

# TRANSMITTAL

Ms. Margie Ring Michigan Department of Environmental Quality Waste Management & Radiological Protection Division Constitution Hall 525 West Allegan, 4th Floor South P.O Box 30473 Lansing, MI 48909

- Re: Monitoring Well Development Alternative Source Demonstration Marquette Board of Light and Power 400 East Hampton Street, Marquette, MI
  - FOR REVIEW
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Project No. 180827

September 5, 2018

Sent By: Todd C. Campbell, CPG/aes

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1	9/5/2018	Monitoring Well Development – Alternative Source Demonstration Report

#### COMMENTS

The next round of groundwater samples will be collected on September 20, 2018.

If you have any questions or require additional information, please contact me at 269.544.6948 or tccampbell@ftch.com.

#### By email

- cc/att: Mr. John Schultz Marquette Board of Light and Power
  - Mr. Joshua Hendrickson Marquette Board of Light and Power
  - Mr. Tom Carpenter Marquette Board of Light and Power
  - Mr. Tom Skewis Marquette Board of Light and Power
  - Mr. Stephen J. MacDonald, PE FTCH
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  - Ms. Elizabeth A. Marsh, PE, CHMM FTCH

Monitoring Well Development Alternative Source Demonstration

Marquette Board of Light and Power 400 East Hampton Street, Marquette, Michigan

> Project No. 180827 September 5, 2018



Fishbeck, Thompson, Carr & Huber, Inc. engineers | scientists | architects | constructors



# Monitoring Well Development Alternative Source Demonstration

Prepared For: Marquette Board of Light & Power 400 East Hampton Street, Marquette, Michigan

> September 5, 2018 Project No. 180827

616.575.3824 www.ftch.com Fishbeck, Thompson, Carr & Huber, Inc. engineers I scientists I architects I constructors

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### List of Abbreviations/Acronyms

- ASD Alternative Source Demonstration
- CCR Coal Combustion Residuals
- FTCH Fishbeck, Thompson, Carr & Huber, Inc
- GOF good of fitness
- MBLP Marquette Board of Light & Power
- SSI statistically significant increase
- UPL upper prediction limit

# 1.0 Introduction

Fishbeck, Thompson, Carr & Huber, Inc. (FTCH) on behalf of Marquette Board of Light & Power (MBLP) has prepared this Alternative Source Demonstration (ASD) for the Shiras Steam Plant generating station located at 400 East Hampton Street, Marquette, Michigan; Ash Impoundment WDS ID 478988 (Shiras Steam Plant). This document provides a description of the redevelopment of the five monitoring wells located at the Shiras Steam Plant, pH data collected during and after well redevelopment, and the statistical analysis used to determine if the statistically significant increase (SSI) in pH for monitoring wells MW-2 and MW-3 (reported in the 2017 annual monitoring report) may be a result of a source(s) other than the Coal Combustion Residuals (CCR) unit. This report has been prepared in accordance with 40 Code of Federal Regulations (CFR) Part 257, Disposal of Coal Combustion Residuals from Electric Utilities (CCR rule) published in April 17, 2015.

# 2.0 Summary of Previous Investigations and Regulations Background

The Shiras Steam Plant is located at 400 East Hampton Street, in Marquette, Michigan, along the shoreline of Lake Superior, as shown on Figure 1. The Shiras Steam Plant has one CCR surface impoundment (aka holding pond) located north of the generating station. In January 2018, the MBLP completed the Annual Groundwater Monitoring and Corrective Action Report, which documented the 2017 activities in accordance with the CCR 257.90(e), including data from monitoring wells shown on Figure 2. According to the report, the Shiras Steam Plant Site data showed an SSI in the Appendix III parameter pH at MW-2 and MW-3 over the background (Marquette Board of Light and Power, 2017).

According to CCR 257.94(e) and 257.93(h), if a facility determines there is an SSI over background levels for one or more constituents within 90 days of detecting an SSI, the facility will establish an Assessment Monitoring Program and/or demonstrate an alternative explanation for the exceedance. Alternate explanations could include the existence of a source other than the CCR Unit that could have caused the SSI; the SSI resulted from errors in sampling, analysis, or statistical evaluation; and natural variation in groundwater quality. The owner/operator of the CCR must complete and produce a written document (ASD) that must be certified by a qualified professional engineer, and the CCR unit may continue with detection monitoring. The facility must also include the ASD in the annual groundwater monitoring and corrective action report required by CCR 257.90(e), in addition to certification by a qualified professional engineer.

If the SSI is identified and cannot be attributed to an ASD, the facility must begin assessment monitoring for the CCR Unit. Per the CCR Rule, assessment monitoring must begin within 90 days of identification of an SSI that is not attributed to an alternative source and also include the Appendix IV constituents in accordance to CCR 257.95(b).

# 3.0 Objective

To support collection of high quality data to address CCR 257.94 (e)(2), redevelopment of the existing five monitoring wells (MW-1 through MW-5) for pH was proposed. The objective of this report is to document the redevelopment of these wells and determine if an alternative source other than the CCR unit, previous well conditions, errors, or natural variation in groundwater quality can explain the SSI in pH for MW-2 and MW-3 over the background. According to CCR 257.94 (e)(2), "The owner or operator may demonstrate that a source other than the CCR unit caused the statistically significant increase over background levels for a constituent or



that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality." The current ASD investigated the following lines of evidence:

- Well conditions may affect pH readings. Redeveloping the wells could improve sampling conditions for more representative field parameters measurements.
- There is inherent error present in the equipment used to measure pH in the field.
- There is natural variation within pH ranges from both background wells (MW-4 and MW-5) and downgradient monitoring wells (MW-1, MW-2 and MW-3).

### 4.0 Alternative Source Demonstration Investigation

### 4.1 Well Redevelopment and Re-Evaluation of the Data

Redevelopment activities were originally scheduled to occur during April 2018; however, ice present in the area of the wells prevented safe access to complete the work. The delay in access to the monitoring wells was communicated to the Michigan Department of Environmental Quality (MDEQ) in an email from Mr. John Schultz (MBLP) on April 16, 2018. Ms. Margie Ring, MDEQ State Solid Waste Engineering Coordinator, responded via email that the MDEQ was in agreement with postponing sampling until the wells could be accessed safely. Ms. Ring recommended documenting the delay in the monitoring report if the samples were not collected by April 30, 2018.

Monitoring well redevelopment activities were executed on May 30, 2018, at all five wells within the monitoring network. Prior to redevelopment activities, static water levels were collected from monitoring wells MW-1 through MW-5 and the data was used to calculate groundwater elevations. The groundwater elevation data was then contoured and is shown on Figure 3. As depicted on Figure 3, groundwater flows toward the east and Lake Superior. During redevelopment, pH values were monitored for stabilization (+/- 0.1 SU over 3 consecutive readings) using a YSI Inc. Pro Plus handheld instrument containing a pH meter probe. The pH values were recorded on field documentation forms provided in Appendix A. Statistical analysis was completed on background and downgradient groundwater pH data. As established in the 2017 annual groundwater report, an inter-well approach was considered appropriate for statistical analysis, as the groundwater monitoring system for the WDS ID 478988 unit contains two upgradient (MW-4 and MW-5) and three downgradient wells (MW-1, MW-2, and MW-3 in Lake Superior), which were installed in the uppermost aquifer.

The pH data, obtained during redevelopment of the wells and 24 hours after redevelopment, were added to the existing pH database. The new pH data, except for pH data collected during redevelopment, were used in combination with the baseline data collected in 2017 for statistical analyses of the ASD. The redevelopment pH data was not used because this data is not representative of undisturbed steady-state conditions. All statistical evaluations were completed using the latest version of ProUCL 5.1 software developed by the USEPA (USEPA, 2016).

Initially, the detection frequencies for all wells were computed (Table 1). To establish the prediction limit, historical data and pH measurements collected 24 hours after the redevelopment for MW-4 and MW-5 were used for background calculations. To check for outliers, background data was plotted on a box plot, histogram, and Q-Q plot for a visual assessment of potential outliers followed by the calculations of the Dixon's outlier test (Appendix B). No outliers were detected with a one percent significance level. A good of fitness (GOF) test was used to determine the statistical distribution of the background data; to verify whether the dataset is normal, gamma, lognormal or nonparametrically distributed. The background dataset was identified to be normally distributed (Appendix C). The upper and lower prediction limit were calculated based on normal distribution and



results are shown on Table 2 (additional calculations executed by ProUCL regarding prediction limits are shown on Appendix D).

Historical downgradient data for pH (MW-1, MW-2, and MW-3) were compared with the prediction limit calculated for the updated background data (6.782-8.303) and are shown on Table 3. Among the data tested, only one measurement at MW-2 exceeded the updated prediction limit. This measurement was from the first sampling event on July of 2017 (pH = 8.41), which should not be a concern since many other measurements were taken afterwards. As discussed above, the redevelopment pH data was not used for statistical analysis due to the nature of redeveloping wells, which include mixing solutions, solids, and minerals to clean up the well. These unstable conditions, noticeable by the variability in values observed on each well throughout the redevelopment event, are not representative of undisturbed steady-state conditions. For that reason, the pH measurement collected 24 hours following redevelopment (on May 31, 2018), were within the acceptable limits calculated for background (MW-1 = 7.62, MW-2 = 7.88 and MW-3 = 8.07). Thus, at this time, previous well conditions seem to explain the SSI for pH observed during the monitoring event of 2017. Figures 4, 5, and 6 display the Upgradient vs. Downgradient analysis for MW-1, MW-2, and MW-3.

### 4.2 Evaluation of Inherent Error

The potential of errors due to the calibration of the measurement instrument and the inherent error present due to accuracy limits of the instrument were also evaluated. An investigation of the field forms was conducted to verify if the calibration drifted throughout the course of the sampling event, if adequate amount of groundwater was withdrawn to obtain a representative sample from each monitoring well, and if pH readings were allowed to stabilize prior to sample collection. Additionally, the accuracy limitations of the instrument used to measure pH was assessed and compared to the baseline upper prediction limit (UPL) to ascertain if the margin of error for the pH measurements in questions is below UPL.

Investigation of the field notes/calibration forms showed little drift in pH value (7.06, 7.02 and 7.04 over the course of the day) and reported an adequate amount of water was used to obtain representative pH measurements; thus, these lines of evidence would not be able to explain the SSI for pH in MW-2 and MW-3. Regarding accuracy limitations of the instrument used to measure pH, the instrument manual reports an accuracy of  $\pm 0.2$  (YSI, 2011). By accounting for the equipment accuracy, all pH values measured using this instrument during redevelopment and 24h after the redevelopment event would be actually  $\pm 0.2$  S.U.

### 4.3 Evaluation of Natural Variation

Because no other Appendix III constituent exhibited an SSI in the 2017 monitoring event, the variation in pH data may be indicative of natural variation. Trend analysis of pH was executed using the Mann-Kendall test on ProUCL and results are shown on Appendix E. The purpose of the Mann-Kendall (MK) test (Mann 1945, Kendall 1975, Gilbert 1987) is to statistically assess if there is a monotonic upward or downward trend of the variable of interest over time. Similar to background, both MW-2 and MW-3 had insufficient evidence to identify a significant trend at the 0.01 level of significance (confidence coefficient 0.99).

### 5.0 Conclusions and Recommendations

- 24 hours after redevelopment of the wells, values greater than the prediction limit, set based on current background data, were not observed in MW-2 and MW-3.
- Based on the data, previous well conditions explain the evidence of SSI for pH previously reported.

There is insufficient evidence to identify a significant increasing trend for pH at MW-2 and MW-3, this indicates that, to some extent, any difference between background field pH and downgradient may be naturally-occurring.

This ASD documents the re-assessment of the potential SSI of pH for the downgradient wells MW-2 and MW-3 at the Shiras Steam Plant. Based on all above, especially the statistical study executed after the redevelopment of the wells, previous well conditions explain the SSI. As no SSI was noted after redeveloping the wells, the 2018 monitoring program report will cover Appendix III parameters exclusively.

## 6.0 Monitoring Schedule

Following the ASD study, two monitoring events are expected for the 2018 annual report. The first monitoring event occurred in May 31, 2018 (only pH data shown in this document) and the second sampling event is expected to occur in September 2018. The annual report will be submitted in January 2019 and, based on this ASD, the report will only include Appendix III parameters.

# 7.0 References

Marquette Board of Light and Power, 2017. First Annual CCR Groundwater Monitoring and Corrective Action Report 2017.

YSI, 2011. Professional Plus Water Quality Instrument - Specifications

USEPA, 2016. ProUCL Version 5.1 User Guide - Statistical Software for Environmental Applications for Data Sets with and without Non-detect Observations. https://www.epa.gov/sites/production/files/2016-05/documents/proucl\_5.1\_user-guide.pdf, accessed in July 2018.

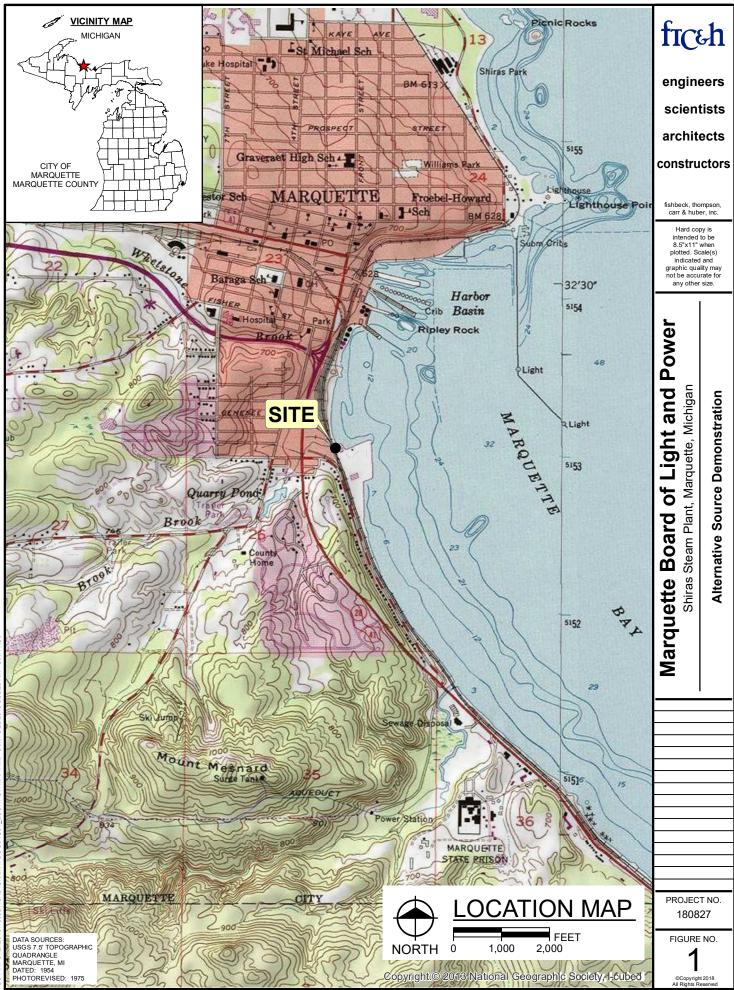
# 8.0 Certification

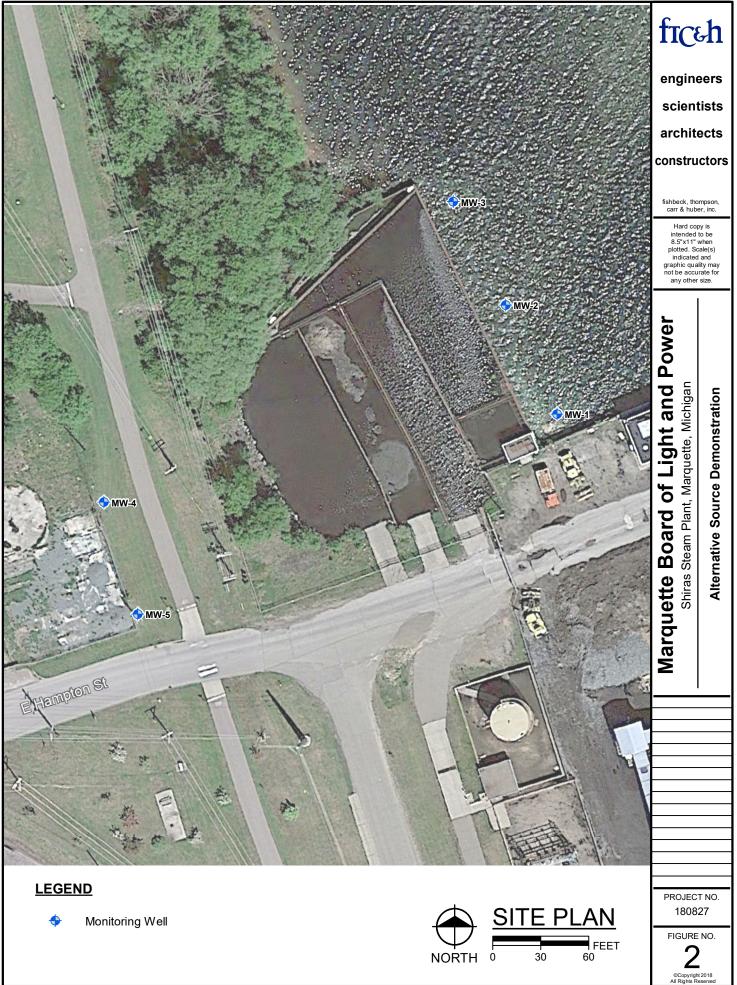
I, Stephen J. MacDonald, a qualified professional engineer, certify that the selected statistical method is appropriate for evaluating the groundwater monitoring data for the CCR ash Impoundment WDS ID 478988 at the Shiras Steam Plant.



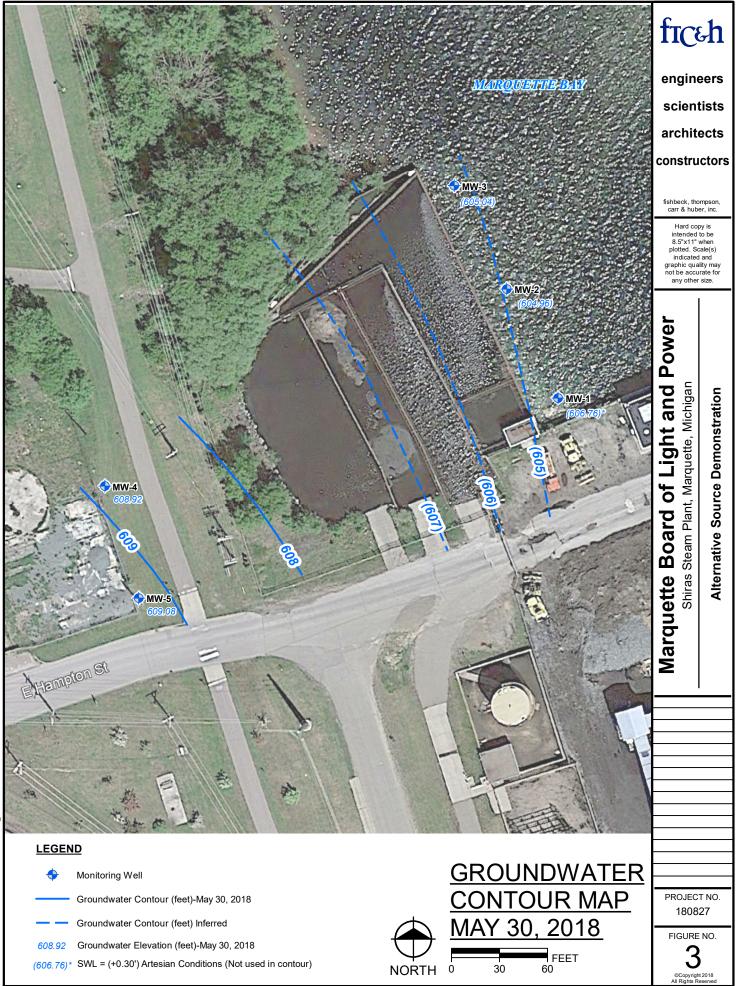
Stephen J. MacDonald, PE License Number 40569 Senior Environmental Engineer Date: September 5, 2018

# **Figures**





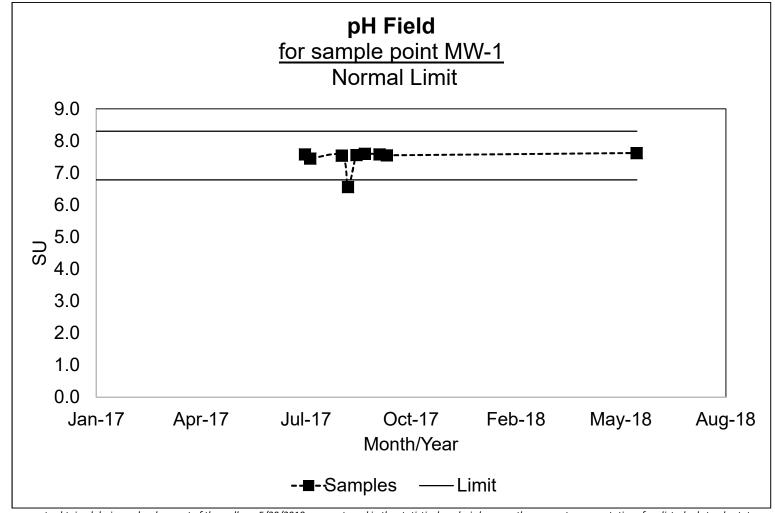
ACS



PLOT INFO: Z/2018/180827/CAD/GIS/MAPDOC/FIG03\_MAY2018-GW CONTOUR MAP.mxd Date: 6/20/2018 10:22:23 AM User:

ACS

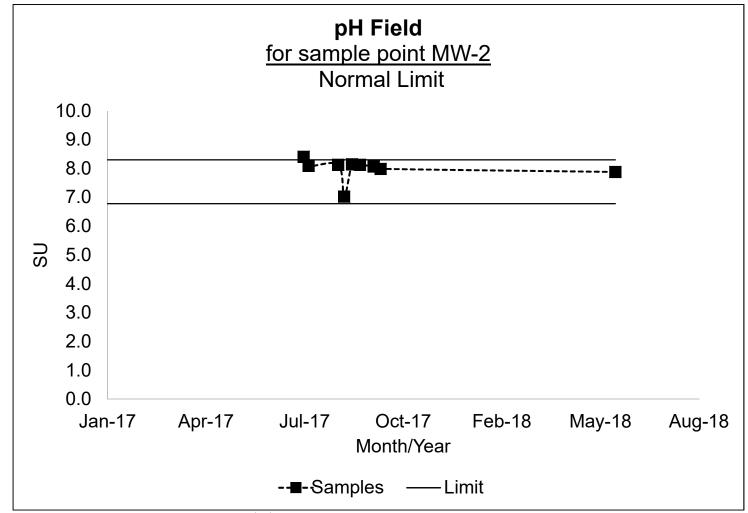
# Up vs. Down Prediction Limits



\*Measurements obtained during redevelopment of the wells on 5/30/2018 were not used in the statistical analysis because they are not representative of undisturbed steady-state conditions

Graph 1

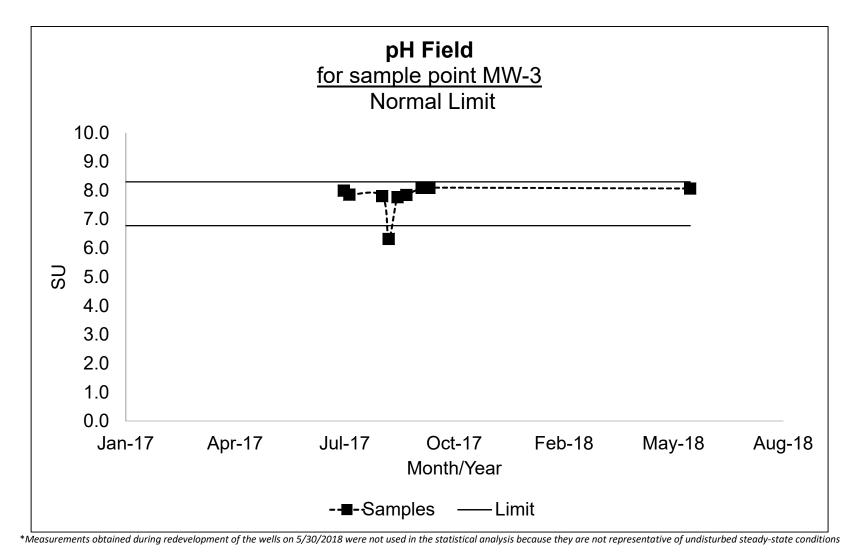
# Up vs. Down Prediction Limits



\*Measurements obtained during redevelopment of the wells on 5/30/2018 were not used in the statistical analysis because they are not representative of undisturbed steady-state conditions

Graph 2

# Up vs. Down Prediction Limits



Graph 3

# **Tables**

### Table 1 - Summary of Detection Frequencies for Appendix III Parameter of pH

Marquette Board of Light and Power

Shiras Steam Plant

Parameter	<b>Detection Frequency</b>	MW-1	MW-2	MW-3	MW-4	MW-5
рН	n	9	9	9	9	9
	ND	0	0	0	0	0
	%ND	0%	0%	0%	0%	0%

Notes:

n - sample size

ND - count of nondetect values in sample

%ND - percentage of nondetects in sample

### Table 2 - Summary Statistics and Prediction Limits

Marquette Board of Light and Power

Shiras Steam Plant

							Student's T test	Upper	Lower
		Model	Sample			Standard	critical value	Prediction	Prediction
Parameter	Unit	Туре	Size	Detect	Mean	Deviation	(.99 confidence)	Limit	Limit
рН	SU	Normal	18	18	7.541	0.289	2.567	8.303	6.782

### Table 3 - Historical Downgradient Data for pH which Failed the Current Statistical Evaluation

Marquette Board of Power and Light

Shiras Steam Plant

Parameter	Unit	Well	Date	Result	<b>Prediction Limit</b>	SSI
рН	SU	MW-1	7/19/2017	7.58	6.861-8.211	
рН	SU	MW-1	7/24/2017	7.45	6.861-8.211	
рН	SU	MW-1	8/23/2017	7.54	6.861-8.211	
рН	SU	MW-1	8/29/2017	6.56	6.861-8.211	
рН	SU	MW-1	9/6/2017	7.56	6.861-8.211	
рН	SU	MW-1	9/14/2017	7.6	6.861-8.211	
рН	SU	MW-1	9/28/2017	7.58	6.861-8.211	
рН	SU	MW-1	10/5/2017	7.55	6.861-8.211	
рН*	SU	MW-1	5/30/2018	7.56	6.861-8.211	
рН*	SU	MW-1	5/30/2018	8.11	6.861-8.211	
рН*	SU	MW-1	5/30/2018	7.77	6.861-8.211	
рН*	SU	MW-1	5/30/2018	9.54	6.861-8.211	
рН	SU	MW-1	5/31/2018	7.62	6.861-8.211	
рН	SU	MW-2	7/19/2017	8.41	6.861-8.211	>PL
рН	SU	MW-2	7/24/2017	8.09	6.861-8.211	
рН	SU	MW-2	8/23/2017	8.13	6.861-8.211	
рН	SU	MW-2	8/29/2017	7.03	6.861-8.211	
рН	SU	MW-2	9/6/2017	8.15	6.861-8.211	
рН	SU	MW-2	9/14/2017	8.13	6.861-8.211	
рН	SU	MW-2	9/28/2017	8.07	6.861-8.211	
рН	SU	MW-2	10/5/2017	7.99	6.861-8.211	
рН*	SU	MW-2	5/30/2018	8.01	6.861-8.211	
pH*	SU	MW-2	5/30/2018	7.89	6.861-8.211	
рН*	SU	MW-2	5/30/2018	8.28	6.861-8.211	
рН	SU	MW-2	5/31/2018	7.88	6.861-8.211	
рН	SU	MW-3	7/19/2017	8	6.861-8.211	
рН	SU	MW-3	7/24/2017	7.86	6.861-8.211	
рН	SU	MW-3	8/23/2017	7.81	6.861-8.211	
рН	SU	MW-3	8/29/2017	6.32	6.861-8.211	
рН	SU	MW-3	9/6/2017	7.77	6.861-8.211	
рН	SU	MW-3	9/14/2017	7.85	6.861-8.211	
рН	SU	MW-3	9/28/2017	8.09	6.861-8.211	
рН	SU	MW-3	10/5/2017	8.1	6.861-8.211	
pH*	SU	MW-3	5/30/2018	8.61	6.861-8.211	
pH*	SU	MW-3	5/30/2018	6.95	6.861-8.211	
pH*	SU	MW-3	5/30/2018	7.82	6.861-8.211	
рН	SU	MW-3	5/31/2018	8.07	6.861-8.211	

\*Measurements obtained during redevelopment of the wells on 5/30/2018 were not used in the statistical analysis because this data is not representative of undisturbed steady-state conditions Notes:

>PL - results exceeds prediction limit; significantly increased over background

# **Appendix A**

### **FIELD NOTES**

Project Name:	MBLP/Shiras ASD & GW Monitoring
Project Number:	180827
Site Location:	Marquette, MI
Date:	5/30/18
Lord State Internet Volumentaria	PIOFZ
Weather Conditions	100
weather Conditions:	62°, overcest
Purpose: MW d	evelopment
- Aller - Aller	
Tizo: AD	+ APS Onsite 10 librating
5:30 : Tom	(MBLP) on the to provide heys/observe
9:20: MW.	5 developed ~17 sellors presed
9:45 MW	"I puyed dry at ~ S 521, tub toot two dity and plt
Lompa	rable to MW-5, will retain forward to sample
10:30 : 1 an	In boat at Cinder Bond Marina
11:20: 12	gin devoloping MW-3 - puged dry of ~ 5 gallons
w: I	I let well recover and return after other 2 wells
64	the nate - boat taking on water, used bilge pump
1145: 5150	development of MW-2, purged day at ~ 55.11005
bont	taleing on nate seemingly quicker, plug is in scaled well
cont	and to interritently use bilge pump
mill	return after allowing time for New-2 to revoure
1219: MW	1 pwgl day at ~ 6 gel
1225: midda	pH and check - 7. 02 5.4.
1258: MW	3 his recovered to 29 below TOC, pundag asan
1305 - MW-	1 pwyel dry grand 8.4'
twe,	after 4 5-11000 purged (9 sollons purged total) move to
Mw	-7
	$\Lambda$ $> \rho$
Completed by:	(signature)
	(date)

### **FIELD NOTES**

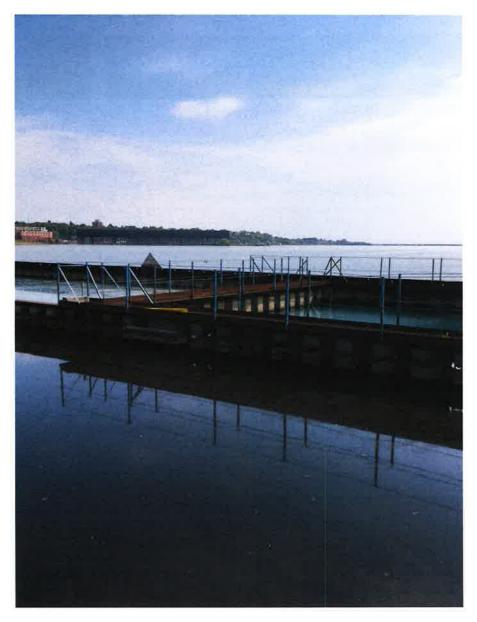
	MBLP/Shiras ASD & GW Monitoring
Project Number:	180827
Site Location:	Marquette, MI
Date:	5/20/18
	22 JE 2
Weather Conditions	
De rationale de DRWI du	
Purpose: MW	hudspron f
1319 - MW+2	- his away recovered to 5.55' below toc, ristanting
pwge	
1322. MW	2 projet day after 3 gallons - & sallons purget total
w-11	more to MW-1. boat filling with substantial amounts
	. , , , , , , , , , , , , , , , , , , ,
oL	not regularly - use pilge pump
0£ 1337 Mw-1	note regularly - use pilge pump resourced to 2.3' below TOC, will purpe again
02 1337 MW-1 NOTE: MW-1,	note regularly - use pilge pump resourced to 2.3' below TOC, will purpe again w-2, MW-3 did not resure fully due to societ issues ( ceaks
0£ 1337 MW-1 NOTE: MW-1,1 ml	not regularly - use pilge pump resourced to 2.3' below TOC, will purpe again w-2, MW-3 did not resure fully due to societ issues (really early thundestorms
02 1337 MW-1 NOTE: MW-1,1	note regularly - use pilge pump resourced to 2.3' below TOC, will purpe again w-2, MW-3 did not resure fully due to seat issues ( ceaks) early thundestorms
0£ 1337 MW-1 NOTE: MW-1,1 ml	not regularly - use pilge pump resourced to 2.3' below TOC, will purpe again w-2, MW-3 did not resure fully due to societ issues (really early thundestorms
0£ 1337 MW-1 NOTE: MW-1,1 ml	note regularly - use pilge pump resourced to 2.3' below TOC, will purpe again w-2, MW-3 did not resure fully due to societ issues (really early thundestorms I purph dry after 4 sellors on success attempt, 10 sal purph total for marine
of 1337 MW-1 NOTE: MW-1,N and ' 1342: MW- Leave	note regularly - use pilge pump resourced to 2.3' below TOC, will purpe again w-2, MW-3 did not resure fully due to societ issues (reak) verse, thundestoins I purged dry after 4 sellors on second attempt, 10 sal purged total for marines to marines to purge at MW-4, SWL =
об 1337 MW-1 NOTE: MW-1,M MOTE: MW-1,M MU-1 1342: MW-1 Leore 1446: retar 1446: retar	note regularly - use pilge pump resourced to 2.3' below TOC, will purpe again w-2, MW-3 did not resure fully due to societ issues (really early thindestorms i purged dry after 4 gellors on second attempt, 10 gal purged tota for marina to purge at MW-4, SWL = in purge at MW-4, SWL =
об 1337 MW-1 NOTE: MW-1,1 MOTE: MW-1,1 MU-1 1342: MW- leave 1446: reter 1446: reter 1446: reter 1446: hw лех.t	not regularly - use pilge pump resourced to 2.3' below TOC, will purpe again w-2, MW-3 did not resure fully due to see at issues (reak) early them destrims i purped dry after 4 sellors on second attempt, 10 sal purped total for marina to purge at MW-4, SWL = in purped dry a second time, 3-idditional sellons (8.5 jullons to task is repairing boot if readed (Docleside Marina)
об 1337 MW-1 NOTE: MW-1,1 end 1342: MW- lence 1446: refer 1446: refer 1446: refer 1446: hw лех.+ 1530: Lew	not regularly - use pilge pump resourced to 2.3' below TOC, will purpe again w-2, MW-3 did not resource fully due to seat issues (reach) early thindustoring i purpel dry after 4 gellons on sucered attempt, 10 gal purgel total for marina to purge at MW-4, SWL = in purgel dry a second time, 3-idstrond gellons (8.5 gallons to table is repaired, boat if readed (Docleside Marina) ing Docleside Morina. They are keeping the boat for the
об 1337 MW-1 NOTE: MW-1, MW-1, MW-1 MOTE: MW-1, MW-1 1342: MW-1 1342: MW-1 Leave 1446: rebar 1446: rebar 1446: rebar 1446: rebar 1446: hW NOTE: MW-1, MW-1 Leave 1446: rebar 1446: rebar 1446: rebar 1446: rebar NOTE: MW-1, MW-1 Leave 1446: rebar NOTE: MW-1, MW-1 Leave 1446: rebar NOTE: MW-1, MW-1 Leave 1446: rebar NOTE: MW-1, MW-1 Leave 1446: rebar NOTE: MW-1, MW-1 Leave NOTE: MW-1, MW-1 Leave NOTE: MW-1, MW-1 NOTE: NOTE: NO	where regularly - use pilge pump resourced to 2.3' below TOC, will purpe again w-2, MW-3 did not resour fully due to speat issues (reach) early themberstorms i purped dry after 4 gellons on second attempt, 10 gal purped total for marina to marina to purge at MW-4, SWL = in purped dry a second time, 3-idditional Gallens (8.5 jullions to table is repaired time, 3-idditional Gallens (8.5 jullions to table is repaired, boat if weeked (Dockeside Marina) ing Dadeside Morina. They are keeping the boat for the pit. Livewill was not plumbed allowing water into the boat
об 1337 MW-1 NOTE: MW-1, MW-1, MW-1 MOTE: MW-1, MW-1 1342: MW-1 1342: MW-1 Leave 1446: rebar 1446: rebar 1446: rebar 1446: rebar 1446: hW NOTE: MW-1, MW-1 Leave 1446: rebar 1446: rebar 1446: rebar 1446: rebar NOTE: MW-1, MW-1 Leave 1446: rebar NOTE: MW-1, MW-1 Leave 1446: rebar NOTE: MW-1, MW-1 Leave 1446: rebar NOTE: MW-1, MW-1 Leave 1446: rebar NOTE: MW-1, MW-1 Leave NOTE: MW-1, MW-1 Leave NOTE: MW-1, MW-1 NOTE: NOTE: NO	not regularly - use pilge pump resourced to 2.3' below TOC, will purpe again w-2, MW-3 did not resource fully due to seat issues (reach) early thindustoring i purpel dry after 4 gellons on sucered attempt, 10 gal purgel total for marina to purge at MW-4, SWL = in purgel dry a second time, 3-idstrond gellons (8.5 gallons to table is repaired, boat if readed (Docleside Marina) ing Docleside Morina. They are keeping the boat for the
01 1337 MW-1 NOTE: MW-1,M and 1 1342: MW- Leave 1446: rebar 1446: rebar	where regularly - use pilge pump resourced to 2.3' below TOC, will purpe again w-2, MW-3 did not resour fully due to speat issues (reach) early themberstorms i purped dry after 4 gellons on second attempt, 10 gal purped total for marina to marina to purge at MW-4, SWL = in purped dry a second time, 3-idditional Gallens (8.5 jullions to table is repaired time, 3-idditional Gallens (8.5 jullions to table is repaired, boat if weeked (Dockeside Marina) ing Dadeside Morina. They are keeping the boat for the pit. Livewill was not plumbed allowing water into the boat
об 1337 MW-1 NOTE: MW-1, MW-1, MW-1 MOTE: MW-1, MW-1 1342: MW-1 1342: MW-1 Leave 1446: rebar 1446: rebar 1446: rebar 1446: rebar 1446: hW NOTE: MW-1, MW-1 Leave 1446: rebar 1446: rebar 1446: rebar 1446: rebar NOTE: MW-1, MW-1 Leave 1446: rebar NOTE: MW-1, MW-1 Leave 1446: rebar NOTE: MW-1, MW-1 Leave 1446: rebar NOTE: MW-1, MW-1 Leave 1446: rebar NOTE: MW-1, MW-1 Leave NOTE: MW-1, MW-1 Leave NOTE: MW-1, MW-1 NOTE: NOTE: NO	where regularly - use pilge pump resourced to 2.3' below TOC, will purpe again w-2, MW-3 did not resour fully due to speat issues (reach) early themberstorms i purped dry after 4 gellons on second attempt, 10 gal purped total for marines to marines to purge at MW-4, SWL = in purped dry a second time, 3-idditional Gallons (8.5 gallons to table is repaired time, 3-idditional Gallons (8.5 gallons to table is repaired tone, boat if weeked (Dockeside Marine) ing Dadeside Morine. They are keeping the boat for the gallons the planted allowing mater into the boat
об 1337 MW-1 NOTE: MW-1, MW-1, MW-1 MOTE: MW-1, MW-1 1342: MW-1 1342: MW-1 Leave 1446: rebar 1446: rebar 1446: rebar 1446: rebar 1446: hW NOTE: MW-1, MW-1 Leave 1446: rebar 1446: rebar 1446: rebar 1446: rebar NOTE: MW-1, MW-1 Leave 1446: rebar NOTE: MW-1, MW-1 Leave 1446: rebar NOTE: MW-1, MW-1 Leave 1446: rebar NOTE: MW-1, MW-1 Leave 1446: rebar NOTE: MW-1, MW-1 Leave NOTE: MW-1, MW-1 Leave NOTE: MW-1, MW-1 NOTE: NOTE: NO	where regularly - use pilge pump resourced to 2.3' below TOC, will purpe again w-2, MW-3 did not resour fully due to speat issues (reach) early themberstorms i purped dry after 4 gellons on second attempt, 10 gal purped total for marines to marines to purge at MW-4, SWL = in purped dry a second time, 3-idditional Gallons (8.5 gallons to table is repaired time, 3-idditional Gallons (8.5 gallons to table is repaired tone, boat if weeked (Dockeside Marine) ing Dadeside Morine. They are keeping the boat for the gallons the planted allowing mater into the boat
об 1337 MW-1 NOTE: MW-1, MW-1, MW-1 MOTE: MW-1, MW-1 1342: MW-1 1342: MW-1 Leave 1446: rebar 1446: rebar 1446: rebar 1446: rebar 1446: hW NOTE: MW-1, MW-1 Leave 1446: rebar 1446: rebar 1446: rebar 1446: rebar NOTE: MW-1, MW-1 Leave 1446: rebar NOTE: MW-1, MW-1 Leave 1446: rebar NOTE: MW-1, MW-1 Leave 1446: rebar NOTE: MW-1, MW-1 Leave 1446: rebar NOTE: MW-1, MW-1 Leave NOTE: MW-1, MW-1 Leave NOTE: MW-1, MW-1 NOTE: NOTE: NO	where regularly - use pilge pump resourced to 2.3' below TOC, will purpe again w-2, MW-3 did not resour fully due to speat issues (reach) early themberstorms i purped dry after 4 gellons on second attempt, 10 gal purped total for marines to marines to purge at MW-4, SWL = in purped dry a second time, 3-idditional Gallons (8.5 gallons to table is repaired time, 3-idditional Gallons (8.5 gallons to table is repaired tone, boat if weeked (Dockeside Marine) ing Dadeside Morine. They are keeping the boat for the gallons the planted allowing mater into the boat

Fishbeck, Thompson, Carr & Huber, Inc.

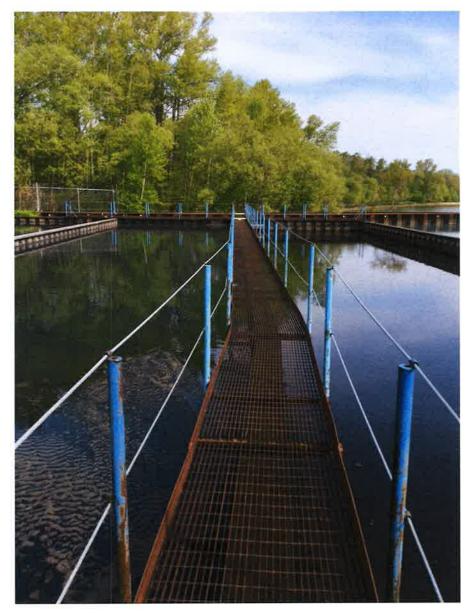
# MBLP/Shiras ASD & GW Monitoring.

Marquette, MI





Retention ponds, facing NNW.



Retention ponds, facing W.



180827

Date: 5/31/2018

18 Project Name:

MBLP/Shiras ASD & GW Monitoring.

.



Well development (MW-4)



Well development (MW-4)



Project No.: 180827

Date: 5/31/2018

2018 **Project Name**:

MBLP/Shiras ASD & GW Monitoring.



Equipment decon between locations.



Dumping of development water.





Offshore wells (MW-3)



Development of offshore locations (MW-3)



180827

5/31/2018 Date:

Project Name:

MBLP/Shiras ASD & GW Monitoring.





Low flow sampling offshore location (MW-3)

Low flow sampling offshore location (MW-1)



MBLP/Shiras ASD & GW Monitoring.

### EQUIPMENT CALIBRATION FORM

Project Name:	MBLP/Shiras ASD	& GW Monitoring	5		Ч.		
Project Number:	180827						
Date/Time:	5/30/18	8:40					
Initials:	AD					NA = Not	Applicable
Parameter	Standard	Lot Number	Units	Measured Value	Measurement Temperature (°C)	Calibration Verification Acceptance Window	Instrument Model/ID Number
	4.00	4612941-01117	S.U.	4.06		3.9 - 4.1	YSIPP
рН		4709695-11087	S.U.	7.06	21.1	6.9 - 7.1	4513
	10.00	442504-01117	S.U.	9.99		9.9 - 10.1	010
Specific	147		µmhos/cm		/	132 - 162	/
Conductance	1412		µmhos/cm			1342 - 1484	
	2765		µmhos/cm			2628 - 2905	
Eh	Zobell's solution	/	mV	/			
Dissolved Oxygen	NA	NA	mg/L		<i>`</i>	±10% Theoretical:	
Turbidity	10 NTU	A6272	NTU	9.41		9 - 11	4410
Notes:							#41D

### EQUIPMENT CALIBRATION VERIFICATION FORM

Project Name:	MBLP/Shiras ASD	& GW Monitoring					
Project Number:	180827						
Date/Time:	5/30/18 12:	25					
Initials:	AD	0 				NA = Not Applicable	
Parameter	Standard	Lot Number	Units	Measured Value	Measurement Temperature (°C)	Calibration Verification Acceptance Window	Instrument Model/ ID Number
рН	7.00	4709645-110817	S.U.	7.02	23.L	6.9 - 7.1	YSI PP
Specific Conductance	1412		µmhos/cm			1342 - 1484	
Eh	Zobell's solution		mV				
Dissolved Oxygen	NA	NA	mg/L			±10% Theoretical:	
Turbidity	10 NTU		NTU		NA	9 - 11	
Notes:							



### EQUIPMENT CALIBRATION VERIFICATION FORM

Project Name:	-	& GW Monitoring					
Project Number:	180827		2				
Date/Time:	5130118 1500		-				
Initials:	A53		-			NA = Not Applicable	
Parameter	Standard	Lot Number	Units	Measured Value	Measurement Temperature (°C)	Calibration Verification Acceptance Window	Instrument Model/ ID Number
рН	7.00	4709095-110817	S.U.	7-04	21.3	6.9 - 7.1	(B, P.P. # 31351
Specific Conductance	1412		µmhos/cm			1342 - 1484	
Eh	Zobell's solution		mV				
Dissolved Oxygen	NA	NA	mg/L			±10% Theoretical:	
Turbidity	10 NTU	A6272	NTU	9.22	NA	9 - 11	1- 7020 We #450
Notes:							
	- A	5					
			24				
			÷				

### EQUIPMENT CALIBRATION FORM

ParameterStandardLot NumberUnitsMeasured ValueTemperature (°C)Verification Acceptance WindowNumberpH $4.00$ $4612341-61117$ $S.U.$ $3.98$ $185$ $3.9-4.1$ $9.9-4.1$ $9.9-10.1$ $9$	nt Model/I	
APSNA = Not ApplicableParameterStandardLot NumberUnitsMeasured ValueMeasurement (°C)Calibration Verification Acceptance WindowInstrume Nu NuoH $4.00$ $46/284(1-6+11/7)$ S.U. $3.9.8$ $7.00$ $18.5$ $3.9-4.1$ $6.9-7.1$ $9.9-10.1$ $9.9-10.1$ $9.9-10.1$ oH $147$ $5c/80208-1c$ $\mu$ mhos/cm $161$ $1412$ $132-162$ $1342-1484$ opecific Conductance $1412$ $5c/80208-2A$ $\mu$ mhos/cm $1470$ $2628-290518.718.71342-1484$	nt Model/I	
Parameter         Standard         Lot Number         Units         Measured Value         Measurement Temperature (°C)         Calibration Verification Acceptance Window         Instrume Nit           pH         4.00 $i(4/29i(1-6i))/7$ S.U. $3.98$ $185$ $3.9-4.1$ $185$ $6.9-7.1$ $9.9-10.1$	nt Model/I	
ParameterStandardLot NumberUnitsMeasured ValueTemperature (°C)Verification Acceptance WindowInstrume NumberpH $4.00$ $4612341-61117$ S.U. $3.98$ $185$ $3.9-4.1$ $9.9-4.1$ $9.9-10.1$ pH $7.00$ $4706095-110917$ S.U. $7.04$ $185$ $6.9-7.1$ $9.9-10.1$ $9.9-10.1$ $9.9-10.1$ $9.9-10.1$ Specific Conductance $1412$ $5c180208-2A$ $\mu$ mhos/cm $161$ $18.7$ $132-162$ $1342-1484$ 2765 $5c130103-3c$ $\mu$ mhos/cm $2802$ $18.7$ $1342-1484$ $2628-2905$	nt Model/I	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	mber	
$\frac{10.00}{10.00} \frac{4672804 - 011117}{4672804 - 011117} = S.U. \frac{10.20}{10.20} = \frac{10.0111}{9.9 - 10.1} = \frac{147}{132 - 162}$ $\frac{147}{2765} \frac{50180208 - 1C}{50180208 - 2A} = \frac{161}{\mu mhos/cm} = \frac{161}{1410} = \frac{18.7}{132 - 1484} = \frac{132 - 1484}{2628 - 2905}$		
10.00         46/2804-01117         S.U.         10.20         9.9-10.1         #4           ippecific         147         \$c/80208-ic         µmhos/cm         161         132-162         1342-1484           inductance         2765         \$c/80103-3c         µmhos/cm         1410         2802         2628-2905         2628-2905		
Specific Conductance         147         \$c180208-1C         μmhos/cm         /61         132-162           1412         \$c180208-2A         μmhos/cm         /4/0         18.7         1342-1484           2765         \$c180103-3C         μmhos/cm         2802         2628-2905	#429	
1412         \$\overline{\current_18208-24}         \mumbos/cm         /4/0         18.7         1342-1484           2765         \$\overline{\current_183-3-2}         \mumbos/cm         \$\overline{\current_802}         2628-2905		
2765 SCISO103-3C μmhos/cm 2802 2628-2905		
h Zobell's solution 2082/045-1 mV 429.5 18.8 425.8-445.8		
Dissolved Oxygen NA NA mg/L 9.20 /9.8 ±10% Theoretical: 9.09	1	
Furbidity 10 NTU A(2272 NTU 9.75 - 9-11 L.2020 -	em	
	C #1	

### **GROUNDWATER SAMPLE COLLECTION FORM - STANDARD**

Project Name:		MBLP/Shira	as ASD & GW	Monitoring		Monitoring Location	1:	_Mw	1	
Project Number:		180827				Sample ID:		NA		
Site Location:		Marquette,	, ML			Well Type:		2" 54	lumized	
Weather/Temp.:		74°	, some	clas de	5	Key Number:		035	6	_
INSPECTION	i est int	m neo			Sup - Mit s	feasible along the			gestant many a	
Label on well?			YES / NO / R	EMEDIED		ls cement pad in goo	d repair?		YES / NO / REM	MEDIED NA
Is reference mark v	visible?		YES / 🔞 / R	EMEDIED		Is protective casing lo	ocked and in goo	d repair?	CES / NO / REM	MEDIED
Standing water pre	esent?	4	YES / NO / R	EMEDIED		Is inner cap in place and properly sealing well?				
Indication of surfac	ce runoff in we	117 09	YE INO/ R	EMEDIED		Is well casing in visib	ly good repair?		(NO / REM	MEDIED
Repair Notes:		1	·							
STATIC WATER LEV	VEL	박정 가 다	DATE:	5/30/18		TIME: 1209	45 - T-e		"最后是我们"。我	
Top of Casing Elev	ation:		M	ft		Measured with:	C	Electronic tape	/ Chalked tape / Other:	
Depth to Water:		+0.	30	ft		Well depth verified?		CEST NO		
Elevation of Water	r:	-	•);	ft						
WELL PURGING	Rod Cent	ted a s	DATE: 5	130/18		TIME: 12:12			Stall English	
CALCULATION OF 3	3 CASING VOL			50 M		PURGE METHOD:			4 4	
Depth of well from	TOC	29.		ft		Bailer / Grundfos / P	eristaltic / Bladde	er / Other:	whale	
Depth to water			. 30	-ft		Equipment #:	603			
Height of water co	lumn		.74	Vít		r		1		
Conversion factor		<u>×( </u> <b>0</b> .	49	1		Conversion Facto	rs (gallons/ft)			
3 Water volumes				gallons		1.25" well - 0.20	4" well - 1.96	-		
Actual volume purp	ged:	~10		gallons		2" well - 0,49	8" well - 7,83	]		
WATER QUALITY S	TABILIZATION	(if required	d)	The second second	In the second second	E FOUL & SAFES				to <sup>11</sup> Steller et al.
Time	Volume I	ourged	pН	Spec Cond	Dissolved O <sub>2</sub>	Temperature	Eh	Turbidity		
12:12	←start	ourge	(S.U.)	(µmhos/cm)	(mg/L)	(*C)	(mV)	(NTU)		
12:15	3		7.56	NA	NA	11.0	NA	ادر م		
12:19	6		8.11	NA	NA	NA 13.4	NA	SA 118	purged dy -	t ~ 6 gal
1339	ristant	porze		NA	NA	NA	NA	NA	1	
1341	8	2	7.77	NA	NA	Mr 9.4	NA	AK1267		1
1342	10		9.54	NA	NA	NA 9.6	NA	DK 951	purgel day a	at 10 gold
	-	and the second	D 4 2 4	NA	NA	NA	NA	NA	-sicond	s-thempet
FIELD ANALYSES			DATE:	°C	Mb CARACTER	TIME:	Disuidat	NIA.		
Temperature:			NA	-°C			n Dioxide:	NA	mg/L HACH CA-DT (	
pH: Feedle Conductor	1		NA	_S.U		Sulfide		NA		(RL = 0.05mg/L)
Specific Conductan	ice;			_µmhos/cm		Ferrou	s Iron (Fe <sup>+2</sup> ):	NA	_mg/L HACH IR-18C (	(κL = U. 2mg/L)
Eh: Dissolved O <sub>2</sub> :			NA NA	_ <sup>mV</sup> mg/L						
Turbidity:			NA	NTU						
	0.11		1	NIU	Carl Street					
SAMPLE COLLECTION		and the state	DATE:		AND AN UNITED	TIME:	그는 것을 가장			
Sample appearance		Della de		the follow	Othe			Duplicate samp		YES / NO
Collection method	•	baller / Gru	maros / Peris	staltic / Bladder /	Uther:			MS/MSD samp		YES / NO
Equipment #:		0.45	1001 / 0.45	m 192000 / 1101	5			Chain of Custo	y Number:	
Filter used:		υ.45 μm (8	100) / 0.45 μ	m (8200) / NONE						
Quantity	Size	Түре	Filtered		Preservati	ive			Parameters	
	40 mL	Glass	Yes No	None	HCI HNO3	H <sub>2</sub> SO <sub>4</sub> NaOH	~			
	250 mL	Plas C	YAN	ANT:	1-19-	TO NOT				
	500 mL	Plas c	1. NE	6 16 2	. н.о,	1. 20 - 10 - 1	-	1		
	500 mL	Plastic	Yes No	None		H <sub>2</sub> SO <sub>4</sub> NaOH				
	500 mL	Plastic	Yes No	None		H <sub>2</sub> SO <sub>4</sub> NaOH				
	1000 mL	Plastic	Yes No	None	HCI HNO₃	H₂SO₄ NaOH				5
SAMPLING PERSO	CALLS	and the local division of the local division		Contraction of the local division of the loc						

### **GROUNDWATER SAMPLE COLLECTION FORM - STANDARD**

	_					COLLECTION				
Project Name:			as ASD & GW	Monitoring	17	Monitoring Location	1:	MW-	<u> </u>	
Project Number:		180827			5	Sample ID:		NA	line in the	
Site Location:		Marquette,			6	Well Type:			alvanized	
Weather/Temp.:		70, 50	m		÷	Key Number:		0350		
INSPECTION	Control II St	8 - 7 <del>-</del>				and of the date	Theory 4912	A PHU C		and see a set of the second of the
Label on well?			YES OR / RE			ls cement pad in goo	d repair?			
is reference mark			YES My / RI			ls protective casing l				REMEDIED
Standing water pr			CES / NO / RI			ls inner cap in place		ing well?		REMEDIED
Indication of surfa Repair Notes:	ice runoff in w	ell?	YES 🔊 / RI	EMEDIED		is well casing in visib	ly good repair?		O / NO /	/ REMEDIED
				120/15	1	il 112	and the second second			
Top of Casing Elev			DATE: >	ft		TIME: 11.43 Measured with:		Floretunalist	Chalked tape / Ot	
Depth to Water:	ation.	-		ft		Well depth verified?		YES/NO	/ chaiked tape / Ot	ner.
Elevation of Water	er:	0	-70	ft		wen deput vermeur		US NO		
WELL PURGING	1. 1. 1.	n marte d	DATE: 5/	5	- Cateria -	TIME: 1145				Sound Service
CALCULATION OF	3 CASING VOL		1			PURGE METHOD:				
Depth of well from			92	ft		Bailer / Grundfos / P	eristaltic / Bladde	er / Other:	whale	
Depth to water			.70	ft		Equipment #:	607	-		
Height of water co	lumn			ft		8		-		
Conversion factor		X(	0.49)	-		Conversion Facto	rs (gallons/ft)			
3 Water volumes		= 13	2.831	gallons		1.25" well - 0.20	4" well - 1.96			
Actual volume pu	ged:	80	5+3)	gallons		2" well - 0.49	8" well - 7,83	]		
WATER QUALITY	STABILIZATION	lif required	4)	ga nga nga	ز رفسه ک	ۇرىيى <u>تە بىخىنىڭ مە</u> ت			part put on St	
Time	Volume	Purged	рН⊫	Spec Cond	Dissolved O <sub>2</sub>	Temperature	Eh	Turbidity		
1145	←start	purge	(S.U.)	(µmhos/cm)	(mg/L)	(°C)	(mV)			
1149	5		8.01	NA	NA	HA 12.9	NA	Nr 757 B	Jourged day	at ~ 5gal
1320	ristery	purge		NA	NA	NA	NA	NA	i	
1321	6		7.59	NA	NA	NA 10.0	NA	NH2 504 1	2	
1322	8		8.28	NA	NA	I CI MA	NA	NA 10.55 M		y at & gall
				NA	NA	NA	NA	NA	- ncon	d time
FIELD ANALYSES	CONTRACT.		DATE:	NA	NA	NA TIME:	NA	NA		State State State
Temperature:			NA	°C	C. C		n Dioxide:	NA	mg/L HACH CA-	·DT (RL = 10mg/L)
pH:						Sulfide		NA		WR (RL = 0.05mg/L)
Specific Conducta	nce;	5	NA	- μmhos/cm			is Iron (Fe <sup>+2</sup> ):	NA	5	18C (RL = 0.2mg/L)
Eh:		-	NA	mV					5	
Dissolved O <sub>2</sub> :			NA	mg/L						
Turbidity:			NA	NTU						
SAMPLE COLLECT	ION	- iiwini	DATE: 🗢	ta a Superio	- 1. Sec	TIME:	orseal that		Yan - P	周期 机干燥 带成制的化
Sample appearance	ce:							Duplicate samp	le collected?	YES / NO
Collection method	\$:	Bailer / Gru	Indfos / Peris	taltic / Bladder /	Other:			MS/MSD samp	le collected?	YES / NO
Equipment #:				a.				Chain of Custor	dy Number:	
Filter used:		0.45 μm (8	100) / 0.45 µ	m (8200) / NONE	÷					
Quantity	Size	Түре	Filtered		Reservativ	ve			Parameters	
	40 mL	Glass	Yes No	None	HCI HNO3	HSO NaOH				
	250 mL	Plas c	Y= M-	ANG-	TTH OT	No. Nem	5			
	500 mL	Plasic	1. NC .	1 10	HO,		-			
	500 mL	Plastic	Yes No	None		H <sub>2</sub> SO <sub>4</sub> NaOH				
	500 mL	Plastic	Yes No	None		H <sub>2</sub> SO <sub>4</sub> NaOH				
			Yes No	None	HCI HNO3 I	H₂SO₄ NaOH				
SAMPLING PERSC	1000 mL	Plastic	Tes No		the second s		ALC: NOT THE OWNER OF	100 T	The second second second	A state of the second state of the

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### **GROUNDWATER SAMPLE COLLECTION FORM - STANDARD**

roject Name:		MBLP/Shira	is ASD & GW	Monitoring		Monitoring Location	:	M	W-3		
roject Number:		180827				Sample ID:		NIA			
Ite Location:		Marquette, MI				Well Type:		2" galvanized			
eather/Temp.:				Key Number:		0356					
SPECTION	BALL THE			THE ALL IN	percenta la		0 m ≡ 4	and all some	Statistics	in mighting the	
abel on well?			YES MO / RI	EMEDIED		Is cement pad in goo	d repair?		YES / NO / I	REMEDIED N/A	
reference mark v	risible?		YES NO/ RE			ls protective casing l	ocked and in goo	od repair?	CTBS / NO / I	REMEDIED	
tanding water pre	sent?	(	TO / NO / RE	EMEDIED		ls inner cap in place	and properly sea	aling well?	(YES / NO / I	REMEDIED	
ndication of surfac	e runoff in we	ell?	YES NO RE	EMEDIED		Is well casing in visib	ly good repair?		(YB / NO / I	REMEDIED	
epair Notes:											
TATIC WATER LEV	/EL	( in An	DATE: 5/	30/18		TIME: 11.10		81.2	그 가 가 가 나 나 나 나 나 나 나 나 나 나 나 나 나 나 나 나		
op of Casing Eleva	ation:	- 2	M	ft		Measured with:	<		/ Chalked tape / Oth	er:	
Depth to Water:	a	0.1	9	ft		Well depth verified?		YES / NO			
levation of Water	: 3			ft				-			
VELL PURGING		PICIE	DATE: 5	130/18	with a fir	TIME: 1120	MILL STATE				
ALCULATION OF 3	CASING VOLU					PURGE METHOD:					
epth of well from	тос	24	10.1	ft		Bailer / Grundfos / P	eristaltic / Bladd	ler / Other:	while		
epth to water	ä	-( 0		ft		Equipment #:	603	-			
leight of water col	umn	= 28	s. n 🗸	ft				7			
onversion factor	- 	×( 0,	49 1	1		Conversion Facto	rs (gallons/ft)	_			
Water volumes		= 13	.77/	gallons		1.25" well - 0.20	4" well - 1,96	_			
ctual volume pure	ged:	5	800 g	gallons	51	2" well - 0.49	8" well - 7.83		24		
VATER QUALITY S	TABILIZATION	(if required	i)	الله الفقي في	S milever				I The second second		
Time	Volume P	Purged	рН	Spec Cond	Dissolved O	2 Temperature	Eh	Turbidity			
(120	←start p	purge	(S.U.)	(µmhos/cm)	(mg/L)	(°C)	(mV)	(NTU)	kU.		
1124	5	-	8.61	NA	NA		NA	SA3671	pryed day	2 Sgal	
303. 5	restart	puse		NA	NA	- NA-	NA	-NA	1	-	
304	6	1-0	6.95	NA	NA	NA 11.2	NA	NA 1 3+93	44		
1305	5		7.82	NA	NA	WA 8.7	NA	NA 98 NTU	przed dy	A 9 50/ (1)	
1.11				NA	NA	NA	NA	NA	1 2 6	5	
				NA	NA	NA	NA	NA	1		
IELD ANALYSES	lind the		DATE:	May 450-5	1. B 2. A	TIME:	in all state				
emperature:			NA	°C		Carbo	n Dioxìde;	NA	_mg/L HACH CA-D	DT (RL = 10mg/L)	
oH:				S,U,		Sulfid	e:	NA	_mg/L HACH HS-V	VR (RL = 0.05mg/L)	
pecific Conductan	ice:		NA	µmhos/cm		Ferro	is Iron (Fe <sup>+2</sup> ):	NA	_mg/L HACH IR-1	8C (RL = 0.2mg/L)	
h:			NA	mV							
Dissolved O <sub>2</sub> :			NA	mg/L							
urbidity:	2		NA	NTU							
AMPLE COLLECTIO	ON	1 20 20 20 20 20	DATE: 💳			TIME:	A 17-22				
ample appearance								Duplicate sam	-	YES / NO	
collection method		Bailer / Gru	undfos / Peris	staltic / Bladder ,	Other:			MS/MSD samp		YES / NO	
quipment #:			COLO MARTIN	-				Chain of Custo	dy Number:		
ilter used:		0.45 µm (8	100) / 0.45 µ	m (8200) / NON	E					3	
Quantity	Size	Туре	Filtered		Preserva	tive			Parameters		
	40 mL	Glass	Yes No	None	HCI HNO3	HISON NaOH					
	250 mL	Plas c	YON	Ner:	HO HO	MO NO	E -				
	500 mL	Plas c	J.J. N.	1 19.7	] PH o	126293211					
	500 mL	Plastic	Yes No	None	HCI HNO	H <sub>2</sub> SO <sub>4</sub> NaOH					
	500 mL	Plastic	Yes No	None	HCI HNO3	H <sub>2</sub> SO <sub>4</sub> NaOH					
	1000 mL	Plastic	Yes No	None	HCI HNO3	H <sub>2</sub> SO <sub>4</sub> NaOH					
AMPLING PERSO	NNEL 1		stinsin <sup>u</sup> t	/	男長 前式 3	신 동안에 있는 것이 있는 것이 없다.	Nite (1)		5월 14 <b>교망</b>	上于"马马车"的25	
			-								

Project Name:		MBLP/Shira	as ASD & GW	Monitoring	-	Monitoring Loo	ation:	MW	MW-4		
Project Number: Site Location:		180827			2	Sample ID:		-N/A	2" PUL FM		
		Marquette,			2	Well Type:		2º NIL			
Weather/Temp.:	2	64%	andimit	- 7		Key Number:		_N/A			
INSPECTION	Call of the	1.000	e la serie de l	MI IN	Thursdays!		100 ( 10 ) ( 10 )		ment have been as the		
Label on well?			YES NO / RI			Is cement pad i	n good repair?		(VES/ NO / REMEDIED		
Is reference mark	visible?		🚱 NO / RI	EMEDIED		ls protective ca	sing locked and ir	n good repair?	(VES) NO / REMEDIED		
Standing water pre	esent?		YES 🔊 / RI	EMEDIED		ls inner cap in p	lace and properly	y sealing well?	NO / REMEDIED		
Indication of surfa Repair Notes:	ce runoff in we	:11?	YES NO/ RI	EMEDIED		Is well casing in	visibly good repa	air?	CES/ NO / REMEDIED		
STATIC WATER LEV	VEL		DATE: 5/	30/18		TIME: 912	8				
Top of Casing Elev	ation:	NI		ft		Measured with		Electronic tape	Chalked tape / Other:		
Depth to Water:	23	15	35	ft		Well depth veri	fied?	YES/NO			
Elevation of Wate	r:		<u> </u>	ft							
WELL PURGING	and the second second	4. AN S	DATE: 5	30/18	- STATE	TIME: 47	0 (94)(7	R)	The second second second		
CALCULATION OF	3 CASING VOLU			-		PURGE METHO	D:				
Depth of well from	тос	46.	73	ft		Bailer / Grundf	os / Peristaltic / B	ladder / Other:	whole		
Depth to water		-( 15	.35	9		Equipment #:	603	<u> </u>	2.18.62		
Height of water co	lumn	= 31	. 34 .	ft		r					
Conversion factor	10	X( 0	.49)	1		Conversion	Factors (gallons/	(ft) * 14:41	- purget dry a sco two at 8.5 gal t (3 add. Herel gallons		
3 Water volumes		= 15.	39 1	gallons		1.25" well - 0.	20 4" well - :	1.96	the at \$15 cal t		
Actual volume pur	ged: 8.5	( 5.	(+3)	gallons		2" well - 0.49	8" well - 1	7.83	13 and Herel orders		
WATER QUALITY	TABILIZATION	(if require	d)	416.14					C - MA J - C Jahreso		
Time	Volume P	urged	рН	Spec Cond	Dissolved O <sub>2</sub>	Temperatu	re Eh	Turbidity			
470	←start p	ourge	(S.U.)	(µmhos/cm)	(mg/L)	(°C)	(mV)	(NTU)			
0946	5.5		7.46	NA	NA	NA 11.6	NA	NA 23.6	* PURGED DRY CS.5.		
· A#	++		Non	NA	NA	NA-	NA	NA	WILL LET DECONSE MO		
-144-	40.5	-	NM	NA	NA	NA	NA	- NA	SAMPLE 5131.		
1446	restart	purge		NA	NA	NA	NA	NA	HA RETURNED TO PURE		
1447	7		7.50	NA	NA	NA 9.9	NA	WA 401	NEY A SELLOND TIME		
14-18	8		7.70	NA	NA	NA 9.7	NA	NA 30 2	541= 72.33		
FIELD ANALYSES	10 11	ni fioreoti	DATE: -	加拿口增加	516-1280 u	TIME: -					
Temperature:	,		NA	°C		(	arbon Dioxide:	NA	mg/L HACH CA-DT (RL = 10mg/L)		
pH:			//	S.U.			ulfide:	NA	mg/L HACH HS-WR (RL = 0.05mg/L		
Specific Conductar	ice:		NA	µmhos/cm		F	errous Iron (Fe <sup>+2</sup> )	: <u>NA</u>	mg/L HACH IR-18C (RL = 0.2mg/L)		
Eh:		-	NA	mV "							
Dissolved O <sub>2</sub> :			NA	mg/L					Contra and		
Turbidity:			NA	NTU					7		
SAMPLE COLLECTI	ON	19-12-14-14-14-14-14-14-14-14-14-14-14-14-14-	DATE:		1.18	TIME: -			and a man down and participation of		
Sample appearanc								Duplicate sam			
Collection method		Bailer / Gru	undfos / Peris	taltic / Bladder /	Other:			MS/MSD sam			
Equipment #:				-				Chain of Custo	ody Number:		
Filter used:		0.45 µm (8	100) / 0.45 μ	m (8200) / NONI	E						
Quantity	Size	Туре	Filtered	1	Preservat	ve			Parameters		
	40 mL	Glass	Yes No	None		H <sub>2</sub> SO <sub>4</sub> NaOH	r				
	250 mL	Plas c	YEN	ANT NOT		CON -	<u></u>				
	500 mL	Plas c	1. N.	/ 10.	H.O.	362122	110				
	500 mL	Plastic	Yes No	None	HCI HNO3	H <sub>2</sub> SO <sub>4</sub> NaOH					
	500 mL	Plastic	Yes No	None	HCI HNO3	H <sub>2</sub> SO <sub>4</sub> NaOH					

### **GROUNDWATER SAMPLE COLLECTION FORM - STANDARD**

Project Name:		MBLP/Shir	as ASD & GW	/ Monitoring		Monitoring Locatio	in:	MW-S	5
Project Number:	ect Number: 180827		Sample ID: N/A		2				
Site Location:	Location: Marquette, MI			=(	Well Type:		2" DI	VC	
Weather/Temp.:		63°,	overest		=1	Key Number:		NIA	
				2					
INSPECTION	1.192 - 191.10	A POW THE R		-					
Label on well?			YES / NOY R			Is cement pad in go			/ NO / REMEDIED
ls reference mark		- 3	(YES / NO / R			Is protective casing	locked and in goo	od repair?	CES NO / REMEDIED
Standing water p			YES NO/ R			ls inner cap in place	and properly sea	ling well?	(YES/ NO / REMEDIED
Indication of surf	ace runoff in w	/ell?	YES / MO R	EMEDIED		ls well casing in visi	bly good repair?		CYES/ NO / REMEDIED
Repair Notes:				1					
STATIC WATER LI		12-11-1	DATE:	130/18	N=W See 11	TIME: 8:50			Weise shield and shield all the
Top of Casing Ele	vation:			ft -		Measured with:	<	Electronic tap	y / Chalked tape / Other:
Depth to Water:		_14	,79	ft		Well depth verified?	?	(YESY NO	
Elevation of Wate	er:			ft					
WELL PURGING			DATE: S	130/18		TIME: \$ 59	14-1-14 A - 7		
CALCULATION OF			1-0-			PURGE METHOD:			
Depth of well from	n TOC	_ 40	175	- <sup>ft</sup>		Bailer / Grundfos / F		er / Other:	WHALE
Depth to water		-(14	.79	-7		Equipment #:	# 603	-0-	
Height of water co		= 29	96	ft		[		1	
Conversion factor		X( 0.4	.68.	/		Conversion Facto		-	
3 Water volumes	. 3	- 14		gallons		1.25" well - 0.20	4" well - 1.96	-	
Actual volume pu	10.5		.D	gallons		2" well - 0.49	8" well - 7.83	]	
WATER QUALITY	100 m							V - CARLER	
Time	Volume	Street Second	рH	Spec Cond	Dissolved O <sub>2</sub>	Temperature	Eh	Turbidity	
8:59	←start	purge	(S.U.)	(µmhos/cm)	(mg/L)	(°C)	(mV)	(NTU)	
0904	5		7.28	NA	NA	NA	NA	NA	TURBIDAY: 708AV, TEMP: 11.1%
1908	10		7.48	NA	NA	NA	NA	NA	TU:2011TY 199 NTO TEMP/1.0°L
000	- 15	,	7.42	NA	NA	NA	NA	NA	TUR. 11.5 NTS TENS: 6.7"
				NA	NA	NA	NA	NA	
				NA	NA	NA	NA	NA	
FIELD ANALYSES	VILLEN PROPERTY	12-24-27	DATE: 51	NA	NA	NA	NA	NA	
Temperature:		4	NA	°C		TIME: 017	- Disuid		
pH:		7.41		- C S.U.		Sulfide	n Dioxide:	NA	mg/L HACH CA-DT (RL = 10mg/L)
Specific Conducta	nce:		NA	- μmhos/cm			e: Js iron (Fe <sup>+2</sup> ):	NA	mg/L HACH HS-WR (RL = 0.05mg/L)
Eh:		-	NA	mV		remot	is from (Fe ):	NA	mg/L HACH IR-18C (RL = 0.2mg/L)
Dissolved O <sub>2</sub> :			NA	mg/L					
Turbidity:		12.8 -	NA	NTU .					
SAMPLE COLLECT	ON	10.0	DATE:		STANDARD	TIBAC.	1.50 110		·
Sample appearance			DAIL.			TIME;		Dualiation	
Collection method		Bailer / Gru	undfos / Peris	taltic / Bladder /	Other:		-	MS/MSD sam	ple collected? YES / NO
Equipment #:		buildty of a	indices y richts	anticy bladdery	other				
Filter used:		0.45 µm (8)	100) / 0.45 u	m (8200) / NONE		1. A.		Chain of Custo	ay Number:
	- N.		. ,,						
Quantity	Size	Type	Filtered		Preservativ	e			Parameters
	40 mL	Glass	Yes No	None	W1942274-1	2SO₄ NaOH			
	250 mL	Plas c	Y-N-	Ner	MA H OF P	0 N. 40	5		
	500 mL	Plas.c	J. P NL -	7-102	1.7 H Q 1.	2012111	-		
	500 mL	Plastic	Yes No	None	HCI HNO3 H	<sub>2</sub> SO <sub>4</sub> NaOH			
	500 mL	Plastic	Yes No	None	HCI HNO3 H	<sub>2</sub> SO <sub>4</sub> NaOH			
	1000 mL	Plastic	Yes No	None	HCI HNO₃ H	₂SO₄ NaOH			
SAMPLING PERSO	NNEL	/	e i i i					il Pilonfi	
Name (SIGNATU	REL: AL	15	>			Name (SIGNATURE)			

ftceh Z:\2018\180827\WORK\FieldNotes\Forms\Collection\_GW-Std.xlsx

Project Name:		MBLP/Shiras	ASD & GW Monito	oring	Monitoring Lo	ocation:	MW-1				1
Project Numbe	roject Number: 180827			Sample ID:		MBLPS-18-05-N	IW-1(I/MS/MS	D)			
Site Location:		Marquette, N	11		Well Type:		2" as	varied		-	
Weather/Temp	o: 🦷	75 500	ty some	durchs	Key Number:		03	varied 56		-	
NSPECTION	and the second		11			Contraction of the	NICE DI LA COMPANY		webs a martin		
abel on well?			YES / NO/ RI	MEDIED	Is cement pad	in good repair?			YES / NO / REN		1
s reference ma	ark visible?		YES / NO/ RI			asing locked and i	n good repair?		TES / NO / REN		1
tanding water	present?		NO / RI	EMEDIED	Is inner cap in	place and properl	y sealing well?		AND / REN		
ndication of su	irface runoff i	n well?	YES / M / RI			n visibly good rep			VES NO / REN	AEDIED	1
epair Notes:	CASIA	full	+ nate			Aspeo 1					
TATIC WATER	LEVEL	- Autown	DATE: 5/31	118	TIME: 150	-3		in die geschi	67.5888. <b>P</b> P	112 BAC	
Fop of Casing E	Elevation:	NM		/	Measured wit		Electronic tape	/ Chalked tape	/ Other:		1
Depth to Wate	er:	0.04	ft		Well depth ve	rified?	YES / QO				
Elevation of W	ater:		ft	× 5.00							
VELL PURGING	S. VICTOR	in a state of the	DATE: -17 (		TIME: 15	WH BATE	POR 10 M	TUS TO A	יד זיאברדי	0	E 4
urge Method:			DATE: 5/31	O BLADDER / OTHER:	111115. 7		2.5	ft from	TOCor	ottom	Los
quipment No.				U SERUCEN / UTHER.		i amp intake @			_ 10001 1	Joctoni	1
				e General st			_		1 00		1
fleasured well		29.44		Screen length:	5	ft	Depth to screer		26.94	ft	1
Time		er Level eet)	Drawdown (feet)	Pumping Rate (mL/min)	pH (S.U.)	Temp (°C)	Spec Cond (µmhos/cm)	Turbidity (NTU)	Eh (mV)	D.O. (mg/L)	1
1618	6.		6.10	140	7.64	14.3	1357	14.0	472	0.19	1
621	6.		6.11	140	7.63	14.7	134	21.0	471	0.30	1
624	6.		6.11	140	7.62		1378	21.)	471	0.36	1
1627	6.1		6. []		7.62		1370	20.0	470	0.29	1
		)		140	1.00	14.8				0.2	1
	-										1
											1
Volume:	2.1	(Gallons)		Stabilization Criteria:	±0,1	±3%	±3%	±10% for values >20	±10 mV	±10%	1
TELD ANALYSE	s	15/5-4	DATE: 431	18	TIME: 162	-8			N. F. S. D.		4
lemperature:		14.9		Carbon Di	ioxide:	NA	mg/L	HACH CA-DT (	RL = 10 mg/L)		ž.
pH:		7.62	S.U.	Sulfide (S	<sup>2</sup> ):	NA	mg/L	HACH HS-WR	(RL = 0.05 mg/L)		
Specific Conduc	ctance:	1367	µmhos/cm	Ferrous Ire	on (Fe <sup>+2</sup> ):	NA	mg/L	HACH IR-18C (	(RL = 0.2 mg/L)		
Eh:		469	mV								1
Dissolved Oxyg	en:	0.29	mg/L								
furbidity:		14.5	NTU								
AMPLE COLLE	CTION	itten Steel	DATE: 5/3	1/18	TIME: ) 62	29	a that the	而即沿岸	心		
ample appear	ance:	-ila	2				Duplicate samp	le collected?		YES /MO	1
Collection meth	nod: 🛛 🧹	PERISTALTIC	BLADDER / MICR	O BLADDER / OTHER:			MS/MSD samp			YES / NO	
Equipment No.:			52				Chain of Custor	dy Number: Ap	PXITGOH	20361	1
Filter used:		0.45 µm (810	0) / 0.45 µm (8200	NONE			Chain of Custor	dy Number: App	px IV	1000	
								Designated N	AS/MSD location	2060 CR	<i>indi</i>
Quantity	Size	Туре	Filtered		Preservative		-	Para	ameters	2.41	or
	40 mL	Glass	Yes No	None HCI			1	Aller			-
	125 mL	Plastic	Yes No	None HCI	HNO <sub>3</sub> H₂SO	4 NaOH	6	041501			-
3	500 mL	Plastic	No		None				FI	/ .	
3	500 mL	Plastic	No		None		+		i, Calcium	-	Ť
3	500 mL	Plastic	No						H, TDS, SO <sub>4</sub>	Co Thu	1
3	500 mL	Plastic	No		HNO <sub>3</sub>		SD, As,		Co, Pb, Hg, Mo,	se, 11, LI	-
Э	1000 mL 1000 mL	Plastic	No Vos No	Nora 110	HNO <sub>3</sub>	NaCU		Radium 22	6, Radium 228	/	-
	-	Glass	Yes No	None HCI	HNO <sub>3</sub> H <sub>2</sub> SO	NaOH	The second line		ing the second	and the second	
AMPLING PER		and the second									a

# **Appendix B**

User Selected Options Date/Time of Computation From File Full Precision

ProUCL 5.17/27/2018 2:26:36 PM WorkSheet\_a.xls OFF

Dixon's Outlier Test for Background

Number of Observations = 18 10% critical value: 0.424 5% critical value: 0.475 1% critical value: 0.561

1. Observation Value 7.93 is a Potential Outlier (Upper Tail)?

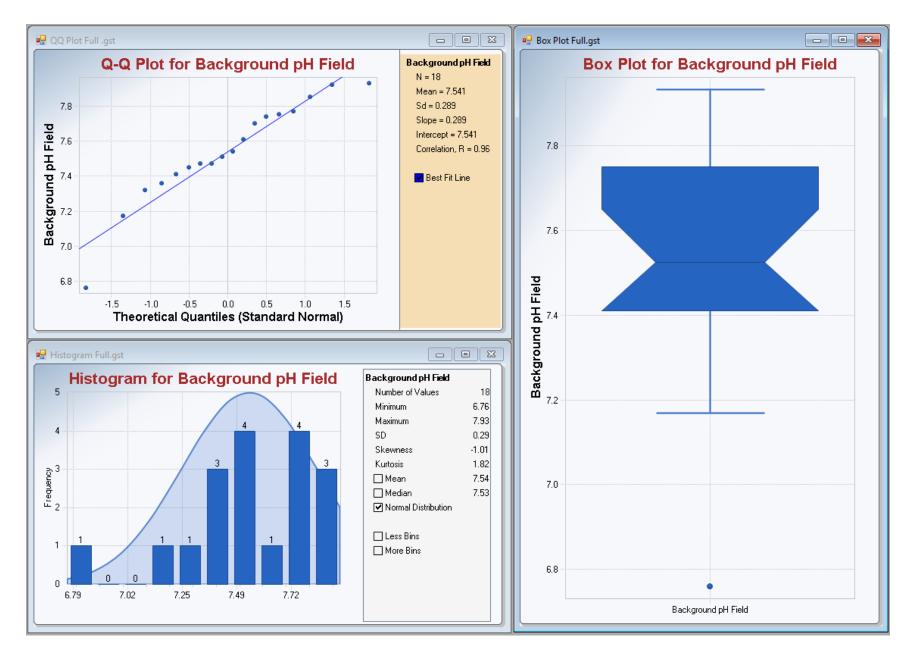
Test Statistic: 0.131

For 10% significance level, 7.93 is not an outlier. For 5% significance level, 7.93 is not an outlier. For 1% significance level, 7.93 is not an outlier.

2. Observation Value 6.76 is a Potential Outlier (Lower Tail)?

Test Statistic: 0.514

For 10% significance level, 6.76 is an outlier. For 5% significance level, 6.76 is an outlier. For 1% significance level, 6.76 is not an outlier.



Data Visualization for detection of Potential Outliers

# **Appendix C**

#### Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.17/27/2018 3:27:19 PM
From File	WorkSheet_a.xls
Full Precision	OFF
Confidence Coefficient	0.99

#### Background

Raw Statistics	
Number of Valid Observations	18
Number of Distinct Observations	17
Minimum	6.76
Maximum	7.93
Mean of Raw Data	7.541
Standard Deviation of Raw Data	0.289
Khat	701.7
Theta hat	0.0107
Kstar	584.8
Theta star	0.0129
Mean of Log Transformed Data	2.02
Standard Deviation of Log Transformed Data	0.0391

#### Normal GOF Test Results

Correlation Coefficient R	0.96
Shapiro Wilk Test Statistic	0.929
Shapiro Wilk Critical (0.01) Value	0.858
Approximate Shapiro Wilk P Value	0.182
Lilliefors Test Statistic	0.112
Lilliefors Critical (0.01) Value	0.235
Data appear Normal at (0.01) Significance Level	

#### Gamma GOF Test Results

Correlation Coefficient R	0.958
A-D Test Statistic	0.387
A-D Critical (0.01) Value	1.006
K-S Test Statistic	0.11
K-S Critical(0.01) Value	0.236
Data appear Gamma Distributed at (0.01) Significance Level	

#### Lognormal GOF Test Results

Correlation Coefficient R	0.953
Shapiro Wilk Test Statistic	0.917
Shapiro Wilk Critical (0.01) Value	0.858
Approximate Shapiro Wilk P Value	0.109
Lilliefors Test Statistic	0.118
Lilliefors Critical (0.01) Value	0.235
Data appear Lognormal at (0.01) Significance Level	

**Appendix D** 

Normal Background Statistics for Uncensored Full Data Sets

User Selected Options			
Date/Time of Computation	ProUCL 5.17/27/2018 2:58:33 PM		
From File	WorkSheet_a.xls		
Full Precision	OFF		
Confidence Coefficient	99%		
Coverage	99%		
New or Future K Observations	1		

#### Background

General Statistics		
Total Number of Observations	18 Number of Distinct Observations	17
Minimum	6.76 First Quartile	7.42
Second Largest	7.92 Median	7.525
Maximum	7.93 Third Quartile	7.748
Mean	7.541 SD	0.289
Coefficient of Variation	0.0384 Skewness	-1.012
Mean of logged Data	2.02 SD of logged Data	0.0391
Critical Values for Background Threshold Values	(BTVs)	
Tolerance Factor K (For UTL)	3.96 d2max (for USL)	2.821
Normal GOF Test		
Character MARIL Track Charlester	0.000 Charling Mills COF Tast	

Shapiro Wilk Test Statistic	0.929 Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.897 Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.112 Lilliefors GOF Test
5% Lilliefors Critical Value	0.202 Data appear Normal at 5% Significance Level
Data appear Normal at 5% Significance Level	
Background Statistics Assuming Normal Distribution	

99% UTL with 99% Coverage	8.686 90% Percentile (z)	7.911
99% UPL (t)	8.303 95% Percentile (z)	8.016
99% USL	8.356 99% Percentile (z)	8.213

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20. Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV

One Sample t-Test for Uncensored Full Data Sets without NDs

User Selected Options	
Date/Time of Computation	ProUCL 5.17/27/2018 3:08:00 PM
From File	WorkSheet_a.xls
Full Precision	OFF
Confidence Coefficient	99%
Substantial Difference	0
Action Level	0
Selected Null Hypothesis	Mean <= Action Level (Form 1)
Alternative Hypothesis	Mean > the Action Level

#### Background

#### One Sample t-Test

Raw Statistics	
Number of Valid Observations	18
Number of Distinct Observations	17
Minimum	6.76
Maximum	7.93
Mean	7.541
Median	7.525
SD	0.289
SE of Mean	0.0682
H0: Sample Mean <= 0 (Form 1)	
Test Value	110.6
Degrees of Freedom	17
Critical Value (0.01)	2.567
P-Value	4.88E-26

Conclusion with Alpha = 0.01 Reject H0, Conclude Mean > 0 P-Value < Alpha (0.01)

# **Appendix E**

### Mann-Kendall Trend Test Analysis

User Selected Options	
Date/Time of Computation	ProUCL 5.17/27/2018 3:40:33 PM
From File	WorkSheet_a.xls
Full Precision	OFF
Confidence Coefficient	0.99
Level of Significance	0.01

pH-mw-1

General Statistics	
Number of Events Reported (m)	9
Number of Missing Events	0
Number or Reported Events Used	9
Number Values Reported (n)	9
Minimum	6.56
Maximum	7.62
Mean	7.449
Geometric Mean	7.442
Median	7.56
Standard Deviation	0.337
Coefficient of Variation	0.0452

Mann-Kendall Test	
M-K Test Value (S)	13
Tabulated p-value	0.13
Standard Deviation of S	9.539
Standardized Value of S	1.258
Approximate p-value	0.104

## Insufficient evidence to identify a significant trend at the specified level of significance.

pH-mw-2

General Statistics	
Number of Events Reported (m)	9
Number of Missing Events	0
Number or Reported Events Used	9
Number Values Reported (n)	9
Minimum	7.03
Maximum	8.41
Mean	7.987
Geometric Mean	7.978
Median	8.09
Standard Deviation	0.386
Coefficient of Variation	0.0483

Mann-Kendall Test	
M-K Test Value (S)	-17
Tabulated p-value	0.06
Standard Deviation of S	9.539
Standardized Value of S	-1.677
Approximate p-value	0.0467

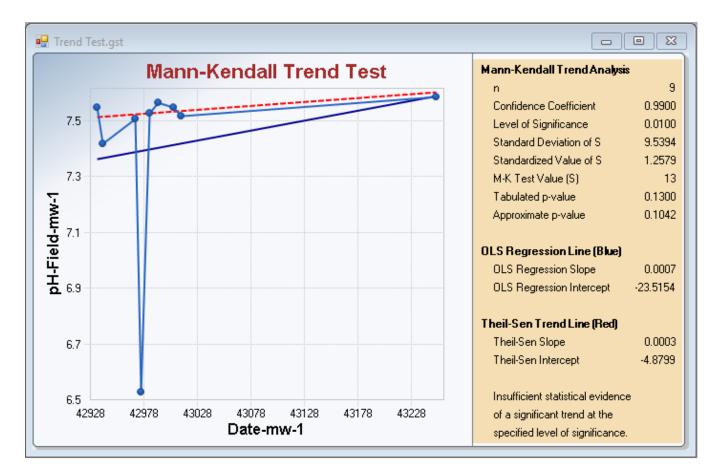
### Insufficient evidence to identify a significant trend at the specified level of significance.

pH-mw-3

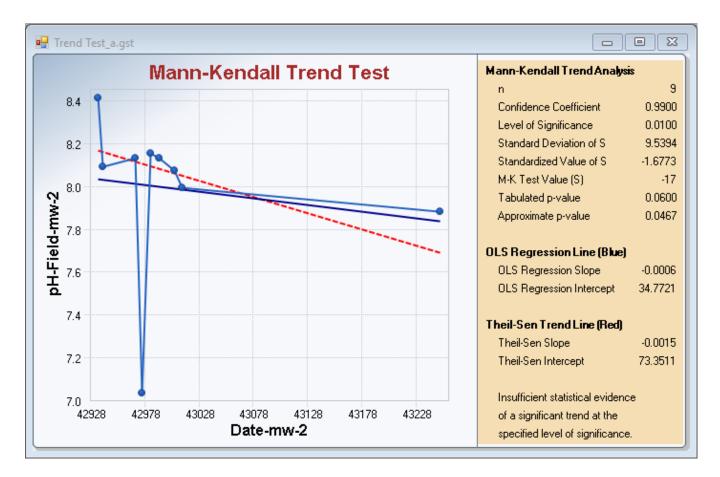
General Statistics	
Number of Events Reported (m)	9
Number of Missing Events	0
Number or Reported Events Used	9
Number Values Reported (n)	9
Minimum	6.32
Maximum	8.1
Mean	7.763
Geometric Mean	7.744
Median	7.86
Standard Deviation	0.556
Coefficient of Variation	0.0716

Mann-Kendall Test	
M-K Test Value (S)	10
Tabulated p-value	0.179
Standard Deviation of S	9.592
Standardized Value of S	0.938
Approximate p-value	0.174

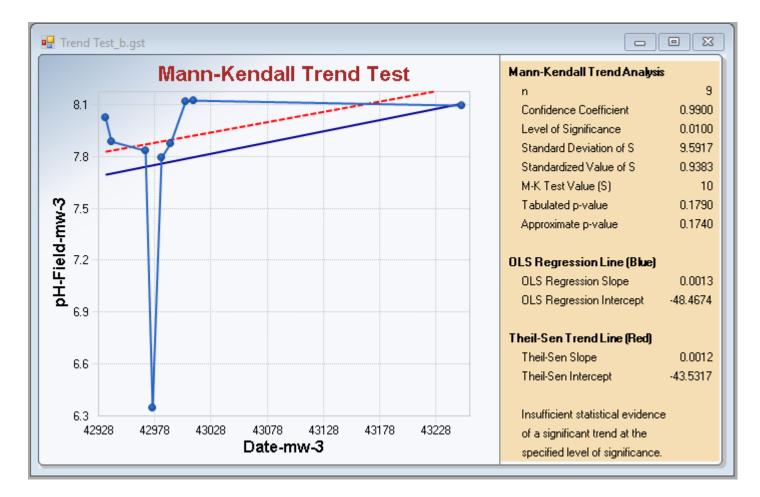
Insufficient evidence to identify a significant trend at the specified level of significance.



**Trend Analysis for MW-1** 



**Trend Analysis for MW-1** 



Trend Analysis for MW-1