PIONEER
TECHNICAL SERVICES, INC.

June 25, 2018

Mr. Scott Helm, P.G.
Geotechnical Operations Manager
Montana Department of Transportation
2701 Prospect Avenue
Helena, MT 59620-1001

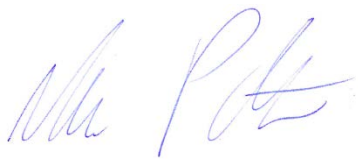
RE: Phase III Geotechnical/Hydrogeological Site Evaluation and Monitoring
Stone Creek North, NH 49-1(25)9, UPN 7931000 – Summary Report

Dear Mr. Helm:

Pioneer Technical Services, Inc. (Pioneer) has incorporated your comments into the final Summary Report for the Stone Creek North Geotechnical/ Hydrogeological Site Evaluation and Monitoring report. The report is included with this letter for your records. The report provides an update on the work completed in 2018, summarizes the key findings from the previous reports sent to the Montana Department of Transportation (on July 3, 2016, April 28, 2017, and December 31, 2017), and provides recommendations for future tasks at this site.

We appreciate the opportunity to assist you with this project and look forward to working with the Department in the future.

Sincerely,



Mike Potts
Project Engineer
Pioneer Technical Services, Inc.

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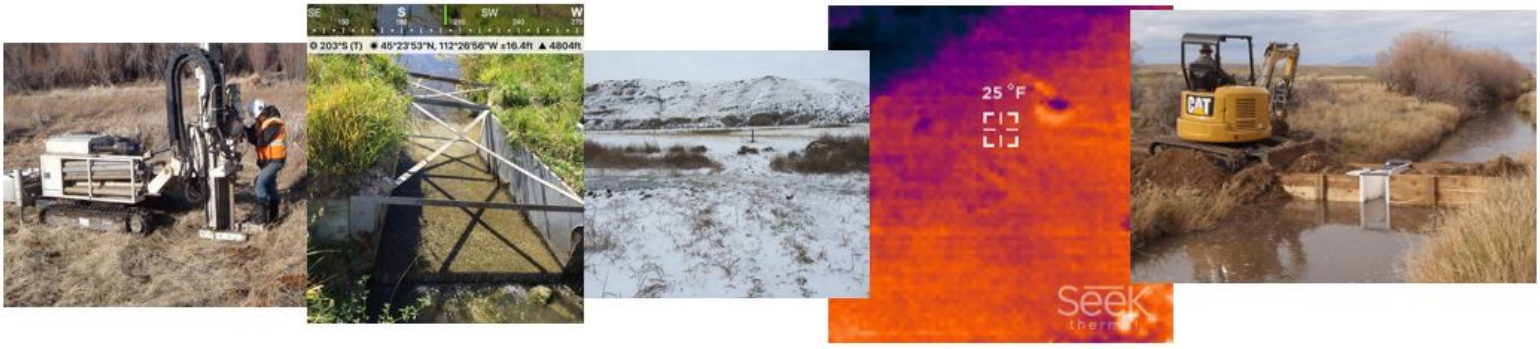
RESTORING OUR ENVIRONMENT • DESIGNING OUR FUTURE

Summary Report for the Stone Creek North Geotechnical/ Hydrogeological Site Evaluation and Monitoring

Stone Creek North, Highway 41 (N-49)
North of Dillon, Montana



Prepared for:
Montana Department of Transportation
2701 Prospect, PO Box 201001,
Helena, MT 59620-1001

Prepared by:
Pioneer Technical Services, Inc.
P. O. Box 3445 Butte, Montana 59702

6/22/2018

Summary Report for the Stone Creek North Geotechnical/ Hydrogeological Site Evaluation and Monitoring

[For Work Performed from April 2016 through May 2018]

Prepared for:
Montana Department of Transportation
2701 Prospect, PO Box 201001
Helena, MT 59620-1001

Prepared by:
Pioneer Technical Services, Inc.
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Butte, Montana 59702

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REVISION SUMMARY

Revision No.	Author	Version	Description	Date
Rev 0	Name	Draft	Issued for Review	06/13/2018
Rev 1	Name	Final	Issued as Final	06/25/2018

1 INTRODUCTION

This Summary Report describes the work performed by Pioneer Technical Services, Inc. (Pioneer) for the Montana Department of Transportation (MDT) on the Stone Creek North project near Beaverhead Rock (Figure 1) from April 2016 through May 2018. The report provides an update on the work completed in 2018, summarizes the key findings from the previous years, and provides recommendations for future tasks at this site. Progress reports sent to MDT on July 3, 2016, April 28, 2017, and December 31, 2017, provide details on the tasks completed during 2016 and 2017, with key findings summarized in Section 2.

1.1 Background

For safety purposes, MDT is widening Highway 41 from Dillon, Montana, to Twin Bridges, Montana. A section of this highway located approximately 9 miles north of Dillon passes through an area where thermal groundwater upwells into diversion ditches on either side of the highway. *Thermal water* in this report is defined as water that is at least 10 degrees Fahrenheit (°F) warmer than the mean groundwater temperature but is less than 122 °F and is heated by geologic sources.

Pioneer provided services to help MDT gather the information necessary to provide geometric improvements to the existing roadway (shoulder widening, sloping, and structure replacements) while ensuring the integrity of the thermal spring complex (i.e., flow, temperature, and water quality) is not inadvertently compromised.

A diversion ditch exists on the west side of the highway and is called the Co-Op Ditch. The Co-Op Ditch receives water from the Beaverhead River at a headgate located approximately 0.5 miles west of the Highway 41 bridge over the Beaverhead River. In addition to the water from the Beaverhead River, thermal groundwater upwells into this ditch at numerous locations along the approximately 1-mile length from the headgate to the 2 culverts downstream. A 10-foot wooden flume is located approximately 25 feet downstream of the headgate and Pioneer personnel recorded gage height readings during each site visit. In April 2016, a Pioneer team installed 2 stilling wells in the Co-Op Ditch with transducers to record water levels and temperatures. One stilling well (SW-01) was installed near a waste gate approximately 0.3 miles downstream of the headgate and another stilling well (SW-02) was installed between 2 culverts approximately 1 mile downstream of the headgate across Highway 41 from the Warm Springs. Two SonTek-IQ Pipe flow meters were also installed to measure flows in each culvert.

The Warm Springs on the east side of Highway 41 are the sole water source of the Warm Springs Ditch (WSD), which flows parallel to Highway 41 past the Point of Rocks (POR) Ranch. In April 2016, Pioneer installed a 6-inch Parshall Flume and stilling well (SW-03) with a transducer in this ditch (approximately 450 feet downstream of the Warm Springs). The 6-inch Parshall flume was later moved approximately 650 feet further downstream (refer to Section 2). In February 2016, Pioneer installed 6 piezometers on the east side of Highway 41 to investigate the groundwater conditions near the Warm Springs. In January 2017, Pioneer installed an additional

8 piezometers to expand the monitoring network (refer to Section 2). All the piezometers were instrumented with transducers to record water level and temperature data on 15-minute intervals.

2 PREVIOUS FINDINGS FROM 2016-2017 INVESTIGATIONS

Initial investigations determined that the source of the thermal water was a fault-fracture system extending from Beaverhead Rock to the northwest (MBMG, 2013), as shown on Figure 1. This finding was critical to the decision by MDT to build a new highway alignment to the east of the current alignment, rather than attempt to widen the current alignment between the Co-Op Ditch and WSD, which would have involved impacting portions of the Beaverhead Rock and could have compromised the flow of thermal groundwater into one or both ditches.

Based on the decision to move the alignment, Pioneer installed additional piezometers (labeled PZ and a number) on both sides of the proposed new alignment and monitored them monthly (Figure 1). One key finding from this expansion of the monitoring network was that there appeared to be two separate thermal expressions of groundwater: one centered at the Warm Springs Pond and one located to the south near PZ-13 with cooler water in between. Continued monitoring and conversations with the POR Ranch revealed that cattle use the upwelling warm groundwater in the oxbow as a source of drinking water during the winter (Figure 2).

Previous inspections have shown that the 3-foot cutthroat flume installed downstream of the Co-Op Ditch inflow does not accurately measure flows; consequently, a decision was made to discontinue monitoring at this location. However, after discussions with the POR Ranch, it appears that the flows from the 3-foot flume could present a contentious issue. The inaccuracy of this flume is caused by a combination of factors (e.g., improper size, not being level, and algae and sediment accumulation) that cause it to overestimate the flows. If this flume was replaced with a device that properly measured the flow, the results could appear to show that flows have decreased and if this coincided with work completed by MDT, the POR Ranch could try to make the argument that the apparent reduction in flow was caused by MDT, when in reality the flows never changed. Because of this revelation, a key recommendation of this report is to continue to monitor flows at the 3-foot cutthroat flume throughout the duration of the project (see Section 4).

Site challenges mostly related to wildlife and livestock caused some loss of data in some locations and led to modifications to the monitoring network. Muskrats continuously burrowed beneath the 6-inch Parshall flume on the WSD until it was removed in fall 2016 and reinstalled at a downstream location by R.E. Miller and Sons, which is a firm that specializes in flume installations (Photograph 1 and Photograph 2). The primary reason for relocating the 6-inch Parshall flume to a downstream location was because the POR Ranch believed that groundwater was at times upwelling into the WSD downstream of the original flume location. Based on this information, Pioneer recommended that the flume be moved approximately 650 feet downstream to ensure that the flow data from the flume represented the entire flow of upwelling groundwater from the Warm Springs.

Additionally, cattle damaged the cable to one of the SonTek-IQ Pipe flow meters by apparently stepping on it and damaged some of the piezometers by rubbing on them and causing the outer steel casings to become loose and settle into the ground. The damaged SonTek cable was

repaired and re-routed over the culvert, and the outer steel casings on PZ-11 and PZ-12 were left open and allowed to settle into the soft ground. The outer steel casings on PZ-07, PZ-09, and PZ-10 were also damaged by cattle and/or frost-jacking during winter in the early months of 2018 and stilling well SW-02 was knocked over and the SonTek cable was again damaged in February 2018 as detailed in the following section.

3 2018 WORK PERFORMED

Pioneer personnel visited the site 7 times between January 1 and May 31, 2018. Site visits occurred monthly to download data from transducers and SonTek-IQ Pipe flow meters, record manual groundwater elevation measurements, record surface water elevations and flow measurements, and ensure site equipment were operating satisfactorily. The site was visited twice in January due to weather and an additional site visit took place in April to assist MDT personnel identify piezometers that needed repairs.

The ongoing groundwater monitoring continued at the 14 piezometers installed by Pioneer and the 2 monitoring wells installed by MDT. Groundwater monitoring included recording depth-to-water (DTW) measurements at each location and downloading the continuous transducer data, which recorded water level and water temperature on 15-minute intervals. Pioneer personnel monitored the surface water using the in-place instrumentation and a manual flow-measuring device. The manual flow-measuring device was a SonTek FlowTracker2® Handheld-Acoustic Doppler Velocimeter® (FlowTracker2). The in-place instruments in the Co-Op Ditch include the 10-foot wooden flume near the headgate, a stilling well near the waste gate (SW-01), and SonTek-IQ Pipe flow meters installed in the culverts across Highway 41 from the Warm Springs Pond source area. From the stilling well (SW-02) installed between the culverts, Pioneer developed a rating curve using manual flow measurements to potentially simplify continuous flow monitoring at this location in the future.

Pioneer personnel periodically collected manual flow measurements from the stilling well (SW-03) installed across Highway 41 from the culverts and recorded gage heights and downloaded data from the 6-inch Parshall flume.

3.1 Site Visits

Typical tasks completed during the site visits included measuring flow, downloading instrument data, and collecting water level measurements. As such, only the tasks beyond the usual monitoring, downloading, and/or issues are detailed below. All information from each site visit was recorded in a log book (included in Appendix A).

3.1.1 January 4 and 16, 2018

On January 4, the water surface was frozen within piezometers PZ-02, PZ-06, PZ-07, PZ-10, PZ-12, and PZ-14, so no DTW measurements were recorded and transducers could not be retrieved. The Pioneer team could not download any data from these piezometers.

The lid on the outer steel casing at PZ-07 had to be pried open and could not be closed with the polyvinyl chloride (PVC) well cap on. This appears to be a result of the outer protective steel casing settling or possibly frost jacking of the well. The outer steel casing was closed and locked without the inner PVC well cap.

On January 16, flows were measured at the culverts in the Co-Op ditch, the SonTek-IQ Pipe batteries were replaced, and flows were measured in the WSD at stilling well SW-03. No piezometers were visited during this visit.

3.1.2 February 28, 2018

On this date, the water surface was frozen within piezometers PZ-02, PZ-06, PZ-12, and PZ-14, so no DTW measurements were recorded and transducers could not be retrieved. The team could not download any data from these piezometers.

The outer steel casing to piezometers PZ-07, PZ-09, and PZ-10 appeared to have settled and were resting on the inner PVC piezometer casing so the team could not access these locations. It should be noted that during spring and summer 2017, the outer steel casings on piezometers PZ-11, and PZ-12 had also settled and had to be pried open. They have been left open since (Photograph 3 and Photograph 4).

The inspection of the surface water monitoring site at the culverts showed that the stilling well (SW-02) had been knocked over, apparently by cattle (Photograph 5), and the cable to the right (east) of the SonTek-IQ Pipe was visibly damaged again (Photograph 6). The team was unable to connect to the right SonTek-IQ Pipe and were not equipped to enter the culvert and remove the instrument for repairs at that time. The stilling well SW-02 was reinstalled, but the measuring point elevation should be re-surveyed.

3.1.3 March 20, 2018

On this date, although the ground surface had thawed, the lids to piezometers PZ-07, PZ-09, and PZ-10 could still not be opened so the team did not collect any data from these locations. Additionally, the transducer was missing from PZ-12. The assumption was that the transducer and hanging cable were knocked loose by cattle and fell into the well. This assumption was based on the information that the protective outer casing was settled near the ground surface at this location (Photograph 4) so the PVC was exposed. There was also evidence of cows rubbing on the piezometer. Retrieval attempts were unsuccessful at this time, but the team scheduled additional efforts with different tools for the next site visit in April.

On this date, MDT personnel also downloaded data from MW-103A to the west of PZ-05, and Pioneer personnel recorded the DTW at that location.

After inspecting the SonTek-IQ Pipe flow meter and following discussions with MDT personnel, it was decided that the SonTek-IQ Pipes should be permanently removed at this time. Monthly flow measurements with the FlowTracker2 had been used to develop a good correlation with the

water level at SW-02. The continuous water level data from the transducer at SW-02 would still allow a rating curve to be used to calculate the flow at this location.

The SonTek-IQ Pipe flow meters were originally selected because of the high accuracy data they provide, and because flows in the Co-Op Ditch needed to be closely monitored to ensure the road construction would not affect the springs that upwell into the ditch. Once MDT made the decision not to use the original highway alignment and to move a new highway alignment further to the east, the high accuracy data provide by the SonTek-IQ pipes was no longer necessary. Because these flow meters also come at a higher cost and require more time and effort to maintain, it is recommended that a stilling well and rating curve be used for future monitoring at this location.

3.1.4 April 18 and 20, 2018

The primary purpose of the site visit on April 18 was to meet with MDT personnel to show them the piezometers that needed repairs. While on the site, Pioneer personnel downloaded data, scraped and removed algal accumulation from the 6-inch Parshall flume, and collected surface water flow measurements. The transducer and cable were retrieved from PZ-12 and were reset to continue recording.

A follow-up visit was completed on April 20 to take new water level measurements and download data from all the locations and to ensure that all repairs had been completed and all locations were being monitored.

3.1.5 May 24, 2018

A surface water flow measurement could not be completed at the culverts at SW-02 during this inspection because the water was too deep to safely wade into. All other routine monitoring was completed.

3.2 Data Collection

Groundwater
As of April 2016, the original 6 piezometers have been instrumented and have been collecting water level and temperature data. Since March 2017, all 14 piezometers have been instrumented and have been collecting water level and temperature data (Figure 3 through Figure 7a, Table 1, and Table 2). The data collected are supplemented with manual depth measurements taken once a month by Pioneer personnel.

Surface Water
The SonTek-IQ Pipes and transducers in the stilling wells have been recording since April 2016. The SonTek-IQ Pipes were permanently removed on March 20, 2018. Figure 8 shows the rating curve for SW-02 and the estimated flow data. The Parshall flume and its associated transducer were moved downstream from its original location on October 27, 2016, and the equipment has been recording since (Figure 9). Data collected before the move were likely erroneous and were

not used in any calculations. All collected surface water information is supplemented with manual flow measurements taken once a month by Pioneer personnel.

3.2.1 Data Results

Groundwater
As previously observed and based on the monitoring results, there are two distinct areas where thermal water appears to be upwelling near the MDT alignment (Figure 3 and Figure 4). Each thermal area either has been or is currently being used by the POR Ranch and will have to be continually monitored before, during, and after construction of the highway alignment.

Data downloaded from the 3 "vertically nested" transducers that were temporarily installed in PZ-5 on April 25 and PZ-13 on May 19 showed that thermal water was likely upwelling from a lower elevation (Table 3).

The piezometers with installed pressure transducers continue to measure and record the water levels. Pioneer created a potentiometric map with groundwater contours from the minimum and maximum measured groundwater levels at PZ-1 through PZ-14 and the 2 MDT wells (123 and 128) using all available data (Figure 5). The average hydraulic gradients were 0.008 feet per foot during the low water table and 0.0075 feet per foot during the high water table. Additionally, the flow direction was generally to the east during the low water table and slightly more to the east-northeast during the high water table. Figure 3 and Figure 4 show the minimum and maximum groundwater temperatures, respectively.

Surface Water: Co-Op Ditch
Surface water flows from the Co-Op Ditch have been measured monthly at the 10-foot wooden flume, from within the 2 culverts, and manually with the FlowTracker2. The SonTek-IQ Pipes have been removed, but a good rating curve has been developed with stilling well SW-02 to continuously measure flows. With this method it will be important to continue to collect high-quality manual DTW and flow measurements. Baseflow from upwelling groundwater in the Co-Op Ditch averages approximately 12.3 cubic feet per second (cfs) during the months without irrigation, but flows vary widely in the Co-Op Ditch with base flows as low as 1.7 cfs and flows greater than 50 cfs during summer months due to irrigation demands.

Surface Water: WSD
Manual flow measurements collected within the WSD during site visits continue to reflect what is measured by the 6-inch Parshall flume. Pioneer continues to be confident that these measurements are representative of the actual flow within the WSD and that the flow maintains an average 1.43 cfs flow rate with relatively little fluctuation ranging from 1.10 to 1.85 cfs (Figure 9).

Pioneer personnel stopped monitoring and taking flow measurements at the 3-foot cutthroat flume (Figure 1) in early 2017 due to its compromised installation and algae/sediment buildup, which was causing it to overreport flow. However, on further review of data and after discussions with POR Ranch, understanding the discrepancy in flow and potential changes to flows could be problematic if the flume were removed, replaced, or modified during or after the

MDT construction project. For this reason, Pioneer recommends recommencing the monthly flow measurements at the 3-foot cutthroat flume and moving stilling well SW-01 (currently located at the waste gate on the Co-Op Ditch) to the 3-foot cutthroat flume and developing a rating curve with water levels and manual measurements at this location.

4 RECOMMENDATIONS

Groundwater Monitoring

To ensure that groundwater conditions are not significantly altered as a result of the MDT construction project or can be mitigated, the baseline conditions must first be established. Based on 2 years of monitoring data at the original 6 piezometers and 1 year of monitoring data from all other locations, the baseline conditions appear to be well understood at this time. Pioneer recommends the following ongoing groundwater monitoring tasks:

1. Continue downloading the 15-minute transducer data and recording manual DTW readings on a monthly basis at all locations until at least 1 full year after completion of the construction project.
2. Resurvey the measuring point (MP) elevations on all monitoring locations each spring after the ground has thawed (typically late March to early May timeframe) to account for any changes in elevations caused by frost jacking, cattle damage, or other issues and to ensure water levels are accurate.

Surface Water Monitoring

To ensure that surface water conditions are not significantly altered as a result of the MDT highway realignment construction project requires comparing conditions against the established baseline conditions. Based on 2 years of monitoring results from the Co-Op Ditch and 19 months of monitoring data on the WSD, the baseline conditions appear to be well understood at this time. Pioneer recommends the following ongoing surface water monitoring:

1. Continue collecting monthly manual flow measurements (using a FlowTracker2 or similar instrument), DTW measurements, gage height readings, and transducer downloads until at least 1 full year after completion of the construction project at the following locations:
    a. The culverts at SW-02.
        i. The SonTek-IQ Pipe flow meters were removed on March 20, 2018, so it is important to continue to manually measure flows at the culverts and DTW at SW-02 to maintain the accuracy of the rating curve at this location.
    b. The 3-foot cutthroat flume.
        i. The discrepancy in flows from this flume compared to manual FlowTracker2 measurements could cause disputes if the flume is moved or a different device is installed, so it is critically important to monitor flows at this location to protect MDT from potential future litigation.

2. Perform quarterly manual flow measurements (using a FlowTracker2 or similar instrument) and monthly gage height readings and transducer downloads (where applicable) at the following locations:
    a. The 10-foot flume.
    b. The 6-inch Parshall Flume.
3. Remove stilling well SW-01 and its transducer from current location and reinstall at the 3-foot cutthroat flume (refer to Section 3.2.1, *Surface Water: WSD*).

5 PHOTOGRAPHS

Photograph 1. Original Installation of 6-inch Parshall Flume

Photograph 2. Re-installation of 6-inch Parshall Flume by R.E. Miller and Sons

Photograph 3. PZ-11 Outer Steel Casing Settled into Ground

Photograph 4. PZ-12 Outer Steel Casing Settled into Ground

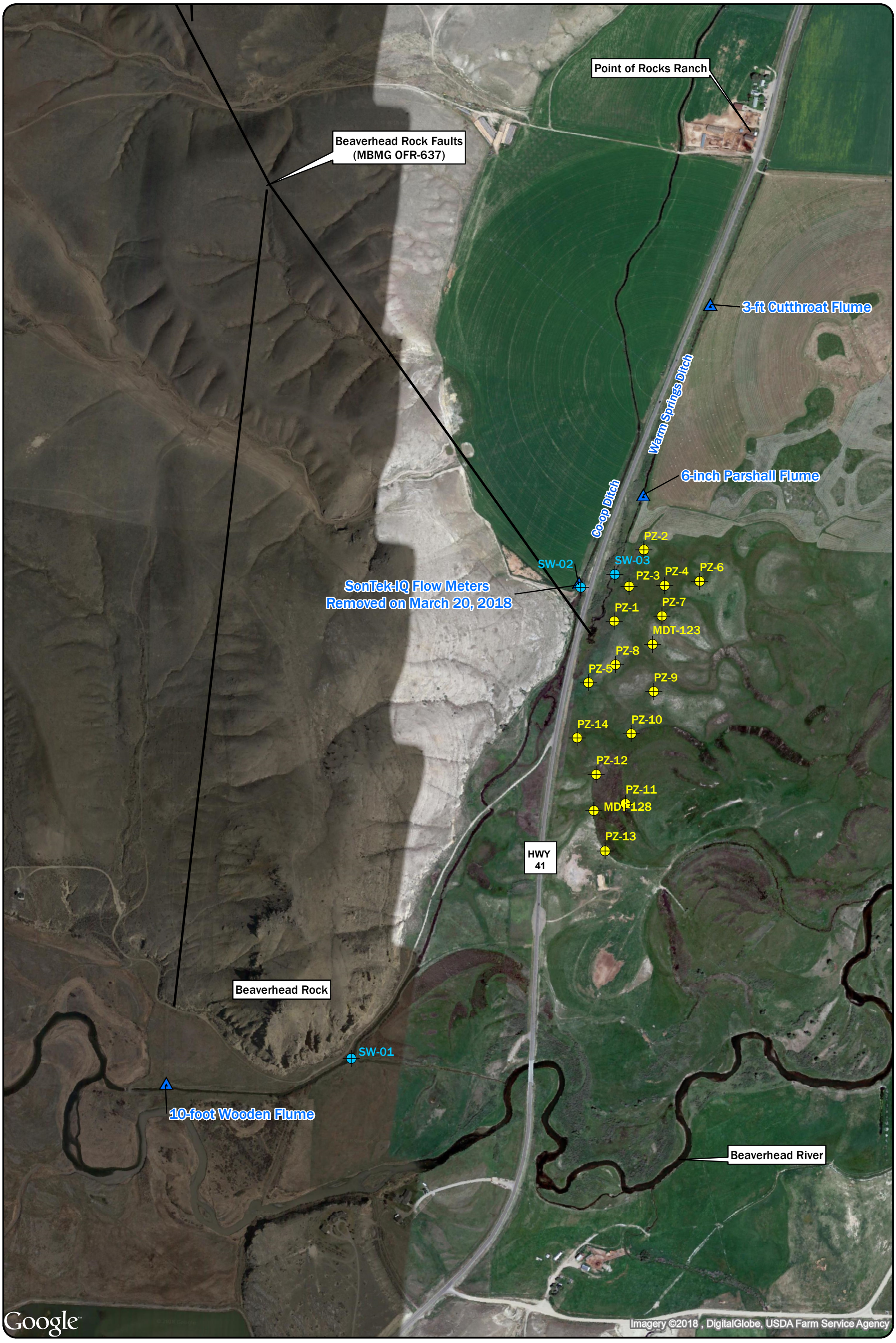
Photograph 5. Stilling Well SW-02 Damaged by Cattle

Photograph 6. SonTek-IQ Pipe Cable Damaged by Cattle

6 REFERENCES

MBMG, 2013. Hydrogeologic Investigation of The Beaverhead River Study Area, Beaverhead County, Montana. Montana Bureau of Mine and Geology Open-File Report 637. 2013.

FIGURES



Surface Water Flow Location
Piezometer Location
Stilling Well Location
Beaverhead Rock Faults (MBMG, OFR-637)

N

DISPLAYED AS:
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DATUM: NAD83/NAVD88
UNITS: INT. FEET
SOURCE: Pioneer/Google

0 250 500 1,000
Feet

FIGURE 1

SITE MAP

PIONEER TECHNICAL SERVICES, INC.

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DATE: 6/13/2018

Co-op Ditch

Warm Springs Ditch

SW-03

PZ-1

PZ-2

PZ-3

PZ-4

PZ-5

PZ-7

PZ-8

PZ-9

PZ-10

PZ-11

PZ-12

PZ-13

PZ-14

MDT-123

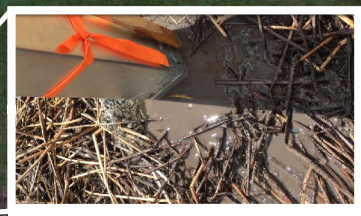
MDT-128

HWY 41

Steam emanating from thermal groundwater upwelling into the Warm Springs Ditch. (January 5, 2016).

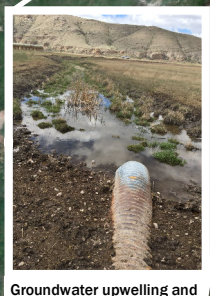
Steam emanating from thermal groundwater upwelling into the Co-op Ditch. (January 5, 2016).

Groundwater elevation inside PZ-14 is approximately 5-inches higher than the ground surface demonstrating artesian potential (April 25, 2017).



Upwelling groundwater around PZ-12 recorded on video (available upon request) on April 25, 2017.

Thermal groundwater remains unfrozen and appears to be used by cattle during winter months. Picture taken February 13, 2017.



Groundwater upwelling and flowing through the culvert southeast of the oxbow. (April 25, 2017)

Areas of Documented Upwelling Groundwater

Piezometer

Proposed Highway Alignment

N

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DATUM: NAD83/NAVD88
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SOURCE: Pioneer/Google

0 100 200 400
Feet

FIGURE 2

MDT PROPOSED ALIGNMENT AND AREAS OF UPWELLING GROUNDWATER

PIONEER TECHNICAL SERVICES, INC.

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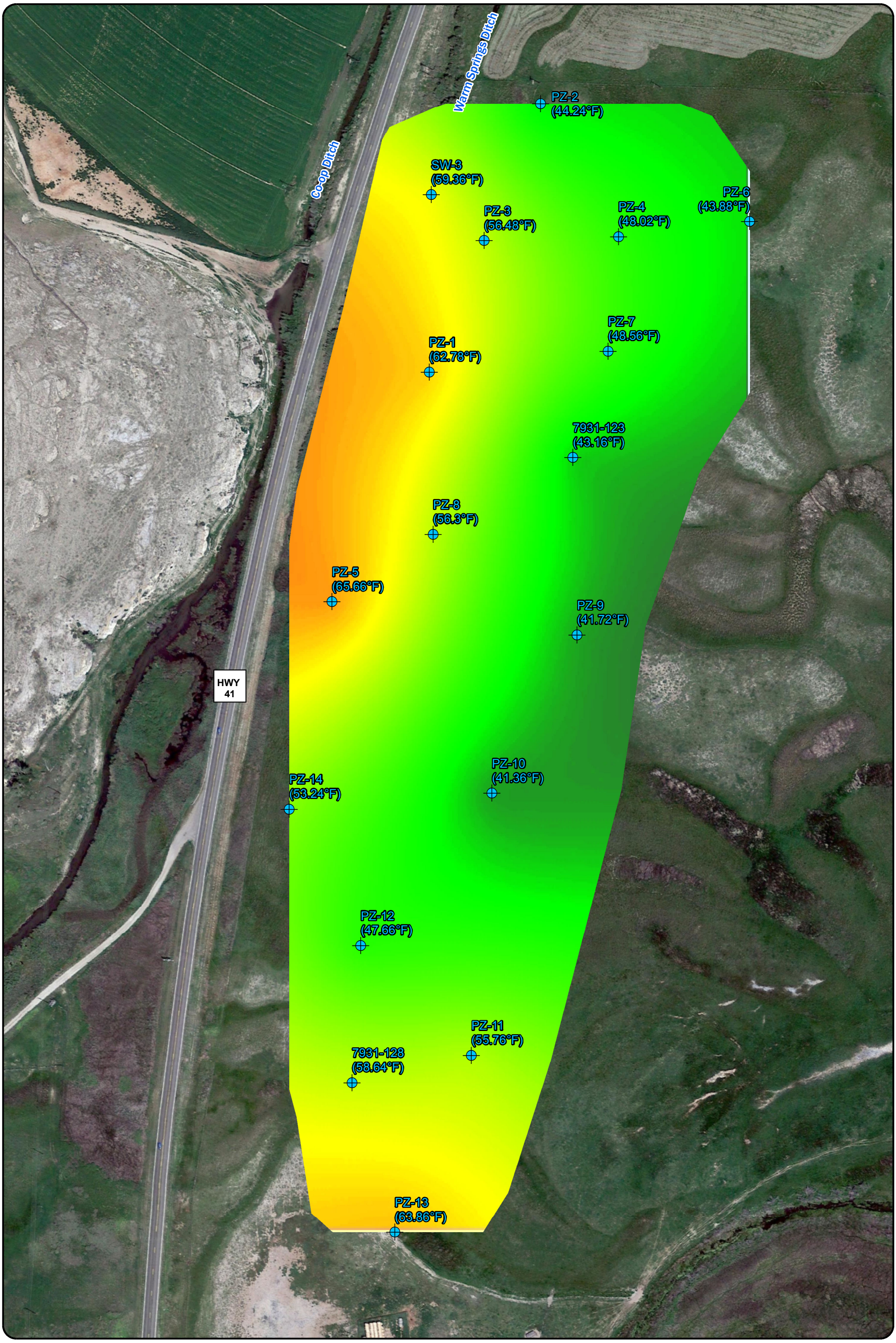
DATE: 6/13/2018



Piezometer Locations

90 87 84 81 78 75 72 69 66 63 60 57 54 51 48 45 42 39

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DATUM: NAD83/NAVD88
UNITS: INT. FEET
SOURCE: Pioneer/Google

0 50 100 200 300
Feet

FIGURE 3

MINIMUM TEMPERATURE GRADIENTS

PIONEER TECHNICAL SERVICES, INC.

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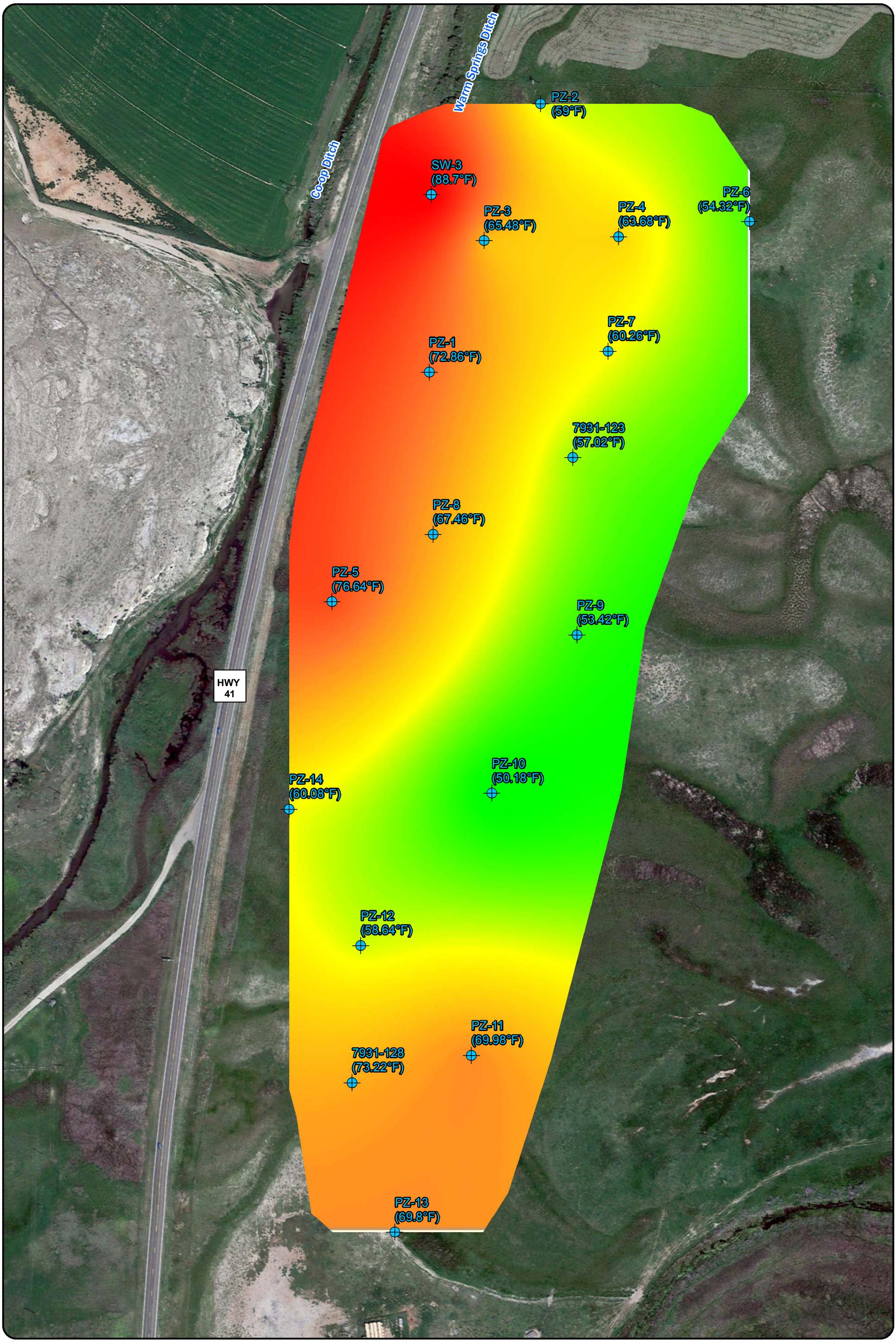
DATE: 6/13/2018



Piezometer Locations

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DISPLAYED AS:
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DATUM: NAD83/NAVD88
UNITS: INT. FEET
SOURCE: Pioneer/Google

0 50 100 200 300
Feet

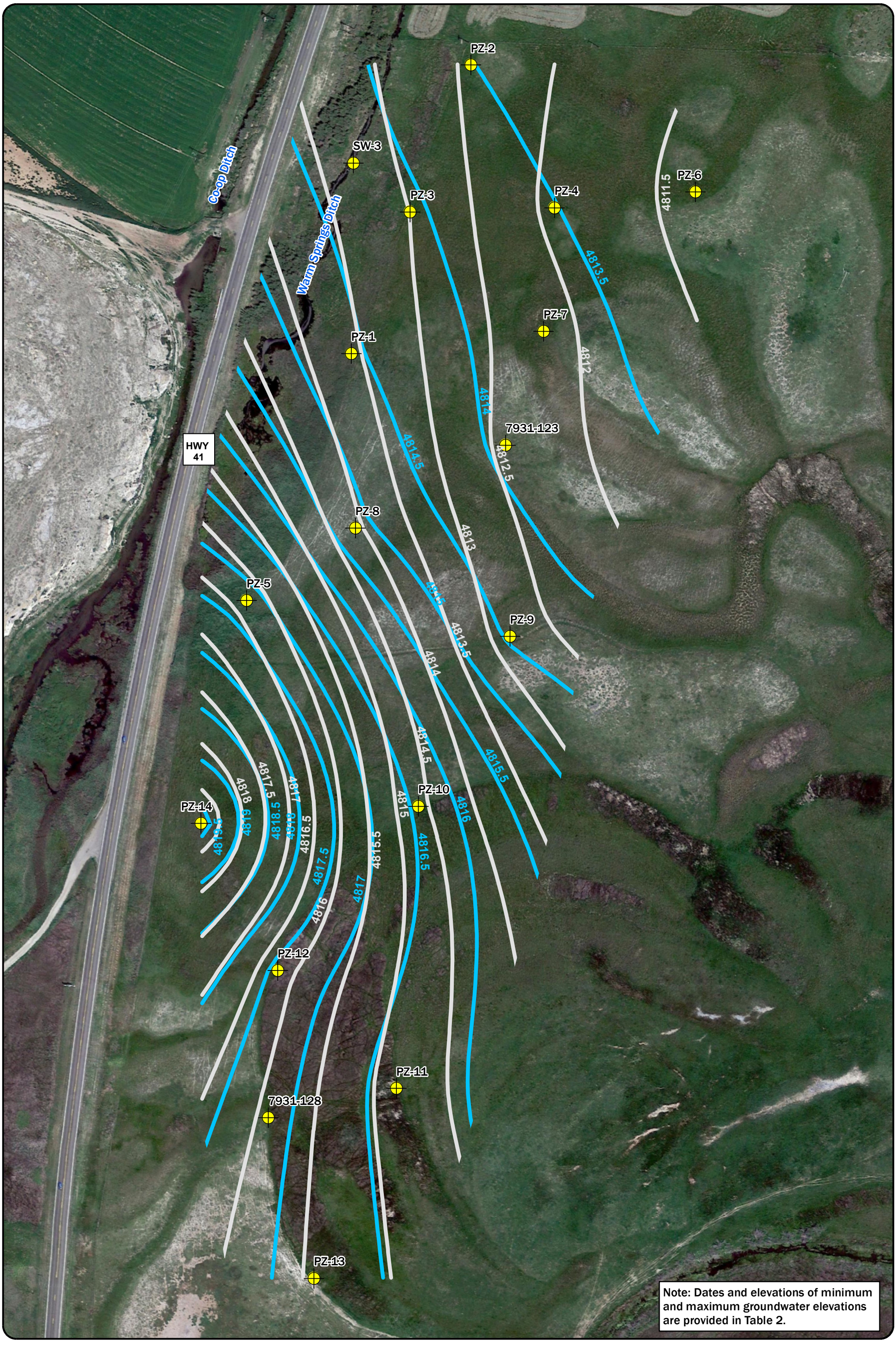
FIGURE 4

MAXIMUM TEMPERATURE GRADIENTS

PIONEER TECHNICAL SERVICES, INC.

Path: P:\MDT\StoneCreekAreaInvestigation\OfficeWork\Figures\GIS\FIG-4.mxd

DATE: 6/13/2018



Piezometers

Minimum Groundwater Contours (NAVD88 FT)

Maximum Groundwater Contours (NAVD88 FT)

N

DISPLAYED AS:
PROJECTION/ZONE: MSP (2011)
DATUM: NAD83/NAVD88
UNITS: INT. FEET
SOURCE: Pioneer/Google

0 25 50 100 150 200 250
Feet

FIGURE 5

PIONEER TECHNICAL SERVICES, INC.

MINIMUM AND MAXIMUM GROUNDWATER CONTOURS

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DATE: 6/22/2018

Figure 6a. Groundwater Hydrographs in Phase II Piezometers

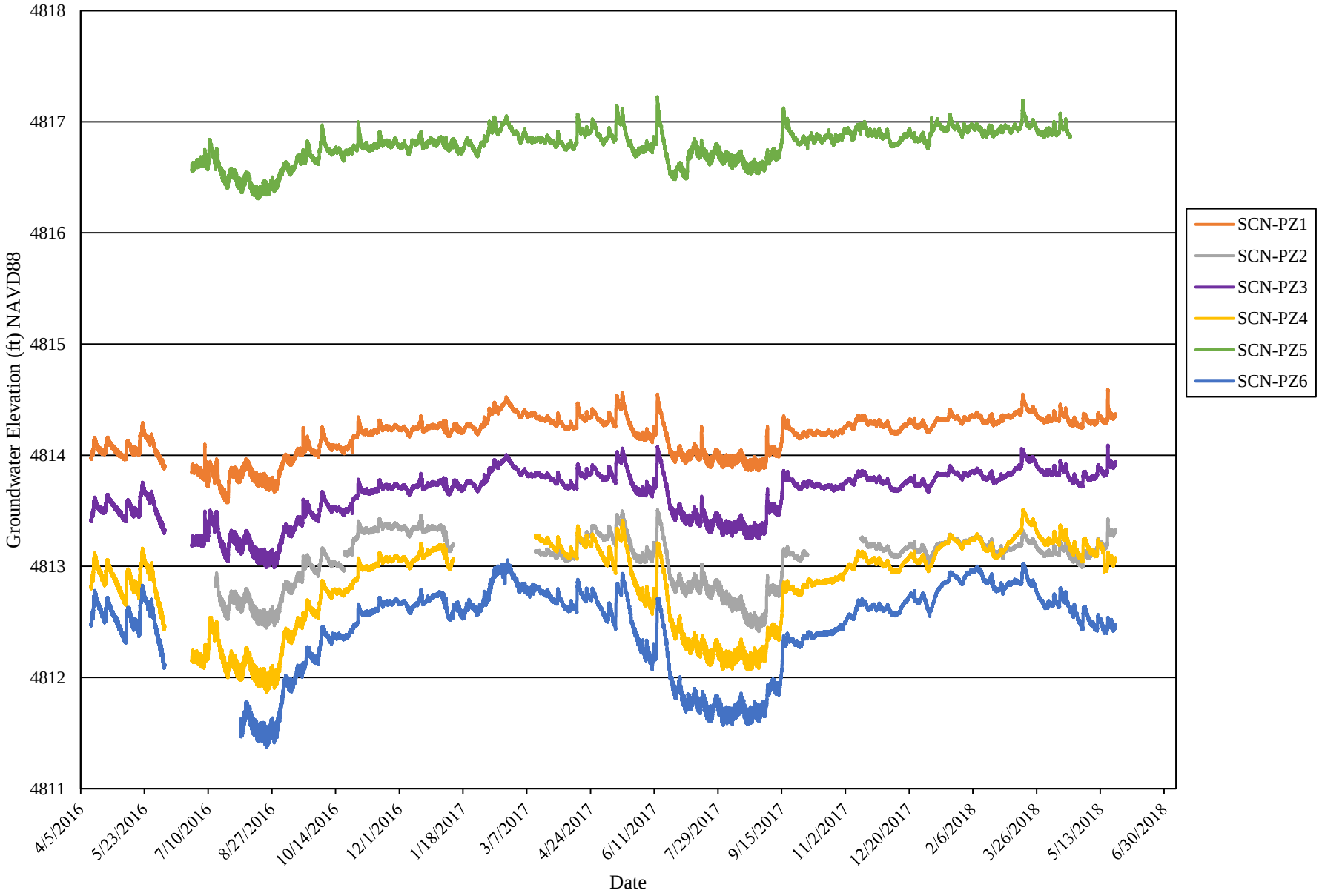


Figure 6b. Groundwater Hydrographs in Phase III Piezometers

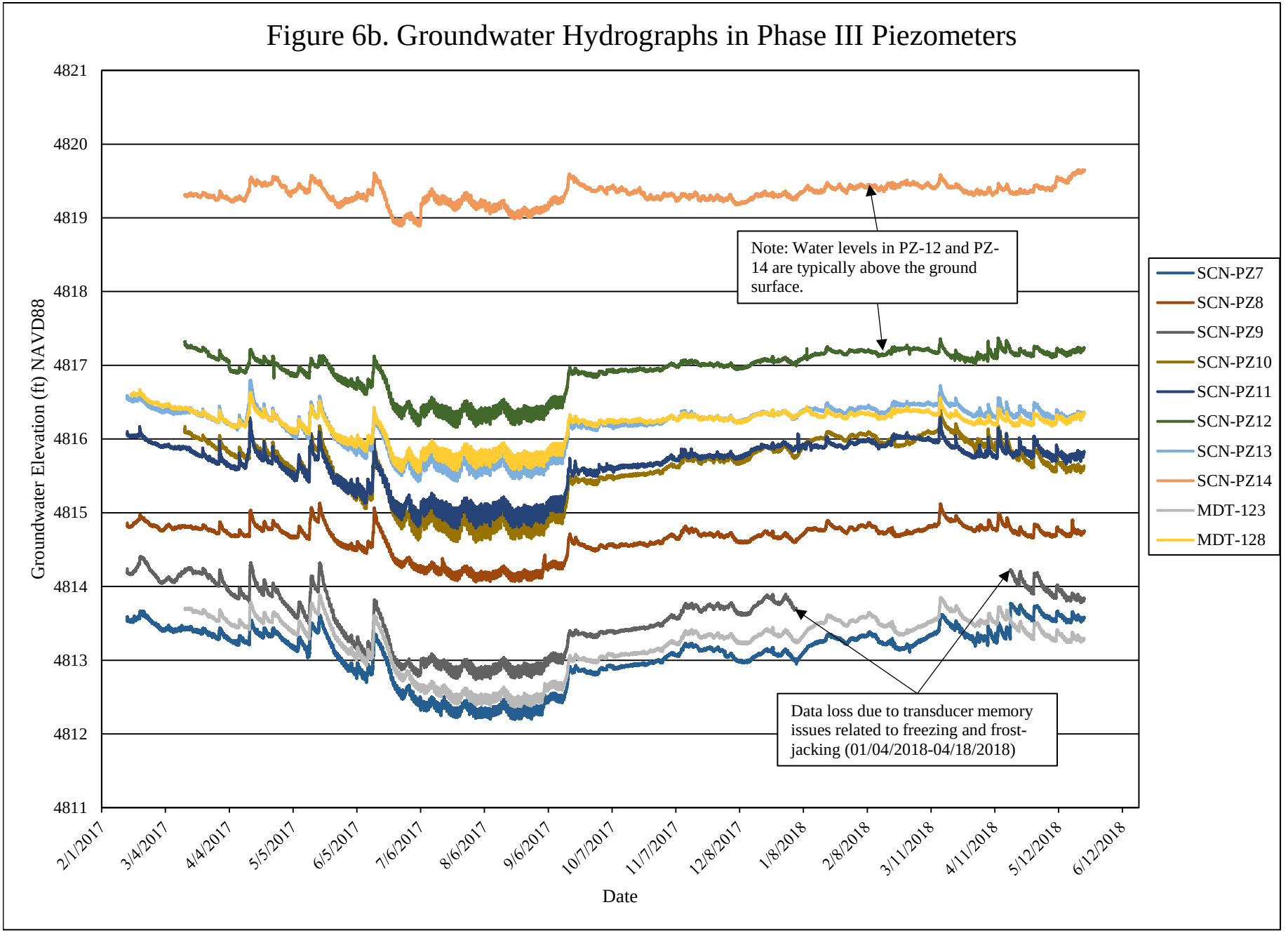


Figure 7a. Groundwater Temperatures in Phase II Piezometers

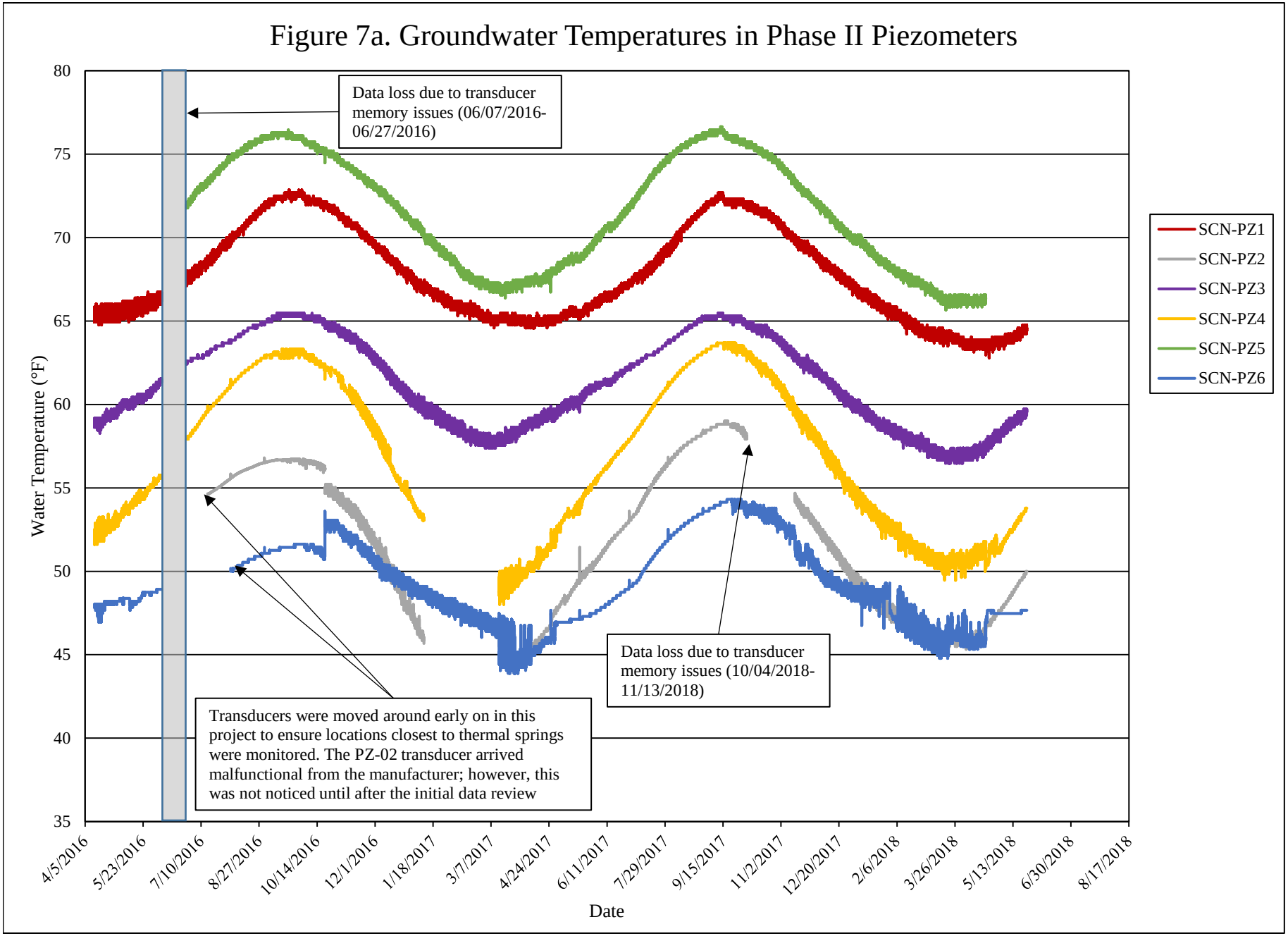


Figure 7b. Groundwater Temperatures in Phase III Piezometers

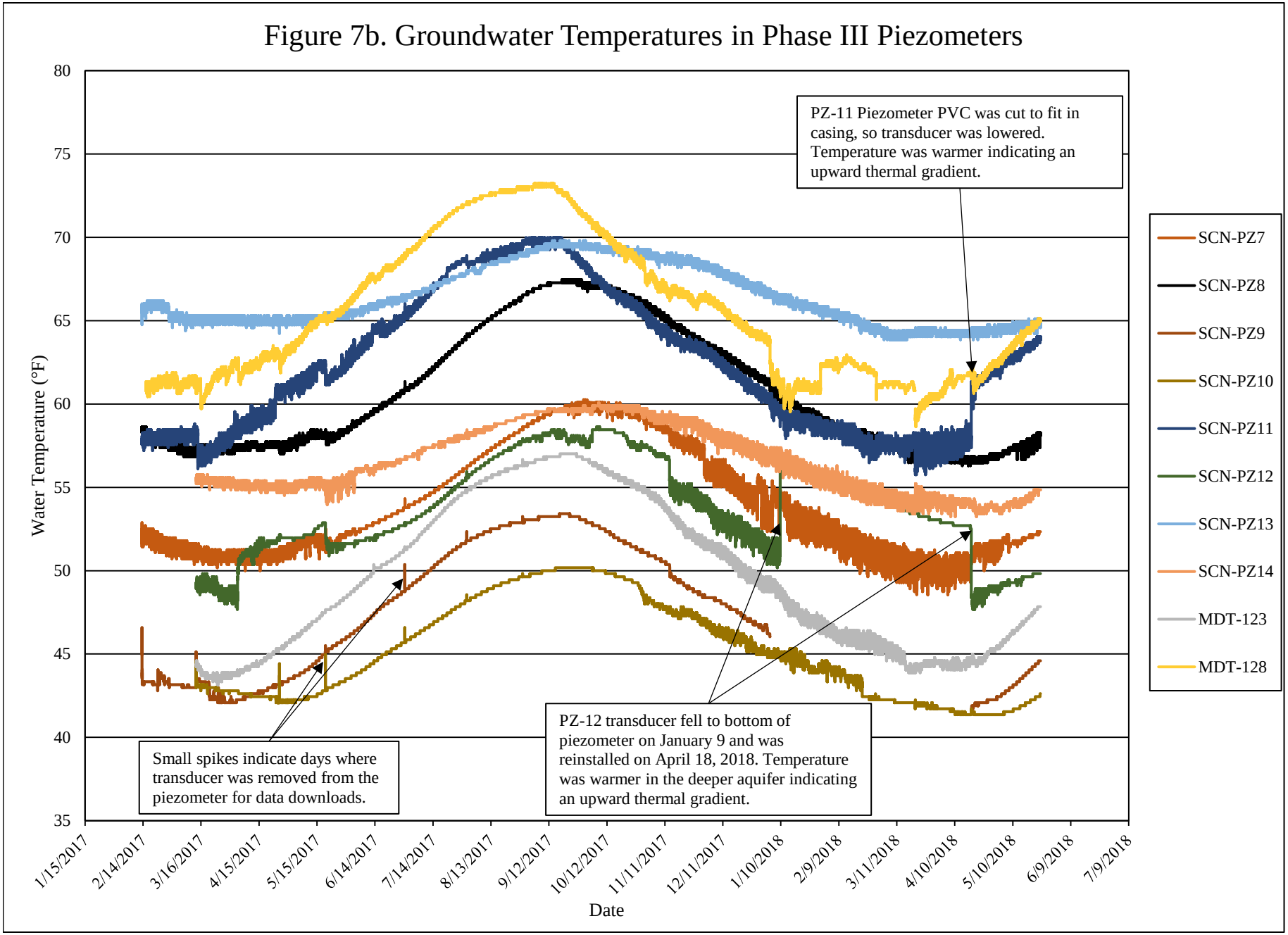
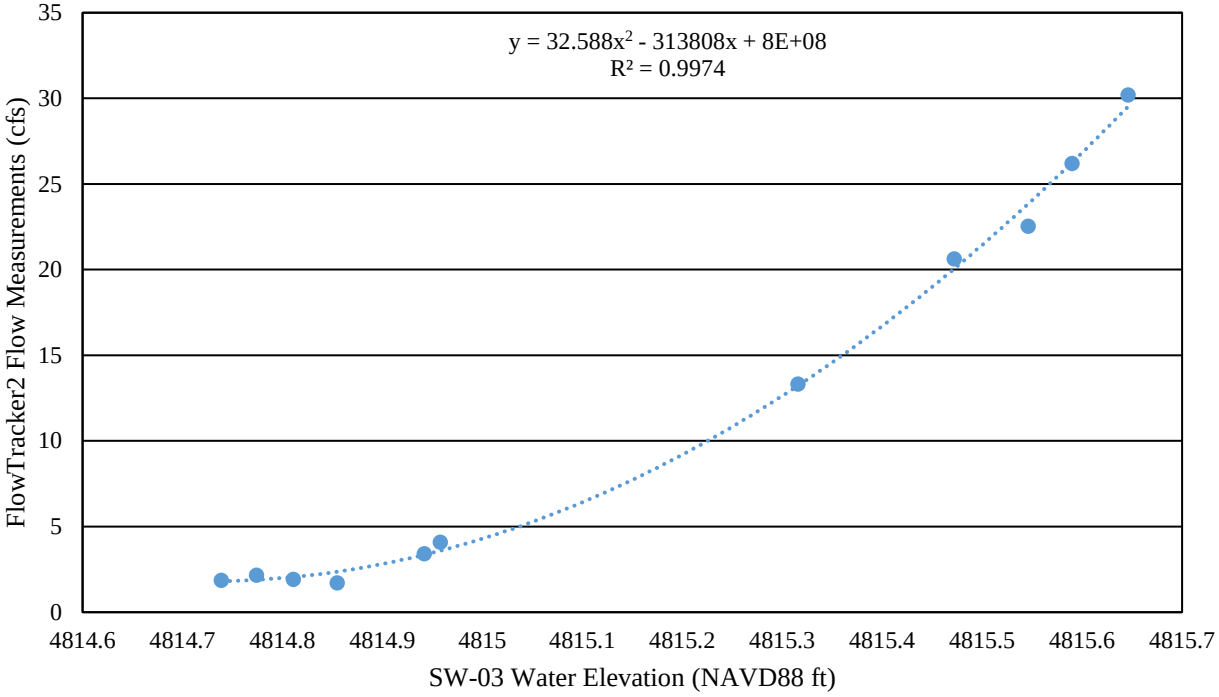


Figure 8. Co-Op Ditch Estimated Flows and Rating Curve at SW-02



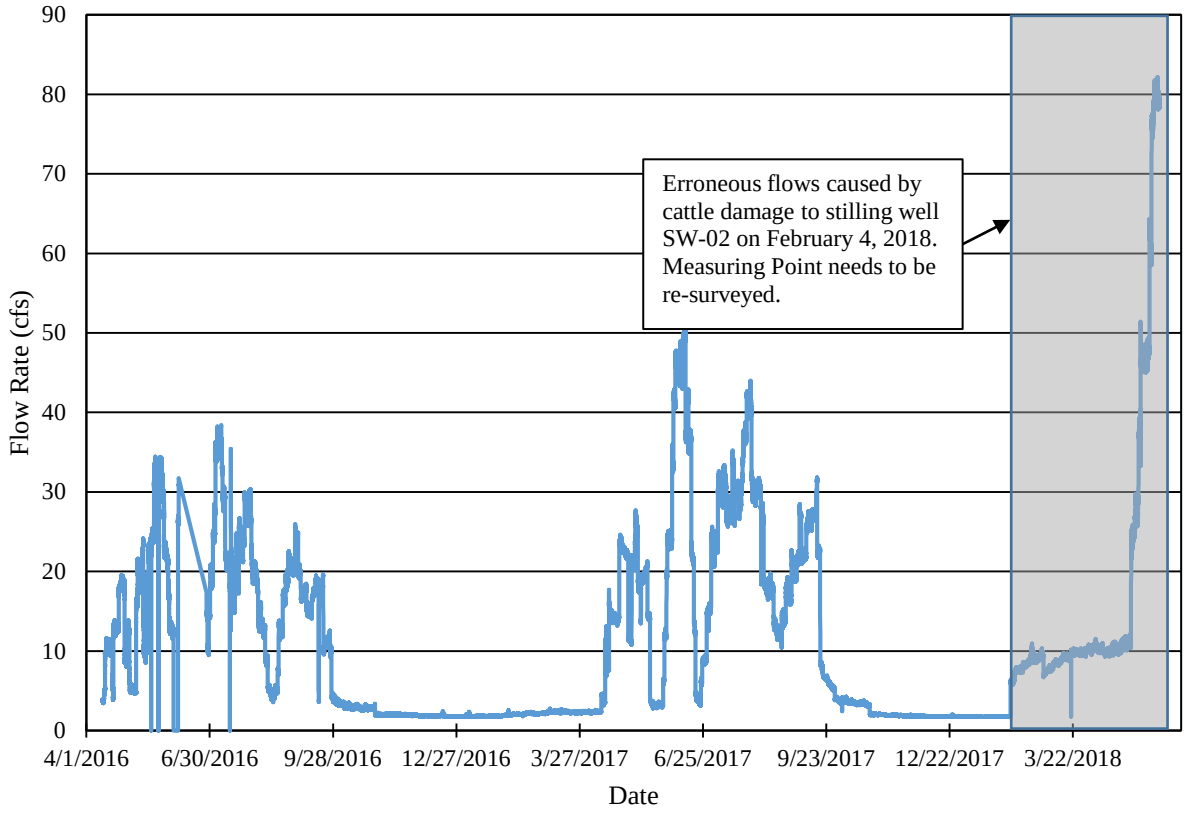
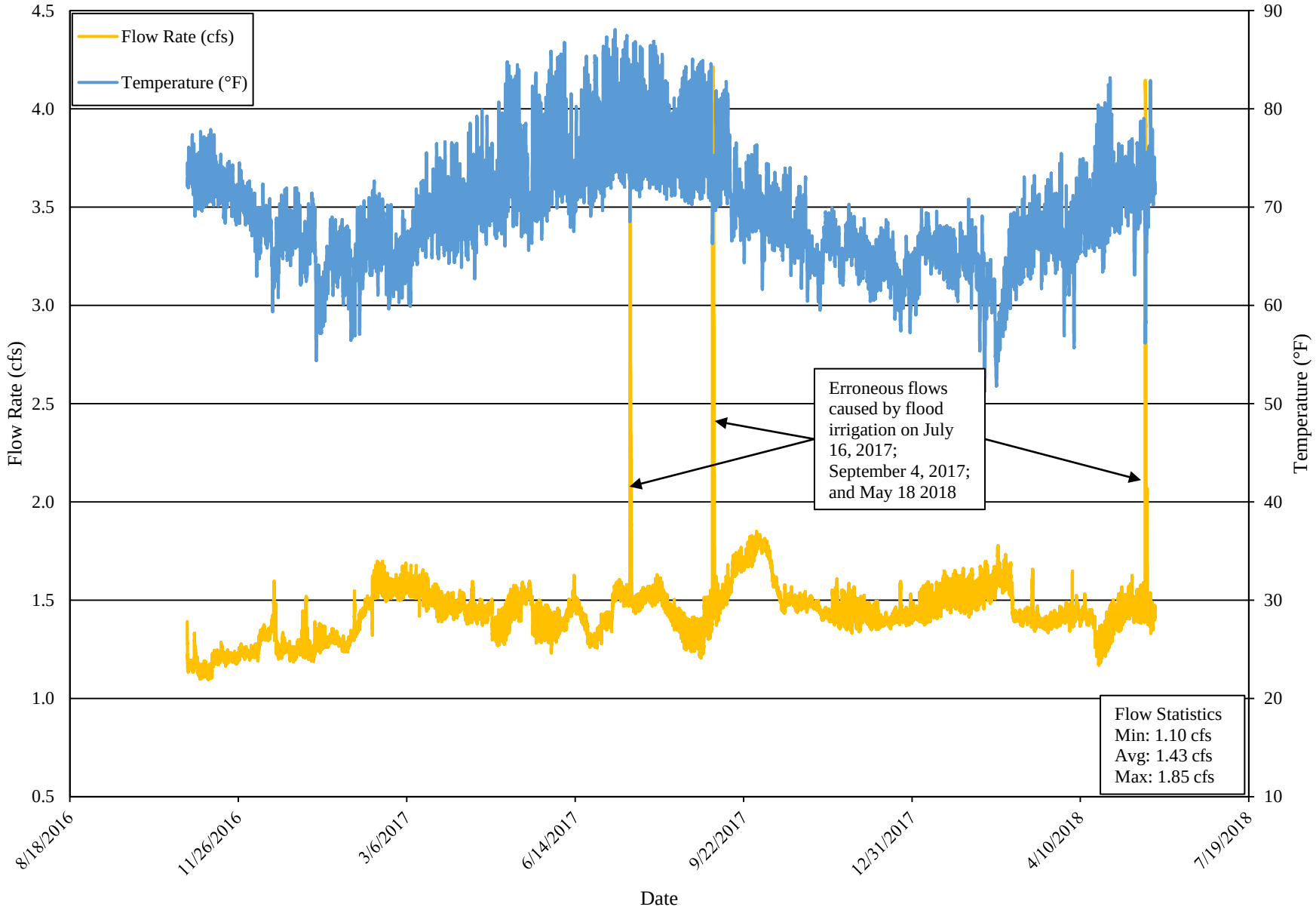


Figure 9. Warm Springs Ditch 6-Inch Parshall Flume Data



TABLES

Table 1. Minimum and Maximum Temperatures over Period of Record

Location	Min Temp (^{o}F)	Date Recorded	Max Temp (^{o}F)	Date Recorded	Delta (^{o}F)
PZ-1	62.8	4/23/2018	72.9	9/20/2016	10.1
PZ-2	44.2	3/25/2017	70.6	10/20/2016	26.4
PZ-3	56.5	3/18/2018	65.5	9/10/2016	9.0
PZ-4	48.0	3/14/2017	63.7	9/10/2017	15.7
PZ-5	64.6	2/13/2017	76.6	9/13/2017	12.1
PZ-6	43.9	3/21/2017	54.3	8/31/2016	10.4
PZ-7	50.0	4/7/2017	60.3	9/29/2017	10.3
PZ-8	56.3	4/13/2018	67.5	9/18/2017	11.2
PZ-9	41.7	1/4/2018	53.4	9/17/2017	11.7
PZ-10	41.4	4/10/2018	50.2	9/15/2017	8.8
PZ-11	55.8	3/20/2018	70.0	8/31/2017	14.2
PZ-12	47.7	4/3/2017	58.6	10/6/2017	11.0
PZ-13	63.5	3/13/2017	69.8	9/13/2017	6.3
PZ-14	53.2	4/7/2018	60.1	10/7/2017	6.8
7931-123	43.2	3/24/2017	57.0	9/17/2017	13.9
7931-128	47.5	3/20/2018	73.2	9/4/2017	25.7
SW-3	59.4	12/16/2016	88.7	7/7/2017	29.3

Table 2. Minimum and Maximum Groundwater Levels over Period of Record

Location	Min GW Level (ft)	Date Recorded	Max GW Level (ft)	Date Recorded	Delta
PZ-1	4813.57	7/24/2016	4814.56	5/17/2017	0.99
PZ-2	4812.41	8/28/2017	4813.51	6/13/2017	1.09
PZ-3	4812.99	8/28/2016	4814.08	6/13/2017	1.09
PZ-4	4811.87	8/22/2016	4813.51	3/15/2018	1.64
PZ-5	4816.31	8/16/2016	4817.22	6/13/2017	0.92
PZ-6	4811.37	8/22/2016	4813.06	2/20/2017	1.69
PZ-7	4812.18	8/20/2017	4813.67	2/19/2017	1.49
PZ-8	4814.06	8/1/2017	4815.13	5/17/2017	1.07
PZ-9	4812.73	8/1/2017	4814.41	2/19/2017	1.67
PZ-10	4814.60	8/1/2017	4816.39	3/15/2018	1.79
PZ-11	4814.79	7/23/2017	4816.29	3/15/2018	1.50
PZ-12	4816.16	7/23/2017	4817.37	4/12/2018	1.21
PZ-13	4815.43	7/4/2017	4816.80	4/14/2017	1.37
PZ-14	4818.89	6/26/2017	4819.65	5/21/2018	0.76
7931-123	4812.37	8/20/2017	4813.88	5/17/2017	1.51
7931-128	4815.55	7/4/2017	4816.67	2/19/2017	1.12

Table 3. Vertical Thermal Gradients at Piezometers PZ-05 and PZ-13

PZ-05		PZ-13	
Depth (ft bgs)	Temperature (°F)	Depth (ft bgs)	Temperature (°F)
5	51.8	5.7	56.7
12	65.1	9.5	60.3
17	67.5	16.5	62

PZ-05 Upward thermal gradient = 1.31 (°F/ft)
PZ-13 Upward thermal gradient = 0.49 (°F/ft)

Appendix A Field Logbook Scans

MDT

STONE CREEK NORTH GEOPROBE INVESTIGATION

Rite in the Rain®
ALL-WEATHER
FIELD
№ 353

PIONEER TECHNICAL

FEB. 2016 GEOPROBE WORK

AND

APRIL 2016 WATER SAMPLING

AND

FIELD VISITS 062716 - 011017

BOOK #1

CONTENTS

PAGE	REFERENCE	DATE
	Landowner # 684-5836 (Sherry Smith)	
	Ditch Writer # 684-5154 (Ray Fournier)	
	Sentek IQ combo = 23-33-39	
	WELL KEY # 3212	

MDT STONE CREEK INVESTIGATION

THURSDAY 2-25-16

0930] STEWART SMITH AND LANCE SORENSEN ARRIVE AT SHERI SMITH RANCH SITE ABOUT 500 FT SOUTH OF WORK AREA ; 25°, MOSTLY CLEAR, LT. WIND ; GROUND IS MOSTLY BARE + FROZEN

0940-0955] CONDUCT SAFETY BRIEFING

0955] UNLOAD GEOPROBE 1005] LANCE INSPECTS HYDRAULIC LINES ; HYD. OIL RESERVOIR - GOOD ; AND TRACKS

1135] RIG (6600) SET UP AT SB5 - OUR FIRST HOLE ; WILL ONLY SAMPLE TO 4 FT, BUT GO 0-2' AND 2-4' ; ~ 40°, LT. WIND, CLEAR

1156] DRIVE 0-2' AT SB5

0-2' 13" RECOVERY

0-4" FROZ 0-1" BROWN

REST IS BLACK, ORGANIC SILT + CLAY

0-8" HAS ROOTS + INSECTS

BAGGED 0-8" 8-12", 12-13"

1220] 2-4' FULL RECOVERY

2-2'9" ORGANIC SILT? NOT SURE IF GREASY ; BLACK, WET TO SAT

SOME SULFUR SMELL, LT GRAY MOTTLE

LONG VERTICAL ROOTS TO 4'

Rite in the Rain

2-25-16 TAU S. SMITH

SB-5

2'9" - 3'6" CLAY, DK. GRAY, SAT, VY SOFT STICKY

3'6" - 4.0' SILTY SAND, DK. GRAY, SAT. SAND IS FINE, ~~WELL~~ POORLY GRADED (UNIFORM)

1240] GP RIG MOVES TO SB4

AT SB5 DTW IS 0.8 FT BGS

1248] DRIVE 0-2' AT SB4; NO RECOVERY, TUBE WAS IN BACKWARDS; LANCE WILL MOVE OVER ~1 FT.

1305] SB-4 0-2' 22" RECOVERY

MOSTLY BLACK ORGANIC CLAY

AT 9-9.5" - A SATUR. SANDY LENS W/ VERY SMALL WHITE SHELLS; LIKE SNAILS PERHAPS

3"-16" APPEARS TO BE VERY SIMILAR MORE VISIBLE ROOTS IN 0-8"

0-3" SILTY CLAY;, DARK BROWN, DAMP NOT FROZ; ABUNDANT ROOTS

16-22" IS SAME AS 12-16" CLAY, BLACK, WET, VY. SOFT, SULFIDE

1325] SB4 2-4' 18" RECOVERY

~1330] LANCE ABOUT TO MOVE TO SB2

2-2'11" SILTY CLAY, DK. GRAY, WET, SOFT W/ ROOTS, SULF SMELL, CAN SEE MICA

2-25-16 SB4

2'11" - 3'6" SAND + GRAVEL (GW), DARK GRAY, SATURATED, SAND IS FINE; GRAVEL IS SUB-ROUND, UP TO 1", WELL-GRADED

1350] LANCE BRINGS 0-2' + 2-4' TO TABLE.

1440] PHOTOS LK E, SE, + S AT SB1 LOCATION, UP ON A SMALL RISE OR MOUND

1445] START LOGGING SB2

0-2' 15" RECOVERY

0-4" ORGANIC CLAY, BLACK, DRY, LOTS OF ROOTS 4-8" CLAYEY SILT, TAN, DAMP; SOME ROOTLETS - HAIRY

8-12" + 12-15" SIMILAR TAN COLOR WILL BAG + DESCRIBE LATER - ALL DAMP

1500] 2-4' 18" RECOVERY

2.-2.5' CLAY, LIGHT TAN, DRY TRACE FINE SAND + GRAVEL, ROOTLETS

2.5-3' SILTY CLAY (CL), TAN TO LT. GRAY, DRY

3-3.5' CLAY (CL), GRAY, DAMP

AT 1500] LANCE BRINGS BOTH SAMPLES FROM SB1

SB1 0-2' 14" RECOVERY

0-5", ORGANIC? SILT, DK. BROWN DAMP, W/ ROOTS + GRASS AT TOP

Rite in the Rain

STONE CRK NORTH

2-25-16 THURS SB1 S. SMITH

5"-8" SILTY CLAY (CL), LT. BROWN DAMP, SOME VERY SMALL WHITE SPECKS SOME ROOTLETS

1530] LOG SB1 2-4' 19" RECOVERY

2'-2'8" CLAY (CL), GRAY, WET SOFT, SOME ROOTS

2'8" - 2'10" CLAY (CL), BLACK, DAMP

2'10" - 3'4" SILTY CLAY (CL), DK BROWN WET

3'4" - 3'7" SILT (ML), DK. GRAY, WET

1550] START LOGGING SB3

0-2' 22" RECOVERY

FROZEN TO ~ 10" 0-3" ABUND ROOTS AND SOME GRASS, TOO FROZEN TO GET TEXTURE 0-8" IS RED-BRN

8-12 TRANSITION RED-BRN TO DARK BRN

12-16 BLACKISH /L-22" ORGANIC SILT, SOME CLAY, DK BRN → BLACK, WET LOTS OF ROOT MASS

1615] LANCE IS MEASURING DTW IN COMPLETED BOREHOLES AND PLUGGING W/ 3/8" BENTONITE CHIPS

SB3 2'-4' 20" RECOVERY

2'-2'4" ORGANIC SILT (OL), BLACK TO DK GRAY, DAMP, SULF SMELL, SOME ROOTLETS

2-25-16 SB3

2'4"-3'2" ORGANIC CLAY (CL) BLACK DAMP, SULFUR SMELL, HAIRY ROOTLETS

3'2" - 3'8" MOSTLY ORGANICS, WITH SILT + CLAY, BLACK, WET, SULFUR SM. ROOTS + ROOTLETS

1700] BOTH PICKUPS LV DRILL AREA AFTER CLEAN-UP + MARK MORE SITES; ~40°

1705] SMITH STOPPED AT SHERI SMITH'S TO LET HER KNOW WE ARE OFFSITE; BUT LEFT EQUIPMENT ONSITE

2-26-16 FRIDAY

0735] SMITH ON G-PROBE TRLR; ~ 20°, CLEAR, LT. WIND; LANCE IS HERE, HE WALKED TO PROBE TO START IT. 0745] RIG NOT STARTING

0800] CONDUCT SAFETY BRIEFING - CONDITIONS SAME AS YESTERDAY; MAY BE MORE FROST DUE TO EARLIER START; THAT IS FROST ON GRASSY SURFACE

0835] RIG STARTS; WILL LET IT WARM

0900] LANCE DRIVES RIG TO PZ1, WE WILL START HERE; LAB SAMPLES FOR 0-8", THEN WILL DRIVE TO 15 FT

2-26-16 FRI PZ-1 SMITH

TO INSTALL A 1½" PVC PIEZOMETER

0902] PHOTOS OF PZ1 SITE; GROUND IS FAIRLY SOFT 0910] DRIVE 0-2' PZ1

0-2' 10" RECOVERY

0-3" ORGANIC CLAY, BROWN, WET, VERY SOFT, 0-1" FROZEN; ROOTS + GRASS

3"-10" ORGANIC CLAY, BLACK, WET, ABUNDANT ROOTS; ROOT NETWORK; SULF SMELL

NO 12-16" SAMPLE

0925] TUBE FROM 4-8' IS UP; LANCE SAYS IT GOT HARD AT 6'; HAD TO HAMMER SOME 5.7'

0928] PZ1 2-4' 16" RECOVERY

2'-3'4" ORGANIC CLAY BLACK, WET, VY SOFT, SULF SMELL, ROOTS; BAGGED 24-30"

0935] 8'-12' ALL SATURATED SIMILAR HARDNESS AS 6-8'

0938] PZ1 ~~X~~ 4'-8' 28" RECOVERY

4 5

2'-3'4" ORGANIC CLAY, BLACK, WET, VY SOFT; SULF SMELL; SOME ROOTS

5 5

5 3'-5'3" CLAY (CL), GRAY, SATURATED, VY SOFT

6

5 3"-4'4" SAND + GRAVEL (SW), GRAY SATURATED; GRAVEL IS SUBRND, UP TO 2" GRAV WELL GRADED, SAND IS FINE-MED

2-26-16 PZ1 SMITH

8'-12' 20" RECOVERY

LANCE IS CLEANING SAMPLERS, WAITING TO INSTALL PVC AT PZ1

8'-12' IS ALL SATURATED; SOME SAMPLE RAN OUT 8-12' SAND + GRAVEL GRAY, SAT; SIMILAR TO ST6ABOVE) GRAV SUBRND TO SUB ANG; SAND IS FINE-MED; ABUNDANT BLACK FE/Mg GRAINS IN SAND; BAGGED A GRAB FROM TUBE; LAST INCH IN TUBE HAD BROWN COLORED WATER + SAND

1003] PZ1 12'-15' ~18" RECOVERY THEN START WELL/PZ CONSTRUCT

SCRN END CAP IS 4" LONG

DTW 13.4' INSIDE CASING @1014

1020] PVC STRING GOES TO 15'; CUT 3' STICK-UP AT 3.0' AGS (CUT 28")

START PULLING RODS

1030] EXPEND. POINT WILL NOT COME OFF; BOTTOM OF ROD NOW AT 14'4"; PULL OUT PVC

4'4" ~~1/4~~" STICK-UP; BOT OF PVC 13.8" TOP OF SCR 8'4"; NAT PACK IS AT 7'0 BGS; BRING UP TO 6' BGS

1050] ADD BENT CRUMBLES PARTIAL OPEN BAG Rite Rain

2-26-16 FRI PZ-1 COMPLETION SMITH

CRUMBLES TO SURFACE 1055] CUT OFF MORE PVC (19.5") SO IT HAS 2'8" STICK UP 1110] PUSHED IN STEEL PROTECTOR (4"X4"x 5' LONG); STEEL STICK-UP IS 3.0' PVC STICKUP IS 32" (2'8")

POURED 2/3 BAG (50 LB) OF PLAYGROUND SAND INSIDE PROTECTOR 1120] LANCE MOVES RIG TO SB6/7 AREA 1126] PHOTOS OF RIG GOING N. AND OF PZ1

1130] MEAS. FROM TOP OF PVC CASING

DTW 3.46'

DTB 16.32'

1135] LANCE DRIVING AT SB-~~7~~ 6; SMITH LOG ~~X~~ PZ1 12'-15'; 45°, CLEAR CALM TO LT. WIND

PZ1-12-15' SAND + GRAVEL; BROWN, SATURATED; GRAV UP TO 1", SUBR TO SUBA WELL GRADED; SAND IS F-M-C, WELL GRADED

BAG SAMPLE

1145] LANCE BRINGS 0-2' + 2-4' FROM SB6 0-2' 20" RECOVERY; FROZEN TO ~9" DEEP 0-8" DESCRIBE LATER; ROOTS BUT NO GRASS ON TOP DK BROWN & BLACK MOTTLING AT 9" SOME BLACK WOOD MATERIAL

2-26-16 SB6 SMITH

9"-20" ORGANIC ? CLAY, DK BROWN TO BLACK, WET, SOFT; SLIGHT SULFUR SMELL, SOME ROOTS

1205] LANCE DRIVING AT SB7

SB6 2'-4' 20" RECOVERY; WHOLE INTERVAL IS ORGANIC CLAY, BLACK W/ AREAS OF DARK GRAY, WET; VERY SOFT, FIRMER TOWARD BOTTOM; SLIGHT SULFUR ODOR; MM-SIZED WHITE SHELLS THR-OUT BAGGED 2430"

1220] LANCE BRINGS BOTH TUBES FROM SB7

0-2' 15" RECOVERY NO FROST

0-10" ORGANIC CLAY (CL), BLACK, WET 0-3' DAMP (3-10"); SLIGHT S. SMELL; ROOTLETS/HAIRY; GRASS AT TOP; CLAY IS FIRM

10-12" CLAY (CL) AS ABOVE BUT GRAY

12-15" ORGANIC CLAY, DK BROWN TO BLACK, WET, VY SOFT - LOTS OF ROOT MASS

1235] LANCE PREPS 1" SAMP. TUBES FOR PZ3 - NO LAB SAMPLES

1240] SB7 2'-4' 21" RECOVERY

2'-2'9" ORGANIC SILTY CLAY; BLACK, WET ROOTLETS, VY SOFT, S. SMELL

2'9" -3'9" ~~ORG~~ CLAYEY SILT (ML); DARK GRAY, SATUR.; S. SMELL, BAG 3337" NO ROOTS

Rite in the Rain

↳ POSS. MICA

1250] RIG SET UP AT PZ3

MDT STONE CRK NORTH

2-26-16 FRI PZ3 SMITH

1303] PHOTOS OF RIG ABOUT TO START PZ3

1309] 0'-4' TUBE UP; ONLY 17" RECOVERY

1320] 4'-8' TUBE UP

PZ3 0-1' (COMPRESSED?) ORGANIC CLAY (CL); BLACK, WET, FIRM; S. SMELL; ROOTLETS

12"-17" SILT (ML); DK. GRAY, WET, S. SMELL; TRACE ROOTS; NO BAG SAMPLE

1330] PZ3 4'-8' 17" RECOVERY +4" FREE WATER 4'-4'5" SAND, DK. GRAY, SATUR., SAND IS FINE, POORLY GRADED

4'5"-5'5" SAND + GRAVEL, DK. GRAY TO BROWN AT 5'1", SAT; GRAVEL UP TO 1.5" WELL GRADED; SAND IS FINE-CRS; WELL GRADED

NO BAG SAMPLE 1338] LANCE ABOUT TO PULL OUT 2" RODS; THEN WILL RE-DRIVE W/ 3" RODS (NO SAMPLING) TO 15' FOR PIEZO

PZ3 8'-12"; 14" RECOVERY; WHOLE INTERVAL IS SAND + GRAVEL; GRAY W/ BROWN WATER; SATURATED; GRAVEL IS SUB-R TO SUB-A; UP TO 1-5", WELL GRADED SAND IS FINE-CRS; " "; NO SAMP

PZ3 12-15' 24" RECOVERY, LOTS OF F. WAT SAND + GRAVEL AS ABOVE GRAV. APPEARS COARSER AND HIGHER %, UPPER 14" IS

2-26-16 PZ3 SMITH

BROWN; THEN REST IS GRAY, SATURATED

BAG SAMPLE UPPER 14"

1400] 3" RODS TO 15': READY TO BUILD WELL 1410] PVC APPEARS TO BE SAND-LOCKED INSIDE 3" RODS; WILL PULL BOTH STRINGS OUT AND TRY AGAIN

1435] GO BACK IN HOLE WITH A DIFF. LEAD ROD (5' LONG) AND EXPEND. SOLID POINT; 3 RODS IS 13 FT; 4 RODS IS 17 FT

1457] PZ3 SCR 9-14' BGS, ▼ BOT AT 14'4" 8' BGS - TOP OF NATIVE SAND PACK; ADD CUTT TO 7' BGS; ADD BENT. GRANULES TO SURFACE

1503] CUT PVC OFF AT 31" AGS; CUT 40" S

INSTALL STEEL PROTECTOR

1510] " " IN W/ 3.0 STICK-UP

MOSTLY FILLED W/ PLAY SAND 2/3 BAG

PVC STICK-UP IS 31" (2'7") FROM TOP PVC

1520] DTW 2.97' DTB 16.90'

LANCE HEADS TO PZ6 (EAST SIDE) W/ G+PROBE

1530] AT PZ1; SMITH CUT OFF 1" FROM PVC TO BETTER FIT IN STEEL LID

NEW PVC STICK-UP 31" (2'7")

DTW DTB

Rite in the Rain

2-26-16 PZ6 SMITH

1600] GOT 2 TUBES FROM PZ6
0-2' 19" RECOVERY / 2-4' FULL RECOV
5-2' 0-10" IS FROZEN
0-2' IS BLACK
10"-18"-19" ORGANIC SILT, BLACK, WET
NO S. SMELL; SOME ROOTS
0-2" HAS LOTS OF ROOTS + GRASS
1628] LANCE BRINGS SAMP. DOWN TO 15' EX PZ6; AT ~6.5'-7' BGS PROBING GOT HARD
PZ6 2'-3'2" CLAY (CL), BLACK TO 2'3" THEN GRAY, WET, FAIRLY FIRM, TRACE ROOTS DK
3'2"-4' SILTY? CLAY, DK GRAY, WET SOFTER THAN ABOVE, SOME GRASS IN BOT 2"
~1635] GO HELP LANCE INSTALL PZ6
1650] BOT OF PVC AT 14'8", CUT OFF (CUT 44.5") SO 24" STICK-UP; SCRN INTERVAL IS 9'4"-14'4"; WANT SAND PACK TO 7'4"; NAT PACK TO 8'4" BRING CSST TO 5.0' BGS, BENT GRANU TO SURFACE; STEEL PROTECTOR HAS 2.5' STICK-UP; ADD PLAY SAND

2-26-16 SB8

1730] LANCE/SMITH AT SB8 - N OF FENCE; HAND DIG HOLE FOR 0-8": 0-5" IS BROWN, FROZEN SOIL; GRASS+ ROOTS; FIELD IS CULTIVATED 5"-8" IS BLACK, SAT SOIL IS SAT. TO 16" OR MORE
1805] BOTH AT GEOPROBE TRLR; WE WILL RETURN TOMORROW ~40°, P. CLDY, LT-MOD WIND
1820] LV SMITH'S; SHERI IS O.K. W/ US WORKING SATURDAY; ALSO LANCE TALKED TO TARA ON PHONE - SHE IS O.K W/ US WORKING SHE SAID TO BE CAUTIOUS ABOUT FATIGUE

2-27-16 SATURDAY
0800] LANCE + SMITH AT TRAILER; ~30° CLOUDY; LT-MOD WIND 0830] MADE IT TO DRILL AREA AFTER FORD GOT STUCK IN MUD IN A LOW AREA. 0840] LANCE STARTS RIG 0850] CONDUCT SAFETY BRIEFING; NO SIMOPS; RAIN FORCAST FOR AFTER NOON - WATCH FOR CHANGING COND.
0900] WE WILL START AT PZ2, NEAR POWER POLE IN NW CORNER; SAMPLE W/ 2" RODS, NO LAB SAMPLES

Rite in the Rain

STONE CRK NORTH

2-27-16 SAT PZ2 SMITH

0920] PHOTOS OF RIG AT PZ2; HE IS DRIVING 4-8'; ONE PHOTO LK N TOWARD SB8; THERE IS A PINK PIN FLAG BEFORE GRASSY DITCH

0928] PZ2 0-4' 1" TUBE, 28" RECOVERY

0-4" CLAY (CL); BROWN, DAMP, GRASS+ROOTS

4" - 18" ORGANIC CLAY (CL); BLACK, DAMP, SOME ROOTS, SLGHT S-SMELL

18" - 22" SILTY CLAY (CL), DK. GRAY, WET W/ FINE SAND AT BOTTOM

22" - 28" SAND + GRAVEL (GW), DK GRAY, WET GRAV UP TO 1", SUB-RND, WELL GRADED SAND FINE-CRS, WELL GRADED)

0941] LANCE BRINGS REST OF PZ2 TUBES 4-8' 18" RECOVERY PCUS 12" FREE WAT WHOLE INTERVAL IS SAND+GRAV (GW), GRAY, SATURATED; GRAV UP TO 1-5" WELL GRADED SAND FINE-CRS, WELL GRADED)

BAG 4' - 4.5' W/ LARGER GRAV. PIECES

1000] SMITH AT PZ2 TO HELP INSTALL PVC CASING; LANCE DRIVING 12-15' W/ 3" RODS

LANCE PUSHED 3" RODS TO 15'4"

PVC STRING IN TO 15'4"; CUT OFF 36", SO PVC HAS 25" STICK-UP

1012] ADD WATER IN ANNULUS

1020] RODS OUT; MEAS. BOT OF PVC INSIDE 15.0' BGS; SO SCREEN IS 9'8" - 14'8"

2-27-16 PZ2 SMITH

WANT TOP OF SAND AT 7'8" OR HIGHER NAT PACK AT 8"; ADD CSSI TO 5' BGS; ADD BENT GRANULES TO SURFACE

1030] ~45°, MOD WIND; P-CLDY; LANCE WASHING RODS 1050] FINISHED 2 PARTIAL BAGS OF PLAY SAND AND OPENED 3RD BAG TO FILL STEEL PROTECTOR; WE CUT 1.5" MORE OFF PVC STRING

STEEL STICKUP IS 32" (2'8")

PVC STICKUP IS 27" (2'3")

FROM TOP OF PVC DTW 2.52' DTB 17.14' AT 1055

1100] LANCE MOVES RIG TO PZ4; GETTING WINDY 1106] PHOTO OF PZ2 8-12'

THE SAMPLE IN TUBE SEPARATED DURING TRANSPORT W/ GRAVEL GOING TO BOTTOM; 8'-12', 28" RECOVERY; WHOLE INTERVAL IS SAG AS ABOVE; MAY HAVE HIGHER % OF GRAV; GRAV IS SUBR TO SUBANG-IN 8-12' AND 4-8'; NO BAG SAMP

1115] PZ2 12'-15', 26" RECOVERY; WHOLE INTERVAL IS SAND+GRAVEL (GW), GRAY, SAT.; GRAV SUBR-SUBA, VY WELL GRADED SOME CLASTS OF RED SANDSTONE; SAND IS WELL GRADED W/ ABUND FEMG BLACK GRAINS

NO BAG SAMP

Rite in the Rain

2-27-16 SAT. PZ4 SMITH

1115] LANCE BRINGS 0-4' AT PZ4; 1" TUBE

0-4' PZ4 17" RECOVERY

0-3' ORGANIC SILT, DK BROWN TO BLACK, DRY GRASS & ROOTS

3"-8" SILT (ML), WET, GRAY, SOME ROOTS SLIGHT S SMELL; BLACK COATING IN TUBE, BUT SILT IS GRAY

8"-17" SAND (SP), DK GRAY, SATURATED SAND IS VY FINE & UNIFORM; SLIGHT S SMELL BAG 12'-17"

1140] PZ4 4-8', 21" RECOVERY

1150] SAMPLE TUBE GOT JAMMED W/ S&G AT 12'; I SAID WE DO NOT NEED TO SAMPLE 12-15', BUT SHOULD DRIVE 3" RODS TO 15' FOR PIEZO

1155] PZ4 4'-5'1" SAND (SP), GRAY, SAT.; FINE GRAIN - POORLY GRADED; PIECE OF DECAYING WOOD AT 4'8"-4'9"

5'1"-5'9" SAND & GRAVEL (GW), GRAY, SAT GRAV UP TO 1.5"; GRAV IS COARSER THAN OTHER BORINGS; LOWER % SAND; NO BAG SAMP

1203] MATERIAL SAVED FROM 8'-12' TUBE IS S&G; 1" PLUS PEBBLES; TUBE GOT CRUMPLED

STORM COMING IN FROM NW

NOTES FROM LANCE SORENSEN

THURS 2-25-16: MEAS. WAT LEVELS BEFORE ABANDON HOLES W/ BENT. CHIPS

SB4 WATER AT GROUND LEVEL; OPEN TO 4'

SB2 NO WATER, OPEN TO 4'

SB1 NO WATER, OPEN TO 4'

SB3 DTW 1.23', OPEN TO 4'

FRI 2-26 MEAS. TAKEN W/IN 1 HOUR OF DRILLING

SB6 DTW 2.3', OPEN TO 4'

SB7 DTW 3.5' OPEN TO 4'

2-27-16 SAT

1210] SAMPLE TUBES FROM 2-26-16

PZ6 12'-15' 10" RECOVERY - SAND & GRAVEL, SATURATED BAGGED

1220] BOTH AT PZ4 INSTALL PVC TO 15'4"; ADD WATER; LT. RAIN

1240] RAIN STOPS; ALL RODS OUT; CUT 18.5" OFF SO FAR; BOT OF PVC INSIDE IS 14.7' BGS; SCREEN IS 9'4"-14'4"; WANT TOP OF SAND AT 7'4". NAT PACK IS 8'2". TO SURFACE SAND PACK TO 7'5"; ADD CRUMB

2-27-16 PZ4 SMITH

1252] CUT OFF 22", SO PVC STICK-UP IS 24" AGS ; TOTAL CUT IS 41.5"; WILL PUSH STEEL 2.5' INTO GROUND

1305] RIG MOVES TO PZ5 - AT S. END, LAST BORING ; WILL POSTPONE MEAS. AT PZ4

PZ6 8'-12' FROM 2-26 ; ABOUT 12" RECOV MAY HAVE LOST SOME OUT OF TUBE PHOTO AT 1317 ; INTERVAL IS SAND + GRAV (GW) ; GRAY, SATURATED ; GRAV TO 1.5" SUBR TO SUBA ; SAND IS FINE→CRS

NO BAG SAMP

1358] PHOTOS OF RIG AT PZ5 JUST AS HE STARTS DRIVING 0-4' W/ 3" RODS ; 0-4', 31" RECOVERY

0-6" CLAY (CL) ; DK. BROWN, DAMP, GRASS + ROOTS

6" - 12" SILTY CLAY (CL) ; LT. BROWN, DAMP, ROOTS

12" - 18" CLAY, GRAY, WET ; VY SOFT SOME ROOTS

18" - 31" ORGANIC CLAY ; BLACK, WET SUFFUR SMELL ; SOME ROOTS ; VY SOFT

1410] TUBE 4-8' PZ5 ; DRILLING GOT HARD AT 5.7'

1415] WILL SKIP TO PZ5 8-12'

2-27-16 PZ5 SMITH

ALL SATURATED ; LOTS OF FREE WATER

17" RECOVERY AFTER DUMPING ; INTERVAL IS SAND & GRAVEL (GW) DARK GRAY, SAT ; SLIGHT S. SMELL GRAV IS UP TO 1.5" ; SUBR TO SUBANG ; SAND IS FINE TO CRS, WELL GRADED, BAG OF MIXED COMPONENT

1430] BLDG PZ5 ; TD OF BORING 15' 4" ;

1448] ALL RODS OUT ; BOT OF PVC INSIDE IS 15.1' BGS ; SCREEN IS 9'8" - 14'8" ; WANT TOP OF SAND AT ~~7'~~ 7'5"

TOP OF NAT PACK IS AT 6.5' BGS

ADD BENT CRUMB TO SURFACE

1457] DRIVING IN STEEL PROTECTOR WE HAD CUT 38" OFF PVC

1505] LANCE STARTS TO DRIVE G-PROBE BACK TO TRAILER ; 1,000' PT TO SOUTH

PZ5 STEEL STICK-UP 30"

PVC " " 25"

1542] FROM TOP OF PVC: DTW 3.54' DTB 17.06'

1545] BOTH PICKUPS LV DRILL AREA W/ ALL GEAR.

1645] ALL PIONEER CREW + EQUIPMENT LEAVE RANCH PROPERTY

WCH 04/2/16

04/2/16 POR RANCH

ONSITE @ 0726
SUNNY ~ 45 °F

SCN-PZ6
DTW 2.26' @ ~~0815~~ 0826 WCH
pH 7.70 T 10.1 °C
SC 732 mS/cm DO 0.05 mg/L
ORP -233 @ 0900

SCN-PZ4
DTW 2.37' @ ~~0915~~ WCH 0918
pH 7.71 T 12.9 °C
SC 738 mS/cm DO 0.65 mg/L
ORP -239 @ 0933

SCN-PZ2
DTW 2.66' @ 0955
pH 7.90 T 13.0 °C
SC 727 mS/cm DO 0.10 mg/L
ORP -202.4 @ 1007

Rite in the Rain

SCN - PZ3

DTW 3.04' @ 1040

pH	7.84	T	16.5	°C
SC	733	DO	0.40	mg/L
ORP	-196.8	@	1051	

SCN - PZ1

DTW 3.35' @ 1120

pH	7.66	T	21.8	°C
SC	717	DO	0.30	mg/L
ORP	-193	@	1130	

SCN - PZ5

DTW 3.73' @ 1250

pH	7.70	T	22.9	°C
SC	720	DO	0.14	
ORP	-195.9	@	1309	

SCN - POND 1211

pH	7.58	T	27.2
SC	725	DO	1.41
ORP	-148.5	@	

DUPLICATE SCN - TRIP ON

SCN - ~~WSDH~~ CDN WCH

pH		T	
SC		DO	
ORP		@	

- COULANT DO RELEASE OF COWS POLLUTING THE SOURCE

SCN - ~~WSDS~~ CDS WCH

pH	8.32	T	27.7
SC	712	DO	7.80
ORP	-86.8	@	1448

BEAVERHEAD RIVER ~15 YARDS UPSTREAM OF DIVERSION

pH	9.02	T	14.6
SC	698	DO	10.04
ORP	-104.1	@	14:08

WCH

010317

Rite in the Rain

WCH
04/2016

04/2016 POR RANCH

SUNNY & CLEAR

SIZING OF CULVERT FOR SWALES

X	Y_1	Y_2
0'	1.3'	1.3
0.5'	0.45'	2.38'
1.0'	0.2'	2.89'
1.5'	0.1'	3.17'
2.0'	0.05'	3.34'
WCH ~~2.8'~~ 2.5'	0.0'	3.44'
2.8'	0.00'	3.44
3.3'	0.05	3.34
3.8	0.1	3.17
4.3	0.2	2.89
~~4.8~~	0.45	2.38
5.3	1.3	1.3

WCH
010317

Rite in the Rain

WCH
062716

062716 POR RANCH

ONSITE @ 0705 SUNNY & CLEAR

INSTALLED 6" PARSHALL FLUME
FLOW HT 1300 0.52 CFS
STAFF GAGE = 0.42'

RIGHT CULVERT (LOOKING DOWN)
REAL TIME @ 1333 6.96 CFS } OLD DIMS
LEFT CULVERT
REAL TIME @ 1508 6.17 CFS } OLD DIMS
RIGHT @ 1515 7.06 CFS } NEW DIMS
LEFT @ 6.37 CFS

10' PARSHALL STAGE 0.55' - 0.56'
15.13 - 15.57 CFS

SWL
Stilling well @ 1322 DTW = 4.17'
Logger was full & stopped
Download all data & restart on 15 min
@ 1515

SWL
LOGGER WAS FULL & STOPPED
DOWNLOAD ALL DATA & RESTARTED ON 15-MIN
@ 1615.
DTW @ 1607 = 3.435

Rite in the Rain

PZ5

DTW @ 1620 = 3.91'

~~STOPPED. ZERO READINGS.~~

34.808' 72.14° F

PZ3

DTW = 3.26 @ 1651

logger stopped - Download all data

Reset to 15 min - future start at 1715

PZ1

DTW = 3.48 @ 1705

logger stopped - Download all data

Reset to 15 min - future start @ 1715

PZ4

DTW: 3.00 @ 1716

logger Stopped - Download all data

Reset to 15 min - future start at 1730

PZ6

DTW = 2.975

logger stopped - Download all data

~~MOVED TO FOR STILLING WELL NEAR FLUME~~

~~FOR TEMPORARY USE~~

PZ2

DTW = 2.90 @ 1737

Flume stilling well

DTW = 4.50 @ 1748

Download all data

Move to flume

Restart at 15 min at 1815

Start PZ6 in Stilling well at ~~1615~~ 1815

Download Bard & Restart

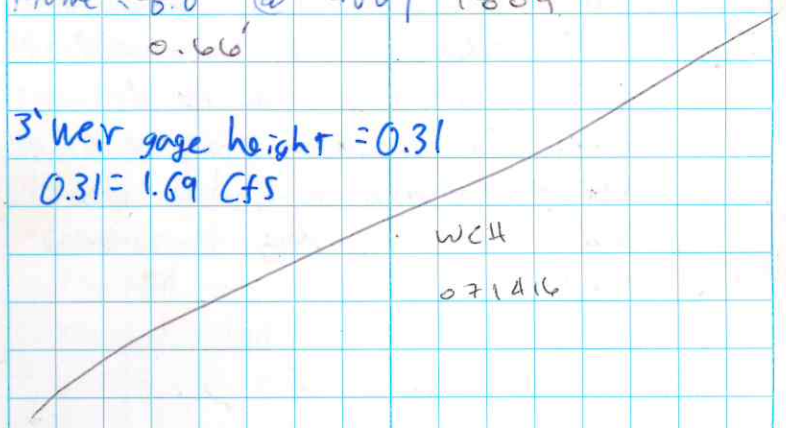
DTW Stilling well = 4.48 at ~~1606~~ 1806

Flume = ~~6.6'~~ @ ~~1609~~ 1809

0.66'

3' weir gage height = 0.31

0.31 = 1.69 CFS



Rite in the Rain

7/15/16 - Potts

0930 arrive at 10-ft weir

0933 Staff plate Reading 0.60 = 15.12

0934 Begin flow measurement From Left Bank

Distance	Depth	Velocity
1	0.6	1.91
2	0.6	2.03
3	0.6	2.01
4	0.6	2.01
5	0.6	2.02
6	0.6	2.02
7	0.6	2.04
8	0.6	2.05
9	0.6	1.98
10	0.6	1.84

Note: These measurements are estimated without a tag line for accurate distances. Because weir is wider than 10 ft at staff plate location a tag line was used to re-measure flows on following page..

mp

7/15/16

Flow Measurement #2

Distance	Velocity	Depth	Flow
1	1.86	0.6	1.116
2	2.07	0.6	1.242
3	2.00	0.6	1.2
4	2.10	0.6	1.26
5	1.93	0.6	1.158
6	2.15	0.6	1.29
7	2.22	0.6	1.332
8	2.14	0.6	1.284
9	2.10	0.6	1.26
10	2.02	0.6	1.212
11	1.82	0.6	1.092
12.2	0	0.6	1.3104

Note: Depth at 10-ft width was 0.4

Total Measured Flow 14.75 cfs

Weir Calc Flow = 15.12 cfs

Difference = 0.36

- Moved to Culverts to download Sontek
- left Sontek file L1 downloaded
- Started new file L2
- Download Right Sontek file R1
- Started new file R2

Rite in the Rain

7/15/16

Culvert stilling well
DTW = 4.21 ft @ 1043
Download transducer @ 1045
Synchronize & Restart @ 1100

- Move to Flume
  - Right side completely blown out under the sheet metal - Picture
  - Used wooden survey stakes to "build a fence" along upstream side of sheet metal
  - Then used mud to block flow like Before
  - Then covered with bentonite & Packed down
  - Will Let stabilize before downloading

- Move to PZ3
  DTW = 3.12 @ 1212
  - Download transducer & Restart

PZ-1 DTW = 3.44 @ 1220
- Download & Restart

PZ-4 DTW = 2.82 @ 1230
- Download & Restart

PZ-6 DTW = 2.78 @ 1237
No Transducer

PZ-2 DTW = 2.72 @ 1242
Download Transducer
- Still Reading 200+ ft with trend same exactly as temp
- will Replace & Send in to Solinst

Flume Stilling Well DTW = 4.52 @ 1255
Install new transducer in PZ-2 at 1323
future start @ 1330
DTW = 2.705 @ 1336 PZ-2
- Flume stilling well
  DTW = 4.47 @ 1352
  Download & future start @ 1400
Barc - download & future start @ 1400
- Flume = 0.55 @ 1400
  - Download transducer - Future start @ 1415
- Stilling well @ Headgate
  DTW = 3.40 @ 1420
  Download & future start @ 1430

Rite in the Rain

PZ-5 DTW = 3.81 @ 1434

- Download Data & Future Start 1445

3-ft $w_{c,r}$ = 0.28

Note talked to Brian & he said they flood irrigated within the past week which is prob what eroded the flume

WCH

010317

7/25/16

- in office future started LTC 1066705 to start at 0900 15 min intervals & renamed to PZ-6

PZ-6 DTW = 3.075 @0749

install transducer @ 0756

- Unable to install - no cap
- work on flume
- initially Reading Zero
- Installed sheet pilings in front & back of each flume & in front of flume
- Paved 300 lbs of bentonite between, in front, & on back of sheets

at 1056 stilling well DTW = 4.49

Flume height = 0.52

WCH

010317

Rite in the Rain

8/3/2016 Potts

arrive at culvert 7:45

calm, clear, warm

- Small amount of flow - much less than on 7/25 (pictures)
- flume height = 0.66 at 8:04

Looks like a small amount of flow is going through the Right side and a small amount of flow is going around the right side through mustrat tunnel (Pictures)

- Drive to 10' weir - 0.7 = 912 miners inch
- Ray there (told me the 912 miner's inches
- Said a spring appeared in field ~~2~~ 75 yds from weir after earthquake
- also said everyone would be much happier to see MDT use existing alignment & blast rock
- Begin walking new alignment

WCH

010317

- SW1 at headgate
  DTW = 3.22 @ 0945
  Stop logger, download, Restart at 1000
- SW2 at culvert
  DTW = 4.11 @ 1214
  stop, download, Restart at 1230
- Santek R - download data
- Santek L - download
- Flume 0.68 at 1226 - Download logger & Restart at 1245
- Stilling well @ Flume
  DTW = 4.52 @ 1230
  Download logger + Baro & Restart
- PZ-3 DTW = 3.30 @ 1241
- PZ-1 DTW = 3.52 @ 1250
- PZ-2 DTW = 2.95 @ 1259
- PZ-6 install LTC 1066705 on 15 second intervals for a few minutes
  - Download & future start at 1315
  - install in well at 1313

  DTW = 3.11 at 1315

PZ-4 DTW = 3.11 @ 1318

PZ-5 DTW = 3.96 @ 1328

New well S. DTW = 5.05 @ 1350
approx 3' stickup

Driller said Rig pushed up water
Tried to drill down in sedges and
rig started flipping

New well N DTW = 5.31 @ 1357
approx 2.5' Stickup
- Install temporary Transducer to get
a water Temp ≈ 14°C

Final Flume height = 0.69 @ 1412

3' Weir = 0.24 @ 1420

WCH
@10317

8/31/2016

25.92

Arrive @ 10' flume @ 0754 9

Total Flow = 24.435

0758 0.4 Stage = 0.77

	Left bank	d	v	Flow
1	1.0	0.75	2.53	1.176
2	1.5	0.8	2.52	1.008
3	2.0	0.8	2.56	1.024
4	2.5	0.8	2.68	1.072
5	3.0	0.8	2.60	1.04
6	3.5	0.8	2.74	1.096
7	4.0	0.8	2.80	1.12
8	4.5	0.8	2.64	1.056
9	5.0	0.8	2.83	1.132
10	5.5	0.8	2.87	1.148
11	6.0	0.8	2.66	1.064
12	6.5	0.8	2.65	1.06
	7.0	0.8	2.68	1.064
	7.5	0.8	2.73	1.092
	8.0	0.8	2.71	1.084
	8.5	0.8	2.73	1.092
	9.0	0.8	2.63	1.052
	9.5	0.8	2.58	1.032
	10.0	0.8	2.64	1.056
	10.5	0.8	2.52	1.008
	11.0	0.8	2.47	0.988
	11.5	0.8	2.35	0.94
	12.0	0.8	2.24	0.822

Right bank = 12.6

26.46

stage = 0.78

Rite in the Rain

- Look for evidence of seismic-induced temporary spring - None found
- Muerto Waste Gate SW-01
  DTW = 3.15 @ 0847
  Download all data & Restart @ 0900
- Check area on map highlighted by landowners near headgate (pictures)
  No water but looks ephemerally wet and has wetland plants
- Move to culverts upstream side of
  Right (east) culvert plugged by beaver
  Removed debris @ 0907
- Download Sontek's
  Download Right culvert R3
  Replace battery & Restart @ 0928
  New file name R4
- Staff gage well (SW-02) DTW = 4.00 @ 0919
- Download & Future start @ 0930
  Download Left culvert L3
  Replace battery & Restart @ 0939
  New file name L4
- Move about 50 ft downstream for flow measurements

left bank = 0.4

#	Station	d	v
1	1.0	1.3	2.11
	1.5	1.4	2.10
	2.0	1.45	2.10
	2.5	1.45	2.10
	3.0	1.4	2.01
	3.5	1.4	2.02
	4.0	1.35	1.97
	4.5	1.4	1.97
	5.0	1.35	1.98
	5.5	1.3	1.98
	6.0	1.2	1.96
	6.5	1.1	1.93
	7.0	1.05	1.98
	7.5	1.05	1.98
	8.0	1.0	1.94
	8.5	0.9	1.89
	9.0	0.85	1.88
	9.5	0.85	1.90
	10.0	0.85	1.79
	10.5	0.80	1.88
	11.0	0.75	1.72
	11.5	0.70	1.65

Station	d	v
12.0	0.65	1.86
12.5	0.6	1.79
13.0	0.5	1.97
13.0 – 15.0	d = 0.10	N/A

LEw = 15.0

Flume looks to have a small leak on Right side will download pizos then get waders to fix

PZ3 DTW = 3.33 @ 1031
Download & Restart @ 1045

PZ1 DTW = 3.55 @ 1037
Download & Restart @ 1045

PZ2 DTW = 3.01 @ 1045
Download & Restart @ 1100

PZ6 DTW = 3.13 @ 1053
Download & Restart @ 1100

PZ4 DTW = 3.11 @ 1100
Download & Restart @ 1115

PZ5 DTW = 3.90 @ 1115
Download & Restart @ 1130

MDT-N DTW = 5.33 @ 1108
MDT-S DTW = 4.88 @ 1128

Investigate Oxbow areas indicated on map & investigate culvert infield (pictures)
- Ran into Brian

Conversation notes:
- Field Oxbow has Never been dry
- will flood irrigate within next month
- today is Ray's last day
- Never less than 80 miles inches at weir
- Need to quantify flow from Culvert they don't know what it is

- Flume height = 0.52 @ 1244
  - will try to fix leak
  - Made Repairs
  Download logger & Restart
- Stilling well - DTW = 4.39 @ 1309
  Download logger & Store
  Rename from SCN_PZ6_Flume
  to SCN_Flume-SW-03
- Flume GH = 0.60 @ 1324

Investigate USD downstream of flume take Marsh-McBirney flow Msmt

Rite in the Rain

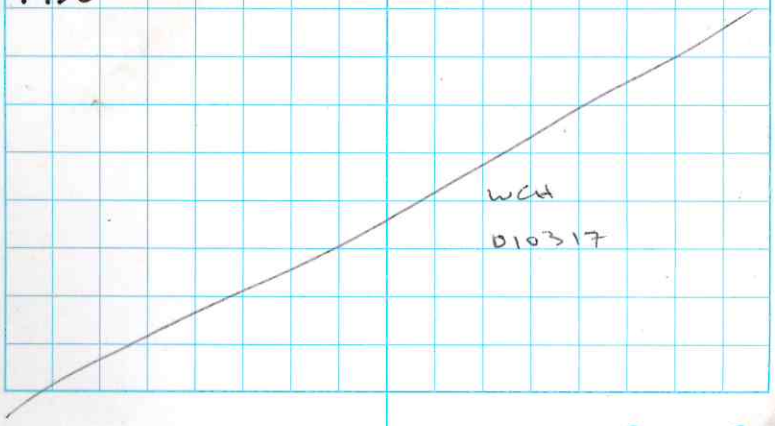
1328	Station	d	V
Left Bank	1.2	0	0
	1.8	0.45	0.13
	2.2	0.475	0.19
2.5	2.8	0.45	0.23
3.0	3.2	0.45	0.38
3.5	3.8	0.475	0.40
4.0	4.2	0.35	0.43
4.5	4.8	0.30	0.45
5.0	5.2	0.275	0.38
5.5	5.8	0.35	0.26
6.0	6.2	0.40	0.35
6.5	6.8	0.30	0.40
7.0	7.2	0.30	0.37
7.5	7.8	0.20	0.28
8.0		0.20	0.37
8.5		0.20	0.30
9.0		0.20	0.17
9.5		0.20	0.16
10.0		0.25	0.13
REW =	13.0	0	0
1355			
Plume	GH = 0.63 @ 1357		

Downstream of culvert

	Station	d	V	L =
1.0	Left Bank	0	0	1.0 ft
	1.5	0.25	0	
	2.0	0.40	0.13	
	2.5	0.55	0.54	
	3.0	0.575	0.60	
	3.5	0.60	0.62	
	4.0	0.60	0.64	
	4.5	0.65	0.60	
	5.0	0.65	0.45	
	5.5	0.65	0.67	
	6.0	0.60	0.49	
	6.5	0.575	0.23	
	7.0	0.45	0	

REW = 7.4 - 0 - 0

1430



Upstream of culvert

	Station	d	v
LEW	1.8	0	0
	3.0	0.05	0
	4.0	0.2	0
	5.0	0.3	0
	6.0	0.3	0.04
	7.0	0.4	0.01
	8.0	0.5	0.01
	9.0	0.6	0.03
	10.0	0.6	0.14
	10.5	0.6	0.14
	11.0	0.7	0.12
	11.5	0.7	0.14
	12.0	0.7	0.26
	12.5	0.7	0.24
	13.0	0.65	0.21
	13.5	0.65	0.22
	14.0	0.7	0.23
	14.5	0.65	0.25
	15.0	0.6	0.21
	15.5	0.6	0.14
	16.0	0.55	0.14
	16.5	0.55	0.03
REW	16.8	0	0

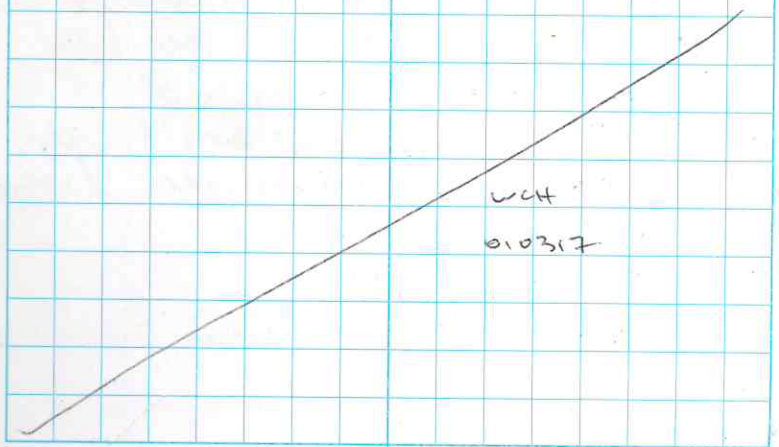
1352

3' weir

GH=0.38 @ 1502

Station	d	v
LEW=0.0	0	0
0.3	0.3	1.61
0.6	0.5	1.55
0.9	0.3	1.62
1.2	0.3	1.61
1.5	0.3	1.63
1.8	0.3	1.66
2.1	0.3	1.75
2.4	0.3	1.45
2.7	0.3	1.50
REW=3.0	0	0

GH=0.4 @ 1512



Rite in the Rain

9/19/2016 Potts
Calm, clear, warm
Arrive at culverts at 1052 - No blockage
- Move to wetland along BH Rock
- Still dry - Pictures
- Move to North BH Rock wetland - Still dry
- took pictures & located wood culvert - Dry
- Move to south culvert Hwy - 41
- North - dry both sides
- South - West side wet, east - dry
- Investigate areas near new alignment
"Spring" near haystacks - dry
Culvert NE of haystack - dry
- Check Parshall flume
looks like flood irrigation downstream
water levels very high & stagnant
GH = Meaningless - No free-flow
- Downstream of Rectangle plentro of
descent flume locations ≈ 12-14 ft width
- Cutthroat - ok Flood irrigation diverted
at culvert
- GH = 0.24 @ 1210
H_a = 0.25, H_d = 0.1 @ 1212

Upstream GH_A = .24 H_d = 0.09 @ 1218 Start

L=0	d	v
1=0.4	0.24	0
2=0.8	0.23	0
3=1.0	0.23	0.1
1.3	0.23	0.28
1.6	0.23	0.38
1.9	0.22	0.71
2.2	0.22	0.62
2.5	0.22	0.58
2.8	0.22	0.61
3.1	0.22	0.58
3.4	0.22	0.43
3.7	0.25	0.41
4.0	0.25	0.58
4.3	0.24	0.09
4.6	0.24	0.08
5.0	0	0

H_a = 0.23
H_d = 0.08
@ 1232
Stop

WCH
010317

Rite in the Rain

0	d	v
0.3	0.19	0.79
0.6	0.18	0.68
0.9		
1.2		
1.5		
1.8		
2.1		
2.4		
2.7		

Hq = 0.23
Hd = 0.08
@ 1235

Marsh acting up
velocities jumping around +
going negative
- Lost connection

Restart	Mid @ Neck	
0.2	0.19	0.58
0.5	0.18	0.66
0.8	0.18	0.72
1.1	0.18	0.71
1.4	0.18	0.67
1.7	0.18	0.68
2.0	0.19	0.65
2.3		0.62
2.6		0.62
2.8		0.61
0	0	0

Hq = 0.23
Hd = 0.08
1315

10/20/2016 Potts
Calm slight breeze, Cool, Cloudy
Arrive 10' flume - GH=0.19 @ 1017
* too shallow for flow Measurement
SW-01 = 3.98 @ 1024
Download & Restart logger
- Flowtracker DS of Culvert
- Got pretty windy during Measurements
- Marsh same location

Width	depth	vel
LEW	0	0
1	0.4	-0.07
2	0.5	0.06
2.5	0.55	0.66
3.0	0.5	1.0
3.5	0.55	0.87
4.0	0.6	0.88
4.5	0.55	0.98
5.0	0.6	0.97
5.5	0.52	0.94
6.0	0.5	0.93
6.5	0.48	0.90
7.0	0.45	0.99
7.5	0.4	0.88
8.0	0.39	0.98
9.0	0.38	0.70
10.0	0.35	0.58
11.0	0.27	0.49

10/20/2016 continued

Download culverts & Replace batteries

R4 - Note "Velocity data filtered Turbulent or Low flow detected"

SW-2 = 4.69 @ 1207

Download & Restart

- Install Combination Lock on Sontek Battery box - 23-33-39
- Leave extra well key inside toolbox
- PZ-3 = 2.98 @ 1233

Download & Restart logger

- PZ-1 = 3.29 @ 1241

Download & Restart logger

- PZ-5 = 3.69 @ 1248
- MDJ - South = 4.33 @ 1256
- MDJ - North = 4.74 @ 1305
- PZ-4 = 2.43 @ 1308
- PZ-6 = 2.37 @ 1315

Replace F30 with Refurbished F5

Serial NO: 2056286

- PZ-2 = 2.64 @ 1324

* Could not connect

Replaced with LIC from PZ-6

- Flume SW = 4.36 @ 1342

Download & Restart logger & Baro

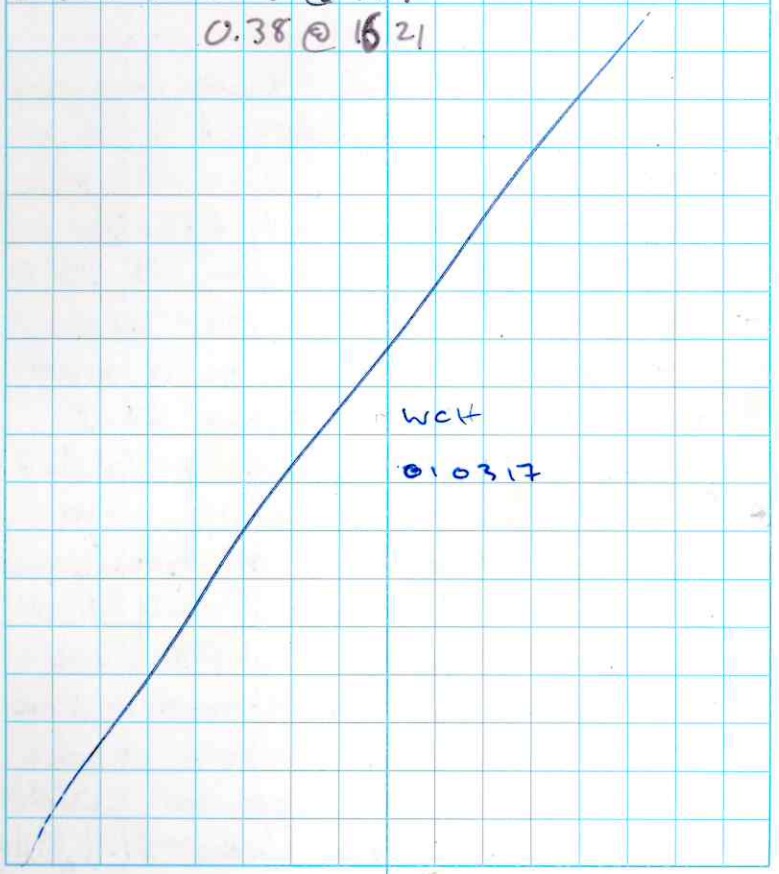
- Flume height = 0.40 * Meaningless because Flow is going around/under flume

After 10/20/2016 cont.inued

- Made Flowtracker measurement about 30 ft downstream of parshall
- Made flow measurement at approx new location of parshall
- Flow Tracker Mount at 3' flume

3' Flume = 0.36 @ 1550

0.38 @ 1621



Rite in the Rain

10/26/2016 Wednesday - Patt
arrive @ Parshall Flume @ 0915
- Rick & Donald - R.E. Miller
arrive @ 0920
- Remove all-thread nuts & pull sheet metal & Fence Posts
- Use track hoe to lift flume out
- Remove all threads
* will allow until next site visit for ditch to naturally grade out
- Move to new location
- Discuss temporarily damming & Flooding the field - Brian Smith said OK @ 11:00
- Rick dammed up the ditch at around 12:00
* This ditch is much wider than it needs to be - gives the illusion of more flow
- Looks like sediments beneath the ditch bed are moist, but not wet or saturated
- Excavation not filling in with groundwater
1400 - Over 2 hr have elapsed & the ditch upstream of the dam is still filling with no "flood irrigation" yet = not much flow
1525 - still no overflow upstream of dam
- Download & Restart logger for 1530
1548 - flow begins through Flume - still filling back
GH = 0.78' @ 1630

11/10/16 (mp) Thursday
Calm, Clear, cold
0829 - 10' Flume Staff Gage = 0.17'
Note - Waste gate at SW-01 wide open
- Only very small trickle going under headgate
0844 - PZ-103 DTW = 1.52'
Download logger - Could not Connect wrong connection cable for logger or Direct-Read
- SonTek IQ pipes
Connect to RS - Set to standard time at 0910
Download data - Reset to log 5 min
Start at 0916
- Left - Reset clock at 0917
Download data & Reset to 5 min
Start at 0922
Discharge Measurement @ 50' DS
start →
Soup → 0854
Flow 1.79 cfs
Take Velocity & Depth Msmts in both culverts upstream & Downstream center
* Named backwards (i.e., RT & LFT looking US)
IQ Named looking DS

Download IQ 5-min data, reset to 15 min & Restart

1028-WSO SW-03 - DTW: 3.78

Discharge Msmt ≈ 10 ft DS of SW-03

Start

Stop

Flow = 1.29 cfs

Parshall - GH: 0.71 @ 1117 = 1.2 cfs

Discharge Msmt

Note- Tried to do downstream in channel but flow too shallow in very soft silty streambed - too difficult to accurately measure depth & set correct height at 0.6.

Measured in Flume at Staff gage

Flow = 1.23 cfs

GH: 0.71 @ 1224 = 1.2 cfs

-3 Cutthroat GH: 0.35 @ 1235

US Flow = 1.17

DS Flow = 1.33

GH: 0.36 @ 1337

12-08-16 Thurs Potts

Cold, Clear, Calm * Very Cold

Arrive at Sonteks @ 0810

Do Beam Check

Download data

Restart on 5-min for Test

Download data

Clean both Sonteks

Right - Covered in sticks, Rocks, & Sediment Cleared & Brushed clean with nylon brush - Depth: 0.38 ft

Left - Covered in light film of fine sediment - Brushed clean Depth = 0.45 ft

Left - DS = 0.44 US = 0.43

Right - DS = 0.50 US = 0.74

Swap Batteries - MOT #1 for Right old

* MOT #2 - Not working in left so put old battery back in

Move to Parshall

GH = 0.75 @ 1035 = 1.31 cfs

* Dead Muskrat in stilling well - chewed through cable holding Transducer

Removed Muskrat & fished Transducer out

download & Restart at 1100

GH @ 1057 = 0.75 - 1.31 cfs

Rite in the Rain

* Download Baro to Comp Parshall data
3-FT GH=0.324 @ 1115
Scrape bottom of flume
Approx 0.1 ft of Scaling & Sediment
GH = 0.34
D.I charge Msmt = (MP)
GH = 0.34 @ 1206
Check level approx 1.2° low Left - Right
approx 1.0° Low Font to back
upstream Left side (west side) is low point
Done (MP)
Go back to culverts & take discharge measurements
Right = 0.99 cfs
Left = 0.82 cfs
Download Sontek's
Download Baro
Return to 3-ft GH = 0.30 @ 1322

WCH
010317

1/10/2016 PoHT Calm, Cloudy, Cold
10-ft flume = 0.16 @ 0918

SW-01 = 4.30 @ 0925
Download & Restart logger
* Waste Gate wide open
Stake PZ 13, 11, & 12
DTW @ MDT-South = 4.10 @ 1018
Stake PZ-14, 10, 9
DTW @ MDT-North = 4.54 @ 1038
Stake PZ-07
PZ-04 - DTW = 2.13 @ 1048
Download & Restart
PZ06 - Frozen - DT ICE = 1.97 @ 1058
Could not download
PZ-02 - DTW = 2.42 @ 1105
Download & Restart
PZ-03 - DTW = 2.73 @ 1112
Download & Restart
SW-03 - DTW = 3.74 @ 1119
Download logger & BARO & Restart
PZ-01 - DTW = 3.09 @ 1129
Download & Restart
PZ-05 - DTW = 3.54 @ 1139
Download & Restart

Rite in the Rain

Insert New coordinates for PZ-08
and state that location

SW-02 - OTW = 4.82 @ 1207
Download & Restart

Coop Culv L7 - Download & Replace battery

Coop Culv R7 - Download & Replace battery

Parshall - GH = 0.78 @ 1145 = 1.39 cfs
Download logger & Restart

Cutthroat = GH = 0.32 @ 1305 = 1.82 cfs
Level adjust to 1.63 cfs

Start flowtracker Measurement
Suddenly wind is gusting hard from south
GH going up
GH = 0.38 @ 1325
Cancel Measurement

Stop by Smiths to inform about Geoprobe work next week
- Mrs. Smith very adamant that she does not want the Road out in the field
- Chad said to call Tom Miller

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CONTENTS

PAGE	REFERENCE	DATE

MDT NICK JAYNES CELL 565-0317

LAND OWNER SHERRY SMITH 684-5836

SONTEK BOX COMBO 23-33-39

WELL KEY # 3212

MDT STONE CRK N PHASE 3

1-17-17 TUESDAY

1030] STEWART SMITH + LANCE SORENSON AT HAY STACK FOR STONE CRK GEO PROBE PIEZOMETER INSTALLATION; ~ 20°, WIND 0-5 MPH, CLEAR; SMITH TALKED TO BRIAN SMITH AT RANCH HOUSE BEFORE COMING TO FIELD SITE; HE WAS EXPECTING US; THERE ARE BULLS AND 2 RAMS IN THIS FIELD 1045] LOOK AT LOCALE FOR PZ-13 (SOUTH MOST); WE WILL START THERE TO BE SURE PROBE IS WORKING WELL; GEOPROBE 66DT 1055] MOVE PROBE OUT OF TRAILER 1105] LANCE DOING MAINT. CHECK ON HYDRAULIC LINES; HE WILL ADD SOME HYD. OIL TO TANK; GROUND IS SNOW COVERED WITH 4-6" ON FLAT GROUND; MORE IN DRIFTS 1130] CHECK HYDRAULICS MORE AFTER ADDING OIL 1215] CONDUCT SAFETY BRIEFING; ~ 25°, WIND 5 MPH 1242] PHOTO OF PZ-13 SITE; STANDING H_2O JUST BE LOW SNOW 1255] WE WILL DRIVE 0-3' ON FIRST RUN - SEE HOW IT GOES; MDT WANTS BAGGED SAMPLES FOR 0-15' 1256] START DRIVING AT PZ-13

Rite in the Rain

MOT STONE CRK N

1-17-17 TUES PZ-13 SMITH

TUBE 0-3' 1.8' RECOVERY

0-3' SNOW 0-0.25' FROZEN

PREDOMINANLY CLAY, MOIST, BLACK TO DK. GRAY, SOFT TO MOD. FIRM

FROZEN PART IS DK RED-BROWN W/ ROOTS + GRASS; BLACK CLAY - SLIGHT SULFUR ODOR

1315] TUBE UP 3'-7'; LANCE HIT GRAVEL AT 4.5'; 1.7'/4' RECOVERED; WHOLE TUBE SATURATED/WET

3-4.5' SILTY CLAY, WET, DK GRAY; SULF SMELL; FINE VERTICAL ROOTS AND STRAW

1325] TUBE UP FROM 7'-11' (1.5' RECOVERY)

4.5-7.0' WELL GRADED GRAVEL (GW) W/ SAND; WET; DARK GRAY DOWN TO RED-BROWN; GRV IS SUB ROUNDED, UP TO 1.5" DIAM; SAND IS FINE → (0.9' RECOVERY)

1350] TUBE 11-15' OUT; WAS OVER DRIVEN 8"; HARD TO GET OUT, BUT DID

15'7" TD INSIDE 3" TUBES

INSTALL 1½" PVC; PRE-PACK SCREEN

5' SCRN LENGTH; BOTTOM CAP IS 4"

1400] ~30°, WIND 5 MPH; 15' OF BLANK PVC; PULL 3" RODS 1420] TOP OF SLOUGH AT 5' BGS; NO FILTER SAND USED; CUT OF 2' PLUS FEMALE THREADS FROM PVC STICK-UP. CREW O.K W/ COLD WEATHER

1-17-17 PZ-13/-14 SMITH

1430] ADD GRAN. BENTONITE TO SURFACE

1445] PHOTOS OF PZ-13 W/ SURFACE PROTECTOR

THEN ADD ½ BAG PLAYSAND INSIDE 4", PROBE LEAVES PZ-13 SITE.

1525] START PROBING AT PZ-14, CLOSE TO HWY 41S; CLEAR, CALM, 30°

1530] TUBE 0-3' 1.9' RECOVERY

0-8" FROZEN, DK BROWN, ROOTS AND GRASS

8" (0.8') (0.67') ORGANIC SOIL W/ SILT, MOIST TO WET; BLACK; ROOTS; MAN/ VERTICAL

1540] TUBE 3-7' UP; 2.8' RECOVERY

1547] TUBE 7'-11' UP; TOP OF GRAVEL NOT FAR BELOW 7'

PZ-14 3'-4.5' ORGANIC SOIL W/ SILT, WET BLACK; MM SIZE WHITE SHELLS - TOP 1' FINE ROOTS, SOFT

4.5-7' CLAY, WET, GRAY, SOFT, FINE ROOTS

1555] TUBE UP 11-15.5', ~0.7' RECOVERY WILL BUILD WELL NOW

1600] 15'5" TD INSIDE 3" TUBE, CUT OFF 2' FROM PVC

1615] SUN BEHIND BURHD ROCK; TOP OF SLOUGH 9.2' 1619] TOP OF 10-20 7' 9"; ADD BENT CRUMBLES SURFACE

Rite in the Rain

MDT STONE CRK N

1-17-17 TUES SMITH

1625] CUT OFF ANOTHER 10" OF PVC; STRING HAD COME UP; INSTALL COVER

1645] PROBE + PICK-UP LV PZ-14

1705] SIGN OUT ON JRA; ~25° CLEAR; <5 MPH 1720] BOTH VEHICLES LEAVE FIELD; LANCE HAS PROBE + TRAILER

Mark Smith 1-17-17

1-18-17 WED

0745] SMITH AT HAYSTACK; LANCE IS HERE W/ PROBE WARMING; ~30°, 5-10MPH WIND; CLOUDY; WE DISCUSS CONDITIONS AND SIGN CHECK-IN; LITTLE CHANGE FROM YESTERDAY 0820] SMITH LOCATES PZ-7; NORTH-MOST POINT FOR OUR WORK; 2 RAMS ARE IN AREA

0855] PROBING PZ-7

0904] TUBE 3'-7' UP; GOT HARDER AT 5.5'; TUBE 0-3' ALREADY UP

0914] TUBE 7'-11' UP; NO LOGGING SO FAR

0924] TUBE 11-15.5' UP; MOSTLY SAND, SATURATED

0930] 15'8" TD BGS INSIDE 3" RODS

INSTALL 20'4" CASING + SCRN STRING

0950] TOP OF SLOUGH 6.3' BGS; BENTONITE TO SURFACE; INSTALL STEEL PROTECTOR

1-18-17 WED PZ-7 SMITH

1010] PIEZO IS INSTALLED

11-15.5' 1.4' RECOVERY

7'-11' 2.1' "

3'-7' 2.5' "

0-3' 3.0' "

TUBES TAPED TO LOG LATER

WIND ~10 MPH; MOSTLY CLOUDY 30°

1030] START PROBING AT PZ-8

1035] TUBE 0-3' UP, 2.3' RECOVERED

GEN DESCRIPT. SILTY CLAY MIX, LT BROWN TO TAN ~1.7-2.0 SOFT CLAY, TAN, WET 2.0-3.0' ORGANIC SOIL W/ CLAY, BLACK, MOIST

1045] TUBE 3-7' UP; GRAVEL OR HARD AT 6.0'; 2.6' RECOVERY

1053] TUBE 7'-11' UP; 1.5' RECOVERY MOSTLY SAND, SATURA.; LANCE SAYS ALL DROVE THE SAME

1059] TUBE 11-15.5' UP; 1.0' RECOVERY LANCE SAYS SORT OF LOOSE-LIKE PEA GRAV

WIND CALM

1106] 15'7" TD PZ-8 INSIDE 3" ROD

INSTALL PVC STRING

1130] BOT OF PVC INSIDE IS 15'3" BGS TOP OF SLOUGH AT 7.2' BGS- ADD NO SAND; ADD BENT TO SURFACE

1-18-17 PZ-8 / -9 SMITH

1150] PROBE LVS PZ-8 NOTE: 0.6" AT PZ-8 WAS FROZEN

1210] PROBE SET UP AT PZ-9, ABOUT TO DRILL 35°, CLOUDY, 5-10 MPH WIND; CREW OK

1215] TUBE 0-3' UP; 2.6' RECOVERY FROZEN TO ~16"

1.8'-2.2' CLAY, GRAY MOIST
2.2-3' SILTY CLAY BLACK & BROWN

1228] TUBE 3-7' UP; 2.5' RECOVERY GOT HARD ~4.5'

1235] TUBE 7'-11' UP, 1.3' RECOVERY, MOSTLY SAND - SATURATED

1243] TUBE 11'-15.5' UP, 1.0' RECOVERY NOTE: MALE THREAD ON BOTTOM OF SCRN FOR PZ-9 IS CHIPPED - PARTLY BROKEN - WE WILL USE AS IS; ALSO - LAST TUBE - LANCE ONLY DROVE TO 15.2' DUE TO VERY HARD GROUND. 1250] 15'4" TO PZ-9 INSIDE 3" TUBE / ROD.

1305] PVC CAME UP W/ RODS - IT SEEMS EXPENDABLE TIP DID NOT COME OFF; REMOVE PVC AND RE-DRIVE RODS TO ~15' +

1325] PVC BACK IN RODS, IT WAS GNAWED UP IN RODS 1340] TOP OF SLOUGH - 6.2' BGS, ADD NO SAND; ADD BENTONITE TO SURFACE 1400] DONE AT PZ-9

1-18-17 WED PZ-10 SMITH

1420] AFTER SHORT LUNCH BRK; SET UP AT PZ-10 1425] NICK JAYNES, MDT HERE PART. CLDY, WIND 5°, 35°

1438] TUBE 0-3' UP; 2.7' RECOVERY

1455] NICK ABOUT TO LEAVE; LANCE SAYS TUBE FOR 3-7' IS STUCK 1500] PULLING 3' RODS OUT OF PZ-10; WILL START OVER; NJ GONE FROM PZ-10

1509] RETRIEVED SAMPLE TUBE 3-7'; 2.0' RECOVERY 3-5' - SAND (SP) POORLY GRADED, WET/SATUR, DK. GRAY, SAND IS FINE; SULFUR ODOR, A FEW ROOTS

1535] AT GEOPROBE TRLR TO LOOK FOR PARTS 1620] BACK AT PZ-10, WILL TRY TO SAMPLE W/OUT AN EXPEND. SHOE, THEN INSTALL WELL ON A 2ND RUN 1645] SMITH DECIDES TO BAG IT FOR THE DAY; AT PZ-10 THERE IS HEAVING SAND AT 7' OR SHALLOWER; SAND KEEPS COMING UP INTO 3" ROD AND WE CAN NOT GET SAMPLE TUBE TO 7' TO GO DEEP

1700] AT GEOPROBE TRLR; LANCE WILL LV TRLR W/ " ONSITE TONIGHT

1730] SIGN OUT 1740] BOTH OFFSITE

Steven Smith 1-18-17

Rite in the Rain

MDT STONE CRK N

1-19-17 THURS PZ-10 SMITH

0840] SMITH AT HAYSTACK; LANCE HERE W/ RIG WARMING IN TRLR, 30°, CLOUDY, 5MPH 0855] BACK RIG OUT OF TRAILER, LANCE DOES MAINT. CHECK OF GEOPROBE. HE WAS NOT ABLE TO SEPARATE CUTTING SHOE FROM HOLDER. 0930] RIG IS SETTING UP AT PZ-10; WE WILL NOT SAMPLE ANYMORE, WE WILL DRIVE DOWN TO 15' W/ A SOLID EXPENDABLE TIP AND INSTALL A PIEZOMETER 0943] START DRIVING AT PZ-10; LEAD ROD IS 5' LONG (3"); OTHER RODS WILL BE 4'; NEW HOLE IS 2 FT N. OF YESTERDAY'S PROBE HOLE 0953] LANCE TAGGED TOP OF GRAVEL AT 10.0' BASED ON DRILLING CHANGE; ABOUT 6" OF SOFT MATERIAL ABOVE GRAVEL 0958] TD AT PZ-10 INSIDE 3" ROD = 15'5" BGS TIP STILL IN. 1010] CUT = 2.5' OFF PVC 1015] TOP OF SLOUGH 5.3' BGS; NO SAND ADDED; BENT. CRUMBLES TO SURFACE 1020] INSTALL STEEL PROTECTOR, 1ST HOLE WAS OPEN TO 21" = ABANDON W/ 3/8" BENT CHIPS 1030] PROBE LUS PZ-10

1042] START PROBING AT PZ-12; WE WILL COLLECT 0-3' USING A 4FT 3" ROD; THEN NO MORE SAMPLES HERE; WILL REVERT TO SOLID EXPEND. POINT

1-19-17 THURS PZ-12 SMITH

1045] 0-3' TUBE UP; LANCE SAYS ~1 FT OF ICE; SITE IS MARSHY; PHOTO AT 1048 0-3', 1.2' RECOVERY, ALL FROZEN SILT OR CLAY, DK. BROWN W/ ROOTS AND GRASS ALL RECOVERED SOIL WENT INTO BAGS 1101] START DRIVING SOLID POINT AT PZ-12 LANCE SAYS TOP OF GRAVEL AT 6.5'; THEN HARDER AGAIN AT 9.5' 1106] LANCE DECIDED TOP OF GRAVEL AT 9.5' IT WAS LIKELY SAND AT 6.5' 1115] PVC STRING IS IN THE HOLE; HOLE WAS PROBED TO 15.5' BGS; CUT OFF 20" OF PVC 1125] TOP OF SLOUGH 7.1' BGS; ADD NO SAND; ADD BENTONITE TO SURFACE

PZ-11

1150] SETTING UP AT PZ-11, THE LAST SITE FOR THIS TASK, SITE IS ON EAST SIDE OF OXBOW/SLOUGH FROM PZ-12; OVERCAST, 5MPH; 35°; WILL ONLY SAMPLE 0-3' AS AT PZ-12 1200] LANCE HAMMERED THRU 10" OF ICE BEFORE INSERTING SAMPLE TUBE 1205] 0-3' TUBE UP; 2.2' RECOVERY LAST INCH OR SO IS GRAVEL VERY FINE SAND AT 16" 0-8" IS MOIST NOT FROZEN; 8"-16" ARE WET

MDT STONE CRK N

1-19-17 PZ-11 SMITH

1212] DRIVING AT 3' W/ SOLID POINT
1220] LANCE SAYS 13'-14' WAS SOFT, THEN REALLY HARD AT 14' 1230] PVC STRING IN HOLE; CUT OFF 18"; HOLE DRIVEN TO 15.5' BELOW ICE 1235] ALL READS OUT; TOP OF SLOUGH AT ~7' BELOW TOP OF ICE - HARD TO FEEL; ADD 10-20 MESH SAND TO 3.5' BELOW TOP OF ICE; BENT CRIMPLES TO SURFACE
1244] PLACE STEEL PROTECTOR; ADD PLAY SAND; LT. SNOW STARTING
1300] BACK AT TRLR TO LOAD UP GEOPROBE ALL 8 PIEZOS ARE INSTALLED
1315] LANCE SIGNS OUT AND HEADS TO BUTTE W/ GEOPROBE; I WILL STAY TO MEASURE SOME WATER LEVELS; SKIP A PAGE TO SEE DATA. 1450] DONE MEASURING WAT. LEVELS; CHECK OUT ON SAFETY SHEET SNOW STOPPED AT ~1400; 1455] LV FIELD, TRY TO STOP AT SMITH'S RANCH HOUSE TO NOTIFY WE ARE DONE.

Steve Smith 1-19-17

BOTTOM CAP 0.35' LONG

2/1/2017 Potts/Stratton

Super cold, very windy, cloudy

PZ1 DTW = 3.05 @ 1041
PZ3 - DTW = 2.71 @ 1043
SW03 - DTW = 3.76 @ 1045
PZ2 - DTW = ICE 2.30 @ 1051
PZ6 - DTW = ICE 1.97 @ 1055
PZ4 - DTW = ICE 1.95 @ 1058
PZ7 - DTW = 3.24 @ 1104
MDT-N - DTW = 4.46 @ 1116
PZ10 - DTW = 2.78 ICE @ 1310
* Note steel cap was open probably by wind
PZ9 - DTW = 4.43 @ 1312
PZ8 - DTW = 5.06 @ 1316
PZ14 - DTW = ICE 2.30 @ 1320
PZ12 - DTW = ICE 2.26 @ 1324
PZ11 - DTW = 3.36 @ 1326
MDT-S - DTW = 4.05 @ 1329
PZ13 - DTW = 2.97 @ 1406
* Note steel cap open - cow home inside
PZ5 - DTW = 3.58 @ 1413
6" - Parshall = 0.75 @ 1418 = 1.31
3' - Cut throat 0.35 @ 1427 = 2.10
Flow Tracker = 1.24
3" - Cut = 0.35 @ 1458 = 2.10

MDT STONE CRK N — S. SMITH
1-19-17 THURS MEASURE 8 NEW PIEZOS

TIME	PZ #	DTW FT TOP OF PVC	DTB TOP OF PVC	PVC STICK-UP AGS
1338	PZ-7	3.30	18.32 ← SOFT	3.0'
1348	PZ-8	5.11	18.20 HARD BOTTOM	2.9
1355	PZ-9	4.57	17.40 HARD	2-3
1410	PZ-10	2.98	17.62 SOFT	2.9
1433	PZ-11	3.45	18.57 HARD	3.0
1425	PZ-12	2.46	18.50 HARD	2.9
1445	PZ-13	2.99	18.00 HARD	2.9
1417	PZ-14	2.43	17.50 HARD	2.9

020717
WCH

2/13/2017 Potts
Calm, clear, Cold
Arrive at PZ-13, some water took thermal pic
PZ-13 DTW = 2.86 @ 0918
Install Transducer 01020 65991
walked to culvert - frozen dry
Southeast blue springs pond water very cold
No surface springs
PZ-11 DTW = 3.25 @ 0943
Transducer - 65964
Area east of MDT S - standing water
took some pictures
- Broke through ice while walking
- water felt lukewarm
- Much warmer than area near blue springs
MDT-S DTW = 3.94 @ 0959
PZ12 DTW = ICE 2.04 @ 1002
PZ14 DTW = ICE 2.27 @ 1005
PZ16 DTW = ICE 2.81 @ 1011
PZ09 DTW = 3.99 @ 1014
Transducer -
PZ08 DTW = 4.90 @ 1024
Transducer - 65998
MDT-123 DTW = 4.14 @ 1036

PZ07 DTW: 2.97 @ 1038

Transducer ~ 65995

PZ04 DTW: ICE 1.69 @ 1050

PZ06 DTW: ICE 2.00 @ 1052

PZ02 DTW: ICE 2.20 @ 1055

PZ03 DTW: 2.57

Download data & Restart

SW03 DTW: 3.71 @ 1104

Download data & Baro & Restart

PZ01 DTW: 2.96 @ 1115

Download & Restart

PZ05 DTW: 3.50 @ 1125 68°F

Download & Restart

PZ08 4.90 @ 1130 58°F

PZ07 2.97 @ 1135 52°F

PZ09 3.91 @ 1140 44°F

PZ11 3.25 @ 1147 56°F

PZ13 2.85 @ 1201 66°F

MDT-126-S 58°F

Parshall - 6" GH: 0.78 @ 1326 1.39 cfs

Cut-throat - 3' GH = 0.35 @ 1343 2.10 cfs

- Note: algae buildup & Sediment in flume

- Scrape sediment & algae & take FT measurement *

GH = 0.36 @ 1425 2.19 cfs

Download Sontek

- Left Sontek ok - downloaded & Restarted after Replacing battery

- Right - could not connect

Replaced battery - still could not connect

Examined cables - Look ok in box

Metal conduit broken at culvert outlet

Cable looks ok there but must be damaged somewhere

2/15/2017 Potts

Calm, clear, Cool

Arrive at Culverts 0835

prepare propane torch & drill

Alert Bill Henne that I am entering culvert

Torch spiders, drill pop-rivets, Remove Right Sontek & cable.

- Cable was broken & detached from Sontek
- Reset Left Sontek with Beta Software & upgraded firmware & take a few recordings.
- Appears to be correctly measuring flow now.
- Move to MDT-128 piezo
  - Install Transducer temporarily, while others are frozen
- PZ13 - Pull existing transducer
  - Install deep transducer at approx 17 ft - MP
  - Re-install Existing at 12 ft Below MP
  - Install transducer at 5 ft below MP

Depart site 1100

MP

3/13/2017 Potts

Windy, Overcast, Cool

Arrive at SW-01 @ 1010

DTW = 4.30 @ 1016

Download & Restart

PZ-13 - DTW = 3.00 @ 1030

Shallow 5ft = 51.8 °F

Med 12ft = 65.1 °F

Deep 17ft = 67.5 °F

Download all & Remove shallow/Deep Restart Med

MDT-128 - DTW = 4.10 @ 1043

Download & Restart

PZ12 - DTW = 2.46 @ 1047

Note: stickup approx 2.8 ft = artesian?

Install logger at approx 12 ft from MP

PZ-11 - DTW = 3.42 @ 1058

Download & Restart

PZ-10 - DTW = 2.82 @ 1107

Installer at approx 12 ft below MP

PZ-14 - DTW = 2.46 @ 1115

Note: stickup approx 2.95 = artesian?

PZ5 - DTW = 3.54 @ 1124

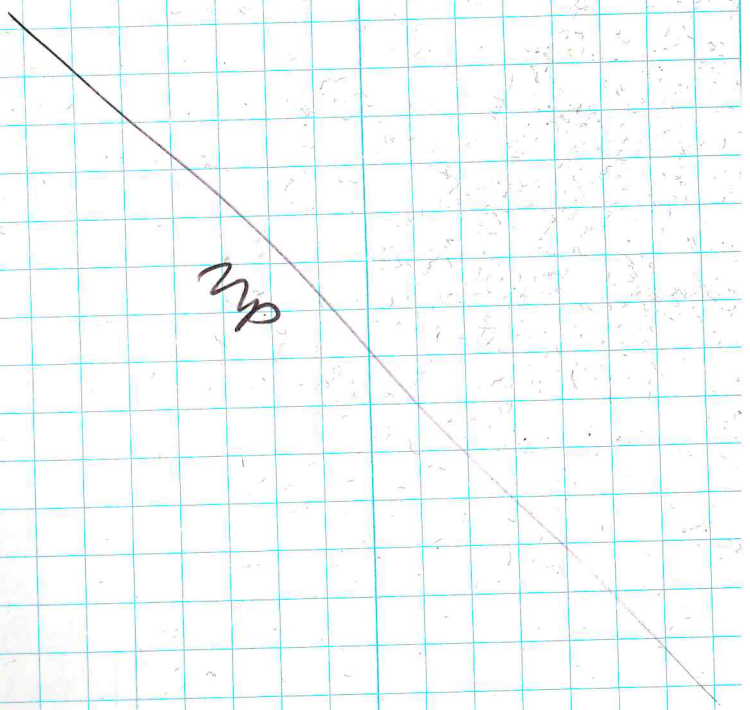
Download & Restart

PZ8 - DTW = 4.94 @ 1130

Download & Restart

MDT-123 - DTW = 4.20 @ 1136
Install Transducer approx 12ft below MP
PZ7 - DTW = 3.07 @ 1143
Download & Restart
PZ4 - DTW = 1.92 @ 1149
Download & Restart
PZ6 - DTW = 1.94 @ 1155
Download & Restart
PZ2 - DTW = 2.43 @ 1203
Download & ~~Restart~~ Swap Transducer
PZ-02 had an LTC - Replaced with a new edge - unable to connect to LTC
PZ3 - DTW = 2.64 @ 1211
Download & Restart
SW03 - DTW = 3.71 @ 1216
Download logger & BARO & Restart
PZ1 - DTW = 5.00 @ 1226
Download & Restart
PZ4 - DTW = 4.04 @ 1239
Download & Restart
SW02 - DTW = 4.75 @ 1315
Download & Restart

Connect to Left Sontek - download & Restart
Note: Had trouble connecting but was ultimately able to connect
Exported Configuration for Right
Could not install Right Sontek - Mounting Brac
6th Parshall - DTW = 0.79 @ 1354
Download & Restart
Depart Site



Rite in the Rain

3/20/2017 Potos
Cold, breezy, light snow
- Install Right Sontek
- Inspect Battery box, feed cable through
- Clean culvert of spiders & debris
- Install Sontek at exact same location using original holes
- Run cable over the side of culvert & behind stilling well then over Left culvert to protect from Cows
- Start Sontek
- Clean other Sontek
- Take Discharge measurements
Right Q = 0.95 Sontek = 0.93
Left Q = 0.76 Sontek = 0.86
- Download data & depart site.

WCH
032117

4/25/2017 Tuesday
light Breeze, cloudy, cool
Arrive at PZ-5 @ 0923
DTW = 3.37 @ 0924
Deploy stratified Transducers at following Depth
PZ-5-deep - 15 ft below MP
PZ5 - 10 ft below MP
PZ5-shallow - 5 ft below MP
Note: TD ≈ 16 ft

10ft Flume GH=0.73@ 0945 =25.8 cfs
NOTE: Significant algal buildup on flume floor
SW-01 DTW = 3.25 @ 0952
Download & Restart logger
NOTE: waste gate mostly shut, vapor still getting through
SW-02 DTW = 4.04 @ 1009
Download & Restart
Connect & Download Right SonTek
Tried various options to connect to Left SonTek - NO luck
Replace Both batteries - still no luck
Took Flow tracker Measurements at downstream end of each culvert

Rite in the Rain

Right = 12.5 cfs = 22.5 cfs
Left = 10 cfs
Move to SW-05 & Take flow Msmt
approx 3 ft upstream = 1.2 cfs
Go to Parshall - partially blocked by sticks & also significant algae buildup
Removed sticks & scraped algae
Download Transducer & Restart
GH = 0.80 @ 1335 - No change = 1.45 cfs
Note: Culvert from Co-op flowing
3ft Cut = 0.69 @ 1340 = 6.04 cfs

-Check Culvert SE of PZ13 - Flowing with a small trickle of water
PZ13 - DTW = 3.03 @ 1353
Download data & Restart
PZ11 - DTW = 3.53 @ 1359
Down load & Restart
MDT-128 - DTW = 4.15 @ 1407
Pownload & Restart
PZ12 - Could not open - looks to be damaged by cows or freeze-thaw & is frost-jacked up into the casing
Note: Groundwater is upwelling to surface around casing & Artesian flow

PZ10 - DTW = 3.01 @ 1423
Download & Restart
PZ9 - DTW = 4.22 @ 1428
Download & Restart
MDT-123 - DTW = 4.24 @ 1435
Download & Restart
PZ7 - DTW = 3.09 @ 1440
Download & Restart
PZ4 - DTW = 1.92 @ 1446
Download & Restart
PZ6 - DTW = 1.96 @ 1452
Download & Restart
PZ2 - DTW = 2.27 @ 1459
Download & Restart
PZ3 - DTW = 2.57 @ 1506
Download & Restart
SW-03 - DTW = 3.74 @ 1511
Download & Restart
Download & Restart BARO
PZ1 - DTW = 2.92 @ 1520
Download & Restart
PZ8 - DTW = 4.88 @ 1525
Download & Restart
Move to PZ5 ↓

PZ5 - DTW = 3.40 @ 1530

Deep = 72.2

Med = 67.82

shallow = 60.44 15.8°C

PZ14 - DTW = 2.26 @ 1541

Download & Restart

Note: GW in pizzo is noticeably higher than ground surface - Picture

WCH

060917

5/19/2017

Calm, Clear, Cool

Arrive at site @ 0800

PZ-3 - DTW = 2.45 @ 0809

PZ-3 = 9.5 ft below MP

TD = 16.9 ft

PZ3 - Deep = 16.5 ft below MP

PZ3 - Shallow = 5.7 ft below MP

Culverts

- Download & Restart both IO - Piper

Flow Tracker

- Left culv - Start 0851, STOP 0912

Flow = 1.57 cfs

- Right culv - Start 0914, Stop 0932

Flow = 1.83 cfs

Download both SonTeks

SW-02 - DTW = 4.64 @ 0937

Download & Restart loger

10' Flume - GH = 0.16 @ 0948 = N/A

SW-01 - DTW = 4.04 @ 0953

Download & Restart

PZ-13 - DTW = 2.97 @ 1022

Download & Restart

Note: small amount of flow through SW Culvert. (Pictures)

PZ-11 - DTW = 3.47 @ 1029
Download & Restart

MDT-128 - DTW = 4.13 @ 1035
Download & Restart

PZ-12 - DTW = 2.60 @ 1043
Was able to lift steel casing to open well. Lid was resting on top of PVC holding up. Once open it slid back down even deeper - (Pic)
Download & Restart
Note: Left Casing lid open

PZ-10 DTW = 2.95 @ 1051
Download & Restart

PZ-9 DTW = 4.10 @ 1057
Download & Restart

PZ-7 DTW = 3.01 @ 1106
Download & Restart

MDT-123 DTW = 4.13 @ 1102
Download & Restart

PZ-4 DTW = 1.87 @ 1113
Download & Restart

PZ-6 DTW = 1.89 @ 1117
Download & Restart

PZ-2 DTW = 2.21 @ 1123
Download & Restart

PZ-1 - DTW = 2.88 @ 1129
Download & Restart

PZ-8 - DTW = 2.82 @ 1136
Download & Restart

PZ-5 - DTW = 3.43 @ 1141
Download & Restart

PZ-14 - DTW = 2.37 @ 1146
Download & Restart

SW-03 - DTW = 3.68 @ 1201
Download logger & Bare & Restore

PZ-3 - DTW = 2.46 @ 1212
Deep = 61.99 °F
Med = ~~56.66~~ 60.26 °F
Shallow = 56.66 °F

FlowTracker @ SW-01
Flow = 1.4 cfs

6" Parshall - GH = 0.8 @ 1306 = 1.45 cfs
Note: Algae buildup in flume - scraped as much as possible

Download logger - GH = 0.78 @ 1313 = 1.31 cfs

wcht
060917

6/29/2017 Potts

Arrive at Site 8:40

10' Flume - GH = 0.56 @ 0842 = 15.57 cfs

SW-01 - DTW = 3.53 @ 0849

Note: waste gate closed but water still flowing through gate

SW-02 - DTW = 4.23 @ 0911

Sontek R-10 - Connect & Download, restart

Sontek L-10 - Connect Download, Restart

Replaced Both Batteries

FlowTracker Right Culv = 7.5 cfs

Left Culv = 5.8 cfs

PZ-13 =	3.62	@ 1044
PZ-11 =	4.11	@ 1051
MDT-128 =	4.69	@ 1104
PZ-12 =	3.15	@ 1110
PZ-10 =	3.91	@ 1116
PZ-09 =	5.25	@ 1124
MDT-123 =	5.05	@ 1128
PZ-07 =	3.87	@ 1133
PZ-04 =	2.68	@ 1139
PZ-06 =	2.78	@ 1145
PZ-02 =	2.72	@ 1151
PZ-03 =	2.92	@ 1157
SW-03 =	3.72	@ 1202

PZ-01 = ~~NA~~ map 3.28 @ 1211

PZ-08 = 5.39 @ 1219

PZ-05 = 3.78 @ 1225

PZ-14 = 2.74 @ 1232

FlowTracker @ SW-03 = 1.39 @ 1300-1330

Parshall 6" GH = 0.74 @ 1336 = 1.28 cfs

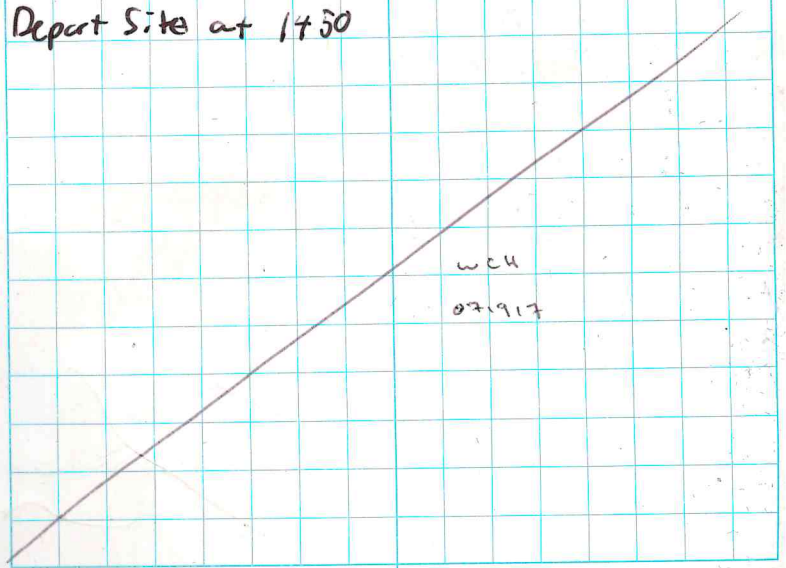
Scraped & cleaned off algae

Note: Flow from culvert under Hwy from Co-op to WSD

Attempted to measure with FlowTracker but could not find a good site

Discarded all msmt attempts

Depart Site at 1450



7/31/2017 Potts

Arrive at 10' Flume @ 0900

GH=0.84' @0906 = 29.79

SW-01 DTW = 3.02' @0916 Download/Restart

SW-02 DTW = 3.94' @0935 Download/Restart

Culv Left - Connect, stop, download, & Restart

Culv Right - Connect, stop, download, & Restart

Flow Msmts	Sontek
Right culv = 16.3 cfs	13.9
Left Culv = 13.9 cfs	13.8

PZ-13 - DTW = 3.67 @ 1125

Note: ~~Ditch~~ no Culvert SE is dry

PZ-11 - DTW = 4.24 @ 1134

MDT-128 DTW = 4.72 @ 1140

PZ-12 DTW = 3.25 @ 1145

PZ-10 DTW = 4.66 @ 1152

PZ-9 DTW = 5.32 @ 1159

MDT-123 DTW = 5.38 @ 1206

PZ-7 DTW = 4.15 @ 1211

PZ-4 DTW = 2.95 @ 1226

PZ-6 DTW = 3.00 @ 1231

PZ-2 DTW = 2.82 @ 1237

PZ-3 DTW = 3.06 @ 1249

SW-03 - 3.65 @ 1258

PZ-01 - 3.36 @ 1313

PZ-[illegible] - 5.59 @ 1320

PZ05 - 3.70 @ 1326

PZ-14 - 2.58 @ 1332

Parshall 6" - GH = 0.81 @ 1347 = 1.48 cfs

1400 Depart Site

mp

08/17/2017 Thursday Potts
Calm, Clear/Smoky, Warm - Maintenance
. GH Flume 10" = 0.5 @ 1346 = 12.99 cfs
waste gate partially open
Coop Culv -R- connect battery #1
voltage > 11.36
Stop data collection & Download
Replace with Battery #2
Connect & Restart Logging

Coop Culv -L- Connect battery #3
Voltage = 10.52
Stop data collection & download
Replace with Battery #4

Parshall 6" GH = 0.78 @ 1419 = 1.39 cfs

Culvert under Hwy 41 - Flowing
Depot site

mp

8/29/2017 - Potts Tuesday
Calm, smoky & cloudy, warm
Arrive at 10" Flume at 0850
0853 - GH @ 10" Flume = 0.67 = 20.75 cfs

0859 - SW-01 DTW = 3.26
waste gate closed, but water still flowing through

PZ-13 - DTW = 3.70 @ 0920
Note SE culvert is dry (picture)
PZ-11 - DTW = 4.25 @ 0928
Note PZ-11 very wobbly, coir hair inside, very difficult to open, cannot close
MDT-128 - DTW = 4.73 @ 0935
PZ-12 - DTW = 3.23 @ 0943
PZ-10 - DTW = 4.05 @ 0950
PZ-09 - DTW = 5.31 @ 0955
MDT-123 - DTW = 5.40 @ 1001
PZ-07 - DTW = 4.17 @ 1006
PZ-04 - DTW = 2.97 @ 1012
PZ-06 - DTW = 3.00 @ 1024
PZ-02 - DTW = 2.91 @ 1032
PZ-03 - DTW = 3.10 @ 1038
SW-03 - DTW = 3.65 @ 1043

PZ-01 DTW = 3.38 @ 1051
PZ-08 DTW = 5.57 @ 1056
PZ-05 DTW = 3.75 @ 1101
PZ-14 DTW = 2.66 @ 1113
SW-02 DTW = 4.09 @ 1143

Left Suntek Battery #4 voltage = 11.76
don't change battery or download
Flow = 8.96

Right Suntek Battery #2 voltage = 11.74
don't change battery or download
Flow = 9.43

Flowtracker Right
Left

Parshall 6" GH = 0.79 @ 1300 = 1.42 cfs
lots of macrophytes growing into upstream side of flume & lots of periphyton attached in flume - Tried to clean off

9/12/17 Potts
Arrive at 10' Flume @ 0855
Calm, clear, cool
GH = 0.77 @ 0959 10' Flume
= 25.92 cfs
SW-01 waste gate closed but flow going around it as usual

FlowTracker @ Culvert
RT = 14.24 cfs 9:15 - 9:45
LFT = 11.95 cfs 9:45 - 10:15

Connect to Suntekes
RT Suntek - Battery = 11.5
Note - stopped recording Aug 31
Not sure why ??
Left Suntek - Battery = 11.6
Download & Restart
Depart site

mp

10/4/2017 Wednesday Potts
Arrive @ 0910 - calm, cloudy, cold

0916	10' Flume	GH= 0.21'	+ Flow N/A
0922	waste gate @ SW-01	open	
0923	SW-01	DTW= 3.92'	
0941	PZ-13	DTW= 3.17'	
0948	MDT-128	DTW= 4.30'	
0954	PZ-12	DTW= 2.76'	
1002	PZ-10	DTW= 3.45'	
1008	PZ-9	DTW= 4.86'	
1106	MDT-122	DTW= 4.86'	
1113	PZ-7	DTW= 3.62'	
1119	PZ-4	DTW= 2.37'	
1124	PZ-6	DTW= 2.38'	
1130	PZ-2	DTW= 2.51'	
1136	PZ-3	DTW= 2.74'	
1141	SW-05	DTW= 3.65'	
1148	PZ-1	DTW= 3.12'	
1154	PZ-8	DTW= 5.20'	
1159	PZ-5	DTW= 3.53'	
1207	PZ-14	DTW= 2.45'	
1224	SW-02	DTW= 4.60	
1232	6" Parshall	GH= 0.79'	= 1.42 cfs

10/16/2017 Monday - Potts
Calm, Clear, Cool
10' Flume GH= 0.21 @ 9:07 - Flow N/A
Waste Gate open @ SW-01

Loop Calc L - Download file L-14
- Battery #4 - 11.12 V

Loop Calc R - unable to connect
- Tried disconnecting/Reconnecting power
- Tried different USB ports
- Tried both software versions
- Able to connect to Left Sontek but still can't connect to Right
- No visible Damage to Cables
- Will Measure flow & Brainstorm back at office...

FlowTracker
Right = 2.25 cfs
Left = 1.8 cfs

WSP @ SW-03 = 1.25 cfs
Parshall 6" GH= 0.80 @ 1156 = 1.45 cfs
Note Macrophytes/Periphyton in flume cleaned + scraped

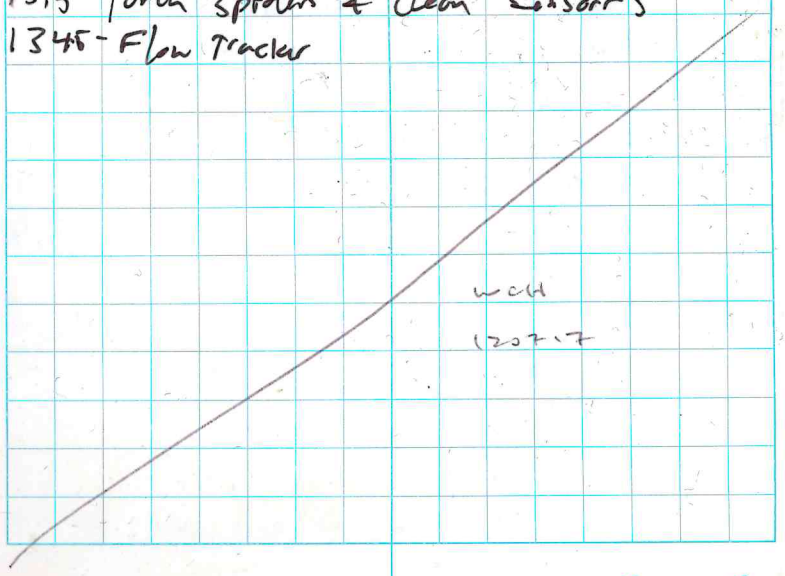
11-13-2017 - Monday - Perrys
Calm, Clear, Cool
Arrive at site @ 1010

1014	GH = 0.18' at 10' flume → Flow N/A	
1020	DTW = 4.23' at SW-01	
PZ-13	DTW = 3.065' @ 1035	
PZ-11	DTW = 3.55' @ 1043	
MDT-128	DTW = 4.23' @ 1049	
PZ-12	DTW = 2.62' @ 1055	
PZ-10	DTW = 3.20' @ 1101	
PZ-9	DTW = 4.62' @ 1106	
MDT-123	DTW = 4.545' @ 1111	
PZ-7	DTW = 3.32 @ 1117	
PZ-4	DTW = 2.10 @ 1122	
PZ-6	DTW = 2.09 @ 1128	
PZ-2	DTW = 2.45 @ 1136	
PZ-3	DTW = 2.645' @ 1141	
SW-03	DTW = 3.66 @ 1146	
PZ-1	DTW = 3.01 @ 1154	
PZ-8	DTW = 5.01 @ 1200	
PZ-5	DTW = 3.45 @ 1206	
PZ-14	DTW = 3.48 @ 1211	
Parshall 6" - GH = 0.79 @ 1227		= 1.42 cfs
SW-02	DTW = 4.74 @ 1235	

Connect to Left SonTek
Connect ok - Reset clock to PC time
Download Data → Battery #4 = 10.8V
Swap with battery #1 = 11.59V
Restart calv L16

Unable to Connect to Right SonTek
- Swap Battery #2 for #3
- Connected ok! - Reset Clock to PC
Download Data → Battery #3 = 11.94 V
Restart calv R16

1315 - Torch spiders & clean sensors
1345 - Flow Tracker



12/19/2017 - Tuesday - Potts

Arrive at site @ 1310

lt. breeze, cool, overcast

Flow track at SW-03 - WSP

begin at

End at 1354

Flow = 1.188 cfs

Move to CO-OP Ditch

Right Culvert (looking downstream)

Begin at 1405

End at 1421

Flow = 0.999

Left Culvert

Begin at 1424

End at 1439

Flow = 1.166

well

on 1/8

1/4/2018 Thursday - Potts

Arrive at 10' Flume at 0950

Calm, Clear, Cold

10' Flume GH: 0.17 @ 0952 = N/A

Minimum GH = 0.3

SW-01 - waste gate open - Muskrat in ditch

Co-op ditch Frozen over a few hundred feet DS of waste gate

PZ-13 download & Restart

PZ-11 " "

Note well worn path from cows moving into oxbow SE of MDT-128 To drink from unfrozen warm water

PZ-MDT 128 - download/Restart

PZ-12 - Frozen

PZ-10 - Frozen

PZ-09 - Download/Restart

PZ-MDT-123 - " "

PZ-07 - Frozen - had to pry open and could not close with PVC well cap. Outer casing settled on PVC frost locked up

PZ-04 - Download/Restart

PZ06 - Frozen & full of cow hair
PZ-02 - Frozen
PZ-03 - Download / Restart
SW-03 - Download / Restart
Baro - Download / Restart
PZ-01 - Download / Restart
PZ-08 - Download / Restart
PZ-05 - Download / Restart
PZ-14 - Frozen
SW-02 - Download / Restart

Left Culv - Battery = 10.81 V
- Download - L16
- Restart - L17

Right Culv - Battery = 11.27 V
- Download - R16
- Restart - R17

6" Parshall - GH = 0.78 @ 1222 = 1.39 cfs
- Download / Restart

Report Site(s) @ 1227

mp

1/16 Tuesday
Calm, Clear, Cold
arrive at 10' Flume at 0925
GH = 0.16' @ 0927
Note: lots of algal buildup in flume so flows likely do not correspond to gage height

- Waste Gate open
- Ditch frozen over DS of waste gate
- No flow over diversion

Right Sontek - battery = 11.15 V
- download R17
- Swap battery #3 for new Battery - #5
- battery = 12.22 V
- Restart R18

Left Sontek - Could not Connect
- Swap battery #1 with #4
- #4 = 11.64 V
- No data Files...
- Restart L18
- Data Files appeared
- Download L17

Flow Tracking

Right Culv Start 1020
Stop 1036

Q = 1.05 cfs

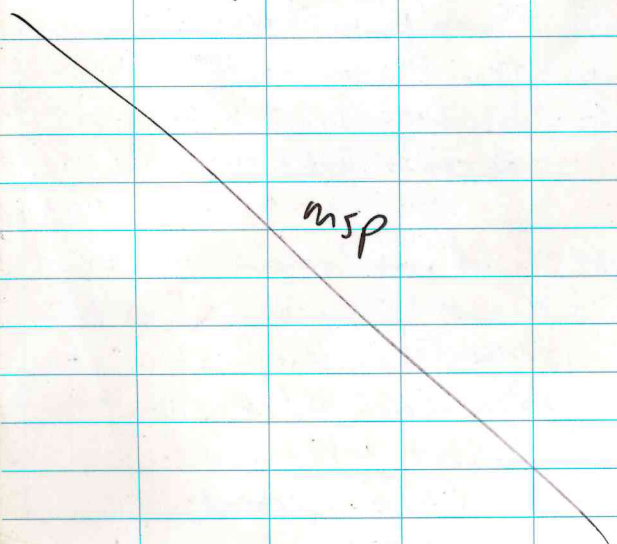
Left Culv Start 1039
Stop 1055

Q = 0.809 cfs

WSD Start 1116
Stop 1144

Q = 1.207 cfs

Depart Site @ 1155



2/28/2018 - wednesday Potts

arrive at 10' Flume 0943

Weather - Calm, Pt. Cloudy, Cold

10' Flume GH = 0.17' @0947 = Too low to measure Flow

* Note: Significant algal buildup in Flum - pic

Sw-01 = 4.24 @ 0957 download/Restart

Sw-02 =

Sw-03 = 3.66 @ 1119 download/Restart BARO too

Pz-01 = 3.02 @ 1128 download/Restart

Pz-02 = ICE = 2.48 @ 1109 - Could NOT Download

Pz-03 = 2.67 @ 1112 download/Restart

Pz-04 = 2.07' @ 1059 download/Restart

Pz-05 = 3.48 @ 1145 download/Restart

Pz-06 = ICE - 1.93 @ 1106 - Could NOT Download

Pz-07 = Can't open - Frost Jacked - Could Not Download

Pz-08 = 5.05 @ 1138 download/Restart

Pz-09 = Cannot Open - Fost Jack - Could NOT DL

Pz-10 = Cannot Open - Frost heaved - Could NOT DL.

Pz-11 = 3.28 @ 1027 - casing - no cap - Satisfied download/restart

Pz 12 = ICE - 2.42 @ 1042 - Could NOT DL

Pz 13 = 2.92' @ 1019 download/Restart

Pz 14 = ICE - 2.33 @ 1152 - Could NOT DL

MDT-128 = 4.15 @ 1035 download/Restart

MDT-1283 = 4.32 @ 1050 download/Restart

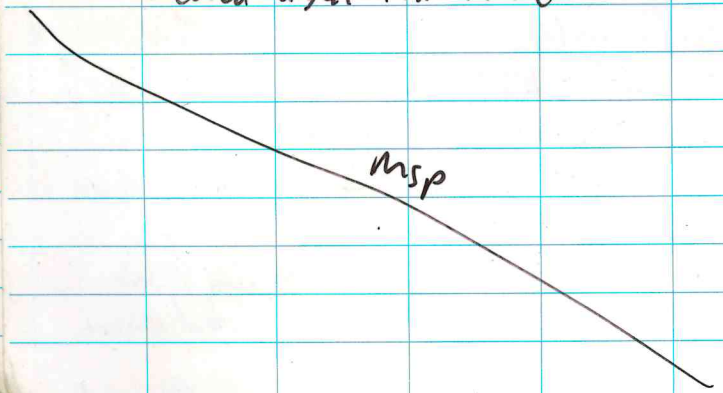
Flowtracker at SW-03 = 1.27 CFS at 1300

Move to Culverts
SW-02 knocked over by cows
Cable to Rt Culv visibly damaged
could not connect to Sontek

Reinstalled Stilling well
New DTW = 4.45 @ 1322
Download SW-02 & Restart

Not equipped to Remove Sontek
will Remove for Repair on next visit

Parshall 6" GH: 0.81 @ 1335 = 1.48 cfs
Download & Restart
cleared algae from flume



3/20/2018 Tuesday - Potts / Jaynes-MPT
Arrive @ SW-02 @ 0900
Calm, pt1y. cloudy, cold · 31° F

Remove SonTek IQ pipes
Flow Measurement = Rt = 0.76
Lft = 0.95

10" Flume GH: 0.2 @ 1206

SW-01 - GH: 4.2 @ 1212
Download & Restart

PZ-1	DTW = 2.94 @ 1426	
PZ-2	DTW = 2.41 @ 1400	
PZ-3	DTW = 2.52 @ 1410	
PZ-4	DTW = 1.81 @ 1344	
PZ-5	DTW = 3.44 @ 1445	
PZ-6	DTW = 1.9 @ 1351	
PZ-7	could not open	
PZ-8	DTW = 2.88 @ 1432	
PZ-9	Frost Jacked	
PZ-10	Frost Jacked	
PZ-11	DTW = 3.39 @ 1243	
PZ-12	DTW = 2.52 @ 1306	Transducer gone Assume down well
PZ13	DTW = 2.92 @ 1232	

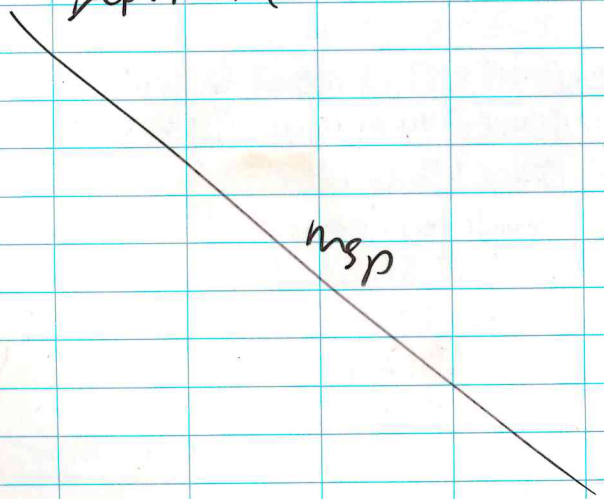
PZ-14 DTW = 2.37 @ 1452
MDT-127 - DTW = 4.205 @ 1338
MDT-128 DTW = 4.17 @ 1500

SW-03: 3.70 @ 1420
SW-02 -

MDT - MW-103A - DTW = 1.33 @ 1524

6" Parshall - GH = 0.77 @ 1543
flow = 1.36 cfs

Report Site



4/18/2018 - Potts & MDT personnell
Calm, clear, Cool

10' Flume = 0.22' @ 0940
NOTE: significant algae buildup

Download SW-01
NOTE: waste gate open

Flow Msmts
Left Culv = 0.544 cfs
Rt Culv = 1.32 cfs
NOTE: substantial manner accumulation along sides of left culvert

Parshall 6" - Some algae buildup
GH = 0.78 @ 1107 = 1.39 cfs
download Logger
Scraped & scrubbed algae
GH = 0.78 @ 1110 = 1.39 cfs
- MDT on site @ 1110
3' Cutthroat GH = 0.38 @ 1206 = 2.28 cfs
FlowTracker = 1.56 cfs
GH = 0.39 @ 1237 = 2.37 cfs

PZ 1 - Did not download
PZ 2 - did not download
PZ 3 - did not download
PZ 4 - did not download
PZ 5 - did not download
PZ 6 - did not download
PZ 7 - Download - cut
PZ 8 - did not download
PZ 9 - Download - cut
PZ 10 - Download - Cut
PZ 11 - Download - Cut
PZ 12 - Download - Cut
PZ 13 - Download
PZ 14 - did not download
MDT-123
MDT-128

Note: MDT personell cutting & stabilizing piezometers. They will finish tomorrow & I will return of Friday to reset everything

mgp

4/20/2018 - Friday - Potts
Calm, Clear, Warm

SW-01 - DTW = 4.19' @ 1000
download & Restart

PZ-01 = 3.05 @ 1127
PZ-02 = 2.54 @ 1111
PZ-03 = 2.68 @ 1116
PZ-04 = 2.03 @ 1059
PZ-05 = 3.52 @ 1138
PZ-06 = 2.14 @ 1105
PZ-07 = 2.78 @ 1054
PZ-08 = 5.04 @ 1133
PZ-09 = 4.09 @ 1042
PZ-10 = 3.12 @ 1036
PZ-11 = 2.01 @ 1020
PZ-12 = 1.49 @ 1029
PZ-13 = 3.05 @ 1012
PZ-14 = 2.44 @ 1143
MDT-128 = 4.315 @ 1024
MDT-123 = 4.43 @ 1047
SW-02 = 3.44 @ 1157
SW-03 = 3.70 @ 1121
6" Parshall = 0.74 @ 1203 :

5/24/2018 - Thurs - Patt
Calm, Ptly Cloudy, Warm

10" Flume - GH = 0.95 @ 0905 = 36.27 cfs

PZ-01 = 2.96 @ 1041
PZ-02 = 2.29 @ 1023
PZ-03 = 2.52 @ 1029
PZ-04 = 2.115 @ 1010
PZ-05 = 3.34 @ 1053
PZ-06 = 2.26 @ 1016
PZ-07 = 2.915 @ 1004
PZ-08 = 5.02 @ 1047
PZ-09 = 4.39 @ 0953
PZ-10 = 3.275 @ 0948
PZ-11 = 1.97 @ 0928
PZ-12 = 1.42 @ 0941
PZ-13 = 3.0 @ 0915
PZ-14 = 2.13 @ 1058

WL Above ground surface

Note: water flowing through new culvert SE of site

MDJ-128 = 4.18 @ 0935
MDJ-123 = 4.60 @ 0958

SW-03 = 3.64 @ 1034
SW-01 = 2.86 @ 1113
SW-02 = 3.33 @ 1126

5/24/18 continued...

6" Parshall - GH = 0.79 @ 1134
Flow = 1.42

Note: Waste gate mostly closed at SW-01 (leaking)

Note: Culvert under Hwy 41 from Coop to WSD Flowing

3' Cutthroat - GH = 0.85 @ 1150 = 9.3
0.89 @ 1156 = 10.0
Start @ 1153
0.90 @ 1159 = 10.17
Stop @ 1215
0.91 @ 1205 = 10.35
0.90 @ 1212 = 10.17
0.89 @ 1215 = 10.0

Flow = 7.52 cfs Avg = 9.998 cfs

Note percentage of discrepancy is reduced at higher flows, but still appox 2.5 cfs higher than FlowTracker

MSP