

A CMS Energy Company

Date: October 17, 2017

To: Operating Record

HAP

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

RE: Groundwater Monitoring System Certification, §257.91(f) Former BC Cobb Power Plant, Bottom Ash Pond and Ponds 0-8

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 use of only the minimum.

Groundwater Monitoring System

A groundwater monitoring system has been established for the BC Cobb Bottom Ash Pond and Ponds 0-8, which established the following locations for determining background groundwater quality and detection monitoring.

Background:

]	BCC MW-15002	BCC MW-15003	BCC MW-15004
]	BCC MW-15005	BCC MW-15006	BCC MW-15007
]	BCC MW-15008		
Downg	radient:		
]	BCC MW-15009	BCC MW-15010	BCC MW-15011
]	BCC MW-15012	BCC MW-15013	BCC MW-15014
]	BCC MW-15018	BCC MW-15019	BCC MW-15020
]	BCC MW-15021	BCC MW-15022	BCC MW-15023

"Groundwater Monitoring System Certification BC Cobb Bottom Ash Pond and Ponds 0-8" October 17, 2017 Page 2

Provided herein, as required by §257.91(f), is certification from a qualified professional engineer that the groundwater monitoring system at Consumers Energy BC Cobb Bottom Ash Pond and Ponds 0-8 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.

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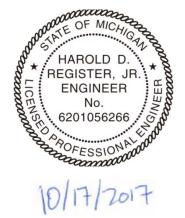
Signature

October 17, 2017

Date of Certification

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

6201056266 Professional Engineer Certification Number



ENCLOSURES

ARCADIS (2016). "Summary of Monitoring Well Design, Installation, and Development"



Consumers Energy Company

SUMMARY OF MONITORING WELL DESIGN, INSTALLATION, AND DEVELOPMENT

B.C. Cobb Electric Generation Facility – Muskege Michigan

May 13, 2016

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

Summary of Monitoring Well Design, Installation, and Development

B.C. Cobb Electric Generation Facility – Muskegon, MI

Prepared for: Consumers Energy Company Jackson, Michigan

Mark Robert Klemmer, PE Printed Name of Registered Professional Engineer

Signature of Registered Professional Engineer Registration Number: <u>62010-49167</u> State: <u>MI</u>

Date:

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

Our Ref.: DE000722.0004.00006

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 at the BC Cobb electric generation facility (BCC), located in Muskegon, 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) in Landfills and Surface Impoundments (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

Twenty-three (23) soil borings 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 is extracted from the ground and emptied into a clear plastic liner for logging. This process was repeated until the total depth of the boring is 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. The length of the monitoring well screens at the Site varied from 3 feet 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 2 feet above the top of the well screen. A 2-foot thick bentonite grout seal was placed on top of the well screen. The remainder of the annular space was sealed with a cement-bentonite grout to a depth approximately 1.5-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-22370**. 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, oxygen 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 fluid 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**.

Groundwater Parameter	Stabilization Criteria
рН	3 readings within +/- 0.1 Standard Units
Specific Conductance (SpC)	3 readings within +/- 3% mS/cms
Temperature	3 readings within +/- 3%
Oxygen 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

Table 2. Groundwater Parameter Stabilization Criteria

3.4 Hydraulic Testing

On November 9, 2015, Arcadis conducted hydraulic tests (slug tests) at six monitoring wells (BCC-MW-15001, BCC-MW-15005, BCC-MW-15008, BCC-MW-15017, BCC-MW-15020, and BCC-MW-15021) 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 details are summarized in **Table 1**.

The slug tests at these wells were completed to estimate hydraulic conductivity (K) by introducing a displacement by removing a known volume of water or depressing the water level by compressed air and measuring the recovery. The tests at BCC-MW-15017, BCC-MW-15020, BCC-MW-15021 and BCC-MW-15001 were completed using the pneumatic slug test method where a manifold and pump was used to depress the water level. The tests at BBC-MW-15005 and BCC-MW-15008 were completed using a disposable bailer to remove a known volume of water. The bailer used at both wells was 1.5-inches in diameter and 36-inches long. All wells used have casing and screen diameters of 2-inches and filter pack diameter of 8-inches. BCC-MW-15017, BCC-MW-15020, BCC-MW-15021 and BCC-MW-15001 were screened below the water table (7.09 to 28.9 feet below the water table) at the time of development and hydraulic testing. BCC-MW-15005 was screened approximately 0.5 feet below the water table and BCC-MW-15008 was screened across the water table at the time of development and hydraulic testing. At all the wells, a pressure transducer was set to record at 0.5 second intervals to measure static water elevation, displacement, and water recovery data.

All tests at the six monitoring wells reached full recovery within approximately 40 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 BCC-MW-15008, which is screened across the water table. The results indicated an estimated hydraulic conductivity range from 30 to 107 feet per day (ft/d) with an average of 58 ft/d and a geometric mean of 54 ft/d. The results of this test seem to be a reasonable fit with the interbedded sands in the formation. The monitoring well locations where slug tests were conducted are shown on **Drawing SG-22370** and the results of the hydraulic conductivity tests are presented in **Table 3** and **Appendix B**.

TABLES

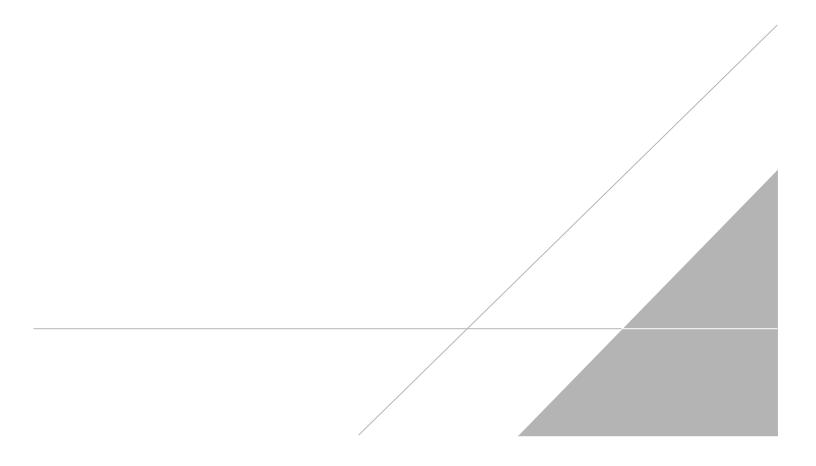


Table 1 Monitoring Well Construction and Development Summary Consumers Energy Co. B.C. Cobb Generating Facility Muskegon, Michigan

ARCADIS	Design & Consultancy for natural and built assets
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MW ID	Northing	Easting	Ground Surface Elevation	TOC Elevation	Date Installed	Geologic Unit of Screen Interval	Well Construction	Well Screen	Screen Interval (ft		Development Details				
		Lucing	(ft above msl)	(ft above msl)				Length (ft)	bgs)	Static DTW (ft below TOC)	Total Depth	Gallons Removed	Final Turbity (NTU)		
Downgradient MW															
BCC MW-15009	645606.92	12623622.98	586.3	589.27	10/14/2015	Sand (14 - 17.2 ft bgs)and Clay/silt (17.2 - 24 ft bgs)	2" PVC, 10 slot	10	14 - 24	7.51	26.79	180	8.65		
BCC MW-15010	645690.69	12623979.47	585.2	588.11	10/15/2015	Sand w/little silt and organic matter	2" PVC, 10 slot	10	12 - 22	6.93	25.09	200	5.99		
BCC MW-15011	645780.29	12623765.87	592.3	595.22	10/15/2015	Sand w/some silt	2" PVC, 10 slot	10	21 - 31	13.03	33.66	150	8.09		
BCC MW-15012	645889.92	12623545.99	594.5	597.39	10/15/2015	Sand	2" PVC, 10 slot	10	21 - 31	13.79	34.25	150	9.88		
BCC MW-15013	645716.41	12623389.21	595.9	598.5	10/16/2015	Sand with clay/silt and organic material from 36.5 - 37.5 ft bgs	2" PVC, 10 slot	10	30 - 40	16.38	43.03	100	8.38		
BCC MW-15014	645925.93	12623318.73	596.2	599.04	10/16/2015	Sand/silty sand	2" PVC, 10 slot	8	23 - 31	15.50	34.00	150	9.61		
BCC MW-15015	646138.93	12623024.09	593.9	596.75	10/19/2015	Sand with clay/silt and organic material from 29 - 29.5 ft bgs	2" PVC, 10 slot	10	20 - 30	12.16	30.18	140	9.79		
BCC MW-15016	646227.56	12622459.26	586.2	589.05	10/19/2015	Sand (35-40.5)/Clay (40.5-45)	2" PVC, 10 slot	10	35 - 40	8.65	42.93	150	6.50		
BCC MW-15017	646354.69	12622085.55	585.7	588.61	10/20/2015	Sand	2" PVC, 10 slot	10	35 -40	8.53	42.8	150	7.89		
BCC MW-15018	646789.54	12622179.74	589.4	592.43	10/20/2015	Sand	2" PVC, 10 slot	5	37.5 - 42.5	11.78	45.08	120	4.68		
BCC MW-15019	647103.13	12622369.93	589.4	592.42	10/20/2015	Sand	2" PVC, 10 slot	5	37 - 42	12.22	45.09	140	6.21		
BCC MW-15020	647436.97	12622626.85	589.5	592.23	10/21/2015	Sand	2" PVC, 10 slot	5	35 - 40	12.19	42.89	150	3.12		
BCC MW-15021	646654.84	12623310.03	590.7	593.73	10/21/2015	Sand	2" PVC, 10 slot	3	39.5 - 42.5	14.00	45.64	150	4.98		
BCC MW-15022	646263.16	12623634.96	592.6	595.82	10/23/2015	Sand	2" PVC, 10 slot	6	24 - 30	12.28	34.01	150	9.86		
BCC MW-15023	647125.15	12622999.24	585.4	588.08	10/23/2015	Sand/silty sand	2" PVC, 10 slot	7.5	12 - 19.5	3.81	22.33	140	1.02		
Background MW															
BCC MW-15001	645763.32	12624262.18	583.6	586.52	10/12/2015	Sand w/organic seam at 18.8' bgs	2" PVC, 10 slot	10	10 - 20	5.96	23.06	175	9.80		
BCC MW-15002	645701.73	12624512.86	583.8	586.87	10/12/2015	Sand	2" PVC, 10 slot	5	15 - 20	6.45	23.14	150	4.31		
BCC MW-15003	645555.93	12624726.22	584.1	587.12	10/13/2015	Sand	2" PVC, 10 slot	5	13 - 18	6.77	21.14	150	6.62		
BCC MW-15004	645491.68	12624824.48	587.7	590.57	10/13/2015	Sand	2" PVC, 10 slot	10	5 - 15	10.27	18.01	NR	5.15		
BCC MW-15005	645166.74	12624783.15	584.8	587.77	10/13/2015	Sand	2" PVC, 10 slot	10	5 - 15	7.61	18.12	150	5.84		
BCC MW-15006	645291.65	12624610.52	584.9	587.81	10/13/2015	Sand	2" PVC, 10 slot	10	5 - 15	7.45	16.95	150	8.21		
BCC MW-15007	645409.39	12624188.85	584.5	587.43	10/14/2015	Sand	2" PVC, 10 slot	6	4 - 10	6.78	13.08	140	9.37		
BCC MW-15008	645340.01	12623510.47	584.8	587.76	10/14/2015	Sand	2" PVC, 10 slot	5	4 - 9	7.11	11.95	170	10.0		

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



Table 3 Estimated Hydraulic Conductivity (K) Values Consumers Energy Co. B.C. Cobb Generating Facility Muskegon, Michigan

		Initial Displacement	(calculated) Displacement			
Well ID	Test	(ft)	(ft)	K (ft/d)	K (cm/sec)	Slug Test Solution
	2	0.804	1.15	39	1.38E-02	KGS Model (Hyder et. al, 1994)
_	3	1.393	2.31	38	1.34E-02	KGS Model (Hyder et. al, 1994)
BCC MW-15017		Average		39	1.36E-02	
	1	0.98	1.15	30	1.06E-02	KGS Model (Hyder et. al, 1994)
	3	1.911	2.31	35	1.24E-02	KGS Model (Hyder et. al, 1994)
BCC MW-15020		Average		33	1.15E-02	
	1	0.936	1.15	62	2.19E-02	KGS Model (Hyder et. al, 1994)
	3	1.973	2.31	55	1.94E-02	KGS Model (Hyder et. al, 1994)
BCC MW-15021		Average		59	2.06E-02	
	2	0.962	1.25	62	2.19E-02	KGS Model (Hyder et. al, 1994)
Γ	3	1.828	2.31	56	1.98E-02	KGS Model (Hyder et. al, 1994)
BCC MW-15001		Average		59	2.08E-02	
	1	1.191	1.69	90	3.18E-02	KGS Model (Hyder et. al, 1994)
Γ	2	0.72	1.69	107	3.78E-02	KGS Model (Hyder et. al, 1994)
BCC MW-15005		Average		99	3.48E-02	
	1	0.951	1.69	71	2.51E-02	Bouwer-Rice (1976)
	3	1.359	1.69	45	1.59E-02	Bouwer-Rice (1976)
BCC MW-15008		Average		58	2.05E-02	
		0	ver all Average	58	2.03E-02	
		Over all G	eometric mean	54	1.89E-02	
			Minimum	30	1.06E-02	
			Maximum	107	3.78E-02	

Note:

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

References

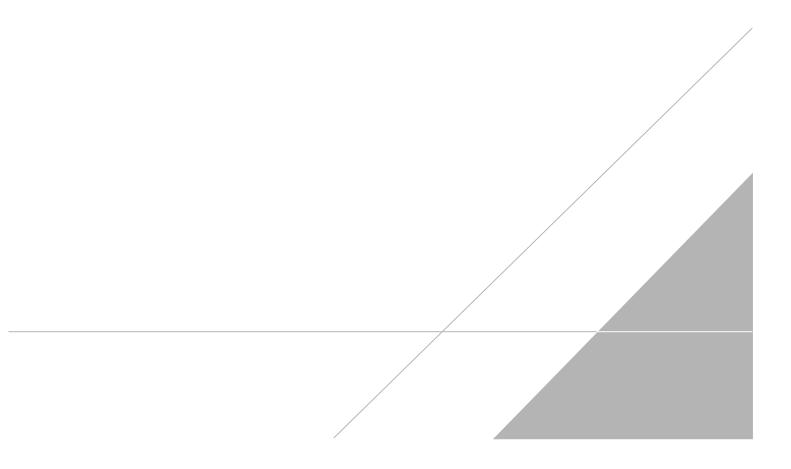
Bouwer, H., 1989. The Bouwer and Rice slug test--an update, Ground Water, vol. 27, no. 3, pp. 304-309

Bouwer, H. and R.C. Rice, 1976. A slug test method for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells, Water Resources Research, vol. 12, no. 3, pp. 423-428.

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

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







BCC MW-15006



BCC MW-15011

22370 CCR Groundwater Monitoring Systems As-built Survey	11/23/2

			•	-			
			WW#215195				
		T.O.C.	T.O.C.			T.O.C.	T.O.C.
SURVEY		SPC	SPC	GROUND	T.O.C.	LATITUDE	LONGITUDE
POINT	MONITOR WELL	NAD83(2011)	NAD83(2011)	ELEVATION	ELEVATION	DECIMAL	DECIMAL
NUMBER	NUMBER	NORTHING	EASTING	NAVD88	NAVD88	DEGREES	DEGREES
101	BCC MW-15001	645763.32	12624262.18	583.6	586.52	43.256731	-86.240400
102	BCC MW-15002	645701.73	12624512.86	583.8	586.87	43.256578	-86.239455
103	BCC MW-15003	645555.93	12624726.22	584.1	587.12	43.256191	-86.238642
104	BCC MW-15004	645491.68	12624824.48	587.7	590.57	43.256020	-86.238268
105	BCC MW-15005	645166.74	12624783.15	584.8	587.77	43.255127	-86.238395
106	BCC MW-15006	645291.65	12624610.52	584.9	587.81	43.255459	-86.239054
107	BCC MW-15007	645409.39	12624188.85	584.5	587.43	43.255756	-86.240646
108	BCC MW-15008	645340.01	12623510.47	584.8	587.76	43.255524	-86.243186
109	BCC MW-15009	645606.92	12623622.98	586.3	589.27	43.256263	-86.242786
110	BCC MW-15010	645690.69	12623979.47	585.2	588.11	43.256515	-86.241455
111	BCC MW-15011	645780.29	12623765.87	592.3	595.22	43.256747	-86.242265
112	BCC MW-15012	645889.92	12623545.99	594.5	597.39	43.257035	-86.243099
113	BCC MW-15013	645716.41	12623389.21	595.9	598.50	43.256549	-86.243673
114	BCC MW-15014	645925.93	12623318.73	596.2	599.04	43.257120	-86.243955
115	BCC MW-15015	646138.93	12623024.09	593.9	596.75	43.257686	-86.245078
116	BCC MW-15016	646227.56	12622459.26	586.2	589.05	43.257894	-86.247206
117	BCC MW-15017	646354.69	12622085.55	585.7	588.61	43.258220	-86.248619
118	BCC MW-15018	646789.54	12622179.74	589.4	592.43	43.259419	-86.248302
119	BCC MW-15019	647103.13	12622369.93	589.4	592.42	43.260291	-86.247614
120	BCC MW-15020	647436.97	12622626.85	589.5	592.23	43.261222	-86.246678
121	BCC MW-15021	646654.84	12623310.03	590.7	593.73	43.259119	-86.244049
122	BCC MW-15022	646263.16	12623634.96	592.6	595.82	43.258064	-86.242796
123	BCC MW-15023	647125.15	12622999.24	585.4	588.08	43.260390	-86.245254

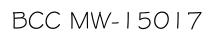
	FIELD BOOK NO. XXXX			A 11-23 2015 REVISED SPREADSHEET, ADDED SIGNATURE LINE JCV	W
DRAWING NO.	REFERENCE DRAWINGS	REV. DATE	DESCRIPTION BY	PP. REV. DATE DESCRIPTION BY APP. REV. DATE DESCRIPTION BY	BY APP.

0

BCC MW-1502

SCC NIW-15015







SCALE:

616.224.1500 phone 616.224.1501 facsimile 549 Ottawa Ave NW Grand Rapids, MI 49503

| " = | OO'

ConEn FILE NAME:22370BASE №#W FILE NAME: 219195BM

CLOSED LOOP.

BCC MW-15012

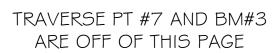
BCC MW-15011 BCC MW-15013

BCC MW-15009

BM#5 BOX CUT N.W. CORNER CONC PAD ELEV= 587.03'

BCC MW-150

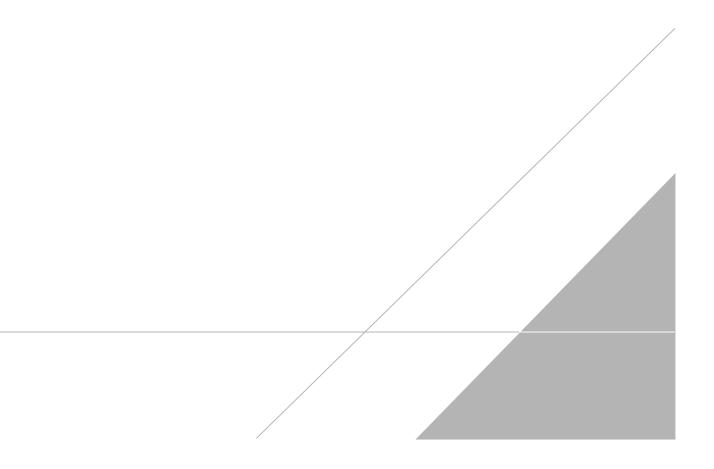
DEPARTMENT HEAD



120 17 31	
EARING Coordinate System 2011) SKY & MIMK CORS S-31BR bridge projects, but GRID, NOT GROUND. 3	
LEVATION S Derived) MSKY \$	
Easting Elevation 12624604.79 585.04 12624686.43 584.24 12624686.43 584.67 12624270.64 584.05 12624197.69 584.79 12623561.88 584.80 12623565.56 584.18	
Easting Elevation 12624653.67 585.64 12623562.44 585.46 12624749.98 585.10 12624038.33 587.03 12622090.00 583.47 12622818.53 590.87	
OF MICH JONATHON C WILDROM PROFESSIONAL SURVEYOR No. 54059 FOFESSIONAL	
FOUND MON, S1/4 CORNER, SEC 17, T1ON,R16W	
ONITORING WELLS	
DRAWING NO. SHEET R	EV.

APPENDIX A

Soil Boring and Monitoring Well Construction Logs



Dat Dril Dril Dril Sar Rig Wat	Date Start: 10/12/15 Date Finish: 10/12/15 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.): 3.8 Water Level Finish (ft. btoc.): 5.96					nic		Northing: 645763.32 Easting: 12624262.15 Casing Elevation: 586.52 Borehole Depth (ft. bgs.): 20.0 Surface Elevation: 583.6 Descriptions By: A. Westhuis	Client: Con Location: E 1 N	sume 3C Co 51 N /uske	
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 = 586.52 (ft. above msi)
		. 1	0.0- 6.0'	6.0	NA			 (0.0 - 0.1') GRASS and TOPSOIL. (0.1 - 1.0') SAND, fine to very fine, subround; little silt; well sorted; di brown (10YR 3/3). (1.0 - 3.8') ASH, some fine to very fine sand, subround; little silt; poot to wet; dark grayish brown (10YR 4/2). NOTE: Fill material. (3.8 - 4.0') SAND, fine, little very fine, subround; trace to little silt; we grayish brown (10YR 5/2). NOTE: trace organic matter, trace ash. (4.0 - 7.0') CLAY, some silt, high plasticity, no dilatancy; trace very fi subround; medium stiff to soft; moist; gray (10YR 5/1) to grayish brow NOTE: very soft, gray (10Yr 5/1) to gray (10YR 6/1) from 6.0-7.0' bg 	orly sorted; moist ell sorted; wet; ine sand; wn (10YR 5/2).		Concrete (0.0- 1.0' bgs)
- 10		2	6.0- 10.0'	3.0	NA	-		 (7.0 - 7.5') CLAY, some silt, medium plasticity, slow dilatancy; trace subround; soft; moist to wet; very dark gray (10YR 3/1). NOTE: little organic matter. (7.5 - 8.0') WOOD, dark gray (10YR 4/1). (8.0 - 9.0') CLAY and SILT, low plasticity, slow dilatancy; little very fi subround; medium stiff; moist to wet; brown (10YR 4/3). NOTE: so matter, trace to little wood. (9.0 - 9.1') SAND, very fine, subround; trace silt; well sorted; wet; light 7/2). (9.1 - 9.6') CLAY and SILT, high plasticity, no dilatancy; little to some subround; medium stiff; moist; brown (10YR 4/3). (9.6 - 20.0') SAND, fine to medium; trace to little very fine sand, subrilittle silt; well sorted; wet; light brownish gray (10YR 6/2). 	e to some ine to fine sand, me organic ht gray (10Yr e very fine sand,		
	Period Remarks: bgs = below ground surface btoc = below top of casing Hand Auger to 6.0' bgs. Groundwater encountered at 3.8' bgs during drilling. Water level at development was 5.96' btoc. No odor or staining observed. Groundwater elevation measured on November 30, 2015 was 580.84 feet roject: DE000722.0004.00006 Template: ARCADIS_Analytical Boring-Well 2013_New Logo Page: 1 of 2										

Date Dril Dril Dril San Rig Wat	e Fini ling C ler's I ling M npling Type ær Le	sh: 10 Compa Name: Methoo g Metho: Soni Soni Svel St	12/15 D/12/15 any: M : Johr d: Har nod: C c c rart (ft. nish (f	fateco n Pitscl nd Aug Continu bgs.)	h jer/Sor Jous : 3.8	nic		Northing: 645763.32 Easting: 12624262.15 Casing Elevation: 586.52 Borehole Depth (ft. bgs.): 20.0 Surface Elevation: 583.6 Descriptions By: A. Westhuis	Client: Cons Location: B0 15 Mi	ID: BCC MW-15001 umers Energy C Cobb Facility 51 N Causeway St. uskegon, MI nditions: 60 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 evel (# hns)	Well/Boring Construction
- 15	- 570 - - - 565 - -	3	10.0-20.0'	9.0	NA			NOTE: organic matter, roots, from 18.8 to 18.9' bgs.		Sand Pack K&E WP1 (10.0- 20.0' bgs) 2" PVC 10 Slot Well Screen (10.0-20.0' bgs)
- 25	- - - - - - - -							End of boring 20.0' bgs.		
ARCADIS Design & Consultancy for natural and built assets								btoc = below top of casing Hand Auger to 6.0' bgs. Groundwater encountered at 3.8' by Water level at development was 5.9 No odor or staining observed. Groundwater elevation measured o RCADIS Analytical Boring-Well 2013 New Logo	6' btoc.	

Dat Dri Dri Dri Sar Rig Wa	e Fini lling C ller's I lling M npling Type ter Le	Compa Name Metho g Meth e: Soni evel St	0/12/15 any: M : Johr d: Air nod: (lateco n Pitsc Knife/S Continu bgs.)	h Sonic Jous : 5.0	-		Northing: 645701.73 Easting: 12624512.86 Casing Elevation: 586.87 Borehole Depth (ft. bgs.): 20.0 Surface Elevation: 583.8 Descriptions By: A. Westhuis	nsur BC (151 Mus	g ID: BCC MW-15002 Isumers Energy BC Cobb Facility I51 N Causeway St. Muskegon, MI onditions: 60 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	
-	- - 585 -										TOC Elevation = 586.87 (ft. above msl)	
		1	0.0- 8.0'	4.0	NA			(0.0 - 0.1') GRASS and TOPSOIL. (0.1 - 12.0') SAND, fine to medium; trace to little very fine sand, subr sorted; moist to wet; dark brown (10YR 3/3). NOTE: Wet at 5.0' bgs.	round; well		Concrete (0.0- 1.0' bgs)	
- 10	575 - -	2	8.0- 10.0'	1.0	NA						15.0' bgs)	
- 15	- 570 - - - - - - - - - - 	3	10.0- 20.0'	7.0	NA			 (12.0 - 13.0') SAND, fine to medium, subround; trace silt; well sorted (10YR 5/3). (13.0 - 13.5') CLAY and SILT, medium plasticity, no dilatancy; little to fine sand, subround; medium stiff; moist; brown (10YR 4/3). (13.5 - 20.0') SAND, fine to medium; trace to little very fine sand, sub silt; well sorted; wet; light brownish gray (10YR 6/2). 	o some very fine		Bentonite Pellets (11.0- 13.0' bgs) Sand Pack K&E WP1 (13.0- 20.0' bgs) 2" PVC 10 Slot Well Screen (15.0-20.0' bgs)	
-	Image: Second											
Proje	ect: DI	E0007	22.000 4W-15	4.000	06 T			Air Knife to 8.0' bgs. Groundwater encountered at 5.0' bg Water level at development was 6.4 No odor or staining observed. Groundwater elevation measured o RCADIS_Analytical Boring-Well 2013_New Logo Date: 2/8/2016 Created/Edited by: C. S	5' btoc.	-	2015 was 580.86 feet Page: 1 of 1	

Dat Dri Dri Dri Sar Rig Wa	te Fini Iling C Iler's I Iling N npling Type ter Le	Compa Name: Methoo g Meth e: Soni evel St	0/12/18 any: N : Johr d: Air nod: (/lateco n Pitsc Knife/S Continu bgs.)	h Sonic Jous : 11.0)		Northing: 645555.93 Easting: 12624726.22 Casing Elevation: 587.12 Borehole Depth (ft. bgs.): 20.0 Surface Elevation: 584.1 Descriptions By: A. Westhuis	Client: Con	nsur BC (151 Mus	D: BCC MW-18 mers Energy Cobb Facility N Causeway St. kegon, MI litions: 60 F Clo	
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/B Constri	•
-	- - 585 -											TOC Elevation =587.12 (ft. above msl)
		. 1	0.0- 8.0'	3.5	NA			(0.0 - 0.1') GRASS and TOPSOIL. (0.1 - 10.0') SAND, fine to medium; trace to little very fine sand, subre sorted; moist to wet; dark brown (10YR 3/3).	ound; well			 Concrete (0.0- 1.0' bgs) Bentonite/Cement Grout (1.0-9.0' bgs) 2" PVC Well Casing (-3.0- 13.0' bgs)
- 10	- 575	2	8.0- 10.0'	1.0	NA	-		(40.0, 41.0%) CLAV and SILT, madium planticity, and dilataness little to	nome van fine	_		Bentonite
-	_							 (10.0 - 11.0') CLAY and SILT, medium plasticity, no dilatancy; little to to fine sand, subround; medium stiff; moist; brown (10YR 4/3). NOTE some organic matter; roots, wood. (11.0 - 18.0') SAND, fine to medium; trace to little very fine sand, sub silt; well sorted; wet; light brownish gray (10YR 6/2). 	E: little to			Pellets (9.0- 11.0' bgs)
Proje	ect: DI	E0007	22.000 /W-15	04.000	06 T			Remarks: bgs = below ground surface btoc = below top of casing Air Knife to 8.0' bgs. Groundwater encountered at 11.0' b Water level at development was 6.7 No odor or staining observed. Groundwater elevation measured or Groundwater elevation measured or RCADIS_Analytical Boring-Well 2013_New Logo Date: 2/8/2016	7' btoc.	-	2015 was 580.84	feet Page: 1 of 2

Dat Dril Dril Dril San Rig Wat	e Fini ling C ler's l ling M npling Type ter Le	Compa Name: Methoo g Meth : Soni evel St	0/12/15 iny: M Johr d: Air I iod: (lateco Pitscl Knife/S Continu bgs.)	h Sonic Jous : 11.0)		Northing: 645555.93 Easting: 12624726.22 Casing Elevation: 587.12Well/Boring ID: BCC MW-15003 Client: Consumers EnergyBorehole Depth (ft. bgs.): 20.0 Surface Elevation: 584.1 Descriptions By: A. WesthuisLocation: BC Cobb Facility 151 N Causeway St. Muskegon, MIWeather Conditions: 60 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
- 15	- 570 - - - 565 -	3	10.0- 20.0'	9.0	NA			(18.0 - 20.0') SAND, very fine to fine, subround; little to trace silt; wel grayish brown (10YR 5/2) to gray (10YR 6/1). NOTE: Organic matter; roots, leaves, wood from 18.0 to 18.3' bgs at bgs.			Sand Pack K&E WP1 (11.0- 20.0' bgs) 2" PVC 10 Slot Well Screen (13.0-18.0' bgs)
- 20 - - - - - 25 -	- - 560 - - -							End of boring 20.0' bgs. Remarks: bgs = below ground surface btoc = below top of casing			
								Air Knife to 8.0' bgs. Groundwater encountered at 11.0' bgs during drilling. Water level at development was 6.77' btoc. No odor or staining observed. Groundwater elevation measured on November 30, 2015 was 580.84 feet RCADIS_Analytical Boring-Well 2013_New Logo Page: 2 of 2			

Date Dril Dril San Rig Wat	e Fini ling C ler's I ling M npling Type ter Le	compa Name: Nethoo Meth Sonic Vel St	0/13/15 iny: M Dan d: Air I iod: (lateco Moure Knife/S Continu bgs.) :	er Sonic Jous : 7.0			Northing: 645491.68 Easting: 12624824.48 Casing Elevation: 590.57 Borehole Depth (ft. bgs.): 20.0 Surface Elevation: 587.7 Descriptions By: A. Westhuis	D: BCC MW-15004 mers Energy Cobb Facility N Causeway St. skegon, MI ditions: 50 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		
-	- 590 - -										TOC Elevation = 590.57 (ft. above msl)		
- - - - - - - -		1	0.0- 8.0'	3.5	NA			(0.0 - 0.1') GRASS and TOPSOIL. (0.1 - 10.0') SAND, fine; little very fine sand, subround; trace granule trace silt; well sorted; dry to moist; light yellowish brown (10YR 6/4). NOTE: Wet at 7.0' bgs.	s, subround;		Concrete (0.0- 1.0' bgs) 2" PVC Well Casing (-3.0- 5.0' bgs) Bentonite Pellets (1.0-4.0' bgs)		
- 10	580 - - - 575 -	2	8.0-	10.0	NA	-		(10.0 - 14.0') SAND, fine; little medium, subround; trace to little silt; v grayish brown (10YR 5/2). NOTE: Trace organice material; wood at 13.5' bgs.	well sorted; wet; Well sorted; wet; Support of the sorted of the sorte				
- 15 - - - -	- - 570 - -	_	20.0'					(14.0 - 17.0') SAND, medium; little coarse sand, subround; trace gra subround; little silt; well sorted; wet; grayish brown (10YR 5/2). NOTE: Organic matter, wood; dark brown (10YR 3/3) from 16.5 to 1 (17.0 - 20.0') SAND, very fine to fine, subround; little silt; well sorted; brown (10YR 5/2).	7.0' bgs.				
-	_												
			22.000					Remarks: bgs = below ground surface btoc = below top of casing Air Knife to 8.0' bgs. Groundwater encountered at 7.0' bg Water level at development was 10. No odor or staining observed. Groundwater elevation measured o RCADIS_Analytical Boring-Well 2013_New Logo	27' btoc.	-	2015 was 580.82 feet Page: 1 of 1		

Data File: BCC-MW-15004.dat Date: 2/8/2016 Created/Edited by: C. Jeffers

Date Dril Dril Dril San Rig Wat	e Fini ling (ler's l ling M npling Type ter Le	Compa Name: Methoo g Meth s: Soni evel St	0/13/18 any: M : Dan d: Air nod: (Aateco Moure Knife/S Continu	er Sonic Jous : 6.0			Northing: 645166.74 Easting: 12624783.15 Casing Elevation: 587.77 Borehole Depth (ft. bgs.): 20.0 Surface Elevation: 584.8 Descriptions By: A. Westhuis	: BCC MW-15005 ners Energy Cobb Facility N Causeway St. kegon, MI itions: 50 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 = 587.77 (ft. above msl)
	- - 580 -	1	0.0- 6.0'	6.0	NA			(0.0 - 0.1') GRASS and TOPSOIL. (0.1 - 10.0') SAND, fine; little very fine sand, subround; trace granule little to trace silt; well sorted; moist to wet; pale brown (10YR 6/3).	es, subround;		Concrete (0.0- 1.0' bgs) 2" PVC Well Casing (-3.0- 5.0' bgs) Bentonite Pellets (1.0-4.0' bgs)
10		2	6.0- 10.0'	4.0	NA			NOTE: Wet at 6.0' bgs.	lark gray (10YR		Sand Pack K&E
-	- - 570 - - - - - - - - - - - - 	3	10.0-20.0'	8.0	NA			3/1). NOTE: trace organic matter, large wood fragments. (10.5 - 20.0') SAND, fine to medium; trace coarse sand, subround; li well sorted; wet; grayish brown (10YR 5/2).	ittle to trace silt;		bgs) 2" PVC 10 Slot Well Screen (5.0-15.0' bgs)
-	-							End of boring 20.0' bgs.			
ARCADIS Design & Consultancy for natural and built assets								Remarks: bgs = below ground surface btoc = below top of casing Air Knife to 6.0' bgs. Groundwater encountered at 6.0' bg Water level at development was 7.6 No odor or staining observed. Groundwater elevation measured o Groundwater elevation measured o	51' btoc.	-	015 was 580.54 feet Page: 1 of 1

Data File: BCC-MW-15005.dat Date: 2/8/2016 Created/Edited by: C. Jeffers

Date Drill Drill San Rig Wat	e Fini ling C ler's I ling M npling Type ær Le	Compa Name: Methoo g Meth e: Soni evel St	0/13/18 any: M : Dan d: Air nod: (Aateco Moure Knife/S Continu	er Sonic Jous : 5.0			Northing: 645291.65 Easting: 12624610.52 Casing Elevation: 587.81 Borehole Depth (ft. bgs.): 20.0 Surface Elevation: 584.9 Descriptions By: A. Westhuis	ID: BCC MW-15006 umers Energy C Cobb Facility 1 N Causeway St. uskegon, MI aditions: 50 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. bds.)	Well/Boring Construction			
-	-									TOC Elevation = 587.81 (ft. above msl)			
5 	580 - - - - - - - - - - - - - - - - - - -	1	0.0- 10.0' 10.0- 20.0'	4.0	NA			(0.0 - 0.1') LANDSCAPING STONE. (0.1 - 9.0') SAND, fine, subround; trace granules, subround; trace sil moist to wet; light yellowish brown (10YR 6/4). NOTE: Wet at 5.0' bgs. (9.0 - 20.0') SAND, fine to medium, subround; trace granules, subrou wet; light brownish gray (10YR 6/2).		Concrete (0.0- 1.0' bgs) 2" PVC Well Casing (-3.0- 5.0' bgs) Bentonite Pellets (1.0-4.0' bgs) 2" PVC 10 Slot Well Screen (5.0-15.0' bgs)			
<u>- 20</u> -	<u>- 565</u>							End of boring 20.0' bgs.	poring 20.0' bgs.				
ARCADIS Design & Consultancy for natural and built assets								Remarks: bgs = below ground surface btoc = below top of casing Air Knife to 6.0' bgs. Groundwater encountered at 5.0' bg Water level at development was 7.4 No odor or staining observed. Groundwater elevation measured o RCADIS_Analytical Boring-Well 2013_New Logo	5' btoc.				

Date Dril Dril Dril San Rig Wat	e Fini ling C ler's I ling M npling Type cer Le	sh: 10 Compa Name: Methoo g Meth : Soni vel St	14/15 0/14/1{ any: M : Dan d: Air nod: (c c cart (ft. nish (f	Aateco Moure Knife/S Contine	er Sonic uous : 5.0	-		Northing: 645409.39 Easting: 12624188.85 Casing Elevation: 587.43Well/Boring ID: BCC MW-15007 Client: Consumers EnergyBorehole Depth (ft. bgs.): 20.0 Surface Elevation: 584.5Location: BC Cobb Facility 151 N Causeway St. Muskegon, MIDescriptions By: A. WesthuisWeather Conditions: 50 F Cloudy		
DEPTH (feet bgs.)	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	(jt pds:) Water Level (ft bds:) Construction	
-	- - 585 -								TOC Elevatio = 587.43 (ft. above msl)	
		1	0.0- 10.0'	2.0	NA			(0.0 - 0.1') GRASS and TOPSOIL. (0.1 - 10.0') SAND, very fine to fine, subround; trace granules to sam subround; little to trace silt; well sorted; moist to wet; brown (10YR 5/		
- 10	575 -		CA	DIS	S Des for bui	sign & Co natural a lt assets	sultancy	Remarks: bgs = below ground surface btoc = below top of casing Air Knife to 9.0' bgs. Groundwater encountered at 5.0' bg Water level at development was 6.7 No odor or staining observed.	gs during drilling.	

Date Dril Dril Dril San Rig Wat	e Fini ling C ler's l ling M npling Type ter Le	Compa Name: Methoo g Meth : Sonio evel St	D/14/15 any: M : Dan d: Air nod: (c art (ft.	lateco Moure Knife/S Continu bgs.)	Sonic uous			Northing: 645409.39 Easting: 12624188.85 Casing Elevation: 587.43Well/Boring ID: BCC MW-1 Client: Consumers EnergyBorehole Depth (ft. bgs.): 20.0 Surface Elevation: 584.5 Descriptions By: A. WesthuisLocation: BC Cobb Facility 151 N Causeway St. Muskegon, MIWeather Conditions: 50 F Clope			ners Energy Cobb Facility N Causeway St. kegon, MI
DEPTH (feet bgs.) ELEVATION Sample Run Number Sample/Int/Type Recovery (feet) PID Headspace (ppm) PID Headspace (ppm) Analytical Sample Geologic Column Udater Level (ft. bgs.)									Well/Boring Construction		
- - 15 - -	- 570 - - - 565 -	2	10.0-20.0'	8.0	NA			(11.7 - 12.5') SAND, very fine to fine, subround; little silt; poorly sorter brown (10YR 6/3). NOTE: Organic rich matter roots and wood; dark brown (10YR 3/3) f 12.5' bgs. (12.5 - 20.0') SAND, fine to medium; little very fine sand, subround; tr sorted; wet; light brownish gray (10YR 6/2). NOTE: Organic matter wood; dark brown (10YR 3/3) from 19.5 to 20 End of boring 20.0' bgs.	rom 12.0 to		
- 25								Remarks: bgs = below ground surface btoc = below top of casing			
ARCADIS Design & Consultancy for natural and built assets								Water level at development was 6.7 No odor or staining observed.	Groundwater encountered at 5.0' bgs during drilling. Water level at development was 6.78' btoc.		

Date: 2/8/2016 Created/Edited by: C. Jeffers

Data File: BCC-MW-15007.dat

Dat Dril Dril Dril Sar Rig Wa	e Fini Iling C Iler's I Iling M npling Type ter Le	Compa Name: Method g Meth : Soni evel St	0/14/18 any: M : Dan d: Air nod: (/lateco Moure Knife/: Contin	er Sonic uous : 4.5	-		Northing: 645340.01 Easting: 12623510.47 Casing Elevation: 587.76 Borehole Depth (ft. bgs.): 20.0 Surface Elevation: 584.8 Descriptions By: A. Westhuis	BCC MW-15008 ers Energy bbb Facility Causeway St. egon, MI ions: 60 F Partly 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
-											TOC Elevation = 587.76 (ft. above msl)
- 5	580 -	1	0.0- 10.0'	3.0	NA			(0.0 - 0.1') LANDSCAPING STONE. (0.1 - 9.5') SAND, fine to very fine, subround; trace granules to smal subround; little silt; well sorted; moist to wet; brown (10YR 5/3). NOTE: Wet at 4.5' bgs.	l pebble,		Concrete (0.0- 1.0' bgs) 2" PVC Well Casing (-3.0- 4.0' bgs) Bentonite Pellets (1.0-3.0' bgs) Sand Pack K&E WP1 (3.0-20.0' bgs) 2" PVC 10 Slot Well Screen (4.0-9.0' bgs)
- 10	575 -					-		(9.5 - 12.0') SAND, fine, little medium sand, subround; little to trace s wet; grayish brown (10YR 5/2).	silt; well sorted;		
								Remarks: bgs = below ground surface btoc = below top of casing Air Knife to 8.0' bgs. Groundwater encountered at 4.5' bg Water level at development was 7.1 No staining observed. Groundwater elevation measured o Groundwater elevation measured o	1' btoc.	-	15 was 580.99 feet Page: 1 of 2

Dat Dril Dril Dril San Rig Wat	e Fini ling C ler's l ling M npling Type ter Le	Compa Name: Methoo g Meth e: Soni- evel St	0/14/15 any: M : Dan d: Air hod: (lateco Moure Knife/S Continu bgs.)	er Sonic uous : 4.5	-		Easting: 12623510.47Client: CorCasing Elevation: 587.76Client: CorBorehole Depth (ft. bgs.): 20.0Location: fSurface Elevation: 584.8IDescriptions By: A. WesthuisI			g ID: BCC MW-15008 nsumers Energy BC Cobb Facility I51 N Causeway St. Muskegon, MI onditions: 60 F Partly 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		
- - 15	- 570 -	2	10.0-20.0'	9.0	NA			 (12.0 - 13.0') SAND, fine, little medium sand, subround; little to some sorted; wet; dark grayish brown (10YR 4/2). NOTE: wood fragments (10YR 3/1), slight odor at 12.0' bgs. (13.0 - 13.5') CLAY and SILT, low plasticity, no dilatancy; little to tract fine sand, subround; soft; dark brown (10YR 3/3). NOTE: little organ roots. (13.5 - 15.5') SAND, fine, subround; some silt; poorly sorted; wet; br NOTE: trace organics. 					
-	- - 565 -		20.0					(15.5 - 20.0') SAND, fine to medium; trace silt; well sorted; wet; gray (10YR 5/2).	rish brown				
- 20 -	-							End of boring 20.0' bgs.					
- 25	- -												
Proje	Remarks: bgs = below ground surface btoc = below top of casing Air Knife to 8.0' bgs. Groundwater encountered at 4.5' bgs during drilling. Water level at development was 7.11' btoc. No staining observed. Groundwater elevation measured on November 30, 2015 was 580.99 feet roject: DE000722.0004.00006 Template: ARCADIS_Analytical Boring-Well 2013_New Logo Page: 2 of 2 roject: DE000722.0004.00006 Template: ARCADIS_Analytical Boring-Well 2013_New Logo Page: 2 of 2 roject: DE000722.0004.00006 Template: 2/8/2016 Created/Edited by: C. Jeffers												

Dat Dri Dri Dri Sar Rig Wa	e Fini Iling C Iler's I Iling M npling Type ter Le	ish: 10 Compa Name Metho g Meth e: Soni evel St	(14/15 0/14/15 any: M : Dan d: Air nod: (c c tart (ft. nish (f	Mateco Moure Knife/S Continu bgs.)	er Sonic uous : 0.5	-		Northing: 645606.92 Easting: 12623622.98 Casing Elevation: 589.27 Borehole Depth (ft. bgs.): 24.0 Surface Elevation: 586.3 Descriptions By: A. Westhuis	Client: Con	nsur BC (151 Mus	D: BCC MW-15009 mers Energy Cobb Facility N Causeway St. skegon, MI ditions: 60 F Partly 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	
-	590 — — —										TOC Elevation = 589.27 (ft. above msl)	
- 0								(0.0 - 8.0') NO RECOVERY, soils not logged, air knife soil cuttings d approved area.	isposed in CE		Concrete (0.1	0-
- 5		1	0.0-	0.0	NA			NOTE: Wet at 4.5' bgs.			2" PVC Well Casing (-3.0- 14.0' bgs) Bentonite/Ce Grout (1.0- 11.0' bgs)	-
-	_	2	8.0- 10.0'	2.0	NA	-	× × × × × × × ×	(8.0 - 10.0') ASH, rapid dilatancy; wet; soft; very dark gray (10YR 3/ material. Little to trace organic matter; roots and wood fragments.	1). NOTE: Fill	-		
- 10								(10.0 - 12.0') CLAY and SILT, low plasticity, no dilatancy; some to lit fine sand, subround; soft; dark brown (10YR 3/3).	tle very fine to			
						i <mark>ign & Co</mark> natural a It assets	nsultancy nd	Remarks: bgs = below ground surface btoc = below top of casing Air Knife to 8.0' bgs. Groundwater encountered at 0.5' by Water level at deveopment was 7.5 No odor or staining observed. Groundwater elevation measured o RCADIS_Analytical Boring-Well 2013_New Logo	1' btoc.	-	2015 was 581.88 feet Page: 1 of 2	

Date Dril Dril Dril San Rig Wat	e Fini ling C ler's I ling M npling Type er Le	ish: 1 Compa Name Jetho g Meti g Soni evel St	(14/15 0/14/15 any: M : Dan d: Air nod: (c tart (ft. nish (f	lateco Moure Knife/S Continu bgs.)	er Sonic Jous : 0.5	-		Northing: 645606.92 Easting: 12623622.98 Casing Elevation: 589.27 Borehole Depth (ft. bgs.): 24.0 Surface Elevation: 586.3 Descriptions By: A. Westhuis	Well/Boring ID: BCC MW-15009 Client: Consumers Energy Location: BC Cobb Facility 151 N Causeway St. Muskegon, MI Weather Conditions: 60 F Partly 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	
-	575 -	3	10.0- 15.0'	4.0	NA			(12.0 - 17.2') SAND, fine, subround; litle silt; well sorted; wet; brown NOTE: Some clay, low plasticity, no dilatancy; soft; dark brown (10)		Bentonite Pellets (11.0- 13.0' bgs)	
- 15	- 570 -	4	15.0- 20.0'	5.0	NA			NOTE: Some organic rich matter, roots and wood; wet; very dark br from 17.0 to 17.2' bgs. (17.2 - 24.0') CLAY and SILT, low plasticity, no dilatancy; little to trac fine sand, subround; soft; dark brown (10YR 3/3). NOTE: little orga roots.	ce very fine to	Sand Pack K&E WP1 (13.0- 24.0 bgs) 2" PVC 10 Slot Well Screen (14.0-24.0' bgs)	
-	20 565 - 5 20.0- 24.0' 4.0 NA							End of boring 24.0' bgs.			
- 25	-										
Project: DE000722.0004.00006 Template: ARC								Remarks: bgs = below ground surface btoc = below top of casing Air Knife to 8.0' bgs. Groundwater encountered at 0.5' bg Water level at deveopment was 7.5 No odor or staining observed. Groundwater elevation measured o	1' btoc.		

Date Drill Drill San Rig Wat	ate Start: 10/14/15 ate Finish: 10/15/15 rilling Company: Mateco Drilling riller's Name: Dan Mourer rilling Method: Air Knife/Sonic ampling Method: Continuous ig Type: Sonic /ater Level Start (ft. bgs.): 0.3 /ater Level Finish (ft. btoc.): 6.93Northing: 645690.69 Easting: 12623979.47 Casing Elevation: 588.11Well/Boring ID: BCC MW-15010 Client: Consumers Energy Location: BC Cobb Facility 151 N Causeway St. Muskegon, MIVater Level Start (ft. bgs.): 0.3 /ater Level Finish (ft. btoc.): 6.93Borehole Depth (ft. bgs.): 24.0 											
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/Borin Construct	-
-												 TOC Elevation = 588.11 (ft. above msl)
-	- 585							(0.0 - 0.3') STONE, parking lot aggregate. (0.3 - 10.0') ASH, some fine sand, subround; little granules to small p subround; wet; soft; very dark gray (10YR 3/1). NOTE: Fill material.	pebble			 — Concrete (0.0- 1.0' bgs) — 2" PVC Well
- 5	580 -	1	0.0-10.0'	3.0	NA		· · · · · · · · · · · · · · · · · · ·					Casing (-3.0- 12.0' bgs) Bentonite/Cemem Grout (1.0-9.0' bgs)
- 10	575 -					-	×	(10.0 - 24.0') SAND, very fine to fine; trace to little medium sand, sub silt; well sorted; wet; grayish brown (10YR 5/2).	pround; trace			 Bentonite Pellets (9.0- 11.0' bgs)
C) /	R	CA	DIS	S for buil	s <mark>ign & Co</mark> natural a It assets	nsultancy nd	Remarks: bgs = below ground surface btoc = below top of casing Air Knife to 8.0' bgs. Groundwater encountered at 0.3' bg Water level at development was 6.9 No odor or staining observed. Groundwater elevation measured or	3' btoc.	-		et ge: 1 of 2

Dat Dril Dril Dril Sar Rig Wat	e Fini ling C ler's l ling M npling Type ter Le	ish: 1 Compa Name Metho g Meth s: Soni evel St	(14/15 0/15/15 any: M : Dan d: Air nod: (c tart (ft. nish (f	Mateco Moure Knife/S Contine bgs.)	er Sonic uous : 0.3			Northing: 645690.69 Easting: 12623979.47 Casing Elevation: 588.11 Borehole Depth (ft. bgs.): 24.0 Surface Elevation: 585.2 Descriptions By: A. Westhuis	Client: Consur Location: BC 151 Mus	
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
- - - - - - - - - - - - - - - - - - -		2	10.0- 20.0' 20.0- 24.0'	8.0	NA			NOTE: Little silt and organic matter near 17.0' bgs.		Sand Pack K&E WP1 (11.0- 22.0' bgs) 2' PVC 10 Slot Well Screen (12.0-22.0' bgs)
	_							End of boring 24.0' bgs.		
- 25	560 -									
Proje	ect: DI	E0007	22.000 MW-15	04.000	06 T			Remarks: bgs = below ground surface btoc = below top of casing Air Knife to 8.0' bgs. Groundwater encountered at 0.3' bg Water level at development was 6.9 No odor or staining observed. Groundwater elevation measured o RCADIS_Analytical Boring-Well 2013_New Logo Date: 2/8/2016 Created/Edited by: C. Sector	3' btoc. n November 30, 2	2015 was 581.42 feet Page: 2 of 2

Dat Dril Dril Dril Sar Rig Wat	e Fini ling C ler's l ling M npling Type ter Le	ish: 1 Compa Name Jetho g Meti s: Soni evel St	(15/15 0/15/15 any: M : Dan d: Air nod: (c c tart (ft. nish (f	lateco Moure Knife/S Continu bgs.)	er Sonic Jous : 6.5	-		Northing: 64578029 Easting: 12623765.87 Casing Elevation: 595.22 Borehole Depth (ft. bgs.): 32.0 Surface Elevation: 592.3 Descriptions By: A. Westhuis	Client: Cor	Well/Boring ID: BCC MW-15011 Client: Consumers Energy Location: BC Cobb Facility 151 N Causeway St. Muskegon, MI Weather Conditions: 60 F Partly 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		
-	 595 -										TOC Elevation = 595.22 (ft. above msl)		
-	- 590 -						× × × × × × × × × × × × × × × × × × ×	(0.0 - 0.1') GRASS, ROOTS and ASH. (0.1 - 18.0') ASH, non-plastic, rapid dilatancy, little fine sand, subrou sorted; soft; wet; gray (10YR 5/1) to dark gray (10YR 4/1). NOTE:	/ und; poorly Fill material.		Concrete (0.0- 1.0' bgs)		
- 5	_ 585 _ _	1	0.0-	3.0	NA		× × × × × × × × × × × ×	NOTE: Wet at 6.5' bgs.			AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA		
- 10 - - -	- 580 - -						× × × × × × × × × × × × × × × × × × ×	NOTE: Laminated from 13.5 to 15.0' bgs.			21.0' bgs) Bentonite/Cemerr Grout (1.0- 18.0' bgs)		
•			10.0- 20.0'					Remarks: bgs = below ground surface btoc = below top of casing Air Knife to 9.0' bgs. Groundwater encountered at 6.5' b Water level at development was 13 No staining observed. Groundwater elevation measured of RCADIS_Analytical Boring-Well 2013_New Logo	.03' btoc.	-	2015 was 582.13 feet Page: 1 of 2		

Dat Dril Dril Dril Sar Rig Wa	e Fini lling C ller's I lling N npling Type ter Le	ish: 10 Compa Name Jetho g Meth s: Soni evel St	15/15 0/15/15 any: M : Dan d: Air nod: C c c c c art (ft.	lateco Moure Knife/S Contine bgs.)	er Sonic uous : 6.5	-		Northing: 64578029 Easting: 12623765.87 Casing Elevation: 595.22 Borehole Depth (ft. bgs.): 32.0 Surface Elevation: 592.3 Descriptions By: A. Westhuis	Client: Cons Location: B 1! M	ell/Boring ID: BCC MW-15011 ient: Consumers Energy pocation: BC Cobb Facility 151 N Causeway St. Muskegon, MI eather Conditions: 60 F Partly Cloudy					
DEPTH (feet bgs.)	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description		Well/Boring Construction					
-	_ 575 _ _						$\times \times $	(18.0 - 19.0') CLAY and SILT, medium to high plasticity, no dilatancy; soft; moist; dark brown (10YR 3/3). NOTE: organic rich, some wood slight odor. (19.0 - 26.0') SAND, fine, subround; some to little silt; well sorted; we gray (10YR 6/2).	and roots;	Bentonite Pellets (18.0- 20.0' bgs)					
- 20	_ 570 — _														
- 25 - -	_ 565 — _	3	20.0- 32.0'	9.0	NA			(26.0 - 27.0') SAND, fine, little medium sand, subround; little silt; poor dark grayish brown (10YR 4/2). NOTE: organic rich, some roots and (27.0 - 32.0') SAND, fine, little very fine sand, subround; trace silt; we light brownish gray (10YR 6/2).	l wood.	Sand Pack K&E WP1 (20.0- 32.0' bgs) 2" PVC 10 Slot Well Screen (21.0-31.0' bgs)					
- 30	- 560 -							End of boring 32.0' bgs.							
- 35	_							Remarks: bgs = below ground surface btoc = below top of casing							
								Air Knife to 9.0' bgs. Groundwater encountered at 6.5' bg Water level at development was 13. No staining observed. Groundwater elevation measured or RCADIS Analytical Boring-Well 2013 New Logo	03' btoc.						

Date Finish: 10/15/15Easting: 12623545.99ClientDrilling Company: Mateco DrillingCasing Elevation: 597.39ClientDriller's Name: Dan MourerBorehole Depth (ft. bgs.): 35.0LocaDrilling Method: Air Knife/SonicBorehole Depth (ft. bgs.): 35.0LocaSampling Method: ContinuousSurface Elevation: 594.5Vater Level Start (ft. bgs.): 8.0Water Level Start (ft. bgs.): 8.0Descriptions By: A. Westhuis									Client: Con Location: E 1 N	Well/Boring ID: BCC MW-15012 Client: Consumers Energy Location: BC Cobb Facility 151 N Causeway St. Muskegon, MI Weather Conditions: 60 F Partly 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		
-	- - 595 -										TOC Elevation = 597.39 (ft. above msl)		
		1	0.0- 10.0'	3.0	NA			(0.0 - 0.1') GRASS, ROOTS and ASH. (0.1 - 9.0') SAND, fine, subround, and ASH; little silt; poorly sorted; w grayish brown (10YR 4/2). NOTE: Wet at 8.0' bgs. (9.0 - 18.0') ASH, little fine sand, subround; non-plastic, rapid dilatar sorted; wet; soft; gray (10YR 5/1). NOTE: Fill material.			Concrete (0.0- 1.0' bgs)		
- 10 - - - - 15	- - 580 -	2	10.0- 20.0'	9.0	NA		× × × × × × × × × × × × × × × × × × ×	NOTE: Laminated from 13.0-15.0' bgs.			Bentonite/Cemerr Grout (1.0- 18.0' bgs)		
								Remarks: bgs = below ground surface btoc = below top of casing Air Knife to 9.0' bgs. Groundwater encountered at 8.0' bg Water level at development was 13 No staining observed. Groundwater elevation measured o RCADIS_Analytical Boring-Well 2013_New Logo Date: 2/8/2016 Created/Edited by: C.	79' btoc. n November 3	-	015 was 583.46 feet Page: 1 of 2		

Dat Dril Dril Dril Sar Rig Wat	e Fini lling C ller's I lling N npling Type ter Le	Compa Name Metho g Meth c: Soni evel St	0/15/15 any: M : Dan d: Air nod: (lateco Moure Knife/S Continu bgs.)	er Sonic uous : 8.0	-		Northing: 645889.92 Easting: 12623545.99 Casing Elevation: 597.39 Borehole Depth (ft. bgs.): 35.0 Surface Elevation: 594.5 Descriptions By: A. Westhuis	Client: Cor	Well/Boring ID: BCC MW-15012 Client: Consumers Energy Location: BC Cobb Facility 151 N Causeway St. Muskegon, MI Weather Conditions: 60 F Partly 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	_ 						× × ×	(18.0 - 19.0') CLAY and SILT, medium plasticity, no dilatancy; moist soft; dark brown (10YR 3/3). NOTE: organic rich; some wood and r odor. (19.0 - 30.0') SAND, fine, subround; little silt; well sorted; wet; light b (10YR 6/2). NOTE: trace organics; dark brown (10YR 3/3).	oots; slight		Bentonite Pellets (18.0- 20.0' bgs)					
25			20.0-25.0'	5.0	NA						Sand Pack K&E					
	- - 565 -	3	25.0- 30.0	5.0	NA					_	WP1 (20.0- 35.0' bgs) 2" PVC 10 Slot Well Screen (21.0-31.0' bgs)					
-	- - 560 -		30.0- 35.0	5.0	NA			(30.0 - 35.0') SAND, fine, subround; little silt; well sorted; wet; light b (10YR 6/2).	rownish gray							
Proje	35 End of boring 35.0' bgs. 35 End of boring 35.0' bgs. Air Knife to 9.0' bgs. Air Knife to 9.0' bgs. Groundwater encountered at 8.0' bgs during drilling. Water level at development was 13.79' btoc. No staining observed. Groundwater elevation measured on November 30, 2015 was 583.46 feet															

 Project:
 DE000722.0004.00006
 Template:
 ARCADIS_Analytical Boring-Well 2013_New Logo

 Data
 File:
 BCC-MW-15012.dat
 Date:
 2/8/2016
 Created/Edited by:
 C. Jeffers

Dat Dri Dri Dri Sar Rig Wa	Date Start: 10/15/15 Northing: 645716.41 Well/Boring ID: BCC MW-15013 Date Finish: 10/16/15 Easting: 12623389.21 Client: Consumers Energy Driller's Name: Dan Mourer Dorible Sonic Borehole Depth (ft. bgs.): 40.0 Location: BC Cobb Facility Date Finish: 10/16/15 Borehole Depth (ft. bgs.): 40.0 Location: BC Cobb Facility 151 N Causeway St. Drilling Method: Continuous Surface Elevation: 595.9 Muskegon, MI Water Level Start (ft. bgs.): 9.5 Descriptions By: A. Westhuis Weather Conditions: 60 F Partly Cloudy										ners Energy Cobb Facility N Causeway St. kegon, MI
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
-	-										TOC Elevation = 598.50 (ft. above msl)
- - - - - - -	595 - - - - - - 590 - - - - - -	1	0.0- 10.0'	5.0	NA			(0.0 - 0.1') GRASS, ROOTS and ASH. (0.1 - 9.5') SAND, fine, subround, and ASH; poorly sorted; moist; yel (10YR 5/6) to dark yellowish brown (10YR 3/6).	lowish brown		Concrete (0.0- 1.0' bgs)
- 10 - - - 15 - - - 20		2	10.0-20.0'	9.0	NA	-		(9.5 - 10.5') ASH, little fine sand, subround; non-plastic, rapid dilatar sorted; wet; soft; gray (10YR 5/1) to dark gray (10YR 4/1). NOTE: F (10.5 - 13.5') SAND, fine to medium, and ASH; trace coarse sand, s sorted; moist to wet; dark yellowish brown (10YR 4/4) to brown (10Y (13.5 - 28.0') ASH; little fine sand, subround; non-plastic, rapid dilata sorted; wet; very soft; gray (10YR 5/1) to grayish brown (10YR 5/2).	ill material. Jbround; poorly R 4/3).		2" PVC Well Casing (-3.0- 30.0' bgs) Bentonite/Cemem Grout (1.0- 27.0' bgs)
							nsultancy nd	Remarks: bgs = below ground surface Air Knife to 9.0' bgs. Groundwater encountered at 9.5' bg Water level at development was 16 No odor or staining observed. Groundwater elevation measured o above mean sea level. RCADIS_Analytical Boring-Well 2013_New Logo Date: 2/8/2016 Created/Edited by: C	38' btoc. n November 3	-	015 was 582.33 feet Page: 1 of 2

Dat Dril Dril Dril Sar Rig Wa	Date Start: 10/15/15 Northing: 645716.41 Well/Boring ID: BCC MW-15013 Date Finish: 10/16/15 Easting: 12623389.21 Client: Consumers Energy Driller's Name: Dan Mourer Borehole Depth (ft. bgs.): 40.0 Location: BC Cobb Facility Drilling Method: Air Knife/Sonic Borehole Depth (ft. bgs.): 40.0 Location: BC Cobb Facility Sampling Method: Continuous Surface Elevation: 595.9 Location: BC Cobb Facility Notter Level Start (ft. bgs.): 9.5 Descriptions By: A. Westhuis Weather Conditions: 60 F Partly 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
-	-		20.0- 25.0'	4.0	NA		× × × × ×				
- 25 - - - - -	570 - - - -	3	25.0- 30.0	5.0	NA		× × × × × ×	(28.0 - 36.0') SAND, fine, trace medium sand, subround; trace silt; we light gray (10YR 7/2) to very pale brown (10YR 7/3).	ell sorted; wet;	-	Bentonite Pellets (27.0- 29.0' bgs)
35	565 - - -		30.0- 35.0	5.0	NA						Sand Pack K&E WP1 (29.0-
-	560 - - -		35.0- 40.0	4.0	NA			 (36.0 - 36.5') SAND, fine, subround; trace silt and organics; light gray dark yellowish brown (10YR 4/4). NOTE: some leaves and small still (36.5 - 37.5') CLAY and SILT, low plasticity to non-plastic, no dilatane medium stiff; dark brown (10YR 3/3). NOTE: some organics, leaves wood. (37.5 - 40.0') SAND, fine, subround; trace silt; well sorted; wet; light gray and subround; trace silt; well sorted; well; light gray and subround; trace silt; well sorted; well; light gray and subround; trace silt; well sorted; well; light gray and subround; trace silt; well sorted; well; light gray and subround; sorted; well; light gray and subround; so the subround; so th	cks. cy; moist; , roots and		40.0' bgs) 2" PVC 10 Slot Well Screen (30.0-40.0' bgs)
- 40 - -	555 - -							End of boring 40.0' bgs.			
- - 45 -	- 550 -										
			CA					Remarks: bgs = below ground surface Air Knife to 9.0' bgs. Groundwater encountered at 9.5' bg Water level at development was 16. No odor or staining observed. Groundwater elevation measured or above mean sea level. RCADIS_Analytical Boring-Well 2013_New Logo	38' btoc.		2015 was 582.33 feet Page: 2 of 2

Dat Dri Dri Dri Sat Rig Wa	te Fini Iling C Iler's I Iling M mpling Type Iter Le	Compa Name Metho g Meth s: Soni evel St	0/16/18 any: M : Dan d: Air nod: (Mateco Moure Knife/S Continu bgs.)	er Sonic Jous : 14.0)		Northing: 645925.93 Easting: 12623318.73 Casing Elevation: 599.04 Borehole Depth (ft. bgs.): 40.0 Surface Elevation: 596.2 Descriptions By: A. Westhuis	Well/Boring ID: BCC MW-15014 Client: Consumers Energy Location: BC Cobb Facility 151 N Causeway St. Muskegon, MI Weather Conditions: 60 F Partly Cloudy	
DEPTH (feet bgs.)	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Mater Level (ft. bgs.) Construction	
-	600 — — —								TOC Eleva = 599.04 (t above ms)	ft.
	- 595 - - - - - 590 - - - - - -	. 1	0.0- 10.0'	3.0	NA			(0.0 - 0.1') GRASS, ROOTS and ASH. (0.1 - 14.0') SAND, fine to medium, subround, and ASH; poorly sort wet; brown (10YR 5/3) to dark grayish brown (10YR 4/2). NOTE: Fill	ill material.	
- 15		2	10.0-20.0'	9.0	NA	-		 (14.0 - 14.5') ASH, little fine sand, subround; non-plastic, rapid dilata sorted; wet; soft; very dark grayish brown (10YR 5/2) to dark gray (1 NOTE: Fill material. Little to trace organics; roots. (14.5 - 17.5') ASH, non-plastic, rapid dilatancy; poorly sorted; wet; so (10YR 4/1). NOTE: Fill material. (17.5 - 20.0') ASH, non-plastic, rapid dilatancy; poorly sorted; wet; so brown (10YR 5/2) to dark gray (10YR 4/1). NOTE: Fill material, lam (20.0 - 27.0') SAND, fine, subround; trace silt; well sorted; wet; light 	tancy: poorly 10YR 4/1). soft; dark gray	.0- Cemem
			CA					(10YR 6/2). NOTE: Organic rich matter, roots, leaves; dark brown (10YR 3/3) fro bgs. Remarks: bgs = below ground surface btoc = below top of casing Air Knife to 9.25' bgs. Groundwater encountered at 14.0' I Water level at development was 15 No odor or staining observed.	bgs during drilling.	1.0-

Dat Drii Drii Drii Sar Rig Wa	te Fini Iling C Iler's I Iling M mpling Type ter Le	Compa Name Metho g Meth e: Soni evel St	0/16/18 any: M : Dan d: Air nod: (lateco Moure Knife/S Continu bgs.)	er Sonic Jous : 14.0)		Northing: 645925.93 Easting: 12623318.73 Casing Elevation: 599.04 Borehole Depth (ft. bgs.): 40.0 Surface Elevation: 596.2 Descriptions By: A. Westhuis	Client: Cons Location: B 1: M	ng ID: BCC MW-15014 Insumers Energy BC Cobb Facility 151 N Causeway St. Muskegon, MI Conditions: 60 F Partly Cloudy
DEPTH (feet bgs.)	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description		Mater Level (ft. bgs.) Construction
- - 25 - - - -	- - 570 - - -	3	20.0- 30.0'	8.0	NA			(27.0 - 31.0') SAND, fine, subround; some silt; little clay; poorly sorter brownish gray (10YR 6/2). NOTE: little to some organics, roots and to 27.1' bgs and at 30.0' bgs.	d; wet; light wood from 27.0	Sand Pack K&E WP1 (22.0- 40.0' bgs) 2" PVC 10 Slot Well Screen (23.0-31.0' bgs)
- 35		4	30.0- 40.0	9.0	NA			 (31.0 - 34.0') SAND and SILT; trace clay; non-plastic, rapid dilatancy; sorted; soft; dark grayish brown (10YR 4/2). NOTE: rich organic lay; and wood. (34.0 - 36.0') SAND, fine, subround; little silt; well sorted; wet; light br (10YR 6/2). (36.0 - 37.5') SAND, fine, and ORGANICS; poorly sorted; wet; dark b 3/3) to light gray (10YR 7/2). (37.5 - 39.0') SAND, fine, subround; well sorted; wet; light brownish g (39.0 - 40.0') CLAY and SILT, low plasticity to non-plastic, no dilatance medium stiff; dark brown (10YR 3/3). End of boring 40.0' bgs. 	r; some roots ownish gray rown (10YR gray (10YR 6/2).	
			CA					Remarks: bgs = below ground surface btoc = below top of casing Air Knife to 9.25' bgs. Groundwater encountered at 14.0' b Water level at development was 15. No odor or staining observed. Groundwater elevation measured or RCADIS Analytical Boring-Well 2013 New Logo	50' btoc.	

Dat Dril Dril Dril Sar Rig Wa	e Fini lling C ller's I lling N npling Type ter Le	Compa Name: Methoo g Meth e: Soni evel St	0/19/18 any: M : Dan d: Air nod: (Aateco Moure Knife/S Contine	er Sonic uous : 8.5			Northing: 646138.93 Easting: 12623024.09 Casing Elevation: 596.75 Borehole Depth (ft. bgs.): 30.0 Surface Elevation: 593.9 Descriptions By: A. Westhuis	Client: Cons Location: B(15 M	ID: BCC MV sumers Energy C Cobb Facility 51 N Causeway uskegon, MI nditions: 60 F	, ⁄ St.
DEPTH (feet bgs.)	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Motor Loval (# hac)	ע	ell/Boring onstruction
-	- 595 -										TOC Elevation = 596.75 (ft. above msl)
- 0 	- - - - - - - - - - - - - - - - - - -	- - - - -	0.0-10.0'	2.0	NA		× × × × × × × × × × × × × × × × × × ×				Concrete (0.0- 1.0' bgs) 2" PVC Well Casing (-3.0- 20.0' bgs) Bentonite/Cemem Grout (1.0- 17.0' bgs)
Proje	ect: DI	E0007	CA	04.000	06 T			NOTE: Wood fragments at 14.0' bgs. Remarks: bgs = below ground surface btoc = below top of casing Air Knife to 8.5' bgs. Groundwater encountered at 8.5' b Water level at development was 12 No odor or staining observed. Groundwater elevation measured of RCADIS_Analytical Boring-Well 2013_New Logo Date: 2/8/2016 Created/Edited by: C.	16' btoc. on November 30		0.81 feet Page: 1 of 2

Date Drill Drill San Rig Wat	e Fini ling C ler's I ling M npling Type cer Le	ish: 1 Compa Name Metho g Metho e: Soni evel St	(16/15 0/19/15 any: M : Dan d: Air nod: (c c tart (ft. nish (f	lateco Moure Knife/S Continu bgs.)	er Sonic Jous : 8.5	-		Northing: 646138.93 Easting: 12623024.09 Casing Elevation: 596.75 Borehole Depth (ft. bgs.): 30.0 Surface Elevation: 593.9 Descriptions By: A. Westhuis	Client: Con Location: E 1 N	Sumers 3C Cobb 51 N Ca Juskego	o Facility auseway St.
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
- 15 - - - 20 - - - - 25 - - - - - - - - - - - - - - - - - - -	- - - - - - - - - - - - - - - - - - -	2	10.0- 20.0'	9.0	NA			 (14.0 - 17.0') SAND, fine, subround; well sorted; wet; light brownish NOTE: light yellowish brown (10YR 6/4) from 14.0-16.0' bgs; pale 6/3) from 1617.0' bgs. (17.0 - 19.0') FILL material, wood fragments; brown (10YR 4/3) to ve (10YR 2/2). (19.0 - 29.0') SAND, fine, subround; trace silt; well sorted; wet; light (10YR 6/4). NOTE: Little clay and silt at 27.0' bgs. (29.0 - 29.5') CLAY and SILT, low to medium plasticity, no dilatancy, subround; moist; medium stiff; brown (10YR 4/3). NOTE: organic ri 29.5' bgs. (29.5 - 30.0') SAND, fine, subround; trace silt; well sorted; wet; light (10YR 6/4). 	brown (10YR ery dark brown brownish gray		Bentonite Pellets (17.0- 19.0' bgs) Sand Pack K&E WP1 (19.0- 30.0' bgs) 2" PVC 10 Slot Well Screen (20.0-30.0' bgs)
Proje	ct: DI	E0007	22.000 MW-15	4.000	06 T			Remarks: bgs = below ground surface btoc = below top of casing Air Knife to 8.5' bgs. Groundwater encountered at 8.5' bg Water level at development was 12 No odor or staining observed. Groundwater elevation measured o RCADIS_Analytical Boring-Well 2013_New Logo Date: 2/8/2016 Created/Edited by: C	.16' btoc.	-	was 580.81 feet Page: 2 of 2

Da Dri Dri Dri Sa Rig Wa	te Fini Iling (Iler's Iling M mpling Type ater Le	Compa Name Metho g Meth e: Soni evel St	0/19/18 any: M : Dan d: Air nod: (/lateco Moure Knife/S Continu bgs.)	er Sonic Jous : 8.5	-		Northing: 646227.56 Easting: 12622459.26 Casing Elevation: 589.05 Borehole Depth (ft. bgs.): 45.0 Surface Elevation: 586.2 Descriptions By: A. Westhuis	Well/Boring ID: BCC MV Client: Consumers Energy Location: BC Cobb Facility 151 N Causewa Muskegon, MI Weather Conditions: 60 F	/ y St.
DEPTH (feet bgs.)	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	l d l	/ell/Boring onstruction
-	- 590 - -									TOC Elevation = 589.05 (ft. above msl)
	- 585 - - - - 580 - - - - -	1	0.0- 10.0'	3.0	NA	_		(0.0 - 15.0') SAND, fine to medium, and ASH; little coarse, subround; moist to wet; dark grayish brown (10YR 4/2). NOTE: Fill material, tra fragments.		Concrete (0.0- 1.0' bgs)
- 15	575 - - - - 570 - - - -	2	10.0- 20.0'	10.0	NA			(15.0 - 17.0') SAND, fine, subround; little silt; well sorted; wet; light br (10YR 6/4). (17.0 - 19.0') FILL material, wood fragments; some fine sand, subrou (10YR 4/3) to very dark brown (10YR 2/2).		2" PVC Well Casing (-3.0- 35.0' bgs) Bentonite/Cemem Grout (1.0- 32.0' bgs)
- 20 - -	- 565 -					_		(19.0 - 25.0') SAND, fine, subround; some clay; some to trace silt, no dilatancy; medium stiff; well sorted; wet; light brownish gray (10YR 6/ NOTE: organic rich matter, leaves, sticks, wood; moist; dark brown (* 21.0 to 25.0' bgs.	4).	
			22.000					Remarks: bgs = below ground surface btoc = below top of casing Air Knife to 8.5' bgs. Groundwater encountered at 8.5' bg Water level at development was 8.6 No odor or staining observed. Groundwater elevation measured or RCADIS_Analytical Boring-Well 2013_New Logo	5' btoc.	0.08 feet Page: 1 of 2

Dat Dril Dril Dril Sar Rig Wat	e Fini lling C ller's I lling N npling Type ter Le	sh: 1 Compa Name Metho g Metho : Soni vel St	19/15 0/19/15 any: M : Dan d: Air nod: (c c art (ft. nish (f	Mateco Moure Knife/S Continu bgs.) :	er Sonic Jous : 8.5			Northing: 646227.56 Easting: 12622459.26 Casing Elevation: 589.05 Borehole Depth (ft. bgs.): 45.0 Surface Elevation: 586.2 Descriptions By: A. Westhuis	Well/Boring ID: BCC Client: Consumers En Location: BC Cobb Fa 151 N Caus Muskegon, I Weather Conditions:	ergy acility eway St. MI
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
- 25 - - - 30		3	20.0- 30.0'	10.0	NA	-		 (25.0 - 27.0') SAND, fine, subround; trace silt; well sorted; wet; light (10YR 6/4). (27.0 - 28.5') CLAY and SILT, low plasticity to non-plastic, no dilatal sand, subround; moist; soft; dark brown (10YR 3/3). NOTE: organ roots. (28.5 - 28.8') SAND, fine, subround; trace silt; well sorted; wet; light (10YR 6/4). (28.8 - 35.0') CLAY and SILT, low plasticity to non-plastic, no dilatal sorted; wet; light (10YR 6/4). 	brownish gray	
- - - - - - -	555 - - - - 550 - - - -	4	30.0- 40.0'	9.0	NA			sand, subround; moist; soft; dark brown (10YR 3/3). NOTE: Organ roots from 28.8 to 30.0' bgs. NOTE: Trace shell fragments at 34.0' bgs. (35.0 - 37.0') SAND, fine, subround; little silt; well sorted; wet; yellow (10YR 5/4). (37.0 - 40.5') SAND, fine, subround; trace silt; well sorted; wet; pale 6/3). NOTE: Trace small pebble, subround at 39.0' bgs.	vish brown	Bentonite Pellets (32.0- 34.0' bgs) Sand Pack K&E WP1 (34.0- 45.0' bgs) 2" PVC 10 Slot Well Screen (35.0-40.0' bgs)
- 40 - - - - - - -	545 - - - - 540 -	5	40.0- 45.0'	5.0	NA			(40.5 - 45.0') CLAY, high plasticity, no dilatancy; trace silt; moist; most; soft; gray (10YR 7/1).	edium stiff to	
			CA					Remarks: bgs = below ground surface btoc = below top of casing Air Knife to 8.5' bgs. Groundwater encountered at 8.5' b Water level at development was 8.1 No odor or staining observed. Groundwater elevation measured of RCADIS_Analytical Boring-Well 2013_New Logo	65' btoc.	s 580.08 feet Page: 2 of 2

Date: 2/8/2016 Created/Edited by: C. Jeffers

Data File: BCC-MW-15016.dat

Date Dril Dril Dril San Rig Wat	e Fini ling C ler's I ling N npling Type ter Le	Compa Name: Nethod Method Sonid Vel St Vel Fin	0/20/18 any: M : Dan d: Air nod: (Aateco Moure Knife/S Contine	er Sonic uous : 8.0 c.): 8.	-		Northing: 646354.69 Easting: 12622085.55 Casing Elevation: 588.61 Borehole Depth (ft. bgs.): 40.0 Surface Elevation: 585.7 Descriptions By: A. Westhuis	Client: Cor	BC (151 Mus	9: BCC MW-15017 ners Energy Cobb Facility N Causeway St. kegon, MI Iitions: 60 F Partly 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
- - -	-										TOC Elevation = 588.61 (ft. above msl)
- 5	585	1	0.0- 10.0'	3.0	NA			(0.0 - 11.0') SAND, fine to medium, subround, and ASH; little coarse subround; poorly sorted; moist to wet; very dark grayish brown (10YI Fill material. NOTE: Wet at 9.0' bgs; trace coal fragments.			Concrete (0.0- 1.0' bgs)
- 15	575	2	10.0- 20.0'	9.0	NA			 (11.0 - 14.0') SAND, fine, subround, and SILT; trace clay, non-plastic moist to wet; poorly sorted; soft; dark brown (10YR 3/3) to light brow 6/2). NOTE: little to trace organic matter, sticks, wood, and leaves. (14.0 - 15.0') CLAY and SILT, low plasticity to non-plastic, no dilatan sand subround; moist; soft; dark brown (10YR 3/3). (15.0 - 18.5') SAND, fine, subround; little to trace silt; well sorted; we gray (10YR 6/4). (18.5 - 20.0') FILL material, wood fragments; some fine sand, subrou (10YR 4/3) to dark brown (10YR 3/3). NOTE: Trace sticks and leaves (20.0 - 20.5') SAND, fine, subround; trace silt; well sorted; wet; pale 	nish gray (10YR cy; little fine t; light brownish und; brown es.	-	2" PVC Well Casing (-3.0- 35.0' bgs) Bentonite/Cement Grout (1.0- 32.0' bgs)
							nsultancy nd	Remarks: bgs = below ground surface Air Knife to 8.0' bgs. Groundwater encountered at 8.0' bg Water level at development was 8.5 No odor or staining observed. Groundwater elevation measured o above mean sea level. RCADIS_Analytical Boring-Well 2013_New Logo	2015 was 579.99 feet Page: 1 of 2		

Data File: BCC-MW-15017.dat

Dat Dril Dril Dril San Rig Wat	e Fini ling C ler's I ling M npling Type ter Le	Compa Name: Method g Meth : Soni evel St	0/20/15 any: M : Dan d: Air aod: C	lateco Moure Knife/S Continu bgs.) :	er Sonic Jous : 8.0			Northing: 646354.69 Easting: 12622085.55 Casing Elevation: 588.61 Borehole Depth (ft. bgs.): 40.0 Surface Elevation: 585.7 Descriptions By: A. Westhuis	Client: Con	nsu BC 151 Mus	D: BCC MW-15017 mers Energy Cobb Facility N Causeway St. skegon, MI ditions: 60 F Partly 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
- 25	565	3	20.0- 30.0'	9.0	NA			 6/3). (20.5 - 21.5') SAND, fine, subround; trace silt; trace wood; poorly sorbrown (10YR 6/3) to dark brown (10YR 3/3). NOTE: Organic rich matter, wood, sticks; dark brown (10YR 3/3) frobgs. (21.5 - 22.0') SAND, fine subround; trace silt; well sorted; wet; pale the 6/3). (22.0 - 23.5') CLAY and SILT, non-plastic, no dilatancy; little fine sarmoist; soft; brown (10YR 3/3). (23.5 - 33.0') CLAY and SILT, non-plastic, no dilatancy; some fine sarmoist; soft; brown (10YR 3/3). 	orr 21.0 to 21.5' prown (10YR nd, subround;		
- - - - - - - - - - - - -	555 - - 550 - - - - - - - - - - - - - - - - - - -	4	30.0- 40.0'	9.0	NA			NOTE: Some wood and sticks; trace shell fragments at 33.0' bgs. (33.0 - 35.0') SAND, fine, subround; trace silt; well sorted; wet; yellow (35.0 - 40.0') SAND, fine, subround; trace silt; well sorted; wet; pale 6/3). End of boring 40.0' bgs.			Bentonite Pellets (32.0- 34.0' bgs) Sand Pack K&E WP1 (34.0- 45.0' bgs) 2" PVC 10 Slot Well Screen (35.0-40.0' bgs)
	Project: DE000722.0004.00006 Template: AR						5	Remarks: bgs = below ground surface Air Knife to 8.0' bgs. Groundwater encountered at 8.0' bg Water level at development was 8.5 No odor or staining observed. Groundwater elevation measured o above mean sea level. RCADIS_Analytical Boring-Well 2013_New Logo	3' btoc.	-	2015 was 579.99 feet Page: 2 of 2

Dat Dri Dri Dri Sar Rig Wa	te Fini Iling C Iler's I Iling N npling Type ter Le	ish: 1 Compa Name Metho g Metho e: Soni evel St	/20/15 0/20/1 any: M : Dan d: Air hod: (ic tart (ft. inish (f	/lateco Moure Knife/S Contine	er Sonic uous : 8.0	-		Northing: 646789.54 Easting: 12622179.74 Casing Elevation: 592.43 Borehole Depth (ft. bgs.): 45.0 Surface Elevation: 589.4 Descriptions By: A. Westhuis	Client: Cor	nsume BC Co 151 N Muske	
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 -										TOC Elevation = 592.43 (ft. above msl)
-0	_						.	(0.0 - 0.3') STONE, aggregate for road base.	/		Concrete (0.0-
		. 1	0.0- 10.0'	3.0	NA	-	* * * * * * * * * * * * *	(0.3 - 14.0') ASH, trace to little fine sand, subround; non-plastic; slow moist to wet; soft; very dark gray (10YR 3/1). NOTE: Fill material.	v dilatancy;		1.0' bgs)
- - - - - -	_ 575 — _ _ _ _	2	10.0- 20.0'	9.0	NA			(14.0 - 23.0') SAND, fine, subround; some silt; trace granules; trace sorted; wet; light brownish gray (10YR 6/4). NOTE: Some large wo 17.5' and 20.0' bgs.	clay; poorly od fragments at		2" PVC Well Casing (-3.0- 37.5' bgs) Bentonite/Cemen
- 20	570 - -					_		NOTE: Increase in silt at 20.0' bgs			Grout (1.0- 34.5' bgs)
							••••	NOTE: Organic Rich Matter, wood, sticks, leaves; dark brown (10Yf to 23.0' bgs. Remarks: bgs = below ground surface	R 3/3) from 22.0		
			CA					btoc = below top of casing Air Knife to 8.5' bgs. Groundwater encountered at 8.0' bg Water level at development was 11 No odor or staining observed. Groundwater elevation measured o RCADIS_Analytical Boring-Well 2013_New Logo	.78' btoc.	-	5 was 580.08 feet Page: 1 of 2

Dat Dril Dril Dril Sar Rig Wa	te Fini Iling C Iler's I Iling M mpling Type ter Le	Compa Name: Methoo g Meth e: Soni evel St	0/20/18 any: M : Dan d: Air nod: (lateco Moure Knife/S Continu bgs.) :	er Sonic Jous : 8.0			Northing: 646789.54 Easting: 12622179.74 Casing Elevation: 592.43 Borehole Depth (ft. bgs.): 45.0 Surface Elevation: 589.4 Descriptions By: A. Westhuis	Well/Boring ID: BCC MW-15018 Client: Consumers Energy Location: BC Cobb Facility 151 N Causeway St. Muskegon, MI 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	Mater Level (ft. bgs.) Construction
- - - - - - - - - - 30 -	- 565 - - - - - - - - - - - - - - - - - - -	3	20.0- 30.0'	10.0	NA			 (23.0 - 25.5') SAND, fine, subround; some silt; poorly sorted; wet; ligh gray (10YR 6/4). NOTE: wood debris from 24.0 to 24.3' bgs. NOTE: Organic rich matter, wood, sticks, leaves; dark brown (10YR to 25.5' bgs. (25.5 - 27.5') SAND, fine, subround; little to some silt; well sorted; we gray (10YR 6/4). NOTE: wood debris, sticks; brown (10YR 3/3) from bgs. (27.5 - 28.0') CLAY and SILT, low plasticity to non-plastic, no dilatance sand, subround; moist; soft; dark brown (10YR 3/3). (28.0 - 30.0') SAND, fine, subround, and SILT; wet; poorly sorted; soft gray (10YR 6/4). to dark brown (10YR 3/3). NOTE: little wood debris near 29.0' bgs. (30.0 - 37.0') CLAY and SILT, low plasticity to non-plastic, no dilatance sand, subround; moist; medium stiff to soft; dark brown (10YR 3/3). (30.0 - 37.0') CLAY and SILT, low plasticity to non-plastic, no dilatance sand, subround; moist; medium stiff to soft; dark brown (10YR 3/3). (30.0 - 37.0') CLAY and SILT, low plasticity to non-plastic, no dilatance sand, subround; moist; medium stiff to soft; dark brown (10YR 3/3). 	2 3/3) from 25.0 et; light brownish m 26.0 to 26.3' icy; little fine oft; light browish s, organic rich icy; trace fine o very dark
- 35 40	555 - - - - 550 - -	4	30.0- 40.0'	10.0	NA			(37.0 - 42.5') SAND, fine, subround; well sorted; wet; very pale brown	m (10YR 7/3).
- - 	- - 545 - - - -	5	40.0- 45.0'	5.0	NA			(42.5 - 45.0') CLAY, high plasticity, no dilatancy; trace silt; moist; med soft; gray (10YR 7/1). End of boring 45.0' bgs.	(37.5-42.5' bgs
	540 - Design & Consultancy for natural and built assets								

 Project:
 DE000722.0004.00006
 Template:
 ARCADIS_Analytical Boring-Well 2013_New Logo

 Data
 File:
 BCC-MW-15018.dat
 Date:
 2/8/2016
 Created/Edited by:
 C. Jeffers

Da Dri Dri Dri Sa Riç Wa	te Fini Iling C Iler's I Iling N mpling Type iter Le	ish: 10 Compa Name Metho g Metho s: Soni svel St	(20/15 0/20/15 any: M : Dan d: Air nod: (c c tart (ft. nish (f	/lateco Moure Knife/S Contine	er Sonic uous : 7.0	-		Northing: 647103.13 Easting: 12622369.93 Casing Elevation: 592.42 Borehole Depth (ft. bgs.): 45.0 Surface Elevation: 589.4 Descriptions By: A. Westhuis	Well/Boring ID: BCC MW-15019 Client: Consumers Energy Location: BC Cobb Facility 151 N Causeway St. Muskegon, MI 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	Mater Level (ft. bgs.) Construction
-	_ _ 590 —								TOC Elevation = 592.42 (ft. above msl)
-0	-	-					 ×	(0.0 - 0.3') STONE, aggregate for road base.	Concrete (0.0-
	- 585 - - - 580 - - -	· · · ·	0.0-10.0'	4.0	NA		× × × × × × × × × × × × × ×	(0.3 - 13.0') ASH, little fine sand, subround; trace granules, subangu slow to rapid dilatancy; moist to wet; soft; very dark gray (10YR 3/1), material. NOTE: Wet at 7.0' bgs.	llar; non-plastic,
- - - - - -	- 575 - - - - - - - - - - - 	2	10.0- 20.0'	9.0	NA		< ×	 (13.0 - 15.0') SAND, fine, subround; little to some silt; well sorted; we (10YR 6/3). (15.0 - 18.0') SAND, fine, subround; some silt; well sorted; wet; gray (10YR 5/2). NOTE: Large wood fragments at 17.0' bgs. (18.0 - 18.5') SAND, fine, subround; and SILT; poorly sorted; wet; da 3/3). NOTE: some organic matter; sticks; wood. (18.5 - 26.0') SAND, fine; little silt; trace medium sand, subround; we light brownish gray (10YR 6/2). 	rish brown
- 20	-								
								Remarks: bgs = below ground surface btoc = below top of casing Air Knife to 8.5' bgs. Groundwater encountered at 7.0' bg Water level at development was 12 No odor or staining observed. Groundwater elevation measured o RCADIS_Analytical Boring-Well 2013_New Logo	

Dat Dri Dri Dri Sar Rig Wa	e Fini Iling C Iler's I Iling M npling Type ter Le	Compa Name Metho g Meth g Soni svel St	0/20/18 any: M : Dan d: Air nod: (Mateco Moure Knife/S Continu bgs.)	er Sonic uous : 7.0	-		Northing: 647103.13 Easting: 12622369.93 Casing Elevation: 592.42 Borehole Depth (ft. bgs.): 45.0 Surface Elevation: 589.4 Descriptions By: A. Westhuis	Well/Boring ID: BCC MW-15019 Client: Consumers Energy Location: BC Cobb Facility 151 N Causeway St. Muskegon, MI 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	Mater Level (ft. bgs.) Construction
- 25 - 25 		3	20.0- 30.0' 30.0- 40.0' 40.0'	9.0	NA			 (26.0 - 27.0') CLAY and SILT, non-plastic, no dilatancy; little fine sa moist; soft; dark brown (10YR 3/3). (27.0 - 27.5') SAND, fine, subround; little silt; well sorted; wet; light I (10YR 6/2). NOTE: some organic debris, sticks. (27.5 - 29.0') SAND, fine, subround; and SILT; trace clay, non-plast dilatancy; poorly sorted; wet; brown (10YR 4/3) to dark brown (10YI (29.0 - 30.0') SAND, fine, subround; some silt; trace clay; poorly sort brownish gray (10YR 6/2). NOTE: some roots, sticks and wood. (30.0 - 31.5') CLAY and SILT, low plasticity, no dilatancy; little to trasubround; moist; soft to medium stiff, dark brown (10YR 3/3). NOT (31.5 - 32.5') SAND, fine, subround, and SILT; poorly sorted; wet; g (10YR 5/2). (32.5 - 37.0') CLAY and SILT, low plasticity, no dilatancy; little fine s moist; medium stiff, dark brown (10YR 3/3). NOTE: ganic rich; trace fragments at 32.5 to 36.5' bgs. (37.0 - 42.0') SAND, fine, subround; trace silt; well sorted; wet; pale 6/3). (42.0 - 45.0') CLAY, high plasticity, no dilatancy; trace silt; moist; m	brownish gray ic, slow R 3/3). rted; wet; light ace fine sand, E: organic rich. prayish brown sand, subround; se white shell brown (10YR brown (10YR Sand Pack K&E WP1 (36.0- 36.0' bgs) 2" PVC 10 Slot Well Screen (37.0-42.0' bgs)
- 45-	545 -		CA	DIS	S Dee for buil	sign & Co natural a lt assets	prosultancy	End of boring 45.0' bgs. Remarks: bgs = below ground surface btoc = below top of casing Air Knife to 8.5' bgs. Groundwater encountered at 7.0' b Water level at development was 12 No odor or staining observed.	
Broid	act: DI	=0007	22 000	14 000	<u>06 T</u>	emn	late: Al		on November 30, 2015 was 580.11 feet Page: 2 of 2

Dat Dri Dri Dri Sat Rig Wa	te Fini Iling (Iler's I Iling N mpling Type iter Le	ish: 1 Compa Name Metho g Metho e: Soni evel St	21/15 0/21/1{ any: M : Dan d: Air nod: (c c cart (ft. nish (f	Mateco Moure Knife/S Contine bgs.)	er Sonic Jous : 7.0			Northing: 647436.97 Easting: 12622626.85 Casing Elevation: 592.23 Borehole Depth (ft. bgs.): 45.0 Surface Elevation: 589.5 Descriptions By: A. Westhuis	Well/Boring ID: BCC MW-15020 Client: Consumers Energy Location: BC Cobb Facility 151 N Causeway St. Muskegon, MI Weather Conditions: 60 F Partly 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
-	- - 590 -										TOC Elevation = 592.23 (ft. above msl)
- - - - - - - - -	- - - 585 - - - - - - - - - - - - - - - - - 	1	0.0- 10.0'	0.0	NA			(0.0 - 10.0') NO RECOVERY; most soil cuttings from air knife were n int the hole.	ot placed back		Concrete (0.0- 1.0' bgs)
- 10 - - - - - - - - - - - - - -	- - 575 - - - -	2	10.0-20.0'	5.0	NA			 (10.0 - 18.0') SAND, fine, subround; some ash; little medium sand; tr small pebble, subangular; moist to wet; poorly sorted; very dark gray (10YR 3/2). NOTE: little large stones; road base fill material. (10YR 3/2). NOTE: little large stones; road base fill material. (10YR 3/2). NOTE: little large stones; road base fill material. 	ish brown		2" PVC Well Casing (-3.0- 35.0' bgs) Bentonite/Ceme Grout (1.0- 32.5' bgs)
- 20 - -	570 - - -					-	×	(20.0 - 31.0') SAND fine, subround; little silt; well sorted; wet; light br (10YR 6/2).	ownish gray		
								Remarks: bgs = below ground surface btoc = below top of casing Air Knife to 8.5' bgs. Groundwater encountered at 7.0' bg Water level at development was 12. No odor or staining observed. Groundwater elevation measured o RCADIS_Analytical Boring-Well 2013_New Logo	19' btoc.	-	2015 was 580.14 feet Page: 1 of 2

Date Start: 10/21/15 Date Finish: 10/21/15 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.): 7.0 Water Level Finish (ft. btoc.): 12.19								Northing: 647436.97 Easting: 12622626.85 Casing Elevation: 592.23 Borehole Depth (ft. bgs.): 45.0 Surface Elevation: 589.5 Descriptions By: A. Westhuis	Client: Cor	BC 151 Mus	D: BCC MW-15020 mers Energy Cobb Facility N Causeway St. skegon, MI litions: 60 F Partly 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
- 25 - - - 30	- 565 - - - - 560 -	3	20.0- 30.0'	5.0	NA						
- - - 35 -	- - - - - - - - - - - - - - - - - - -	4	30.0- 40.0'	10.0	NA	-		 (31.0 - 32.5') CLAY and SILT, medium plasticity, no dilatancy; trace subround; moist; medium stiff; dark brown (10YR 3/3). NOTE: trace fragments. (32.5 - 34.0') SAND, fine, subround; some to little silt; well sorted; w 5/3). (34.0 - 35.0') CLAY and SILT, low plasticity to non-plastic; some fine subround; wet; soft to very soft; brown (10YR 4/3). (35.0 - 40.0') SAND, fine, subround; trace silt; well sorted; wet; light NOTE: large cobble at 35.0' bgs. 	e white shell et; brown (10YR e sand,		Bentonite Pellets (32.5- 34.5' bgs) Sand Pack K&E WP1 (34.5- 45.0' bgs) 2" PVC 10 Slot Well Screen (35.0-40.0' bgs)
- 40 - - - - -		5	40.0- 45.0'	4.0	NA			(40.0 - 45.0') CLAY, high plasticity, no dilatancy; trace silt; moist; me soft; gray (10YR 5/1). End of boring 45.0' bgs.	edium stiff to		
			CA					Remarks: bgs = below ground surface btoc = below top of casing Air Knife to 8.5' bgs. Groundwater encountered at 7.0' by Water level at development was 12 No odor or staining observed. Groundwater elevation measured of RCADIS_Analytical Boring-Well 2013_New Logo	.19' btoc.	-	2015 was 580.14 feet Page: 2 of 2

Date: 2/8/2016 Created/Edited by: C. Jeffers

Data File: BCC-MW-15020.dat

Date Start: 10/21/15 Date Finish: 10/21/15 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.): 14.00								Northing: 646654.84 Easting: 12623310.03 Casing Elevation: 593.73 Borehole Depth (ft. bgs.): 50.0 Surface Elevation: 590.7 Descriptions By: A. Westhuis	Well/Boring ID: BCC MW-15021 Client: Consumers Energy Location: BC Cobb Facility 151 N Causeway St. Muskegon, MI Weather Conditions: 60 F Partly 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
-	-										TOC Elevation = 593.73 (ft. above msl)
- 0 - - - - - - - -	590 - - - - 585 - - - -	1	0.0- 10.0'	5.5	NA		× × × × × × × × × × × × × × × × × × ×	(0.0 - 20.5') ASH, trace fine sand, subround; non-plastic, rapid dilatan moist to wet; very soft; dark gray (10YR 4/1). NOTE: Fill material.	cy; well sorted;		Concrete (0.0- 1.0' bgs)
- 10 - - - - - - - - -		2	10.0-20.0'	10.0	NA	-	* * * * * * * * * * * * * * * * * * * *				 A A
- 20	570 — — — —						×	 (20.5 - 22.0') SANd, fine, subround; some silt; trace granules, subrour sorted; wet; gray (10YR 5/1) to pale brown (10YR 6/3). (21.5 - 22.0') NOTE: Organic rich matter, wood, sticks, leaves; dark ye (10YR 3/6) from 21.5 to 22.0' bgs. (22.0 - 23.5') SAND, fine, subround; some silt; poorly sorted; wet; gray (10YR 5/2). NOTE: Some organic rich debris, wood and sticks; dark 3/3). 	ellowish brown		A^A A^A Bentonite/Cemem A^A Grout (1.0- 36.5' bgs) A^A A^A A^A
			22.000					Remarks: bgs = below ground surface Air Knife to 8.0' bgs. Groundwater encountered at 5.0' bgs Water level at development was 14.0 No odor or staining observed. Groundwater elevation measured on above mean sea level.	0' btoc.		2015 was 580.1 feet Page: 1 of 2

Dat Dril Dril Dril San Rig Wat	e Fini ling C ler's l ling N npling Type ter Le	Compa Name Metho g Metho e: Soni evel St	0/21/18 any: M : Dan d: Air nod: (Mateco Moure Knife/S Continu bgs.)	er Sonic Jous : 5.0	-		Northing: 646654.84 Easting: 12623310.03 Casing Elevation: 593.73 Borehole Depth (ft. bgs.): 50.0 Surface Elevation: 590.7 Descriptions By: A. Westhuis	Client: Cor Location: E	ISUM BC C 151 N Musk	
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
	565 -	3	20.0- 30.0'	10.0	NA			 (23.5 - 25.0') SAND, fine, subround; little silt; well sorted; wet; light g (25.0 - 27.0') SAND, fine, subround, and SILT; poorly sorted; moist (10YR 4/3) to dark gray (10YR 4/1). NOTE: some organic debris, s leaves. (27.0 - 28.5') SAND, fine, subround; little to some silt; well sorted; w (10YR 7/2). (28.5 - 29.5') CLAY and SILT, non-plastic, no dilatancy; little fine sa medium stiff; moist, dark brown (10YR 3/3). NOTE: some organic 	to wet; brown tot wet; brown sticks, wood, ret; light gray		
- 30 - - - - 35 - -	560 - - - 555 - - - -	4	30.0- 40.0'	10.0	NA			 (29.5 - 32.5') SAND, fine, subround, and SILT; poorly sorted; moist; (10YR 3/3). NOTE: wood, sticks and leaves from 29.5 to 30.0' and bgs. (32.5 - 35.0') SAND, fine, subround; little silt; well sorted; wet; pale I 6/3). (34.5 - 35.0') NOTE: Organics, wood, sticks. (35.0 - 39.5') CLAY, medium to high plasticity, no dilatancy; little to smedium stiff; very dark brown (10YR 2/2). NOTE: White shell fragments at 37.5' and 38.0' bgs. 	32.0 to 32.5'		A A
- 40 - - - 45 - - -	550 - - - - - - - - - - - - - - - - - - -	5	40.0- 50.0'	10.0	NA			(39.5 - 42.5') SAND, fine, subround; trace silt; well sorted; wet; light (42.5 - 50.0') CLAY, high plasticity, no dilatancy; trace silt; moist; me (10YR 5/1).			Sand Pack K&E WP1 (38.5- 50.0' bgs) 2" PVC 10 Slot Well Screen (39.5-42.5' bgs)
								Remarks: bgs = below ground surface Air Knife to 8.0' bgs. Groundwater encountered at 5.0' b Water level at development was 14 No odor or staining observed. Groundwater elevation measured of above mean sea level. RCADIS_Analytical Boring-Well 2013_New Logo	.00' btoc.	-)15 was 580.1 feet Page: 2 of 2

Date: 2/8/2016 Created/Edited by: C. Jeffers

Data File: BCC-MW-15021.dat

Date Start: 10/23/15 Date Finish: 10/23/15 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.): 7.0 Water Level Finish (ft. btoc.): 12.28								Northing: 646263.16 Easting: 12623634.96 Casing Elevation: 595.82 Borehole Depth (ft. bgs.): 45.0 Surface Elevation: 592.6 Descriptions By: A. Westhuis	Client: Co	BC 151 Mus	D: BCC MW-15022 mers Energy Cobb Facility N Causeway St. skegon, MI ditions: 40 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
-	-										TOC Elevation = 595.82 (ft. above msl)
	595 - - - - - - - - - - - - - - - -	1	0.0- 10.0'	4.5	NA		* * * * * * * * * * * * * * * * * * * *	(0.0 - 22.0') ASH, trace fine sand, subround; non-plastic, rapid dilatar moist to wet; gray (10YR 5/1). NOTE: Fill material. NOTE: Wet at 7.0' bgs.	ncy; well sorted;		Concrete (0.0- 1.0' bgs)
- 10 - - - 15 - - - - 20	585 - - - - 580 - - - - - -	2	10.0-20.0'	9.0	NA		* * * * * * * * * * * * *				A 2" PVC Well Casing (-3.0- 24.0' bgs) Bentonite/Cemem Grout (1.0- A A
-	575 - - -	AR	CA	DIS	5 Des for buil	iign & Con natural a lt assets	× × ×	(22.0 - 30.0') SAND, fine, subround; trace silt; well sorted; wet; light the (10YR 6/2). Remarks: bgs = below ground surface btoc = below top of casing Air Knife to 9.0' bgs. Groundwater encountered at 7.0' bg Water level at development was 12. No odor or staining observed. Groundwater elevation measured ou	s during drilli 28' btoc.	-	

Dat Dril Dril Dril Sar Rig Wa	e Fini Iling C Iler's I Iling M npling Type ter Le	Compa Name Metho g Meth e: Soni evel St	0/23/18 any: M : Dan d: Air nod: (Mateco Moure Knife/S Continu bgs.)	er Sonic uous : 7.0	-		Northing: 646263.16 Easting: 12623634.96 Casing Elevation: 595.82 Borehole Depth (ft. bgs.): 45.0 Surface Elevation: 592.6 Descriptions By: A. Westhuis	Well/Boring ID: BCC MW-15022 Client: Consumers Energy Location: BC Cobb Facility 151 N Causeway St. Muskegon, MI Weather Conditions: 40 F Sunny		ers Energy obb Facility I Causeway St. egon, MI
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
- 25 - -	- 570 - - -	3	20.0- 30.0'	8.0	NA						Sand Pack K&E WP1 (23.0- 45.0' bgs) 2" PVC 10 Slot Well Screen (24.0-30.0' bgs)
- 30 - - - - 35 - -	565 - - - - - - - - - - - - - - - -	4	30.0- 40.0'	9.0	NA	-		 (30.0 - 33.0') SAND, fine, subround, and SILT, non-plastic, no dilata dilatancy; moist to wet; poorly sorted; light brownish gray (10YR 6/2 brown (10YR 5/2). NOTE: little to some organic debris. (33.0 - 37.0') SILT, non-plastic, no dilatancy; some fine sand, subrour poorly sorted; moist to wet; grayish brown (10YR 5/2) to dark brown NOTE: Organic rich debris, sitcks and wood from 36.0 to 37.0' bgs. (37.0 - 40.5') SAND, fine, subround; little silt; well sorted; wet; light to (10YR 6/2).) to grayish und; little clay; (10YR 3/3).		
- 40 - - - - - - -	555 - - - - - - - - - - - - - - - - - -	5	40.0- 45.0'	5.0	NA			(40.5 - 43.0') CLAY and SILT, non-plastic, no dilatancy; some to little subround; poorly sorted; moist; dark brown (10YR 3/3). NOTE: whi fragments at 41.0' bgs; organic rich. (43.0 - 44.0') SAND, fine, subround; well sorted; light grayish brown (44.0 - 45.0') CLAY and SILT, non-plastic to low plasticity, no dilatar fine sand, subround; moist; dark gray (10YR 3/3). End of boring 45.0' bgs.	(10YR 6/2).		
					bu i	lt assets	nsultancy nd	Remarks: bgs = below ground surface btoc = below top of casing Air Knife to 9.0' bgs. Groundwater encountered at 7.0' by Water level at development was 12 No odor or staining observed. Groundwater elevation measured of Groundwater elevation measured of CADIS_Analytical Boring-Well 2013_New Logo	.28' btoc.	-	15 was 583.42 feet Page: 2 of 2

Dat Dril Dril Dril San Rig Wat	e Fini ling C ler's l ling M npling Type ter Le	Compa Name: Method g Meth : Soni evel St	0/23/18 any: M : Dan d: Har nod: (Mateco Moure nd Aug Continu bgs.) :	er Jer/Sor Jous : 0.0	nic		Northing: 647125.15 Easting: 12622999.24 Casing Elevation: 588.08 Borehole Depth (ft. bgs.): 20.0 Surface Elevation: 585.4 Descriptions By: A. Westhuis	Client: Cor Location: E	nsui BC 151 Mus	D: BCC MW-15023 mers Energy Cobb Facility N Causeway St. skegon, MI ditions: 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
-	-										TOC Elevation = 588.08 (ft. above msl)
	585 - - - 580 - - - - -	1	0.0- 10.0'	10.0	NA		× × × × × × × × × × × × × × × × × × ×	(0.0 - 10.0') ASH, non-plastic, rapid dilatancy; well sorted; wet; dark NOTE: Fill material. Wet at 0.0' bgs. NOTE: Organic debris, leaves, sticks; dark brown (10YR 2/2) from 9 slight odor.			Concrete (0.0- 1.0' bgs)
- 10 - - - - - - - - - - - - - - - - - - -	575	2	10.0-20.0'	10.0	NA			 (10.0 - 13.0') SAND, fine to medium, subround; trace silt; well sorted brown (10YR 6/3). (13.0 - 16.0') SAND, very fine to fine, subround; some to little silt; we gayish brown (10YR 5/2). (16.0 - 19.5') SAND, fine, subround; little to trace silt; well sorted; we (10YR 6/3). (19.5 - 20.0') SILT, some clay, non-plastic, no dilatancy; some to little silt subround; poorly sorted; wet; dark brown (10YR 3/3). NOTE: little of wood. End of boring 20.0' bgs. 	Il sorted; wet; t; pale brown	-	Sand Pack K&E WP1 (11.0- 20.0' bgs) 2" PVC 10 Slot Well Screen (12.0-19.5' bgs)
			CA					Remarks: bgs = below ground surface btoc = below top of casing Hand Auger to 7.0' bgs. Groundwater encountered at 0.0' bg Water level at development was 3.6 No staining observed. Groundwater elevation measured o RCADIS_Analytical Boring-Well 2013_New Logo	1' btoc.	-	2015 was 584.06 feet Page: 1 of 1

Data File: BCC-MW-15023.dat Date: 2/8/2016 Created/Edited by: C. Jeffers

SOIL DESCRIPTION

		worth Scale CADIS, 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	1⁄2 - 1	0.02 - 0.04	No.18 - No.35
Medium sand	1/4 - 1/2	0.01 - 0.02	No.35 - No.60
Fine sand	1/8 -1⁄4	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.
High	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 orumbles when drier than the plastic limit.
	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 orumbling 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 1/4 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

Coarse-grained soil - Density

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

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	-
Rounded	Particles have nearly plane sides but have well-rounded corners and edges.
	Particles have smoothly curved sides and no edges.

APPENDIX B

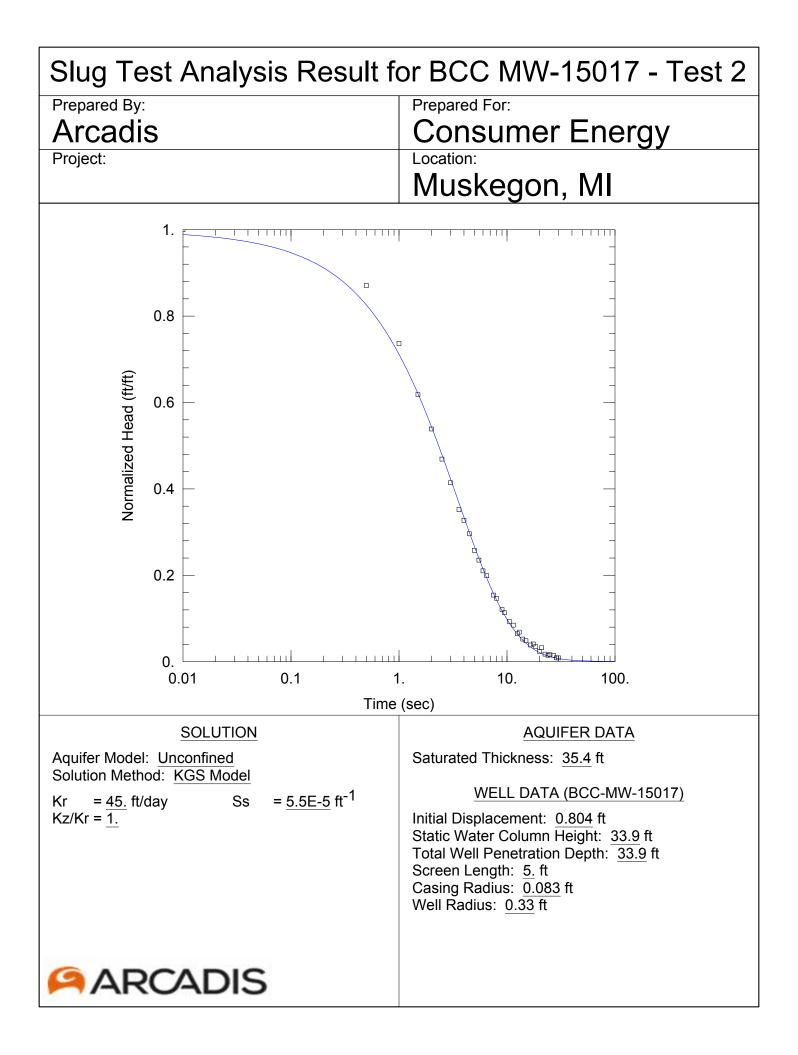
Photographic Log

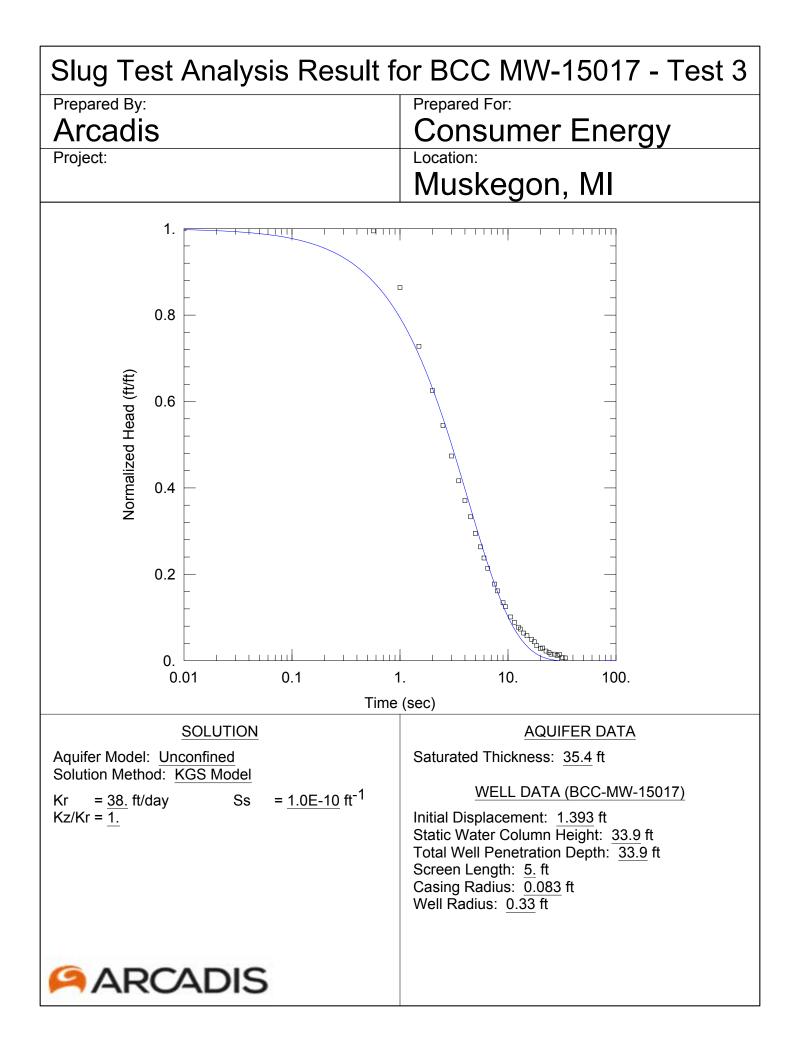


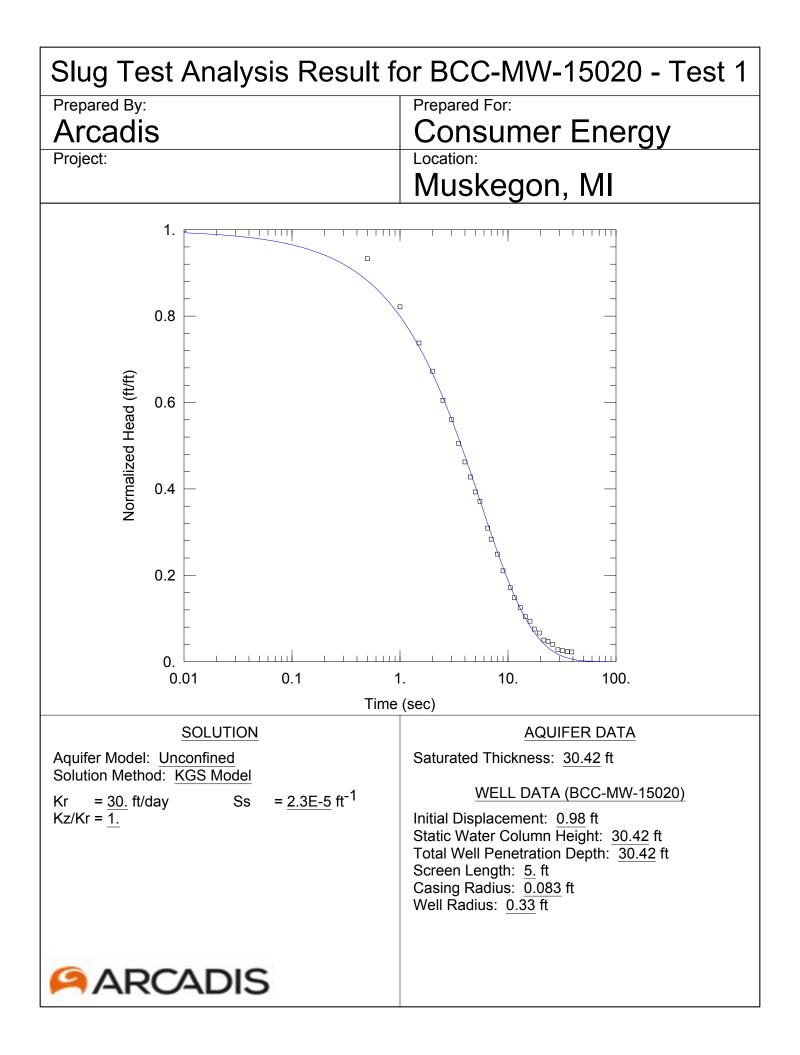
APPENDIX C

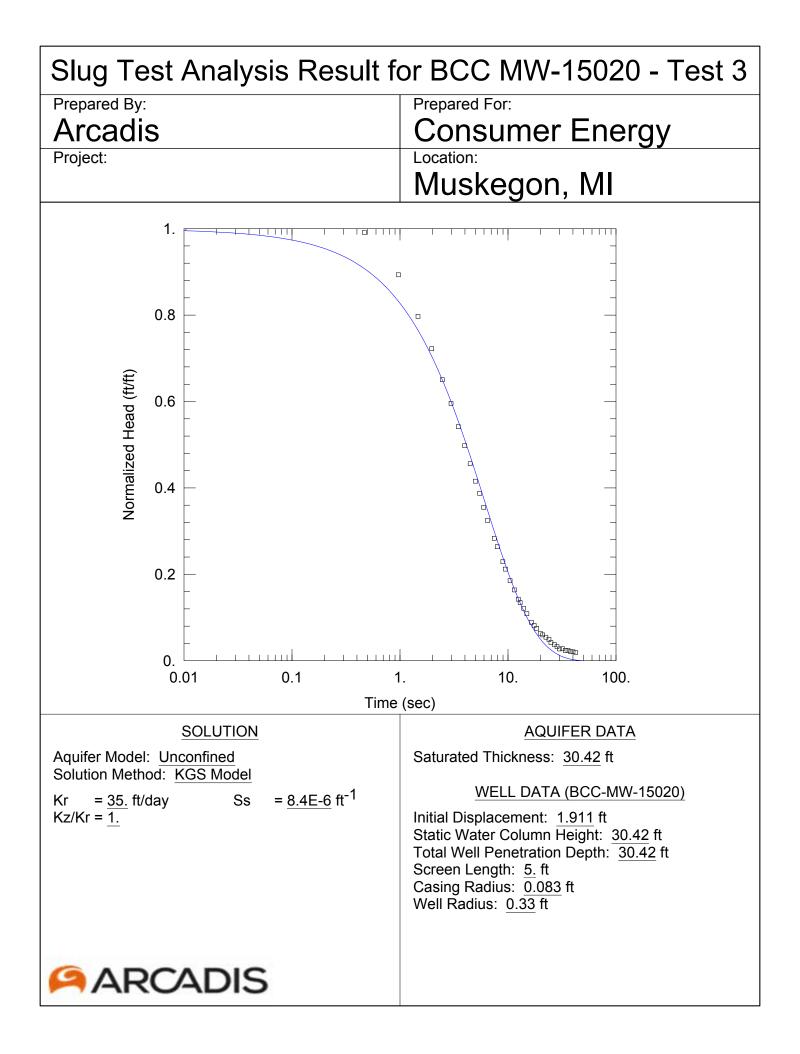
Hydraulic Test Logs

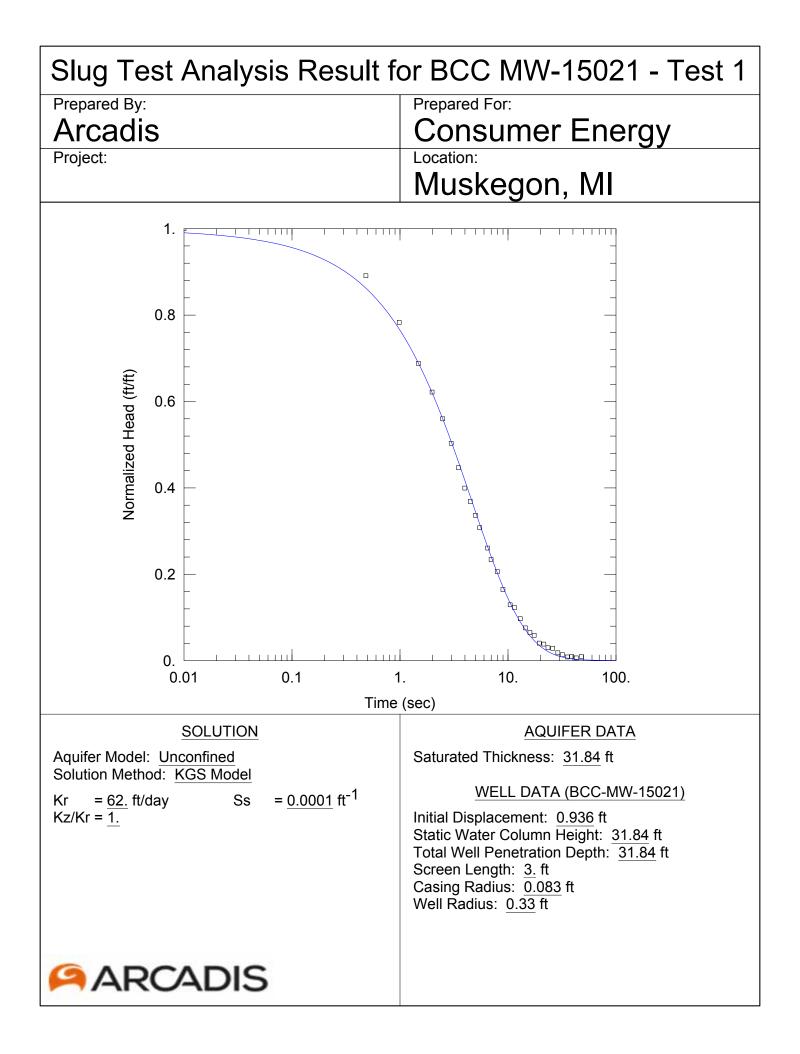


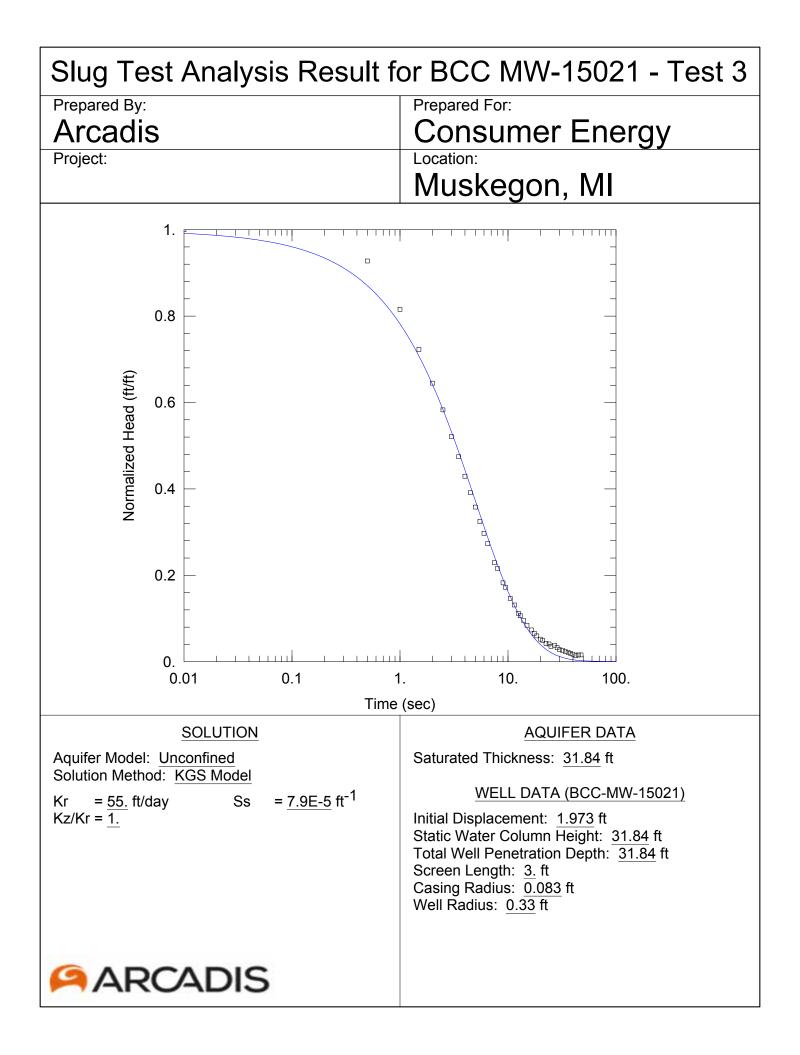


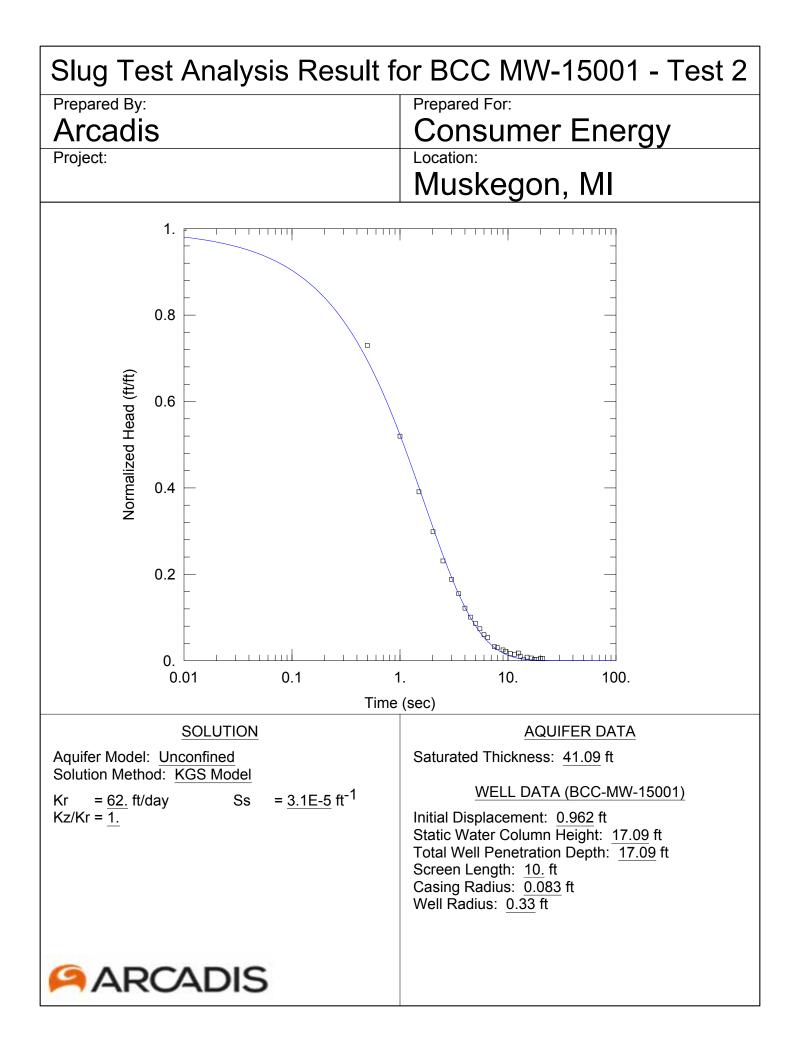


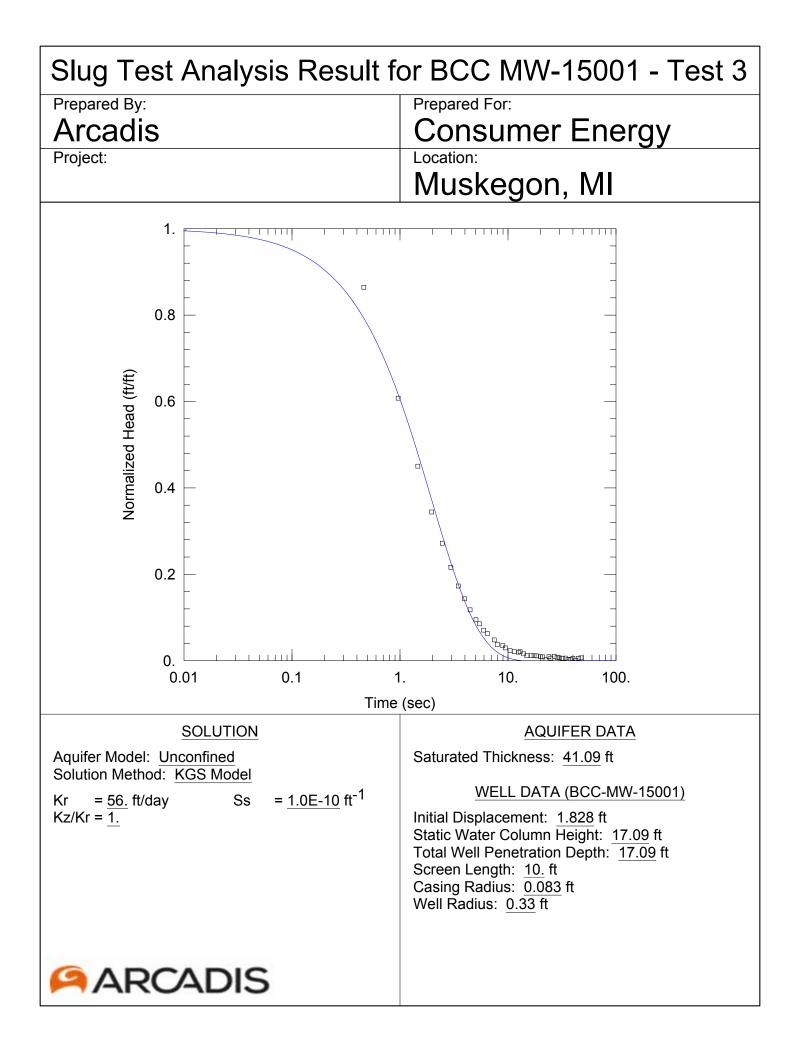


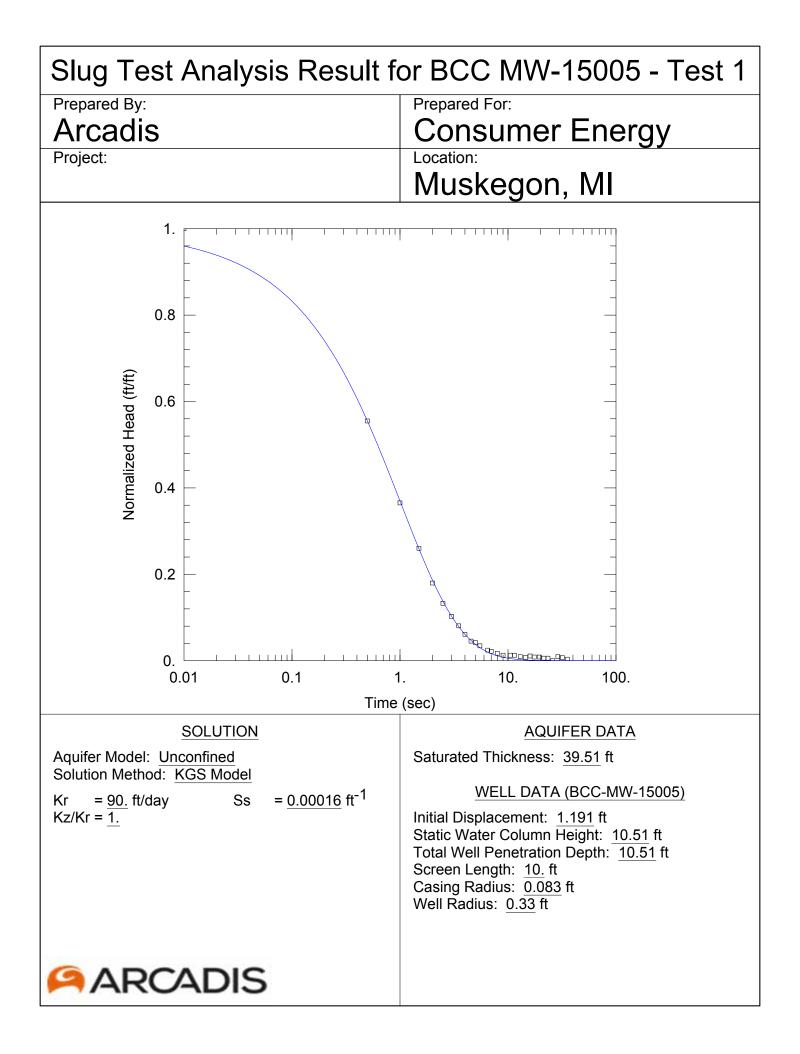


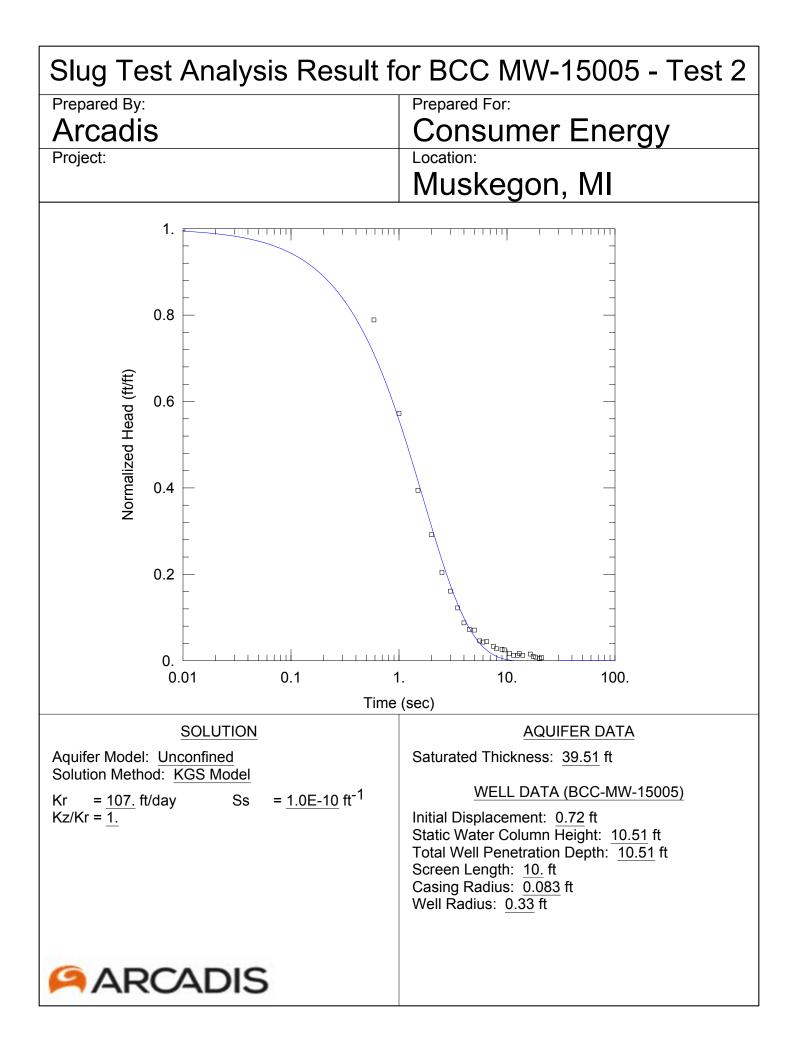


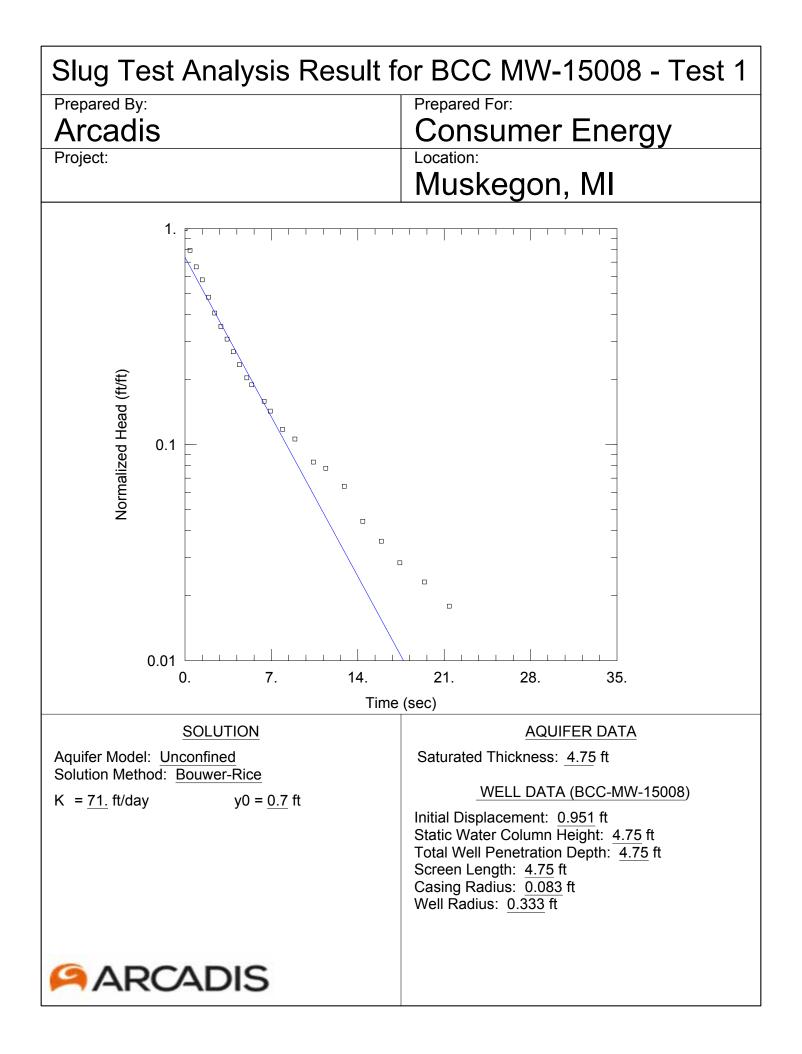


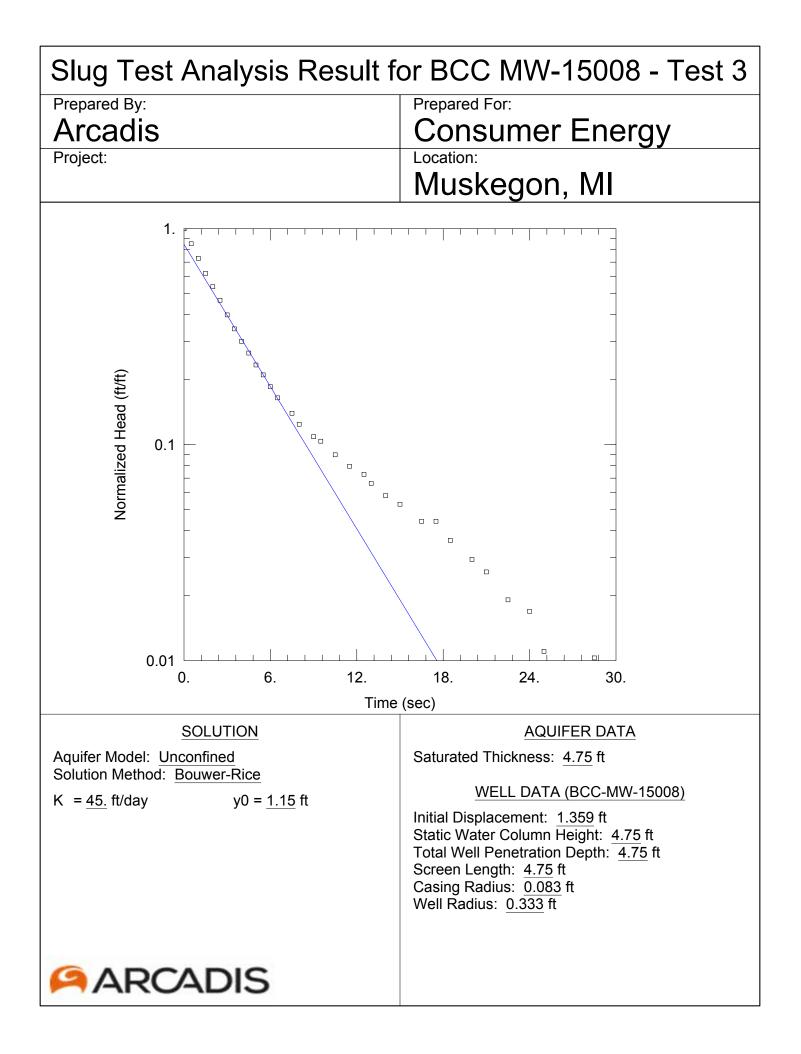














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