Well Construction Log

Sheet: 1 of 16

ARCADIS Design & Consultancy for natural and built assets

Date Started:	10/27/2018	Surface Elevation:	529.95 ft amsl	**Well ID: MW-83-225, MW-83-245**	
Date Completed:	04/04/2019	Shallow Well Elevation:	529.80 ft amsl		
Drilling Co.:	Cascade	Deep Well Elevation:	529.65 ft amsl	Client:	PG&E
Drilling Method:	Sonic Drilling	Northing (NAD83):	2102858.77	Project:	Final GW Remedy Phase 1
Driller Name:	Dan O'Mara	Easting (NAD83):	7615264.94	Location:	PG&E Topock, Needles, California
Drilling Asst:	E. Huellmantel / J. Campbell	Borehole Diameter:	4-12 inches		
Logger:	SM / GJ / MA	Static Water Level:	See Log for Depths	Project Number:	RC000753.0051
Editor:	Sean McGrane	Development End Date:	3/29/2019		
Total Depth:	315 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
1		Topock - Fluvial Deposits	SW		(+0.2 - 1.0') Surface completion; (0.3 - 235.0') 2" PVC Sch 80 Casing		(+0.2 - 1.0') 12 bags Note: 3.5 x 3.5 ft concrete pad with 18" diameter lockable vault, King Kon-Crete 4000 PSI.
2					(0.2 - 205.0') 2" PVC Sch 80 Casing		
3		Topock - Fluvial Deposits	SW				
4							
5							
6							
7		Topock - Fluvial Deposits	SM		(1.0 - 15.0') Portland Cement 5% Bentonite Type I, II and V with Hydrogel	(1.0 - 15.0') 77.6 gallons	(1.0 - 15.0') 100 gallons (129%) Note: Grout seal. Used >20% of the calculated volume due to a large void at approximately 15 feet bgs migration into the formation.
8							
9							
10					(0.0 - 28.0') 12" Borehole		
11		Topock - Fluvial Deposits	SW-SM				
12							
13							
14							
15							
16		Topock - Fluvial Deposits	SW-SM		(15.0 - 50.0') Portland Cement 5% Bentonite Type I, II and V with Hydrogel	(15.0 - 50.0') 168.6 gallons	(15.0 - 50.0') 450 gallons (267%) Note: Grout seal. Used >20% of the calculated volume due to potential voids that formed during drilling and migration into the formation.
17							
18							
19							

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-83d

Well Construction Log

ARCADIS Design & Consultancy for natural and built assets

Date Started:	10/27/2018	Surface Elevation:	529.95 ft amsl	**Well ID: MW-83-225, MW-83-245**	
Date Completed:	04/04/2019	Shallow Well Elevation:	529.80 ft amsl		
Drilling Co.:	Cascade	Deep Well Elevation:	529.65 ft amsl	Client:	PG&E
Drilling Method:	Sonic Drilling	Northing (NAD83):	2102858.77	Project:	Final GW Remedy Phase 1
Driller Name:	Dan O'Mara	Easting (NAD83):	7615264.94	Location:	PG&E Topock, Needles, California
Drilling Asst:	E. Huellmantel / J. Campbell	Borehole Diameter:	4-12 inches		
Logger:	SM / GJ / MA	Static Water Level:	See Log for Depths	Project Number:	RC000753.0051
Editor:	Sean McGrane	Development End Date:	3/29/2019		
Total Depth:	315 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
21		Topock - Fluvial Deposits	SW-SM		(0.2 - 205.0') 2" PVC Sch 80 Casing; (0.3 - 235.0') 2" PVC Sch 80 Casing		
22		Topock - Fluvial Deposits	SM				
23		Topock - Fluvial Deposits	GP				
24					(0.0 - 28.0') 12" Borehole		
25			NR				
26							
27		Topock - Fluvial Deposits	ML				
28							
29		Topock - Fluvial Deposits	ML				
30		Topock - Fluvial Deposits	GW		(15.0 - 50.0') Portland Cement 5% Bentonite Type I, II and V with Hydrogel	(15.0 - 50.0') 168.6 gallons	(15.0 - 50.0') 450 gallons (267%) Note: Grout seal. Used >20% of the calculated volume due to potential voids that formed during drilling and migration into the formation.
31							
32		Topock - Fluvial Deposits	ML				
33							
34					(28.0 - 249.0') 10" Borehole		
35							
36		Topock - Fluvial Deposits	SM				
37							
38		Topock - Fluvial Deposits	SM				
39		Topock - Fluvial Deposits	SM				

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Well Construction Log

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Date Started:	10/27/2018	Surface Elevation:	529.95 ft amsl	**Well ID: MW-83-225, MW-83-245**	
Date Completed:	04/04/2019	Shallow Well Elevation:	529.80 ft amsl		
Drilling Co.:	Cascade	Deep Well Elevation:	529.65 ft amsl	Client:	PG&E
Drilling Method:	Sonic Drilling	Northing (NAD83):	2102858.77	Project:	Final GW Remedy Phase 1
Driller Name:	Dan O'Mara	Easting (NAD83):	7615264.94	Location:	PG&E Topock, Needles, California
Drilling Asst:	E. Huellmantel / J. Campbell	Borehole Diameter:	4-12 inches		
Logger:	SM / GJ / MA	Static Water Level:	See Log for Depths	Project Number:	RC000753.0051
Editor:	Sean McGrane	Development End Date:	3/29/2019		
Total Depth:	315 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
41		Topock - Fluvial Deposits	SM		(0.2 - 205.0') 2" PVC Sch 80 Casing; (0.3 - 235.0') 2" PVC Sch 80 Casing		
42							
43							
44		Topock - Fluvial Deposits	SW				
45					(15.0 - 50.0') Portland Cement 5% Bentonite Type I, II and V with Hydrogel	(15.0 - 50.0') 168.6 gallons	(15.0 - 50.0') 450 gallons (267%) Note: Grout seal. Used >20% of the calculated volume due to potential voids that formed during drilling and migration into the formation.
46							
47					(46.5 - 47.5') Centralizer		
48		Topock - Fluvial Deposits	SM				
49							
50					(28.0 - 249.0') 10" Borehole		
51							
52		Topock - Fluvial Deposits	SW-SM				
53							
54					(50.0 - 58.0') Bentonite seal chips Puregold medium chips	(50.0 - 58.0') 6.25 bags	(50.0 - 58.0') 2 bags (32%) Note: Chips to backfill potential void and reduce potential issues with heat of hydration. Used <20% of the calculated volume due to grout coating borehole walls reducing borehole diameter.
55		Topock - Fluvial Deposits	SW				
56							
57							
58							
59		Topock - Fluvial Deposits	SM		(58.0 - 66.0') Portland Cement 5% Bentonite Type I, II and V with Hydrogel	(58.0 - 66.0') 35.1 gallons	(58.0 - 66.0') 310 gallons (883%) Note: Grout seal. Used >20% of the calculated volume due to potential voids that formed from 58 to 66 ft bgs and potential grout migration into the formation.

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-83d

Well Construction Log

ARCADIS Design & Consultancy for natural and built assets

Date Started:	10/27/2018	Surface Elevation:	529.95 ft amsl	**Well ID: MW-83-225, MW-83-245**	
Date Completed:	04/04/2019	Shallow Well Elevation:	529.80 ft amsl		
Drilling Co.:	Cascade	Deep Well Elevation:	529.65 ft amsl	Client:	PG&E
Drilling Method:	Sonic Drilling	Northing (NAD83):	2102858.77	Project:	Final GW Remedy Phase 1
Driller Name:	Dan O'Mara	Easting (NAD83):	7615264.94	Location:	PG&E Topock, Needles, California
Drilling Asst:	E. Huellmantel / J. Campbell	Borehole Diameter:	4-12 inches		
Logger:	SM / GJ / MA	Static Water Level:	See Log for Depths	Project Number:	RC000753.0051
Editor:	Sean McGrane	Development End Date:	3/29/2019		
Total Depth:	315 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
61		Topock - Fluvial Deposits	SM		(0.2 - 205.0') 2" PVC Sch 80 Casing; (0.3 - 235.0') 2" PVC Sch 80 Casing		
62							
63		Topock - Fluvial Deposits	GW		(58.0 - 66.0') Portland Cement 5% Bentonite Type I, II and V with Hydrogel	(58.0 - 66.0') 35.1 gallons	(58.0 - 66.0') 310 gallons (883%) Note: Grout seal. Used >20% of the calculated volume due to potential voids that formed from 58 to 66 ft bgs and potential grout migration into the formation.
64							
65							
66		Topock - Fluvial Deposits	SM				
67							
68		Topock - Fluvial Deposits	SW-SM				
69							
70					(28.0 - 249.0') 10" Borehole		
71							
72							
73					(66.0 - 91.0') Bentonite seal chips Puregold medium chips	(66.0 - 91.0') 20.4 bags	(66.0 - 91.0') 18 bags (88%) Note: Seal between high solids bentonite grout and grout seal.
74		Topock - Fluvial Deposits	SM				
75							
76							
77	MW-L-VAS-76-81 (31 ppb) 10/6/2018 16:34						
78							
79							
		Topock -	ML				

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Well Construction Log

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Date Started:	10/27/2018	Surface Elevation:	529.95 ft amsl	**Well ID: MW-83-225, MW-83-245**	
Date Completed:	04/04/2019	Shallow Well Elevation:	529.80 ft amsl		
Drilling Co.:	Cascade	Deep Well Elevation:	529.65 ft amsl	Client:	PG&E
Drilling Method:	Sonic Drilling	Northing (NAD83):	2102858.77	Project:	Final GW Remedy Phase 1
Driller Name:	Dan O'Mara	Easting (NAD83):	7615264.94	Location:	PG&E Topock, Needles, California
Drilling Asst:	E. Huellmantel / J. Campbell	Borehole Diameter:	4-12 inches		
Logger:	SM / GJ / MA	Static Water Level:	See Log for Depths	Project Number:	RC000753.0051
Editor:	Sean McGrane	Development End Date:	3/29/2019		
Total Depth:	315 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
81		Alluvium Deposits			(0.2 - 205.0') 2" PVC Sch 80 Casing		
		Topock - Alluvium Deposits	SM		(0.3 - 235.0') 2" PVC Sch 80 Casing		
82							
83							
84		Topock - Alluvium Deposits	SM				
85					(66.0 - 91.0') Bentonite seal chips Puregold medium chips	(66.0 - 91.0') 20.4 bags	(66.0 - 91.0') 18 bags (88%) Note: Seal between high solids bentonite grout and grout seal.
86							
87							
88							
89							
90		Topock - Alluvium Deposits	SM		(28.0 - 249.0') 10" Borehole		
91							
92							
93							
94		Topock - Alluvium Deposits	ML				
		Topock - Alluvium Deposits	SM				
95					(91.0 - 201.0') Agua Guard High Solids Bentonite Grout	(91.0 - 201.0') 482.5 gallon	(91.0 - 201.0') 570.2 gallon (118%) Note: Annular seal across the screen intervals of the well in MW-83s. Grout settled 20 ft below projected depth of 71 ft bgs.
96							
97		Topock - Alluvium Deposits	ML				
98							
99							

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Well Construction Log

Sheet: 6 of 16

Date Started:	10/27/2018	Surface Elevation:	529.95 ft amsl	**Well ID: MW-83-225, MW-83-245**	
Date Completed:	04/04/2019	Shallow Well Elevation:	529.80 ft amsl		
Drilling Co.:	Cascade	Deep Well Elevation:	529.65 ft amsl	Client:	PG&E
Drilling Method:	Sonic Drilling	Northing (NAD83):	2102858.77	Project:	Final GW Remedy Phase 1
Driller Name:	Dan O'Mara	Easting (NAD83):	7615264.94	Location:	PG&E Topock, Needles, California
Drilling Asst:	E. Huellmantel / J. Campbell	Borehole Diameter:	4-12 inches		
Logger:	SM / GJ / MA	Static Water Level:	See Log for Depths	Project Number:	RC000753.0051
Editor:	Sean McGrane	Development End Date:	3/29/2019		
Total Depth:	315 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
101					(0.2 - 205.0') 2" PVC Sch 80 Casing		
102							
103							
104							
105							
106		Topock - Alluvium Deposits	ML		(0.3 - 235.0') 2" PVC Sch 80 Casing		
107					(106.5 - 107.5') Centralizer		
108	MW-L-VAS-106-111 (0.84 ppb) 10/9/2018 11:46						
109							
110					(91.0 - 201.0') Agua Guard High Solids Bentonite Grout	(91.0 - 201.0') 482.5 gallon	(91.0 - 201.0') 570.2 gallon (118%) Note: Annular seal across the screen intervals of the well in MW-83s. Grout settled 20 ft below projected depth of 71 ft bgs.
111					(28.0 - 249.0') 10" Borehole		
112							
113		Topock - Alluvium Deposits	ML				
114							
115							
116							
117		Topock - Alluvium Deposits	ML				
118							
119							

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Well Construction Log

ARCADIS Design & Consultancy for natural and built assets

Well ID: MW-83-225, MW-83-245

Date Started:	10/27/2018	Surface Elevation:	529.95 ft amsl		
Date Completed:	04/04/2019	Shallow Well Elevation:	529.80 ft amsl		
Drilling Co.:	Cascade	Deep Well Elevation:	529.65 ft amsl	Client:	PG&E
Drilling Method:	Sonic Drilling	Northing (NAD83):	2102858.77	Project:	Final GW Remedy Phase 1
Driller Name:	Dan O'Mara	Easting (NAD83):	7615264.94	Location:	PG&E Topock, Needles, California
Drilling Asst:	E. Huellmantel / J. Campbell	Borehole Diameter:	4-12 inches		
Logger:	SM / GJ / MA	Static Water Level:	See Log for Depths	Project Number:	RC000753.0051
Editor:	Sean McGrane	Development End Date:	3/29/2019		
Total Depth:	315 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
121		Topock - Alluvium Deposits	ML		(0.2 - 205.0') 2" PVC Sch 80 Casing; (0.3 - 235.0') 2" PVC Sch 80 Casing		
122							
123		Topock - Alluvium Deposits	ML				
124							
125							
126							
127		Topock - Alluvium Deposits	ML				
128							
129					(91.0 - 201.0') Agua Guard High Solids Bentonite Grout; (28.0 - 249.0') 10" Borehole	(91.0 - 201.0') 482.5 gallon	(91.0 - 201.0') 570.2 gallon (118%) Note: Annular seal across the screen intervals of the well in MW-83s. Grout settled 20 ft below projected depth of 71 ft bgs.
130							
131							
132		Topock - Alluvium Deposits	ML				
133							
134							
135							
136							
137							
138							
139							
			ML				

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Well Construction Log

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ARCADIS Design & Consultancy for natural and built assets

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Driller Name:	Dan O'Mara	Easting (NAD83):	7615264.94	Location:	PG&E Topock, Needles, California
Drilling Asst:	E. Huellmantel / J. Campbell	Borehole Diameter:	4-12 inches		
Logger:	SM / GJ / MA	Static Water Level:	See Log for Depths	Project Number:	RC000753.0051
Editor:	Sean McGrane	Development End Date:	3/29/2019		
Total Depth:	315 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
141					(0.2 - 205.0') 2" PVC Sch 80 Casing; (0.3 - 235.0') 2" PVC Sch 80 Casing		
142							
143	MW-L-VAS-141-146 (<0.033 U ppb) 10/10/2018 14:58	Topock - Alluvium Deposits	ML				
144							
145							
146							
147		Topock - Alluvium Deposits	SM				
148							
149					(91.0 - 201.0') Agua Guard High Solids Bentonite Grout; (28.0 - 249.0') 10" Borehole	(91.0 - 201.0') 482.5 gallon	(91.0 - 201.0') 570.2 gallon (118%) Note: Annular seal across the screen intervals of the well in MW-83s. Grout settled 20 ft below projected depth of 71 ft bgs.
150							
151							
152		Topock - Alluvium Deposits	SM				
153		Topock - Alluvium Deposits	GM				
154		Topock - Alluvium Deposits	SM				
155		Topock - Alluvium Deposits	ML				
156		Topock - Alluvium Deposits	GM				
157							
158		Topock - Alluvium Deposits	SM				
159							

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Well Construction Log

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Drilling Asst:	E. Huellmantel / J. Campbell	Borehole Diameter:	4-12 inches		
Logger:	SM / GJ / MA	Static Water Level:	See Log for Depths	Project Number:	RC000753.0051
Editor:	Sean McGrane	Development End Date:	3/29/2019		
Total Depth:	315 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
161		Topock - Alluvium Deposits	SM		(0.2 - 205.0') 2" PVC Sch 80 Casing; (0.3 - 235.0') 2" PVC Sch 80 Casing		
162							
163							
164		Topock - Alluvium Deposits	SM				
165							
166							
167		Topock - Alluvium Deposits	GM		(166.5 - 167.5') Centralizer		
168		Topock - Alluvium Deposits	SM				
169							
170					(91.0 - 201.0') Agua Guard High Solids Bentonite Grout; (28.0 - 249.0') 10" Borehole	(91.0 - 201.0') 482.5 gallon	(91.0 - 201.0') 570.2 gallon (118%) Note: Annular seal across the screen intervals of the well in MW-83s. Grout settled 20 ft below projected depth of 71 ft bgs.
171		Topock - Alluvium Deposits	GM				
172							
173							
174							
175		Topock - Alluvium Deposits	GM				
176							
177		Topock - Alluvium Deposits	SM				
178		Topock - Alluvium Deposits	SM				
179							

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ARCADIS Design & Consultancy for natural and built assets

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Driller Name:	Dan O'Mara	Easting (NAD83):	7615264.94	Location:	PG&E Topock, Needles, California
Drilling Asst:	E. Huellmantel / J. Campbell	Borehole Diameter:	4-12 inches		
Logger:	SM / GJ / MA	Static Water Level:	See Log for Depths	Project Number:	RC000753.0051
Editor:	Sean McGrane	Development End Date:	3/29/2019		
Total Depth:	315 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
181	MW-L-VAS-181-186 (3.3 ppb) 10/20/2018 11:06	Topock - Alluvium Deposits	SM		(0.2 - 205.0') 2" PVC Sch 80 Casing; (0.3 - 235.0') 2" PVC Sch 80 Casing		
182							
183		Topock - Alluvium Deposits	ML				
184							
185		Topock - Alluvium Deposits	SM				
186							
187		Topock - Alluvium Deposits	ML				
188							
189		Topock - Alluvium Deposits	SM		(91.0 - 201.0') Agua Guard High Solids Bentonite Grout; (28.0 - 249.0') 10" Borehole	(91.0 - 201.0') 482.5 gallon	(91.0 - 201.0') 570.2 gallon (118%) Note: Annular seal across the screen intervals of the well in MW-83s. Grout settled 20 ft below projected depth of 71 ft bgs.
190							
191							
192							
193							
194							
195							
196		Topock - Alluvium Deposits	ML				
197							
198							
199							

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-83d

Well Construction Log

Sheet: 11 of 16

Date Started:	10/27/2018	Surface Elevation:	529.95 ft amsl	**Well ID: MW-83-225, MW-83-245**	
Date Completed:	04/04/2019	Shallow Well Elevation:	529.80 ft amsl		
Drilling Co.:	Cascade	Deep Well Elevation:	529.65 ft amsl	Client:	PG&E
Drilling Method:	Sonic Drilling	Northing (NAD83):	2102858.77	Project:	Final GW Remedy Phase 1
Driller Name:	Dan O'Mara	Easting (NAD83):	7615264.94	Location:	PG&E Topock, Needles, California
Drilling Asst:	E. Huellmantel / J. Campbell	Borehole Diameter:	4-12 inches		
Logger:	SM / GJ / MA	Static Water Level:	See Log for Depths	Project Number:	RC000753.0051
Editor:	Sean McGrane	Development End Date:	3/29/2019		
Total Depth:	315 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
201		Topock - Alluvium Deposits	ML		(0.2 - 205.0') 2" PVC Sch 80 Casing; (0.3 - 235.0') 2" PVC Sch 80 Casing	(91.0 - 201.0') 482.5 gallon	
202		Topock - Alluvium Deposits	SM		(201.0 - 203.0') Bentonite seal pellets Pel-Plug (TR30) 3/8"	(201.0 - 203.0') 1.9 buckets	(201.0 - 203.0') 2.5 buckets (132%) Note: Seal between filter pack and high solids bentonite grout. Used >20% of the calculated volume due to potential voids forming during drilling.
203							
204							
205		Topock - Alluvium Deposits	ML		(205.0 - 225.0') 2" Sch 80 PVC (20-slot) Screen		
206							
207		Topock - Alluvium Deposits	GM				
208		Topock - Alluvium Deposits	GM				
209							
210					(28.0 - 249.0') 10" Borehole		
211					(203.0 - 228.5') Cemex #3 MESH (8x20) Lapis Lustre Sand	(203.0 - 228.5') 29.9 bags	(203.0 - 228.5') 29 bags (97%) Note: Filter pack
212							
213							
214							
215		Topock - Alluvium Deposits	SM				
216							
217		Topock - Alluvium Deposits	SM				
218							
219	MW-L-VAS-218-223 (66 ppb) 10/21/2018 10:50						
			GM				

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-83d

Well Construction Log

ARCADIS Design & Consultancy for natural and built assets

Well ID: MW-83-225, MW-83-245

Date Started:	10/27/2018	Surface Elevation:	529.95 ft amsl		
Date Completed:	04/04/2019	Shallow Well Elevation:	529.80 ft amsl		
Drilling Co.:	Cascade	Deep Well Elevation:	529.65 ft amsl	Client:	PG&E
Drilling Method:	Sonic Drilling	Northing (NAD83):	2102858.77	Project:	Final GW Remedy Phase 1
Driller Name:	Dan O'Mara	Easting (NAD83):	7615264.94	Location:	PG&E Topock, Needles, California
Drilling Asst:	E. Huellmantel / J. Campbell	Borehole Diameter:	4-12 inches		
Logger:	SM / GJ / MA	Static Water Level:	See Log for Depths	Project Number:	RC000753.0051
Editor:	Sean McGrane	Development End Date:	3/29/2019		
Total Depth:	315 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
221	MW-L-VAS-218-223 (66 ppb) 10/21/2018 10:50	Topock - Alluvium Deposits	GM		(205.0 - 225.0') 2" Sch 80 PVC (20-slot) Screen; (0.3 - 235.0') 2" PVC Sch 80 Casing		
222							
223							
224		Topock - Alluvium Deposits	ML		(203.0 - 228.5') Cemex #3 MESH (8x20) Lapis Lustre Sand	(203.0 - 228.5') 29.9 bags	(203.0 - 228.5') 29 bags (97%) Note: Filter pack
225							
226					(225.5 - 226.5') Centralizer		
227					(225.0 - 227.4') Sump and PVC End Cap		
228							
229					(28.0 - 249.0') 10" Borehole		
230							
231		Topock - Alluvium Deposits	ML		(228.5 - 233.0') Bentonite seal pellets Pel-Plug (TR30) 3/8"	(228.5 - 233.0') 4.4 buckets	(228.5 - 233.0') 4 buckets (91%) Note: Intermediate seal
232							
233							
234							
235					(235.0 - 245.0') 2" Sch 80 PVC (20-slot) Screen		
236							
237					(233.0 - 249.0') Cemex #3 MESH (8x20) Lapis Lustre Sand	(233.0 - 249.0') 19.5 bags	(233.0 - 249.0') 25 bags (128%) Note: Filter pack. Used >20% of the calculated volume due to potential voids forming during drilling.
238		Topock - Alluvium Deposits	ML				
239							

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-83d

Well Construction Log

Sheet: 13 of 16

Date Started:	10/27/2018	Surface Elevation:	529.95 ft amsl	**Well ID: MW-83-225, MW-83-245**	
Date Completed:	04/04/2019	Shallow Well Elevation:	529.80 ft amsl		
Drilling Co.:	Cascade	Deep Well Elevation:	529.65 ft amsl	Client:	PG&E
Drilling Method:	Sonic Drilling	Northing (NAD83):	2102858.77	Project:	Final GW Remedy Phase 1
Driller Name:	Dan O'Mara	Easting (NAD83):	7615264.94	Location:	PG&E Topock, Needles, California
Drilling Asst:	E. Huellmantel / J. Campbell	Borehole Diameter:	4-12 inches		
Logger:	SM / GJ / MA	Static Water Level:	See Log for Depths	Project Number:	RC000753.0051
Editor:	Sean McGrane	Development End Date:	3/29/2019		
Total Depth:	315 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
241		Topock - Alluvium Deposits	SM		(235.0 - 245.0') 2" Sch 80 PVC (20-slot) Screen		
242							
243							
244					(233.0 - 249.0') Cemex #3 MESH (8x20) Lapis Lustre Sand; (28.0 - 249.0') 10" Borehole	(233.0 - 249.0') 19.5 bags	(233.0 - 249.0') 25 bags (128%) Note: Filter pack. Used >20% of the calculated volume due to potential voids forming during drilling.
245					(245.5 - 246.5') Centralizer		
246							
247					(245.0 - 247.4') Sump and PVC End Cap		
248							
249		Topock - Alluvium Deposits	ML				
250							
251							
252							
253							
254					(249.0 - 266.0') Bentonite seal chips Puregold medium chips; (249.0 - 303.0') 7" Borehole	(249.0 - 266.0') 6.3 bags	(249.0 - 266.0') 8 bags (127%) Note: Used to decommission rathole. Used >20% of the calculated volume due to potential voids forming during drilling.
255							
256		Topock - Alluvium Deposits	ML				
257							
258							
259		Topock - Alluvium Deposits	ML				

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-83d

Well Construction Log

Sheet: 14 of 16

Date Started:	10/27/2018	Surface Elevation:	529.95 ft amsl	**Well ID: MW-83-225, MW-83-245**	
Date Completed:	04/04/2019	Shallow Well Elevation:	529.80 ft amsl		
Drilling Co.:	Cascade	Deep Well Elevation:	529.65 ft amsl	Client:	PG&E
Drilling Method:	Sonic Drilling	Northing (NAD83):	2102858.77	Project:	Final GW Remedy Phase 1
Driller Name:	Dan O'Mara	Easting (NAD83):	7615264.94	Location:	PG&E Topock, Needles, California
Drilling Asst:	E. Huellmantel / J. Campbell	Borehole Diameter:	4-12 inches		
Logger:	SM / GJ / MA	Static Water Level:	See Log for Depths	Project Number:	RC000753.0051
Editor:	Sean McGrane	Development End Date:	3/29/2019		
Total Depth:	315 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
261		Topock - Alluvium Deposits	ML		(249.0 - 266.0') Bentonite seal chips Puregold medium chips	(249.0 - 266.0') 6.3 bags	(249.0 - 266.0') 8 bags (127%) Note: Used to decommission rathole. Used >20% of the calculated volume due to potential voids forming during drilling.
262							
263	MW-L-VAS-261-266 (<0.17 U ppb) 10/22/2018 14:50						
264							
265							
266							
267							
268							
269							
270					(249.0 - 303.0') 7" Borehole		
271		Topock - Alluvium Deposits	ML				
272							
273					(266.0 - 308.0') 100% Portland Cement Type I, II and V	(266.0 - 308.0') 77.5 gallons	(266.0 - 308.0') 80 gallons (103%) Note: Used to decommission rathole. A section of 6-inch casing broke off downhole and was grouted in place at ~303 ft. bgs.
274							
275							
276							
277							
278							
279							

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-83d

Well Construction Log

Sheet: 15 of 16

Date Started:	10/27/2018	Surface Elevation:	529.95 ft amsl	**Well ID: MW-83-225, MW-83-245**	
Date Completed:	04/04/2019	Shallow Well Elevation:	529.80 ft amsl		
Drilling Co.:	Cascade	Deep Well Elevation:	529.65 ft amsl	Client:	PG&E
Drilling Method:	Sonic Drilling	Northing (NAD83):	2102858.77	Project:	Final GW Remedy Phase 1
Driller Name:	Dan O'Mara	Easting (NAD83):	7615264.94	Location:	PG&E Topock, Needles, California
Drilling Asst:	E. Huellmantel / J. Campbell	Borehole Diameter:	4-12 inches		
Logger:	SM / GJ / MA	Static Water Level:	See Log for Depths	Project Number:	RC000753.0051
Editor:	Sean McGrane	Development End Date:	3/29/2019		
Total Depth:	315 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
281		Topock - Alluvium Deposits	ML				
282							
283							
284							
285							
286							
287							
288							
289							
290					(266.0 - 308.0') 100% Portland Cement Type I, II and V	(266.0 - 308.0') 77.5 gallons	(266.0 - 308.0') 80 gallons (103%) Note: Used to decommission rathole. A section of 6-inch casing broke off downhole and was grouted in place at ~303 ft. bgs.
291		Topock - Weathered Bedrock - conglomerate	ML				
292							
293							
294							
295							
296							
297							
298							
299			NR		(249.0 - 303.0') 7" Borehole		

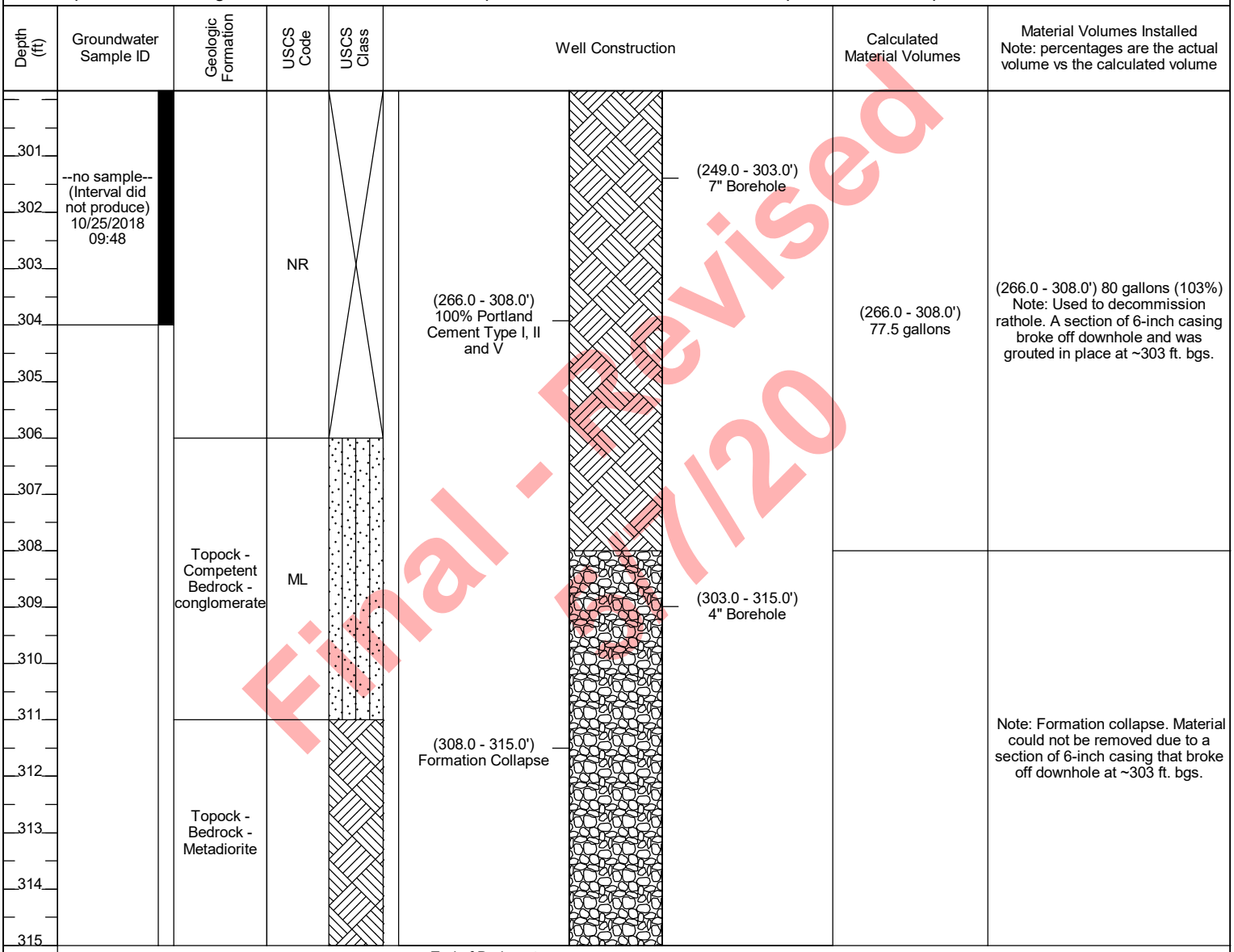
Abbreviations: USCS = Unified Soil Classification System, ft = feet, bgs = below ground surface, amsl = above mean sea level, GW = groundwater, ppb = parts per billion, U = not detected above the laboratory reporting limit, NR = no recovery; Notes: solid blue and hollow blue water table marks represent depth to water (ft. bgs.) measured post development for the shallow well and deep well respectively; installed in MW-83d

Well Construction Log

Sheet: 16 of 16

ARCADIS Design & Consultancy for natural and built assets

Date Started:	10/27/2018	Surface Elevation:	529.95 ft amsl	**Well ID: MW-83-225, MW-83-245**	
Date Completed:	04/04/2019	Shallow Well Elevation:	529.80 ft amsl		
Drilling Co.:	Cascade	Deep Well Elevation:	529.65 ft amsl	Client:	PG&E
Drilling Method:	Sonic Drilling	Northing (NAD83):	2102858.77	Project:	Final GW Remedy Phase 1
Driller Name:	Dan O'Mara	Easting (NAD83):	7615264.94	Location:	PG&E Topock, Needles, California
Drilling Asst:	E. Huellmantel / J. Campbell	Borehole Diameter:	4-12 inches		
Logger:	SM / GJ / MA	Static Water Level:	See Log for Depths	Project Number:	RC000753.0051
Editor:	Sean McGrane	Development End Date:	3/29/2019		
Total Depth:	315 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
(266.0 - 308.0') 77.5 gallons	(266.0 - 308.0') 80 gallons (103%) Note: Used to decommission rathole. A section of 6-inch casing broke off downhole and was grouted in place at ~303 ft. bgs.
	Note: Formation collapse. Material could not be removed due to a section of 6-inch casing that broke off downhole at ~303 ft. bgs.

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-83d

ARCADIS Design & Consultancy for natural and built assets

Boring Log

Sheet: 1 of 16

Date Started:	10/03/2018	Surface Elevation:	529.95 ft amsl	**Boring No.:**	**MW-83d**
Date Completed:	10/27/2018	Northing (NAD83):	2102858.77		
Drilling Co.:	Cascade	Easting (NAD83):	7615264.94	Client:	PG&E
Drilling Method:	Sonic Drilling	Total Depth:	315 ft bgs	Project:	Final GW Remedy Phase 1
Drill Rig Type:	Terrasonic Track Mount	Borehole Diameter:	4-12 inches	Location:	PG&E Topock, Needles, California
Driller Name:	Dan O'Mara	Depth to First Water:	74.7 ft bgs		
Drilling Asst:	E. Huellmantel / J. Campbell	Sampling Method:	4 inch x 10 ft. Core Barrel	Project Number:	RC000753.0051
Logger:	SM / GJ / MA	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	72	No sieve samples collected		Topock - Fluvial Deposits	SW		(0.0 - 1.5') Topock - Fluvial Deposits; Well graded sand with gravel (SW); brown (10YR 4/3); very fine grained to very coarse grained, angular to subround; some granule to large pebbles; some coarse to very coarse grained sand, subangular to subround; trace; trace boulders, angular to subangular; trace silt; dry	(0.0 - 5.0') Hand cleared for utility clearance	(0.0 - 315.0') 12800 gallons of water used; 2600 gallons of water recovered; 10200 gallons of water lost
2									
3				Topock - Fluvial Deposits	SW		(1.5 - 6.0') Topock - Fluvial Deposits; Well graded sand with gravel (SW); brown (7.5YR 4/3); very fine grained to very coarse grained, subangular to round; some granule to medium pebbles, angular to subangular; trace silt; dry		
4									
5									
6				Topock - Fluvial Deposits	SM		(6.0 - 11.0') Topock - Fluvial Deposits; Sand Silty sand (SM); brown (7.5YR 4/3); very fine grained to very coarse grained, angular to subrounded; some granule to very large pebbles, angular to subangular; some silt; trace angular; trace boulders, angular to subangular; dry		
7									
8									
9									
10									
11	120			Topock - Fluvial Deposits	SW-SM		(11.0 - 16.0') Topock - Fluvial Deposits; Well graded sand with silt and gravel (SW-SM); dark grayish brown / dark yellowish brown (10YR 4/2); very fine grained to very coarse grained, angular to subangular; some granule to large pebbles; little silt; trace angular to subangular; dry		
12									
13									
14									
15									
16				Topock - Fluvial Deposits	SW-SM		(16.0 - 21.5') Topock - Fluvial Deposits; Well graded sand with silt and gravel (SW-SM); very dark gray (10YR 3/1); very fine grained to very coarse grained, angular to subangular; some granule to very large pebbles; little silt; trace angular to subangular; dry	(16.0') Lost core barrel down hole	
17									
18	96								
19									
20									

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-83-225, MW-83-245 installed in borehole

ARCADIS Design & Consultancy for natural and built assets

Boring Log

Boring No.: MW-83d

Date Started:	10/03/2018	Surface Elevation:	529.95 ft amsl	Client:	PG&E
Date Completed:	10/27/2018	Northing (NAD83):	2102858.77	Project:	Final GW Remedy Phase 1
Drilling Co.:	Cascade	Easting (NAD83):	7615264.94	Location:	PG&E Topock, Needles, California
Drilling Method:	Sonic Drilling	Total Depth:	315 ft bgs		
Drill Rig Type:	Terrasonic Track Mount	Borehole Diameter:	4-12 inches		
Driller Name:	Dan O'Mara	Depth to First Water:	74.7 ft bgs		
Drilling Asst:	E. Huellmantel / J. Campbell	Sampling Method:	4 inch x 10 ft. Core Barrel	Project Number:	RC000753.0051
Logger:	SM / GJ / MA	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				Topock - Fluvial Deposits	SW-SM				
22				Topock - Fluvial Deposits	SM		(21.5 - 22.5') Topock - Fluvial Deposits; Silty sand with gravel (SM); dark gray (10YR 4/1); very fine grained to very coarse grained, angular to subround; some granule to very large pebbles, angular to subangular; some silt; dry		
23	96			Topock - Fluvial Deposits	GP		(22.5 - 24.0') Topock - Fluvial Deposits; Poorly graded gravel (GP); black (10YR 2/1); small cobbles to large cobbles, angular to subround; dry		
24					NR		(24.0 - 26.0') No recovery (NR); sample bags broke		
25									
26				Topock - Fluvial Deposits	ML		(26.0 - 28.0') Topock - Fluvial Deposits; Sandy silt with gravel (ML); brown (10YR 5/3); no plasticity; some very fine to very coarse grained sand, angular to subangular; little granule to very large pebbles, angular to subangular; trace angular to subangular; trace mica; dry	(26.0') Rough drilling	
27									
28	60			Topock - Fluvial Deposits	ML		(28.0 - 29.5') Topock - Fluvial Deposits; Sandy silt with gravel (ML); brown (10YR 5/3); no plasticity; and very fine to very coarse grained sand, angular to subangular; little granule to very large pebbles, angular to subangular; trace angular to subangular; trace mica; dry		
29									
30		No sieve samples collected		Topock - Fluvial Deposits	GW		(29.5 - 31.0') Topock - Fluvial Deposits; Well graded gravel with sand (GW); dark yellowish brown (10YR 4/4); granules to small cobbles, angular to subround; little very fine to coarse grained sand, subangular to subround; dry		
31									
32				Topock - Fluvial Deposits	ML		(31.0 - 34.5') Topock - Fluvial Deposits; Sandy silt with gravel (ML); brown (10YR 5/3); no plasticity; some very fine to very coarse grained sand, angular to subangular; little granule to very large pebbles, angular to subangular; trace angular to subangular; trace mica; dry	(31.0') Lost core barrel down hole	
33									
34									
35	84			Topock - Fluvial Deposits	SM		(34.5 - 38.0') Topock - Fluvial Deposits; Silty sand (SM); brown (10YR 5/3); very fine grained to fine grained, subangular to subround; and silt; dry		
36								(36.0 - 38.0') Drilled to extra two feet to collect lost core 31 to 36 ft. bgs.	
37									
38									
39	96			Topock - Fluvial Deposits	SM		(38.0 - 39.0') Topock - Fluvial Deposits; Silty sand with gravel (SM); grayish brown (2.5Y 5/2); very fine grained to very coarse grained, angular to subround; some silt; little granule to large pebbles, angular to subangular; moist		
40				Topock - Fluvial Deposits	SM		(39.0 - 43.0') Topock - Fluvial Deposits; Silty sand (SM); very dark grayish brown (2.5Y 3/2); very fine grained to coarse grained,		

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-83-225, MW-83-245 installed in borehole

ARCADIS Design & Consultancy for natural and built assets

Boring Log

Date Started:	10/03/2018	Surface Elevation:	529.95 ft amsl	**Boring No.:**	**MW-83d**
Date Completed:	10/27/2018	Northing (NAD83):	2102858.77		
Drilling Co.:	Cascade	Easting (NAD83):	7615264.94	Client:	PG&E
Drilling Method:	Sonic Drilling	Total Depth:	315 ft bgs	Project:	Final GW Remedy Phase 1
Drill Rig Type:	Terrasonic Track Mount	Borehole Diameter:	4-12 inches	Location:	PG&E Topock, Needles, California
Driller Name:	Dan O'Mara	Depth to First Water:	74.7 ft bgs		
Drilling Asst:	E. Huellmantel / J. Campbell	Sampling Method:	4 inch x 10 ft. Core Barrel	Project Number:	RC000753.0051
Logger:	SM / GJ / MA	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				Topock - Fluvial Deposits	SM		angular to subangular; and silt; trace granule to medium pebbles, angular to subangular; trace clay; moist		
42									
43	96								
44				Topock - Fluvial Deposits	SW		(43.0 - 46.0') Topock - Fluvial Deposits; Well graded sand (SW); brown (7.5YR 5/3); very fine grained to very coarse grained, subangular to subround; trace granule to very large pebbles, angular to subround; trace subround; trace silt; dry		
45									
46									
47				Topock - Fluvial Deposits	SM		(46.0 - 51.5') Topock - Fluvial Deposits; Silty sand with gravel (SM); brown (10YR 4/3); very fine grained to very coarse grained, subangular to subround; little granule to very large pebbles, subangular to subround; little silt; trace subangular to subround; trace clay; trace mica; dry; gravel coarsening downward in formation		
48									
49									
50		No sieve samples collected							
51	120								
52				Topock - Fluvial Deposits	SW-SM		(51.5 - 52.0') Topock - Fluvial Deposits; Well graded sand with silt (SW-SM); brown (10YR 5/3); very fine grained to medium grained, angular to subround; trace silt; little mica; dry		
53				Topock - Fluvial Deposits	SW		(52.0 - 59.0') Topock - Fluvial Deposits; Well graded sand with gravel (SW); very dark grayish brown (10YR 3/2); very fine grained to very coarse grained, angular to subangular; and granule to very large pebbles, subangular to round; trace subangular to subround; some mica; dry		
54									
55									
56									
57									
58	120								
59									
60				Topock - Fluvial Deposits	SM		(59.0 - 62.0') Topock - Fluvial Deposits; Silty sand (SM); brown (10YR 5/3); very fine grained to very coarse grained, angular to subround; little silt; little clay; trace granule to large pebbles,		

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ARCADIS Design & Consultancy for natural and built assets

Boring Log

Boring No.: MW-83d

Date Started:	10/03/2018	Surface Elevation:	529.95 ft amsl	Client:	PG&E
Date Completed:	10/27/2018	Northing (NAD83):	2102858.77	Project:	Final GW Remedy Phase 1
Drilling Co.:	Cascade	Easting (NAD83):	7615264.94	Location:	PG&E Topock, Needles, California
Drilling Method:	Sonic Drilling	Total Depth:	315 ft bgs		
Drill Rig Type:	Terrasonic Track Mount	Borehole Diameter:	4-12 inches		
Driller Name:	Dan O'Mara	Depth to First Water:	74.7 ft bgs		
Drilling Asst:	E. Huellmantel / J. Campbell	Sampling Method:	4 inch x 10 ft. Core Barrel	Project Number:	RC000753.0051
Logger:	SM / GJ / MA	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 - Fluvial Deposits	SM		angular to subround; dry		
62									
63	120			Topock - Fluvial Deposits	GW		(62.0 - 65.5') Topock - Fluvial Deposits; Well graded gravel with sand (GW); light brownish gray / pale yellowish brown (10YR 6/2); granules to small cobbles, angular to subround; little very fine to very coarse grained sand, angular to subround; trace boulders, angular to subangular; dry		
64									
65									
66				Topock - Fluvial Deposits	SM		(65.5 - 67.0') Topock - Fluvial Deposits; Silty sand with gravel (SM); dark grayish brown / dark yellowish brown (10YR 4/2); very fine grained to very coarse grained, angular to subround; little granule to large pebbles, angular to subangular; little silt; little clay; trace angular; dry		
67				Topock - Fluvial Deposits	SW-SM		(67.0 - 69.0') Topock - Fluvial Deposits; Well graded gravel with silt (SW-SM); light brownish gray / pale yellowish brown (10YR 6/2); very fine grained to very coarse grained, angular to subangular; little silt; trace granule to medium pebbles, subangular to round; dry		
68									
69									
70		No sieve samples collected		Topock - Fluvial Deposits	SM		(69.0 - 79.5') Topock - Fluvial Deposits; Silty sand with gravel (SM); brown (7.5YR 5/3); fine grained to very coarse grained, subangular to subround; little granule to very large pebbles, subangular to round; little silt; trace angular to subangular; trace boulders, subangular to well-round; little mica; dry		
71	120								
72									
73							(72.5') olive / moderate olive brown (5Y 4/4); some granule to very large pebbles		
74							(74') dark grayish brown / dark yellowish brown (10YR 4/2)		
75							(75') dark brown (7.5YR 3/4); moist		
76							(76') brown (7.5YR 4/3); and granule to very large pebbles, subangular to round; little silt; trace subangular to round; wet; water table	(76.0') Approximate depth of water table	
77									
78	120		MW-L-VAS-76-81 (31 ppb) 10/6/2018 16:34						
79									
80				Topock -	ML		(79.5 - 80.0') Topock - Alluvium Deposits; Sandy silt with gravel		

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Boring Log

ARCADIS Design & Consultancy for natural and built assets

Boring No.: MW-83d

Date Started:	10/03/2018	Surface Elevation:	529.95 ft amsl	Client:	PG&E
Date Completed:	10/27/2018	Northing (NAD83):	2102858.77	Project:	Final GW Remedy Phase 1
Drilling Co.:	Cascade	Easting (NAD83):	7615264.94	Location:	PG&E Topock, Needles, California
Drilling Method:	Sonic Drilling	Total Depth:	315 ft bgs		
Drill Rig Type:	Terrasonic Track Mount	Borehole Diameter:	4-12 inches		
Driller Name:	Dan O'Mara	Depth to First Water:	74.7 ft bgs		
Drilling Asst:	E. Huellmantel / J. Campbell	Sampling Method:	4 inch x 10 ft. Core Barrel	Project Number:	RC000753.0051
Logger:	SM / GJ / MA	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				Alluvium Deposits			(ML); reddish brown (2.5YR 4/3) with reddish brown (5YR 5/3); no plasticity; some very fine to very coarse grained sand, subangular to subround; little granule to very large pebbles, subround to round; wet		
82				Topock - Alluvium Deposits	SM		(80.0 - 82.5') 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; some granule to large pebbles, angular to subround; some silt; wet		
83	120						(82.5 - 86.0') Topock - Alluvium Deposits; Silty sand (SM); grayish brown (10YR 5/2); very fine grained to very coarse grained, angular to subangular; and silt; trace granule to very large pebbles, angular to subangular; trace angular; trace clay; some caliche; dry; strong cementation		
84				Topock - Alluvium Deposits	SM				
85									
86							(86.0 - 93.5') 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; some silt; little granule to very large pebbles, angular to subangular; little clay; moist; moderate cementation		
87									
88									
89									
90		No sieve samples collected		Topock - Alluvium Deposits	SM		(89.5'); decrease in granules to large pebbles, increase in silt		
91	120								
92									
93									
94				Topock - Alluvium Deposits	ML		(93.5 - 94.0') Topock - Alluvium Deposits; Sandy silt with gravel (ML); grayish brown (2.5Y 5/2); no plasticity; some very fine to very coarse grained sand, angular to subround; little granule to large pebbles, angular to subround; little silt; little clay; wet; weak cementation		
95				Topock - Alluvium Deposits	SM		(94.0 - 95.0') 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; some silt; little granule to large pebbles, angular to subangular; little clay; trace angular to subangular; moist; moderate cementation		
96									
97				Topock - Alluvium Deposits	ML		(95.0 - 112.0') Topock - Alluvium Deposits; Sandy silt with gravel (ML); grayish brown (2.5Y 5/2); no plasticity; some very fine to very coarse grained sand, angular to subangular; little granule to very large pebbles, angular to subangular; trace clay; trace mica; wet; strong cementation		
98	234						(96'); moist to dry; iron oxide staining; increase in granules to very large pebbles, decrease in sand, increase in silt, decrease in clay		
99									
100									

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ARCADIS Design & Consultancy for natural and built assets

Boring Log

Boring No.: MW-83d

Date Started:	10/03/2018	Surface Elevation:	529.95 ft amsl	Client:	PG&E
Date Completed:	10/27/2018	Northing (NAD83):	2102858.77	Project:	Final GW Remedy Phase 1
Drilling Co.:	Cascade	Easting (NAD83):	7615264.94	Location:	PG&E Topock, Needles, California
Drilling Method:	Sonic Drilling	Total Depth:	315 ft bgs		
Drill Rig Type:	Terrasonic Track Mount	Borehole Diameter:	4-12 inches		
Driller Name:	Dan O'Mara	Depth to First Water:	74.7 ft bgs		
Drilling Asst:	E. Huellmantel / J. Campbell	Sampling Method:	4 inch x 10 ft. Core Barrel	Project Number:	RC000753.0051
Logger:	SM / GJ / MA	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									
102									
103									
104									
105									
106				Topock - Alluvium Deposits	ML		(106'); wet; moderate cementation; iron oxide staining; decrease in granules to large pebbles, increase in sand		
107							(107'); moist to dry; strong cementation; iron oxide staining; increase in granules to large pebbles, decrease in sand		
108	234		MW-L-VAS-106-111 (0.84 ppb) 10/9/2018 11:46						
109									
110		No sieve samples collected							
111									
112				Topock - Alluvium Deposits	ML		(112.0 - 114.0') Topock - Alluvium Deposits; Sandy silt with gravel (ML); brown (10YR 5/3) little dark reddish brown (2.5YR 3/4); no plasticity; some granule to very large pebbles, angular to subangular; some very fine to very coarse grained sand, angular to subangular; trace clay; trace mica; little caliche; moist to dry; strong cementation; iron oxide staining		
113									
114									
115				Topock - Alluvium Deposits	ML		(114.0 - 121.0') Topock - Alluvium Deposits; Sandy silt with gravel (ML); grayish brown (2.5Y 5/2); no plasticity; some very fine to very coarse grained sand, angular to subangular; little granule to very large pebbles, angular to subangular; trace clay; trace mica; with caliche; moist; moderate cementation; iron oxide staining		
116									
117							(116') brown (10YR 4/3); no caliche; iron oxide staining		
118	108								
119									
120									

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Date Started:	10/03/2018	Surface Elevation:	529.95 ft amsl	**Boring No.:**	**MW-83d**
Date Completed:	10/27/2018	Northing (NAD83):	2102858.77		
Drilling Co.:	Cascade	Easting (NAD83):	7615264.94	Client:	PG&E
Drilling Method:	Sonic Drilling	Total Depth:	315 ft bgs	Project:	Final GW Remedy Phase 1
Drill Rig Type:	Terrasonic Track Mount	Borehole Diameter:	4-12 inches	Location:	PG&E Topock, Needles, California
Driller Name:	Dan O'Mara	Depth to First Water:	74.7 ft bgs		
Drilling Asst:	E. Huellmantel / J. Campbell	Sampling Method:	4 inch x 10 ft. Core Barrel	Project Number:	RC000753.0051
Logger:	SM / GJ / MA	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	ML				
122							(121.0 - 126.0') Topock - Alluvium Deposits; Sandy silt with gravel (ML); brown (10YR 4/3) and reddish brown / moderate brown (5YR 4/4); no plasticity; some granule to very large pebbles, angular to subangular; some very fine to very coarse grained sand, angular to subangular; trace mica; trace caliche; moist; strong cementation; iron oxide staining		
123	108			Topock - Alluvium Deposits	ML				
124									
125									
126									
127				Topock - Alluvium Deposits	ML		(126.0 - 131.0') Topock - Alluvium Deposits; Sandy silt with gravel (ML); dark grayish brown / dark yellowish brown (10YR 4/2); no plasticity; some granule to very large pebbles, angular to subangular; some very fine to very coarse grained sand, angular to subangular; trace clay; little mica; moist; weak cementation; iron oxide staining		
128									
129									
130		No sieve samples collected							
131									
132				Topock - Alluvium Deposits	ML		(131.0 - 139.5') Topock - Alluvium Deposits; Sandy silt with gravel (ML); dark yellowish brown (10YR 4/4); no plasticity; some very fine to very coarse grained sand, angular to subangular; little granule to large pebbles, angular to subangular; little clay; little mica; wet; iron oxide staining (132'); some granule to large pebbles, angular to subangular; trace clay; iron oxide staining; decrease sand, increase silt		
133	182.4								
134									
135									
136							(136'); iron oxide staining; increase gravel, decrease silt		
137									
138									
139									
140					ML		(139.5 - 146.0') Topock - Alluvium Deposits; Gravelly silt with sand		

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ARCADIS Design & Consultancy for natural and built assets

Boring Log

Date Started:	10/03/2018	Surface Elevation:	529.95 ft amsl	**Boring No.:**	**MW-83d**
Date Completed:	10/27/2018	Northing (NAD83):	2102858.77		
Drilling Co.:	Cascade	Easting (NAD83):	7615264.94	Client:	PG&E
Drilling Method:	Sonic Drilling	Total Depth:	315 ft bgs	Project:	Final GW Remedy Phase 1
Drill Rig Type:	Terrasonic Track Mount	Borehole Diameter:	4-12 inches	Location:	PG&E Topock, Needles, California
Driller Name:	Dan O'Mara	Depth to First Water:	74.7 ft bgs		
Drilling Asst:	E. Huellmantel / J. Campbell	Sampling Method:	4 inch x 10 ft. Core Barrel	Project Number:	RC000753.0051
Logger:	SM / GJ / MA	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							(ML); brown (10YR 4/3); no plasticity; some granule to very large pebbles, angular to subangular; some very fine to very coarse grained sand, angular to subangular; trace mica; wet; iron oxide staining		
142									
143	182.4		MW-L-VAS-141-146 (<0.033 U ppb) 10/10/2018 14:58	Topock - Alluvium Deposits	ML				
144									
145									
146									
147							(146.0 - 151.0') Topock - Alluvium Deposits; Sandy silt with gravel (SM); dark grayish brown / dark yellowish brown (10YR 4/2); very fine grained to very coarse grained, angular to subangular; some granule to very large pebbles, angular to subangular; some very fine to very coarse grained sand, angular to subangular; little silt; trace angular; trace mica; dry; weak cementation	(146.0') Seepage from outside conductor casing, pull 6" casing and 7" conductor casing and install 12" conductor casing.	
148									
149				Topock - Alluvium Deposits	SM				
150		No sieve samples collected							
151	120								
152				Topock - Alluvium Deposits	SM		(151.0 - 153.0') Topock - Alluvium Deposits; Silty sand with gravel (SM); brown (10YR 4/3); very fine grained to very coarse grained, angular to subround; some granule to very large pebbles, angular to subangular; some silt; little clay; trace angular; trace mica; wet; weak cementation; iron oxide staining		
153									
154				Topock - Alluvium Deposits	GM		(153.0 - 154.0') Topock - Alluvium Deposits; Silty gravel with sand (GM); brown (10YR 4/3); granules to very large pebbles, angular to subangular; some very fine to very coarse grained sand, angular to subangular; some silt; trace mica; moist; weak cementation; iron oxide staining		
155				Topock - Alluvium Deposits	SM		(154.0 - 155.0') Topock - Alluvium Deposits; Silty sand with gravel (SM); brown (10YR 4/3); very fine grained to very coarse grained, angular to subround; some granule to very large pebbles, angular to subangular; some silt; little clay; trace angular; trace mica; wet; moderate cementation; iron oxide staining		
156				Topock - Alluvium Deposits	ML				
157				Topock - Alluvium Deposits	GM		(155.0 - 156.0') Topock - Alluvium Deposits; Sandy silt with gravel (ML); brown (10YR 4/3); low plasticity; some granule to very large pebbles, angular to subangular; some very fine to very coarse grained sand, angular to subangular; little clay; trace mica; moist; strong cementation; iron oxide staining	(156.0') Refill casing with 110 gallons after sampling from 261-266ft bgs.	
158	120			Topock - Alluvium Deposits	SM		(156.0 - 157.0') Topock - Alluvium Deposits; Silty gravel with sand (GM); brown (10YR 4/3); granules to very large pebbles, angular to subangular; some very fine to very coarse grained sand, angular to subangular; little silt; little clay; trace mica; wet; weak cementation; iron oxide staining		
159									
160							(157.0 - 163.0') Topock - Alluvium Deposits; Silty sand with gravel (SM); brown (10YR 4/3); very fine grained to very coarse grained, angular to subround; some granule to very large pebbles, angular		

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ARCADIS Design & Consultancy for natural and built assets

Boring Log

Date Started:	10/03/2018	Surface Elevation:	529.95 ft amsl	**Boring No.:**	**MW-83d**
Date Completed:	10/27/2018	Northing (NAD83):	2102858.77		
Drilling Co.:	Cascade	Easting (NAD83):	7615264.94	Client:	PG&E
Drilling Method:	Sonic Drilling	Total Depth:	315 ft bgs	Project:	Final GW Remedy Phase 1
Drill Rig Type:	Terrasonic Track Mount	Borehole Diameter:	4-12 inches	Location:	PG&E Topock, Needles, California
Driller Name:	Dan O'Mara	Depth to First Water:	74.7 ft bgs		
Drilling Asst:	E. Huellmantel / J. Campbell	Sampling Method:	4 inch x 10 ft. Core Barrel	Project Number:	RC000753.0051
Logger:	SM / GJ / MA	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				Topock - Alluvium Deposits	SM		to subangular; some silt; little clay; trace mica; moist; strong cementation; iron oxide staining		
162									
163	120								
164				Topock - Alluvium Deposits	SM		(163.0 - 166.0') Topock - Alluvium Deposits; Silty sand with gravel (SM); reddish brown (5YR 5/4); very fine grained to very coarse grained, angular to subangular; some granule to very large pebbles, angular to subangular; some silt; little clay; little mica; wet; weak cementation; iron oxide staining		
165									
166				Topock - Alluvium Deposits	GM		(166.0 - 167.5') Topock - Alluvium Deposits; Silty gravel with sand (GM); brown (10YR 4/3); granules to boulders, angular to subangular; some very fine to very coarse grained sand, angular to subangular; little silt; little clay; some mica; wet; strong cementation; iron oxide staining		
167									
168				Topock - Alluvium Deposits	SM		(167.5 - 170.0') Topock - Alluvium Deposits; Silty sand with gravel (SM); brown (10YR 4/3); very fine grained to very coarse grained, angular to subround; some granule to very large pebbles, angular to subangular; some silt; little clay; trace mica; wet; strong cementation; iron oxide staining		
169									
170		No sieve samples collected							
171	120			Topock - Alluvium Deposits	GM		(170.0 - 174.0') Topock - Alluvium Deposits; Silty gravel with sand (GM); brown (10YR 5/3); granules to boulders, angular to subangular; some very fine to very coarse grained sand, angular to subangular; little silt; trace clay; some mica; wet; strong cementation; iron oxide staining		
172									
173									
174									
175				Topock - Alluvium Deposits	GM		(174.0 - 176.0') Topock - Alluvium Deposits; Silty gravel with sand (GM); dark grayish brown / dark yellowish brown (10YR 4/2); granules to very large pebbles, angular to subangular; some very fine to very coarse grained sand, angular to subangular; some silt; little clay; some mica; wet; strong cementation		
176									
177				Topock - Alluvium Deposits	SM		(176.0 - 177.5') Topock - Alluvium Deposits; Silty sand with gravel (SM); brown (7.5YR 5/3); very fine grained to very coarse grained, angular to subangular; some small to very large pebbles, angular to subangular; some silt; little clay; little mica; wet; strong cementation; iron oxide staining		
178	134.4								
179				Topock - Alluvium Deposits	SM		(177.5 - 181.5') Topock - Alluvium Deposits; Silty sand with gravel (SM); brown (7.5YR 5/3); very fine grained to very coarse grained, angular to subangular; some silt; little small to very large pebbles, angular to subangular; trace clay; little mica; wet; moderate cementation; iron oxide staining		
180									

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Boring Log

Boring No.: MW-83d

Date Started:	10/03/2018	Surface Elevation:	529.95 ft amsl	Client:	PG&E
Date Completed:	10/27/2018	Northing (NAD83):	2102858.77	Project:	Final GW Remedy Phase 1
Drilling Co.:	Cascade	Easting (NAD83):	7615264.94	Location:	PG&E Topock, Needles, California
Drilling Method:	Sonic Drilling	Total Depth:	315 ft bgs		
Drill Rig Type:	Terrasonic Track Mount	Borehole Diameter:	4-12 inches		
Driller Name:	Dan O'Mara	Depth to First Water:	74.7 ft bgs		
Drilling Asst:	E. Huellmantel / J. Campbell	Sampling Method:	4 inch x 10 ft. Core Barrel	Project Number:	RC000753.0051
Logger:	SM / GJ / MA	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				Topock - Alluvium Deposits	SM				
182				Topock - Alluvium Deposits	ML		(181.5 - 184.5') Topock - Alluvium Deposits; Sandy silt with gravel (ML); brown (10YR 5/3); medium plasticity; some granule to very large pebbles, angular to subangular; some very fine to very coarse grained sand, angular to subround; wet; iron oxide staining		
183	134.4		MW-L-VAS-181-186 (3.3 ppb) 10/20/2018 11:06						
184									
185				Topock - Alluvium Deposits	SM		(184.5 - 186.5') Topock - Alluvium Deposits; Silty sand with gravel (SM); brown (10YR 5/3); very fine grained to very coarse grained, angular to subround; some small to very large pebbles, angular to subangular; some silt; trace clay; some mica; wet; weak cementation; iron oxide staining		
186									
187				Topock - Alluvium Deposits	ML		(186.5 - 188.5') Topock - Alluvium Deposits; Sandy silt with gravel (ML); brown (7.5YR 4/3); no plasticity; some granule to very large pebbles, angular to subangular; some very fine to very coarse grained sand, angular to subangular; little clay; moist; strong cementation; iron oxide staining		
188									
189				Topock - Alluvium Deposits	SM		(188.5 - 195.0') Topock - Alluvium Deposits; Silty sand with gravel (SM); brown (7.5YR 5/4); very fine grained to very coarse grained, angular to subangular; some granule to very large pebbles, angular to subangular; some silt; little clay; some mica; dry to moist; strong cementation; iron oxide staining		
190		No sieve samples collected							
191									
192									
193									
194									
195									
196				Topock - Alluvium Deposits	ML		(195.0 - 201.0') Topock - Alluvium Deposits; Sandy silt with gravel (ML); reddish brown / moderate brown (5YR 4/4) and brown (10YR 4/3); low plasticity; some granule to very large pebbles, angular to subangular; some very fine to very coarse grained sand, angular to subangular; trace clay; some mica; wet; stiff; mottled; weak cementation; iron oxide staining		
197									
198	120								
199									
200									

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Boring Log

ARCADIS Design & Consultancy for natural and built assets

Date Started:	10/03/2018	Surface Elevation:	529.95 ft amsl	**Boring No.:**	**MW-83d**
Date Completed:	10/27/2018	Northing (NAD83):	2102858.77		
Drilling Co.:	Cascade	Easting (NAD83):	7615264.94	Client:	PG&E
Drilling Method:	Sonic Drilling	Total Depth:	315 ft bgs	Project:	Final GW Remedy Phase 1
Drill Rig Type:	Terrasonic Track Mount	Borehole Diameter:	4-12 inches	Location:	PG&E Topock, Needles, California
Driller Name:	Dan O'Mara	Depth to First Water:	74.7 ft bgs		
Drilling Asst:	E. Huellmantel / J. Campbell	Sampling Method:	4 inch x 10 ft. Core Barrel	Project Number:	RC000753.0051
Logger:	SM / GJ / MA	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				Topock - Alluvium Deposits	ML				
202				Topock - Alluvium Deposits	SM		(201.0 - 205.0') Topock - Alluvium Deposits; Silty sand with gravel (SM); brown (10YR 5/3); very fine grained to very coarse grained, angular to subround; some granule to very large pebbles, angular to subround; some silt; trace clay; some mica; dry to moist; moderate cementation; iron oxide staining		
203	120								
204									
205				Topock - Alluvium Deposits	ML		(205.0 - 206.5') Topock - Alluvium Deposits; Sandy silt with gravel (ML); brown (10YR 5/3) and reddish brown / moderate brown (5YR 4/4); no plasticity; some granule to very large pebbles; some very fine to very coarse grained sand, angular to subangular; trace clay; little mica; wet; medium stiff; mottled; weak cementation; iron oxide staining		
206									
207				Topock - Alluvium Deposits	GM		(206.5 - 208.0') Topock - Alluvium Deposits; Silty gravel with sand (GM); dark grayish brown / dark yellowish brown (10YR 4/2); granules to very large pebbles, angular to subangular; some silt; little very fine to very coarse grained sand, angular to subangular; little clay; trace mica; moist; moderate cementation; iron oxide staining		
208									
209				Topock - Alluvium Deposits	GM		(208.0 - 215.0') Topock - Alluvium Deposits; Silty gravel with sand (GM); dark grayish brown / dark yellowish brown (10YR 4/2); granules to very large pebbles, angular to subangular; no plasticity; some very fine to very coarse grained sand, angular to subangular; some silt; little clay; trace mica; moist; moderate cementation; iron oxide staining		
210		No sieve samples collected							
211	133.2								
212									
213									
214									
215									
216				Topock - Alluvium Deposits	SM		(215.0 - 216.0') Topock - Alluvium Deposits; Silty sand with gravel (SM); brown (7.5YR 4/4) and reddish brown (5YR 5/4); very fine grained to very coarse grained, angular to subangular; some granule to very large pebbles, angular to subangular; some silt; trace mica; moist; mottled; weak cementation; iron oxide staining	(216.0') Driller's observed some heaving when tagging depths during reaming with 10-inch casing.	
217				Topock - Alluvium Deposits	SM		(216.0 - 219.5') Topock - Alluvium Deposits; Silty sand with gravel (SM); reddish brown / moderate brown (5YR 4/4); very fine grained to very coarse grained, angular to subangular; some granule to very large pebbles, angular to subangular; some silt; little mica; wet; iron oxide staining		
218	111.6								
219			MW-L-VAS-218-223 (66 ppb) 10/21/2018 10:50						
220					GM		(219.5 - 222.0') Topock - Alluvium Deposits; Silty gravel with sand		

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ARCADIS Design & Consultancy for natural and built assets

Boring Log

Boring No.: MW-83d

Date Started:	10/03/2018	Surface Elevation:	529.95 ft amsl	Client:	PG&E
Date Completed:	10/27/2018	Northing (NAD83):	2102858.77	Project:	Final GW Remedy Phase 1
Drilling Co.:	Cascade	Easting (NAD83):	7615264.94	Location:	PG&E Topock, Needles, California
Drilling Method:	Sonic Drilling	Total Depth:	315 ft bgs		
Drill Rig Type:	Terrasonic Track Mount	Borehole Diameter:	4-12 inches		
Driller Name:	Dan O'Mara	Depth to First Water:	74.7 ft bgs		
Drilling Asst:	E. Huellmantel / J. Campbell	Sampling Method:	4 inch x 10 ft. Core Barrel	Project Number:	RC000753.0051
Logger:	SM / GJ / MA	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
221		No sieve samples collected	MW-L-VAS-218-223 (66 ppb) 10/21/2018 10:50	Topock - Alluvium Deposits	GM		(GM); reddish brown / moderate brown (5YR 4/4); granules to very large pebbles, angular to subangular; some very fine to very coarse grained sand, angular to subround; some silt; little mica; wet; iron oxide staining		
222									
223	111.6			Topock - Alluvium Deposits	ML		(222.0 - 227.5') Topock - Alluvium Deposits; Sandy silt with gravel (ML); reddish brown (5YR 5/4) with gray / light olive gray (5Y 6/1); no plasticity; some granule to very large pebbles, angular to subangular; some very fine to very coarse grained sand, angular to subangular; trace clay; little mica; moist; stiff to very stiff; mottled; moderate cementation; iron oxide staining		
224									
225									
226									
227									
228				Topock - Alluvium Deposits	ML		(227.5 - 236.0') Topock - Alluvium Deposits; Sandy silt with gravel (ML); reddish brown (5YR 5/4); no plasticity; some granules to very large pebbles, angular to subangular; some very fine to very coarse grained sand, angular to subangular; little clay; little mica; moist; stiff to very stiff; moderate cementation; iron oxide staining		
229									
230							(230') yellowish red (5YR 4/6); dry; very stiff; strong cementation; iron oxide staining		
231	120								
232									
233									
234							(233.5'); trace clay; iron oxide staining; increase in sand and silt		
235									
236									
237				Topock - Alluvium Deposits	ML		(236.0 - 240.0') Topock - Alluvium Deposits; Sandy silt with gravel (ML); reddish brown (5YR 5/4); no plasticity; some granule to very large pebbles, angular to subangular; some very fine to very coarse grained sand, angular to subangular; trace subangular; trace clay; little mica; moist to wet; weak cementation; iron oxide staining		
238	120								
239									
240									

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Boring Log

ARCADIS Design & Consultancy for natural and built assets

Boring No.: MW-83d

Date Started:	10/03/2018	Surface Elevation:	529.95 ft amsl	Client:	PG&E
Date Completed:	10/27/2018	Northing (NAD83):	2102858.77	Project:	Final GW Remedy Phase 1
Drilling Co.:	Cascade	Easting (NAD83):	7615264.94	Location:	PG&E Topock, Needles, California
Drilling Method:	Sonic Drilling	Total Depth:	315 ft bgs		
Drill Rig Type:	Terrasonic Track Mount	Borehole Diameter:	4-12 inches		
Driller Name:	Dan O'Mara	Depth to First Water:	74.7 ft bgs		
Drilling Asst:	E. Huellmantel / J. Campbell	Sampling Method:	4 inch x 10 ft. Core Barrel	Project Number:	RC000753.0051
Logger:	SM / GJ / MA	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
241				Topock - Alluvium Deposits	SM		(240.0 - 244.0') Topock - Alluvium Deposits; Silty sand with gravel (SM); reddish brown / moderate brown (5YR 4/4); very fine grained to very coarse grained, angular to subangular; some granule to very large pebbles, angular to subround; some silt; trace subangular; little mica; wet; iron oxide staining		
242									
243	120								
244									
245				Topock - Alluvium Deposits	ML		(244.0 - 254.0') Topock - Alluvium Deposits; Sandy silt with gravel (ML); reddish brown / moderate brown (5YR 4/4); no plasticity; some granule to very large pebbles, angular to subangular; some very fine to very coarse grained sand, angular to subangular; little mica; moist to wet; medium stiff to stiff; iron oxide staining		
246		No sieve samples collected							
247									
248									
249									
250									
251	114								
252									
253									
254									
255				Topock - Alluvium Deposits	ML		(254.0 - 258.0') Topock - Alluvium Deposits; Sandy silt with gravel (ML); reddish brown / moderate brown (5YR 4/4); no plasticity; some granule to very large pebbles, angular to subangular; some very fine to very coarse grained sand, angular to subangular; trace angular; trace clay; little mica; moist; medium stiff to stiff; weak cementation; iron oxide staining		
256									
257									
258	108								
259				Topock - Alluvium Deposits	ML		(258.0 - 262.5') Topock - Alluvium Deposits; Sandy silt with gravel (ML); reddish brown / moderate brown (5YR 4/4); medium plasticity; some granule to very large pebbles, angular to subangular; some very fine to very coarse grained sand, angular to subangular; little clay; little mica; moist; medium stiff to stiff; weak cementation; iron oxide staining		
260									

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Boring Log

Date Started:	10/03/2018	Surface Elevation:	529.95 ft amsl	**Boring No.:**	**MW-83d**
Date Completed:	10/27/2018	Northing (NAD83):	2102858.77		
Drilling Co.:	Cascade	Easting (NAD83):	7615264.94	Client:	PG&E
Drilling Method:	Sonic Drilling	Total Depth:	315 ft bgs	Project:	Final GW Remedy Phase 1
Drill Rig Type:	Terrasonic Track Mount	Borehole Diameter:	4-12 inches	Location:	PG&E Topock, Needles, California
Driller Name:	Dan O'Mara	Depth to First Water:	74.7 ft bgs		
Drilling Asst:	E. Huellmantel / J. Campbell	Sampling Method:	4 inch x 10 ft. Core Barrel	Project Number:	RC000753.0051
Logger:	SM / GJ / MA	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
261				Topock - Alluvium Deposits	ML		(261'); dry to moist; moderate cementation	(261.0 - 266.0') Sample collected with a disposable bailer	
262									
263	108		MW-L-VAS-261-266 (<0.17 U ppb) 10/22/2018 14:50				(262.5 - 283.0') Topock - Alluvium Deposits; Sandy silt with gravel (ML); dark reddish brown (2.5YR 3/4); medium plasticity; some granule to very large pebbles, angular to subangular; some very fine to very coarse grained sand, angular to subangular; little clay; little mica; wet; medium stiff; iron oxide staining		
264									
265									
266									
267									
268							(268'); some clay; little granule to very large pebbles, angular to subangular; little very fine to very coarse grained sand, angular to subangular; moist; stiff; weak cementation		
269									
270		No sieve samples collected							
271	138			Topock - Alluvium Deposits	ML				
272									
273									
274									
275									
276									
277									
278	120								
279									
280									

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Boring Log

ARCADIS Design & Consultancy for natural and built assets

Boring No.: MW-83d

Date Started:	10/03/2018	Surface Elevation:	529.95 ft amsl
Date Completed:	10/27/2018	Northing (NAD83):	2102858.77
Drilling Co.:	Cascade	Easting (NAD83):	7615264.94
Drilling Method:	Sonic Drilling	Total Depth:	315 ft bgs
Drill Rig Type:	Terrasonic Track Mount	Borehole Diameter:	4-12 inches
Driller Name:	Dan O'Mara	Depth to First Water:	74.7 ft bgs
Drilling Asst:	E. Huellmantel / J. Campbell	Sampling Method:	4 inch x 10 ft. Core Barrel
Logger:	SM / GJ / MA	Sampling Interval:	Continuous
Editor:	Sean McGrane	Converted to Well:	☒ Yes ☐ No

Client: PG&E
Project: Final GW Remedy Phase 1
Location: PG&E Topock, Needles, California
Project Number: RC000753.0051

Depth (ft)	Recovery (in)	Sieve Sample ID	Groundwater Sample ID	Geologic Formation	USCS Code	USCS Class	Soil Description	Drilling Notes	Drilling Fluid
281				Topock - Alluvium Deposits	ML				
282									
283	120						(283.0 - 299.0') Topock - Weathered Bedrock - conglomerate; Gravelly silt with sand (ML); reddish brown / moderate brown (5YR 4/4); medium plasticity; some granule to very large pebbles, angular to subangular; little very fine to very coarse grained sand, angular to subangular; little silt; little clay; trace mica; moist; stiff; strong cementation		
284									
285									
286									
287									
288									
289									
290		No sieve samples collected							
291	120			Topock - Weathered Bedrock - conglomerate	ML				
292									
293									
294									
295									
296								(296.0') Lost core down hole	
297									
298	36								
299									
300					NR		(299.0 - 306.0') No recovery (NR); sample fell out of core barrel	(299.0') Attempted to collect GW	

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Boring Log

ARCADIS Design & Consultancy for natural and built assets

Boring No.: MW-83d

Date Started:	10/03/2018	Surface Elevation:	529.95 ft amsl	Client:	PG&E
Date Completed:	10/27/2018	Northing (NAD83):	2102858.77	Project:	Final GW Remedy Phase 1
Drilling Co.:	Cascade	Easting (NAD83):	7615264.94	Location:	PG&E Topock, Needles, California
Drilling Method:	Sonic Drilling	Total Depth:	315 ft bgs		
Drill Rig Type:	Terrasonic Track Mount	Borehole Diameter:	4-12 inches		
Driller Name:	Dan O'Mara	Depth to First Water:	74.7 ft bgs		
Drilling Asst:	E. Huellmantel / J. Campbell	Sampling Method:	4 inch x 10 ft. Core Barrel	Project Number:	RC000753.0051
Logger:	SM / GJ / MA	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
301								sample but formation was non-permeable and produced no water.	
302									
303	36		--no sample-- (Interval did not produce) 10/25/2018 09:48		NR			(303.0 - 306.0') 6-inch casing got stuck and approximately 3 ft broke off down hole and could not be retrieved.	
304									
305									
306								(304.0') Rough Drilling	
307	18	No sieve samples collected					(306.0 - 311.0') Topock - Competent Bedrock - conglomerate; dark reddish brown (2.5YR 3/3); some fine to medium grained sand, subangular to subround; trace coarse-grained sand; trace mica; dry; strong cementation; friable pulverized by drilling	(305.0') Drill rods chattering	
308				Topock - Competent Bedrock - conglomerate				(306.0 - 308.0') Drilled extra two feet to collect lost core, core sample was saturated with drilling/formation water above 307 ft. bgs.	
309									
310									
311									
312	84						(311.0 - 315.0') Topock - Bedrock - Metadiorite; dry; partially weathered metadiorite	(311.0') Rough drilling	
313				Topock - Bedrock - Metadiorite					
314								(313.5') Core barrel stuck down hole, pulled both core barrel and 6" casing.	
315							End of Boring at 315.0 ft bgs.		
316									
317									
318									
319									
320									

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