Well Construction Log

Sheet: 1 of 10

Date Started:	11/05/2019	Surface Elevation:	480.26 ft amsl	**Well ID: IRZ-17**	
Date Completed:	11/19/2019	Shallow Well Elevation:	N/A		
Drilling Co.:	Cascade	Deep Well Elevation:	N/A	Client:	PG&E
Drilling Method:	Dual Rotary	Northing (NAD83):	2103000.19	Project:	Final GW Remedy Phase 1
Driller Name:	Jon Martinez	Easting (NAD83):	7615871.28	Location:	PG&E Topock, Needles, California
Drilling Asst:	A. & H. Amezguita	Borehole Diameter:	16-18 inches		
Logger:	K. Keon / E. Redner	Static Water Level:	See Log for Depths	Project Number:	RC000753.0051
Editor:	Sean McGrane	Development End Date:	1/24/2020		
Total Depth:	192 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
1–20		Topock - Fill	SP		(0.0 - 36.2') 10" SHUR-GRIP SDR17 PVC Casing (0.0 - 4.0') Cemex #0/30 MESH (30x50) Lapis Lustre Sand (4.0 - 7.0') Bentonite seal chips Puregold medium chips (7.0 - 18.3') Portland Cement 3% Bentonite Type I, II and V with Hydrogel (18.3 - 25.5') Portland Cement 3% Bentonite Type I, II and V with Hydrogel (0.0 - 19.9') 18.0" Borehole	(0.0 - 4.0') 9.8 bags	(0.0 - 4.0') 13 bags (133%) Note: Temporary backfill sand to fill annular space prior to vault installation. Used >20% of the calculated volume due to hole diameter increasing near surface.
						(4.0 - 7.0') 5.1 bags	(4.0 - 7.0') 20 bags (392%) Note: Chips were used to fill large void that formed during drilling, void resulted in the installation of >20% of the calculated volume.
			NR			(7.0 - 18.3') 103.2 gallons	(7.0 - 18.3') 180 gallons (174%) Note: Grout seal second lift. Used >20% of the calculated volume due to voids that formed during drilling.
						(18.3 - 25.5') 65.8 gallons	(18.3 - 25.5') 230 gallons (350%) Note: Grout seal. Used >20% of the calculated volume due to voids that formed during drilling. Stopped installation and let cure before adding second lift.

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, J = estimated value, NR = no recovery; Notes: solid blue and hollow blue water table marks represent depth to water (ft. bgs.) measured pre-specific capacity for the shallow and deep screens respectively

Well Construction Log

Sheet: 2 of 10

Date Started:	11/05/2019	Surface Elevation:	480.26 ft amsl	**Well ID: IRZ-17**	
Date Completed:	11/19/2019	Shallow Well Elevation:	N/A		
Drilling Co.:	Cascade	Deep Well Elevation:	N/A	Client:	PG&E
Drilling Method:	Dual Rotary	Northing (NAD83):	2103000.19	Project:	Final GW Remedy Phase 1
Driller Name:	Jon Martinez	Easting (NAD83):	7615871.28	Location:	PG&E Topock, Needles, California
Drilling Asst:	A. & H. Amezguita	Borehole Diameter:	16-18 inches		
Logger:	K. Keon / E. Redner	Static Water Level:	See Log for Depths	Project Number:	RC000753.0051
Editor:	Sean McGrane	Development End Date:	1/24/2020		
Total Depth:	192 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 - Fill	SP		(0.0 - 36.2') 10" SHUR-GRIP SDR17 PVC Casing		
22		Topock - Fluvial Deposits	SM		(18.3 - 25.5') Portland Cement 3% Bentonite Type I, II and V with Hydrogel	(18.3 - 25.5') 65.8 gallons	(18.3 - 25.5') 230 gallons (350%) Note: Grout seal. Used >20% of the calculated volume due to voids that formed during drilling. Stopped installation and let cure before adding second lift.
23							
24							
25		Topock - Fluvial Deposits	ML		(24.5 - 25.5') Centralizer		
26					(25.5 - 26.9') Bentonite seal chips Puregold medium chips	(25.5 - 26.9') 2.38 bags	(25.5 - 26.9') 2 bags (84%) Note: Seal between sand and grout
27					(26.9 - 27.9') Cemex #0/30 MESH (30x50) Lapis Lustre Sand	(26.9 - 27.9') 2.3 bags	(26.9 - 27.9') 2 bags (87%) Note: Transition sand
28		Topock - Fluvial Deposits	SM				
29		Topock - Fluvial Deposits	ML				
30					(19.9 - 40.6') 18.0" Borehole		
31		Topock - Fluvial Deposits	MH				
32							
33							
34	IRZ-17-VAS-32-37 (67 ppb) 3/2/2019 13:14	Topock - Fluvial Deposits	SM		(27.9 - 59.9') Cemex #8 MESH (8x16) Lapis Lustre Sand	(27.9 - 59.9') 78.2 bags	(27.9 - 59.9') 81 bags (104%) Note: Filter pack. Swabbed upper screen for approximately 60 minutes.
35							
36		Topock - Alluvium Deposits	SM		(36.2 - 57.1') 10" 50-Slot 316 SS Wire Wrap Screen		
37							
38							
39		Topock - Alluvium Deposits	GM				
40							

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, J = estimated value, NR = no recovery; Notes: solid blue and hollow blue water table marks represent depth to water (ft. bgs.) measured pre-specific capacity for the shallow and deep screens respectively

Well Construction Log

ARCADIS Design & Consultancy for natural and built assets

Sheet: 3 of 10

Date Started:	11/05/2019	Surface Elevation:	480.26 ft amsl	**Well ID: IRZ-17**	
Date Completed:	11/19/2019	Shallow Well Elevation:	N/A		
Drilling Co.:	Cascade	Deep Well Elevation:	N/A	Client:	PG&E
Drilling Method:	Dual Rotary	Northing (NAD83):	2103000.19	Project:	Final GW Remedy Phase 1
Driller Name:	Jon Martinez	Easting (NAD83):	7615871.28	Location:	PG&E Topock, Needles, California
Drilling Asst:	A. & H. Amezguita	Borehole Diameter:	16-18 inches		
Logger:	K. Keon / E. Redner	Static Water Level:	See Log for Depths	Project Number:	RC000753.0051
Editor:	Sean McGrane	Development End Date:	1/24/2020		
Total Depth:	192 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 - Alluvium Deposits	GM		(36.2 - 57.1') 10" 50-Slot 316 SS Wire Wrap Screen; (19.9 - 40.6') 18.0" Borehole		
42							
43							
44							
45		Topock - Alluvium Deposits	SM				
46							
47							
48							
49							
50					(27.9 - 59.9') Cemex #8 MESH (8x16) Lapis Lustre Sand; (40.6 - 61.8') 18.0" Borehole	(27.9 - 59.9') 78.2 bags	(27.9 - 59.9') 81 bags (104%) Note: Filter pack. Swabbed upper screen for approximately 60 minutes.
51							
52							
53		Topock - Alluvium Deposits	SW				
54		Topock - Alluvium Deposits	SM				
55							
56							
57							
58		Topock - Alluvium Deposits	SW-SM		(57.1 - 137.2') 10" SHUR-GRIP SDR17 PVC Casing		
59							
60		Topock - Alluvium Deposits	ML / 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, J = estimated value, NR = no recovery; Notes: solid blue and hollow blue water table marks represent depth to water (ft. bgs.) measured pre-specific capacity for the shallow and deep screens respectively

ARCADIS Design & Consultancy for natural and built assets

Well Construction Log

Date Started:	11/05/2019	Surface Elevation:	480.26 ft amsl	**Well ID: IRZ-17**	
Date Completed:	11/19/2019	Shallow Well Elevation:	N/A		
Drilling Co.:	Cascade	Deep Well Elevation:	N/A	Client:	PG&E
Drilling Method:	Dual Rotary	Northing (NAD83):	2103000.19	Project:	Final GW Remedy Phase 1
Driller Name:	Jon Martinez	Easting (NAD83):	7615871.28	Location:	PG&E Topock, Needles, California
Drilling Asst:	A. & H. Amezguita	Borehole Diameter:	16-18 inches		
Logger:	K. Keon / E. Redner	Static Water Level:	See Log for Depths	Project Number:	RC000753.0051
Editor:	Sean McGrane	Development End Date:	1/24/2020		
Total Depth:	192 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 - Alluvium Deposits	SM		(59.9 - 61.3') Cemex #0/30 MESH (30x50) Lapis Lustre Sand; (40.6 - 61.8') 18.0" Borehole; (57.1 - 137.2') 10" SHUR-GRIP SDR17 PVC Casing	(59.9 - 61.3') 3.4 bags	(59.9 - 61.3') 7 bags (206%) Note: Transition sand. Used >20% of the calculated volume due to potential voids forming during drilling.
62							
63							
64	IRZ-17-VAS-62-67 (0.604 J ppb) 3/2/2019 15:50	Topock - Alluvium Deposits	GM				
65							
66							
67							
68		Topock - Alluvium Deposits	SM		(69.5 - 70.5') Centralizer; (61.3 - 128.2') Bentonite seal pellets Pel-Plug (TR30) 3/8"; (61.8 - 79.5') 18.0" Borehole	(61.3 - 128.2') 113.9 buckets	(61.3 - 128.2') 126 buckets (111%) Note: Intermediate seal
69							
70							
71							
72							
73							
74							
75							
76		Topock - Alluvium Deposits	ML		(79.5 - 99.8') 18.0" Borehole		
77							
78							
79							
80							

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, J = estimated value, NR = no recovery; Notes: solid blue and hollow blue water table marks represent depth to water (ft. bgs.) measured pre-specific capacity for the shallow and deep screens respectively

Well Construction Log

Sheet: 5 of 10

Date Started:	11/05/2019	Surface Elevation:	480.26 ft amsl	**Well ID: IRZ-17**	
Date Completed:	11/19/2019	Shallow Well Elevation:	N/A		
Drilling Co.:	Cascade	Deep Well Elevation:	N/A	Client:	PG&E
Drilling Method:	Dual Rotary	Northing (NAD83):	2103000.19	Project:	Final GW Remedy Phase 1
Driller Name:	Jon Martinez	Easting (NAD83):	7615871.28	Location:	PG&E Topock, Needles, California
Drilling Asst:	A. & H. Amezguita	Borehole Diameter:	16-18 inches		
Logger:	K. Keon / E. Redner	Static Water Level:	See Log for Depths	Project Number:	RC000753.0051
Editor:	Sean McGrane	Development End Date:	1/24/2020		
Total Depth:	192 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		Topock - Alluvium Deposits	ML / SM		(57.1 - 137.2') 10" SHUR-GRIP SDR17 PVC Casing		
82							
83		Topock - Alluvium Deposits	ML				
84							
85							
86		Topock - Alluvium Deposits	SM				
87							
88		Topock - Alluvium Deposits	ML		(61.3 - 128.2') Bentonite seal pellets Pel-Plug (TR30) 3/8"; (79.5 - 99.8') 18.0" Borehole	(61.3 - 128.2') 113.9 buckets	(61.3 - 128.2') 126 buckets (111%) Note: Intermediate seal
89							
90							
91							
92							
93							
94							
95							
96							
97		Topock - Alluvium Deposits	SM				
98							
99							
100							

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ARCADIS Design & Consultancy for natural and built assets

Well Construction Log

Date Started:	11/05/2019	Surface Elevation:	480.26 ft amsl	**Well ID: IRZ-17**	
Date Completed:	11/19/2019	Shallow Well Elevation:	N/A		
Drilling Co.:	Cascade	Deep Well Elevation:	N/A	Client:	PG&E
Drilling Method:	Dual Rotary	Northing (NAD83):	2103000.19	Project:	Final GW Remedy Phase 1
Driller Name:	Jon Martinez	Easting (NAD83):	7615871.28	Location:	PG&E Topock, Needles, California
Drilling Asst:	A. & H. Amezguita	Borehole Diameter:	16-18 inches		
Logger:	K. Keon / E. Redner	Static Water Level:	See Log for Depths	Project Number:	RC000753.0051
Editor:	Sean McGrane	Development End Date:	1/24/2020		
Total Depth:	192 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
101–120	IRZ-17-VAS-102-107 (<0.17 U ppb) 3/3/2019 11:50	Topock - Alluvium Deposits	SM		(57.1 - 137.2') 10" SHUR-GRIP SDR17 PVC Casing; (61.3 - 128.2') Bentonite seal pellets Pel-Plug (TR30) 3/8"; (99.8 - 121.1') 16.0" Borehole; (119.5 - 120.5') Centralizer	(61.3 - 128.2') 113.9 buckets	(61.3 - 128.2') 126 buckets (111%) Note: Intermediate seal
		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, J = estimated value, NR = no recovery; Notes: solid blue and hollow blue water table marks represent depth to water (ft. bgs.) measured pre-specific capacity for the shallow and deep screens respectively

Well Construction Log

Sheet: 7 of 10

Date Started:	11/05/2019	Surface Elevation:	480.26 ft amsl	**Well ID: IRZ-17**	
Date Completed:	11/19/2019	Shallow Well Elevation:	N/A		
Drilling Co.:	Cascade	Deep Well Elevation:	N/A	Client:	PG&E
Drilling Method:	Dual Rotary	Northing (NAD83):	2103000.19	Project:	Final GW Remedy Phase 1
Driller Name:	Jon Martinez	Easting (NAD83):	7615871.28	Location:	PG&E Topock, Needles, California
Drilling Asst:	A. & H. Amezguita	Borehole Diameter:	16-18 inches		
Logger:	K. Keon / E. Redner	Static Water Level:	See Log for Depths	Project Number:	RC000753.0051
Editor:	Sean McGrane	Development End Date:	1/24/2020		
Total Depth:	192 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		(99.8 - 121.1') 16.0" Borehole (57.1 - 137.2') 10" SHUR-GRIP SDR17 PVC Casing		
122							
123							
124					(61.3 - 128.2') Bentonite seal pellets Pel-Plug (TR30) 3/8"	(61.3 - 128.2') 113.9 buckets	(61.3 - 128.2') 126 buckets (111%) Note: Intermediate seal
125		Topock - Alluvium Deposits	SM				
126							
127							
128					(128.2 - 128.7') Cemex #60 Mesh (40x70) Lapis Lustre Sand	(128.2 - 128.7') 0.9 bags	(128.2 - 128.7') 2 bags (222%) Note: Transition sand. Used >20% of the calculated volume due to potential voids forming during drilling.
129							
130					(121.1 - 138.8') 16.0" Borehole		
131							
132		Topock - Alluvium Deposits	ML				
133							
134	IRZ-17VAS-132-137 (<0.17 U ppb) 3/13/2019 23:35	Topock - Alluvium Deposits	GM		(128.7 - 177.5') Cemex #1/20 MESH (20x40) Lapis Lustre Sand	(128.7 - 177.5') 88.5 bags	(128.7 - 177.5') 78.1 bags (88%) Note: Lapis Lustre Sand, swabbed lower screen for approximately 60 minutes.
135							
136							
137							
138	IRZ-17-VAS-137-142 (<0.17 U ppb) 3/12/2019 14:50	Topock - Alluvium Deposits	SM		(137.2 - 167.1') 10" 15-Slot 316 SS Wire Wrap Screen		
139							
140					(138.8 - 158.8') 16.0" Borehole		

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Well Construction Log

Sheet: 8 of 10

Date Started:	11/05/2019	Surface Elevation:	480.26 ft amsl	**Well ID: IRZ-17**	
Date Completed:	11/19/2019	Shallow Well Elevation:	N/A		
Drilling Co.:	Cascade	Deep Well Elevation:	N/A	Client:	PG&E
Drilling Method:	Dual Rotary	Northing (NAD83):	2103000.19	Project:	Final GW Remedy Phase 1
Driller Name:	Jon Martinez	Easting (NAD83):	7615871.28	Location:	PG&E Topock, Needles, California
Drilling Asst:	A. & H. Amezguita	Borehole Diameter:	16-18 inches		
Logger:	K. Keon / E. Redner	Static Water Level:	See Log for Depths	Project Number:	RC000753.0051
Editor:	Sean McGrane	Development End Date:	1/24/2020		
Total Depth:	192 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	IRZ-17-VAS-137-142 (<0.17 U ppb) 3/12/2019 14:50				(137.2 - 167.1') 10" 15-Slot 316 SS Wire Wrap Screen		
142							
143							
144	IRV-17-VAS-142-147 (84 ppb) 3/4/2019 10:24						
145							
146							
147							
148		Topock - Alluvium Deposits	SM				
149	IRZ-17-VAS-147-152 (<0.33 U ppb) 3/12/2019 10:50				(138.8 - 158.8') 16.0" Borehole		
150					(128.7 - 177.5') Cemex #1/20 MESH (20x40) Lapis Lustre Sand	(128.7 - 177.5') 88.5 bags	(128.7 - 177.5') 78.1 bags (88%) Note: Lapis Lustre Sand, swabbed lower screen for approximately 60 minutes.
151							
152							
153							
154	IRZ-17-VAS-152-157 (7.0 ppb) 3/4/2019 13:46						
155							
156							
157							
158		Topock - Alluvium Deposits	ML				
159					(158.8 - 178.8') 16.0" Borehole		
160							

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Well Construction Log

Sheet: 9 of 10

Date Started:	11/05/2019	Surface Elevation:	480.26 ft amsl	**Well ID: IRZ-17**	
Date Completed:	11/19/2019	Shallow Well Elevation:	N/A		
Drilling Co.:	Cascade	Deep Well Elevation:	N/A	Client:	PG&E
Drilling Method:	Dual Rotary	Northing (NAD83):	2103000.19	Project:	Final GW Remedy Phase 1
Driller Name:	Jon Martinez	Easting (NAD83):	7615871.28	Location:	PG&E Topock, Needles, California
Drilling Asst:	A. & H. Amezguita	Borehole Diameter:	16-18 inches		
Logger:	K. Keon / E. Redner	Static Water Level:	See Log for Depths	Project Number:	RC000753.0051
Editor:	Sean McGrane	Development End Date:	1/24/2020		
Total Depth:	192 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	ML / SM		(137.2 - 167.1') 10" 15-Slot 316 SS Wire Wrap Screen		
162							
163		Topock - Alluvium Deposits	GM				
164	IRZ-17-VAS-162-167 (<0.17 U ppb) 3/4/2019 17:01						
165							
166							
167							
168					(128.7 - 177.5') Cemex #1/20 MESH (20x40) Lapis Lustre Sand	(128.7 - 177.5') 88.5 bags	(128.7 - 177.5') 78.1 bags (88%) Note: Lapis Lustre Sand, swabbed lower screen for approximately 60 minutes.
169					(168.5 - 169.5') Centralizer		
170					(158.8 - 178.8') 16.0" Borehole		
171							
172		Topock - Alluvium Deposits	SM				
173					(167.1 - 172.8') Sump and PVC End Cap		
174	IRZ-17-VAS-172-177 (<0.17 U ppb) 3/5/2019 14:50						
175							
176							
177							
178					(177.5 - 192.0') Bentonite seal pellets Pel-Plug (TR30) 3/8"	(177.5 - 192.0') 32.4 buckets	(177.5 - 192.0') 33 buckets (102%) Note: Decommissioned rathole
179							
180					(178.8 - 192.0') 15.5" 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, J = estimated value, NR = no recovery; Notes: solid blue and hollow blue water table marks represent depth to water (ft. bgs.) measured pre-specific capacity for the shallow and deep screens respectively

Well Construction Log

Sheet: 10 of 10

Date Started:	11/05/2019	Surface Elevation:	480.26 ft amsl	**Well ID: IRZ-17**	
Date Completed:	11/19/2019	Shallow Well Elevation:	N/A		
Drilling Co.:	Cascade	Deep Well Elevation:	N/A	Client:	PG&E
Drilling Method:	Dual Rotary	Northing (NAD83):	2103000.19	Project:	Final GW Remedy Phase 1
Driller Name:	Jon Martinez	Easting (NAD83):	7615871.28	Location:	PG&E Topock, Needles, California
Drilling Asst:	A. & H. Amezguita	Borehole Diameter:	16-18 inches		
Logger:	K. Keon / E. Redner	Static Water Level:	See Log for Depths	Project Number:	RC000753.0051
Editor:	Sean McGrane	Development End Date:	1/24/2020		
Total Depth:	192 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
181–183		Topock - Alluvium Deposits	SM				
183–186		Topock - Alluvium Deposits	ML		(177.5 - 192.0') Bentonite seal pellets Pel-Plug (TR30) 3/8" (178.8 - 192.0') 15.5" Borehole	(177.5 - 192.0') 32.4 buckets	(177.5 - 192.0') 33 buckets (102%) Note: Decommissioned rathole
186–187		Topock - Alluvium Deposits	SM				
187–192		Topock - Alluvium Deposits	ML				
192					End of Boring at 192.0 ft bgs.		

PROFESSIONAL GEOLOGIST
Craig Prunier
No. 7723
STATE OF CALIFORNIA

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, J = estimated value, NR = no recovery; Notes: solid blue and hollow blue water table marks represent depth to water (ft. bgs.) measured pre-specific capacity for the shallow and deep screens respectively

ARCADIS Design & Consultancy for natural and built assets

Drilling Log

Boring No.: IRZ-17

Date Started:	10/31/2019	Surface Elevation:	480.26 ft amsl		
Date Completed:	11/05/2019	Northing (NAD83):	2103000.19		
Drilling Co.:	Cascade	Easting (NAD83):	7615871.28	Client:	PG&E
Drilling Method:	Dual Rotary	Total Depth:	192 ft bgs	Project:	Final GW Remedy Phase 1
Drill Rig Type:	Foremost DR-24HD	Conductor Casing Diameter:	18 inches	Location:	PG&E Topock, Needles, California
Driller Name:	Jon Martinez	Drill Casing Diameter:	16 inches		
Drilling Asst:	A. & H. Amezguita	Drill Bit:	15.5 & 17.5 inch Tri-cone	Project Number:	RC000753.0051
Tool-Pusher:	Arnold Lamon	Depth to First Water:	26.6 ft bgs		
Rig Geologist:	K. Keon / E. Redner	Converted to Well:	☒ Yes ☐ No		

Depth (ft)	Drilling Run (ft) and Average Penetration Rate	USCS Code	USCS Class	Casing Diameter	Description (See Pilot boring log for full geologic descriptions)	Drilling notes and observations confirming presence of temporary backfill material in drill cuttings	Drilling Fluid
1–20	(0.0 - 19.9) 6.67 mins/ft	NR		(0.0 - 19.9') 18.0" Steel Casing	(0.0 - 19.5') No recovery (NR)	(0.0') Confirmed drill casing was centered on pilot borehole. Observed trace amounts of Wildcat Washed Plastering Sand in drill cuttings (See Photo Log). (0.0 - 19.9') Smooth drilling	(0.0 - 19.9') 1281.38 gallons of water used; 0 gallons of water recovered; 1281.38 gallons of water lost
						(10.0') Observed trace amounts of Cal-Silica 1/4"-3/8" Pea Gravel in drill cuttings (See Photo Log).	
		SP			(19.5 - 21.5') Topock - Fill;		

Abbreviations: USCS = Unified Soil Classification System, ft = feet, bgs = below ground surface, amsl = above mean sea level, GW = groundwater, U = not detected above the laboratory reporting limit, J = estimated value, NR = no recovery; Notes: depth to water collected during the first VAS interval of the pilot borehole

ARCADIS Design & Consultancy for natural and built assets

Drilling Log

Date Started:	10/31/2019	Surface Elevation:	480.26 ft amsl	**Boring No.:**	**IRZ-17**
Date Completed:	11/05/2019	Northing (NAD83):	2103000.19		
Drilling Co.:	Cascade	Easting (NAD83):	7615871.28	Client:	PG&E
Drilling Method:	Dual Rotary	Total Depth:	192 ft bgs	Project:	Final GW Remedy Phase 1
Drill Rig Type:	Foremost DR-24HD	Conductor Casing Diameter:	18 inches	Location:	PG&E Topock, Needles, California
Driller Name:	Jon Martinez	Drill Casing Diameter:	16 inches		
Drilling Asst:	A. & H. Amezguita	Drill Bit:	15.5 & 17.5 inch Tri-cone	Project Number:	RC000753.0051
Tool-Pusher:	Arnold Lamon	Depth to First Water:	26.6 ft bgs		
Rig Geologist:	K. Keon / E. Redner	Converted to Well:	☒ Yes ☐ No		

Depth (ft)	Drilling Run (ft) and Average Penetration Rate	USCS Code	USCS Class	Casing Diameter	Description (See Pilot boring log for full geologic descriptions)	Drilling notes and observations confirming presence of temporary backfill material in drill cuttings	Drilling Fluid
21		SP			Poorly graded sand (SP); yellowish brown / moderate yellowish brown (10YR 5/4)	(19.9 - 40.6') Smooth drilling (20.0') Observed trace amounts of Cal-Silica 1/4"-3/8" Pea Gravel in drill cuttings (See Photo Log).	(19.9 - 40.6') 427.14 gallons of water used; 1250 gallons of water recovered; 822.86 gallons of water gained
22		SM			(21.5 - 24.0') Topock - Fluvial Deposits; Silty sand with gravel (SM); dark yellowish brown (10YR 4/4)		
23							
24		ML			(24.0 - 28.0') Topock - Fluvial Deposits; Sandy silt with gravel (ML); yellowish brown / moderate yellowish brown (10YR 5/4)		
25							
26							
27							
28		SM			(28.0 - 29.0') Topock - Fluvial Deposits; Silty sand with gravel (SM); yellowish brown / moderate yellowish brown (10YR 5/4)		
29		ML			(29.0 - 30.0') Topock - Fluvial Deposits; Sandy silt with gravel (ML); yellowish brown / moderate yellowish brown (10YR 5/4)		
30	(19.9 - 40.6) 2.13 mins/ft	MH		(19.9 - 40.6') 18.0" Steel Casing	(30.0 - 33.5') Topock - Fluvial Deposits; Elastic silt with sand (MH); yellowish brown / moderate yellowish brown (10YR 5/4)	(30.0') Observed trace amounts of Cal-Silica 1/4"-3/8" Pea Gravel in drill cuttings (See Photo Log).	
31							
32							
33							
34		SM			(33.5 - 35.5') Topock - Fluvial Deposits; Silty sand with gravel (SM); yellowish brown / moderate yellowish brown (10YR 5/4)		
35							
36		SM			(35.5 - 38.0') Topock - Alluvium Deposits; Silty sand with gravel (SM); yellowish brown / moderate yellowish brown (10YR 5/4)		
37							
38		GM			(38.0 - 44.5') Topock - Alluvium Deposits; Silty gravel with sand (GM); reddish brown (5YR 4/3)		
39							
40							

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ARCADIS Design & Consultancy for natural and built assets

Drilling Log

Boring No.: IRZ-17

Date Started:	10/31/2019	Surface Elevation:	480.26 ft amsl		
Date Completed:	11/05/2019	Northing (NAD83):	2103000.19		
Drilling Co.:	Cascade	Easting (NAD83):	7615871.28	Client:	PG&E
Drilling Method:	Dual Rotary	Total Depth:	192 ft bgs	Project:	Final GW Remedy Phase 1
Drill Rig Type:	Foremost DR-24HD	Conductor Casing Diameter:	18 inches	Location:	PG&E Topock, Needles, California
Driller Name:	Jon Martinez	Drill Casing Diameter:	16 inches		
Drilling Asst:	A. & H. Amezguita	Drill Bit:	15.5 & 17.5 inch Tri-cone	Project Number:	RC000753.0051
Tool-Pusher:	Arnold Lamon	Depth to First Water:	26.6 ft bgs		
Rig Geologist:	K. Keon / E. Redner	Converted to Well:	☒ Yes ☐ No		

Depth (ft)	Drilling Run (ft) and Average Penetration Rate	USCS Code	USCS Class	Casing Diameter	Description (See Pilot boring log for full geologic descriptions)	Drilling notes and observations confirming presence of temporary backfill material in drill cuttings	Drilling Fluid
40	(19.9 - 40.6) 2.13 mins/ft	GM		(19.9 - 40.6') 18.0" Steel Casing		(40.0') Observed trace amounts of Cal-Silica 1/4"-3/8" Pea Gravel in drill cuttings (See Photo Log).	
41						(40.6 - 53.0') Smooth drilling	(40.6 - 61.8') 2000 gallons of water used; 500 gallons of water recovered; 1500 gallons of water lost
42							
43							
44							
45		SM			(44.5 - 53.0') Topock - Alluvium Deposits; Silty sand with gravel (SM); reddish brown / moderate brown (5YR 4/4)		
46							
47							
48							
49							
50	(40.6 - 61.8) 3.74 mins/ft			(40.6 - 61.8') 18.0" Steel Casing		(50.0') Observed trace amounts of Cal-Silica 1/4"-3/8" Pea Gravel in drill cuttings (See Photo Log).	
51							
52							
53		SW			(53.0 - 54.0') Topock - Alluvium Deposits; Well graded sand with gravel (SW); brown (10YR 4/3)	(53.0 - 55.0') Rough drilling	
54		SM			(54.0 - 57.0') Topock - Alluvium Deposits; Silty sand with gravel (SM); reddish brown / moderate brown (5YR 4/4)		
55						(55.0 - 60.6') Smooth drilling	
56							
57							
58		SW-SM			(57.0 - 59.0') Topock - Alluvium Deposits; Well graded sand with silt and gravel (SW-SM); reddish brown (5YR 4/3)		
59		ML			(59.0 - 59.5') Topock - Alluvium Deposits; Sandy silt with gravel (ML); reddish brown / moderate		
60		SM					

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ARCADIS Design & Consultancy for natural and built assets

Drilling Log

Boring No.: IRZ-17

Date Started:	10/31/2019	Surface Elevation:	480.26 ft amsl		
Date Completed:	11/05/2019	Northing (NAD83):	2103000.19		
Drilling Co.:	Cascade	Easting (NAD83):	7615871.28	Client:	PG&E
Drilling Method:	Dual Rotary	Total Depth:	192 ft bgs	Project:	Final GW Remedy Phase 1
Drill Rig Type:	Foremost DR-24HD	Conductor Casing Diameter:	18 inches	Location:	PG&E Topock, Needles, California
Driller Name:	Jon Martinez	Drill Casing Diameter:	16 inches		
Drilling Asst:	A. & H. Amezguita	Drill Bit:	15.5 & 17.5 inch Tri-cone	Project Number:	RC000753.0051
Tool-Pusher:	Arnold Lamon	Depth to First Water:	26.6 ft bgs		
Rig Geologist:	K. Keon / E. Redner	Converted to Well:	☒ Yes ☐ No		

Depth (ft)	Drilling Run (ft) and Average Penetration Rate	USCS Code	USCS Class	Casing Diameter	Description (See Pilot boring log for full geologic descriptions)	Drilling notes and observations confirming presence of temporary backfill material in drill cuttings	Drilling Fluid
61	(40.6 - 61.8) 3.74 mins/ft			(40.6 - 61.8') 18.0" Steel Casing	brown (5YR 4/4) (59.5 - 64.0') Topock - Alluvium Deposits; Silty sand with gravel (SM); reddish brown / moderate brown (5YR 4/4)	(60.0') Observed trace amounts of Cal-Silica 1/4"-3/8" Pea Gravel in drill cuttings (See Photo Log). (60.6 - 63.0') Smooth drilling	
62		SM					(61.8 - 79.5') 584.03 gallons of water used; 750 gallons of water recovered; 165.97 gallons of water gained
63						(63.0 - 64.0') Rough drilling	
64		GM			(64.0 - 65.0') Topock - Alluvium Deposits; Silty gravel with sand (GM); reddish brown / moderate brown (5YR 4/4)	(64.0 - 77.0') Smooth drilling	
65					(65.0 - 75.5') Topock - Alluvium Deposits; Silty sand with gravel (SM); brown (10YR 5/3)		
66							
67							
68							
69							
70		SM		(61.8 - 79.5') 18.0" Steel Casing		(70.0') Observed trace amounts of Cal-Silica 1/4"-3/8" Pea Gravel in drill cuttings (See Photo Log).	
71	(61.8 - 79.5) 5.64 mins/ft						
72							
73							
74							
75							
76					(75.5 - 80.5') Topock - Alluvium Deposits; Sandy silt with gravel (ML); reddish brown (5YR 5/4)		
77						(77.0 - 79.5') Rough drilling	
78		ML					
79							
80	(79.5 - 99.8) 4.06 mins/ft					(79.5 - 99.8') Drill rods chattering	(79.5 - 99.8') 206.16

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Drilling Log

Sheet: 5 of 10

Date Started:	10/31/2019	Surface Elevation:	480.26 ft amsl	**Boring No.:**	**IRZ-17**
Date Completed:	11/05/2019	Northing (NAD83):	2103000.19		
Drilling Co.:	Cascade	Easting (NAD83):	7615871.28	Client:	PG&E
Drilling Method:	Dual Rotary	Total Depth:	192 ft bgs	Project:	Final GW Remedy Phase 1
Drill Rig Type:	Foremost DR-24HD	Conductor Casing Diameter:	18 inches	Location:	PG&E Topock, Needles, California
Driller Name:	Jon Martinez	Drill Casing Diameter:	16 inches		
Drilling Asst:	A. & H. Amezguita	Drill Bit:	15.5 & 17.5 inch Tri-cone	Project Number:	RC000753.0051
Tool-Pusher:	Arnold Lamon	Depth to First Water:	26.6 ft bgs		
Rig Geologist:	K. Keon / E. Redner	Converted to Well:	☒ Yes ☐ No		

Depth (ft)	Drilling Run (ft) and Average Penetration Rate	USCS Code	USCS Class	Casing Diameter	Description (See Pilot boring log for full geologic descriptions)	Drilling notes and observations confirming presence of temporary backfill material in drill cuttings	Drilling Fluid
81	(79.5 - 99.8) 4.06 mins/ft	ML		(79.5 - 99.8') 18.0" Steel Casing		(80.0') Observed trace amounts of Cal-Silica 1/4"-3/8" Pea Gravel in drill cuttings (See Photo Log).	gallons of water used; 3748.28 gallons of water recovered; 3542.12 gallons of water gained
82		SM			(80.5 - 82.0') Topock - Alluvium Deposits; Silty sand with gravel (SM); reddish brown / moderate brown (5YR 4/4)		
83		ML			(82.0 - 85.5') Topock - Alluvium Deposits; Sandy silt with gravel (ML); reddish brown (5YR 5/4)		
84							
85							
86		SM			(85.5 - 88.0') Topock - Alluvium Deposits; Silty sand with gravel (SM); reddish brown / moderate brown (5YR 4/4) trace dusky red (5R 3/4)		
87							
88							
89		ML			(88.0 - 96.5') Topock - Alluvium Deposits; Sandy silt with gravel (ML); reddish brown (5YR 5/4)		
90						(90.0') Observed trace amounts of Cal-Silica 1/4"-3/8" Pea Gravel in drill cuttings (See Photo Log).	
91							
92							
93							
94							
95							
96							
97		SM			(96.5 - 119.0') Topock - Alluvium Deposits; Silty sand with gravel (SM); reddish brown / moderate brown (5YR 4/4)		
98							
99							
100							

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Drilling Log

Sheet: 6 of 10

Boring No.: IRZ-17

Date Started:	10/31/2019	Surface Elevation:	480.26 ft amsl
Date Completed:	11/05/2019	Northing (NAD83):	2103000.19
Drilling Co.:	Cascade	Easting (NAD83):	7615871.28
Drilling Method:	Dual Rotary	Total Depth:	192 ft bgs
Drill Rig Type:	Foremost DR-24HD	Conductor Casing Diameter:	18 inches
Driller Name:	Jon Martinez	Drill Casing Diameter:	16 inches
Drilling Asst:	A. & H. Amezguita	Drill Bit:	15.5 & 17.5 inch Tri-cone
Tool-Pusher:	Arnold Lamon	Depth to First Water:	26.6 ft bgs
Rig Geologist:	K. Keon / E. Redner	Converted to Well:	[X] Yes [ ] No

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

Depth (ft)	Drilling Run (ft) and Average Penetration Rate	USCS Code	USCS Class	Casing Diameter	Description (See Pilot boring log for full geologic descriptions)	Drilling notes and observations confirming presence of temporary backfill material in drill cuttings	Drilling Fluid
101						(99.8 - 121.1') Drill rods chattering (100.0') Observed trace amounts of Cal-Silica 1/4"-3/8" Pea Gravel in drill cuttings (See Photo Log).	(99.8 - 121.1') 2424.66 gallons of water used; 2544.22 gallons of water recovered; 119.56 gallons of water gained
102							
103							
104							
105							
106							
107							
108							
109							
110	(99.8 - 121.1) 1.41 mins/ft	SM		(99.8 - 121.1') 16.0" Steel Casing		(110.0') Observed trace amounts of Cal-Silica 1/4"-3/8" Pea Gravel in drill cuttings (See Photo Log).	
111							
112							
113							
114							
115							
116							
117							
118							
119		ML			(119.0 - 124.0') Topock - Alluvium Deposits; Sandy silt with gravel (ML); reddish brown		
120							

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Drilling Log

Date Started:	10/31/2019	Surface Elevation:	480.26 ft amsl	**Boring No.:**	**IRZ-17**
Date Completed:	11/05/2019	Northing (NAD83):	2103000.19		
Drilling Co.:	Cascade	Easting (NAD83):	7615871.28	Client:	PG&E
Drilling Method:	Dual Rotary	Total Depth:	192 ft bgs	Project:	Final GW Remedy Phase 1
Drill Rig Type:	Foremost DR-24HD	Conductor Casing Diameter:	18 inches	Location:	PG&E Topock, Needles, California
Driller Name:	Jon Martinez	Drill Casing Diameter:	16 inches		
Drilling Asst:	A. & H. Amezguita	Drill Bit:	15.5 & 17.5 inch Tri-cone	Project Number:	RC000753.0051
Tool-Pusher:	Arnold Lamon	Depth to First Water:	26.6 ft bgs		
Rig Geologist:	K. Keon / E. Redner	Converted to Well:	☒ Yes ☐ No		

Depth (ft)	Drilling Run (ft) and Average Penetration Rate	USCS Code	USCS Class	Casing Diameter	Description (See Pilot boring log for full geologic descriptions)	Drilling notes and observations confirming presence of temporary backfill material in drill cuttings	Drilling Fluid
121	(99.8 - 121.1) 1.41 mins/ft	ML		(99.8 - 121.1') 16.0" Steel Casing	/ moderate brown (5YR 4/4) trace dusky red (5R 3/4)	(120.0') Observed trace amounts of Cal-Silica 1/4"-3/8" Pea Gravel in drill cuttings (See Photo Log).	
122						(121.1 - 135.0') Changed out bottom hole assembly to drill with constant water due to heaving sands. Smooth drilling.	1910.69 gallons used; 4245.74 gallons recovered; 2335.05 gallons gained
123							
124					(124.0 - 132.0') Topock - Alluvium Deposits; Silty sand with gravel (SM); brown (7.5YR 4/3) some strong brown (7.5YR 4/6)		
125							
126							
127							
128		SM					
129							
130	(121.1 - 138.8) 1.80 mins/ft			(121.1 - 138.8') 16.0" Steel Casing		(130.0') Observed trace amounts of Cal-Silica 1/4"-3/8" Pea Gravel in drill cuttings (See Photo Log).	
131							
132					(132.0 - 133.0') Topock - Alluvium Deposits; Sandy silt with gravel (ML); reddish brown / moderate brown (5YR 4/4)		
133		ML					
134		GM			(133.0 - 136.5') Topock - Alluvium Deposits; Silty gravel with sand (GM); reddish brown / moderate brown (5YR 4/4)		
135						(135.0 - 140.5') Rough drilling	
136							
137					(136.5 - 156.5') Topock - Alluvium Deposits; Silty sand with gravel (SM); reddish brown / moderate brown (5YR 4/4)		
138		SM					
139	(138.8 - 158.8) 1.72 mins/ft			(138.8 - 158.8') 16.0" Steel Casing			(138.8 - 158.8') 3445.74 gallons of water used; 2703 gallons of water recovered; 742.74 gallons
140							

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Drilling Log

Sheet: 8 of 10

Date Started:	10/31/2019	Surface Elevation:	480.26 ft amsl
Date Completed:	11/05/2019	Northing (NAD83):	2103000.19
Drilling Co.:	Cascade	Easting (NAD83):	7615871.28
Drilling Method:	Dual Rotary	Total Depth:	192 ft bgs
Drill Rig Type:	Foremost DR-24HD	Conductor Casing Diameter:	18 inches
Driller Name:	Jon Martinez	Drill Casing Diameter:	16 inches
Drilling Asst:	A. & H. Amezguita	Drill Bit:	15.5 & 17.5 inch Tri-cone
Tool-Pusher:	Arnold Lamon	Depth to First Water:	26.6 ft bgs
Rig Geologist:	K. Keon / E. Redner	Converted to Well:	[x] Yes [ ] No

Boring No.: IRZ-17

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

Depth (ft)	Drilling Run (ft) and Average Penetration Rate	USCS Code	USCS Class	Casing Diameter	Description (See Pilot boring log for full geologic descriptions)	Drilling notes and observations confirming presence of temporary backfill material in drill cuttings	Drilling Fluid
141						(140.0') Observed trace amounts of Cal-Silica 1/4"-3/8" Pea Gravel in drill cuttings (See Photo Log).	of water lost
						(140.5 - 158.8') Smooth drilling	
142							
143							
144							
145							
146							
147							
148		SM					
149	(138.8 - 158.8) 1.72 mins/ft			(138.8 - 158.8') 16.0" Steel Casing			
150						(150.0') Observed trace amounts of Cal-Silica 1/4"-3/8" Pea Gravel in drill cuttings (See Photo Log).	
151							
152							
153							
154							
155							
156							
157					(156.5 - 160.5') Topock - Alluvium Deposits; Sandy silt with gravel (ML); reddish brown / moderate brown (5YR 4/4)		
158		ML					
159	(158.8 - 178.8) 1.52 mins/ft			(158.8 - 178.8') 16.0" Steel Casing		(158.8 - 179.0') Smooth drilling	(158.8 - 192.0') 3164.5 gallons of water used; 8081.1 gallons of water recovered; 4916.6 gallons
160							

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Drilling Log

Sheet: 9 of 10

Date Started:	10/31/2019	Surface Elevation:	480.26 ft amsl	**Boring No.:**	**IRZ-17**
Date Completed:	11/05/2019	Northing (NAD83):	2103000.19		
Drilling Co.:	Cascade	Easting (NAD83):	7615871.28	Client:	PG&E
Drilling Method:	Dual Rotary	Total Depth:	192 ft bgs	Project:	Final GW Remedy Phase 1
Drill Rig Type:	Foremost DR-24HD	Conductor Casing Diameter:	18 inches	Location:	PG&E Topock, Needles, California
Driller Name:	Jon Martinez	Drill Casing Diameter:	16 inches		
Drilling Asst:	A. & H. Amezguita	Drill Bit:	15.5 & 17.5 inch Tri-cone	Project Number:	RC000753.0051
Tool-Pusher:	Arnold Lamon	Depth to First Water:	26.6 ft bgs		
Rig Geologist:	K. Keon / E. Redner	Converted to Well:	☒ Yes ☐ No		

Depth (ft)	Drilling Run (ft) and Average Penetration Rate	USCS Code	USCS Class	Casing Diameter	Description (See Pilot boring log for full geologic descriptions)	Drilling notes and observations confirming presence of temporary backfill material in drill cuttings	Drilling Fluid
161		ML				(160.0') Observed trace amounts of Cal-Silica 1/4"-3/8" Pea Gravel in drill cuttings (See Photo Log).	of water gained
162		SM			(160.5 - 162.5') Topock - Alluvium Deposits; Silty sand (SM); reddish brown / moderate brown (5YR 4/4)		
163		GM			(162.5 - 164.0') Topock - Alluvium Deposits; Silty gravel with sand (GM); reddish brown / moderate brown (5YR 4/4)		
164					(164.0 - 183.0') Topock - Alluvium Deposits; Silty sand with gravel (SM); reddish brown / moderate brown (5YR 4/4)		
165							
166							
167							
168							
169	(158.8 - 178.8) 1.52 mins/ft			(158.8 - 178.8') 16.0" Steel Casing			
170						(170.0') Observed trace amounts of Cal-Silica 1/4"-3/8" Pea Gravel in drill cuttings (See Photo Log).	
171							
172		SM					
173							
174							
175							
176							
177							
178							
179	(178.8 - 192.0) 2.45 mins/ft			(178.8 - 192.0') 15.5" Open Hole		(179.0 - 192.0') Drilled without advancing casing. Tagged bottom to verify formation did not collapse after drilling complete.	
180							

Abbreviations: USCS = Unified Soil Classification System, ft = feet, bgs = below ground surface, amsl = above mean sea level, GW = groundwater, U = not detected above the laboratory reporting limit, J = estimated value, NR = no recovery; Notes: depth to water collected during the first VAS interval of the pilot borehole

Drilling Log

ARCADIS Design & Consultancy for natural and built assets

Boring No.: IRZ-17

Date Started:	10/31/2019	Surface Elevation:	480.26 ft amsl	Client:	PG&E
Date Completed:	11/05/2019	Northing (NAD83):	2103000.19	Project:	Final GW Remedy Phase 1
Drilling Co.:	Cascade	Easting (NAD83):	7615871.28	Location:	PG&E Topock, Needles, California
Drilling Method:	Dual Rotary	Total Depth:	192 ft bgs		
Drill Rig Type:	Foremost DR-24HD	Conductor Casing Diameter:	18 inches		
Driller Name:	Jon Martinez	Drill Casing Diameter:	16 inches		
Drilling Asst:	A. & H. Amezguita	Drill Bit:	15.5 & 17.5 inch Tri-cone	Project Number:	RC000753.0051
Tool-Pusher:	Arnold Lamon	Depth to First Water:	26.6 ft bgs		
Rig Geologist:	K. Keon / E. Redner	Converted to Well:	[X] Yes [ ] No		

Depth (ft)	Drilling Run (ft) and Average Penetration Rate	USCS Code	USCS Class	Casing Diameter	Description (See Pilot boring log for full geologic descriptions)	Drilling notes and observations confirming presence of temporary backfill material in drill cuttings	Drilling Fluid
181		SM				(180.0') Observed trace amounts of Cal-Silica 1/4"-3/8" Pea Gravel in drill cuttings (See Photo Log)	
182							
183							
184		ML			(183.0 - 185.5') Topock - Alluvium Deposits; Gravelly silt with sand (ML); yellowish red (5YR 4/6)		
185							
186	(178.8 - 192.0) 2.45 mins/ft	SM		(178.8 - 192.0') 15.5" Open Hole	(185.5 - 187.0') Topock - Alluvium Deposits; Silty sand with gravel (SM); yellowish red (5YR 4/6)		
187							
188		ML			(187.0 - 192.0') Topock - Alluvium Deposits; Sandy silt with gravel (ML); yellowish red (5YR 4/6)		
189							
190						(190.0') Observed trace amounts of Cemex #3 MESH (8x10) Lapis Lustre Sand in drill cuttings (See Photo Log).	
191							
192					End of Boring at 192.0 ft bgs.		
193							
194							
195							
196							
197							
198							
199							
200							

PROFESSIONAL GEOLOGIST
Craig Prunier
No. 7723
STATE OF CALIFORNIA

Abbreviations: USCS = Unified Soil Classification System, ft = feet, bgs = below ground surface, amsl = above mean sea level, GW = groundwater, U = not detected above the laboratory reporting limit, J = estimated value, NR = no recovery; Notes: depth to water collected during the first VAS interval of the pilot borehole

ARCADIS Design & Consultancy for natural and built assets

Boring Log

Sheet: 1 of 12

Boring No.: IRZ-17 Pilot

Date Started:	03/02/2019	Surface Elevation:	480.3 ft amsl	Client:	PG&E
Date Completed:	03/13/2019	Northing (NAD83):	2103000.2		
Drilling Co.:	Cascade	Easting (NAD83):	7615871.3	Project:	Final GW Remedy Phase I
Drilling Method:	Sonic Drilling	Total Depth:	227 ft bgs	Location:	PG&E Topock, Needles, California
Drill Rig Type:	Prosonic Truck Mount	Borehole Diameter:	6-12 inches		
Driller Name:	Steve Vasquez	Depth to First Water:	26.55 ft bgs		
Drilling Asst:	O. Flores, L. Amaya	Sampling Method:	4 inch x 10 ft Core Barrel	Project Number:	RC000753.0051
Logger:	G Jeffers / J. Wanner	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
1–10	0				NR		(0.0 - 19.5') (NR); No recovery loose dredge sands falling out of core barrel could not provide core will accurate depths.	(0.0 - 17.0') Due to loose dredge sand, little to no recovery, push 6" casing to try and get recovery, was not successful	(0.0 - 217.0') No water used
17–18								(17.0 - 19.5') Loose dredge sands continuosly fell out of core barrel	
20	90			Topock - Fill	SP		(19.5 - 21.5') Topock - Fill; Poorly graded sand (SP); yellowish brown /		

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ARCADIS Design & Consultancy for natural and built assets

Boring Log

Boring No.: IRZ-17 Pilot

Date Started:	03/02/2019	Surface Elevation:	480.3 ft amsl		
Date Completed:	03/13/2019	Northing (NAD83):	2103000.2		
Drilling Co.:	Cascade	Easting (NAD83):	7615871.3	Client:	PG&E
Drilling Method:	Sonic Drilling	Total Depth:	227 ft bgs	Project:	Final GW Remedy Phase I
Drill Rig Type:	Prosonic Truck Mount	Borehole Diameter:	6-12 inches	Location:	PG&E Topock, Needles, California
Driller Name:	Steve Vasquez	Depth to First Water:	26.55 ft bgs		
Drilling Asst:	O. Flores, L. Amaya	Sampling Method:	4 inch x 10 ft Core Barrel	Project Number:	RC000753.0051
Logger:	G Jeffers / J. Wanner	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 - Fill	SP		moderate yellowish brown(10YR 5/4); very fine grained to fine grained, angular to subround; trace silt; little mica; dry to moist; no odor; no staining; moist at 20.5' bgs		(0.0 - 217.0') No water used
22				Topock - Fluvial Deposits	SM		(21.5 - 24.0') Topock - Fluvial Deposits; Silty sand with gravel (SM); dark yellowish brown (10YR 4/4); very fine grained to very coarse grained, subangular to round; some granules to very large pebbles, subangular to round; little silt; trace cobbles, subangular to subround; moist; no odor; no staining; larger clasts consist of sandstone, granodiorite and metadiorite. Higher gravel content at bottom 4" of soil bed.		
23	90								
24		IRZ-17-SS-22-27 3/7/2019 11:28							
25				Topock - Fluvial Deposits	ML		(24.0 - 28.0') Topock - Fluvial Deposits; Sandy silt with gravel (ML); yellowish brown / moderate yellowish brown(10YR 5/4); no plasticity, slow dilatency; some very fine to fine grained sand, subangular to subround; little granules to very large pebbles, subangular to round; trace cobbles, subround to round; trace mica; wet; medium stiff; no odor; no staining	(24.0') Approximate depth of water table	
26							(26'); some granules to very large pebbles, subangular to round; trace fine to very course sand, 3" lense at 26' bgs of decrease in silt.		
27									
28				Topock - Fluvial Deposits	SM		(28.0 - 29.0') Topock - Fluvial Deposits; Silty sand with gravel (SM); yellowish brown / moderate yellowish brown(10YR 5/4); very fine grained to fine grained, subangular to round; and silt; little granules to very large pebbles, subangular to round; little mica; wet; no odor; no staining; trace med to very fine sand.	(27.0 - 32.0') Set temporary well screen, ~6" of water in screen, due to silt and clays, drilled an additonal 5 ft to collect sample	
29	60	IRZ-17-SS-27-32 3/7/2019 11:33		Topock - Fluvial Deposits	ML		(29.0 - 30.0') Topock - Fluvial Deposits; Sandy silt with gravel (ML); yellowish brown / moderate yellowish brown(10YR 5/4); medium plasticity, slow dilatency; some very fine to fine grained sand, subangular to subround; little granules to very large pebbles, subangular to round; trace mica; wet; medium stiff; no odor; no staining		
30									
31				Topock - Fluvial Deposits	MH		(30.0 - 33.5') Topock - Fluvial Deposits; Elastic silt with sand (MH); yellowish brown / moderate yellowish brown(10YR 5/4); high plasticity, no dilatency; little very fine grained sand, subangular to subround; trace granules to very large pebbles, subround to round; trace cobbles, round; trace clay; trace mica; wet; very soft; no odor; no staining; increase granules to very large pebbles at bottom of soil bed (4"), oxidized staining observed at bottom of bed.		
32									
33									
34	48	IRZ-17-SS-32-37 3/7/2019 11:36	IRZ-17-VAS-32-37 (67 ppb) 3/2/2019 13:14	Topock - Fluvial Deposits	SM		(33.5 - 35.5') Topock - Fluvial Deposits; Silty sand with gravel (SM); yellowish brown / moderate yellowish brown(10YR 5/4); very fine grained to very coarse grained, subangular to round; some silt; little granules to very large pebbles, subround to round; trace cobbles, round; trace clay; little mica; wet; no odor; iron oxide staining		
35									
36				Topock - Alluvium Deposits	SM		(35.5 - 38.0') Topock - Alluvium Deposits; Silty sand with gravel (SM); yellowish brown / moderate yellowish brown(10YR 5/4); very fine grained to very coarse grained, angular to subangular; some granules to very large pebbles, angular to subangular; little silt; little mica; wet; no odor; no staining		
37									
38	240	IRZ-17-SS-36-42 3/7/2019 11:45		Topock - Alluvium Deposits	GM		(38.0 - 44.5') Topock - Alluvium Deposits; Silty gravel with sand (GM); reddish brown (5YR 4/3); granules to very large pebbles, angular to subround; some very fine to very coarse grained sand, angular to subround; little silt; trace mica; wet; no odor; no staining; larger clasts consist of granodiorite.		
39									
40									

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Boring Log

ARCADIS Design & Consultancy for natural and built assets

Boring No.: IRZ-17 Pilot

Date Started:	03/02/2019	Surface Elevation:	480.3 ft amsl	Client:	PG&E
Date Completed:	03/13/2019	Northing (NAD83):	2103000.2		
Drilling Co.:	Cascade	Easting (NAD83):	7615871.3	Project:	Final GW Remedy Phase I
Drilling Method:	Sonic Drilling	Total Depth:	227 ft bgs	Location:	PG&E Topock, Needles, California
Drill Rig Type:	Prosonic Truck Mount	Borehole Diameter:	6-12 inches		
Driller Name:	Steve Vasquez	Depth to First Water:	26.55 ft bgs		
Drilling Asst:	O. Flores, L. Amaya	Sampling Method:	4 inch x 10 ft Core Barrel	Project Number:	RC000753.0051
Logger:	G Jeffers / J. Wanner	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		IRZ-17-SS-36-42 3/7/2019 11:45		Topock - Alluvium Deposits	GM		(40'); Increase in granules to very large pebbles.		(0.0 - 217.0') No water used
42									
43									
44		IRZ-17-SS-42-47 3/7/2019 11:50							
45				Topock - Alluvium Deposits	SM		(44.5 - 53.0') 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; little granules to very large pebbles, angular to subangular; little silt; trace cobbles, angular; little mica; wet; no odor; no staining; larger clasts consist of granodiorite and metadiorite.		
46									
47		IRZ-17-SS-47-52 3/7/2019 11:55					(46.5'); some granules to very large pebbles, angular to subangular; decrease in sand and silt.		
48	240								
49							(49'); increase in silt, decrease in granules to very large pebbles.		
50							(49.5'); decrease in silt.		
51									
52									
53		IRZ-17-SS-52-57 3/7/2019 12:10		Topock - Alluvium Deposits	SW		(53.0 - 54.0') Topock - Alluvium Deposits; Well graded sand with gravel (SW); brown (10YR 4/3); very fine grained to very coarse grained, angular to subround; little granules to very large pebbles, angular to subround; trace cobbles, subround; trace silt; little mica; wet; no odor; no staining; larger clasts consist of granodiorite, clasts coarsen downward.		
54									
55				Topock - Alluvium Deposits	SM		(54.0 - 57.0') Topock - Alluvium Deposits; Silty sand with gravel (SM); reddish brown / moderate brown(5YR 4/4); very fine grained to very coarse grained, subangular to subround; some granules to very large pebbles, angular to subround; little silt; little mica; wet; no odor; no staining; larger clasts consist of granodiorites.		
56									
57									
58	120	IRZ-17-SS-57-62 3/7/2019 12:25		Topock - Alluvium Deposits	SW-SM		(57.0 - 59.0') Topock - Alluvium Deposits; Well graded sand with silt and gravel (SW-SM); reddish brown (5YR 4/3); very fine grained to very coarse grained, angular to subround; some granules to very large pebbles, angular to subround; little silt; trace mica; wet; no odor; no staining; larger clasts consist of granodiorite.		
59									
60				Topock - Alluvium Deposits	ML / SM		(59.0 - 59.5') Topock - Alluvium Deposits; Sandy silt with gravel (ML); reddish brown / moderate brown(5YR 4/4); low plasticity, no dilatency; some very fine to very coarse grained sand, angular to subround; little		

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Boring Log

ARCADIS Design & Consultancy for natural and built assets

Boring No.: IRZ-17 Pilot

Date Started:	03/02/2019	Surface Elevation:	480.3 ft amsl	Client:	PG&E
Date Completed:	03/13/2019	Northing (NAD83):	2103000.2		
Drilling Co.:	Cascade	Easting (NAD83):	7615871.3	Project:	Final GW Remedy Phase I
Drilling Method:	Sonic Drilling	Total Depth:	227 ft bgs	Location:	PG&E Topock, Needles, California
Drill Rig Type:	Prosonic Truck Mount	Borehole Diameter:	6-12 inches		
Driller Name:	Steve Vasquez	Depth to First Water:	26.55 ft bgs		
Drilling Asst:	O. Flores, L. Amaya	Sampling Method:	4 inch x 10 ft Core Barrel	Project Number:	RC000753.0051
Logger:	G Jeffers / J. Wanner	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	120	IRZ-17-SS-57-62 3/7/2019 12:25		Topock - Alluvium Deposits	SM		granules to very large pebbles, angular to subangular; trace mica; wet; medium stiff to stiff; no odor; no staining (59.5 - 64.0') Topock - Alluvium Deposits; Silty sand with gravel (SM); reddish brown / moderate brown(5YR 4/4); very fine grained to very coarse grained, subangular to subround; some granules to very large pebbles, angular to subangular; some silt; little mica; wet; no odor; no staining; larger clasts consist of metadiorite and granodiorite. (60'); little silt; increase in sand. (61'); some silt; decrease in sand.		(0.0 - 217.0') No water used
62									
63									
64		IRZ-17-SS-62-67 3/7/2019 13:05	IRZ-17-VAS-62-67 (0.604 J ppb) 3/2/2019 15:50	Topock - Alluvium Deposits	GM		(64.0 - 65.0') Topock - Alluvium Deposits; Silty gravel with sand (GM); reddish brown / moderate brown(5YR 4/4); granules to very large pebbles, angular to subangular; and very fine to very coarse grained sand, subangular to subround; little silt; little mica; wet; no odor; no staining		
65									
66							(65.0 - 75.5') Topock - Alluvium Deposits; Silty sand with gravel (SM); brown (10YR 5/3); very fine grained to very coarse grained, angular to subround; some granules to very large pebbles, angular to subangular; little silt; trace mica; wet; no odor; weak cementation; no staining (66') reddish brown / moderate brown(5YR 4/4); some silt; decrease in granules to very large pebbles, no cementation. (67'); little granules to very large pebbles, angular to subangular; increase in sand, increase in silt, weathered granules to very large pebbles observed.		
67								(67.0 - 87.0') Core compaction observed. switch back to 10' runs.	
68	192	IRZ-17-SS-67-72 3/7/2019 13:12		Topock - Alluvium Deposits	SM				
69									
70									
71							(70.5'); some granules to very large pebbles, angular to subangular; weathered granules to very large pebbles observed.		
72									
73		IRZ-17-SS-72-77 3/7/2019 13:25							
74							(73.5'); little granules to very large pebbles, angular to subangular; increase in silt.		
75									
76							(75.5 - 80.5') Topock - Alluvium Deposits; Sandy silt with gravel (ML); reddish brown (5YR 5/4); no plasticity, slow dilatency; some granules to very large pebbles, angular to subangular; some very fine to very coarse grained sand, subangular to subround; trace mica; wet; stiff; no odor; no staining		
77									
78		IRZ-17-SS-77-82 3/7/2019 13:35		Topock - Alluvium Deposits	ML				
79									
80									

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Boring Log

ARCADIS Design & Consultancy for natural and built assets

Boring No.: IRZ-17 Pilot

Date Started:	03/02/2019	Surface Elevation:	480.3 ft amsl	Client:	PG&E
Date Completed:	03/13/2019	Northing (NAD83):	2103000.2		
Drilling Co.:	Cascade	Easting (NAD83):	7615871.3	Project:	Final GW Remedy Phase I
Drilling Method:	Sonic Drilling	Total Depth:	227 ft bgs	Location:	PG&E Topock, Needles, California
Drill Rig Type:	Prosonic Truck Mount	Borehole Diameter:	6-12 inches		
Driller Name:	Steve Vasquez	Depth to First Water:	26.55 ft bgs		
Drilling Asst:	O. Flores, L. Amaya	Sampling Method:	4 inch x 10 ft Core Barrel	Project Number:	RC000753.0051
Logger:	G Jeffers / J. Wanner	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
					ML			(67.0 - 87.0') Core compaction observed. switch back to 10' runs.	(0.0 - 217.0') No water used
81	192	IRZ-17-SS-77-82 3/7/2019 13:35		Topock - Alluvium Deposits	SM		(80.5 - 82.0') Topock - Alluvium Deposits; Silty sand with gravel (SM); reddish brown / moderate brown(5YR 4/4); very fine grained to very coarse grained, angular to subround; some granules to very large pebbles, angular to subangular; some silt; trace mica; wet; no odor; no staining		
82									
83		IRZ-17-SS-82-87 3/7/2019 13:51		Topock - Alluvium Deposits	ML		(82.0 - 85.5') Topock - Alluvium Deposits; Sandy silt with gravel (ML); reddish brown (5YR 5/4); no plasticity, no dilatency; some granules to very large pebbles, angular to subangular; some very fine to very coarse grained sand, subangular to subround; trace mica; wet; very stiff; no odor; weak cementation; iron oxide staining		
84									
85									
86				Topock - Alluvium Deposits	SM		(85.5 - 88.0') Topock - Alluvium Deposits; Silty sand with gravel (SM); reddish brown / moderate brown(5YR 4/4) trace dusky red(5R 3/4); very fine grained to very coarse grained, angular to subround; some granules to very large pebbles, angular to subangular; some silt; trace mica; wet; no odor; iron oxide staining; crushed gravel fragments at bottom of formation.		
87									
88	120	IRZ-17-SS-87-92 3/7/2019 14:01		Topock - Alluvium Deposits	ML		(88.0 - 96.5') Topock - Alluvium Deposits; Sandy silt with gravel (ML); reddish brown (5YR 5/4); no plasticity, no dilatency; some granules to very large pebbles, angular; some very fine to very coarse grained sand, angular to subround; trace mica; wet; very stiff; no odor		
89									
90									
91									
92							(92'); moist; weak cementation; increase in granules to very large pebbles, decrease in sand.		
93		IRZ-17-SS-92-97 3/7/2019 14:07							
94									
95									
96									
97				Topock - Alluvium Deposits	SM		(96.5 - 119.0') Topock - Alluvium Deposits; Silty sand with gravel (SM); reddish brown / moderate brown(5YR 4/4); very fine grained to very coarse grained, angular to subround; some granules to very large pebbles, angular to subround; some silt; trace mica; wet; no odor; no staining		
98	120	IRZ-17-SS-97-102 3/7/2019 14:12							
99									
100							(99.5'); little silt; increase in granules to very large pebbles.		

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ARCADIS Design & Consultancy for natural and built assets

Boring Log

Boring No.: IRZ-17 Pilot

Date Started:	03/02/2019	Surface Elevation:	480.3 ft amsl		
Date Completed:	03/13/2019	Northing (NAD83):	2103000.2		
Drilling Co.:	Cascade	Easting (NAD83):	7615871.3	Client:	PG&E
Drilling Method:	Sonic Drilling	Total Depth:	227 ft bgs	Project:	Final GW Remedy Phase I
Drill Rig Type:	Prosonic Truck Mount	Borehole Diameter:	6-12 inches	Location:	PG&E Topock, Needles, California
Driller Name:	Steve Vasquez	Depth to First Water:	26.55 ft bgs		
Drilling Asst:	O. Flores, L. Amaya	Sampling Method:	4 inch x 10 ft Core Barrel	Project Number:	RC000753.0051
Logger:	G Jeffers / J. Wanner	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		IRZ-17-SS-97-102 3/7/2019 14:12							(0.0 - 217.0') No water used
102							(102'); some silt; moderate cementation; decrease in sand and granules to very large pebbles.		
103	120						(103'); increase in sand and granules to very large pebbles, decrease in silt.		
104		IRZ-17-SS-102-107 3/7/2019 14:18	IRZ-17-VAS-102-107 (<0.17 U ppb) 3/3/2019 11:50						
105									
106							(106'); decrease in sand, increase in granules to very large pebbles, silt nodules.		
107							(107'); increase slit, decrease in granules to very large pebbles.		
108									
109		IRZ-17-SS-107-112 3/7/2019 14:22		Topock - Alluvium Deposits	SM		(108.5'); and granules to very large pebbles, angular to subround; little silt; decrease in silt.		
110							(109.5'); some silt; increase in silt, decrease in granules to very large pebbles.		
111									
112	120						(112') reddish brown / moderate brown(5YR 4/4) some dusky red(5R 3/4); increase silt, decrease granules to very large pebbles, trace weathered gravel, mottling.		
113									
114		IRZ-17-SS-112-117 3/7/2019 14:26							
115									
116									
117							(117') reddish brown / moderate brown(5YR 4/4); little silt; decrease in silt, increase sand, no mottling.		
118		IRZ-17-SS-117-122 3/7/2019 14:31							
119	120								
120				Topock - Alluvium Deposits	ML		(119.0 - 124.0') Topock - Alluvium Deposits; Sandy silt with gravel (ML); reddish brown / moderate brown(5YR 4/4) trace dusky red(5R 3/4); low plasticity, no dilatency; some granules to very large pebbles,		

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, blue water table symbol represents depth to water measured during the first VAS interval

Date Started: 03/02/2019
Date Completed: 03/13/2019
Drilling Co.: Cascade
Drilling Method: Sonic Drilling
Drill Rig Type: Prosonic Truck Mount
Driller Name: Steve Vasquez
Drilling Asst: O. Flores, L. Amaya
Logger: G Jeffers / J. Wanner
Editor: Sean McGrane

Surface Elevation: 480.3 ft amsl
Northing (NAD83): 2103000.2
Easting (NAD83): 7615871.3
Total Depth: 227 ft bgs
Borehole Diameter: 6-12 inches
Depth to First Water: 26.55 ft bgs
Sampling Method: 4 inch x 10 ft Core Barrel
Sampling Interval: Continuous
Converted to Well: ☒ Yes ☐ No

Boring No.: IRZ-17 Pilot

Client: PG&E
Project: Final GW Remedy Phase I
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
121	120	IRZ-17-SS-117-122 3/7/2019 14:31		Topock - Alluvium Deposits	ML		angular to subangular; some very fine to very coarse grained sand, angular to subround; wet; medium stiff to stiff; no odor; no staining; larger clasts consist of granodiorite and metadiorite. (120'); decrease in sand, increase in granules to very large pebbles.		(0.0 - 217.0') No water used
122							(122'); decrease silt, increase sand.		
123		IRZ-17-SS-122-127 3/7/2019 14:36							
124				Topock - Alluvium Deposits	SM		(124.0 - 132.0') Topock - Alluvium Deposits; Silty sand with gravel (SM); brown (7.5YR 4/3) some (7.5R 4/6); very fine grained to very coarse grained, angular to subround; some granules to very large pebbles, angular to subround; little silt; trace mica; wet; no odor; no staining; larger clasts consist of quartzite, granodiorite, and metadiorite, weathered gravel observed.		
125									
126							(126') reddish brown / moderate brown(5YR 4/4); some silt; decrease sand.		
127									
128									
129		IRZ-17-SS-127-132 3/7/2019 14:40							
130									
131							(129.5 - 132.0'); little silt; increase sand.		
132	120								
133				Topock - Alluvium Deposits	ML		(132.0 - 133.0') Topock - Alluvium Deposits; Sandy silt with gravel (ML); reddish brown / moderate brown(5YR 4/4); low plasticity, no dilatency; some granules to very large pebbles, angular to subround; some very fine to very coarse grained sand, angular to subround; trace cobbles, subangular to subround; wet; stiff; no odor; no staining; larger clasts consist of metadiorite.	(132.0 - 137.0') Sample collected during the installation of temporary backfill	
134		IRZ-17-SS-132-137 3/7/2019 14:45	IRZ-17VAS-132-137 (<0.17 U ppb) 3/13/2019 12:05	Topock - Alluvium Deposits	GM		(133.0 - 136.5') Topock - Alluvium Deposits; Silty gravel with sand (GM); reddish brown / moderate brown(5YR 4/4); granules to very large pebbles, angular to subround; some very fine to very coarse grained sand, angular to subround; some silt; trace cobbles, subangular to subround; trace mica; wet; no odor; no staining; larger clasts consist of granite, granodiorite, and metadiorite, weathered granules to very large pebbles observed. 4" Silty sand with gravel lense at 134' bgs.		
135									
136									
137				Topock - Alluvium Deposits	SM		(136.5 - 156.5') Topock - Alluvium Deposits; Silty sand with gravel (SM); reddish brown / moderate brown(5YR 4/4); very fine grained to very coarse grained, angular to subround; some granules to very large pebbles, angular to subangular; some silt; trace mica; wet; no odor; no staining; larger clasts consist of metadiorite and granodiorite, trace weathered granules to very coarse pebbles. (137'); decrease granules to very large pebbles, increase sand.	(137.0 - 142.0') Sample collected during the installation of temporary backfill	
138	120	IRZ-17-SS-137-142 3/7/2019 14:47	IRZ-17-VAS-137-142 (<0.17 U ppb) 3/12/2019 14:50						
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, blue water table symbol represents depth to water measured during the first VAS interval

Date Started: 03/02/2019
Date Completed: 03/13/2019
Drilling Co.: Cascade
Drilling Method: Sonic Drilling
Drill Rig Type: Prosonic Truck Mount
Driller Name: Steve Vasquez
Drilling Asst: O. Flores, L. Amaya
Logger: G Jeffers / J. Wanner
Editor: Sean McGrane

Surface Elevation: 480.3 ft amsl
Northing (NAD83): 2103000.2
Easting (NAD83): 7615871.3
Total Depth: 227 ft bgs
Borehole Diameter: 6-12 inches
Depth to First Water: 26.55 ft bgs
Sampling Method: 4 inch x 10 ft Core Barrel
Sampling Interval: Continuous
Converted to Well: ☒ Yes ☐ No

Boring No.: IRZ-17 Pilot

Client: PG&E
Project: Final GW Remedy Phase I
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
141	120	IRZ-17-SS-137-142 3/7/2019 14:47	IRZ-17-VAS-137-142 (<0.17 U ppb) 3/12/2019 14:50	Topock - Alluvium Deposits	SM		(142'); little silt; decrease in granules to very large pebbles, increase in sand.	(137.0 - 142.0') Sample collected during the installation of temporary backfill	(0.0 - 217.0') No water used
142									
143		IRZ-17-SS-142-147 3/7/2019 14:50	IRZ-17-VAS-142-147 (84 ppb) 3/4/2019 10:24						
144									
145							(145'); some silt; decrease in sand.		
146									
147									
148	120	IRZ-17-SS-147-152 3/7/2019 14:53	IRZ-17-VAS-147-152 (<0.33 U ppb) 3/12/2019 11:05					(147.0 - 152.0') Sample collected during the installation of temporary backfill	
149									
150									
151									
152		IRZ-17-SS-152-157 3/7/2019 14:57	IRZ-17-SS-152-157 3/4/2019 12:00				(152') dark grayish brown (2.5Y 4/2); decrease in sand, increase silt, some mottling.		
153							(153'); increase in sand, decrease silt, no moddling.		
154									
155							(154.5'); 12-24 mm silt nodules.		
156									
157									
158	120	IRZ-17-SS-157-162 3/7/2019 14:59		Topock - Alluvium Deposits	ML		(156.5 - 160.5') Topock - Alluvium Deposits; Sandy silt with gravel (ML); reddish brown / moderate brown(5YR 4/4); low plasticity, no dilatency; some granules to very large pebbles, angular to subround; some very fine to very coarse grained sand, angular to subround; wet; stiff; no odor; no staining; larger clasts consist of granodiorite, metadiorite, and feldspars. (158'); moist; hard; weak cementation; decrease silt, increase sand. (158.5'); wet; very stiff; increase silt, no cementation.		
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, blue water table symbol represents depth to water measured during the first VAS interval

Date Started:	03/02/2019	Surface Elevation:	480.3 ft amsl	**Boring No.:**	**IRZ-17 Pilot**
Date Completed:	03/13/2019	Northing (NAD83):	2103000.2		
Drilling Co.:	Cascade	Easting (NAD83):	7615871.3	Client:	PG&E
Drilling Method:	Sonic Drilling	Total Depth:	227 ft bgs	Project:	Final GW Remedy Phase I
Drill Rig Type:	Prosonic Truck Mount	Borehole Diameter:	6-12 inches	Location:	PG&E Topock, Needles, California
Driller Name:	Steve Vasquez	Depth to First Water:	26.55 ft bgs		
Drilling Asst:	O. Flores, L. Amaya	Sampling Method:	4 inch x 10 ft Core Barrel	Project Number:	RC000753.0051
Logger:	G Jeffers / J. Wanner	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
					ML				(0.0 - 217.0') No water used
161		IRZ-17-SS-157-162 3/7/2019 14:59		Topock - Alluvium Deposits	SM		(160.5 - 162.5') Topock - Alluvium Deposits; Silty sand (SM); reddish brown / moderate brown(5YR 4/4); very fine grained to very coarse grained, angular to subangular; little granules to large pebbles, subangular to subround; little silt; trace mica; wet; no odor; no staining; 2-15 mm silt nodules, larger clasts consist of metadiorite.		
162									
163	120		IRZ-17-VAS-162-167 (<0.17 U ppb) 3/4/2019 17:01	Topock - Alluvium Deposits	GM		(162.5 - 164.0') Topock - Alluvium Deposits; Silty gravel with sand (GM); reddish brown / moderate brown(5YR 4/4); granules to very large pebbles, angular to subround; and very fine to very coarse grained sand, angular to subround; little silt; trace mica; wet; no odor; no staining; larger clasts consist of granodiorite and metadiorite.		
164		IRZ-17-SS-162-167 3/7/2019 15:01							
165				Topock - Alluvium Deposits	SM		(164.0 - 183.0') 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; little granules to large pebbles, angular to subround; little silt; trace mica; wet; no odor; no staining; larger clasts consist of metadiorite.		
166							(165.5'); some granules to large pebbles, angular to subround; decrease in sand, increase in silt.		
167									
168									
169		IRZ-17-SS-167-172 3/7/2019 15:02							
170							(170') dark reddish brown (5YR 3/3); and granules to large pebbles, angular to subround; decrease in sand.		
171									
172	120								
173							(173') dark reddish brown (5YR 3/3) and black (5YR 2.5/1); silt mottled.		
174		IRZ-17-SS-172-177 3/7/2019 15:04	IRZ-17-VAS-172-177 (<0.17 U ppb) 3/5/2019 15:20				(173.5') reddish brown / moderate brown(5YR 4/4); some granules to large pebbles, angular to subround; trace cobbles, subround; increase in sand, no mottling.		
175									
176									
177							(177'); some silt; trace clay; decrease in granules to very large pebbles and grain size, decrease sand.		
178									
179	120	IRZ-17-SS-177-182 3/7/2019 15:05					(178.5'); little silt; no clay, increase sand, trace weathered granules to very large pebbles.		
180							(179.5'); some silt; decrease in sand.		

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Date Started: 03/02/2019
Date Completed: 03/13/2019
Drilling Co.: Cascade
Drilling Method: Sonic Drilling
Drill Rig Type: Prosonic Truck Mount
Driller Name: Steve Vasquez
Drilling Asst: O. Flores, L. Amaya
Logger: G Jeffers / J. Wanner
Editor: Sean McGrane

Surface Elevation: 480.3 ft amsl
Northing (NAD83): 2103000.2
Easting (NAD83): 7615871.3
Total Depth: 227 ft bgs
Borehole Diameter: 6-12 inches
Depth to First Water: 26.55 ft bgs
Sampling Method: 4 inch x 10 ft Core Barrel
Sampling Interval: Continuous
Converted to Well: ☒ Yes ☐ No

Boring No.: IRZ-17 Pilot

Client: PG&E
Project: Final GW Remedy Phase I
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
181	120	IRZ-17-SS-177-182 3/7/2019 15:05		Topock - Alluvium Deposits	SM		(180.5'); little granules to large pebbles, angular to subround; increase sand.		(0.0 - 217.0') No water used
182									
183		IRZ-17-SS-182-187 3/7/2019 15:06		Topock - Alluvium Deposits	ML		(183.0 - 185.5') Topock - Alluvium Deposits; Gravelly silt with sand (ML); yellowish red (5YR 4/6); low plasticity, no dilatency; some granules to very large pebbles, angular to subangular; some very fine to very coarse grained sand, angular to subround; trace mica; wet; stiff to very stiff; no odor; no staining; larger clasts consist of granodiorite and metadiorite.		
184									
185									
186				Topock - Alluvium Deposits	SM		(185.5 - 187.0') Topock - Alluvium Deposits; Silty sand with gravel (SM); yellowish red (5YR 4/6); medium grained to very coarse grained, angular to subangular; some silt; little small to large pebbles, angular to subangular; little mica; wet; no odor; no staining; larger clasts consist of metadiorite.		
187									
188	60	IRZ-17-SS-187-192 3/7/2019 15:07		Topock - Alluvium Deposits	ML		(187.0 - 192.0') Topock - Alluvium Deposits; Sandy silt with gravel (ML); yellowish red (5YR 4/6); low plasticity, no dilatency; some granules to very large pebbles, angular to subround; some very fine to very coarse grained sand, angular to subround; trace mica; wet; stiff; no odor; no staining; larger clasts consist of metadiorite.		
189									
190									
191									
192									
193	60			Topock - Weathered Bedrock - conglomerate	SM		(192.0 - 206.5') Topock - Weathered Bedrock - conglomerate; Silty sand with gravel (SM); reddish brown (2.5YR 4/4); very fine grained to very coarse grained, angular to subangular; some granules to very large pebbles, angular to subangular; some silt; some mica; wet; no odor; weak cementation; no staining; trace weathered granules, tight formation.		
194									
195									
196									
197									
198	60		IRZ-17-VAS-197-202 (<0.17 U ppb) 3/6/2019 11:20						
199									
200									

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Boring Log

ARCADIS Design & Consultancy for natural and built assets

Boring No.: IRZ-17 Pilot

Date Started:	03/02/2019	Surface Elevation:	480.3 ft amsl	Client:	PG&E
Date Completed:	03/13/2019	Northing (NAD83):	2103000.2		
Drilling Co.:	Cascade	Easting (NAD83):	7615871.3	Project:	Final GW Remedy Phase I
Drilling Method:	Sonic Drilling	Total Depth:	227 ft bgs	Location:	PG&E Topock, Needles, California
Drill Rig Type:	Prosonic Truck Mount	Borehole Diameter:	6-12 inches		
Driller Name:	Steve Vasquez	Depth to First Water:	26.55 ft bgs		
Drilling Asst:	O. Flores, L. Amaya	Sampling Method:	4 inch x 10 ft Core Barrel	Project Number:	RC000753.0051
Logger:	G Jeffers / J. Wanner	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	60		IRZ-17-VAS-197-202 (<0.17 U ppb) 3/6/2019 11:20	Topock - Weathered Bedrock - conglomerate	SM				(0.0 - 217.0') No water used
202								(202.0 - 212.0') Tight formation	
203									
204									
205									
206									
207	120			Topock - Weathered Bedrock - conglomerate	ML		(206.5 - 209.5') Topock - Weathered Bedrock - conglomerate; Sandy silt with gravel (ML); red (2.5YR 4/6); low plasticity, no dilatency; some granules to very large pebbles, angular to subangular; some very fine to very coarse grained sand, angular to subround; trace mica; wet; very stiff; no odor; weak cementation; no staining; larger clasts consist of metadiorite and granodiarite trace weathred granules to very large pebbles.		
208									
209									
210				Topock - Weathered Bedrock - conglomerate	SM		(209.5 - 213.0') Topock - Weathered Bedrock - conglomerate; Silty sand with gravel (SM); reddish brown (2.5YR 4/4); very fine grained to very coarse grained, subangular to subround; some granules to very large pebbles, angular to subangular; some silt; some mica; wet; no odor; no staining; trace weathered granules to very large pebbles.		
211									
212								(212.0 - 222.0') Soft drilling	
213	120			Topock - Weathered Bedrock - conglomerate	ML		(213.0 - 215.5') Topock - Weathered Bedrock - conglomerate; Sandy silt with gravel (ML); red (2.5YR 4/6); low plasticity, no dilatency; some granules to very large pebbles, angular to subangular; some very fine to very coarse grained sand, angular to subround; trace mica; wet; very stiff; no odor; no staining; larger clasts consist of metadiorite and granodiarite. trace weathred granules to very large pebbles.		
214									
215									
216				Topock - Weathered Bedrock - conglomerate	SM		(215.5 - 227.0') Topock - Weathered Bedrock - conglomerate; Silty sand with gravel (SM); reddish brown (2.5YR 4/4); very fine grained to very coarse grained, subangular to subround; some granules to very large pebbles, angular to subangular; some silt; some mica; wet; no odor; no staining; trace weathered granules to very large pebbles.		
217									
218			IRZ-17-VAS-217-222 (<0.17 U ppb) 3/6/2019 16:17						
219									
220									

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ARCADIS Design & Consultancy for natural and built assets

Boring Log

Sheet: 12 of 12

Boring No.: IRZ-17 Pilot

Date Started:	03/02/2019	Surface Elevation:	480.3 ft amsl		
Date Completed:	03/13/2019	Northing (NAD83):	2103000.2		
Drilling Co.:	Cascade	Easting (NAD83):	7615871.3	Client:	PG&E
Drilling Method:	Sonic Drilling	Total Depth:	227 ft bgs	Project:	Final GW Remedy Phase I
Drill Rig Type:	Prosonic Truck Mount	Borehole Diameter:	6-12 inches	Location:	PG&E Topock, Needles, California
Driller Name:	Steve Vasquez	Depth to First Water:	26.55 ft bgs		
Drilling Asst:	O. Flores, L. Amaya	Sampling Method:	4 inch x 10 ft Core Barrel	Project Number:	RC000753.0051
Logger:	G Jeffers / J. Wanner	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	120		IRZ-17-VAS-217-222 (<0.17 U ppb) 3/6/2019 16:17	Topock - Weathered Bedrock - conglomerate	SM			(212.0 - 222.0') Soft drilling	
222									
223									
224									
225	60								
226									
227							End of Boring at 227.0 'bgs.		
228									
229									
230									
231									
232									
233									
234									
235									
236									
237									
238									
239									
240									

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, blue water table symbol represents depth to water measured during the first VAS interval

Temporary Backfill Log

ARCADIS Design & Consultancy for natural and built assets

Date Started:	03/02/2019	Surface Elevation:	480.3 ft amsl	**Well ID: IRZ-17 Pilot**	
Date Completed:	03/13/2019	Northing (NAD83):	2103000.2		
Drilling Co.:	Cascade	Easting (NAD83):	7615871.3	Client:	PG&E
Drilling Method:	Sonic Drilling	Total Depth:	227 ft bgs	Project:	Final GW Remedy Phase I
Driller Name:	Steve Vasquez	Borehole Diameter:	6-12 inches	Location:	PG&E Topock, Needles, California
Drilling Asst:	O. Flores, L. Amaya	Depth to First Water:	26.55 ft bgs		
Logger:	G Jeffers / J. Wanner	Editor:	Sean McGrane	Project Number:	RC000753.0051

Depth (ft)	Groundwater Sample ID	Geologic Formation	USCS Code	USCS Class	Well Construction	Calculated Material Volumes	Material Volumes Installed
1–20		Topock - Fill	NR / SP		(0.0 - 0.5') Temporary Steel Plate with BMP (0.5 - 5.0') Plastering Sand (0.0 - 9.0') 12" Borehole (5.0 - 137.0') Pea Gravel (9.0 - 227.0') 6" Borehole	(0.5 - 5.0') 7.9 bags (5.0 - 137.0') 55.3 bags	(0.5 - 5.0') 6 bags (-24%) Note: Wildcat Washed, actual volume installed was 24% less because of dredged materials collapsing during casing removal (5.0 - 137.0') 60 bags (8%) Note: Cal-Silica 1/4"-3/8", Actual volume is lower because backfilling was done in lifts to allow collection of VAS groundwater samples.

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, blue water table symbol represents depth to water measured during the first VAS interval Note: Granule backfill material will be excavated from the pilot borehole during drilling for the construction of the well.

Temporary Backfill Log

Sheet: 2 of 12

Date Started:	03/02/2019	Surface Elevation:	480.3 ft amsl	**Well ID: IRZ-17 Pilot**	
Date Completed:	03/13/2019	Northing (NAD83):	2103000.2		
Drilling Co.:	Cascade	Easting (NAD83):	7615871.3	Client:	PG&E
Drilling Method:	Sonic Drilling	Total Depth:	227 ft bgs	Project:	Final GW Remedy Phase I
Driller Name:	Steve Vasquez	Borehole Diameter:	6-12 inches	Location:	PG&E Topock, Needles, California
Drilling Asst:	O. Flores, L. Amaya	Depth to First Water:	26.55 ft bgs		
Logger:	G Jeffers / J. Wanner	Editor:	Sean McGrane	Project Number:	RC000753.0051

Depth (ft)	Groundwater Sample ID	Geologic Formation	USCS Code	USCS Class	Well Construction	Calculated Material Volumes	Material Volumes Installed
21		Topock - Fill	SP				
22		Topock - Fluvial Deposits	SM				
23							
24							
25		Topock - Fluvial Deposits	ML				
26							
27							
28		Topock - Fluvial Deposits	SM				
29		Topock - Fluvial Deposits	ML				
30					(5.0 - 137.0') Pea Gravel	(5.0 - 137.0') 55.3 bags	(5.0 - 137.0') 60 bags (8%) Note: Cal-Silica 1/4"-3/8", Actual volume is lower because backfilling was done in lifts to allow collection of VAS groundwater samples.
31		Topock - Fluvial Deposits	MH				
32							
33							
34	IRZ-17-VAS-32-37 (67 ppb) 3/2/2019 13:14	Topock - Fluvial Deposits	SM				
35							
36		Topock - Alluvium Deposits	SM				
37							
38		Topock - Alluvium Deposits	GM				
39							
40					(9.0 - 227.0') 6" 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, blue water table symbol represents depth to water measured during the first VAS interval Note: Granule backfill material will be excavated from the pilot borehole during drilling for the construction of the well.

ARCADIS Design & Consultancy for natural and built assets

Temporary Backfill Log

Sheet: 3 of 12

Date Started:	03/02/2019	Surface Elevation:	480.3 ft amsl	**Well ID: IRZ-17 Pilot**	
Date Completed:	03/13/2019	Northing (NAD83):	2103000.2		
Drilling Co.:	Cascade	Easting (NAD83):	7615871.3	Client:	PG&E
Drilling Method:	Sonic Drilling	Total Depth:	227 ft bgs	Project:	Final GW Remedy Phase I
Driller Name:	Steve Vasquez	Borehole Diameter:	6-12 inches	Location:	PG&E Topock, Needles, California
Drilling Asst:	O. Flores, L. Amaya	Depth to First Water:	26.55 ft bgs		
Logger:	G Jeffers / J. Wanner	Editor:	Sean McGrane	Project Number:	RC000753.0051

Depth (ft)	Groundwater Sample ID	Geologic Formation	USCS Code	USCS Class	Well Construction	Calculated Material Volumes	Material Volumes Installed
41		Topock - Alluvium Deposits	GM		(5.0 - 137.0') Pea Gravel; (9.0 - 227.0') 6" Borehole	(5.0 - 137.0') 55.3 bags	(5.0 - 137.0') 60 bags (8%) Note: Cal-Silica 1/4"-3/8", Actual volume is lower because backfilling was done in lifts to allow collection of VAS groundwater samples.
42							
43							
44							
45		Topock - Alluvium Deposits	SM				
46							
47							
48							
49							
50							
51							
52							
53		Topock - Alluvium Deposits	SW				
54		Topock - Alluvium Deposits	SM				
55							
56							
57							
58		Topock - Alluvium Deposits	SW-SM				
59		Topock - Alluvium Deposits	ML				
60			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, blue water table symbol represents depth to water measured during the first VAS interval Note: Granule backfill material will be excavated from the pilot borehole during drilling for the construction of the well.

ARCADIS Design & Consultancy for natural and built assets

Temporary Backfill Log

Sheet: 4 of 12

Date Started:	03/02/2019	Surface Elevation:	480.3 ft amsl	**Well ID: IRZ-17 Pilot**	
Date Completed:	03/13/2019	Northing (NAD83):	2103000.2		
Drilling Co.:	Cascade	Easting (NAD83):	7615871.3	Client:	PG&E
Drilling Method:	Sonic Drilling	Total Depth:	227 ft bgs	Project:	Final GW Remedy Phase I
Driller Name:	Steve Vasquez	Borehole Diameter:	6-12 inches	Location:	PG&E Topock, Needles, California
Drilling Asst:	O. Flores, L. Amaya	Depth to First Water:	26.55 ft bgs		
Logger:	G Jeffers / J. Wanner	Editor:	Sean McGrane	Project Number:	RC000753.0051

Depth (ft)	Groundwater Sample ID	Geologic Formation	USCS Code	USCS Class	Well Construction	Calculated Material Volumes	Material Volumes Installed
61							
62		Topock - Alluvium Deposits	SM				
63							
64	IRZ-17-VAS-62-67 (0.604 J ppb) 3/2/2019 15:50	Topock - Alluvium Deposits	GM				
65							
66							
67							
68							
69							
70		Topock - Alluvium Deposits	SM		(5.0 - 137.0') Pea Gravel; (9.0 - 227.0') 6" Borehole	(5.0 - 137.0') 55.3 bags	(5.0 - 137.0') 60 bags (8%) Note: Cal-Silica 1/4"-3/8", Actual volume is lower because backfilling was done in lifts to allow collection of VAS groundwater samples.
71							
72							
73							
74							
75							
76							
77							
78		Topock - Alluvium Deposits	ML				
79							
80							

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, blue water table symbol represents depth to water measured during the first VAS interval Note: Granule backfill material will be excavated from the pilot borehole during drilling for the construction of the well.

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Temporary Backfill Log

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Date Started:	03/02/2019	Surface Elevation:	480.3 ft amsl	**Well ID: IRZ-17 Pilot**	
Date Completed:	03/13/2019	Northing (NAD83):	2103000.2		
Drilling Co.:	Cascade	Easting (NAD83):	7615871.3	Client:	PG&E
Drilling Method:	Sonic Drilling	Total Depth:	227 ft bgs	Project:	Final GW Remedy Phase I
Driller Name:	Steve Vasquez	Borehole Diameter:	6-12 inches	Location:	PG&E Topock, Needles, California
Drilling Asst:	O. Flores, L. Amaya	Depth to First Water:	26.55 ft bgs		
Logger:	G Jeffers / J. Wanner	Editor:	Sean McGrane	Project Number:	RC000753.0051

Depth (ft)	Groundwater Sample ID	Geologic Formation	USCS Code	USCS Class	Well Construction	Calculated Material Volumes	Material Volumes Installed
81			ML				
82		Topock - Alluvium Deposits	SM				
83		Topock - Alluvium Deposits	ML				
84							
85							
86		Topock - Alluvium Deposits	SM				
87							
88							
89							
90		Topock - Alluvium Deposits	ML		(5.0 - 137.0') Pea Gravel; (9.0 - 227.0') 6" Borehole	(5.0 - 137.0') 55.3 bags	(5.0 - 137.0') 60 bags (8%) Note: Cal-Silica 1/4"-3/8", Actual volume is lower because backfilling was done in lifts to allow collection of VAS groundwater samples.
91							
92							
93							
94							
95							
96							
97		Topock - Alluvium Deposits	SM				
98							
99							
100							

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, blue water table symbol represents depth to water measured during the first VAS interval Note: Granule backfill material will be excavated from the pilot borehole during drilling for the construction of the well.

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Temporary Backfill Log

Sheet: 6 of 12

Well ID: IRZ-17 Pilot

Date Started:	03/02/2019	Surface Elevation:	480.3 ft amsl	Client:	PG&E
Date Completed:	03/13/2019	Northing (NAD83):	2103000.2		
Drilling Co.:	Cascade	Easting (NAD83):	7615871.3	Project:	Final GW Remedy Phase I
Drilling Method:	Sonic Drilling	Total Depth:	227 ft bgs	Location:	PG&E Topock, Needles, California
Driller Name:	Steve Vasquez	Borehole Diameter:	6-12 inches		
Drilling Asst:	O. Flores, L. Amaya	Depth to First Water:	26.55 ft bgs		
Logger:	G Jeffers / J. Wanner	Editor:	Sean McGrane	Project Number:	RC000753.0051

Depth (ft)	Groundwater Sample ID	Geologic Formation	USCS Code	USCS Class	Well Construction	Calculated Material Volumes	Material Volumes Installed
101							
102							
103							
104	IRZ-17-VAS-102-107 (<0.17 U ppb) 3/3/2019 11:50						
105							
106							
107							
108							
109		Topock - Alluvium Deposits	SM		(5.0 - 137.0') Pea Gravel; (9.0 - 227.0') 6" Borehole	(5.0 - 137.0') 55.3 bags	(5.0 - 137.0') 60 bags (8%) Note: Cal-Silica 1/4"-3/8", Actual volume is lower because backfilling was done in lifts to allow collection of VAS groundwater samples.
110							
111							
112							
113							
114							
115							
116							
117							
118							
119		Topock - Alluvium Deposits	ML				
120							

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Temporary Backfill Log

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Date Started:	03/02/2019	Surface Elevation:	480.3 ft amsl	**Well ID: IRZ-17 Pilot**	
Date Completed:	03/13/2019	Northing (NAD83):	2103000.2		
Drilling Co.:	Cascade	Easting (NAD83):	7615871.3	Client:	PG&E
Drilling Method:	Sonic Drilling	Total Depth:	227 ft bgs	Project:	Final GW Remedy Phase I
Driller Name:	Steve Vasquez	Borehole Diameter:	6-12 inches	Location:	PG&E Topock, Needles, California
Drilling Asst:	O. Flores, L. Amaya	Depth to First Water:	26.55 ft bgs		
Logger:	G Jeffers / J. Wanner	Editor:	Sean McGrane	Project Number:	RC000753.0051

Depth (ft)	Groundwater Sample ID	Geologic Formation	USCS Code	USCS Class	Well Construction	Calculated Material Volumes	Material Volumes Installed
121		Topock - Alluvium Deposits	ML				
122							
123							
124							
125		Topock - Alluvium Deposits	SM		(5.0 - 137.0') Pea Gravel	(5.0 - 137.0') 55.3 bags	(5.0 - 137.0') 60 bags (8%) Note: Cal-Silica 1/4"-3/8", Actual volume is lower because backfilling was done in lifts to allow collection of VAS groundwater samples.
126							
127							
128							
129							
130					(9.0 - 227.0') 6" Borehole		
131							
132		Topock - Alluvium Deposits	ML				
133							
134	IRZ-17VAS-132-137 (<0.17 U ppb) 3/13/2019 12:05	Topock - Alluvium Deposits	GM				
135							
136							
137					(137.0 - 138.0') Plastering Sand	(137.0 - 138.0') 0.4 bags	(137.0 - 138.0') 0.86 bags (115%) Note: Wildcat Washed, installed before sampling
138	IRZ-17-VAS-137-142 (<0.17 U ppb) 3/12/2019 14:50	Topock - Alluvium Deposits	SM				
139					(138.0 - 142.0') Pea Gravel	(138.0 - 142.0') 2.1 bags	(138.0 - 142.0') 2 bags (-5%) Note: Cal-Silica 1/4"-3/8" inch
140							

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Date Started:	03/02/2019	Surface Elevation:	480.3 ft amsl	**Well ID: IRZ-17 Pilot**	
Date Completed:	03/13/2019	Northing (NAD83):	2103000.2		
Drilling Co.:	Cascade	Easting (NAD83):	7615871.3	Client:	PG&E
Drilling Method:	Sonic Drilling	Total Depth:	227 ft bgs	Project:	Final GW Remedy Phase I
Driller Name:	Steve Vasquez	Borehole Diameter:	6-12 inches	Location:	PG&E Topock, Needles, California
Drilling Asst:	O. Flores, L. Amaya	Depth to First Water:	26.55 ft bgs		
Logger:	G Jeffers / J. Wanner	Editor:	Sean McGrane	Project Number:	RC000753.0051

Depth (ft)	Groundwater Sample ID	Geologic Formation	USCS Code	USCS Class	Well Construction	Calculated Material Volumes	Material Volumes Installed
141	IRZ-17-VAS-137-142 (<0.17 U ppb) 3/12/2019 14:50				(138.0 - 142.0') Pea Gravel	(138.0 - 142.0') 2.1 bags	(138.0 - 142.0') 2 bags (-5%) Note: Cal-Silica 1/4"-3/8" inch
142							
143					(142.0 - 143.0') Plastering Sand	(142.0 - 143.0') 0.4 bags	(142.0 - 143.0') 0.88 bags (120%) Note: Wildcat Washed, installed before sampling
144	IRZ-17-VAS-142-147 (84 ppb) 3/4/2019 10:24						
145							
146							
147							
148		Topock - Alluvium Deposits	SM		(143.0 - 152.3') Pea Gravel	(143.0 - 152.3') 3.9 bags	(143.0 - 152.3') 5 bags (28%) Note: Cal-Silica 1/4"-3/8" inch
149	IRZ-17-VAS-147-152 (<0.33 U ppb) 3/12/2019 11:05						
150					(9.0 - 227.0') 6" Borehole		
151							
152							
153					(152.3 - 153.0') Plastering Sand	(152.3 - 153.0') 0.3 bags	(152.3 - 153.0') 0.25 bags (-17%) Note: Wildcat Washed, installed before sampling
154	IRZ-17-SS-152-157 3/4/2019 12:00						
155							
156							
157					(153.0 - 182.0') Pea Gravel	(153.0 - 182.0') 12.2 bags	(153.0 - 182.0') 10 bags (-18%) Note: Cal-Silica 1/4"-3/8" inch
158		Topock - Alluvium Deposits	ML				
159							
160							

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Temporary Backfill Log

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Date Started:	03/02/2019	Surface Elevation:	480.3 ft amsl	**Well ID: IRZ-17 Pilot**	
Date Completed:	03/13/2019	Northing (NAD83):	2103000.2		
Drilling Co.:	Cascade	Easting (NAD83):	7615871.3	Client:	PG&E
Drilling Method:	Sonic Drilling	Total Depth:	227 ft bgs	Project:	Final GW Remedy Phase I
Driller Name:	Steve Vasquez	Borehole Diameter:	6-12 inches	Location:	PG&E Topock, Needles, California
Drilling Asst:	O. Flores, L. Amaya	Depth to First Water:	26.55 ft bgs		
Logger:	G Jeffers / J. Wanner	Editor:	Sean McGrane	Project Number:	RC000753.0051

Depth (ft)	Groundwater Sample ID	Geologic Formation	USCS Code	USCS Class	Well Construction	Calculated Material Volumes	Material Volumes Installed
161			ML				
162		Topock - Alluvium Deposits	SM				
163		Topock - Alluvium Deposits	GM				
164	IRZ-17-VAS-162-167 (<0.17 U ppb) 3/4/2019 17:01						
165							
166							
167							
168							
169							
170					(153.0 - 182.0') Pea Gravel; (9.0 - 227.0') 6" Borehole	(153.0 - 182.0') 12.2 bags	(153.0 - 182.0') 10 bags (-18%) Note: Cal-Silica 1/4"-3/8" inch
171							
172		Topock - Alluvium Deposits	SM				
173							
174	IRZ-17-VAS-172-177 (<0.17 U ppb) 3/5/2019 15:20						
175							
176							
177							
178							
179							
180							

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Temporary Backfill Log

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Date Started:	03/02/2019	Surface Elevation:	480.3 ft amsl	**Well ID: IRZ-17 Pilot**	
Date Completed:	03/13/2019	Northing (NAD83):	2103000.2		
Drilling Co.:	Cascade	Easting (NAD83):	7615871.3	Client:	PG&E
Drilling Method:	Sonic Drilling	Total Depth:	227 ft bgs	Project:	Final GW Remedy Phase I
Driller Name:	Steve Vasquez	Borehole Diameter:	6-12 inches	Location:	PG&E Topock, Needles, California
Drilling Asst:	O. Flores, L. Amaya	Depth to First Water:	26.55 ft bgs		
Logger:	G Jeffers / J. Wanner	Editor:	Sean McGrane	Project Number:	RC000753.0051

Depth (ft)	Groundwater Sample ID	Geologic Formation	USCS Code	USCS Class	Well Construction	Calculated Material Volumes	Material Volumes Installed
181		Topock - Alluvium Deposits	SM		(153.0 - 182.0') Pea Gravel	(153.0 - 182.0') 12.2 bags	(153.0 - 182.0') 10 bags (-18%) Note: Cal-Silica 1/4"-3/8" inch
182							
183		Topock - Alluvium Deposits	ML				
184							
185							
186		Topock - Alluvium Deposits	SM				
187					(182.0 - 192.0') Cemex #3 MESH (8x10)	(182.0 - 192.0') 4.2 bags	(182.0 - 192.0') 6 bags (43%) Note: Lapis Lustre Sand
188		Topock - Alluvium Deposits	ML				
189							
190					(9.0 - 227.0') 6" Borehole		
191							
192							
193		Topock - Weathered Bedrock - conglomerate	SM				
194							
195							
196					(192.0 - 227.0') Bentonite seal pack	(192.0 - 227.0') 10.2 bags	(192.0 - 227.0') 13 bags (27%) Note: Puregold Medium Chips and Enviroplug Chips
197							
198	IRZ-17-VAS-197-202 (<0.17 U ppb) 3/6/2019 11:20						
199							
200							

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Temporary Backfill Log

Well ID: IRZ-17 Pilot

Date Started:	03/02/2019	Surface Elevation:	480.3 ft amsl	Client:	PG&E
Date Completed:	03/13/2019	Northing (NAD83):	2103000.2	Project:	Final GW Remedy Phase I
Drilling Co.:	Cascade	Easting (NAD83):	7615871.3	Location:	PG&E Topock, Needles, California
Drilling Method:	Sonic Drilling	Total Depth:	227 ft bgs		
Driller Name:	Steve Vasquez	Borehole Diameter:	6-12 inches		
Drilling Asst:	O. Flores, L. Amaya	Depth to First Water:	26.55 ft bgs		
Logger:	G Jeffers / J. Wanner	Editor:	Sean McGrane	Project Number:	RC000753.0051

Depth (ft)	Groundwater Sample ID	Geologic Formation	USCS Code	USCS Class	Well Construction	Calculated Material Volumes	Material Volumes Installed
201	IRZ-17-VAS-197-202 (<0.17 U ppb) 3/6/2019 11:20	Topock - Weathered Bedrock - conglomerate	SM				
202							
203							
204							
205							
206							
207		Topock - Weathered Bedrock - conglomerate	ML				
208							
209							
210		Topock - Weathered Bedrock - conglomerate	SM		(192.0 - 227.0') Bentonite seal pack; (9.0 - 227.0') 6" Borehole	(192.0 - 227.0') 10.2 bags	(192.0 - 227.0') 13 bags (27%) Note: Puregold Medium Chips and Enviroplug Chips
211							
212							
213		Topock - Weathered Bedrock - conglomerate	ML				
214							
215							
216							
217							
218	IRZ-17-VAS-217-222 (<0.17 U ppb) 3/6/2019 16:17	Topock - Weathered Bedrock - conglomerate	SM				
219							
220							

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Temporary Backfill Log

Sheet: 12 of 12

Well ID: IRZ-17 Pilot

Date Started:	03/02/2019	Surface Elevation:	480.3 ft amsl	Client:	PG&E
Date Completed:	03/13/2019	Northing (NAD83):	2103000.2		
Drilling Co.:	Cascade	Easting (NAD83):	7615871.3	Project:	Final GW Remedy Phase I
Drilling Method:	Sonic Drilling	Total Depth:	227 ft bgs	Location:	PG&E Topock, Needles, California
Driller Name:	Steve Vasquez	Borehole Diameter:	6-12 inches		
Drilling Asst:	O. Flores, L. Amaya	Depth to First Water:	26.55 ft bgs		
Logger:	G Jeffers / J. Wanner	Editor:	Sean McGrane	Project Number:	RC000753.0051

Depth (ft)	Groundwater Sample ID	Geologic Formation	USCS Code	USCS Class	Well Construction	Calculated Material Volumes	Material Volumes Installed
221	IRZ-17-VAS-217-222 (<0.17 U ppb) 3/6/2019 16:17	Topock - Weathered Bedrock - conglomerate	SM		(192.0 - 227.0') Bentonite seal pack; (9.0 - 227.0') 6" Borehole	(192.0 - 227.0') 10.2 bags	(192.0 - 227.0') 13 bags (27%) Note: Puregold Medium Chips and Enviroplug Chips
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

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, blue water table symbol represents depth to water measured during the first VAS interval Note: Granule backfill material will be excavated from the pilot borehole during drilling for the construction of the well.