Consumers Energy
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A CMS Energy Company

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, Bottom Ash Pond

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 Bottom Ash Pond, which established the following locations for determining background groundwater quality and detection monitoring.

Background:

MW-15002	MW-15008
MW-15016	MW-15019

Downgradient:

JCW-MW-15007	JCW-MW-15009	JCW-MW-15010
JCW-MW-15028		

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 Bottom Ash Pond 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.

Harold D. Register J.

Signature

October 17, 2017

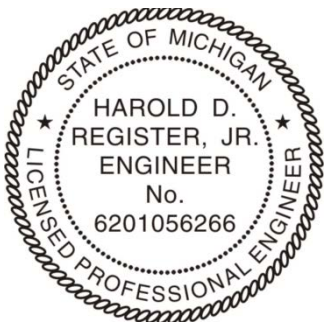
Date of Certification

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

Name

6201056266

Professional Engineer Certification Number



10/17/2017

ENCLOSURES

ARCADIS (2016). "*Summary of Monitoring Well Design, Installation, and Development – Impoundment Unit*"

ARCADIS Design & Consultancy for natural and built assets

Consumers Energy Company

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

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

May 13, 2016

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 – Impoundment Unit

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

Prepared for:

Consumers Energy Company

Jackson, Michigan

Prepared by:

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Our Ref.:

DE000722.0001.00006

Date:

May 13, 2016

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1 INTRODUCTION

Arcadis has prepared this Summary of Monitoring Well Design, Installation, and Development (Report) to summarize monitoring well installation activities for the impoundment 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 wells were determined to be appropriately constructed and will be included in the monitoring program for the impoundment unit and designated as follows for the CCR monitoring program:

Historical Well Name	RCRA Well Name
MW-116A	MW-15027
MW-106A	MW-15028

2 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.

3 FIELD ACTIVITIES

3.1 Soil Borings

Fifteen (15) 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**. Five 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 fifteen (15) soil borings that were completed, ten (10) of the soil boring locations were converted into permanent monitoring wells. The five (5) soil borings not converted to monitoring wells (Soil Borings SB-15004, SB-15005, SB-15014, SB-15015 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 1.5 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 2 feet above the top of the well screen. Approximately 1 to 2 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 bentonite pellets.

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-22345**. 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**. The existing well (MW-116A/MW-15027) was not developed during this event.

Table 2. Groundwater Parameter Stabilization Criteria

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

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. During the slug testing activities, three tests were completed at each of the monitoring wells. Well construction logs are included in **Appendix A**; well construction is summarized in **Table 1.**

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-22345** and the results of the hydraulic conductivity tests are presented in **Table 3** and **Appendix C**.

TABLES

Table 1
Monitoring Well Construction and Development Summary - Impoundment Unit
Consumers Energy Co.
J.C. Weadock Generating Facility
Essexville, Michigan

MW ID	Former MW ID	Site Coordinates				Date Installed	Geologic Unit of Screen Interval	Well Construction	Well Screen Length (ft)	Screen Interval (ft bgs)	Development Details				
		Northing	Easting	Ground Surface Elevation (ft above msl)	TOC Elevation (ft above msl)						Static DTW (ft below TOC)	Total Depth	Pumping DTW (ft below TOC)	Gallons Removed	Final Turbity (NTU)
Background Monitoring Well															
MW-15002	--	777616.5	13263683.7	584.90	587.71	9/17/2015	Sand	2" PVC, 10 slot	10	4 - 14	7.8	16.9	NR	150	15.7
MW-15008	--	778850.3	13262994.1	582.70	585.36	9/24/2015	Sand	2" PVC, 10 slot	10	4 - 14	4.78	17.46	5.76	110	2.94
MW-15016	--	777566.2	13263941.7	583.70	586.49	9/30/2015	Sand	2" PVC, 10 slot	3	2.5-5.5	4.33	8.03	8.00	51	5.1
MW-15018	--	777822.4	13263663.8	583.60	586.42	10/1/2015	Sand	2" PVC, 10 slot	4	3 - 7	6.26	10.03	10.00	68	2.07
MW-15019	--	778024.1	13263504.9	583.50	586.17	10/1/2015	Sand/Clay-Sand	2" PVC, 10 slot	10	4 - 14	6.02	16.00	10.17	280	0.84
MW-15020	--	778708.4	13263077.4	582.50	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	13263347.9	583.70	586.56	10/8/2015	Sand	2" PVC, 10 slot	10	4 - 14	6.40	17.11	11.37	200	2.6
MW-15027	MW-116A	778601.3	13263139.3	583.20	586.25	4/26/2005	Sand	NR	10	5 - 15	5.73	18.29	6.45	110	1.51
Impoundment Monitoring Well															
JCW MW-15007	--	780148.9	13263474.2	585.20	587.40	9/23/2015	Sand	2" PVC, 10 slot	3.5	2.5 - 6	NR	NR	NR	NR	NR
JCW MW-15009	--	780481.4	13262254.9	586.90	589.64	9/24/2015	Sand	2" PVC, 10 slot	5	5 - 10	8.78	13	12.7	65	1.46
JCW MW-15010	--	780809.2	13263418.0	595.20	597.76	9/24/2015	Sand	2" PVC, 10 slot	1.5	15.5 - 17	15.55	19.45	NA	23	2.55
JCW MW-15028	MW-106A	780181.7	13262428.8	586.70	589.37	9/24/2002	Sand	Unknown	3	19 - 22	7.23	24.98	11.55	81	0.89
Hydraulic Testing Wells															
MW-15008	--	778850.3	13262994.1	582.70	585.36	9/24/2015	Sand	2" PVC, 10 slot	10	4 - 14	4.78	17.46	5.76	110	2.94
JCW MW-15009	--	780481.4	13262254.9	586.90	589.64	9/24/2015	Sand	2" PVC, 10 slot	5	5 - 10	8.78	13	12.7	65	1.46
JCW MW-15010	--	780809.2	13263418.0	595.20	597.76	9/24/2015	Sand	2" PVC, 10 slot	1.5	15.5 - 17	15.55	19.45	NA	23	2.55
JCW-MW-15011	--	780807.4	13265133.1	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
MW-15020	--	778708.4	13263077.4	582.50	585.95	10/1/2015	Sand	2" PVC, 10 slot	10	4 - 14	5.41	17.03	5.95	135	6.1
JCW-MW-15023	--	780840.7	13265275.9	592.7	595.32	10/8/2015	Sand	2" PVC, 10 slot	5	13 - 18	11.05	20.85	15.85	100	0.81
MW-15024	--	778249.1	13263347.9	583.70	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
NR = Not recorded
msl = mean sea level

Table 3
Estimated Hydraulic Conductivity (K) Values
Consumers Energy Co.
J.C. Weadock Generating Facility
Essexville, Michigan

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

Note:
cm/sec = centimeters per second
ft = feet
ft/d = feet per day

References

Butler, J.J., Jr., 1998. The Design, Performance, and Analysis of Slug Tests, Lewis Publishers, Boca Raton, 252p.

Cooper, H.H., J.D. Bredehoeft and S.S. Papadopulos, 1967. Response of a finite-diameter well to an instantaneous charge of water, Water Resources Research, vol. 3, no. 1, pp. 263-269

Hyder, Z, J.J. Butler, Jr., C.D. McElwee and W. Liu, 1994. Slug tests in partially penetrating wells, Water Resources Research, vol. 30, no. 11, pp. 2945-2957

FIGURES

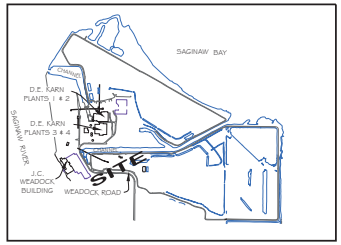
KARN / WEADOCK CCR MONITORING BENCHMARKS AFTER ADJUSTMENTS

BM #	ELEV	DESCRIPTION
150	584.16	NAIL, WEST FACE POWER POLE, 80'± NORTH OF RAILROAD TRACKS, 140' EAST WEADOCK ROAD
151	584.84	NAIL, SOUTHEAST FACE LIGHT POLE, 170'± NORTHWEST CENTERLINE WEADOCK ROAD, & SOUTHWEST RAILROAD TRACKS
152	586.80	SOUTH SOUTHEASTERLY FLANGE BOLT HYDRANT NEAR SOUTHEAST PC OF RAILROAD TRACKS
5035H	585.12	NGS BENCHMARK DISK OVER STEEL ROD IN NOAA CASING 4 COVER
153	586.50	NAIL, NORTH SIDE LIGHT POLE, SOUTH SIDE WEADOCK ROAD, 100'± EAST "DEER XING/DO NOT PASS" SIGN
154	587.31	NAIL, WEST SIDE LIGHT POLE, SOUTHWEST CORNER WEADOCK ASH POND
155	586.21	MARKER "SQUARE", TOP OF EAST END CONCRETE CURB NORTH OF DIESEL PUMP @ FLY ASH SILO
156	582.51	FOUND RAILROAD SPIKE, SOUTH FACE LIGHT POLE, SOUTH SIDE BARRIER ACROSS DISCHARGE CHANNEL
157	582.59	FOUND NAIL, SOUTH FACE WESTERLY MOST POWER POLE @ NORTH SIDE DIKE
158	581.71	FOUND NAIL, SOUTH FACE 4TH POWER POLE FROM THE WEST 5 POWER POLES @ NORTH SIDE DIKE
159	582.51	FOUND NAIL, SOUTH FACE POWER POLE @ NORTHEAST CORNER DIKE
160	581.36	SET CHISELED "SQUARE" IN CONCRETE BASE MONITORING WELL 53R @ EAST SIDE DIKE/ EAST-WEST HAUL ROAD INTERSECTION
161	586.77	FOUND NAIL, NORTH FACE 26" COTTONWOOD @ INTERSECTION OF SLURRY WALL 4 NORTH-SOUTH ROAD
162	584.50	NAIL, WEST FACE POWER POLE, 45'± EAST OF CENTERLINE BOUTELL ROAD, 45'± SOUTH MW15025

SURVEYOR'S NOTES:

1) THE HORIZONTAL COORDINATE VALUES AND GROUND ELEVATIONS WERE OBTAINED WITH GPS RTK EQUIPMENT UTILIZING THE EXISTING SITE SURVEY MONUMENT PERMANENT CONTROL AS FOR THE LOCATION AND ELEVATION CONTROL OF THE BASE STATION. CHECKS WERE MADE BY LOCATING OTHER BASELINE OR PERMANENT CONTROL POINTS OF KNOWN/REPORTED VALUES FOR ACCURACY VERIFICATION. THE TOP OF CASING ELEVATION VALUES WERE ESTABLISHED BY UTILIZING A DIGITAL LEVEL AND RUNNING A CLOSED LEVEL LOOP FROM POINTS OF KNOWN ELEVATION (BASELINE/PERMANENT CONTROL MONUMENTATION AND PREVIOUSLY UTILIZED SITE BENCHMARKS). EACH TOP OF CASING WAS INCLUDED AS A TURN POINT FOR THE LEVEL LOOP. NO SIDE SHOTS WERE USED AS PART OF THE LEVEL LOOP.

2) AERIAL IMAGERY IS SHOWN FROM JUNE 2007 FLIGHT FOR THE PORTION SOUTH OF THE STORAGE TANKS AT THE SOUTH END OF THE SITE AND APRIL 2013 FLIGHT FOR THE IMAGERY NORTH OF THE STORAGE TANKS. IMAGERY PROVIDED BY AIR-LAND SURVEYS.



LOCATION MAP
NOT TO SCALE

SECTION 1, 2, 11 & 12 T14N-R5E
HAMPTON TOWNSHIP BAY COUNTY

BASIS OF BEARING

MICHIGAN STATE PLANE COORDINATE SYSTEM,
SOUTH ZONE NAD83 (1994), COMBINED SCALE FACTOR = 0.99996543

BASIS OF ELEVATION

NORTH AMERICAN VERTICAL DATUM 1988
(NAVD88)

*NAVD88 = NORTH AMERICAN VERTICAL DATUM OF 1988
*NGVD29 = NATIONAL GEODETIC VERTICAL DATUM OF 1929
*USLS = UNITED STATE LAKE SURVEY 1935
*IGLD55 = INTERNATIONAL GREAT LAKES DATUM 1955 ADJUSTMENT
*IGLD85 = INTERNATIONAL GREAT LAKES DATUM 1985 ADJUSTMENT
* REPORTED IN UNITS OF FEET.

CONVERSIONS

NAVD88 TO USLS = +0.92'
NAVD88 TO IGLD85 = -0.11'
USLS TO IGLD55 = -1.754'
USLS TO NGVD29 = -0.297'
IGLD55 TO IGLD85 = +0.72'

NOTE: THE CONVERSIONS TO USLS AND TO IGLD DATUMS ONLY APPLY TO THE IMMEDIATE AREA AT THE KARN PLANT AND SHOULD NOT BE USED ELSEWHERE.

LEGEND

JCW MW-406 JC WEADOCK BOTTOM ASH POND WELL
MW-408 BACKGROUND MONITORING WELL
JCW MW-407 LANDFILL MONITORING WELL
JCW MW-410 BEDROCK MONITORING WELL

JC WEADOCK - MONITORING WELLS; WO#25477893; ROWE #15L0109; OCTOBER 2015

ROWE POINT #	WELL NAME	NORTHING (MSPC NAD83(1994) INTERNATIONAL FEET)	EASTING (MSPC NAD83(1994) INTERNATIONAL FEET)	GROUND ELEV. (NAVD88)	T/CASING ELEV. (NAVD88)	LATITUDE (DECIMAL DEGREES)	LONGITUDE (DECIMAL DEGREES)
15017	JCW MW-15001	777615.4	13263677.1	585.3	587.99	43.6325013	-83.8366837
150091	JCW MW-15003	780479.7	13262242.2	586.4	589.10	43.6403837	-83.8420358
15006	JCW MW-15006	781147.2	13265077.1	587.9	590.50	43.6421658	-83.8313111
15021	JCW MW-15021	778462.7	13268914.4	592.1	595.05	43.6347336	-83.8168819
15022	JCW MW-15022	781673.5	13268937.1	591.9	594.72	43.6435414	-83.8167172
15025	JCW MW-15025	776221.6	13267177.6	585.7	588.51	43.6286164	-83.8234966
15026	JCW MW-15026	780242.6	13268936.2	591.3	594.03	43.6396161	-83.8167560
15007	JCW MW-15007	780148.9	13263474.2	585.2	587.40	43.6394549	-83.8373899
15009	JCW MW-15009	780481.4	13262254.9	586.9	589.64	43.6403880	-83.8419878
15010	JCW MW-15010	780809.2	13263418.0	595.2	597.76	43.6412674	-83.8375867
15011	JCW MW-15011	780807.4	13265133.1	594.9	597.07	43.6412327	-83.8311080
15012	JCW MW-15012	780995.6	13265672.5	592.2	595.07	43.6417396	-83.8290659
15023	JCW MW-15023	780840.7	13265275.9	592.7	595.32	43.6413214	-83.8305676
15002	MW-15002	777616.5	13263683.7	584.9	587.71	43.6325042	-83.8366589
15008	MW-15008	778850.3	13262994.1	582.7	585.36	43.6359007	-83.8392343
15016	MW-15016	777566.2	13263941.7	583.7	586.49	43.6323619	-83.8356858
15018	MW-15018	777822.4	13263663.8	583.6	586.42	43.6330693	-83.8367291
15019	MW-15019	778024.1	13263504.9	583.5	586.17	43.6336254	-83.8373244
15020	MW-15020	778708.4	13263077.4	582.5	585.95	43.6355101	-83.8389231
15024	MW-15024	778249.1	13263347.9	583.7	586.56	43.6342456	-83.8379121
15027	MW 116A/MW-15027	778601.3	13263139.3	583.2	586.25	43.6352151	-83.8386919
15028	MW-106A/MW-15028	780181.7	13262428.8	586.7	589.37	43.6395629	-83.8413382

DRAWING NO.	REFERENCE DRAWINGS
FIG 1, REV 4	ARCADIS RCRA CCR GROUNDWATER MONITORING PROGRAM
FIG 1, REV 2	ARCADIS RCRA CCR DEEP GROUNDWATER MONITORING PROGRAM

REV.	DATE	DESCRIPTION	BY	APP.
A	11/30/15	EDIT TABLE AND LEGEND	EMB	

DR. J. PLUMMER 11/05/15
FIELD BOOK # 1959 KD. BGDM 11/4/15
CHKD. M. HORTON 11/06/15
APP.

Consumers Energy
ROWE PROFESSIONAL SERVICES COMPANY

JC WEADOCK MONITORING WELLS CCR MONITORING

SECTION 1, 2, 11 & 12 T14N-R5E
HAMPTON TOWNSHIP SAP 25477893 BAY COUNTY

SCALE:	DRAWING NO.	SHEET	REV.
1"=300'	SG-22354	1	A

FILE NAME: 22354BASE.DWG
ROWE # 15L0109

APPENDIX A

Soil Boring and Monitoring Well Construction Logs

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

Northing: 777616.5
Easting: 13263683.7
Casing Elevation: 587.71

Borehole Depth (ft. bgs.): 15.0
Surface Elevation: 584.9

Descriptions By: L. Rogers

Well/Boring ID: **MW-15002**

Client: Consumers Energy

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

Weather Conditions: 72 F Sunny

DEPTH (feet bgs.) / ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
0 / 585	1	0.0-6.0'	6.0	NA			(0.0 - 6.0') Hydrovac no lithology recorded.		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)
5 / 580	2	6.0-10.0'	2.5	NA			(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).		Sand Pack K&E WP00 (2.0-15.0' bgs); 2" PVC 10 Slot Well Screen (4.0-14.0' bgs)
							(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).		
10 / 575	3	10.0-15.0'	4.7	NA			NOTE: trace small pebbles to small cobbles, subrounded to subangular from 12.0 to 14.0' bgs.		
15 / 570							(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).		
							End of boring 15.0' bgs.		

ARCADIS Design & Consultancy for natural and built assets

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.

Date Start: 09/23/15
Date Finish: 09/23/15
Drilling Company: Stock Drilling
Driller's Name: Austin Goldsmith
Drilling Method: Hydrovac/Sonic
Sampling Method: Continuous
Rig Type: Sonic
Water Level Start (ft. bgs.): 3.0
Water Level Finish (ft. btoc.): 3.82

Northing: 780148.9
Easting: 13263474.2
Casing Elevation: 587.4

Borehole Depth (ft. bgs.): 19.0
Surface Elevation: 585.2

Descriptions By: L. Rogers

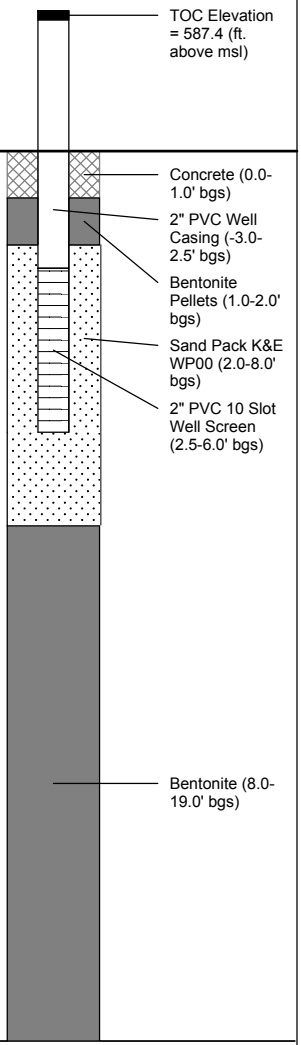
Well/Boring ID: **JCW MW-15007**

Client: Consumers Energy

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

Weather Conditions: 65 F Sunny

DEPTH (feet bgs.) / ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)
0 / 585	1	0.0-6.0'	0.0	NA			(0.0 - 6.0') Hydrovac no lithology recorded.	
5 / 580	2	6.0-9.0'	6.3	NA			(6.0 - 7.0') ASH. NOTE: Fill material. (7.0 - 19.0') CLAY, low to medium plasticity; trace silt; trace very fine to medium sand; trace granule to medium pebble; subrounded to subangular; trace organics; dry; stiff; dark gray (10YR 4/1).	
10 / 575	3	9.0-14.0'	6.2	NA			NOTE: trace large pebbles to small cobbles, subrounded; color change to brown (10YR 4/3) from 9.0 to 11.5' bgs.	
15 / 570	4	14.0-19.0'	6.8	NA				
20 / 565							End of boring 19.0' bgs.	



ARCADIS Design & Consultancy for natural and built assets

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

Hydrovac to 6.0' bgs.
Groundwater encountered at 3.0' bgs during drilling.
Water level at development was 3.82' btoc.
No odor or staining observed.
Groundwater elevation measured on December 8, 2015 was 583.58 feet above mean sea level.

Date Start: 09/23/15
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.): 2.0
Water Level Finish (ft. btoc.): 4.78

Northing: 778850.3
Easting: 13262994.1
Casing Elevation: 585.36

Borehole Depth (ft. bgs.): 39.0
Surface Elevation: 582.7

Descriptions By: L. Rogers

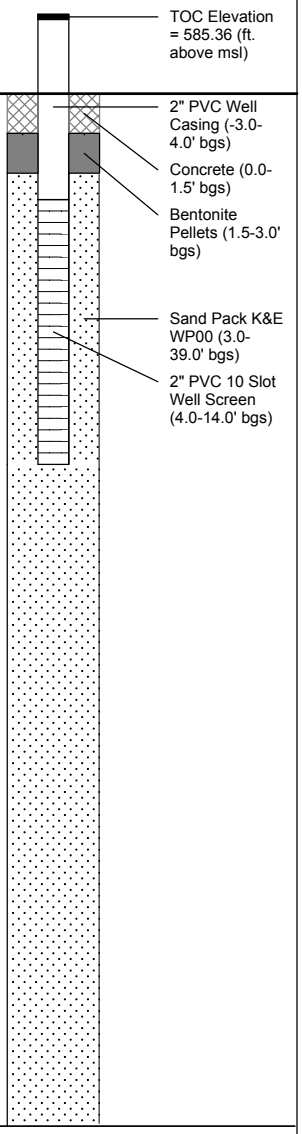
Well/Boring ID: **MW-15008**

Client: Consumers Energy

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

Weather Conditions: 71 F Sunny

DEPTH (feet bgs.) / ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)
585 / 0								
580 / 5	1	0.0-6.0'	0.0	NA			(0.0 - 6.0') Hydrovac no lithology recorded.	
575 / 10	2	6.0-9.0'	3.2	NA			(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.	
							(8.0 - 8.5') CLAY, low plasticity; trace granule to small pebbles, subrounded to subangular; dry; stiff; dark yellowish brown (10YR 4/4).	
570 / 15	3	9.0-19.0'	9.4	NA			(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). 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.	
565 / 20								
560 / 25	4	19.0-29.0'	10.0	NA			(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).	
555 / 30								
550 / 35	5	29.0-39.0'	8.7	NA			(33.0 - 39.0') SILT and CLAY, medium to high plasticity, slow dilatancy; trace organics; moist; soft; olive brown (2.5Y 4/3).	
545 / 40							End of boring 39.0' bgs.	



ARCADIS Design & Consultancy for natural and built assets

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

Northing: 780481.4
Easting: 13262254.9
Casing Elevation: 589.64

Borehole Depth (ft. bgs.): 10.0
Surface Elevation: 586.9

Descriptions By: L. Rogers

Well/Boring ID: **JCW MW-15009**

Client: Consumers Energy

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

Weather Conditions: 70 F Sunny

DEPTH (feet bgs.) / ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
590 / 0									TOC Elevation = 589.64 (ft. above msl)
585 / 5	1	0.0-6.0'	0.0	NA			(0.0 - 6.0') Hydrovac; no lithology recorded.		Concrete (0.0-2.0' bgs); 2" PVC Well Casing (-3.0-5.0' bgs); Bentonite Pellets (2.0-4.0' bgs)
580 / 10	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). NOTE: Lose trace organics at 9.0' bgs.		Sand Pack K&E WP00 (4.0-10.0' bgs); 2" PVC 10 Slot Well Screen (5.0-10.0' bgs)
575							End of boring 10.0' bgs.		

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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.

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.): 10.5
Water Level Finish (ft. btoc.): 15.75

Northing: 780809.2
Easting: 13263418
Casing Elevation: 597.76

Borehole Depth (ft. bgs.): 19.0
Surface Elevation: 595.2

Descriptions By: L. Rogers

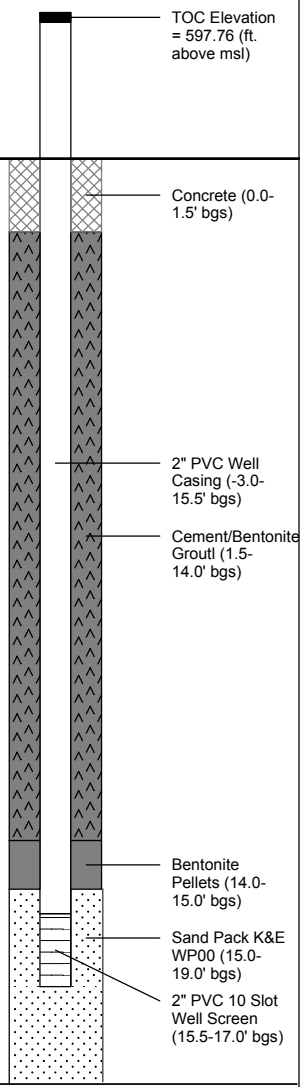
Well/Boring ID: **JCW MW-15010**

Client: Consumers Energy

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

Weather Conditions: 70 F Sunny

DEPTH (feet bgs.)	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)
0	595	1	0.0-6.0'	0.0	NA			(0.0 - 6.0') Hydrovac no lithology recorded.	
5	590	2	6.0-9.0'	4.6	NA			(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.	
10	585	3	9.0-19.0'	10.0	NA			(9.0 - 10.5') SAND, very fine to fine; well sorted; dry; grayish brown (10YR 5/2).	
								(10.5 - 14.0') ASH, fly ash, very fine; wet. NOTE: Fill material.	
15	580							(14.0 - 15.0') FILL, roots and organics; trace ash.	
								(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).	
								(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).	
20	575							End of boring 19.0' bgs.	



ARCADIS Design & Consultancy for natural and built assets

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.

Date Start: 09/29/15
Date Finish: 09/29/15
Drilling Company: Stock Drilling
Driller's Name: Austin Goldsmith
Drilling Method: Hydrovac/Sonic
Sampling Method: Continuous
Rig Type: Sonic
Water Level Start (ft. bgs.): 10.0
Water Level Finish (ft. btoc.): 12.67

Northing: 780807.4
Easting: 13265133.1
Casing Elevation: 597.07

Borehole Depth (ft. bgs.): 18.0
Surface Elevation: 594.9

Descriptions By: L. Rogers

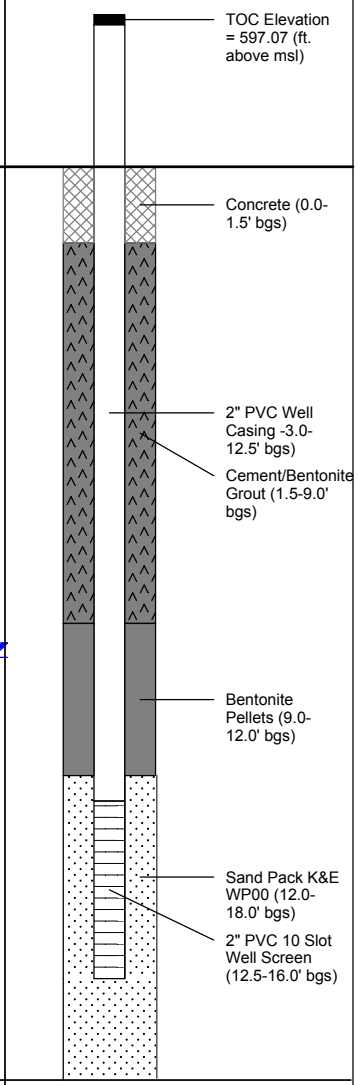
Well/Boring ID: **JCW MW-15011**

Client: Consumers Energy

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

Weather Conditions: 65 F Cloudy

DEPTH (feet bgs.) / ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)
0 / 595								
	1	0.0-6.0'	0.0	NA			(0.0 - 6.0') Hydrovac no lithology recorded.	
5 / 590	2	6.0-9.0'	2.3	NA			(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).	
10 / 585	3	9.0-18.0'	8.5	NA			(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.	
15 / 580							(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).	
20 / 575							End of boring 18.0' bgs.	



ARCADIS Design & Consultancy for natural and built assets

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.

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

Northing: 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

DEPTH (feet bgs.) / ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
585									TOC Elevation = 586.49 (ft. above msl)
0							(0.0 - 0.1') GRASS and TOPSOIL.		Concrete (0.0-1.0' bgs)
							(0.1 - 4.0') SAND, very fine to coarse; little granule; trace small pebbles, subrounded to subangular; poorly sorted; dry; gray (10YR 4/1).		2" PVC Well Casing (-3.0-2.5' bgs)
							NOTE: Trace clay at 2.0' bgs.		Bentonite Pellets (1.0-2.0' bgs)
							NOTE: Wet at 2.5' bgs.		
	1	0.0-6.0'	6.0	NA			NOTE: Trace organics, roots from 3.0 to 4.0' bgs.		
580									Sand Pack K&E WP00 (2.0-9.0' bgs)
5							(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).		2" PVC 10 Slot Well Screen (2.5-5.5' bgs)
							(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).		
	2	6.0-9.0'	6.0	NA			NOTE: Loose trace organics at 6.0' bgs; little granule to small cobbles, subrounded to subangular from 6.0' to 9.0' bgs.		
575									
10							End of boring 9.0' bgs.		

ARCADIS Design & Consultancy for natural and built assets

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.

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

Northing: 777822.4
Easting: 13263663.8
Casing Elevation: 586.42

Borehole Depth (ft. bgs.): 9.0
Surface Elevation: 583.6

Descriptions By: L. Rogers

Well/Boring ID: **MW-15018**

Client: Consumers Energy

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

Weather Conditions: 54 F

DEPTH (feet bgs.) / ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
585									TOC Elevation = 586.42 (ft. above msl)
0							(0.0 - 0.2') GRASS and TOPSOIL.		Concrete (0.0-0.5' bgs)
							(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).		Bentonite Pellets (0.5-2.0' bgs)
							NOTE: Moist at 2.0' bgs.		2" PVC Well Casing (-3.0-3.0' bgs)
	1	0.0-6.0'	6.0	NA			NOTE: Wet at 3.0' bgs.	▼	
580									Sand Pack K&E WP00 (2.0-9.0' bgs)
5							NOTE: Little peat and organics at 5.5' to 6.0' bgs.		2" PVC 10 Slot Well Screen (3.0-7.0' bgs)
							NOTE: Loose peat at 6.0' bgs.		
	2	6.0-9.0'	3.2	NA			(7.0 - 9.0') CLAY, medium plasticity; little granule to small pebbles, subrounded to subangular; trace silt; dry stiff; dark gray (10YR 4/1).		
575									
10							End of boring 9.0' bgs.		

ARCADIS Design & Consultancy for natural and built assets

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.

Date Start: 10/01/15
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.): 6.02

Northing: 778024.1
Easting: 13263504.9
Casing Elevation: 586.17

Borehole Depth (ft. bgs.): 19.0
Surface Elevation: 583.5

Descriptions By: L. Rogers

Well/Boring ID: **MW-15019**

Client: Consumers Energy

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

Weather Conditions: 55 F Windy

DEPTH (feet bgs.) / ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
585									TOC Elevation = 586.17 (ft. above msl)
0							(0.0 - 0.2') GRASS and TOPSOIL.		Concrete (0.0-1.5' bgs)
							(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).		2" PVC Well Casing (-3.0-4.0' bgs)
580	1	0.0-6.0'	6.0	NA			(2.0 - 7.5') SAND, very fine to medium; trace coarse sand; moist; well sorted; very dark brown (10YR 2/2). NOTE: Wet at 3.0' bgs. NOTE: Little coarse sand to granule, subrounded to subangular starting at 4.0' bgs.		Bentonite Pellets (1.5-3.0' bgs)
5									
	2	6.0-9.0'	NA	NA			(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).		Sand Pack K&E WP00 (3.0-19.0' bgs)
575									2" PVC 10 Slot Well Screen (4.0-14.0' bgs)
10									
570	3	9.0-19.0'	9.5	NA			(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).		
15							(16.5 - 19.0') SAND, very fine to fine; some clay; trace medium sand; well sorted; wet; dark gray (10YR 4/1).		
565									
20							End of boring 19.0' bgs.		

ARCADIS Design & Consultancy for natural and built assets

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.

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.): 5.0
Water Level Finish (ft. btoc.): 5.41

Northing: 778708.4
Easting: 13263077.4
Casing Elevation: 585.95

Borehole Depth (ft. bgs.): 19.0
Surface Elevation: 582.5

Descriptions By: L. Rogers

Well/Boring ID: **MW-15020**

Client: Consumers Energy

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

Weather Conditions: 54 F Windy

DEPTH (feet bgs.) / ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
585									TOC Elevation = 585.95 (ft. above msl)
0							(0.0 - 0.2') GRASS, TOPSOIL. and FRAGMITES.		
							(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).		Concrete (0.0-1.5' bgs)
580	1	0.0-6.0'	6.0	NA			(1.0 - 19.0') SAND, very fine to fine; trace medium sand; well sorted; moist; dark yellowish brown (10YR 4/4).		2" PVC Well Casing (-3.0-4.0' bgs)
							NOTE: Color change to gray (10YR 5/1) at 2.0' bgs.		Bentonite Pellets (1.5-3.0' bgs)
5							NOTE: Trace coarse sand; color change to very dark brown (10YR 2/2) at 4.0' bgs.		
							NOTE: Trace organics, shells; wet at 5.0' bgs.		
575	2	6.0-9.0'	3.5	NA			NOTE: Loose trace shells; color change to dark gray (10YR 4/1) at 6.0' bgs.		Sand Pack K&E WP00 (3.0-19.0' bgs)
10									2" PVC 10 Slot Well Screen (4.0-14.0' bgs)
570	3	9.0-19.0'	9.6	NA					
15									
565									
20							End of boring 19.0' bgs.		

ARCADIS Design & Consultancy for natural and built assets

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.

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
Water Level Start (ft. bgs.): 6.0
Water Level Finish (ft. btoc.): 11.05

Northing: 780840.7
Easting: 13265275.9
Casing Elevation: 595.32

Borehole Depth (ft. bgs.): 19.0
Surface Elevation: 592.7

Descriptions By: L. Rogers

Well/Boring ID: **JCW MW-15023**

Client: Consumers Energy

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

Weather Conditions: 43 F Partly Sunny

DEPTH (feet bgs.) / ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
595									TOC Elevation = 595.32 (ft. above msl)
0							(0.0 - 6.0') Hydrovac; no lithology recorded.		Concrete (0.0-1.5' bgs)
590	1	0.0-6.0'	0.0	NA					
5									2" PVC Well Casing (-3.0-13.0' bgs)
							(6.0 - 7.0') SAND, very fine to fine; trace medium sand; trace ash; trace organics, shells; wet; dark gray (10YR 4/1).		Bentonite Pellets (0.3-12.0' bgs)
585	2	6.0-9.0'	3.2	NA			(7.0 - 11.5') CLAY, medium plasticity; little very fine to fine sand; trace medium sand to granule, subrounded to subangular; trace silt; dry; dark grayish brown (10YR 4/2).	▼	
10									
							(11.5 - 18.0') SAND, very fine to medium; little coarse sand; trace very coarse sand; trace orgainics, shells; wet; well sorted; dark gray (10YR 4/1).		
580	3	9.0-19.0'	NA	NA					Sand Pack K&E WP00 (12.0-19.0' bgs)
15							NOTE: Color change to very dark gray (10YR 3/1) at 16.0' bgs.		2" PVC 10 Slot Well Screen (13.0-18.0' bgs)
575							(18.0 - 19.0') CLAY, low plasticity; trace fine sand to small pebbles, subrounded to subangular; dry; stiff; dark gray (10YR 4/1).		
							End of boring 19.0' bgs.		
20									

ARCADIS Design & Consultancy for natural and built assets

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.

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

Northing: 778249.1
Easting: 13263347.9
Casing Elevation: 586.56

Borehole Depth (ft. bgs.): 19.5
Surface Elevation: 583.7

Descriptions By: L. Rogers

Well/Boring ID: **MW-15024**

Client: Consumers Energy

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

Weather Conditions: 61 F Cloudy

DEPTH (feet bgs.) / ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
585									TOC Elevation = 586.56 (ft. above msl)
0							(0.0 - 0.2') GRASS and TOPSOIL.		Concrete (0.0-1.5' bgs)
							(0.2 - 1.0') CLAY, medium plasticity; trace fine to medium sand; trace granule to small cobbles, subrounded to subangular; dry; stiff; dark yellowish brown (10YR 4/6).		2" PVC Well Casing (-3.0-4.0' bgs)
580	1	0.0-6.0'	6.0	NA			(1.0 - 13.0') SAND, very fine to medium; trace coarse sand to small pebbles, subrounded to subangular; well sorted; mosit; very dark gray brown (10YR 3/2).		Bentonite Pellets (1.5-3.0' bgs)
5							NOTE: Loose trace small pebbles; change to trace coarse sand to granule; color change to black (10YR 2/1) at 3.0' bgs.		
							NOTE: Change to little coarse to very coarse sand with trace organics, shells; color change to very dark gray (10YR 3/1) at 4.0' bgs.		
							NOTE: Little shell fragments; wet at 5.0' bgs.		
575	2	6.0-9.5'	3.0	NA					Sand Pack K&E WP00 (3.0-19.5' bgs)
10							NOTE: Little coarse sand to small cobbles, subrounded from 10.0-13.0' bgs.		2" PVC 10 Slot Well Screen (4.0-14.0' bgs)
570							(13.0 - 19.5') SAND, medium to very coarse; some granule to large cobbles, subrounded to subangular; poorly sorted; wet; dark gray (10YR 4/1).		
15	3	9.5-19.5'	10.0	NA					
565									
20							End of boring 19.5' bgs.		

ARCADIS Design & Consultancy for natural and built assets

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 6.4' btoc.
No odor or staining observed.
Groundwater elevation measured on December 8, 2015 was 580.27 feet above mean sea level.

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

Northing: 778601
Easting: 13263139
Casing Elevation:

Borehole Depth (ft. bgs.): 15.5
Surface Elevation: 584.1

Descriptions By: B Hennings (NRT, Inc.)

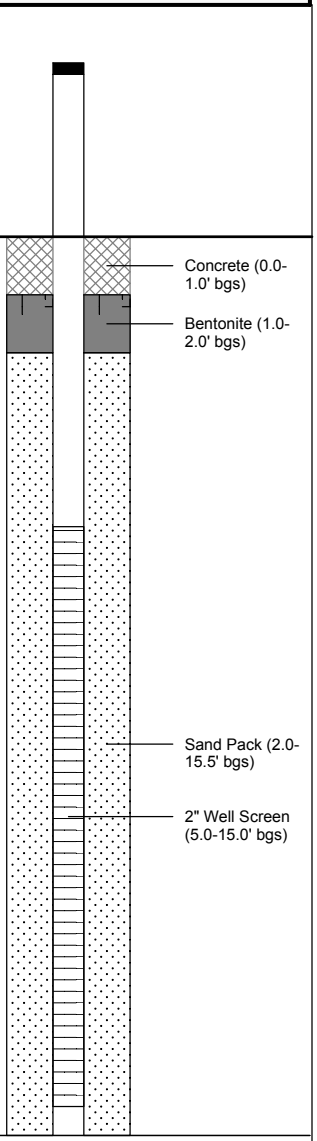
Well/Boring ID: **MW-15027**

Client: Consumers Energy

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

Weather Conditions: NA

DEPTH (feet bgs.) / ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)
585 / 0								
	1	0.0-2.0'	1	NA	X		(0.0 - 1.0') CLAY, tan low plasticity lean clay, trace gravel and organics.	
							(1.0 - 2.0') SAND, brown medium grained sand, trace fine gravel.	
	2	2.0-4.0'	2	NA	X		(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.	
580 / 5							NOTE: Sand becomes gray, no mottling.	
	3	4.0-6.0'	1.6	NA	X		NOTE: Sand becomes medium grained, well graded with trace coarse sand.	
	4	6.0-8.0'	1.5	NA	X		NOTE: Sand becomes brown (10YR 5/3), 5% shell fragments, trace roots.	
575 / 10	5	8.0-10.0'	1.5	NA	X			
	6	10.0-12.0'	1.7	NA	X			
	7	12.0-14.0'	1.7	NA	X		NOTE: Sand becomes well-graded medium to coarse grained, 5% shell fragments, no roots.	
570 / 15	8	14.0-15.5'	1.7	NA	X			
							End of boring 15.5' bgs.	



Well/Boring Construction

ARCADIS Design & Consultancy for natural and built assets

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: 09/24/2002
Date Finish: 09/24/2002
Drilling Company: Rau Drilling
Driller's Name: Tom Rau
Drilling Method: Hollow Stem Auger
Sampling Method: Continuous
Rig Type: Auger
Water Level Start (ft. bgs.): 10.0
Water Level Finish (ft. btoc.): NA

Northing: NA
Easting: NA
Casing Elevation: NA

Borehole Depth (ft. bgs.): 22.0
Surface Elevation: NA

Descriptions By: EPK (NRT, Inc.)

Well/Boring ID: **JCW MW-15028**

Client: Consumers Energy

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

Weather Conditions: NA

DEPTH (feet bgs.) / ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
585									
0				NA			(0.0 - 10.0') ASH; dark gray, thick layers of fly ash (silt like) and thin layers of bottom ash (like f-c sand).		Concrete (0.0-2.0' bgs)
				NA					
580									
5				NA					
				NA					
575		8.0-10.0'	1.3	NA	X				Bentonite (2.0-16.5' bgs)
10		10.0-12.0'	1.5	NA	X		(10.0 - 22.0') SAND; brown to gray, fine to very fine beach sand with shells, wet (flows into augers).		
		12.0-14.0'	1.5	NA	X				
570									
15		14.0-16.0'	1.7	NA	X				
565									
		18.0-20.0'	2.0		X				Sand Pack (16.5-22.0' bgs)
20									2" Well Screen (19.0-22.0' bgs)
							End of boring 22.0' bgs.		

ARCADIS Design & Consultancy for natural and built assets

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

Groundwater encountered at 10.0' 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
Water Level Start (ft. bgs.): NA
Water Level Finish (ft. btoc.): NA

Northing: NA
Easting: NA
Casing Elevation: NA

Borehole Depth (ft. bgs.): 20.0
Surface Elevation: NA

Descriptions By: L. Rogers

Well/Boring ID: **SB-15004**

Client: Consumers Energy

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

Weather Conditions: 74 F Sunny

DEPTH (feet bgs.) / ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
0 / 0									
	1	0.0-6.0'	0.0	NA			(0.0 - 0.6') Hydrovac; no lithology recorded.		
5 / -5									
	2	6.0-10.0'	7.5	NA			(6.0 - 6.5') Bottom ASH. NOTE: Fill material. (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).		
10 / -10									Borehole backfilled with soil cuttings.
	3	10.0-15.0'	7.5	NA			NOTE: color change to dark gray (10YR 4/1) at 13.5' bgs.		
15 / -15									
	4	15.0-20.0'	9.0	NA					
20 / -20							End of boring 20.0' bgs.		

ARCADIS Design & Consultancy for natural and built assets

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.

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
Water Level Start (ft. bgs.): NA
Water Level Finish (ft. btoc.): NA

Northing: NA
Easting: NA
Casing Elevation: NA

Borehole Depth (ft. bgs.): 20.0
Surface Elevation: NA

Descriptions By: L. Rogers

Well/Boring ID: **SB-15005**

Client: Consumers Energy

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

Weather Conditions: 70 F Sunny

DEPTH (feet bgs.) / ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
0 / 0	1	0.0-6.0'	0.0	NA			(0.0 - 6.0') Hydrovac; no lithology recorded.		
5 / -5	2	6.0-10.0'	5.0	NA			(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).		
10 / -10	3	10.0-15.0'	7.0	NA			NOTE: color change to dark gray (10YR 4/1) at 13.0' bgs.		Borehole backfilled with soil cuttings.
15 / -15	4	15.0-20.0'	7.0	NA					
20 / -20							End of boring 20.0' bgs.		

ARCADIS Design & Consultancy for natural and built assets

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.

Date Start: 09/30/15
Date Finish: 09/30/15
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.): NA

Northing: NA
Easting: NA
Casing Elevation: NA

Borehole Depth (ft. bgs.): 19.0
Surface Elevation: NA

Descriptions By: L. Rogers

Well/Boring ID: **JCW SB-15013**

Client: Consumers Energy

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

Weather Conditions: 55 F Cloudy

DEPTH (feet bgs.) / ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
0 / 0	1	0.0-6.0'	0.0	NA			(0.0 - 6.0') Hydrovac; no lithology recorded.		Borehole backfilled with soil cuttings.
5 / -5	2	6.0-9.0'	2.4	NA			(6.0 - 11.0') CLAY, medium to low plasticity; little fine to coarse sand; trace granule to large pebbles, subrounded to subangular; trace silt; dry; stiff; dark gray (10YR 4/1). NOTE: Sand seam, very coarse; poorly sorted; dry from 8.0-8.1' bgs. NOTE: Clay is medium stiff to soft from 9.5 to 11.0' bgs.		
10 / -10	3	9.0-19.0'	9.5	NA			(11.0 - 16.5') Fly ASH and Clay mixture; moist; very soft; balck (10YR 2/1). NOTE: Fill material.		
15 / -15							(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).		
20 / -20							End of boring 19.0' bgs.		

ARCADIS Design & Consultancy for natural and built assets

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

Hydrovac to 6.0' bgs.
Groundwater not encountered.
No odor or staining observed.

Date Start: 09/30/15
Date Finish: 09/30/15
Drilling Company: Stock Drilling
Driller's Name: Austin Goldsmith
Drilling Method: Hydrovac/Sonic
Sampling Method: Continuous
Rig Type: Sonic
Water Level Start (ft. bgs.): 11.0
Water Level Finish (ft. btoc.): NA

Northing: NA
Easting: NA
Casing Elevation: NA

Borehole Depth (ft. bgs.): 19.0
Surface Elevation: NA

Descriptions By: L. Rogers

Well/Boring ID: **JCW SB-15014**

Client: Consumers Energy

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

Weather Conditions: 55 F Cloudy

DEPTH (feet bgs.) / ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
0 / 0	1	0.0-6.0'	0.0	NA			(0.0 - 6.0') Hydrovac; no lithology recorded.		Borehole backfilled with soil cuttings.
5 / -5	2	6.0-9.0'	2.4	NA			(6.0 - 11.0') CLAY, little fine to medium sand; trace silt; trace coarse sand to large pebbles, subrounded to subangular; dry; stiff; dark gray (10YR 4/1).		
10 / -10	3	9.0-19.0'	8.0	NA			(11.0 - 17.0') ASH and CLAY; little coarse sand to medium pebbles, subrounded to subangular; wet; very soft; black (10YR 2/1). NOTE: Fill material.		
15 / -15							(17.0 - 19.0') CLAY, low plasticity; little medium sand to large pebbles; trace silt; dry; stiff; very dark grayish brown (10YR 3/2).		
20 / -20							End of boring 19.0' bgs.		

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

Hydrovac to 6.0' bgs.
Groundwater encounteredat 11.0' bgs.
No odor or staining observed.

ARCADIS Design & Consultancy for natural and built assets

Date Start: 09/30/15
Date Finish: 09/30/15
Drilling Company: Stock Drilling
Driller's Name: Austin Goldsmith
Drilling Method: Hydrovac/Sonic
Sampling Method: Continuous
Rig Type: Sonic
Water Level Start (ft. bgs.): 2.5
Water Level Finish (ft. btoc.): NA

Northing: NA
Easting: NA
Casing Elevation: NA

Borehole Depth (ft. bgs.): 9.0
Surface Elevation: NA

Descriptions By: L. Rogers

Well/Boring ID: **JCW SB-15015**

Client: Consumers Energy

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

Weather Conditions: 55 F Cloudy

DEPTH (feet bgs.) / ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
0 / 0	1	0.0-6.0'	0.0	NA			(0.0 - 6.0') Hydrovac; no lithology recorded. NOTE: TOPSOIL and GRASS from 0.0-0.1' bgs. NOTE: ASH and SAND from 0.1 to 2.5' bgs. NOTE: Wet at 2.5' bgs. NOTE: Fly ASH from 2.5 to 5.0' bgs.		Borehole backfilled with soil cuttings.
5 / -5	2	6.0-9.0'	3.7	NA			(6.0 - 9.0') CLAY, medium to low plasticity; trace fine to medium sand, little granule to large pebbles, subrounded to subangular; dry; stiff; dark gray (10YR 4/1).		
10 / -10							End of boring 9.0' bgs.		
15 / -15									

ARCADIS Design & Consultancy for natural and built assets

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

Hydrovac to 6.0' bgs.
Groundwater encounteredat 2.5' bgs.
No odor or staining observed.

Date Start: 10/01/15
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.): NA

Northing: NA
Easting: NA
Casing Elevation: NA

Borehole Depth (ft. bgs.): 9.0
Surface Elevation: NA

Descriptions By: L. Rogers

Well/Boring ID: **SB-15017**

Client: Consumers Energy

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

Weather Conditions: 51 F Cloudy, windy

DEPTH (feet bgs.) / ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
0 / 0							(0.0 - 0.1') TOPSOIL, GRASS and road GRAVEL.		
							(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.		
							(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).		
	1	0.0-6.0'	6.0	NA			NOTE: Lose trace ash, clay becomes stiff; wet; dark grayish brown (10YR 4/2) at 3.0' bgs.		
5 / -5							(5.0 - 6.0') PEAT; black (10YR 2/1).		Borehole backfilled with soil cuttings.
	2	6.0-9.0'	3.0	NA			(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).		
10 / -10							End of boring 9.0' bgs.		

ARCADIS Design & Consultancy for natural and built assets

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

Hydrovac to 6.0' bgs.
Groundwater encounteredat 3.0' bgs during drilling.
No odor or staining observed.

SOIL DESCRIPTION

Udden-Wenworth Scale Modified ARCADIS, 2008			
Size Class	Millimeters	Inches	Standard Sieve #
Boulder	256 – 4096	10.08+	
Large cobble	128 - 256	5.04 -10.08	
Small cobble	64 - 128	2.52 – 5.04	
Very large pebble	32 – 64	0.16 - 2.52	
Large pebble	16 – 32	0.63 – 1.26	
Medium pebble	8 – 16	0.31 – 0.63	
Small pebble	4 – 8	0.16 – 0.31	No. 5 +
Granule	2 – 4	0.08 – 0.16	No.5 – No.10
Very coarse sand	1 -2	0.04 – 0.08	No.10 – No.18
Coarse sand	½ - 1	0.02 – 0.04	No.18 - No.35
Medium sand	¼ - ½	0.01 – 0.02	No.35 - No.60
Fine sand	1/8 -¼	0.005 – 0.1	No.60 - No.120
Very fine sand	1/16 – 1/8	0.002 – 0.005	No. 120 – No. 230
Silt (subgroups not included)	1/256 – 1/16	0.0002 – 0.002	Not applicable (analyze by pipette or hydrometer)
Clay (subgroups not included	1/2048 – 1/256	.00002 – 0.0002	

Modifier	Percent of Total Sample (by volume)
and	36 - 50
some	21 - 35
little	10 - 20
trace	<10

Description	Criteria
Nonplastic	A $^1/_8$ inch (3 mm) thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading 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

Description	Criteria
Dry	Absence of moisture, dry to touch, dusty.
Moist	Damp but no visible water.
Wet (Saturated)	Visible free water, soil is usually below the water table.

Fine-grained soil – Consistency

Description	Criteria
Very soft	N-value < 2 or easily penetrated several inches by thumb.
Soft	N-value 2-4 or easily penetrated one inch by thumb.
Medium stiff	N-value 9-15 or indented about ¼ inch by thumb with great effort.
Very stiff	N-value 16-30 or readily indented by thumb nail.
Hard	N-value > than 30 or indented by thumbnail with difficulty

Description	Criteria
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.

Coarse-grained soil – Density

Description	Criteria
Very loose	N-value 1- 4
Loose	N-value 5-10
Medium dense	N-value 11-30
Dense	N-value 31- 50
Very dense	N-value >50

APPENDIX B

Photographic Logs

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

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

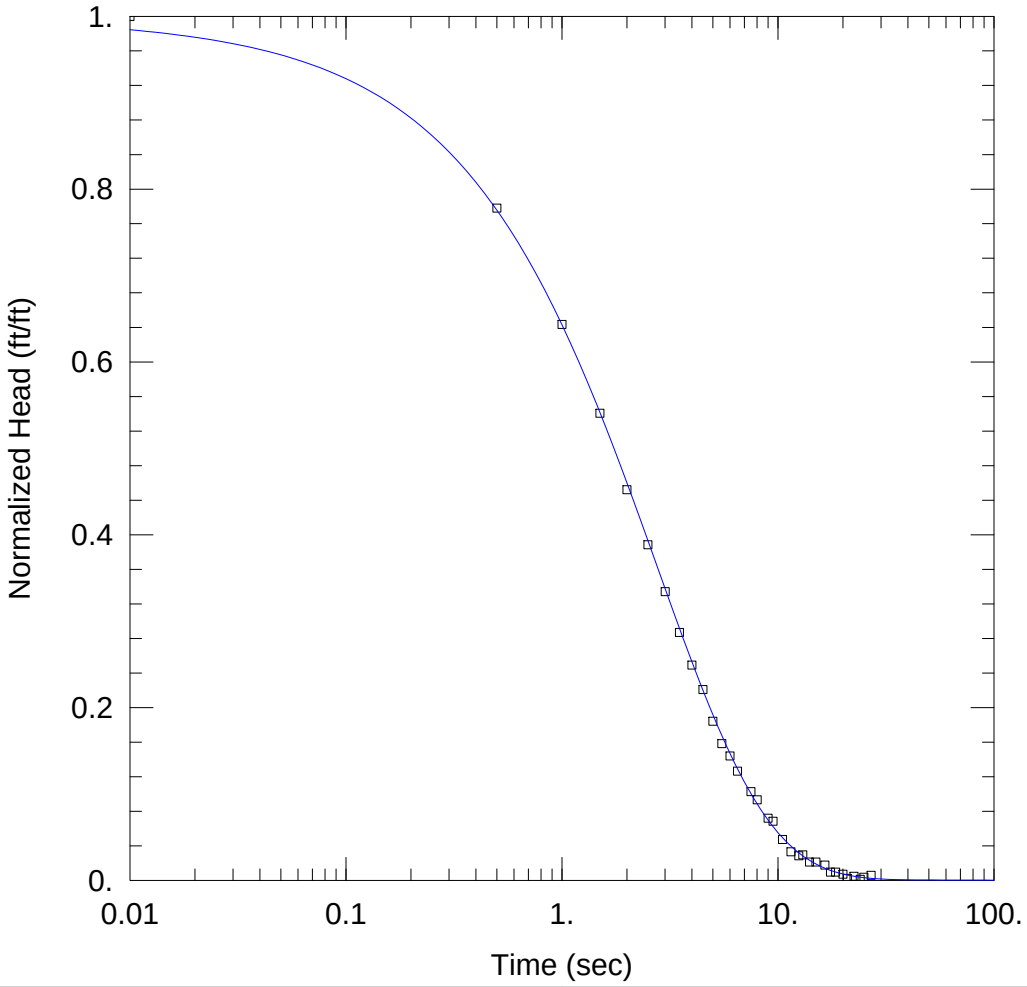
Date of Photograph:
October 8, 2015

APPENDIX C

Hydraulic Test Logs

Slug Test Analysis Results for JCW MW-15008 -Test 2

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



SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 30. ft/day Ss = 5.2E-5 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 27. ft

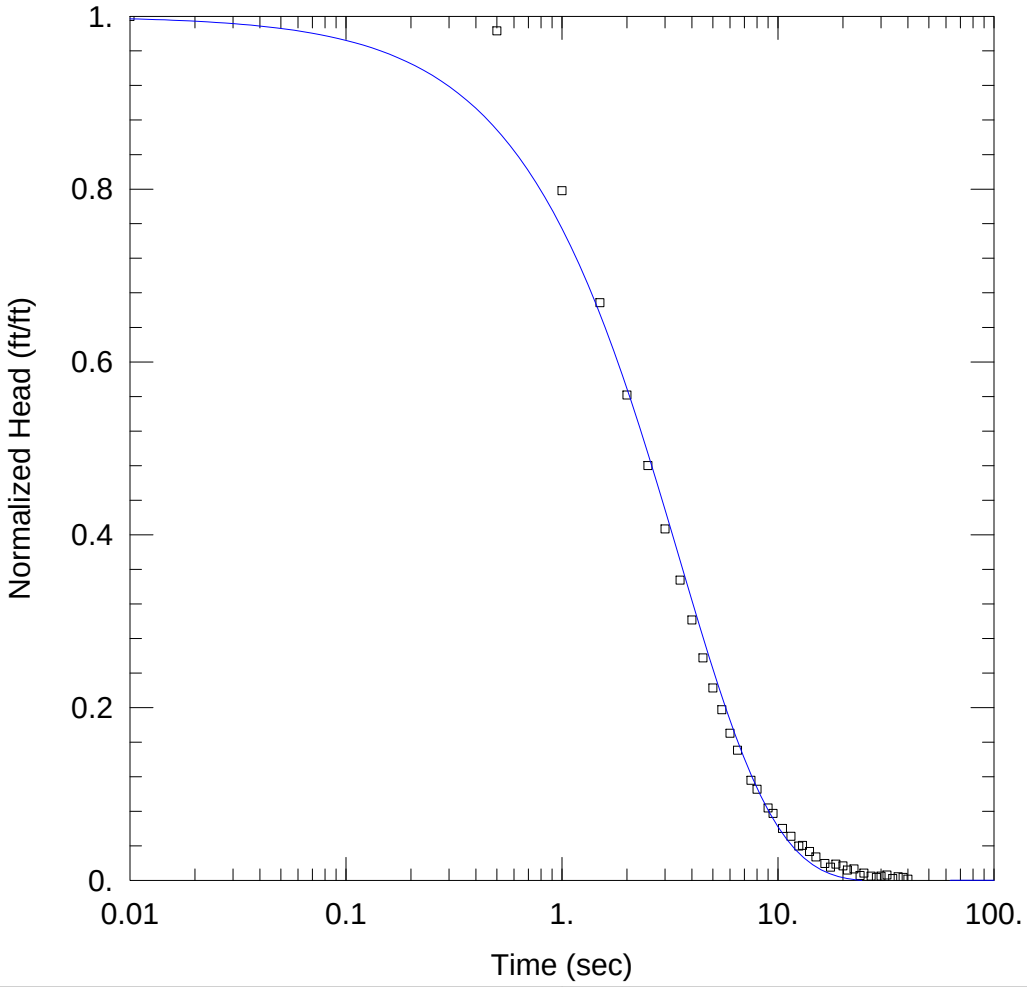
WELL DATA (JCW MW-15008)

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

ARCADIS

Slug Test Analysis Results for JCW MW-15008 -Test 3

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



SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 26. ft/day Ss = 2.2E-13 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 27. ft

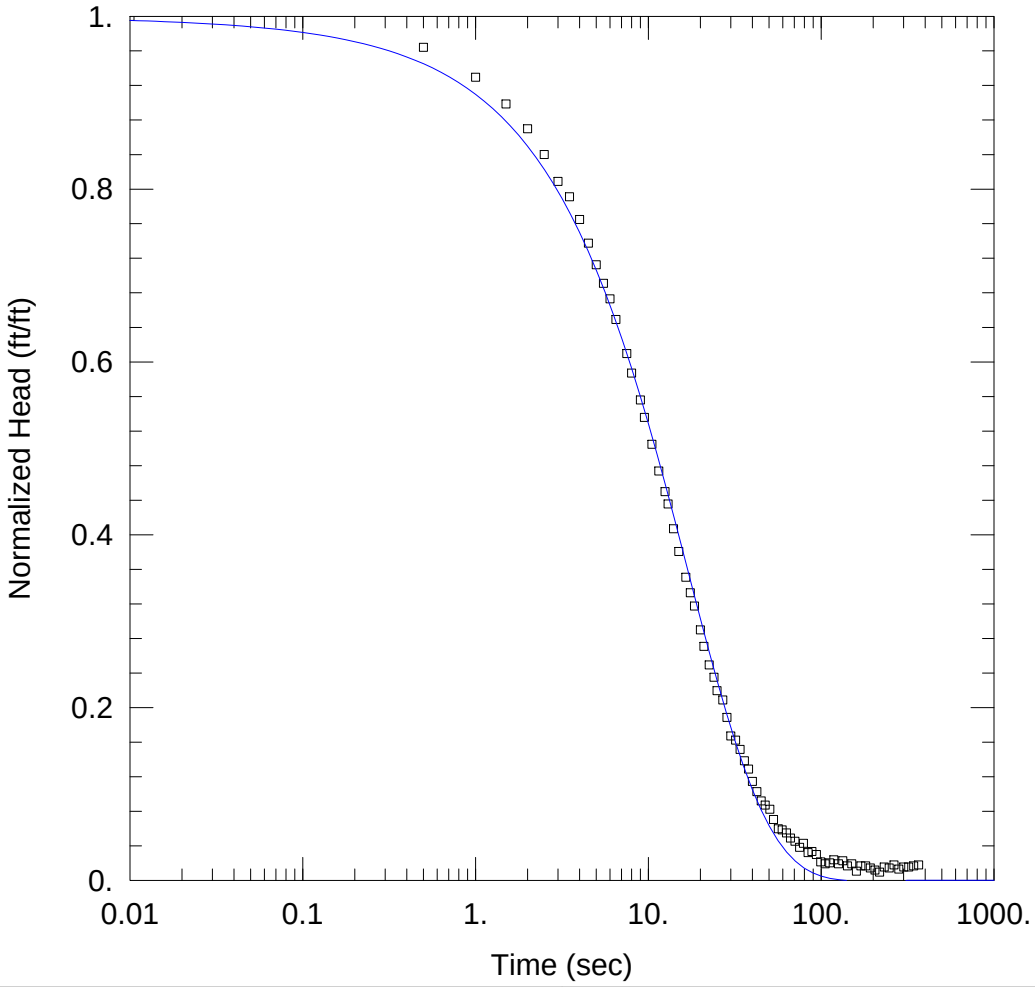
WELL DATA (JCW MW-15008)

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

ARCADIS

Slug Test Analysis Results for JCW MW-15009 -Test 1

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



SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 8. ft/day Ss = 0.00013 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 22.46 ft

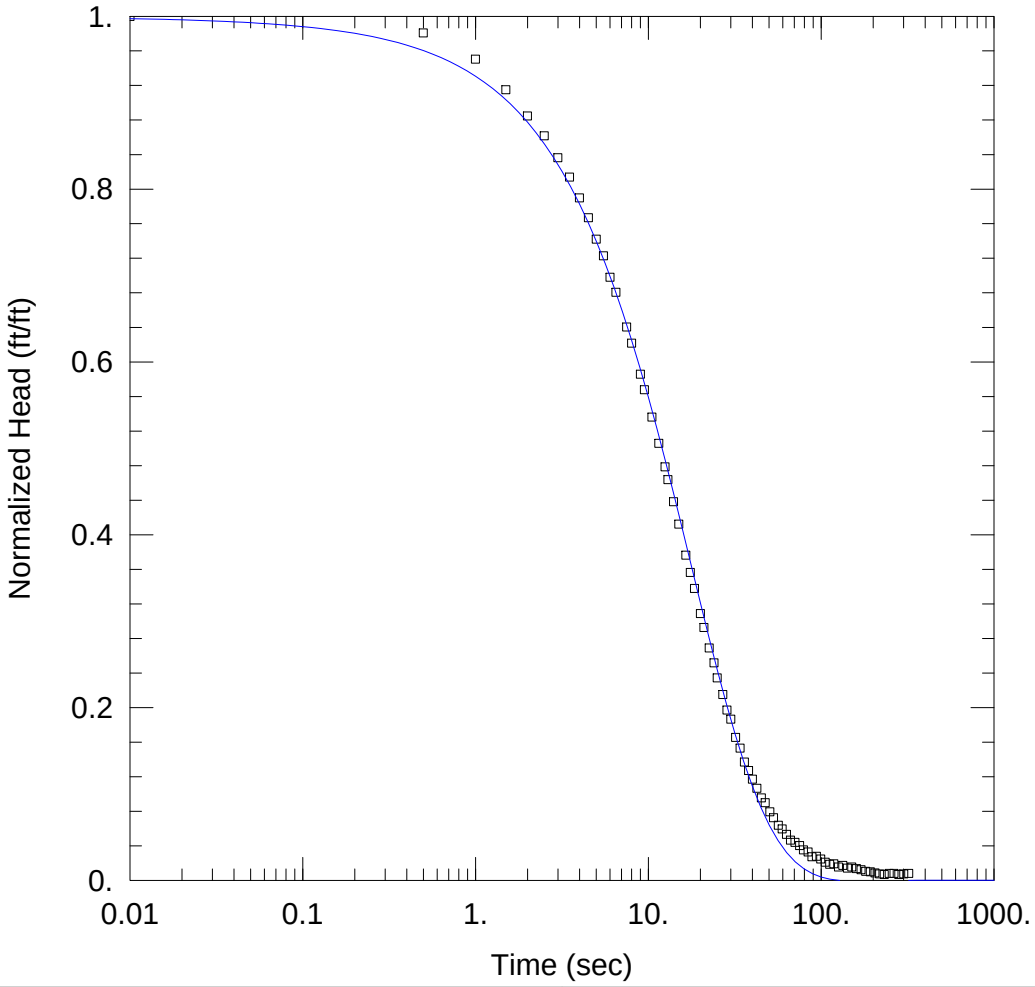
WELL DATA (JCW MW-15009)

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

ARCADIS

Slug Test Analysis Results for JCW MW-15009 -Test 3

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



SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 7.7 ft/day Ss = 3.4E-5 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 22.46 ft

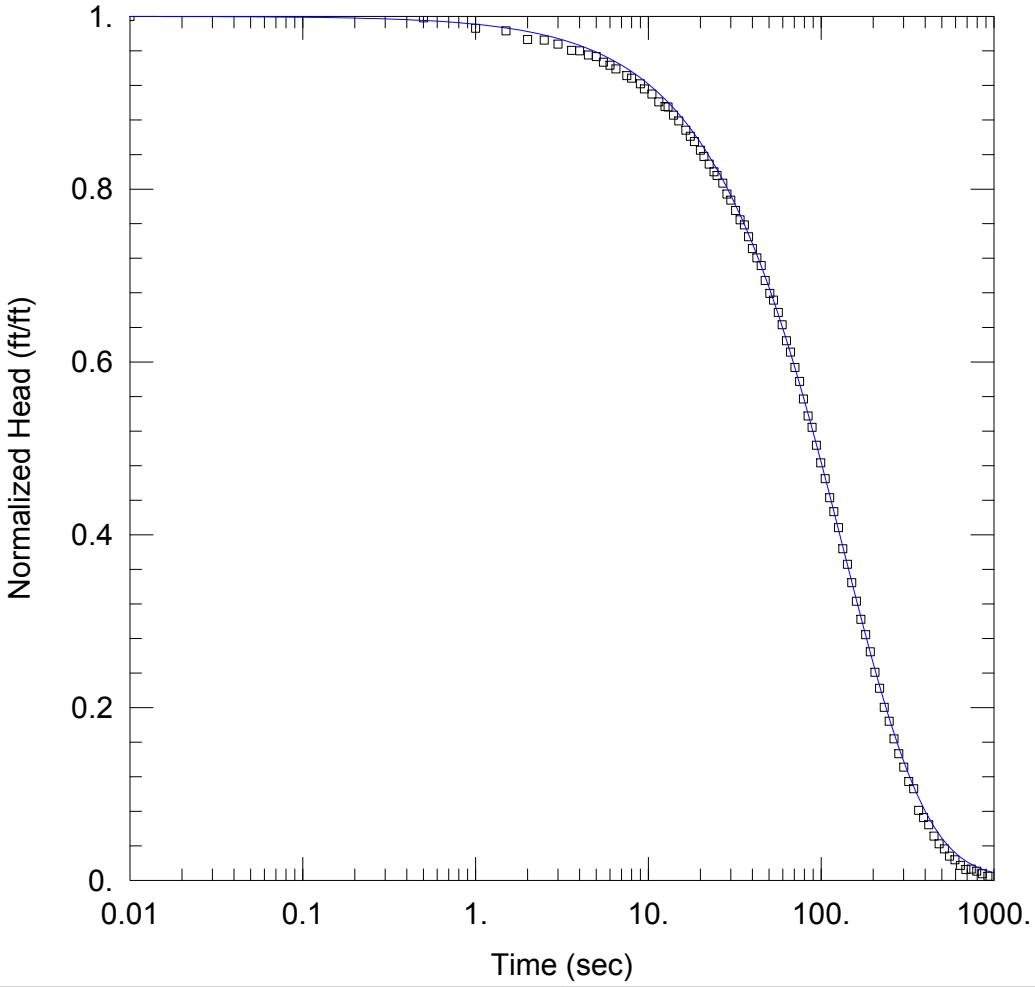
WELL DATA (JCW MW-15009)

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

ARCADIS

Slug Test Analysis Results for JCW MW-15010 -Test 3

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



SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 13. ft/day Ss = 2.1E-11 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 2. ft

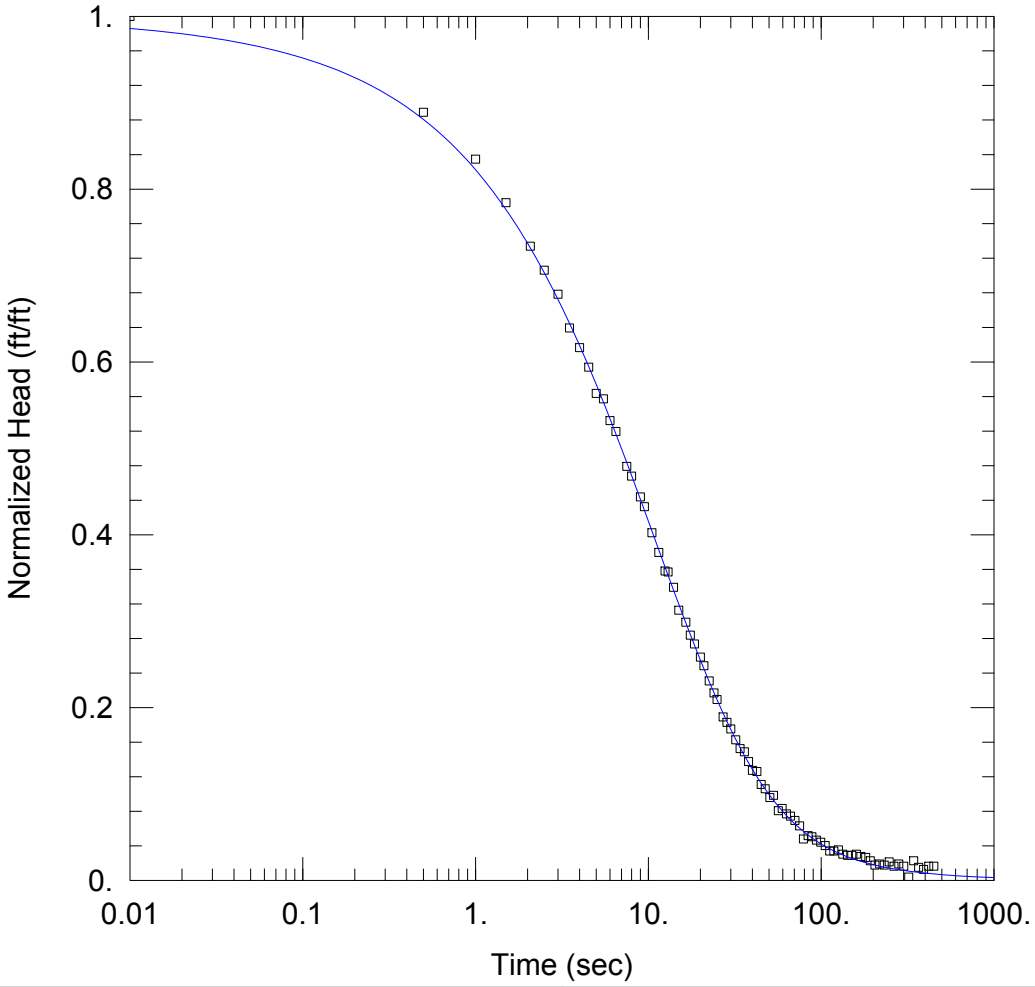
WELL DATA (JCW MW-15010)

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

ARCADIS

Slug Test Analysis Results for JCW MW-15011 -Test 2

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



SOLUTION

Aquifer Model: Confined
Solution Method: Cooper-Bredehoeft-Papadopulos

T = 49. ft^2/day S = 0.0047

AQUIFER DATA

Saturated Thickness: 5.83 ft

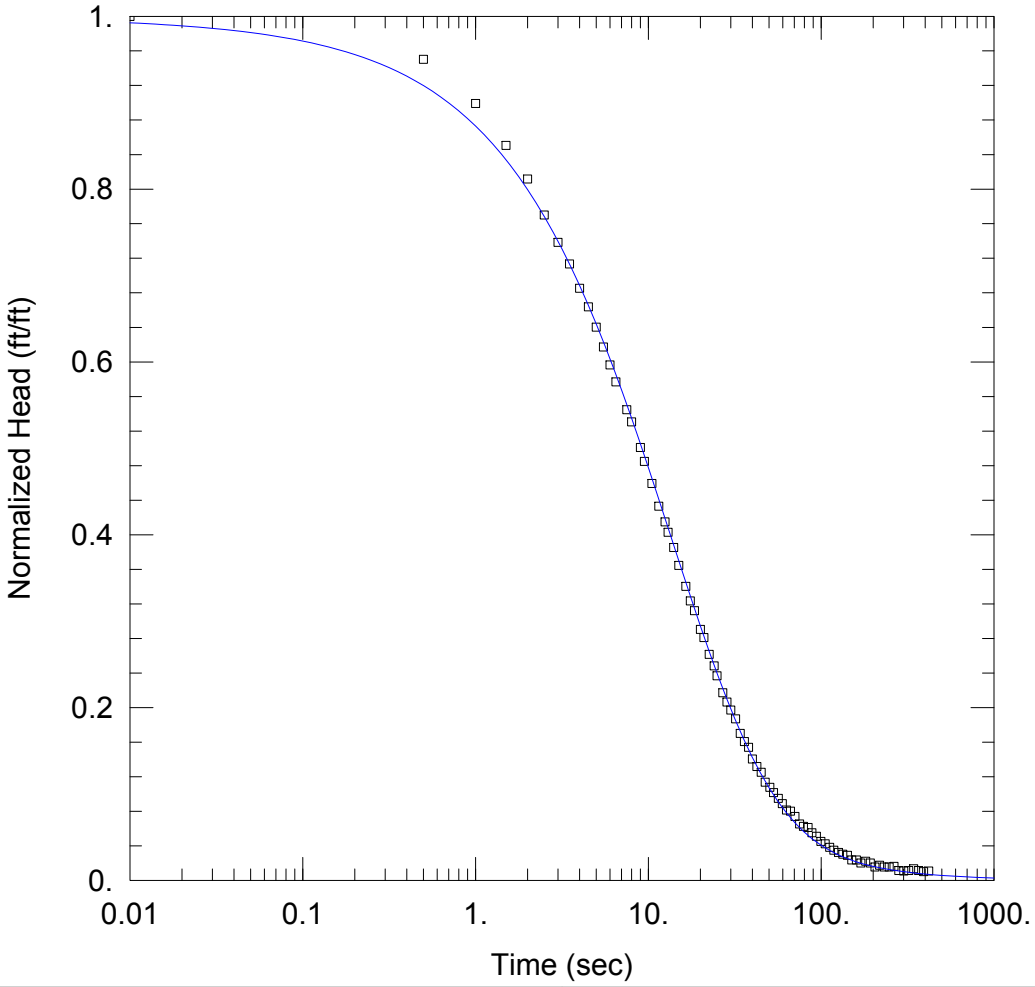
WELL DATA (JCW MW-15011)

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

ARCADIS

Slug Test Analysis Results for JCW MW-15011 -Test 3

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



SOLUTION

Aquifer Model: Confined
Solution Method: Cooper-Bredehoeft-Papadopulos

T = 57. ft^2/day S = 0.00098

AQUIFER DATA

Saturated Thickness: 5.83 ft

WELL DATA (JCW 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

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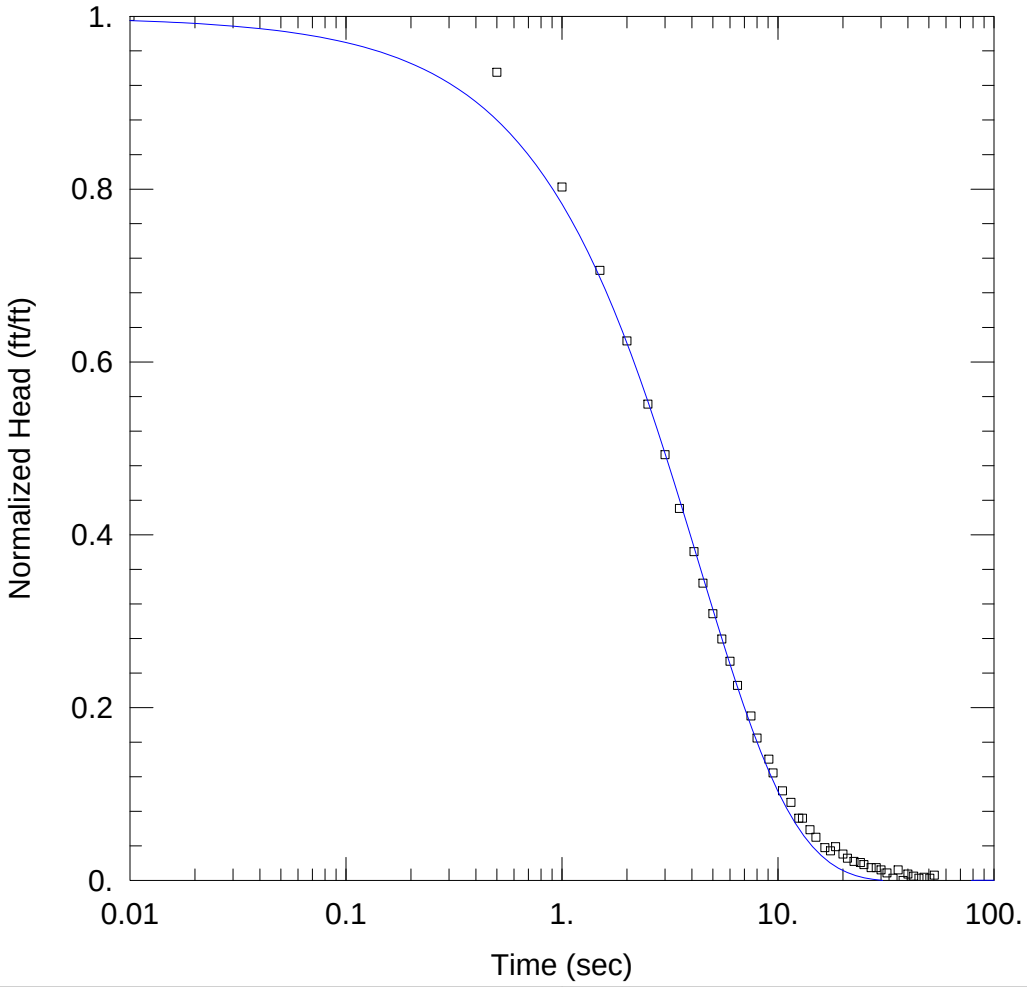
Slug Test Analysis Results for JCW MW-15020 -Test 1

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



SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 21. ft/day Ss = 2.6E-6 ft^{-1}
Kz/Kr = 1.

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. ft
Casing Radius: 0.083 ft
Well Radius: 0.25 ft

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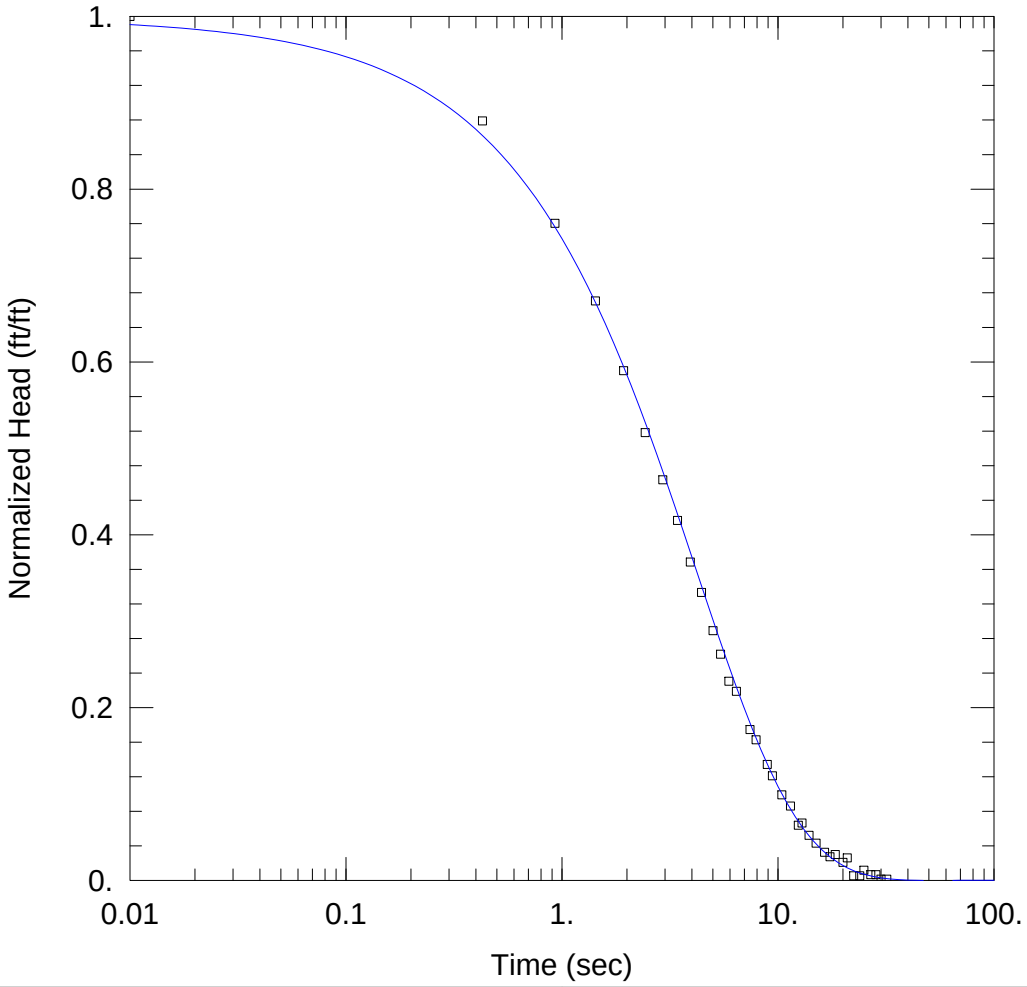
Slug Test Analysis Results for JCW MW-15020 -Test 2

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



SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 21. ft/day Ss = 2.5E-5 ft^{-1}
Kz/Kr = 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

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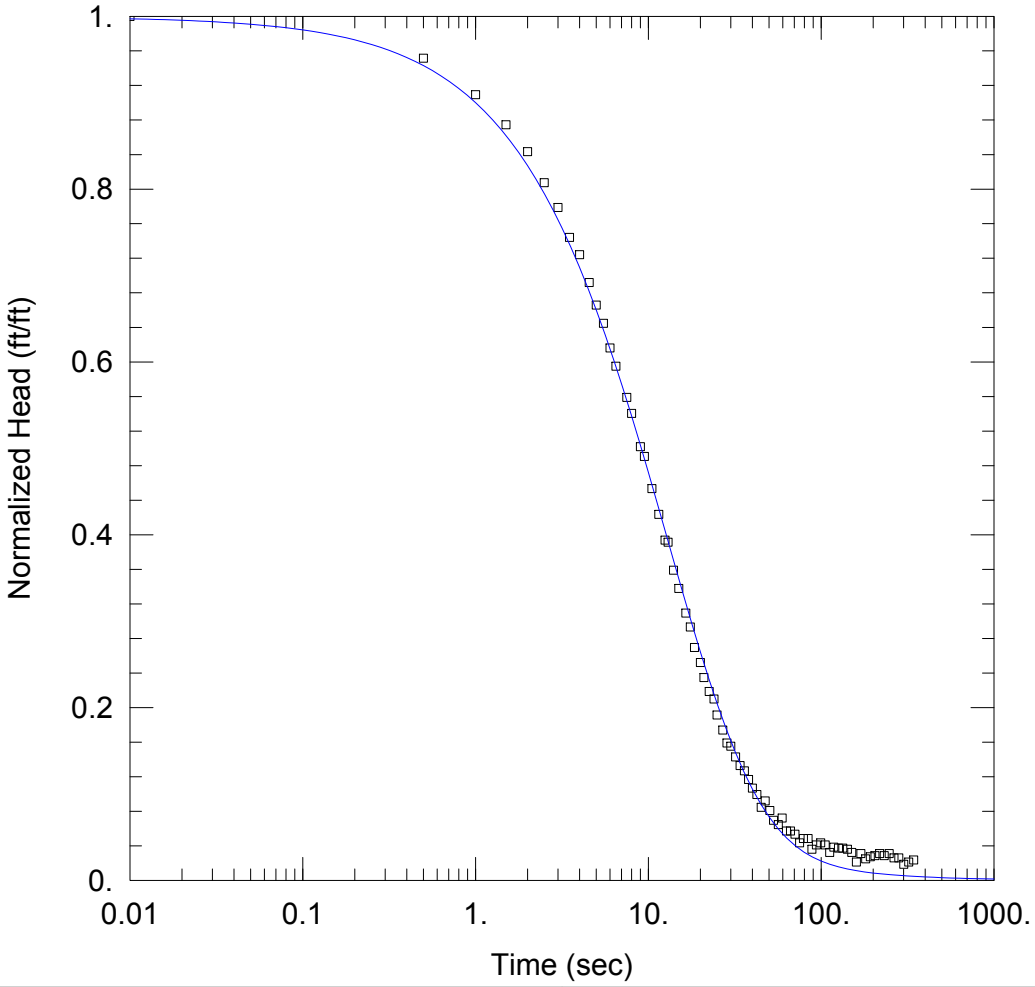
Slug Test Analysis Results for JCW MW-15023 -Test 2

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



SOLUTION

Aquifer Model: Confined
Solution Method: Cooper-Bredehoeft-Papadopulos

T = 104. ft^2/day S = 2.5E-5

AQUIFER DATA

Saturated Thickness: 6.5 ft

WELL DATA (JCW MW-15023)

Initial Displacement: 0.805 ft
Static Water Column Height: 9.48 ft
Total Well Penetration Depth: 6.5 ft
Screen Length: 5. ft
Casing Radius: 0.083 ft
Well Radius: 0.25 ft

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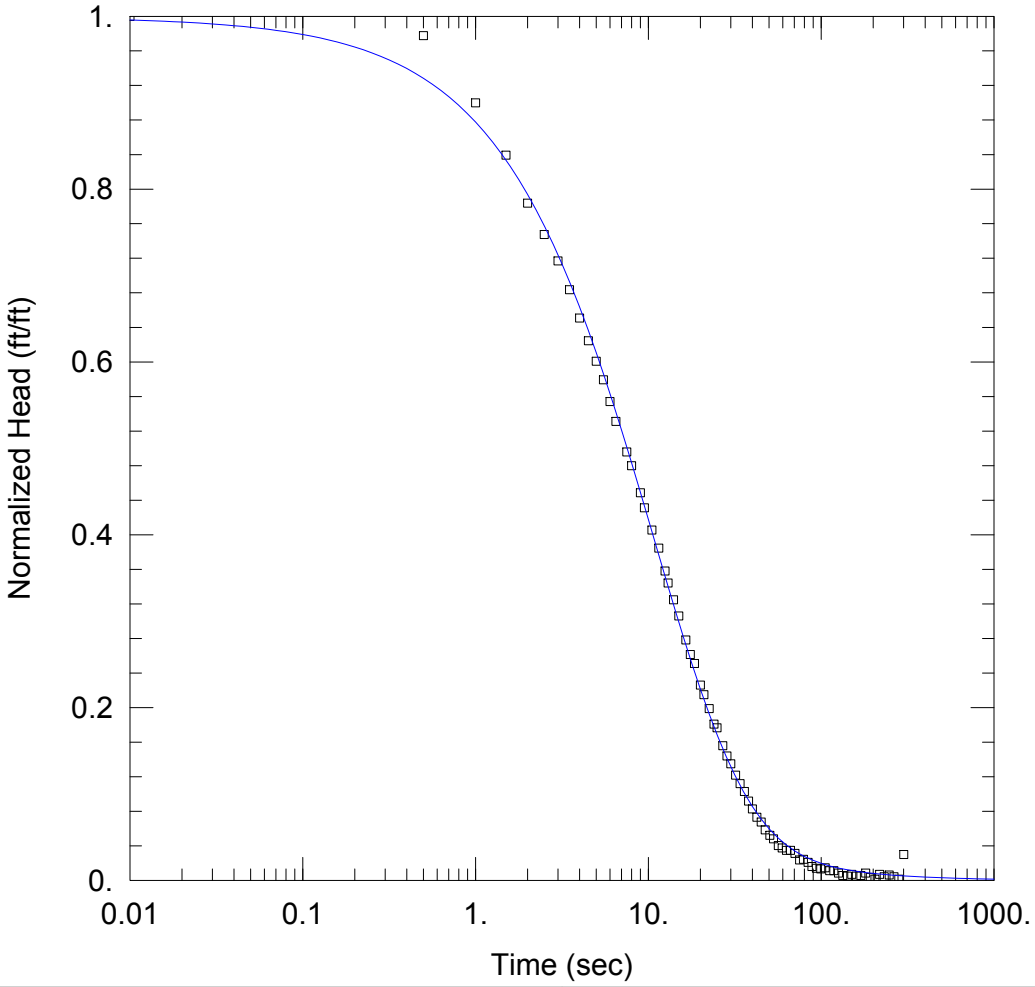
Slug Test Analysis Results for JCW MW-15024 -Test 3

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



SOLUTION

Aquifer Model: Confined
Solution Method: Cooper-Bredehoeft-Papadopulos

T = 107. ft^2/day S = 8.5E-5

AQUIFER DATA

Saturated Thickness: 28.5 ft

WELL DATA (JCW 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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