Pawnee Station, Morgan County, Colorado

Monitoring Well Installation Report

For Compliance with the Coal Combustion Residuals (CCR) Rule

Pawnee Station

Xcel Energy

February 1, 2016

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Table of Abbreviations and Acronyms

Abbreviation	Definition
AMSL	above mean sea level
BGS	below ground surface
BTOC	below top of casing
CCR	Coal Combustion Residuals
cm/sec	centimeter per second
HP Geotech	Hepworth-Pawlak Geotechnical, Inc.
µS/cm	microsiemens per centimeter
NTU	nephelometric turbidity unit
PSCo	Public Service Company of Colorado
TOC	top of casing
USCS	Unified Soil Classification System

1.0 Introduction

The purpose of this Monitoring Well Installation Report is to document details pertaining to the drilling, construction, and development of eleven groundwater monitoring wells installed at the Xcel Energy Pawnee Generating Station (Pawnee Station) in Morgan County, Colorado (**Figure 1**). The groundwater monitoring system is intended to support compliance with the U.S. Environmental Protection Agency's final Coal Combustion Residuals (CCR) Rule (40 CFR Parts 257 and 261). Pawnee Station has an existing CCR landfill unit (North Landfill) subject to the CCR Rule, as well as a new CCR landfill (East Landfill). The East Landfill was constructed in 2018 and is scheduled to begin operations in 2019. There are also two former CCR Impoundments (Ash Water Recovery Pond and Bottom Ash Storage Pond) that are subject to the CCR Rule. The drilling and well installation was performed in accordance with the State of Colorado Water Well Construction Rules (2 Code of Colorado Regulations 402-2).

HDR was contracted to locate, design, permit and oversee the installation of groundwater monitoring wells at Pawnee Station. HDR retained Hepworth-Pawlak Geotechnical, Inc. (HP Geotech) and Site Services Drilling, LLC to provide on-site drilling services, while HDR provided oversight of the drilling, well installation, and development. All on-site personnel completed the site-specific safety training. Additionally, daily safety briefs were conducted by the on-site project team prior to commencing work. The training and safety briefs were documented in accordance with the *PSCo CCR Rule Compliance Health & Safety Plan.*

2.0 Background Information

Prior hydrogeologic and geotechnical investigations have been conducted at Pawnee as documented in reports identified and summarized in the Pawnee Monitoring Well Installation Plan (HDR, 2015). Dune sand deposits are present at both the existing North Landfill and East Landfill, which overlie a sandy silt (referred to in other reports as fine-grained residual soil) and Pierre Shale Formation bedrock. Groundwater is generally found at the bedrock and sandy silt contact. Dune sands in the CCR landfill areas overlay the residual soil and generally do not contain water; however, perched water-table conditions can be present in localized areas underlain by low-permeability material (PSCo, 2015).

Regional groundwater flow is generally to the northeast across the site towards the South Platte River; however, a bedrock high, trending northwest to southeast, is present beneath the North CCR landfill area, resulting in an eastern radial flow away from both of the landfill sites on the eastern side (PSCo, 2015; shown in **Figure 2**).

The eleven new monitoring wells installed at Pawnee Station (PNMW-13, -14, -15, -16, -17, -18, -19, -20, -21, -22, and -23; shown in **Figure 2**) were sited based on monitoring requirements in the CCR Rule, facility design, and existing hydrogeologic data for the vicinity, as described in the Groundwater Monitoring System Certification (HDR, 2018). Wells PNMW-13, -14, -15, and -16 were installed to monitor the North Landfill; wells PNMW-17, -18, -19, and -20 were installed to monitor the former Ash Water Recovery Pond; and PNMW-17, -21, -22, and -23 were installed to monitor the East Landfill and the former Bottom Ash Storage Pond. The East Landfill was constructed in the footprint of the former Bottom Ash Storage Pond which had all waste removed and was closed in 2017.

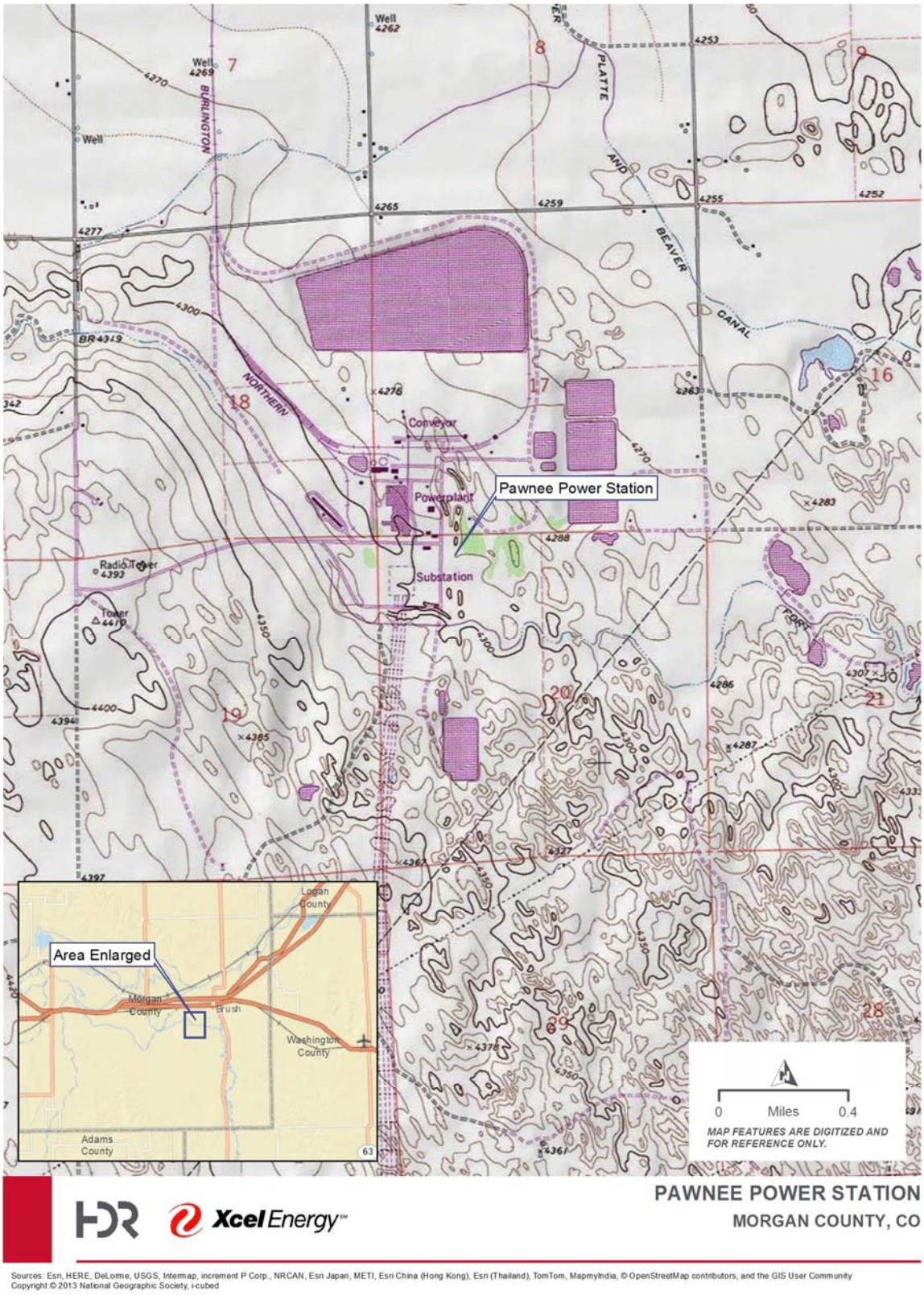

Figure 1. Vicinity Map for Pawnee Station

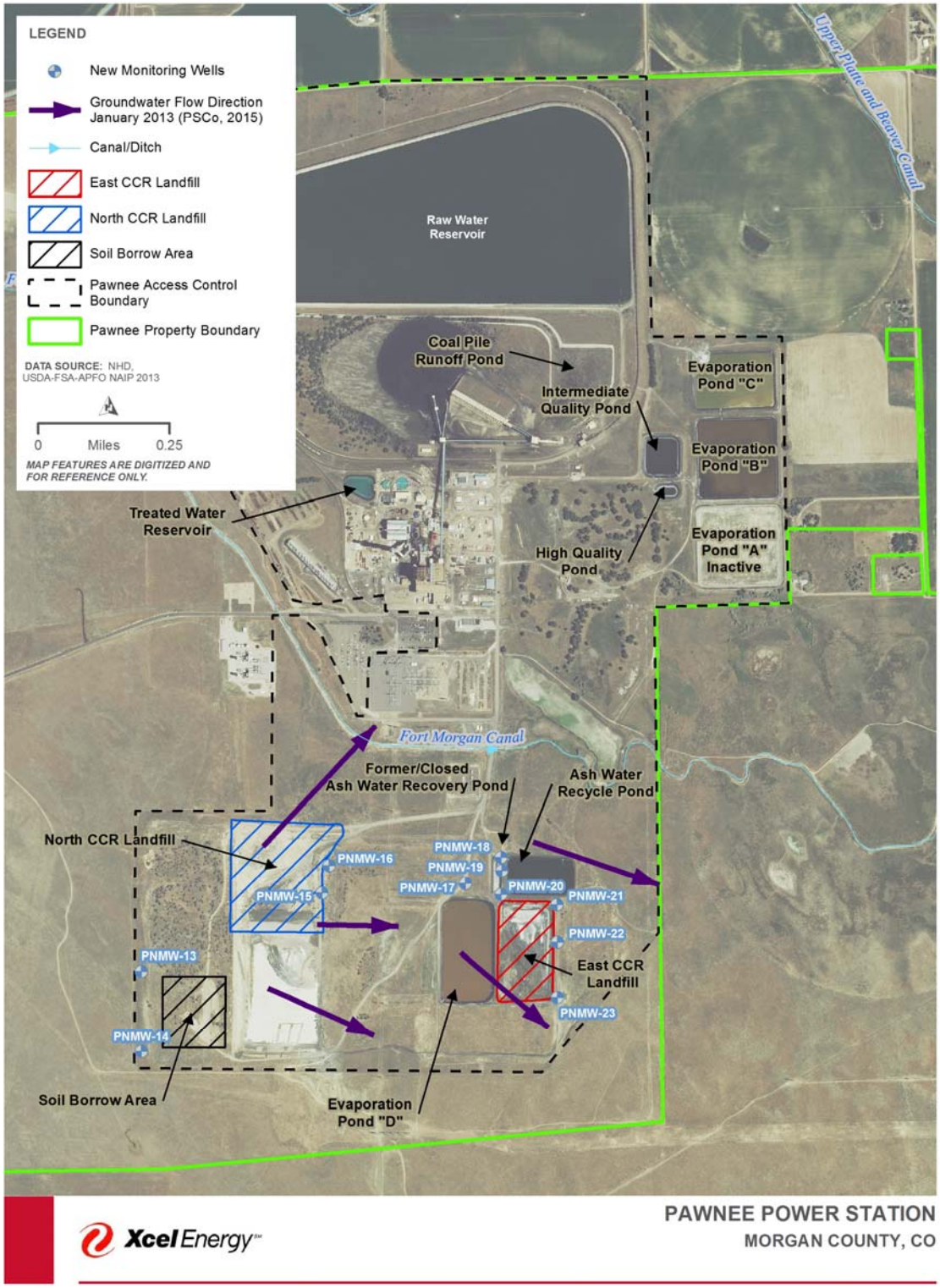

Figure 2. Well Location Map, Pawnee Station

3.0 Field and Laboratory Methods

3.1 Borehole Drilling

The boreholes for wells PNMW-13 and PNMW-14 were drilled by HP Geotech using a hollow stem auger drilling method between November 16 and 18, 2015. The boreholes for wells PNMW-15 through PNMW- 23 were drilled by Site Services Drilling, LLC using a hollow stem auger method between January 23 and February 8, 2017. Utility locations were identified prior to beginning drilling operations. However, to ensure the absence of any buried utilities, the driller advanced soil borings from the ground surface to a depth of approximately 8 feet using a pot-holing technique prior to drilling. The borehole was then advanced using the hollow stem auger drilling method with a CME-55 drill rig. The nominal borehole diameter was 6 inches to accommodate construction of 2-inch diameter wells.

Similar to the previously constructed groundwater monitoring wells on site[1], screen depth was targeted for placement above the Pierre Shale bedrock, including weathered bedrock, within the dune deposits and silt layers between the dune sands and the weathered bedrock. All well screens were placed at and below the water table and to represent both the dune sand and residual soil above the weathered bedrock. This resulted in boreholes with total depths of approximately 50 and 70 feet below ground surface (bgs), as further described in **Section 4.3**.

An HDR geologist was present during drilling operations to collect samples and log the subsurface material, in addition to overseeing site safety and proper well construction. Soil samples from boreholes were collected in plastic bags and logged every 5 feet by the field geologist during drilling to document lithologic soil characteristics. The geologist visually classified soil type, consistency/relative density, color, and water content in accordance with the Unified Soil Classification System (USCS) as well as grain size, mineralogy, sorting, rounding, hardness, and matrix/clast support, among other textural properties. Samples were placed in sample bags labeled with the borehole identification and depth interval. One undisturbed soil sample was collected within the well screen depth interval from PNMW-13, and -14 and submitted to a lab for hydraulic properties analysis, as described below in **Section 3.2**. It was determined that the screened interval for the wells was characterized through the testing of those wells and additional laboratory analysis is not necessary. Boring logs for each borehole are provided in **Appendix A**.

Soil cuttings, fluids, and potholing slurry generated during drilling were transported to and disposed of at an existing on-site evaporation pond. Drilling equipment was decontaminated with potable water before moving to the next bore hole.

[1] The existing wells on site are screened above the Pierre Shale bedrock. The screened intervals at these existing wells capture the higher of either the residual soil/dune sand contact or the residual soil/weathered bedrock, up to the maximum historic groundwater elevation. This screening interval intercepts potential seepage from the landfill through either the dune sand or transition zone bedrock (PSCo, 2015). This approach has worked well for the groundwater monitoring program conducted on the site and wells for this project were therefore similarly constructed.

3.2 Soil Samples – Geotechnical Analysis

Soils were logged from the cutting returns during November 2015 drilling and classified based on the USCS. During drilling, one undisturbed soil sample was obtained from each borehole at a depth coinciding with the interval of the well screen depth. An 18-inch long California Modified Style Split-Spoon Sampler was used to collect the undisturbed core of sediment. The undisturbed soil samples (one from PNMW-13 and -14) were submitted to HP Geotech for geotechnical analysis of the following parameters:

- Grain-size: Sieve and Hydrometer (ASTM D421/422)
- Total Porosity (SW9100)
- Bulk Density (ASTM D2937)
- Moisture Content (ASTM D2216)
- Specific Gravity (ASTM D854)

Analysis was completed in accordance with the method for grain-size analysis using sieve and hydrometer described in ASTM D421/422 (ASTM D421-85, 1998 and ASTM D422-63, 2007). Chain of custody documentation is provided in **Appendix B**.

Soils were logged from the cutting returns during February 2017 drilling and classified based on the USCS. During drilling, soil samples were obtained from the boreholes at PNMW-21 and -22 for geotechnical properties to assist in design of the East Landfill. A brass liner was used to collect undisturbed cores of sediment and other samples were bagged for analysis. The following soil samples were submitted to Advanced Terra Testing for geotechnical analysis of the parameters in Table 1.

Table 1. February 2017 Geotechnical Soil Samples

Boring	Sample Depth below ground surface	Lithologic Material	Laboratory Analyses
PNMW-21 (also referred to as TB-4)	60-62 feet (just below screened interval 30-60)	Weathered Shale	Permeability (ASTM D5084 Method D)
PNMW-22 (also referred to as TB-5)	49-51 feet (in screened interval)	Sandy Silt	Grain size (ASTM D6913)

3.3 Well Construction

Once the target drilling depth was reached at each location, 2-inch diameter, Schedule 40 PVC casing and well screens (0.010-inch slots) were assembled and lowered into each borehole. Approximately 30 feet of screen was installed at PNMW-13, -14, -15, -16, -17, -18, -19, -20, -21, -22, and -23.

After PVC casing and screen placement in the borehole, the filter pack sand and the bentonite pellet seal were placed via gravity feed from the surface into the annular space. The filter pack consisted of 10-20 (sieve size) washed silica sand emplaced from the bottom of the hole to approximately 5 feet above the well screen. An annular seal of bentonite pellets was placed to 5 feet above the top of the filter pack and hydrated for 12 hours after placement. HP Geotech and Site Services Drilling, LLC then used a tremie pipe to place bentonite grout above the bentonite seal to within approximately 2 feet of the surface.

An annular surface seal consisting of neat cement was installed from the top of the bentonite grout to the surface. All wells were finished with a 2-foot-by-2-foot concrete pad. Each well included between 2 and 4 feet of PVC stick-up. Bollards were installed at all wells except PNMW-13 and -14 where they were not deemed necessary due to well locations. Each well was secured with a protective steel casing and lock. Well construction is further described in **Section 4.3**.

3.4 Well Development

Wells were developed over several days to improve hydraulic connectivity in the area immediately surrounding the well and remove any fluids introduced during drilling. Well development involves removing as much of the introduced drilling fluids, cuttings, and particulates from within and adjacent to the well as possible. Development did not begin until at least 12 hours after the wells had been grouted to ensure grout had sufficiently set.

Wells were developed by surge blocking and pumping. This method involves moving a surge block up and down the well screen and casing which alternately forces water in and out of the screen, loosens sediment, and draws fine-grained materials into the well, then removing the purge water and fine sediment from the well using a pump.

The duration of development; initial water level; well depth; method; and field parameter measurements of pH, specific conductance, temperature, and turbidity were recorded on the development record for each well. The amount of purge water removed from each well was estimated in the field. Field parameters were recorded approximately every five (5) minutes of discharge and checked more often for wells with slow recharge. Well development continued until field parameters stabilized. Stabilized field parameters were defined as three (3) consecutive readings where temperatures were within 1°C, pH readings were within 0.2 standard units, and conductivity within 10 percent, and turbidity values were less than 10 nephelometric turbidity units (NTU). The field manager was notified when field parameters stabilized, and development ceased when the water was visually free of suspended solids. Purge water was placed into drums and/or buckets and disposed of in an on-site evaporation pond. The wells took considerable time to develop, between four (4) and six (6) days. All non-dedicated down-well equipment used during development was decontaminated between wells.

3.5 Well Survey

Surveying of the monitoring wells was performed by a professional land surveyor (PLS), Edward-James Surveying, Inc. after well completion. The surveyor recorded elevations of the top of PVC casing (point at notch on the north side of the casing top) and ground surface using a level loop. The northing and easting coordinates of the wells were also surveyed.

3.6 Groundwater Level Measurement and Aquifer (Slug) Testing

HDR performed slug tests on monitoring wells PNMW-13, and PNMW-14 on December 9, 2015; and PNMW-15-23 in February and March 2017 to obtain estimates of hydraulic conductivity for the shallow unconfined aquifer. A 1.5-inch diameter by 2.7-foot long watertight slug was used. Given a 2-inch diameter well, an expected slug displacement of 1.52 feet is estimated for the slug. A transducer was suspended on a communications cable near the bottom of the well, and recorded water level measurements at 1-second intervals. Both slug-in and slug-out tests were performed. Slug-in tests were completed by dropping the slug into the water column as quickly as possible, and measuring the falling water level that followed. Slug-out tests were completed after each slug-in test by removing the slug from the water column as quickly as possible and measuring the rising water level that followed. Well-specific testing details are summarized below:

- PNMW-13: One slug-in and one slug-out test were performed on December 9, 2015. The depth to water in the well was 42.68 feet below top of casing. With a well screen interval of 20−50 feet below ground surface and a casing stick-up of 3.89 feet, 18.7 feet of the well screen was exposed to the vadose zone.

- PNMW-14: One slug-in and one slug-out test were performed on December 9, 2015. The depth to water in the well was 59.32 feet below top of casing. With a well screen interval of 40−70 feet below ground surface and a casing stick-up of 4.00 feet, 15.3 feet of the well screen was exposed to the vadose zone.

- PNMW-15: One slug-in and two slug-out tests were performed on February 27, 2017. The depth to water in the well was 28.9 feet below top of casing. With a well screen interval of 25−55 feet below ground surface and a casing stick-up of 2.18 feet, 1.7 feet of the well screen was exposed to the vadose zone.

- PNMW-17: Two slug-in and two slug-out tests were performed on February 27, 2017. The depth to water in the well was 8.93 feet below top of casing. With a well screen interval of 5−35 feet below ground surface and a casing stick-up of 2.23 feet, 1.7 feet of the well screen was exposed to the vadose zone.

- PNMW-18: One slug-in and one slug-out test were performed on February 28, 2017. The depth to water in the well was 30.36 feet below top of casing. With a well screen interval of 20−50 feet below ground surface and a casing stick-up of 2.35 feet, 8.01 feet of the well screen was exposed to the vadose zone.

- PNMW-19: One slug-in and one slug-out test were performed on February 28, 2017. The depth to water in the well was 31 feet below top of casing. With a well screen interval of 23−53 feet below ground surface and a casing stick-up of 2.17 feet, 5.83 feet of the well screen was exposed to the vadose zone.

- PNMW-20: One slug-in and two slug-out tests were performed on March 6, 2017. Depth to water was 29.11 feet below top of casing. With a well screen interval of 21.2−51.2 feet below the ground surface and a casing stick-up of 2.15 feet, 5.76 feet of the well screen was exposed to the vadose zone. All three slug tests in PNMW-20 had initial displacements significantly less than the expected displacement of 1.52 feet, and for this reason the estimated conductivity at PNMW-20 should be viewed as less reliable.

- PNMW- 21: Two slug-in and two slug-out tests were performed on March 6, 2017. Depth to water was 39.25 feet below top of casing. With a well screen interval of 30.7 to 60.7 feet below the ground surface and a casing stick-up of 2.35 feet, 6.2 feet of the well screen was exposed to the vadose zone.

- PNMW-22: Two slug-in and two slug-out tests were performed on March 6, 2017. Depth to water was 41.32 feet below top of casing. With a well screen interval of 30 TO 60 feet below the ground surface and a casing stick-up of 2.59 feet, 8.7 feet of the well screen was exposed to the vadose zone.

- PNMW-23: Two slug-in and two slug-out tests were performed on March 6, 2017. Depth to water was 47.51 feet below top of casing. With a well screen interval of 30 to 61.3 feet below the ground surface and a casing stick-up of 2.24 feet, 14.8 feet of the well screen was exposed to the vadose zone.

3.7 Decontamination of Field Equipment

Field instrumentation (such as interface probes or water quality meters) was decontaminated between sample locations by rinsing with an Alconox/distilled water solution followed by a potable water rinse and a final rinse with deionized water.

4.0 Field and Laboratory Results

4.1 Borehole Drilling

Boring logs for each borehole are provided in **Appendix A**. Soil cuttings from the borehole samples, which consisted primarily of fine to medium grained sand and silty sand, were dry at the wells from the ground surface to approximately 30 to 35 feet. Weathered shale was encountered at approximately 45 to 50 feet. This was presumed to be the top of the Pierre Shale formation. Lean clay was encountered in PNMW-19 at 45 feet.

4.2 Soil Samples – Geotechnical Analysis

The soil samples collected from some of the boreholes were analyzed for grain size and porosity in PNMW-13 and -14, for permeability of the weathered bedrock below the screened interval in PNMW-21, and for grain size in the screened interval in PNMW-22. Results are summarized in **Table 1**. The soils laboratory results are presented in **Appendix B**.

Laboratory results show the wells are screened in sandy silt, with porosities between 32 and 40 percent, which is consistent with the silty sand material noted in the drilling logs.

Table 2. Summary of Geotechnical Testing Results

Well I.D.	Sample Depth (ft BGS)	Gradation			Total Porosity (%)	Permeability (cm/s)
		Gravel (%)	*Sand (%)*	*Silt and Clay (%)*		
PNMW-13	34	0	38	62	31.7	NM
PNMW-14	69	0	31	69	39.7	NM
PNMW-21	61 (weathered bedrock below screen interval)	NM	NM	NM	NM	3.3E-08
PNMW-22	50	0	13	87	NM	NM

Note:
NM = Not measured; BGS = below ground surface

4.3 Well Construction

A diagram for each well documenting well construction is provided in **Appendix C**. Approximately 30 feet of screen was installed in each well. The screen was placed above the Pierre Shale formation. Well construction details for all wells are summarized in **Table 2**. State well construction permits are included in **Appendix D**.

Table 3. Well Construction Details for Groundwater Monitoring Wells at Pawnee Station

Well I.D.	Northing (State Plane, NAD 1983 UTM Zone 13 N meters)	Easting (State Plane, NAD 1983 UTM Zone 13 N meters)	Elevation TOC (feet AMSL)	Well Total Depth (feet BGS)	Depth of Screen Interval (feet BGS)	Well Stickup (feet)	Casing Type	Depth to Water (feet BTOC)	Static Water Level (feet AMSL)
PNMW-13	611555.4201	4451735.628	4378.11	50	20−50	3.90	2-inch Sch. 40 PVC	42.78	4335.33
PNMW-14	611555.2833	4451488.609	4376.96	70	40−70	4.00	2-inch Sch. 40 PVC	59.34	4317.62
PNMW-15	612108.6655	4451975.9531	4341.57	55	25−55	2.18	2-inch Sch. 40 PVC	28.9	4312.67
PNMW-16	612130.9766	4452060.4886	4322.73	35	5−35	2.45	2-inch Sch. 40 PVC	15.59	4307.14
PNMW-17	612548.5390	4452006.0495	4314.78	35	5−35	2.23	2-inch Sch. 40 PVC	8.93	4305.85
PNMW-18	612658.3353	4452085.1461	4331.21	50	20-55	2.35	2-inch Sch. 40 PVC	30.36	4300.85
PNMW-19	612660.9447	4452044.6224	4330.82	53	23-53	2.17	2-inch Sch. 40 PVC	31	4299.82
PNMW-20	612657.8838	4451971.2478	4330.83	50	20-50	2.15	2-inch Sch. 40 PVC	29.11	4301.72
PNMW-21	612828.8799	4451939.3059	4331.06	60	30−60	2.35	2-inch Sch. 40 PVC	39.29	4291.81
PNMW-22	612830.1897	4451823.4324	4331.05	60	30−60	2.59	2-inch Sch. 40 PVC	41.32	4289.73
PNMW-23	612830.8628	4451655.4639	4331.48	60	30−60	2.24	2-inch Sch. 40 PVC	47.50	4283.97

Notes:
TOC = top of casing
BTOC = below top of casing
BGS = below ground surface
AMSL = above mean sea level

4.4 Well Development

Wells PNMW-13 and -14 were developed over several weeks (November 19 through December 7, 2015). Development was considered relatively difficult for both wells, due primarily to high turbidity readings and relatively slow recharge rates. On December 7, 2015 the field parameters stabilized at PNMW-13 after 64 gallons of water had been removed. Development of PNMW-14 was completed on December 4, 2015 after 127 gallons of water had been removed. Water quality parameters measured in the field after development are noted in **Table 4**.

Wells PNMW-15, -16, -17, -18, -19, -20 -21, -22, and -23 were developed after installation (between January 23 and February 9, 2017). Development was time consuming due to high turbidity readings and relatively slow recharge rates. Water quality parameters measured in the field after development are noted in **Table 4**.

Table 4. Field Water Quality After Well Development

Well I.D.	Conductivity (µS/cm)	pH	Temperature (degrees C)	Turbidity (NTU)
PNMW-13	583	7.61	14.1	9.4
PNMW-14	377.3	7.78	14.3	3.0
PNMW-15	2568	7.18	14.5	3.5
PNMW-16	1097	7.44	14.7	2.2
PNMW-17	1480	7.63	12.3	3.2
PNMW-18	1215	7.63	15.9	4.4
PNMW-19	471.2	7.66	15.9	4.8
PNMW-20	3430	7.31	16.5	4.0
PNMW-21	4305	7.35	18.0	91.3
PNMW-22	564	7.66	13.9	3.9
PNMW-23	2005	7.49	12.9	4.2

Notes:
µS/cm = microsiemens per centimeter
NTU = nephelometric turbidity unit

4.5 Well Survey

Survey coordinates and elevations are provided in **Table 3**.

4.6 Groundwater Level Measurement and Aquifer (Slug) Testing

All slug-in and slug-out tests were analyzed using the Dagan (1978) slug test solution for unconfined aquifers, and implemented using Aqtesolv® v4.5. Each well screen intersected the water table (i.e., was partially submerged) during the slug testing. An effective casing radius correction was applied using Aqtesolv® to account for drainage to and from the filter pack. For this correction, a well radius of 0.25 ft was used and an equipment radius of 0.005 ft was specified for the transducer cable for the December 2015 tests, an equipment radius of 0.01 ft was specified for the transducer cable for the March 2017 tests. The aquifer at each location was represented with the following estimates of saturated thickness: 11.22 feet (PNMW-13), 14.68 feet (PNMW-14), 28.28 (PNMW-15), 28.3

(PNMW-17), 21.99 feet (PNMW-18), 17 feet (PNMW-19), 17.64 feet (P-20), 23.8 (PNMW-21), 21.27 (PNMW-22), 16.03 (PNMW-23). An anisotropy ratio of 1 (unitless) was assigned to the aquifer at each well location.

Initial displacement created by the slug, and hydraulic conductivity results for the slug testing are shown in Table 5. With exception of two tests, the initial displacement was less than the expected displacement of 1.52 feet; it is suspected that this is due either to filter pack effects or to the transducer not recording quickly enough to read the initial displacement at the moment it reached maximum. Plots of the analyses are included in **Appendix E**. The geometric mean of the hydraulic conductivity calculated at PNMW-13, and PNMW-14 is 4.32 x 10^{-3} cm/sec. This value corresponds with the textbook range of 10^{-5} to 10^{-1} cm/sec for silty sand by Freeze and Cherry (1979), which generally agrees with the range of formation materials noted in the boring logs (medium silty sand at PNMW-13, and fine silty sand at PNMW-14). The geometric mean of the hydraulic conductivity calculated from the slug tests at PNMW-15, -16, -17, -21, -22, -23 is 4.27 x 10^{-4}. The geometric mean of the hydraulic conductivity calculated from the slug tests at PNMW-18, -19, -20 is 3.31 x 10^{-4} cm/sec. This value also corresponds with the textbook range of 10^{-5} to 10^{-1} cm/sec for silty sand by Freeze and Cherry (1979), and generally agrees with the formation materials noted in the boring logs (silt and silt with sand at PNMW-15, silt with sand at PNMW-17, silty fine sand at PNMW-18, fine sand and sandy silt at PNMW-19, silt and sand at PNMW-20, silt at PNMW-21, fine sand and silt at PNMW-22, and medium to coarse sand and silt at PNMW-23).

Table 5. Slug Testing Results

Well	Test Name	Initial Displacement (ft)	Hydraulic Conductivity (cm/sec)
PNMW-13	Slug In	0.99	3.45E-03
PNMW-13	Slug Out	1.26	5.90E-03
PNMW-14	Slug In	1.22	2.06E-02
PNMW-14	Slug Out	1.47	8.33E-04
PNMW-15	Slug in	1.70	5.93E-04
PNMW-15	Slug Out	1.30	2.28E-03
PNMW-15	Slug Out (2nd Test)	1.30	8.83E-04
PNMW-17	Slug In	1.61	2.61E-04
PNMW-17	Slug In(2nd Test)	1.72	1.78E-04
PNMW-17	Slug Out	1.09	4.81E-04
PNMW-17	Slug Out (2nd Test)	1.40	3.69E-04
PNMW-18	Slug In	1.17	3.47E-04
PNMW-18	Slug In (2nd Test)	1.14	2.11E-04
PNMW-18	Slug Out	1.35	1.41E-03
PNMW-18	Slug Out (2nd Test)	1.24	7.99E-04
PNMW-19	Slug In (2nd Test)	1.34	1.47E-04
PNMW-19	Slug In	0.79	1.00E-04
PNMW-19	Slug Out (2nd Test)	1.40	3.12E-04
PNMW-19	Slug Out	1.09	4.39E-04
PNMW-20	Slug In	0.51	3.12E-03

PNMW-20	Slug Out	0.85	1.13E-03
PNMW-20	Slug Out (2nd test)	0.62	5.75E-03
PNMW-21	Slug In	1.00	3.12E-04
PNMW-21	Slug In (2nd test)	1.04	2.55E-04
PNMW-21	Slug Out	0.91	8.90E-05
PNMW-21	Slug Out (2nd Test)	0.89	4.58E-04
PNMW-22	Slug In	1.07	7.90E-05
PNMW-22	Slug Out	1.43	1.79E-04
PNMW-22	Slug Out (2nd Test)	1.23	2.94E-04
PNMW-23	Slug In	0.84	5.31E-05
PNMW-23	Slug Out (2nd test)	1.17	3.25E-04
PNMW-23	Slug In (2nd Test)	0.79	6.33E-05
PNMW-23	Slug Out	1.38	1.46E-04
		Geometric Mean:	4.27E-04

5.0 References

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Appendix A

Borehole Logs

Boring Log

Project Name	Project No.	Drilling Company
Xcel CCR	266180-006	HP Geotech

Boring No.	Location	Drilling Rig Type and Drilling Method
PNMW-13	Pawnee Station	CME-55 Hollow Stem Auger (6-inch diameter)

Sample No.	Blow Count	Depth (feet)	Description (USCS)	Elevation (feet)	Remarks
1	N/A		Brown 10YR 4/3; Fine-medium SAND (SP); Dry		Pothole to 8 ft
2	N/A	5	Light yellow brown 2.5Y 6/4; Fine-medium SAND (SP); Dry		
3	2-2-3	10	Yellow brown 10YR 5/4; ; Fine-medium SAND (SP); Dry		
4	3-3-5	15	As above		
5	7-14-12	20	Light yellow-brown 10YR 6/4; Fine-medium SAND (SP); Dry		
6	8-15-19 (SS)	25	Light yellow-brown 2.5YR 6/4; Fine SAND (SP); Dry		SS=Split spoon sampler
7	13-15-13	30	Light yellow-brown 2.5YR 6/4; Medium SAND (SP); Dry		
MW-13: 34' bgs	12-20-2	35	Light olive brown 2.5Y 5/4; Fine-medium SAND (SP); Dry		Soil sample submitted for geotech analysis
9	50/11"	40	Light olive brown 2.5Y 5/3; Fine-medium SAND (SP); Dry		
10	50/9"	45	Light olive brown 2.5Y 5/3; Silty SAND (SM); Dry		
11	5/4"	50	Light olive brown 7.5Y 5/3; Fine SAND (SP) and Shale; Dry		

Total Depth (feet)	Water Level (feet)		Logged/Sampled By:	Drilled By:
	After Drilling:	Hours After:	Matthew Keaveney	HP Geotech
50	--	--	Date Started: 11/18/2015	Date Completed: 11/18/2015

Boring Log

Project Name	Project No.	Drilling Company
Xcel CCR	266180-006	HP Geotech
Boring No.	**Location**	**Drilling Rig Type and Drilling Method**
PNMW-14	Pawnee Station	CME-55 Hollow Stem Auger (6-inch diameter)

Sample No.	Blow Count	Depth (feet)	Description (USCS)	Elevation (feet)	Remarks
1	N/A		Brown 10YR 4/3; Fine Silty SAND (SM); Dry		Pothole to 8 ft
2	N/A		Brown 10YR 4/3; Fine SAND (SP); Dry		
3	4-6-6 (SS)	10	Light yellowish brown 2.5Y 6/4; Fine SAND (SP); Dry		SS=Split spoon sampler
4	5-8-8 (SS)		As above		
5	9-12-13 (SS)	20	Yellowish brown 10YR 5/6; Fine-medium Silty SAND (SM); Dry		
6	50/10"		Light yellowish brown 2.5Y 6/3; Fine SAND (SP); Dry		
7	50/11"	30	Light yellowish brown 2.5Y 6/4; Very fine SAND (SP); Dry		
8	50/11"		As above		
9	10-15-18(SS)	40	As above		
10	10-14-15(SS)		As above		
11	8-14-17 (SS)	50	Light yellowish brown 10YR 6/4; Very fine SAND (SP); Dry		
12	9-13-13 (SS)		Light olive brown 2.5Y 5/4; Very fine SAND (SP); Moist		Moist
13	5-9-12 (SS)	60	Light olive brown 2.5Y 5/4; Silty SAND (SM); Wet		Wet
14	5-7-10 (SS)		As above		
MW-14: 69' bgs	50/9"	70	Light olive brown 2.5Y 5/4; Silty SAND (SP) with trace SHALE; Wet		Undisturbed sample submitted for geotech analysis

Total Depth (feet)	Water Level (feet)		Logged/Sampled By:	Drilled By:
	After Drilling:	Hours After:	Matthew Keaveney	HP Geotech
70	59.00	24	Date Started: 11/18/2015	Date Completed: 11/18/2015

Boring Log

Project Name	Project No.	Drilling Company
Xcel CCR	266180-006	Site Services Drilling, LLC
Boring No.	**Location**	**Drilling Rig Type and Drilling Method**
PNMW-15	Pawnee Station	CME-55 Hollow Stem Auger (6-inch diameter)

Sample No.	Blow Count	Depth (feet)	Description (USCS)	Elevation (feet)	Remarks
1	N/A				Pothole to 8 ft
2	N/A				
3	4-9-13 (SS)	10	Very pale brown 10YR 7/4; Medium-fine SAND (SM); Dry		SS=Split spoon sampler
4	19-28-39 (SS)		Light gray 10Y 7/1; SILT with Sand (ML); Dry		
5	50/6"	20	As above		
6	13-23-38 (SS)		As above		
7	18-26-43 (SS)	30	Dark gray Gley 1 4/N; SILT; Dry		Likely weathered shale and limestone
8	50/4"		Brownish yellow 10YR 6/6; SILT with Sand (ML); Moist		Likely weathered shale and limestone
9	50/5"	40	As above		Likely weathered shale and limestone
10	50/5"		As above		Likely weathered shale and limestone
11	50/6"	50	Dark gray Gley 1 4/N; SILT (ML); Moist		Likely weathered shale and limestone
	50/9"		As above		Weathered shale

Total Depth (feet)	Water Level (feet below top of casing)		Logged/Sampled By:	Drilled By:
	After Drilling:	Hours After:	N. Hanrahan	Site Services Drilling, LLC
55	28.90	+48	Date Started: 1/26/2017	Date Completed: 1/27/2017

Boring Log

Project Name	Project No.	Drilling Company
Xcel CCR	266180-006	Site Services Drilling, LLC

Boring No.	Location	Drilling Rig Type and Drilling Method
PNMW-16	Pawnee Station	CME-55 Hollow Stem Auger (6-inch diameter)

Sample No.	Blow Count	Depth (feet)	Description (USCS)	Elevation (feet)	Remarks
1	N/A				Pothole to 8 ft
2	N/A	5			
3	22-34-38 (SS)	10	Light gray 10YR 7/2; SILT (ML); Dry		
4	50/6"	15	As above		
5	50/6"	20	As above		
6	50/4"	25	Light gray 10YR 7/2; SILT with Sand (ML); Dry		SS=Split spoon sampler
7	50/6"	30	As above		
		35			
		40			
		45			
		50			

Total Depth (feet)	Water Level (feet below top of casing)		Logged/Sampled By:	Drilled By:
	After Drilling:	Hours After:	N. Hanrahan	Site Services Drilling, LLC
35	15.59	+48	Date Started: 1/25/2017	Date Completed: 1/26/2017

Boring Log

Project Name	Project No.	Drilling Company
Xcel CCR	266180-006	Site Services Drilling, LLC

Boring No.	Location	Drilling Rig Type and Drilling Method
PNMW-17	Pawnee Station	CME-55 Hollow Stem Auger (6-inch diameter)

Sample No.	Blow Count	Depth (feet)	Description (USCS)	Elevation (feet)	Remarks
1	N/A				Pothole to 8 ft
2	N/A	5			
3	22-34-38 (SS)	10	Light gray 10YR 7/2; SILT (ML); Dry		
4	50/6"	15	As above		
5	50/6"	20	As above		
6	50/4"	25	Light gray 10YR 7/2; SILT with Sand (ML); Dry		SS=Split spoon sampler weathered bedrock
7	50/6"	30	As above		
		35			
		40			
		45			
		50			

Total Depth (feet)	Water Level (feet below top of casing)		Logged/Sampled By:	Drilled By:
	After Drilling:	Hours After:	N. Hanrahan	Site Services Drilling, LLC
37	8.93	+48	Date Started: 1/25/2017	Date Completed: 1/25/2017

Boring Log

Project Name	Project No.	Drilling Company
Xcel CCR	266180-006	Site Services Drilling, LLC

Boring No.	Location	Drilling Rig Type and Drilling Method
PNMW-18	Pawnee Station	CME-55 Hollow Stem Auger (6-inch diameter)

Sample No.	Blow Count	Depth (feet)	Description (USCS)	Elevation (feet)	Remarks
1	N/A				Pothole to 8 ft
2	N/A				
3	5-7-8 (SS)	10	Light yellowish brown 10YR 6/4; Fine SAND (SP); Moist		SS=Split spoon sampler
4	4-4-6 (SS)		As above		
5	5-5-2 (SS)	20	Light yellowish brown 10YR 6/4; Fine SAND (SP); Dry		
6	18-22-33 (SS)		Light gray; 10YR 7/2; Medium SAND (SP); Dry		SS=Split spoon sampler
7	14-21-28 (SS)	30	Light yellowish brown 2.5Y 6/4; Silty SAND (SM); Moist		
8			As above		
9		40	Olive yellow 2.5Y 6/4; Silty Fine SAND (SM); Moist		
10			As above		
11	28-33-50 (SS)	50	As above		
			As above		

Total Depth (feet)	Water Level (feet below top of casing)		Logged/Sampled By:	Drilled By:
	After Drilling:	Hours After:	N. Hanrahan	Site Services Drilling, LLC
55	30.36	+48	Date Started: 1/26/2017	Date Completed: 1/27/2017

Boring Log

Project Name	Project No.	Drilling Company
Xcel CCR	266180-006	Site Services Drilling, LLC
Boring No.	**Location**	**Drilling Rig Type and Drilling Method**
PNMW-19	Pawnee Station	CME-55 Hollow Stem Auger (6-inch diameter)

Sample No.	Blow Count	Depth (feet)	Description (USCS)	Elevation (feet)	Remarks
1	N/A				Pothole to 8 ft
2	N/A				
3	8-8-5 (SS)	10	Brownish yellow 10YR 6/6; Poorly graded fine medium SAND; Dry		SS=Split spoon sampler
4			As above		
5	8-11-11 (SS)	20	As above		
6	13-18-14 (SS)		Brownish yellow 10 YR 6/6; Fine SAND (SW); Dry		SS=Split spoon sampler
7	19-25-36 (SS)	30	Brownish yellow 10 YR 6/4; Sandy SILT (ML); Dry		
8	32-59-5 (SS)		As above		
9	30/5"	40	As above; Wet		
10	50/5"		As above		
		46	Light olive brown 2.5Y 5/6; Lean CLAY (CL); Wet		
11	50/6"	50	As above		

Total Depth (feet)	Water Level (feet below top of casing)		Logged/Sampled By:	Drilled By:
	After Drilling:	Hours After:	N. Hanrahan	Site Services Drilling, LLC
53.5	31.00	+48	Date Started: 1/23/2017	Date Completed: 1/23/2017

Boring Log

Project Name	Project No.	Drilling Company
Xcel CCR	266180-006	Site Services Drilling, LLC
Boring No.	**Location**	**Drilling Rig Type and Drilling Method**
PNMW-20	Pawnee Station	CME-55 Hollow Stem Auger (6-inch diameter)

Sample No.	Blow Count	Depth (feet)	Description (USCS)	Elevation (feet)	Remarks
1	N/A				Pothole to 8 ft
2	N/A				
3	16-21-26 (SS)	10	Reddish yellow 7.5 YR 6/6; Fine to medium SAND (SP); Dry		SS=Split spoon sampler
4	10-11-12 (SS)		As above		
5	8-12-19 (SS)	20	As above		
6	10-13-20 (SS)		Light yellowish brown 2.5Y 6/4; SILT (ML) with sand; Dry		
7	10-13-20 (SS)	30	As above		
8	50/5"		As above		
9	50/6"	40	As above; Moist		
10	50/6"		Light gray 2.5Y 7/2; SILT and fine SAND (ML-SP);		weathered bedrock
11	50/6"	50			

Total Depth (feet)	Water Level (feet below top of casing)		Logged/Sampled By:	Drilled By:
			N. Hanrahan	Site Services Drilling, LLC
50.5	After Drilling: 29.11	Hours After: +48	Date Started: 1/24/2017	Date Completed: 1/24/2017

Boring Log

Project Name	Project No.	Drilling Company
Xcel CCR	266180-006	Site Services Drilling, LLC
Boring No.	**Location**	**Drilling Rig Type and Drilling Method**
TB-4/PNMW-21	Pawnee Station	CME-55 Hollow Stem Auger (6-inch diameter)

Sample No.	Blow Count	Depth (feet)	Description (USCS)	Elevation (feet)	Remarks
1	N/A		Brown 10YR 4/3; Fine Silty SAND (SM); Dry		Pothole to 8 ft
2	N/A		Brown 10YR 4/3; Fine SAND (SP); Dry		
3	21-23-35 (SS)	10	Light yellowish brown 10 YR 6/4; Fine to medium SAND (SP); Dry		SS=Split spoon sampler
4	5-7-10 (SS)		As above		
5	9-10-11 (SS)	20	As above		
6	12-14-17 (SS)		As above		
7	11-12-20 (SS)	30	As above		
8	19-22-24 (SS)		As above		
9	12-20-29 (SS)	40	Brownish gray 2.5Y 6/2; SILT (ML) with sand; M		
10	50/3"		As above		
11	50/6"	50	As above		
12	50/6"		Light brownish gray 2.5Y 6/2; SILT (ML); Moist		
13	50/3"	60	Dark gray Gley 1 4/N; SILT (ML); Moist		weathered bedrock

Total Depth (feet)	Water Level (feet below top of casing)		Logged/Sampled By:	Drilled By:
	After Drilling:	Hours After:	N. Hanrahan	Site Services Drilling, LLC
60	39.25	+48	Date Started: 1/30/2017	Date Completed: 1/30/2017

Boring Log

Project Name	Project No.	Drilling Company
Xcel CCR	266180-006	Site Services Drilling, LLC

Boring No.	Location	Drilling Rig Type and Drilling Method
TB-5/PNMW-22	Pawnee Station	CME-55 Hollow Stem Auger (6-inch diameter)

Sample No.	Blow Count	Depth (feet)	Description (USCS)	Elevation (feet)	Remarks
1	N/A				Pothole to 8 ft
2	N/A				
3	4-6-6 (SS)	10	Light yellowish brown 10 YR 6/4; Poorly graded sand (SP); Moist		SS=Split spoon sampler
4	5-8-8 (SS)		As above		
5	9-12-13 (SS)	20	As above		
6	50/10"		As above		
7	50/11"	30	Pale yellow 2.5Y 7/3; Poorly graded fine SAND (SP); Moist		
8	50/11"		As above; heavu FE :		
9	10-15-18(SS)	40	Light gray 5Y 7/2; Sl		
10	10-14-15(SS)		As above		
11	8-14-17 (SS)	50	Light gray 5 Y 7/2; SILT (ML); Moist		Some weathered shale
12	9-13-13 (SS)		As above		Moist
13	5-9-12 (SS)	60			
14	5-7-10 (SS)		Light gray 5Y 7/2; SILT (ML); Moist		Laminated weathered shale
PNMW-22: 70' bgs	50/9"	70	Dark gray Gley 1 4/N; SHALE BEDROCK; Wet		

Total Depth (feet)	Water Level (feet below top of casing)		Logged/Sampled By:	Drilled By:
	After Drilling:	Hours After:	N. Hanrahan	Site Services Drilling, LLC
71	41.32	+48	Date Started: 2/8/2017	Date Completed: 2/8/2017

Boring Log

Project Name	Project No.	Drilling Company
Xcel CCR	266180-006	Site Services Drilling, LLC

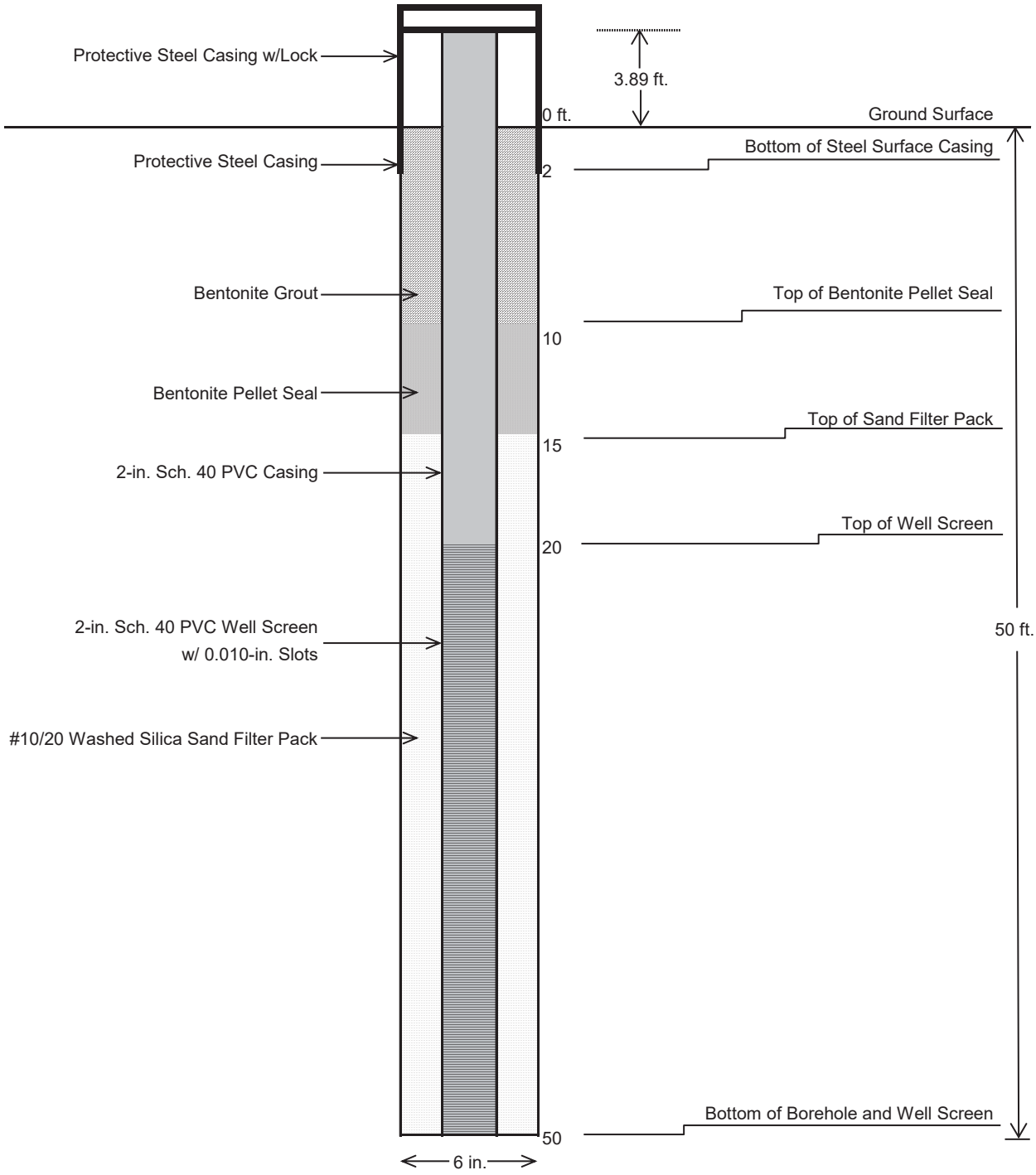
Boring No.	Location	Drilling Rig Type and Drilling Method
TB-6/PNMW-23	Pawnee Station	CME-55 Hollow Stem Auger (6-inch diameter)

Sample No.	Blow Count	Depth (feet)	Description (USCS)	Elevation (feet)	Remarks
1	N/A				Pothole to 8 ft
2	N/A				
3	4-5-5 (SS)	10	Light yellowish brown 10 YR 6/4; Medium SAND (SP)		SS=Split spoon sampler
4	9-14-7 (SS)		As above		
5	18-26-30 (SS)	20	As above		notable preferrential flow pathway
6	23-30-30 (SS)		As above		
7	14-17-16 (SS)	30	As above; some Fe staining		
8	20-34-24 (SS)		As above; some coarse grained sand		
9	17-29-46 (SS)	40	Light yellowish brown 10YR 6/4; Silty SAND (SM)		
10	50/5"		Gray 10YR 6/1; SILT (ML);		
11	50/4"	50	Thinnly bedded, Fe staining		
12	50/4"		Gray Gley1 6/N; SILT (ML); Moist		weathered shale
13	50/4"	60	As above		Wet
		70			

Total Depth (feet)	Water Level (feet below top of casing)		Logged/Sampled By:	Drilled By:
	After Drilling:	Hours After:	N. Hanrahan	Site Services Drilling, LLC
61	47.51	+48	Date Started: 1/31/2017	Date Completed: 1/31/2017

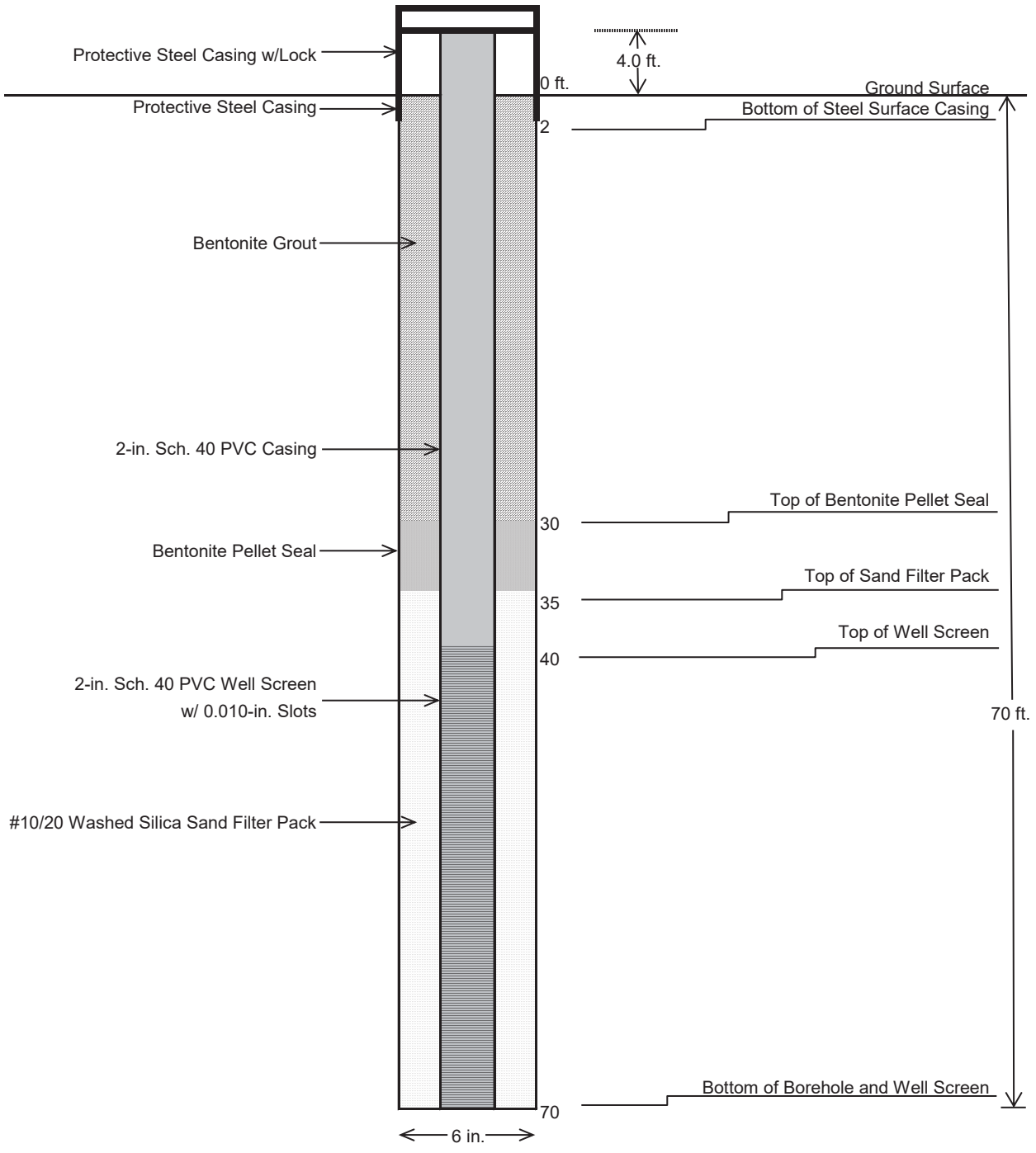
Appendix B

Well Construction Diagrams



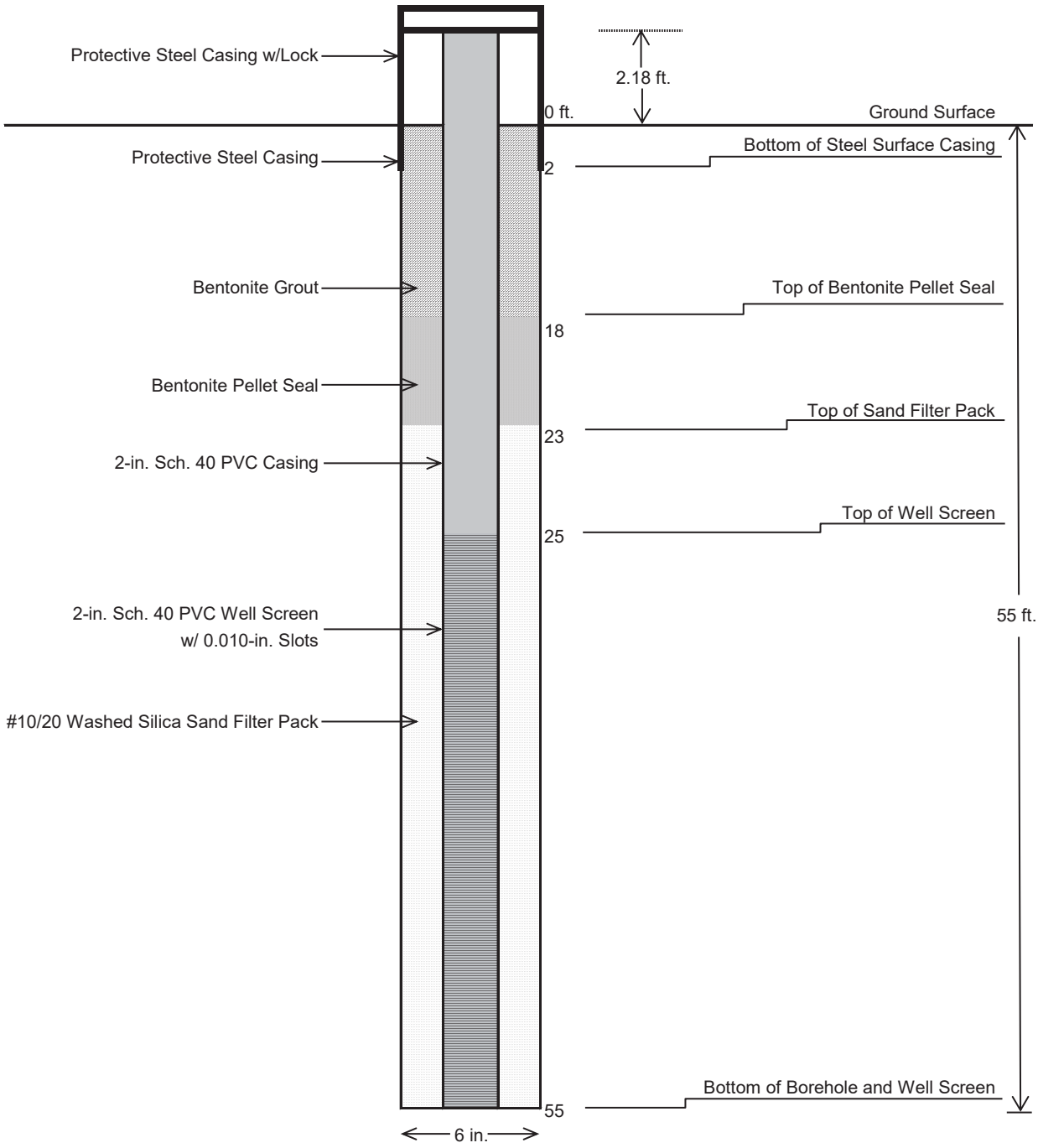
Constructed: 11/18/2015
Drilled By: HP Geotech
PVC Casing EL: 4378.11 ft amsl
Water EL: 4335.33 ft amsl (December 2015)

Monitoring Well Construction Diagram
PNMW-13
Pawnee Station
Xcel Energy



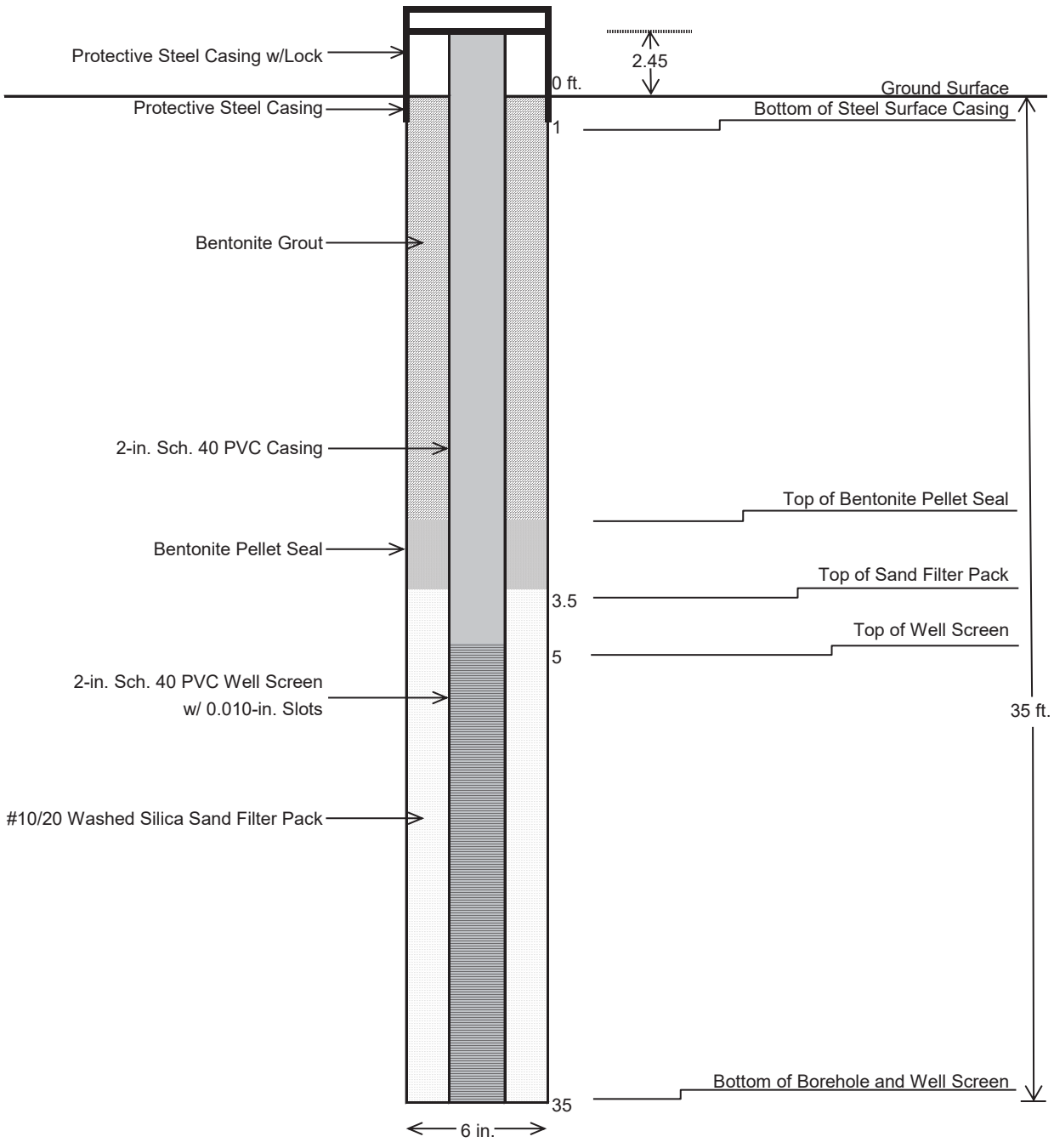
Constructed: 11/16/2015
Drilled By: HP Geotech
PVC Casing EL: 4376.96 ft amsl
Water EL: 4317.62 ft amsl (December 2015)

Monitoring Well Construction Diagram
PNMW-14
Pawnee Station
Xcel Energy



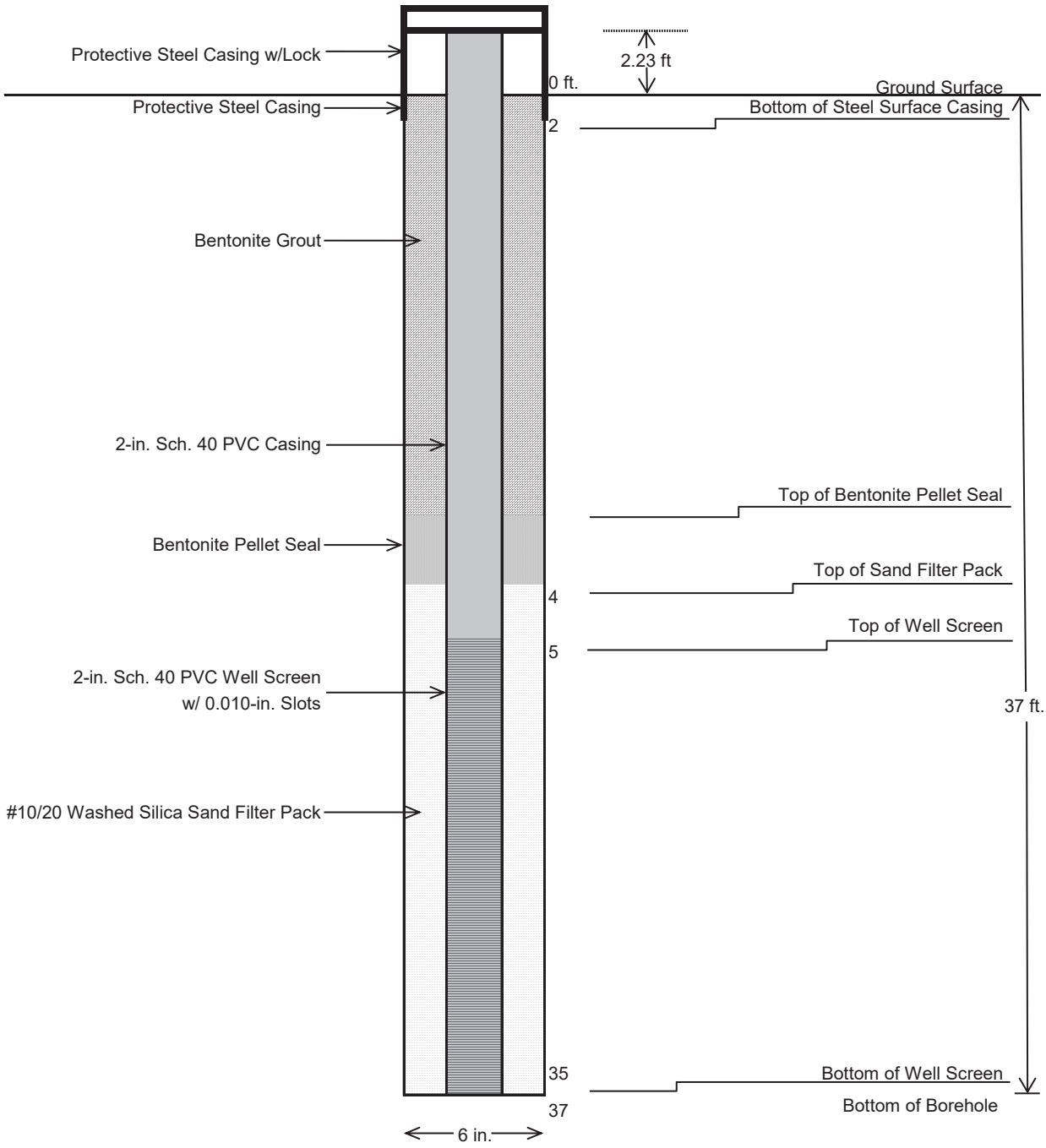
Constructed: 1/31/2017
Drilled By: Site Services Drilling, LLC
PVC Casing EL: 4341.57 ft amsl
Water EL: 4312.67 ft amsl (February 2017)

Monitoring Well Construction Diagram
PNMW-15
Pawnee Station
Xcel Energy



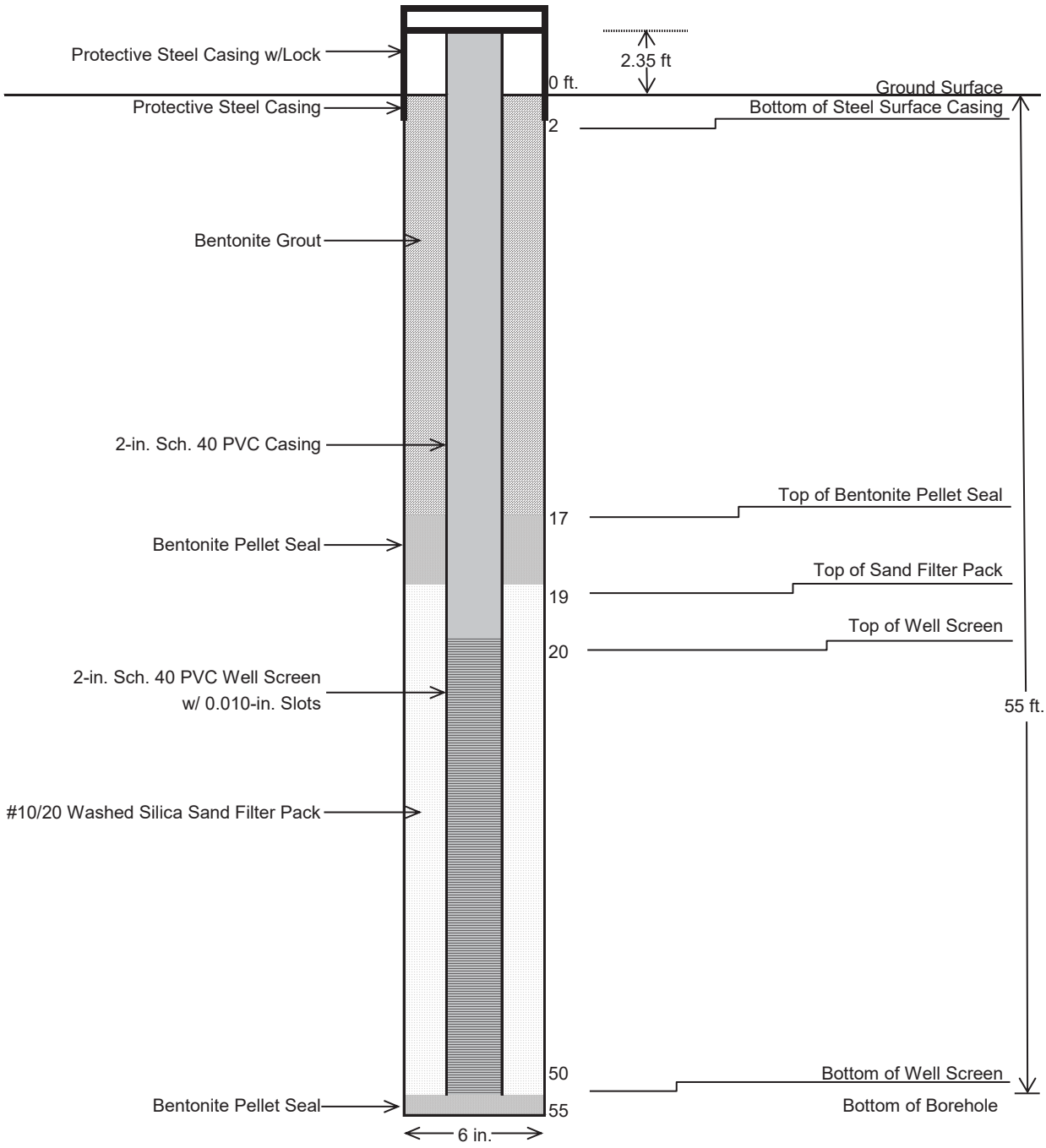
Constructed: 1/26/2017
Drilled By: Site Services Drilling, LLC
PVC Casing EL: 4322.73 ft amsl
Water EL: 4307.14 ft amsl (February 2017)

Monitoring Well Construction Diagram
PNMW-16
Pawnee Station
Xcel Energy



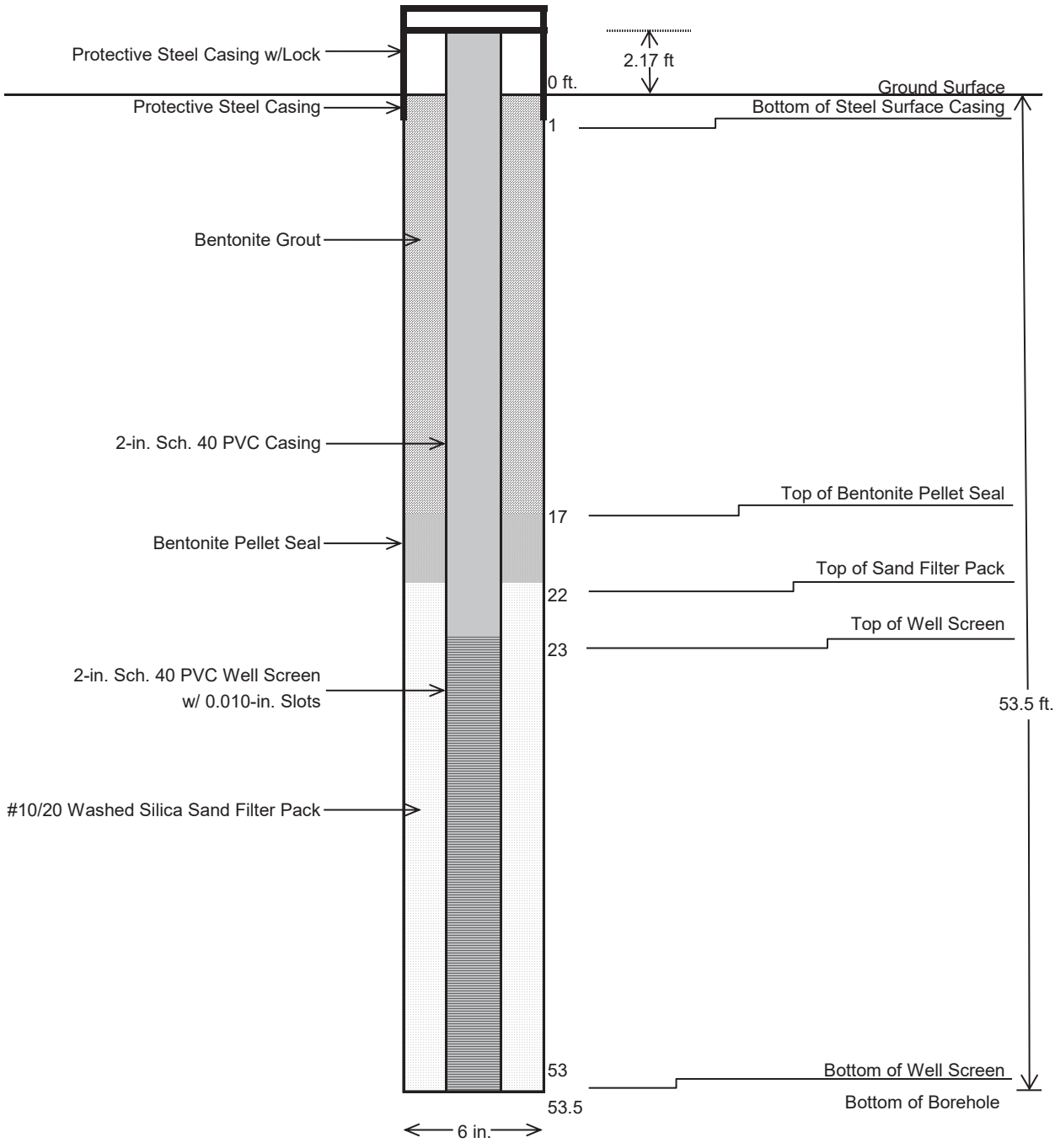
Constructed: 1/26/2017
Drilled By: Site Services Drilling, LLC
PVC Casing EL: 4314.78 ft amsl
Water EL: 4305.85 ft amsl (February 2017)

Monitoring Well Construction Diagram
PNMW-17
Pawnee Station
Xcel Energy



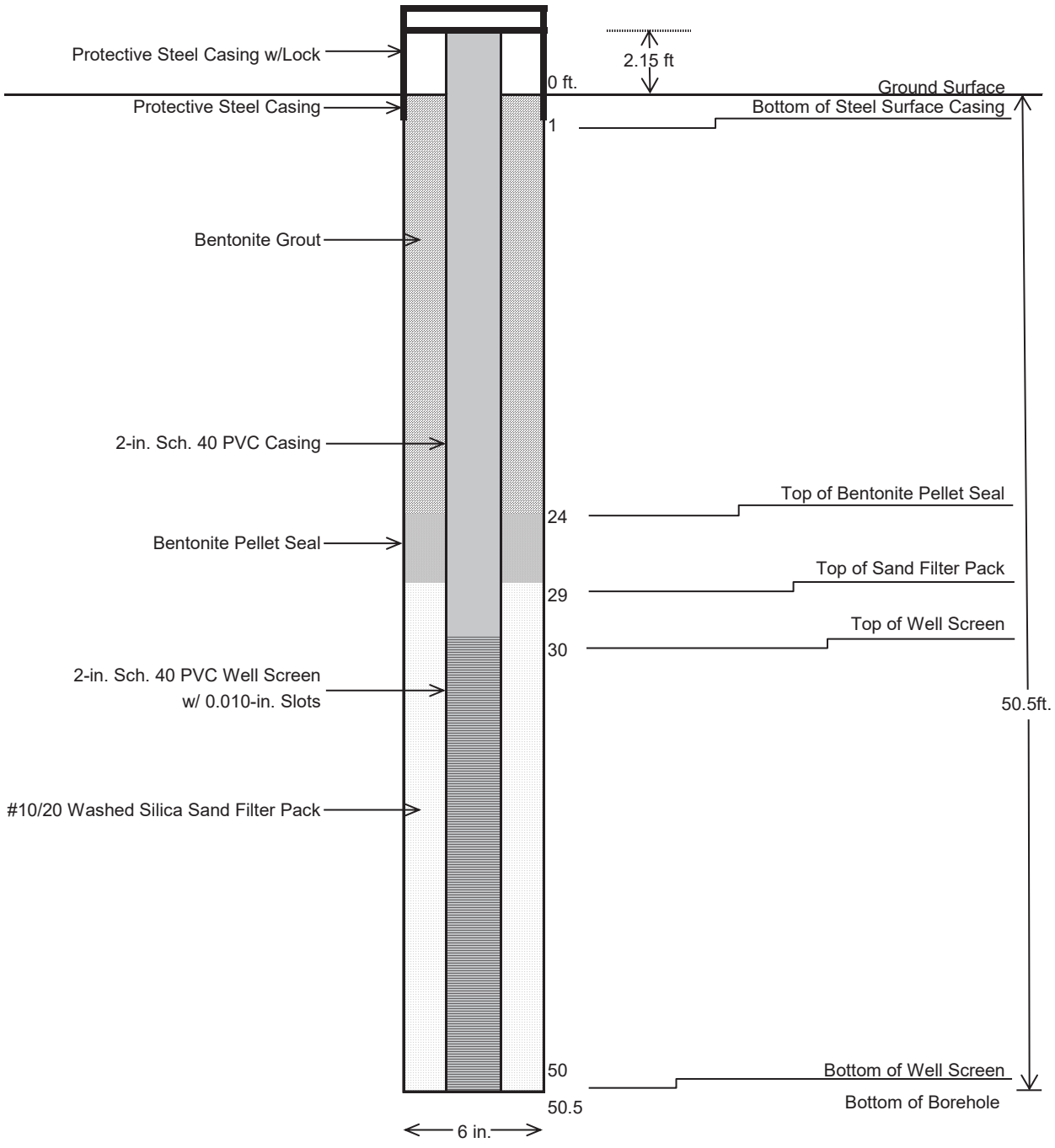
Constructed: 1/19/2017
Drilled By: Site Services Drilling, LLC
PVC Casing EL: 4331.21 ft amsl
Water EL: 4300.85 ft amsl (Feb 2017)

Monitoring Well Construction Diagram
PNMW-18
Pawnee Station
Xcel Energy



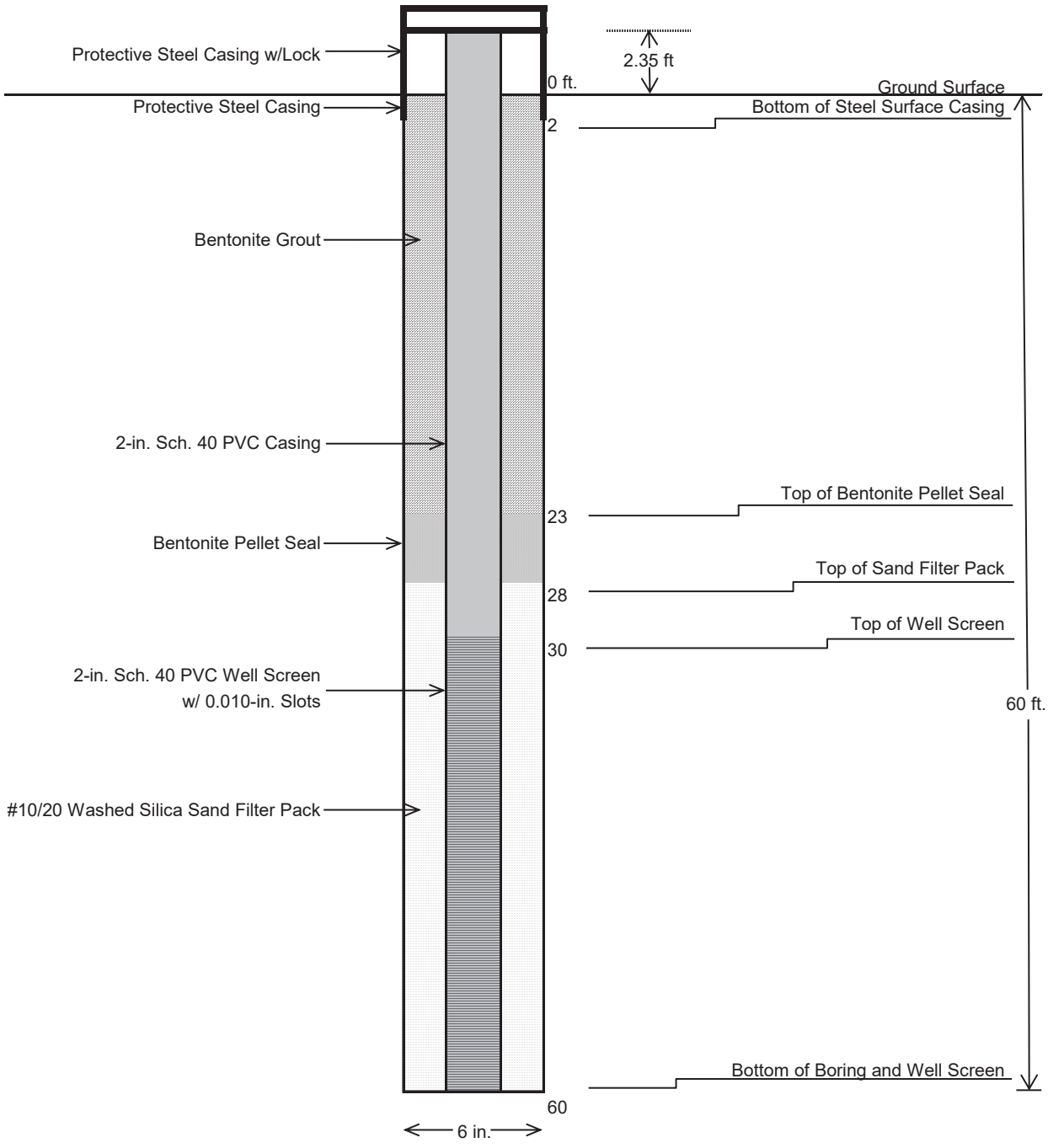
Constructed: 1/23/2017
Drilled By: Site Services Drilling, LLC
PVC Casing EL: 4330.82 ft amsl
Water EL: 4299.82 ft amsl (Febraury 2017)

Monitoring Well Construction Diagram
PNMW-19
Pawnee Station
Xcel Energy



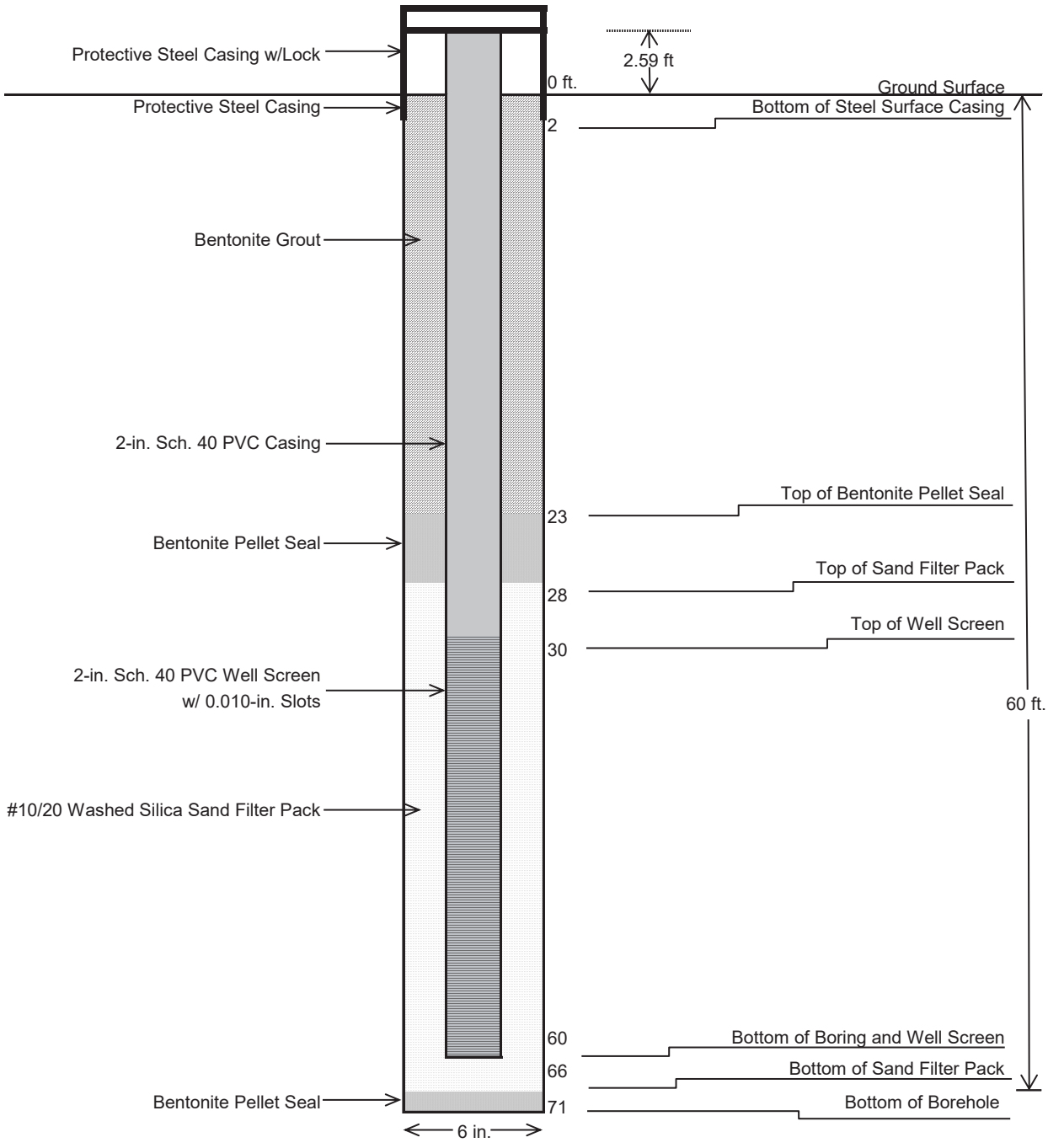
Constructed:	**1/24/2017**
Drilled By:	**Site Services Drilling, LLC**
PVC Casing EL:	**4330.83 ft amsl**
Water EL:	**4301.72 ft amsl (February 2017)**

Monitoring Well Construction Diagram
PNMW-20
Pawnee Station
Xcel Energy



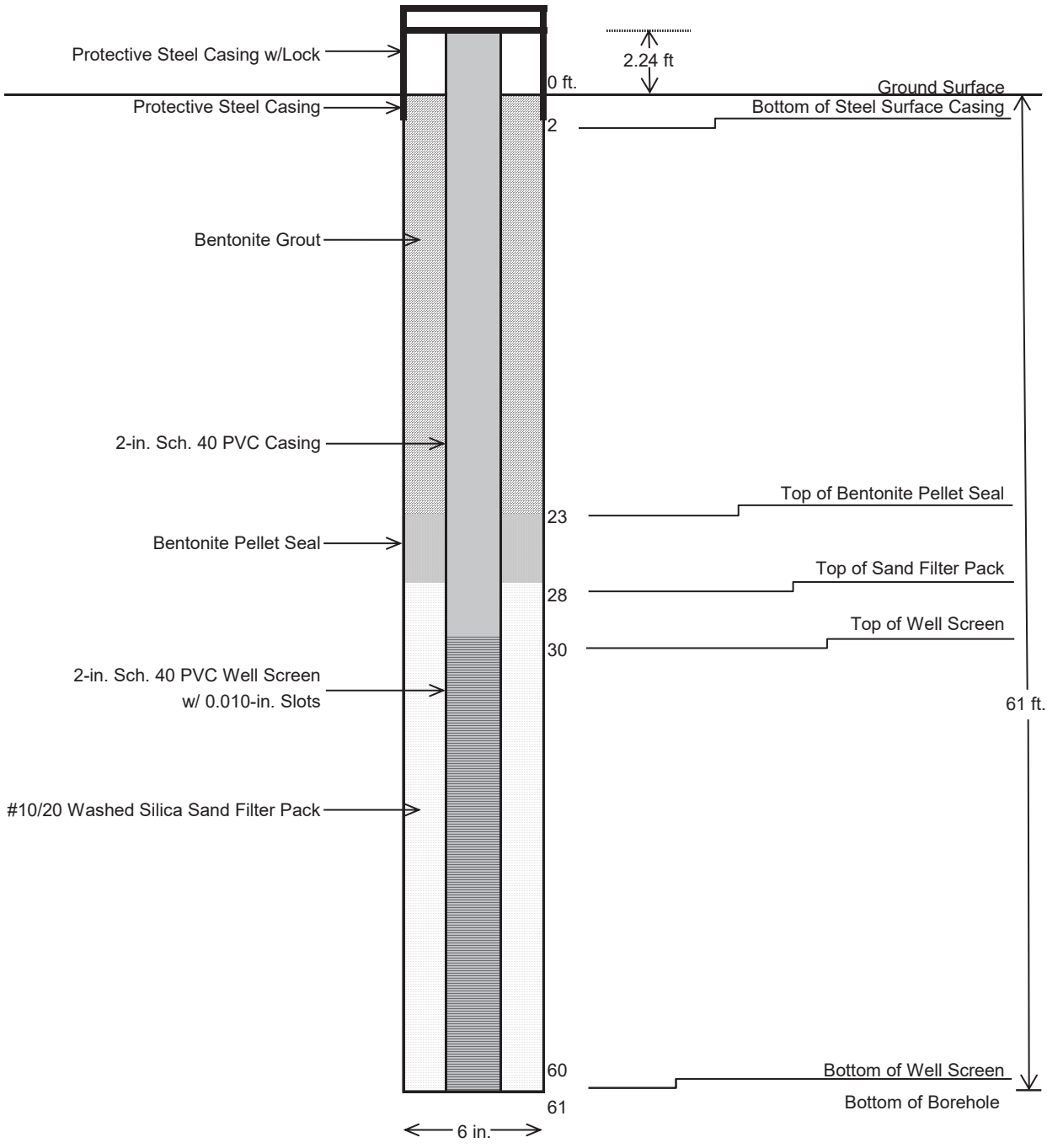
Constructed: 1/30/2017
Drilled By: Site Services Drilling, LLC
PVC Casing EL: 4331.06 ft amsl
Water EL: 4291.81 ft amsl (Febraury 2017)

Monitoring Well Construction Diagram
PNMW-21
Pawnee Station
Xcel Energy



Constructed: 2/8/2017
Drilled By: Site Services Drilling, LLC
PVC Casing EL: 4331.05 ft amsl
Water EL: 4289.73 ft amsl (February 2017)

Monitoring Well Construction Diagram
PNMW-22
Pawnee Station
Xcel Energy



Constructed: 1/30/2017
Drilled By: Site Services Drilling, LLC
PVC Casing EL: 4331.48 ft amsl
Water EL: 4283.97 ft amsl (February 2017)

Monitoring Well Construction Diagram
PNMW-23
Pawnee Station
Xcel Energy

Appendix C

Geotechnical Analysis Laboratory Reports

Hepworth-Pawlak Geotechnical, Inc.
10302 South Progress Way
Parker, Colorado 80134
Phone: 303-841-7119
Fax: 303-841-7556
www.hpgeotech.com

December 14, 2015

Anna Lundin
HDR
1670 Broadway, Suite 3400
Denver, CO 80202

215333B
Anna.Lundin@HDRinc.com

Subject: Laboratory Tests Results – Xcel Coal Combustion Residuals Rule Compliance Project, Pawnee Power Station.

Dear Ms. Lundin:

This letter presents the results of laboratory tests performed on samples submitted for the subject project. The test results are presented on the attached Figures 1-3 and Table 1.

If there are any questions, please feel free to contact us.

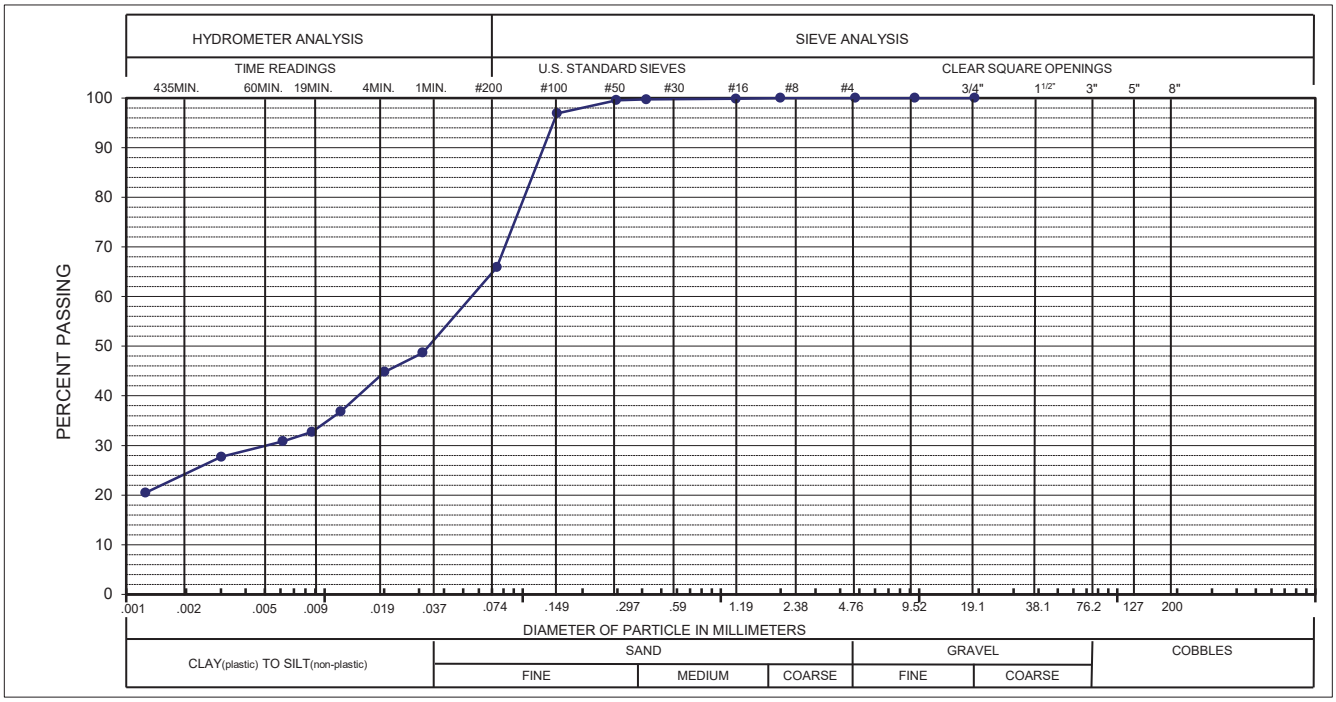
Sincerely,

HEPWORTH-PAWLAK GEOTECHNICAL, Inc.

Cuong Vu, Ph.D., P.E.

Reviewed by: Arben Kalaveshi, P.E.

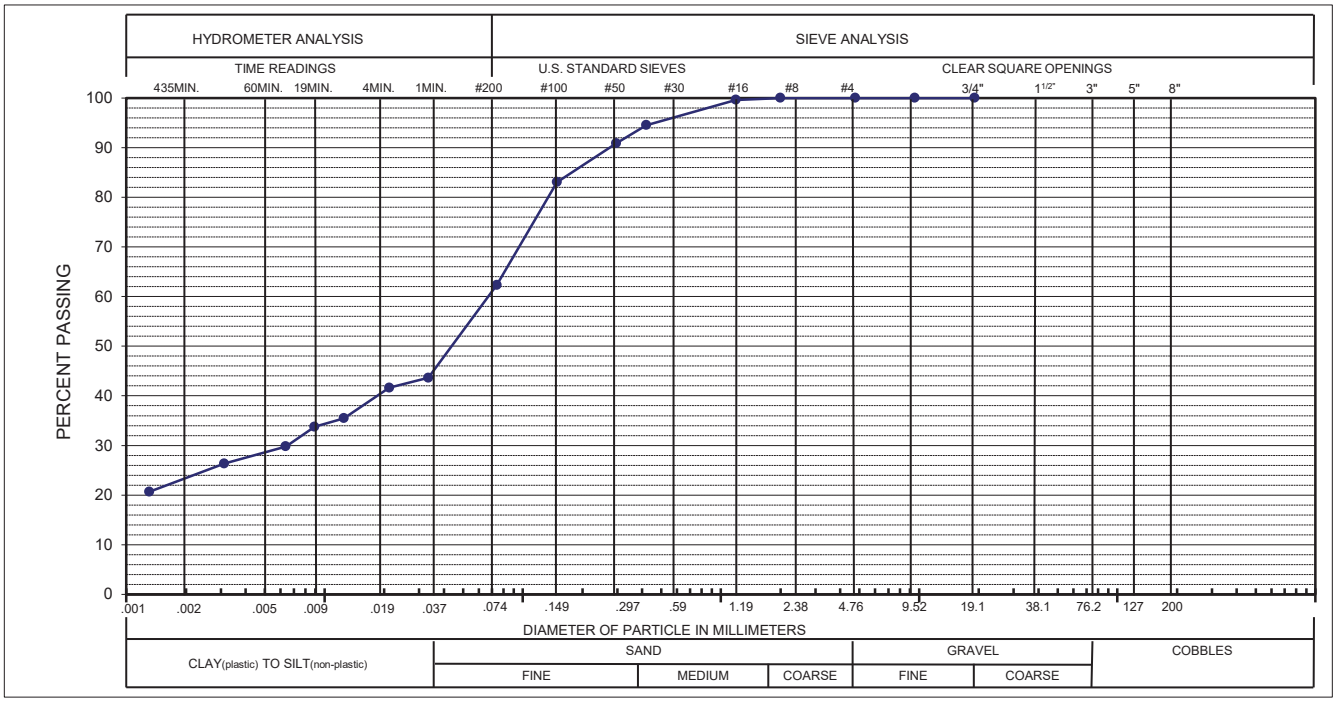
215333B (Pawnee) xmittal.doc



GRAVEL: 0%
SAND: 34%
SILT / CLAY: 66%
BORING : MW12
Specific Gravity: 2.83
DEPTH : 44 feet
Porosity : 39.5%

Sieve Size / Particle Diameter	Percent Passing
(1")	100
(3/4")	100
(1/2")	100
(3/8")	100
(#4)	100
(#10)	100
(#16)	100
(#40)	100
(#50)	100
(#100)	97
(#200)	66
0.0313	49
0.0201	45
0.0121	37
0.0086	33
0.0062	31
0.0030	28
0.0013	20

215333B	HEPWORTH-PAWLAK GEOTECHNICAL, INC.	HDR PAWNEE HYDROMETER AND SIEVE ANALYSIS	FIG. 1



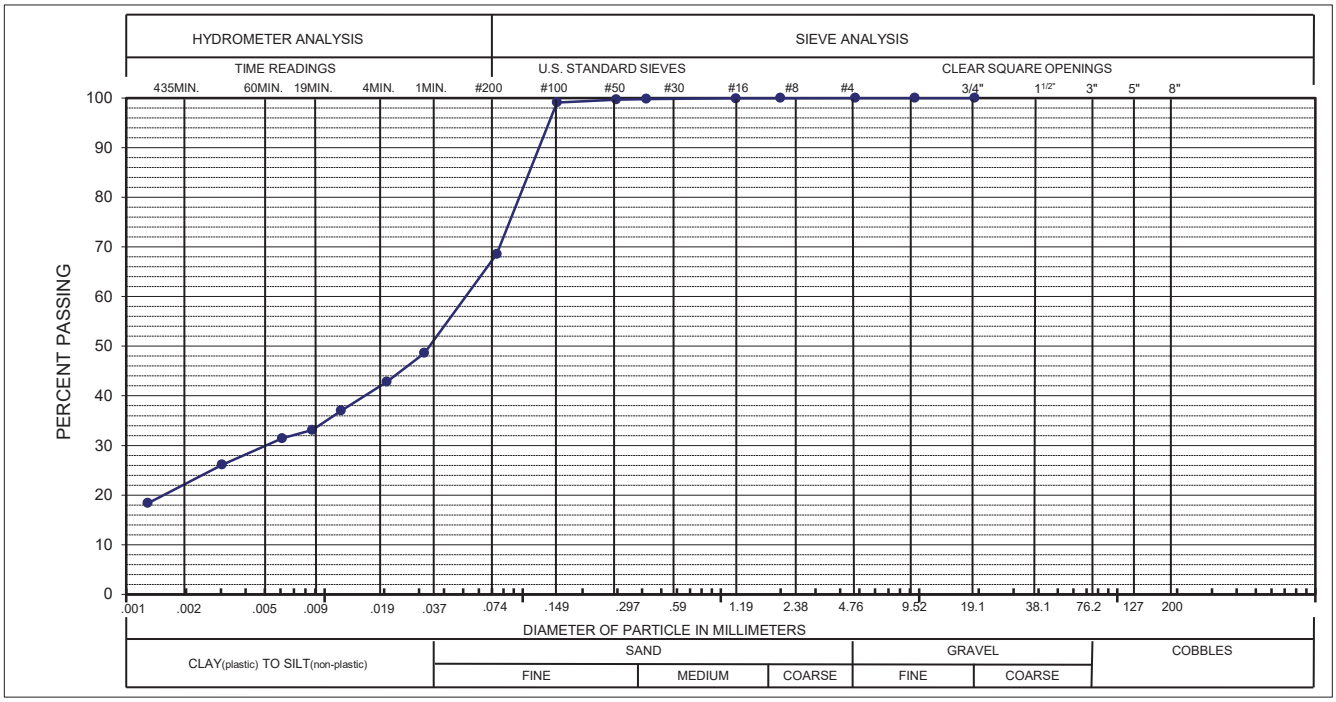
GRAVEL: 0%
BORING : MW13
DEPTH : 34 feet

SAND: 38%

SILT / CLAY: 62%
Specific Gravity: 2.72
Porosity : 31.7%

Sieve Size / Particle Diameter	Percent Passing
(1")	100
(3/4")	100
(1/2")	100
(3/8")	100
(#4)	100
(#10)	100
(#16)	100
(#40)	95
(#50)	91
(#100)	83
(#200)	62
0.0334	44
0.0212	42
0.0125	35
0.0089	34
0.0064	30
0.0031	26
0.0013	21

215333B	HEPWORTH-PAWLAK GEOTECHNICAL, INC.	HDR PAWNEE HYDROMETER AND SIEVE ANALYSIS	FIG. 2



GRAVEL: 0%
BORING : MW14
DEPTH : 69 feet

SAND: 31%

SILT / CLAY: 69%
Specific Gravity: 2.81
Porosity : 39.7%

Sieve Size / Particle Diameter	Percent Passing
(1")	100
(3/4")	100
(1/2")	100
(3/8")	100
(#4)	100
(#10)	100
(#16)	100
(#40)	100
(#50)	100
(#100)	99
(#200)	69
0.0319	49
0.0206	43
0.0121	37
0.0087	33
0.0061	31
0.0030	26
0.0013	18

215333B	HEPWORTH-PAWLAK GEOTECHNICAL, INC.	HDR PAWNEE HYDROMETER AND SIEVE ANALYSIS	FIG. 3

HEPWORTH-PAWLAK GEOTECHNICAL, INC.

JOB NO. 215333B
PROJECT: PAWNEE

TABLE 1
SUMMARY OF LABORATORY TEST RESULTS

SAMPLE LOCATION		NATURAL MOISTURE CONTENT (%)	NATURAL DRY UNIT WEIGHT (PCF)	GRADATION			SPECIFIC GRAVITY	POROSITY (%)
BORING	DEPTH feet			GRAVEL (%)	SAND (%)	SILT & CLAY (%)		
MW12	44	20.4	107	0	34	66	2.83	39.5
MW13	34	14.7	116	0	38	62	2.72	31.7
MW14	69	21.4	106	0	31	69	2.81	39.7

PERMEABILITY TEST - BACK PRESSURE SATURATED - FLOW PUMP METHOD

ASTM D5084 Method D

CLIENT	HDR	JOB NO.	2279-11

PROJECT	Xcel Pawnee			
PROJECT NO.	--	SAMPLED	--	By: --
BORING NO.	TB-3	TEST STARTED	3/16/2017	By: CAL
DEPTH	42-44'	TEST FINISHED	3/23/2017	By: CAL
SAMPLE NO.	--	CELL NUMBER	4P	
LOCATION	--	PERMEANT	Tap Water	
SAMPLE TYPE	Liner	CONF. PRES. - (psf)	5169	

MOISTURE / DENSITY DATA	BEFORE TEST	AFTER TEST
Wt. Soil + Moisture - (g)	290.22	294.06
Wt. Wet Soil & Pan - (g)	296.96	300.80
Wt. Dry Soil & Pan - (g)	243.37	243.37
Wt. Lost Moisture - (g)	53.59	57.43
Wt. of Pan Only - (g)	6.74	6.74
Wt. of Dry Soil - (g)	236.63	236.63
Moisture Content - (%)	22.6	24.3
Wet Density - (pcf)	122.9	129.2
Dry Density - (pcf)	100.2	104.0
Init. Diameter - (in)	1.938	
Init. Area - (sq in)	2.950	
Init. Height - (in)	3.049	
Vol. Bef. Consol. - (cu ft)	0.00520	
Vol. After Consol. - (cu ft)	0.00502	
Porosity - (%)	40.41	

FLOW PUMP CALCULATIONS	
Pump Setting (gear number)	12
Percentage of Pump Setting	100
Q - (cc/s)	2.30E-05
Height - (in)	2.985
Diameter - (in)	1.923
Pressure - (psi)	0.710
Area after consol. - (sq cm)	18.741
Gradient	6.584
Permeability k - (cm/s)	1.9E-07
Permeability k - (m/s)	1.9E-09
Back Pressure - (psi)	48.0
Cell Pressure - (psi)	83.9
Ave. Effective Stress - (psi)	35.545
Average temperature degree - (c°)	23.2

Data entry by:	KR	Date:	03/27/2017
Checked by:	CM	Date:	3/28/2017

PERMEABILITY TEST - BACK PRESSURE SATURATED - FLOW PUMP METHOD

ASTM D5084 Method D

CLIENT	HDR	JOB NO.	2279-11

PROJECT	Xcel Pawnee			
PROJECT NO.	--	SAMPLED	--	By: --
BORING NO.	TB-3	TEST STARTED	3/16/2017	By: CAL
DEPTH	42-44'	TEST FINISHED	3/23/2017	By: CAL
SAMPLE NO.	--	CELL NUMBER	4P	
LOCATION	--	PERMEANT	Tap Water	
SAMPLE TYPE	Liner	CONF. PRES. - (psf)	5169	

SATURATION DATA

Cell Press.	Back Press.	Burette Reading (cc)		Pore Press. (psi)			
(psi)	(psi)	Close	Open	Close	Open	Change	B
40.0	38.0	1.5	11.2				
50.0	48.0	10.9	11.8	38.5	47.9	9.4	0.94
60.0		11.9	12.0	48.5	58.1	9.6	0.96

CONSOLIDATION DATA

Elapsed Time (Min)	SQRT Time (Min)	Burette Reading (cc)	Volume Defl. (cc)
0.00	0.00	12.10	0.00
0.25	0.50	15.60	-3.50
0.5	0.71	15.80	-3.70
1	1.00	16.20	-4.10
2	1.41	16.70	-4.60
4	2.00	17.35	-5.25
9	3.00	18.40	-6.30
16	4.00	19.25	-7.15
30	5.48	20.00	-7.90
60	7.75	20.50	-8.40
120	10.95	20.75	-8.65
240	15.49	20.90	-8.80
360	18.97	20.90	-8.80

Initial Height - (in)	3.049	Init. Vol. - (cc)	147.41
Height Change - (in)	0.064	Vol. Change - (cc)	19.50
Ht. After Cons. - (in)	2.985	Cell Exp. - (cc)	14.21
Initial Area - (sq in)	2.950	Net Change - (cc)	5.29
Area After Cons. - sq in	2.905	Cons. Vol. - (cc)	142.12

ATT
ADVANCED TERRA TESTING

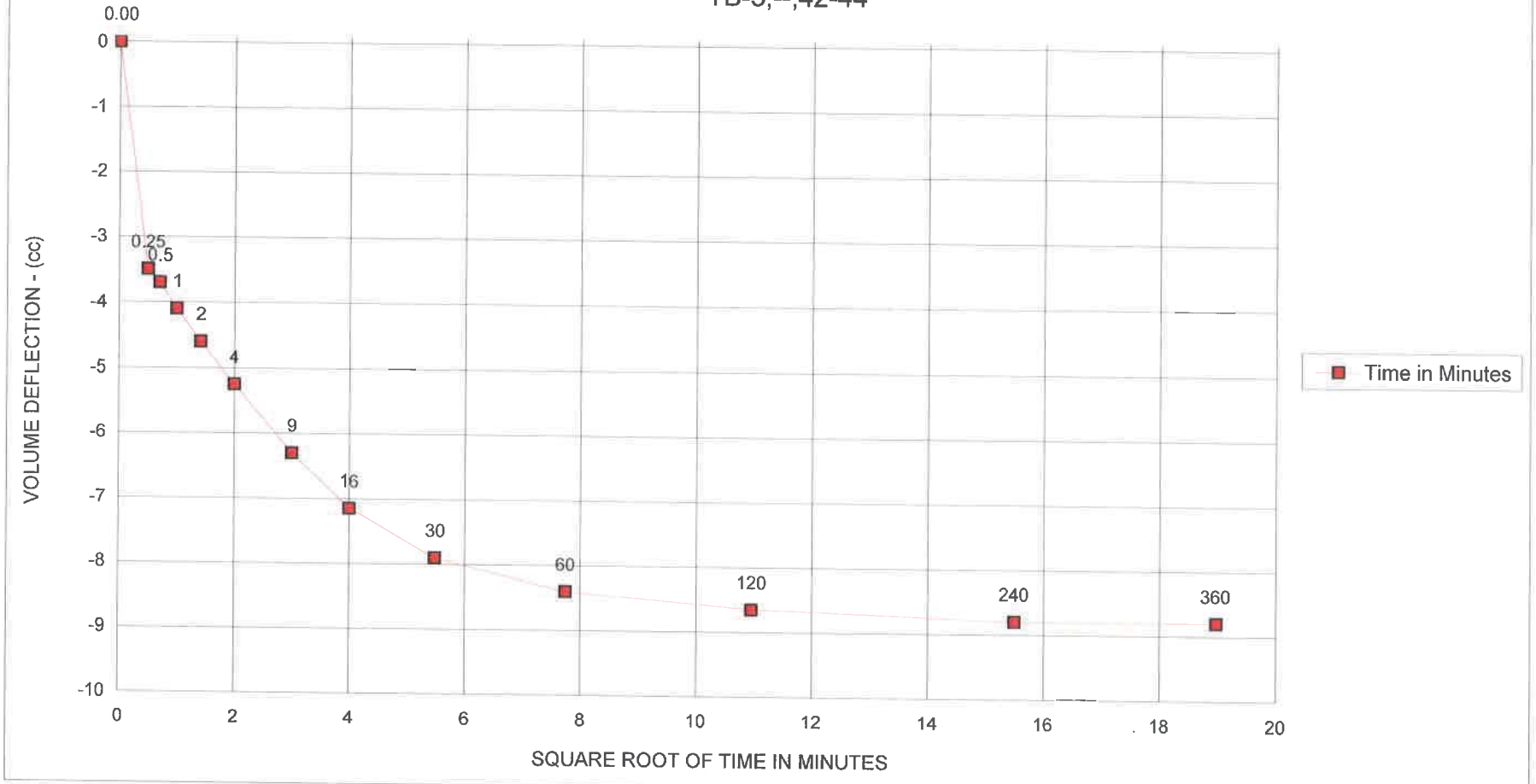
PERMEABILITY TEST - BACK PRESSURE SATURATED - FLOW PUMP METHOD

ASTM D5084 Method D

CLIENT HDR		JOB NO. 2279-11

CONSOLIDATION DATA

TB-3,--,42-44'

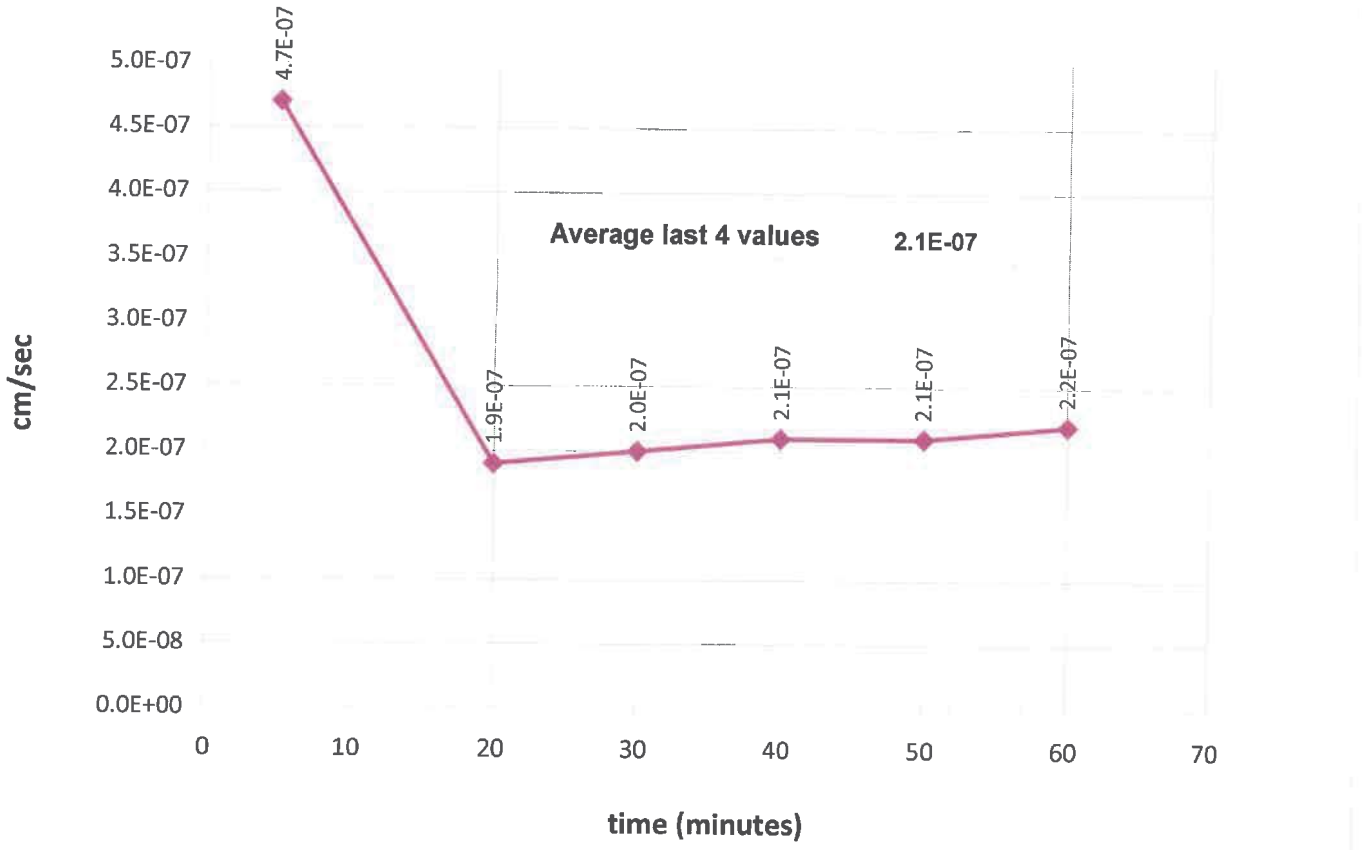


FileName: 2279_11_HarvardFlowPump-Perm-ASTMD-5084-R3_0.xls

ADVANCED TERRA TESTING

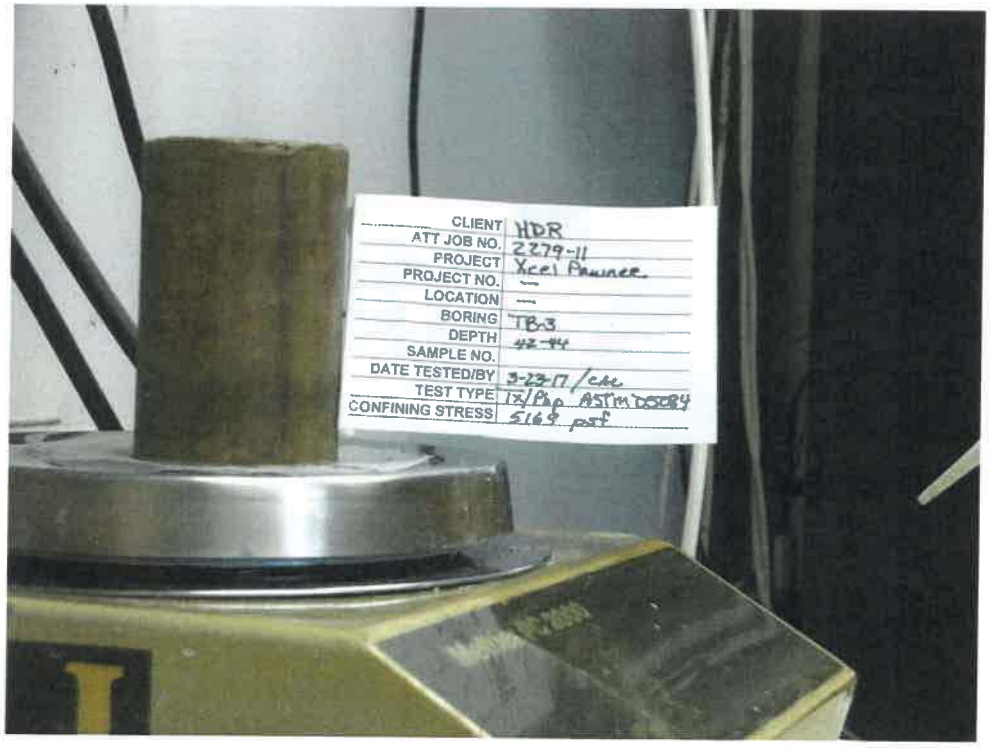
Preliminary Flow Pump Test Data
ASTM D5084

Client:	HDR	Boring Number:	TB-3		
Job Number:	2279-11	Depth:	42-44'		
Project:	Xcel Pawnee	Sample Number:	--		
Location:	--	Sampled Date:	--	Sampled By:	--
Project Number:		Test Date:	3/23/2017	Technician:	CAL



Data Entered By: CAL
Date: 3/23/2017
File Name: 2279_11_PrelimPerm_ASTMD-5084-methodD-R0_0.xls

Checked By: KA
Date: 3/27/17



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PERMEABILITY TEST - BACK PRESSURE SATURATED - FLOW PUMP METHOD

ASTM D5084 Method D

CLIENT	HDR	JOB NO.	2279-11

PROJECT	Xcel Pawnee			
PROJECT NO.	--	SAMPLED	--	By: --
BORING NO.	MW-21	TEST STARTED	3/16/2017	By: CAL
DEPTH	59-61'	TEST FINISHED	3/29/2017	By: CAL
SAMPLE NO.	--	CELL NUMBER	6P	
LOCATION	--	PERMEANT	Tap Water	
SAMPLE TYPE	liner	CONF. PRES. - (psf)	7359	

MOISTURE / DENSITY DATA	BEFORE TEST	AFTER TEST
Wt. Soil + Moisture - (g)	287.94	289.73
Wt. Wet Soil & Pan - (g)	294.89	296.68
Wt. Dry Soil & Pan - (g)	241.05	241.05
Wt. Lost Moisture - (g)	53.84	55.63
Wt. of Pan Only - (g)	6.95	6.95
Wt. of Dry Soil - (g)	234.10	234.10
Moisture Content - (%)	23.0	23.8
Wet Density - (pcf)	124.7	130.3
Dry Density - (pcf)	101.4	105.3
Init. Diameter - (in)	1.918	
Init. Area - (sq in)	2.889	
Init. Height - (in)	3.044	
Vol. Bef. Consol. - (cu ft)	0.00509	
Vol. After Consol. - (cu ft)	0.00490	
Porosity - (%)	40.08	

FLOW PUMP CALCULATIONS	
Pump Setting (gear number)	12
Percentage of Pump Setting	100
Q - (cc/s)	2.30E-05
Height - (in)	2.966
Diameter - (in)	1.907
Pressure - (psi)	4.010
Area after consol. - (sq cm)	18.422
Gradient	37.424
Permeability k - (cm/s)	3.3E-08
Permeability k - (m/s)	3.3E-10
Back Pressure - (psi)	68.0
Cell Pressure - (psi)	119.1
Ave. Effective Stress - (psi)	49.095
Average temperature degree - (c°)	22.2

Data entry by:	CAL	Date:	03/30/2017
Checked by:	DRM	Date:	3/31/17

PERMEABILITY TEST - BACK PRESSURE SATURATED - FLOW PUMP METHOD

ASTM D5084 Method D

CLIENT	HDR	JOB NO.	2279-11

PROJECT	Xcel Pawnee			
PROJECT NO.	--	SAMPLED	--	By: --
BORING NO.	MW-21	TEST STARTED	3/16/2017	By: CAL
DEPTH	59-61'	TEST FINISHED	3/29/2017	By: CAL
SAMPLE NO.	--	CELL NUMBER	6P	
LOCATION	--	PERMEANT	Tap Water	
SAMPLE TYPE	liner	CONF. PRES. - (psf)	7359	

SATURATION DATA

Cell Press.	Back Press.	Burette Reading (cc)		Pore Press. (psi)			
(psi)	(psi)	Close	Open	Close	Open	Change	B
40.0	38.0	1.8	8.9				
50.0	48.0	9.6	10.6	38.4	47.1	8.7	0.87
60.0	58.0	10.6	11.4	48.6	57.7	9.1	0.91
70.0	68.0	11.6	12.4	58.6	67.9	9.3	0.93
80.0		12.5	12.6	68.5	78.0	9.5	0.95

CONSOLIDATION DATA

Elapsed Time (Min)	SQRT Time (Min)	Burette Reading (cc)	Volume Defl. (cc)
0.00	0.00	12.60	0.00
0.25	0.50	17.40	-4.80
0.5	0.71	17.70	-5.10
1	1.00	18.00	-5.40
2	1.41	18.45	-5.85
4	2.00	19.00	-6.40
9	3.00	19.90	-7.30
16	4.00	20.60	-8.00
30	5.48	21.50	-8.90
60	7.75	22.70	-10.10
120	10.95	23.60	-11.00
240	15.49	24.25	-11.65
360	18.97	24.35	-11.75

Initial Height - (in)	3.044	Init. Vol. - (cc)	144.15
Height Change - (in)	0.078	Vol. Change - (cc)	23.90
Ht. After Cons. - (in)	2.966	Cell Exp. - (cc)	18.56
Initial Area - (sq in)	2.889	Net Change - (cc)	5.34
Area After Cons. - sq in	2.855	Cons. Vol. - (cc)	138.81

ATT
ADVANCED TERRA TESTING

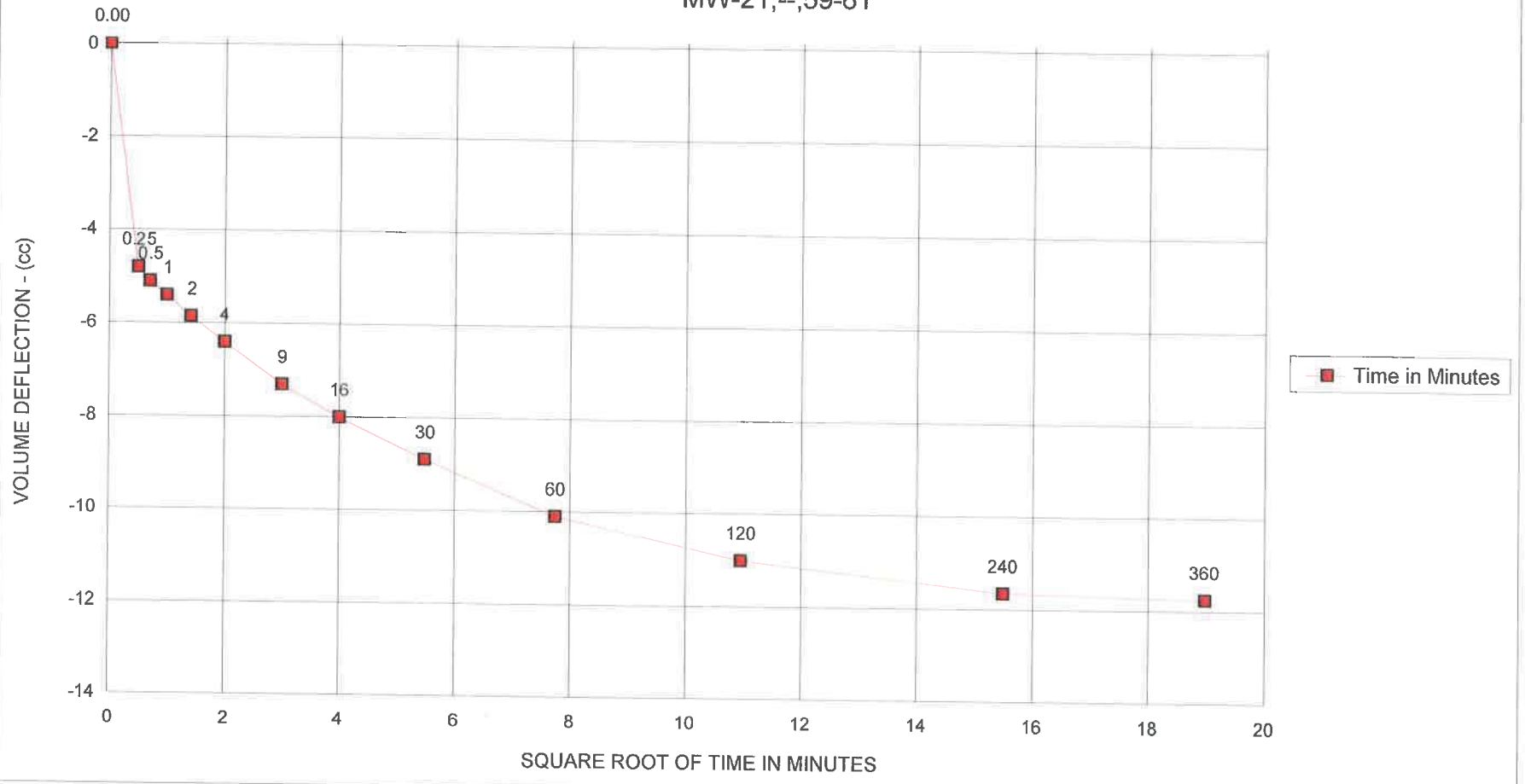
PERMEABILITY TEST - BACK PRESSURE SATURATED - FLOW PUMP METHOD

ASTM D5084 Method D

CLIENT HDR		JOB NO. 2279-11

CONSOLIDATION DATA

MW-21,--,59-61'

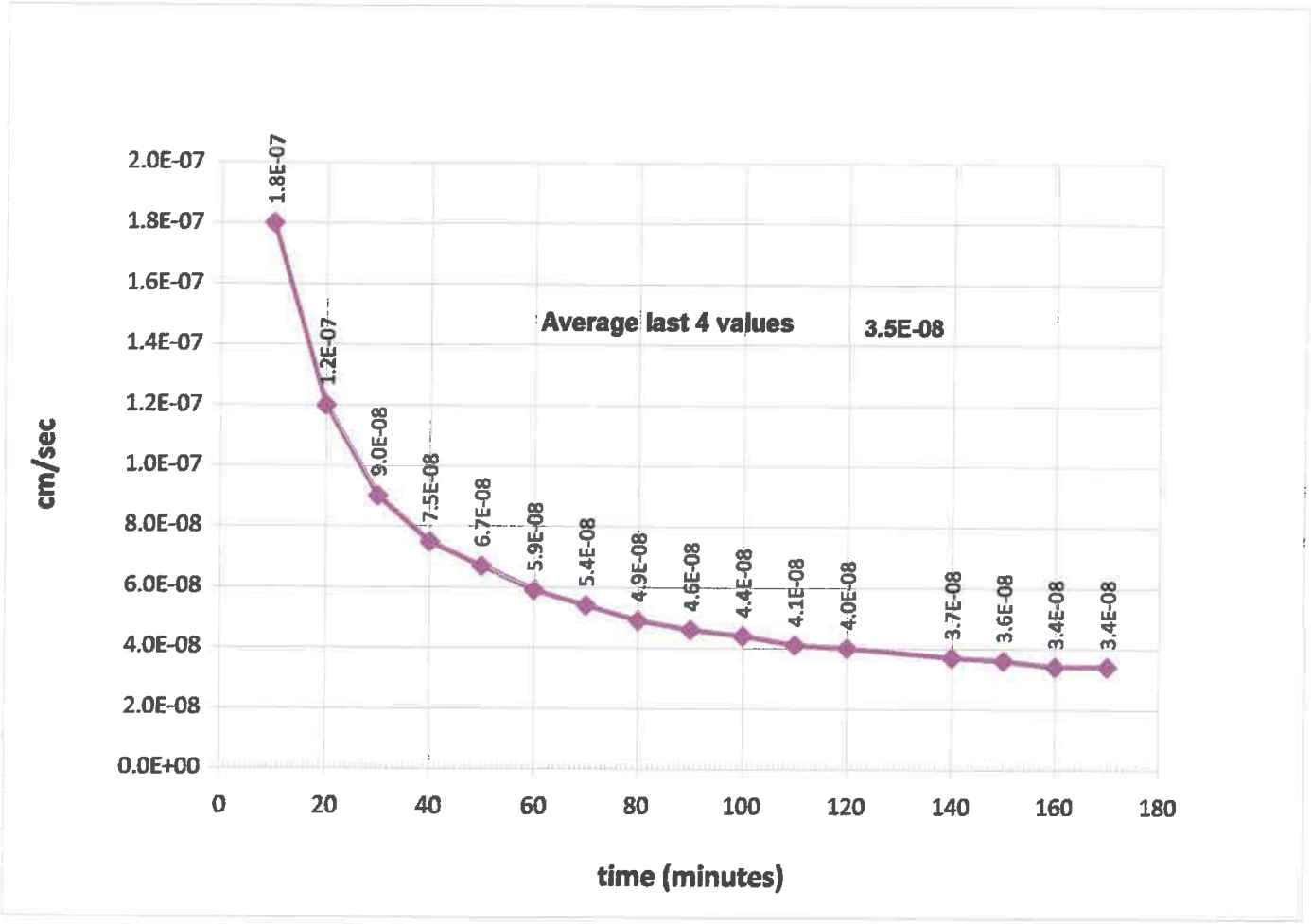


FileName: 2279_11_HarvardFlowPump-Perm-ASTMD-5084-R3_1.xls

ADVANCED TERRA TESTING

Preliminary Flow Pump Test Data
ASTM D5084

Client:	HDR	Boring Number:	MW-21		
Job Number:	2279-11	Depth:	59-61'		
Project:	Xcel Pawnee	Sample Number:	--		
Location:	--	Sampled Date:	--	Sampled By:	--
Project Number:		Test Date:	3/29/2017	Technician:	CAL



Data Entered By: CAL
Date: 3/29/2017
File Name: 2279_11_PrelimPerm_ASTMD-5084-methodD-R0_1.xls

Checked By: DPM
Date: 3/31/17

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PERMEABILITY TEST - BACK PRESSURE SATURATED - FLOW PUMP METHOD

ASTM D5084 Method D

CLIENT	HDR	JOB NO.	2279-11

PROJECT	Xcel Pawnee			
PROJECT NO.	--	SAMPLED	--	By: --
BORING NO.	TP-7	TEST STARTED	3/16/2017	By: CAL
DEPTH	19-21'	TEST FINISHED	3/30/2017	By: CAL
SAMPLE NO.	--	CELL NUMBER	11P	
LOCATION	--	PERMEANT	Tap Water	
SAMPLE TYPE	liner	CONF. PRES. - (psf)	2175	

MOISTURE / DENSITY DATA	BEFORE TEST	AFTER TEST
Wt. Soil + Moisture - (g)	263.98	285.45
Wt. Wet Soil & Pan - (g)	270.50	291.97
Wt. Dry Soil & Pan - (g)	256.71	256.71
Wt. Lost Moisture - (g)	13.79	35.26
Wt. of Pan Only - (g)	6.52	6.52
Wt. of Dry Soil - (g)	250.19	250.19
Moisture Content - (%)	5.5	14.1
Wet Density - (pcf)	114.5	126.4
Dry Density - (pcf)	108.5	110.8
Init. Diameter - (in)	1.923	
Init. Area - (sq in)	2.904	
Init. Height - (in)	3.025	
Vol. Bef. Consol. - (cu ft)	0.00508	
Vol. After Consol. - (cu ft)	0.00498	
Porosity - (%)	25.01	

FLOW PUMP CALCULATIONS	
Pump Setting (gear number)	1
Percentage of Pump Setting	100
Q - (cc/s)	1.09E-01
Height - (in)	3.022
Diameter - (in)	1.904
Pressure - (psi)	0.082
Area after consol. - (sq cm)	18.367
Gradient	0.751
Permeability k - (cm/s)	7.9E-03
Permeability k - (m/s)	7.9E-05
Back Pressure - (psi)	78.0
Cell Pressure - (psi)	93.1
Ave. Effective Stress - (psi)	15.059
Average temperature degree - (c°)	22.1

Data entry by:	CAL	Date:	03/31/2017
Checked by:	DPM	Date:	4/5/17

PERMEABILITY TEST - BACK PRESSURE SATURATED - FLOW PUMP METHOD

ASTM D5084 Method D

CLIENT	HDR	JOB NO.	2279-11

PROJECT	Xcel Pawnee		
PROJECT NO.	--	SAMPLED	-- By: --
BORING NO.	TP-7	TEST STARTED	3/16/2017 By: CAL
DEPTH	19-21'	TEST FINISHED	3/30/2017 By: CAL
SAMPLE NO.	--	CELL NUMBER	11P
LOCATION	--	PERMEANT	Tap Water
SAMPLE TYPE	liner	CONF. PRES. - (psf)	2175

SATURATION DATA

Cell Press.	Back Press.	Burette Reading (cc)		Pore Press. (psi)			
(psi)	(psi)	Close	Open	Close	Open	Change	B
40.0	38.0	1.8	9.6				
50.0	48.0	10.2	11.1	38.2	43.1	4.9	0.49
60.0	58.0	11.6	12.4	48.7	56.3	7.6	0.76
70.0	68.0	12.5	13.3	58.9	67.2	8.3	0.83
80.0	78.0	13.6	14.3	68.6	77.7	9.1	0.91
90.0		14.4	14.4	78.6	88.2	9.6	0.96

CONSOLIDATION DATA

Elapsed Time (Min)	SQRT Time (Min)	Burette Reading (cc)	Volume Defl. (cc)
0.00	0.00	14.40	0.00
0.25	0.50	16.00	-1.60
0.5	0.71	16.00	-1.60
1	1.00	16.05	-1.65
2	1.41	16.10	-1.70
4	2.00	16.10	-1.70
9	3.00	16.10	-1.70
16	4.00	16.20	-1.80
30	5.48	16.20	-1.80
60	7.75	16.20	-1.80
120	10.95	16.25	-1.85
240	15.49	16.25	-1.85
360	18.97	16.25	-1.85

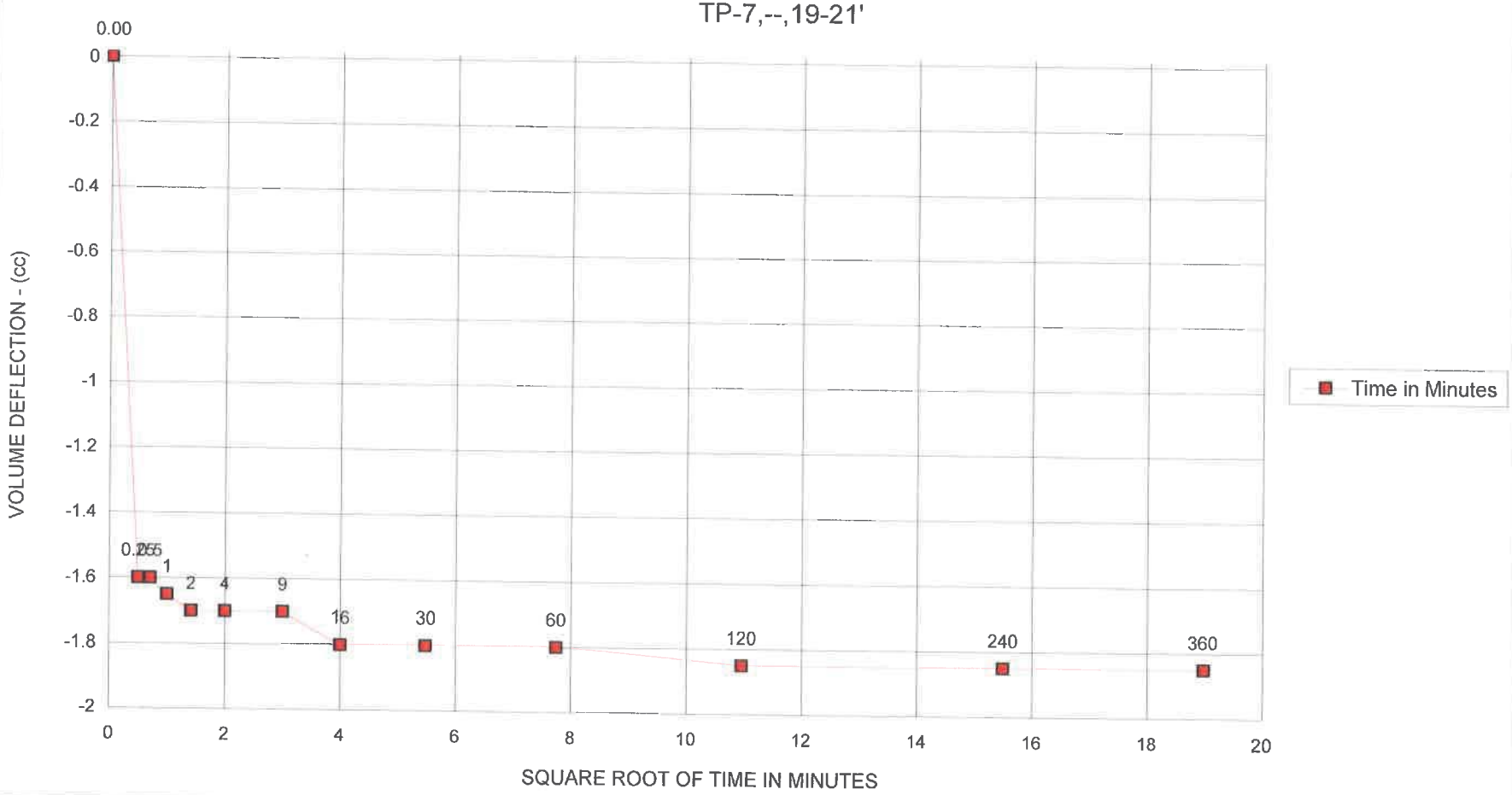
Initial Height - (in)	3.025	Init. Vol. - (cc)	144.00
Height Change - (in)	0.003	Vol. Change - (cc)	15.40
Ht. After Cons. - (in)	3.022	Cell Exp. - (cc)	12.41
Initial Area - (sq in)	2.904	Net Change - (cc)	2.99
Area After Cons. - sq in	2.847	Cons. Vol. - (cc)	141.01

ATT
ADVANCED TERRA TESTING

PERMEABILITY TEST - BACK PRESSURE SATURATED - FLOW PUMP METHOD
ASTM D5084 Method D

CLIENT HDR		JOB NO. 2279-11

CONSOLIDATION DATA
TP-7,--,19-21'

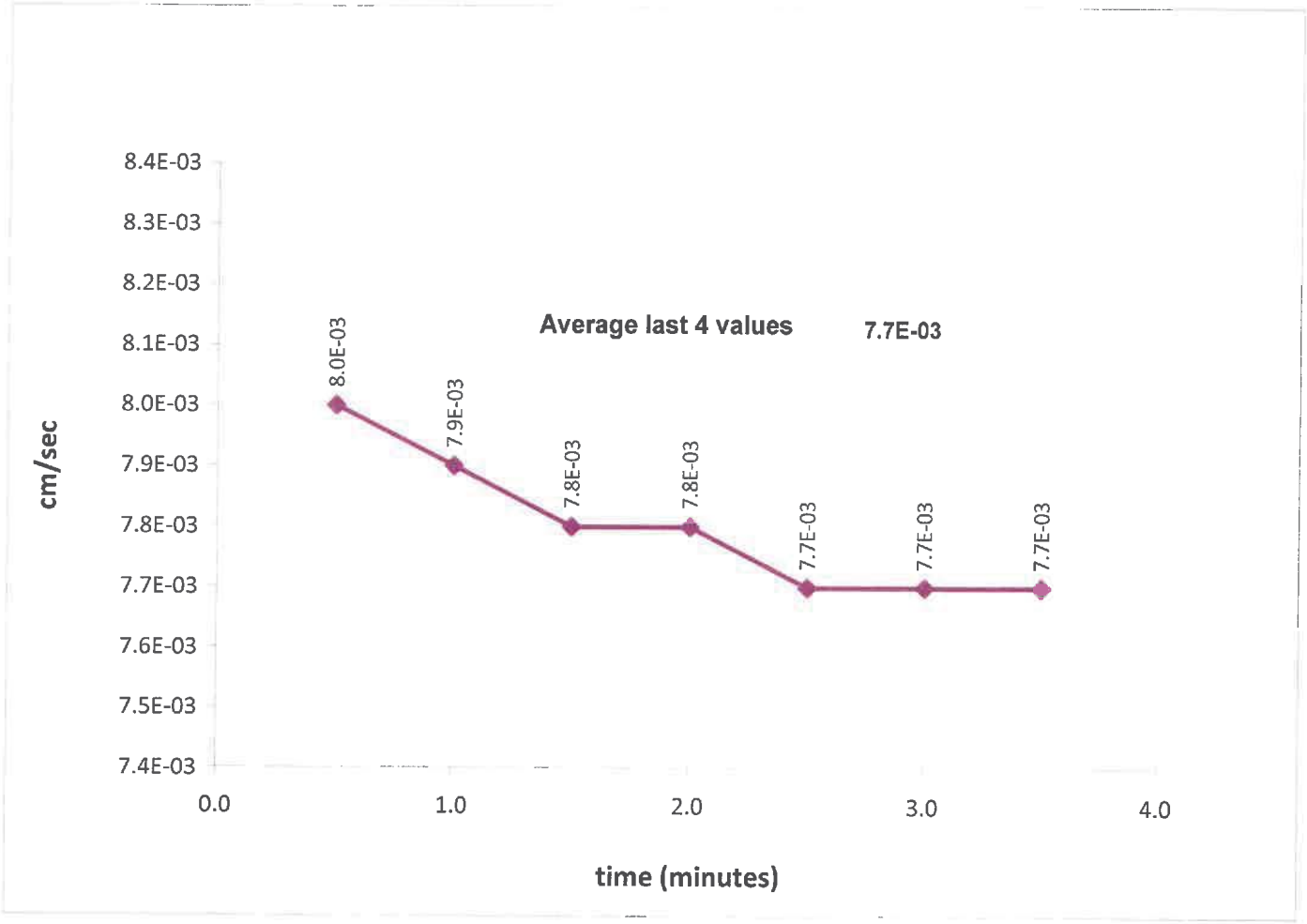


FileName: 2279_11_HarvardFlowPump-Perm-ASTMD-5084-R3_2.xls

ADVANCED TERRA TESTING

Preliminary Flow Pump Test Data
ASTM D5084

Client:	HDR	Boring Number:	TP-7		
Job Number:	2279-11	Depth:	19-21'		
Project:	Xcel Pawnee	Sample Number:	--		
Location:	--	Sampled Date:	--	Sampled By:	--
Project Number:		Test Date:	3/30/2017	Technician:	CAL



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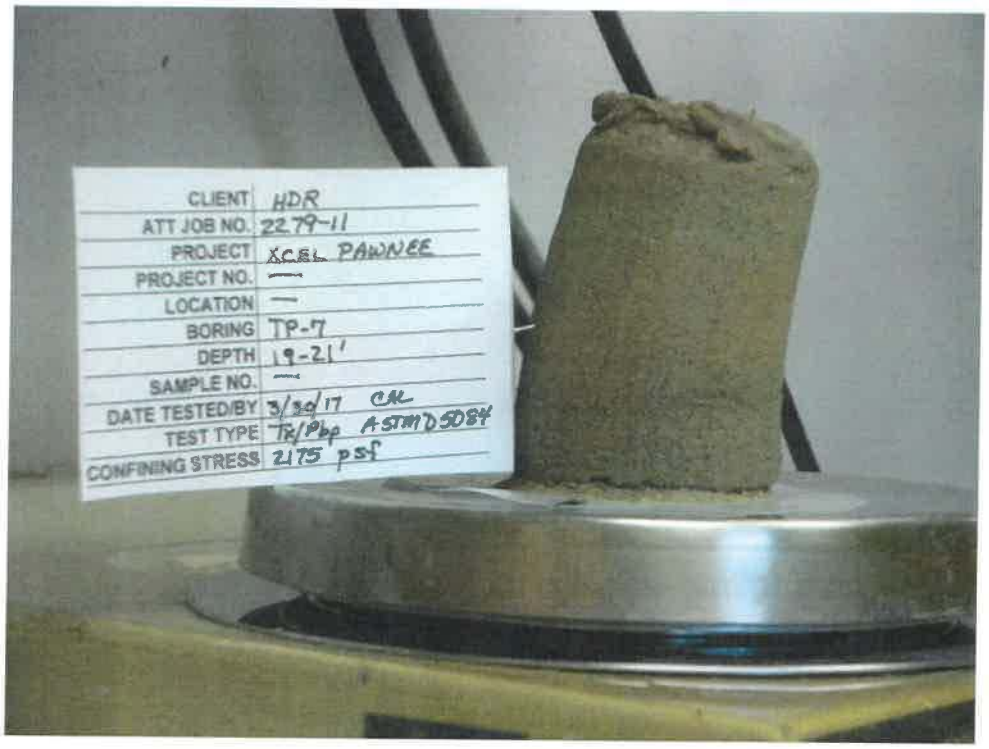
Date: 3/30/2017
File Name: 2279_11_PrelimPerm_ASTMD-5084-methodD-R0_2.xls

Checked By: DPM
Date: 4/5/17



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PERMEABILITY TEST - BACK PRESSURE SATURATED - FLOW PUMP METHOD

ASTM D5084 Method D

CLIENT	HDR	JOB NO.	2279-11

PROJECT	Xcel Pawnee			
PROJECT NO.	--	SAMPLED	--	By: --
BORING NO.	TP-8	TEST STARTED	3/17/2017	By: CAL
DEPTH	19-21'	TEST FINISHED	3/30/2017	By: CAL
SAMPLE NO.	--	CELL NUMBER	9P	
LOCATION	--	PERMEANT	Tap Water	
SAMPLE TYPE	liner	CONF. PRES. - (psf)	1973	

MOISTURE / DENSITY DATA	BEFORE TEST	AFTER TEST
Wt. Soil + Moisture - (g)	242.46	287.50
Wt. Wet Soil & Pan - (g)	249.16	294.20
Wt. Dry Soil & Pan - (g)	240.40	240.40
Wt. Lost Moisture - (g)	8.76	53.80
Wt. of Pan Only - (g)	6.70	6.70
Wt. of Dry Soil - (g)	233.70	233.70
Moisture Content - (%)	3.7	23.0
Wet Density - (pcf)	103.9	121.9
Dry Density - (pcf)	100.1	99.1
Init. Diameter - (in)	1.931	
Init. Area - (sq in)	2.929	
Init. Height - (in)	3.037	
Vol. Bef. Consol. - (cu ft)	0.00515	
Vol. After Consol. - (cu ft)	0.00520	
Porosity - (%)	36.53	

FLOW PUMP CALCULATIONS	
Pump Setting (gear number)	1
Percentage of Pump Setting	100
Q - (cc/s)	1.09E-01
Height - (in)	3.021
Diameter - (in)	1.946
Pressure - (psi)	0.078
Area after consol. - (sq cm)	19.189
Gradient	0.715
Permeability k - (cm/s)	7.9E-03
Permeability k - (m/s)	7.9E-05
Back Pressure - (psi)	78.0
Cell Pressure - (psi)	91.7
Ave. Effective Stress - (psi)	13.661
Average temperature degree - (c°)	22.2

Data entry by:	CAL	Date:	03/31/2017
Checked by:	DPM	Date:	4/5/17

PERMEABILITY TEST - BACK PRESSURE SATURATED - FLOW PUMP METHOD

ASTM D5084 Method D

CLIENT	HDR	JOB NO.	2279-11

PROJECT	Xcel Pawnee			
PROJECT NO.	--	SAMPLED	--	By: --
BORING NO.	TP-8	TEST STARTED	3/17/2017	By: CAL
DEPTH	19-21'	TEST FINISHED	3/30/2017	By: CAL
SAMPLE NO.	--	CELL NUMBER	9P	
LOCATION	--	PERMEANT	Tap Water	
SAMPLE TYPE	liner	CONF. PRES. - (psf)	1973	

SATURATION DATA

Cell Press.	Back Press.	Burette Reading (cc)		Pore Press. (psi)			
(psi)	(psi)	Close	Open	Close	Open	Change	B
40.0	38.0	2.3	9.7				
50.0	48.0	10.4	11.3	39.0	45.0	6.0	0.60
60.0	58.0	11.7	12.5	49.1	56.4	7.3	0.73
70.0	68.0	12.9	13.6	59.1	67.2	8.1	0.81
80.0	78.0	13.8	14.5	68.7	77.8	9.1	0.91
90.0		15.1	15.1	78.6	88.4	9.8	0.98

CONSOLIDATION DATA

Elapsed Time (Min)	SQRT Time (Min)	Burette Reading (cc)	Volume Defl. (cc)
0.00	0.00	15.10	0.00
0.25	0.50	16.85	-1.75
0.5	0.71	16.90	-1.80
1	1.00	16.90	-1.80
2	1.41	16.95	-1.85
4	2.00	16.95	-1.85
9	3.00	17.00	-1.90
16	4.00	17.00	-1.90
30	5.48	17.00	-1.90
60	7.75	17.05	-1.95
120	10.95	17.10	-2.00
240	15.49	17.10	-2.00
360	18.97	17.10	-2.00

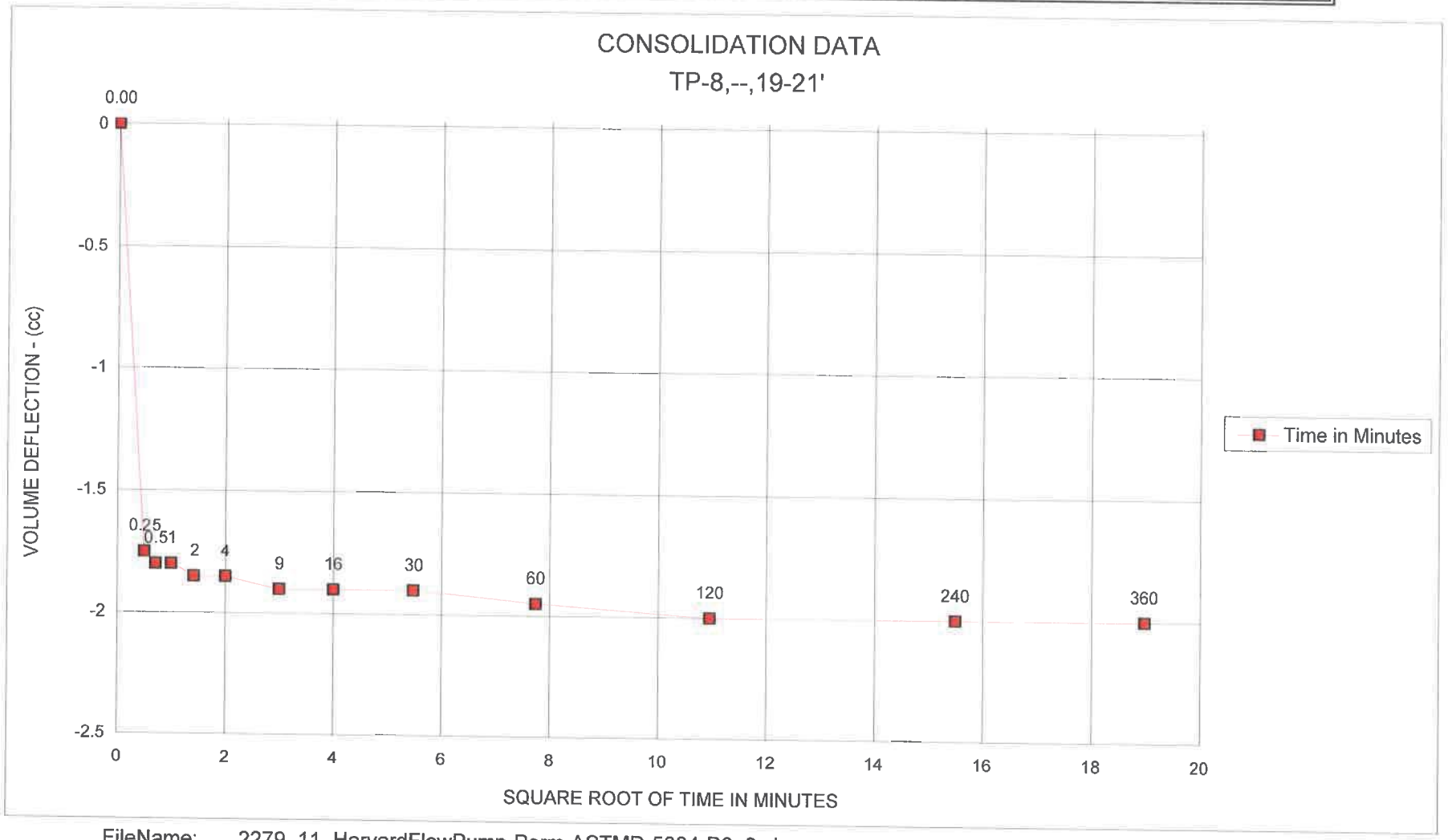
Initial Height - (in)	3.037	Init. Vol. - (cc)	145.77
Height Change - (in)	0.016	Vol. Change - (cc)	15.10
Ht. After Cons. - (in)	3.021	Cell Exp. - (cc)	16.59
Initial Area - (sq in)	2.929	Net Change - (cc)	-1.49
Area After Cons. - sq in	2.974	Cons. Vol. - (cc)	147.27

ATT
ADVANCED TERRA TESTING

PERMEABILITY TEST - BACK PRESSURE SATURATED - FLOW PUMP METHOD

ASTM D5084 Method D

CLIENT HDR		JOB NO. 2279-11

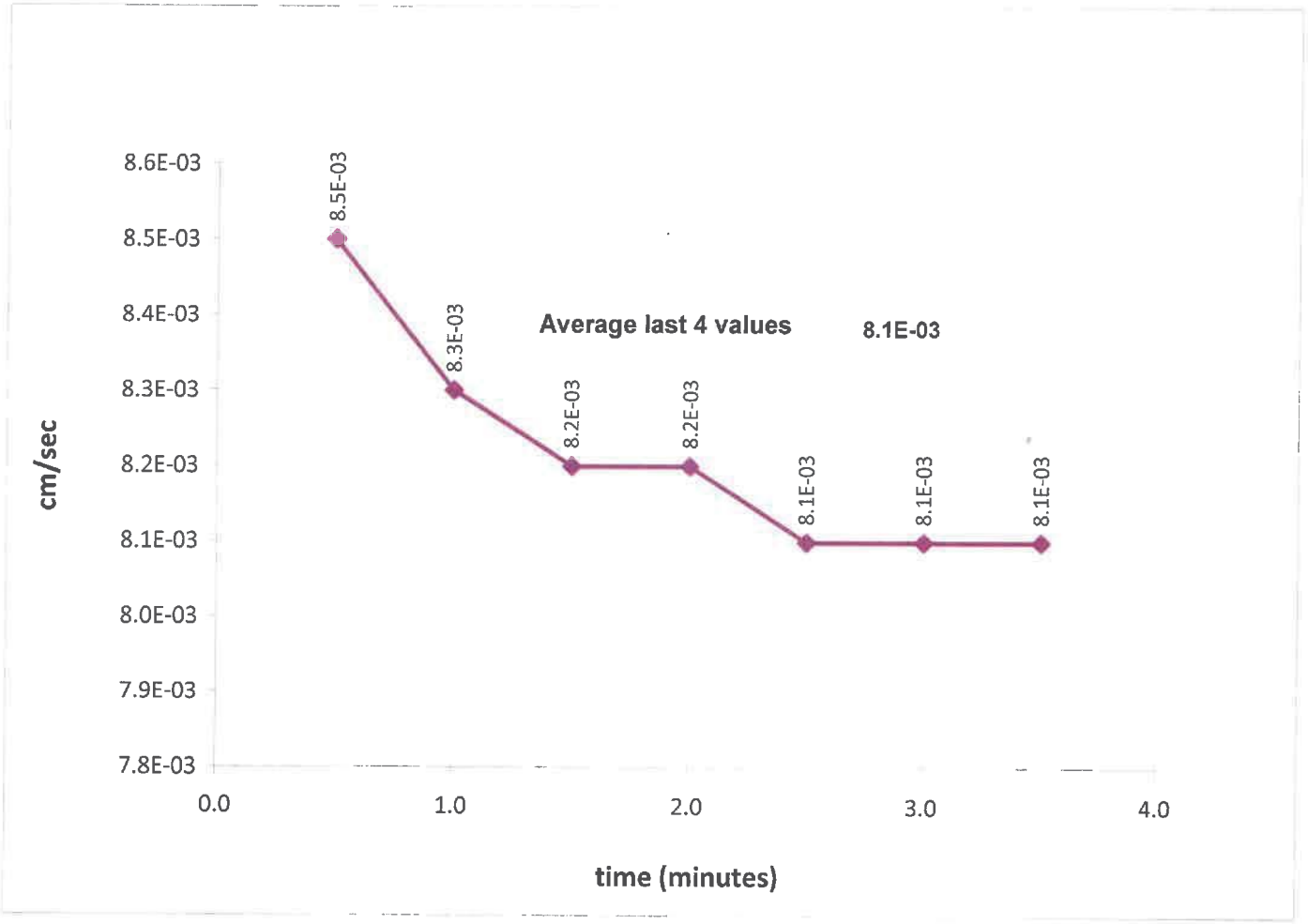


FileName: 2279_11_HarvardFlowPump-Perm-ASTMD-5084-R3_3.xls

ADVANCED TERRA TESTING

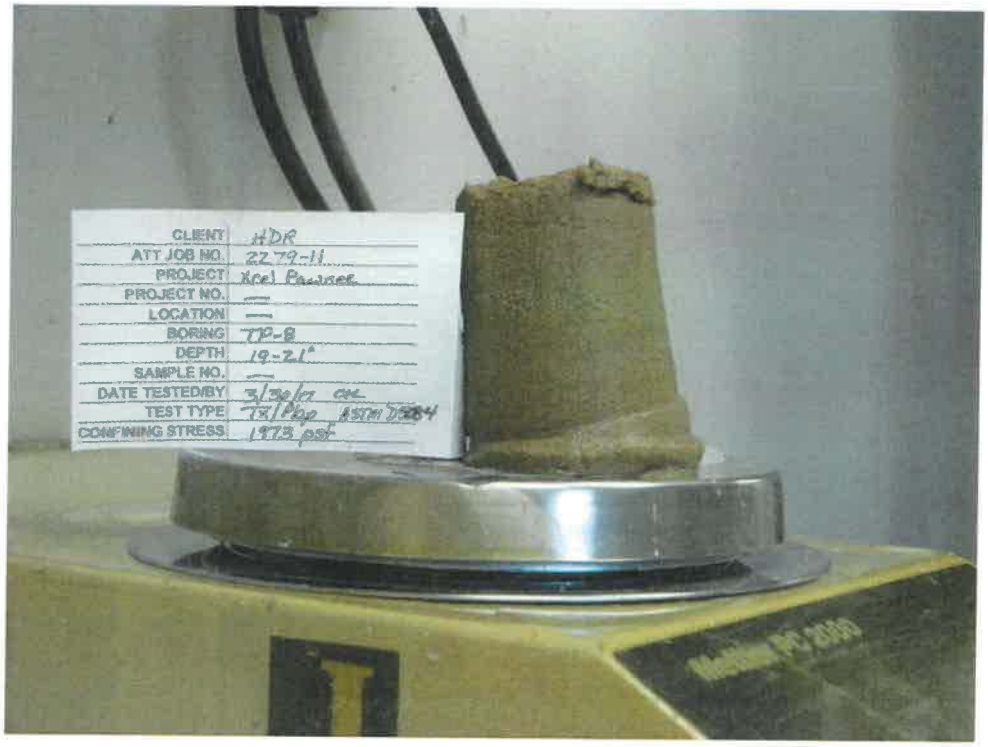
Preliminary Flow Pump Test Data
ASTM D5084

Client:	HDR	Boring Number:	TP-8		
Job Number:	2279-11	Depth:	19-21'		
Project:	Xcel Pawnee	Sample Number:	--		
Location:	--	Sampled Date:	--	Sampled By:	--
Project Number:		Test Date:	3/30/2017	Technician:	CAL



Data Entered By: CAL
Date: 3/30/2017
File Name: 2279_11_PrelimPerm_ASTMD-5084-methodD-R0_3.xls

Checked By: DPM
Date: 4/5/17



Q:\Client Data File\2279\11\PICTURE\DSCF6593.JPG

Particle Size Distribution (Gradation) of Soil Using Sieve Analysis
ASTM D 6913

Client: HDR
Job Number: 2279-11
Project: Xcel Pawnee
Location: --
Project Number: --

Boring Number: TB-8
Depth: 10-56'
Sample Number: --
Sampled Date: --
(+) Wash Date: 03/06/2017
(-) Wash Date: 03/08/2017

Sampled By: --
Technician: CKP
Technician: SKS

Grain Size Data

Hygroscopic Moisture of Fines

Weight of Wet Soil & Pan (g): 1078.70
Weight of Dry Soil & Pan (g): 1066.14
Weight of Water (g): 12.56
Weight of Pan (g): 843.27
Weight of Dry Soil (g): 222.87
Moisture (%): 5.6

Total Wet Weight of Sample (g): 15,727.28
Total Dry Weight of Sample (g): 14,888.41
Calculated Weight Plus #200 (g): 11,209.63
Moisture of Total Sample (%): 5.6
Percent Retained #200 Sieve (%): 75.3

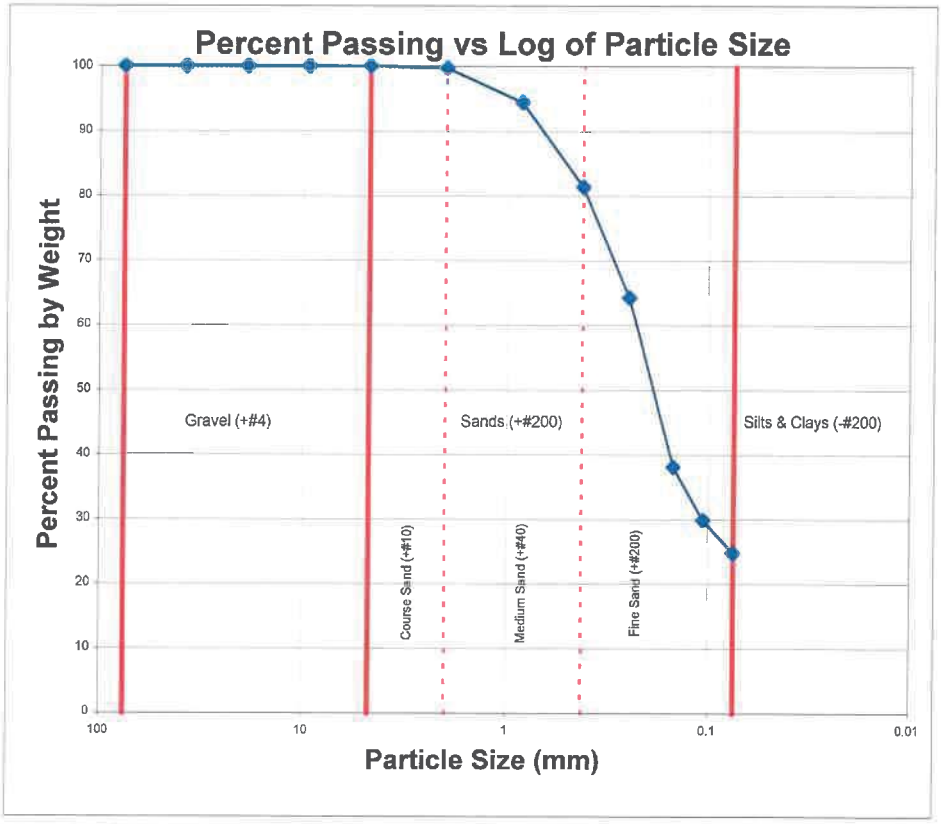
Sieve Number	Sieve Size (mm)	Weight of Retained Soil & Pan (g)	Weight of Pan (g)	Weight of Retained Soil (g)	Calculated Weight of Retained Soil (g)	Percent Passing by Weight (%)
3"	**76.2**	0.00	0.00	0.00	0.00	100.0
1.5"	**38.10**	0.00	0.00	0.00	0.00	100.0
3/4"	**19.05**	0.00	0.00	0.00	0.00	100.0
3/8"	**9.525**	0.00	0.00	0.00	0.00	100.0
#4	**4.750**	3.23	0.00	3.23	3.23	100.0
235.43g split out of -#4 material.						
#10	**2.000**	3.75	3.08	0.67	44.95	99.7
#20	**0.850**	14.93	3.11	11.82	789.31	94.4
#40	**0.425**	32.20	3.11	29.09	1942.88	81.3
#60	**0.250**	41.19	3.13	38.07	2542.51	64.2
#100	**0.150**	61.40	3.17	58.23	3889.30	38.1
#140	**0.106**	21.49	3.12	18.37	1226.64	29.9
#200	**0.075**	14.66	3.12	11.54	770.81	24.7

Plus Split Data

Original Weight of +#4 (g): 3.28
Calculated Weight of +#4 (g): 3.23

Minus Split Data

Original Weight of -#4 (g): 15,724.00
Calculated Dry Weight of -#4 (g): 14,885.18



Data Entered By: CKP
Date: 3/10/2017
File Name: 2279_11_grainSize-ASTM-C33-D1140-D6319-D2487-R6_0.xls

Checked By:
Date: 3/14/17

ATT
ADVANCED TERRA TESTING

Appendix D

State Well Permits

Form No.
GWS-25

OFFICE OF THE STATE ENGINEER
COLORADO DIVISION OF WATER RESOURCES

818 Centennial Bldg., 1313 Sherman St., Denver, Colorado 80203
(303) 866-3581

EXST

WELL PERMIT NUMBER 299821 - -
DIV. 1 WD 1 DES. BASIN MD

APPLICANT

PUBLIC SERVICE COMPANY OF COLORADO
14940 CR 24
BRUSH, CO 80723-

(303) 571-7340

APPROVED WELL LOCATION
MORGAN COUNTY
SE 1/4 SE 1/4 Section 19
Township 3 N Range 56 W Sixth P.M.

DISTANCES FROM SECTION LINES
1129 Ft. from South Section Line
944 Ft. from East Section Line

UTM COORDINATES (Meters,Zone:13,NAD83)
Easting: Northing:

PERMIT TO USE AN EXISTING WELL

ISSUANCE OF THIS PERMIT DOES NOT CONFER A WATER RIGHT

CONDITIONS OF APPROVAL

1) This well shall be used in such a way as to cause no material injury to existing water rights. The issuance of this permit does not ensure that no injury will occur to another vested water right or preclude another owner of a vested water right from seeking relief in a civil court action.
2) The construction of this well shall be in compliance with the Water Well Construction Rules 2 CCR 402-2, unless approval of a variance has been granted by the State Board of Examiners of Water Well Construction and Pump Installation Contractors in accordance with Rule 18.
3) Approved pursuant to CRS 37-92-602(3)(b)(I) for uses as described in CRS 37-92-602(1)(f). Use of this well is limited to monitoring water levels and/or water quality sampling.
4) Approved for the use of an existing well known as PNMW-12.
5) This well must be equipped with a locking cap or seal to prevent well contamination or possible hazards as an open well. The well must be kept capped and locked at all times except during sampling or measuring.
6) Records of water level measurements and water quality analyses shall be maintained by the well owner and submitted to the Division of Water Resources upon request.
7) Upon conclusion of the monitoring program the well owner shall plug this well in accordance with Rule 16 of the Water Well Construction Rules. A Well Abandonment Report must be completed and submitted to the Division of Water Resources within 60 days of plugging.
8) The owner shall mark the well in a conspicuous place with the well permit number and name of aquifer as appropriate, and shall take necessary means and precautions to preserve these markings.
9) This well must have been constructed by or under the supervision of a licensed well driller or other authorized individual according to the Water Well Construction Rules.
10) This well must be located not more than 200 feet from the location specified on this permit.

NOTE: Issuance of this permit does not guarantee that this well can be converted to a production well under a future permit. Additionally, pursuant to Rule 14.2 of the Water Well Construction Rules (2 CCR 402-2), monitoring holes constructed pursuant to a monitoring hole notice shall not be converted to a production well. (Upon obtaining a permit from the State Engineer, a monitoring hole may be converted to a monitoring well, recovery well for remediation of the aquifer, or a dewatering system for dewatering the aquifer.)

NOTICE: This permit has been approved subject to the following changes: The UTM coordinate values provided with the permit application were not used and the well location was determined from the PLSS coordinates provided. In addition MH-54630 was not referenced on this permit since it is not located in the SE 1/4 of the SE 1/4 of Sec 19, Twp 3N, Rng 56W. You are hereby notified that you have the right to appeal the issuance of this permit, by filing a written request with this office within sixty (60) days of the date of issuance, pursuant to the State Administrative Procedures Act. (See Section 24-4-104 through 106, C.R.S.)

APPROVED
DG2

Dick Wolfe
State Engineer

By

Receipt No. 3672804A DATE ISSUED 01-05-2016 EXPIRATION DATE N/A

Form No.
GWS-25

OFFICE OF THE STATE ENGINEER
COLORADO DIVISION OF WATER RESOURCES

818 Centennial Bldg., 1313 Sherman St., Denver, Colorado 80203
(303) 866-3581

EXST

WELL PERMIT NUMBER 299822 - - -
DIV. 1 WD 1 DES. BASIN MD

APPLICANT

PUBLIC SERVICE COMPANY OF COLORADO
14940 CR 24
BRUSH, CO 80723-

(303) 571-7340

APPROVED WELL LOCATION
MORGAN COUNTY
NE 1/4 SW 1/4 Section 19
Township 3 N Range 56 W Sixth P.M.

DISTANCES FROM SECTION LINES
2230 Ft. from South Section Line
2722 Ft. from East Section Line

UTM COORDINATES (Meters,Zone:13,NAD83)
Easting: Northing:

PERMIT TO USE AN EXISTING WELL

ISSUANCE OF THIS PERMIT DOES NOT CONFER A WATER RIGHT

CONDITIONS OF APPROVAL

1) This well shall be used in such a way as to cause no material injury to existing water rights. The issuance of this permit does not ensure that no injury will occur to another vested water right or preclude another owner of a vested water right from seeking relief in a civil court action.
2) The construction of this well shall be in compliance with the Water Well Construction Rules 2 CCR 402-2, unless approval of a variance has been granted by the State Board of Examiners of Water Well Construction and Pump Installation Contractors in accordance with Rule 18.
3) Approved pursuant to CRS 37-92-602(3)(b)(I) for uses as described in CRS 37-92-602(1)(f). Use of this well is limited to monitoring water levels and/or water quality sampling.
4) Approved for the use of an existing well known as PNMW-13.
5) This well must be equipped with a locking cap or seal to prevent well contamination or possible hazards as an open well. The well must be kept capped and locked at all times except during sampling or measuring.
6) Records of water level measurements and water quality analyses shall be maintained by the well owner and submitted to the Division of Water Resources upon request.
7) Upon conclusion of the monitoring program the well owner shall plug this well in accordance with Rule 16 of the Water Well Construction Rules. A Well Abandonment Report must be completed and submitted to the Division of Water Resources within 60 days of plugging.
8) The owner shall mark the well in a conspicuous place with the well permit number and name of aquifer as appropriate, and shall take necessary means and precautions to preserve these markings.
9) This well must have been constructed by or under the supervision of a licensed well driller or other authorized individual according to the Water Well Construction Rules.
10) This well must be located not more than 200 feet from the location specified on this permit.

NOTE: Issuance of this permit does not guarantee that this well can be converted to a production well under a future permit. Additionally, pursuant to Rule 14.2 of the Water Well Construction Rules (2 CCR 402-2), monitoring holes constructed pursuant to a monitoring hole notice shall not be converted to a production well. (Upon obtaining a permit from the State Engineer, a monitoring hole may be converted to a monitoring well, recovery well for remediation of the aquifer, or a dewatering system for dewatering the aquifer.)

NOTICE: This permit has been approved subject to the following changes: The UTM coordinate values provided with the permit application were not used and the well location was determined from the PLSS coordinates provided. In addition MH-54630 was not referenced on this permit since it is not located in the NE 1/4 of the SW 1/4 of Sec 19, Twp 3N, Rng 56W. You are hereby notified that you have the right to appeal the issuance of this permit, by filing a written request with this office within sixty (60) days of the date of issuance, pursuant to the State Administrative Procedures Act. (See Section 24-4-104 through 106, C.R.S.)

APPROVED
DG2

Dick Wolfe
State Engineer

By

Receipt No. 3672804B DATE ISSUED 01-05-2016 EXPIRATION DATE N/A

Form No. GWS-25

OFFICE OF THE STATE ENGINEER
COLORADO DIVISION OF WATER RESOURCES

818 Centennial Bldg., 1313 Sherman St., Denver, Colorado 80203
(303) 866-3581

EXST

WELL PERMIT NUMBER 299823 - - -
DIV. 1 WD 1 DES. BASIN MD

APPLICANT

PUBLIC SERVICE COMPANY OF COLORADO
14940 CR 24
BRUSH, CO 80723-

(303) 571-7340

APPROVED WELL LOCATION
MORGAN COUNTY
SE 1/4 SW 1/4 Section 19
Township 3 N Range 56 W Sixth P.M.

DISTANCES FROM SECTION LINES
1063 Ft. from South Section Line
2459 Ft. from East Section Line

UTM COORDINATES (Meters,Zone:13,NAD83)
Easting: 611580 Northing: 4451458

PERMIT TO USE AN EXISTING WELL

ISSUANCE OF THIS PERMIT DOES NOT CONFER A WATER RIGHT

CONDITIONS OF APPROVAL

1) This well shall be used in such a way as to cause no material injury to existing water rights. The issuance of this permit does not ensure that no injury will occur to another vested water right or preclude another owner of a vested water right from seeking relief in a civil court action.
2) The construction of this well shall be in compliance with the Water Well Construction Rules 2 CCR 402-2, unless approval of a variance has been granted by the State Board of Examiners of Water Well Construction and Pump Installation Contractors in accordance with Rule 18.
3) Approved pursuant to CRS 37-92-602(3)(b)(I) for uses as described in CRS 37-92-602(1)(f). Use of this well is limited to monitoring water levels and/or water quality sampling.
4) Approved for the use of an existing well acknowledged for construction under monitoring hole notice MH-54630, and known as PNMW-14.
5) This well must be equipped with a locking cap or seal to prevent well contamination or possible hazards as an open well. The well must be kept capped and locked at all times except during sampling or measuring.
6) Records of water level measurements and water quality analyses shall be maintained by the well owner and submitted to the Division of Water Resources upon request.
7) Upon conclusion of the monitoring program the well owner shall plug this well in accordance with Rule 16 of the Water Well Construction Rules. A Well Abandonment Report must be completed and submitted to the Division of Water Resources within 60 days of plugging.
8) The owner shall mark the well in a conspicuous place with the well permit number and name of aquifer as appropriate, and shall take necessary means and precautions to preserve these markings.
9) This well must have been constructed by or under the supervision of a licensed well driller or other authorized individual according to the Water Well Construction Rules.
10) This well must be located not more than 200 feet from the location specified on this permit.

NOTE: Issuance of this permit does not guarantee that this well can be converted to a production well under a future permit. Additionally, pursuant to Rule 14.2 of the Water Well Construction Rules (2 CCR 402-2), monitoring holes constructed pursuant to a monitoring hole notice shall not be converted to a production well. (Upon obtaining a permit from the State Engineer, a monitoring hole may be converted to a monitoring well, recovery well for remediation of the aquifer, or a dewatering system for dewatering the aquifer.)

NOTICE: This permit has been approved subject to the following changes: The distances from section lines were calculated from UTM coordinate values provided with the permit application. You are hereby notified that you have the right to appeal the issuance of this permit, by filing a written request with this office within sixty (60) days of the date of issuance, pursuant to the State Administrative Procedures Act. (See Section 24-4-104 through 106, C.R.S.)

APPROVED
DG2

Dick Wolfe
State Engineer

By

Receipt No. 3672804C DATE ISSUED 01-05-2016 EXPIRATION DATE N/A

COLORADO
Division of Water Resources
Department of Natural Resources

WELL PERMIT NUMBER 306572-
RECEIPT NUMBER 3680794A

ORIGINAL PERMIT APPLICANT(S)

PUBLIC SERVICE COMPANY OF COLORADO

APPROVED WELL LOCATION

Water Division: 1 Water District: 1
Designated Basin: N/A
Management District: N/A
County: MORGAN
Parcel Name: N/A

SE 1/4 NE 1/4 Section 19 Township 3.0 N Range 56.0 W Sixth P.M.

UTM COORDINATES (Meters, Zone:13, NAD83)

Easting: 612109.0 Northing: 4451976.0

PERMIT TO USE AN EXISTING WELL

ISSUANCE OF THIS PERMIT DOES NOT CONFER A WATER RIGHT
CONDITIONS OF APPROVAL

1) This well shall be used in such a way as to cause no material injury to existing water rights. The issuance of this permit does not ensure that no injury will occur to another vested water right or preclude another owner of a vested water right from seeking relief in a civil court action.
2) The construction of this well shall be in compliance with the Water Well Construction Rules 2 CCR 402-2, unless approval of a variance has been granted by the State Board of Examiners of Water Well Construction and Pump Installation Contractors in accordance with Rule 18.
3) Approved pursuant to CRS 37-92-602(3)(b)(I) for uses as described in CRS 37-92-602(1)(f). Use of this well is limited to monitoring water levels and/or water quality sampling.
4) Approved for the use of an existing well known as PNMW-15.
5) This well must be equipped with a locking cap or seal to prevent well contamination or possible hazards as an open well. The well must be kept capped and locked at all times except during sampling or measuring.
6) Records of water level measurements and water quality analyses shall be maintained by the well owner and submitted to the Division of Water Resources upon request.
7) Upon conclusion of the monitoring program the well owner shall plug this well in accordance with Rule 16 of the Water Well Construction Rules. A Well Abandonment Report must be completed and submitted to the Division of Water Resources within 60 days of plugging.
8) The owner shall mark the well in a conspicuous location with the well permit number and name of aquifer as appropriate, and shall take necessary means and precautions to preserve these markings.
9) This well must have been constructed by or under the supervision of a licensed well driller or other authorized individual according to the Water Well Construction Rules.
10) This well must be located not more than 200 feet from the location specified on this permit.

NOTE: Issuance of this permit does not guarantee that this well can be converted to a production well under a future permit. Additionally, pursuant to Rule 14.2 of the Water Well Construction Rules (2 CCR 402-2), monitoring holes constructed pursuant to a monitoring hole notice shall not be converted to a production well. (Upon obtaining a permit from the State Engineer, a monitoring hole may be converted to a monitoring well, recovery well for remediation of the aquifer, or a dewatering system for dewatering the aquifer.)

NOTICE: This permit has been approved subject to the following changes: MH-56328 was not referenced on this permit since it is located in the NE 1/4 of the NE 1/4 of Sec 19, Twp 3 N, Rng 56 W. You are hereby notified that you have the right to appeal the issuance of this permit, by filing a written request with this office within sixty (60) days of the date of issuance, pursuant to the State Administrative Procedures Act. (See Section 24-4-104 through 106, C.R.S.)

Debbie Gonzales

Issued By DEBRA GONZALES

Date Issued: 8/15/2017
Expiration Date: N/A

COLORADO
Division of Water Resources
Department of Natural Resources

WELL PERMIT NUMBER 306573-
RECEIPT NUMBER 3680794B

ORIGINAL PERMIT APPLICANT(S)

PUBLIC SERVICE COMPANY OF COLORADO

APPROVED WELL LOCATION

Water Division: 1 Water District: 1
Designated Basin: N/A
Management District: N/A
County: MORGAN
Parcel Name: N/A

SE 1/4 NE 1/4 Section 19 Township 3.0 N Range 56.0 W Sixth P.M.

UTM COORDINATES (Meters, Zone:13, NAD83)

Easting: 612131.0 Northing: 4452060.0

PERMIT TO USE AN EXISTING WELL

ISSUANCE OF THIS PERMIT DOES NOT CONFER A WATER RIGHT
CONDITIONS OF APPROVAL

1) This well shall be used in such a way as to cause no material injury to existing water rights. The issuance of this permit does not ensure that no injury will occur to another vested water right or preclude another owner of a vested water right from seeking relief in a civil court action.
2) The construction of this well shall be in compliance with the Water Well Construction Rules 2 CCR 402-2, unless approval of a variance has been granted by the State Board of Examiners of Water Well Construction and Pump Installation Contractors in accordance with Rule 18.
3) Approved pursuant to CRS 37-92-602(3)(b)(I) for uses as described in CRS 37-92-602(1)(f). Use of this well is limited to monitoring water levels and/or water quality sampling.
4) Approved for the use of an existing well acknowledged for construction under monitoring hole notice MH-56329, and known as PNMW-16.
5) This well must be equipped with a locking cap or seal to prevent well contamination or possible hazards as an open well. The well must be kept capped and locked at all times except during sampling or measuring.
6) Records of water level measurements and water quality analyses shall be maintained by the well owner and submitted to the Division of Water Resources upon request.
7) Upon conclusion of the monitoring program the well owner shall plug this well in accordance with Rule 16 of the Water Well Construction Rules. A Well Abandonment Report must be completed and submitted to the Division of Water Resources within 60 days of plugging.
8) The owner shall mark the well in a conspicuous location with the well permit number and name of aquifer as appropriate, and shall take necessary means and precautions to preserve these markings.
9) This well must have been constructed by or under the supervision of a licensed well driller or other authorized individual according to the Water Well Construction Rules.
10) This well must be located not more than 200 feet from the location specified on this permit.

NOTE: Issuance of this permit does not guarantee that this well can be converted to a production well under a future permit. Additionally, pursuant to Rule 14.2 of the Water Well Construction Rules (2 CCR 402-2), monitoring holes constructed pursuant to a monitoring hole notice shall not be converted to a production well. (Upon obtaining a permit from the State Engineer, a monitoring hole may be converted to a monitoring well, recovery well for remediation of the aquifer, or a dewatering system for dewatering the aquifer.)

Debbie Gonzales

Issued By DEBRA GONZALES

Date Issued: 8/15/2017
Expiration Date: N/A

COLORADO
Division of Water Resources
Department of Natural Resources

WELL PERMIT NUMBER 306574-
RECEIPT NUMBER 3680794C

ORIGINAL PERMIT APPLICANT(S)

PUBLIC SERVICE COMPANY OF COLORADO

APPROVED WELL LOCATION

Water Division: 1 Water District: 1
Designated Basin: N/A
Management District: N/A
County: MORGAN
Parcel Name: N/A

NW 1/4 SW 1/4 Section 20 Township 3.0 N Range 56.0 W Sixth P.M.

UTM COORDINATES (Meters, Zone:13, NAD83)

Easting: 612549.0 Northing: 4452006.0

PERMIT TO USE AN EXISTING WELL

ISSUANCE OF THIS PERMIT DOES NOT CONFER A WATER RIGHT
CONDITIONS OF APPROVAL

1) This well shall be used in such a way as to cause no material injury to existing water rights. The issuance of this permit does not ensure that no injury will occur to another vested water right or preclude another owner of a vested water right from seeking relief in a civil court action.
2) The construction of this well shall be in compliance with the Water Well Construction Rules 2 CCR 402-2, unless approval of a variance has been granted by the State Board of Examiners of Water Well Construction and Pump Installation Contractors in accordance with Rule 18.
3) Approved pursuant to CRS 37-92-602(3)(b)(I) for uses as described in CRS 37-92-602(1)(f). Use of this well is limited to monitoring water levels and/or water quality sampling.
4) Approved for the use of an existing well acknowledged for construction under monitoring hole notice MH-56330, and known as PNMW-17.
5) This well must be equipped with a locking cap or seal to prevent well contamination or possible hazards as an open well. The well must be kept capped and locked at all times except during sampling or measuring.
6) Records of water level measurements and water quality analyses shall be maintained by the well owner and submitted to the Division of Water Resources upon request.
7) Upon conclusion of the monitoring program the well owner shall plug this well in accordance with Rule 16 of the Water Well Construction Rules. A Well Abandonment Report must be completed and submitted to the Division of Water Resources within 60 days of plugging.
8) The owner shall mark the well in a conspicuous location with the well permit number and name of aquifer as appropriate, and shall take necessary means and precautions to preserve these markings.
9) This well must have been constructed by or under the supervision of a licensed well driller or other authorized individual according to the Water Well Construction Rules.
10) This well must be located not more than 200 feet from the location specified on this permit.

NOTE: Issuance of this permit does not guarantee that this well can be converted to a production well under a future permit. Additionally, pursuant to Rule 14.2 of the Water Well Construction Rules (2 CCR 402-2), monitoring holes constructed pursuant to a monitoring hole notice shall not be converted to a production well. (Upon obtaining a permit from the State Engineer, a monitoring hole may be converted to a monitoring well, recovery well for remediation of the aquifer, or a dewatering system for dewatering the aquifer.)

Debbie Gonzales

Issued By DEBRA GONZALES

Date Issued: 8/15/2017
Expiration Date: N/A

COLORADO
Division of Water Resources
Department of Natural Resources

WELL PERMIT NUMBER 306575-

RECEIPT NUMBER 3680794D

ORIGINAL PERMIT APPLICANT(S)

PUBLIC SERIVCE COMPANY OF COLORADO

APPROVED WELL LOCATION

Water Division: 1 Water District: 1
Designated Basin: N/A
Management District: N/A
County: MORGAN
Parcel Name: N/A

SW 1/4 NW 1/4 Section 20 Township 3.0 N Range 56.0 W Sixth P.M.

UTM COORDINATES (Meters, Zone:13, NAD83)

Easting: 612658.0 Northing: 4452085.0

PERMIT TO USE AN EXISTING WELL

ISSUANCE OF THIS PERMIT DOES NOT CONFER A WATER RIGHT
CONDITIONS OF APPROVAL

1) This well shall be used in such a way as to cause no material injury to existing water rights. The issuance of this permit does not ensure that no injury will occur to another vested water right or preclude another owner of a vested water right from seeking relief in a civil court action.

2) The construction of this well shall be in compliance with the Water Well Construction Rules 2 CCR 402-2, unless approval of a variance has been granted by the State Board of Examiners of Water Well Construction and Pump Installation Contractors in accordance with Rule 18.

3) Approved pursuant to CRS 37-92-602(3)(b)(I) for uses as described in CRS 37-92-602(1)(f). Use of this well is limited to monitoring water levels and/or water quality sampling.

4) Approved for the use of an existing well acknowledged for construction under monitoring hole notice MH-56331, and known as PNMW-18.

5) This well must be equipped with a locking cap or seal to prevent well contamination or possible hazards as an open well. The well must be kept capped and locked at all times except during sampling or measuring.

6) Records of water level measurements and water quality analyses shall be maintained by the well owner and submitted to the Division of Water Resources upon request.

7) Upon conclusion of the monitoring program the well owner shall plug this well in accordance with Rule 16 of the Water Well Construction Rules. A Well Abandonment Report must be completed and submitted to the Division of Water Resources within 60 days of plugging.

8) The owner shall mark the well in a conspicuous location with the well permit number and name of aquifer as appropriate, and shall take necessary means and precautions to preserve these markings.

9) This well must have been constructed by or under the supervision of a licensed well driller or other authorized individual according to the Water Well Construction Rules.

10) This well must be located not more than 200 feet from the location specified on this permit.

NOTE: Issuance of this permit does not guarantee that this well can be converted to a production well under a future permit. Additionally, pursuant to Rule 14.2 of the Water Well Construction Rules (2 CCR 402-2), monitoring holes constructed pursuant to a monitoring hole notice shall not be converted to a production well. (Upon obtaining a permit from the State Engineer, a monitoring hole may be converted to a monitoring well, recovery well for remediation of the aquifer, or a dewatering system for dewatering the aquifer.)

NOTICE: This permit has been approved subject to the following changes: The quarter/quarter, quarter, Section, Township, Range and P.M. were determined from UTM coordinate values provided with the permit application. You are hereby notified that you have the right to appeal the issuance of this permit, by filing a written request with this office within sixty (60) days of the date of issuance, pursuant to the State Administrative Procedures Act. (See Section 24-4-104 through 106, C.R.S.)

Debbie Gonzales

Issued By DEBRA GONZALES

Date Issued: 8/15/2017

Expiration Date: N/A

COLORADO
Division of Water Resources
Department of Natural Resources

WELL PERMIT NUMBER 306576-
RECEIPT NUMBER 3680794E

ORIGINAL PERMIT APPLICANT(S)

PUBLIC SERVICE COMPANY OF COLORADO

APPROVED WELL LOCATION

Water Division: 1 Water District: 1
Designated Basin: N/A
Management District: N/A
County: MORGAN
Parcel Name: N/A

SW 1/4 NW 1/4 Section 20 Township 3.0 N Range 56.0 W Sixth P.M.

UTM COORDINATES (Meters, Zone:13, NAD83)

Easting: 612661.0 Northing: 4452045.0

PERMIT TO USE AN EXISTING WELL

ISSUANCE OF THIS PERMIT DOES NOT CONFER A WATER RIGHT

CONDITIONS OF APPROVAL

1) This well shall be used in such a way as to cause no material injury to existing water rights. The issuance of this permit does not ensure that no injury will occur to another vested water right or preclude another owner of a vested water right from seeking relief in a civil court action.

2) The construction of this well shall be in compliance with the Water Well Construction Rules 2 CCR 402-2, unless approval of a variance has been granted by the State Board of Examiners of Water Well Construction and Pump Installation Contractors in accordance with Rule 18.

3) Approved pursuant to CRS 37-92-602(3)(b)(I) for uses as described in CRS 37-92-602(1)(f). Use of this well is limited to monitoring water levels and/or water quality sampling.

4) Approved for the use of an existing well known as PNMW-19.

5) This well must be equipped with a locking cap or seal to prevent well contamination or possible hazards as an open well. The well must be kept capped and locked at all times except during sampling or measuring.

6) Records of water level measurements and water quality analyses shall be maintained by the well owner and submitted to the Division of Water Resources upon request.

7) Upon conclusion of the monitoring program the well owner shall plug this well in accordance with Rule 16 of the Water Well Construction Rules. A Well Abandonment Report must be completed and submitted to the Division of Water Resources within 60 days of plugging.

8) The owner shall mark the well in a conspicuous location with the well permit number and name of aquifer as appropriate, and shall take necessary means and precautions to preserve these markings.

9) This well must have been constructed by or under the supervision of a licensed well driller or other authorized individual according to the Water Well Construction Rules.

10) This well must be located not more than 200 feet from the location specified on this permit.

NOTE: Issuance of this permit does not guarantee that this well can be converted to a production well under a future permit. Additionally, pursuant to Rule 14.2 of the Water Well Construction Rules (2 CCR 402-2), monitoring holes constructed pursuant to a monitoring hole notice shall not be converted to a production well. (Upon obtaining a permit from the State Engineer, a monitoring hole may be converted to a monitoring well, recovery well for remediation of the aquifer, or a dewatering system for dewatering the aquifer.)

NOTICE: This permit has been approved subject to the following changes: MH-56330 was not referenced on this permit since it is located in the NW 1/4 of the SW 1/4 of Sec 20, Twp 3 N, Rng 56 W, You are hereby notified that you have the right to appeal the issuance of this permit, by filing a written request with this office within sixty (60) days of the date of issuance, pursuant to the State Administrative Procedures Act. (See Section 24-4-104 through 106, C.R.S.)

Debbie Gonzales

Issued By DEBRA GONZALES

Date Issued: 8/15/2017

Expiration Date: N/A

COLORADO
Division of Water Resources
Department of Natural Resources

WELL PERMIT NUMBER 306577-
RECEIPT NUMBER 3680794F

ORIGINAL PERMIT APPLICANT(S)

PUBLIC SERVICE COMPANY OF COLORADO

APPROVED WELL LOCATION

Water Division: 1 Water District: 1
Designated Basin: N/A
Management District: N/A
County: MORGAN
Parcel Name: N/A

NW 1/4 SW 1/4 Section 20 Township 3.0 N Range 56.0 W Sixth P.M.

UTM COORDINATES (Meters, Zone:13, NAD83)

Easting: 612658.0 Northing: 4451971.0

PERMIT TO USE AN EXISTING WELL

ISSUANCE OF THIS PERMIT DOES NOT CONFER A WATER RIGHT
CONDITIONS OF APPROVAL

1) This well shall be used in such a way as to cause no material injury to existing water rights. The issuance of this permit does not ensure that no injury will occur to another vested water right or preclude another owner of a vested water right from seeking relief in a civil court action.
2) The construction of this well shall be in compliance with the Water Well Construction Rules 2 CCR 402-2, unless approval of a variance has been granted by the State Board of Examiners of Water Well Construction and Pump Installation Contractors in accordance with Rule 18.
3) Approved pursuant to CRS 37-92-602(3)(b)(I) for uses as described in CRS 37-92-602(1)(f). Use of this well is limited to monitoring water levels and/or water quality sampling.
4) Approved for the use of an existing well acknowledged for construction under monitoring hole notice MH-56330, and known as PNMW-20.
5) This well must be equipped with a locking cap or seal to prevent well contamination or possible hazards as an open well. The well must be kept capped and locked at all times except during sampling or measuring.
6) Records of water level measurements and water quality analyses shall be maintained by the well owner and submitted to the Division of Water Resources upon request.
7) Upon conclusion of the monitoring program the well owner shall plug this well in accordance with Rule 16 of the Water Well Construction Rules. A Well Abandonment Report must be completed and submitted to the Division of Water Resources within 60 days of plugging.
8) The owner shall mark the well in a conspicuous location with the well permit number and name of aquifer as appropriate, and shall take necessary means and precautions to preserve these markings.
9) This well must have been constructed by or under the supervision of a licensed well driller or other authorized individual according to the Water Well Construction Rules.
10) This well must be located not more than 200 feet from the location specified on this permit.

NOTE: Issuance of this permit does not guarantee that this well can be converted to a production well under a future permit. Additionally, pursuant to Rule 14.2 of the Water Well Construction Rules (2 CCR 402-2), monitoring holes constructed pursuant to a monitoring hole notice shall not be converted to a production well. (Upon obtaining a permit from the State Engineer, a monitoring hole may be converted to a monitoring well, recovery well for remediation of the aquifer, or a dewatering system for dewatering the aquifer.)

Debbie Gonzales

Issued By DEBRA GONZALES

Date Issued: 8/15/2017
Expiration Date: 8/15/2019

COLORADO
Division of Water Resources
Department of Natural Resources

WELL PERMIT NUMBER 306578-
RECEIPT NUMBER 3680794G

ORIGINAL PERMIT APPLICANT(S)

PUBLIC SERVICE COMPANY OF COLORADO

APPROVED WELL LOCATION

Water Division: 1 Water District: 1
Designated Basin: N/A
Management District: N/A
County: MORGAN
Parcel Name: N/A

NE 1/4 SW 1/4 Section 20 Township 3.0 N Range 56.0 W Sixth P.M.

UTM COORDINATES (Meters, Zone:13, NAD83)

Easting: 612829.0 Northing: 4451939.0

PERMIT TO USE AN EXISTING WELL

ISSUANCE OF THIS PERMIT DOES NOT CONFER A WATER RIGHT
CONDITIONS OF APPROVAL

1) This well shall be used in such a way as to cause no material injury to existing water rights. The issuance of this permit does not ensure that no injury will occur to another vested water right or preclude another owner of a vested water right from seeking relief in a civil court action.
2) The construction of this well shall be in compliance with the Water Well Construction Rules 2 CCR 402-2, unless approval of a variance has been granted by the State Board of Examiners of Water Well Construction and Pump Installation Contractors in accordance with Rule 18.
3) Approved pursuant to CRS 37-92-602(3)(b)(I) for uses as described in CRS 37-92-602(1)(f). Use of this well is limited to monitoring water levels and/or water quality sampling.
4) Approved for the use of an existing well acknowledged for construction under monitoring hole notice MH-56332, and known as PNMW-21.
5) This well must be equipped with a locking cap or seal to prevent well contamination or possible hazards as an open well. The well must be kept capped and locked at all times except during sampling or measuring.
6) Records of water level measurements and water quality analyses shall be maintained by the well owner and submitted to the Division of Water Resources upon request.
7) Upon conclusion of the monitoring program the well owner shall plug this well in accordance with Rule 16 of the Water Well Construction Rules. A Well Abandonment Report must be completed and submitted to the Division of Water Resources within 60 days of plugging.
8) The owner shall mark the well in a conspicuous location with the well permit number and name of aquifer as appropriate, and shall take necessary means and precautions to preserve these markings.
9) This well must have been constructed by or under the supervision of a licensed well driller or other authorized individual according to the Water Well Construction Rules.
10) This well must be located not more than 200 feet from the location specified on this permit.

NOTE: Issuance of this permit does not guarantee that this well can be converted to a production well under a future permit. Additionally, pursuant to Rule 14.2 of the Water Well Construction Rules (2 CCR 402-2), monitoring holes constructed pursuant to a monitoring hole notice shall not be converted to a production well. (Upon obtaining a permit from the State Engineer, a monitoring hole may be converted to a monitoring well, recovery well for remediation of the aquifer, or a dewatering system for dewatering the aquifer.)

Debbie Gonzales

Issued By DEBRA GONZALES

Date Issued: 8/15/2017
Expiration Date: N/A

COLORADO
Division of Water Resources
Department of Natural Resources

WELL PERMIT NUMBER 306579-
RECEIPT NUMBER 3680794H

ORIGINAL PERMIT APPLICANT(S)

PUBLIC SERVICE COMPANY OF COLORADO

APPROVED WELL LOCATION

Water Division: 1 Water District: 1
Designated Basin: N/A
Management District: N/A
County: MORGAN
Parcel Name: N/A

NE 1/4 SW 1/4 Section 20 Township 3.0 N Range 56.0 W Sixth P.M.

UTM COORDINATES (Meters, Zone:13, NAD83)

Easting: 612830.0 Northing: 4451823.0

PERMIT TO USE AN EXISTING WELL

ISSUANCE OF THIS PERMIT DOES NOT CONFER A WATER RIGHT
CONDITIONS OF APPROVAL

1) This well shall be used in such a way as to cause no material injury to existing water rights. The issuance of this permit does not ensure that no injury will occur to another vested water right or preclude another owner of a vested water right from seeking relief in a civil court action.
2) The construction of this well shall be in compliance with the Water Well Construction Rules 2 CCR 402-2, unless approval of a variance has been granted by the State Board of Examiners of Water Well Construction and Pump Installation Contractors in accordance with Rule 18.
3) Approved pursuant to CRS 37-92-602(3)(b)(I) for uses as described in CRS 37-92-602(1)(f). Use of this well is limited to monitoring water levels and/or water quality sampling.
4) Approved for the use of an existing well acknowledged for construction under monitoring hole notice MH-56332, and known as PNMW-22.
5) This well must be equipped with a locking cap or seal to prevent well contamination or possible hazards as an open well. The well must be kept capped and locked at all times except during sampling or measuring.
6) Records of water level measurements and water quality analyses shall be maintained by the well owner and submitted to the Division of Water Resources upon request.
7) Upon conclusion of the monitoring program the well owner shall plug this well in accordance with Rule 16 of the Water Well Construction Rules. A Well Abandonment Report must be completed and submitted to the Division of Water Resources within 60 days of plugging.
8) The owner shall mark the well in a conspicuous location with the well permit number and name of aquifer as appropriate, and shall take necessary means and precautions to preserve these markings.
9) This well must have been constructed by or under the supervision of a licensed well driller or other authorized individual according to the Water Well Construction Rules.
10) This well must be located not more than 200 feet from the location specified on this permit.

NOTE: Issuance of this permit does not guarantee that this well can be converted to a production well under a future permit. Additionally, pursuant to Rule 14.2 of the Water Well Construction Rules (2 CCR 402-2), monitoring holes constructed pursuant to a monitoring hole notice shall not be converted to a production well. (Upon obtaining a permit from the State Engineer, a monitoring hole may be converted to a monitoring well, recovery well for remediation of the aquifer, or a dewatering system for dewatering the aquifer.)

Debbie Gonzales

Issued By DEBRA GONZALES

Date Issued: 8/15/2017
Expiration Date: N/A

COLORADO
Division of Water Resources
Department of Natural Resources

WELL PERMIT NUMBER 306580-
RECEIPT NUMBER 3680794I

ORIGINAL PERMIT APPLICANT(S)

PUBLIC SERVICE COMPANY OF COLORADO

APPROVED WELL LOCATION

Water Division: 1 Water District: 1
Designated Basin: N/A
Management District: N/A
County: MORGAN
Parcel Name: N/A

NE 1/4 SW 1/4 Section 20 Township 3.0 N Range 56.0 W Sixth P.M.

UTM COORDINATES (Meters, Zone:13, NAD83)

Easting: 612831.0 Northing: 4451655.0

PERMIT TO USE AN EXISTING WELL

ISSUANCE OF THIS PERMIT DOES NOT CONFER A WATER RIGHT
CONDITIONS OF APPROVAL

1) This well shall be used in such a way as to cause no material injury to existing water rights. The issuance of this permit does not ensure that no injury will occur to another vested water right or preclude another owner of a vested water right from seeking relief in a civil court action.
2) The construction of this well shall be in compliance with the Water Well Construction Rules 2 CCR 402-2, unless approval of a variance has been granted by the State Board of Examiners of Water Well Construction and Pump Installation Contractors in accordance with Rule 18.
3) Approved pursuant to CRS 37-92-602(3)(b)(I) for uses as described in CRS 37-92-602(1)(f). Use of this well is limited to monitoring water levels and/or water quality sampling.
4) Approved for the use of an existing well acknowledged for construction under monitoring hole notice MH-56332, and known as PNMW-23.
5) This well must be equipped with a locking cap or seal to prevent well contamination or possible hazards as an open well. The well must be kept capped and locked at all times except during sampling or measuring.
6) Records of water level measurements and water quality analyses shall be maintained by the well owner and submitted to the Division of Water Resources upon request.
7) Upon conclusion of the monitoring program the well owner shall plug this well in accordance with Rule 16 of the Water Well Construction Rules. A Well Abandonment Report must be completed and submitted to the Division of Water Resources within 60 days of plugging.
8) The owner shall mark the well in a conspicuous location with the well permit number and name of aquifer as appropriate, and shall take necessary means and precautions to preserve these markings.
9) This well must have been constructed by or under the supervision of a licensed well driller or other authorized individual according to the Water Well Construction Rules.
10) This well must be located not more than 200 feet from the location specified on this permit.

NOTE: Issuance of this permit does not guarantee that this well can be converted to a production well under a future permit. Additionally, pursuant to Rule 14.2 of the Water Well Construction Rules (2 CCR 402-2), monitoring holes constructed pursuant to a monitoring hole notice shall not be converted to a production well. (Upon obtaining a permit from the State Engineer, a monitoring hole may be converted to a monitoring well, recovery well for remediation of the aquifer, or a dewatering system for dewatering the aquifer.)

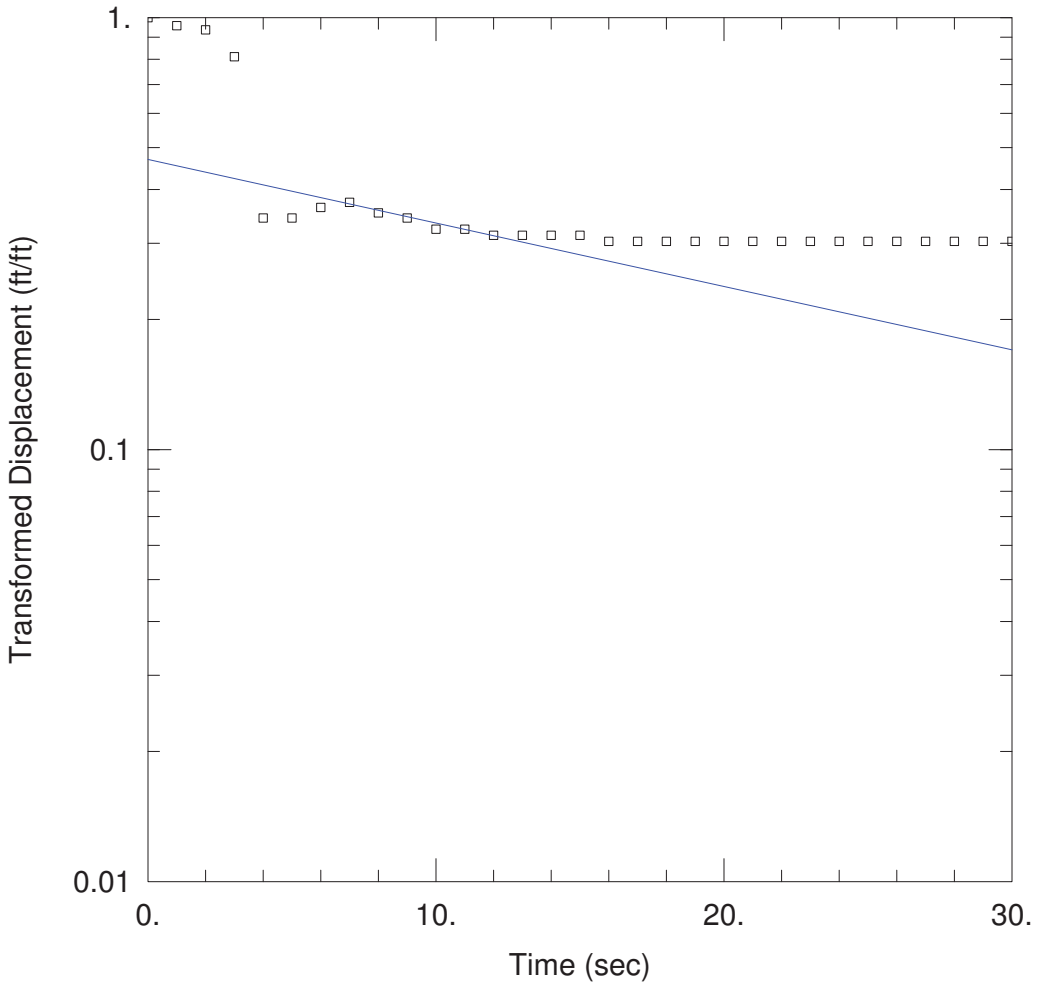
Debbie Gonzales

Issued By DEBRA GONZALES

Date Issued: 8/15/2017
Expiration Date: N/A

Appendix E

Slug Test Analyses



PNMW-13 SLUG IN

Data Set: P:\...\Pawnee_PNMW-13_Slug_In_Dagan.aqt
Date: 02/01/16 Time: 14:35:10

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Project: 266180
Location: Pawnee Station
Test Well: PNMW-13
Test Date: 12/9/2015

AQUIFER DATA

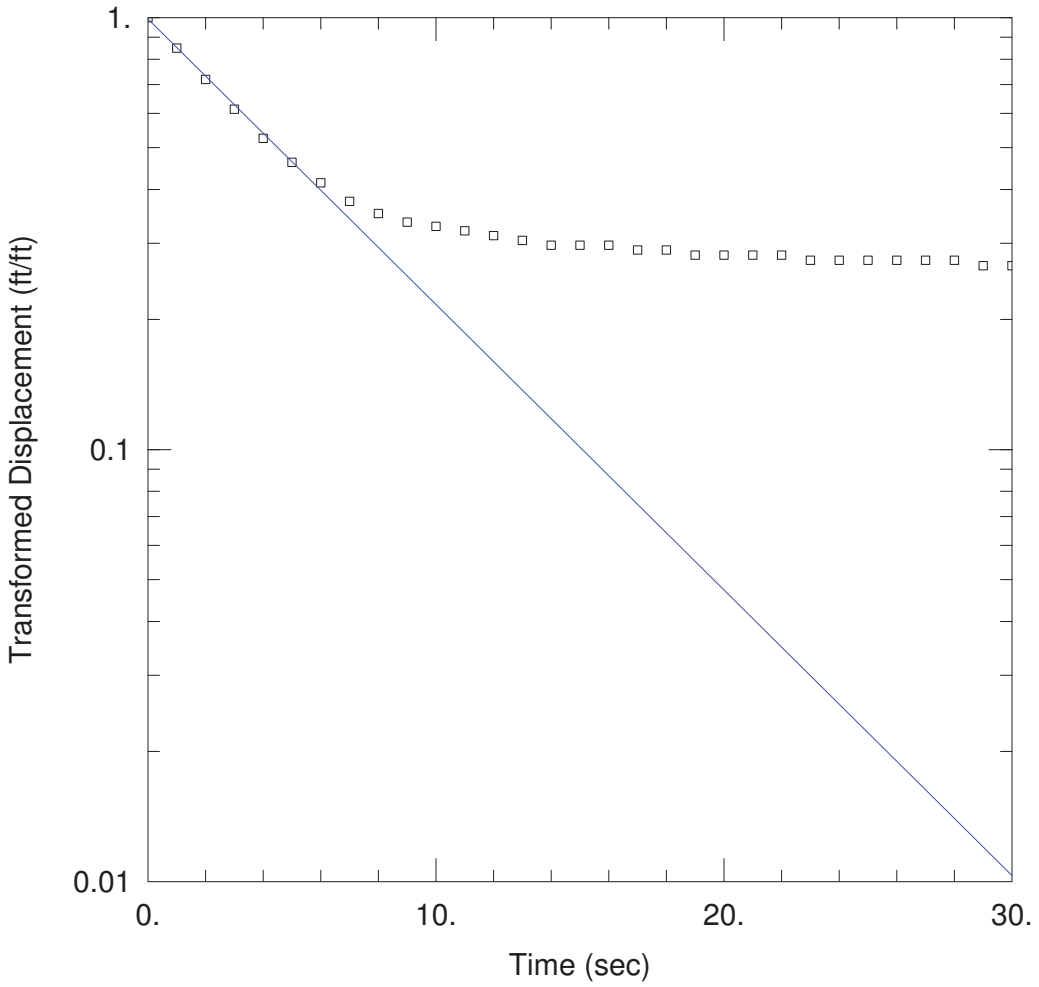
Saturated Thickness: 11.22 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (PNMW-13)

Initial Displacement: 0.99 ft
Total Well Penetration Depth: 11.22 ft
Casing Radius: 0.083 ft
Static Water Column Height: 11.22 ft
Screen Length: 11.22 ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Dagan
K = 0.003451 cm/sec
y0 = 0.4755 ft



PNMW-13 SLUG OUT

Data Set: P:\...\Pawnee_PNMW-13_Slug_Out_Dagan.aqt
Date: 02/01/16 Time: 14:36:00

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Project: 266180
Location: Pawnee Station
Test Well: PNMW-13
Test Date: 12/9/2015

AQUIFER DATA

Saturated Thickness: 11.22 ft Anisotropy Ratio (Kz/Kr): 1.

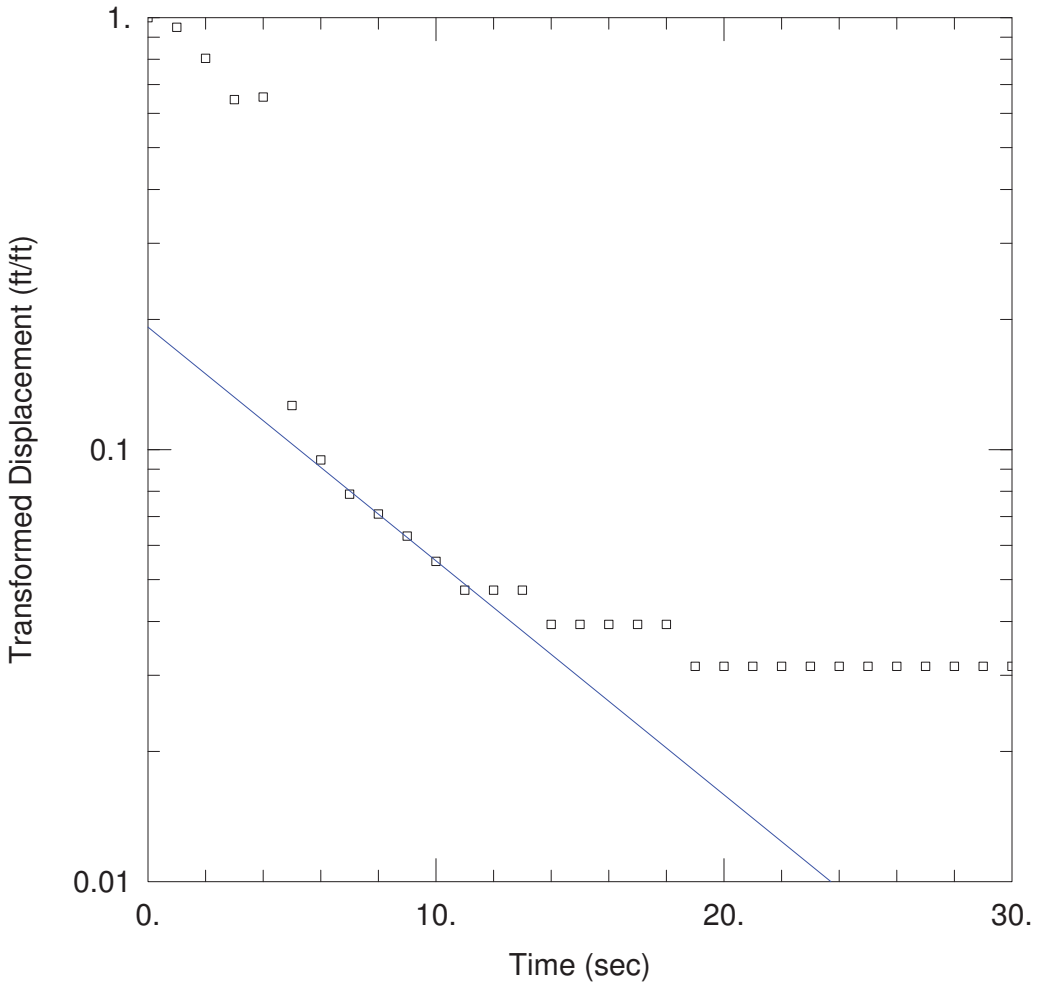
WELL DATA (PNMW-13)

Initial Displacement: 1.26 ft
Total Well Penetration Depth: 11.22 ft
Casing Radius: 0.083 ft
Static Water Column Height: 11.22 ft
Screen Length: 11.22 ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Dagan

K = 0.005901 cm/sec y0 = 1.251 ft



PNMW-14 SLUG IN

Data Set: P:\...\Pawnee_PNMW-14_Slug_In_Dagan.aqt
Date: 02/01/16 Time: 14:36:47

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Project: 266180
Location: Pawnee Station
Test Well: PNMW-14
Test Date: 12/9/2015

AQUIFER DATA

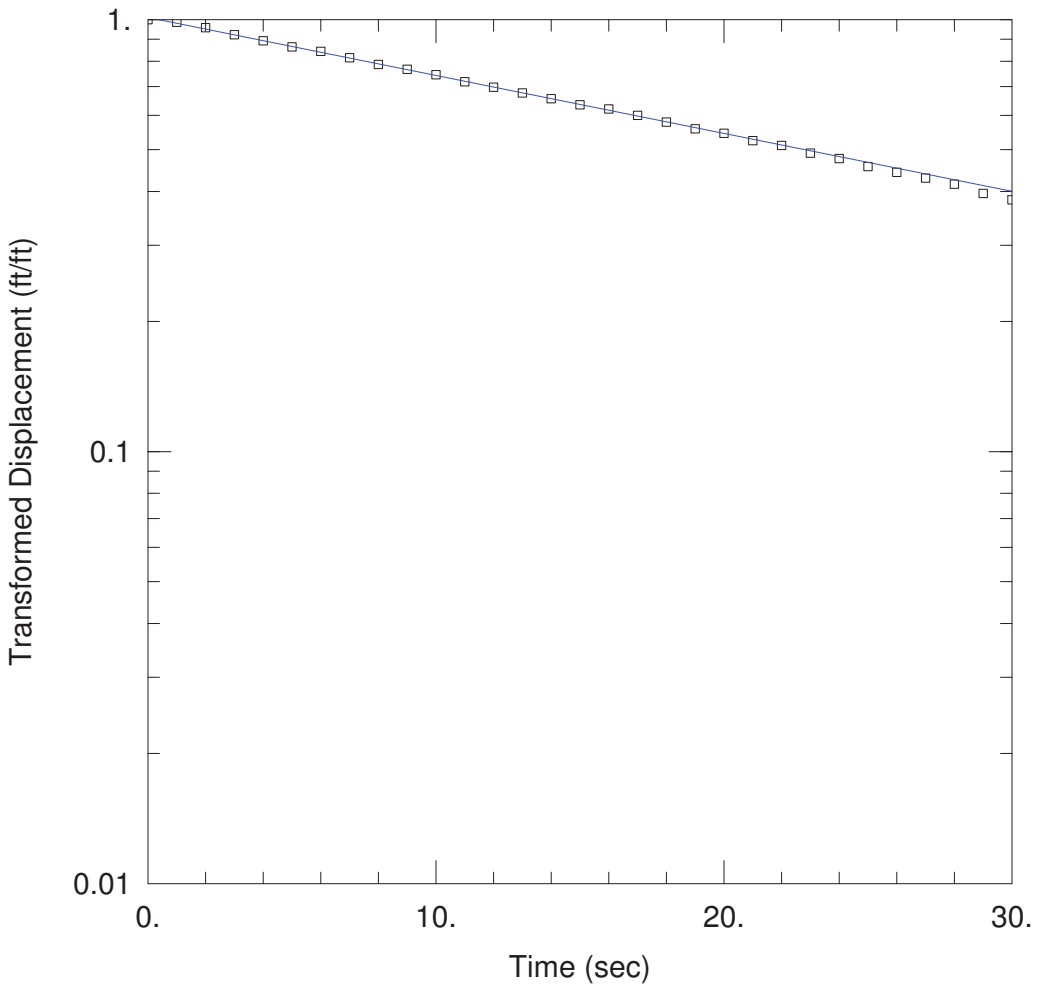
Saturated Thickness: 14.68 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (PNMW-14)

Initial Displacement: 1.22 ft
Total Well Penetration Depth: 14.68 ft
Casing Radius: 0.083 ft
Static Water Column Height: 14.68 ft
Screen Length: 14.68 ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Dagan
K = 0.02059 cm/sec
y0 = 0.2426 ft



PNMW-14 SLUG OUT

Data Set: P:\...\Pawnee_PNMW-14_Slug_Out_Dagan.aqt
Date: 02/01/16 Time: 14:37:42

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Project: 266180
Location: Pawnee Station
Test Well: PNMW-14
Test Date: 12/9/2015

AQUIFER DATA

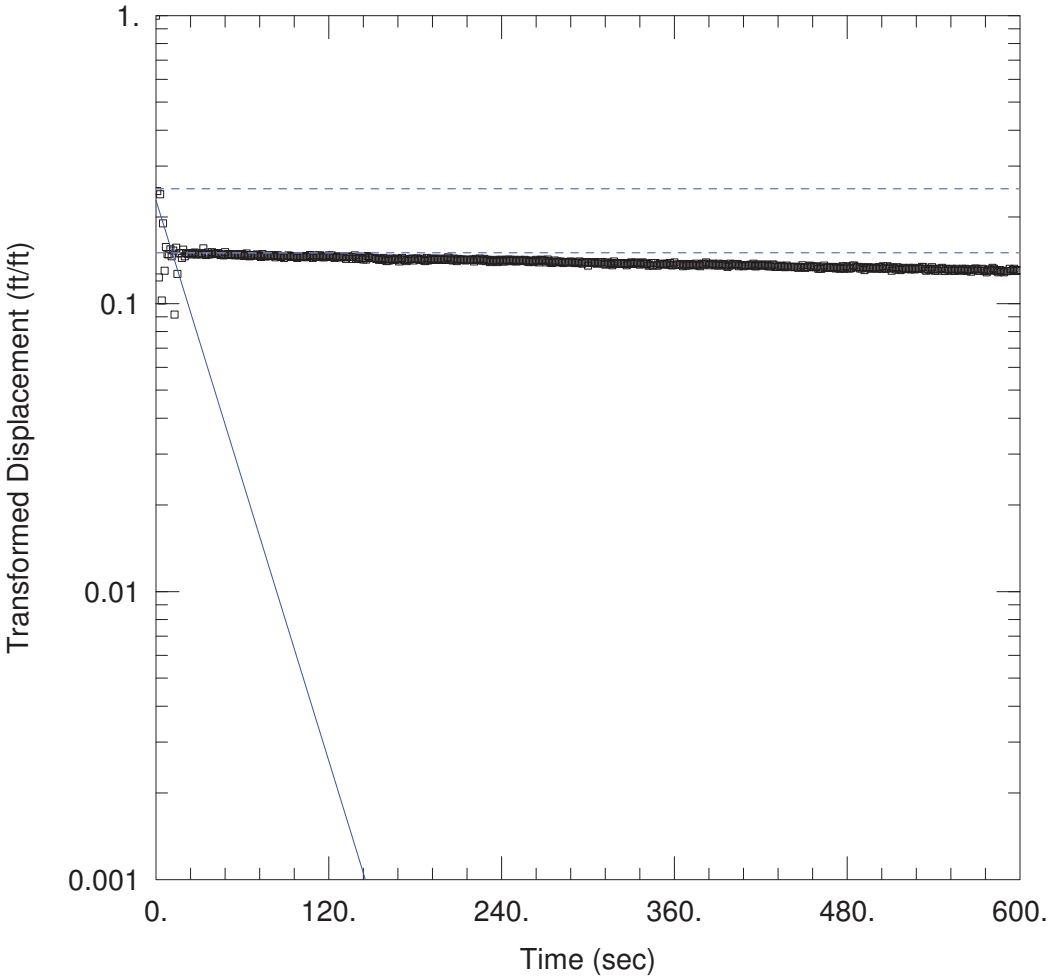
Saturated Thickness: 14.68 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (PNMW-14)

Initial Displacement: 1.47 ft
Total Well Penetration Depth: 14.68 ft
Casing Radius: 0.083 ft
Static Water Column Height: 14.68 ft
Screen Length: 14.68 ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Dagan
K = 0.0008333 cm/sec
y0 = 1.485 ft



MW-15 (SLUG IN)

Data Set:
Date: 04/10/17 Time: 13:04:06

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Location: Pawnee Station
Test Well: MW-15

AQUIFER DATA

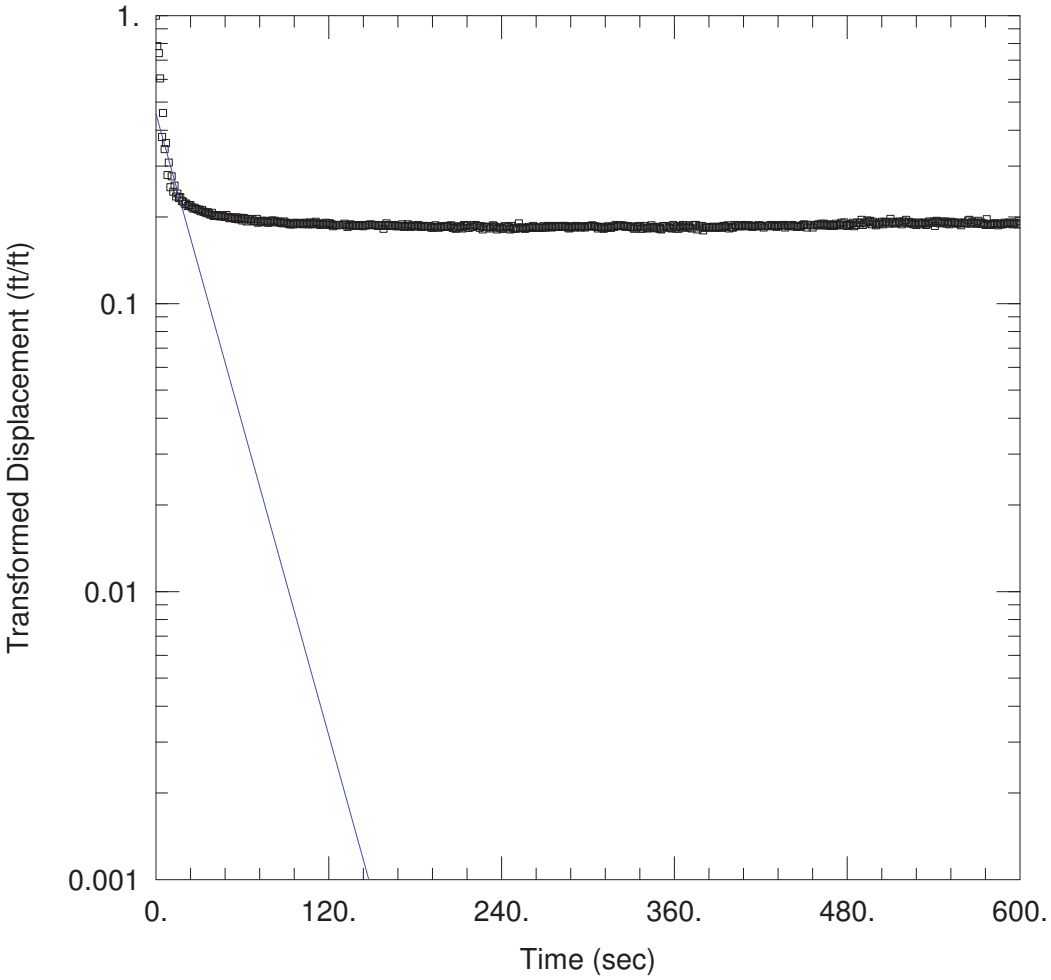
Saturated Thickness: 28.28 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-15)

Initial Displacement: 1.697 ft Static Water Column Height: 28.28 ft
Total Well Penetration Depth: 30. ft Screen Length: 30. ft
Casing Radius: 0.083 ft Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Dagan
K = 0.0005934 cm/sec y0 = 0.3961 ft



MW-15 SLUG OUT

Data Set:
Date: 04/10/17 Time: 13:35:23

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Location: Pawnee Station
Test Well: MW-15

AQUIFER DATA

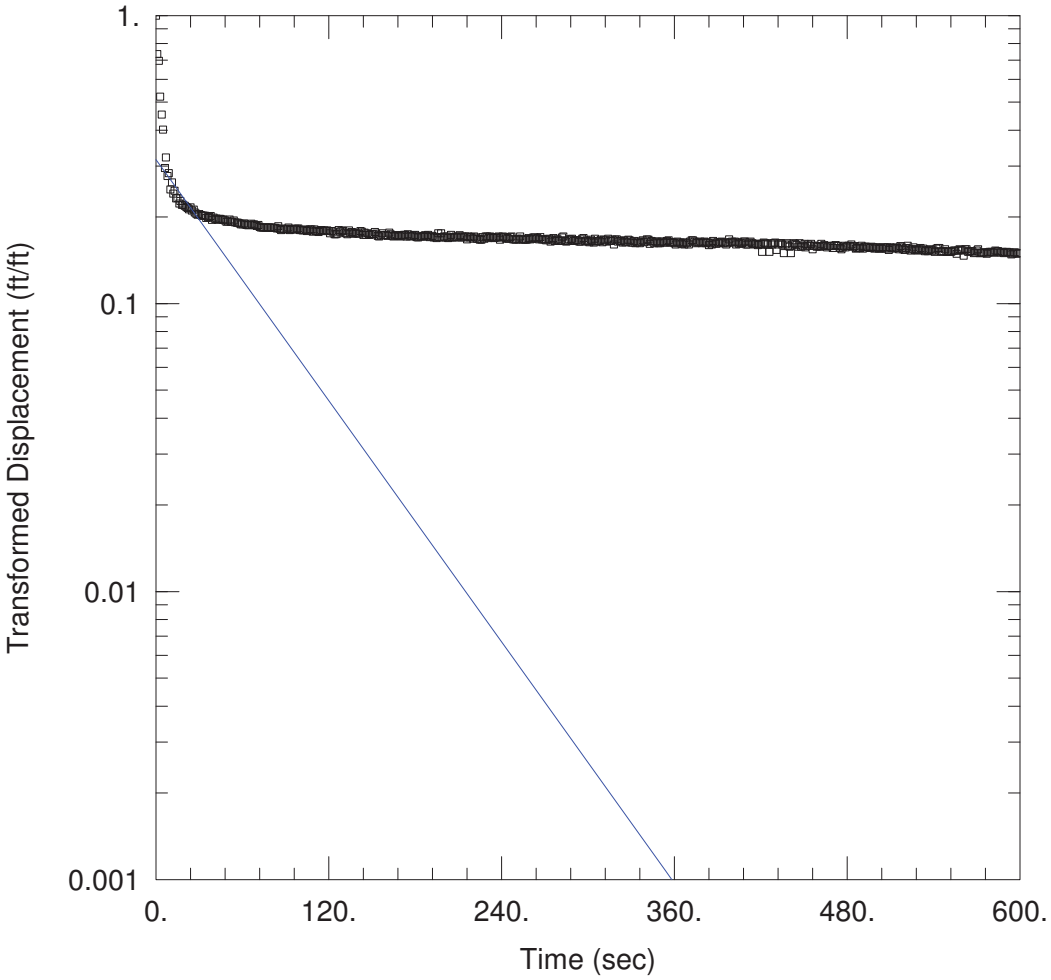
Saturated Thickness: 28.28 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-15)

Initial Displacement: 1.296 ft
Total Well Penetration Depth: 28.28 ft
Casing Radius: 0.083 ft
Static Water Column Height: 28.28 ft
Screen Length: 28.28 ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Dagan
K = 0.002275 cm/sec
y0 = 0.5979 ft



MW-15 (SLUG OUT -2ND TEST)

Data Set: C:\...\MW15_slugout2_304.aqt
Date: 04/10/17 Time: 13:56:33

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Location: Pawnee Station
Test Well: MW-15

AQUIFER DATA

Saturated Thickness: 28.28 ft Anisotropy Ratio (Kz/Kr): 1.

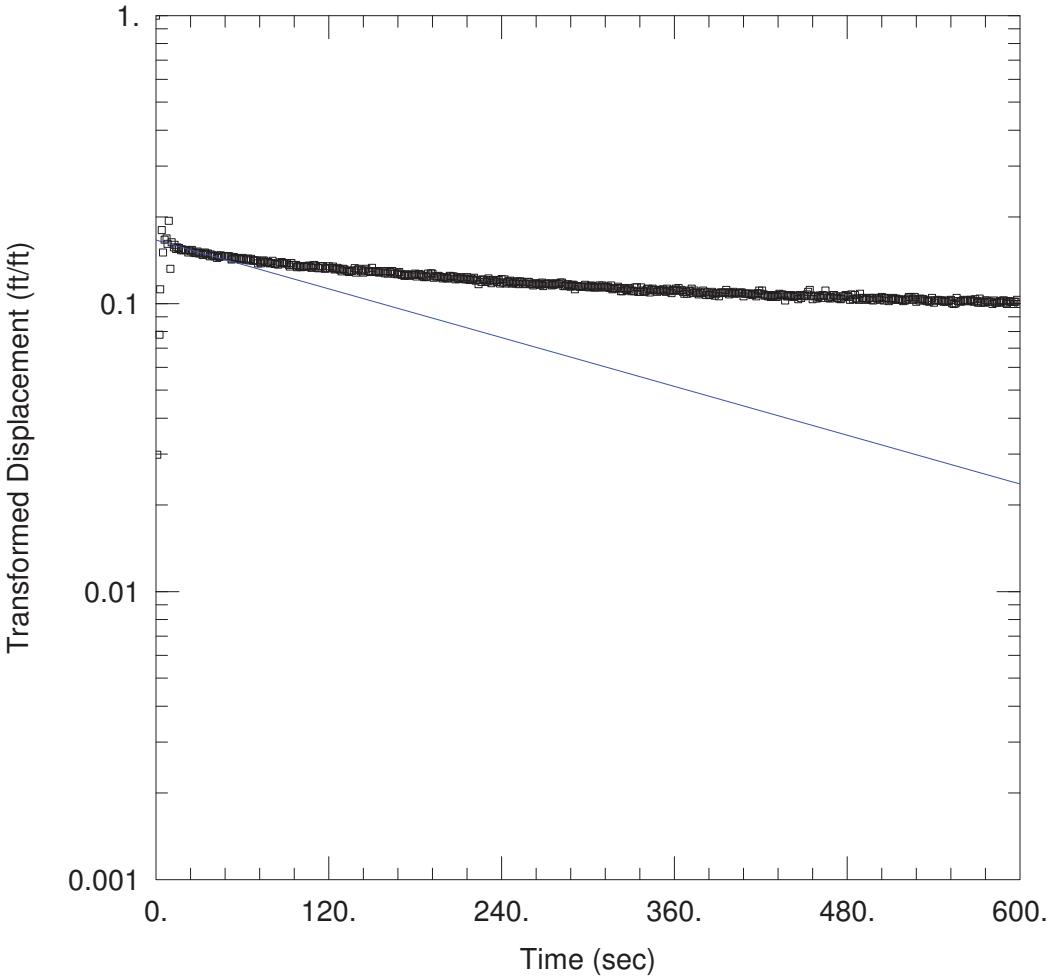
WELL DATA (MW-15)

Initial Displacement: 1.302 ft
Total Well Penetration Depth: 28.28 ft
Casing Radius: 0.083 ft
Static Water Column Height: 28.28 ft
Screen Length: 28.28 ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Dagan

K = 0.0008826 cm/sec y0 = 0.4183 ft



MW-17 (SLUG IN - 2ND TEST)

Data Set: C:\...\MW-17_slugin2_847.aqt
Date: 04/10/17 Time: 14:48:04

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Location: Pawnee Station
Test Well: MW-17

AQUIFER DATA

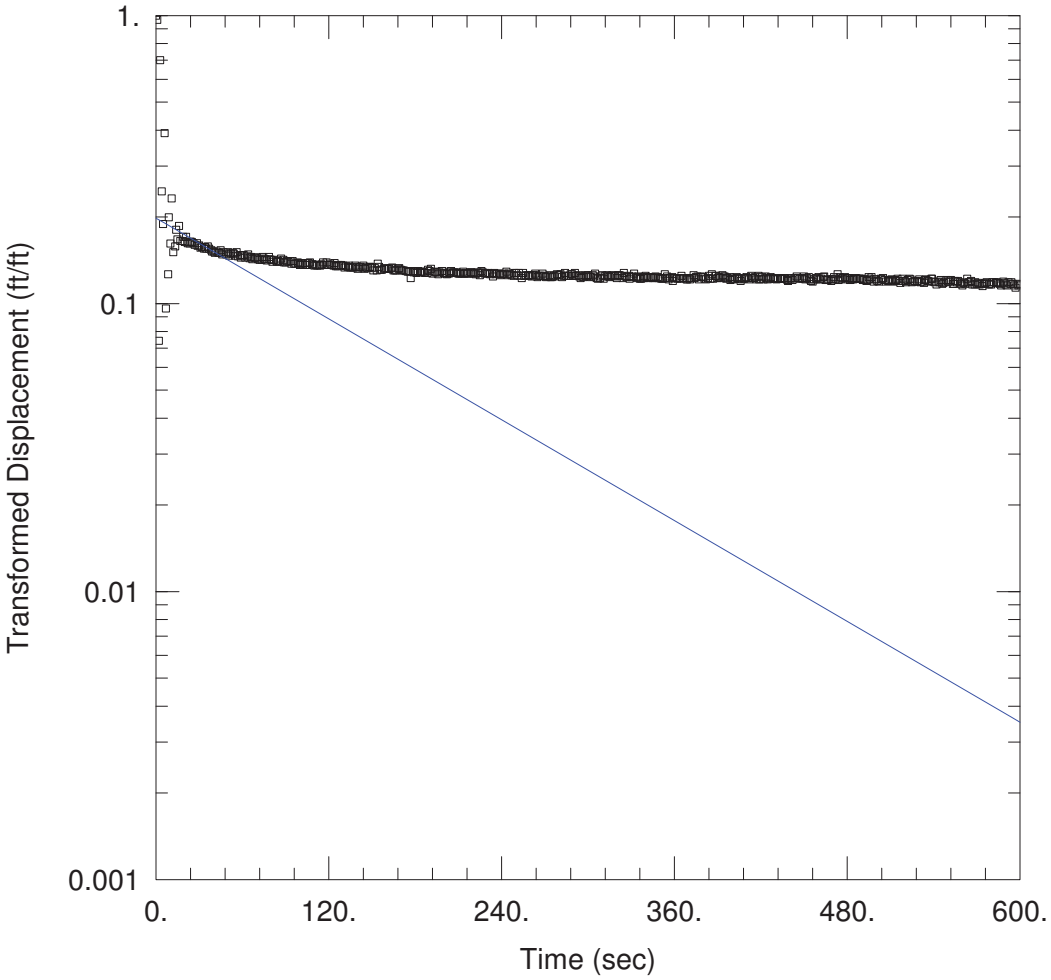
Saturated Thickness: 28.3 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-17)

Initial Displacement: 1.717 ft
Total Well Penetration Depth: 28.3 ft
Casing Radius: 0.083 ft
Static Water Column Height: 28.3 ft
Screen Length: 28.3 ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Dagan
K = 0.0001783 cm/sec
y0 = 0.2923 ft



MW-17 (SLUG OUT- 2ND TEST)

Data Set: C:\...\MW17-slugout2-213.aqt
Date: 04/10/17 Time: 15:18:12

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Location: Pawnee Station
Test Well: MW-17

AQUIFER DATA

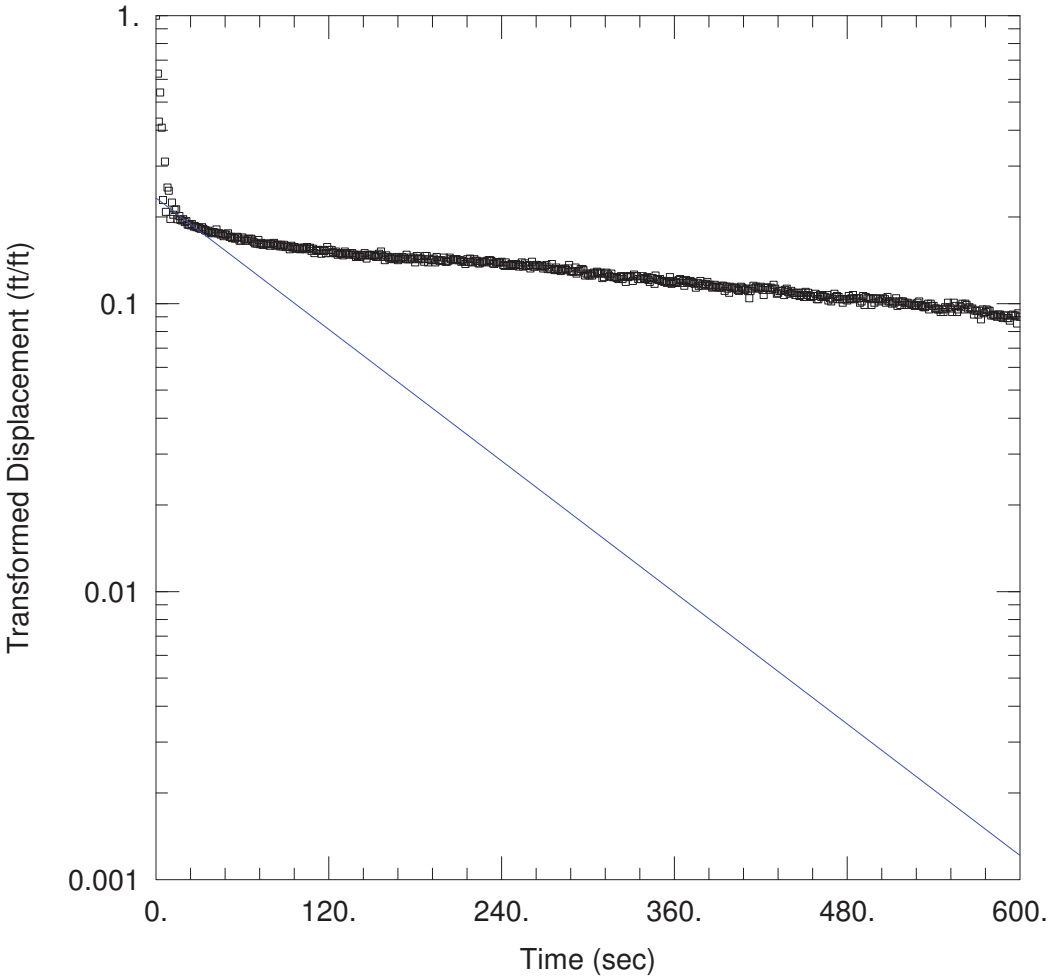
Saturated Thickness: 28.3 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-17)

Initial Displacement: 1.397 ft
Total Well Penetration Depth: 28.3 ft
Casing Radius: 0.083 ft
Static Water Column Height: 28.3 ft
Screen Length: 28.3 ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Dagan
K = 0.0003688 cm/sec
y0 = 0.2822 ft



MW-17 (SLUG OUT)

Data Set: C:\...\MW17-slugout-412.aqt
Date: 04/10/17 Time: 15:10:16

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Location: Pawnee Station
Test Well: MW-17

AQUIFER DATA

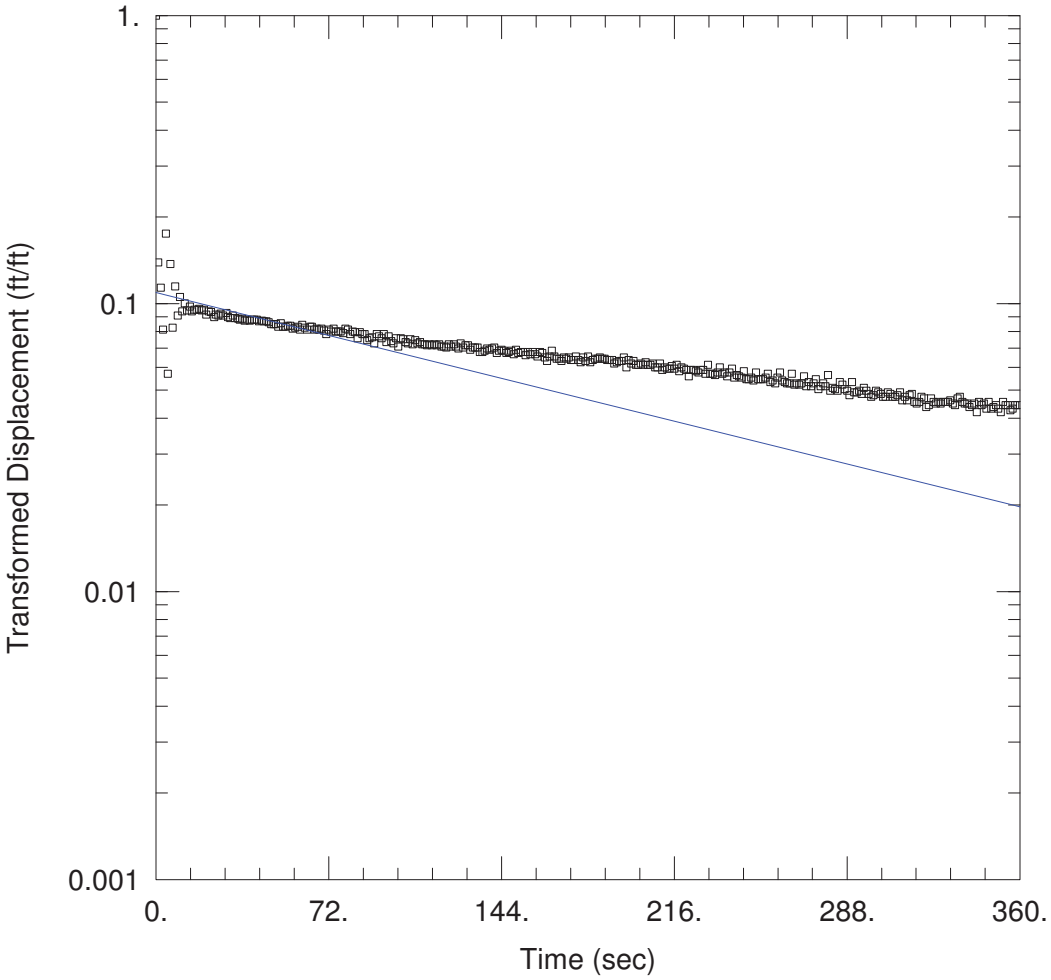
Saturated Thickness: 28.3 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-17)

Initial Displacement: 1.086 ft
Total Well Penetration Depth: 28.3 ft
Casing Radius: 0.083 ft
Static Water Column Height: 28.3 ft
Screen Length: 28.3 ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Dagan
K = 0.000481 cm/sec
y0 = 0.2565 ft



MW-17 (SLUG IN)

Data Set: C:\...\MW17_slugin_465.aqt
Date: 04/10/17 Time: 14:32:56

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Location: Pawnee Station
Test Well: MW-17

AQUIFER DATA

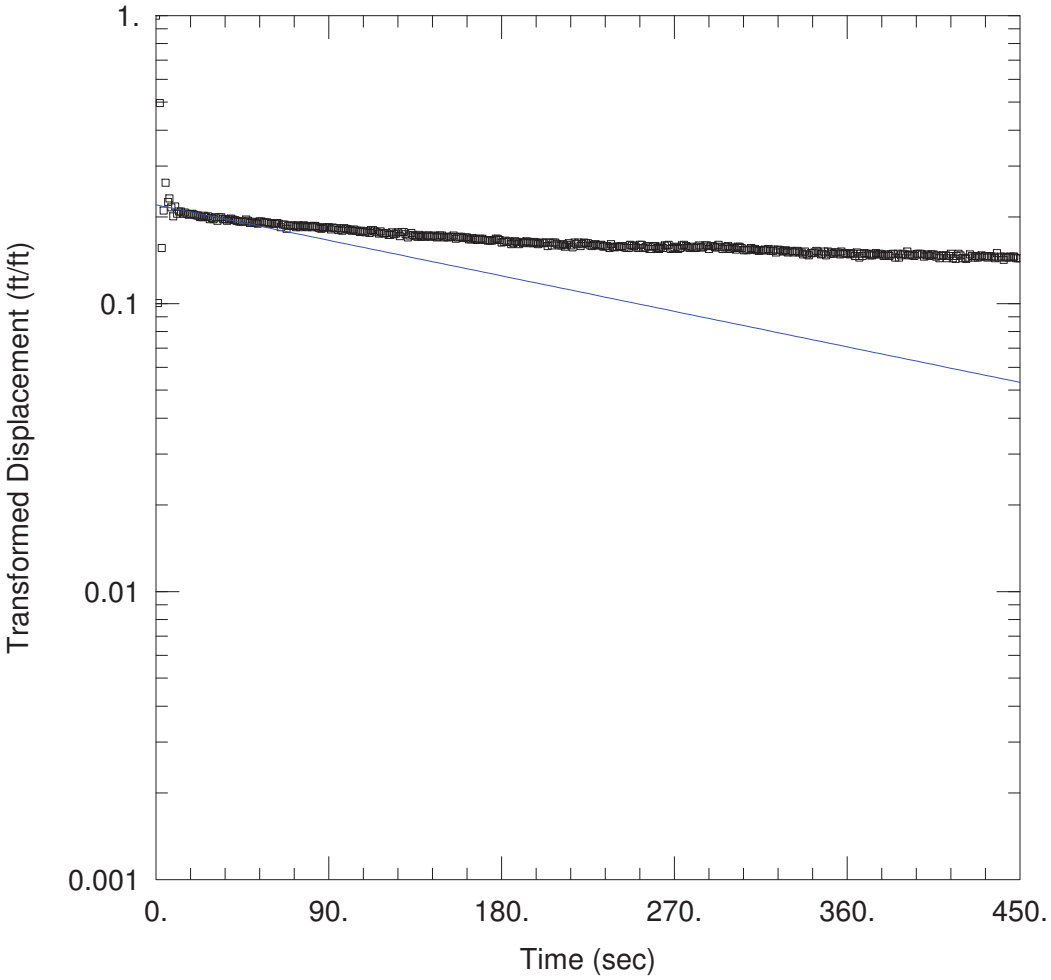
Saturated Thickness: 28.3 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-17)

Initial Displacement: 1.613 ft
Total Well Penetration Depth: 28.3 ft
Casing Radius: 0.083 ft
Static Water Column Height: 28.3 ft
Screen Length: 28.3 ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Dagan
K = 0.0002614 cm/sec
y0 = 0.1807 ft



MW-18 (SLUG IN - 2ND TEST)

Data Set: C:\...\MW18-SlugIn2-843.aqt
Date: 04/10/17 Time: 19:49:33

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Location: Pawnee Station
Test Well: MW-18

AQUIFER DATA

Saturated Thickness: 21.99 ft Anisotropy Ratio (Kz/Kr): 1.

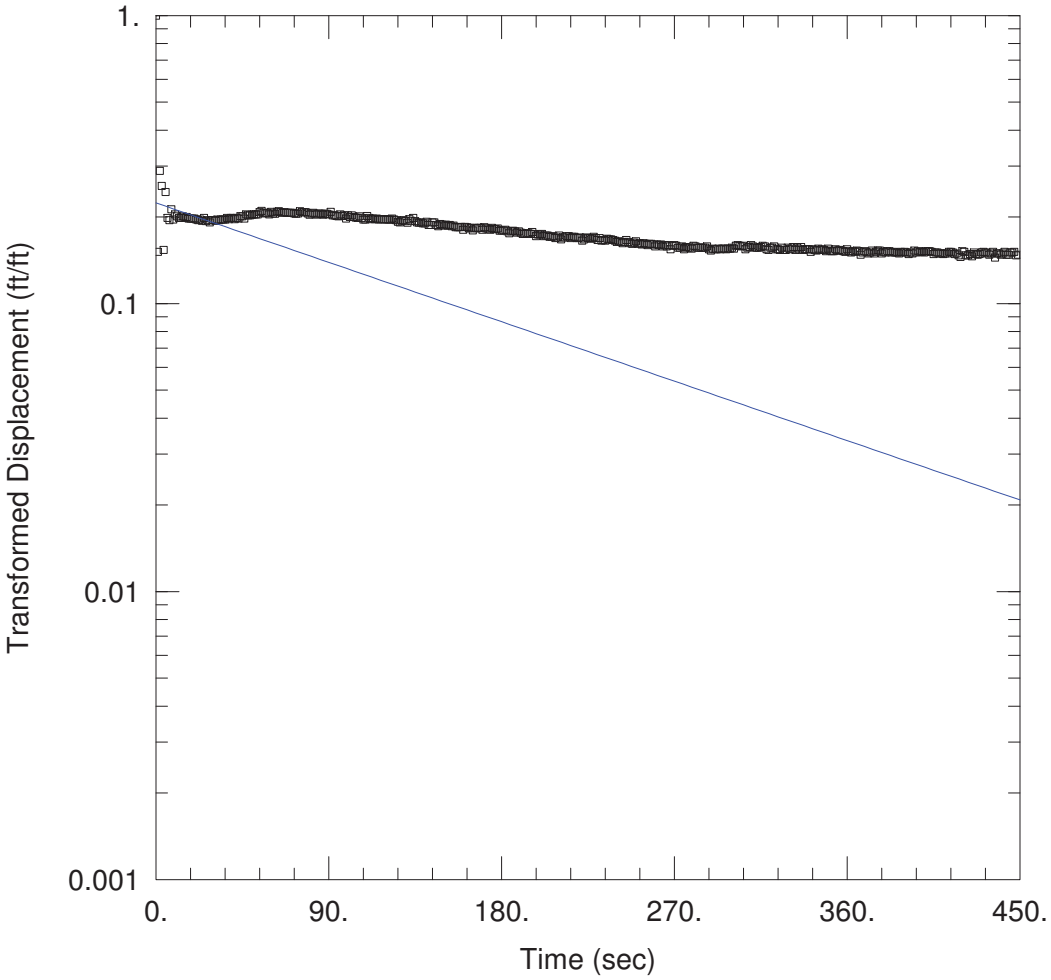
WELL DATA (MW-18)

Initial Displacement: 1.136 ft
Total Well Penetration Depth: 21.99 ft
Casing Radius: 0.083 ft
Static Water Column Height: 21.99 ft
Screen Length: 21.99 ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Dagan

K = 0.0002107 cm/sec y0 = 0.2552 ft



MW-18 (SLUG IN)

Data Set:
Date: 04/10/17 Time: 19:38:06

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Location: Pawnee Station
Test Well: MW-18

AQUIFER DATA

Saturated Thickness: 21.99 ft Anisotropy Ratio (Kz/Kr): 1.

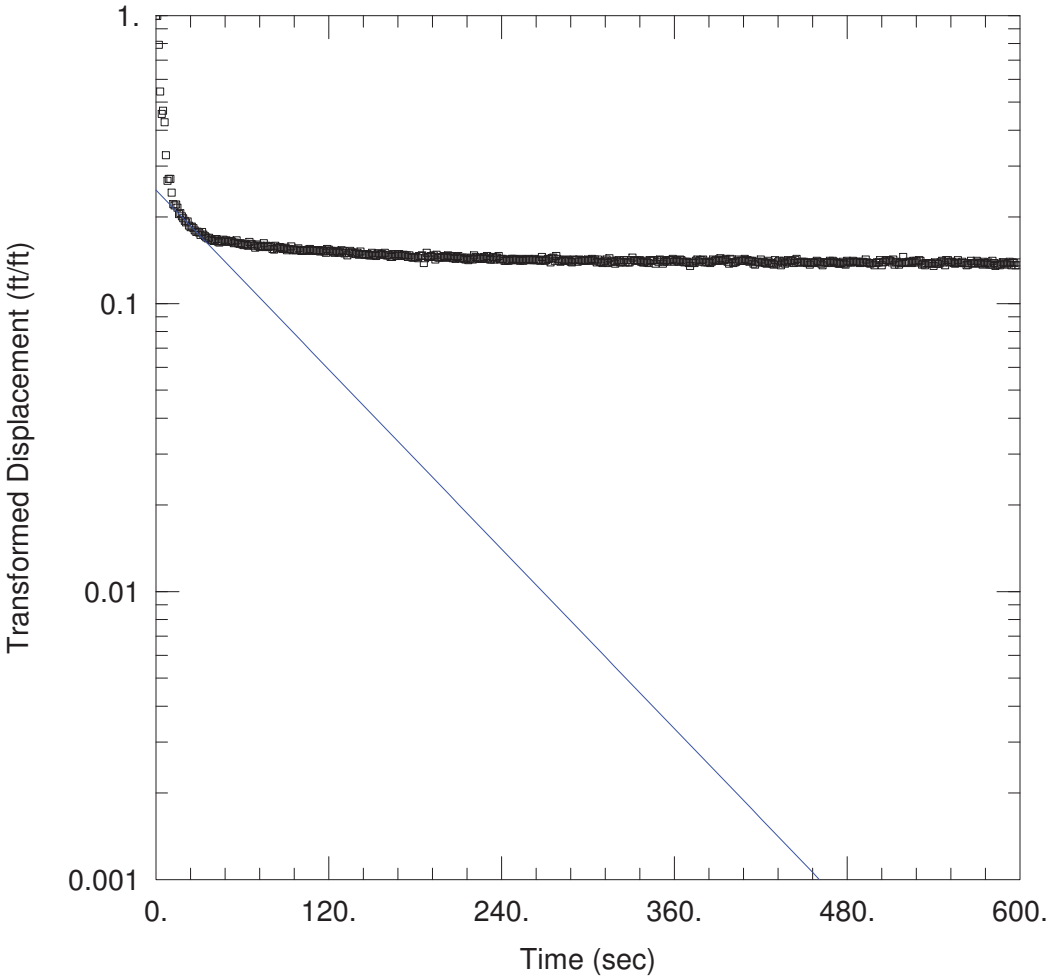
WELL DATA (MW-18)

Initial Displacement: 1.169 ft
Total Well Penetration Depth: 21.99 ft
Casing Radius: 0.08 ft
Static Water Column Height: 21.99 ft
Screen Length: 21.99 ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Dagan

K = 0.0003473 cm/sec y0 = 0.2667 ft



MW-18 (SLUG OUT - 2ND TEST)

Data Set: C:\...\MW18-SlugOut2-648.aqt
Date: 04/10/17 Time: 20:13:36

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Location: Pawnee Station
Test Well: MW-18

AQUIFER DATA

Saturated Thickness: 21.99 ft Anisotropy Ratio (Kz/Kr): 1.

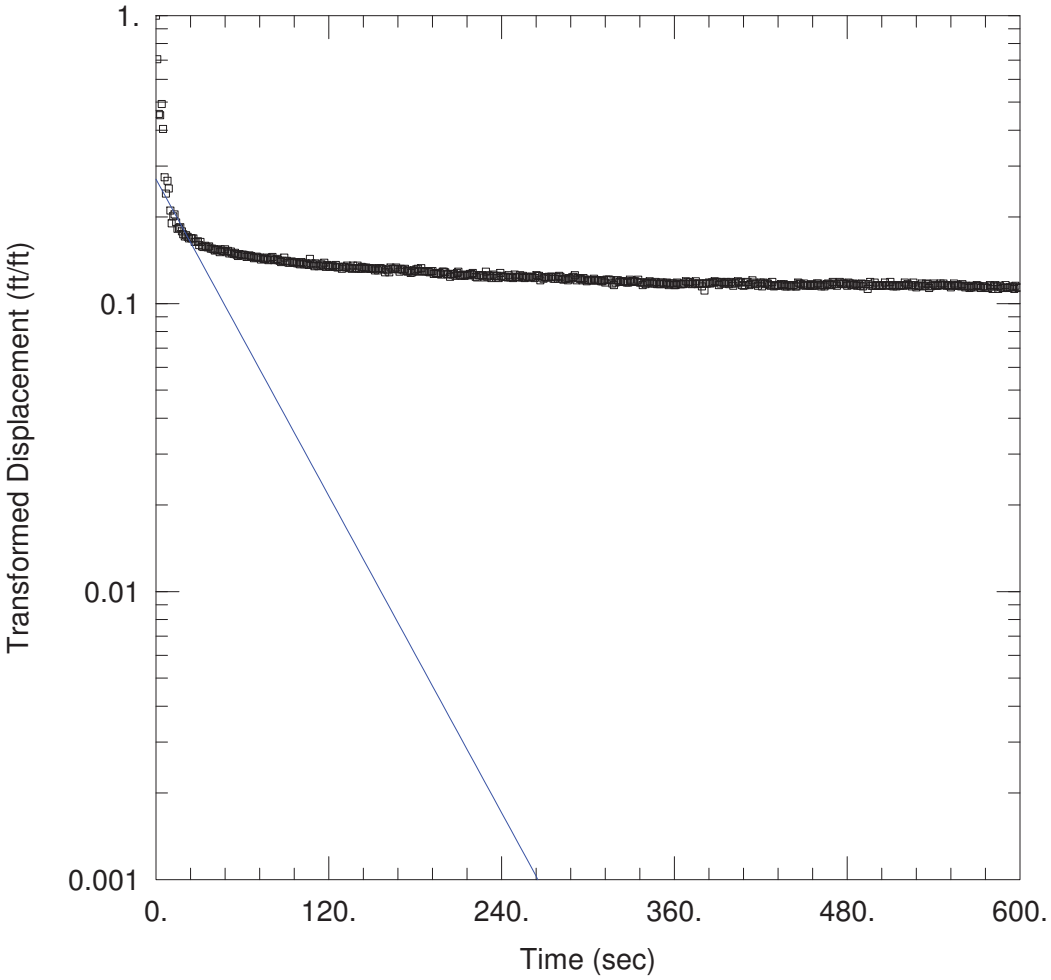
WELL DATA (MW-18)

Initial Displacement: 1.24 ft
Total Well Penetration Depth: 21.99 ft
Casing Radius: 0.083 ft
Static Water Column Height: 21.99 ft
Screen Length: 21.99 ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Dagan

K = 0.0007989 cm/sec y0 = 0.314 ft



MW-18 (SLUG IN)

Data Set: C:\...\MW18-SlugOut-131.aqt
Date: 04/10/17 Time: 20:06:34

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Location: Pawnee Station
Test Well: MW-18

AQUIFER DATA

Saturated Thickness: 21.99 ft Anisotropy Ratio (Kz/Kr): 1.

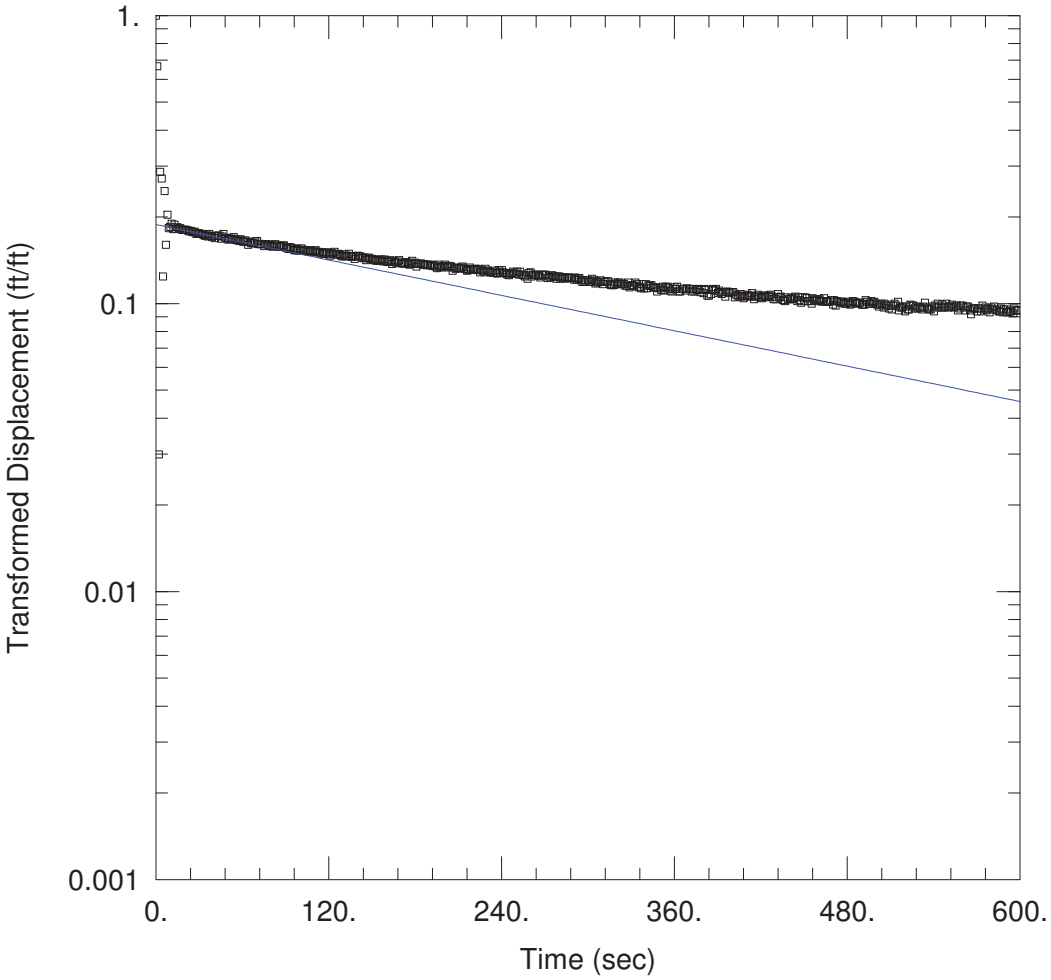
WELL DATA (MW-18)

Initial Displacement: 1.351 ft
Total Well Penetration Depth: 21.99 ft
Casing Radius: 0.083 ft
Static Water Column Height: 21.99 ft
Screen Length: 21.99 ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Dagan

K = 0.00141 cm/sec y0 = 0.3738 ft



MW-19 (SLUG OUT)

Data Set: C:\...\MW19_slugout-480.aqt
Date: 04/10/17 Time: 15:51:55

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Location: Pawnee Station
Test Well: MW-19

AQUIFER DATA

Saturated Thickness: 24.17 ft Anisotropy Ratio (Kz/Kr): 1.

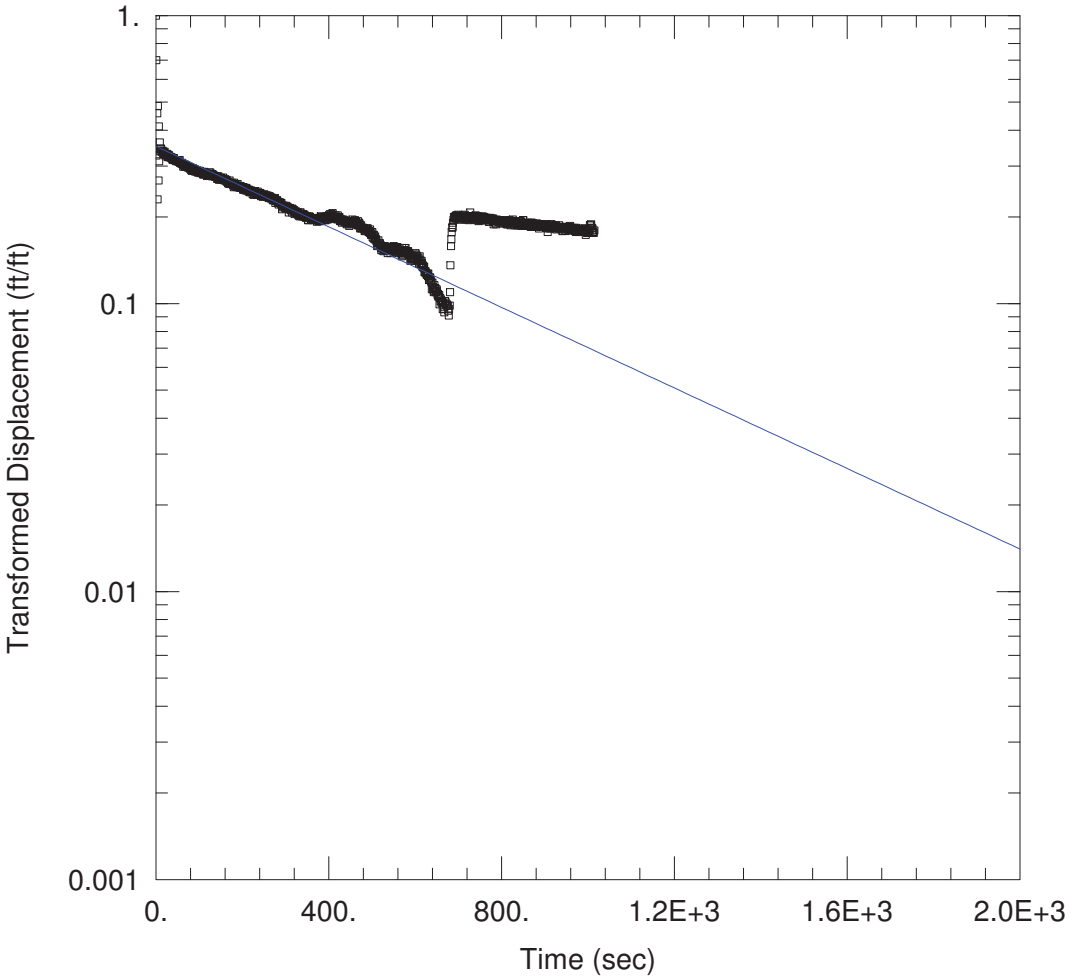
WELL DATA (MW-19)

Initial Displacement: 1.339 ft
Total Well Penetration Depth: 24.17 ft
Casing Radius: 0.083 ft
Static Water Column Height: 24.17 ft
Screen Length: 24.17 ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Dagan

K = 0.000147 cm/sec y0 = 0.2574 ft



MW-19 (SLUG IN)

Data Set: C:\...\MW19_SlugIn_066.aqt
Date: 04/10/17 Time: 15:59:35

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Location: Pawnee Station
Test Well: MW-19

AQUIFER DATA

Saturated Thickness: 24.17 ft Anisotropy Ratio (Kz/Kr): 1.

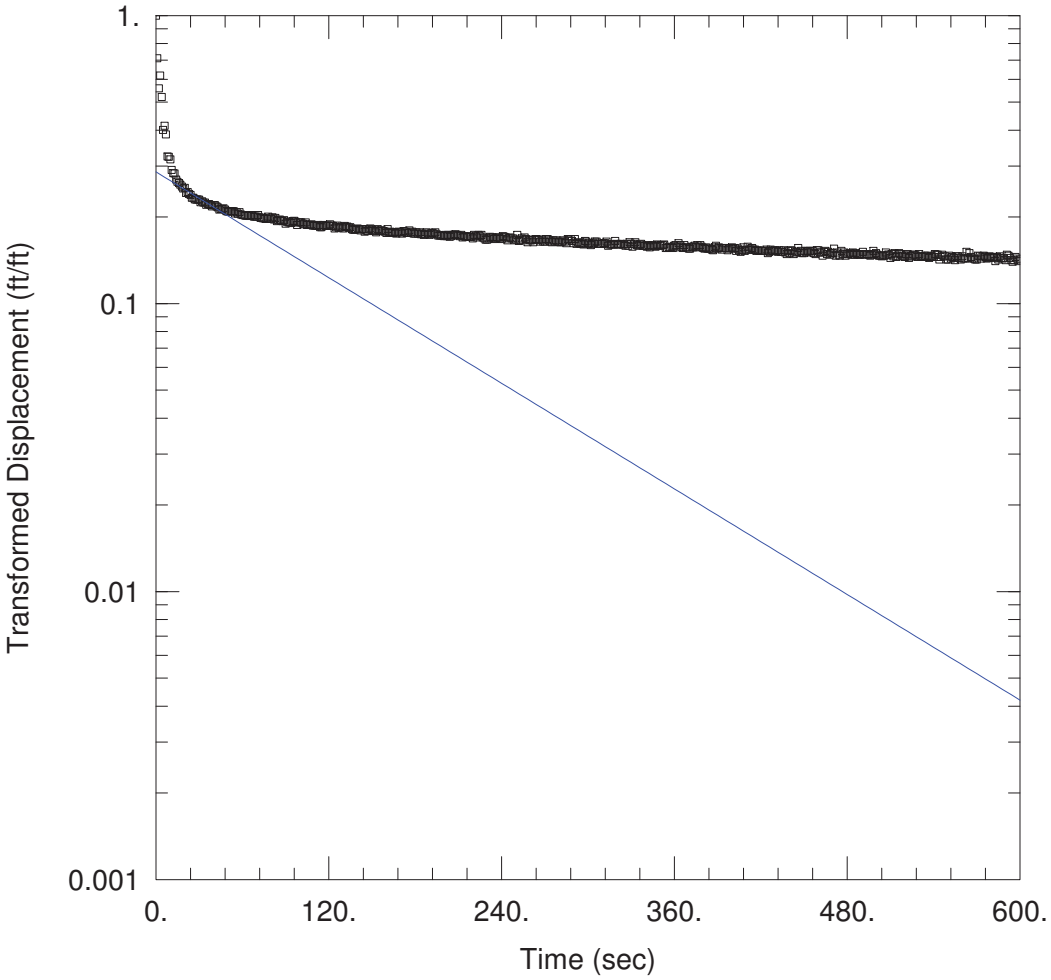
WELL DATA (MW-19)

Initial Displacement: 0.7897 ft
Total Well Penetration Depth: 24.17 ft
Casing Radius: 0.083 ft
Static Water Column Height: 24.17 ft
Screen Length: 24.17 ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Dagan

K = 0.0001004 cm/sec y0 = 0.2806 ft



MW-19 (SLUG OUT)

Data Set: C:\...\MW19-SlugOut-905.aqt
Date: 04/10/17 Time: 16:22:55

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Location: Pawnee Station
Test Well: MW-19

AQUIFER DATA

Saturated Thickness: 24.17 ft Anisotropy Ratio (Kz/Kr): 1.

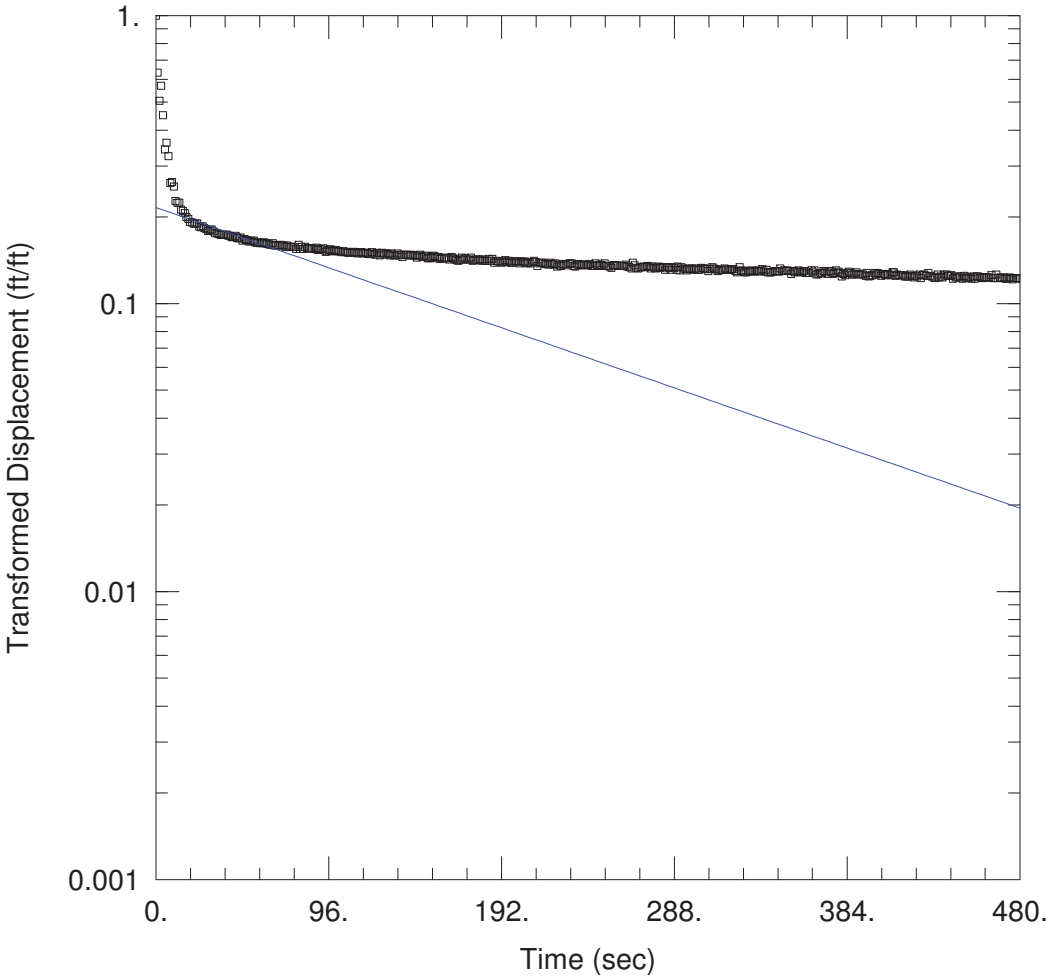
WELL DATA (MW-19)

Initial Displacement: 1.087 ft
Total Well Penetration Depth: 24.17 ft
Casing Radius: 0.083 ft
Static Water Column Height: 24.17 ft
Screen Length: 24.17 ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Dagan

K = 0.0004388 cm/sec y0 = 0.3161 ft



MW-19 (SLUG OUT - 2ND TEST)

Data Set: C:\...\MW19-slugout2-619.aqt
Date: 04/10/17 Time: 16:12:02

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Location: Pawnee Station
Test Well: MW-19

AQUIFER DATA

Saturated Thickness: 24.17 ft Anisotropy Ratio (Kz/Kr): 1.

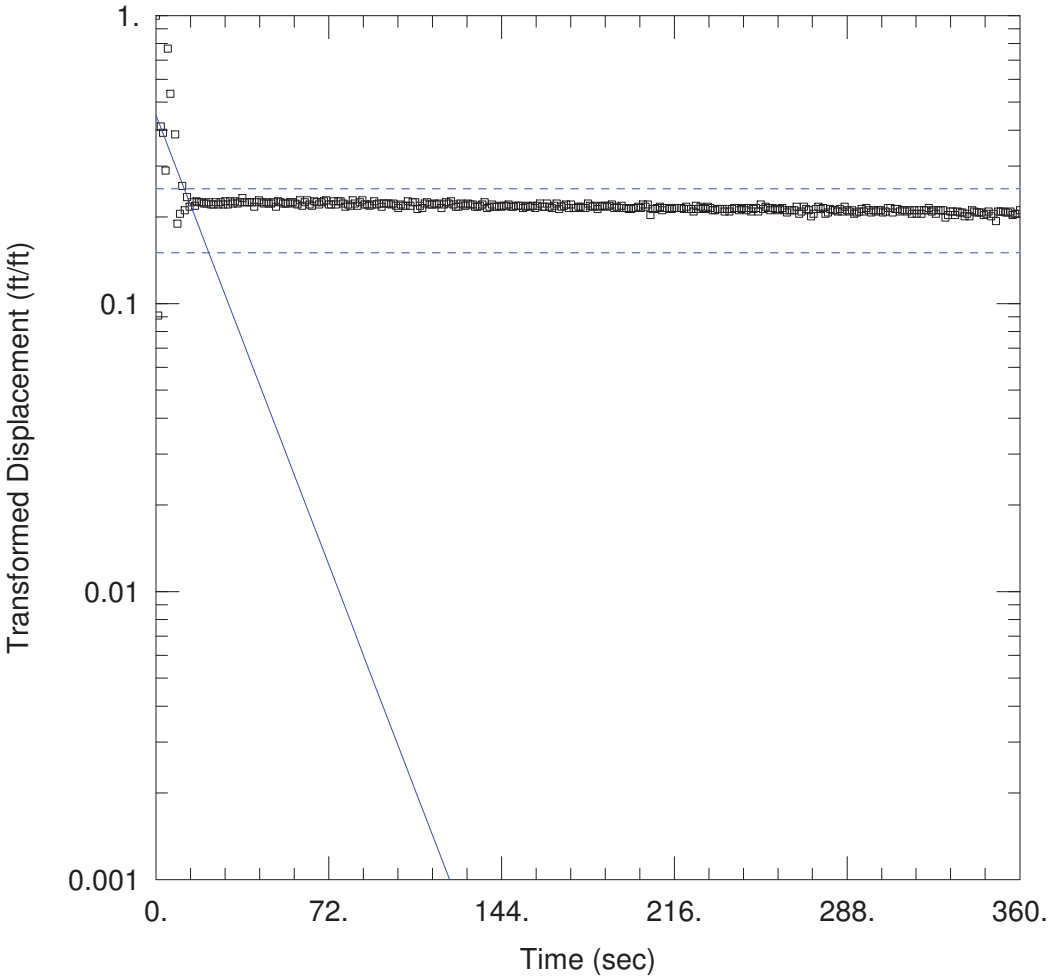
WELL DATA (MW-19)

Initial Displacement: 1.399 ft
Total Well Penetration Depth: 24.17 ft
Casing Radius: 0.083 ft
Static Water Column Height: 24.17 ft
Screen Length: 24.17 ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Dagan

K = 0.0003122 cm/sec y0 = 0.3083 ft



WELL TEST ANALYSIS

Data Set: C:\WorkProjects\XcelEnergy\SlugTests\SlugTestData\Analysed\MW-20_in\MW-20_in.aqt
Date: 03/30/17 Time: 10:08:12

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Location: Pawnee Station
Test Well: MW-20 (in)
Test Date: 3/6/17

AQUIFER DATA

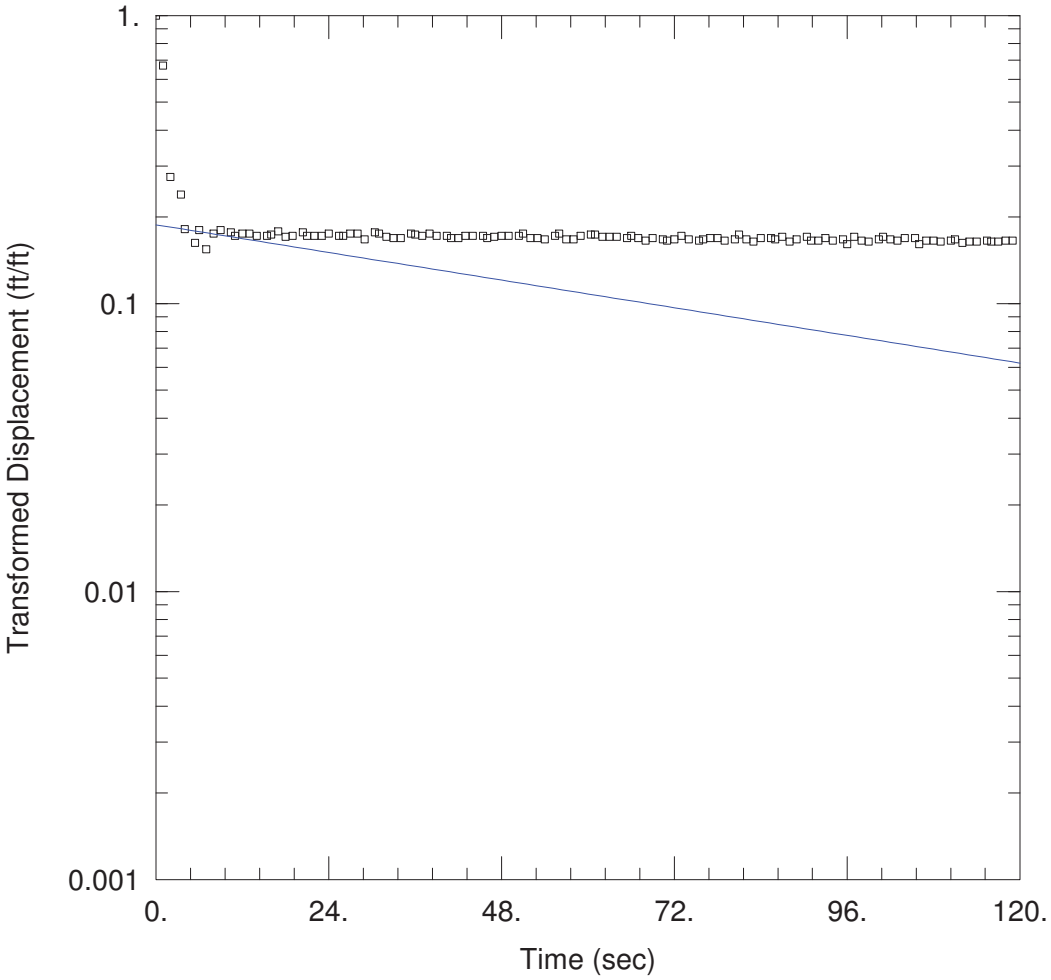
Saturated Thickness: 24.24 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-20 (In))

Initial Displacement: 0.5054 ft
Total Well Penetration Depth: 24.24 ft
Casing Radius: 0.083 ft
Static Water Column Height: 24.24 ft
Screen Length: 24.24 ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Dagan
K = 0.003115 cm/sec
y0 = 0.229 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW20_out2.aqt
Date: 03/30/17 Time: 14:53:51

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Location: Pawnee Station
Test Well: MW-20 (Out - 2nd test)
Test Date: 3/6/17

AQUIFER DATA

Saturated Thickness: 24.24 ft Anisotropy Ratio (Kz/Kr): 1.

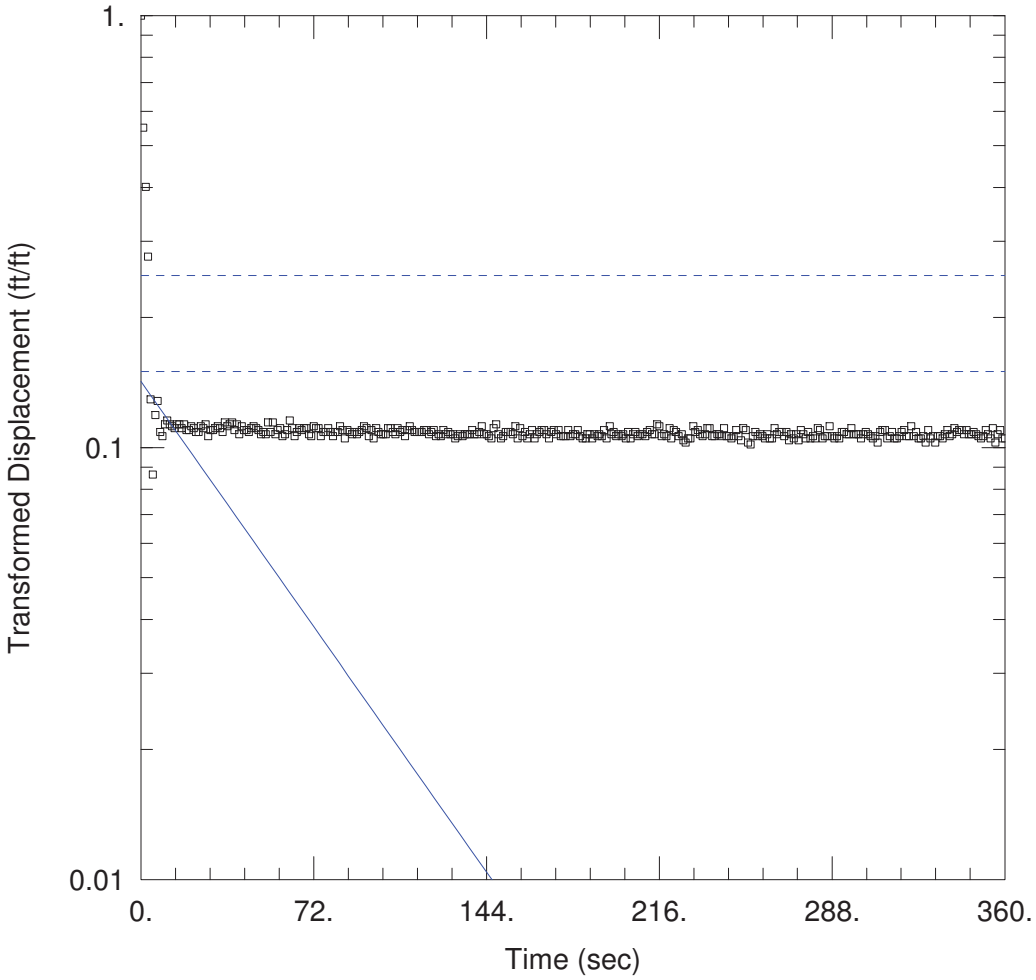
WELL DATA (MW-20 (Out - 2nd test))

Initial Displacement: 0.6233 ft
Total Well Penetration Depth: 24.24 ft
Casing Radius: 0.083 ft
Static Water Column Height: 24.24 ft
Screen Length: 24.24 ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Dagan

K = 0.0005751 cm/sec y0 = 0.1182 ft



WELL TEST ANALYSIS

Data Set: C:\WorkProjects\XcelEnergy\SlugTests\SlugTestData\Analysed\MW-20_out\MW-20-out.aqt
Date: 03/30/17 Time: 09:33:29

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Location: Pawnee Station
Test Well: MW-20 (Out)
Test Date: 3/6/17

AQUIFER DATA

Saturated Thickness: 24.24 ft Anisotropy Ratio (Kz/Kr): 1.

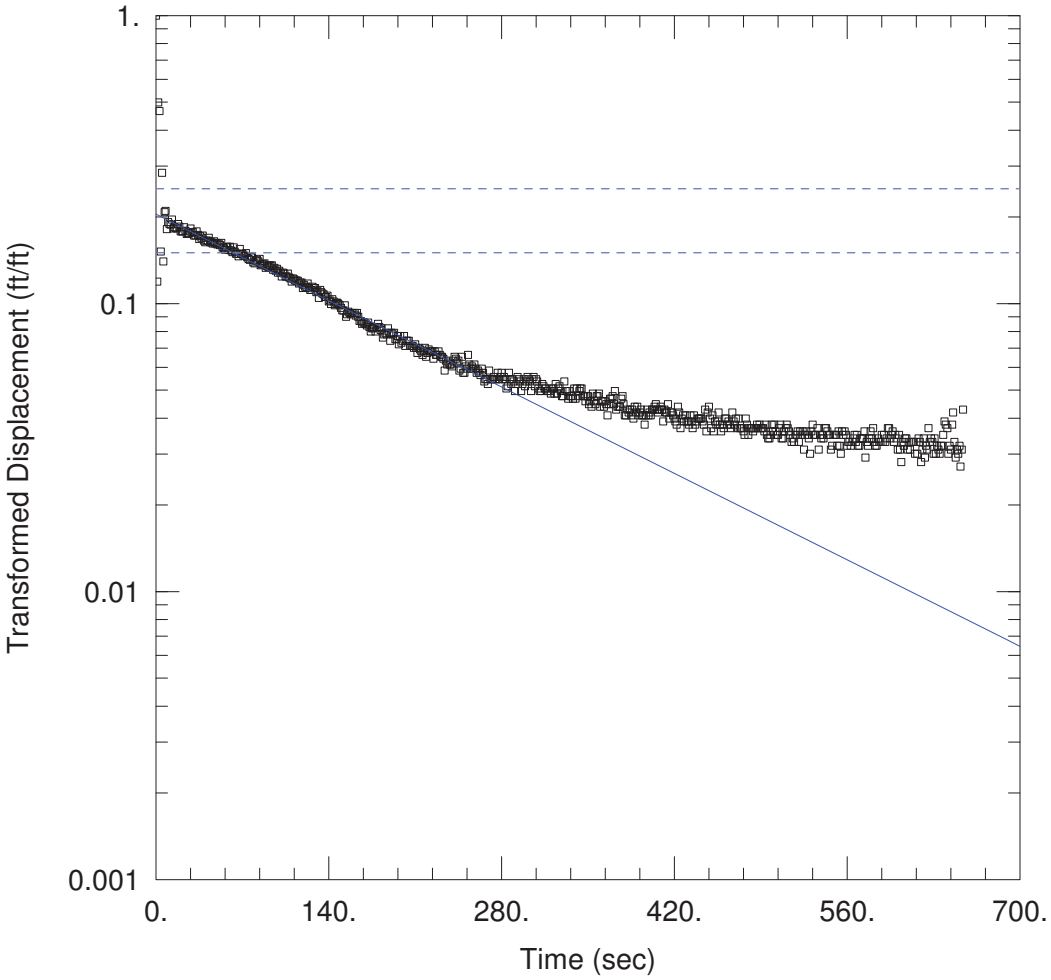
WELL DATA (MW-20 (Out))

Initial Displacement: 0.8531 ft
Total Well Penetration Depth: 24.24 ft
Casing Radius: 0.083 ft
Static Water Column Height: 24.24 ft
Screen Length: 24.24 ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Dagan

K = 0.001133 cm/sec y0 = 0.1231 ft



WELL TEST ANALYSIS

Data Set: C:\WorkProjects\XcelEnergy\SlugTests\SlugTestData\Analysed\MW-21\MW_21_in.aqt
Date: 03/29/17 Time: 13:37:18

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Location: Pawnee Station
Test Well: MW-21 (in)
Test Date: 3/6/17

AQUIFER DATA

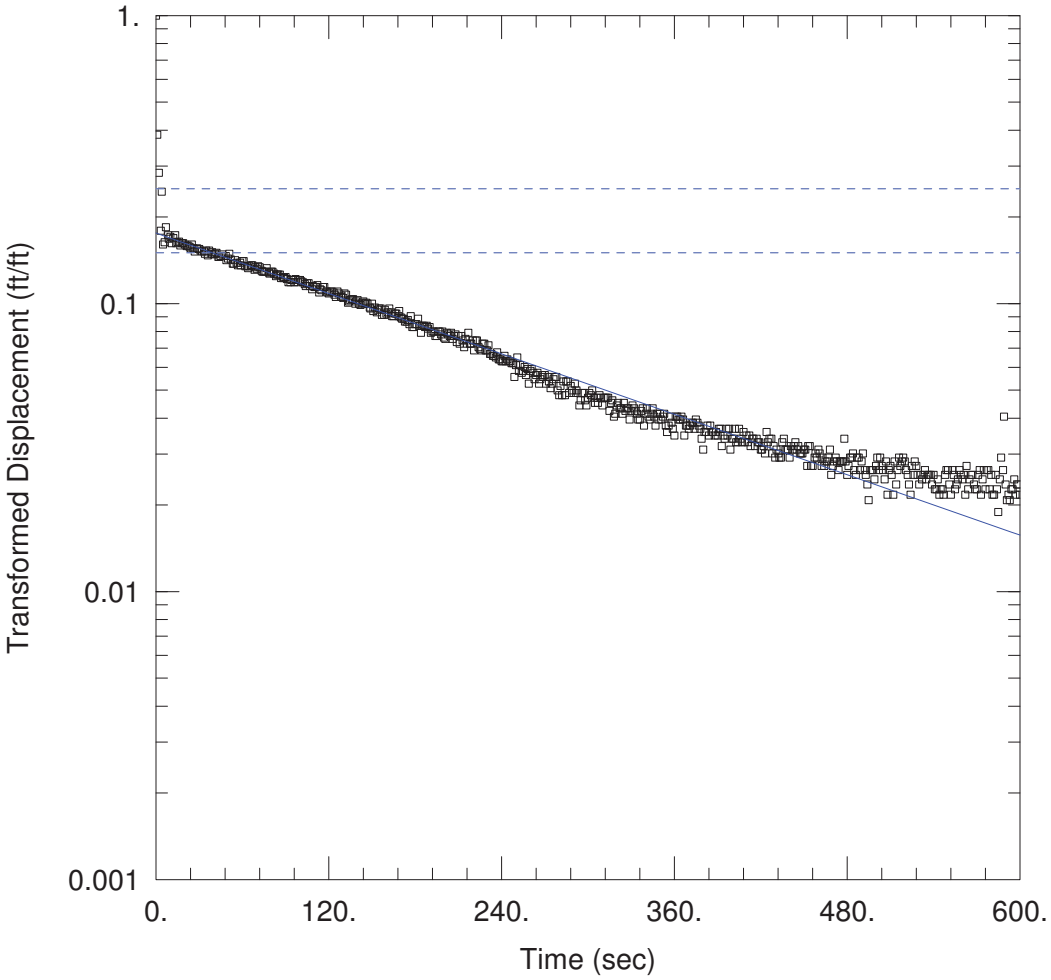
Saturated Thickness: 23.8 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-21)

Initial Displacement: 1.003 ft
Total Well Penetration Depth: 23.8 ft
Casing Radius: 0.083 ft
Static Water Column Height: 23.8 ft
Screen Length: 23.8 ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Dagan
K = 0.0003122 cm/sec
y0 = 0.2083 ft



WELL TEST ANALYSIS

Data Set: C:\WorkProjects\XcelEnergy\SlugTests\SlugTestData\Analysed\MW-21in_2\MW21_in2ndtest.aqt
Date: 03/30/17 Time: 10:37:08

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Location: Pawnee Station
Test Well: MW-21 (In - 2nd Test)
Test Date: 3/6/17

AQUIFER DATA

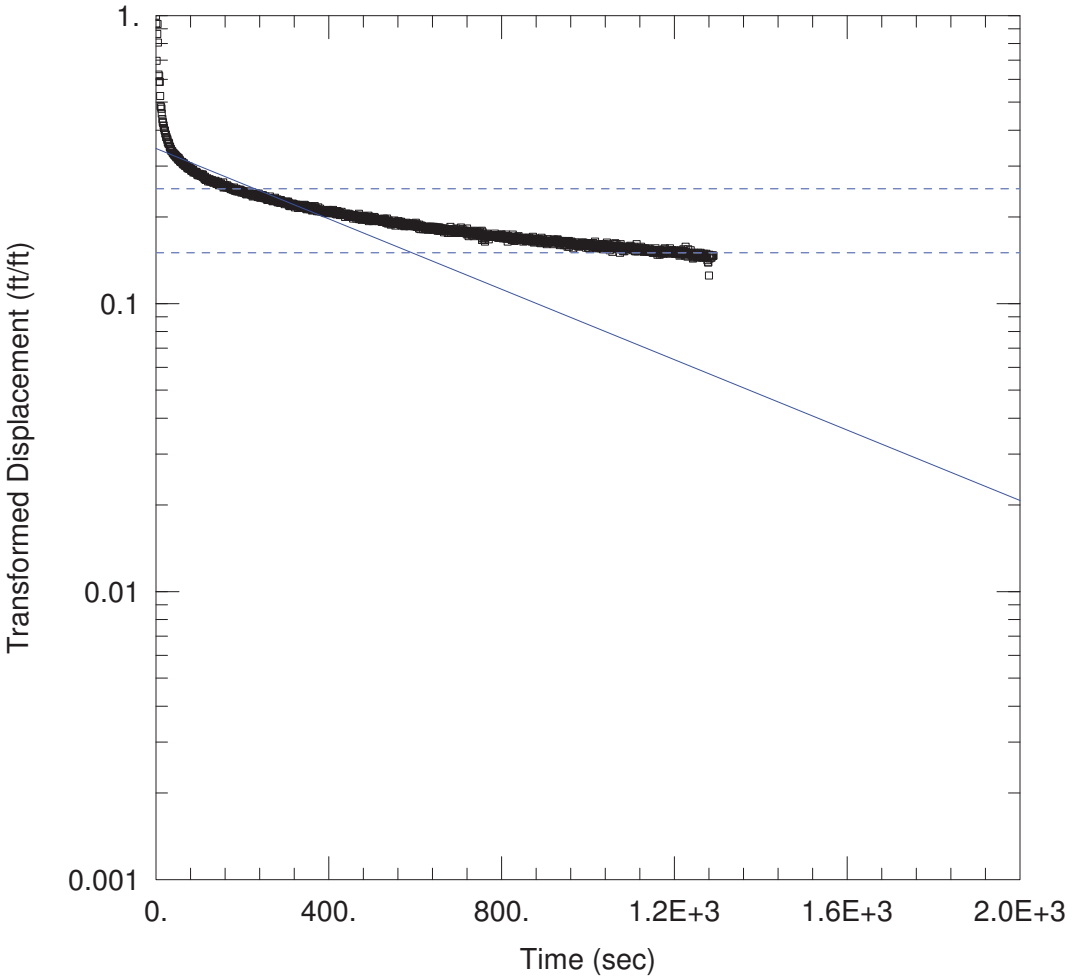
Saturated Thickness: 23.8 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW - 21 (In - 2nd Test))

Initial Displacement: 1.042 ft
Total Well Penetration Depth: 23.8 ft
Casing Radius: 0.083 ft
Static Water Column Height: 23.8 ft
Screen Length: 23.8 ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Dagan
K = 0.0002546 cm/sec
y0 = 0.1864 ft



WELL TEST ANALYSIS

Data Set:
Date: 03/30/17 Time: 08:52:06

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Location: Pawnee Station
Test Well: MW-21 (Out)
Test Date: 3/6/17

AQUIFER DATA

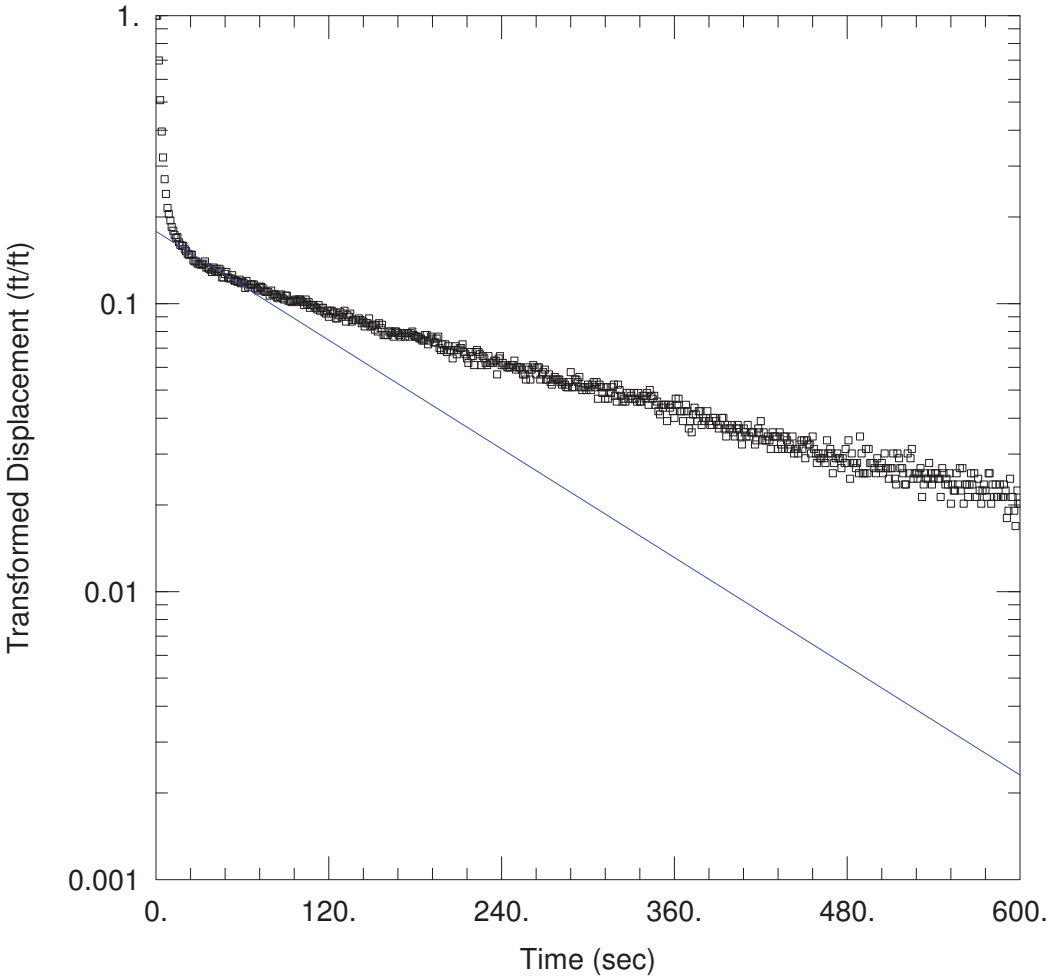
Saturated Thickness: 23.8 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-21 (Out))

Initial Displacement: 0.9134 ft
Total Well Penetration Depth: 23.8 ft
Casing Radius: 0.083 ft
Static Water Column Height: 23.8 ft
Screen Length: 23.8 ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Dagan
K = 8.903E-5 cm/sec
y0 = 0.3196 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW-21_out2.aqt
Date: 03/30/17 Time: 15:02:34

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Location: Pawnee Station
Test Well: MW-21 (Out - 2nd test)
Test Date: 3/6/17

AQUIFER DATA

Saturated Thickness: 23.8 ft Anisotropy Ratio (Kz/Kr): 1.

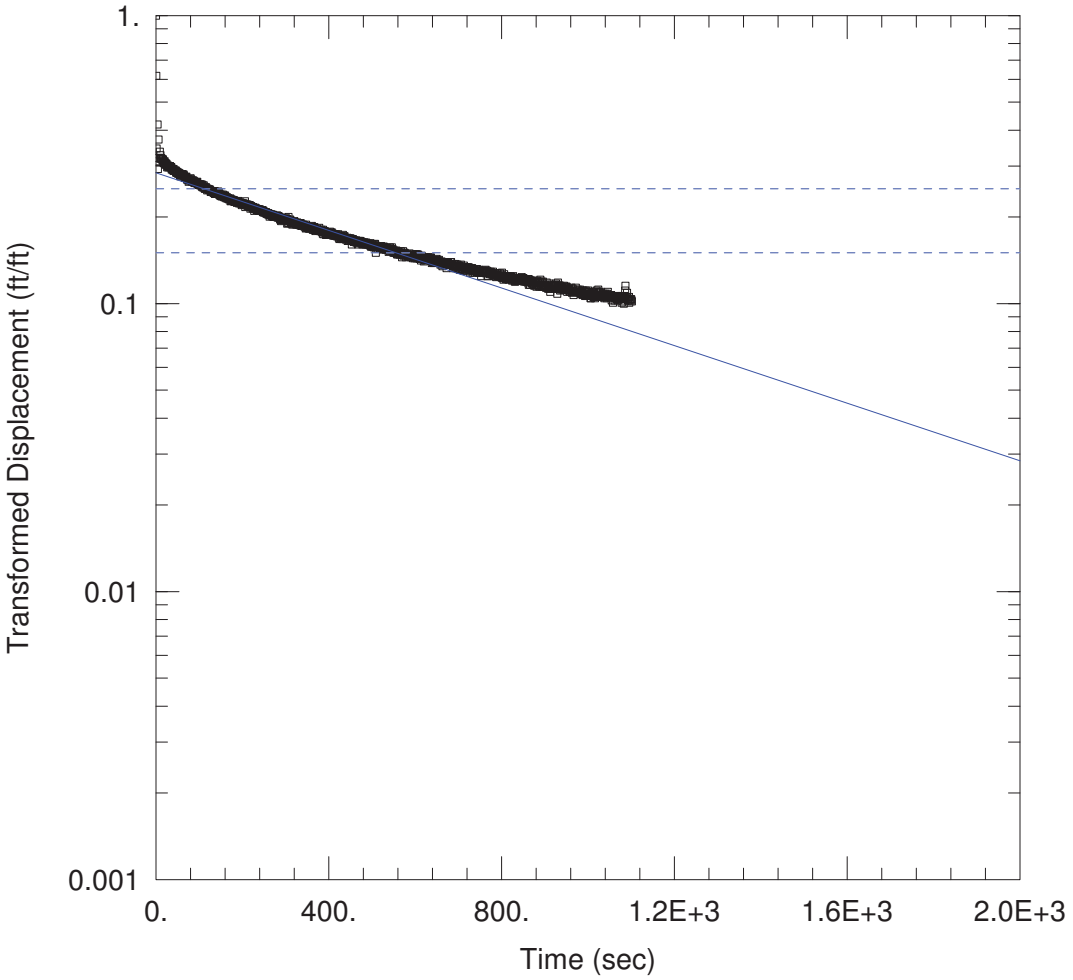
WELL DATA (MW-21 (Out - 2nd Test))

Initial Displacement: 0.8883 ft
Total Well Penetration Depth: 23.8 ft
Casing Radius: 0.083 ft
Static Water Column Height: 23.8 ft
Screen Length: 23.8 ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Dagan

K = 0.0004582 cm/sec y0 = 0.1606 ft



WELL TEST ANALYSIS

Data Set: C:\WorkProjects\XcelEnergy\SlugTests\SlugTestData\Analysed\MW-22-in\MW-22_in_1.aqt
Date: 03/29/17 Time: 13:58:47

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Location: Pawnee Station
Test Well: MW-22 (in)
Test Date: 3/6/17

AQUIFER DATA

Saturated Thickness: 21.27 ft Anisotropy Ratio (Kz/Kr): 1.

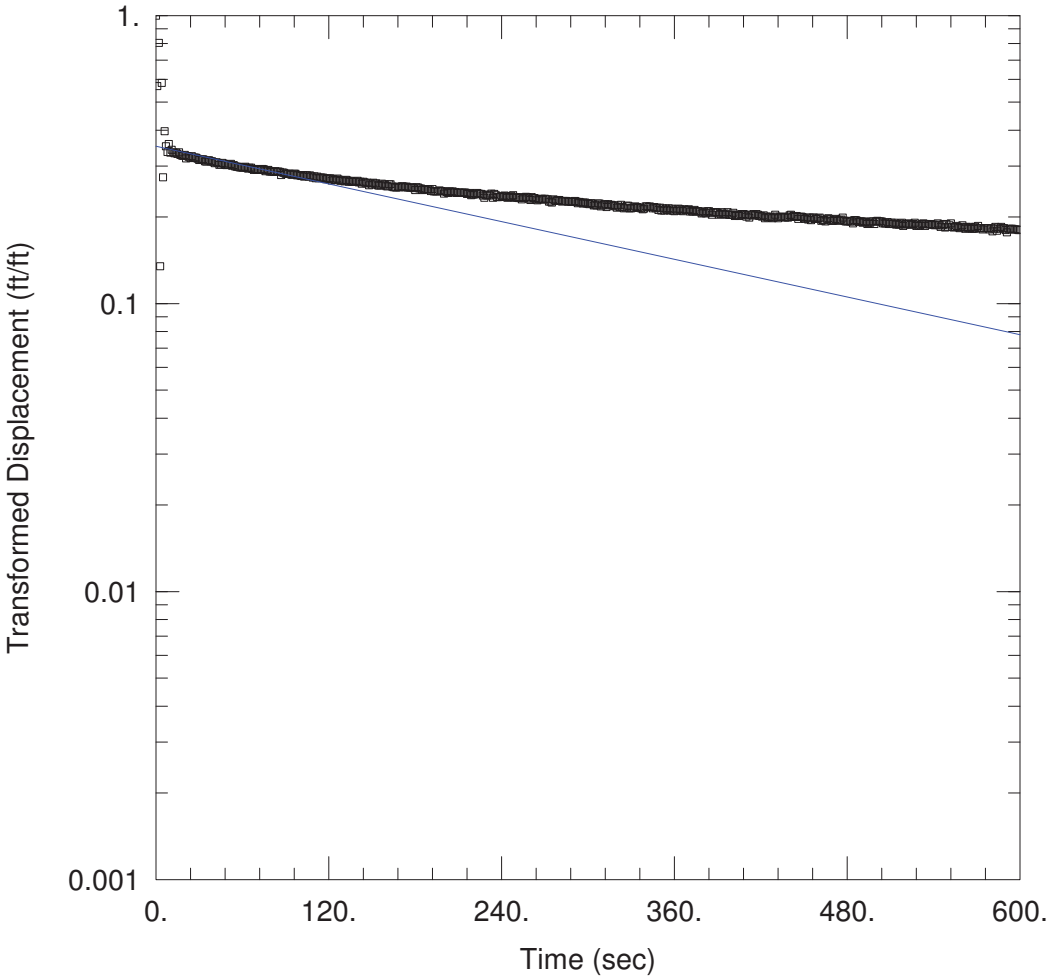
WELL DATA (MW-22 (In))

Initial Displacement: 1.074 ft
Total Well Penetration Depth: 21.27 ft
Casing Radius: 0.083 ft
Static Water Column Height: 21.27 ft
Screen Length: 21.27 ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Dagan

K = 7.904E-5 cm/sec y0 = 0.3108 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW-22in2ndtest.aqt
Date: 03/30/17 Time: 15:11:45

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Location: Pawnee Station
Test Well: MW-22 (In - 2nd test)
Test Date: 3/6/17

AQUIFER DATA

Saturated Thickness: 21.27 ft Anisotropy Ratio (Kz/Kr): 1.

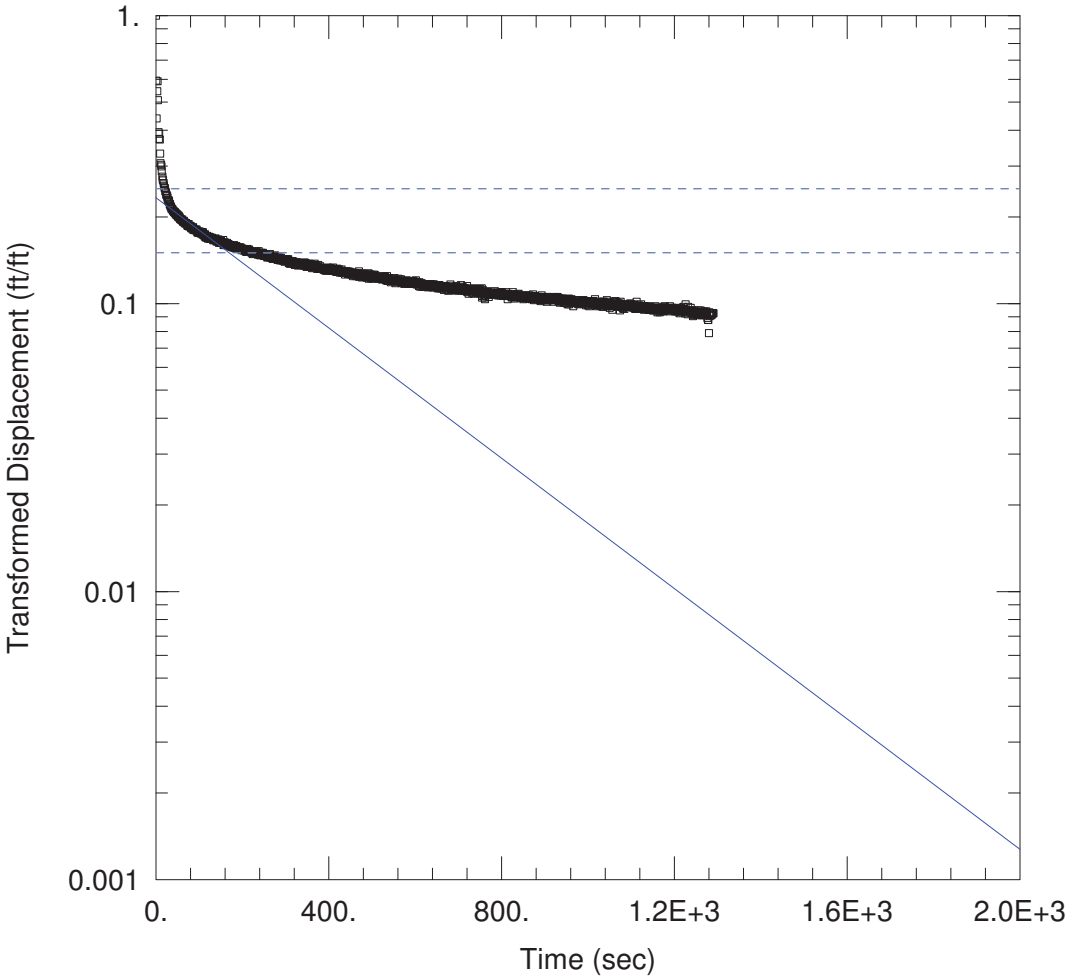
WELL DATA (MW-22 (In - 2nd Test))

Initial Displacement: 1.002 ft
Total Well Penetration Depth: 21.27 ft
Casing Radius: 0.083 ft
Static Water Column Height: 21.27 ft
Screen Length: 21.27 ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Dagan

K = 0.0001722 cm/sec y0 = 0.3575 ft



WELL TEST ANALYSIS

Data Set: C:\WorkProjects\XcelEnergy\SlugTests\SlugTestData\Analysed\MW-22_out\MW-22_out.aqt
Date: 03/30/17 Time: 08:30:18

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Location: Pawnee Station
Test Well: MW-22 (Out)
Test Date: 3/6/17

AQUIFER DATA

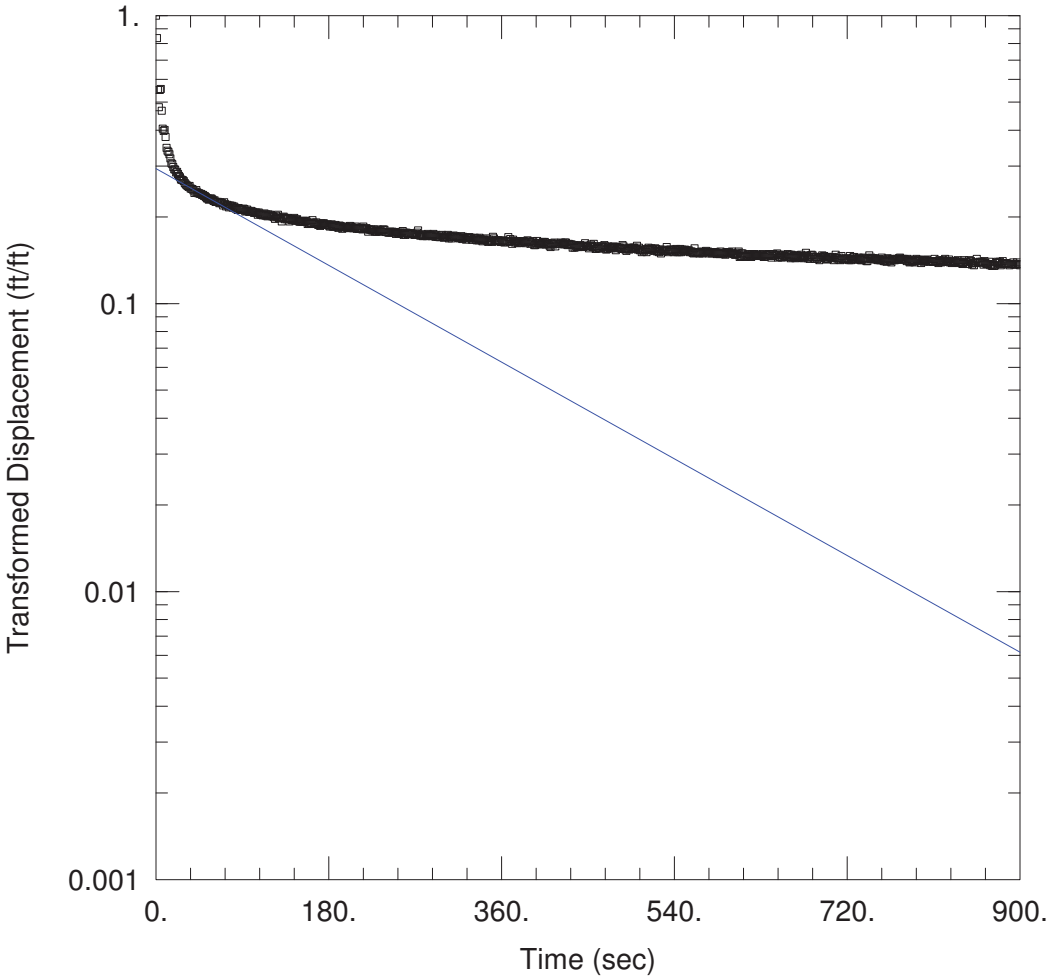
Saturated Thickness: 21.27 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-22)

Initial Displacement: 1.427 ft
Total Well Penetration Depth: 21.27 ft
Casing Radius: 0.083 ft
Static Water Column Height: 21.27 ft
Screen Length: 21.27 ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Dagan
K = 0.0001788 cm/sec
y0 = 0.3416 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW22-out2nd.aqt
Date: 03/31/17 Time: 11:16:36

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Location: Pawnee Station
Test Well: MW-22 (Out - 2nd test)
Test Date: 3/6/17

AQUIFER DATA

Saturated Thickness: 21.27 ft Anisotropy Ratio (Kz/Kr): 1.

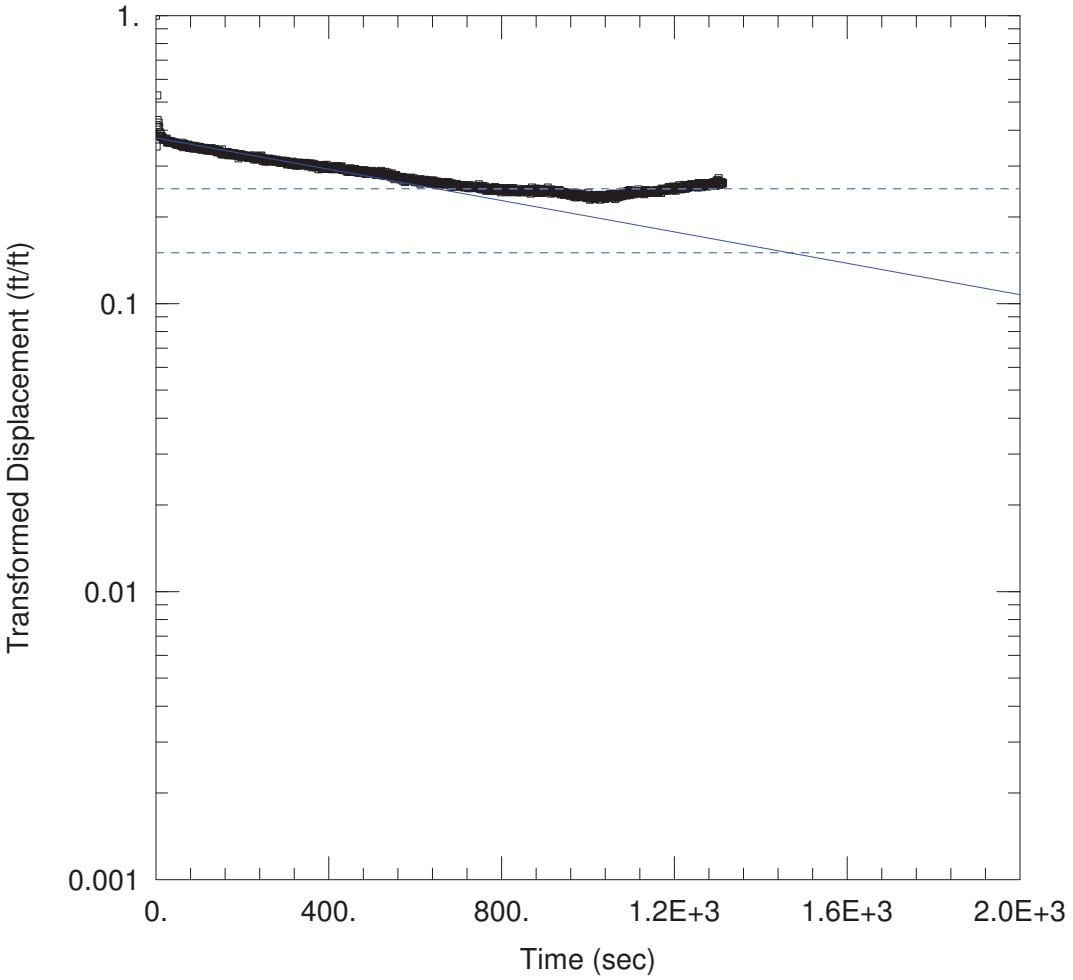
WELL DATA (MW-22 (Out - 2nd Test))

Initial Displacement: 1.235 ft
Total Well Penetration Depth: 21.27 ft
Casing Radius: 0.083 ft
Static Water Column Height: 21.27 ft
Screen Length: 21.27 ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Dagan

K = 0.0002939 cm/sec y0 = 0.3704 ft



WELL TEST ANALYSIS

Data Set:
Date: 03/29/17 Time: 14:26:19

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Location: Pawnee Station
Test Well: MW-23 (in)
Test Date: 3/6/17

AQUIFER DATA

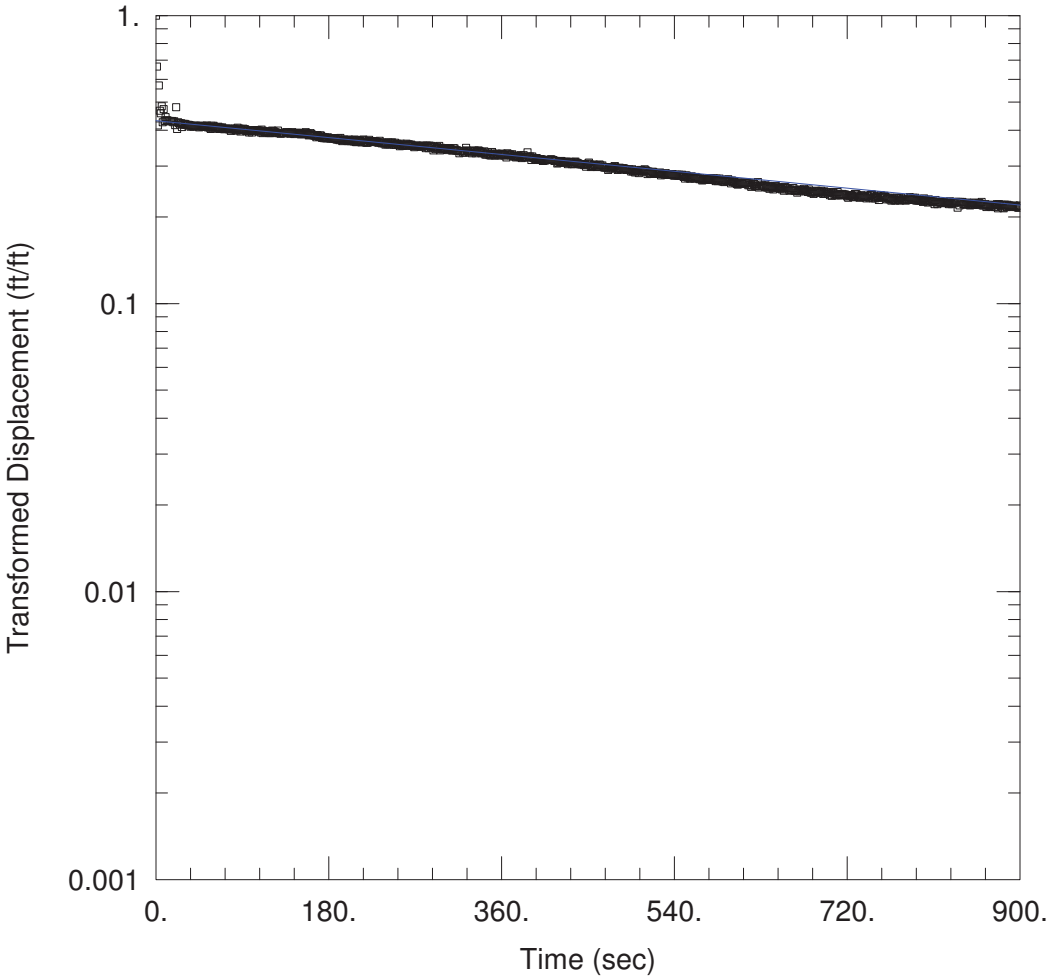
Saturated Thickness: 16.03 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-23)

Initial Displacement: 0.8432 ft
Total Well Penetration Depth: 16.03 ft
Casing Radius: 0.083 ft
Static Water Column Height: 16.03 ft
Screen Length: 16.03 ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Dagan
K = 5.307E-5 cm/sec
y0 = 0.3224 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW-23in2ndtest.aqt
Date: 03/31/17 Time: 11:48:54

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Location: Pawnee Station
Test Well: MW-23 (In - 2nd test)
Test Date: 3/6/17

AQUIFER DATA

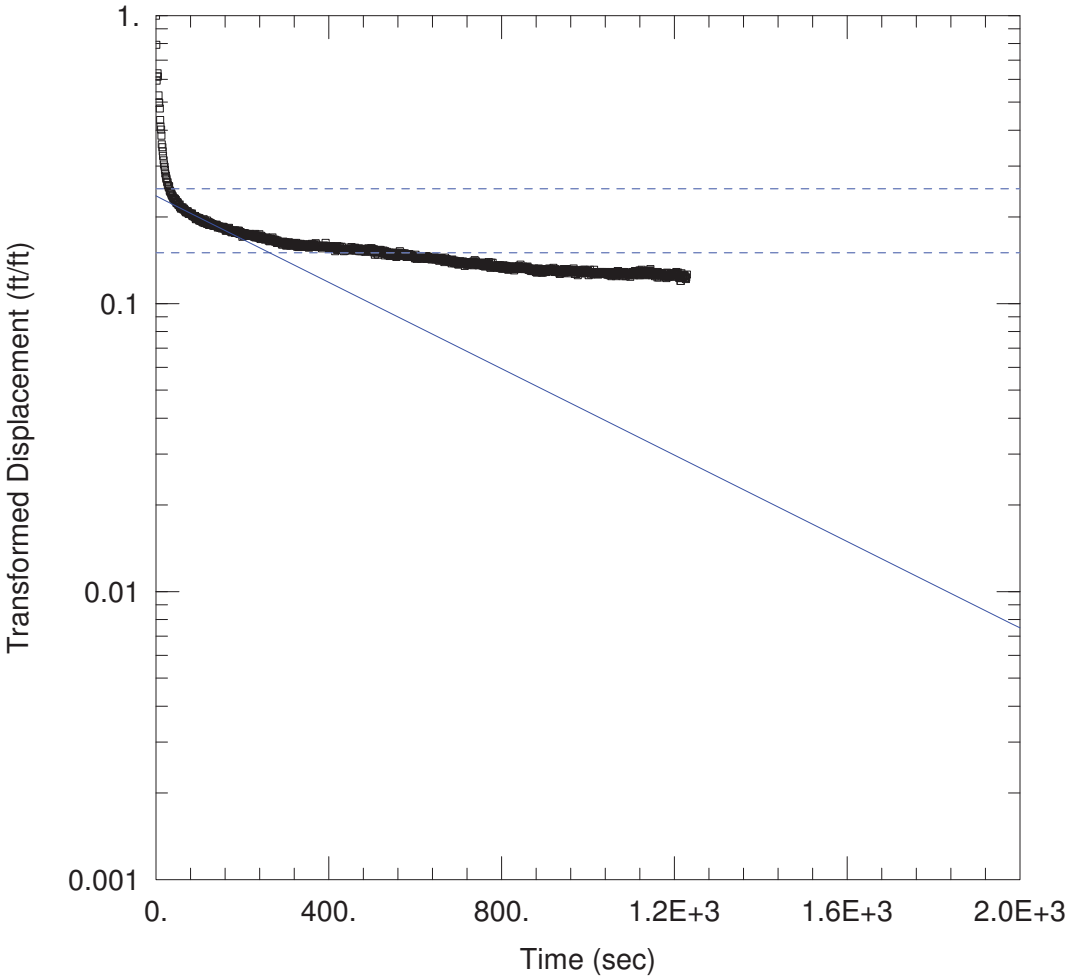
Saturated Thickness: 16.03 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-23 (In - 2nd test))

Initial Displacement: 0.7931 ft
Total Well Penetration Depth: 16.03 ft
Casing Radius: 0.083 ft
Static Water Column Height: 16.03 ft
Screen Length: 16.03 ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Dagan
K = 6.326E-5 cm/sec y0 = 0.347 ft



WELL TEST ANALYSIS

Data Set: C:\WorkProjects\XcelEnergy\SlugTests\SlugTestData\Analysed\M-23-out\MW-23-out.aqt
Date: 03/29/17 Time: 18:52:07

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Location: Pawnee Station
Test Well: MW-23 (Out)
Test Date: 3/6/17

AQUIFER DATA

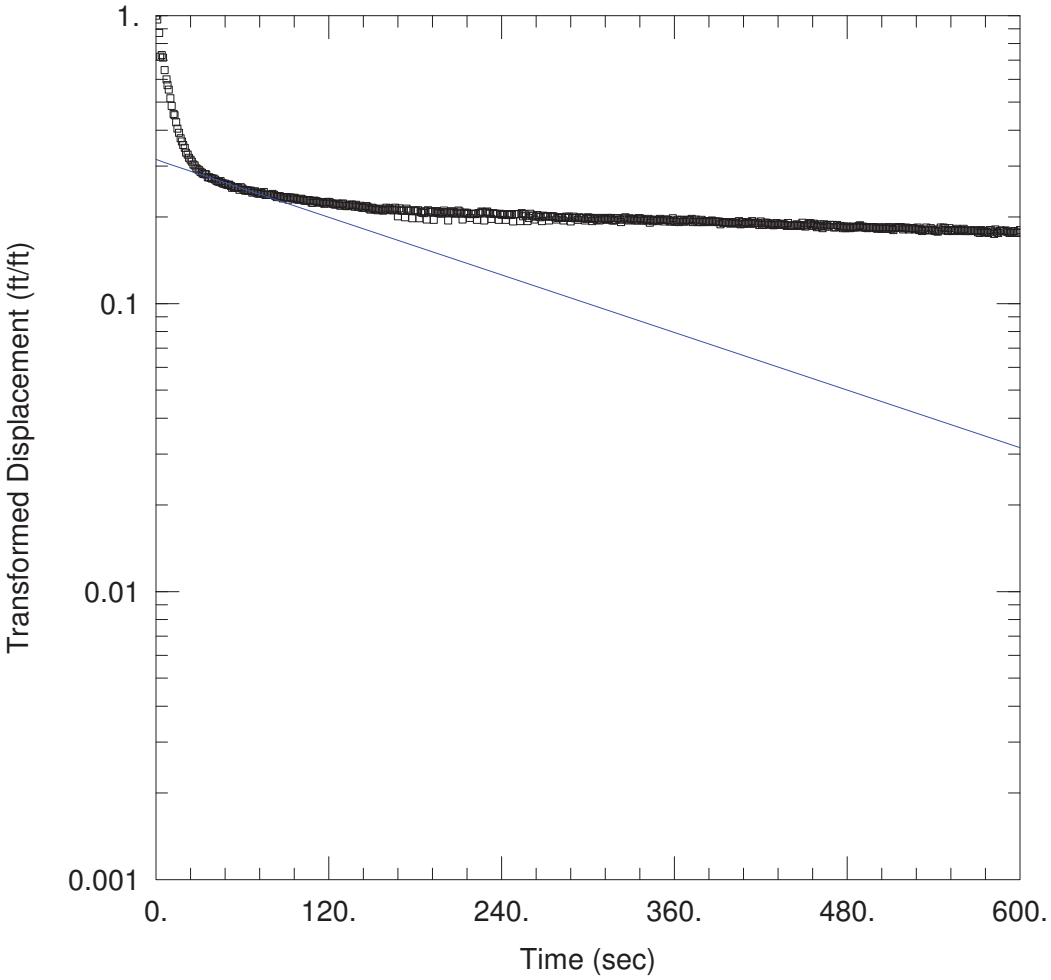
Saturated Thickness: 16.03 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-23 (Out))

Initial Displacement: 1.378 ft
Total Well Penetration Depth: 16.03 ft
Casing Radius: 0.083 ft
Static Water Column Height: 16.03 ft
Screen Length: 16.03 ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Dagan
K = 0.0001462 cm/sec
y0 = 0.3371 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW23out_2ndtest.aqt
Date: 03/30/17 Time: 11:12:26

PROJECT INFORMATION

Company: HDR
Client: Xcel Energy
Location: Pawnee Station
Test Well: MW-23 (Out - 2nd test)
Test Date: 3/6/17

AQUIFER DATA

Saturated Thickness: 16.03 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-23 (Out - 2nd test))

Initial Displacement: 1.171 ft
Total Well Penetration Depth: 16.03 ft
Casing Radius: 0.083 ft
Static Water Column Height: 16.03 ft
Screen Length: 16.03 ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Dagan

K = 0.0003249 cm/sec y0 = 0.38 ft