 ft

WELL DATA (JGW MW-15024)
Initial Displacement: 1.438 ft
Static Water Column Height: 11. ft
Total Well Penetration Depth: 11. ft
Screen Length: 10. ft
Casing Radius: 0.083 ft
Well Radius: 0.25 ft
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