

Groundwater Model Progress Report 10, Red Hill Bulk Fuel Storage Facility

JOINT BASE PEARL HARBOR-HICKAM, O'AHU, HAWAI'I

Administrative Order on Consent in the Matter of Red Hill Bulk Fuel Storage Facility, EPA Docket Number RCRA 7003-R9-2015-01 and DOH Docket Number 15-UST-EA-01, Attachment A, Statement of Work Section 6.2, Section 7.1.2, Section 7.2.2, and Section 7.3.2

April 5, 2020
Revision 00



Comprehensive Long-Term Environmental Action Navy
Contract Number N62742-17-D-1800, CTO18F0126

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1 **Groundwater Model Progress**
2 **Report 10, Red Hill Bulk Fuel**
3 **Storage Facility**

4 **JOINT BASE PEARL HARBOR-HICKAM, O'AHU, HAWAI'I**

5 **Administrative Order on Consent in the Matter of Red Hill Bulk Fuel Storage**
6 **Facility, EPA Docket Number RCRA 7003-R9-2015-01 and**
7 **DOH Docket Number 15-UST-EA-01, Attachment A, Statement of Work**
8 **Section 6.2, Section 7.1.2, Section 7.2.2, and Section 7.3.2**

9 **April 5, 2020**
10 **Revision 00**

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22 **Comprehensive Long-Term Environmental Action Navy**
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ACRONYMS AND ABBREVIATIONS

1		
2	AOC	Administrative Order on Consent
3	bgs	below ground surface
4	BWS	Board of Water Supply, City and County of Honolulu
5	CWRM	Commission on Water Resource Management
6	DLA	Defense Logistics Agency
7	DLNR	Department of Land and Natural Resources, State of Hawai‘i
8	DOH	Department of Health, State of Hawai‘i
9	DON; Navy	Department of the Navy, United States
10	EPA	Environmental Protection Agency, United States
11	ft	foot/feet
12	GWMWG	Groundwater Modeling Working Group
13	msl	mean sea level
14	NWIS	National Water Information System
15	PVC	polyvinyl chloride
16	SME	subject matter expert
17	SOW	scope of work
18	TWG	Technical Working Group
19	U.S.	United States
20	USGS	United States Geological Survey
21	UH	University of Hawai‘i
22	WP	work plan

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1. Introduction

This *Groundwater Model Progress Report 10* is the tenth in a series of model progress reports that describe the technical status of the groundwater modeling effort being conducted for the Investigation and Remediation of Petroleum Product Releases and Groundwater Protection and Evaluation project at the Red Hill Bulk Fuel Storage Facility (“Facility”), Joint Base Pearl Harbor-Hickam, O’ahu, Hawai’i. The progress report is a component of the overall project reporting as specified in the project work plan (WP) / scope of work (SOW) (DON 2017a). The WP/SOW presents the process, tasks, and deliverables that address the goals and requirements of Statement of Work Sections 6 and 7 of the *Administrative Order on Consent (AOC) In the Matter of Red Hill Bulk Fuel Storage Facility, EPA Docket No: RCRA 7003-R9-2015-01; DOH Docket No: 15-UST-EA-01* (EPA Region 9 and DOH 2015). Submittal of *Groundwater Model Progress Reports* at a minimum of every 4 months is stipulated in AOC Statement of Work Section 7.1.2.

The objectives of AOC Statement of Work Sections 6 and 7 are to take steps to ensure that the drinking water resources in the vicinity of the Facility are protected and to ensure that operation of the Facility remains protective of human health and the environment. Work to support Section 6 is being conducted in response to the January 2014 release from Tank 5 and to evaluate potential remediation methods for the January 2014 Tank 5 release as well as any potential future releases. Work to support Section 7 is being conducted to monitor and characterize the flow of groundwater in the vicinity of the Facility and includes groundwater modeling. The work conducted under Section 7 will be used to inform changes to the current Red Hill *Groundwater Protection Plan* (DON 2014).

Reporting Period 10 covered in this report represents progress for the tenth approximately 4-month period (November 16, 2019 – March 15, 2020) following the Regulatory Agencies’ conditional approval of the project WP/SOW, which the United States (U.S.) Department of the Navy (DON; Navy) received on December 5, 2016 (EPA Region 9 and DOH 2016). *Groundwater Model Progress Reports 01 – 09* were submitted previously (DON 2017b; 2017c; 2017d; 2018a; 2018b; 2018c; 2019a; 2019c; 2019d).

2. Work Completed This Reporting Period

2.1 CURRENT STATUS

Groundwater Modeling Working Group (GMMWG). The GMMWG is composed of representatives from the Navy, Defense Logistics Agency (DLA), U.S. Geological Survey (USGS), U.S. Environmental Protection Agency (EPA), State of Hawai’i Department of Health (DOH), State of Hawai’i Department of Land and Natural Resources (DLNR) Commission on Water Resource Management (CWRM), City and County of Honolulu Board of Water Supply (BWS), and the University of Hawai’i (UH). The working group was formed to coordinate the Navy’s development of accurate and reliable groundwater flow and contaminant fate and transport models, and to solicit technical feedback from stakeholders during the model development process. Each meeting includes a review of the modeling objectives and responses to previous meeting action items. No GMMWG meetings were held during this reporting period.

AOC Parties and Subject Matter Experts (SMEs) Meetings. The AOC Parties Technical Working Group (TWG) met one time during this reporting period, on March 5, 2020. The main topics covered at the meeting are described below:

- *TWG Meeting #24, March 05, 2020*
 - *Groundwater Flow Model Report*

- 1 – Multimodel approach
- 2 – Model calibration / verification
- 3 – Multimodel applicability for risk-based decision making

4 **2.1.1 Technical Progress**

5 2.1.1.1 GROUNDWATER SAMPLING

6 During this reporting period, the Navy performed the First Quarter 2020 Red Hill groundwater
7 monitoring event. The following monitoring locations were sampled during this event:
8 RHMW2254-01; RHMW01 through RHMW10; RHMW11 Zone 5; RHMW14 Zones 1, 2, and 3;
9 RHMW15 Zones 3, 4, and 5; HDMW2253-03; and OWDFMW01. Analytical data will be presented
10 in the forthcoming First Quarter 2020 quarterly groundwater monitoring report.

11 Additionally, a monthly groundwater sampling event was performed in March 2020 at RHMW13
12 Zones 1 to 5. Analytical data will be included in the forthcoming Second Quarter 2020 quarterly
13 groundwater monitoring report.

14 2.1.1.2 FIELD ACTIVITIES

15 The Navy conducted the following field work during this reporting period (see Figure 1 for well and
16 test boring locations).

17 **RHMW11:**

- 18 • Downloaded transducer data.
- 19 RHMW11 planned future activities:
- 20 • Continue downloading transducer data.

21 **RHMW12:**

- 22 • Completed installation of RHMW12 (conventional well) above the regional basal aquifer
23 piezometric surface.
 - 24 • Performed well development.
 - 25 • USGS installed LT 700H vented pressure transducer.
- 26 RHMW12 planned future activities:
- 27 • Continue with USGS monitoring of water levels.
 - 28 • Periodically download transducer data from the USGS National Water Information System
29 (NWIS) website.

30 **RHMW13:**

- 31 • Completed installation of multilevel Westbay well.
- 32 • Installed Westbay MOSDAX pressure transducers in completed Westbay zones.
- 33 • Purged RHMW13 Zones 1 through 5a.
- 34 • Sampled RHMW13 Zones 1 through 5a.

1 RHMW13 planned future activities:

- 2 • Continue downloading transducer data.

3 **RHMW14:**

- 4 • Downloaded transducer data.

5 RHMW14 planned future activities:

- 6 • Continue downloading transducer data.

7 **RHMW15:**

- 8 • Downloaded transducer data.

9 RHMW15 planned future activities:

- 10 • Continue downloading transducer data.

11 **RHMW19:**

- 12 • Commenced road and drill pad construction.

13 RHMW19 planned future activities:

- 14 • Install multilevel Westbay System well

15 **RHTB01:**

- 16 • Downloaded transducer data.

17 RHTB01 planned future activities:

- 18 • Continue downloading transducer data.

19 **2.1.1.3 RECENTLY COLLECTED HYDROGEOLOGIC DATA**

20 **RHMW11.** A discussion on RHMW11 multilevel well construction is presented in the *Conceptual*
21 *Site Model Revision 01* report (DON 2019b). Monitoring in RHMW11 used non-vented MOSDAX
22 pressure transducers in Zones 5, 6, 7, and 8 during this reporting period. The pressure transducers were
23 removed to facilitate purging and sampling of select zones for the First Quarter 2020 groundwater
24 monitoring event. As discussed in *Groundwater Model Progress Report 09* (DON 2019d),
25 groundwater levels in all zones appear to either have equilibrated or are asymptotically approaching
26 equilibration within the formations the zones are completed in. Hydrographs for RHMW11 for this
27 reporting period are presented in Appendix A. Data from monitoring well UMW-1, located at the
28 Hālawā Correctional Facility, have been added to these hydrographs for comparison. Heads in Zones
29 6, 7, and 8 remained well above the regional basal aquifer piezometric elevation. Heads in UMW-1
30 remained more than 40 ft above Zone 8. Heads in UMW-1 are shown for comparison to Westbay zones
31 since this well was described by the original investigators (Unitek 1988) as being completed in a
32 perched water zone above the regional basal aquifer. Heads in Zone 5 (regional basal aquifer) oscillate
33 in the range of approximately 18–19 feet (ft) mean sea level (msl).

34 **RHMW12.** The USGS installed a LT 700H vented pressure transducer in the open borehole
35 (approximately 22–37 ft msl). Head data from the open borehole, presented in Appendix A, were on
36 the order of 53 ft msl.

1 RHMW12 well construction was completed on January 27, 2020. The boring log of RHMW12 is
 2 included in Appendix B of this report, and the well completion log is presented in Appendix C. The
 3 well was completed with 3-inch-diameter Schedule 80 polyvinyl chloride (PVC) well casing. The well
 4 was screened between approximately 22 and 37 ft msl. The 3-inch PVC well casing was installed in
 5 the existing 5-inch-diameter Schedule 40 steel casing from 0 to 200 ft below ground surface (bgs) and
 6 in the ~4.83-inch-diameter open borehole (PQ size) from 200 to 215 ft bgs. The lower 15-ft section of
 7 casing in the open borehole was screened with 0.020-inch slots. The casing was stabilized inside the
 8 existing 5-inch-diameter Schedule 40 steel casing with K-Packer well seals top and bottom with
 9 centralizers spaced between the K-Packers. Packers were installed at approximately 5 ft and 190 ft
 10 bgs. No annular materials were added, which will allow for removal of the PVC casing in the event
 11 that redesign is warranted in the future. The recommended well design will accommodate a number of
 12 sampling methods, including a submersible pump, HydraSleeves, and Snap Samplers. The surface
 13 completion consists of a steel vault designed to secure and lock the well. The USGS installed a LT
 14 700H vented pressure transducer in the completed well on January 31, 2020.

15 **RHMW13.** The geology encountered at RHMW13 is described in *Groundwater Model Progress*
 16 *Report 09* (DON 2019d). The boring log of RHMW13 is included in Appendix B of this report.
 17 Multilevel well RHMW13 was completed with five discrete zones that are independently sealed and
 18 isolated using a series of Westbay System packers (as illustrated on the well completion log in
 19 Appendix C). The well is constructed with Zone 1 as the deepest zone, with each subsequent zone
 20 completed at a shallower depth, Zone 5 as the shallowest.

21 Non-vented Westbay MOSDAX pressure transducers were deployed in Zones 1 through 5 from
 22 January 31, 2020 through February 12, 2020. The pressure transducers were removed from the zones
 23 to facilitate purging and sampling of all five zones. All five zones were completed in basalt with
 24 variable degrees of weathering. Information on Westbay zone completion at RHMW13 is presented in
 25 Table 1, and the summary completion log is presented in Appendix C.

26 **Table 1: RHMW13 Westbay Zone Completion Summary**

Zone Identifier	Zone Top (ft bgs)	Zone Bottom (ft bgs)	Zone Top (elevation ft msl)	Zone Bottom (elevation ft msl)	Generalized Geology
Zone 5	214.3	231.6	33.7	16.4	Basalt
Zone 4	234.6	268.8	13.4	-20.8	Basalt
Zone 3	271.8	317.1	-23.8	-69.1	Basalt
Zone 2	320.1	388.3	-72.1	-140.3	Basalt
Zone 1	401.3	442.3	-153.3	-194.3	Basalt

27 Notes: Approximate ground surface elevation = 248 ft msl.

28 Hydrographs for RHMW13 for this reporting period are presented in Appendix A. All zones have
 29 relatively similar piezometric head measurements of approximately 19–20 ft msl, consistent with the
 30 expected piezometric surface of the regional basal aquifer. Heads in Zones 3 and 4 are slightly higher
 31 than other zones, and heads are lowest in Zone 1.

32 **RHMW14.** A discussion on RHMW14 multilevel well Westbay construction is presented in
 33 *Groundwater Model Progress Report 08* (DON 2019c). Monitoring in RHMW14 used non-vented
 34 Westbay MOSDAX pressure transducers in Zones 1 through 7 during this reporting period. The
 35 pressure transducers were removed to facilitate purging and sampling of select zones for the First
 36 Quarter 2020 groundwater monitoring event. Hydrographs for RHMW14 during this reporting period,
 37 presented in Appendix A, show that heads in Zones 1, 2, and 3 are consistent with the regional basal

1 aquifer. Heads in Zone 4 are generally about 2 ft higher than heads in Zones 1, 2 and 3. Heads in
2 Zones 5, 6, 7, and 8 range from approximately 17 ft (Zones 5–6) to more than 40 ft (Zones 7–8) above
3 the regional basal aquifer.

4 **RHMW15.** The geology encountered at multilevel well RHMW15 is described *Groundwater Model*
5 *Progress Report 08* (DON 2019c). Monitoring in RHMW15 used non-vented Westbay MOSDAX
6 pressure transducers in Zones 1 through 5 during this reporting period. The pressure transducers were
7 removed to facilitate purging and sampling of select zones for the First Quarter 2020 groundwater
8 monitoring event. Hydrographs for RHMW15 for this reporting period are presented in Appendix A.
9 All zones have relatively similar piezometric head measurements of approximately 19–20 ft msl,
10 consistent with the expected piezometric surface of the regional basal aquifer. Heads are highest in
11 Zone 4 and lowest in Zone 1.

12 **RHTB01.** A discussion of test boring RHTB01's four grouted-in-place vibrating wire piezometers is
13 presented in *Groundwater Model Progress Report 09* (DON 2019d). Hydrographs for RHTB01 for
14 this reporting period are presented in Appendix A. Heads in all four monitoring zones declined slightly
15 during this reporting period, but heads in Zone 2, 3, and 4 remained more than 50 ft above the expected
16 regional basal aquifer piezometric head (19–20 ft msl).

17 2.1.1.4 GROUNDWATER MODELING

18 The Navy conducted the following groundwater modeling activities this reporting period:

- 19 • Held weekly groundwater modeling team progress meetings to establish short-term milestones
20 and resolve technical issues as they arose.
- 21 • Developed and delivered transient calibration runs, calibration verification runs, and
22 predictive particle tracking runs for ten model variants. As part of the multimodel approach,
23 the various models allow examination of a range of reasonable outcomes by testing different
24 conceptual models to verify that they can match field data, followed by evaluating their
25 predictions. Each calibrated model represents hundreds to thousands of model calibration runs
26 leading to the final versions. The models delivered include:
 - 27 – Model 51, Model 51 variants (51a, 51b, 51c, 51d, and 51e)
 - 28 – Models 52, 53, 54, 55, 56, 57, 58, and 59
- 29 • Produced text and figures for the March 25, 2020 *Groundwater Flow Model Report*. This
30 report contains over 200 figures illustrating the different geologic and hydrologic concepts
31 explored with the modeling, and the results of calibration and predictive runs made with the
32 models.

33 2.1.2 Technical Issues

34 No technical issues were identified during this reporting period.

35 2.2 SUBMITTAL OF MODELING DELIVERABLES

36 Relevant deliverables submitted during this reporting period include:

- 37 • *Final Fourth Quarter 2019 - Quarterly Groundwater Monitoring Report* (DON 2020)
- 38 • *Draft First Quarter 2020 - Quarterly Groundwater Monitoring Report*

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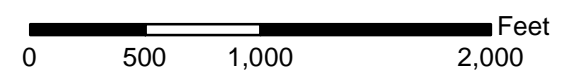
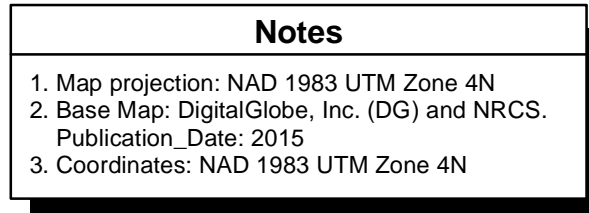
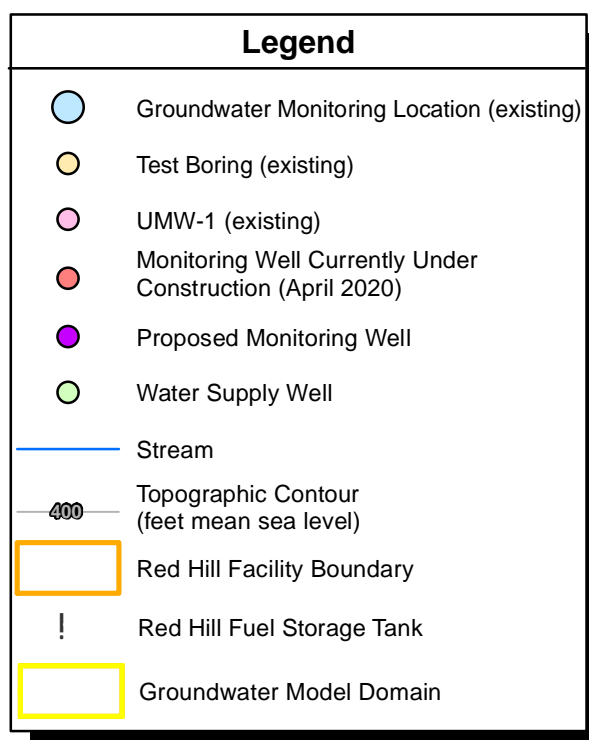
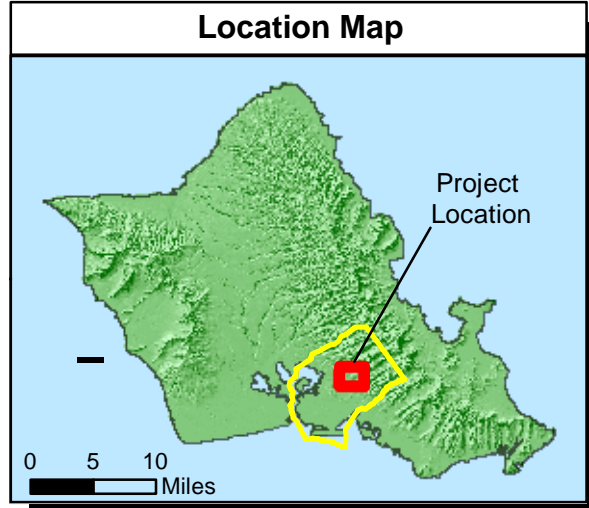
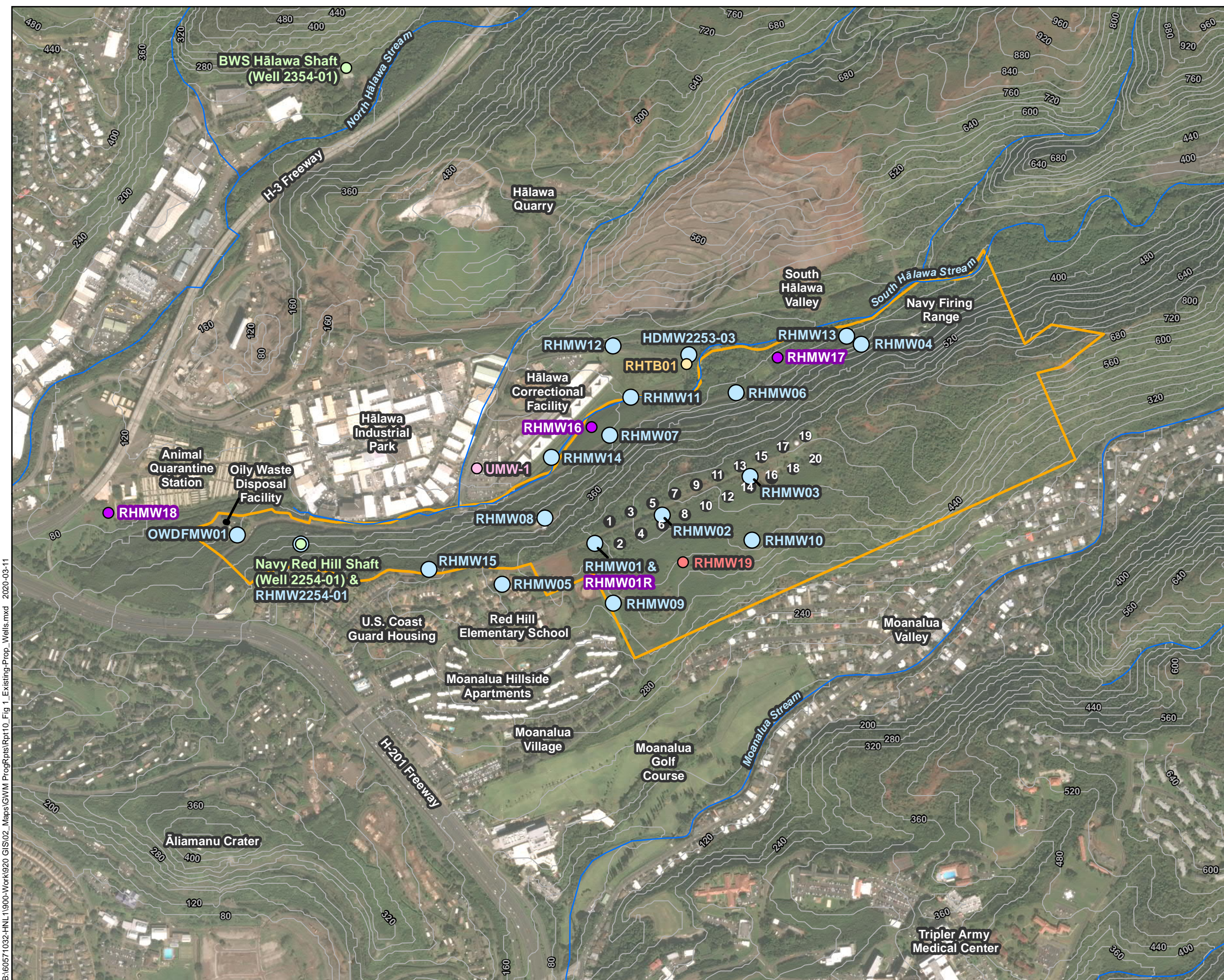


Figure 1
Existing and Proposed
Groundwater Monitoring Well
and Boring Locations
Groundwater Model Progress Report 10
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i

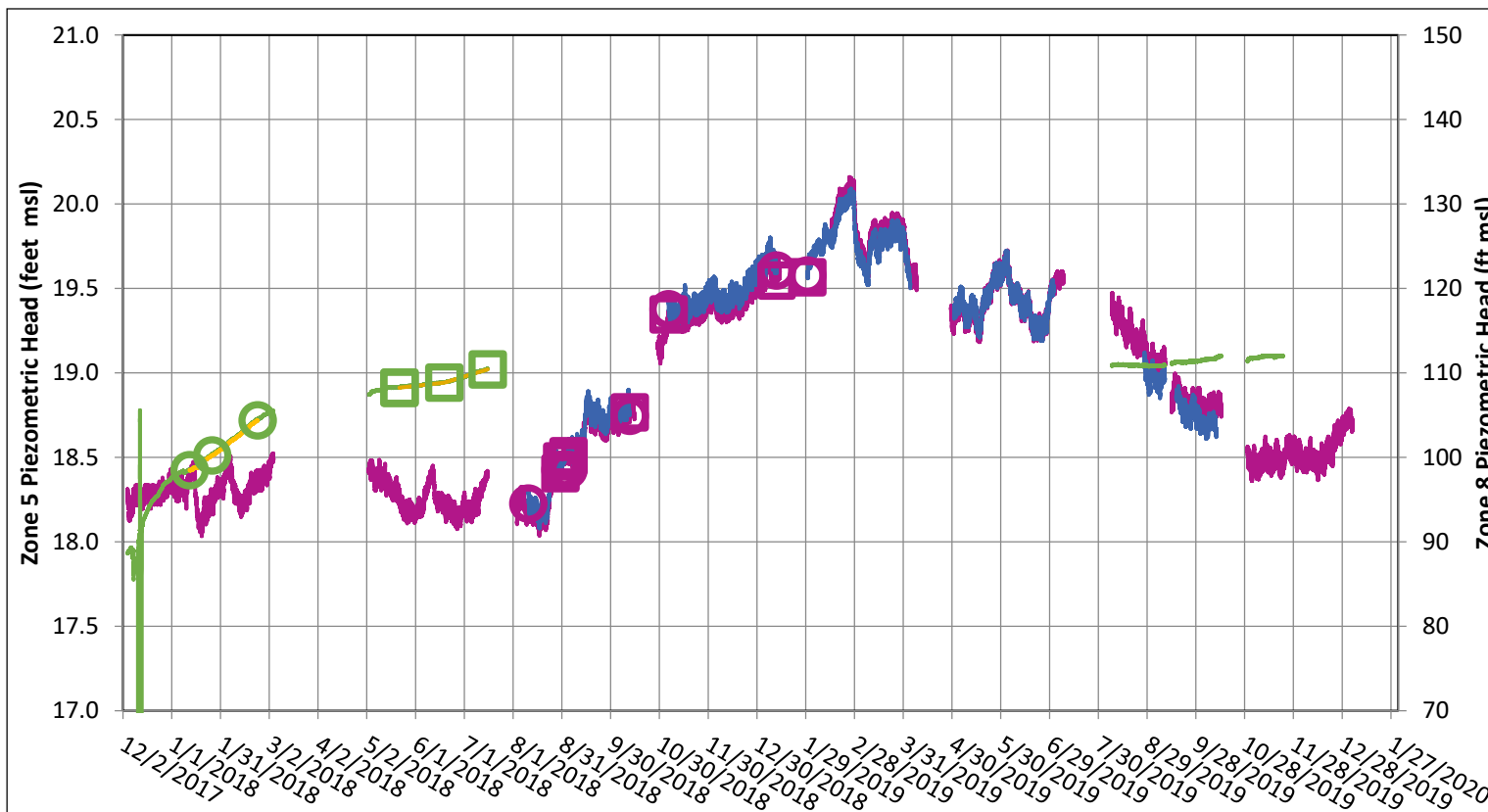
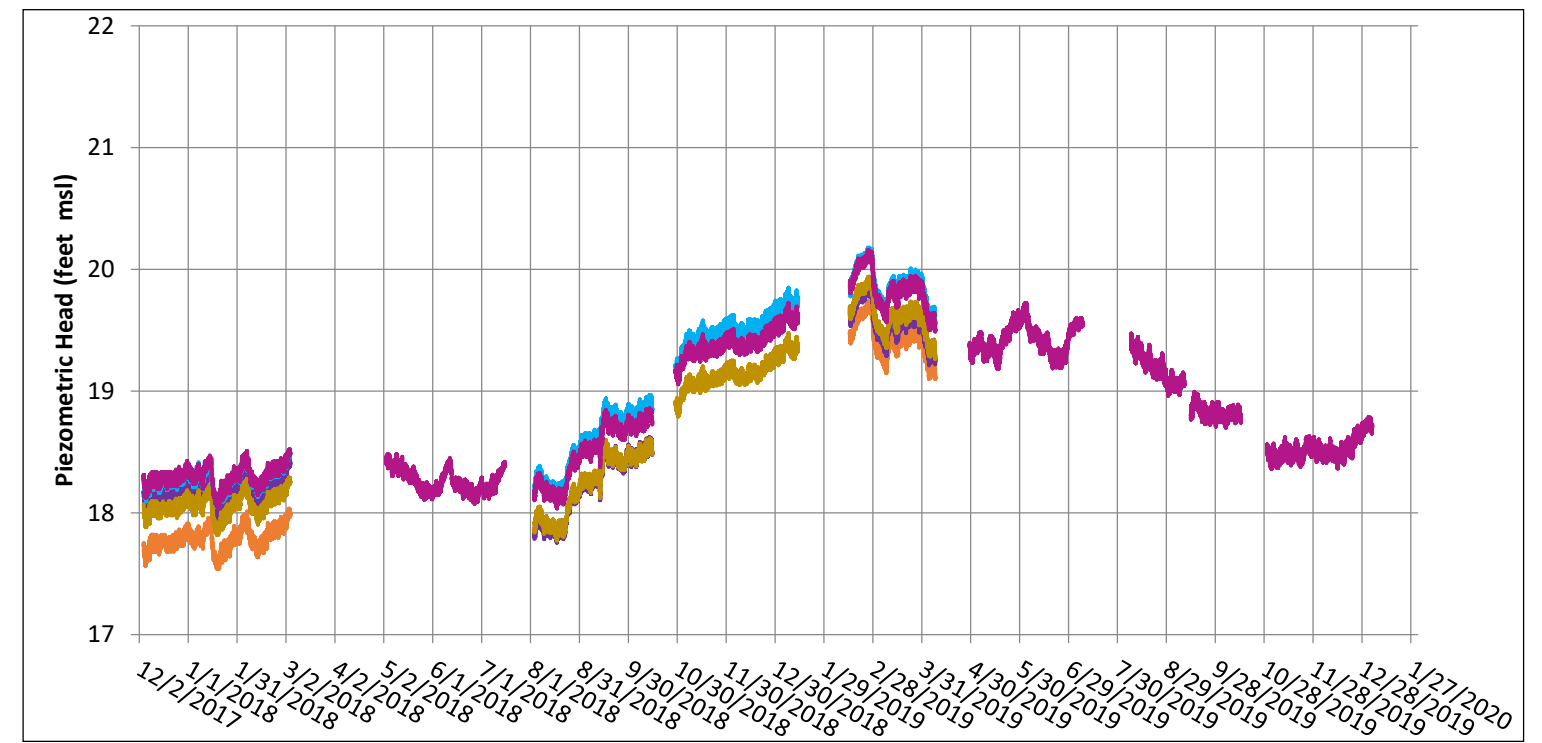
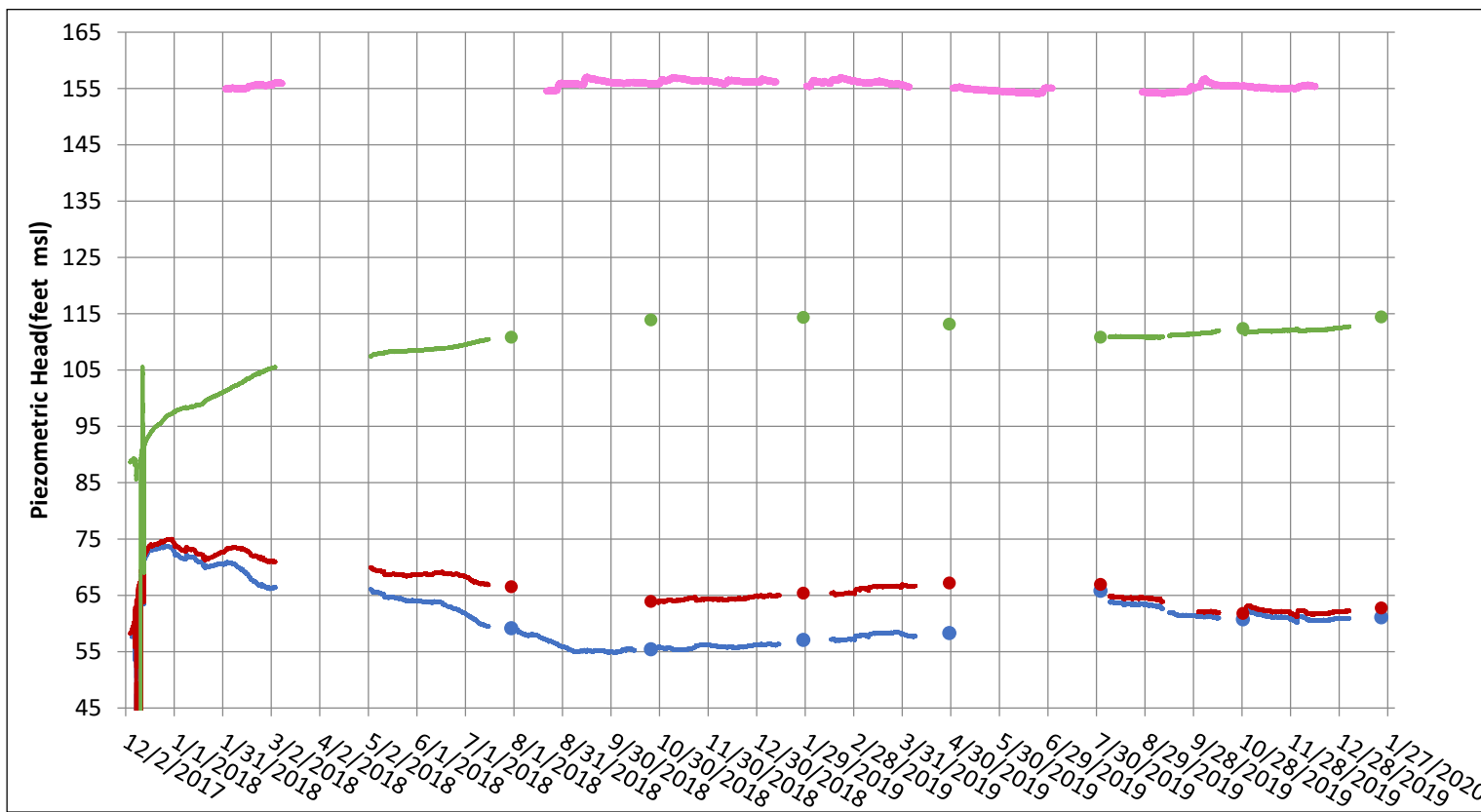
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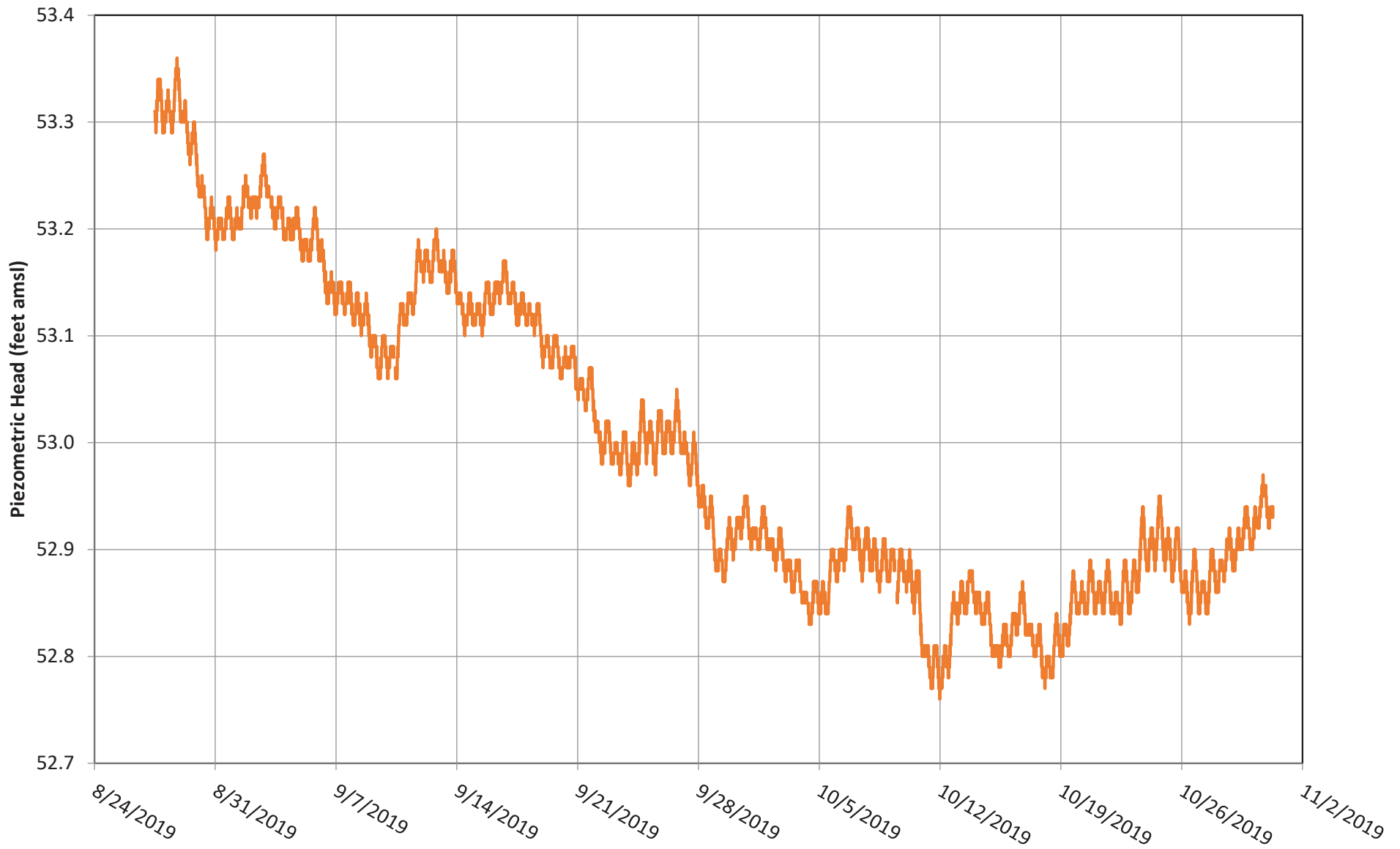
Appendix A: Hydrographs

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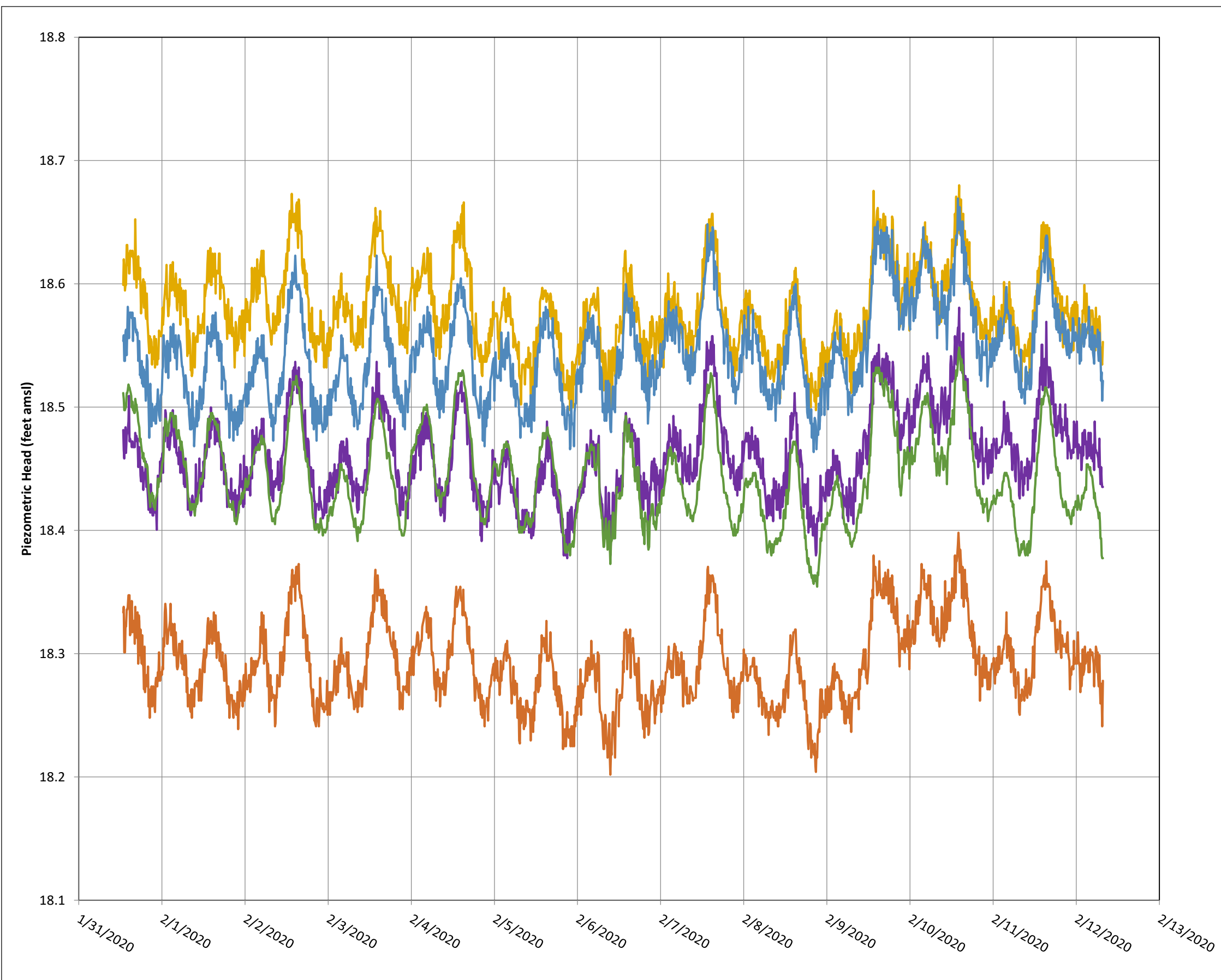


LEGEND		Generalized Geology	Zone Top (ft msl)	Zone Bottom (ft msl)
—	Zone 8 – MOSDAX Transducer	Saprolite	51.06	5.86
—	Zone 7 – MOSDAX Transducer	Saprolite	0.56	-29.44
—	Zone 6 – MOSDAX Transducer	Saprolite	34.64	-45.14
—	Zone 5 – MOSDAX Transducer	Basalt	-66.94	-19.94
—	Zone 4 – MOSDAX Transducer	Basalt	-120.14	-132.44
—	Zone 3 – MOSDAX Transducer	Basalt	-137.44	-156.64
—	Zone 2 – MOSDAX Transducer	Basalt	-183.64	-209.94
—	Zone 1 – MOSDAX Transducer	Basalt	-239.91	-259.15
—	UMW-1 – 700H Vented Transducer			
●	Zone 8 – Pressure Profile			
●	Zone 7 – Pressure Profile			
●	Zone 6 – Pressure Profile			
—	Zone 8 – 700H Vented Transducer			
○	Zone 8 USGS Hand Measurements			
□	Zone 8 Navy Hand Measurements			
—	Zone 5 – 700H Vented Transducer			
○	Zone 5 USGS Hand Measurements			
□	Zone 5 Navy Hand Measurements			

RHMW11 and UMW-1 – Long-Term Piezometric Heads
 Groundwater Model Progress Report 10
 Red Hill Bulk Fuel Storage Facility
 JBPHH, O'ahu, Hawai'i



**RHMW12 (open borehole) – Long-Term Piezometric Heads
Groundwater Model Progress Report 10
Red Hill Bulk Fuel Storage Facility
JBPHH, O’ahu, Hawai’i**

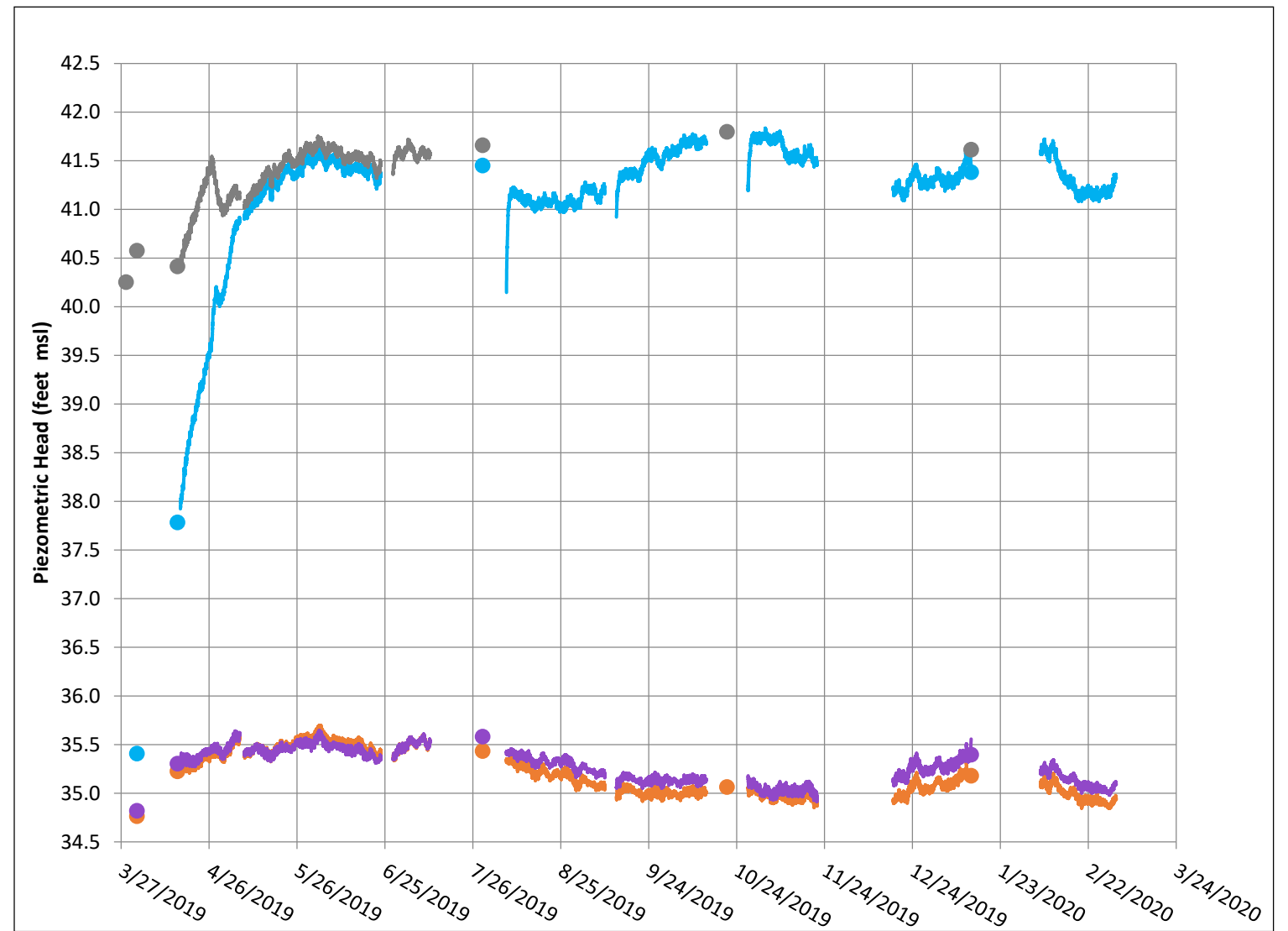
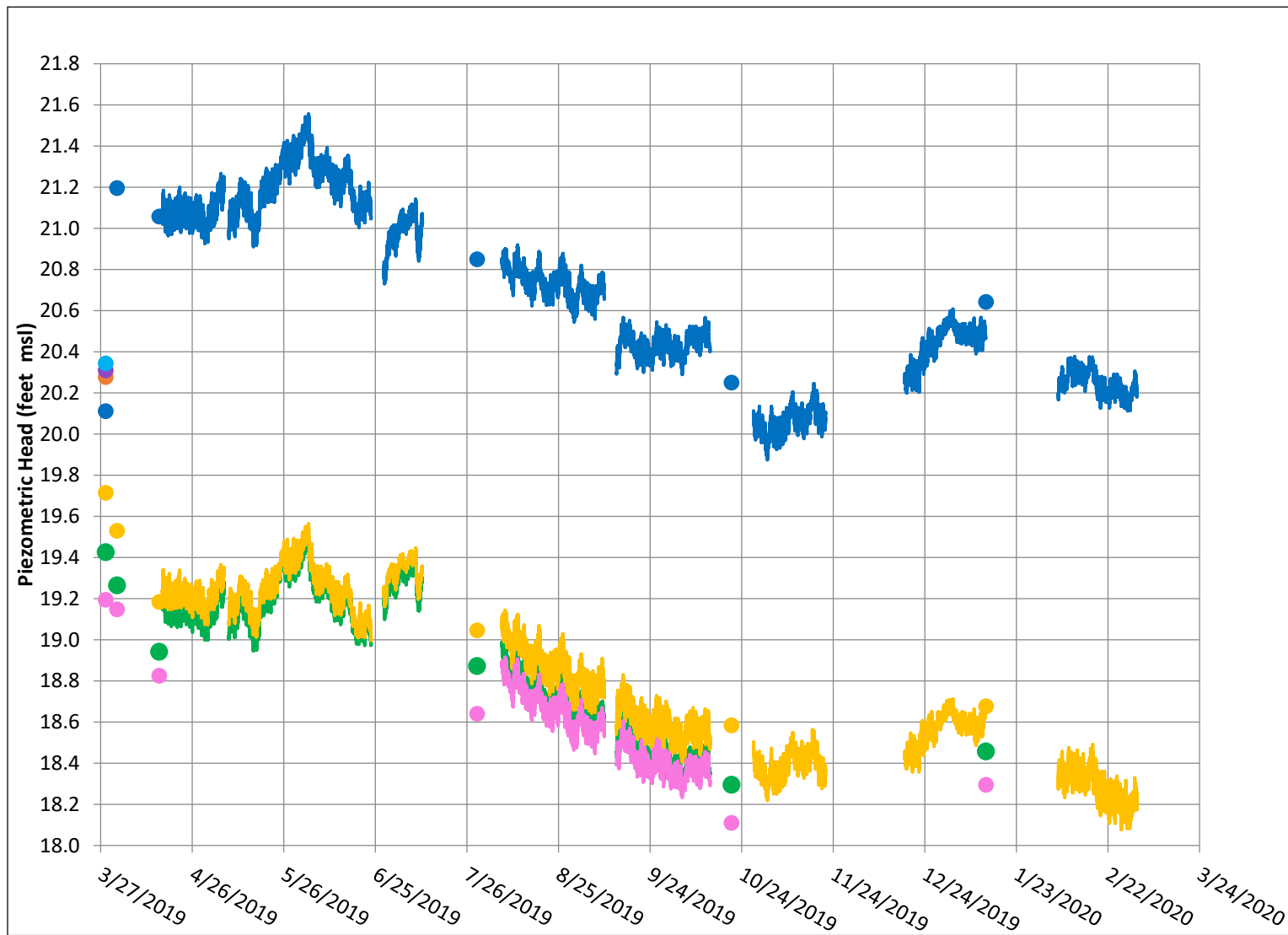


LEGEND

- Zone 5 – MOSDAX Transducer
- Zone 4 – MOSDAX Transducer
- Zone 3 – MOSDAX Transducer
- Zone 2 – MOSDAX Transducer
- Zone 1 – MOSDAX Transducer

<u>Zone</u>	<u>Generalized Geology</u>	<u>Zone Top (ft msl)</u>	<u>Zone Bottom (ft msl)</u>
5	Basalt	33.7	16.4
4	Basalt	13.4	-20.8
3	Basalt	-23.8	-69.1
2	Basalt	-72.1	-140.3
1	Basalt	-153.3	-194.3

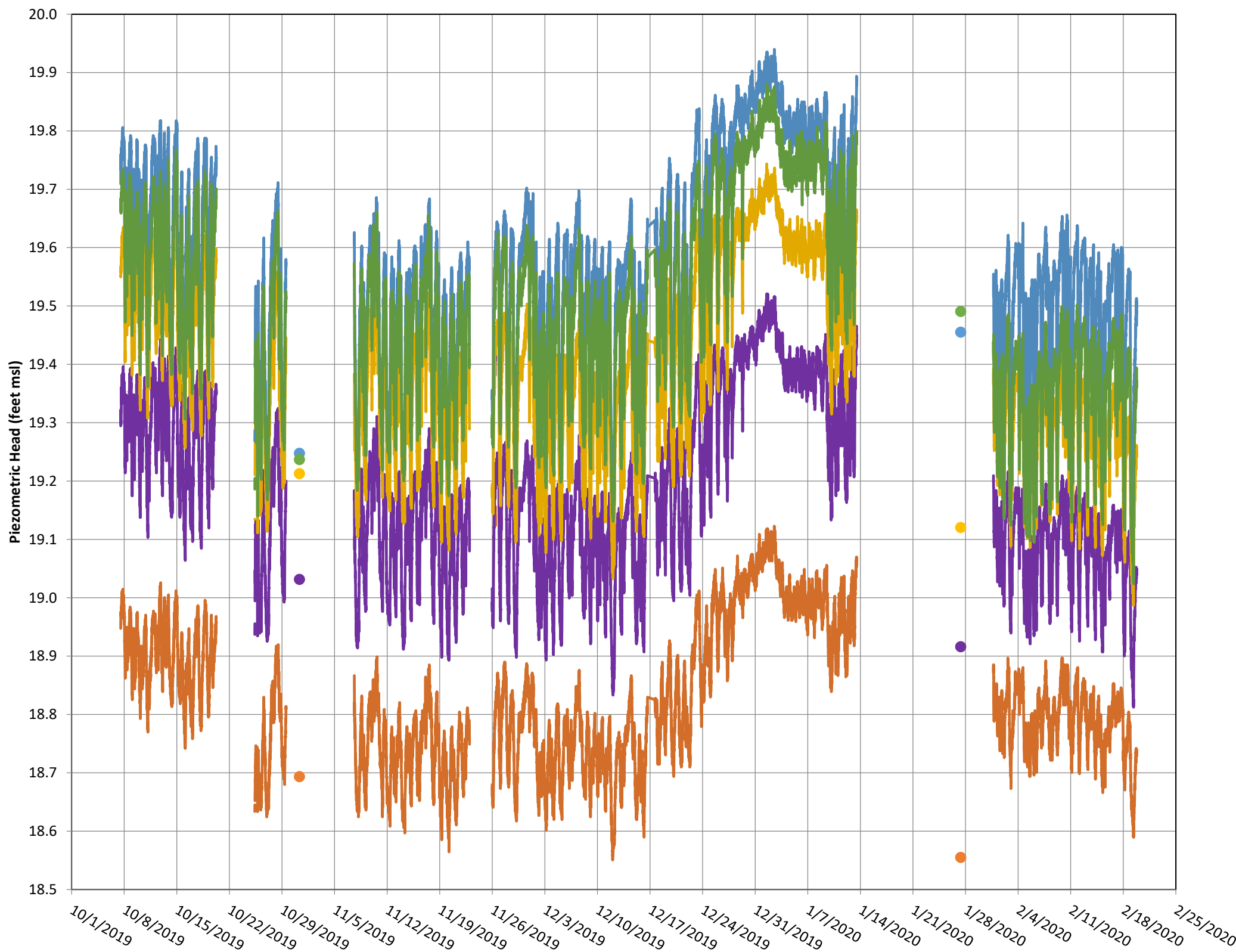
**RHMW13 – Long-Term Piezometric Heads
Groundwater Flow Model Progress 10
Red Hill Bulk Fuel Storage Facility
JBPHH, O’ahu, Hawai’i**



<u>LEGEND</u>		<u>Generalized Geology</u>	<u>Zone Top (ft msl)</u>	<u>Zone Bottom (ft msl)</u>
—	Zone 8 – MOSDAX Transducer	Weathered Basalt	49.8	30.8
—	Zone 7 – MOSDAX Transducer	Weathered Basalt	25.8	10.8
—	Zone 6 – MOSDAX Transducer	Weathered Basalt	32.8	-19.2
—	Zone 5 – MOSDAX Transducer	Basalt	-24.2	-36.2
—	Zone 4 – MOSDAX Transducer	Basalt	-65.2	-85.4
—	Zone 3 – MOSDAX Transducer	Basalt	-140.4	-157.3
—	Zone 2 – MOSDAX Transducer	Basalt	-230.6	-243.2
—	Zone 1 – MOSDAX Transducer	Basalt	-273.8	-285.0

<u>LEGEND</u>		<u>Generalized Geology</u>	<u>Zone Top (ft msl)</u>	<u>Zone Bottom (ft msl)</u>
●	Zone 8 – Pressure Profile	Weathered Basalt	49.8	30.8
●	Zone 7 – Pressure Profile	Weathered Basalt	25.8	10.8
●	Zone 6 – Pressure Profile	Weathered Basalt	32.8	-19.2
●	Zone 5 – Pressure Profile	Basalt	-24.2	-36.2
●	Zone 4 – Pressure Profile	Basalt	-65.2	-85.4
●	Zone 3 – Pressure Profile	Basalt	-140.4	-157.3
●	Zone 2 – Pressure Profile	Basalt	-230.6	-243.2
●	Zone 1 – Pressure Profile	Basalt	-273.8	-285.0

RHMW14 – Long-Term Piezometric Heads
Groundwater Flow Model Progress 10
Red Hill Bulk Fuel Storage Facility
JBPBH, O’ahu, Hawai’i

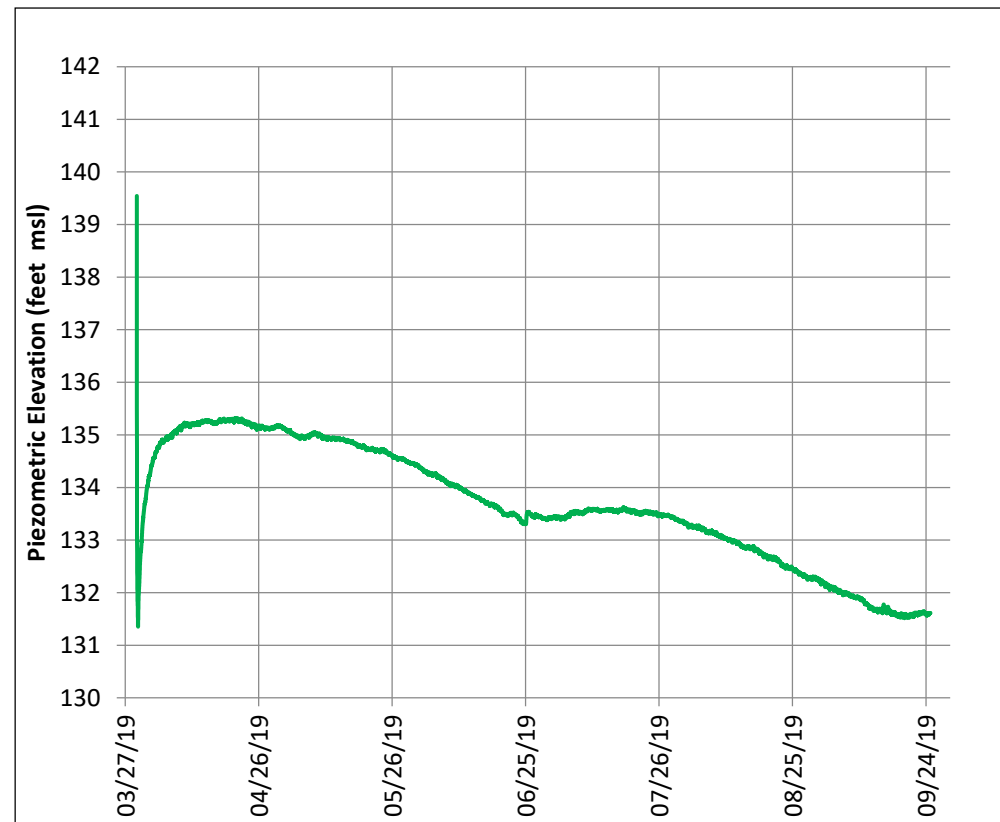
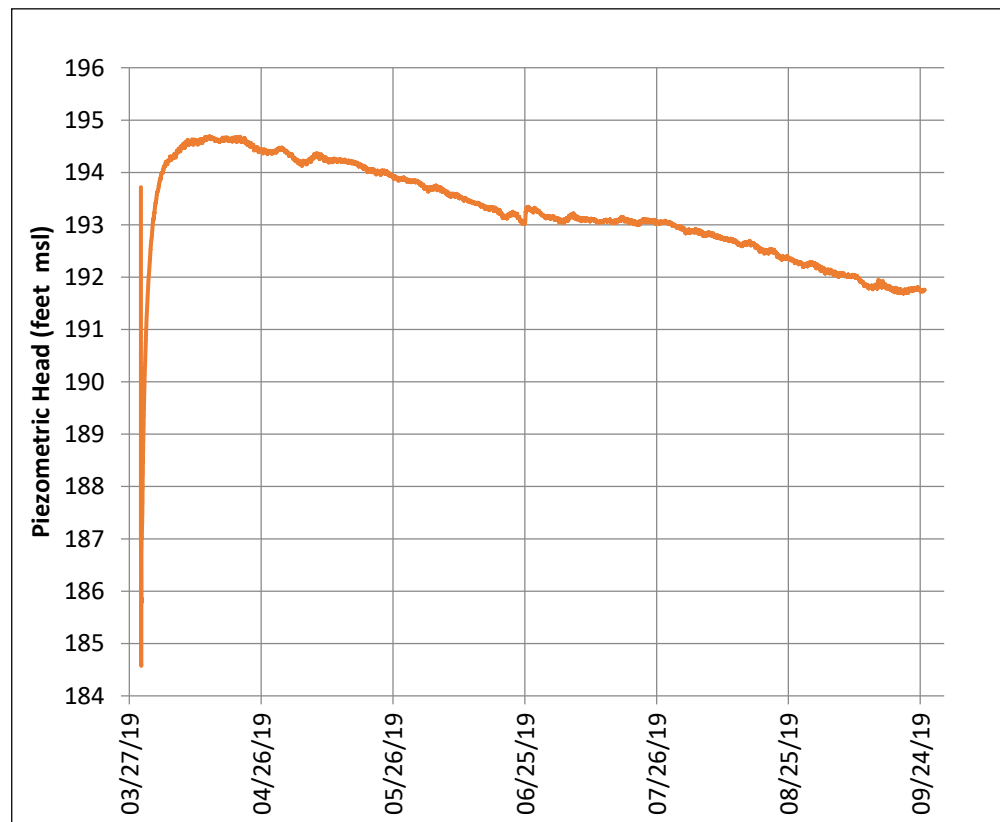
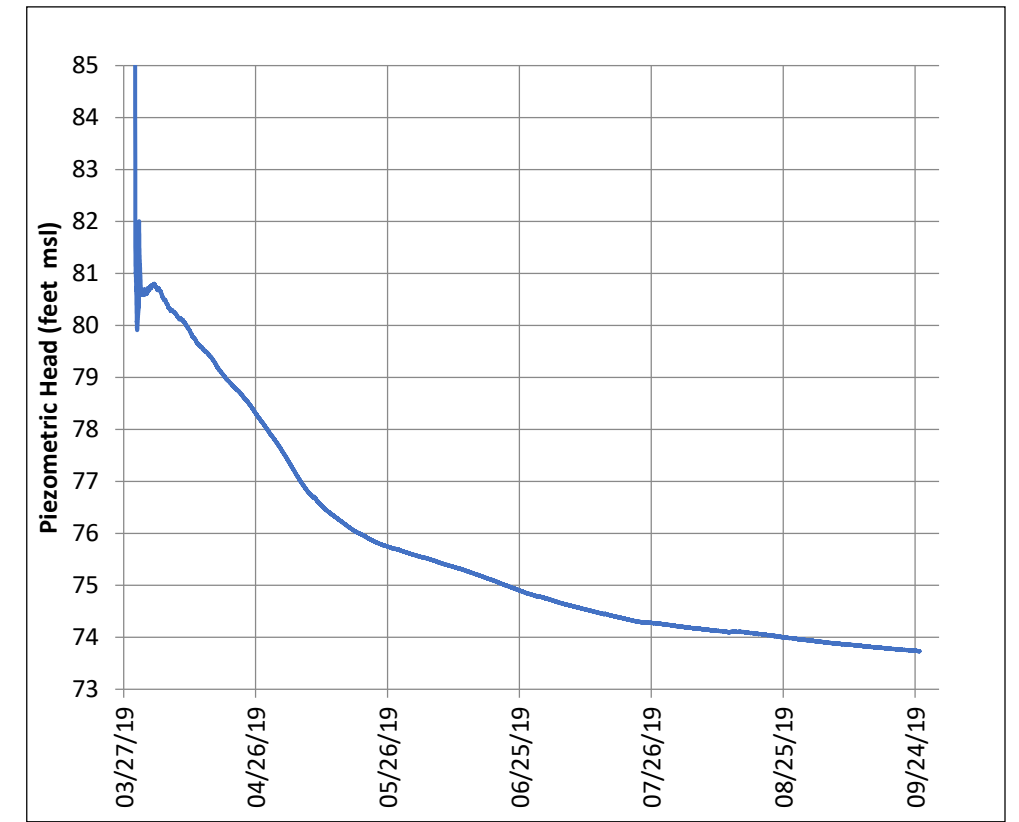
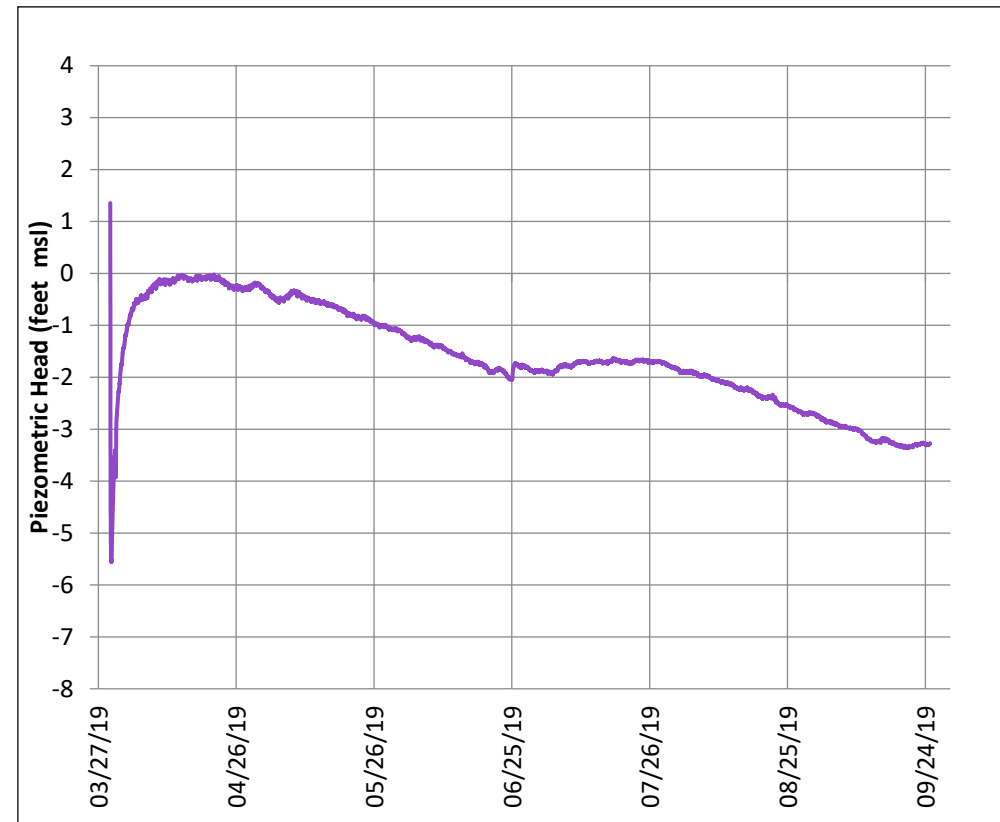
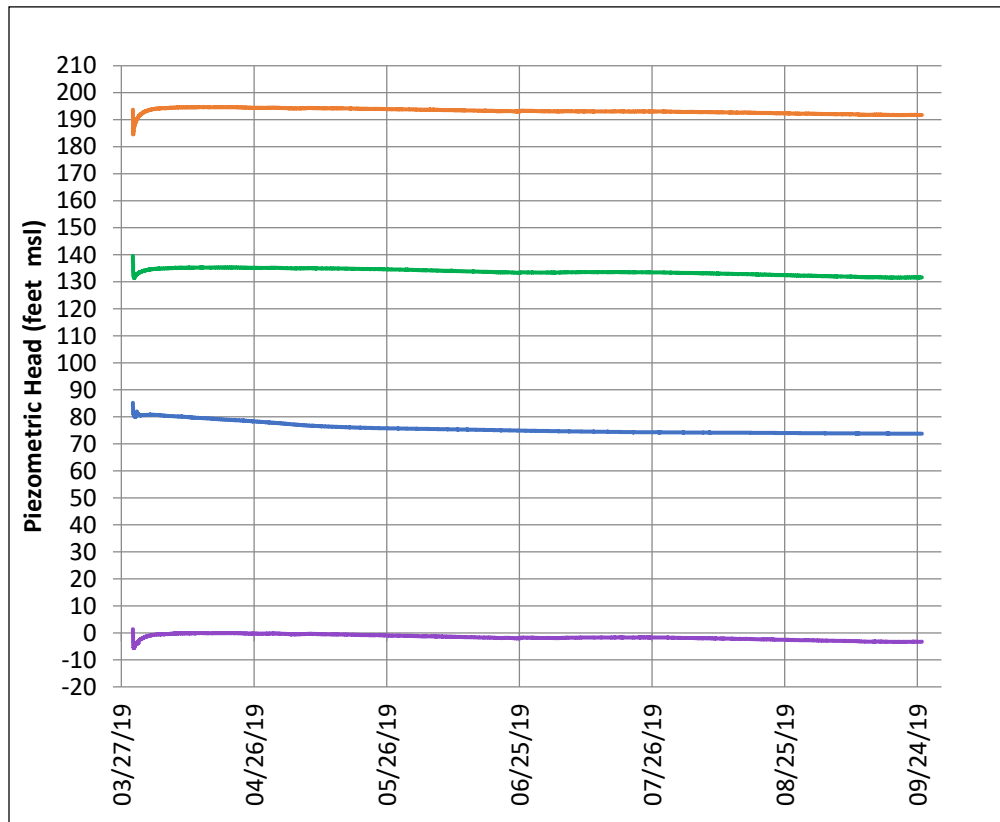


LEGEND

- Zone 5 – MOSDAX Transducer
- Zone 4 – MOSDAX Transducer
- Zone 3 – MOSDAX Transducer
- Zone 2 – MOSDAX Transducer
- Zone 1 – MOSDAX Transducer
- Zone 5 – Pressure Profile
- Zone 4 – Pressure Profile
- Zone 3 – Pressure Profile
- Zone 2 – Pressure Profile
- Zone 1 – Pressure Profile

Zone	Generalized Geology	Zone Top (ft msl)	Zone Bottom (ft msl)
5	Weathered Basalt	33.7	-11.6
4	Weathered Basalt	- 14.6	- 33.8
3	Weathered Basalt	- 86.8	- 145.1
2	Basalt	- 148.1	- 163.3
1	Basalt	- 249.3	- 273.2

**RHMW15 – Long-Term Piezometric Heads
Groundwater Model Progress Report 10
Red Hill Bulk Fuel Storage Facility
JBPHH, O’ahu, Hawai’i**



LEGEND		Generalized Geology	Probe Elevation (ft msl)
Green Line	Zone 4	Saprolite	106
Orange Line	Zone 3	Saprolite	79
Blue Line	Zone 2	Saprolite	43
Purple Line	Zone 1	Basalt	-37

1
2

Appendix B: Boring Logs

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Project: CTO1850126 - Red Hill Bulk Fuel Storage Facility
 Project Location: CTO18F0126
 Project Number: 60571032

Log of Boring RHMW12

Sheet 1 of 15

Date(s) Drilled	05/09/2019 - 06/26/2019	Logged By	M. Higley, B. Mintz, J. Kronen	Checked By (Date)	J. Kronen
Drilling Method	HSA / Core Bucket Auger / Mud Rotary / Air Rotary / HQ core / PQ core	Drill Bit Size/Type	24" core bucket auger / 17.5" rotary / 9.875" rotary / HQ and PQ diamond bit	Total Depth of Borehole	215.0 feet
Drill Rig Type	Mobile B-59 / Mobile B-90 / T-3	Drilling Contractor	Valley Well Drilling	Approximate Surface Elevation	237.6 Feet
Groundwater Level	53 Feet msl	Location	Halawa Correctional Facility	Inclination from Horizontal/Bearing	90°
Borehole Completion	3-inch diameter monitoring well.			Hammer Data	140 lbs/30-inch drop

Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES			FIELD NOTES AND TEST RESULTS
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %				Fracture Drawing Number	Type	Number Blows per foot	
0							FILL Gray basalt angular GRAVEL (GW), well graded drill pad (FILL), moist				0.0		Hand augered 0'-4.3' bgs. Encounter basalt boulder obstruction on 05/09/2019.
1							Moist, brown, SILTY GRAVEL (GM) with basaltic and coralline sand, fine to coarse, medium plasticity with some basalt cobbles (FILL). 40% gravel, 20% sand, 40% silt.		40				
2													
3							Grades with more orangish-brown sand. 35% gravel, 30% sand, 35% fines.						
4				100			Alluvium Moist, dark brown, GRAVELLY FAT CLAY (CH), basaltic, subangular, coarse gravel (FILL).						Begin 8" HSA on 05/10/2019 at 0853 hours.
5													Augers grinding very hard at 4.0' bgs to ~5.0' bgs.
6							Moist, very dark grayish-brown (10YR3/2) FAT CLAY (CH) with basaltic sand and basaltic cobbles. 80% fines, 20% sand.						Augers grinding very hard at 6.0' bgs to ~9.0' bgs.
7							Very hard grinding, light gray, slight weathered basalt gravel in auger cuttings, probably basalt.						
8													
9							Very dark gray (N3) BASALT, massive a'a, slightly weathered, strong to very strong, 15% vesicles, 1-4m, stretched.				0.0	[150]	HSA to 9.0' bgs, then setup to HQ core. Using 8" HSA as temporary casing.
10							Very dark grayish brown (10YR3/2) FAT CLAY (CH) seam.						Good water return. Grayish water.
11							Basalt as above.						
12		1	1	72		30	Dark grayish brown (10YR3/2) FAY CLAY (CH) with massive a'a basalt cobbles/boulders broken to gravel, slight to moderate weathering.						
13							Contains ~8mm platy mica crystal at 12' bgs.						
							No recovery						

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOGS.GPJ; 3/18/2020 RHMW12

Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES			FIELD NOTES AND TEST RESULTS
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %				Fracture Drawing Number	Type	Number Blows per foot	
13							NR	No recovery					
14								Very dark gray (N3) basalt, massive a.a. Slightly weathered, very strong.			0.0		
15	2			85		0		Dark yellowish brown (10YR3/2) FAT CLAY (CH) with traces of moderately weathered basalt gravel. Very stiff.					Good water return. Grayish brown.
16							NR	Slight to moderately weathered basalt boulder, massive a.a.			0.0	[180]	
17								Dark grayish brown (10YR3/2) FAT CLAY (CH) with moderately weathered basaltic gravel and traces of mica around gravel. Clear, probably muscovite.					
18							NR						
19								Grades with slight to moderately weathered basalt cobbles, becomes soft to medium stiffness.			0.0	[80]	
20													
21	4			100		0							Light grayish brown water
22								Becomes more stiff.					
23								Very dark gray basalt cobble, slightly weathered, massive a.a.			0.0	[60]	Light grayish brown water return
24								Dark grayish brown (10YR3/2) FAT CLAY (CH)			0.0	[100]	Recovered 3' of core, remainder stuck in barrel, approximately 3 inches.
25							1	Very dark gray (gley 1 3/N) basalt, massive a.a. Slight weathering, ~7% vesicles at top, decreasing with depth. Stretched vesicles, ~3mm long. Very strong.					At 1234: DTW= 4.03' BTOC, stickup= 3.05'
26							2	1. 10°, J, MW, CL-washed away, Fi, Wa, SR					At 1316: DTW= 4.5' BTOC, stickup 3.05' Logged by JF.
27	6			60		24	3	2. 5°, J, MW, CL-washed away + Fe, Pa, Pl, SR					Brownish gray water, good return.
28							4	3. 45°, J, MW, Cl, Fi, Pl, SR					
29							5	4. 10°, J MW, Cl, Fi, Pl, SR					
								5. 0°, J, W, Cl, Fi, Ir, SR					
							NR	Very stiff FAT CLAY (CH), same as above. Minor angular basalt gravel.					

Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES			FIELD NOTES AND TEST RESULTS	
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %				Fracture Drawing Number	Type	Number Blows per foot		PID (ppm)
29			2									0.0	[100]	
30														Grayish brown water return
31		7		100		0								
32														
33														
34												0.0	[75]	
35														Grayish brown water return
36								Very wet						
37		8	3	100		0								
38								Zone of increase angular basalt gravel, approximately 1' thick.						
39								Decrease gravel proportion in FAT CLAY (CH); increased sand to ~10%. Moderately stiff, less cohesive than above.				0.0	[60]	
40								Dark reddish brown (5YR3/3), hard, indurated weathered breccia TUFF (?) with angular 3-5 mm pebbles.						Drilled to 39.0' bgs. DTW= 9.4' BTOC, stickup = 3.25' (1400 on 05/10/2019) Boring paused on 05/10/19 at 39.0' bgs at 1354. Continue drilling on 05/13/2019 at 0750.
41														
42		9	4	90		37	1 2 3 M M	Dark gray (Gley 3.1) basalt, massive a'a, slightly weathered, 5% vesicles, very strong (boulder). 1. 20°, J, N, Fe + Mn, Fi, Wa, SR 2. 20°, J, N, Fe + Mn, Fi, Wa, SR 3. 30°, J, N, Fe + Mn, Fi, Wa, S						Good water return.
43														
44												0.0	[100]	
45								Dark reddish brown (5YR3/3) moderate to very stiff FAT CLAY (CH), trace basalt gravel.						

Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES			FIELD NOTES AND TEST RESULTS
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %				Fracture Drawing Number	Type	Number Blows per foot	
45													
46		10	4	76		0							
47													Good water return.
48							NR ↓	No recovery					
49								Same as above.			0.0	[37.5]	
50													
51		11		92		0							Good water return.
52								↓ Becomes silty, loosens.					
53								↓ Becomes moderately stiff.					
54							NR	No recovery			0.0	[60]	
55								Same as above.					
56								Dark reddish brown (5YR3/3), hard, weathered indurated breccia (TUFF?) with angular basalt pebbles and cobbles. Weak.					
57		12	5	100		33	M						Good water return.
58							M						179.9' msl
59							M				0.0	[75]	
60							M	BASALT Pahoehoe Dark brown (7.5YR3/2) slight to moderate weathered basalt, pahoehoe, 30% vesicles. Moderately strong. 1. 15°, J, N, Fe + Mn, Fi, Pl, SR 2. 30°, J, N, Fe + Mn, Fi, Pl, SR Becomes fresh, extremely strong, large vesicles. 1. 10°, J, N, Fe + Mn, Fi, Pl, S 2. 10°, J, N, Fe + Mn, Fi, Pl, SR 3. 5°, J, VN, Fe + Mn, Fi, Pl, S 4. 0°, J, N, Fe + Mn, Fi, Pl, SR					Brown/gray water return.
61							M						

Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES			FIELD NOTES AND TEST RESULTS
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %				Fracture Drawing Number	Type	Number Blows per foot	
61		13		100		86	2	5. 0°, J, N, Fe + Mn, Fi, Pl, SR					
62							3						
63							4						
							5	↓ Becomes slightly weathered, strong.					Good water return.
							6	6. 0°, J, VN, Fe + Mn, Su, Pl, S					
							7	7. 0°, J, N, Fe + Mn, Su, St, SR					
64							1	↓ Becomes unweathered, very strong.			0.0	[75]	
							2	1. 15°, J, N, Fe + Mn, Su, Wa, SR					
							3	2. 10°, J, VN, Fe + Mn, Su, Pl, S					
65							4	3. 50°, J, N, Cl, Fi, Wa, R					
							5	4. 15°, J, N, CL, Pa, Wa, SR					
66		14	6	100		84	M	↓ Becomes slightly weathered, strong.					Good water return.
67							4						
							5	↓ Becomes unweathered. Very strong.					
							6	5. 45°, J, N, Fe, Fi, Wa, R					
68							6	6. IF, J, N, Fe + Mn, Su, Pl, SR					
69							6	} Highly Fractured			0.0	[75]	
								Same as above.					
70							M	TUFF ashfall					Good water return.
								Light yellowish brown (2.5YR6/4) moderate to highly weathered ash tuff, weak where in contact with overlying basalt. Extremely weathered where loose.					
71		15	7	100		52		BASALT Pahoehoe					
							1	Very dark gray (5YR3/1) moderately weathered, strong, basalt, pahoehoe with infilled vesicles (approximately 5-20%).					
72							2	1. 45°, J, N, Fe + Mn + Cl, Fi, St, R					
							3	2. 5°, J, VN, Fe + Mn, Su, Pl, S					
							M	3. 45°, J, N, Cl, S, Wa, SR					
73								4. 90°, J, N, Cl, Fi, Pl, SR					
74							4				0.0	[100]	
							1	↓ Becomes slightly weathered, very strong. No infilling of vesicles (approximately 30-40%).					
75							2	1. 15°, J, N, Fe + Mn, Su, Wa, R					Good water return.
							3	2. 30°, J, VN, Fe + Mn, Pa, Wa, R					
							4	3. 20°, J, MW, Fe + Mn + Cl, Fi, Pl, SR					
76		16		100		82		4. 30°, J, MW, Cl, Fi, Pl, SR					
77													

Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES			FIELD NOTES AND TEST RESULTS
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %				Fracture Drawing Number	Type	Number Blows per foot	
77													
78			7				5. 30°, J, MW, CL, Fi, Ir, SR 6. 60°, J, MW, Cl, Fi, Wa, SR 7. 5°, J, VN, Fe + Mn, Su, Pl, SR 8. 30°, J, VN, Fe + Mn, Su, Wa, SR -Note clay filled joints						
79							Slightly weathered, very strong, 30-40% vesicles. IF. J, MW, Cl, Fi, Wa, SR 1. 45°, J, MW, CL, Fi, Pl, SR 2. 80°, J, N, Cl, Fi, Pl, SR -Note clay filled joints			0.0	[75]	158.6' msl	
80													
81		17		83		35							Used ~400 gallons of water.
82							Becomes slight to moderately weathered, strong.						
83							No recovery						
84										0.0	[60]	153.6 msl	
85							1. 5°, J, N, Fe + Mn, SU, Pl, S 2. 10°, J, N, Cl, Fi, Pl, SR 3. 10°, J, N, Cl, Fi, Pl, SR 4. 5°, J, VN, Fe + Mn, SU, Wa, SR -Note clay filled joints						
86		18	8	87		40							Used ~100 gallons of water.
87							Becomes highly weathered, very to extremely weak. Infilled vesicles and intensely fractured.						
88							No recovery						
89							Becomes slightly weathered to unweathered. Very strong, 20-30% vesicles.			0.0	[60]		
90							1. 45°, J, VN, Cl, Fi, Pl, S 2. 45°, J, N, Cl, Fi, Pl, S 3. 45°, J, N, Cl, Fi, Wa, SR 4. 90°, J, N, Cl, Pa, Wa, SR 5. 60°, J, MW, Cl, Fi, Pl, SR 6. 50°, J, N, Cl, Fi, Pl, SR 7. 15°, J, N, Cl, Fi, Pl, SR						
91		19	9	100		52	8. 45°, J, VN, Cl, Pa, Wa, SR 9. 45°, J, VN, Cl, Pa, Wa, SR -Note clay filled joints.						Used ~200 gallons of water.
92													
93													

Elevation, feet	Depth, feet	ROCK CORE					Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES			FIELD NOTES AND TEST RESULTS
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %					Type	Number Blows per foot	PID (ppm)	
93														
94								Same as above.				0.0	[60]	
95								1. 0°, J, VN, Fe + Mn, Su, Wa, SR 2. 45°, J, VN, Fe + Mn, Su, Pl, SR 3. 35°, J, VN, Cl, Su, Wa, SR 4. 30°, J, VN, Fe + Mn, Su, Wa, S 5. 45°, J, N, Cl, Fi, Wa, SR 6. 90°, J, N, Cl, Pa, Pl, S 7. 45°, J, N, Cl, Pa, Pl, SR						
96		20	9	100		67								Used ~200 gallons of water.
97								IF, N, Cl, Fi, Wa, SR						
98														
99								IF section is more weathered.				0.0	[150]	
100														
101		21	10	100		60		Same as above. 1. 60°, J, VN, Cl, Pa, Pl, S 2. IF, MW, Cl, Fi, Wa, SR (Halloysite) 3. 45°, J, VN, Cl, Pa, Pl, S (Halloysite) -Note clay filled joints						
102								IF is more weathered.						Used ~200 gallons of water.
103														
104								Becomes unweathered, very strong to extremely strong, medium (2 mm) to large (5 mm) vesicles.				0.0	[75]	End 05/13/2019 Start 05/14/2019
105								~15% vesicles						
106								~5% vesicles						
107		22	11	100		94		~30% vesicles						Used ~500 gallons of water.
108														
109								1. 0°, J, T, Fe + Mn, Pa, Wa, SR 2. 20°, J, VN, Fe + Mn, Su, Wa, S						

Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES			FIELD NOTES AND TEST RESULTS	
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %				Fracture Drawing Number	Type	Number Blows per foot		PID (ppm)
109														
110														
111		23		24		0	NR ↓	BASALT A'a Clinker Basalt cobbles, rounded cobble size due to core jamming; Contact from pahoe-hoe down into a'a, note massive a'a cobbles. No recovery may be a'a clinker.				0.0	[30]	
112								No recovery						Used ~700 gallons of water.
113														
114														
115								BASALT Massive A'a Dark gray (7.5YR4/1), moderate to slightly weathered basalt, massive a'a. Note fractured with clay infilled vesicles. Recovered rounded cobbles is less weathered, very strong.				0.0	[42.8]	
116														Used ~450 gallons of water.
117		24	11	26		0	NR ↓	BASALT A'a Clinker						Cannot pull core barrel out. Issues with core barrel jamming, rock loosened from above is jamming barrel and bit.
118								No recovery						
119														
120							A NR					0.0	[75]	
121		25		70		62	M M M	BASALT Massive A'a Becomes unweathered, extremely strong massive a'a, ~20% vesicles.						Used ~200 gallons of water.
122														
123							M M M							
124			12				M	Bottom cored in at 124' bgs. Same as above. ~1% vesicles				0.0	[50]	
125														

Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES			FIELD NOTES AND TEST RESULTS
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %				Fracture Drawing Number	Type	Number Blows per foot	
125													
126		26	12	96		94	M	~10% vesicles 1. 10°, J, VN, Cl, Fi, St + Pl, S					
127							M	~8% vesicles					
128							M	~5% vesicles					
129							NR	Stop coring at 129' bgs. Prepping to pull out core assembly to ream open hole and set 10" <1% vesicles No recovery					Used ~200 gallons of water.
130								BASALT Massive A'a gray, gley 6/N, unweathered, very strong, elongate semi rounded vesicles, 5%, 2-3mm 1. 60°, J, VN, Cl, Sp, St Wa, S 2. 20°, J, VN, Cl, Sp, Pl, S 3. 20°, J, VN, Wa, SR 4. 80°, J, VN, Mn, Sp, Wa, S 5. 10°, J, VN, Mn, Sp, Wa, S 6. 45°, J, VN, Mn, Sp, Pl, S 7. 45°, J, VN, Cl, Sp, St, SR			0.0	[42.8]	DTW= 111.2' bgs at 1048 End 05/14/2019 Begin coring with HQ core on 06/17/2019 at 1025. 1028-1032- first run starting at bottom of 10" casing ~122' bgs to 125', previously logged as massive a'a. 1045 next run: 125' - 130', 125' to 129' previously logged. Log 129' to 130' at 1045 - 1051, start logging at 130'.
131							M						
132		27	13	100		64							
133							IF						
134								4. 1% vesicles, <1mm 5. 6. 2% vesicles, elongate 7.					
135								1. 70°, J, VN, Cl, Pa, Pl, SR (very pale brown [10YR5/3]) 2. 60°, J, VN, Mn, Sp, Wa, SR 3. 0°, J, VN, Mn, Cl, Sp, Wa, SR			0.0	[50]	No water added, per driller. <30 gallons water. No returns.
136								1% vesicles, <1mm 5% vesicles, elongated, <1-10mm					
137													
138		28		92		58							
139							IF	BASALT A'a Clinker broken clinker pieces, loose, dark reddish brown, 5YR4/3, 10YR3/1, very dark gray, clay reddish yellow (7.5YR7/5) some a'a clinker clasts infilled with clay contact with heat alteration					
140								BASALT Pahoehoe black 2.5YR5/1, moderate weathering, strong, 20% vesicles, irregular and rounded, 4-25mm, partially infilled with clay. 1. 45°, J, VN, Cl, Sp, Wa, R			0.0	[150]	
141													

Elevation, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES			FIELD NOTES AND TEST RESULTS
	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %				Fracture Drawing Number	Type	Number Blows per foot	
141							2. 0°, J, VN, Cl, Mn, Sp, Wa, SR 3. 10°, J, VN, Cl Su, Mn Sp, Wa, R 4. 0°, J, VN, Mn, Cl, Sp, Wa, R ▼ 30% vesicles, rounded, <5mm					
142	29	14	102		78	3	▼ Possible flow contact-- dark reddish brown (2.5YR3/3), moderate weathering, strong 25% vesicles, rounded <2mm, partially infilled with clay. 4. ▼ Dark reddish gray (2.5YR3/1), slightly weathered, strong, 15% vesicles, rounded 1-4mm					
143						4	5. 5°, J, VN, Cl Su, Mn Sp, Wa, SR 6. 10°, J, VN, Cl, Mn, Sp, Wa, SR 7. 0°, J, VN, Cl Su, Mn Sp, Pl, SR 8. 45°, J, VN, Cl Su, Mn Sp, Pl, SR 9. 5°, J, VN, No, No, Pl, SR					
144						5						
145						6				0.0	[75]	Used ~150 gallons of water. No returns.
146						7						
147	30		100		96	1	▼ Possible heat alteration, moderate weathering, medium strong, brown (7.5YR4/2), 10YR5/3 brown, black 10YR2/1, 15% vesicles, subrounded to rounded, <2mm, partially infilled with clay. 1. 30°, J, VN, Clay, Mn Fe, Sp, Wa, SR 2. 20°, J, VN, Clay Su, Mn Fe, Sp, S 3. 45°, J, VN, Clay, Mn Fe, Pl, SR					
148						2	4. 0°, J, VN, Clay, Mn Fe, Pa, Pl, SR 5. 10°, J, VN, Clay, Mn, Pa, Pl, S 6. 5°, J, VN, Clay Su, Mn Sp, Pl, S 7. 20°, J, VN, Clay Su, Mn Sp, Pl, S					
149						3	▼ Becomes black (10YR2/1), slightly weathered, strong, 15% vesicles, <5mm subrounded to rounded.					
150						4				0.0	[150]	
151						5	▼ Becomes dark gray (2.5Y4/1), slightly weathered, strong, 5% vesicles, rounded, 5-10mm, partially infilled with clay.					
152	31	15	90		76	6	▼ Becomes 20% vesicles, rounded, 2-5mm					Used ~150 gallons of water. No returns.
153						7	▼ Becomes very dark gray (GLEYS 3/N), moderate weathering, medium strong, 25% vesicles, <2mm subrounded, partially infilled with clay. 1. 5°, J, VN, Clay, Pa, Wa, SR 2. 5°, J, VN, Clay Su, Mn Sp, Wa, S 3. 5°, J, VN, Clay Su, Mn Fe Sp, Wa, S 4. 45°, J, VN, Clay, Mn, Fe, Sp, Wa, SR 5. 45°, J, VN, Clay Su, Mn Fe Sp, Wa, SR					
154						8						
155						9				0.0	[150]	Used ~150 gallons of water. No returns.
156						M	1. 5°, J, VN, Cl Su, Mn Sp, Wa, S 2. 0°, J, VN, Fe Su, Mn Clay Sp, Pl, SR 3. 10°, J, VN, Clay, Fe, Mn, Sp, Wa St, SR 4. 30°, J, VN, Clay, Fe, Mn, Sp, Wa, SR 5. 10°, J, VN, Clay, Fe, Mn, Sp, Wa, SR					
157						M						

Report: CTO63 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOGS.GPJ; 3/18/2020 RHMW12

Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES			FIELD NOTES AND TEST RESULTS
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %				Fracture Drawing Number	Type	Number Blows per foot	
157		32		110		74	IF						
158							6	▼ 10% vesicles, 2-8mm, subangular, partially infilled with clay 6. 10°, J, VN, Clay, Mn, SP, Wa, SR 7. 0°, J, VN, Clay, Sp, Wa, SR 8. 60°, J, VN, Clay Su, Mn, Sp, Wa, S 9. 20°, J, VN, Clay, Mn Fe, Sp, Wa St, SR					
159							7						
160							8						
161							9						
162							1	▼ Becomes reddish brown (5YR4/3), moderate weathering, medium strong, 20% vesicles, rounded, <3mm, mostly infilled with clay. 1. 50°, J, VN, Clay, Mn, Fe, Su Sp, Wa, S 2. 0°, J, VN, Clay, Mn, Fe, Sp Su, Wa, St, SR 3. 0°, J, VN, Clay, Mn, Fe, Sp, Wa, R 4. 80°, J, VN, Clay, Pa, Mn, Sp, Wa, S 5. 0°, J, VN, Clay, Pa, Mn, Sp, Wa, SR 6. 50°, J, VN, Clay, Mn Fe, Sp, Wa, SR			0.0	[150]	
163		33	16	96		78	2						
164							3						
165							4						
166							5						
167							6	▼ Becomes black (2.5Y2.5/1) slight to moderate weathering, strong, 20% vesicles, rounded, <2mm					
168							1	1. 60°, J, VN, Mn, Clay, Fe, Sp, Wa, S					
169							M	BASALT A'a Clinker welded and clay infilled, brown (7.5YR4/3), gray (GLE Y 6/N), black (Gley 2.5/N), infilled clay reddish yellow (2.5YR7/8), moderately weathered, medium strong to strong.					
170		34	17	104		92	2	2. 40°, J, VN, Clay, Mn, Fe, Sp Su, St, SR 3. 20°, J, VN, Clay Su, Mn Fe Sp, Wa, SR 4. 5°, J, VN, Clay Su, Mn Fe Sp, Wa, R					
171							3	} a'a boulder, gray (GLE Y 6/N), slightly weathered, strong, 7% vesicles, elongate, 1-5mm					
172							4						
173							1	1. 0°, J, VN, Mn, Clay, Sp, Wa, R					
							2	2. 0°, J, VN, Clay Su, Mn Sp, Wa, SR					
							IF						
							IF	BASALT Massive A'a light gray (GLE Y 1 7/N), slightly weathered, very strong, 5% elongate vesicles, <5mm angular ▼ fractures partially infilled with clay					
		35		100		72	IF						

Used ~150 gallons of water. No returns.

Used ~150 gallons of water. No returns.

Used ~150 gallons of water. No returns.

Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES			FIELD NOTES AND TEST RESULTS
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %				Fracture Drawing Number	Type	Number Blows per foot	
173								3. 45°, J, VN, Mn, Clay, Sp, Pl, SR 4. 5°, J, VN, Mn, Clay, Sp, St, SR 5. 50°, J, VN, Mn, Sp, Su, SR					
174													
175											0.0	[60]	
176								1. 5°, J, VN, Clay, Su, Mn, Sp, Pl, S 2. 5°, J, VN, Clay, Mn, Sp, Wa, SR 3. 45°, J, VN, Mn, Sp, Wa, SR 4. 45°, J, VN, Mn, Sp, Wa, SR 5. 0°, J, VN, Mn, Sp, Wa, SR 6. 90°, J, VN, Mn, Sp, Wa, SR					Used ~150 gallons of water. No returns.
177		36	18	100		88		▾ Becomes 10% vesicles, irregular, elongated, 2-25mm					
178													
179													
180								▾ Becomes 2% olivine, 2-5mm			0.0	[60]	
181								1. 5°, J, VN, Mn, Sp, St, SR 2. 60°, J, VN, Mn, Sp, Wa, SR 3. 10°, J, VN, Mn, Sp, St, SR 4. 10°, J, VN, Mn, Sp, St, SR 5. 20°, J, VN, Mn, Clay, Sp, Wa, SR 6. 10°, J, VN, Mn, Clay, Sp, Wa, SR 7. 5°, J, VN, Mn, Clay, Sp, Wa, SR					Used ~150 gallons of water. No returns.
182		37		100		56							
183													
184													
185											0.0	[23]	
186								▾ Becomes 1% vesicles, <1mm					
187		38	19	100		68		1. 15°, J, VN, Mn, Sp, Clay, Pa, St, SR 2. 10°, J, VN, Mn Sp, Clay Pa, Wa, S 3. 45°, J, VN, Clay Pa, Mn Sp, Wa, S 4. 30°, J, VN, Clay Su, Mn Sp, Wa, S 5. 5°, J, VN, Clay, Mn, Sp, Wa, S 6. 60°, J, VN, Clay Su, Mn Sp, Wa, S 7. 5°, J, VN, Mn Fe Sp, Clay Su, St, SR 8. 10°, J, VN, Mn, Sp, St, R 9. 5° J, VN, Mn Sp, Clay Su, St, S 10. 85°, J, VN, Mn Sp, Wa S					Used ~150 gallons of water. No returns.
188													
189													

Elevation, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES			FIELD NOTES AND TEST RESULTS		
	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %				Type	Number Blows per foot	PID (ppm)		Drill Time [Rate, ft/hr]	
189						10	BASALT A'a Clinker cemented, brown (7.5YR4/3), very dark gray (10YR3/1), strong brown (7.5YR5/6), moderate weathering, medium strong. No recovery						Drilling paused at 190' bgs. Water level = 125.1' bgs at 1433.	
190						M					0.0	[50]	Resume coring on 06/18/2019 at 0658. Water level = 125.14' bgs at 0654.	
191						1	BASALT Pahoehoe red (2.5YR4/8), moderately weathered, medium strong, 5% vesicles, irregular, <4mm, 10% weathered olivine							
192	39	84			80	2	▼ Becomes dark reddish brown (5YR3/4), moderately weathered, medium strong, 5% vesicles, irregular, 2-10mm, 10% weathered olivine, partial clay infilled reddish yellow (5YR6/8).							Used ~200 gallons of water. No returns.
193						3	▼ Becomes very dark gray (5YR3/3), slightly weathered, strong, 10% vesicles, subrounded, 2-25mm, 15% olivine.							
194						4	1. 0°, J, VN, No, No, Wa, R 2. 15°, J, VN, Clay, Pa, Mn Pa, Mn Sp, Wa, SR 3. 0°, J, VN, No, No, Wa, R 4. 0°, J, VN, Clay Su, Mn Sp, Wa, R 5. 0°, J, VN, Clay Pa, Mn Sp, Wa, SR 6. 20°, J, VN, Clay Pa, Mn Sp, St, SR							
195						5								
196						6	▼ 50 x 20mm vug ▼ 50 x 25 mm vug				0.0	[100]		Used ~200 gallons of water. No returns.
197	40	20	102		88	1	1. 90°, J, VN, Clay Pa, Mn Sp, Pl, S 2. 0°, J, VN, Clay Su, Mn Sp, Wa, R 3. 0°, J, VN, Clay Su, Mn Sp, Wa, R							Used ~200 gallons of water. No returns.
198						M								
199						2	▼ Becomes dark reddish brown (5YR3/4), moderate weathering, medium strong, 2% vesicles, <5mm, mostly infilled with clay, reddish yellow (5YR6/8), 2% weathered olivine.							
200						3								
201						M								
202	41	21	98		74	M	1. 10°, J, VN, Clay, Mn, Sp, Wa, SR 2. 45°, J, VN, Clay Su, Mn Sp, Wa, SR 3. 45°, J, VN, Clay Mn Fe, Sp, Wa, R							
203						1	▼ Becomes very dark gray (7.5YR3/1), moderately weathered, medium strong, 5% vesicles, irregular, <5mm, mostly clay infilled, 10% weathered olivine							Used ~200 gallons of water. No returns.
204						2								
205						3	▼ Becomes very dark gray (10YR3/1), little to slight weathering, strong to very strong, 15% vesicles, subrounded, 2-8mm, 10% olivine, weathered and unweathered.							

Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES			FIELD NOTES AND TEST RESULTS	
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %				Fracture Drawing Number	Type	Number Blows per foot		PID (ppm)
205														
206														
207		42	21	100		100		▼ Becomes 10% unweathered olivine, 15% vesicles, subrounded, 2-20mm. ▼ 20 x 15mm vug ▼ 20 x 8mm vug						drilled to 210' bgs. Paused drilling at 0729. Water level = 124.85' bgs at 0945. Water level = 125.2' bgs at 0805. Used ~200 gallons of water. No returns.
208							M							
209								▼ Becomes 20% vesicles, rounded, 1-4mm, 10% unweathered olivine.						
210								▼ Becomes 10% vesicles, <4mm, rounded, 10% unweathered olivine.						
211							1							
212		43	22	100		94	2	▼ Becomes 10% vesicles, subangular, 2-25mm, 10% unweathered olivine 1. 15°, J, VN, Mn, ???? 2. 45°, J, VN, Mn, Sp, Wa, R 3. 45°, J, VN, Mn, Sp, Wa, SR						Resume coring PQ on 06/26/2019 at 0721. Light brown water return circulation.
213							M							
214			23				M							
215														
216								RHMW12 was hand cleared from ground surface to 4.3 ft below ground surface (bgs). The borehole was then drilled using 10" OD hollow stem auger from 0 to 9 ft bgs, where there was refusal. HQ coring commenced from 9 ft to 129 ft bgs. Reamed borehole with 17.5" tricone bit from 0 ft to 12 ft bgs with refusal. Drilled with 24" OD core bucket with production auger rig from 0 ft to 58.6 ft bgs. Installed 18" steel surface casing to 58 ft bgs. Reamed borehole with 17.5" tricone bit from 58 ft to 125 ft bgs. Installed 10" steel conductor casing to 123 ft bgs. HQ coring continued from 129 ft to 200 ft bgs. Borehole was reamed from 125 ft to 200 ft bgs with 9 7/8" tricone bit. Installed 5" steel casing to 200 ft bgs. PQ coring commenced from 200 ft bgs to a TD of 215 ft bgs.						Paused coring at 0724 to monitor water levels.
217														
218														
219								Clean water filtered through a granulated activated carbon (GAC) filter was used for drilling fluid. Approximately 5,295 gallons of water were used during drilling and rock coring. A total of 675 gallons of development water were removed with pump set at 134' bgs.						
220								RHMW12 well construction was completed on January 27, 2020. The well was completed with 3 inch diameter Schedule 80 polyvinyl chloride (PVC) well casing. The well was screened between approximately 22 and 37 ft msl. The 3-inch PVC well casing was installed in the existing 5 inch diameter Schedule 40 steel casing from 0						End of boring on 06/26/2019 Total Depth = 215' bgs
221														

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facility
 Project Location: CTO18F0126
 Project Number: 60571032

Log of Boring RHMW12

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Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES			FIELD NOTES AND TEST RESULTS
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %				Fracture Drawing Number	Type	Number Blows per foot	
221								<p>to 200 ft below ground surface (bgs) and in the ~4.83 inch-diameter open borehole (PQ size) from 200 to 215 ft bgs. The lower 15-ft section of casing in the open borehole was screened with 0.020 inch slots. The casing was stabilized inside the existing 5-inch-diameter Schedule 40 steel casing with K-Packer well seals top and bottom with centralizers spaced between the K-Packers. Packers were installed at approximately 5 ft and 190 ft bgs. There is a bentonite seal from 1 ft to 5 ft bgs. No annular materials were added, which will allow for removal of the PVC casing in the event that redesign is warranted in the future. The recommended well design will accommodate a number of sampling methods, including a submersible pump, HydraSleeves, and Snap Samplers. The surface completion consists of a steel vault designed to secure and lock the well.</p>					
222													
223													
224													
225													
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235													
236													
237													

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facility
 Project Location: CTO18F0126
 Project Number: 60571032

Log of Boring RHMW13

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Date(s) Drilled	08/21/19 - 10/14/19	Logged By	B. Mintz, C. Ellis	Checked By (Date)	J. Kronen
Drilling Method	Hand auger, HSA, HQ core/ PQ core, Mud rotary	Drill Bit Size/Type	24" core bucket/prod auger, 10" HSA, HQ/PQ core diamond bit	Total Depth of Borehole	530.0 feet
Drill Rig Type	Mobile B-59 / Mobile B-90/ Watson 1100 and 2000	Drilling Contractor	Valley Well Drilling	Approximate Surface Elevation	248.0
Groundwater Level	El. 19.50'	Location	RHSF	Inclination from Horizontal/Bearing	90°
Borehole Completion	Westbay MP38 Well			Hammer Data	140 lbs/30-inch drop

Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	SAMPLES			FIELD NOTES AND TEST RESULTS	
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %			Fracture Drawing Number	Type	Number Blows per foot		PID (ppm)
248	0							FILL					8/21/19: attempt hand clear and drill through gravel fill to boulder at 3' bgs
246	2							VALLEY FILL					
244	4	0						no recovery - Washed out boulders	1	50/6"			Begin 10" HSA at 0714 to try to get through boulder, paused to repair rig, 1238 resume drilling HSA grinding sound at ~9ft bgs.
	5	1							2	50/6"		[37.5]	Collect 12-18" sample per 5' run
242	6												
240	8							(GC) Clayey Gravel 80G, 15F, 5S, subrounded gravel, gray (5Y6/1), brown matrix (7.5YR4/3), 750mm gravel light gray (10YR6/1)					
	9							(CH) Fat Clay with gravel 15G, 80F, 5S Brown (10YR4/3) subrounded, 15mm gravel pieces.					
238	10	2							3	50/6"	2.5	[37.5]	Grinding sound at 10ft bgs.
236	12												
	13												

Report: CTO53 RED HILL WITH WELL AND PID: File: CTO18F0126 RED HILL CORE LOGS.GPJ: 2/6/2020 RHMW13

Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	SAMPLES			FIELD NOTES AND TEST RESULTS	
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %			Fracture Drawing Number	Type	Number Blows per foot		PID (ppm)
13													
234	14							no recovery - Boulders likely washed out. Light gray (10YR6/1) subrounded boulder remnants.					
	15	3							4	50/6"	0.0	[33.33]	"no water but damp" per VWD. ~16ft grinding sound
232	16												
	17												
230	18												
	19						(GC) Clayey gravel, 80G, 15F, 5S Subrounded - subangular 750 mm. Some pieces gravel gray (5YR6/1)						
	20	4					(CH) Fat Clay with gravel, 20G, 75F, 5S. Very dark gray (2.5Y3/1), subangular gravel pieces <6mm, gray (5YR6/1) some reddish yellow clay (5YR6/8) Subrounded boulder, light gray (10YR6/1) some reddish yellow clay (5YR6/8) on gravel pieces.		5	100/2"	0.0	[15.38]	Grinding sound, "dried up" per VWD
	21												Grinding sound
226	22		1				VOLCANIC SAPROLITE highly weathered basalt, very weak, dark brown (10YR 3/3), yellowish red (5YR 5/6) clay, yellow (10YR 2/6) clay				0.0	166.67	Refusal. Added 5 gals water to hole to remove HSA rods - 5" PVC temporary casing lowered into hole to 21'bgs. Begin to set up for HQ core at 22ft bgs. Begin HQ coring on 8/22/19 at 0847. Light brown WR. 500 gals of WL but none lost now
	23	5		100									
224	24												
	25						basalt, highly weathered, weak, very dark black (2.5Y 2.5/1) 5% vesicles, 2-8mm, subrounded, yellowish red (5YR 5/6) clay, yellow (10YR 7/6) clay intensely fractured.				0.0	[60.24]	
222	26												
	27						highly to completely weathered basalt, very weak, broken pieces mostly covered with clay						
	28	6		84			basalt, highly weathered, weak, very dark rock (2.5Y 3/1), 2% subrounded, 1-4 mm, vesicles, yellow (10YR 7/6) clay, yellowish red (5YR 5/6) clay, intensely fractured a'a.						
220	28												
	29												

Elevation, feet	Depth, feet	ROCK CORE						Lithology	MATERIAL DESCRIPTION	SAMPLES			FIELD NOTES AND TEST RESULTS	
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number			Type	Number Blows per foot	PID (ppm)		Drill Time [Rate, ft/hr]
29														
218	30		2				1	no recovery greenish black (GLE Y1 2.5/1), moderately weathered, medium strong, 5% subrounded 2-11m vesicles, partially infilled with clay				0.0	[75]	Monitoring water levels, see log book for details.
	31						2	vesicles become 5%, 4-20 mm, subrounded to rounded, minerals infilling vesicles; translucent minerals, running across/connecting vesicles - needle like						Light brown WR, no WL
	32						3	1. 0° J, VN, Cl, Sp, Wa, S 2. 0° J, VN, Cl, Su, Pa, Pl 3. 5° J, VN, Mn, Fe, Cl, Sp, Wa, S						
216	33	7		100		74	4	4. 10° J, VN, Mn, Fe, Sp, Wa, S 5. 5° J, VN, Cl, Sp, Wa, S						
	34						5	6. 0° J, VN, Mn, Fe, Cl, Sp, Wa, S						
	35						6	7. 20° J, VN, Mn, Fe, Cl, Su + Sp, Wa, S 8. 20° K, VN, Mn, Fe, Sp, Cl, Su, St, S						
214	36						8					0.0	[75]	Monitor water levels, see log book for details.
	37						1	greenish black (GLE Y1 2.5/1); moderately weathered; medium strong; 20% vesicles, rounded, <2 mm; possibly a'a						Light brown WR, no WL
212	38		3				IF	very dark greyish brown (10YR3/2); highly to completely weathered; weak to very weak; intensely fractured; clay coating most pieces, brown (5YR5/4); reddish yellow (7.5YR6/6); possibly massive a'a						
	39						IF							
210	40							no recovery						
	41						1	very dark gray (7.5YR3/1); moderately to highly weathered; weak; 5% vesicles, irregular to subrounded, 1-12 mm, partially infilled with clay; possibly a'a						
	42						2	1. 0° J, VN, clay, Su + Sp, IR, SR 2. 0° J, VN, clay, Fe, Su + Sp, Wa, SR						Light brown WR, no WL
206	43							highly to completely weathered, very weak, very dark gray (7.5YR3/1), clay coating most pieces, brown (5YR5/4), reddish yellow (7.4YR4/6)						
	44	9		88		28								
	45							no recovery						
								BASALT Massive a'a very dark gray (10YR3/1); moderately to slightly weathered; medium strong to strong; 5%, <2 mm, subrounded vesicles, angular fractures; fracture faces Mn + Fe, clay coating Sp, light brown (2.5Y5/4); yellowish red (5YR4/6); yellow (10YR 8/10); likely						

Elevation, feet	Depth, feet	ROCK CORE						Lithology	MATERIAL DESCRIPTION	SAMPLES			FIELD NOTES AND TEST RESULTS	
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number			Type	Number Blows per foot	PID (ppm)		Drill Time [Rate, ft/hr]
61														
186	62	13		100		68	IF	1. 50°, J, VN, Cl, Mn, Fe, Sp, IR, SR - oxidized surface 2. 0°, J, VN, Mn, Sp, Wa, SR - oxidized surface 3. 45°, J, VN, Mn, Fe, Cl, Sp, Wa, SR IF - mostly covered with clay - reddish yellow (7.5YR7/6) 4. 0°, J, VN, Clay, Sp, Pl, SR						No WL, light brown WR.
184	64						4	↓ becomes 10% vesicles, 1-8 mm, subangular to subrounded ↓ becomes 10% vesicles, rounded, <2 mm, partially infilled with clay 5. 5°, J, VN, Mn, Cl, Sp, Wa, SR				0.0 [100]		
182	66							1. 45°, J, VN, Mn, Fe, Cl, Sp, IR, SR 2. 90°, J, VN, Cl, Filled with yellow (10YR7/6) clay 3. 5°, J, VN, Mn, Fe, Sp, Cl, Su, Wa, SR 4. 5°, J, VN, Mn, Fe, Cl, Sp, Pl, S 5. 90°, J, VN, Mn, Fe, Cl, Sp, St, S 6. 45°, J, N, Cl, Pa, Wa, S						No WL, light brown WR.
180	68	14		100		66								
178	70		6				IF	BASALT a'a clinker loose, highly to completely weathered; weak; clay matrix around clasts; dark reddish-gray (5YR4/2); very dark gray (5YR2/1), reddish-yellow (5YR4/6) clay IF pieces covered with reddish-yellow (5YR6/6) clay 7. 0°, J, VN, Mn, Fe, Cl, Sp, Wa, SR 8. 10°, J, VN, Mn, Fe, Cl, SP, Wa, SR				0.0 [75]		
176	72							no recovery						
176	72						IF	↓ completely weathered clinker (?), extremely weak, brown (7.5YR4/2)						No WL, light brown WR.
174	74	15		76		26		BASALT Massive a'a medium weathered; medium strong to strong; 10% vesicles, 2-12 mm, elongate, subangular, partially infilled with yellow (10YR7/6) clay 1. 5°, J, N, Mn, Sp, Cl, Pa, St, S 2. 10°, J, VN, Mn, Sp, Cl, Su, St, S 3. 10°, J, VN, Mn, Sp, Clay, Su, St, S 4. 45°, J, VN, Mn, Fe, Sp, Cl, Su, Wa, S 5. 45°, J, VN, Mn, Sp, Cl, Su, Wa, S						
174	74													
172	76		7					BASALT a'a clinker loose, completely weathered; extremely weak; clay matrix, dark reddish-gray (5YR4/2) clay, yellow (10YR7/6), reddish-yellow (5YR6/6) ↓ highly to completely weathered, very weak to weak 1. 45°, J, N, Cl, Fe, Pa, Wa, SR 2. 20°, J, N, Cl, Fe, Pa, St, SR ↓ dark yellowish-brown (10YR2/4), black (10YR2/1); highly weathered; weak; reddish-yellow (5YR7/6) clay 3. 0°, J, N, Mn, No, Wa, R 4. 0°, J, N, No, IR, R				0.0 [100]		Paused to bail and monitor water levels, see log book #13 for details (pg 44-46)
172	76													
	77													

Report: CTO63 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOGS.GPJ; 2/6/2020 RHMW13

Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	SAMPLES			FIELD NOTES AND TEST RESULTS	
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %			Fracture Drawing Number	Type	Number Blows per foot		PID (ppm)
77		16		80		56		5. 45°, J, W, Fe, No, Wa, SR					Add 100 gal water to hole.
170	78		7				4 5 IF	· brown (10YR 3/4); completely weathered; extremely weak					Light brown WR, no WL
168	80						VK	no recovery			0.0	[75]	
	81							· Same as above, clay covered faces of IF pieces, reddish-yellow (5YR7/6) clay					
	82	17		90		78	1 2 3	· Clasts - gray (GLE Y1 5/N); "matrix" dark reddish-brown (5YR 3/3), clay reddish yellow (7.5YR 6/6); medium to highly weathered, weak.					Light brown WR, no WL
166	83						4 5 6	1. 5°, J, N, Cl, Sp, Wa, R 2. 35°, J, N, Mn, Cl, Sp, Wa, R 3. 20°, J, N, Mn, Sp, Wa, SR 4. 45°, J, N, Mn, Sp, Cl, Su, Wa, SR 5. 45°, J, N, Mn, Sp, Cl, Su, Wa, SR 6. 10°, J, N, Cl, Su, IR, R					
164	84												
	85							BASALT Massive a'a gray (GLE Y 5/N); slightly weathered; very strong; 15% vesicles, elongated, irregular, subrounded, 2-12 mm			0.0	[50]	Paused drilling to monitor WL. See log book #13 (pg 46-52) for details.
162	86		8				1 2						
	87						3 4	· becomes 2% vesicles, <1 mm					Light gray WR, 50 gal WL
160	88			106		60	IF	1. 90°, J, N, Mn, Sp, Cl, Pa, Wa, S 2. 50°, J, N, Mn, Sp, Cl, Pa, Wa, S 3. 20°, J, VN, Mn, Sp, Pl, S 3. 15°, J, VN, Mn, Sp, Wa, S 4. 15°, J, VN, Mn, Sp, Wa, S IF pieces have Cl (Su) on faces, Mn (Sp)					
	89												
158	90							· becomes 10% vesicles, elongate, subrounded 1-7 mm			0.0	[60]	Pause to monitor WL. See log book #13 (pg 46-52) for details.
	91						1 2	1. 5°, J, VN, Mn, Fe, Cl, Sp, Wa, S 2. 90°, J, VN, Mn, Sp, Cl, Su, Wa, S - olive clay (5Y 5/4) 3. 0°, J, VN, Mn, Sp, Wa, S					
156	92		9			80		· becomes 5% vesicles, elongate 2-30 mm					Light gray WR, 20 gal WL
	93	19		100			4	4. 0°, J, VN, Mn, Sp, Cl, Su, Wa, S					

Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	SAMPLES			FIELD NOTES AND TEST RESULTS	
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %			Fracture Drawing Number	Type	Number Blows per foot		PID (ppm)
93							5	5. 10°, J, VN, Mn, Sp, Cl, Su, Wa, SR					
154	94												
	95										0.0	[42.86]	Add 50 gal
152	96		9					becomes 2% vesicles, 1-8 mm subrounded					
	97						1						Light gray WR, ~50 gals WL
150	98	20		100				1. 5°, J, VN, Mn, Cl, Sp, Wa, S 2. 20°, J, N, Cl, Su, Mn, Sp, Wa, SR 3. 30°, J, N, Mn, Cl, Sp, Wa, SR					
	99						2	BASALT a'a' Clinker loose, clasts - black (10YR2/1); "Matrix" dark reddish-brown (5YR3/3), reddish-yellow (7.5YR6/6) clay; medium to highly weathered; weak					
148	100						1	1. 30°, J, VN, Mn, Cl, Sp, IR, S 2. 0°, J, VN, Mn, Fe, Cl, Sp, St, SR			0.0	[75]	Pause to monitor WL. See log book #13 (pg 46-52) for details
	101						2	BASALT Pahoehoe heat alteration (flow contact); red (2.5YR4/6) dark reddish-brown (5YR3/2); slightly weathered; strong; 15% vesicles, rounded to subrounded, 1-4 mm, partially infilled with clay					Light brown WR, 40-50 gals WL
146	102		21	100			3	becomes 10% vesicles, rounded, 3-10 mm, partially infilled with clay					
	103						4	becomes very dark gray (5YR3/1); slightly weathered; strong; 20% vesicles, round, <2 mm, partially infilled with clay					
144	104		10				5	3. 15°, J, VN, Mn, Fe, Sp, Cl, Su, Sp, Wa, SR 4. 40°, J, VN, Mn, Sp, Cl, Su, Wa, SR 5. 60°, J, VN, Mn, Sp, Cl, Su, Wa, SR 6. 0°, J, VN, Mn, Sp, Cl, Su, Pl, S 7. 20°, J, VN, Cl, Sp, Wa, SR 8. 20°, J, VN, Mn, Cl, Sp, St, SR					
	105						6						
142	106						1	1. 75°, J, VN, Mn, Sp, Cl, Su, Wa, SR - reddish-yellow (5YR7/8) clay			0.0	[150]	Pause to monitor WL. See log book #13 (pg 46-52) for details
	107						2	2. 0°, J, VN, Mn, Sp, Cl, Su, Wa, SR 3. 5°, J, VN, Mn, Sp, Cl, Su, Pl, SR					Light gray WR, "very little WL" per driller
	108	22		80			3	IF - pieces covered with thick clay, partially infilled with yellowish-red (5YR4/0) clay					
	109						IF						

Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	SAMPLES			FIELD NOTES AND TEST RESULTS
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %			Type	Number Blows per foot	PID (ppm)	
109												
138	110					NR	no recovery					
	111					1	↓ becomes very dark gray (7.5YR3/1); medium weathering; strong; 5-15% vesicles, round, <4 mm, partially infilled with reddish-yellow (5YR6/6) clay ↓ becomes very dark gray (GLE Y 3/N), slightly weathered, strong, 45% 5mm, angular vesicles			0.0	[100]	"Very little WL" per driller, Light gray WR
136	112	23		92		74						
	113					2	↓ becomes 25% >3 mm, round vesicles, partially infilled vesicles with reddish-yellow (5YR6/6) clay 1. 10°, J, WM, Cl, Sp, Mn, Su, Wa, SR 2. 20°, J, N, Cl, Sp, Pl, S ↓ becomes slightly weathered, strong, 15% <2 mm vesicles 3. 75°, J, N, Cl, Su, Mn, Sp, Wa, S 4. 0°, J, N, Cl, Su, Pl, S					
134	114					3						
	115		11			4	BASALT a'a' Clinker clasts - dark reddish-brown (5YR3/2); "matrix" - brown (10YR4/4) clay, reddish-yellow (7.5YR7/6); completely weathered; extremely weak 1. 0°, J, VN, Cl, Sp, IR, SR 2. 0°, J, VN, Mn, Cl, Sp, IR, SR 3. 0°, J, VN, Mn, Cl, Sp, Wa, S 4. 10°, J, VN, Mn, SP, Cl, Su, Wa, R IF pieces covered with clay			0.0	[75]	Pause to monitor WL. See log book #13 (pg 46-52) for details.
132	116					1						
	117	24		100		64						Light brown WR, no WL
130	118					3						
	119					IF						
128	120					4	no recovery					
	121					IF						
126	122	25	12	92		22	BASALT Massive a'a' gray (GLE Y 1 5/N); moderately to slightly weathered; strong to very strong; 15% vesicles, 2-20 mm, elongate, subrounded, reddish-yellow (7.5YR6/8) clay infilling some vesicles 1. 40°, J, VN, Mn, Sp, Cl, Su, Wa, SR 2. 90°, J, VN, Mn, Sp, Cl, Su, Wa, SR 3. 5°, J, VN, Mn, Sp, Cl, Su, Wa, SR 4. 10°, J, VN, Mn, Sp, Cl, Su, Pa, SR 5. 5°, J, VN, Mn, SP, Cl, Su, St, SR 6. 5°, J, VN, Mn, SP, Cl, Su, St, SR					Lost circulation
	123					IF						
124	124					7	BASALT a'a' Clinker loose, completely weathered; extremely weak; dark reddish-brown (5YR3/2); covered with reddish-yellow (7.5YR6/6) clay 7. 5°, J, VN, Mn, Sp, Cl, Su, Wa, SR IF pieces covered with reddish-yellow (7.5YR7/6) clay					
	125					IF	BASALT Pahoehoe					

Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	SAMPLES			FIELD NOTES AND TEST RESULTS	
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %			Fracture Drawing Number	Type	Number Blows per foot		PID (ppm)
125													
122	126							very dark brown (7.5YR2.5/3); slight to moderately weathered; medium strong to strong; 20% vesicles, <2 mm, mostly infilled with clay ▼ becomes 10% vesicles, subrounded to rounded, 2-6 mm, partially infilled with clay ▼ becomes >20% vesicles, <2 mm, subrounded ▼ becomes 10% vesicles, <2 mm, subrounded, mostly infilled with clay			0.0	[150]	Pause to monitor WL. See log book #13 (pg 46-52) for details. Added 500 gals, light brown WR, some WL.
127		26		100		84		1. 0°, J, Mn, Cl, Pa, SR 2. 10°, J, Mn, Cl, Pa, SR 3. 0°, J, VN, Cl, Su, SR 4. 10°, J, VN, Mn, Fe, Cl, Sp, Wa, SR					
120	128							▼ becomes black (2.5YR2.5/1); dark reddish-brown (2.5YR2.5/4); slightly to moderately weathered; strong; 15% vesicles, rounded to subrounded, <2 mm, mostly infilled with reddish-yellow (7.5YR7/6) clay					
129								5. 10°, J, VN, Mn, Sp, Cl, Sp, Su, Wa, SR 6. 5°, J, VN, Mn, Sp, Cl, Su, Wa, SR					
118	130										0.0	[75]	Added 500 gals, light brown WR, some WL.
116	132		13					▼ becomes very dark gray (5YR3/1); slightly weathered; strong; 15% vesicles, 2-7 mm, subrounded to rounded 1. 0°, J, VN, Mn, Cl, Sp, Pl, SR 2. 50°, J, VN, Mn, Sp, Cl, Sp, Su, Wa, SR 3. 90°, J, VN, Mn, Fe, Sp, Cl, Sp, Su, Wa, SR 4. 60°, J, VN, Mn, Fe, Cl, Sp, Wa, SR 5. 0°, J, N, Mn, Fe, Sp, Cl, Pa, Wa, SR					
114	134		27	100		74		▼ become 15% vesicles, <3 mm, subrounded to rounded					
112	136							▼ becomes 20% vesicles, rounded, <2 mm 1. 5°, J, VN, Mn, Cl, Sp, Wa, SR 2. 10°, J, VN, Mn, Fe, Cl, Wa, SR - oxidized face heat alteration (possible flow contact); red (2.5YR5/8) ▼ becomes very dark gray (10YR3/1); slightly weathered; strong; 10% vesicles, rounded to sunrounded, 1-4mm					
110	138							3. 20°, J, VN, Mn, Sp, Wa, SR 4. 0°, J, VN, Mn, Sp, Wa, SR					
108	140		14					IF pieces coated with yellow (10YR7/6) clay Pahoehoe ropey texture on IF pieces					
108	140							BASALT Massive a'a' very dark gray (GLEYS 3/N); slightly weathered; strong; 10% vesicles, elongate, 2-25 mm, a few infilled with clay 1. 50°, J, VN, No, No, IR, SR			0.0	[60]	End coring at 135ft bgs to monitor WL, see log for details (logbook #13 pg 46-52) Resume coring on 8/26/19 at 0728. Add 300 gals, light brown WR, most returned, some WL. Add 300 gals, light brown WR, most returned, some WL.
141													

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facility

Project Location: CTO18F0126

Project Number: 60571032

Log of Boring RHMW13

Sheet 11 of 34

Elevation, feet	Depth, feet	ROCK CORE						Lithology	MATERIAL DESCRIPTION	SAMPLES				FIELD NOTES AND TEST RESULTS
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number			Type	Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	
157	33		88		52		IF	BASALT a'a' Clinker loose, dark reddish-brown (5YR 3/2); strong brown (7.5YR 5/6), yellowish-red (5YR 4/8), red (10YR 4/8); moderately to highly weathered; weak; some clay on clasts						
90	158						1	"welded clasts" - dark gray (2.5YR 4/1), dark reddish-brown (2.5YR 3/3), yellow (10YR 7/6) clay; moderately weathering; weak to medium strong						
159							IF							
88	160						IF	BASALT Massive a'a' gray (GLEY 5/1); slightly weathered; medium strong to strong; 5% vesicles, elongate, subrounded, 2-5 mm			0.0	[25]		
161							IF	IF - yellow (10YR 7/6) clay on some faces - Sp, Mn +Fe - Sp						
86	162						IF	IF clay on some faces - yellow (10YR 7/6) - Mn +Fe - sp						Light gray WR, added 500 gals, mostly returned, some WL.
163	34		96		10		IF							
164							IF							
84	164						IF							
165							1	BASALT a'a' Clinker loose clasts - dark gray (7.5YR 4/1); strong brown (7.5YR 5/6), red (2.4YR 4/6) clay; moderately weathered; weak			0.0	[37.5]		
82	166		17				IF	1. 0°, J, VN, Cl, Sp, Wa, SR						Light brown WR, added 500 gals, mostly returned, some WL.
167														
80	168							no recovery						
169							1	BASALT Pahoehoe brown (7.5YR 4/8), red (2.5YR 4/6); highly weathered; weak; some clay						
78	170						1	1. 20°, J, VN, Mn, Su, Pl, Slk						
171							2	2. 0°, J, VN, Mn, Fe, Cl, Sp, Wa, SR						
171							3	3. 0°, J, VN, Mn, Cl, Sp, Wa, R						
76	172						M	possible flow contact, becomes very dark brown (7.5YR 2.5/3); moderately weathered; medium strong; some clay						
173	36		100		82		4	4. 5°, J, VN, Mn, Cl, Sp, Wa, SR						Light brown WR, added 500 gals, mostly returned, some WL.

Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	SAMPLES			FIELD NOTES AND TEST RESULTS	
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %			Fracture Drawing Number	Type	Number Blows per foot		PID (ppm)
173													
74	174						becomes completely weathered, extremely weak						
175							becomes very dark brown (7.5YR 2.5/3), completely weathered, extremely weak			0.0	[54]	Pause coring at 175ft bgs to monitor WL. See log book #13 8/26/19 for details 10" casing set at 172' bgs	
72	176					NR	No Recovery						
177		37		44									
70	178												resume coring on 9/19/19, drill 172' to 175' at 0829-0831 light brown WR, no WL
179			18										
68	180						becomes gray (GLE1 5/N) and strong brown (7.5YR 4/6), highly to moderately weathered, weak to medium strong, 10%, 2mm round to subrounded, partially infilled vesicles. reddish yellow (7.5YR 5/6) and white (10YR 3/1) clay infill.			0.0	[66]	pause to monitor WLs. No WL, light gray WR	
181													
66	182	38		100			becomes gray (GLE1 6/N), highly to moderately weathered, medium strong, 10% 1-7mm, subrounded irregular vesicles, partially infilled with white (7.5YR 8/6) clay						
183							1. 5°, J, VN, Mn, Fe, clay, Sp, SR 2. 45°, J, VN, Mn, Fe, Sp, Clay, Su, SR 3. 0°, J, VN, Mn, Sp, Clay, Su, S 4. 0°, J, VN, clay, Sp, St, R						
64	184						becomes very dark grayish brown (10YR 3/2), moderately weathered, medium strong, 15% <2mm rounded vesicles						
185							1. 0°, J, VN, Mn, FE, clay, SP, Wa, SR 2. 0°, J, VN, Mn, clay, SP, Wa, SR 3. 80°, J, VN, Mn, FE, clay, SP, Wa, SR			0.0	[50]	pause to monitor WL pause to add bentonite and create seal. End coring 9/19/19	
62	186		19										
187							possible flow contact reddish brown (5YR 4/3) moderately weathered, medium strong, 2% 1-3mm partially infilled vesicles, clay infilled.						
60	188	39		100			4. 10°, J, VN, Mn, Fe, clay, SP, PI, S 5. 0°, J, VN, Mn, Fe, clay, SP, Wa, SR 6. 80°, J, VN, Mn, clay, SP, Wa, R 7. 0°, J, VN, Mn, Fe, Clay, Sp Wa, S						resume coring on 9/20/19 brown WR, No WL
189													

Elevation, feet	Depth, feet	ROCK CORE						Lithology	MATERIAL DESCRIPTION	SAMPLES				FIELD NOTES AND TEST RESULTS
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number			Type	Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	
189							8	8. 0° J, VN, Fe, Sp, Ir, R IF -> Mn Fe, Clay sp - face shows evidence of oxidation.						
58	190						1	becomes very dark gray (10YR 3/2) slightly to moderately weathered, medium strong, 10% 2-5mm subrounded - subangular vesicles.				0.0	[42]	pause to monitor WLs, end drilling for 9/20/19
191		19					1	1. 0° J, N, Clay, SP, IR, R 2. 0° J, VN, Mn, Fe, Clay, SP, Wa, SR Oxidation on face 3. 90° J, VN, Mn, Fe, clay, SP, Wa, SR 4. 15° J, VN, Mn, Fe, Clay, SP, Wa, SR						resume coring on 9/23/19 light brown WR, gray/black at first foot of WR, white film on mudpan water. No WL
56	192			100		76	2	becomes dark grayish brown (10YR 3/2) highly weathered, weak, clay partially infilled vesicles						
193		40					3	becomes very dark gray (10YR 3/2) moderately weathered, medium strong, 10% 1-3mm subrounded vesicles.						
54	194						4	5. 0° J, VN, Mn, Fe, Clay, SP, Wa, R 6. 50° J, VN, Mn, Fe, Clay, SP, Wa, R						
195							5	becomes medium strong to weak, 5% 1-2mm subrounded vesicles.						pause to bail and monitor
52	196						6	7. 5° J, VN, Mn, Clay, SP, Wa, R				0.0	[23]	
197							7	becomes very dark gray (10YR 3/1) slightly weathered, strong 15% 1-4mm subrounded to rounded vesicles.						light brown WR, no WL
50	198						1	1. 0° J, VN, No, No, St, SR 2. 45° J, VN, Mn, SP, Wa, SR 3. 5° J, VN, Mn, Clay, SP, Wa, SR						
199		41		100		54	2	possible flow contact /thermal alteration, red (2.5YR 5/6)						
48	200						3	becomes very dark brown (10YR 2/2) moderately weathered, medium strong, 5% 1-3mm subrounded vesicles.						
201		20					4	4. 85° J, N, Clay, SP, IR, R 5. 45° J, VN, Mn + Fe Sp, Clay Su, Wa, SR 6. 45° J, VN, Mn, Fe, Clay, SP, Wa, SR - oxidation on face						
46	202						5	red (2.5YR 5/6) heat alteration band						pause to bail and monitor
203							6	becomes very dark gray (10YR 3/1), slightly weathered, strong, 10% 1-2mm subrounded vesicles				0.0	[42]	"orange stain" comes out in mudpan at start of run, no odor, no PID. No WL, light brown WR
44	204						7	1. 5° J, VN, Mn, Clay, Sp, Wa SR 2. 15° J, VN, No, No, Wa, R						
205		42		100		80	1	becomes 15% 1-2mm subrounded vesicles						
							2	becomes dusky red (7.5YR 3/2) slightly weathered, strong, 20% <2mm rounded vesicles						
		21					3	becomes very dark gray (10YR 3/1) slightly weathered, strong, 5% 4mm subangular to subrounded vesicles.						
							4	3. 15° J, VN, No, No, Wa, R 4. 0° J, VN, No, No, Wa, R						

Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	SAMPLES			FIELD NOTES AND TEST RESULTS		
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %			Type	Number Blows per foot	PID (ppm)		Drill Time [Rate, ft/hr]	
205											0.0	[60]	pause to monitor WL. End coring for 9/23/19 resume coring on 9/24/19 brown WR, no WL	
42	206							1. 45°, J, VN, Mn, Fe, Clay, Sp, Wa, SR becomes very dark brown (10YR 2/2) highly weathered, weak						
	207	43	21	100		70		2. 0°, J, N, Mn, Clay, SP, Wa, R - very little sp clay 3. 0°, J, N, Clay, SP, Wa, R 4. 0°, J, MN, No, No, Wa, R 5. 0°, J, N, No, No, Wa, R 6. 0°, J, MN, Clay, Sp, Wa, R - very little Sp clay 7. 0°, J, MN, Clay, Sp, Wa, R - very little Sp clay						
40	208							becomes slightly weathered, strong 10% 1-4mm subrounded vesicles						
	209							becomes dark gray (GLE1 4/N) unweathered, very strong 20% 1-4mm rounded to subrounded vesicles.				0.0	[75]	pause coring to bail and monitor WLs. (book #13)
38	210							becomes 2% 1-12mm rounded to subrounded vesicles. becomes 20% 1-6mm rounded to subrounded vesicles						brown WR. No WL
	211							1. 0°, J, VN, Mn, Fe, Sp, Wa, SR 2. 10°, J, VN, Mn, Fe, Sp, Wa, SR 3. 10°, J, VN, Mn, Fe, Sp, Wa, SR						
36	212	44	94			18		becomes reddish brown (2.5YR 4/4) moderately to highly weathered, weak						
	213							becomes reddish brown (5YR 4/3) moderately weathered, moderate strength						
34	214							becomes brown (10YR 4/3) slightly weathered, strong						
	215		22					4. 50°, J, VN, Mn, Fe, Sp, Wa, SR 5. 45°, J, VN, Mn, Fe, Sp, Wa, SR No Recovery				0.0	[60]	pause to monitor WLs (book #13)
32	216							becomes 5% 1-8mm, subrounded to rounded vesicles. 1. 90°, J, VN, Mn, Fe, Clay, Sp, Wa, SR 2. 20°, J, VN, Mn, Fe, Clay, Sp, Wa, SR becomes 20% 1-4mm, subrounded to rounded vesicles becomes 2% <2mm, rounded vesicles						brown WR. Lost circulation at 219' to 220' bgs. WL = 200 gals
	217	45	100			78		possible heat alteration /flow contact - dark yellowish brown (10YR 3/4), yellowish (5YR 4/6) and black (5YR 2.5/1)						
30	218							becomes very dark grayish brown (10YR 3/2) moderately weathered, medium strong						
	219							3. 5°, J, VN, Mn, Fe, Clay, Sp, Wa, R 4. 10°, J, VN, Mn, Fe, Clay, Sp, Wa, R 5. 0°, J, N, Mn, Fe, Sp, Wa, R becomes slightly weathered, strong 10% 1-4mm, rounded to subrounded vesicles						Void observed on video log between ~219' and 220' bgs.
	220		23					becomes 15% 1-6mm, subrounded vesicles becomes 10% 1-2mm subrounded to rounded vesicles becomes 15% 1-4mm rounded to subrounded vesicles				0.0	[75]	pause coring for 9/24/19
28	220							reddish black (2.5YR 2.5/1) unweathered, very strong, 10% 2-26mm subrounded to rounded vesicles						Installed 5" casing set at
	221													

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOGS.GPJ; 2/6/2020 RHMW13

Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	SAMPLES			FIELD NOTES AND TEST RESULTS	
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %			Fracture Drawing Number	Type	Number Blows per foot		PID (ppm)
221													
26	222	46	24	100		64	M	▼ becomes gray (10YR 5/1), unweathered, very to extremely strong 1. 15°, J, VN, Mn, Fe, Sp, Wa, SR 2. 0°, J, VN, Mn, Fe, Sp, Pl, SR 3. 0°, J, VN, Mn, Fe, Sp, Pl, SR 4. 5°, J, VN, Mn, Fe, Sp, Wa, SR					220' bgs resume coring on 10/7/19, light brown WR, add 50 gals, no WL
	223						M	▼ becomes 20% 1-3mm rounded vesicles 5. 0°, J, VN, Mn, Fe, Sp, Pl, SR 6. 5°, J, VN, Mn, Fe, Sp, Wa, SR 7. 0°, J, VN, Mn, Fe, Clay, Sp, Wa, SR 8. 35°, J, VN, Mn, Fe, Clay, Sp, Wa, SR					
24	224						M	▼ becomes slightly weathered, strong, 1% <1mm rounded vesicles ▼ becomes 15% 1-2mm rounded vesicles ▼ becomes 10% <1mm rounded vesicles					
	225						M	▼ becomes 2% 1-3mm rounded vesicles ▼ becomes gray (10YR 5/1), unweathered, very to extremely strong, 10% 1-4mm rounded to subrounded vesicles.			0.0	[60]	pause to bail and monitor (book #15 page 38)
22	226		25				M	▼ becomes 15% 1-7mm subrounded to rounded vesicles ▼ becomes 10% 1-4mm rounded to subrounded vesicles					resume coring on 10/8/19, light gray WR, No WL
	227	47		2		68	M	1. 5°, J, VN, No, No, Wa, SR 2. 0°, J, VN, Mn, Sp, Pl, SR 3. 10°, J, VN, Mn, Fe, Sp, St, S ▼ becomes very dark gray (10YR 3/1) unweathered, strong to very strong, 20% 1-3mm rounded to subrounded vesicles.					
20	228						M	4. 5°, J, VN, No, No, Wa, SR 5. 15°, J, VN, Mn, Fe, Sp, Wa, R 6. 80°, J, VN, Mn, Fe, Sp, Wa, R 7. 0°, J, VN, No, No, Wa, R 8. 0°, J, VN, Mn, Fe, Sp, Wa, SR					
	229						M	▼ becomes 15% 1-8mm rounded to subrounded vesicles.					
18	230		26				M	9. 5°, J, VN, No, No, Wa, SR 10. 0°, J, VN, No, No, Wa, SR 1. 0°, J, VN, Mn, Fe, Sp, St, S 2. 0°, J, VN, No, No, Sp, Wa, SR			0.0	[150]	pause to bail and monitor (book #15, pg.43)
	231						IF						light brown WR, No WL
16	232	48		100		56	IF	▼ becomes red (5YR 4/4), reddish brown (2.5YR 4/3) and reddish black (2.5YR 2.5/1) unweathered, very strong 15% 1-5mm rounded to subrounded vesicles. Possible flow contact.					
	233						IF	Mn + Fe on intensely fractured pieces, ropey texture					
14	234		27				IF	IF - Mn + Fe on IF fragments, ropey texture					
	235						IF	3. 0°, J, VN, Mn, Fe, Sp, Wa, R 4. 0°, J, VN, Mn, Fe, Sp, IR, SR - ropey texture					
	236						IF	▼ becomes dark reddish gray (2.5YR 3/1), slightly weathered, strong, 15% 1-3mm rounded to subangular vesicles. Halloysite in vesicles and in fractures.			0.0	[27]	pause to bail and monitor (book #15, pg.43) 235'-236' light brown WR.
12	237						IF	▼ becomes 10% 2-8mm subrounded vesicles, Mn and Fe on fractures					lost circulation ~236' bgs

Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	SAMPLES			FIELD NOTES AND TEST RESULTS	
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %			Type	Number Blows per foot	PID (ppm)		Drill Time [Rate, ft/hr]
237		49		104		22	IF						pause to fill water truck.
10	238						IF	Halloysite on fractures					add 50' gal. WL
	239		28				IF	1. 10°, J, VN, Mn, Fe, Halloysite, Sp, Wa, R 2. 5°, J, VN, No, No, IR, SR 3. 20°, J, VN, Mn, Fe, Sp, Halloysite Su, IR, SR					
8	240						IF	becomes greenish black (GLE Y1 2.5/10Y), slightly weathered, very strong, 10% 1-9mm subangular vesicles. Halloysite in vesicles and in fractures. SP+Su			0.0	[300]	
	241						IF						
6	242	50		100		14	IF	becomes very dark gray (GLE Y1 3/N), unweathered, very strong, 10% 1-8mm rounded to subrounded vesicles.					add 300 - 400 gal, WL
	243						IF	1. 5°, J, VN, No, No, Wa, S					
4	244						IF	becomes 30% 1-4mm rounded vesicles.					
	245		29				IF	becomes dusky red (2.5 YR 3/3) and reddish black (2.5YR 2.5/1), slightly weathered, strong, 5% <3mm rounded to subrounded vesicles.			0.0	[300]	
2	246						M	1. 70°, J, VN, No, No, Wa, SR 2. 15°, J, VN, No, No, Wa, SR					
	247						IF	becomes dark brown (7.5YR 3/2), slightly weathered very strong, 15% <3mm subrounded to subangular vesicles.					
0	248	51		94		58	IF	3. 5°, J, VN, No, No, Wa, S very dark gray (GLE Y1 3/N) unweathered, very strong, 5% <1mm rounded vesicles.					add 300 gal, WL
	249						IF	becomes 10% 1-8mm rounded vesicles.					
-2	250		30				IF	becomes reddish brown (2.5YR 4/4) slightly weathered, strong, 15% 1-3mm rounded vesicles. No Recovery			0.0	[150]	
	251						IF	1. 90°, J, VN, Mn, Sp, Wa, SR 2. 20°, J, VN, Mn, Sp, Wa, SR					
-4	252						IF	becomes 20% <2mm rounded vesicles.					add 300 gal, WL
	253	52		106		18	IF						

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Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	SAMPLES			FIELD NOTES AND TEST RESULTS
		Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %			Fracture Drawing Number	Type	Number Blows per foot	
253												
-6	254		31				IF 3	1% 1-4mm weathered olivine phenocrysts, 15% 1-5mm subrounded vesicles. 3. 45°, J, VN, Mn, Sp, Wa, S				
	255						IF AIR	No Recovery			0.0	[150]
-8	256						IF 1	heat alteration, possible flow contact very dark gray (10YR 3/1), slightly weathered, strong, 15% 1-4mm subrounded to subangular vesicles				
	257	53		88		28	IF	1. 5°, J, VN, Mn, Fe, Sp, Pl, S 2. 5°, J, VN, Fe, Sp, Pl, S				add 300 gal, WL
-10	258						IF 2	becomes very dark gray (10YR 3/1) and reddish brown (5YR 5/4), moderately weathered, medium strong. 10% 1-5mm subrounded vesicles.				
	259						IF 3	3. 0°, J, VN, No, No, IR, R				
-12	260		32				IF				0.0	[100]
	261						IF					
-14	262	54		10		40	IF					700 gal WL
	263						IF 1 2	becomes very dark gray (GLE1 3/N), slightly weathered, strong to very strong, 5% 2-12mm rounded to subrounded vesicles.				
-16	264						IF 3 4	1. 90°, J, VN, Mn, Fe, Sp, Wa, S 2. 0°, J, VN, Mn, Fe, Sp, Wa, SR 3. 0°, J, VN, Mn, Fe, Sp, Wa, SR 4. 15°, J, VN, Mn, Fe, Sp, Wa, SR - Olivine Phenocrysts				
	265		33				IF	reddish brown (2.5YR 4/3), highly weathered, very weak.			0.0	[100]
-18	266						IF					
	267	55		74		0	IF					300 gal WL
-20	268						IF					
	269						IF NR					

Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	SAMPLES			FIELD NOTES AND TEST RESULTS	
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %			Fracture Drawing Number	Type	Number Blows per foot		PID (ppm)
269								No Recovery					
-22	270		34				1	very dark gray (GLE Y1 3/N) unweathered, very strong, 15% 1-8mm rounded to subrounded vesicles.			0.0	[300]	
	271						2	1. 45°, J, VN, Mn, Fe, Clay, Sp, Wa, S 2. 0°, J, VN, Mn, Fe, Sp, IR, SR 3. 50°, J, VN, Mn, Fe, Sp, Wa, SR					
-24	272	56		100		84	3	· becomes 5% 1-12mm rounded to subrounded vesicles, 2% unweathered olivine phenocrysts.					300 gal WL
	273												
-26	274		35				4	· becomes 2% <1mm rounded vesicles 4. 5°, J, VN, Mn, Fe, Clay, Sp, Wa, S 5. 50°, J, VN, Mn, Fe, Sp, Wa, S - oxidized Pa? 6. 10°, J, VN, Mn, Fe, Sp, Wa, S - Olivine Phenocryst					
	275						5	· becomes 5% 1-10mm rounded to subrounded vesicles			0.0	[30]	
	276						6	1. 50°, J, VN, Mn, Fe, Sp, Wa, SR 40mm X 30mm vug					
-28	277	57		94		56	2	2. 0°, J, VN, Mn, Fe, Sp, Pl, S 3. 5°, J, VN, Mn, Sp, IR, R 4. 0°, J, VN, Mn, Fe, Clay, Sp, Pl, S 5. 5°, J, VN, Mn, Fe, Clay, Sp, Pl, S					300 gal WL
	278						3	· becomes very dark gray (10YR 3/1) moderately weathered, medium strong, 2% 1-4mm subrounded vesicles					
	279						4	· becomes red (2.5YR 4/6), slightly to moderately weathered, medium strong, 5% <3mm subangular vesicles, halloysite in some vesicles.					
	280		36				5	6. 5°, J, VN, Mn, Fe, Clay, Sp, Wa, SR 7. 15°, J, VN, Mn, Fe, Clay, Sp, IR, SR			0.0	[75]	
-32	281						6	No Recovery					
	282						7	· becomes reddish brown (2.5YR 4/3), slightly weathered, strong, 10% <2mm subrounded vesicles. Some halloysite in vesicles.					
-34	283	58		106		74	1	1. 0°, J, VN, Mn, Fe, Clay, Sp, Wa, S 2. 0°, J, VN, Mn, Fe, Clay, Sp, Wa, SR 3. 80°, J, VN, Mn, Fe, Clay, Sp, Wa, SR 4. 10°, J, VN, Mn, Fe, Clay, Sp, St, SR 5. 0°, J, VN, Mn, Fe, Clay, Sp, Wa, SR					300 gal WL
	284		37				2	5% 2-12mm subrounded to rounded vesicles.					
	285						3	6. 45°, J, VN, Mn, Fe, Clay, Sp, Wa, S · becomes dark gray (10YR 4/1), slightly weathered, strong 5% 1-11mm subrounded to rounded vesicles.					

Elevation, feet	Depth, feet	ROCK CORE						Lithology	MATERIAL DESCRIPTION	SAMPLES			FIELD NOTES AND TEST RESULTS	
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number			Type	Number Blows per foot	PID (ppm)		Drill Time [Rate, ft/hr]
285														
-38	286						1	becomes 10% <2mm rounded vesicles.				0.0	[50]	
	287	59		56		20	2	BASALT a'a' Clinker loose dark reddish brown (5YR 3/2), completely weathered, extremely weak						500 gal WL - high pressure release
-40	288													
	289						NR	No Recovery						
-42	290	60		150		0	IF	BASALT Massive a'a' very dark gray (7.5YR 3/1) moderately weathered, strong, 15% >3mm vesicles. highly fractured silty seam brown (7.5YR 4/2) may be drill cuttings, no weathering features, completely fractured.				0.0	[20]	end coring for 10/8/19 resume coring on 10/9/19 at 0639
	291													
-44	292						NR	No Recovery						0642 drill rig rotation bogging down, high water pressure, drill rods become stuck at 291 ft bgs (see log book #15 pt 49-50)
	293	61		80		55	1	BASALT a'a' Clinker loose, reddish brown (2.5YR 4/3) too very dusky red (2.5YR 2.5/2), highly weathered, very weak. Clayey with signs of the drill shoe						
-46	294						IF	BASALT Pahoehoe Brown (7.5YR 4/6) to very dark brown (7.5YR 2.5/2) moderately weathered, strong, 40% 1-2 mm round vesicles. Minimal clay infill in vesicles. 1. 90°, J, N, Clay, Pa, Wa, R 2. 45°, J, N, Clay, No, Wa, R						slow drilling - drill string appears to be binding up, 500 WL - high pressure release
	295						2	becomes highly weathered, weak, 50% 1mm vesicles indicative of flow boundary						
-48	296	39					M	becomes moderately to slightly weathered, medium strong, 30% <5mm elongated vesicles 1. 90°, J, N, Clay, Pa, Wa, SR 2. 0°, J, MW, Clay, Pa, PI, S				0.0	[100]	
	297													No WR - 200 gal WL
-50	298	62		110		76	M	becomes 20% 5-10mm vesicles.						
	299							becomes black (2.5Y 2.5/1) slightly to unweathered, strong to very strong, 5% 10mm vesicles						
-52	300	40						grades to 40% 1-2mm vesicles.						
	301						IF	becomes moderately weathered, medium strong, 5% 1mm vesicles partially infilled with clay.				0.0	[100]	

Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	SAMPLES			FIELD NOTES AND TEST RESULTS	
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %			Fracture Drawing Number	Type	Number Blows per foot		PID (ppm)
301								<ul style="list-style-type: none"> grades to dark gray (5YR 4/1), moderately weathered, medium strong, 40% 2mm rounded vesicles. 					
-54	302	63	40	100	60	IF	<ul style="list-style-type: none"> dark reddish brown (5YR 4/3) highly to moderately weathered, medium strong to weak, 40% 1-2 mm rounded vesicles, ropey texture with clay infill on IF pieces. becomes 35% 2-3mm vesicles. 						
	303					1	<ul style="list-style-type: none"> 1. 10°, J, N, Clay, Pa, Wa, SR IF - clay infill on fractures 						
-56	304					IF	<ul style="list-style-type: none"> becomes dark gray (5YR 4/1) moderately weathered, medium strong, 25% <6mm round vesicles slightly infilled with clay. 						
	305		41			M					0.0	[50]	
-58	306					IF	<ul style="list-style-type: none"> grades to reddish gray (2.5 YR 4/1) slightly to moderately weathered, strong, 40% 1-2mm vesicles. becomes moderately weathered, medium strong, partial clay infill on surface. 						
	307	64		100	60	1	<ul style="list-style-type: none"> 1. 10°, J, MW, No, No, IR, R 2. 90°, J, N, Mn, Sp, Pl, S dark reddish brown (2.5YR 5/3) 10-15% 3mm vesicles 						No WR - 400 gals WL, adding water from surface down annulus
-60	308					3	<ul style="list-style-type: none"> 3. 45°, J, MW, Mn, Fe, St, Wa, S Yellowish red (5YR 4/6), 25% 0.5mm vesicles. 						
	309					IF	<ul style="list-style-type: none"> becomes moderately to highly weathered, weak, 30% 1-2mm rounded vesicles, light brown (7.5YR 6/3) clay infill in vesicles. 						
-62	310					4	<ul style="list-style-type: none"> 4. 15°, J, N, No, Wa, R becomes dark brown (7.5YR 3/2) moderately weathered, medium strong, 30% 2-3mm vesicles. 				0.0	[42.8]	
	311					1	<ul style="list-style-type: none"> BASALT a'a' Clinker Welded, yellowish red (5YR 5/6) to very dark gray (5YR 3/2) moderately weathered, strong. 						
-64	312	65		80	35	IF	<ul style="list-style-type: none"> 1. 10°, J, N, No, No, St, R 2. 25°, J, N, Mn, Fe, Su, Wa, S 						No WR - 500 gal WL
	313					2	<ul style="list-style-type: none"> loose clinker fragments become dark reddish brown (2.5YR 4/3) and very dark gray (5YR 3/2) moderately weathered, strong, minimal clay infill 						
-66	314												
	315		43			NR	No Recovery				0.0	[42.8]	
-68	316						<ul style="list-style-type: none"> becomes dusky red (2.5YR 3/2) moderately weathered, strong. 						No WR - 500 gal WL
	317												

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Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	SAMPLES			FIELD NOTES AND TEST RESULTS	
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %			Fracture Drawing Number	Type	Number Blows per foot		PID (ppm)
317		66		74		42	IF						
-70	318		43				1	BASALT Massive a'a black (10YR 2/1) fresh to slightly weathered, strong 15% 5-10mm elongated vesicles, olivine phenocrysts					
	319							1. 15°, J, N, Mn, Sp, IR, S					
-72	320						IF				0.0	[37.5]	
	321						1	• becomes very dark gray (10YR 4/1) 1% >30mm elongated vesicles with 15% 1-2mm slightly weathered olivine phenocrysts. Phenocrysts slightly discolored.					No WR - 600 gal WL
	322						2	1. 10°, J, N, Mn, Sp, IR, R 2. 15°, J, N, Mn, Sp, Wa, S 3. 45°, J, N, Mn, Fe, Sp, Pl, S					
-74	322	67	44	92		44	IF	• becomes slightly weathered, strong 5% >10mm vesicles					
	323						4	4. 15°, J, N, Mn, Fe, Sp, Wa, S 5. 15°, J, N, Mn, Su, Wa, S 6. 0°, J, N, Clay, Sp, Wa, S 7. 35°, J, N, Mn, Sp, Wa, SR					drill rig rotation slowing - drill rods possibly binding, high pressure release
	324						5						
	325						6						
	325						7						
	325						IF	No Recovery					
	325										0.0	[30]	
-78	326						1						
	327	68		64		22	IF	BASALT a'a Clinker welded, dark reddish brown (2.5YR 2.5/4) to reddish black, (2.5YR 2.5/1) moderately weathered, weak to medium strong, intensely fractured, with Mn stains on surfaces.					No WR - 500 gal WL
-80	328		45				IF						
	329												
	329							No Recovery					
-82	330												
	330										0.0	[60]	
	331							BASALT Massive a'a very dark brown (7.5YR 2.5/2) slightly weathered, very strong, 30% 5-20mm irregular vesicles					No WR - 500 gal WL
	331						1						
-84	332	69		100		86	IF	1. 80°, J, VN, Mn, Sp, Wa, S 2. 5°, J, VN, No, No, St, R					
	332												
	333						2						

Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	SAMPLES			FIELD NOTES AND TEST RESULTS
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %			Fracture Drawing Number	Type	Number Blows per foot	
333							3. 0°, J, VN, Mn, Sp, IR, R 4. 45°, J, VN, Mn, Sp, IR, R					
-86	334		46									
335							· becomes very dark gray (5YR 3/1), slightly to moderately weathered, strong, 5% 10-15mm elongated vesicles.			0.0	[60]	
-88	336						1. 90°, J, N, Mn, Fe, Clay, Su, Wa, R 2. 10°, J, N, Mn, Sp, IR, R 3. 10°, J, N, Mn, Sp, IR, R 4. 10°, J, N, Mn, Sp, Pl, S					
337		70		104		56						No WR - 500 gal WL
-90	338						· becomes dark gray (5YR4/1) slightly weathered, very strong					
339							5. 15°, J, N, Mn, Sp, Wa, S 6. 5°, J, N, Mn, Su, Wa, S 7. 70°, J, N, Mn, Su, St, S					
-92	340									0.0	[50]	
341							No Recovery					
-94	342						BASALT a'a' Clinker loose, dark red (2.5YR 3/6) and very dusky red (2.5YR 3/2) highly weathered, clay infill on fracture joints.					No WR - 500 gal WL
343		71		80		60	BASALT Pahoehoe dark reddish gray (2.5YR 4/1) slightly weathered, strong 30% 1-3mm elongated vesicles					
-96	344						1. 10°, J, N, Mn, Sp, Wa, S					
345							· becomes 40% 5-10mm vesicles					
-98	346						2. 45°, J, N, Mn, Sp, Wa, S			0.0	[60]	End coring on 10/9/19 resume coring on 10/10/19
347							· becomes very dark gray (10YR 3/1) slightly weathered, strong, 10% 10-30mm irregular vesicles					
-100	348						1. 10°, J, N, No, No, Pl, S					
349		72		108		88	· becomes 30% 5mm vesicles.					
							· becomes moderately weathered, medium strong to weak, 40% 1-2mm vesicles IF. highly vesiculated, moderately to highly weathered, weak					No WR - 200 gal WL

Elevation, feet	Depth, feet	ROCK CORE						Lithology	MATERIAL DESCRIPTION	SAMPLES			FIELD NOTES AND TEST RESULTS
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number			Type	Number Blows per foot	PID (ppm)	
349								▼ becomes slightly weathered, strong, 20% >4mm vesicles 2. 20°, J, N, No, No, IR, R					high pressure release
-102	350							▼ becomes very dark gray (7.5YR 3/1) 30% 1mm rounded vesicles. 1. 80°, J, N, Halloysite, Sp, Wa, R ▼ becomes 10% <20mm elongated irregular vesicles.			0.0	[37.5]	
351								2. 60°, J, N, Mn, Fe, Halloysite, Pa, St, R ▼ becomes a mottled dark gray (GLEY1 4/N) and gray (GLEY1 5/N), slightly weathered, strong rock, 15% <10mm rounded vesicles.					No WR - 300 gal WL
-104	352	73	50	90	46			▼ becomes very dark gray (5YR 3/1) with 5% 10mm elongate vesicles. 3. 90°, J, N, Mn, Su, St, R ▼ becomes moderately weathered, strong to medium strong, 20% 1-2mm vesicles.					
353							IF	No Recovery			0.0	[33.33]	
-106	354							} No Recovery BASALT a'a' Clinker loose, mottled dark gray (5YR 4/1) and dark reddish gray (5YR 4/2) with Halloysite veinlets, moderately weathered, minimal clay. BASALT Massive a'a' Slightly to moderately weathered, strong to medium strong, 2-22mm elongated vesicles					No WR - 500 gal WL
355							IF						
-108	356	74		94	20			▼ becomes slightly weathered, strong, 5% 10mm rounded vugs and 20% 1-2mm elongated pinched vesicles. 1. 40°, J, N, Mn, Sp, Wa, SR 2. 60°, J, N, Mn, Su, Pl, S					
357							IF						
-110	358	51						BASALT a'a' Clinker Loose, very dusky red (2.5YR 2.5/2) slightly weathered, strong to medium strong. ▼ becomes reddish brown (2.5YR 4/4) and dark reddish brown (5YR 4/4), highly weathered, very weak, 25% <10mm elongated vesicles.			0.0	[42.85]	paused to retrieve more water
359													
-112	360							BASALT Massive a'a' Reddish brown (5YR 4/4) slightly to moderately weathered, strong, 25% <10mm elongated vesicles.					No WR - 600 gal WL
361													
-114	362	75		100	32			IF is highly fractured, Mn on fracture joints.					
363							IF						
-116	364	52						1. 15°, J, N, Mn, Sp, Wa, S					
365													

Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	SAMPLES			FIELD NOTES AND TEST RESULTS	
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %			Type	Number Blows per foot	PID (ppm)		Drill Time [Rate, ft/hr]
365													
-118	366						IF	BASALT a'a' Clinker loose, reddish brown (5YR 4/3) and dark reddish brown (5YR 3/2) moderately weathered, medium strong			0.0	[6.38]	drill rods possibly binding - 1 ft of clinker retrieved in core barrel, continues coring No WR - 1000 gals WL, high pressure release
	367	76		54				No Recovery					
-120	368												
	369						1	BASALT Massive a'a' dark gray (10YR 4/1) slightly to unweathered, very strong, 2-35 mm subangular elongated vesicles. vug - 40mm x 28mm					add 50 gals of mud - 1 bag of bentonite
-122	370		53				2	1. 60°, J, VN, Mn, Fe, Sp, Wa, SR 2. 60°, J, VN, Mn, Fe, Sp, Wa, SR			0.0	[30]	No WR for rest of log unless otherwise stated
	371						1	1. 40°, J, VN, Mn, Fe, Sp, Wa, S					
	372						IF	2. 5°, J, VN, Mn, Fe, Sp, St, S					800 gals WL - stuck for part of run
-124	372						2	3. 10°, J, VN, Mn, Fe, Sp, Wa, S					
	373	77		100			3	4. 10°, J, VN, Mn, Fe, Sp, Wa, S					
	373						4	5. 5°, J, VN, Mn, Fe, Sp, Wa, S					
	373						5						
	373						IF						
-126	374						IF						
	374						6	6. 45°, J, VN, Mn, Fe, Sp, Wa, S					
	374						7	7. 5°, J, VN, Mn, Fe, Sp, Wa, S					
	375												
	375										0.0	[37.5]	
	375		54				1	1. 25°, J, VN, Mn, Fe, Sp, Wa, S					
-128	376							BASALT a'a' Clinker loose, dusky red (2.5YR 3/2), dark reddish brown (5YR 3/3) and black (5YR 2.5/1) slightly weathered, medium strong					high pressure release - 400 gals WL
	377							No Recovery					
	377	78		92				BASALT Pahoehoe very dark gray (10YR 3/1) slightly weathered, strong 5% 1-6mm rounded to subrounded vesicles.					
	378						IF	2. 10°, J, VN, Mn, Fe, Sp, Wa, SR					
	378							· becomes 5% <2mm rounded to subrounded vesicles.					
	379						2	· becomes 10% 1-6mm rounded to subrounded vesicles.					
	379						IF	· becomes 5% 1-3mm rounded to subrounded vesicles					
	379												
-132	380		55					· becomes dark red (2.5YR 2.5/4) slightly weathered, strong, 40% 1-2mm rounded vesicles, possible flow contact.			0.0	[100]	high pressure release - 300 gal WL
	380						IF						
	381												

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Elevation, feet	Depth, feet	ROCK CORE						Lithology	MATERIAL DESCRIPTION	SAMPLES				FIELD NOTES AND TEST RESULTS
		Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number			Type	Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	
381			55				1	grades to 25% 5-8mm vesicles.						
-134	382	79		106		40	IF	grades to dark reddish brown (5YR 3/4), moderately weathered, medium strong, 40% 1-2mm vesicles. Ropy textures on possible flow contact - mottled yellowish red (5YR 4/4)						
383								1. 80°, J, VN, No, No, Wa, S 2. 0°, J, MW, Clay, Pa, Wa, R 3. 0°, J, MW, Clay, Pa., Wa, R 4. 45°, J, VN, No, No, Wa, R 5. 45°, J, VN, No, No, St, R						
-136	384						5	becomes dark reddish brown (5YR 2.5/2) 35% 2-4mm round vesicles.						
385							IF					0.0	[75]	
-138	386		56					becomes very dark gray (GLE1 3/N) moderately to slightly weathered, medium strong, 5% <2mm rounded to rubounded vesicles.						
387						44		1. 0°, J, N, Fe, Sp, Wa, R 2. 0°, J, N, Fe, Sp, Wa, R 3. 5°, J, N, Fe, Clay, Sp, Wa, R 4. 10°, J, VN, Fe, Sp, Wa, R						150 gal WL
-140	388						6	becomes 15% 1-5mm rounded to subrounded vesicles.						
389							IF	becomes 15% <1mm rounded vesicles.						
-142	390		57					5. 5°, J, VN, No, No, Wa, SR 6. 0°, J, VN, Mn, Fe, Sp, St, SR 7. 90°, J, VN, Mn, Fe, Clay, Sp, Wa, SR 8. 45°, J, VN, Mn, Fe, Clay, Sp, Wa, SR						
391							8	becomes gray (10YR 5/1) slightly weathered, strong, 10% 1-10mm subrounded to rounded vesicles.						
-144	392					76		becomes 5% 1-4mm vesicles.						
393							1	becomes 15% <2mm vesicles.						
-146	394						2	becomes reddish black (2.5YR 2.5/1), slightly weathered, strong, 20% 1-3mm rounded to subrounded.						
395							3	1. 90°, J, VN, Mn, Fe, Clay, Sp, Pl, SIk 2. 0°, J, VN, Mn, Fe, Clay, Sp, Wa, SR - Halloysite 3. 0°, J, VN, Mn, Fe, Sp, IR, SR - oxidized ropy texture						200 gal WL
-148	396							Heat alteration/ possible flow contact, becomes dark reddish gray (5YR 4/2), moderately weathered, medium strong, 5% 1-4mm rounded to subrounded vesicles.						
397							4	becomes 10% 1-4mm subrounded to rounded vesicles.						
								4. 5°, J, VN, Mn, Fe, Clay, Sp, Wa, SR - Halloysite						
								No Recovery						
								1. 0°, J, VN, Mn, Fe, Sp, Wa, SR 2. 60°, J, VN, Mn, Fe, Clay, Sp, Wa, SR						
								possible flow contact, becomes yellowish red (5YR 4/6) moderately to slightly weathered, strong, 20% <2mm rounded vesicles. 5% weathered olivine phenocrysts.						high pressure release

Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	SAMPLES			FIELD NOTES AND TEST RESULTS	
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %			Type	Number Blows per foot	PID (ppm)		Drill Time [Rate, ft/hr]
397		82		108		70	IF 3 4	3. 80°, J, VN, Mn, Fe, Sp, Wa, SR 4. 60°, J, VN, Mn, Fe, Clay, Sp, Wa, SR ▼ becomes very dark gray (10YR 3/1) unweathered to slightly weathered, very strong, 10% 1-10mm rounded to subrounded vesicles.					
-150	398						5	5. 0°, J, VN, Fe, Sp, Wa, SR 6. 20°, J, VN, Mn, Fe, Clay, Sp, Wa, SR					200 gal WL
399			59				IF 6						
-152	400						IF 1	▼ dark reddish brown (5YR 3/2) and reddish yellow 7. 5YR 6/6 highly weathered to completely weathered, very weak.			0.0	[75]	
401							IF 2	becomes very dark gray (10YR 3/1), slightly weathered, strong, 10% 1-3mm rounded to subrounded vesicles.					
-154	402						M 3	1. 20°, J, VN, No, No, Wa, SR 2. 30°, J, VN, Mn, Fe, Sp, Wa, R ▼ becomes 20% 2mm rounded vesicles.					200 gal WL
403		83		108		72	IF 4	3. 20°, J, VN, Mn, Fe, Sp, St, SR ▼ becomes 10% 1-5mm rounded to subrounded vesicles.					
404			60				IF 5	▼ becomes 20% <2mm rounded vesicles. 4. 50°, J, VN, Mn, Fe, Sp, Wa, SR 5. 0°, J, VN, Clay, Sp, Pl, SR ▼ becomes dark gray (GLE1 3/N), unweathered, very strong, 10% 1-4mm rounded to subrounded vesicles.					
-156	404						IF 6	▼ becomes 5% 2-21mm subrounded vesicles. 6. 90°, J, VN, Mn, Fe, Clay, Sp, Wa, SR 7. 0°, J, VN, Mn, Fe, Sp, Wa, SR ▼ becomes 15% 1-2mm rounded to subrounded vesicles.			0.0	[100]	
405							IF						
-158	406							BASALT a'a Clinker loose, reddish brown (5YR 4/3) and dark reddish gray (2.5YR 3/2) slightly to moderately weathered, medium strong to weak.					150 gal WL
407		84		88		8							
-160	408		61					1. 50°, J, VN, Mn, Fe, Clay, Sp, IR, SR					
409							IF 1	BASALT Massive a'a Very dark gray (5YR 3/1), slightly weathered, very strong, 10% vesicles.					
-162	410						NR	No Recovery					
411								BASALT a'a Clinker loose, dark reddish brown (5YR 3/2) reddish black (2.5YR 2.5/1) moderately weathered, medium strong.			0.0	[75]	
412													high pressure release - 200 gal WL
-164	412						IF 1 2 3	BASALT Massive a'a Dark gray (GLE1 4/N), slightly weathered, strong, 5% 2-30mm elongate, subangular vesicles.					
413		85		90		16	IF	1. 45°, J, N, Mn, Fe, Clay, Sp, Tr, SR 2. 0°, J, VN, Mn, Fe, Clay, Sp, Wa, S 3. 20°, J, VN, Mn, Fe, Clay, Sp, Wa, S					

Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	SAMPLES			FIELD NOTES AND TEST RESULTS	
		Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %			Fracture Drawing Number	Type	Number Blows per foot		PID (ppm)
413							IF	4. 50°, J, VN, Mn, Fe, Clay, Sp, Wa, S 5. 5°, J, VN, Mn, Fe, Clay, Sp, Wa, SR					
-166	414						4 5 M IF	becomes 15% 1-4mm subrounded to subangular vesicles.					
	415		62					BASALT a'a' Clinker loose, red (10YR 4/8) and dark reddish brown (2.5YR 4/3), slightly weathered, medium strong			0.0	[42.85]	
-168	416							No Recovery					500 gal WL
	417	86		60		40							
-170	418						1	BASALT Massive a'a' very dark gray (GLE Y1 3/N) unweathered, very strong 5% 2-30 mm elongate subrounded - subangular vesicles vug - 10mm x 35mm					
	419						2	1. 5°, J, MW, Mn Su, Fe, Sp, IR, SR 2. 20°, J, MW, Mn Su, Fe, Sp, IR, SR					
-172	420		63								0.0	[42.85]	
	421							vug - 10mm x 30mm					
-174	422	87		100		38	1 2 3 4 5	1. 0°, J, VN, Mn, Fe, Sp, Wa, S 2. 45°, J, VN, Mn, Fe, Clay, Sp, Wa, S 3. 5°, J, VN, Mn, Fe, Sp, Wa, SR 4. 90°, J, VN, Mn, Fe, Clay, Sp, Wa, S 5. 20°, J, VN, Mn Su, Fe, Clay, Sp, IR, S					500 gal WL
	423						IF						
-176	424		64										
	425							BASALT a'a' Clinker loose, red (2.5YR 4/6), reddish brown (2.5YR 4/4) and dark gray (10YR4/1), slightly to moderately weathered, medium strong			0.0		
-178	426												500 gal WL. 1410 at 428' bgs out of water - end of coring for 10/10/19
	427	88		96		16	IF	BASALT Massive a'a' very dark gray (10YR 3/1), slightly weathered, strong, 3% 1-12mm elongate, subrounded irregular vesicles.					
-180	428						1	1. 90°, J, VN, Mn, Fe, Sp, St, SR					10/11/19 - resume coring at 0737. 150 gal WL
	429						IF						

Report: CTO63 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOGS.GPJ; 2/6/2020 RHMW13


Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	SAMPLES			FIELD NOTES AND TEST RESULTS		
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %			Fracture Drawing Number	Type	Number Blows per foot		PID (ppm)	Drill Time [Rate, ft/hr]
429														
-182	430						IF	No Recovery				0.0	[37.5]	
	431		65				1	1. 90°, J, VN, Mn, Fe, Sp, Wa, S 2. 5°, J, VN, Mn, Fe, Sp, Pl, S						
	432						2	3. 45°, J, VN, Mn, Fe, Sp, Wa, SR 4. 0°, J, N, Mn, Fe, Sp, Wa, SR						
-184	433		89	104	24		3	vug - 50mm x 15mm vug - 33mm x 18mm						400 gal WL
	434						4	vug - 51mm x 18mm 5. 10°, J, VN, Mn, Fe, Sp, Wa, SR 6. 5°, J, VN, Mn, Fe, Sp, Wa, SR 7. 50°, J, VN, Mn, Fe, Sp, Wa, SR						
	435						5	vug - 35mm x 28mm vug - 30mm x 15mm vug - 55mm x 9mm						
	436						6					0.0	[15]	0818 pause to check water truck (~437) 0824 resume coring
-186	437		66				7	becomes very dark gray (GLE Y1 3/N) unweathered, very strong, 3% 1-12mm subangular, irregular, elongate vesicles. 1% unweathered olivine phenocrysts. 1. 30°, J, N, Mn, Fe, Sp, Wa, SR 2. 40°, J, VN, Mn, Fe, Clay, Sp, Wa, S 3. 40°, J, VN, Mn, Fe, Sp, Pl, S						800 gal WL
	438		90	68	40		IF	BASALT a'a' Clinker loose, very dark gray (5YR 3/1), dark reddish brown (2.5YR 3/1) and reddish brown (5YR 5/3), moderately weathered, weak to medium strong.						
-190	439						HR	No Recovery						
	440						IF	BASALT Massive a'a' greenish black (GLE Y1 2.5/10Y) unweathered, strong, 5% 2-25 mm subrounded, elongate, irregular vesicles.				0.0	[3.529]	0850 pause to fill water truck (~441) 0923 - resume coring
	441						1							
	442		67				2							
-194	443		91	92	20		3	1. 0°, J, N, Mn, Fe, Sp, Wa, SR 2. 10°, J, VN, Mn, Fe, Sp, Wa, SR 3. 90°, J, VN, Mn, Fe, Sp, Wa, SR						800 gal WL
	444						IF							
	445						IF							

Elevation, feet	Depth, feet	ROCK CORE						Lithology	MATERIAL DESCRIPTION	SAMPLES			FIELD NOTES AND TEST RESULTS	
		Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number			Type	Number Blows per foot	PID (ppm)		Drill Time [Rate, ft/hr]
445														
-198	446		68				IF							
	447	92		100		40								300 gal WL
-200	448							BASALT a'a' Clinker Welded, reddish black (2.5YR 2.5/1) and dark brown (7.5YR 3/2), slightly weathered, strong to medium strong						
	449						IF	BASALT Pahoehoe dark reddish brown (2.5YR 2.5/3) slightly weathered, strong 15% 1-6mm, rounded - subrounded vesicles.						
								becomes dusky red (2.5YR 2/2) moderately weathered, medium strong, 3% <2mm rounded to subrounded vesicles.						
-202	450						IF	possible flow contact, becomes black (10YR 2/1), slightly weathered, strong, 10% vesicles 1-7mm rounded to subrounded.			0.0	[33.33]		
	451							becomes very dark grayish brown (10YR 3/2) moderately weathered, medium strong.						
-204	452	93		78		40		BASALT a'a' Clinker Welded, dark reddish brown (2.5YR 3/3) reddish black (2.5YR 2.5/1) slightly weathered, strong, some loose clasts. 1. 40°, J, VN, No, No, IR, SR 2. 40°, J, MW, Mn, Sp, IR, SR 3. 0°, J, MW, Mn, Sp, IR, SR						High pressure release - 500 gal WL
	453		69				IF	BASALT Massive a'a' very dark gray (10YR 3/2) moderately weathered, strong, 5% 2-13 mm irregular, elongated, subangular - subrounded vesicles (possibly massive a'a' boulder?)						
-206	454						IF	BASALT a'a' Clinker loose, dark gray (10YR 4/1) very dark brown (10YR 2/2) slightly weathered, strong.						
	455							No Recovery			0.0	[27.27]		
-208	456													
	457	94		60		12								500 gal WL
-210	458						IF	1. 30°, J, VN, Mn, Fe, Sp, Wa, S 2. 0°, J, VN, Mn, Fe, Sp, Wa, S 3. 90°, J, VN, Mn, Fe, Sp, Wa, S						
	459							BASALT Massive a'a' very dark gray (10YR 3/1) slightly weathered, very strong, 1% 1-2mm subrounded vesicles.						
								becomes 3% 1-10mm elongate and subrounded vesicles.						
-212	460										0.0	[30]		
	461							1. 45°, J, VN, Mn, Fe, Sp, Wa, S						

Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	SAMPLES			FIELD NOTES AND TEST RESULTS	
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %			Fracture Drawing Number	Type	Number Blows per foot		PID (ppm)
461			70					BASALT a'a' Clinker loose, very dark gray (5YR 3/2) and dark reddish brown (2.5YR 3/4), slightly weathered, medium strong.					high pressure release - 500 gal WL
-214	462	95		76		16	2	BASALT Pahoehoe brown (7.5YR 4/2), moderately weathered, strong, 5% 1-34mm, subrounded - subangular vesicles.					
	463						3	2. 5°, J, N, Mn Su, Fe, Sp, IR, SR 3. 60°, J, VN, Mn Su, Fe, Sp, Wa, S					
-216	464							BASALT a'a' Clinker No Recovery					
	465		71					BASALT Massive a'a' very dark gray (10YR 3/1), slightly weathered, very strong, 5% <1-18mm, subrounded - subangular, elongate vesicles.			0.0	[18.75]	400 gal WL
-218	466						1						1215 - pause to check water truck ~467.5'
	467	96		92		28	2	1. 10°, J, VN, Mn, Fe, Sp, Wa, SR 2. 60°, J, MN, Mn, Fe, Sp, Wa, SR					1217 resume coring
-220	468												
	469						3						
	470						4	3. 10°, J, VN, Mn, Fe, Sp, Wa, SR 4. 5°, J, VN, Mn, Fe, Sp, Wa, SR					high pressure release
-222	470							No Recovery			0.0	[30]	pause coring on 10/11/19 resume coring on 10/14/19
	471		72										
-224	472												
	473	97		100		36							800 gal WL
	474							becomes 7% 1-11mm, subrounded vesicles					
-226	474												
	475							BASALT a'a' Clinker welded, yellowish red (5YR 4/6), dark reddish gray (2.5YR 4/1) and brown (7.5YR 4/4), moderately weathered, medium strong			0.0	[33.33]	high pressure release - 400 gal WL
-228	476		73				1						
	476						2	BASALT Pahoehoe brown (7.5YR 4/2) moderately weathered, medium strong, 10% 1-15mm subrounded - subangular vesicles, 3% halloysite, vug 30mm x 20mm					
	477												

Elevation, feet	Depth, feet	ROCK CORE						Lithology	MATERIAL DESCRIPTION	SAMPLES				FIELD NOTES AND TEST RESULTS
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number			Type	Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	
477		98		100		72	3	becomes gray (10YR 5/1) slightly weathered, strong, 5% 2-25mm rounded to subrounded vesicles.						
-230	478						4	becomes dark gray (GLE Y1 3/N) slightly weathered to unweathered, strong, 10% 1-8mm rounded to subrounded vesicles. 1% olivine phenocrysts. 3% halloysite						
	479						5	1. 45°, J, N, Mn, Fe, Clay, Sp, Wa, SR 2. 0°, J, MW, Mn, Fe, Clay, Sp, IR, SR 3. 0°, J, VN, Mn, Fe, Clay, Sp, Wa, S 4. 50°, J, VN, Mn, Fe, Clay, Sp, Wa, SR 5. 70°, J, MW, Mn, Fe, Clay, Sp, IR, SR 6. 80°, J, N, Mn, Fe, Sp, Wa, SR						
-232	480		74				IF	BASALT a'a' Clinker welded, yellowish red (5YR 4/6) and red (2.5YR 4/4), moderately weathered, medium strong.				0.0	[33.33]	
	481						IF	BASALT Massive a'a' very dark gray (10YR 3/1), moderately weathered, medium strong, 3% olivine phenocrysts, 2% Halloysite						500 gal WL
-234	482	99		86		32	1	becomes slightly weathered, strong, 10% 2-40mm subrounded elongate vesicles.						
	483						2	becomes moderately weathered, strong						
	484						3	becomes greenish black (GLE Y1 3/10Y), slightly weathered, very strong, 5% 1-6mm subrounded to subangular vesicles.						
-236	484						4	becomes very dark gray (GLE Y1 3/N) unweathered, very strong, 5% 1-18mm subrounded, elongate vesicles.						
	485						1	1. 10° J, VN, Mn, Clay, Sp, Pl, S 2. 30° J, VN, Mn, Sp, Pl, S 3. 20° J, VN, Mn, Clay, Sp, Pl, S 4. 10° J, N, Mn, Fe, Sp, Wa, SR						
	486		75				IF	becomes slightly weathered, strong, 5% 1-8mm subrounded to subangular irregular vesicles. vug - 32mm x 19mm No Recovery						
-238	486						1	1. 20°, J, VN, Mn, Fe, Sp, Wa, SR				0.0	[5.45]	500 gal WL
	487						IF	TUFF Olive yellow (2.5Y 6/6), moderately weathered, medium strong, dark red (2.5YR 3/6) laminated ~2mm						0750 run out of water ~489'
-240	488	100		68		0	IF	BASALT a'a' Clinker loose, reddish black (2.5YR 2.5/1), dark red (2.5YR 3/6) and dark reddish brown (5YR 3/4) slightly to moderately weathered, medium strong						resume coring at 0833
	489							No Recovery						
-242	490							No Recovery				0.0	[12]	high pressure release - 600 gal WL 0654 - pause drilling ~493' b/c core is jammed
	491							No Recovery						resume at 0907
-244	492	101		76		0		becomes reddish clack (2.5YR 2.5/1), highly weathered, weak						
	493													

Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	SAMPLES			FIELD NOTES AND TEST RESULTS	
		Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %			Fracture Drawing Number	Type	Number Blows per foot		PID (ppm)
509			79				8 9	▼ becomes 15% 1-7mm rounded to subrounded vesicles 8. 0°, J, N, Mn, Fe, Sp, Wa, SR 9. 90°, J, VN, No, No, Wa, SR					
-262	510						10 11	▼ becomes 10% 1-10mm subrounded to rounded vesicles 10. 0°, J, VN, Mn, Clay, Sp, Wa, SR 11. 90°, J, VN, No, No, Wa, SR			0.0	[50]	
511							12 IF	▼ becomes 15% <2mm subrounded to rounded vesicles					
-264	512	105		100		28	IF	1. 0°, J, N, No, No, Wa, SR 2. 20°, J, VN, Clay, Sp, Wa, SR 3. 0°, J, VN, Clay, Sp, Wa, SR					200 gal WL
513							IF						
-266	514		80				3	▼ becomes 10% <2mm subrounded to rounded vesicles					
515							IF				0.0	[17.64]	
-268	516						1	Halloysite in vesicles 1. 0°, J, VN, Mn, Sp, Pl, Slk 2. 20°, J, VN, Mn, Fe, Sp, Pl, SR 3. 0°, J, VN, Clay, Sp, Wa, SR 4. 0°, J, VN, No, No, Pl, SR					high pressure release - 500 gal WL
517		106		100		66	IF						
-270	518		81				IF	▼ becomes 10% 1-9mm rounded to subrounded vesicles					
519							3	▼ becomes unweathered, very strong, 15% <2mm rounded vesicles.					
-272	520						4	▼ becomes very dark grayish brown (10YR 3/2) unweathered, strong 15% 1-3mm rounded to subrounded vesicles.			0.0	[60]	
521							1	1. 55°, J, VN, Mn, Clay, Sp, Wa, SR					
-274	522	107		100		20	IF	▼ becomes reddish black (2.5YR 2.5/1), red (2.5YR 4/6), red (2.5YR 5/8) slightly to moderately weathered, medium strong, 10% <2mm rounded to subrounded.					high pressure release - 400 gal WL
523			82				IF						
-276	524						IF	▼ becomes reddish black (2.5YR 2.5/1) moderate to slightly weathered, medium strong, 10% 1-5mm rounded to subrounded vesicles.					
525													

Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	SAMPLES			FIELD NOTES AND TEST RESULTS	
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %			Fracture Drawing Number	Type	Number Blows per foot		PID (ppm)
525													
-278	526						 <p>becomes 10% <2mm rounded to subrounded vesicles</p> <p>1. 0°, J, VN, Mn, Fe, Clay, Sp, Wa, SR 2. 0°, J, VN, Mn, Fe, Clay, Sp, IR, SR 3. 30°, J, VN, Mn, Fe, Clay, Sp, Wa, SR 4. 0°, J, VN, Mn, Fe, Clay, Sp, Wa, SR</p>						
527		108		100		46							
-280	528		83				<p>becomes reddish brown (2.5YR 4/3), moderately weathered, medium strong, 5% <2mm rounded to subrounded vesicles</p> <p>becomes brown (7.5YR4/3) moderately weathered, medium strong, 10% <1mm rounded to subrounded vesicles</p> <p>heat alteration - reddish black (2.5YR 2.5/1) possible flow contact.</p>						400 gal WL
529							<p>becomes red (2.5YR 4/6), reddish brown (2.5YR 4/4) moderately to highly weathered, medium strong clay on surface</p> <p>becomes dark reddish brown (2.5YR 3/3) highly weathered, weak</p>						
-282	530						<p>becomes moderately weathered, medium strong</p>						end of coring on 10/14/19 TD = 530' bgs
531							<p>RHMW13 was hand cleared from ground surface to 3 ft below ground surface (bgs). The borehole was then drilled using 10" OD hollow stem auger from 0 to 22 ft bgs, where there was refusal. HQ coring commenced from 22 ft to 175 ft bgs. Drilled with 24" OD core bucket with production auger rig from 0 ft to 40 ft bgs. Installed 18" steel surface casing to 40 ft bgs. Reamed borehole with 17.5" tricone bit from 40 ft to 175 ft bgs. Installed 10" steel conductor casing to 172 ft bgs. HQ coring continued from 175 ft to 220 ft bgs. Borehole was reamed from 173 ft to 220 ft bgs with 9 7/8" tricone bit. Installed 5" steel casing to 220 ft bgs. PQ coring commenced from 220 ft bgs to a TD of 530 ft bgs.</p>						
-284	532						<p>Clean water filtered through a granulated activated carbon (GAC) filter was used for drilling fluid. Approximately 30,600 gallons of water were used during drilling and rock coring. 50 lb bags of max gel bentonite powder were added to the borehole during rock coring at two drill depths for added lubrication. Upon completion of drilling, a gyroscopic survey was performed. The borehole was logged using 3-arm caliper and acoustic televiwer tools. The borehole was developed using a Grundfos pump placed at four selected depths. A total of 4,523 gallons of development water were removed: 1,000 gallons with pump set at 500' bgs, 1,050 gallons with pump set at 400' bgs, 1,073 gallons with pump set at 320' bgs and 1,400 gallons with pump set at 240' bgs.</p>						
-286	534												
535													
-288	536												
537													
-290	538												
539													
-292	540												
541													

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Appendix C: Well Construction Diagrams

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RHMW12 Monitoring Well

GROUND SURFACE

24" MIN BOREHOLE
TO 58.6' BGS

18" SCH 40 STEEL
CASING TO 58' BGS

17.5" MIN BOREHOLE
TO 123.00' BGS

10" SCH 40 STEEL
CONDUCTOR CASING
TO 123.00' BGS

3" SCH 80 PVC
WELL CASING

CEMENT GROUT
(PORTLAND TYPE I CEMENT
WITH 3 - 5% BENTONITE)

9.875" MIN BOREHOLE
TO 200.00' BGS

5" SCH 40 STEEL
CASING TO 200.00' BGS

4.8" MIN BOREHOLE
TO 215' BGS

3" SCH 80 PVC WELL SCREEN
- 0.020 OPENING
- INTERVAL = 15'

BOREHOLE DEPTH:
215' BGS

LOCKING WELL HEAD COVER

SURFACE - TOP OF 3" WELL
CASING

GROUND SURFACE: ~ 237.6' MSL

CEMENT GROUT
(PORTLAND TYPE I CEMENT
WITH 3 - 5% BENTONITE)

TOP OF SCREEN:
200.0' BGS

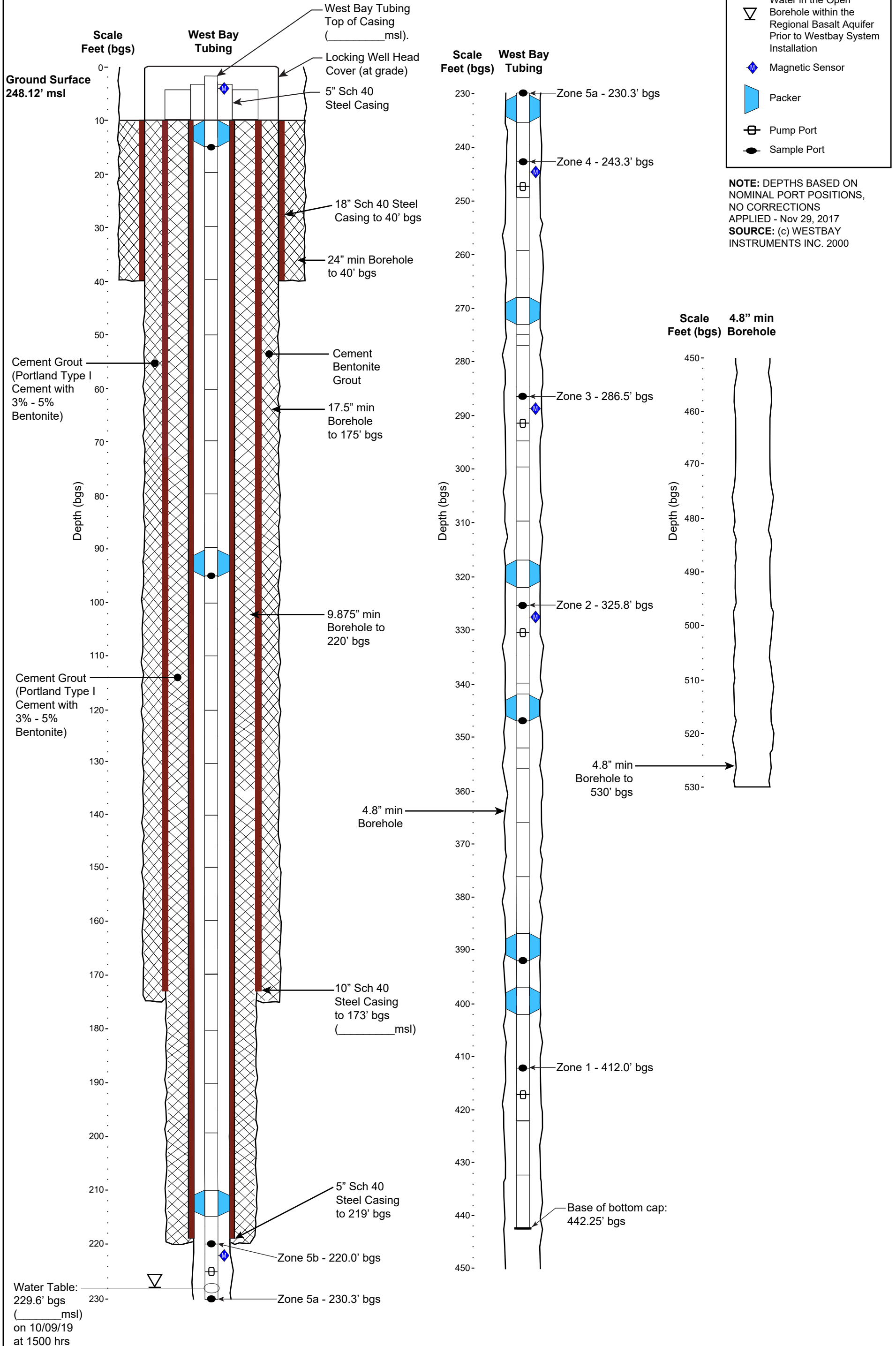
BOTTOM OF SCREEN:
214.6' BGS

BASE OF BOTTOM CAP:
215' BGS

B:\60571032-HNL\900-Work\910-CAD\20-SHEETS\MM-WP\CrossSection-RHMW12-Well.dwg 03/13/20 5:03 PM Nemco

**Cross Section of RHMW12 Monitoring Well
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i**

RHMW13 Monitoring Well



**Cross Section RHMW13 Monitoring Well
 Red Hill Bulk Fuel Storage Facility
 JBPHH, O'ahu, Hawaii**