Well Construction Log

ARCADIS Design & Consultancy for natural and built assets

Date Started:	07/23/2019	Surface Elevation:	464.47 ft amsl	**Well ID: RB-5**	
Date Completed:	06/29/2020	Shallow Well Elevation:	464.95 ft amsl		
Drilling Co.:	Cascade	Deep Well Elevation:	NA	Client:	PG&E
Drilling Method:	Dual Rotary	Northing (NAD83):	2102420.60	Project:	Final GW Remedy Phase 1
Driller Name:	Jon Martinez	Easting (NAD83):	7616397.54	Location:	PG&E Topock, Needles, California
Drilling Asst:	H. & A. Amezquita	Borehole Diameter:	18-24 inches		
Logger:	Drew Martzolf	Static Water Level:	See Log for Depths	Project Number:	RC000753.0051
Editor:	Sean McGrane	Development End Date:	10/24/2019		
Total Depth:	99.25 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
0					(+0.9 - 2.6') Temporary surface completion		(+0.9 - 2.6') 23.5 bags Note: 30 inch diameter Quickrete cement pad dyed buff with 18 inch diameter lockable vault.
1					(+0.5 - 24.0') 8" SHUR-GRIP SDR17 PVC Casing		
2		Topock - Fill	SP				Note: 12 inch diameter sonotube around well casing filled with native sand.
3					(2.6 - 3.9') Cemex #60 (40/70) and Cemex #0/30 Mesh (30x50) Lapis Lustre Sand	(2.6 - 3.9') 21.8 bags	(2.6 - 3.9') 26 bags (119%) Note: Temporary backfill sand to fill annular space prior to vault installation. Partially excavated during the installation of the temporary surface completion.
4							
5		Topock - Fill	SP				
6		Topock - Fill	SC				
7		Topock - Fill	SP				
8					(3.9 - 12.0') Portland Cement 3% Bentonite Type I, II and V with Hydrogel	(3.9 - 12.0') 168.1 gallons	(3.9 - 12.0') 153 gallons (91%) Note: Grout seal
9		Topock - Fill	SP-SM				
10					(0.0 - 20.0') 24.0" Borehole		
11		Topock - Fluvial Deposits	SP				
12		Topock - Fluvial Deposits	SM				
12		Topock - Fluvial Deposits	SP-SM		(12.0 - 13.2') Bentonite seal chips Puregold medium chips	(12.0 - 13.2') 2.5 bags	(12.0 - 13.2') 5 bags (200%) Note: Seal above transition sand, used >20% of the calculated volume due to potential voids forming during drilling.
13		Topock - Fluvial Deposits	SM				
14	RB-5-VAS-12.0-17.0 (0.125 J ppb) 4/4/2019 10:49	Topock - Fluvial Deposits	NR		(13.2 - 16.1') Cemex #60 (40x70) Lapis Lustre Sand	(13.2 - 16.1') 8.2 bags	(13.2 - 16.1') 16 bags (195%) Note: Transition sand, used >20% of the calculated volume due to potential voids forming during drilling.
15							
16							
17							
18		Topock - Fluvial Deposits	SM		(16.1 - 47.1') Cemex #0/30 Mesh (30x50) Lapis Lustre Sand	(16.1 - 47.1') 87.9 bags	(16.1 - 47.1') 121 bags (138%) Note: Filter pack, swabbed filter pack for approximately 74 minutes prior to installation of transition sand. Used >20% of the calculated volume due to potential voids forming during drilling.
19							

Abbreviations: USCS = Unified Soil Classification System, ft = feet, bgs = below ground surface, amsl = above mean sea level, GW = groundwater, ppb = parts per billion, U = not detected above the laboratory reporting limit, 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

Well ID: RB-5

Date Started:	07/23/2019	Surface Elevation:	464.47 ft amsl		
Date Completed:	06/29/2020	Shallow Well Elevation:	464.95 ft amsl		
Drilling Co.:	Cascade	Deep Well Elevation:	NA	Client:	PG&E
Drilling Method:	Dual Rotary	Northing (NAD83):	2102420.60	Project:	Final GW Remedy Phase 1
Driller Name:	Jon Martinez	Easting (NAD83):	7616397.54	Location:	PG&E Topock, Needles, California
Drilling Asst:	H. & A. Amezquita	Borehole Diameter:	18-24 inches		
Logger:	Drew Martzolf	Static Water Level:	See Log for Depths	Project Number:	RC000753.0051
Editor:	Sean McGrane	Development End Date:	10/24/2019		
Total Depth:	99.25 ft bgs	Well Completion:	☒ Flush ☐ Stick-up ☐ To Be Completed in Well Vault		

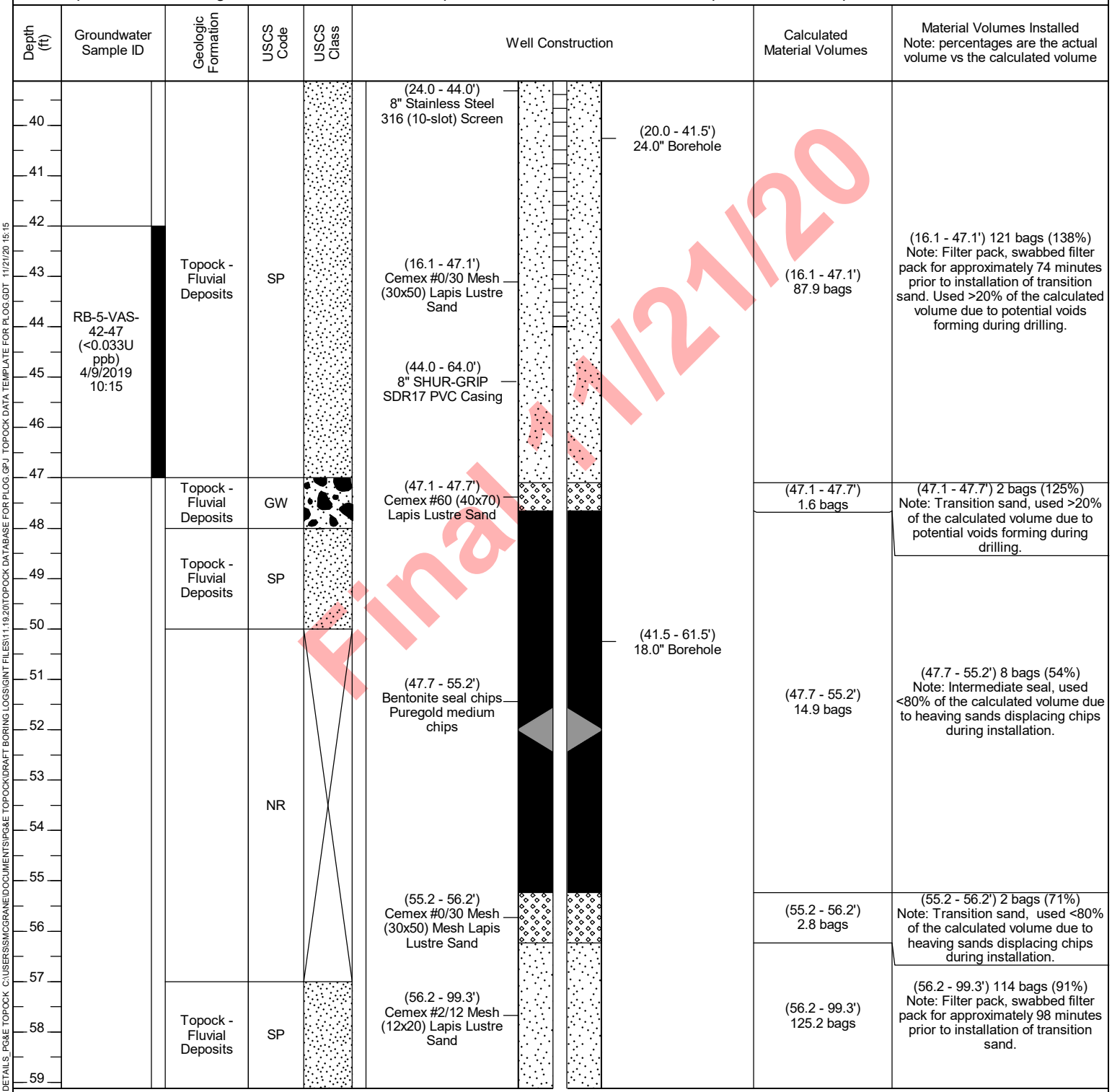
Depth (ft)	Groundwater Sample ID	Geologic Formation	USCS Code	USCS Class	Well Construction	Calculated Material Volumes	Material Volumes Installed Note: percentages are the actual volume vs the calculated volume
20		Topock - Fluvial Deposits	SM / SP-SM		(+0.5 - 24.0') 8" SHUR-GRIP SDR17 PVC Casing; (0.0 - 20.0') 24.0" Borehole		
21		Topock - Fluvial Deposits	SP				
22							
23			NR				
24					(24.0 - 44.0') 8" Stainless Steel 316 (10-slot) Screen		
25							
26							
27							
28							
29					(16.1 - 47.1') Cemex #0/30 Mesh (30x50) Lapis Lustre Sand; (20.0 - 41.5') 24.0" Borehole	(16.1 - 47.1') 87.9 bags	(16.1 - 47.1') 121 bags (138%) Note: Filter pack, swabbed filter pack for approximately 74 minutes prior to installation of transition sand. Used >20% of the calculated volume due to potential voids forming during drilling.
30							
31		Topock - Fluvial Deposits	SP				
32							
33							
34							
35							
36							
37							
38							
39							

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

Date Started:	07/23/2019	Surface Elevation:	464.47 ft amsl	**Well ID: RB-5**	
Date Completed:	06/29/2020	Shallow Well Elevation:	464.95 ft amsl		
Drilling Co.:	Cascade	Deep Well Elevation:	NA	Client:	PG&E
Drilling Method:	Dual Rotary	Northing (NAD83):	2102420.60	Project:	Final GW Remedy Phase 1
Driller Name:	Jon Martinez	Easting (NAD83):	7616397.54	Location:	PG&E Topock, Needles, California
Drilling Asst:	H. & A. Amezquita	Borehole Diameter:	18-24 inches		
Logger:	Drew Martzolf	Static Water Level:	See Log for Depths	Project Number:	RC000753.0051
Editor:	Sean McGrane	Development End Date:	10/24/2019		
Total Depth:	99.25 ft bgs	Well Completion:	☒ Flush ☐ Stick-up ☐ To Be Completed in Well Vault		



Calculated Material Volumes	Material Volumes Installed Note: percentages are the actual volume vs the calculated volume
(16.1 - 47.1') 87.9 bags	(16.1 - 47.1') 121 bags (138%) Note: Filter pack, swabbed filter pack for approximately 74 minutes prior to installation of transition sand. Used >20% of the calculated volume due to potential voids forming during drilling.
(47.1 - 47.7') 1.6 bags	(47.1 - 47.7') 2 bags (125%) Note: Transition sand, used >20% of the calculated volume due to potential voids forming during drilling.
(47.7 - 55.2') 14.9 bags	(47.7 - 55.2') 8 bags (54%) Note: Intermediate seal, used <80% of the calculated volume due to heaving sands displacing chips during installation.
(55.2 - 56.2') 2.8 bags	(55.2 - 56.2') 2 bags (71%) Note: Transition sand, used <80% of the calculated volume due to heaving sands displacing chips during installation.
(56.2 - 99.3') 125.2 bags	(56.2 - 99.3') 114 bags (91%) Note: Filter pack, swabbed filter pack for approximately 98 minutes prior to installation of transition sand.

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

Date Started:	07/23/2019	Surface Elevation:	464.47 ft amsl	**Well ID: RB-5**	
Date Completed:	06/29/2020	Shallow Well Elevation:	464.95 ft amsl		
Drilling Co.:	Cascade	Deep Well Elevation:	NA	Client:	PG&E
Drilling Method:	Dual Rotary	Northing (NAD83):	2102420.60	Project:	Final GW Remedy Phase 1
Driller Name:	Jon Martinez	Easting (NAD83):	7616397.54	Location:	PG&E Topock, Needles, California
Drilling Asst:	H. & A. Amezquita	Borehole Diameter:	18-24 inches		
Logger:	Drew Martzolf	Static Water Level:	See Log for Depths	Project Number:	RC000753.0051
Editor:	Sean McGrane	Development End Date:	10/24/2019		
Total Depth:	99.25 ft bgs	Well Completion:	☒ Flush ☐ Stick-up ☐ To Be Completed in Well Vault		

Depth (ft)	Groundwater Sample ID	Geologic Formation	USCS Code	USCS Class	Well Construction	Calculated Material Volumes	Material Volumes Installed Note: percentages are the actual volume vs the calculated volume
60		Topock - Fluvial Deposits	SP		(44.0 - 64.0') 8" SHUR-GRIP SDR17 PVC Casing; (41.5 - 61.5') 18.0" Borehole		
61							
62							
63							
64							
65			NR		(64.0 - 89.0') 8" Stainless Steel 316 (30-slot) Screen		
66		Topock - Fluvial Deposits	SP				
67							
68							
69					(56.2 - 99.3') Cemex #2/12 Mesh (12x20) Lapis Lustre Sand	(56.2 - 99.3') 125.2 bags	(56.2 - 99.3') 114 bags (91%) Note: Filter pack, swabbed filter pack for approximately 98 minutes prior to installation of transition sand.
70							
71			NR		(61.5 - 80.0') 18.0" Borehole		
72							
73		Topock - Fluvial Deposits	SP				
74							
75		Topock - Fluvial Deposits	SP				
76		Topock - Fluvial Deposits	CL				
77							
78		Topock - Fluvial Deposits	SP				
79							

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

Date Started:	07/23/2019	Surface Elevation:	464.47 ft amsl	**Well ID: RB-5**	
Date Completed:	06/29/2020	Shallow Well Elevation:	464.95 ft amsl		
Drilling Co.:	Cascade	Deep Well Elevation:	NA	Client:	PG&E
Drilling Method:	Dual Rotary	Northing (NAD83):	2102420.60	Project:	Final GW Remedy Phase 1
Driller Name:	Jon Martinez	Easting (NAD83):	7616397.54	Location:	PG&E Topock, Needles, California
Drilling Asst:	H. & A. Amezquita	Borehole Diameter:	18-24 inches		
Logger:	Drew Martzolf	Static Water Level:	See Log for Depths	Project Number:	RC000753.0051
Editor:	Sean McGrane	Development End Date:	10/24/2019		
Total Depth:	99.25 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
80		Topock - Fluvial Deposits	SP		(64.0 - 89.0') 8" Stainless Steel 316 (30-slot) Screen; (61.5 - 80.0') 18.0" Borehole		
81							
82					(80.0 - 84.0') 18.0" Borehole		
83							
84	RB-5-VAS-82-87 (0.127 J ppb) 4/9/2019 14:05	Topock - Fluvial Deposits	GW				
85					(84.0 - 87.0') 18.0" Borehole		
86			NR				
87		Topock - Weathered Bedrock - conglomerate	GM				
88							
89					(56.2 - 99.3') Cemex #2/12 Mesh (12x20) Lapis Lustre Sand	(56.2 - 99.3') 125.2 bags	(56.2 - 99.3') 114 bags (91%) Note: Filter pack, swabbed filter pack for approximately 98 minutes prior to installation of transition sand.
90							
91							
92							
93		Topock - Competent Bedrock - conglomerate			(87.0 - 99.3') 18.0" Borehole		
94							
95					(89.0 - 94.6') Sump and PVC End Cap		
96							
97							
98							
99							

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

Date Started:	07/23/2019	Surface Elevation:	464.47 ft amsl	**Well ID: RB-5**	
Date Completed:	06/29/2020	Shallow Well Elevation:	464.95 ft amsl		
Drilling Co.:	Cascade	Deep Well Elevation:	NA	Client:	PG&E
Drilling Method:	Dual Rotary	Northing (NAD83):	2102420.60	Project:	Final GW Remedy Phase 1
Driller Name:	Jon Martinez	Easting (NAD83):	7616397.54	Location:	PG&E Topock, Needles, California
Drilling Asst:	H. & A. Amezquita	Borehole Diameter:	18-24 inches		
Logger:	Drew Martzolf	Static Water Level:	See Log for Depths	Project Number:	RC000753.0051
Editor:	Sean McGrane	Development End Date:	10/24/2019		
Total Depth:	99.25 ft bgs	Well Completion:	☒ Flush ☐ Stick-up ☐ To Be Completed in Well Vault		

Depth (ft)	Groundwater Sample ID	Geologic Formation	USCS Code	USCS Class	Well Construction	Calculated Material Volumes	Material Volumes Installed Note: percentages are the actual volume vs the calculated volume
100					End of Boring at 99.3 ft bgs.		
101							
102							
103							
104							
105							
106							
107							
108							
109							
110							
111							
112							
113							
114							
115							
116							
117							
118							
119							

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

Drilling Log

Sheet: 1 of 5

Date Started:	07/11/2019	Surface Elevation:	464.47 ft amsl	**Boring No.:**	**RB-5**
Date Completed:	07/17/2019	Northing (NAD83):	2102420.60		
Drilling Co.:	Cascade	Easting (NAD83):	7616397.54	Client:	PG&E
Drilling Method:	Dual Rotary	Total Depth:	99.3 ft bgs	Project:	Final GW Remedy Phase 1
Drill Rig Type:	Foremost DR-24 HD	Conductor Casing Diameter:	24 inches	Location:	PG&E Topock, Needles, California
Driller Name:	Jon Martinez	Drill Casing Diameter:	18 inches		
Drilling Asst:	H. & A. Amezquita	Drill Bit:	17 inch tricone	Project Number:	RC000753.0051
Tool-Pusher:	Arnold Lamon	Depth to First Water:	10.0 ft bgs		
Rig Geologist:	Drew Martzolf	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
1–4		SP			(0.0 - 4.0') Topock - Fill; Poorly graded sand (SP); brown (7.5YR 5/4)		(0.0 - 20.0') 237.9 gallons of water used; 70 gallons of water recovered; 167.9 gallons of water lost
4–6		SP			(4.0 - 6.0') Topock - Fill; Poorly graded sand (SP); brown (10YR 5/3)		
6–7		SC			(6.0 - 7.0') Topock - Fill; Clayey sand (SC); brown (7.5YR 5/4)		
7–8		SP			(7.0 - 8.0') Topock - Fill; Poorly graded sand (SP); brown (7.5YR 5/4)		
8–10	(0.0 - 20.0) 2.10 mins/ft	SP-SM		(0.0 - 20.0') 24.0" Steel Casing	(8.0 - 10.5') Topock - Fill; Poorly graded sand with silt (SP-SM); brown (7.5YR 5/3)	(10.0') Observed pea gravel in drill cuttings (see photo log).	
10–11		SP			(10.5 - 11.8') Topock - Fluvial Deposits; Poorly graded sand (SP); brown (7.5YR 5/4)		
11–12		SM			(11.8 - 12.0') Topock - Fluvial Deposits; Silty sand (SM); dark gray (7.5YR 4/1)		
12–13		SP-SM			(12.0 - 13.0') Topock - Fluvial Deposits; Poorly graded sand with silt (SP-SM); brown (7.5YR 5/3)		
13–14		SM			(13.0 - 14.0') Topock - Fluvial Deposits; Silty sand (SM); dark gray (7.5YR 4/1)		
14–17		NR			(14.0 - 17.0') No recovery (NR)	(15.0') Water generated by formation after reaching water table approximate 15 feet bgs.	
17–19		SM			(17.0 - 19.5') Topock - Fluvial Deposits; Silty sand (SM); (7.5R 5/3)		
19–20		SP-SM			(19.5 - 21.0') Topock - Fluvial		

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: blue water table symbol represents approximate depth to water during the first VAS sample collected from RB-5 Pilot

Drilling Log

ARCADIS Design & Consultancy for natural and built assets

Boring No.: RB-5

Date Started:	07/11/2019	Surface Elevation:	464.47 ft amsl	Client:	PG&E
Date Completed:	07/17/2019	Northing (NAD83):	2102420.60	Project:	Final GW Remedy Phase 1
Drilling Co.:	Cascade	Easting (NAD83):	7616397.54	Location:	PG&E Topock, Needles, California
Drilling Method:	Dual Rotary	Total Depth:	99.3 ft bgs		
Drill Rig Type:	Foremost DR-24 HD	Conductor Casing Diameter:	24 inches		
Driller Name:	Jon Martinez	Drill Casing Diameter:	18 inches		
Drilling Asst:	H. & A. Amezquita	Drill Bit:	17 inch tricone	Project Number:	RC000753.0051
Tool-Pusher:	Arnold Lamon	Depth to First Water:	10.0 ft bgs		
Rig Geologist:	Drew Martzolf	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-SM			Deposits; Poorly graded sand with silt (SP-SM); brown (7.5YR 4/2)	(20.0') Heaving sands at 20 feet bgs following installation of 18-inch casing to 41.46 ft, see Drilling Notes from 41.5-61.5 ft., observed pea gravel in drill cuttings (see photo log)	(20.0 - 41.5') 1789.74 gallons of water used; 1683.5 gallons of water recovered; 106.24 gallons of water lost
22		SP			(21.0 - 22.0') Topock - Fluvial Deposits; Poorly graded sand (SP); dark gray (7.5YR 4/1)		
23		NR			(22.0 - 24.0') No recovery (NR)		
24					(24.0 - 47.0') Topock - Fluvial Deposits; Poorly graded sand (SP); brown (7.5YR 4/2)		
25							
26							
27							
28							
29							
30	(20.0 - 41.5) 2.13 mins/ft			(20.0 - 41.5') 24.0" Steel Casing		(30.0') Observed pea gravel in drill cuttings (see photo log).	
31							
32		SP					
33							
34							
35							
36							
37							
38							
39							
40							

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: blue water table symbol represents approximate depth to water during the first VAS sample collected from RB-5 Pilot

Drilling Log

Sheet: 3 of 5

Date Started:	07/11/2019	Surface Elevation:	464.47 ft amsl	**Boring No.:**	**RB-5**
Date Completed:	07/17/2019	Northing (NAD83):	2102420.60		
Drilling Co.:	Cascade	Easting (NAD83):	7616397.54	Client:	PG&E
Drilling Method:	Dual Rotary	Total Depth:	99.3 ft bgs	Project:	Final GW Remedy Phase 1
Drill Rig Type:	Foremost DR-24 HD	Conductor Casing Diameter:	24 inches	Location:	PG&E Topock, Needles, California
Driller Name:	Jon Martinez	Drill Casing Diameter:	18 inches		
Drilling Asst:	H. & A. Amezquita	Drill Bit:	17 inch tricone	Project Number:	RC000753.0051
Tool-Pusher:	Arnold Lamon	Depth to First Water:	10.0 ft bgs		
Rig Geologist:	Drew Martzolf	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
41	(20.0 - 41.5) 2.13 mins/ft			(20.0 - 41.5') 24.0" Steel Casing		(40.0') Observed pea gravel in drill cuttings (see photo log).	
42						(41.5') Following installation of 18-inch casing to 41.46 feet, heaving sands were tagged at 20 feet bgs inside the drill casing. Approximately 1207.8 gallons of water was injected into the drill casing in an attempt to remove the heaving sands. Injecting water was unsuccessful at removing the sand. The drill pipe was remove from the drill casing and drill assembly changed to a reverse flow configuration. The reverse flow configuration used approximately 347.7 gallons of water and successfully removed the sand from the casing. The 1207.8 gallons and 347.7 gallons were recovered in the soil bin.	(41.5 - 61.5') 2971.92 gallons of water used; 3399.66 gallons of water recovered; 427.74 gallons of water gained
43		SP					
44							
45							
46							
47		GW			(47.0 - 48.0') Topock - Fluvial Deposits; Well graded gravel with sand (GW); brown (7.5YR 5/4)		
48					(48.0 - 50.0') Topock - Fluvial Deposits; Poorly graded sand (SP); brown (7.5YR 5/4)		
49		SP					
50					(50.0 - 57.0') No recovery (NR)	(50.0') Rough Drilling, observed pea gravel in drill cuttings (see photo log).	
51	(41.5 - 61.5) 2.75 mins/ft			(41.5 - 61.5') 18.0" Steel Casing			
52							
53							
54		NR					
55							
56							
57					(57.0 - 64.0') Topock - Fluvial Deposits; Poorly graded sand (SP); brown (7.5YR 5/4)		
58							
59		SP					
60							

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: blue water table symbol represents approximate depth to water during the first VAS sample collected from RB-5 Pilot

Drilling Log

ARCADIS Design & Consultancy for natural and built assets

Boring No.: RB-5

Date Started:	07/11/2019	Surface Elevation:	464.47 ft amsl	Client:	PG&E
Date Completed:	07/17/2019	Northing (NAD83):	2102420.60	Project:	Final GW Remedy Phase 1
Drilling Co.:	Cascade	Easting (NAD83):	7616397.54	Location:	PG&E Topock, Needles, California
Drilling Method:	Dual Rotary	Total Depth:	99.3 ft bgs		
Drill Rig Type:	Foremost DR-24 HD	Conductor Casing Diameter:	24 inches		
Driller Name:	Jon Martinez	Drill Casing Diameter:	18 inches		
Drilling Asst:	H. & A. Amezquita	Drill Bit:	17 inch tricone	Project Number:	RC000753.0051
Tool-Pusher:	Arnold Lamon	Depth to First Water:	10.0 ft bgs		
Rig Geologist:	Drew Martzolf	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	(41.5 - 61.5) 2.75 mins/ft			(41.5 - 61.5') 18.0" Steel Casing		(60.0') Observed pea gravel in drill cuttings (see photo log).	
62		SP					(61.5 - 80.0') 5565.59 gallons of water used; 5656.11 gallons of water recovered; 90.5199999999995 gallons of water gained
63							
64					(64.0 - 66.0') No recovery (NR)		
65		NR					
66					(66.0 - 69.0') Topock - Fluvial Deposits; Poorly graded sand (SP); brown (7.5YR 5/4)		
67		SP					
68							
69					(69.0 - 73.0') No recovery (NR)		
70						(70.0') Observed pea gravel in drill cuttings (see photo log).	
71	(61.5 - 80.0) 5.25 mins/ft	NR		(61.5 - 80.0') 18.0" Steel Casing		(71.0') Tri-cone drill bit was ahead of the 18" casing, sands heaved into the outer casing above the tri-cone bit and locked it up the bit in the casing.	
72							
73					(73.0 - 75.0') Topock - Fluvial Deposits; Poorly graded sand with gravel (SP); brown (7.5YR 5/4)		
74		SP					
75					(75.0 - 76.0') Topock - Fluvial Deposits; Poorly graded sand (SP); brown (7.5YR 5/4)		
76		SP					
77		CL			(76.0 - 77.0') Topock - Fluvial Deposits; Lean clay (CL); brown (7.5YR 4/2)		
78					(77.0 - 84.0') Topock - Fluvial Deposits; Poorly graded sand (SP); brown (7.5YR 5/4)		
79		SP					
80							

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: blue water table symbol represents approximate depth to water during the first VAS sample collected from RB-5 Pilot

Drilling Log

ARCADIS Design & Consultancy for natural and built assets

Boring No.: RB-5

Date Started:	07/11/2019	Surface Elevation:	464.47 ft amsl	Client:	PG&E
Date Completed:	07/17/2019	Northing (NAD83):	2102420.60	Project:	Final GW Remedy Phase 1
Drilling Co.:	Cascade	Easting (NAD83):	7616397.54	Location:	PG&E Topock, Needles, California
Drilling Method:	Dual Rotary	Total Depth:	99.3 ft bgs		
Drill Rig Type:	Foremost DR-24 HD	Conductor Casing Diameter:	24 inches		
Driller Name:	Jon Martinez	Drill Casing Diameter:	18 inches		
Drilling Asst:	H. & A. Amezquita	Drill Bit:	17 inch tricone	Project Number:	RC000753.0051
Tool-Pusher:	Arnold Lamon	Depth to First Water:	10.0 ft bgs		
Rig Geologist:	Drew Martzolf	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						(80.0 - 90.0') Observed Cemex #3 MESH (8x10) Lapis Luster Sand and pea gravel in drill cuttings (see photo log). Approximately 2100 gallons of water was used and 2130 gallons were recovered to remove sand from the casing.	(80.0 - 84.0') 5400 gallons of water used; 5590 gallons of water recovered; 190 gallons of water gained
82	(80.0 - 84.0) 2.50 mins/ft	SP		(80.0 - 84.0') 18.0" Steel Casing			
83							
84							
85		GW			(84.0 - 85.0') Topock - Fluvial Deposits; Well graded gravel (GW); brown (7.5YR 5/4)	(84.0') On 7/15/2019, approximately 2725 gallons of water was used and 2775 gallons were recovered to remove heaving sands in drill casing at 84 feet bgs. On 7/16/19, approximately 350 gallons of water was used and 7703.59 gallons were recovered to remove heaving sands in drill casing at 84 feet bgs. Volumes uses and recovered are included in the Drilling Fluid notes.	(84.0 - 87.0') 3267.68 gallons of water used; 11380.33 gallons of water recovered; 8112.65 gallons of water gained
86	(84.0 - 87.0) 22.67 mins/ft	NR		(84.0 - 87.0') 18.0" Steel Casing	(85.0 - 87.0') No recovery (NR)		
87							
88		GM			(87.0 - 89.0') Topock - Weathered Bedrock - conglomerate; Silty gravel with sand (GM); dusky red (2.5YR 3/2)		(87.0 - 99.3') 5939.8 gallons of water used; 6148.42 gallons of water recovered; 208.62 gallons of water gained
89					(89.0 - 99.3') Topock - Competent Bedrock - conglomerate; dusky red (2.5YR 3/2)		
90						(90.0') Observed Cemex #3 MESH (8x10) Lapis Luster Sand in drill cuttings (see photo log)	
91							
92							
93	(87.0 - 99.3) 13.96 mins/ft			(87.0 - 99.3') 18.0" Steel Casing			
94							
95							
96							
97							
98							
99							
100					End of Boring at 99.3 ft bgs.		

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: blue water table symbol represents approximate depth to water during the first VAS sample collected from RB-5 Pilot

ARCADIS Design & Consultancy for natural and built assets

Boring Log

Sheet: 1 of 5

Date Started:	04/03/2019	Surface Elevation:	464.70 ft amsl	**Boring No.:**	**RB-5 Pilot**
Date Completed:	04/09/2019	Northing (NAD83):	2102420.71		
Drilling Co.:	Cascade	Easting (NAD83):	7616398.00	Client:	PG&E
Drilling Method:	Sonic Drilling	Total Depth:	97 ft bgs	Project:	Final GW Remedy Phase 1
Drill Rig Type:	Terrasonic track mount	Borehole Diameter:	6-12 inches	Location:	PG&E Topock, Needles, California
Driller Name:	Dan O'Mara	Depth to First Water:	10.0 ft bgs		
Drilling Asst:	E. Huellmantel / J. Pacheco	Sampling Method:	4 inch x 10 ft. Core Barrel	Project Number:	RC000753.0051
Logger:	S. McGrane / D. Maurer	Sampling Interval:	Continuous		
Editor:	S. McGrane / G. Jeffers	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
1–4	0			Topock - Fill	SP		(0.0 - 4.0') Topock - Fill; Poorly graded sand (SP); brown (7.5YR 5/4); very fine grained to medium grained, subround to round; trace silt; dry; logged from cuttings in hoppers from conductor casing clean out run.	(0.0 - 4.0') During the clean out run to set the conductor casing, soil core was put into the hopper and not bagged.	(0.0 - 17.0') No water used
4–5	48			Topock - Fill	SP		(4.0 - 6.0') Topock - Fill; Poorly graded sand (SP); brown (10YR 5/3); very fine grained to medium grained, subangular to round; trace clay; trace organics; dry; trace silt nodules (5'); moist		
6–7				Topock - Fill	SC		(6.0 - 7.0') Topock - Fill; Clayey sand (SC); brown (7.5YR 5/4); very fine grained to fine grained, subangular to round; little clay; trace silt; trace organics; moist		
7–8				Topock - Fill	SP		(7.0 - 8.0') Topock - Fill; Poorly graded sand (SP); brown (7.5YR 5/4); very fine grained to fine grained, subround to round; trace silt; trace clay; moist		
8–10		RB-5-SS-7.0-12.0 4/10/2019 14:10		Topock - Fill	SP-SM		(8.0 - 10.5') Topock - Fill; Poorly graded sand with silt (SP-SM); brown (7.5YR 5/3); very fine grained to medium grained, subangular to round; little silt; trace clay; trace organics; moist	(8.0 - 17.0') Poor recovery, core fell out of core barrel, 5 ft recovered and 2 ft retrieved with second run, actual depths of contacts unclear due to loss of core.	
10–11				Topock - Fluvial Deposits	SP		(10.5 - 11.8') Topock - Fluvial Deposits; Poorly graded sand (SP); brown (7.5YR 5/4); very fine grained to fine grained, subround to round; trace silt; moist to wet		
11–12	84			Topock - Fluvial Deposits	SM			(10.0') Approximate depth to water table	
12–13		RB-5-SS-12.0-14.0 4/10/2019 10:00	RB-5-VAS-12.0-17.0 (0.125 J ppb) 4/4/2019 10:49	Topock - Fluvial Deposits	SP-SM		(11.8 - 12.0') Topock - Fluvial Deposits; Silty sand (SM); dark gray (7.5YR 4/1) with brown (7.5YR 5/3); very fine grained to fine grained, subround to round; little silt; trace clay; moist to wet; organic odor		
13–14				Topock - Fluvial Deposits	SM		(12.0 - 13.0') Topock - Fluvial Deposits; Poorly graded sand with silt (SP-SM); brown (7.5YR 5/3); very fine grained to medium grained, subangular to round; little silt; trace clay; trace organics; moist; slough from having to retrieve lost core		
14–17				Topock - Fluvial Deposits	NR		(13.0 - 14.0') Topock - Fluvial Deposits; Silty sand (SM); dark gray (7.5YR 4/1) with brown (7.5YR 5/3); very fine grained to fine grained, subround to round; little silt; trace clay; moist to wet; organic odor (14.0 - 17.0') No recovery (NR); poor recovery when lost core was retrieved		
17–19	60	RB-5_17.0-19.5 4/10/2019 10:05		Topock - Fluvial Deposits	SM		(17.0 - 19.5') Topock - Fluvial Deposits; Silty sand (SM); (7.5R 5/3) with dark gray (7.5YR 4/1); very fine grained to fine grained, subround to round; little silt; little clay; trace medium grained sand, subangular to subround; wet; organic odor (18'); trace clay; increase in sand	(17.0 - 22.0') Drilled with water due to heaving sands.	(17.0 - 22.0') 10 gallons of water used; 5 gallons of water recovered; 5 gallons of water lost
19–20					SP-SM		(19.5 - 21.0') Topock - Fluvial Deposits; Poorly graded sand with		

Abbreviations: USCS = Unified Soil Classification System, ft = feet, bgs = below ground surface, amsl = above mean sea level, GW = groundwater, ppb = parts per billion; Notes: apparent partial recoveries can be the result of potential compaction of sediments in the core bag

Boring Log

Boring No.: RB-5 Pilot

Date Started:	04/03/2019	Surface Elevation:	464.70 ft amsl	Client:	PG&E
Date Completed:	04/09/2019	Northing (NAD83):	2102420.71	Project:	Final GW Remedy Phase 1
Drilling Co.:	Cascade	Easting (NAD83):	7616398.00	Location:	PG&E Topock, Needles, California
Drilling Method:	Sonic Drilling	Total Depth:	97 ft bgs		
Drill Rig Type:	Terrasonic track mount	Borehole Diameter:	6-12 inches		
Driller Name:	Dan O'Mara	Depth to First Water:	10.0 ft bgs		
Drilling Asst:	E. Huellmantel / J. Pacheco	Sampling Method:	4 inch x 10 ft. Core Barrel	Project Number:	RC000753.0051
Logger:	S. McGrane / D. Maurer	Sampling Interval:	Continuous		
Editor:	S. McGrane / G. Jeffers	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	60	RB-5_19.5-22.0 4/10/2019 10:10		Topock - Fluvial Deposits	SP-SM		silt (SP-SM); brown (7.5YR 4/2) with dark gray (7.5YR 4/1); very fine grained to fine grained, subround to round; little silt; wet; organic odor; laminated		
22				Topock - Fluvial Deposits	SP		(21.0 - 22.0') Topock - Fluvial Deposits; Poorly graded sand (SP); dark gray (7.5YR 4/1) with brown (7.5YR 5/3); very fine grained to medium grained, subround to round; trace silt; trace clay; wet; organic odor		
23					NR		(22.0 - 24.0') No recovery (NR)	(22.0') Change in logging geologist to D. Maurer.	(22.0 - 77.0') No water used
24							(24.0 - 47.0') Topock - Fluvial Deposits; Poorly graded sand (SP); brown (7.5YR 4/2) with dark gray (7.5YR 4/1); very fine grained to fine grained, subround to round; trace silt; wet		
25									
26									
27		RB-5_25.0-30.0 4/10/2019 10:15							
28									
29	138								
30									
31									
32		RB-5_30.0-35.0 4/10/2019 10:20		Topock - Fluvial Deposits	SP				
33									
34							(34') very fine grained to medium grained, subround to round		
35									
36									
37		RB-5_35.0-40.0 4/10/2019 10:25						(37.0 - 47.0') Soft drilling	
38	120								
39									
40									

Abbreviations: USCS = Unified Soil Classification System, ft = feet, bgs = below ground surface, amsl = above mean sea level, GW = groundwater, ppb = parts per billion; Notes: apparent partial recoveries can be the result of potential compaction of sediments in the core bag

ARCADIS Design & Consultancy for natural and built assets

Boring Log

Boring No.: RB-5 Pilot

Date Started:	04/03/2019	Surface Elevation:	464.70 ft amsl	Client:	PG&E
Date Completed:	04/09/2019	Northing (NAD83):	2102420.71	Project:	Final GW Remedy Phase 1
Drilling Co.:	Cascade	Easting (NAD83):	7616398.00	Location:	PG&E Topock, Needles, California
Drilling Method:	Sonic Drilling	Total Depth:	97 ft bgs		
Drill Rig Type:	Terrasonic track mount	Borehole Diameter:	6-12 inches		
Driller Name:	Dan O'Mara	Depth to First Water:	10.0 ft bgs		
Drilling Asst:	E. Huellmantel / J. Pacheco	Sampling Method:	4 inch x 10 ft. Core Barrel	Project Number:	RC000753.0051
Logger:	S. McGrane / D. Maurer	Sampling Interval:	Continuous		
Editor:	S. McGrane / G. Jeffers	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									
42		RB-5_40.0-45.0 4/10/2019 10:30							
43				Topock - Fluvial Deposits	SP				
44	120		RB-5-VAS-42-47 (<0.033U ppb) 4/9/2019 10:15						
45									
46		RB-5_45.0-47.0 4/10/2019 10:35							
47									
48				Topock - Fluvial Deposits	GW		(47.0 - 48.0') Topock - Fluvial Deposits; Well graded gravel with sand (GW); brown (7.5YR 5/4); granules to very large pebbles, subround to round; and very fine to medium grained sand; trace small cobbles, subround to round; wet	(47.0') Change of rig geologist to D. Maurer.	
49		RB-5_48.0-50.0 4/10/2019 10:40		Topock - Fluvial Deposits	SP		(48.0 - 50.0') Topock - Fluvial Deposits; Poorly graded sand (SP); brown (7.5YR 5/4); very fine grained to medium grained, subround to round; trace granules to small, subround to round; trace silt; wet		
50									
51							(50.0 - 57.0') No recovery (NR)	(50.0 - 57.0') No recovery, drilled through loose sands, no indication of core loss out of core barrel.	
52	36								
53					NR				
54									
55									
56									
57									
58		RB-5_57.0-60.0 4/10/2019 10:45		Topock - Fluvial Deposits	SP		(57.0 - 64.0') Topock - Fluvial Deposits; Poorly graded sand (SP); brown (7.5YR 5/4); very fine grained to coarse grained; trace granules to medium pebbles, subround to round; wet	(57.0 - 62.0') Drilled through loose sands, no indication of core loss from the core barrel.	
59	156						(59'); little granules to large pebbles, subround to round		
60									

Abbreviations: USCS = Unified Soil Classification System, ft = feet, bgs = below ground surface, amsl = above mean sea level, GW = groundwater, ppb = parts per billion; Notes: apparent partial recoveries can be the result of potential compaction of sediments in the core bag

ARCADIS Design & Consultancy for natural and built assets

Boring Log

Boring No.: RB-5 Pilot

Date Started:	04/03/2019	Surface Elevation:	464.70 ft amsl	Client:	PG&E
Date Completed:	04/09/2019	Northing (NAD83):	2102420.71	Project:	Final GW Remedy Phase 1
Drilling Co.:	Cascade	Easting (NAD83):	7616398.00	Location:	PG&E Topock, Needles, California
Drilling Method:	Sonic Drilling	Total Depth:	97 ft bgs		
Drill Rig Type:	Terrasonic track mount	Borehole Diameter:	6-12 inches		
Driller Name:	Dan O'Mara	Depth to First Water:	10.0 ft bgs		
Drilling Asst:	E. Huellmantel / J. Pacheco	Sampling Method:	4 inch x 10 ft. Core Barrel	Project Number:	RC000753.0051
Logger:	S. McGrane / D. Maurer	Sampling Interval:	Continuous		
Editor:	S. McGrane / G. Jeffers	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									
62		RB-5_60.0-64.0 4/10/2019 10:50		Topock - Fluvial Deposits	SP				
63									
64									
65					NR		(64.0 - 66.0') No recovery (NR)	(64.0 - 66.0') Lost 2 feet of core in hopper during core collection.	
66									
67		RB-5_66.0-69.0 4/10/2019 10:55		Topock - Fluvial Deposits	SP		(66.0 - 69.0') Topock - Fluvial Deposits; Poorly graded sand (SP); brown (7.5YR 5/4); very fine grained to coarse grained; little granules to large pebbles, subround to round; wet		
68	156								
69									
70					NR		(69.0 - 73.0') No recovery (NR)	(69.0 - 73.0') Lost core during collection.	
71									
72									
73									
74		RB-5_73.0-76.0 4/10/2019 11:05		Topock - Fluvial Deposits	SP		(73.0 - 75.0') Topock - Fluvial Deposits; Poorly graded sand with gravel (SP); brown (7.5YR 5/4); very fine grained to medium grained; little small to very large pebbles, subround to round; wet	(73.0 - 77.0') Drilling through loose sands, no indication of core loss from the core barrel, CL at 76.0 to 77.0 not collected per direction of on-site archaeologist.	
75				Topock - Fluvial Deposits	SP		(75.0 - 76.0') Topock - Fluvial Deposits; Poorly graded sand (SP); brown (7.5YR 5/4); very fine grained to medium grained; trace clay; wet		
76				Topock - Fluvial Deposits	CL		(76.0 - 77.0') Topock - Fluvial Deposits; Lean clay (CL); brown (7.5YR 4/2); medium plasticity; trace very fine to medium grained sand; wet		
77									
78				Topock - Fluvial Deposits	SP		(77.0 - 84.0') Topock - Fluvial Deposits; Poorly graded sand (SP); brown (7.5YR 5/4); very fine grained to medium grained; trace silt; wet		(77.0 - 87.0') 10 gallons of water used; 0 gallons of water recovered; 10 gallons of water lost
79	96								
80									

Abbreviations: USCS = Unified Soil Classification System, ft = feet, bgs = below ground surface, amsl = above mean sea level, GW = groundwater, ppb = parts per billion; Notes: apparent partial recoveries can be the result of potential compaction of sediments in the core bag

ARCADIS Design & Consultancy for natural and built assets

Boring Log

Boring No.: RB-5 Pilot

Date Started:	04/03/2019	Surface Elevation:	464.70 ft amsl	Client:	PG&E
Date Completed:	04/09/2019	Northing (NAD83):	2102420.71	Project:	Final GW Remedy Phase 1
Drilling Co.:	Cascade	Easting (NAD83):	7616398.00	Location:	PG&E Topock, Needles, California
Drilling Method:	Sonic Drilling	Total Depth:	97 ft bgs		
Drill Rig Type:	Terrasonic track mount	Borehole Diameter:	6-12 inches		
Driller Name:	Dan O'Mara	Depth to First Water:	10.0 ft bgs		
Drilling Asst:	E. Huellmantel / J. Pacheco	Sampling Method:	4 inch x 10 ft. Core Barrel	Project Number:	RC000753.0051
Logger:	S. McGrane / D. Maurer	Sampling Interval:	Continuous		
Editor:	S. McGrane / G. Jeffers	Converted to Well:	☒ Yes ☐ No		

Depth (ft)	Recovery (in)	Sieve Sample ID	Groundwater Sample ID	Geologic Formation	USCS Code	USCS Class	Soil Description	Drilling Notes	Drilling Fluid
81									
82		RB-5_80.0-85.0 4/10/2019 11:10		Topock - Fluvial Deposits	SP				
83									
84	96		RB-5-VAS-82-87 (0.127 J ppb) 4/9/2019 14:05	Topock - Fluvial Deposits	GW		(84.0 - 85.0') Topock - Fluvial Deposits; Well graded gravel (GW); brown (7.5YR 5/4); granules to very large pebbles, subangular to round; trace very fine to very coarse grained sand, subangular to subround; wet		
85								(85.0 - 87.0') Drilled through loose sands, no indication of core loss from the core barrel.	
86					NR		(85.0 - 87.0') No recovery (NR)		
87									
88		RB-5-SS-87.0-89.0 4/10/2019 11:15		Topock - Weathered Bedrock - conglomerate	GM		(87.0 - 89.0') Topock - Weathered Bedrock - conglomerate; Silty gravel with sand (GM); dusky red (2.5YR 3/2); granules to very large pebbles, angular to subround; some very fine to medium grained sand; little silt; trace clay; wet; weak cementation		(87.0 - 97.0') No water used
89									
90							(89.0 - 97.0') Topock - Competent Bedrock - conglomerate; dusky red (2.5YR 3/2); moist; friable		
91									
92	120							(92.0 - 97.0') Rough drilling	
93				Topock - Competent Bedrock - conglomerate					
94									
95									
96									
97									
							End of Boring at 97.0 ft bgs.		
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; Notes: apparent partial recoveries can be the result of potential compaction of sediments in the core bag

Temporary Backfill Log

ARCADIS Design & Consultancy for natural and built assets

Well ID: RB-5 Pilot

Date Started:	04/10/2019	Surface Elevation:	464.70 ft amsl	Client:	PG&E
Date Completed:	04/10/2019	Northing (NAD83):	2102420.71		
Drilling Co.:	Cascade	Easting (NAD83):	7616398.00		
Drilling Method:	Sonic Drilling	Total Depth:	97 ft bgs	Project:	Final GW Remedy Phase 1
Driller Name:	Dan O'Mara	Borehole Diameter:	6-12 inches	Location:	PG&E Topock, Needles, California
Drilling Asst:	E. Huellmantel / J. Pacheco	Depth to First Water:	10.0 ft bgs		
Logger:	S. McGrane / D. Maurer	Editor:	S. McGrane / G. Jeffers	Project Number:	RC000753.0051

Depth (ft)	Groundwater Sample ID	Geologic Formation	USCS Code	USCS Class	Well Construction	Calculated Material Volumes	Material Volumes Installed Note: percentages are the actual volume vs the calculated volume
1		Topock - Fill	SP		(0.0 - 0.5') Steal plate with BMPs		
2					(0.0 - 4.0') 12" Borehole		
3					(0.5 - 5.0') Washed Wildcat Washed Plastering Sand	(0.5 - 5.0') 6.7 bags	(0.5 - 5.0') 5.5 bags (82%) Note: Wildcat Washed, used >20% of the calculated volume due to potential voids forming during drilling.
4							
5		Topock - Fill	SP				
6		Topock - Fill	SC				
7		Topock - Fill	SP				
8		Topock - Fill	SP-SM				
9							
10							
11		Topock - Fluvial Deposits	SP				
12		Topock - Fluvial Deposits	SM		(4.0 - 97.0') 6" Borehole		
13		Topock - Fluvial Deposits	SP-SM		(5.0 - 86.0') Pea Gravel	(5.0 - 86.0') 31.8 bags	(5.0 - 86.0') 33 bags (104%) Note: Gravel backfill
14	RB-5-VAS-12.0-17.0 (0.125 J ppb) 4/4/2019 10:49	Topock - Fluvial Deposits	SM				
15			NR				
16							
17							
18		Topock - Fluvial Deposits	SM				
19							
20			SP-SM				

Abbreviations: USCS = Unified Soil Classification System, ft = feet, bgs = below ground surface, amsl = above mean sea level, GW = groundwater, ppb = parts per billion, BMP = Best Management Practices for stormwater, U = not detected above the laboratory reporting limit, J = estimated value, NR = no recovery; Notes: blue water table symbol represents depth to water measured during the first VAS interval; granular backfill material was removed during overdrilling of the pilot borehole

ARCADIS Design & Consultancy for natural and built assets

Temporary Backfill Log

Sheet: 2 of 5

Well ID: RB-5 Pilot

Date Started:	04/10/2019	Surface Elevation:	464.70 ft amsl		
Date Completed:	04/10/2019	Northing (NAD83):	2102420.71		
Drilling Co.:	Cascade	Easting (NAD83):	7616398.00	Client:	PG&E
Drilling Method:	Sonic Drilling	Total Depth:	97 ft bgs	Project:	Final GW Remedy Phase 1
Driller Name:	Dan O'Mara	Borehole Diameter:	6-12 inches	Location:	PG&E Topock, Needles, California
Drilling Asst:	E. Huellmantel / J. Pacheco	Depth to First Water:	10.0 ft bgs		
Logger:	S. McGrane / D. Maurer	Editor:	S. McGrane / G. Jeffers	Project Number:	RC000753.0051

Depth (ft)	Groundwater Sample ID	Geologic Formation	USCS Code	USCS Class	Well Construction	Calculated Material Volumes	Material Volumes Installed Note: percentages are the actual volume vs the calculated volume
21		Topock - Fluvial Deposits	SP-SM				
22		Topock - Fluvial Deposits	SP				
23			NR				
24							
25							
26							
27							
28							
29							
30					(5.0 - 86.0') Pea Gravel; (4.0 - 97.0') 6" Borehole	(5.0 - 86.0') 31.8 bags	(5.0 - 86.0') 33 bags (104%) Note: Gravel backfill
31							
32		Topock - Fluvial Deposits	SP				
33							
34							
35							
36							
37							
38							
39							
40							

Abbreviations: USCS = Unified Soil Classification System, ft = feet, bgs = below ground surface, amsl = above mean sea level, GW = groundwater, ppb = parts per billion, BMP = Best Management Practices for stormwater, U = not detected above the laboratory reporting limit, J = estimated value, NR = no recovery; Notes: blue water table symbol represents depth to water measured during the first VAS interval; granular backfill material was removed during overdrilling of the pilot borehole

ARCADIS Design & Consultancy for natural and built assets

Temporary Backfill Log

Well ID: RB-5 Pilot

Date Started:	04/10/2019	Surface Elevation:	464.70 ft amsl		
Date Completed:	04/10/2019	Northing (NAD83):	2102420.71		
Drilling Co.:	Cascade	Easting (NAD83):	7616398.00	Client:	PG&E
Drilling Method:	Sonic Drilling	Total Depth:	97 ft bgs	Project:	Final GW Remedy Phase 1
Driller Name:	Dan O'Mara	Borehole Diameter:	6-12 inches	Location:	PG&E Topock, Needles, California
Drilling Asst:	E. Huellmantel / J. Pacheco	Depth to First Water:	10.0 ft bgs		
Logger:	S. McGrane / D. Maurer	Editor:	S. McGrane / G. Jeffers	Project Number:	RC000753.0051

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							
42							
43		Topock - Fluvial Deposits	SP				
44	RB-5-VAS-42-47 (<0.033U ppb) 4/9/2019 10:15						
45							
46							
47		Topock - Fluvial Deposits	GW				
48							
49		Topock - Fluvial Deposits	SP				
50					(5.0 - 86.0') Pea Gravel	(5.0 - 86.0') 31.8 bags	(5.0 - 86.0') 33 bags (104%) Note: Gravel backfill
51					(4.0 - 97.0') 6" Borehole		
52							
53			NR				
54							
55							
56							
57							
58		Topock - Fluvial Deposits	SP				
59							
60							

Abbreviations: USCS = Unified Soil Classification System, ft = feet, bgs = below ground surface, amsl = above mean sea level, GW = groundwater, ppb = parts per billion, BMP = Best Management Practices for stormwater, U = not detected above the laboratory reporting limit, J = estimated value, NR = no recovery; Notes: blue water table symbol represents depth to water measured during the first VAS interval; granular backfill material was removed during overdrilling of the pilot borehole

ARCADIS Design & Consultancy for natural and built assets

Temporary Backfill Log

Sheet: 4 of 5

Well ID: RB-5 Pilot

Date Started:	04/10/2019	Surface Elevation:	464.70 ft amsl	Client:	PG&E
Date Completed:	04/10/2019	Northing (NAD83):	2102420.71		
Drilling Co.:	Cascade	Easting (NAD83):	7616398.00	Project:	Final GW Remedy Phase 1
Drilling Method:	Sonic Drilling	Total Depth:	97 ft bgs	Location:	PG&E Topock, Needles, California
Driller Name:	Dan O'Mara	Borehole Diameter:	6-12 inches		
Drilling Asst:	E. Huellmantel / J. Pacheco	Depth to First Water:	10.0 ft bgs		
Logger:	S. McGrane / D. Maurer	Editor:	S. McGrane / G. Jeffers	Project Number:	RC000753.0051

Depth (ft)	Groundwater Sample ID	Geologic Formation	USCS Code	USCS Class	Well Construction	Calculated Material Volumes	Material Volumes Installed Note: percentages are the actual volume vs the calculated volume
61		Topock - Fluvial Deposits	SP				
62							
63							
64							
65			NR				
66		Topock - Fluvial Deposits	SP				
67							
68							
69							
70					(5.0 - 86.0') Pea Gravel; (4.0 - 97.0') 6" Borehole	(5.0 - 86.0') 31.8 bags	(5.0 - 86.0') 33 bags (104%) Note: Gravel backfill
71			NR				
72							
73							
74		Topock - Fluvial Deposits	SP				
75							
76		Topock - Fluvial Deposits	SP				
77		Topock - Fluvial Deposits	CL				
78		Topock - Fluvial Deposits	SP				
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, BMP = Best Management Practices for stormwater, U = not detected above the laboratory reporting limit, J = estimated value, NR = no recovery; Notes: blue water table symbol represents depth to water measured during the first VAS interval; granular backfill material was removed during overdrilling of the pilot borehole

Temporary Backfill Log

ARCADIS Design & Consultancy for natural and built assets

Sheet: 5 of 5

Well ID: RB-5 Pilot

Date Started:	04/10/2019	Surface Elevation:	464.70 ft amsl	Client:	PG&E
Date Completed:	04/10/2019	Northing (NAD83):	2102420.71		
Drilling Co.:	Cascade	Easting (NAD83):	7616398.00	Client:	PG&E
Drilling Method:	Sonic Drilling	Total Depth:	97 ft bgs	Project:	Final GW Remedy Phase 1
Driller Name:	Dan O'Mara	Borehole Diameter:	6-12 inches	Location:	PG&E Topock, Needles, California
Drilling Asst:	E. Huellmantel / J. Pacheco	Depth to First Water:	10.0 ft bgs		
Logger:	S. McGrane / D. Maurer	Editor:	S. McGrane / G. Jeffers	Project Number:	RC000753.0051

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							
82		Topock - Fluvial Deposits	SP		(5.0 - 86.0') Pea Gravel	(5.0 - 86.0') 31.8 bags	(5.0 - 86.0') 33 bags (104%) Note: Gravel backfill
83							
84	RB-5-VAS-82-87 (0.127 J ppb) 4/9/2019 14:05	Topock - Fluvial Deposits	GW				
85							
86			NR				
87		Topock - Weathered Bedrock - conglomerate	GM		(4.0 - 97.0') 6" Borehole		
88							
89							
90							
91					(86.0 - 97.0') Cemex #3 MESH (8x10) Lapis Lustre Sand	(86.0 - 97.0') 4.3 bags	(86.0 - 97.0') 4 bags (93%) Note: Indicator sand
92							
93		Topock - Competent Bedrock - conglomerate					
94							
95							
96							
97							
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, BMP = Best Management Practices for stormwater, U = not detected above the laboratory reporting limit, J = estimated value, NR = no recovery; Notes: blue water table symbol represents depth to water measured during the first VAS interval; granular backfill material was removed during overdrilling of the pilot borehole