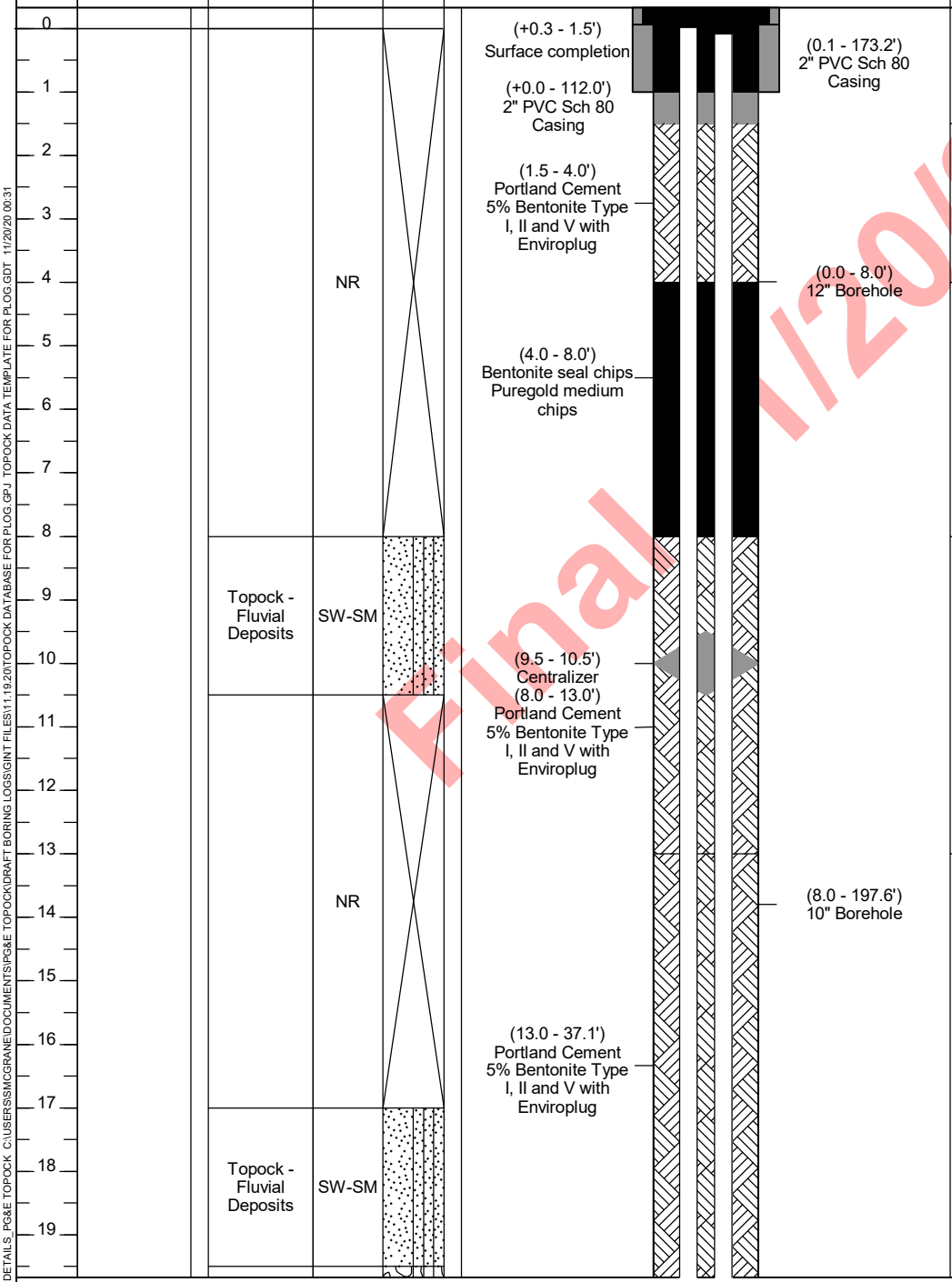
Well Construction Log

Sheet: 1 of 11

ARCADIS Design & Consultancy for natural and built assets

Date Started:	04/30/2019	Surface Elevation:	501.27 ft amsl	**Well ID: MW-84-132, MW-84-193**	
Date Completed:	07/30/2019	Shallow Well Elevation:	501.26 ft amsl		
Drilling Co.:	Cascade	Deep Well Elevation:	501.18 ft amsl	Client:	PG&E
Drilling Method:	Sonic Drilling	Northing (NAD83):	2102363.81	Project:	Final GW Remedy Phase 1
Driller Name:	Tyler Alymer	Easting (NAD83):	7614866.21	Location:	PG&E Topock, Needles, California
Drilling Asst:	C. Winland/J. Candelaria	Borehole Diameter:	4-12 inches		
Logger:	C. Bonessi/R. Moniz	Static Water Level:	See Log for Depths	Project Number:	RC000753.0051
Editor:	Sean McGrane	Development End Date:	6/15/2019		
Total Depth:	216 ft bgs	Well Completion:	☒ Flush ☐ Stick-up ☐ To Be Completed in Well Vault		



Calculated Material Volumes	Material Volumes Installed Note: percentages are the actual volume vs the calculated volume
	(+0.3 - 1.5') 5 bags Note: 2.5 x 2.5 ft concrete pad with 18 diameter lockable vault, King Kon-Crete 4000 PSI
(1.5 - 4.0') 13.9 gallons	(1.5 - 4.0') 8 gallons (58%) Note: Grout seal, used <20% of the calculated volume due to formation collapse.
(4.0 - 8.0') 4.12 bags	(4.0 - 8.0') 15 bags (364%) Note: Installed due to some formation collapse, which shifted the well casing to side of of the borehole, well checked no obstruction was observed. Used >20% of the calcluated volume to fill void.
(8.0 - 13.0') 19.8 gallons	(8.0 - 13.0') 70 gallons (354%) Note: Grout seal, used >20% of the calculated volume due to potential voids forming during drilling and potential grout migration.
(13.0 - 37.1') 95.4 gallons	(13.0 - 37.1') 200 gallons (210%) Note: Grout seal, used >20% of the calculated volume due to potential voids forming during drilling and potential grout migration.

Abbreviations: USCS = Unified Soil Classification System, ft = feet, bgs = below ground surface, amsl = above mean sea level, GW = groundwater, ppb = parts per billion, U = not detected above the laboratory reporting limit, NR = no recovery; Notes: solid blue and hollow blue water table marks represent depth to water (ft. bgs.) measured post development for the shallow well and deep well respectively; installed in MW-84d

Well Construction Log

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ARCADIS Design & Consultancy for natural and built assets

Date Started:	04/30/2019	Surface Elevation:	501.27 ft amsl	**Well ID: MW-84-132, MW-84-193**	
Date Completed:	07/30/2019	Shallow Well Elevation:	501.26 ft amsl		
Drilling Co.:	Cascade	Deep Well Elevation:	501.18 ft amsl	Client:	PG&E
Drilling Method:	Sonic Drilling	Northing (NAD83):	2102363.81	Project:	Final GW Remedy Phase 1
Driller Name:	Tyler Alymer	Easting (NAD83):	7614866.21	Location:	PG&E Topock, Needles, California
Drilling Asst:	C. Winland/J. Candelaria	Borehole Diameter:	4-12 inches		
Logger:	C. Bonessi/R. Moniz	Static Water Level:	See Log for Depths	Project Number:	RC000753.0051
Editor:	Sean McGrane	Development End Date:	6/15/2019		
Total Depth:	216 ft bgs	Well Completion:	☒ Flush ☐ Stick-up ☐ To Be Completed in Well Vault		

Depth (ft)	Groundwater Sample ID	Geologic Formation	USCS Code	USCS Class	Well Construction	Calculated Material Volumes	Material Volumes Installed Note: percentages are the actual volume vs the calculated volume
20–39		Topock - Fluvial Deposits	GW-GM		(+0.0 - 112.0') 2" PVC Sch 80 Casing; (0.1 - 173.2') 2" PVC Sch 80 Casing; (13.0 - 37.1') Portland Cement 5% Bentonite Type I, II and V with Enviroplug; (8.0 - 197.6') 10" Borehole; (34.5 - 35.5') Centralizer; (37.1 - 46.0') Bentonite seal chips Puregold/Halliburton medium chips	(13.0 - 37.1') 95.4 gallons	(13.0 - 37.1') 200 gallons (210%) Note: Grout seal, used >20% of the calculated volume due to potential voids forming during drilling and potential grout migration.
		Topock - Fluvial Deposits	SW-SM				
		Topock - Fluvial Deposits	SM			(37.1 - 46.0') 6.54 bags	(37.1 - 46.0') 24 bags (367%) Note: Seal above high solids grout, used >20% due to chips potentially settling into high solids grout.

Abbreviations: USCS = Unified Soil Classification System, ft = feet, bgs = below ground surface, amsl = above mean sea level, GW = groundwater, ppb = parts per billion, U = not detected above the laboratory reporting limit, NR = no recovery; Notes: solid blue and hollow blue water table marks represent depth to water (ft. bgs.) measured post development for the shallow well and deep well respectively; installed in MW-84d

Well Construction Log

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ARCADIS Design & Consultancy for natural and built assets

Date Started:	04/30/2019	Surface Elevation:	501.27 ft amsl	**Well ID: MW-84-132, MW-84-193**	
Date Completed:	07/30/2019	Shallow Well Elevation:	501.26 ft amsl		
Drilling Co.:	Cascade	Deep Well Elevation:	501.18 ft amsl	Client:	PG&E
Drilling Method:	Sonic Drilling	Northing (NAD83):	2102363.81	Project:	Final GW Remedy Phase 1
Driller Name:	Tyler Alymer	Easting (NAD83):	7614866.21	Location:	PG&E Topock, Needles, California
Drilling Asst:	C. Winland/J. Candelaria	Borehole Diameter:	4-12 inches		
Logger:	C. Bonessi/R. Moniz	Static Water Level:	See Log for Depths	Project Number:	RC000753.0051
Editor:	Sean McGrane	Development End Date:	6/15/2019		
Total Depth:	216 ft bgs	Well Completion:	☒ Flush ☐ Stick-up ☐ To Be Completed in Well Vault		

Depth (ft)	Groundwater Sample ID	Geologic Formation	USCS Code	USCS Class	Well Construction	Calculated Material Volumes	Material Volumes Installed Note: percentages are the actual volume vs the calculated volume
40–59	MW-M-VAS-52-57 (28 ppb) 3/28/2019 11:10	Topock - Fluvial Deposits	SM		(+0.0 - 112.0') 2" PVC Sch 80 Casing		
					(0.1 - 173.2') 2" PVC Sch 80 Casing		
		Topock - Alluvium Deposits	GM		(37.1 - 46.0') Bentonite seal chips Puregold/Halliburton medium chips	(37.1 - 46.0') 6.54 bags	(37.1 - 46.0') 24 bags (367%) Note: Seal above high solids grout, used >20% due to chips potentially settling into high solids grout.
		Topock - Alluvium Deposits	GM		(8.0 - 197.6') 10" Borehole		
		Topock - Alluvium Deposits	GW		(46.0 - 94.3') Agua Guard High Solids Bentonite Grout	(46.0 - 94.3') 191.2 gallons	(46.0 - 94.3') 228 gallons (119%) Note: Annular seal across the screen intervals of the wells in the MW-84s borehole.
			SM				

Abbreviations: USCS = Unified Soil Classification System, ft = feet, bgs = below ground surface, amsl = above mean sea level, GW = groundwater, ppb = parts per billion, U = not detected above the laboratory reporting limit, NR = no recovery; Notes: solid blue and hollow blue water table marks represent depth to water (ft. bgs.) measured post development for the shallow well and deep well respectively; installed in MW-84d

Well Construction Log

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ARCADIS Design & Consultancy for natural and built assets

Date Started:	04/30/2019	Surface Elevation:	501.27 ft amsl	**Well ID: MW-84-132, MW-84-193**	
Date Completed:	07/30/2019	Shallow Well Elevation:	501.26 ft amsl		
Drilling Co.:	Cascade	Deep Well Elevation:	501.18 ft amsl	Client:	PG&E
Drilling Method:	Sonic Drilling	Northing (NAD83):	2102363.81	Project:	Final GW Remedy Phase 1
Driller Name:	Tyler Alymer	Easting (NAD83):	7614866.21	Location:	PG&E Topock, Needles, California
Drilling Asst:	C. Winland/J. Candelaria	Borehole Diameter:	4-12 inches		
Logger:	C. Bonessi/R. Moniz	Static Water Level:	See Log for Depths	Project Number:	RC000753.0051
Editor:	Sean McGrane	Development End Date:	6/15/2019		
Total Depth:	216 ft bgs	Well Completion:	☒ Flush ☐ Stick-up ☐ To Be Completed in Well Vault		

Depth (ft)	Groundwater Sample ID	Geologic Formation	USCS Code	USCS Class	Well Construction	Calculated Material Volumes	Material Volumes Installed Note: percentages are the actual volume vs the calculated volume
60		Topock - Alluvium Deposits	SM		(+0.0 - 112.0') 2" PVC Sch 80 Casing; (0.1 - 173.2') 2" PVC Sch 80 Casing		
61							
62		Topock - Alluvium Deposits	GM				
63							
64		Topock - Alluvium Deposits	SM		(64.5 - 65.5') Centralizer		
65							
66							
67							
68		Topock - Alluvium Deposits	GM		(46.0 - 94.3') Agua Guard High Solids Bentonite Grout; (8.0 - 197.6') 10" Borehole	(46.0 - 94.3') 191.2 gallons	(46.0 - 94.3') 228 gallons (119%) Note: Annular seal across the screen intervals of the wells in the MW-84s borehole.
69							
70							
71							
72							
73							
74	MW-M-VAS-72-77 (<0.033 U ppb) 3/29/2019 14:01						
75							
76		Topock - Alluvium Deposits	SW-SM				
77							
78		Topock - Alluvium Deposits	GM				
79		Topock -	SW-SM				

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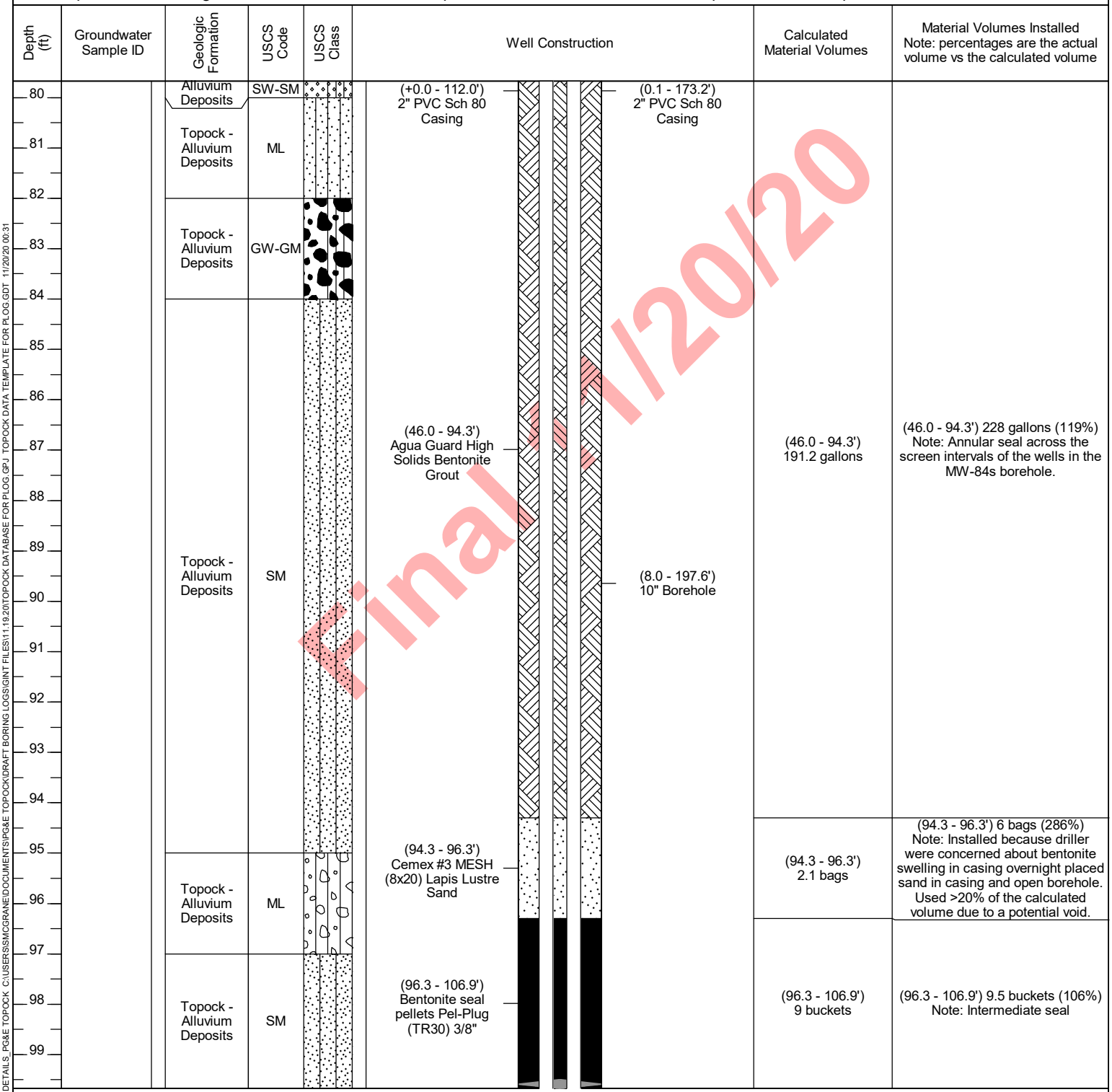
ARCADIS Design & Consultancy for natural and built assets

Well Construction Log

Well ID: MW-84-132, MW-84-193

Date Started:	04/30/2019	Surface Elevation:	501.27 ft amsl		
Date Completed:	07/30/2019	Shallow Well Elevation:	501.26 ft amsl		
Drilling Co.:	Cascade	Deep Well Elevation:	501.18 ft amsl	Client:	PG&E
Drilling Method:	Sonic Drilling	Northing (NAD83):	2102363.81	Project:	Final GW Remedy Phase 1
Driller Name:	Tyler Alymer	Easting (NAD83):	7614866.21	Location:	PG&E Topock, Needles, California
Drilling Asst:	C. Winland/J. Candelaria	Borehole Diameter:	4-12 inches		
Logger:	C. Bonessi/R. Moniz	Static Water Level:	See Log for Depths	Project Number:	RC000753.0051
Editor:	Sean McGrane	Development End Date:	6/15/2019		
Total Depth:	216 ft bgs	Well Completion:	☒ Flush ☐ Stick-up ☐ To Be Completed in Well Vault		



Calculated Material Volumes	Material Volumes Installed Note: percentages are the actual volume vs the calculated volume
(46.0 - 94.3') 191.2 gallons	(46.0 - 94.3') 228 gallons (119%) Note: Annular seal across the screen intervals of the wells in the MW-84s borehole.
(94.3 - 96.3') 2.1 bags	(94.3 - 96.3') 6 bags (286%) Note: Installed because driller were concerned about bentonite swelling in casing overnight placed sand in casing and open borehole. Used >20% of the calculated volume due to a potential void.
(96.3 - 106.9') 9 buckets	(96.3 - 106.9') 9.5 buckets (106%) Note: Intermediate seal

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Well Construction Log

Sheet: 6 of 11

Date Started:	04/30/2019	Surface Elevation:	501.27 ft amsl	**Well ID: MW-84-132, MW-84-193**	
Date Completed:	07/30/2019	Shallow Well Elevation:	501.26 ft amsl		
Drilling Co.:	Cascade	Deep Well Elevation:	501.18 ft amsl	Client:	PG&E
Drilling Method:	Sonic Drilling	Northing (NAD83):	2102363.81	Project:	Final GW Remedy Phase 1
Driller Name:	Tyler Alymer	Easting (NAD83):	7614866.21	Location:	PG&E Topock, Needles, California
Drilling Asst:	C. Winland/J. Candelaria	Borehole Diameter:	4-12 inches		
Logger:	C. Bonessi/R. Moniz	Static Water Level:	See Log for Depths	Project Number:	RC000753.0051
Editor:	Sean McGrane	Development End Date:	6/15/2019		
Total Depth:	216 ft bgs	Well Completion:	☒ Flush ☐ Stick-up ☐ To Be Completed in Well Vault		

Depth (ft)	Groundwater Sample ID	Geologic Formation	USCS Code	USCS Class	Well Construction	Calculated Material Volumes	Material Volumes Installed Note: percentages are the actual volume vs the calculated volume
100			SM		(99.5 - 100.5') Centralizer; (0.1 - 173.2') 2" PVC Sch 80 Casing		
101		Topock - Alluvium Deposits	ML		(+0.0 - 112.0') 2" PVC Sch 80 Casing		
102							
103					(96.3 - 106.9') Bentonite seal pellets Pel-Plug (TR30) 3/8"	(96.3 - 106.9') 9 buckets	(96.3 - 106.9') 9.5 buckets (106%) Note: Intermediate seal
104		Topock - Alluvium Deposits	SM				
105							
106							
107							
108	MW-M-VAS-107-112 (<0.033 U ppb) 3/30/2019 13:59	Topock - Alluvium Deposits	SM		(8.0 - 197.6') 10" Borehole		
109							
110							
111							
112					(112.0 - 132.0') 2" Sch 80 PVC (20-slot) Screen		
113					(106.9 - 136.0') Cemex #3 MESH (8x20) Lapis Lustre Sand	(106.9 - 136.0') 30.2 bags	(106.9 - 136.0') 35 bags (116%) Note: Filter pack
114							
115							
116							
117		Topock - Alluvium Deposits	GM				
118							
119							

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Well Construction Log

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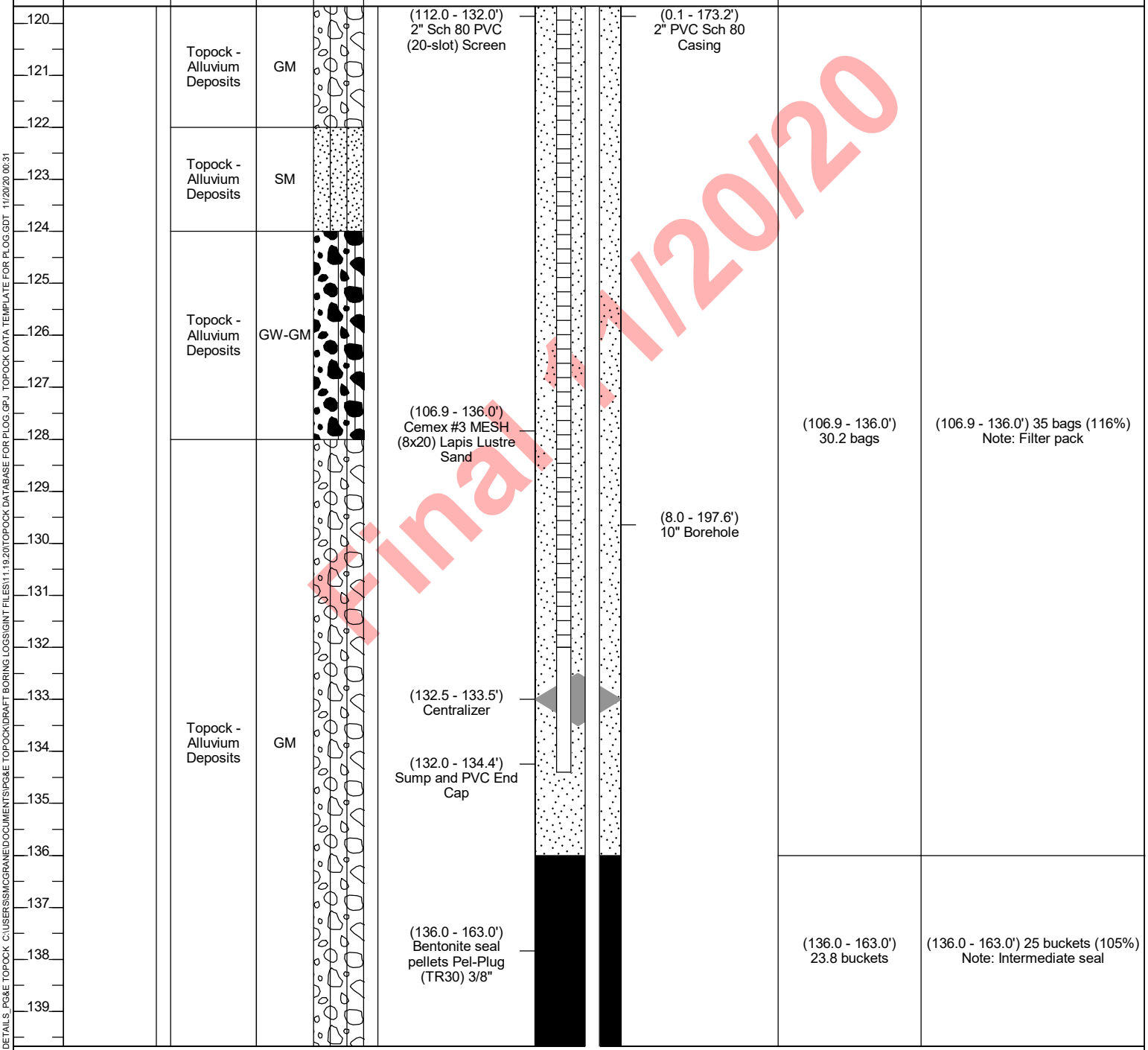
Date Started:	04/30/2019	Surface Elevation:	501.27 ft amsl	**Well ID: MW-84-132, MW-84-193**	
Date Completed:	07/30/2019	Shallow Well Elevation:	501.26 ft amsl		
Drilling Co.:	Cascade	Deep Well Elevation:	501.18 ft amsl	Client:	PG&E
Drilling Method:	Sonic Drilling	Northing (NAD83):	2102363.81	Project:	Final GW Remedy Phase 1
Driller Name:	Tyler Alymer	Easting (NAD83):	7614866.21	Location:	PG&E Topock, Needles, California
Drilling Asst:	C. Winland/J. Candelaria	Borehole Diameter:	4-12 inches		
Logger:	C. Bonessi/R. Moniz	Static Water Level:	See Log for Depths	Project Number:	RC000753.0051
Editor:	Sean McGrane	Development End Date:	6/15/2019		
Total Depth:	216 ft bgs	Well Completion:	☒ Flush ☐ Stick-up ☐ To Be Completed in Well Vault		



Calculated Material Volumes	Material Volumes Installed Note: percentages are the actual volume vs the calculated volume
(106.9 - 136.0') 30.2 bags	(106.9 - 136.0') 35 bags (116%) Note: Filter pack
(136.0 - 163.0') 23.8 buckets	(136.0 - 163.0') 25 buckets (105%) Note: Intermediate seal

Abbreviations: USCS = Unified Soil Classification System, ft = feet, bgs = below ground surface, amsl = above mean sea level, GW = groundwater, ppb = parts per billion, U = not detected above the laboratory reporting limit, NR = no recovery; Notes: solid blue and hollow blue water table marks represent depth to water (ft. bgs.) measured post development for the shallow well and deep well respectively; installed in MW-84d

Well Construction Log

ARCADIS Design & Consultancy for natural and built assets

Date Started:	04/30/2019	Surface Elevation:	501.27 ft amsl	**Well ID: MW-84-132, MW-84-193**	
Date Completed:	07/30/2019	Shallow Well Elevation:	501.26 ft amsl		
Drilling Co.:	Cascade	Deep Well Elevation:	501.18 ft amsl	Client:	PG&E
Drilling Method:	Sonic Drilling	Northing (NAD83):	2102363.81	Project:	Final GW Remedy Phase 1
Driller Name:	Tyler Alymer	Easting (NAD83):	7614866.21	Location:	PG&E Topock, Needles, California
Drilling Asst:	C. Winland/J. Candelaria	Borehole Diameter:	4-12 inches		
Logger:	C. Bonessi/R. Moniz	Static Water Level:	See Log for Depths	Project Number:	RC000753.0051
Editor:	Sean McGrane	Development End Date:	6/15/2019		
Total Depth:	216 ft bgs	Well Completion:	☒ Flush ☐ Stick-up ☐ To Be Completed in Well Vault		

Depth (ft)	Groundwater Sample ID	Geologic Formation	USCS Code	USCS Class	Well Construction	Calculated Material Volumes	Material Volumes Installed Note: percentages are the actual volume vs the calculated volume
140–159	MW-M-VAS-147-152 (<0.17 U ppb) 3/31/2019 15:21	Topock - Alluvium Deposits	GM / ML / SM / GM		(0.1 - 173.2') 2" PVC Sch 80 Casing; (8.0 - 197.6') 10" Borehole; (136.0 - 163.0') Bentonite seal pellets Pel-Plug (TR30) 3/8"	(136.0 - 163.0') 23.8 buckets	(136.0 - 163.0') 25 buckets (105%) Note: Intermediate seal

Abbreviations: USCS = Unified Soil Classification System, ft = feet, bgs = below ground surface, amsl = above mean sea level, GW = groundwater, ppb = parts per billion, U = not detected above the laboratory reporting limit, NR = no recovery; Notes: solid blue and hollow blue water table marks represent depth to water (ft. bgs.) measured post development for the shallow well and deep well respectively; installed in MW-84d

Well Construction Log

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Date Started:	04/30/2019	Surface Elevation:	501.27 ft amsl	**Well ID: MW-84-132, MW-84-193**	
Date Completed:	07/30/2019	Shallow Well Elevation:	501.26 ft amsl		
Drilling Co.:	Cascade	Deep Well Elevation:	501.18 ft amsl	Client:	PG&E
Drilling Method:	Sonic Drilling	Northing (NAD83):	2102363.81	Project:	Final GW Remedy Phase 1
Driller Name:	Tyler Alymer	Easting (NAD83):	7614866.21	Location:	PG&E Topock, Needles, California
Drilling Asst:	C. Winland/J. Candelaria	Borehole Diameter:	4-12 inches		
Logger:	C. Bonessi/R. Moniz	Static Water Level:	See Log for Depths	Project Number:	RC000753.0051
Editor:	Sean McGrane	Development End Date:	6/15/2019		
Total Depth:	216 ft bgs	Well Completion:	☒ Flush ☐ Stick-up ☐ To Be Completed in Well Vault		

Depth (ft)	Groundwater Sample ID	Geologic Formation	USCS Code	USCS Class	Well Construction	Calculated Material Volumes	Material Volumes Installed Note: percentages are the actual volume vs the calculated volume
160–179	MW-M-VAS-172-177 (<0.033 U ppb) 4/2/2019 14:57	Topock - Alluvium Deposits	GM		(0.1 - 173.2') 2" PVC Sch 80 Casing; (136.0 - 163.0') Bentonite seal pellets Pel-Plug (TR30) 3/8"; (8.0 - 197.6') 10" Borehole; (163.0 - 197.6') Cemex #3 MESH (8x20) Lapis Lustre Sand; (173.2 - 193.2') 2" Sch 80 PVC (20-slot) Screen	(136.0 - 163.0') 23.8 buckets; (163.0 - 197.6') 38.2 bags	(136.0 - 163.0') 25 buckets (105%) Note: Intermediate seal; (163.0 - 197.6') 42 bags (110%) Note: Filter pack
163–167		Topock - Alluvium Deposits	SM				
167–177		Topock - Alluvium Deposits	GM				
177–179		Topock - Alluvium Deposits	GM				

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Well Construction Log

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Date Started:	04/30/2019	Surface Elevation:	501.27 ft amsl	**Well ID: MW-84-132, MW-84-193**	
Date Completed:	07/30/2019	Shallow Well Elevation:	501.26 ft amsl		
Drilling Co.:	Cascade	Deep Well Elevation:	501.18 ft amsl	Client:	PG&E
Drilling Method:	Sonic Drilling	Northing (NAD83):	2102363.81	Project:	Final GW Remedy Phase 1
Driller Name:	Tyler Alymer	Easting (NAD83):	7614866.21	Location:	PG&E Topock, Needles, California
Drilling Asst:	C. Winland/J. Candelaria	Borehole Diameter:	4-12 inches		
Logger:	C. Bonessi/R. Moniz	Static Water Level:	See Log for Depths	Project Number:	RC000753.0051
Editor:	Sean McGrane	Development End Date:	6/15/2019		
Total Depth:	216 ft bgs	Well Completion:	☒ Flush ☐ Stick-up ☐ To Be Completed in Well Vault		

Depth (ft)	Groundwater Sample ID	Geologic Formation	USCS Code	USCS Class	Well Construction	Calculated Material Volumes	Material Volumes Installed Note: percentages are the actual volume vs the calculated volume
180–199	MW-M-VAS-190-195 (<0.17 U ppb) 4/10/2019 16:35	Topock - Alluvium Deposits	GM		(173.2 - 193.2') 2" Sch 80 PVC (20-slot) Screen (163.0 - 197.6') Cemex #3 MESH (8x20) Lapis Lustre Sand (8.0 - 197.6') 10" Borehole (193.7 - 194.7') Centralizer (193.2 - 195.5') Sump and PVC End Cap (197.6 - 209.5') Bentonite seal chips Halliburton Holeplug 3/8" chips (197.6 - 211.0') 6" Borehole	(163.0 - 197.6') 38.2 bags	(163.0 - 197.6') 42 bags (110%) Note: Filter pack
192–195		Topock - Alluvium Deposits	SM				
196–199		Topock - Alluvium Deposits	GM			(197.6 - 209.5') 3.4 bags	(197.6 - 209.5') 3 bags (88%) Note: Decommissioned rathole, during reaming drilled out 0.6 ft of seal.

Abbreviations: USCS = Unified Soil Classification System, ft = feet, bgs = below ground surface, amsl = above mean sea level, GW = groundwater, ppb = parts per billion, U = not detected above the laboratory reporting limit, NR = no recovery; Notes: solid blue and hollow blue water table marks represent depth to water (ft. bgs.) measured post development for the shallow well and deep well respectively; installed in MW-84d

Well Construction Log

Sheet: 11 of 11

Well ID: MW-84-132, MW-84-193

Date Started:	04/30/2019	Surface Elevation:	501.27 ft amsl		
Date Completed:	07/30/2019	Shallow Well Elevation:	501.26 ft amsl		
Drilling Co.:	Cascade	Deep Well Elevation:	501.18 ft amsl	Client:	PG&E
Drilling Method:	Sonic Drilling	Northing (NAD83):	2102363.81	Project:	Final GW Remedy Phase 1
Driller Name:	Tyler Alymer	Easting (NAD83):	7614866.21	Location:	PG&E Topock, Needles, California
Drilling Asst:	C. Winland/J. Candelaria	Borehole Diameter:	4-12 inches		
Logger:	C. Bonessi/R. Moniz	Static Water Level:	See Log for Depths	Project Number:	RC000753.0051
Editor:	Sean McGrane	Development End Date:	6/15/2019		
Total Depth:	216 ft bgs	Well Completion:	☒ Flush ☐ Stick-up ☐ To Be Completed in Well Vault		

Depth (ft)	Groundwater Sample ID	Geologic Formation	USCS Code	USCS Class	Well Construction	Calculated Material Volumes	Material Volumes Installed Note: percentages are the actual volume vs the calculated volume
200							
201							
202	--no sample-- (Interval did not produce.) 4/10/2019 12:28	Topock - Alluvium Deposits	GM				
203							
204							
205					(197.6 - 209.5') Bentonite seal chips Halliburton Holeplug 3/8" chips	(197.6 - 209.5') 3.4 bags	(197.6 - 209.5') 3 bags (88%) Note: Decommissioned rathole, during reaming drilled out 0.6 ft of seal.
206		Topock - Bedrock - metadiorite			(197.6 - 211.0') 6" Borehole		
207							
208							
209							
210							
211							
212		Topock - Bedrock - metadiorite					
213					(209.5 - 216.0') Bentonite seal pellets Pel-Plug (TR30) 3/8"	(209.5 - 216.0') 1.2 buckets	(209.5 - 216.0') 1 buckets (83%) Note: Decommissioned rathole
214					(211.0 - 216.0') 4" Borehole		
215							
216							
217					End of Boring at 216.0 ft bgs.		
218							
219							

Abbreviations: USCS = Unified Soil Classification System, ft = feet, bgs = below ground surface, amsl = above mean sea level, GW = groundwater, ppb = parts per billion, U = not detected above the laboratory reporting limit, NR = no recovery; Notes: solid blue and hollow blue water table marks represent depth to water (ft. bgs.) measured post development for the shallow well and deep well respectively; installed in MW-84d

ARCADIS Design & Consultancy for natural and built assets

Boring Log

Boring No.: MW-84d

Date Started:	03/20/2019	Surface Elevation:	501.27 ft amsl	Client:	PG&E
Date Completed:	04/30/2019	Northing (NAD83):	2102363.81	Project:	Final GW Remedy Phase 1
Drilling Co.:	Cascade	Easting (NAD83):	7614866.21	Location:	PG&E Topock, Needles, California
Drilling Method:	Sonic Drilling	Total Depth:	216 ft bgs		
Drill Rig Type:	Boart Longyear Track	Borehole Diameter:	4-12 inches		
Driller Name:	Tyler Alymer	Depth to First Water:	46.4 ft bgs		
Drilling Asst:	C. Winland/J. Candelaria	Sampling Method:	4-8 inch x 10 ft. Core Barrel	Project Number:	RC000753.0051
Logger:	C. Bonessi/R. Moniz	Sampling Interval:	Continuous		
Editor:	Sean McGrane	Converted to Well:	☒ Yes ☐ No		

Depth (ft)	Recovery (in)	Sieve Sample ID	Groundwater Sample ID	Geologic Formation	USCS Code	USCS Class	Soil Description	Drilling Notes	Drilling Fluid
1–5	0	No Sieve Samples Collected			NR		(0.0 - 8.0') No recovery (NR); and cleared for utility clearance to 1 foot bgs, ~2 foot boulder encountered had to used rig to break boulder loose, drilled to 8 ft. bgs with no core collected.	(0.0 - 8.0') Added 10 gallons of water to hydrate bentonite mud tub seal.	(0.0 - 37.0') No water used
6–8	0								
8–10				Topock - Fluvial Deposits	SW-SM		(8.0 - 10.5') Topock - Fluvial Deposits; Well graded sand with silt and gravel (SW-SM); light olive brown (2.5Y 5/4); very fine grained to very coarse grained, subangular to subround; some granules to very large pebbles, subangular to subround; trace subangular to subround; trace silt; trace clay; dry; some moisture present due to hydration of bentonite	(8.0 - 32.0') Soft drilling, formation collapsing after every run.	
10–17	24				NR		(10.5 - 17.0') No recovery (NR)		
17–18				Topock - Fluvial Deposits	SW-SM		(17.0 - 19.5') Topock - Fluvial Deposits; Well graded sand with silt and gravel (SW-SM); light olive brown (2.5Y 5/4); very fine grained to very coarse grained, subangular to subround; some granules to very large pebbles, subangular to subround; trace subangular to subround; trace silt; trace clay; dry; some moisture present due to hydration of bentonite		
18–20	120				GW-GM		(19.5 - 27.0') Topock - Fluvial Deposits; Well graded gravel with		

Abbreviations: USCS = Unified Soil Classification System, ft = feet, bgs = below ground surface, amsl = above mean sea level, GW = groundwater, ppb = parts per billion, U = not detected above the laboratory reporting limit, NR = no recovery; Notes: depth to water measured during the first VAS interval; apparent partial recoveries can be the result of potential compaction of sediments in the core bag; wells MW-84-132, MW-84-193 installed in borehole

ARCADIS Design & Consultancy for natural and built assets

Boring Log

Boring No.: MW-84d

Date Started:	03/20/2019	Surface Elevation:	501.27 ft amsl	Client:	PG&E
Date Completed:	04/30/2019	Northing (NAD83):	2102363.81	Project:	Final GW Remedy Phase 1
Drilling Co.:	Cascade	Easting (NAD83):	7614866.21	Location:	PG&E Topock, Needles, California
Drilling Method:	Sonic Drilling	Total Depth:	216 ft bgs		
Drill Rig Type:	Boart Longyear Track	Borehole Diameter:	4-12 inches		
Driller Name:	Tyler Alymer	Depth to First Water:	46.4 ft bgs		
Drilling Asst:	C. Winland/J. Candelaria	Sampling Method:	4-8 inch x 10 ft. Core Barrel	Project Number:	RC000753.0051
Logger:	C. Bonessi/R. Moniz	Sampling Interval:	Continuous		
Editor:	Sean McGrane	Converted to Well:	☒ Yes ☐ No		

Depth (ft)	Recovery (in)	Sieve Sample ID	Groundwater Sample ID	Geologic Formation	USCS Code	USCS Class	Soil Description	Drilling Notes	Drilling Fluid
21–27	120	No Sieve Samples Collected		Topock - Fluvial Deposits	GW-GM		silt and sand (GW-GM); light olive brown (2.5Y 5/4); granules to very large pebbles, subangular to subround; some very fine to very coarse grained sand, subangular to subround; trace subangular to subround; trace silt; trace clay; dry		
27–32	60			Topock - Fluvial Deposits	SW-SM		(27.0 - 38.0') Topock - Fluvial Deposits; Well graded sand with silt and gravel (SW-SM); light olive brown (2.5Y 5/4); very fine grained to very coarse grained, subangular to subround; some granules to very large pebbles, subangular to subround; little silt; trace subangular to subround; dry		
32–37	60						(32'); iron oxide staining; ~2 ft. diameter boulder	(32.0 - 37.0') Hard drilling due to boulder. Borehole collapsing after each clean out run. Rod broke while doing clean out at 35 ft bgs.	
37–40	60			Topock - Fluvial Deposits	SM		(38.0 - 42.0') Topock - Fluvial Deposits; Silty sand with gravel (SM); strong brown (7.5YR 5/6); very fine grained to very coarse grained, angular to subangular; some granules to very large pebbles, angular to subangular; some silt; little subangular; dry to moist; weak cementation; iron oxide staining; cobbles composed of sandstone/breccia	(37.0 - 42.0') Drill rods chattering, change geologist from CB to RM. (37.1') Change in geologist from CB to RM.	(37.0') 5 gallons of water used; 5 gallons of water recovered; 0 gallons of water lost (37.0 - 205.0') No used

Abbreviations: USCS = Unified Soil Classification System, ft = feet, bgs = below ground surface, amsl = above mean sea level, GW = groundwater, ppb = parts per billion, U = not detected above the laboratory reporting limit, NR = no recovery; Notes: depth to water measured during the first VAS interval; apparent partial recoveries can be the result of potential compaction of sediments in the core bag; wells MW-84-132, MW-84-193 installed in borehole

ARCADIS Design & Consultancy for natural and built assets

Boring Log

Date Started:	03/20/2019	Surface Elevation:	501.27 ft amsl	**Boring No.:**	**MW-84d**
Date Completed:	04/30/2019	Northing (NAD83):	2102363.81		
Drilling Co.:	Cascade	Easting (NAD83):	7614866.21	Client:	PG&E
Drilling Method:	Sonic Drilling	Total Depth:	216 ft bgs	Project:	Final GW Remedy Phase 1
Drill Rig Type:	Boart Longyear Track	Borehole Diameter:	4-12 inches	Location:	PG&E Topock, Needles, California
Driller Name:	Tyler Alymer	Depth to First Water:	46.4 ft bgs		
Drilling Asst:	C. Winland/J. Candelaria	Sampling Method:	4-8 inch x 10 ft. Core Barrel	Project Number:	RC000753.0051
Logger:	C. Bonessi/R. Moniz	Sampling Interval:	Continuous		
Editor:	Sean McGrane	Converted to Well:	☒ Yes ☐ No		

Depth (ft)	Recovery (in)	Sieve Sample ID	Groundwater Sample ID	Geologic Formation	USCS Code	USCS Class	Soil Description	Drilling Notes	Drilling Fluid
41	60	No Sieve Samples Collected		Topock - Fluvial Deposits	SM				
42				Topock - Alluvium Deposits	GM		(42.0 - 47.0') Topock - Alluvium Deposits; Silty gravel with sand (GM); strong brown (7.5YR 5/6); granules to very large pebbles, angular to subangular; some very fine to very coarse grained sand, angular to subround; little; little silt; moist; weak cementation; iron oxide staining; Interbedded silty units, cobbles composed of sandstone/breccia	(44.0 - 47.0') Drill rods chattering	
47				Topock - Alluvium Deposits	GM		(47.0 - 52.0') Topock - Alluvium Deposits; Silty gravel with sand (GM); dark yellowish brown (10YR 4/4); granules to very large pebbles, angular to subround; some silt; little; little very fine to medium grained sand, angular to subround; little clay; moist to wet	(48.0') Approximate depth to water table.	
52	120		MW-M-VAS-52-57 (28 ppb) 3/28/2019 11:10	Topock - Alluvium Deposits	GW		(51') brown (7.5YR 5/4); little silt; trace clay; moist; weak cementation; iron oxide staining; increase in granules and pebbles, decrease in sand (52.0 - 59.0') Topock - Alluvium Deposits; Well graded gravel with sand (GW); strong brown (7.5YR 5/6); granules to very large pebbles, angular to subround; some very fine to very coarse grained sand, angular to subround; little; trace silt; wet; weak cementation; iron oxide staining	(52.0 - 57.0') Drill rods chattering, driller suggest water table has been encountered.	
57								(57.0 - 67.0') Hard drilling and became harder at 61 ft.	
58	114						(58'); moist		
59				Topock - Alluvium Deposits	SM		(59.0 - 61.0') Topock - Alluvium Deposits; Silty sand with gravel (SM); grayish brown (10YR 5/2); very fine grained to medium grained; some silt; little granules to very large pebbles, angular to		
60									

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Boring Log

ARCADIS Design & Consultancy for natural and built assets

Boring No.: MW-84d

Date Started:	03/20/2019	Surface Elevation:	501.27 ft amsl	Client:	PG&E
Date Completed:	04/30/2019	Northing (NAD83):	2102363.81	Project:	Final GW Remedy Phase 1
Drilling Co.:	Cascade	Easting (NAD83):	7614866.21	Location:	PG&E Topock, Needles, California
Drilling Method:	Sonic Drilling	Total Depth:	216 ft bgs		
Drill Rig Type:	Boart Longyear Track	Borehole Diameter:	4-12 inches		
Driller Name:	Tyler Alymer	Depth to First Water:	46.4 ft bgs		
Drilling Asst:	C. Winland/J. Candelaria	Sampling Method:	4-8 inch x 10 ft. Core Barrel	Project Number:	RC000753.0051
Logger:	C. Bonessi/R. Moniz	Sampling Interval:	Continuous		
Editor:	Sean McGrane	Converted to Well:	☒ Yes ☐ No		

Depth (ft)	Recovery (in)	Sieve Sample ID	Groundwater Sample ID	Geologic Formation	USCS Code	USCS Class	Soil Description	Drilling Notes	Drilling Fluid
61				Topock - Alluvium Deposits	SM		subround; little clay; trace angular to subround; moist		
62				Topock - Alluvium Deposits	GM		(61.0 - 63.0') Topock - Alluvium Deposits; Silty gravel with sand (GM); light brownish gray / pale yellowish brown (10YR 6/2); granules to very large pebbles, subangular to subround; little very fine to medium grained sand, subangular to subround; little silt; trace clay; dry		
63									
64	114			Topock - Alluvium Deposits	SM		(63.0 - 67.0') Topock - Alluvium Deposits; Silty sand (SM); brown (7.5YR 4/3); very fine grained to medium grained, angular to subround; little granules to very large pebbles, angular to subround; little silt; trace angular to subround; trace clay; dry; weak cementation; iron oxide staining		
65							(65'); potential caliche deposits in sediments		
66									
67									
68		No Sieve Samples Collected		Topock - Alluvium Deposits	GM		(67.0 - 75.0') Topock - Alluvium Deposits; Silty gravel with sand (GM); brown (7.5YR 4/3); granules to very large pebbles, angular to subround; some angular to subround; some very fine to very coarse grained sand, angular to subround; little silt; moist	(67.0 - 77.0') Softer drilling	
69							(69.5') brown (10YR 5/3); some silt; little angular to subround; little clay; moist; weak cementation		
70									
71							(70.5'); dry; potential caliche deposits in sediments		
72	120						(71'); moist		
73							(72'); wet; lens of green staining		
74			MW-M-VAS-72-77 (<0.033 U ppb) 3/29/2019 14:01						
75				Topock - Alluvium Deposits	SW-SM		(75.0 - 78.0') Topock - Alluvium Deposits; Well graded sand with gravel (SW-SM); weak red (2.5YR 5/2); very fine grained to coarse grained, angular to subround; little granules to very large pebbles, angular to subround; little silt; trace angular to subangular; wet		
76									
77								(77.0 - 87.0') Soft drilling, lost core 82 to 87 ft downhole.	
78	120			Topock - Alluvium Deposits	GM		(78.0 - 79.0') Topock - Alluvium Deposits; Silty gravel with sand (GM); weak red (2.5YR 4/2); granules to very large pebbles, angular to subround; little angular to subround; little very fine to very coarse grained sand, angular to subround; little silt; little clay; wet		
79									
80				Topock - Alluvium Deposits	SW-SM		(79.0 - 80.0') Topock - Alluvium Deposits; Poorly graded sand with		

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ARCADIS Design & Consultancy for natural and built assets

Boring Log

Date Started:	03/20/2019	Surface Elevation:	501.27 ft amsl	**Boring No.:**	**MW-84d**
Date Completed:	04/30/2019	Northing (NAD83):	2102363.81		
Drilling Co.:	Cascade	Easting (NAD83):	7614866.21	Client:	PG&E
Drilling Method:	Sonic Drilling	Total Depth:	216 ft bgs	Project:	Final GW Remedy Phase 1
Drill Rig Type:	Boart Longyear Track	Borehole Diameter:	4-12 inches	Location:	PG&E Topock, Needles, California
Driller Name:	Tyler Alymer	Depth to First Water:	46.4 ft bgs		
Drilling Asst:	C. Winland/J. Candelaria	Sampling Method:	4-8 inch x 10 ft. Core Barrel	Project Number:	RC000753.0051
Logger:	C. Bonessi/R. Moniz	Sampling Interval:	Continuous		
Editor:	Sean McGrane	Converted to Well:	☒ Yes ☐ No		

Depth (ft)	Recovery (in)	Sieve Sample ID	Groundwater Sample ID	Geologic Formation	USCS Code	USCS Class	Soil Description	Drilling Notes	Drilling Fluid
81				Topock - Alluvium Deposits	ML		silt and gravel (SW-SM); weak red (2.5YR 5/2); medium grained to very coarse grained, angular to subround; and granules to very large pebbles, angular to subround; little silt; trace angular to subangular; wet		
82							(80.0 - 82.0') Topock - Alluvium Deposits; Sandy silt with gravel (ML); brown (7.5YR 4/3); low plasticity; some very fine to medium grained sand, angular to subround; little granules to very large pebbles, angular to subangular; little clay; moist to wet; medium stiff		
83				Topock - Alluvium Deposits	GW-GM		(82.0 - 84.0') Topock - Alluvium Deposits; Well graded gravel with silt and sand (GW-GM); weak red (2.5YR 5/2); granules to very large pebbles, angular to subround; some medium to very coarse grained sand, angular to subround; little angular to subangular; little silt; wet		
84	120								
85							(84.0 - 95.0') Topock - Alluvium Deposits; Silty sand with gravel (SM); brown (7.5YR 4/3); medium grained to very coarse grained, angular to subround; some granules to very large pebbles, angular to subround; some silt; little angular to subround; trace clay; moist; interbedded with layers of silty gravel, with sand and gravelly silt with sand		
86									
87									
88								(87.0 - 97.0') Soft drilling, recovered 82 to 87 ft core.	
89									
90		No Sieve Samples Collected		Topock - Alluvium Deposits	SM				
91									
92	120						(91.7'); dry; with lenses of potential caliche in sediments and weak cementation		
93									
94									
95									
96				Topock - Alluvium Deposits	ML		(95.0 - 97.0') Topock - Alluvium Deposits; Sandy silt with gravel (ML); brown (7.5YR 4/3); low plasticity; some medium to very coarse grained sand, angular to subround; little granules to very large pebbles, angular to subround; little angular to subround; trace clay; moist		
97									
98				Topock - Alluvium Deposits	SM		(97.0 - 100.0') Topock - Alluvium Deposits; Silty sand with gravel (SM); brown (7.5YR 4/3); medium grained to very coarse grained, angular to subround; some granules to very large pebbles, angular to subround; some silt; trace angular to subround; trace clay; moist; interbedded with layers of silty gravel with sand and gravelly silt with sand	(97.0 - 127.0') Formation collapse during clean out drilling with 10 inch casing, soft drilling (97' to 107'), slightly rough drilling	
99	120								
100									

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ARCADIS Design & Consultancy for natural and built assets

Boring Log

Boring No.: MW-84d

Date Started:	03/20/2019	Surface Elevation:	501.27 ft amsl	Client:	PG&E
Date Completed:	04/30/2019	Northing (NAD83):	2102363.81	Project:	Final GW Remedy Phase 1
Drilling Co.:	Cascade	Easting (NAD83):	7614866.21	Location:	PG&E Topock, Needles, California
Drilling Method:	Sonic Drilling	Total Depth:	216 ft bgs		
Drill Rig Type:	Boart Longyear Track	Borehole Diameter:	4-12 inches		
Driller Name:	Tyler Alymer	Depth to First Water:	46.4 ft bgs		
Drilling Asst:	C. Winland/J. Candelaria	Sampling Method:	4-8 inch x 10 ft. Core Barrel	Project Number:	RC000753.0051
Logger:	C. Bonessi/R. Moniz	Sampling Interval:	Continuous		
Editor:	Sean McGrane	Converted to Well:	☒ Yes ☐ No		

Depth (ft)	Recovery (in)	Sieve Sample ID	Groundwater Sample ID	Geologic Formation	USCS Code	USCS Class	Soil Description	Drilling Notes	Drilling Fluid
101	120	No Sieve Samples Collected	MW-M-VAS-107-112 (<0.033 U ppb) 3/30/2019 13:59	Topock - Alluvium Deposits	ML		(100.0 - 103.5') Topock - Alluvium Deposits; Sandy silt with gravel (ML); brown (7.5YR 4/3); low plasticity; some very fine to medium grained sand, angular to subround; little granules to very large pebbles, angular to subround; trace angular to subround; trace clay; moist; weak cementation; iron oxide staining (101'); dry; with lens of potential caliche in sediments and weak cementation	(107' to 109'), soft drilling (109' to 117'), soft drilling lost 5 feet of sample downhole (117' to 127') with 6 inch casing.	
102									
103									
104				Topock - Alluvium Deposits	SM		(103.5 - 105.0') Topock - Alluvium Deposits; Silty sand with gravel (SM); grayish brown (2.5Y 5/2) and brown (7.5YR 4/3); medium grained to very coarse grained; little granules to very large pebbles, angular to subround; little silt; trace angular to subround; trace clay; moist; interbedded color changes (104'); to 104.5', wet silty gravel lens		
105									
106				Topock - Alluvium Deposits	SM		(105.0 - 114.5') Topock - Alluvium Deposits; Silty sand with gravel (SM); brown (7.5YR 4/3); medium grained to very coarse grained, angular to subround; some granules to very large pebbles, angular to subround; some silt; trace angular to subround; trace clay; moist; interbedded layers with poor to moderate gradation (106'); to 107', dry with green staining (107'); to 109.5', wet		
107									
108	108							(107.0') During reaming with 10-inch casing flapper bit broke, getting poor recovery. Driller thinks material is getting pushed into formation or falling down 6-inch rathole.	
109									
110									
111									
112									
113									
114									
115				Topock - Alluvium Deposits	GM		(114.5 - 122.0') Topock - Alluvium Deposits; Silty gravel with sand (GM); brown (7.5YR 4/3); granules to very large pebbles, angular to subround; some very fine to medium grained sand, angular to subangular; some silt; little angular to subround; trace clay; moist; green staining		
116									
117									
118	120						(118.2'); sand lens at 118.2 ft		
119									
120									

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ARCADIS Design & Consultancy for natural and built assets

Boring Log

Boring No.: MW-84d

Date Started:	03/20/2019	Surface Elevation:	501.27 ft amsl	Client:	PG&E
Date Completed:	04/30/2019	Northing (NAD83):	2102363.81	Project:	Final GW Remedy Phase 1
Drilling Co.:	Cascade	Easting (NAD83):	7614866.21	Location:	PG&E Topock, Needles, California
Drilling Method:	Sonic Drilling	Total Depth:	216 ft bgs		
Drill Rig Type:	Boart Longyear Track	Borehole Diameter:	4-12 inches		
Driller Name:	Tyler Alymer	Depth to First Water:	46.4 ft bgs		
Drilling Asst:	C. Winland/J. Candelaria	Sampling Method:	4-8 inch x 10 ft. Core Barrel	Project Number:	RC000753.0051
Logger:	C. Bonessi/R. Moniz	Sampling Interval:	Continuous		
Editor:	Sean McGrane	Converted to Well:	☒ Yes ☐ No		

Depth (ft)	Recovery (in)	Sieve Sample ID	Groundwater Sample ID	Geologic Formation	USCS Code	USCS Class	Soil Description	Drilling Notes	Drilling Fluid
121				Topock - Alluvium Deposits	GM		(120.5'); weathered metamorphic cobble, black and green staining around cobble		
122									
123	120			Topock - Alluvium Deposits	SM		(122.0 - 124.0') Topock - Alluvium Deposits; Silty sand with gravel (SM); dark grayish brown / dark yellowish brown (10YR 4/2); very fine grained to very coarse grained, angular to subangular; little granules to very large pebbles, angular to subangular; little silt; trace clay; wet		
124									
125				Topock - Alluvium Deposits	GW-GM		(124.0 - 128.0') Topock - Alluvium Deposits; Well graded gravel with silt and sand (GW-GM); light olive brown (2.5Y 5/6); granules to very large pebbles, angular to subangular; some very fine to very coarse grained sand, angular to subangular; little silt; trace; wet; iron oxide staining; occasional sandier and siltier lenses		
126							(126') brown (7.5YR 4/3); orange staining		
127							(127'); moist	(127.0 - 132.0') Soft drilling, recovered lost 5 feet of sample from drilling run (117' to 127').	
128				Topock - Alluvium Deposits	GM		(128.0 - 144.0') Topock - Alluvium Deposits; Silty gravel with sand (GM); light olive brown (2.5Y 5/6); granules to very large pebbles, angular to subangular; little very fine to very coarse grained sand, angular to subangular; little silt; little clay; trace; gravel lens; moist		
129									
130	60	No Sieve Samples Collected							
131							(131'); to 131.5' cobbles		
132							(132') brown (7.5YR 4/2)	(132.0 - 142.0') Rough drilling	
133									
134							(133.5'); dry; with potential caliche in sediments and weak cementation		
135									
136	90								
137									
138									
139									
140									

Abbreviations: USCS = Unified Soil Classification System, ft = feet, bgs = below ground surface, amsl = above mean sea level, GW = groundwater, ppb = parts per billion, U = not detected above the laboratory reporting limit, NR = no recovery; Notes: depth to water measured during the first VAS interval; apparent partial recoveries can be the result of potential compaction of sediments in the core bag; wells MW-84-132, MW-84-193 installed in borehole

Boring Log

ARCADIS Design & Consultancy for natural and built assets

Date Started:	03/20/2019	Surface Elevation:	501.27 ft amsl	**Boring No.:**	**MW-84d**
Date Completed:	04/30/2019	Northing (NAD83):	2102363.81		
Drilling Co.:	Cascade	Easting (NAD83):	7614866.21	Client:	PG&E
Drilling Method:	Sonic Drilling	Total Depth:	216 ft bgs	Project:	Final GW Remedy Phase 1
Drill Rig Type:	Boart Longyear Track	Borehole Diameter:	4-12 inches	Location:	PG&E Topock, Needles, California
Driller Name:	Tyler Alymer	Depth to First Water:	46.4 ft bgs		
Drilling Asst:	C. Winland/J. Candelaria	Sampling Method:	4-8 inch x 10 ft. Core Barrel	Project Number:	RC000753.0051
Logger:	C. Bonessi/R. Moniz	Sampling Interval:	Continuous		
Editor:	Sean McGrane	Converted to Well:	☒ Yes ☐ No		

Depth (ft)	Recovery (in)	Sieve Sample ID	Groundwater Sample ID	Geologic Formation	USCS Code	USCS Class	Soil Description	Drilling Notes	Drilling Fluid
141	90	No Sieve Samples Collected	MW-M-VAS-147-152 (<0.17 U ppb) 3/31/2019 15:21	Topock - Alluvium Deposits	GM			(152.0 - 167.0') Soft drilling	
142									
143									
144				Topock - Alluvium Deposits	ML		(144.0 - 144.5') Topock - Alluvium Deposits; Sandy silt with gravel (ML); brown (10YR 5/3); low plasticity; some very fine to medium grained sand, angular to subangular; trace granules to very large pebbles, angular to subround; wet; liquefied		
145									
146							(144.5 - 154.4') Topock - Alluvium Deposits; Silty sand with gravel (SM); brown (7.5YR 4/2) and brown (7.5YR 4/3); very fine grained to very coarse grained, angular to subround; some granules to very large pebbles, angular to subround; some silt; trace angular to subangular; trace clay; moist to wet; occasional gravelly and silty lenses 2in to 6in thick		
147	120								
148									
149									
150				Topock - Alluvium Deposits	SM				
151									
152									
153									
154									
155							(154.4 - 166.5') Topock - Alluvium Deposits; Silty gravel with sand (GM); brown (7.5YR 4/2) and brown (7.5YR 4/3); granules to very large pebbles, angular to subround; some very fine to medium grained sand, angular to subround; some silt; little angular to subangular; moist to wet; iron oxide staining; occasional sand lens 2in to 6in thick		
156	180								
157				Topock - Alluvium Deposits	GM		(157'); dry; with red and green staining		
158							(158'); moist		
159									
160									

Abbreviations: USCS = Unified Soil Classification System, ft = feet, bgs = below ground surface, amsl = above mean sea level, GW = groundwater, ppb = parts per billion, U = not detected above the laboratory reporting limit, NR = no recovery; Notes: depth to water measured during the first VAS interval; apparent partial recoveries can be the result of potential compaction of sediments in the core bag; wells MW-84-132, MW-84-193 installed in borehole

Boring Log

ARCADIS Design & Consultancy for natural and built assets

Date Started:	03/20/2019	Surface Elevation:	501.27 ft amsl	**Boring No.:**	**MW-84d**
Date Completed:	04/30/2019	Northing (NAD83):	2102363.81		
Drilling Co.:	Cascade	Easting (NAD83):	7614866.21	Client:	PG&E
Drilling Method:	Sonic Drilling	Total Depth:	216 ft bgs	Project:	Final GW Remedy Phase 1
Drill Rig Type:	Boart Longyear Track	Borehole Diameter:	4-12 inches	Location:	PG&E Topock, Needles, California
Driller Name:	Tyler Alymer	Depth to First Water:	46.4 ft bgs		
Drilling Asst:	C. Winland/J. Candelaria	Sampling Method:	4-8 inch x 10 ft. Core Barrel	Project Number:	RC000753.0051
Logger:	C. Bonessi/R. Moniz	Sampling Interval:	Continuous		
Editor:	Sean McGrane	Converted to Well:	☒ Yes ☐ No		

Depth (ft)	Recovery (in)	Sieve Sample ID	Groundwater Sample ID	Geologic Formation	USCS Code	USCS Class	Soil Description	Drilling Notes	Drilling Fluid
161									
162									
163				Topock - Alluvium Deposits	GM				
164	180						(164'); moist to dry		
165									
166									
167									
168				Topock - Alluvium Deposits	SM		(166.5 - 170.0') Topock - Alluvium Deposits; Silty sand with gravel (SM); reddish brown (5YR 4/3); very fine grained to medium grained, angular to subround; some silt; little granules to very large pebbles, angular to subround; trace angular to subangular; trace clay; wet	(167.0 - 177.0') Soft drilling	
169									
170		No Sieve Samples Collected							
171									
172	120						(170.0 - 176.5') Topock - Alluvium Deposits; Silty gravel with sand (GM); brown (7.5YR 4/3) with brown (7.5YR 5/2); granules to very large pebbles, angular to subround; some angular to subangular; little very fine to medium grained sand, angular to subangular; little silt; moist		
173				Topock - Alluvium Deposits	GM		(172'); dry; to 176.5', with red and green staining, potential caliche in sediments and weak cementation		
174			MW-M-VAS-172-177 (<0.033 U ppb) 4/2/2019 14:57						
175									
176									
177							(176.5 - 192.0') Topock - Alluvium Deposits; Silty gravel with sand (GM); reddish brown / moderate brown (5YR 4/4); granules to small pebbles, angular to subangular; some very fine to very coarse grained sand; little medium to very large pebbles, angular to subangular; little; little silt; trace clay; wet to moist; interbedded GW and GM with occasional well graded sand with gravel lenses 2in to 6 in thick	(177.0 - 192.0') Soft drilling	
178									
179	180			Topock - Alluvium Deposits	GM				
180									

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Boring Log

ARCADIS Design & Consultancy for natural and built assets

Date Started:	03/20/2019	Surface Elevation:	501.27 ft amsl	**Boring No.:**	**MW-84d**
Date Completed:	04/30/2019	Northing (NAD83):	2102363.81		
Drilling Co.:	Cascade	Easting (NAD83):	7614866.21	Client:	PG&E
Drilling Method:	Sonic Drilling	Total Depth:	216 ft bgs	Project:	Final GW Remedy Phase 1
Drill Rig Type:	Boart Longyear Track	Borehole Diameter:	4-12 inches	Location:	PG&E Topock, Needles, California
Driller Name:	Tyler Alymer	Depth to First Water:	46.4 ft bgs		
Drilling Asst:	C. Winland/J. Candelaria	Sampling Method:	4-8 inch x 10 ft. Core Barrel	Project Number:	RC000753.0051
Logger:	C. Bonessi/R. Moniz	Sampling Interval:	Continuous		
Editor:	Sean McGrane	Converted to Well:	☒ Yes ☐ No		

Depth (ft)	Recovery (in)	Sieve Sample ID	Groundwater Sample ID	Geologic Formation	USCS Code	USCS Class	Soil Description	Drilling Notes	Drilling Fluid
181									
182									
183									
184									
185									
186	180			Topock - Alluvium Deposits	GM				
187									
188									
189									
190		No Sieve Samples Collected							
191									
192			MW-M-VAS-190-195 (<0.17 U ppb) 4/10/2019 16:35						
193				Topock - Alluvium Deposits	GM		(192.0 - 195.0') Topock - Alluvium Deposits; Silty gravel with sand (GM); reddish brown / moderate brown (5YR 4/4) trace reddish brown (2.5YR 4/4); granules to large pebbles, angular to subround; some very fine to very coarse grained sand, angular to subround; little silt; little clay; trace; wet; weak cementation	(192.0') Change in geologist to CB.	
194									
195				Topock - Alluvium Deposits	SM		(195.0 - 196.0') Topock - Alluvium Deposits; Silty sand with gravel (SM); reddish brown / moderate brown (5YR 4/4); very fine grained to coarse grained, angular to subround; some silt; little granules to large pebbles, angular to subround; trace clay; wet		
196	120							(196.0 - 203.0') Rough drilling	
197				Topock - Alluvium Deposits	GM		(196.0 - 205.0') Topock - Alluvium Deposits; Silty gravel with sand (GM); reddish brown / moderate brown (5YR 4/4) trace reddish brown (2.5YR 4/4); granules to large pebbles, angular to subround; some very fine to very coarse grained sand, angular to subround; little silt; little clay; trace; wet; weak cementation		
198									
199									
200									

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Boring Log

ARCADIS Design & Consultancy for natural and built assets

Sheet: 11 of 11

Boring No.: MW-84d

Date Started:	03/20/2019	Surface Elevation:	501.27 ft amsl	Client:	PG&E
Date Completed:	04/30/2019	Northing (NAD83):	2102363.81	Project:	Final GW Remedy Phase 1
Drilling Co.:	Cascade	Easting (NAD83):	7614866.21	Location:	PG&E Topock, Needles, California
Drilling Method:	Sonic Drilling	Total Depth:	216 ft bgs		
Drill Rig Type:	Boart Longyear Track	Borehole Diameter:	4-12 inches		
Driller Name:	Tyler Alymer	Depth to First Water:	46.4 ft bgs		
Drilling Asst:	C. Winland/J. Candelaria	Sampling Method:	4-8 inch x 10 ft. Core Barrel	Project Number:	RC000753.0051
Logger:	C. Bonessi/R. Moniz	Sampling Interval:	Continuous		
Editor:	Sean McGrane	Converted to Well:	☒ Yes ☐ No		

Depth (ft)	Recovery (in)	Sieve Sample ID	Groundwater Sample ID	Geologic Formation	USCS Code	USCS Class	Soil Description	Drilling Notes	Drilling Fluid
201									
202									
203	120		--no sample-- (Interval did not produce.) 4/10/2019 12:28	Topock - Alluvium Deposits	GM				
204									
205									
206				Topock - Bedrock - metadiorite			(205.0 - 208.0') Topock - Bedrock - metadiorite; grayish brown (2.5Y 5/2) with greenish gray (10Y 6/1); moist; moderate cementation; weathered metadiorite	(205.0 - 211.0') Very tight drilling, locked up core barrel at 208 ft. bgs.	(205.0 - 211.0') 600 gallons of water used; 600 gallons of water recovered; 0 gallons of water lost
207									
208	72	No Sieve Samples Collected					(208.0 - 216.0') Topock - Bedrock - metadiorite; grayish brown (2.5Y 5/2) with greenish gray (10Y 6/1); dry; moderate cementation; bedrock pulverized during drilling		
209									
210									
211							(211'); to 213 ft. moist, potential slough based on QC geologist review of time between runs, notes, and photos	(211.0 - 216.0') Rough drilling, hard, rods and head chattering.	(211.0 - 216.0') No used
212				Topock - Bedrock - metadiorite					
213									
214	48						(214'); to 214.2 silt lens potentially pulverized metadiorite		
215									
216							End of Boring at 216.0 ft bgs.		
217									
218									
219									
220									

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