



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)
J.H. Campbell Generating Complex, JH Campbell Pond A

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 JH Campbell Pond A, which established the following locations for determining background groundwater quality and detection monitoring.

Background:

JHC MW-15023

JHC MW-15024

JHC MW-15025

JHC MW-15026

JHC MW-15027

JHC MW-15028

Downgradient:

JHC MW-15006

JHC MW-15007

JHC MW-15008

JHC MW-15009

JHC MW-15010

JHC MW-15011

**“Groundwater Monitoring System Certification
JH Campbell Pond A”
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Provided herein, as required by §257.91(f), is certification from a qualified professional engineer that the groundwater monitoring system at Consumers Energy JH Campbell Pond A meets the requirements of §257.91.

CERTIFICATION

Professional Engineer Certification Statement [40 CFR 257.91]

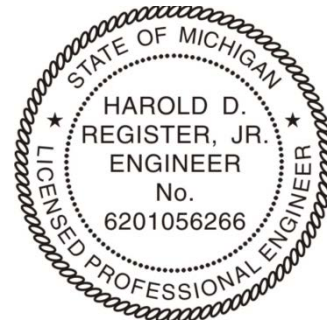
I hereby certify that, having reviewed the attached documentation and being familiar with the provisions of Title 40 of the Code of Federal Regulations §257.91 (40 CFR Part 257.91), I attest that this Groundwater Monitoring System has been designed and constructed to meet the requirements of 40 CFR 257.91. 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, Jr.
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 – Pond A”

Consumers Energy Company

SUMMARY OF MONITORING WELL DESIGN, INSTALLATION, AND DEVELOPMENT – POND A

J.H. Campbell Electric Generation Facility –
West Olive, Michigan

May 13, 2016



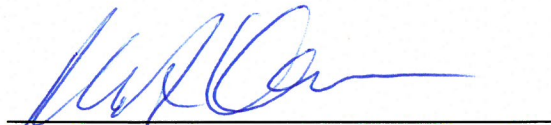


Gregory E. Zellmer, P.G.
Certified Project Manager/Senior Geologist

Summary of Monitoring Well Design, Installation, and Development – Pond A

J.H. Campbell Electric Generation Facility
– West Olive, MI

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

Prepared for:
Consumers Energy Company
Jackson, Michigan

Prepared by:
Arcadis of Michigan, LLC
28550 Cabot Drive
Suite 500
Novi
Michigan 48377
Tel 248 994 2240
Fax 248 994 2241

Our Ref.:
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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 Pond A at the J.H. Campbell electric generation facility (JHC), located in West Olive, Michigan (Site). The groundwater monitoring system for unit consists of eight background wells (JHC MW-15023 through JHC MW-15030) and six downgradient wells (JHC MW-15006 through JHC MW-15011) as depicted on Figure 1. 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.

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

Fourteen (14) soil borings (JHC MW-15006 through JHC MW-15011 and JHC MW-15023 through JHC MW-15030) were completed using rotosonic-drilling methods operated by Mateco Drilling Company of Grand Rapids, 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**. All soil borings were completed as monitoring wells, and details of monitoring well installation are provided in the following section.

3.2 Monitoring Well Installation

Once the total depth of the soil boring was reached, a permanent monitoring well was 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 and are 10 feet in length. A medium-grained sand pack was placed around each well screen to a height 1 to 2 feet above the top of the well screen. A 2 to 7-foot thick bentonite grout seal was placed on top of the sand pack. Where possible, the remainder of the annular space was sealed with a cement-bentonite grout to a depth approximately 1 to 10-foot below ground surface.

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 consisted of the gentle swabbing of the entire screened interval with a surge block. After surging the well screen, water was evacuated 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

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 10, 2015, Arcadis conducted hydraulic tests (slug tests) at nine monitoring wells (JHC MW-15005, JHC MW-15007, JHC MW-15015, JHC MW-15018, JHC MW-15024, JHC MW-15028, JHC MW-15030, JHC MW-15033, and JHC MW-15036) at the Site. Well construction logs are included in **Appendix A**; well construction is summarized in **Table 1**.

During the slug testing activities, three tests were completed at each of the monitoring wells. The slug tests at these 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. With the exception of the tests completed at JHC MW-15005 and JHC MW-15015, the tests at all wells were completed using a disposable bailer to remove a known volume of water. The bailer used at all wells was 1.5-inches in diameter and 36-inches long. At all the wells where the bail-down slug was used, the first two tests were completed using half the bailer size and the last test was completed using the full size bailer. The tests at JHC MW-15005 and JHC MW-15015 were completed using the pneumatic slug test method where a manifold and pump was used to depress the water level. All wells have casing and screen diameters of 2-inches and filter pack diameter of 8-inches. All wells, with the exception of JHC MW-15015 were screened across the water table at the time of well development and hydraulic testing. JHC MW-15015 was screened 2.57 feet below the water table at the time of hydraulic testing. At all wells, a pressure transducer was set to record at 0.5 second intervals to measure static head, displacement and recovery data.

The slug tests at the nine monitoring wells reached full recovery within approximately 7 to 35 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 most of the recovery data was the unconfined KGS model (1994) that accounts for partial penetration effects. The unconfined Bouwer and Rice (1976 and 1989) solution was utilized for recovery data at JHC MW-15030. The results indicated an estimated hydraulic conductivity range from 21 to 139 feet per day (ft/d) with an average of 73 ft/d and a geometric mean of 62 ft/d. The results of this test seem to be a reasonable fit with the sandy formation of the unconfined aquifer where the wells are screened. 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
Consumers Energy Co.
J.H. Campbell Generating Facility
West Olive, 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	TOC	Ground Elevation						Static DTW (ft below TOC)	Total Depth	Pumping DTW (ft below TOC)	Gallons Removed	Final Turbidity (NTU)
Downgradient MW															
JHC MW-15006	---	517535.73	12635481.66	624.74	627.58	9/18/2015	Silty Sand / Sand	2" PVC, 10 slot	10	25 - 35	28.90	38.02	29.05	60	6.69
JHC MW-15007	---	517540.50	12635742.72	624.82	627.70	9/21/2015	Sand	2" PVC, 10 slot	10	22 - 32	29.28	34.75	29.36	55	2.64
JHC MW-15008	---	517560.39	12636031.25	632.43	635.30	9/21/2015	Sand	2" PVC, 10 slot	10	28 - 38	38.25	40.76	NR	30	2.29
JHC MW-15009	---	517779.13	12636014.80	632.33	635.32	9/22/2015	Sand	2" PVC, 10 slot	10	30 - 40	37.14	42.88	37.21	30	1.19
JHC MW-15010	---	518009.36	12636011.46	632.55	635.57	9/23/2015	Sand	2" PVC, 10 slot	10	30 - 40	36.57	42.88	36.64	50	2.90
JHC MW-15011	---	517540.50	12634931.59	627.71	630.83	9/23/2015	Sand	2" PVC, 10 slot	10	27 - 37	34.45	40.12	34.61	90	4.42
Background MW															
JHC MW-15023	---	521927.21	12638205.16	617.01	619.98	10/1/2015	Sand	2" PVC, 10 slot	10	14 - 24	18.91	27.68	NR	130	7.94
JHC MW-15024	---	522366.01	12637322.68	613.79	616.62	10/1/2015	Sand	2" PVC, 10 slot	10	7 - 17	14.12	19.93	14.49	135	3.31
JHC MW-15025	---	522702.98	12636668.15	614.14	617.17	10/1/2015	Sand	2" PVC, 10 slot	10	7 - 17	13.50	19.94	14.42	90	2.32
JHC MW-15026	---	522495.09	12635971.82	615.09	618.04	10/2/2015	Sand	2" PVC, 10 slot	10	8 - 18	15.34	21.02	15.97	180	8.88
JHC MW-15027	---	522394.86	12635097.51	614.77	617.30	10/2/2015	Sand	2" PVC, 10 slot	10	10 - 20	15.85	22.99	16.36	90	4.31
JHC MW-15028	---	521646.20	12634105.34	611.02	613.80	10/2/2015	Sand	2" PVC, 10 slot	10	8 - 18	14.38	20.82	14.62	220	9.80
JHC MW-15029	---	520503.52	12633774.30	608.08	610.95	10/5/2015	Sand	2" PVC, 10 slot	10	8 - 18	10.03	20.96	10.26	105	4.21
JHC MW-15030	---	519760.83	12633044.37	604.05	607.17	10/5/2015	Sand	2" PVC, 10 slot	10	4 - 14	7.99	16.93	8.30	NR	8.81
Hydraulic Testing MW															
JHC MW-15005	---	517781.42	12633905.01	624.37	627.30	9/18/2015	Sand	2" PVC, 10 slot	10	27 - 37	33.26	40.10	33.51	45	2.11
JHC MW-15007	---	517540.50	12635742.72	624.82	627.70	9/21/2015	Sand	2" PVC, 10 slot	10	22 - 32	29.28	34.75	29.36	55	2.64
JHC MW-15015	---	519715.11	12634186.63	632.46	635.20	9/28/2015	Sand	2" PVC, 10 slot	10	28 - 38	28.57	41.28	29.48	90	5.09
JHC MW-15018	---	521075.54	12635979.61	614.26	617.02	9/28/2015	Sand	2" PVC, 10 slot	10	10 - 20	16.23	22.95	NR	80	3.99
JHC MW-15024	---	522366.01	12637322.68	613.79	616.62	10/1/2015	Sand	2" PVC, 10 slot	10	7 - 17	14.12	19.93	14.49	135	3.31
JHC MW-15028	---	521646.20	12634105.34	611.02	613.80	10/2/2015	Sand	2" PVC, 10 slot	10	8 - 18	14.38	20.82	14.62	220	9.80
JHC MW-15030	---	519760.83	12633044.37	604.05	607.17	10/5/2015	Sand	2" PVC, 10 slot	10	4 - 14	7.99	16.93	8.30	NR	8.81
JHC MW-15033	---	521075.81	12638598.12	618.08	620.99	10/6/2015	Sand	2" PVC, 10 slot	10	16 - 26	22.93	28.78	23.2	120	5.47
JHC MW-15036	MW-B6	520099.80	12638094.34	617.94	618.34	3/13/2001	Sand	2" PVC, 10 slot	10	20 - 30	NA	NA	NA	NA	NA

Notes:
ft = feet
bgs = below ground surface
TOC = top of casing
NR = Not recorded

Table 3
Estimated Hydraulic Conductivity (K) Values
Consumers Energy Co.
J.H. Campbell Generating Facility
West Olive, Michigan

Well ID	Test	H ⁰ (ft)	H ¹ (ft)	K (ft/d)	K (cm/sec)	Slug Test Solution
JHC MW-15005	2	0.738	0.844	61	2.15E-02	KGS Model (Hyder et. al, 1994)
	3	1.422	1.69	58	2.05E-02	KGS Model (Hyder et. al, 1994)
	Average			60	2.10E-02	
JHC MW-15036	2	0.777	0.844	118	4.16E-02	KGS Model (Hyder et. al, 1994)
	3	1.219	1.69	139	4.90E-02	KGS Model (Hyder et. al, 1994)
	Average			129	4.53E-02	
JHC MW-15007	1	0.629	0.844	130	4.59E-02	KGS Model (Hyder et. al, 1994)
JHC MW-15015	2	0.879	1.15	22	7.76E-03	KGS Model (Hyder et. al, 1994)
	3	1.98	2.31	21	7.41E-03	KGS Model (Hyder et. al, 1994)
	Average			22	7.59E-03	
JHC MW-15024	2	0.801	0.844	49	1.73E-02	KGS Model (Hyder et. al, 1994)
	3	1.534	1.69	45	1.59E-02	KGS Model (Hyder et. al, 1994)
	Average			47	1.66E-02	
JHC MW-15028	1	0.704	0.844	104	3.67E-02	KGS Model (Hyder et. al, 1994)
	3	1.515	1.69	86	3.03E-02	KGS Model (Hyder et. al, 1994)
	Average			95	3.35E-02	
JHC MW-15033	2	0.669	0.844	74	2.61E-02	KGS Model (Hyder et. al, 1994)
JHC MW-15030	2	0.701	0.844	100	3.53E-02	Bouwer-Rice (1976)
	3	1.194	1.69	87	3.07E-02	Bouwer-Rice (1976)
	Average			94	3.30E-02	
JHC MW-15018	1	0.732	0.844	34	1.20E-02	KGS Model (Hyder et. al, 1994)
	3	1.486	1.69	33	1.16E-02	KGS Model (Hyder et. al, 1994)
	Average			34	1.18E-02	
Over all Average				73	2.56E-02	
Over all Geometric mean				62	2.19E-02	
Minimum				21	7.41E-03	
Maximum				139	4.90E-02	

Note:
H⁰ = initial displacement
H¹ = expected (calculated) displacement
cm/sec = centimeters per second
ft = feet
ft/d = feet per day

FIGURES




APPENDIX A

Soil Boring and Monitoring Well Construction Logs



Date Start: 9/18/15 Date Finish: 9/18/15 Drilling Company: Mateco Drilling Driller's Name: John Pitsch Drilling Method: Air Knife/Sonic Sampling Method: Continuous Rig Type: Sonic Water Level Start (ft. bgs.): 29.0 Water Level Finish (ft. btoc.): 33.26	Northing: 517781.423 Easting: 12633905.01 Casing Elevation: 627.297 Borehole Depth (ft. bgs.): 40.0 Surface Elevation: 624.367 Descriptions By: A. Westhuis	Well/Boring ID: JHC MW-15005 Client: Consumers Energy Location: JH Campbell Facility 1700 Crosswell Street Site A West Olive, MI 49460 Weather Conditions: 70 F Cloudy
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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
20	605							(19.5 - 19.8') SAND, medium; trace fine, subrounded; little to some silt; moist, brown (10YR 4/3).		
								(19.8 - 29.0') SAND, medium, trace fine, subrounded; trace silt; well sorted; dry; very pale brown (10YR 7/4).		
25	600	3	20.0-30.0'	6	NA					
								(29.0 - 31.0') SAND, medium, little fine, trace coarse, subrounded; trace silt; well sorted; wet; pale brown (10YR 6/3).		Bentonite Pellets (23.0-25.0' bgs)
30	595							(31.0 - 33.0') SAND, medium to coarse, little fine, subrounded; trace silt; well sorted; wet; pale brown (10YR 6/3).	595.77	
								(33.0 - 40.0') SAND, fine, some medium, subrounded; well sorted; wet; pale brown (10YR 6/3).		Sand Pack K&E WP1 (25.0-40.0' bgs) 2" PVC 10 Slot Well Screen (27.0-37.0 bgs)
35	590	4	30.0-40.0'	9	NA					
40	585							End of boring at 40.0' bgs.		

	Remarks: bgs = below ground surface btoc = below top of casing Air knife to 10.0' bgs. Groundwater encountered at 29.0' bgs during drilling. Water level at development encountered at 33.26' btoc. No odor or staining observed. Groundwater elevation measured on December 2, 2015 was 595.77 feet
--	---

Date Start: 9/18/15
Date Finish: 9/18/15
Drilling Company: Mateco Drilling
Driller's Name: John Pitsch
Drilling Method: Air Knife/Sonic
Sampling Method: Continuous
Rig Type: Sonic
Water Level Start (ft. bgs.): NA
Water Level Finish (ft. btoc.): 28.90

Northing: 517535.735
Easting: 12635481.66
Casing Elevation: 627.577
Borehole Depth (ft. bgs.): 40.0
Surface Elevation: 624.737
Descriptions By: A. Westhuis

Well/Boring ID: JHC MW-15006
Client: Consumers Energy
Location: JH Campbell Facility
 1700 Crosswell Street Site A
 West Olive, MI 49460
Weather Conditions: 70 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	625							(0.0 - 0.3') Grass, Topsoil.		TOC = 627.577 (ft. above msl)
5	620	1	0.0-10.0'	10	NA		(0.3 - 10.0') SAND, fine to medium, subrounded; trace silt; poorly sorted; dry to moist; light brownish gray (10YR 6/2) to light yellowish brown (10YR 6/4). NOTE: Trace slag fragments from 0.0 to 1.0' bgs.			Concrete (0.0-1.0' bgs)
10	615						(10.0 - 12.0') SAND, fine, subrounded; trace silt; well sorted; dry; pale brown (10YR 6/3).			Bentonite/Cement Grout (1.0-21.0' bgs) 2" PVC Well Casing (-3.0-25.0' bgs)
12.5							(12.0 - 15.0') SAND, fine to medium, subrounded; trace silt; well sorted; brownish yellow (10YR 6/6).			
15	610	2	10.0-20.0'	8	NA		(15.0 - 17.0') SAND, fine to medium, subrounded; trace silt; well sorted; dry; very pale brown (10YR 7/3).			
17.5							(17.0 - 18.0') SAND, fine to very fine, subrounded; little silt; well sorted; dry; light brownish gray (10YR 6/2).			
20							(18.0 - 25.0') SAND, very fine to fine, trace medium, subrounded; little to some silt; well sorted; dry; brown (10YR 4/3).			

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

 Air knife to 10.0' bgs.
 Groundwater not encountered during drilling.
 Water level at development was 28.90' btoc.
 No odor or staining observed.
 Groundwater elevation measured on December 2, 2015 was 599.08 feet



Date Start: 9/18/15
Date Finish: 9/18/15
Drilling Company: Mateco Drilling
Driller's Name: John Pitsch
Drilling Method: Air Knife/Sonic
Sampling Method: Continuous
Rig Type: Sonic
Water Level Start (ft. bgs.): NA
Water Level Finish (ft. btoc.): 28.90

Northing: 517535.735
Easting: 12635481.66
Casing Elevation: 627.577

Borehole Depth (ft. bgs.): 40.0
Surface Elevation: 624.737

Descriptions By: A. Westhuis

Well/Boring ID: JHC MW-15006
Client: Consumers Energy

Location: JH Campbell Facility
 1700 Crosswell Street Site A
 West Olive, MI 49460

Weather Conditions: 70 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
20	605									
25	600	3	20.0-30.0'	6	NA			(25.0 - 29.5') SAND, very fine, subrounded; some silt; well sorted; dry; light brownish gray (10YR 6/2).		<p>Bentonite Pellets (21.0-23.0' bgs)</p>
30	595							(29.5 - 40.0') SAND, fine to medium, subrounded; trace silt; well sorted; light yellowish brown (10YR 6/4).		<p>Sand Pack K&E WP1 (23.0-40.0' bgs)</p> <p>2" PVC 10 Slot Well Screen (25.0-35.0 bgs)</p>
35	590	4	30.0-40.0'	5	NA					
40	585							End of boring at 40.0' bgs.		

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

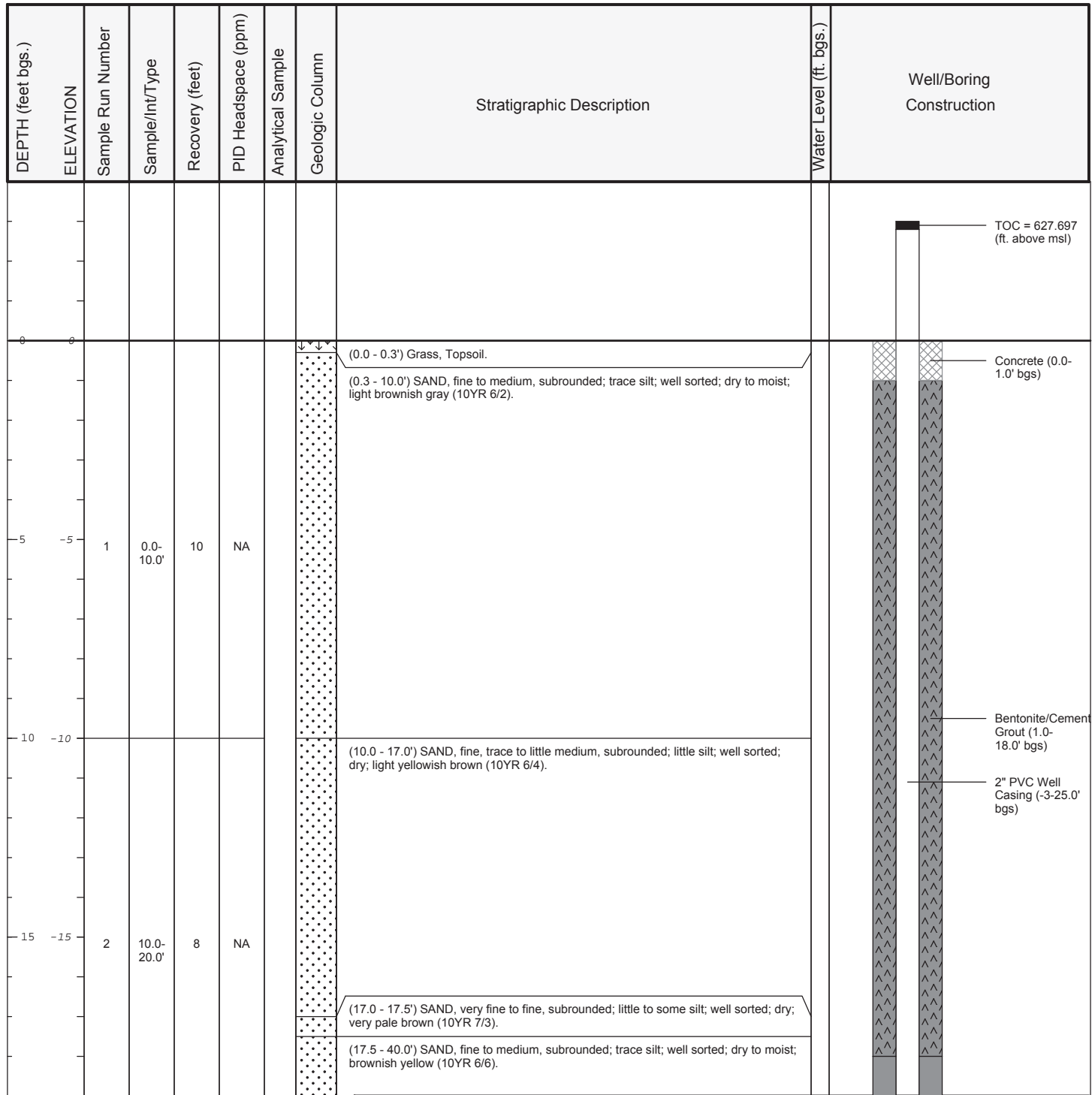
Air knife to 10.0' bgs.
 Groundwater not encountered during drilling.
 Water level at development was 28.90' btoc.
 No odor or staining observed.
 Groundwater elevation measured on December 2, 2015 was 599.08 feet



Date Start: 9/21/15
Date Finish: 9/21/15
Drilling Company: Mateco Drilling
Driller's Name: John Pitsch
Drilling Method: Air Knife/Sonic
Sampling Method: Continuous
Rig Type: Sonic
Water Level Start (ft. bgs.): 21.0
Water Level Finish (ft. btoc.): 29.28

Northing: 517540.502
Easting: 12635742.72
Casing Elevation: 627.697
Borehole Depth (ft. bgs.): 40.0
Surface Elevation: 624.817
Descriptions By: A. Westhuis

Well/Boring ID: JHC MW-15007
Client: Consumers Energy
Location: JH Campbell Facility
 1700 Crosswell Street Site A
 West Olive, MI 49460
Weather Conditions: 75 F Sunny



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

 Air knife to 10.0' bgs.
 Groundwater encountered at 21.0' bgs during drilling.
 Water level at development was 29.28' btoc.
 No odor or staining observed.
 Groundwater elevation measured on December 2, 2015 was 599.22 feet



Date Start: 9/21/15
Date Finish: 9/21/15
Drilling Company: Mateco Drilling
Driller's Name: John Pitsch
Drilling Method: Air Knife/Sonic
Sampling Method: Continuous
Rig Type: Sonic
Water Level Start (ft. bgs.): 21.0
Water Level Finish (ft. btoc.): 29.28

Northing: 517540.502
Easting: 12635742.72
Casing Elevation: 627.697

Borehole Depth (ft. bgs.): 40.0
Surface Elevation: 624.817

Descriptions By: A. Westhuis

Well/Boring ID: JHC MW-15007
Client: Consumers Energy

Location: JH Campbell Facility
 1700 Crosswell Street Site A
 West Olive, MI 49460

Weather Conditions: 75 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
20	-20									
25	-25	3	20.0-30.0'	5	NA			NOTE: Wet at 21.0' bgs.		Bentonite Pellets (18.0-20.0' bgs) Sand Pack K&E WP1 (20.0-40.0' bgs) 2" PVC 10 Slot Well Screen (22.0-32.0' bgs)
30	-30									
35	-35	4	30.0-40.0'	5	NA					
40	-40							End of boring at 40.0' bgs.		


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

 Air knife to 10.0' bgs.
 Groundwater encountered at 21.0' bgs during drilling.
 Water level at development was 29.28' btoc.
 No odor or staining observed.
 Groundwater elevation measured on December 2, 2015 was 599.22 feet



Date Start: 9/21/15 Date Finish: 9/22/15 Drilling Company: Mateco Drilling Driller's Name: John Pitsch Drilling Method: Air Knife/Sonic Sampling Method: Continuous Rig Type: Sonic Water Level Start (ft. bgs.): NA Water Level Finish (ft. btoc.): 38.25	Northing: 517560.39 Easting: 12636031.25 Casing Elevation: 635.302 Borehole Depth (ft. bgs.): 38.0 Surface Elevation: 632.432 Descriptions By: A. Westhuis	Well/Boring ID: JHC MW-15008 Client: Consumers Energy Location: JH Campbell Facility 1700 Crosswell Street Site A West Olive, MI 49460 Weather Conditions: 75 F Sunny
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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
635										TOC = 635.302 (ft. above msl)
0								(0.0 - 0.3') Grass, Topsoil.		Concrete (0.0-1.0' bgs)
5		1	0.0-10.0'	10	NA			(0.3 - 10.0') SAND, fine to medium, subrounded; trace silt; well sorted; dry; light brownish gray (10YR 6/2).		
10								(10.0 - 15.0') SAND, fine, trace to little medium sand, subrounded; little silt; well sorted; dry; light yellowish brown (10YR 6/4).		
15		2	10.0-20.0'	9	NA			(15.0 - 19.0') SAND, very fine to fine, subrounded; little to some silt; well sorted; dry; very pale brown (10YR 7/3).		Bentonite/Cement Grout (1.0-24.0' bgs) 2" PVC Well Casing (-3.0-28.0' bgs)
615										

	Remarks: bgs = below ground surface btoc = below top of casing Air knife to 10.0' bgs. Water level at development was 38.25' btoc. No odor or staining observed. Groundwater elevation measured on December 2, 2015 was 598.09 feet above mean sea level.
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Date Start: 9/21/15 Date Finish: 9/22/15 Drilling Company: Mateco Drilling Driller's Name: John Pitsch Drilling Method: Air Knife/Sonic Sampling Method: Continuous Rig Type: Sonic Water Level Start (ft. bgs.): NA Water Level Finish (ft. btoc.): 38.25	Northing: 517560.39 Easting: 12636031.25 Casing Elevation: 635.302 Borehole Depth (ft. bgs.): 38.0 Surface Elevation: 632.432 Descriptions By: A. Westhuis	Well/Boring ID: JHC MW-15008 Client: Consumers Energy Location: JH Campbell Facility 1700 Crosswell Street Site A West Olive, MI 49460 Weather Conditions: 75 F Sunny
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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
20	610							(19.0 - 25.0') SAND, fine to medium, subrounded; trace silt; well sorted; moist to wet; brownish yellow (10YR 7/3).		
25	605	3	20.0-30.0'	8	NA			(25.0 - 38.0') SAND, fine to medium subrounded; little silt; well sorted; moist; yellowish brown (10YR 5/6).		<p>Bentonite Pellets (24.0-26.0' bgs)</p> <p>Sand Pack K&E WP1 (26.0-38.0' bgs)</p> <p>2" PVC 10 Slot Well Screen (28.0-38.0' bgs)</p>
30	600	4	30.0-35.0'	4	NA					
35	595	5	35.0-38.0'	3	NA					
40								End of boring at 38.0' bgs.		

	Remarks: bgs = below ground surface btoc = below top of casing Air knife to 10.0' bgs. Water level at development was 38.25' btoc. No odor or staining observed. Groundwater elevation measured on December 2, 2015 was 598.09 feet above mean sea level.
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Date Start: 9/22/15
Date Finish: 9/22/15
Drilling Company: Mateco Drilling
Driller's Name: John Pitsch
Drilling Method: Continuous
Sampling Method: Air Knife/Sonic
Rig Type: Enter Rig Type Here
Water Level Start (ft. bgs.): NA
Water Level Finish (ft. btoc.): 37.14

Northing: 517779.126
Easting: 12636014.8
Casing Elevation: 635.322
Borehole Depth (ft. bgs.): 40.0
Surface Elevation: 632.327
Descriptions By: A. Westhuis

Well/Boring ID: JHC MW-15009
Client: Consumers Energy
Location: JH Campbell Facility
 1700 Crosswell Street Site A
 West Olive, MI 49460
Weather Conditions: 75 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
635										TOC = 635.322 (ft. above msl)
0							(0.0 - 0.3') Grass, Topsoil.			Concrete (0.0-1.0' bgs)
630		1	0.0-10.0'	10	NA		(0.3 - 10.0') SAND, fine to medium, subrounded; trace silt; well sorted; dry; light brownish gray (10YR 6/2).			
5										
625										
10								(10.0 - 18.0') SAND, fine, trace medium, subrounded; trace silt; well sorted; dry; light yellowish brown (10YR 6/4).		
620										
15		2	10.0-20.0'	8	NA					Bentonite/Cement Grout (1.0-26.0' bgs) 2" PVC Well Casing (-3.0-30.0' bgs)
615								(18.0 - 18.5') SAND, fine, little very fine, subrounded; little silt; well sorted; dry; very pale brown (10YR 7/3).		
								(18.5 - 27.0') SAND, fine to medium, subrounded; trace silt; well sorted; dry; light		

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

 Air knife to 10.0' bgs.
 Water level at development was 37.14' btoc.
 No odor or staining observed.
 Groundwater elevation measured on December 2, 2015 was 599.88 feet above mean sea level.



Date Start: 9/22/15
Date Finish: 9/22/15
Drilling Company: Mateco Drilling
Driller's Name: John Pitsch
Drilling Method: Continuous
Sampling Method: Air Knife/Sonic
Rig Type: Enter Rig Type Here
Water Level Start (ft. bgs.): NA
Water Level Finish (ft. btoc.): 37.14

Northing: 517779.126
Easting: 12636014.8
Casing Elevation: 635.322

Borehole Depth (ft. bgs.): 40.0
Surface Elevation: 632.327

Descriptions By: A. Westhuis

Well/Boring ID: JHC MW-15009
Client: Consumers Energy

Location: JH Campbell Facility
 1700 Crosswell Street Site A
 West Olive, MI 49460

Weather Conditions: 75 F Sunny

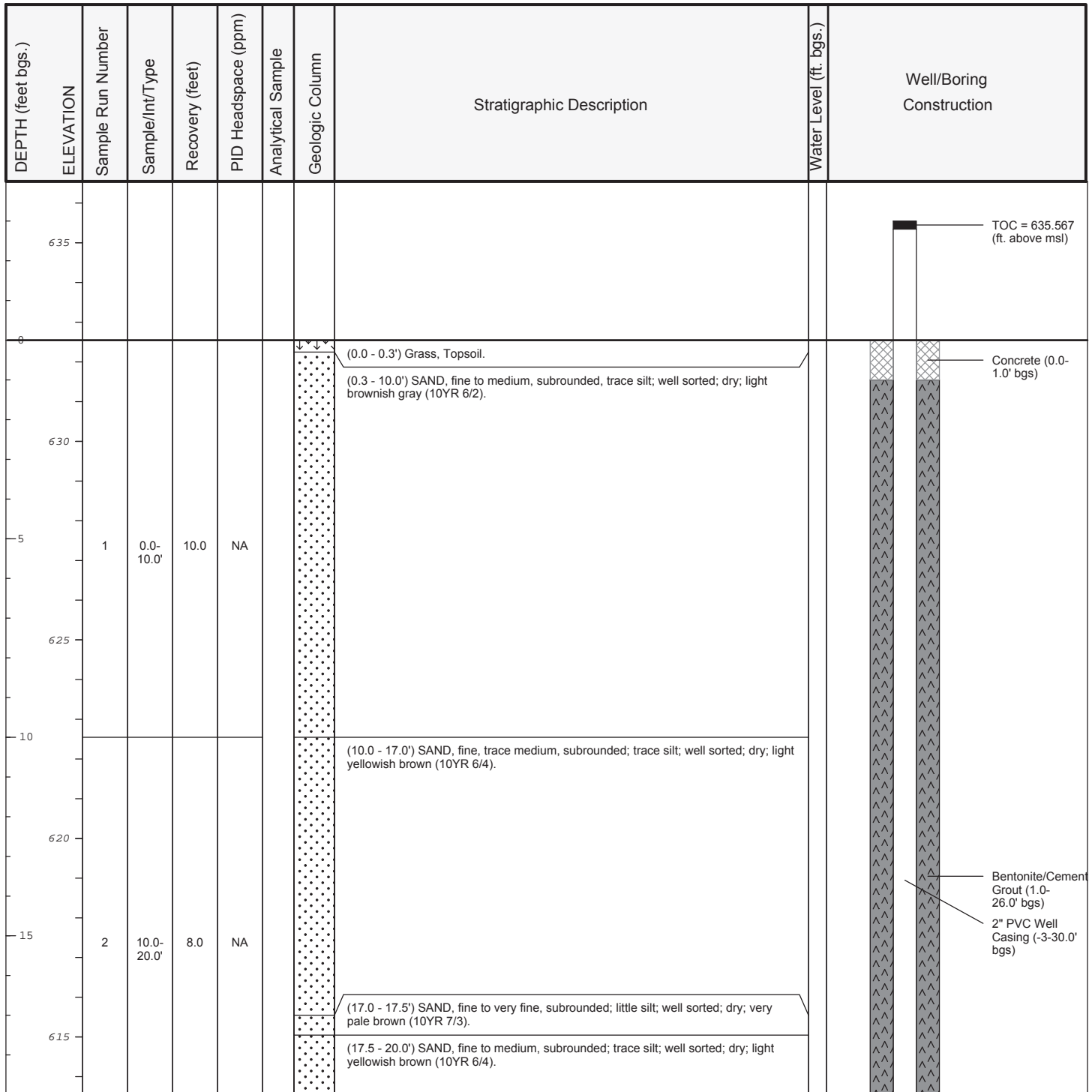
DEPTH (feet bgs.)	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
20								yellowish brown (10YR 6/4).		
610										
25		3	20.0-30.0'	9	NA					
605								(27.0 - 28.0') SAND, fine; little to some very fine sand, subrounded; little silt; well sorted; dry; very pale brown (10YR 7/3).		Bentonite Pellets (26.0-28.0' bgs)
30								(28.0 - 40.0') SAND, fine to medium, subrounded; trace silt; well sorted; dry to moist; brownish yellow (10YR 6/6).		
600										
35		4	30.0-40.0'	6	NA					
595										
40								End of Boring 40.0' bgs		

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

 Air knife to 10.0' bgs.
 Water level at development was 37.14' btoc.
 No odor or staining observed.
 Groundwater elevation measured on December 2, 2015 was 599.88 feet above mean sea level.



Date Start: 9/22/15 Date Finish: 9/23/15 Drilling Company: Mateco Drilling Driller's Name: John Pitsch Drilling Method: Air Knife/Sonic Sampling Method: Continuous Rig Type: Sonic Water Level Start (ft. bgs.): 29.5 Water Level Finish (ft. btoc.): NA	Northing: 518009.361 Easting: 12636011.46 Casing Elevation: 635.567 Borehole Depth (ft. bgs.): 40.0 Surface Elevation: 632.547 Descriptions By: A. Westhuis	Well/Boring ID: JHC MW-15010 Client: Consumers Energy Location: JH Campbell Facility 1700 Crosswell Street Site A West Olive, MI 49460 Weather Conditions: 75 F Sunny
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Remarks: bgs = below ground surface
btoc = below top of casing

Air knife to 10.0' bgs.
Groundwater encountered at 29.5' bgs.
Water level at development was 36.57' btoc.
No odor or staining observed.
Groundwater elevation measured on December 2, 2015 was 600.36 feet



Date Start: 9/22/15 Date Finish: 9/23/15 Drilling Company: Mateco Drilling Driller's Name: John Pitsch Drilling Method: Air Knife/Sonic Sampling Method: Continuous Rig Type: Sonic Water Level Start (ft. bgs.): 29.5 Water Level Finish (ft. btoc.): NA	Northing: 518009.361 Easting: 12636011.46 Casing Elevation: 635.567 Borehole Depth (ft. bgs.): 40.0 Surface Elevation: 632.547 Descriptions By: A. Westhuis	Well/Boring ID: JHC MW-15010 Client: Consumers Energy Location: JH Campbell Facility 1700 Crosswell Street Site A West Olive, MI 49460 Weather Conditions: 75 F Sunny
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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
20										
610								(20.0 - 25.5') SAND, fine to medium, subrounded; little to some silt; well sorted; dry; brown (10YR 5/4).		
25		3	20.0-30.0'	9.0	NA			(25.5 - 28.5') SAND, fine to medium, subrounded; trace silt; well sorted; dry; very pale brown (10YR 7/4).		
605								(28.5 - 29.5') SAND, very fine to fine, subrounded; trace to little silt; well sorted; dry; brown (10YR 5/4).		
30								(29.5 - 40.0') SAND, fine to medium, subrounded; little silt; well sorted; moist to wet; yellowish brown (10YR 5/4).		
600										
35		4	30.0-40.0'	6.0	NA					
595										
40								End of boring at 40.0' bgs.		

	<p>Remarks: bgs = below ground surface btoc = below top of casing</p> <p>Air knife to 10.0' bgs. Groundwater encountered at 29.5' bgs. Water level at development was 36.57' btoc. No odor or staining observed. Groundwater elevation measured on December 2, 2015 was 600.36 feet</p>
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Date Start: 9/23/15
Date Finish: 9/23/15
Drilling Company: Mateco Drilling
Driller's Name: John Pitsch
Drilling Method: Air Knife/Sonic
Sampling Method: Continuous
Rig Type: Sonic
Water Level Start (ft. bgs.): 30.0
Water Level Finish (ft. btoc.): 34.45

Northing: 517540.496
Easting: 12634931.59
Casing Elevation: 630.832
Borehole Depth (ft. bgs.): 40.0
Surface Elevation: 627.712
Descriptions By: A. Westhuis

Well/Boring ID: JHC MW-15011
Client: Consumers Energy
Location: JH Campbell Facility
 1700 Crosswell Street Site A
 West Olive, MI 49460
Weather Conditions: 75 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
630										TOC = 630.832 (ft. above msl)
0							(0.0 - 0.3') Grass, Topsoil.			Concrete (0.0-1.0' bgs)
625		1	0.0-10.0'	10.0	NA		(0.3 - 10.0') SAND, fine to medium, subrounded; trace silt; well sorted; dry; dark grayish brown (10YR 4/2). NOTE: Color change to yellowish brown (10YR 5/6) from 3.0-4.5' bgs. NOTE: Color change to light yellowish brown (10YR 6/4) from 4.5-10.0' bgs.			
5							(10.0 - 17.0') SAND, fine to medium, subrounded; trace silt; well sorted; dry to moist; yellowish brown (10YR 5/6).			
620							(17.0 - 20.0') SAND, very fine to fine, subrounded; little to some silt; well sorted; very pale brown (10YR 7/3). NOTE: Soils hot; cooked by Sonic rig.			Bentonite/Cement Grout (1.0-23.0' bgs) 2" PVC Well Casing (-3-27.0' bgs)
10										
615		2	10.0-20.0'	9.0	NA					
15										
610										


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

 Air knife to 10.0' bgs.
 Groundwater encountered at 30.0' bgs.
 Water level at development was 34.45' btoc.
 No odor or staining observed.
 Groundwater elevation measured on December 2, 2015 was 596.74 feet




Date Start: 9/23/15 Date Finish: 9/23/15 Drilling Company: Mateco Drilling Driller's Name: John Pitsch Drilling Method: Air Knife/Sonic Sampling Method: Continuous Rig Type: Sonic Water Level Start (ft. bgs.): 30.0 Water Level Finish (ft. btoc.): 34.45	Northing: 517540.496 Easting: 12634931.59 Casing Elevation: 630.832 Borehole Depth (ft. bgs.): 40.0 Surface Elevation: 627.712 Descriptions By: A. Westhuis	Well/Boring ID: JHC MW-15011 Client: Consumers Energy Location: JH Campbell Facility 1700 Crosswell Street Site A West Olive, MI 49460 Weather Conditions: 75 F Sunny
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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
20										
605								(20.0 - 24.0') SAND, fine to medium, subrounded; trace silt; well sorted; moist, pale brown (10YR 6/3).		
25		3	20.0-30.0'	9.0	NA			(24.0 - 27.0') SAND, fine to medium; little to some silt; trace coarse sand, subrounded; well sorted; moist, brown (10YR 5/3).		Bentonite Pellets (23.0-25.0' bgs)
600								(27.0 - 29.0') SAND, fine to medium, subrounded; little to some silt; trace coarse sand, subrounded; well sorted; dry; very pale brown (10YR 7/3) to light gray (10YR 7/2). NOTE: Soils hot; cooked by Sonic rig.		
30								(29.0 - 31.0') SAND, fine, subrounded; little silt; well sorted; moist, dark yellowish brown (10YR 4/4). NOTE: Wet at 30.0' bgs.		
595								(31.0 - 38.0') SAND, medium to coarse, subrounded; trace silt; well sorted; wet; brown (10YR 5/3). NOTE: Color change to dark brown (10YR 3/3) from 37.5-38.0' bgs.	▼	Sand Pack K&E WP1 (25.0-40.0' bgs) 2" PVC 10 Slot Well Screen (27.0-37.0' bgs)
35		4	30.0-40.0'	7.0	NA			(38.0 - 40.0') SAND, fine to medium, subrounded; trace silt; well sorted; wet, brown (10YR 5/3).		
590										
40								End of boring at 40.0' bgs.		

 <small>Design & Consultancy for natural and built assets</small>	Remarks: bgs = below ground surface btoc = below top of casing Air knife to 10.0' bgs. Groundwater encountered at 30.0' bgs. Water level at development was 34.45' btoc. No odor or staining observed. Groundwater elevation measured on December 2, 2015 was 596.74 feet
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Date Start: 9/25/15 Date Finish: 9/28/15 Drilling Company: Mateco Drilling Driller's Name: John Pitsch Drilling Method: Air Knife/Sonic Sampling Method: Continuous Rig Type: Sonic Water Level Start (ft. bgs.): 23.92 Water Level Finish (ft. btoc.): 28.57	Northing: 519715.111 Easting: 12634186.63 Casing Elevation: 635.202 Borehole Depth (ft. bgs.): 40.0 Surface Elevation: 632.462 Descriptions By: A. Westhuis	Well/Boring ID: JHC MW-15015 Client: Consumers Energy Location: JH Campbell Facility 1700 Crosswell Street Site A West Olive, MI 49460 Weather Conditions: 75 F Sunny
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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
20										
610										
25		3	20.0-30.0'	8.0	NA			NOTE: Wet at 23.92' bgs.		Bentonite Pellets (24.0-26.0' bgs)
605										
30										
600										
35		4	30.0-40.0'	8.0	NA			(35.0 - 40.0') SAND, very fine to fine, subrounded; trace silt; well sorted; wet; pale brown (10YR 6/3).		Sand Pack K&E WP1 (26.0-40.0' bgs) 2" PVC 10 Slot Well Screen (28.0-38.0 bgs)
595										
40								End of boring at 40.0' bgs.		

	Remarks: bgs = below ground surface btoc = below top of casing Air knife to 10.0' bgs. Groundwater encountered at 23.92' bgs. Water level at development was 28.57' btoc. No odor or staining observed. Groundwater elevation measured on December 3, 2015 was 607.68 feet
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Date Start: 9/29/15
Date Finish: 9/29/15
Drilling Company: Mateco Drilling
Driller's Name: John Pitsch
Drilling Method: Air Knife/Sonic
Sampling Method: Continuous
Rig Type: Sonic
Water Level Start (ft. bgs.): 12.0
Water Level Finish (ft. btoc.): 16.29

Northing: 521075.536
Easting: 12635979.61
Casing Elevation: 617.022
Borehole Depth (ft. bgs.): 20.0
Surface Elevation: 614.262
Descriptions By: A. Westhuis

Well/Boring ID: JHC MW-15018
Client: Consumers Energy
Location: JH Campbell Facility
 1700 Crosswell Street Site A
 West Olive, MI 49460
Weather Conditions: 60 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
615										
0								(0.0 - 0.3') Grass, Topsoil.		TOC Elevation = 617.022 (ft. above msl)
5		1	0.0-10.0'	3.0	NA			(0.3 - 1.0') ASH and SAND, very fine to fine, well sorted; dry; light gray (10YR 7/2). NOTE: Fill material. (1.0 - 10.0') SAND, fine, subrounded; well sorted; dry; brownish yellow (10YR 6/6).		Concrete (0.0-1.0' bgs) Bentonite/Cement Grout (1.0-6.0' bgs) 2" PVC Well Casing (-3-10.0' bgs) Bentonite Pellets (6.0-8.0' bgs)
10								(10.0 - 17.0') SAND, fine, subrounded; trace silt; well sorted; moist to wet; very pale brown (10YR 7/3). NOTE: Wet at 12.0' bgs.		
15		2	10.0-20.0'	7.0	NA			(17.0 - 20.0') SAND, medium, little fine, subrounded; trace granules; subrounded; trace silt; well sorted; wet; very pale brown (10YR 7/4).		Sand Pack K&E WP1 (8.0-20.0' bgs) 2" PVC 10 Slot Well Screen (10.0-20.0 bgs)
20								End of boring at 20.0' bgs.		


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

 Air knife to 10.0' bgs.
 Groundwater encountered at 12.0' bgs during drilling.
 Water level at development was 16.29' btoc.
 No odor or staining observed.
 Groundwater elevation measured on December 2, 2015 was 600.45 feet



Date Start: 10/1/15 Date Finish: 10/1/15 Drilling Company: Mateco Drilling Driller's Name: Dan Mourer Drilling Method: Hand Auger/Sonic Sampling Method: Continuous Rig Type: Sonic Water Level Start (ft. bgs.): 18.0 Water Level Finish (ft. btoc.): 18.91	Northing: 521927.205 Easting: 12638205.16 Casing Elevation: 619.977 Borehole Depth (ft. bgs.): 25.0 Surface Elevation: 617.012 Descriptions By: A. Westhuis	Well/Boring ID: JHC MW-15023 Client: Consumers Energy Location: JH Campbell Facility 1700 Crosswell Street Site A West Olive, MI 49460 Weather Conditions: Sunny, 60F.
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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
620										TOC Elevation = 619.977 (ft. above msl)
0								(0.0 - 0.3') TOPSOIL; grass.		Concrete (0.0-1.0' bgs)
615		1	0-10'	10	NA			(0.3 - 10.0') SAND, very fine to fine, subrounded; trace silt; well sorted; dry; brown (10 YR 4/3). Note: Trace wood fragments from 7.0 to 10.0' bgs.		Bentonite/Cement Grout (1.0-10.0' bgs) 2" PVC Well Casing (-3.0-14.0' bgs)
610								(10.0 - 16.0') SAND, very fine to fine, subrounded; trace to little silt; well sorted; dry to moist; brownish yellow (10 YR 6/8).		Bentonite Pellets (10.0-12.0' bgs)
605		2	10-20'	8	NA			(16.0 - 17.0') SAND, very fine to fine, subrounded; trace silt; well sorted; moist; yellow (10 YR 7/6).	18.91	
600								(17.0 - 18.0') SAND, fine, subrounded; trace silt; well sorted; moist; brownish yellow (10 YR 6/6).		
								(18.0 - 21.0') SAND, very fine; little fine sand, subrounded; trace silt; well sorted; wet; pale brown (10 YR 6/3).		Sand Pack K&E WP1 (12.0-25.0' bgs) 2" PVC 10 Slot Well Screen (14.0-24.0' bgs)
595		3	20-25'	4	NA			(21.0 - 25.0') SAND, medium; trace fine sand, subangular; trace granules, subangular; poorly sorted; wet; pale brown (10 YR 6/3).		
25								End of boring at 25.0' bgs.		
590										

	Remarks: bgs= below ground surface btoc = below top of casing Hand auger to 10.0' bgs. Groundwater encountered at 18.0' bgs during drilling. Water level at development was 18.91' btoc. No odor or staining observed. Groundwater elevation measured on December 2, 2015 was 592.53 feet
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Date Start: 10/1/15
Date Finish: 10/1/15
Drilling Company: Mateco Drilling
Driller's Name: Dan Mourer
Drilling Method: Air Knife/Sonic
Sampling Method: Continuous
Rig Type: Sonic
Water Level Start (ft. bgs.): 10.0
Water Level Finish (ft. btoc.): 14.12

Northing: 522366.013
Easting: 12637322.68
Casing Elevation: 616.617
Borehole Depth (ft. bgs.): 20.0
Surface Elevation: 613.787
Descriptions By: A. Westhuis

Well/Boring ID: JHC MW-15024
Client: Consumers Energy
Location: JH Campbell Facility
 1700 Crosswell Street Site A
 West Olive, MI 49460
Weather Conditions: Sunny, 60F.

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
615										
0								(0.0 - 0.3') TOPSOIL; grass.		TOC Elevation = 616.617 (ft. above msl)
5		1	0-10'	4	NA			(0.3 - 10.0') SAND, fine, subrounded; trace silt; well sorted; dry to moist; brownish yellow (10 YR 6/6).		Concrete (0.0-1.0' bgs) 2" PVC Well Casing (-3.0-7.0' bgs) Bentonite Pellets (1.0-6.0' bgs)
10								NOTE: Wet at 10.0' bgs.		
15		2	10-20'	9	NA			(10.0 - 20.0') SAND, fine to medium, subrounded; trace to little very fine sand; trace silt; well sorted; wet; pale brown (10 YR 6/3).		Sand Pack K&E WP1 (6.0-20.0' bgs) 2" PVC 10 Slot Well Screen (7.0-17.0' bgs)
20								End of boring at 20.0' bgs.		

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

 Air knife to 10.0' bgs.
 Groundwater encountered at 10.0' bgs during drilling.
 Water level at development was 14.12' btoc.
 No odor or staining observed.
 Groundwater elevation measured on December 2, 2015 was 602.24 feet



Date Start: 10/1/15
Date Finish: 10/1/15
Drilling Company: Mateco Drilling
Driller's Name: Dan Mourer
Drilling Method: Hand Auger/Sonic
Sampling Method: Continuous
Rig Type: Sonic
Water Level Start (ft. bgs.): 12.0
Water Level Finish (ft. btoc.): 13.50

Northing: 522702.978
Eastings: 12636668.15
Casing Elevation: 617.167
Borehole Depth (ft. bgs.): 20.0
Surface Elevation: 614.137
Descriptions By: A. Westhuis

Well/Boring ID: JHC MW-15025
Client: Consumers Energy
Location: JH Campbell Facility
 1700 Crosswell Street Site A
 West Olive, MI 49460
Weather Conditions: Sunny, 60F.

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
615										
0								(0.0 - 0.3') TOPSOIL; grass.		TOC Elevation = 617.167 (ft. above msl)
5	610	1	0-10'	10	NA			(0.3 - 5.0') SAND, fine, subrounded; trace silt; well sorted; dry; very pale brown (10 YR 7/3).		Concrete (0.0-1.0' bgs) 2" PVC Well Casing (-3.0-7.0' bgs) Bentonite Pellets (1.0-6.0' bgs)
10	605							(5.0 - 12.0') SAND, fine, subrounded; trace silt; well sorted; dry; brownish yellow (10 YR 6/6). Note: Color change to brownish yellow (10YR 6/8) at 6.0' bgs.		
15	600	2	10-20'	8	NA			(12.0 - 15.0') SAND, fine, subrounded; trace silt; well sorted; wet; pale brown (10 YR 6/3).		Sand Pack K&E WP1 (6.0-20.0' bgs) 2" PVC 10 Slot Well Screen (7.0-17.0' bgs)
20	595							(15.0 - 16.0') SAND, fine to medium, subrounded; trace coarse sand, subrounded; trace granules, subrounded; trace silt; well sorted; wet; pale brown (10 YR 6/3).		
								(16.0 - 20.0') SAND, very fine to fine, subrounded; little silt; well sorted; wet; pale brown (10 YR 6/3).		
								End of boring at 20.0' bgs.		

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

 Hand auger to 10.0' bgs.
 Groundwater encountered at 12.0' bgs during drilling.
 Water level at development was 13.50' btoc.
 No odor or staining observed.
 Groundwater elevation measured on December 2, 2015 was 603.36 feet



Date Start: 10/2/15
Date Finish: 10/2/15
Drilling Company: Mateco Drilling
Driller's Name: Dan Mourer
Drilling Method: Hand Auger/Sonic
Sampling Method: Continuous
Rig Type: Sonic
Water Level Start (ft. bgs.): 12.0
Water Level Finish (ft. btoc.): 15.34

Northing: 522495.091
Easting: 12635971.82
Casing Elevation: 618.042
Borehole Depth (ft. bgs.): 20.0
Surface Elevation: 615.087
Descriptions By: A. Westhuis

Well/Boring ID: JHC MW-15026
Client: Consumers Energy
Location: JH Campbell Facility
 1700 Crosswell Street Site A
 West Olive, MI 49460
Weather Conditions: Sunny, 45F.

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	615							(0.0 - 0.3') TOPSOIL; grass.		TOC Elevation = 618.042 (ft. above msl)
5	610	1	0-10'	10	NA			(0.3 - 3.0') SAND, fine, subrounded; trace medium sand, subrounded; trace silt; well sorted; dry; very pale brown (10 YR 7/3).		Concrete (0.0-1.0' bgs)
								(3.0 - 8.0') SAND, fine, subrounded; trace silt; well sorted; dry; brownish yellow (10 YR 6/6).		2" PVC Well Casing (-3.0-8.0' bgs)
								(8.0 - 12.0') SAND, fine, subrounded; little very fine sand, subrounded; trace silt; well sorted; dry; pale brown (10 YR 6/3) to brownish yellow (10YR 6/6).		Bentonite Pellets (1.0-7.0' bgs)
15	600	2	10-20'	6	NA			(12.0 - 20.0') SAND, very fine to fine, subrounded; trace silt; well sorted; moist to wet; pale brown (10 YR 6/3).	15.34	Sand Pack K&E WP1 (7.0-20.0' bgs)
										2" PVC 10 Slot Well Screen (8.0-18.0' bgs)
20	595							End of boring at 20.0' bgs.		



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

 Hand auger to 10.0' bgs.
 Groundwater encountered at 12.0' bgs during drilling.
 Water level at development was 15.34' btoc.
 No odor or staining observed.
 Groundwater elevation measured on December 2, 2015 was 602.32 feet

Date Start: 10/2/15
Date Finish: 10/2/15
Drilling Company: Mateco Drilling
Driller's Name: Dan Mourer
Drilling Method: Hand Auger/Sonic
Sampling Method: Continuous
Rig Type: Sonic
Water Level Start (ft. bgs.): 13.0
Water Level Finish (ft. btoc.): 15.85

Northing: 522394.86
Easting: 1235097.51
Casing Elevation: 617.302
Borehole Depth (ft. bgs.): 20.0
Surface Elevation: 614.767
Descriptions By: A. Westhuis

Well/Boring ID: JHC MW-15027
Client: Consumers Energy
Location: JH Campbell Facility
 1700 Crosswell Street Site A
 West Olive, MI 49460
Weather Conditions: Sunny, 50F.

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	615							(0.0 - 0.3') TOPSOIL; grass.		TOC Elevation = 617.302 (ft. above msl)
5	610	1	0-10'	10	NA		(0.3 - 2.0') SAND, very fine to fine, subrounded; trace silt; well sorted; dry; dark yellowish brown (10 YR 4/6). (2.0 - 6.0') SAND, very fine to fine, subrounded; trace silt; well sorted; dry; very pale brown (10 YR 7/3).			Concrete (0.0-1.0' bgs) 2" PVC Well Casing (-3.0-10.0' bgs) Bentonite Pellets (1.0-8.0' bgs)
10	605						(6.0 - 16.0') SAND, fine, subrounded; trace silt; well sorted; dry; yellow (10YR 7/6).			
15	600	2	10-20'	8	NA		Note: Wet at 13.0' bgs.			Sand Pack K&E WP1 (8.0-20.0' bgs) 2" PVC 10 Slot Well Screen (10.0-20.0' bgs)
20	595						(16.0 - 20.0') SAND, fine; trace medium sand, subrounded; well sorted; wet; pale brown (10 YR 6/3).			
							End of boring at 20.0' bgs.			

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

 Hand auger to 10.0' bgs.
 Groundwater encountered at 13.0' bgs during drilling.
 Water level at development was 15.85' btoc.
 No odor or staining observed.
 Groundwater elevation measured on December 2, 2015 was 601.04 feet



Date Start: 10/2/15
Date Finish: 10/2/15
Drilling Company: Mateco Drilling
Driller's Name: Dan Mourer
Drilling Method: Air knife/Sonic
Sampling Method: Continuous
Rig Type: Sonic
Water Level Start (ft. bgs.): 9.0
Water Level Finish (ft. btoc.): 14.38

Northing: 521646.198
Easting: 12634105.34
Casing Elevation: 613.8

Borehole Depth (ft. bgs.): 20.0
Surface Elevation: 611.025

Descriptions By: A. Westhuis

Well/Boring ID: JHC MW-15028
Client: Consumers Energy

Location: JH Campbell Facility
 1700 Crosswell Street Site A
 West Olive, MI 49460

Weather Conditions: Sunny, 60F.

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	613.80							(0.0 - 0.3') TOPSOIL; grass.		TOC Elevation = 613.80 (ft. above msl)
0.3	610.5							(0.3 - 5.0') SAND, very fine to fine, subrounded; trace silt; well sorted; dry; yellowish (10 YR 7/8).		Concrete (0.0-1.0' bgs)
5.0	605.0	1	0-10'	10	NA			(5.0 - 9.0') SAND, fine, subrounded; trace silt; well sorted; dry to moist; pale brown (10 YR 6/3).		Bentonite/Cement Grout (1.0-4.0' bgs)
9.0	600.0							(9.0 - 20.0') SAND, medium; trace to little very fine to fine sand, subrounded; trace silt; poorly sorted; moist to wet; pale brown (10 YR 6/3).	9.0	2" PVC Well Casing (-3.0-8.0' bgs)
15.0	595.0	2	10-20'	9	NA					Bentonite Pellets (4.0-6.0' bgs)
20.0	590.0							End of boring at 20.0' bgs.		Sand Pack K&E WP1 (6.0-20.0' bgs)
										2" PVC 10 Slot Well Screen (8.0-18.0' bgs)

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

 Air knife to 10.0' bgs.
 Groundwater encountered at 9.0' bgs during drilling.
 Water level at development was 14.38' btoc.
 No odor or staining observed.
 Groundwater elevation measured on December 3, 2015 was 599.00 feet



Date Start: 10/5/15
Date Finish: 10/5/15
Drilling Company: Mateco Drilling
Driller's Name: Dan Mourer
Drilling Method: Air knife/Sonic
Sampling Method: Continuous
Rig Type: Sonic
Water Level Start (ft. bgs.): 12.0
Water Level Finish (ft. btoc.): 10.03

Northing: 520503.524
Easting: 12633774.3
Casing Elevation: 610.952
Borehole Depth (ft. bgs.): 20.0
Surface Elevation: 608.082
Descriptions By: A. Westhuis

Well/Boring ID: JHC MW-15029
Client: Consumers Energy
Location: JH Campbell Facility
 1700 Crosswell Street Site A
 West Olive, MI 49460
Weather Conditions: Cloudy, Light Rain, 65F.

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
610										TOC Elevation = 610.952 (ft. above msl)
0							(0.0 - 0.3') TOPSOIL; grass.			Concrete (0.0-1.0' bgs)
605		1	0-10'	3	NA		(0.3 - 10.0') SAND, fine, subrounded; trace silt; well sorted; dry; yellowish brown (10 YR 5/4).			2" PVC Well Casing (-3.0-8.0' bgs) Bentonite Pellets (1.0-7.0' bgs)
5							(10.0 - 12.0') SAND, very fine to fine, subrounded; trace silt; well sorted; dry to moist; pale brown (10 YR 6/3).			
600							(12.0 - 15.0') SAND, medium; trace fine sand, subrounded; trace silt; well sorted; wet; pale brown (10 YR 6/3).			
10							(15.0 - 20.0') SAND, medium; little coarse sand; trace granules, subrounded; trace silt; well sorted; wet; pale brown (10 YR 6/4).			Sand Pack K&E WP1 (7.0-20.0' bgs) 2" PVC 10 Slot Well Screen (8.0-18.0' bgs)
595		2	10-20'	6	NA					
15										
590										
20								End of boring at 20.0' bgs.		

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

 Air knife to 10.0' bgs.
 Groundwater encountered at 12.0' bgs during drilling.
 Water level at development was 10.03' btoc.
 No odor or staining observed.
 Groundwater elevation measured on December 3, 2015 was 601.18 feet



Date Start: 10/5/15
Date Finish: 10/5/15
Drilling Company: Mateco Drilling
Driller's Name: Dan Mourer
Drilling Method: Air knife/Sonic
Sampling Method: Continuous
Rig Type: Sonic
Water Level Start (ft. bgs.): 5.0
Water Level Finish (ft. btoc.): 7.99

Northing: 519760.827
Easting: 12633044.37
Casing Elevation: 607.167

Borehole Depth (ft. bgs.): 20.0
Surface Elevation: 604.047

Descriptions By: A. Westhuis

Well/Boring ID: JHC MW-15030
Client: Consumers Energy

Location: JH Campbell Facility
 1700 Crosswell Street Site A
 West Olive, MI 49460

Weather Conditions: Cloudy, Light Rain, 65F.

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
605										
0								(0.0 - 0.3') TOPSOIL; grass.		TOC Elevation = 607.167 (ft. above msl)
5		1	0-10'	3	NA			(0.3 - 10.0') SAND, fine, subrounded; trace silt; well sorted; dry to moist; dark brown (10 YR 3/3) to very pale brown (10YR 7/3). NOTE: Wet at 5.0' bgs.		Concrete (0.0-1.0' bgs) 2" PVC Well Casing (-3.0-4.0' bgs) Bentonite Pellets (1.0-3.0' bgs)
10								(10.0 - 20.0') SAND, fine, subrounded; little medium sand, subrounded; trace silt; well sorted; wet; very pale brown (10 YR 7/3) to light gray (10YR 7/2).		Sand Pack K&E WP1 (3.0-20.0' bgs) 2" PVC 10 Slot Well Screen (4.0-14.0' bgs)
15		2	10-20'	6	NA					
20								End of boring at 20.0' bgs.		

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

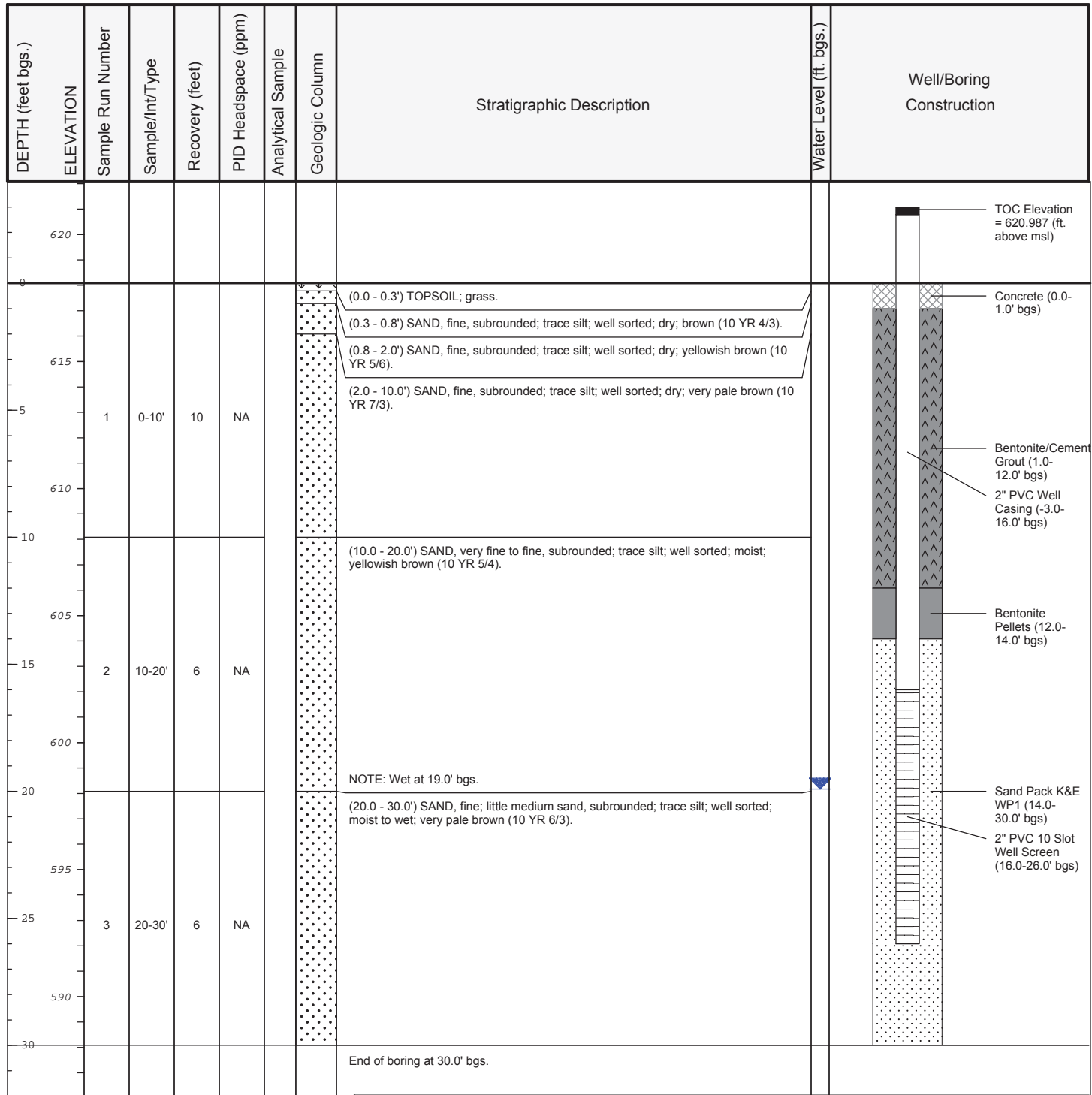
 Air knife to 10.0' bgs.
 Groundwater encountered at 5.0' bgs during drilling.
 Water level at development was 7.99' btoc.
 No odor or staining observed.
 Groundwater elevation measured on December 3, 2015 was 599.65 feet



Date Start: 10/6/15
Date Finish: 10/6/15
Drilling Company: Mateco Drilling
Driller's Name: John Pitsch
Drilling Method: Hand Auger/Sonic
Sampling Method: Continuous
Rig Type: Sonic
Water Level Start (ft. bgs.): 19.0
Water Level Finish (ft. btoc.): 22.93

Northing: 521075.809
Easting: 12638598.12
Casing Elevation: 620.987
Borehole Depth (ft. bgs.): 30.0
Surface Elevation: 618.082
Descriptions By: A. Westhuis

Well/Boring ID: JHC MW-15033
Client: Consumers Energy
Location: JH Campbell Facility
 1700 Crosswell Street Site A
 West Olive, MI 49460
Weather Conditions: Cloudy, 60F.



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

 Hand auger to 10.0' bgs.
 Groundwater encountered at 19.0' bgs during drilling.
 Water level at development was 22.93' btoc.
 No odor or staining observed.
 Groundwater elevation measured on December 2, 2015 was 598.05 feet



Date Start: 3/13/01
Date Finish: 3/13/01
Drilling Company: EDC, Inc.
Driller's Name: Sean Smith
Drilling Method: Hollow Stem Auger
Sampling Method: Split Spoon
Rig Type: Hollow Stem Auger
Water Level Start (ft. bgs.): NA
Water Level Finish (ft. btoc.): NA

Northing: NA
Easting: NA
Casing Elevation: 615.90

Borehole Depth (ft. bgs.): 30.5
Surface Elevation: NA

Descriptions By: Rebecca J. Koepke

Well/Boring ID: JHC MW-15036
Client: Consumers Energy

Location: JH Campbell Facility
 1700 Crosswell Street Site A
 West Olive, MI 49460

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
0	625									TOC = 615.90 (ft. above msl)
0.0 - 0.5'							(0.0 - 0.5') SANDY ORGANIC SOIL, very dark brown, very fine to fine, loose, moist.			Concrete (0.0-1.0' bgs)
0.5 - 30.5'							(0.5 - 30.5') SAND, very pale brown (10YR 7/4), poorly graded, fine, trace silt, round, loose, slightly moist.			2" PVC Well Casing (-3.0-20.0' bgs)
1	620	1	5.0-7.0'	0.9	NA			NOTE: Very fine.		Bentonite Chips (1.0-18.0' bgs)
2	615	2	10.0-12.0'	1.6	NA			NOTE: Very pale brown (10YR 8/3), fine.		
3	610	3	15.0-17.0'	1.6	NA			NOTE: Fine to medium, moist.		
4	605	4	20.0-22.0'	1.8	NA					
5	600	5	25.0-27.0'	1.8	NA					Sand Pack Flat Rock #30 (18.0-30.5' bgs)
										2" PVC 10 Slot Well Screen (20.0-30.0 bgs)
	595									
30								End of boring at 30.5' bgs.		

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

 No odor or staining observed.



SOIL DESCRIPTION

Udden-Wenworth Scale Modified ARCADIS, 2008			
Size Class	Millimeters	Inches	Standard Sieve #
Boulder	256 – 4096	10.09+	
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 log





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.
J.H. Campbell Generating Facility
West Olive, Michigan

Photograph Taken By:
Austin Westhuis

Date of Photograph:
September 17, 2015



Photograph #2

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

Site Location:
Consumers Energy Co.
J.H. Campbell Generating Facility
West Olive, Michigan

Photograph Taken By:
Austin Westhuis

Date of Photograph:
September 23, 2015



Photograph #3

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

Site Location:
Consumers Energy Co.
J.H. Campbell Generating
Facility
West Olive, Michigan

Photograph Taken By:
Austin Westhuis

Date of Photograph:
September 25, 2015



Photograph #4

Description of Photograph:
View of the typical sand layer encountered at the Site where monitoring well screens were installed.

Site Location:
Consumers Energy Co.
J.H. Campbell Generating
Facility
West Olive, Michigan

Photograph Taken By:
Austin Westhuis

Date of Photograph:
September 18, 2015

APPENDIX C

Hydraulic Test Logs



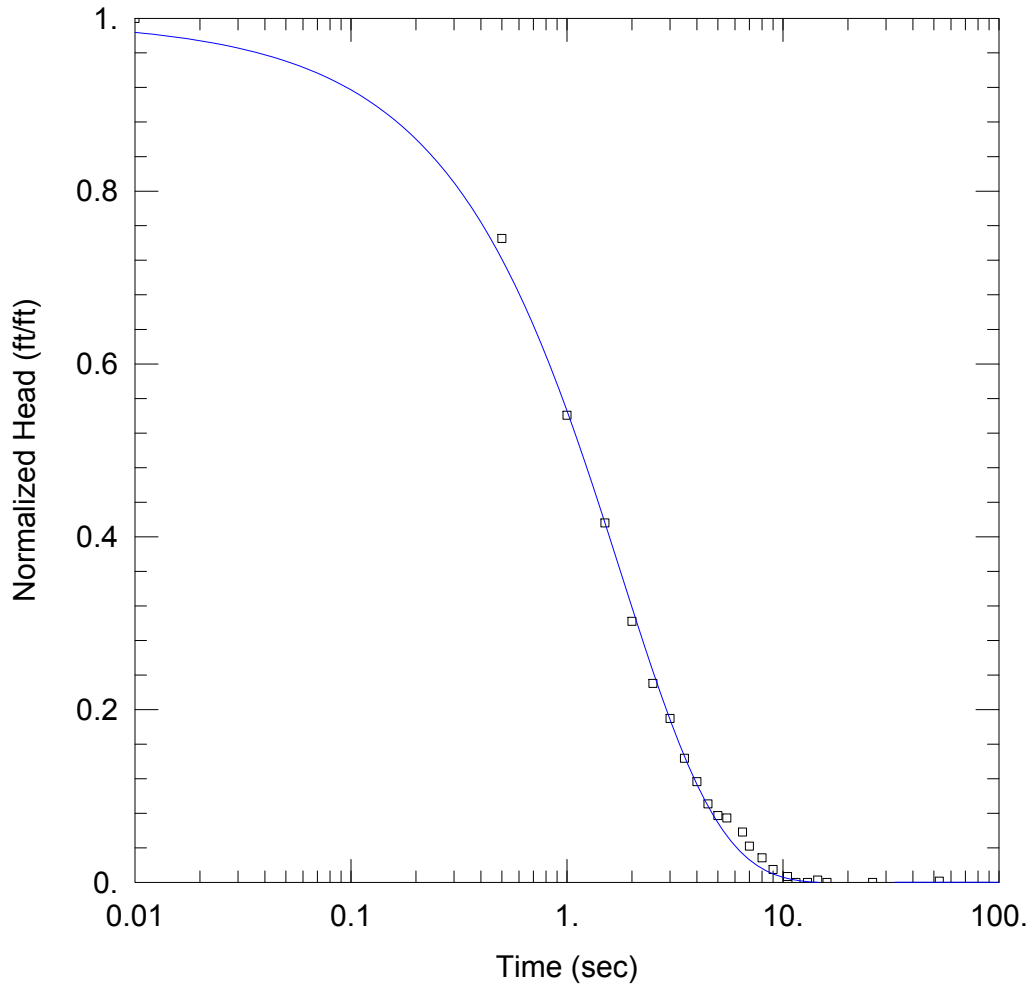
Slug Test Analysis Result for JHC MW-15005 - Test 2

Prepared By:
Arcadis

Prepared For:
Consumer Energy

Project:

Location:
West Olive, MI



SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 61. ft/day Ss = 3.7E-5 ft⁻¹
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 19.82 ft

WELL DATA (JHC MW-15005)

Initial Displacement: 0.738 ft
Static Water Column Height: 6.82 ft
Total Well Penetration Depth: 6.82 ft
Screen Length: 6.82 ft
Casing Radius: 0.083 ft
Well Radius: 0.33 ft

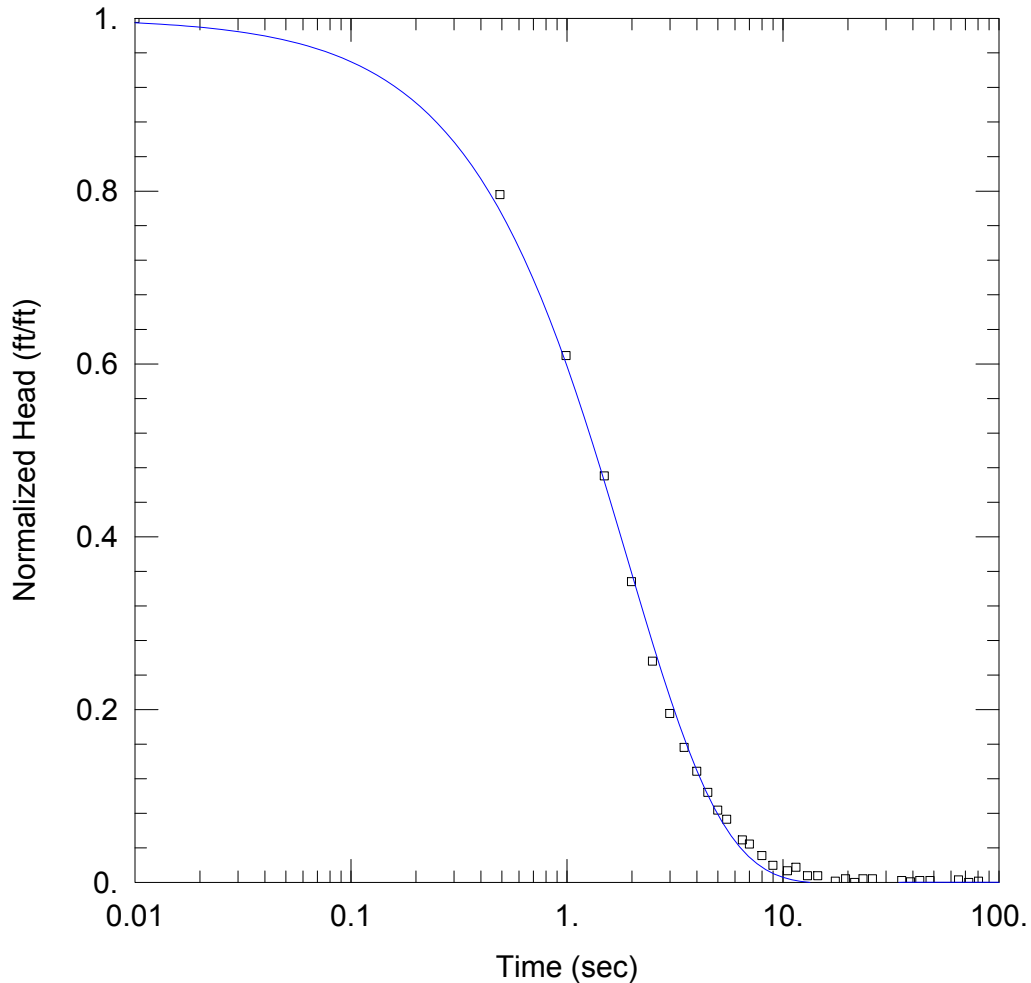
Slug Test Analysis Result for JHC MW-15005 - Test 3

Prepared By:
Arcadis

Prepared For:
Consumer Energy

Project:

Location:
West Olive, MI



SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 58. ft/day Ss = 5.05E-12 ft⁻¹
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 19.82 ft

WELL DATA (JHC MW-15005)

Initial Displacement: 1.422 ft
Static Water Column Height: 6.82 ft
Total Well Penetration Depth: 6.82 ft
Screen Length: 6.82 ft
Casing Radius: 0.083 ft
Well Radius: 0.33 ft

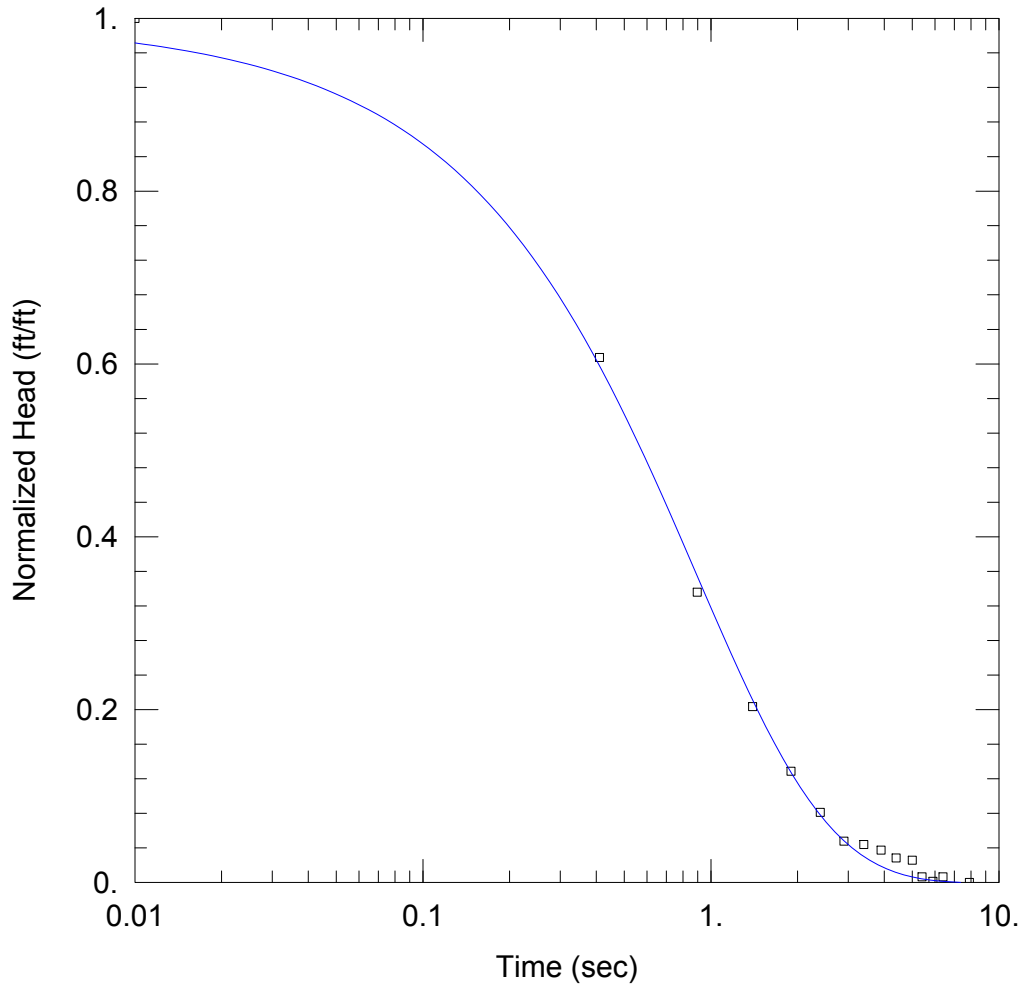
Slug Test Analysis Result for JHC MW-B6 - Test 2

Prepared By:
Arcadis

Prepared For:
Consumer Energy

Project:

Location:
West Olive, MI



SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 118. ft/day Ss = 6.03E-5 ft⁻¹
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 25.71 ft

WELL DATA (JHC MW-B6)

Initial Displacement: 0.777 ft
Static Water Column Height: 5.71 ft
Total Well Penetration Depth: 5.71 ft
Screen Length: 5.71 ft
Casing Radius: 0.083 ft
Well Radius: 0.33 ft

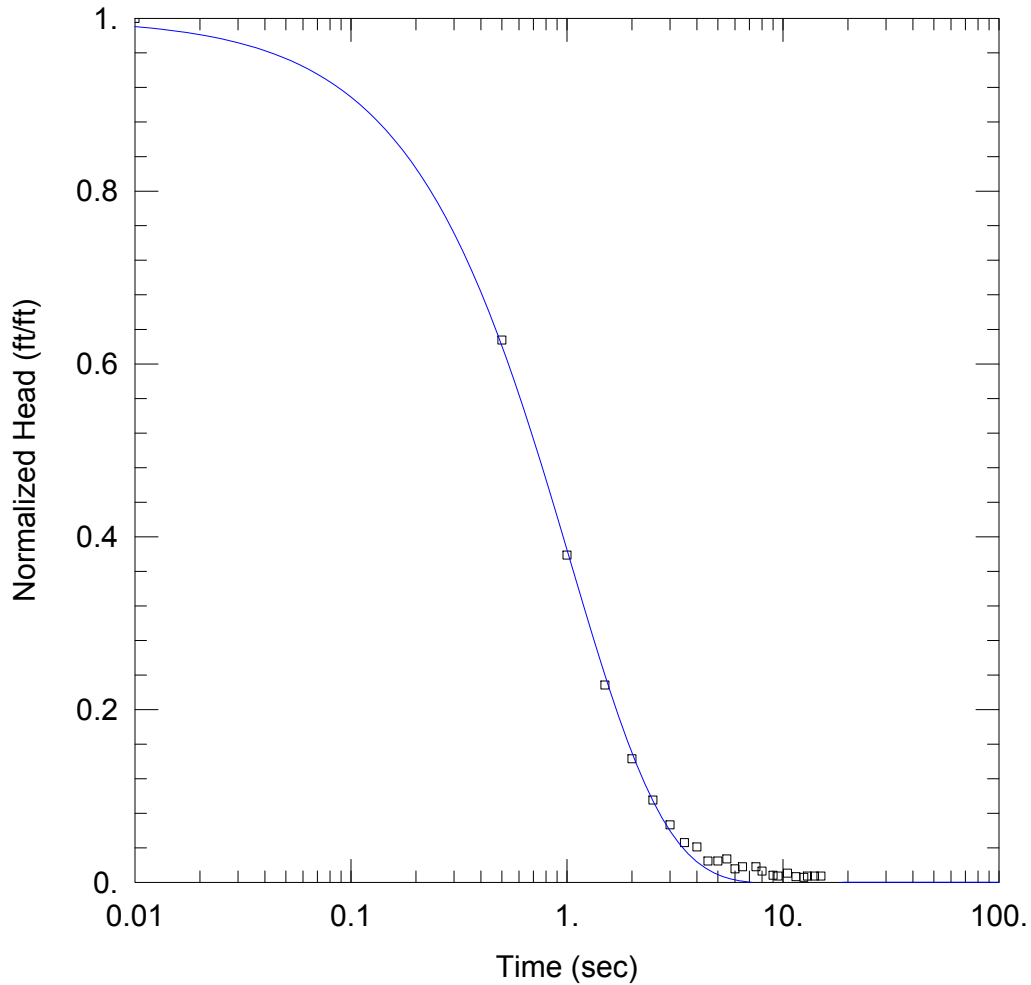
Slug Test Analysis Result for JHC MW-B6 - Test 3

Prepared By:
Arcadis

Prepared For:
Consumer Energy

Project:

Location:
West Olive, MI



SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 139. ft/day Ss = 5.05E-12 ft⁻¹
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 25.71 ft

WELL DATA (JHC MW-B6)

Initial Displacement: 1.217 ft
Static Water Column Height: 5.71 ft
Total Well Penetration Depth: 5.71 ft
Screen Length: 5.71 ft
Casing Radius: 0.083 ft
Well Radius: 0.33 ft



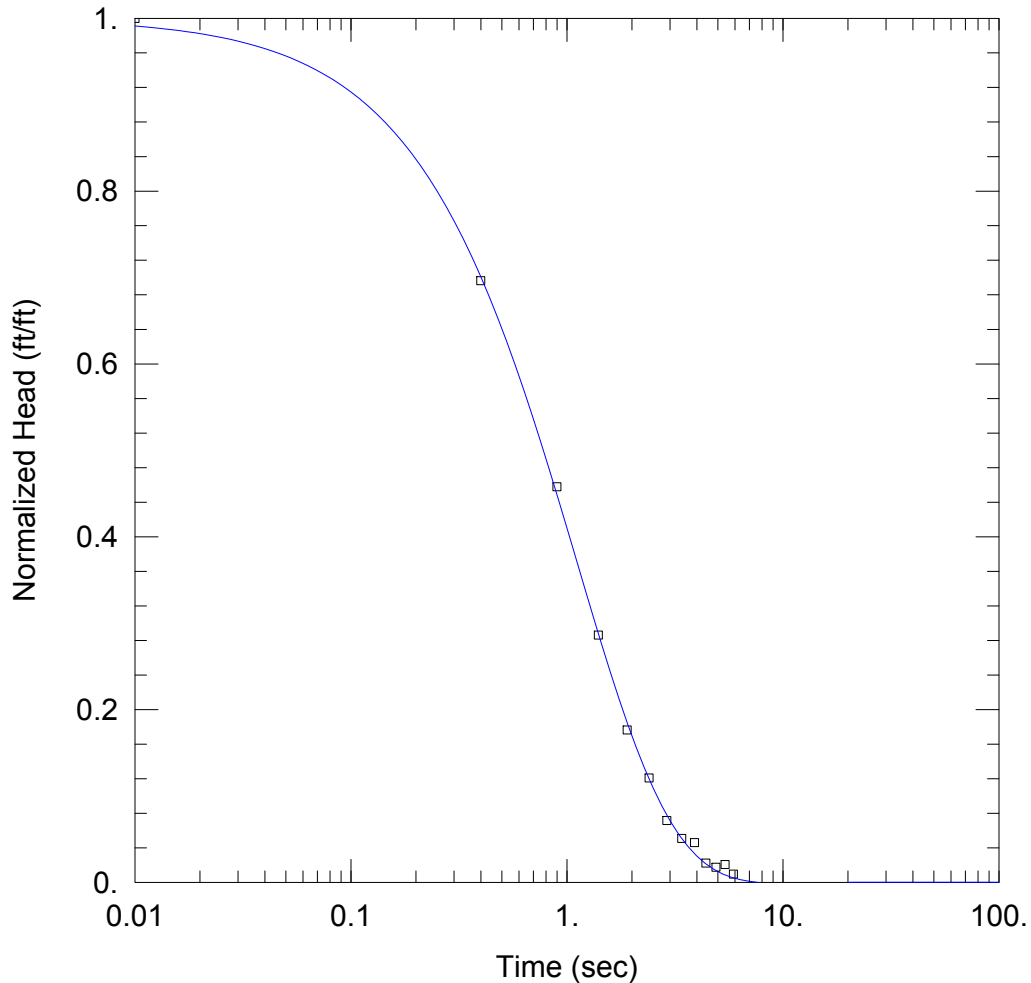
Slug Test Analysis Result for JHC MW-15007 - Test 1

Prepared By:
Arcadis

Prepared For:
Consumer Energy

Project:

Location:
West Olive, MI



SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 130. ft/day Ss = 5.05E-12 ft⁻¹
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 23.37 ft

WELL DATA (JHC MW-15007)

Initial Displacement: 0.629 ft
Static Water Column Height: 5.37 ft
Total Well Penetration Depth: 5.37 ft
Screen Length: 5.37 ft
Casing Radius: 0.083 ft
Well Radius: 0.33 ft

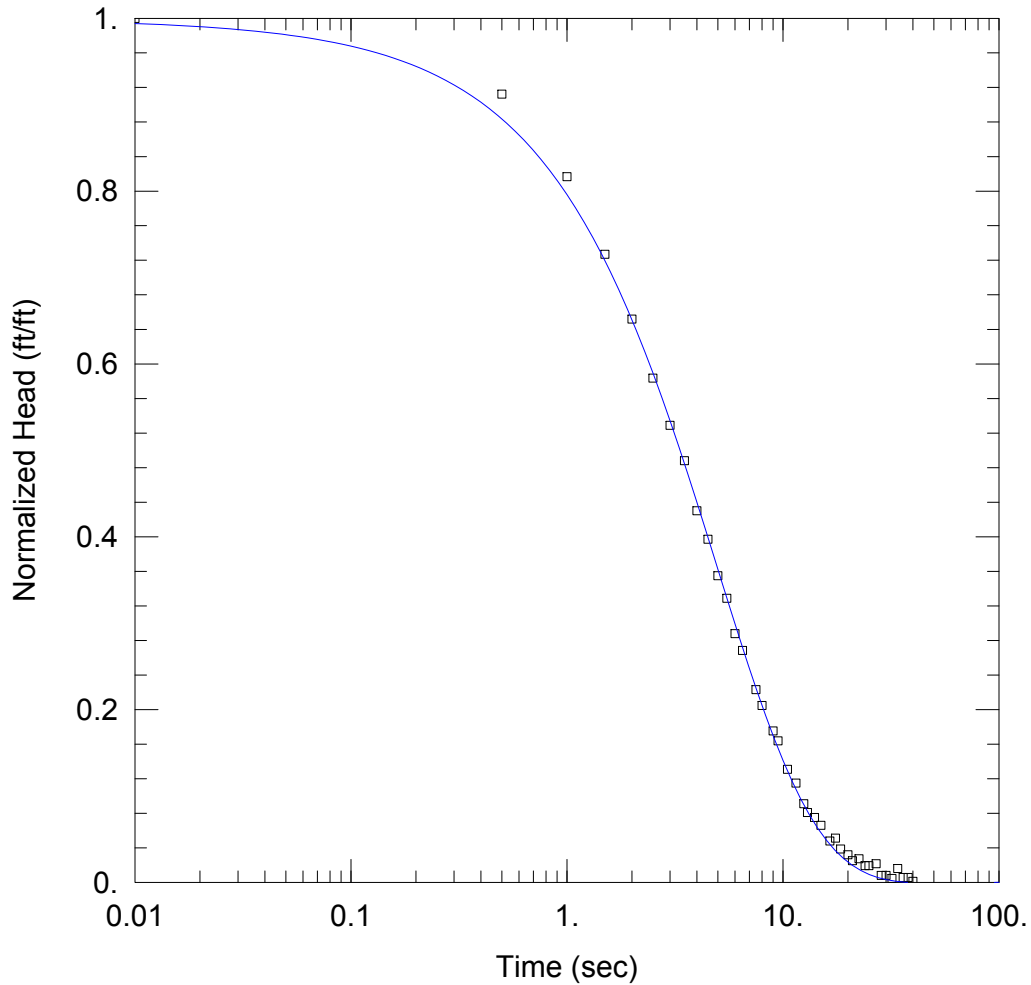
Slug Test Analysis Result for JHC MW-15015 - Test 2

Prepared By:
Arcadis

Prepared For:
Consumer Energy

Project:

Location:
West Olive, MI



SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 22. ft/day Ss = 7.0E-6 ft⁻¹
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 24.57 ft

WELL DATA (JHC MW-15015)

Initial Displacement: 0.879 ft
Static Water Column Height: 12.57 ft
Total Well Penetration Depth: 12.57 ft
Screen Length: 10. ft
Casing Radius: 0.083 ft
Well Radius: 0.33 ft



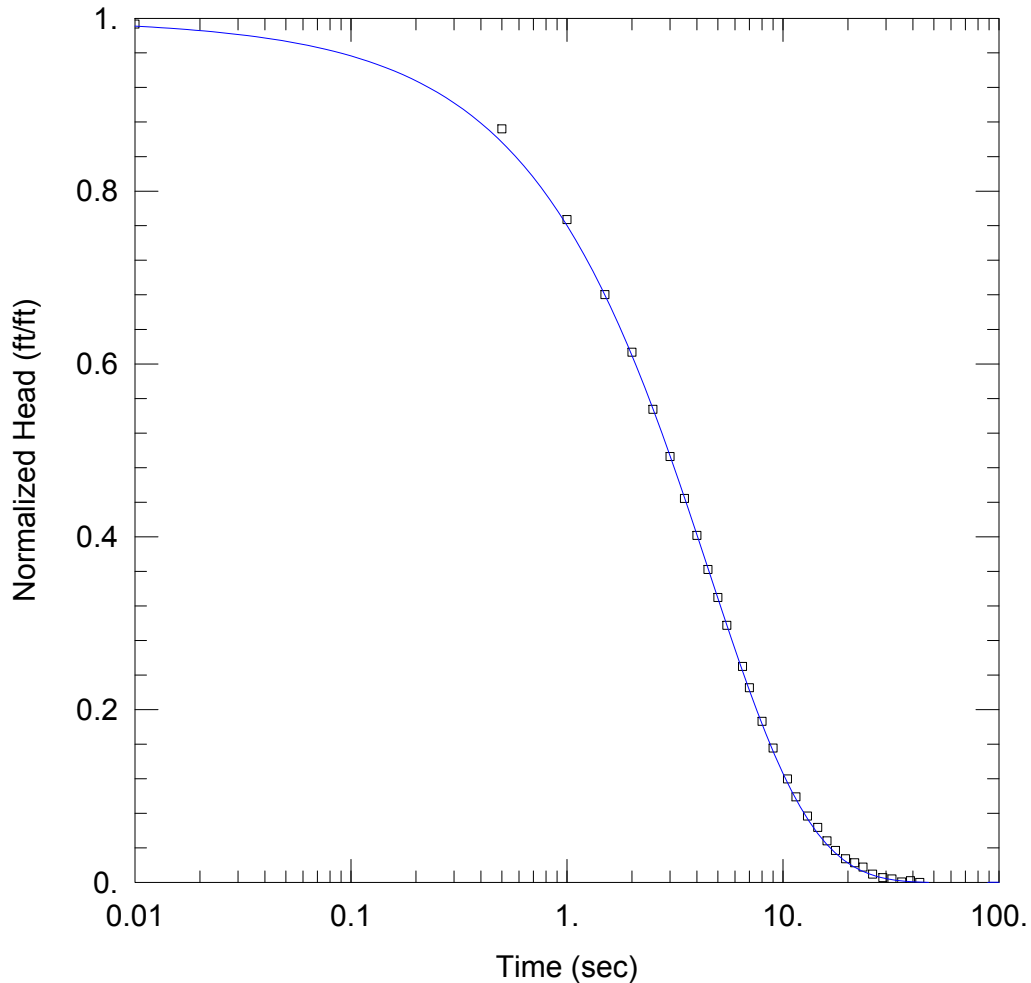
Slug Test Analysis Result for JHC MW-15015 - Test 3

Prepared By:
Arcadis

Prepared For:
Consumer Energy

Project:

Location:
West Olive, MI



SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 21. ft/day Ss = 1.9E-5 ft⁻¹
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 24.57 ft

WELL DATA (JHC MW-15015)

Initial Displacement: 1.98 ft
Static Water Column Height: 12.57 ft
Total Well Penetration Depth: 12.57 ft
Screen Length: 10. ft
Casing Radius: 0.083 ft
Well Radius: 0.33 ft

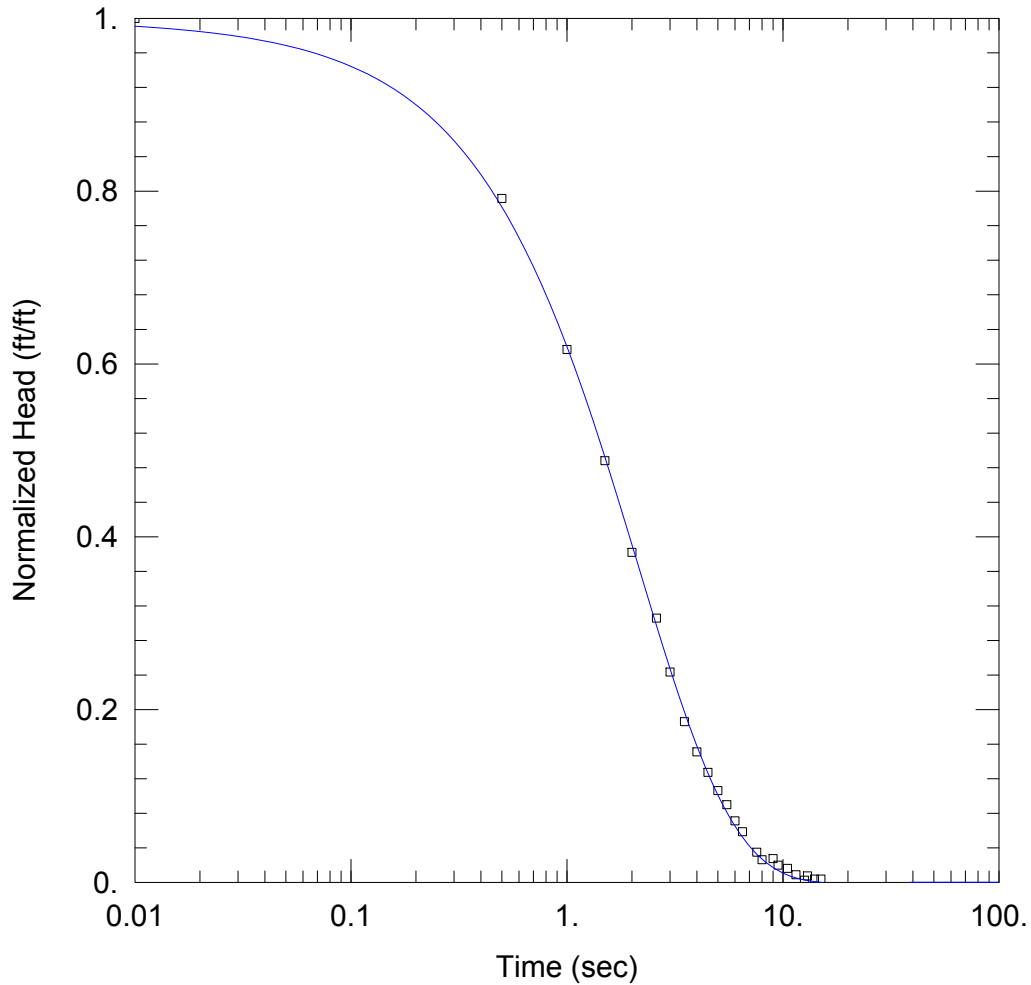
Slug Test Analysis Result for JHC MW-15024 - Test 2

Prepared By:
Arcadis

Prepared For:
Consumer Energy

Project:

Location:
West Olive, MI



SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 49. ft/day Ss = 9.8E-6 ft⁻¹
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 38.71 ft

WELL DATA (JHC MW-15024)

Initial Displacement: 0.801 ft
Static Water Column Height: 5.71 ft
Total Well Penetration Depth: 5.71 ft
Screen Length: 5.71 ft
Casing Radius: 0.083 ft
Well Radius: 0.33 ft

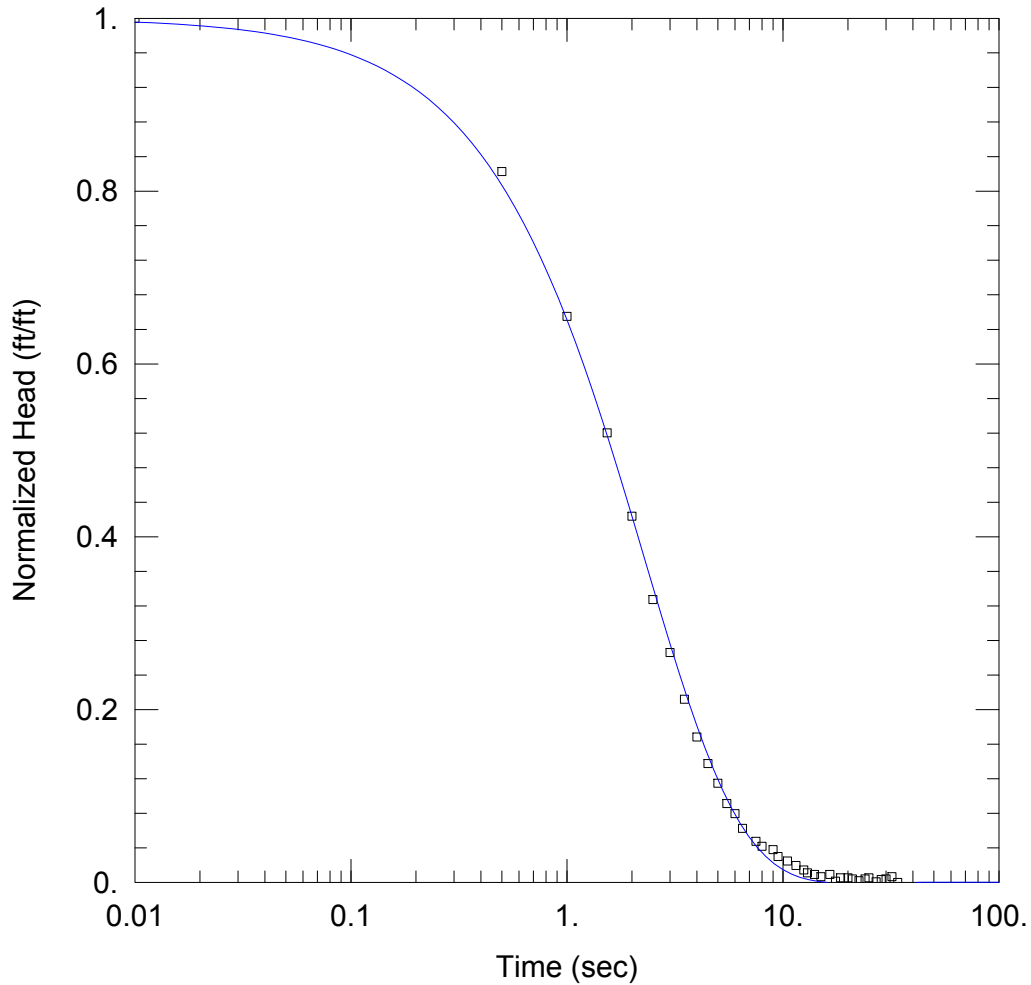
Slug Test Analysis Result for JHC MW-15024 - Test 3

Prepared By:
Arcadis

Prepared For:
Consumer Energy

Project:

Location:
West Olive, MI



SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 45. ft/day Ss = 5.05E-12 ft⁻¹
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 38.71 ft

WELL DATA (JHC MW-15024)

Initial Displacement: 1.534 ft
Static Water Column Height: 5.71 ft
Total Well Penetration Depth: 5.71 ft
Screen Length: 5.71 ft
Casing Radius: 0.083 ft
Well Radius: 0.33 ft

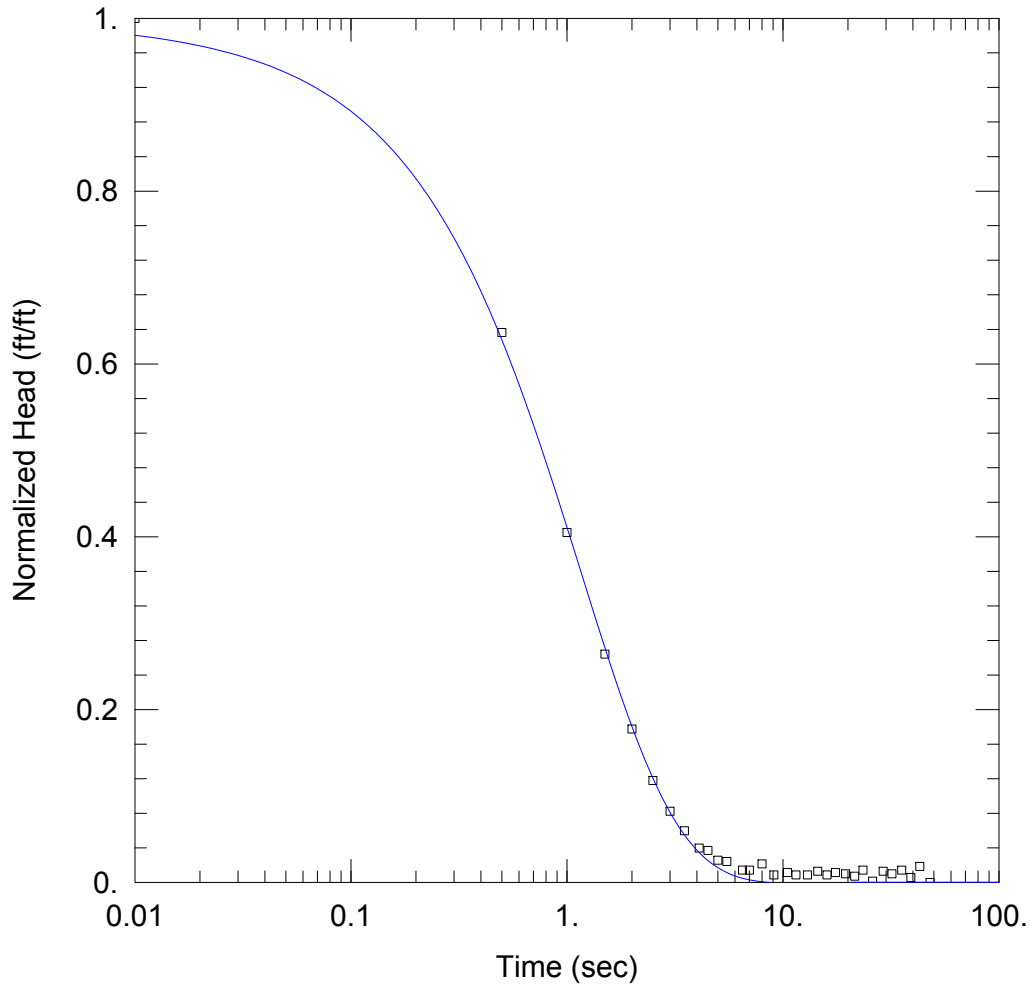
Slug Test Analysis Result for JHC MW-15028 - Test 1

Prepared By:
Arcadis

Prepared For:
Consumer Energy

Project:

Location:
West Olive, MI



SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 104. ft/day Ss = 3.1E-5 ft⁻¹
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 38.22 ft

WELL DATA (JHC MW-15028)

Initial Displacement: 0.704 ft
Static Water Column Height: 6.22 ft
Total Well Penetration Depth: 6.22 ft
Screen Length: 6.22 ft
Casing Radius: 0.083 ft
Well Radius: 0.33 ft

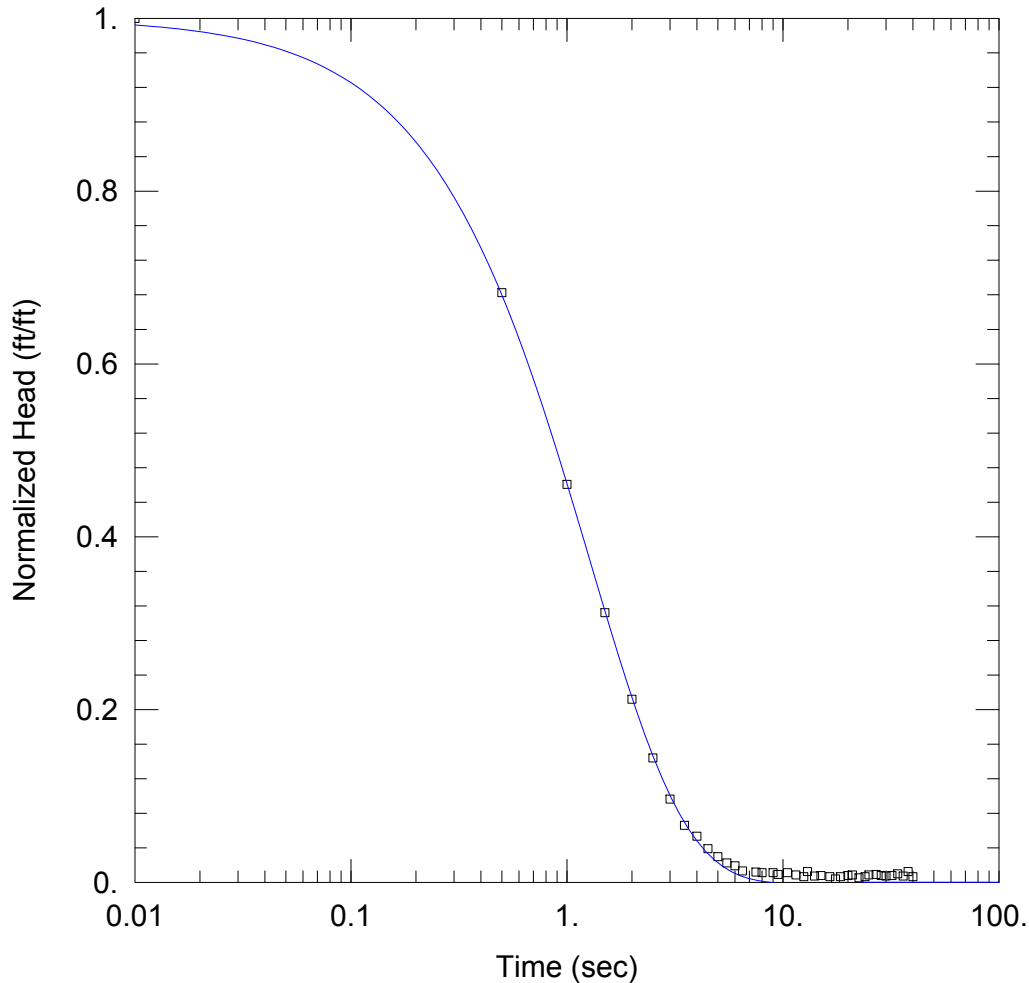
Slug Test Analysis Result for JHC MW-15028 - Test 3

Prepared By:
Arcadis

Prepared For:
Consumer Energy

Project:

Location:
West Olive, MI



SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 86. ft/day Ss = 5.05E-12 ft⁻¹
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 38.22 ft

WELL DATA (JHC MW-15028)

Initial Displacement: 1.515 ft
Static Water Column Height: 6.22 ft
Total Well Penetration Depth: 6.22 ft
Screen Length: 6.22 ft
Casing Radius: 0.083 ft
Well Radius: 0.33 ft

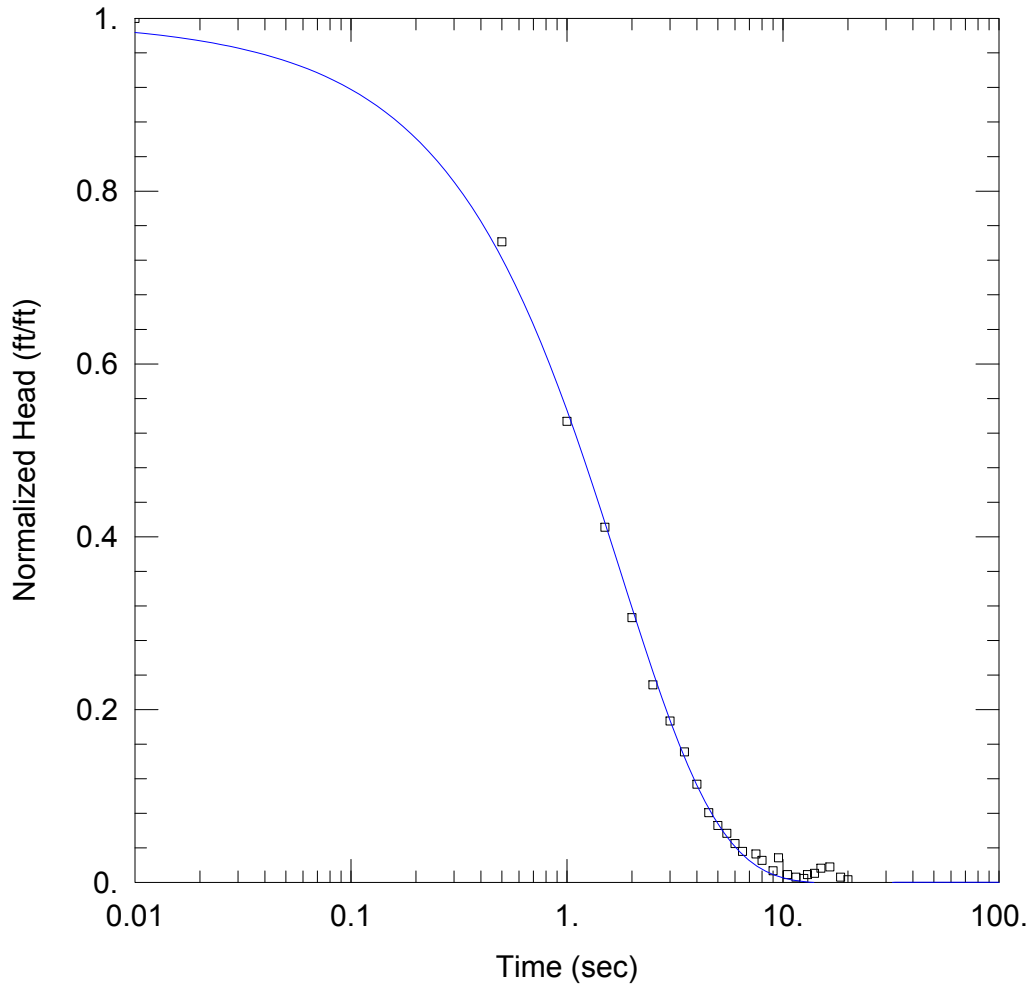
Slug Test Analysis Result for JHC MW-15033 - Test 2

Prepared By:
Arcadis

Prepared For:
Consumer Energy

Project:

Location:
West Olive, MI



SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 74. ft/day Ss = 5.3E-5 ft⁻¹
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 29.83 ft

WELL DATA (JHC MW-15033)

Initial Displacement: 0.669 ft
Static Water Column Height: 5.83 ft
Total Well Penetration Depth: 5.83 ft
Screen Length: 5.83 ft
Casing Radius: 0.083 ft
Well Radius: 0.33 ft

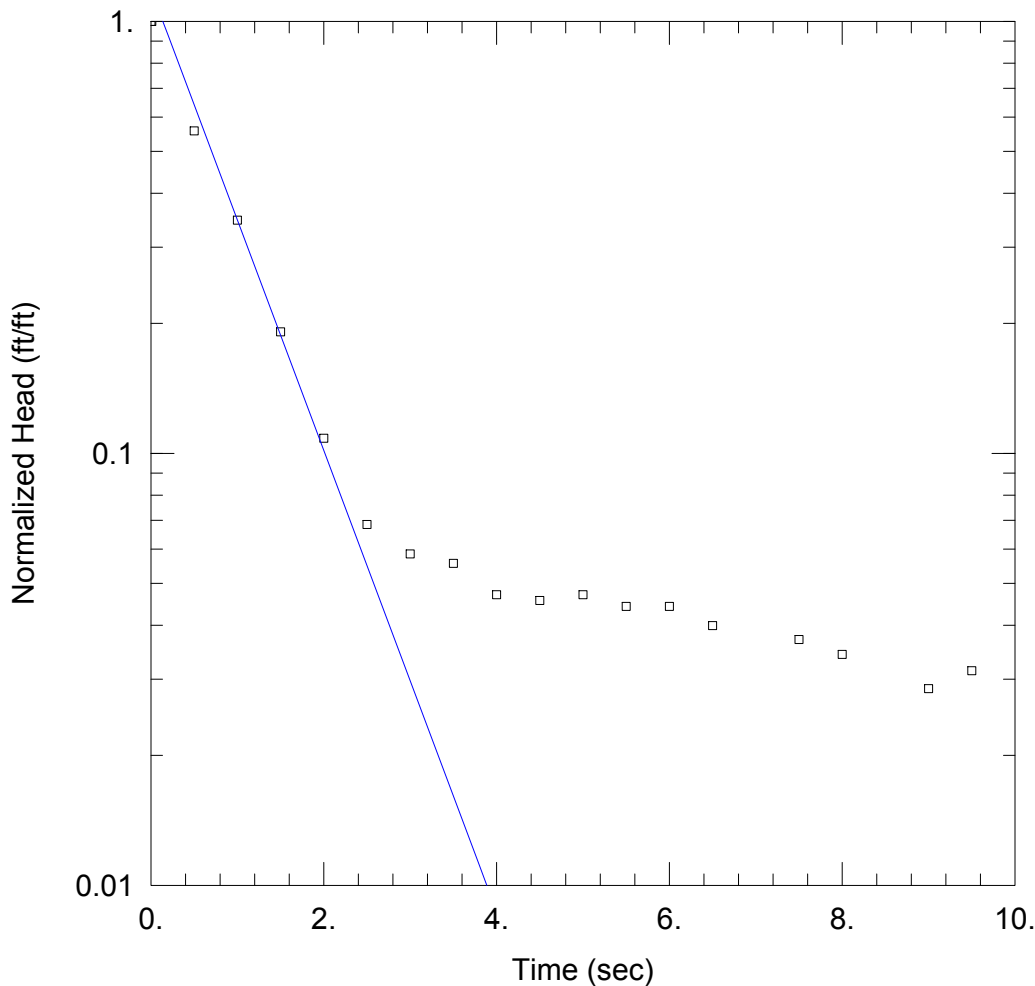
Slug Test Analysis Result for JHC MW-15030 - Test 2

Prepared By:
Arcadis

Prepared For:
Consumer Energy

Project:

Location:
West Olive, MI



SOLUTION

Aquifer Model: Confined
 Solution Method: Bouwer-Rice
 K = 100 ft/day y0 = 0.83 ft

AQUIFER DATA

Saturated Thickness: 45.12 ft

WELL DATA (JHC MW-15030)

Initial Displacement: 0.701 ft
 Static Water Column Height: 9.12 ft
 Total Well Penetration Depth: 9.12 ft
 Screen Length: 9.12 ft
 Casing Radius: 0.083 ft
 Well Radius: 0.33 ft

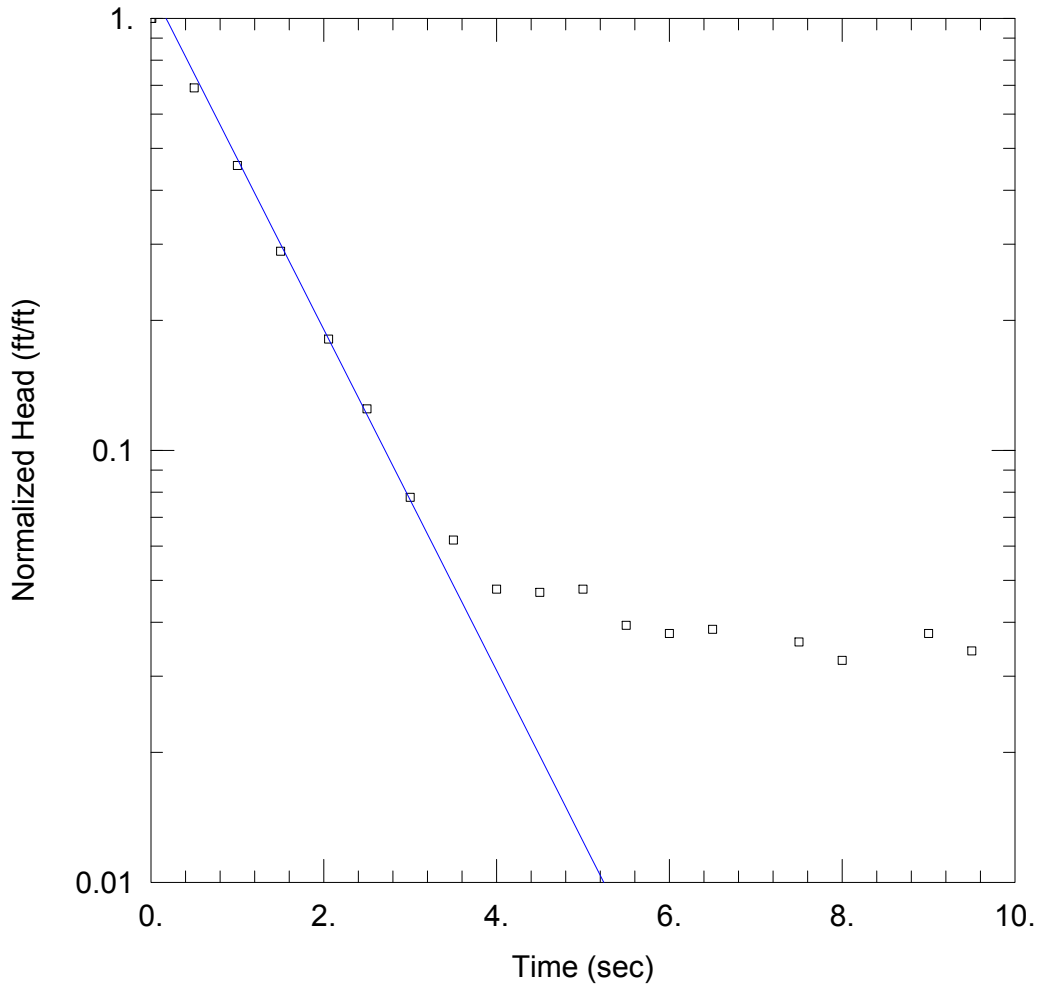
Slug Test Analysis Result for JHC MW-15030 - Test 3

Prepared By:
Arcadis

Prepared For:
Consumer Energy

Project:

Location:
West Olive, MI



SOLUTION

Aquifer Model: Confined
 Solution Method: Bouwer-Rice
 K = 87 ft/day y0 = 1.4 ft

AQUIFER DATA

Saturated Thickness: 45.12 ft

WELL DATA (JHC MW-15030)

Initial Displacement: 1.194 ft
 Static Water Column Height: 9.12 ft
 Total Well Penetration Depth: 9.12 ft
 Screen Length: 9.12 ft
 Casing Radius: 0.083 ft
 Well Radius: 0.33 ft



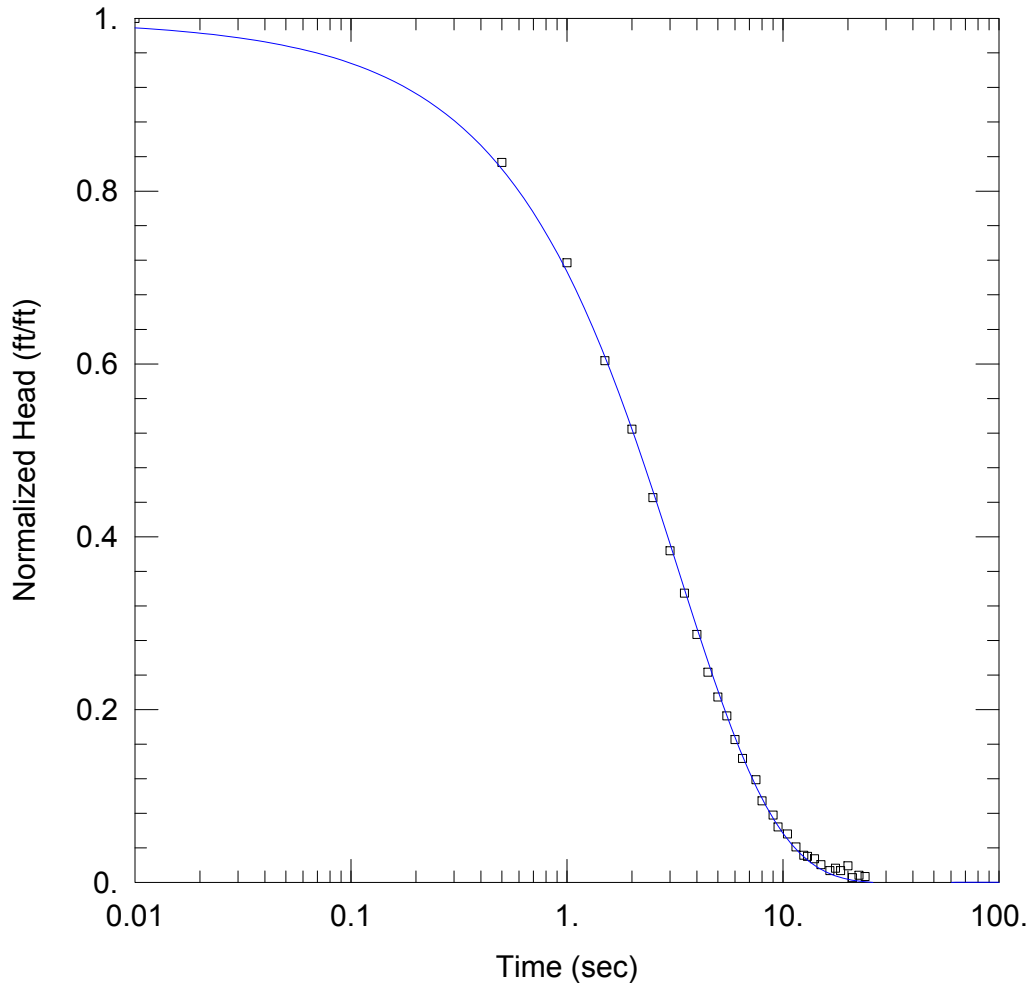
Slug Test Analysis Result for JHC MW-15018 - Test 1

Prepared By:
Arcadis

Prepared For:
Consumer Energy

Project:

Location:
West Olive, MI



SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 34. ft/day Ss = 4.0E-5 ft⁻¹
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 36.5 ft

WELL DATA (JHC MW-15018)

Initial Displacement: 0.732 ft
Static Water Column Height: 6.5 ft
Total Well Penetration Depth: 6.5 ft
Screen Length: 6.5 ft
Casing Radius: 0.083 ft
Well Radius: 0.33 ft

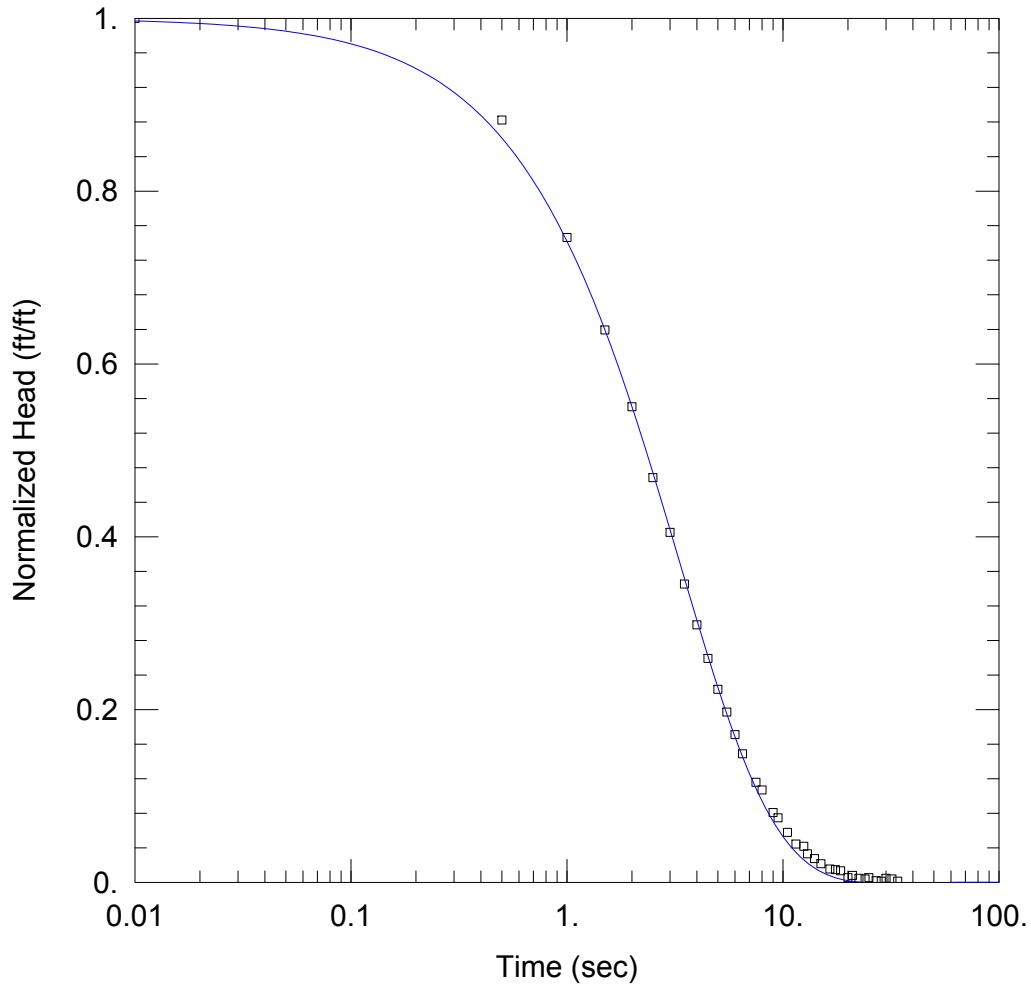
Slug Test Analysis Result for JHC MW-15018 - Test 3

Prepared By:
Arcadis

Prepared For:
Consumer Energy

Project:

Location:
West Olive, MI



SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 33. ft/day Ss = 6.2E-12 ft⁻¹
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 36.5 ft

WELL DATA (JHC MW-15018)

Initial Displacement: 1.486 ft
Static Water Column Height: 6.5 ft
Total Well Penetration Depth: 6.5 ft
Screen Length: 6.5 ft
Casing Radius: 0.083 ft
Well Radius: 0.33 ft

Arcadis of Michigan, LLC

28550 Cabot Drive

Suite 500

Novi, Michigan 48377

Tel 248 994 2240

Fax 248 994 2241

www.arcadis.com

