

Appendix A

DOF-B1



PROJECT: Arkema Pre-Design Investigation	COORDINATES: N 710598.5 E 1175286 (NAD 83)
LOCATION: Former Arkema Manufacturing Facility	SURFACE ELEVATION: 17.5 ft (NAVD88)
DRILLING CONTRACTOR: Cascade Drilling	DATE: 10/19/2023
DRILLING EQUIPMENT: CME 75 Hollow Stem Auger	TOTAL DEPTH OF BORING (bgs): 40 feet
DRILLING METHOD: 8" OD x 4.25" ID by 5' auger	LOGGED BY: A.Cerruti

SAMPLE DATA						SOIL DESCRIPTION		Abandonment Method
DEPTH (feet)	Elevation (ft)	Sample Interval	Recovery (in)	Sampler Type	Blows/foot	Group Symbol	Group Graphic	
5	12.5							
6	11.5	12		SPT	8			
7	10.5					SM		
8	9.5	18		SPT	4			
9	8.5							
10	7.5							
11	6.5	18		SPT	9	ML		
12	5.5					SP		
13	4.5	18		SPT	6			
14	3.5					SM		
15	2.5							
16	1.5	18		SPT	12	SP		
17	0.5							
18	-0.5	18		SPT	4			
19	-1.5					SM		
20	-2.5							
21	-3.5	18		SPT	1			
22	-4.5					MH/ML		
23	-5.5	18		SPT	2			
24	-6.5					SP		
25	-7.5							
26	-8.5	18		SPT	2	SM		
27	-9.5	18		SPT	8			
28	-10.5							
29	-11.5	18		SPT	4			
30	-12.5	18		SPT	9			
31	-13.5							
32	-14.5	18		SPT	6			

DOF-B1												
PROJECT: Arkema Pre-Design Investigation						COORDINATES: N 710598.5 E 1175286 (NAD 83)						
LOCATION: Former Arkema Manufacturing Facility						SURFACE ELEVATION: 17.5 ft (NAVD88)						
DRILLING CONTRACTOR: Cascade Drilling						DATE: 10/19/2023						
DRILLING EQUIPMENT: CME 75 Hollow Stem Auger						TOTAL DEPTH OF BORING (bgs): 40 feet						
DRILLING METHOD: 8" OD x 4.25" ID by 5' auger						LOGGED BY: A.Cerruti						
SAMPLE DATA						SOIL DESCRIPTION					Abandonment Method	
DEPTH (feet)	Elevation (ft)	Sample Interval	Recovery (in)	Sampler Type	Blows/foot	Group Symbol	Group Graphic					
33	-15.5		18	SPT	12	MH		<i>Silt (MH)</i> - 78% fines, 22% fine to medium sands; LL = 72, PL = 39, PI = 33, slow dilatency, mottled gray to brown. Grassy organics and sulfurous odor at 34 ft bgs.				
34	-16.5											
35	-17.5		12	SPT	4							
36	-18.5		18	SPT	1	SM		-----				
37	-19.5											
38	-20.5		18	SPT	2							
39	-21.5		18	SPT	2							
40	-22.5							-----				

DOF-B2										DOF DALTON OLMSTED FUGLEVAND	
PROJECT: Arkema Pre-Design Investigation							COORDINATES: N 710690.7 E 1175186.0 (NAD 83)				
LOCATION: Former Arkema Manufacturing Facility							SURFACE ELEVATION: 14.3 ft (NAVD88)				
DRILLING CONTRACTOR: Cascade Drilling							DATE: 10/19/2023				
DRILLING EQUIPMENT: CME 75 Hollow Stem Auger							TOTAL DEPTH OF BORING (bgs): 36.5 feet				
DRILLING METHOD: 8" OD x 4.25" ID by 5' auger							LOGGED BY: A.Cerruti				
SAMPLE DATA							SOIL DESCRIPTION				Abandonment Method
DEPTH (feet)	Elevation (ft)	Sample Interval	Recovery (in)	Sampler Type	Blows/foot	Group Symbol	Group Graphic				
5	9.3							logging began at 5' bgs.			
6	8.3		18	SPT	4						
7	7.3										
8	6.3		18	SPT	7			Silty Sand (SM) - 83 % fine to coarse sand with 17% fines (as interbedded lenses), trace organics, gray and brown, wet			
9	5.3					SM					
10	4.3							80% fine to coarse sand with 18% silty fines (as interbed lenses), 2% gravel			
11	3.3		24	ST							
12	2.3							80% fine to coarse sand with 20% silty fines (as interbeds)			
13	1.3		18	SPT	1						
14	0.3					ML		Silt (ML) - about 95% low plasticity, rapid dilatency, cohesive silt with grassy organics, brown, wet			
15	-0.7										
16	-1.7		18	SPT	9			Poorly-Graded Sand (SP) - about 95% fine to medium sand with trace silty clasts and trace organics, gray and brown, wet			
17	-2.7					SP					
18	-3.7		18	SPT	7						
19	-4.7										
20	-5.7										
21	-6.7		18	SPT	11						
22	-7.7					SM		Silty Sand (SM) - 61% fine to coarse sand with 38% silty fines (as gray interbeds), 1% gravel, brown, wet			
23	-8.7		18	SPT	19						
24	-9.7										
25	-10.7										
26	-11.7		18	SPT	9						
27	-12.7		18	SPT	15			Poorly Graded Sand with Silt (SP-SM) - about 90% fine to medium sand with 10% fines, dark gray, wet with silty laminations and trace organics			
28	-13.7					SP-SM					
29	-14.7		18	SPT	3						
30	-15.7		18	SPT	3						
31	-16.7							Silt (ML) - 92% silty fines with 8% fine to medium sand, organic lenses and stringers of fine sand, brown and gray, wet			
32	-17.7		24	ST		ML					

DOF-B2

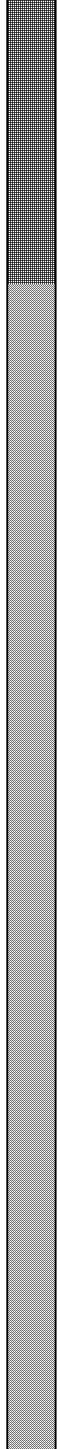


PROJECT: Arkema Pre-Design Investigation	COORDINATES: N 710690.7 E 1175186.0 (NAD 83)
LOCATION: Former Arkema Manufacturing Facility	SURFACE ELEVATION: 14.3 ft (NAVD88)
DRILLING CONTRACTOR: Cascade Drilling	DATE: 10/19/2023
DRILLING EQUIPMENT: CME 75 Hollow Stem Auger	TOTAL DEPTH OF BORING (bgs): 36.5 feet
DRILLING METHOD: 8" OD x 4.25" ID by 5' auger	LOGGED BY: A.Cerruti

SAMPLE DATA						SOIL DESCRIPTION		Abandonment Method
DEPTH (feet)	Elevation (ft)	Sample Interval	Recovery (in)	Sampler Type	Blows/foot	Group Symbol	Group Graphic	
33	-18.7							
34	-19.7		18	SPT	9			
35	-20.7							
36	-21.7		18	SPT	11	SP-SM		
							Poorly Graded Sand with Silt (SP-SM) - about 90% fine to medium sand with 10% fines, dark gray, wet, with silty laminations and trace organics	
37	-22.7							
38	-23.7							
39	-24.7							
40	-25.7							

DOF-B3

PROJECT: Arkema Pre-Design Investigation	COORDINATES: N 710725.4 E 1175013.1 (NAD 83)
LOCATION: Former Arkema Manufacturing Facility	SURFACE ELEVATION: 13.8 ft (NAVD88)
DRILLING CONTRACTOR: Cascade Drilling	DATE: 10/19/2023
DRILLING EQUIPMENT: CME 75 Hollow Stem Auger	TOTAL DEPTH OF BORING (bgs): 40 feet
DRILLING METHOD: 8" OD x 4.25" ID by 5' auger	LOGGED BY: A.Cerruti

SAMPLE DATA						SOIL DESCRIPTION		Abandonment Method
DEPTH (feet)	Elevation (ft)	Sample Interval	Recovery (in)	Sampler Type	Blows/foot	Group Symbol	Group Graphic	
5	8.8							
6	7.8	18		SPT	11	SP		
7	6.8							
8	5.8	10		SPT	6	SM		
9	4.8							
10	3.8							
11	2.8	18		SPT	1			
12	1.8							
13	0.8	18		SPT	0	MH		
14	-0.2							
15	-1.2							
16	-2.2	18		SPT	0			
17	-3.2							
18	-4.2	18		SPT	2	ML		
19	-5.2							
20	-6.2							
21	-7.2	18		SPT	7	SM		
22	-8.2							
23	-9.2	18		SPT	10	ML		
24	-10.2							
25	-11.2							
26	-12.2	18		SPT	10			
27	-13.2	18		SPT	9	SM		
28	-14.2							
29	-15.2	14		SPT	8			
30	-16.2	18		SPT	2	MH		
31	-17.2							
32	-18.2	18		SPT	1			

DOF-B3										DALTON OLMSTED FUGLEVAND	
PROJECT: Arkema Pre-Design Investigation						COORDINATES: N 710725.4 E 1175013.1 (NAD 83)					
LOCATION: Former Arkema Manufacturing Facility						SURFACE ELEVATION: 13.8 ft (NAVD88)					
DRILLING CONTRACTOR: Cascade Drilling						DATE: 10/19/2023					
DRILLING EQUIPMENT: CME 75 Hollow Stem Auger						TOTAL DEPTH OF BORING (bgs): 40 feet					
DRILLING METHOD: 8" OD x 4.25" ID by 5' auger						LOGGED BY: A.Cerruti					
SAMPLE DATA						SOIL DESCRIPTION					Abandonment Method
DEPTH (feet)	Elevation (ft)	Sample Interval	Recovery (in)	Sampler Type	Blows/foot	Group Symbol	Group Graphic				
33	-19.2		18	SPT	1	ML		Silt (ML) - about 95% low plastic fines with fine sandy lenses and trace organics, dark gray, moist			
34	-20.2		18	SPT	2						
35	-21.2		18	SPT	4						
36	-22.2		18	SPT	6						
37	-23.2		18	SPT	7	SP-SM		Poorly-Graded Sand with Silt (SP-SM) - about 90% fine to medium sand with 10% fines and trace organics, dark brown, wet			
38	-24.2		18	SPT							
39	-25.2		18	SPT							
40	-26.2										

DOF-B4										DOF DALTON OLMSTED FUGLEVAND	
PROJECT: Arkema Pre-Design Investigation							COORDINATES: N 710843.0 E 1175021.8 (NAD 83)				
LOCATION: Former Arkema Manufacturing Facility							SURFACE ELEVATION: 13.5 ft (NAVD88)				
DRILLING CONTRACTOR: Cascade Drilling							DATE: 10/25/2023				
DRILLING EQUIPMENT: CME 75 Hollow Stem Auger							TOTAL DEPTH OF BORING (bgs): 39.5 feet				
DRILLING METHOD: 8" OD x 4.25" ID by 5' auger							LOGGED BY: A.Cerruti				
SAMPLE DATA							SOIL DESCRIPTION			Abandonment Method	
DEPTH (feet)	Elevation (ft)	Sample Interval	Recovery (in)	Sampler Type	Blows/foot	Group Symbol	Group Graphic				
5	8.5							logging began at 5' bgs.			
6	7.5	18		SPT	9			Poorly-Graded Sand (SP) - about 90% fine to medium sand with trace silt and fine gravel, and grassy organics organics, dark brown, moist			
7	6.5										
8	5.5	18		SPT	2	SP		black textile at 8.5 ft			
9	4.5							organic silt bed			
10	3.5										
11	2.5	18		SPT	1						
12	1.5										
13	0.5										
14	-0.5	30		ST		ML					
15	-1.5							Silt (ML) - 76% fines with organics, 24% fine to medium sand, 1% course sand, gray, wet			
16	-2.5	18		SPT	2						
17	-3.5										
18	-4.5	18		SPT	1						
19	-5.5										
20	-6.5					SM		Silty Sand (SM) - about 80% fine to medium sand and 20% non-plastic fines with trace organics, dark gray, wet			
21	-7.5	18		SPT	12			dark gray woody material			
22	-8.5										
23	-9.5	18		SPT	2	ML/SM					
24	-10.5							Silt Sand (ML) - about 100% low plastic fines with organics, gray, wet interbedded with silty fine sand			
25	-11.5										
26	-12.5	18		SPT	7	SP-SM					
27	-13.5							Poorly-Graded Sand with Silt (SP-SM) - about 90% fine to medium sand with 10% fines and trace organics, dark brown, wet			
28	-14.5	18		SPT	5	MH		Elastic Silt (MH) - about 90% medium plastic fines, slow dilatency, gray, wet with significant organics at 26.5 ft			
29	-15.5										
30	-16.5	18		SPT	17						
31	-17.5					ML					
32	-18.5	12		SPT	4						
								Sandy Silt (ML) - 64% fines (non-plastic) and 36% fine to medium sand, occassional fine to medium sand interbeds and lenses, with trace organics, dark gray, wet			
								81% silty fines, 19% fine to medium sand (as lenses)			

DOF-B4										DALTON OLMSTED FUGLEVAND	
PROJECT: Arkema Pre-Design Investigation						COORDINATES: N 710843.0 E 1175021.8 (NAD 83)					
LOCATION: Former Arkema Manufacturing Facility						SURFACE ELEVATION: 13.5 ft (NAVD88)					
DRILLING CONTRACTOR: Cascade Drilling						DATE: 10/25/2023					
DRILLING EQUIPMENT: CME 75 Hollow Stem Auger						TOTAL DEPTH OF BORING (bgs): 39.5 feet					
DRILLING METHOD: 8" OD x 4.25" ID by 5' auger						LOGGED BY: A.Cerruti					
SAMPLE DATA						SOIL DESCRIPTION					Abandonment Method
DEPTH (feet)	Elevation (ft)	Sample Interval	Recovery (in)	Sampler Type	Blows/foot	Group Symbol	Group Graphic				
33	-19.5										
34	-20.5		18	SPT	3	ML		90% fines with 10% fine to medium sand (as lenses) and yellow grassy organics			
35	-21.5										
36	-22.5		18	SPT	6						
37	-23.5		18	SPT	7						
38	-24.5					SM		Silty Sand (SM) - about 80% fine sand and 20% non-plastic fines, and occassional silt stringers, dark gray, wet			
39	-25.5		18	SPT	5						
40	-26.5										

DOF-B5										DOF DALTON OLMSTED FUGLEVAND	
PROJECT: Arkema Pre-Design Investigation							COORDINATES: N 710861.9 E 1174887.6 (NAD 83)				
LOCATION: Former Arkema Manufacturing Facility							SURFACE ELEVATION: 13.0 ft (NAVD88)				
DRILLING CONTRACTOR: Cascade Drilling							DATE: 10/20/2023				
DRILLING EQUIPMENT: CME 75 Hollow Stem Auger							TOTAL DEPTH OF BORING (bgs): 40 feet				
DRILLING METHOD: 8" OD x 4.25" ID by 5' auger							LOGGED BY: A.Cerruti				
SAMPLE DATA							SOIL DESCRIPTION				Abandonment Method
DEPTH (feet)	Elevation (ft)	Sample Interval	Recovery (in)	Sampler Type	Blows/foot (N)	Group Symbol	Group Graphic				
5	8							logging began at 5' bgs.			
6	7	12		SPT	4	SM		Silty Sand (SM) - 68% fine to coarse sand with 32% fines, trace organics, dark brown, wet			
7	6										
8	5	18		SPT	3						
9	4										
10	3	18		SPT	0	ML / SM		Silt (ML) - about 100% low plastic fines with organics, dark brown and gray, wet interbedded with silty fine sand			
11	2										
12	1										
13	0	18		SPT	0						
14	-1										
15	-2										
16	-3	18		SPT	0						
17	-4										
18	-5	18		SPT	6	ML		Silt (ML) - 99% low plastic fines with 1% fine sand, rapid dilatency, trace organics, gray, wet			
19	-6										
20	-7										
21	-8	18		SPT	8						
22	-9										
23	-10	18		SPT	4						
24	-11										
25	-12					SM		Silty Sand (SM) - about 80% fine to medium sand and 20% non-plastic fines with trace organics, dark gray, wet			
26	-13	18		SPT	4						
27	-14	18		SPT	3	ML		Silt (ML) - about 90% low plastic fines with 10% fine sand with organics, brown, wet			
28	-15										
29	-16	18		SPT	13	SM		Silty Sand (SM) - about 80% fine to medium sand and 20% non-plastic fines with trace organics, gray, wet			
30	-17										
31	-18	18		SPT	4	ML					
32	-19										
		18		SPT	5			Silt (ML) - 96% low plastic fines with 4% fine to medium sand, trace organics, brown, wet			

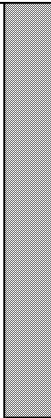
DOF-B5										DALTON OLMSTED FUGLEVAND	
PROJECT: Arkema Pre-Design Investigation						COORDINATES: N 710861.9 E 1174887.6 (NAD 83)					
LOCATION: Former Arkema Manufacturing Facility						SURFACE ELEVATION: 13.0 ft (NAVD88)					
DRILLING CONTRACTOR: Cascade Drilling						DATE: 10/20/2023					
DRILLING EQUIPMENT: CME 75 Hollow Stem Auger						TOTAL DEPTH OF BORING (bgs): 40 feet					
DRILLING METHOD: 8" OD x 4.25" ID by 5' auger						LOGGED BY: A.Cerruti					
SAMPLE DATA						SOIL DESCRIPTION					Abandonment Method
DEPTH (feet)	Elevation (ft)	Sample Interval	Recovery (in)	Sampler Type	Blows/foot (N)	Group Symbol	Group Graphic				
33	-20		18	SPT	5			interbedded grassy organic zones			
34	-21										
35	-22		18	SPT	4						
36	-23		18	SPT	3	ML					
37	-24										
38	-25		18	SPT	2			Poorly-Graded Sand with Silt (SP-SM) - about 90% fine to medium sand with 10% fines dark gray, wet			
39	-26		18	SPT	3	SP-SM					
40	-27										

DOF-B6



PROJECT: Arkema Pre-Design Investigation	COORDINATES: N 710974.4 E 1174877.0 (NAD 83)
LOCATION: Former Arkema Manufacturing Facility	SURFACE ELEVATION: 13.2 ft (NAVD88)
DRILLING CONTRACTOR: Cascade Drilling	DATE: 10/25/2023
DRILLING EQUIPMENT: CME 75 Hollow Stem Auger	TOTAL DEPTH OF BORING (bgs): 40.5 feet
DRILLING METHOD: 8" OD x 4.25" ID by 5' auger	LOGGED BY: A.Cerruti

SAMPLE DATA							SOIL DESCRIPTION		Abandonment Method
DEPTH (feet)	Elevation (ft)	Sample Interval	Recovery (in)	Sampler Type	Blows/foot (N)	Group Symbol	Group Graphic		
5	8.2							logging began at 5' bgs.	
6	7.2	18		SPT	27	SP-SM		Poorly-Graded Sand with Silt (SP-SM) - about 85% fine to medium sand with 10% fines and 5% gravel dark gray, moist	
7	6.2								
8	5.2	18		SPT	14	SM		Silty Sand (SM) - about 80% fine to medium sand and 20% non-plastic fines with trace organics, dark gray, moist	
9	4.2								
10	3.2							interbedded Poorly-Graded Sand with Silt (SP-SM)	
11	2.2	18		SPT	5				
12	1.2								
13	0.2								
14	-0.8	30		ST					
15	-1.8							Silt (ML) - 91% low plastic silty fines with 9% fine sand with organics, gray and brown, wet with lenses of grassy organics	
16	-2.8	18		SPT	3	ML			
17	-3.8								
18	-4.8	18		SPT	28			95% silty fines with 5% fine sand	
19	-5.8								
20	-6.8								
21	-7.8	18		SPT	5	SP		Poorly-Graded Sand (SP) - about 100% fine to medium sand and grassy organics organics, dark gray, moist	
22	-8.8								
23	-9.8	12		SPT	8			silt stringer, 22.5 to 22.7 ft	
24	-10.8							Silty Sand (SM) - 75% fine sand with 24% fines, 1% medium sand trace organics, dark brown, wet	
25	-11.8								
26	-12.8	18		SPT	19	SM			
27	-13.8	18		SPT	15			interbedded with fine to medium sand	
28	-14.8								
29	-15.8	18		SPT	25				
30	-16.8	18		SPT	5	ML		Silt (ML) - about 90% low plastic fines with 10% fine sand with organics, brown, wet	
31	-17.8								
32	-18.8	0		ST		MH		sample lost from tube	

DOF-B6										DALTON OLMSTED FUGLEVAND			
PROJECT: Arkema Pre-Design Investigation						COORDINATES: N 710974.4 E 1174877.0 (NAD 83)							
LOCATION: Former Arkema Manufacturing Facility						SURFACE ELEVATION: 13.2 ft (NAVD88)							
DRILLING CONTRACTOR: Cascade Drilling						DATE: 10/25/2023							
DRILLING EQUIPMENT: CME 75 Hollow Stem Auger						TOTAL DEPTH OF BORING (bgs): 40.5 feet							
DRILLING METHOD: 8" OD x 4.25" ID by 5' auger						LOGGED BY: A.Cerruti							
SAMPLE DATA							SOIL DESCRIPTION				Abandonment Method		
DEPTH (feet)	Elevation (ft)	Sample Interval	Recovery (in)	Sampler Type	Blows/foot (N)	Group Symbol	Group Graphic						
33	-19.8							Elastic Silt (MH) - 81% silty fines with 19% fine to medium sand LL = 57, PL = 35, PI = 22					
34	-20.8					MH							
35	-21.8	30		ST									
36	-22.8							Silt (ML) - about 90% low plastic fines with 10% fine sand with organics, brown, wet					
37	-23.8	18		SPT	7								
38	-24.8	18		SPT	8	ML							
39	-25.8												
40	-26.8	18		SPT	7								

DOF-B7



PROJECT: Arkema Pre-Design Investigation	COORDINATES: N 711122.9 E 1174883.3 (NAD 83)
LOCATION: Former Arkema Manufacturing Facility	SURFACE ELEVATION: 13.7 ft (NAVD88)
DRILLING CONTRACTOR: Cascade Drilling	DATE: 10/20/2023
DRILLING EQUIPMENT: CME 75 Hollow Stem Auger	TOTAL DEPTH OF BORING (bgs): 40 feet
DRILLING METHOD: 8" OD x 4.25" ID by 5' auger	LOGGED BY: A.Cerruti

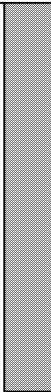
SAMPLE DATA						SOIL DESCRIPTION		Abandonment Method
DEPTH (feet)	Elevation (ft)	Sample Interval Recovery (in)	Sampler Type	Blows/foot	Group Symbol	Group Graphic		
5	8.7						logging began at 5' bgs.	
6	7.7	18	SPT	11	SP-SM		Poorly-Graded Sand with Silt (SP-SM) - about 90% fine to medium sand with 10% fines and trace organics, dark brown, wet	
7	6.7							
8	5.7	18	SPT	4	SM		Silty Sand (SM) - 73% fine to medium sand and 27% non-plastic fines, trace organics, gray, moist	
9	4.7							
10	3.7							
11	2.7	0	SPT	3			no recovery	
12	1.7							
13	0.7	18	SPT	7				
14	-0.3							
15	-1.3							
16	-2.3	18	SPT	16	ML		Silt (ML) - about 88% non-plastic fines with 12% fine to medium sand, trace organics, gray, wet	
17	-3.3							
18	-4.3	18	SPT	12				
19	-5.3							
20	-6.3							
21	-7.3	18	SPT	26				
22	-8.3							
23	-9.3	18	SPT	11	SM		Silty Sand (SM) - about 80% fine to medium sand and 20% non-plastic fines with trace organics, dark gray, moist	
24	-10.3							
25	-11.3							
26	-12.3	18	SPT	3				
27	-13.3	18	SPT	7				
28	-14.3							
29	-15.3	18	SPT	10	ML/SP-SM		Silt (ML) - about 90% low plastic fines with 10% fine sand lenses, and organics, dark gray, wet, with fine sand with silt interbeds	
30	-16.3	18	SPT	7				
31	-17.3							
32	-18.3	18	SPT	3	MH		Silt (MH) - about 95% fines with trace fine sand, medium plasticity, slow dilatency, brown, moist	

DOF-B7										DOF DALTON OLMSTED FUGLEVAND		
PROJECT: Arkema Pre-Design Investigation						COORDINATES: N 711122.9 E 1174883.3 (NAD 83)						
LOCATION: Former Arkema Manufacturing Facility						SURFACE ELEVATION: 13.7 ft (NAVD88)						
DRILLING CONTRACTOR: Cascade Drilling						DATE: 10/20/2023						
DRILLING EQUIPMENT: CME 75 Hollow Stem Auger						TOTAL DEPTH OF BORING (bgs): 40 feet						
DRILLING METHOD: 8" OD x 4.25" ID by 5' auger						LOGGED BY: A.Cerruti						
SAMPLE DATA						SOIL DESCRIPTION					Abandonment Method	
DEPTH (feet)	Elevation (ft)	Sample Interval	Recovery (in)	Sampler Type	Blows/foot	Group Symbol	Group Graphic					
33	-19.3		18	SPT	4	MH		Light gray sandy silt (SM) lense observed at 32.2 ft bgs.				
34	-20.3		18	SPT	5							
35	-21.3		18	SPT	7	SP-SM		Poorly-Graded Sand with Silt (SP) - about 90% fine to medium sand with 10% fines, grassy organics organics, dark brown, moist				
36	-22.3		18	SPT	4	ML		Silt (ML) - 81% fines with 19% fine to medium sand, dark brown, moist				
37	-23.3		18	SPT	7	SP		Poorly-Graded Sand (SP) - about 95% fine to medium sand with trace silt, dark gray, wet				
38	-24.3											
39	-25.3											
40	-26.3											

DOF-B8										DOF DALTON OLMSTED FUGLEVAND	
PROJECT: Arkema Pre-Design Investigation							COORDINATES: N 711230.6 E 1174903.2 (NAD 83)				
LOCATION: Former Arkema Manufacturing Facility							SURFACE ELEVATION: 13.1 ft (NAVD88)				
DRILLING CONTRACTOR: Cascade Drilling							DATE: 10/26/2023				
DRILLING EQUIPMENT: CME 75 Hollow Stem Auger							TOTAL DEPTH OF BORING (bgs): 38 feet				
DRILLING METHOD: 8" OD x 4.25" ID by 5' auger							LOGGED BY: A.Cerruti				
SAMPLE DATA							SOIL DESCRIPTION			Abandonment Method	
DEPTH (feet)	Elevation (ft)	Sample Interval	Recovery (in)	Sampler Type	Blows/foot	Group Symbol	Group Graphic				
5	8.1							logging began at 5' bgs.			
6	7.1	18		SPT	9			Silty Sand (SM) - 74% fine to coarse sand with 24% fines, 2% gravels, trace organics, dark brown, wet			
7	6.1										
8	5.1	18		SPT	13	SM					
9	4.1										
10	3.1										
11	2.1	18		SPT	3						
12	1.1										
13	0.1	18		SPT	0			Silt (ML) - about 90% low plastic fines with 10% fine sand lenses, and organics, brown and gray, moist			
14	-0.9										
15	-1.9					ML					
16	-2.9	30		ST							
17	-3.9										
18	-4.9	18		SPT	3						
19	-5.9										
20	-6.9					SM		Silty Sand (SM) - about 80% fine to medium sand and 20% non-plastic fines with trace organics, gray, wet			
21	-7.9	18		SPT	6						
22	-8.9										
23	-9.9	0		SPT	10			no recovery			
24	-10.9										
25	-11.9					SP /		Poorly-Graded Sand with Silt (SP-SM) - 93.7% fine to medium sand with 6.3% fines, dark gray, wet - with silt lense at base			
26	-12.9	18		SPT	13	SM					
27	-13.9					ML		Sandy Silt (ML) - 59% fines with 41% fine to coarse sand (as interbeds), trace organics, dark gray, wet			
28	-14.9	18		SPT	14						
29	-15.9	18		SPT	9	SP/		Silty Sand (SM) - about 80% fine to medium sand and 20% non-plastic fines with trace organics, dark gray, wet			
30	-16.9					SM		interbedded with Poorly-Graded Sand with Silt (SP-SM)			
31	-17.9	12		SPT	6						
32	-18.9	30		ST		ML		Silt (ML) - about 80% fines and 20% fine sand, non-plastic dark gray, wet, rapid dilatancy			

DOF-B8										DOF DALTON OLMSTED FUGLEVAND	
PROJECT: Arkema Pre-Design Investigation						COORDINATES: N 711230.6 E 1174903.2 (NAD 83)					
LOCATION: Former Arkema Manufacturing Facility						SURFACE ELEVATION: 13.1 ft (NAVD88)					
DRILLING CONTRACTOR: Cascade Drilling						DATE: 10/26/2023					
DRILLING EQUIPMENT: CME 75 Hollow Stem Auger						TOTAL DEPTH OF BORING (bgs): 38 feet					
DRILLING METHOD: 8" OD x 4.25" ID by 5' auger						LOGGED BY: A.Cerruti					
SAMPLE DATA						SOIL DESCRIPTION					Abandonment Method
DEPTH (feet)	Elevation (ft)	Sample Interval	Recovery (in)	Sampler Type	Blows/foot	Group Symbol	Group Graphic				
33	-19.9										
34	-20.9		18	SPT	8	ML/		Silt with Sand (ML) - about 70% low plastic fines with 30% fine sand lenses, and organics, gray, wet			
35	-21.9					SM					
36	-22.9		18	SPT	6						
37	-23.9		18	SPT	6	SM		Silty Sand (SM) - about 80% fine to medium sand and 20% non-plastic fines with trace organics, dark gray, wet - with silt lenses			
38	-24.9										
39	-25.9										
40	-26.9										

DOF-B9										DOF DALTON OLMSTED FUGLEVAND	
PROJECT: Arkema Pre-Design Investigation						COORDINATES: N 711235.3 E 1175047.9 (NAD 83)					
LOCATION: Former Arkema Manufacturing Facility						SURFACE ELEVATION: 13.6 ft (NAVD88)					
DRILLING CONTRACTOR: Cascade Drilling						DATE: 10/23/2023					
DRILLING EQUIPMENT: CME 75 Hollow Stem Auger						TOTAL DEPTH OF BORING (bgs): 40 feet					
DRILLING METHOD: 8" OD x 4.25" ID by 5' auger						LOGGED BY: A.Cerruti					
SAMPLE DATA						SOIL DESCRIPTION					Abandonment Method
DEPTH (feet)	Elevation (ft)	Sample Interval	Recovery (in)	Sampler Type	Blows/foot	Group Symbol	Group Graphic				
5	8.6							logging began at 5' bgs.			
6	7.6		18	SPT	13						
7	6.6							Poorly-Graded Sand (SP) - about 95% fine to medium sand with trace silt and fine gravel, dark gray, wet			
8	5.6		18	SPT	23	SP					
9	4.6										
10	3.6										
11	2.6		0	SPT	11						
12	1.6										
13	0.6		18	SPT	2	SP / SM		Poorly graded Sand with Silt (SP-SM) - 94.7% fine to coarse sand with 5.3% silty fines, dark gray, wet			
14	-0.4										
15	-1.4										
16	-2.4		18	SPT	6	SM		Silty Sand (SM) - about 60% fine sand and 40% fines, with grassy organics, gray, wet,			
17	-3.4										
18	-4.4		18	SPT	2	ML		Silt with Sand (ML) - about 70% low plastic fines with 30% fine sand lenses, and organics, gray, wet			
19	-5.4										
20	-6.4										
21	-7.4		18	SPT	3						
22	-8.4										
23	-9.4		18	SPT	25			Poorly-Graded Sand (SP) - 96.6% fine to medium sand with 3.4% fines, brown, wet, with interbedded Silty Sand (SM)			
24	-10.4										
25	-11.4					SP/ SM					
26	-12.4		18	SPT	11						
27	-13.4		18	SPT	6						
28	-14.4										
29	-15.4		18	SPT	12						
30	-16.4		18	SPT	8						
31	-17.4										
32	-18.4		18	SPT	2	MH		Elastic Silt (MH) - about 75% fines with 24% fine to medium sand, wiith 1% course sand, slow dilatency, brown and gray, with organic and Silt with Sand (ML) interbeds. LL = 28, PL = 52, PI = -24			

DOF-B9										DALTON OLMSTED FUGLEVAND				
PROJECT: Arkema Pre-Design Investigation						COORDINATES: N 711235.3 E 1175047.9 (NAD 83)								
LOCATION: Former Arkema Manufacturing Facility						SURFACE ELEVATION: 13.6 ft (NAVD88)								
DRILLING CONTRACTOR: Cascade Drilling						DATE: 10/23/2023								
DRILLING EQUIPMENT: CME 75 Hollow Stem Auger						TOTAL DEPTH OF BORING (bgs): 40 feet								
DRILLING METHOD: 8" OD x 4.25" ID by 5' auger						LOGGED BY: A.Cerruti								
SAMPLE DATA							SOIL DESCRIPTION					Abandonment Method		
DEPTH (feet)	Elevation (ft)	Sample Interval	Recovery (in)	Sampler Type	Blows/foot	Group Symbol	Group Graphic							
33	-19.4		18	SPT	8			<i>Sandy Silt (ML)</i> - 65% fines with 35% fine to medium sand, slow dilatency, brown and gray, with organic silt interbeds becomes heavily interbedded at base						
34	-20.4													
35	-21.4		18	SPT	13									
36	-22.4		18	SPT	4	MH / ML								
37	-23.4													
38	-24.4		18	SPT	6									
39	-25.4		18	SPT	9			<i>Poorly-Graded Sand (SP)</i> - about 95% fine to medium sand with trace silt and fine gravel, dark gray, wet						
40	-26.4					SP								

DOF-B10



PROJECT: Arkema Pre-Design Investigation	COORDINATES: N 711202.4 E 1175167.7 (NAD 83)
LOCATION: Former Arkema Manufacturing Facility	SURFACE ELEVATION: 16.5 ft (NAVD88)
DRILLING CONTRACTOR: Cascade Drilling	DATE: 10/26/2023
DRILLING EQUIPMENT: CME 75 Hollow Stem Auger	TOTAL DEPTH OF BORING (bgs): 41 feet
DRILLING METHOD: 8" OD x 4.25" ID by 5' auger	LOGGED BY: A.Cerruti

SAMPLE DATA						SOIL DESCRIPTION		Abandonment Method
DEPTH (feet)	Elevation (ft)	Sample Interval	Recovery (in)	Sampler Type	Blows/foot	Group Symbol	Group Graphic	
5	11.5							
6	10.5	18		SPT	11			
7	9.5					SP-SM		
8	8.5	18		SPT	8			
9	7.5							
10	6.5							
11	5.5	18		SPT	3			
12	4.5					SM		
13	3.5	18		SPT	4			
14	2.5							
15	1.5							
16	0.5	24		ST		SP-SM		
17	-0.5							
18	-1.5	18		SPT	3			
19	-2.5							
20	-3.5							
21	-4.5	18		SPT	6	ML/SM		
22	-5.5							
23	-6.5	18		SPT	16			
24	-7.5					SP-SM		
25	-8.5							
26	-9.5	18		SPT	5			
27	-10.5							
28	-11.5	18		SPT	8	ML		
29	-12.5							
30	-13.5							
31	-14.5	30		ST		SM		
32	-15.5							

DOF-B10



PROJECT: Arkema Pre-Design Investigation						COORDINATES: N 711202.4 E 1175167.7 (NAD 83)		
LOCATION: Former Arkema Manufacturing Facility						SURFACE ELEVATION: 16.5 ft (NAVD88)		
DRILLING CONTRACTOR: Cascade Drilling						DATE: 10/26/2023		
DRILLING EQUIPMENT: CME 75 Hollow Stem Auger						TOTAL DEPTH OF BORING (bgs): 41 feet		
DRILLING METHOD: 8" OD x 4.25" ID by 5' auger						LOGGED BY: A.Cerruti		
SAMPLE DATA						SOIL DESCRIPTION		Abandonment Method
DEPTH (feet)	Elevation (ft)	Sample Interval	Recovery (in)	Sampler Type	Blows/foot	Group Symbol	Group Graphic	
33	-16.5		18	SPT	14			
34	-17.5		18	SPT	5			
35	-18.5							
36	-19.5		18	SPT	7	MH		
37	-20.5		12	SPT	9			
38	-21.5							
39	-22.5		12	SPT	5			
40	-23.5		18	SPT	4	SM		
						Elastic <i>Silt (MH)</i> - 81% fines with 18% fine to medium sand, 1% course sand, LL = 73, PL = 41, PI = 32, slow dilatency, light brown and gray, with organic and <i>Silt with Sand (ML)</i> interbeds.		
						<i>Silty Sand (SM)</i> - about 60% fine sand and 40% fines, with grassy organics, dark gray, wet, with fine to medium sand lenses		

DOF-B11



PROJECT: Arkema Pre-Design Investigation	COORDINATES: N 711104.9 E 1175272.0 (NAD 83)
LOCATION: Former Arkema Manufacturing Facility	SURFACE ELEVATION: 16.3 ft (NAVD88)
DRILLING CONTRACTOR: Cascade Drilling	DATE: 10/23/2023
DRILLING EQUIPMENT: CME 75 Hollow Stem Auger	TOTAL DEPTH OF BORING (bgs): 40 feet
DRILLING METHOD: 8" OD x 4.25" ID by 5' auger	LOGGED BY: A.Cerruti

SAMPLE DATA						SOIL DESCRIPTION		Abandonment Method
DEPTH (feet)	Elevation (ft)	Sample Interval	Recovery (in)	Sampler Type	Blows/foot	Group Symbol	Group Graphic	
5	11.3							
6	10.3	6	SPT	14	GW-GM		logging began at 5' bgs. <i>Well-Graded Gravel with Silt and Sand (GW-GM)</i> - 53 % fine to course gravel, 41% fine to fine to course sand, and 6% fines, light brown, moist	
7	9.3							
8	8.3	18	SPT	9	SP		<i>Poorly-Graded Sand (SP)</i> - about 95% fine to medium sand with trace silt dark gray, wet	
9	7.3							
10	6.3						rusty brown color at 8 ft.	
11	5.3	18	SPT	7				
12	4.3					SM	<i>Silty Sand (SM)</i> - about 80% fine to medium sand and 20% non-plastic fines with dark gray, wet	
13	3.3	18	SPT	2				
14	2.3							
15	1.3					ML	<i>Silt (ML)</i> - 87% fines with 13% fine to medium sand (as lenses), LL = 36, PL = 28, PI = 8, brown, wet	
16	0.3	18	SPT	1				
17	-0.7							
18	-1.7	18	SPT	2	SM		<i>Silty Sand (SM)</i> - about 80% fine to medium sand and 20% non-plastic fines with brown, wet	
19	-2.7							
20	-3.7					ML/SM	<i>Silt (ML)</i> - about 85% low plastic fines, 15% fine sand, gray, wet interbedded with <i>Silty Sand (SM)</i>	
21	-4.7	18	SPT	3				
22	-5.7							
23	-6.7	18	SPT	5			<i>Poorly-Graded Sand with Silt (SP-SM)</i> - about 90% fine to medium sand with 10% fines, dark gray, wet	
24	-7.7					SP-SM		
25	-8.7							
26	-9.7	18	SPT	17				
27	-10.7	18	SPT	24	SP		<i>Poorly-Graded Sand (SP)</i> - about 95% fine to medium sand with trace silt dark gray, wet	
28	-11.7							
29	-12.7	18	SPT	5	MH		<i>Silt (MH)</i> - about 95% fines with trace fine sand, medium plasticity, slow dilatency, gray, with organic and <i>Silt with Sand (ML)</i> interbeds.	
30	-13.7							
31	-14.7	18	SPT	1				
32	-15.7	18	SPT	7	SM		<i>Silty Sand (SM)</i> - 68% fine sand and 31% fines, 1% medium sand, dark brown, wet	

DOF-B11



PROJECT: Arkema Pre-Design Investigation	COORDINATES: N 711104.9 E 1175272.0 (NAD 83)
LOCATION: Former Arkema Manufacturing Facility	SURFACE ELEVATION: 16.3 ft (NAVD88)
DRILLING CONTRACTOR: Cascade Drilling	DATE: 10/23/2023
DRILLING EQUIPMENT: CME 75 Hollow Stem Auger	TOTAL DEPTH OF BORING (bgs): 40 feet
DRILLING METHOD: 8" OD x 4.25" ID by 5' auger	LOGGED BY: A.Cerruti

SAMPLE DATA						SOIL DESCRIPTION		Abandonment Method
DEPTH (feet)	Elevation (ft)	Sample Interval	Recovery (in)	Sampler Type	Blows/foot	Group Symbol	Group Graphic	
33	-16.7		18	SPT	8			
34	-17.7							
35	-18.7		18	SPT	9			
36	-19.7		18	SPT	10	ML		
37	-20.7							
38	-21.7		18	SPT	9			
39	-22.7		18	SPT	8			
40	-23.7							

Silt with Sand (ML) - about 70% low plastic fines with 30% fine sand lenses, and organics, brown, wet

Sandy Silt (ML) - 59% fines with 39% fine sand, 2% medium sand, dark brown, wet, with trace organics

DOF-B12



PROJECT: Arkema Pre-Design Investigation	COORDINATES: N 711006.7 E 1175374.8 (NAD 83)
LOCATION: Former Arkema Manufacturing Facility	SURFACE ELEVATION: 15.5 ft (NAVD88)
DRILLING CONTRACTOR: Cascade Drilling	DATE: 10/27/2023
DRILLING EQUIPMENT: CME 75 Hollow Stem Auger	TOTAL DEPTH OF BORING (bgs): 40 feet
DRILLING METHOD: 8" OD x 4.25" ID by 5' auger	LOGGED BY: A.Cerruti

SAMPLE DATA						SOIL DESCRIPTION		Abandonment Method
DEPTH (feet)	Elevation (ft)	Sample Interval	Recovery (in)	Sampler Type	Blows/foot	Group Symbol	Group Graphic	
5	10.5							
6	9.5	18	SPT	2				
7	8.5	18	SPT	4		SW - SM		
8	7.5							
9	6.5	24	ST					
10	5.5							
11	4.5	18	SPT	9				
12	3.5					SP - SM		
13	2.5	24	ST					
14	1.5							
15	0.5	18	SPT	7				
16	-0.5	18	SPT	7		ML/ SP		
17	-1.5	18	SPT	3				
18	-2.5	18	SPT	2				
19	-3.5							
20	-4.5	18	SPT	6				
21	-5.5	24	SPT			SP/ SM		
22	-6.5							
23	-7.5	24	ST					
24	-8.5							
25	-9.5	18	SPT	8				
26	-10.5	18	SPT	55				
27	-11.5							
28	-12.5	18	SPT	24		SP		
29	-13.5							
30	-14.5	24	ST					
31	-15.5					ML		
32	-16.5							

DOF-B12



PROJECT: Arkema Pre-Design Investigation	COORDINATES: N 711006.7 E 1175374.8 (NAD 83)
LOCATION: Former Arkema Manufacturing Facility	SURFACE ELEVATION: 15.5 ft (NAVD88)
DRILLING CONTRACTOR: Cascade Drilling	DATE: 10/27/2023
DRILLING EQUIPMENT: CME 75 Hollow Stem Auger	TOTAL DEPTH OF BORING (bgs): 40 feet
DRILLING METHOD: 8" OD x 4.25" ID by 5' auger	LOGGED BY: A.Cerruti

SAMPLE DATA						SOIL DESCRIPTION		Abandonment Method
DEPTH (feet)	Elevation (ft)	Sample Interval	Recovery (in)	Sampler Type	Blows/foot	Group Symbol	Group Graphic	
33	-17.5		18	SPT	8			
34	-18.5		18	SPT	4	ML		
35	-19.5							
36	-20.5		18	SPT	10			
37	-21.5		12	SPT	13	SP-SM		
38	-22.5							
39	-23.5		12	SPT	11			
40	-24.5							

Poorly-Graded Sand with Silt (SP-SM) - about 90% fine to medium sand with 10% fines,
dark gray, wet

DOF-B13



PROJECT: Arkema Pre-Design Investigation	COORDINATES: N 710909.0 E 1175481.5 (NAD 83)
LOCATION: Former Arkema Manufacturing Facility	SURFACE ELEVATION: 14.9 ft (NAVD88)
DRILLING CONTRACTOR: Cascade Drilling	DATE: 10/24/2023
DRILLING EQUIPMENT: CME 75 Hollow Stem Auger	TOTAL DEPTH OF BORING (bgs): 40 feet
DRILLING METHOD: 8" OD x 4.25" ID by 5' auger	LOGGED BY: A.Cerruti

SAMPLE DATA						SOIL DESCRIPTION		Abandonment Method
DEPTH (feet)	Elevation (ft)	Sample Interval	Recovery (in)	Sampler Type	Blows/foot	Group Symbol	Group Graphic	
5	9.9							
6	8.9	18	SPT	3				
7	7.9							
8	6.9	18	SPT	18		SP-SM		
9	5.9							
10	4.9							
11	3.9	18	SPT	18				
12	2.9							
13	1.9	18	SPT	2				
14	0.9							
15	-0.1					ML		
16	-1.1	18	SPT	2				
17	-2.1							
18	-3.1	18	SPT	8				
19	-4.1					SM		
20	-5.1							
21	-6.1	12	SPT	21				
22	-7.1							
23	-8.1	12	SPT	10		SP		
24	-9.1							
25	-10.1							
26	-11.1	12	SPT	9				
27	-12.1							
28	-13.1	18	SPT	24				
29	-14.1	18	SPT	16		SP-SM		
30	-15.1	18	SPT	8				
31	-16.1							
32	-17.1	18	SPT	3		MH		
						ML		

DOF-B13



PROJECT: Arkema Pre-Design Investigation	COORDINATES: N 710909.0 E 1175481.5 (NAD 83)
LOCATION: Former Arkema Manufacturing Facility	SURFACE ELEVATION: 14.9 ft (NAVD88)
DRILLING CONTRACTOR: Cascade Drilling	DATE: 10/24/2023
DRILLING EQUIPMENT: CME 75 Hollow Stem Auger	TOTAL DEPTH OF BORING (bgs): 40 feet
DRILLING METHOD: 8" OD x 4.25" ID by 5' auger	LOGGED BY: A.Cerruti

SAMPLE DATA						SOIL DESCRIPTION		Abandonment Method	
DEPTH (feet)	Elevation (ft)	Sample Interval	Recovery (in)	Sampler Type	Blows/foot	Group Symbol	Group Graphic		
33	-18.1		18	SPT	4	ML			
34	-19.1								
35	-20.1		18	SPT	2				
36	-21.1		18	SPT	16	SM			
37	-22.1								
38	-23.1		18	SPT	10				
39	-24.1		18	SPT	9				
40	-25.1								

Silt (ML) - about 100% low plastic fines with organics, gray, wet

Silty Sand (SM) - about 80% fine to medium sand and 20% non-plastic fines with trace organics, gray, wet silt and sand lenses

DOF-B14



PROJECT: Arkema Pre-Design Investigation	COORDINATES: N 710802.5 E 1175475.0 (NAD 83)
LOCATION: Former Arkema Manufacturing Facility	SURFACE ELEVATION: 14.8 ft (NAVD88)
DRILLING CONTRACTOR: Cascade Drilling	DATE: 10/26/2023
DRILLING EQUIPMENT: CME 75 Hollow Stem Auger	TOTAL DEPTH OF BORING (bgs): 39.5 feet
DRILLING METHOD: 8" OD x 4.25" ID by 5' auger	LOGGED BY: A.Cerruti

SAMPLE DATA						SOIL DESCRIPTION		Abandonment Method
DEPTH (feet)	Elevation (ft)	Sample Interval	Recovery (in)	Sampler Type	Blows/foot	Group Symbol	Group Graphic	
5	9.8							
6	8.8	18		SPT	5			
7	7.8							
8	6.8	18		SPT	3	SP-SM		
9	5.8							
10	4.8							
11	3.8	18		SPT	8			
12	2.8							
13	1.8	18		SPT	2	CL		
14	0.8							
15	-0.2							
16	-1.2	30		ST				
17	-2.2							
18	-3.2	18		SPT	5	ML		
19	-4.2							
20	-5.2							
21	-6.2	18		SPT	8	SP/SM		
22	-7.2							
23	-8.2	12		SPT	20			
24	-9.2							
25	-10.2							
26	-11.2	12		SPT	24			
27	-12.2	18		SPT	15	SP-SM		
28	-13.2							
29	-14.2	18		SPT	14			
30	-15.2							
31	-16.2	18		SPT	13			
32	-17.2							

DOF-B14



PROJECT: Arkema Pre-Design Investigation	COORDINATES: N 710802.5 E 1175475.0 (NAD 83)
LOCATION: Former Arkema Manufacturing Facility	SURFACE ELEVATION: 14.8 ft (NAVD88)
DRILLING CONTRACTOR: Cascade Drilling	DATE: 10/26/2023
DRILLING EQUIPMENT: CME 75 Hollow Stem Auger	TOTAL DEPTH OF BORING (bgs): 39.5 feet
DRILLING METHOD: 8" OD x 4.25" ID by 5' auger	LOGGED BY: A.Cerruti

SAMPLE DATA						SOIL DESCRIPTION		Abandonment Method
DEPTH (feet)	Elevation (ft)	Sample Interval	Recovery (in)	Sampler Type	Blows/foot	Group Symbol	Group Graphic	
33	-18.2		18	SPT	9			
34	-19.2							
35	-20.2		18	SPT	6	ML		
36	-21.2							
37	-22.2	30		ST				
38	-23.2							
39	-24.2		18	SPT	10	SM		
40	-25.2							

DOF-B15



PROJECT: Arkema Pre-Design Investigation	COORDINATES: N 710699.5 E 1175381.6 (NAD 83)
LOCATION: Former Arkema Manufacturing Facility	SURFACE ELEVATION: 17.7 ft (NAVD88)
DRILLING CONTRACTOR: Cascade Drilling	DATE: 10/24/2023
DRILLING EQUIPMENT: CME 75 Hollow Stem Auger	TOTAL DEPTH OF BORING (bgs): 40 feet
DRILLING METHOD: 8" OD x 4.25" ID by 5' auger	LOGGED BY: A.Cerruti

SAMPLE DATA						SOIL DESCRIPTION		Abandonment Method
DEPTH (feet)	Elevation (ft)	Sample Interval	Recovery (in)	Sampler Type	Blows/foot	Group Symbol	Group Graphic	
5	12.7							
6	11.7	18		SPT	17			
7	10.7							
8	9.7	18		SPT	8			
9	8.7							
10	7.7					SP-SM		
11	6.7	18		SPT	5			
12	5.7							
13	4.7	18		SPT	23			
14	3.7							
15	2.7							
16	1.7	18		SPT	4	ML		
17	0.7							
18	-0.3	18		SPT	1			
19	-1.3							
20	-2.3					MH		
21	-3.3	18		SPT	1			
22	-4.3							
23	-5.3	18		SPT	5	ML		
24	-6.3							
25	-7.3							
26	-8.3	18		SPT	5	SM		
27	-9.3							
28	-10.3	18		SPT	2	ML		
29	-11.3							
30	-12.3	18		SPT	13	SP-SM		
31	-13.3							
32	-14.3	18		SPT	4	ML		

DOF-B15										DALTON OLMSTED FUGLEVAND	
PROJECT: Arkema Pre-Design Investigation						COORDINATES: N 710699.5 E 1175381.6 (NAD 83)					
LOCATION: Former Arkema Manufacturing Facility						SURFACE ELEVATION: 17.7 ft (NAVD88)					
DRILLING CONTRACTOR: Cascade Drilling						DATE: 10/24/2023					
DRILLING EQUIPMENT: CME 75 Hollow Stem Auger						TOTAL DEPTH OF BORING (bgs): 40 feet					
DRILLING METHOD: 8" OD x 4.25" ID by 5' auger						LOGGED BY: A.Cerruti					
SAMPLE DATA						SOIL DESCRIPTION					Abandonment Method
DEPTH (feet)	Elevation (ft)	Sample Interval	Recovery (in)	Sampler Type	Blows/foot	Group Symbol	Group Graphic				
33	-15.3		18	SPT	18	ML		-----			
34	-16.3										
35	-17.3		18	SPT	15			Sandy Silt (ML) - 69% fines with 31% fine to medium sand non-plastic, gray, wet			
36	-18.3		18	SPT	15	MH					
37	-19.3										
38	-20.3		18	SPT	4			Elastic Silt (MH) - 86% fines with 13% fine to medium sand, 1% course sand, LL = 62, PL = 34, PI = 28, trace grassy organics, dark gray with brown mottling, wet			
39	-21.3		18	SPT	7						
40	-22.3							-----			



Analytical Resources, LLC
Analytical Chemists and Consultants
Tukwila, WA

22 November 2023

Trevor Louviere
Dalton, Olmsted & Fuglevand, Inc
1001 SW Klickitat Way, Suite 200B
Seattle, WA 98134

RE: Arkema- Port of Tacoma (Barrier Wall PDI)

Please find enclosed sample receipt documentation and analytical results for samples from the project referenced above.

Sample analyses were performed according to ARI's Quality Assurance Plan and any provided project specific Quality Assurance Plan. Each analytical section of this report has been approved and reviewed by an analytical peer, the appropriate Laboratory Supervisor or qualified substitute, and a technical reviewer.

Should you have any questions or problems, please feel free to contact us at your convenience.

Associated Work Order(s)
23J0781

Associated SDG ID(s)
N/A

I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed in the enclose Narrative. ARI, an accredited laboratory, certifies that the report results for which ARI is accredited meets all the requirements of the accrediting body. A list of certified analyses, accreditations, and expiration dates is included in this report.

Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his/her designee, as verified by the following signature.

Analytical Resources, LLC

Kelly Bottem, Client Services Manager

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.



Chain of Custody Record & Laboratory Analysis Request

AR Assigned Number: 2310781	Turn-around Requested: Standard
---------------------------------------	---

AR Client Company: PIONEER Technologies Corporation	Phone: 360-570-1700
--	----------------------------

Client Contact: Troy Bussey

Date: 10/27/23

Page: 1 of 1

No. of Coolers:	Cooler Temps:
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Analytical Resources, LLC
Analytical Chemists and Consultants
4611 South 134th Place, Suite 100
Tukwila, WA 98168
206-695-6200 206-695-6202 (fax)

Client Project Name: Arkema Barrier Wall PDI					Analysis Requested								Notes/Comments	
Client Project #:		Samplers: JH / KI			Arsenic	pH	TCLP As	TCLP Metals	Total RCRA Metals					
Sample ID	Date	Time	Matrix	No. Containers										
SO-DOF-B12-6.5-8-102723	10/27	8:19	S	1			X							
SO-DOF-B12-10.5-12-102723	10/27	8:26	S	1	X	X								
SO-DOF-B12-17-12.5-102723	10/27	9:00	S	1			X							
SO-DOF-B12-18-19-102723	10/27	9:15	S	1	X	X								
SO-DOF-B12-19-20.5-102723	10/27	9:19	S	1	X	X								
SO-DOF-B12-22-102723	10/27	9:35	S	1			X							
SO-DOF STOCKPILE-102723	10/27	11:45	S	1				X	X				Composite sample	
KI			S											
KI			S											
KI			S											

Comments/Special Instructions	Relinquished by: (Signature) Kent Ishida	Received by: (Signature) Kevin Cruz	Relinquished by: (Signature)	Received by: (Signature)
	Printed Name: Kent Ishida	Printed Name: Kevin Cruz	Printed Name:	Printed Name:
	Company: Pioneer Technologies	Company: AR LLC	Company:	Company:
	Date & Time: 10/30 & 11:44	Date & Time: 10/30 1145	Date & Time:	Date & Time:

Limits of Liability: Analytical Resources, LLC (AR) will perform all requested services in accordance with appropriate methodology following AR Standard Operating Procedures and the AR Quality Assurance Program. This program meets standards for the industry. The total liability of AR, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the invoiced amount for said services. The acceptance by the client of a proposal for services by AR release AR from any liability in excess thereof, notwithstanding any provision to the contrary in any contract, purchase order or co-signed agreement between AR and the Client.

Sample Retention Policy: Unless specified by work order or contract, all water/soil samples submitted to AR will be discarded or returned, no sooner than 90 days after receipt or 60 days after submission of hard copy data, whichever is longer. Sediment samples submitted under PSDDA/PSEP/SMS protocol will be stored frozen for up to one year and then discarded.



Dalton, Olmsted & Fuglevand, Inc
1001 SW Klickitat Way, Suite 200B
Seattle WA, 98134

Project: Arkema- Port of Tacoma
Project Number: Barrier Wall PDI
Project Manager: Trevor Louviere

Reported:
22-Nov-2023 09:12

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
SO-DOF-B12-6.5-8-102723	23J0781-01	Solid	27-Oct-2023 08:19	30-Oct-2023 11:45
SO-DOF-B12-10.5-12-102723	23J0781-02	Solid	27-Oct-2023 08:26	30-Oct-2023 11:45
SO-DOF-B12-17-17.5-102723	23J0781-03	Solid	27-Oct-2023 09:00	30-Oct-2023 11:45
SO-DOF-B12-18-19-102723	23J0781-04	Solid	27-Oct-2023 09:15	30-Oct-2023 11:45
SO-DOF-B12-19-20.5-102723	23J0781-05	Solid	27-Oct-2023 09:19	30-Oct-2023 11:45
SO-DOF-B12-22-102723	23J0781-06	Solid	27-Oct-2023 09:35	30-Oct-2023 11:45
SO-DOFSTOCKPILE-102723	23J0781-07	Solid	27-Oct-2023 11:45	30-Oct-2023 11:45



Dalton, Olmsted & Fuglevand, Inc
1001 SW Klickitat Way, Suite 200B
Seattle WA, 98134

Project: Arkema- Port of Tacoma
Project Number: Barrier Wall PDI
Project Manager: Trevor Louviere

Reported:
22-Nov-2023 09:12

Work Order Case Narrative

Total and TCLP Metals

The sample(s) were digested and analyzed within the recommended holding times.

Initial and continuing calibrations were within method requirements.

The method blank(s) were clean at the reporting limits.

The blank spike (BS/LCS) percent recoveries were within control limits.

The matrix spike (MS) percent recoveries and the duplicate (DUP) relative percent difference (RPD) were within advisory control limits.

The SRM is in control.

Wet Chemistry

The sample(s) were prepared and analyzed within the recommended holding times.

Initial and continuing calibrations were within method requirements.

The blank spike (BS/LCS) percent recoveries were within control limits.



Analytical Resources, LLC
Analytical Chemists and Consultants

Cooler Receipt Form

ARI Client: Pioneer technologies corporation

Project Name: Arkema Barrier Wall PDI

COC No(s): NA

Delivered by: Fed-Ex UPS Courier Hand Delivered Other: _____

Assigned ARI Job No: 23J0781

Tracking No: NA

Preliminary Examination Phase:

Were intact, properly signed and dated custody seals attached to the outside of the cooler? YES NO

Were custody papers included with the cooler? YES NO

Were custody papers properly filled out (ink, signed, etc.) YES NO

Temperature of Cooler(s) (°C) (recommended 2.0-6.0 °C for chemistry)

Time 1145 0.1

If cooler temperature is out of compliance fill out form 00070F

Temp Gun ID#: 3009708

Cooler Accepted by: KFC Date: 10-30-23 Time: 1145

Complete custody forms and attach all shipping documents

Log-In Phase:

Was a temperature blank included in the cooler? YES NO

What kind of packing material was used? ... Bubble Wrap Wet Ice Gel Packs Baggies Foam Block Paper Other: _____

Was sufficient ice used (if appropriate)? NA YES NO

How were bottles sealed in plastic bags? Individually Grouped Not

Did all bottles arrive in good condition (unbroken)? YES NO

Were all bottle labels complete and legible? YES NO

Did the number of containers listed on COC match with the number of containers received? YES NO

Did all bottle labels and tags agree with custody papers? YES NO

Were all bottles used correct for the requested analyses? YES NO

Do any of the analyses (bottles) require preservation? (attach preservation sheet, excluding VOCs) ... NA YES NO

Were all VOC vials free of air bubbles? NA YES NO

Was sufficient amount of sample sent in each bottle? YES NO

Date VOC Trip Blank was made at ARI: NA

Were the sample(s) split by ARI? NA YES Date/Time: _____ Equipment: _____ Split by: _____

Samples Logged by: [Signature] Date: 10/30/23 Time: 1537 Labels checked by: LB

**** Notify Project Manager of discrepancies or concerns ****

Sample ID on Bottle	Sample ID on COC	Sample ID on Bottle	Sample ID on COC

Additional Notes, Discrepancies, & Resolutions:

By: _____ Date: _____



Dalton, Olmsted & Fuglevand, Inc
1001 SW Klickitat Way, Suite 200B
Seattle WA, 98134

Project: Arkema- Port of Tacoma
Project Number: Barrier Wall PDI
Project Manager: Trevor Louviere

Reported:
22-Nov-2023 09:12

SO-DOF-B12-6.5-8-102723

23J0781-01 (Solid)

TCLP Metals and Metallic Compounds

Method: EPA 6010D

Sampled: 10/27/2023 08:19

Instrument: ICP3 Analyst: DOE

Analyzed: 11/03/2023 09:30

Sample Preparation:

Preparation Method: LEN Digestion of EPA 1311 Elutriate

Extract ID: 23J0781-01 A 02

Preparation Batch: BLK0052

Sample Size: 25 mL (wet)

Prepared: 11/02/2023

Final Volume: 25 mL

Analyte	CAS Number	Dilution	Detection Limit	Reporting Limit	Result	Units	Notes
Arsenic	7440-38-2	5	0.0140	0.250	0.0450	mg/L	J



Dalton, Olmsted & Fuglevand, Inc
1001 SW Klickitat Way, Suite 200B
Seattle WA, 98134

Project: Arkema- Port of Tacoma
Project Number: Barrier Wall PDI
Project Manager: Trevor Louviere

Reported:
22-Nov-2023 09:12

SO-DOF-B12-10.5-12-102723

23J0781-02 (Solid)

Metals and Metallic Compounds

Method: EPA 6020B UCT-KED

Sampled: 10/27/2023 08:26

Instrument: ICPMS2 Analyst: MCB

Analyzed: 11/20/2023 17:28

Sample Preparation:

Preparation Method: SWN EPA 3050B

Extract ID: 23J0781-02 A 03

Preparation Batch: BLK0170

Sample Size: 1.003 g (wet)

Dry Weight: 1.00 g

Prepared: 11/08/2023

Final Volume: 50 mL

% Solids: 99.94

Analyte	CAS Number	Dilution	Detection Limit	Reporting Limit	Result	Units	Notes
Arsenic	7440-38-2	20	0.04	0.20	134	mg/kg	



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Seattle WA, 98134

Project: Arkema- Port of Tacoma
Project Number: Barrier Wall PDI
Project Manager: Trevor Louviere

Reported:
22-Nov-2023 09:12

SO-DOF-B12-10.5-12-102723
23J0781-02 (Solid)

Wet Chemistry

Method: EPA 9045D

Sampled: 10/27/2023 08:26

Instrument: Accumet AB150 Analyst: SRB

Analyzed: 11/09/2023 14:31

Sample Preparation:

Preparation Method: No Prep Wet Chem

Extract ID: 23J0781-02 A 03

Preparation Batch: BLK0221

Sample Size: 20.0487 g (wet)

Prepared: 11/07/2023

Final Volume: 20 g

Analyte	CAS Number	Dilution	Detection Limit	Reporting Limit	Result	Units	Notes
pH		1	0.01	0.01	7.33	pH Units	



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Seattle WA, 98134

Project: Arkema- Port of Tacoma
Project Number: Barrier Wall PDI
Project Manager: Trevor Louviere

Reported:
22-Nov-2023 09:12

SO-DOF-B12-17-17.5-102723
23J0781-03 (Solid)

TCLP Metals and Metallic Compounds

Method: EPA 6010D

Sampled: 10/27/2023 09:00

Instrument: ICP3 Analyst: DOE

Analyzed: 11/03/2023 09:33

Sample Preparation:

Preparation Method: LEN Digestion of EPA 1311 Elutriate

Extract ID: 23J0781-03 A 02

Preparation Batch: BLK0052

Sample Size: 25 mL (wet)

Prepared: 11/02/2023

Final Volume: 25 mL

Analyte	CAS Number	Dilution	Detection Limit	Reporting Limit	Result	Units	Notes
Arsenic	7440-38-2	5	0.0140	0.250	9.39	mg/L	



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Project: Arkema- Port of Tacoma
Project Number: Barrier Wall PDI
Project Manager: Trevor Louviere

Reported:
22-Nov-2023 09:12

SO-DOF-B12-18-19-102723

23J0781-04 (Solid)

Metals and Metallic Compounds

Method: EPA 6020B UCT-KED

Sampled: 10/27/2023 09:15

Instrument: ICPMS2 Analyst: MCB

Analyzed: 11/20/2023 18:07

Sample Preparation:

Preparation Method: SWN EPA 3050B

Extract ID: 23J0781-04 A 03

Preparation Batch: BLK0170

Sample Size: 1.024 g (wet)

Dry Weight: 1.01 g

Prepared: 11/08/2023

Final Volume: 50 mL

% Solids: 98.98

Analyte	CAS Number	Dilution	Detection Limit	Reporting Limit	Result	Units	Notes
Arsenic	7440-38-2	1000	1.87	9.87	3190	mg/kg	D



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Project: Arkema- Port of Tacoma
Project Number: Barrier Wall PDI
Project Manager: Trevor Louviere

Reported:
22-Nov-2023 09:12

SO-DOF-B12-18-19-102723
23J0781-04 (Solid)

Wet Chemistry

Method: EPA 9045D

Sampled: 10/27/2023 09:15

Instrument: Accumet AB150 Analyst: SRB

Analyzed: 11/09/2023 14:31

Sample Preparation:

Preparation Method: No Prep Wet Chem

Extract ID: 23J0781-04 A 03

Preparation Batch: BLK0221

Sample Size: 20.0831 g (wet)

Prepared: 11/07/2023

Final Volume: 20 g

Analyte	CAS Number	Dilution	Detection Limit	Reporting Limit	Result	Units	Notes
pH		1	0.01	0.01	6.39	pH Units	



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Project: Arkema- Port of Tacoma
Project Number: Barrier Wall PDI
Project Manager: Trevor Louviere

Reported:
22-Nov-2023 09:12

SO-DOF-B12-19-20.5-102723
23J0781-05 (Solid)

Metals and Metallic Compounds

Method: EPA 6020B UCT-KED

Sampled: 10/27/2023 09:19

Instrument: ICPMS2 Analyst: MCB

Analyzed: 11/20/2023 18:18

Sample Preparation:

Preparation Method: SWN EPA 3050B

Extract ID: 23J0781-05 A 03

Preparation Batch: BLK0170

Sample Size: 1.013 g (wet)

Dry Weight: 1.01 g

Prepared: 11/08/2023

Final Volume: 50 mL

% Solids: 99.56

Analyte	CAS Number	Dilution	Detection Limit	Reporting Limit	Result	Units	Notes
Arsenic	7440-38-2	1000	1.88	9.92	1450	mg/kg	D



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Seattle WA, 98134

Project: Arkema- Port of Tacoma
Project Number: Barrier Wall PDI
Project Manager: Trevor Louviere

Reported:
22-Nov-2023 09:12

SO-DOF-B12-19-20.5-102723
23J0781-05 (Solid)

Wet Chemistry

Method: EPA 9045D

Sampled: 10/27/2023 09:19

Instrument: Accumet AB150 Analyst: SRB

Analyzed: 11/09/2023 14:31

Sample Preparation:

Preparation Method: No Prep Wet Chem

Extract ID: 23J0781-05 A 03

Preparation Batch: BLK0221

Sample Size: 20.7895 g (wet)

Prepared: 11/07/2023

Final Volume: 20 g

Analyte	CAS Number	Dilution	Detection Limit	Reporting Limit	Result	Units	Notes
pH		1	0.01	0.01	6.53	pH Units	



Dalton, Olmsted & Fuglevand, Inc
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Seattle WA, 98134

Project: Arkema- Port of Tacoma
Project Number: Barrier Wall PDI
Project Manager: Trevor Louviere

Reported:
22-Nov-2023 09:12

SO-DOF-B12-22-102723

23J0781-06 (Solid)

TCLP Metals and Metallic Compounds

Method: EPA 6010D

Sampled: 10/27/2023 09:35

Instrument: ICP3 Analyst: DOE

Analyzed: 11/03/2023 09:25

Sample Preparation:

Preparation Method: LEN Digestion of EPA 1311 Elutriate

Extract ID: 23J0781-06 A 02

Preparation Batch: BLK0052

Sample Size: 25 mL (wet)

Prepared: 11/02/2023

Final Volume: 25 mL

Analyte	CAS Number	Dilution	Detection Limit	Reporting Limit	Result	Units	Notes
Arsenic	7440-38-2	5	0.0140	0.250	11.6	mg/L	



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Seattle WA, 98134

Project: Arkema- Port of Tacoma
Project Number: Barrier Wall PDI
Project Manager: Trevor Louviere

Reported:
22-Nov-2023 09:12

SO-DOFSTOCKPILE-102723
23J0781-07 (Solid)

Metals and Metallic Compounds

Method: EPA 6020B UCT-KED

Sampled: 10/27/2023 11:45

Instrument: ICPMS2 Analyst: MCB

Analyzed: 11/16/2023 00:06

Sample Preparation:

Preparation Method: SWN EPA 3050B

Extract ID: 23J0781-07 A 03

Preparation Batch: BLK0170

Sample Size: 1.01 g (wet)

Dry Weight: 0.79 g

Prepared: 11/08/2023

Final Volume: 50 mL

% Solids: 78.47

Analyte	CAS Number	Dilution	Detection Limit	Reporting Limit	Result	Units	Notes
Arsenic	7440-38-2	20	0.05	0.25	64.4	mg/kg	
Cadmium	7440-43-9	20	0.04	0.13	0.14	mg/kg	
Selenium	7782-49-2	20	0.23	0.63	1.08	mg/kg	



Dalton, Olmsted & Fuglevand, Inc
1001 SW Klickitat Way, Suite 200B
Seattle WA, 98134

Project: Arkema- Port of Tacoma
Project Number: Barrier Wall PDI
Project Manager: Trevor Louviere

Reported:
22-Nov-2023 09:12

SO-DOFSTOCKPILE-102723
23J0781-07 (Solid)

Metals and Metallic Compounds

Method: EPA 6020B

Sampled: 10/27/2023 11:45

Instrument: ICPMS2 Analyst: MCB

Analyzed: 11/16/2023 00:06

Sample Preparation:

Preparation Method: SWN EPA 3050B

Extract ID: 23J0781-07 A 03

Preparation Batch: BLK0170

Sample Size: 1.01 g (wet)

Dry Weight: 0.79 g

Prepared: 11/08/2023

Final Volume: 50 mL

% Solids: 78.47

Analyte	CAS Number	Dilution	Detection Limit	Reporting Limit	Result	Units	Notes
Barium	7440-39-3	20	0.14	0.63	66.2	mg/kg	
Chromium	7440-47-3	20	0.33	0.63	23.3	mg/kg	
Lead	7439-92-1	20	0.07	0.13	27.5	mg/kg	
Silver	7440-22-4	20	0.03	0.25	0.14	mg/kg	J



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Seattle WA, 98134

Project: Arkema- Port of Tacoma
Project Number: Barrier Wall PDI
Project Manager: Trevor Louviere

Reported:
22-Nov-2023 09:12

SO-DOFSTOCKPILE-102723
23J0781-07 (Solid)

Metals and Metallic Compounds

Method: EPA 7471B

Sampled: 10/27/2023 11:45

Instrument: HYDRA Analyst: ML

Analyzed: 11/07/2023 13:21

Sample Preparation:

Preparation Method: SMM EPA 7471B

Extract ID: 23J0781-07 A

Preparation Batch: BLK0165

Sample Size: 0.271 g (wet)

Dry Weight: 0.21 g

Prepared: 11/06/2023

Final Volume: 50 mL

% Solids: 78.47

Analyte	CAS Number	Dilution	Detection Limit	Reporting Limit	Result	Units	Notes
Mercury	7439-97-6	1	0.00494	0.0235	0.120	mg/kg	



Dalton, Olmsted & Fuglevand, Inc
1001 SW Klickitat Way, Suite 200B
Seattle WA, 98134

Project: Arkema- Port of Tacoma
Project Number: Barrier Wall PDI
Project Manager: Trevor Louviere

Reported:
22-Nov-2023 09:12

SO-DOFSTOCKPILE-102723
23J0781-07 (Solid)

TCLP Metals and Metallic Compounds

Method: EPA 6010D

Sampled: 10/27/2023 11:45

Instrument: ICP3 Analyst: DOE

Analyzed: 11/03/2023 07:55

Sample Preparation:

Preparation Method: LEN Digestion of EPA 1311 Elutriate

Extract ID: 23J0781-07 A 02

Preparation Batch: BLK0052

Sample Size: 25 mL (wet)

Prepared: 11/02/2023

Final Volume: 25 mL

Analyte	CAS Number	Dilution	Detection Limit	Reporting Limit	Result	Units	Notes
Arsenic	7440-38-2	5	0.0140	0.250	0.0800	mg/L	J
Barium	7440-39-3	5	0.0075	0.0150	ND	mg/L	U
Cadmium	7440-43-9	5	0.0006	0.0100	0.0010	mg/L	J
Chromium	7440-47-3	5	0.0024	0.0250	ND	mg/L	U
Lead	7439-92-1	5	0.0065	0.100	0.0080	mg/L	J
Selenium	7782-49-2	5	0.0408	0.250	ND	mg/L	U
Silver	7440-22-4	5	0.0022	0.0150	ND	mg/L	U



Dalton, Olmsted & Fuglevand, Inc
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Project: Arkema- Port of Tacoma
Project Number: Barrier Wall PDI
Project Manager: Trevor Louviere

Reported:
22-Nov-2023 09:12

SO-DOFSTOCKPILE-102723
23J0781-07 (Solid)

TCLP Metals and Metallic Compounds

Method: EPA 7470A

Sampled: 10/27/2023 11:45

Instrument: HYDRA Analyst: ML

Analyzed: 11/08/2023 12:13

Sample Preparation:

Preparation Method: LEM 7470A Digestion of EPA 1311 Elutriate for Hg

Extract ID: 23J0781-07 A 01

Preparation Batch: BLK0053

Sample Size: 20 mL (wet)

Prepared: 11/02/2023

Final Volume: 20 mL

Analyte	CAS Number	Dilution	Detection Limit	Reporting Limit	Result	Units	Notes
Mercury	7439-97-6	1	0.000007	0.000100	0.000009	mg/L	J



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1001 SW Klickitat Way, Suite 200B
Seattle WA, 98134

Project: Arkema- Port of Tacoma
Project Number: Barrier Wall PDI
Project Manager: Trevor Louviere

Reported:
22-Nov-2023 09:12

Analysis by: Analytical Resources, LLC

Metals and Metallic Compounds - Quality Control

Batch BLK0165 - EPA 7471B

Instrument: HYDRA Analyst: ML

QC Sample/Analyte	Result	Detection Limit	Reporting Limit	Units	Spike Level	Source Result	%REC Limits	RPD	RPD Limit	Notes
Blank (BLK0165-BLK1)										
						Prepared: 06-Nov-2023 Analyzed: 07-Nov-2023 11:21				
Mercury	ND	0.00525	0.0250	mg/kg						U
LCS (BLK0165-BS1)										
						Prepared: 06-Nov-2023 Analyzed: 07-Nov-2023 11:23				
Mercury	0.478	0.00525	0.0250	mg/kg	0.500	95.7	80-120			
Reference (BLK0165-SRM1)										
						Prepared: 06-Nov-2023 Analyzed: 07-Nov-2023 12:57				
Mercury	14.3	0.104	0.498	mg/kg	14.9	96.0	74.5-128.86			D



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Reported:
22-Nov-2023 09:12

Analysis by: Analytical Resources, LLC

Metals and Metallic Compounds - Quality Control

Batch BLK0170 - EPA 6020B

Instrument: ICPMS2 Analyst: MCB

QC Sample/Analyte	Isotope	Result	Detection Limit	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Blank (BLK0170-BLK1)						Prepared: 08-Nov-2023 Analyzed: 15-Nov-2023 23:57						
Barium	135	ND	0.11	0.50	mg/kg							U
Chromium	52	ND	0.26	0.50	mg/kg							U
Lead	208	ND	0.05	0.10	mg/kg							U
Silver	107	ND	0.02	0.20	mg/kg							U
Arsenic	75a	ND	0.04	0.20	mg/kg							U
Cadmium	111	ND	0.03	0.10	mg/kg							U
Selenium	78	ND	0.18	0.50	mg/kg							U
LCS (BLK0170-BS1)						Prepared: 08-Nov-2023 Analyzed: 16-Nov-2023 00:02						
Barium	135	25.0	0.11	0.50	mg/kg	25.0		100	80-120			
Chromium	52	25.1	0.26	0.50	mg/kg	25.0		100	80-120			
Lead	208	26.8	0.05	0.10	mg/kg	25.0		107	80-120			
Silver	107	24.1	0.02	0.20	mg/kg	25.0		96.5	80-120			
Arsenic	75a	24.1	0.04	0.20	mg/kg	25.0		96.3	80-120			
Cadmium	111	24.1	0.03	0.10	mg/kg	25.0		96.3	80-120			
Selenium	78	74.5	0.18	0.50	mg/kg	80.0		93.1	80-120			
Reference (BLK0170-SRM1)						Prepared: 08-Nov-2023 Analyzed: 16-Nov-2023 00:35						
Barium	135	305	0.28	1.24	mg/kg	352		86.6	71.5-104.5			D
Chromium	52	111	0.65	1.24	mg/kg	136		81.3	68-101.5			D
Lead	208	213	0.13	0.25	mg/kg	246		86.9	68.8-102.4			D
Silver	107	64.1	0.05	0.50	mg/kg	80.1		80.0	62.5-100.5			D
Arsenic	75a	72.1	0.09	0.50	mg/kg	66.2		109	95.2-126.9			D
Cadmium	111	72.7	0.07	0.25	mg/kg	91.3		79.6	66.4-97.8			D
Selenium	78	75.1	0.45	1.24	mg/kg	93.0		80.7	61.2-99.4			D



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Reported:
22-Nov-2023 09:12

Analysis by: Analytical Resources, LLC

TCLP Metals and Metallic Compounds - Quality Control

Batch BLK0052 - EPA 6010D

Instrument: ICP3 Analyst: DOE

QC Sample/Analyte	Result	Detection Limit	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Blank (BLK0052-BLK1)						Prepared: 02-Nov-2023 Analyzed: 03-Nov-2023 07:52					
Arsenic	ND	0.0140	0.250	mg/L							U
Barium	0.0090	0.0075	0.0150	mg/L							J
Cadmium	ND	0.0006	0.0100	mg/L							U
Chromium	ND	0.0024	0.0250	mg/L							U
Lead	ND	0.0065	0.100	mg/L							U
Selenium	ND	0.0408	0.250	mg/L							U
Silver	ND	0.0022	0.0150	mg/L							U
Duplicate (BLK0052-DUP1)						Source: 23J0781-07 Prepared: 02-Nov-2023 Analyzed: 03-Nov-2023 07:58					
Arsenic	0.0820	0.0140	0.250	mg/L		0.0800			2.47	20	J
Barium	ND	0.0075	0.0150	mg/L		ND					U
Cadmium	0.0010	0.0006	0.0100	mg/L		0.0010			0.00		J
Chromium	0.0025	0.0024	0.0250	mg/L		ND					J
Lead	ND	0.0065	0.100	mg/L		0.0080					U
Selenium	ND	0.0408	0.250	mg/L		ND					U
Silver	ND	0.0022	0.0150	mg/L		ND					U
Matrix Spike (BLK0052-MS1)						Source: 23J0781-07 Prepared: 02-Nov-2023 Analyzed: 03-Nov-2023 08:01					
Arsenic	4.25	0.0140	0.250	mg/L	4.00	0.0800	104	75-125			
Barium	4.12	0.0075	0.0150	mg/L	4.00	ND	103	75-125			
Cadmium	1.02	0.0006	0.0100	mg/L	1.00	0.0010	102	75-125			
Chromium	0.981	0.0024	0.0250	mg/L	1.00	ND	98.1	75-125			
Lead	4.07	0.0065	0.100	mg/L	4.00	0.0080	102	75-125			
Selenium	4.31	0.0408	0.250	mg/L	4.00	ND	108	75-125			
Silver	1.04	0.0022	0.0150	mg/L	1.00	ND	104	75-125			

Recovery limits for target analytes in MS/MSD QC samples are advisory only.



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Project: Arkema- Port of Tacoma
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Project Manager: Trevor Louviere

Reported:
22-Nov-2023 09:12

Analysis by: Analytical Resources, LLC

TCLP Metals and Metallic Compounds - Quality Control

Batch BLK0053 - EPA 7470A

Instrument: HYDRA Analyst: ML

QC Sample/Analyte	Result	Detection Limit	Reporting Limit	Units	Spike Level	Source Result	%REC Limits	RPD	RPD Limit	Notes
Blank (BLK0053-BLK1)					Prepared: 02-Nov-2023 Analyzed: 08-Nov-2023 12:11					
Mercury	0.000012	0.000007	0.000100	mg/L						J
Duplicate (BLK0053-DUP1)					Source: 23J0781-07 Prepared: 02-Nov-2023 Analyzed: 08-Nov-2023 12:15					
Mercury	0.000010	0.000007	0.000100	mg/L		0.000009		10.90	20	J
Matrix Spike (BLK0053-MS1)					Source: 23J0781-07 Prepared: 02-Nov-2023 Analyzed: 08-Nov-2023 12:18					
Mercury	0.00101	0.000007	0.000100	mg/L	0.00100	0.000009	101	75-125		

Recovery limits for target analytes in MS/MSD QC samples are advisory only.



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Project: Arkema- Port of Tacoma
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Reported:
22-Nov-2023 09:12

Analysis by: Analytical Resources, LLC

Wet Chemistry - Quality Control

Batch BLK0221 - EPA 9045D

Instrument: Accumet AB150 Analyst: SRB

QC Sample/Analyte	Result	Detection Limit	Reporting Limit	Units	Spike Level	Source Result	%REC Limits	RPD Limit	Notes
LCS (BLK0221-BS1)									
Prepared: 07-Nov-2023 Analyzed: 09-Nov-2023 14:31									
pH	6.98	0.01	0.01	pH Units	7.00	99.7	99.2-100.8		



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Project: Arkema- Port of Tacoma
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Reported:
22-Nov-2023 09:12

Certified Analyses included in this Report

Analyte	Certifications
EPA 6010D in Solid	
Silver	NELAP,WADOE,DoD-ELAP
Arsenic	NELAP,WADOE
Barium	NELAP,WADOE
Cadmium	NELAP,WADOE,DoD-ELAP
Chromium	NELAP,WADOE,DoD-ELAP
Lead	NELAP,WADOE,DoD-ELAP
Selenium	NELAP,WADOE,DoD-ELAP
EPA 6020B in Solid	
Silver-107	NELAP,DoD-ELAP,WADOE
Barium-135	NELAP,DoD-ELAP,WADOE,ADEC
Chromium-52	NELAP,DoD-ELAP,WADOE,ADEC
Lead-208	NELAP,DoD-ELAP,WADOE,ADEC
EPA 6020B UCT-KED in Solid	
Arsenic-75a	NELAP,DoD-ELAP,WADOE,ADEC
Cadmium-111	NELAP,DoD-ELAP,WADOE,ADEC
Selenium-78	NELAP,DoD-ELAP,WADOE
EPA 7470A in Solid	
Mercury	WADOE,NELAP,DoD-ELAP
EPA 7471B in Solid	
Mercury	WADOE,NELAP,DoD-ELAP
EPA 9045D in Solid	
pH	WADOE,DoD-ELAP,NELAP

Code	Description	Number	Expires
ADEC	Alaska Dept of Environmental Conservation	17-015	03/28/2025
DoD-ELAP	DoD-Environmental Laboratory Accreditation Program, PJLA Testing	66169	02/28/2025
NELAP	ORELAP - Oregon Laboratory Accreditation Program	WA100006-012	05/12/2024



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Reported:
22-Nov-2023 09:12

Notes and Definitions

*	Flagged value is not within established control limits.
D	The reported value is from a dilution
J	Estimated concentration value detected below the reporting limit.
L	Analyte concentration is ≤ 5 times the reporting limit and the replicate control limit defaults to $\pm$ RL instead of 20% RPD
U	This analyte is not detected above the reporting limit (RL) or if noted, not detected above the limit of detection (LOD).
DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference
[2C]	Indicates this result was quantified on the second column on a dual column analysis.

Appendix B



Trevor Louviere, PE
Dalton Olmsted & Fuglevand
1011 SW Klickitat Way, Ste 2008
Seattle, WA 98134

November 21, 2023

Project Number L231011

PROJECT: Arkema Manufacturing Site 2023 Materials

**SUBJECT: Results of Laboratory Testing
Report #1**

At your request, we provided laboratory testing services for the subject project. Services were limited to the performance of testing of laboratory tests, selected at your discretion.

For this period, our involvement was limited to laboratory testing of forty samples delivered to our laboratory on November 3, 2023. Laboratory tests were conducted in general accordance with methods listed in the attached *Laboratory Summary* sheets.

If you have questions regarding this report, please call.

Respectfully Submitted,
Budinger & Associates, Inc.

Kiel Couch
Laboratory Manager

KC/lat/Addressee –
Trevor Louviere – tlouviere@dofnw.com

Attachments:
Soils Laboratory Summary – 4 pages
Particle Size Distribution Report – 8 pages

SOILS
LABORATORY SUMMARY

LABORATORY NUMBER			23-1216	23-1217	23-1218	23-1219	23-1220	23-1221	23-1222	23-1223	23-1224	23-1225	23-1226
SAMPLED BY			Client	Client	Client	Client	Client	Client	Client	Client	Client	Client	Client
SAMPLE TYPE			Bulk	Bulk	Bulk	Bulk	Bulk	Bulk	Bulk	Bulk	Bulk	Bulk	Bulk
DATE RECEIVED			11/3/23	11/3/23	11/3/23	11/3/23	11/3/23	11/3/23	11/3/23	11/3/23	11/3/23	11/3/23	11/3/23
SAMPLE SOURCE			SO-DOFB1 - 101923-7.5-9	SO-DOFB1 - 101923-17.5-19	SO-DOFB1 - 101923-34-35.5	SO-DOFB2 - 102523-7.5-9	SO-DOFB2 - 102523 20-21.5	SO-DOFB3 - 101923-10-11.5	SO-DOFB3 - 101923-15-16.5	SO-DOFB3 - 101923-20-21.5	SO-DOFB4 - 102523-28-29.5	SO-DOFB4 - 102523-33.5-35	SO-DOFB5 - 102023-5-6.5
	<u>UNITS</u>	<u>TEST METHOD</u>											
ATTERBERG LIMITS		ASTM D4318											
Liquid Limits	%				72								
Plastic Limits	%				39								
Plasticity Index	%				33						*NP		
SIEVE ANALYSIS		ASTM D6913											
	1 1/2"												
S	1"	%											
I	3/4"			100									
E	1/2"	P		98			100						
V	3/8"	A	100	97		100	99	100		100			100
E	#4	S	100-	95		99	99	92	100	100-	100	100	98
	#10	S	100-	91	100	98	99	83	100-	100-	100-	100-	97
S	#16	I	99	88	100-	97	98	79	100-	98	100-	98	97
I	#30	N	93	82	98	92	96	73	99	87	99	98	94
Z	#40	G	82	76	97	84	90	69	99	74	97	97	89
E	#100		31	47	86	36	61	54	97	38	84	93	55
	#200		17	30	78	17	38	43	95	24	64	90	32

*NP = Non Plastic

SOILS
LABORATORY SUMMARY

LABORATORY NUMBER			23-1227	23-1228	23-1229	23-1230	23-1231	23-1232	23-1233	23-1234	23-1235	23-1236	23-1237
SAMPLED BY			Client	Client	Client	Client	Client	Client	Client	Client	Client	Client	Client
SAMPLE TYPE			Bulk	Bulk	Bulk	Bulk	Bulk	Bulk	Bulk	Bulk	Bulk	Bulk	Bulk
DATE RECEIVED			11/3/23	11/3/23	11/3/23	11/3/23	11/3/23	11/3/23	11/3/23	11/3/23	11/3/23	11/3/23	11/3/23
SAMPLE SOURCE			SO-DOFB5 - 102023-15-16.5	SO-DOFB5 - 102023-32.5-34	SO-DOFB6 - 102523-17.5-19A	SO-DOFB6 - 102523-25-26.5	SO-DOFB7 - 102023-7.5-9	SO-DOFB7 - 102023-15-16.5	SO-DOFB7 - 102023-37-38.5	SO-DOFB8 - 102623-7.5-9	SO-DOFB8 - 102623-25-26.5A	SO-DOFB8 - 102623-25-26.5B	SO-DOFB9 - 102323-12.5-14
	UNITS	TEST METHOD											
ATTERBERG LIMITS		ASTM D4318											
Liquid Limits	%												
Plastic Limits	%												
Plasticity Index	%												
SIEVE ANALYSIS		ASTM D6913											
	1 1/2"												
S	1"	%											
I	3/4"									100			
E	1/2"	P							100	99			100
V	3/8"	A					100	100	100-	98	100	100	100-
E	#4	S			100		100-	100-	100-	97	100-	100-	99
	#10	S	100	100	100-	100	98	100-	100-	96	100-	96	98
S	#16	I	100-	100-	100-	100-	97	100-	100-	95	98	93	95
I	#30	N	100-	99	100-	100-	91	99	99	89	83	88	77
Z	#40	G	100-	99	100-	99	81	98	97	82	61	84	54
E	#100		99	98	98	74	47	92	85	44	13	69	12
	#200		99	96	95	24	27	88	81	24	6.3	59	5.3

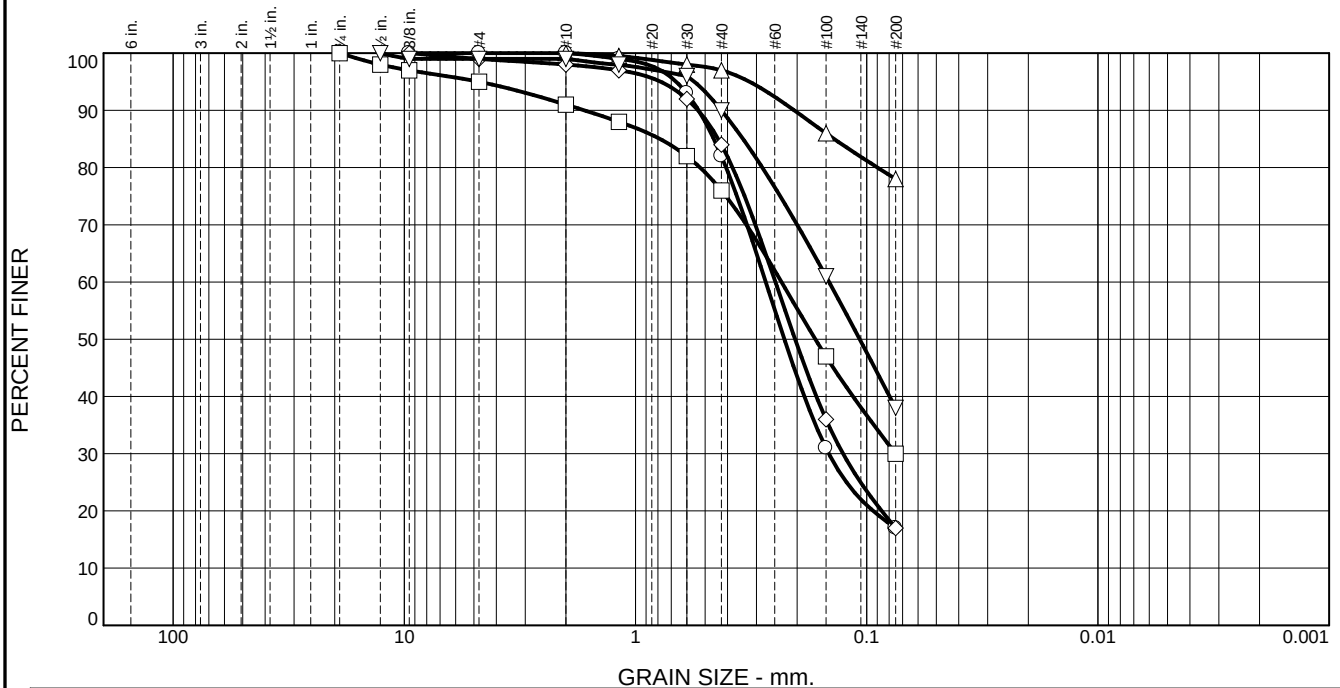
SOILS
LABORATORY SUMMARY

LABORATORY NUMBER			23-1238	23-1239	23-1240	23-1241	23-1242	23-1243	23-1244	23-1245	23-1246	23-1247	23-1248
SAMPLED BY			Client	Client	Client	Client	Client	Client	Client	Client	Client	Client	Client
SAMPLE TYPE			Bulk	Bulk	Bulk	Bulk	Bulk	Bulk	Bulk	Bulk	Bulk	Bulk	Bulk
DATE RECEIVED			11/3/23	11/3/23	11/3/23	11/3/23	11/3/23	11/3/23	11/3/23	11/3/23	11/3/23	11/3/23	11/3/23
SAMPLE SOURCE			SO-DOFB9 - 102323-22.5-24	SO-DOFB9 - 102323-31-32.5	SO-DOFB9 - 102323-35.5-37	SO-DOFB10 - 102623-10-11.5	SO-DOFB10 - 102623-22.5-24	SO-DOFB10 - 102623-35-36.5	SO-DOFB11 - 102323-5-6.5	SO-DOFB11 - 102323-15-16.5	SO-DOFB11 - 102323-31-32.5	SO-DOFB11 - 102323-35.5-37	SO-DOFB12 - 102723-5-6.5
	UNITS	TEST METHOD											
ATTERBERG LIMITS		ASTM D4318											
Liquid Limits	%			82				73		36			
Plastic Limits	%			52				41		28			
Plasticity Index	%			30				32		8			
SIEVE ANALYSIS		ASTM D6913											
	1 1/2"								100				
S	1"	%				100			79				
I	3/4"					99			79				
E	1/2"	P				99			66				
V	3/8"	A	100	100		99		100	58				100
E	#4	S	100-	100-	100	98	100	100-	47	100	100	100	100-
	#10	S	100-	99	100-	97	100-	99	34	100-	100-	100-	97
S	#16	I	98	97	100-	89	100-	97	27	100-	100-	100-	91
I	#30	N	84	94	99	80	97	95	20	99	100-	99	63
Z	#40	G	59	91	98	65	90	93	16	99	99	97	41
E	#100		8	81	89	50	25	87	8	94	75	81	10
	#200		3.4	75	65	30	5.1	82	6.0	87	31	59	6.6

SOILS
LABORATORY SUMMARY

LABORATORY NUMBER			23-1249	23-1250	23-1251	23-1252	23-1253	23-1254	23-1255
SAMPLED BY			Client	Client	Client	Client	Client	Client	Client
SAMPLE TYPE			Bulk	Bulk	Bulk	Bulk	Bulk	Bulk	Bulk
DATE RECEIVED			11/3/23	11/3/23	11/3/23	11/3/23	11/3/23	11/3/23	11/3/23
SAMPLE SOURCE			SO-DOFB12 - 102723-20.5-22.5	SO-DOFB13 - 102423-7.5-9	SO-DOFB13 - 102423-22.5-24	SO-DOFB14 - 102623-12.5-14	SO-DOFB15 - 102423-17.5-19	SO-DOFB15 - 102423-34-35.5	SO-DOFB15 - 102423-37-38.5
	<u>UNITS</u>	<u>TEST METHOD</u>							
ATTERBERG LIMITS		ASTM D4318							
Liquid Limits	%					43	75		62
Plastic Limits	%					26	39		34
Plasticity Index	%					17	36		28
SIEVE ANALYSIS		ASTM D6913							
	1 1/2"								
S	1"	%							
I	3/4"								
E	1/2"	P							
V	3/8"	A		100		100	100		100
E	#4	S	100	100-	100	100-	100-	100	100-
	#10	S	100-	100-	100-	100-	99	100-	99
S	#16	I	99	99	98	99	98	99	99
I	#30	N	94	94	80	99	95	99	97
Z	#40	G	82	77	57	98	93	99	96
E	#100		16	16	9	92	84	94	91
	#200		4.5	8.1	4.1	87	79	69	86

Particle Size Distribution Report



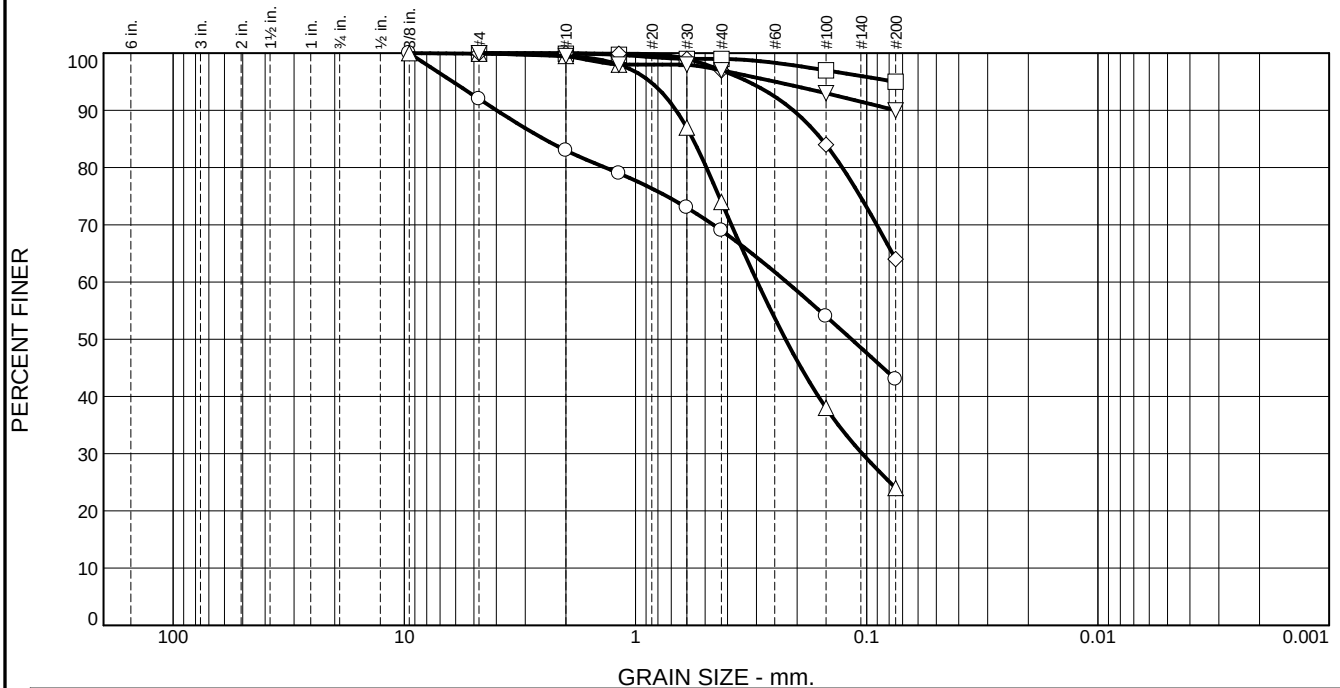
	% Stones	% +3"	% Gravel			% Sand					% Silt		% Clay
			Coarse	Medium	Fine	V. Crs.	Crs.	Med.	Fine	V. Fine	Crs.	Fine	
○	0	0	0	0	0	1	11	33	34			21	
□	0	0	0	5	4	4	8	17	25			37	
△	0	0	0	0	0	1	1	6	11			81	
◇	0	0	0	1	1	2	7	29	37			23	
▽	0	0	0	1	0	1	5	16	29			48	
×	LL	PL	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u			
○			0.4586	0.2732	0.2270	0.1457							
□			0.7827	0.2337	0.1668	0.0750							
△	72	39	0.1383										
◇			0.4387	0.2482	0.2040	0.1266							
▽			0.3428	0.1454	0.1072								

Material Description	USCS	AASHTO
○ Silty sand □ Silty sand with some gravel △ elastic silt with sand ◇ Sand with silt trace gravel ▽ Silt with sand trace gravel	MH	A-7-5(30)

Project No. L231011 Client: Dalton Olmsted & Fuglevand Project: Arkema Manufacturing Site 2023 Materials Source of Sample: On-site Sample Number: 23-1216 Source of Sample: On-site Sample Number: 23-1217 Source of Sample: On-site Sample Number: 23-1218 Source of Sample: On-site Sample Number: 23-1219 Source of Sample: On-site Sample Number: 23-1220	Remarks: ○ Sampled By Client SO-DOFB1-101923 @ 7.5-9 □ SO-DOFB1-101923 @ 17.5-19 △ SO-DOFB1-10923 @ 34-35.5 ◇ SO-DOFB2-102523 @ 7.5-9 ▽ SO-DOFB2-102523 @ 20-21.5
BUDINGER & ASSOCIATES, INC.	
Date: 11/13/23	

Tested By: ○ PK □ PK △ TS ◇ TS ▽ TS Checked By: KC

Particle Size Distribution Report



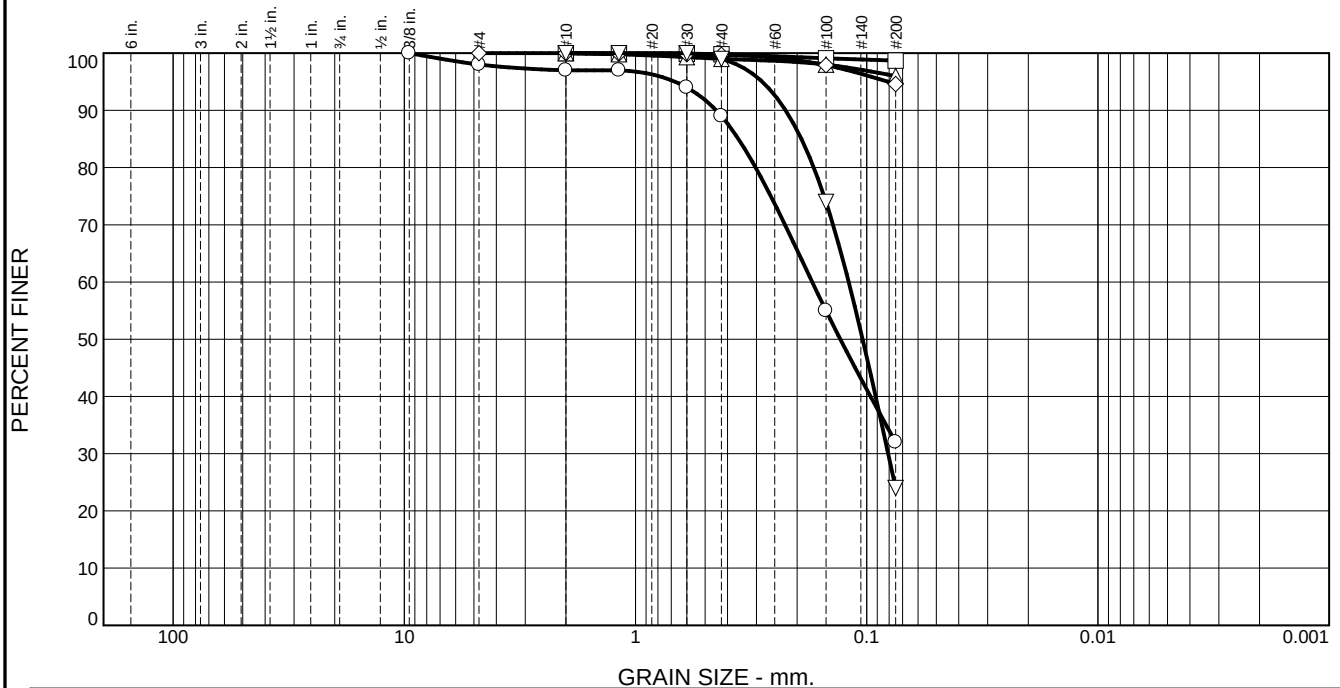
	% Stones	% +3"	% Gravel			% Sand					% Silt		% Clay
			Coarse	Medium	Fine	V. Crs.	Crs.	Med.	Fine	V. Fine	Crs.	Fine	
○	0	0	0	8	9	5	7	9	14			48	
□	0	0	0	0	0	0	1	1	2			96	
△	0	0	0	0	0	3	16	27	25			29	
◇	0	0	0	0	0	0	2	6	19			73	
▽	0	0	0	0	0	2	0	3	4			91	
×	LL	PL	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u			
○			2.4895	0.2219	0.1163								
□													
△			0.5647	0.2972	0.2244	0.1044							
◇	NV	NP	0.1570										
▽													

Material Description	USCS	AASHTO
☐ Silt with sand some gravel ☐ Silt trace sand <input type="triangle"/> Silty sand <input type="diamond"/> sandy silt <input type="inverted-triangle"/> Silt some sand	ML	A-4(0)

Project No. L231011 Client: Dalton Olmsted & Fuglevand Project: Arkema Manufacturing Site 2023 Materials ☐ Source of Sample: On-site Sample Number: 23-1221 ☐ Source of Sample: On-site Sample Number: 23-1222 <input type="triangle"/> Source of Sample: On-site Sample Number: 23-1223 <input type="diamond"/> Source of Sample: On-site Sample Number: 23-1224 <input type="inverted-triangle"/> Source of Sample: On-site Sample Number: 23-1225	Remarks: ☐ Sampled By Client SO-DOFB3-101923 @ 10-11.5 ☐ SO-DOFB3-101923 @ 15-16.5 <input type="triangle"/> SO-DOFB3-101923 @ 20-21.5 <input type="diamond"/> SO-DOFB4-102523 @ 28-29.5 <input type="inverted-triangle"/> SO-DOFB4-102523 @ 33.5-35
BUDINGER & ASSOCIATES, INC.	
Date: 11/13/23	

Tested By: TS Checked By: KC

Particle Size Distribution Report



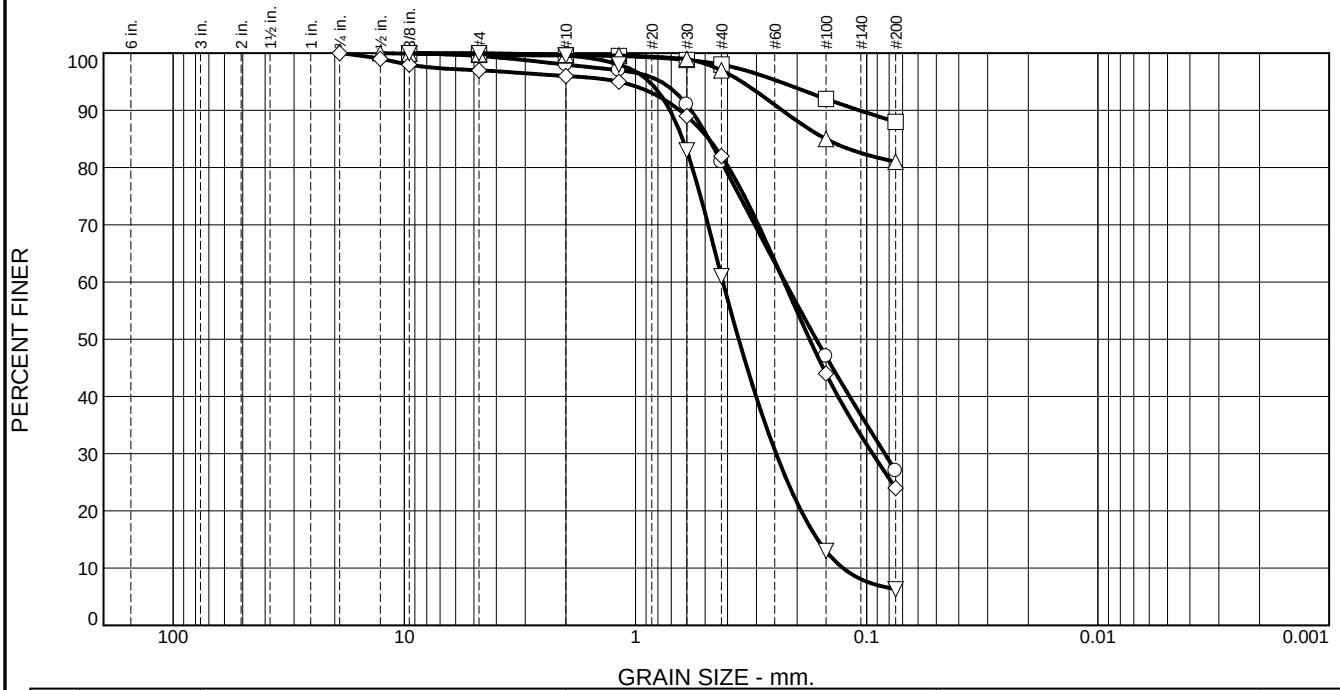
	% Stones	% +3"	% Gravel			% Sand					% Silt		% Clay
			Coarse	Medium	Fine	V. Crs.	Crs.	Med.	Fine	V. Fine	Crs.	Fine	
○	0	0	0	2	1	0	5	18	33			41	
□	0	0	0	0	0	0	0	1	0			99	
△	0	0	0	0	0	0	1	0	2			97	
◇	0	0	0	0	0	0	0	1	3			96	
▽	0	0	0	0	0	0	0	7	46			47	
×	LL	PL	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u			
○			0.3588	0.1721	0.1301								
□													
△													
◇													
▽			0.1916	0.1196	0.1042	0.0808							

Material Description										USCS	AASHTO
○ Silty sand trace gravel											
□ Silt trace sand											
△ Silt trace sand											
◇ Silt trace sand											
▽ Silty sand											

Project No. L231011 Client: Dalton Olmsted & Fuglevand Project: Arkema Manufacturing Site 2023 Materials ○ Source of Sample: On-site Sample Number: 23-1226 □ Source of Sample: On-site Sample Number: 23-1227 △ Source of Sample: On-site Sample Number: 23-1228 ◇ Source of Sample: On-site Sample Number: 23-1229 ▽ Source of Sample: On-site Sample Number: 23-1230	Remarks: ○ Sampled By Client SO-DOFB5-102023 @ 5-6.5 □ SO-DOFB5-102023 @ 15-16.5 △ SO-DOFB5-102023 @ 32.5-34 ◇ SO-DOFB6-102523 @ 17.5-19 ▽ SO-DOFB6-102523 @ 25-26.5
BUDINGER & ASSOCIATES, INC.	
Date: 11/13/23	

Tested By: ○ TS □ TS △ GP ◇ TS ▽ GP Checked By: KC

Particle Size Distribution Report



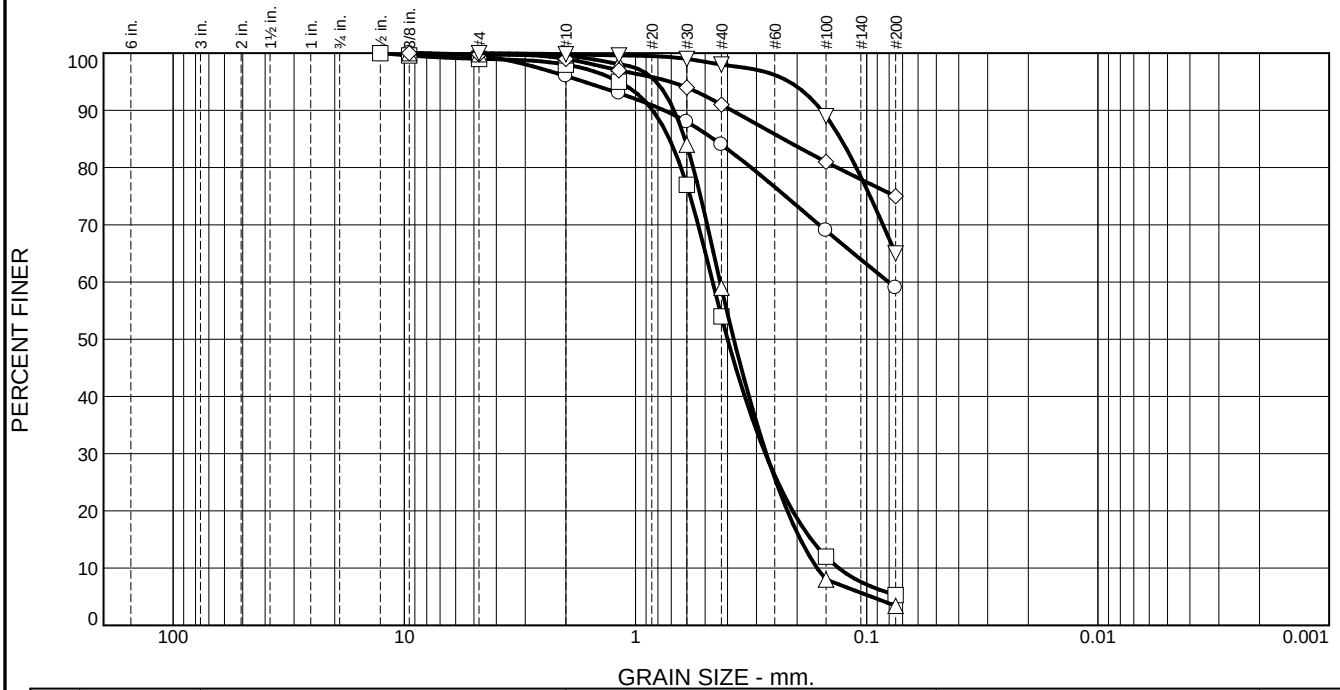
	% Stones	% +3"	% Gravel			% Sand					% Silt		% Clay
			Coarse	Medium	Fine	V. Crs.	Crs.	Med.	Fine	V. Fine	Crs.	Fine	
○	0	0	0	0	2	1	11	23	28			34	
□	0	0	0	0	0	1	1	3	5			90	
△	0	0	0	0	0	0	2	7	9			82	
◇	0	0	0	3	1	2	8	22	32			32	
▽	0	0	0	0	0	3	25	41	23			8	
⊗	LL	PL	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u			
○			0.4814	0.2255	0.1653	0.0835							
□													
△			0.1500										
◇			0.4817	0.2278	0.1767	0.0943							
▽			0.6250	0.4187	0.3579	0.2465	0.1630	0.1267	1.14	3.30			

Material Description	USCS	AASHTO
○ Sand with silt trace gravel		
□ Silt some sand		
△ Silt some sand		
◇ Silty sand trace gravel		
▽ Sand some silt		

Project No. L231011 Client: Dalton Olmsted & Fuglevand Project: Arkema Manufacturing Site 2023 Materials ○ Source of Sample: On-site Sample Number: 23-1231 □ Source of Sample: On-site Sample Number: 23-1232 △ Source of Sample: On-site Sample Number: 23-1233 ◇ Source of Sample: On-site Sample Number: 23-1234 ▽ Source of Sample: On-site Sample Number: 23-1235	Remarks: ○ Sampled By Client SO-DOFB7-102023 @ 7.5-9 □ SO-DOFB7-102023 @ 15-16.5 △ SO-DOFB7-102023 @ 37-38.5 ◇ SO-DOFB8-102623 @ 7.5-9 ▽ SO-DOFB8-102623 @ 25-26.5A
BUDINGER & ASSOCIATES, INC.	
Date: 11/13/23	

Tested By: TS Checked By: KC

Particle Size Distribution Report



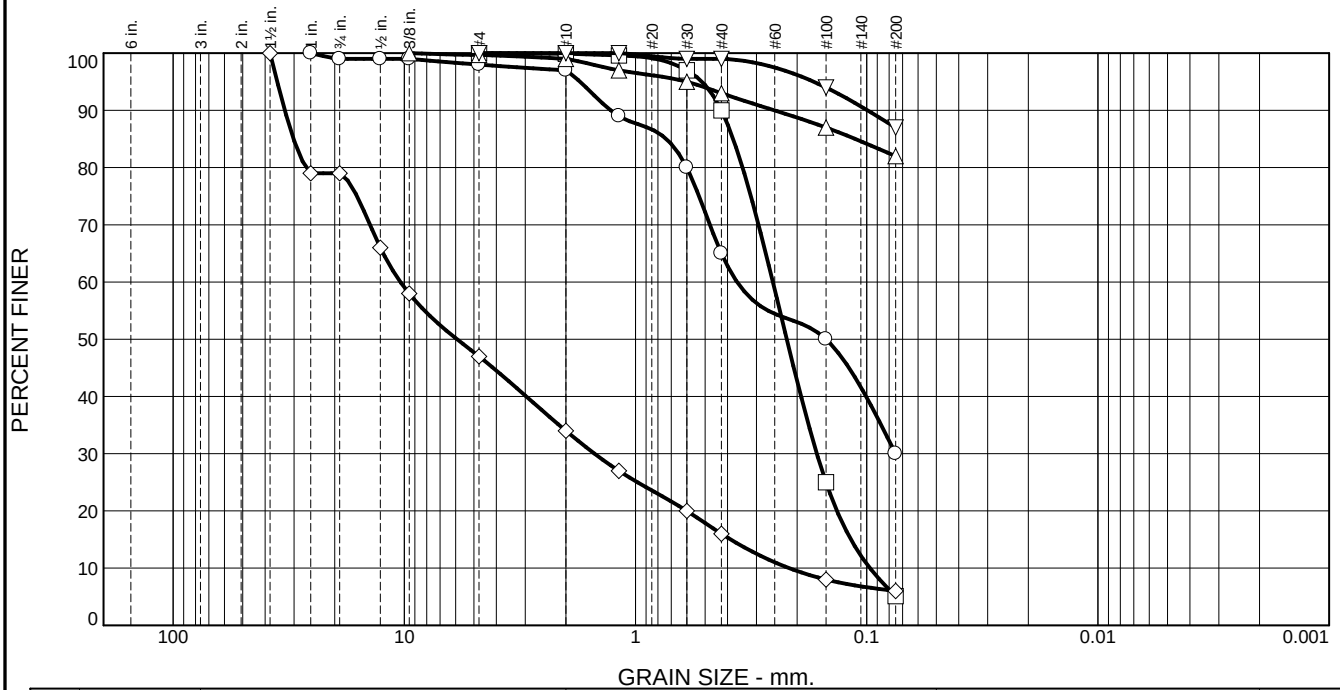
	% Stones	% +3"	% Gravel			% Sand					% Silt		% Clay
			Coarse	Medium	Fine	V. Crs.	Crs.	Med.	Fine	V. Fine	Crs.	Fine	
○	0	0	0	0	4	4	6	9	14			63	
□	0	0	0	1	1	5	28	39	19			7	
△	0	0	0	0	0	3	25	46	21			5	
◇	0	0	0	0	1	3	3	7	9			77	
▽	0	0	0	0	0	0	2	2	20			76	
×	LL	PL	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u			
○			0.4600	0.0805									
□			0.7134	0.4637	0.3997	0.2741	0.1736	0.1321	1.23	3.51			
△			0.6109	0.4306	0.3757	0.2718	0.1935	0.1638	1.05	2.63			
◇	82	52	0.2293										
▽			0.1294										

Material Description	USCS	AASHTO
○ Silt some sand trace gravel □ Sand some silt trace gravel △ Sand trace silt ◇ elastic silt with sand ▽ Sandy silt	MH	A-7-5(28)

Project No. L231011 Client: Dalton Olmsted & Fuglevand Project: Arkema Manufacturing Site 2023 Materials ○ Source of Sample: On-site Sample Number: 23-1236 □ Source of Sample: On-site Sample Number: 23-1237 △ Source of Sample: On-site Sample Number: 23-1238 ◇ Source of Sample: On-site Sample Number: 23-1239 ▽ Source of Sample: On-site Sample Number: 23-1240	Remarks: ○ Sampled By Client SO-DOFB8-102623 @ 25-26.5B □ SO-DOFB9-102323 @ 12.5-14 △ SO-DOFB9-102323 @ 22.5-24 ◇ SO-DOFB9-102323 @ 31-32.5 ▽ SO-DOFB9-102323 @ 35.5-37
BUDINGER & ASSOCIATES, INC.	
Date: 11/13/23	

Tested By: ○ GP □ TS △ TS ◇ TS ▽ TS Checked By: KC

Particle Size Distribution Report



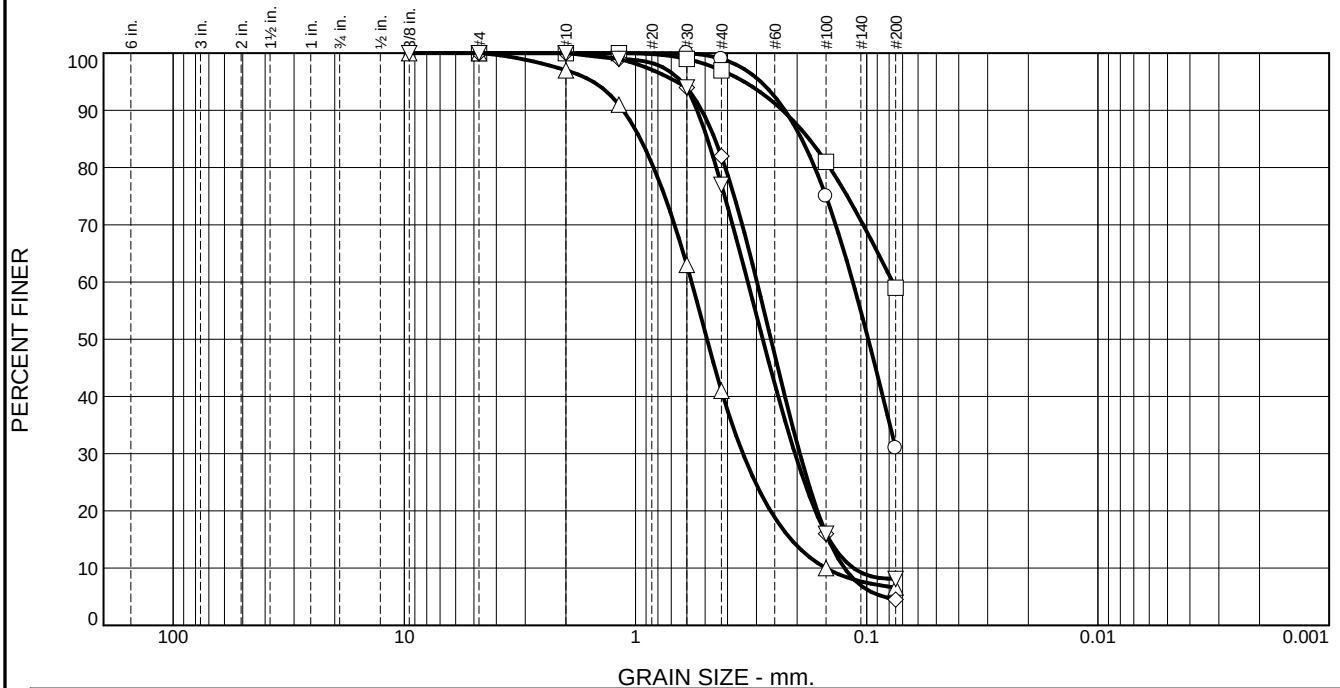
	% Stones	% +3"	% Gravel			% Sand					% Silt		% Clay
			Coarse	Medium	Fine	V. Crs.	Crs.	Med.	Fine	V. Fine	Crs.	Fine	
○	0	0	1	1	1	9	16	18	14			40	
□	0	0	0	0	0	1	5	35	48			11	
△	0	0	0	0	1	2	3	4	6			84	
◇	0	0	21	32	13	9	7	7	4			7	
▽	0	0	0	0	0	0	1	2	7			90	
×	LL	PL	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u			
○			0.7351	0.3636	0.1500	0.0750							
□			0.3782	0.2546	0.2216	0.1643	0.1171	0.0968	1.10	2.63			
△	73	41	0.1121										
◇			30.1265	10.3929	5.9125	1.5040	0.3877	0.2164	1.01	48.03			
▽	36	28											

Material Description	USCS	AASHTO
○ Silty sand trace gravel		
□ Sand some silt		
△ elastic silt with sand	MH	A-7-5(32)
◇ Sandy gravel some silt		
▽ silt	ML	A-4(8)

Project No. L231011 Client: Dalton Olmsted & Fuglevand Project: Arkema Manufacturing Site 2023 Materials ○ Source of Sample: On-site Sample Number: 23-1241 □ Source of Sample: On-site Sample Number: 23-1242 △ Source of Sample: On-site Sample Number: 23-1243 ◇ Source of Sample: On-site Sample Number: 23-1244 ▽ Source of Sample: On-site Sample Number: 23-1245	Remarks: ○ Sampled By B&A SO-DOFB10-102623 @ 10-11.5 □ SO-DOFB10-102623 @ 22.5-24 △ SO-DOFB10-102623 @ 35-36.5 ◇ SO-DOFB11-102323 @ 5-6.5 ▽ SO-DOFB11-102323 @ 15-16.5
BUDINGER & ASSOCIATES, INC.	
Date: 11/13/23	

Tested By: ○ TS □ TS △ TS ◇ PK ▽ PK Checked By: KC

Particle Size Distribution Report



	% Stones	% +3"	% Gravel			% Sand					% Silt		% Clay
			Coarse	Medium	Fine	V. Crs.	Crs.	Med.	Fine	V. Fine	Crs.	Fine	
○	0	0	0	0	0	0	0	8	41			51	
□	0	0	0	0	0	0	2	7	22			69	
△	0	0	0	0	3	10	36	32	12			7	
◇	0	0	0	0	0	1	10	42	41			6	
▽	0	0	0	0	0	2	12	44	33			9	
×	LL	PL	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u			
○			0.1911	0.1148	0.0985								
□			0.1774	0.0772									
△			0.9523	0.5719	0.4906	0.3430	0.2122	0.1500	1.37	3.81			
◇			0.4533	0.2983	0.2596	0.1945	0.1463	0.1249	1.02	2.39			
▽			0.4885	0.3269	0.2816	0.2042	0.1453	0.1140	1.12	2.87			

Material Description	USCS	AASHTO
○ Sandy silt		
□ Sandy silt		
△ Sand some silt trace gravel		
◇ Sand some silt		
▽ Sand some silt		

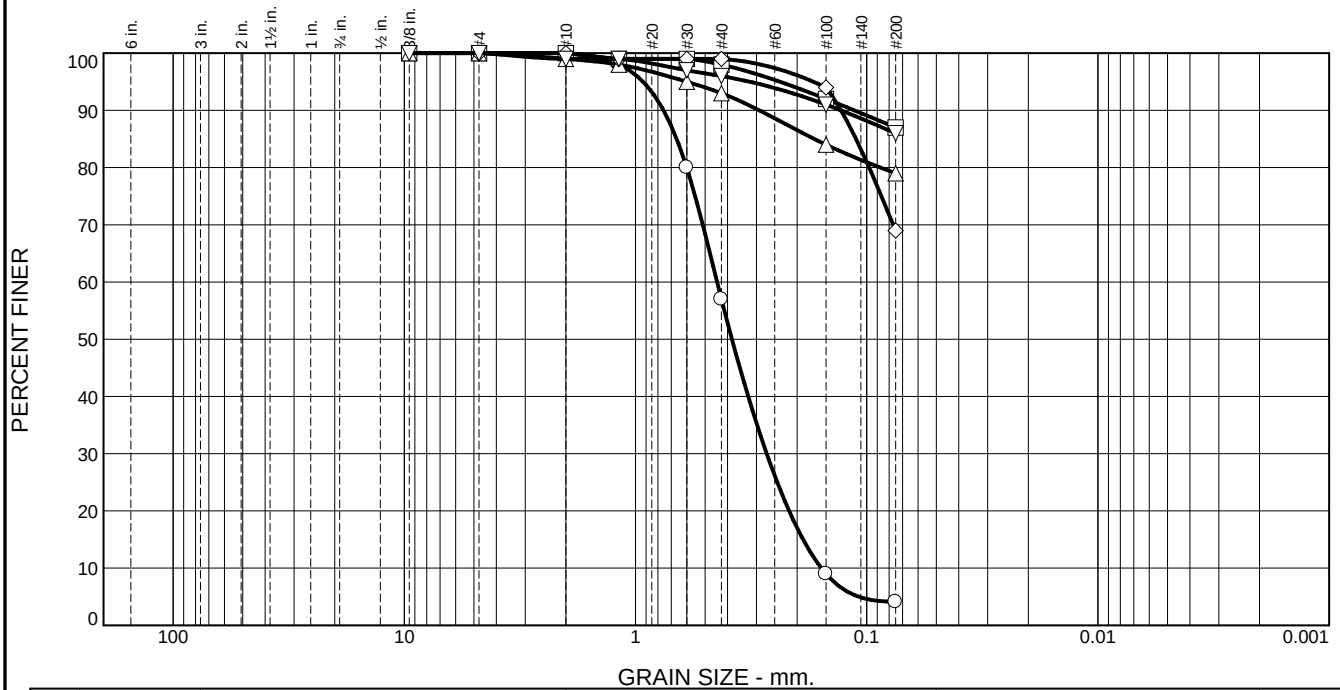
Project No. L231011 Client: Dalton Olmsted & Fuglevand Project: Arkema Manufacturing Site 2023 Materials ○ Source of Sample: On-site Sample Number: 23-1246 □ Source of Sample: On-site Sample Number: 23-1247 △ Source of Sample: On-site Sample Number: 23-1248 ◇ Source of Sample: On-site Sample Number: 23-1249 ▽ Source of Sample: On-site Sample Number: 23-1250	Remarks: ○ Sampled By Client SO-DOFB11-102323 @ 31-32.5 □ SO-DOFB11-102323 @ 35.5-37 △ SO-DOFB12-102723 @ 5-6.5 ◇ SO-DOFB12-102723 @ 20.5-22.5 ▽ SO-DOFB13-102423 @ 7.5-9
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BUDINGER & ASSOCIATES, INC.

Date: 11/13/23

Tested By: ○ TS □ PK △ PK ◇ TS ▽ TS **Checked By:** KC

Particle Size Distribution Report



	% Stones	% +3"	% Gravel			% Sand					% Silt		% Clay
			Coarse	Medium	Fine	V. Crs.	Crs.	Med.	Fine	V. Fine	Crs.	Fine	
○	0	0	0	0	0	4	28	42	21			5	
□	0	0	0	0	0	1	0	4	6			89	
△	0	0	0	0	1	2	3	5	8			81	
◇	0	0	0	0	0	1	0	2	16			81	
▽	0	0	0	0	1	0	3	2	6			88	
×	LL	PL	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u			
○			0.6632	0.4437	0.3828	0.2707	0.1885	0.1572	1.05	2.82			
□	43	26											
△	75	39	0.1685										
◇			0.1113										
▽	62	34											

Material Description										USCS	AASHTO
○ Sand trace silt										SP	
□ lean clay										CL	A-7-6(16)
△ elastic silt with sand										MH	A-7-5(33)
◇ Sandy silt											
▽ elastic silt										MH	A-7-5(29)

Project No. L231011	Client: Dalton Olmsted & Fuglevand	Remarks: ○ Sampled By Client SO-DOFB13-102423 @ 22.5-24 □ SO-DOFB14-102623 @ 12.5-14 △ SO-DOFB15-102423 @ 17.5-19 ◇ SO-DOFB15-102423 @ 34-35.5 ▽ SO-DOFB15-102423 @ 37-38.5
Project: Arkema Manufacturing Site 2023 Materials		
○ Source of Sample: On-site	Sample Number: 23-1251	
□ Source of Sample: On-site	Sample Number: 23-1252	
△ Source of Sample: On-site	Sample Number: 23-1253	
◇ Source of Sample: On-site	Sample Number: 23-1254	
▽ Source of Sample: On-site	Sample Number: 23-1255	

BUDINGER & ASSOCIATES, INC.

Date: 11/13/23

Tested By: ○ TS □ PK △ TS ◇ TS ▽ TS Checked By: KC

Trevor Louviere, PE
Dalton Olmsted & Fuglevand
1011 SW Klickitat Way, Ste 2008
Seattle, WA 98134

April 26, 2024

Project Number L231011

PROJECT: Arkema Manufacturing Site 2023 Materials

**SUBJECT: Results of Laboratory Testing
Report #2**

At your request, we provided laboratory testing services for the subject project. Services were limited to the performance of testing of laboratory tests, selected at your discretion.

For this period, our involvement was limited to laboratory testing of sixteen samples delivered to our laboratory on November 6, 2023. Laboratory tests were conducted in general accordance with methods listed in the attached *Laboratory Summary* sheets.

If you have questions regarding this report, please call.

Respectfully Submitted,
Budinger & Associates, Inc.



Kiel Couch
Laboratory Manager

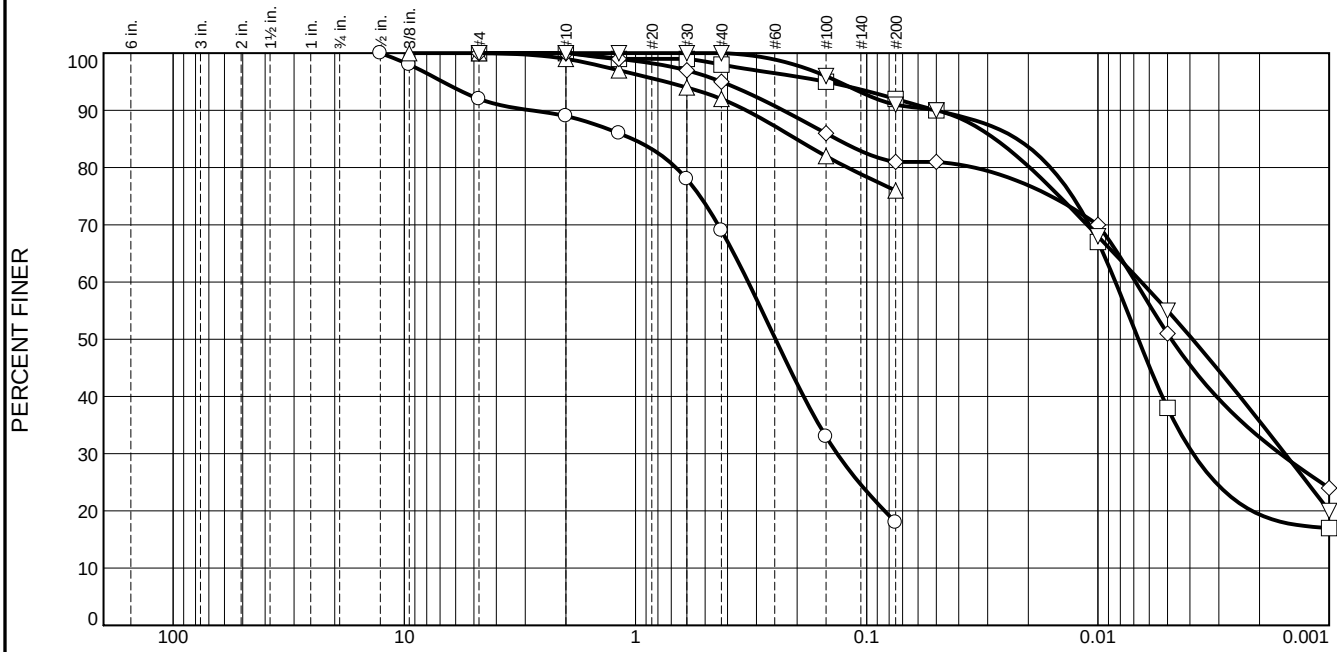
KC/lat/Addressee –
Trevor Louviere – tlouviere@dofnw.com

Attachments:
Soils Laboratory Summary – 1 page
Particle Size Distribution Report – 3 pages
Consolidation Test Results – 129 pages
CP Triaxial Shear Report – 9 pages
CD Triaxial Shear Report – 4 pages

SOIL MECHANICS LABORATORY SUMMARY																					
Project: Arkema Manufacturing Site 2023 Materials																		Project # L231011			
Location: Tacoma, WA																		Page# 1			
LABORATORY NUMBER	UNITS		23-1265	23-1256B	23-1266	23-1267	23-1268	23-1269	23-1269B	23-1270	23-1271	23-1272	23-1273	23-1274	23-1275	23-1276	23-1277	23-1277B	23-1278	23-1279	23-1280
SAMPLED BY			Client	Client	Client	Client	Client	Client	Client	Client	Client	Client	Client	Client	Client	Client	Client	Client	Client	Client	Client
SAMPLE TYPE			Shelby Tube	Shelby Tube	Shelby Tube	Shelby Tube	Shelby Tube	Shelby Tube	Shelby Tube	Shelby Tube	Shelby Tube	Shelby Tube	Shelby Tube	Shelby Tube	Shelby Tube	Shelby Tube	Shelby Tube	Shelby Tube	Shelby Tube	Shelby Tube	Shelby Tube
SAMPLE SOURCE			SO-DOFB2-	SO-DOFB2-	SO-DOFB2-	SO-DOFB4-	SO-DOFB4-	SO-DOFB6-	SO-DOFB6-	SO-DOFB6-	SO-DOFB8-	SO-DOFB8-	SO-DOFB10-	SO-DOFB10-	SO-DOFB12-	SO-DOFB12-	SO-DOFB12-	SO-DOFB12-	SO-DOFB12-	SO-DOFB14-	SO-DOFB14-
			102523	102523	102523	102523	102523	102523	102523	102523	102623	102623	102623	102623	102723	102723	102723	102723	102723	102623	102623
BORING NUMBER			B2	B2	B2	B4	B4	B6	B6	B6	B8	B8	B10	B10	B12	B12	B12	B12	B12	B14	B14
TOTAL SAMPLE DEPTHS	ft		10-12.5	10-12.5	31-33.5	12.5-15	31-33.5	12.5-15	12.5-15	33.5-36	15-17.5	31-33.5	15-17.5	29.5-32	8-10.5	12-14.5	22.5-25	22.5-25	29.5-32	15-17.5	33.5-38
TESTING INTERVALS TOP	ft		10.2	11.8	31.5	14.5	32.8	14.5	14.0	35.0	16.9	31.5	15.0	30.0	9.5	12.0	22.5	24.5	23.5	16.9	36.0
BOTTOM	ft		10.3	12.3	32.0	15.0	33.3	15.0	14.5	35.5	17.4	32.0	15.5	30.5	10.0	14.5	23.0	24.8	24.0	17.4	36.5
		TEST METHOD	*		*	**	*	*		*	*	*	**	**	*	*	*		*	*	**
DRY DENSITY	pcf	ASTM D7263	93.8		81.9	67.2	60.7	73.3		68.3	61.1	72.6	100.1	90.5	100.2	90.4	102.1		98.7	70.7	90.3
MOISTURE	%	ASTM D2216	31.7		34.8	57.1	70.3	52.0		50.9	66.2	50.6	24.8	79.5	14.6	23.8	14.7		23.4	52.7	29.9
CONSOLIDATION		ASTM D2435	Attached		Attached		Attached			Attached	Attached	Attached				Attached				Attached	
CU TRIAXIAL SHEAR		ASTM D4767	Attached		Attached		Attached			Attached	Attached	Attached				Attached	Attached			Attached	
CD TRIAXIAL SHEAR		ASTM D7181						Attached	Attached						Attached				Attached		
ATTERBERG LIMITS		ASTM D4318																			
LIQUID LIMIT	%									57											
PLASTIC LIMIT	%									35											
PLASTICITY INDEX	%									22											
UNIFIED CLASSIFICATION		ASTM D2487								MH											
SIEVE ANALYSIS		ASTM D6913																			
3"																					
1 1/2"																					
GRAVEL	1"																				
S	3/4"																				
I	1/2"	%	100																		
E	3/8"		98	100		100															
V	#4	P	92	96	100	100-	100	100					100		100		100		100		
E	#10	A	89	93	100-	99	100-	100-		100			100-		99		100-		100-	100	
SAND	#16	S	86	91	99	97	99	100-		100-			98		98		99	100	100-	100-	
S	#30	S	78	83	99	94	97	100-		99			88		86		92	100-	100-	99	
I	#40	I	69	74	98	92	95	100-		99			71		70		79	99	100-	99	
Z	#100	N	33	37	95	82	86	96		91			24		20		25	86	97	96	
E	#200	G	18	20	92	76	81	91		81			12		9.8		8.0	39	75	73	
SILT	.05mm	ASTM D7928			90		81	90											32	59	
	.01mm				67		70	68											9.1	17	
CLAY	.005mm				38		51	55											6.3	10	
	.001mm				17		24	20											3.2	6.0	

* = % Dry Density results reflect entire shelby tube sample.
** = % Dry Density results reflect depth intervals listed.

Particle Size Distribution Report



GRAIN SIZE - mm.

	% Stones	% +3"	% Gravel			% Sand					% Silt		% Clay
			Coarse	Medium	Fine	V. Crs.	Crs.	Med.	Fine	V. Fine	Crs.	Fine	
○	0	0	0	8	3	4	11	24	27		23		
□	0	0	0	0	0	1	0	3	3	3	6	65	19
△	0	0	0	0	1	3	3	6	9		78		
◇	0	0	0	0	0	1	3	5	9	1	4	44	33
▽	0	0	0	0	0	0	0	1	6	3	10	44	36
×	LL	PL	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u			
○			1.0301	0.3256	0.2480	0.1342							
□			0.0224	0.0084	0.0067	0.0039							
△			0.2015										
◇			0.1350	0.0069	0.0048	0.0016							
▽			0.0278	0.0065	0.0039	0.0016							

Material Description

USCS

AASHTO

- Silty sand some gravel
- Silt loam
- △ Sandy silt
- ◇ Silty clay loam
- ▽ Silty clay loam

Project No. L231011 **Client:** Dalton Olmsted & Fuglevand

Project: Arkema Manufacturing Site 2023 Materials

○ **Source of Sample:** On-site **Sample Number:** 23-1265

□ **Source of Sample:** On-site **Sample Number:** 23-1266

△ **Source of Sample:** On-site **Sample Number:** 23-1267

◇ **Source of Sample:** On-site **Sample Number:** 23-1268

▽ **Source of Sample:** On-site **Sample Number:** 23-1269

Remarks:

○ Sampled By Client

SO-DOFB2-102523 @ 10-12.5

□ SO-DOFB2-102523 @ 31-33.5

△ SO-DOFB4-102523 @ 12.5-15

◇ SO-DOFB4-102523 @ 31-33.5

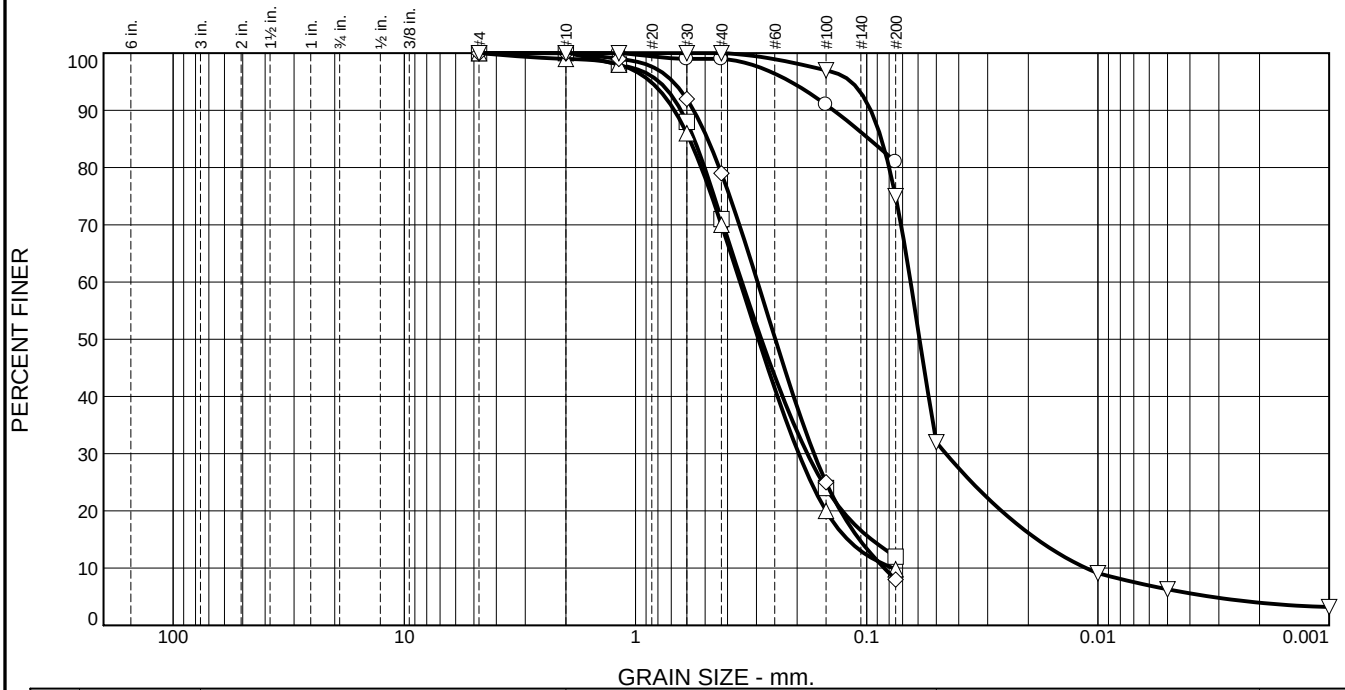
▽ SO-DOFB6-102523 @ 12.5-15

BUDINGER & ASSOCIATES, INC.

Date: 4/26/24

Tested By: ○ WH □ WH △ PK ◇ WH ▽ JS **Checked By:** KC

Particle Size Distribution Report



	% Stones	% +3"	% Gravel			% Sand					% Silt		% Clay
			Coarse	Medium	Fine	V. Crs.	Crs.	Med.	Fine	V. Fine	Crs.	Fine	
○	0	0	0	0	0	0	1	3	11			85	
□	0	0	0	0	0	3	17	36	28			16	
△	0	0	0	0	1	2	19	37	29			12	
◇	0	0	0	0	0	1	13	36	37			13	
▽	0	0	0	0	0	0	0	1	8	59	16	12	4
×													
	LL	PL	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u			
○	57	35	0.0977										
□			0.5578	0.3467	0.2856	0.1807	0.0953						
△			0.5843	0.3531	0.2940	0.1968	0.1209	0.0770	1.42	4.58			
◇			0.4876	0.2965	0.2485	0.1690	0.1075	0.0840	1.15	3.53			
▽			0.0864	0.0646	0.0591	0.0454	0.0183	0.0113	2.84	5.74			

Material Description	USCS	AASHTO
○ elastic silt with sand □ Silty sand △ Silty sand ◇ Silty sand ▽ Sandy loam	MH	A-7-5(21)

Project No. L231011 Client: Dalton Olmsted & Fuglevand Project: Arkema Manufacturing Site 2023 Materials ○ Source of Sample: On-site Sample Number: 23-1270 □ Source of Sample: On-site Sample Number: 23-1273 △ Source of Sample: On-site Sample Number: 23-1275 ◇ Source of Sample: On-site Sample Number: 23-1277 ▽ Source of Sample: On-site Sample Number: 23-1278	Remarks: ○ Sampled By Client SO-DOFB6-102523 @ 33.5-36 □ SO-DOFB10-102623 @ 15-17.5 △ SO-DOFB12-102723 @ 8-10.5 ◇ SO-DOFB12-102723 @ 22.5-25 ▽ SO-DOFB12-102723 @ 29.5-32
BUDINGER & ASSOCIATES, INC.	
Date: 4/26/24	

Tested By: ○ WH □ PK △ WH ◇ WH ▽ WH Checked By: KC

[illegible]

Material Description	USCS	AASHTO
☐ Silt loam ☐ Silty sand trace gravel ☐ Sandy silt		

Project: Arkema Manufacturing Site 2023 Materials

☐ **Source of Sample:** On-site **Sample Number:** 23-1279
☐ **Source of Sample:** On-site **Sample Number:** 23-1265B
☐ **Source of Sample:** On-site **Sample Number:** 23-1277B

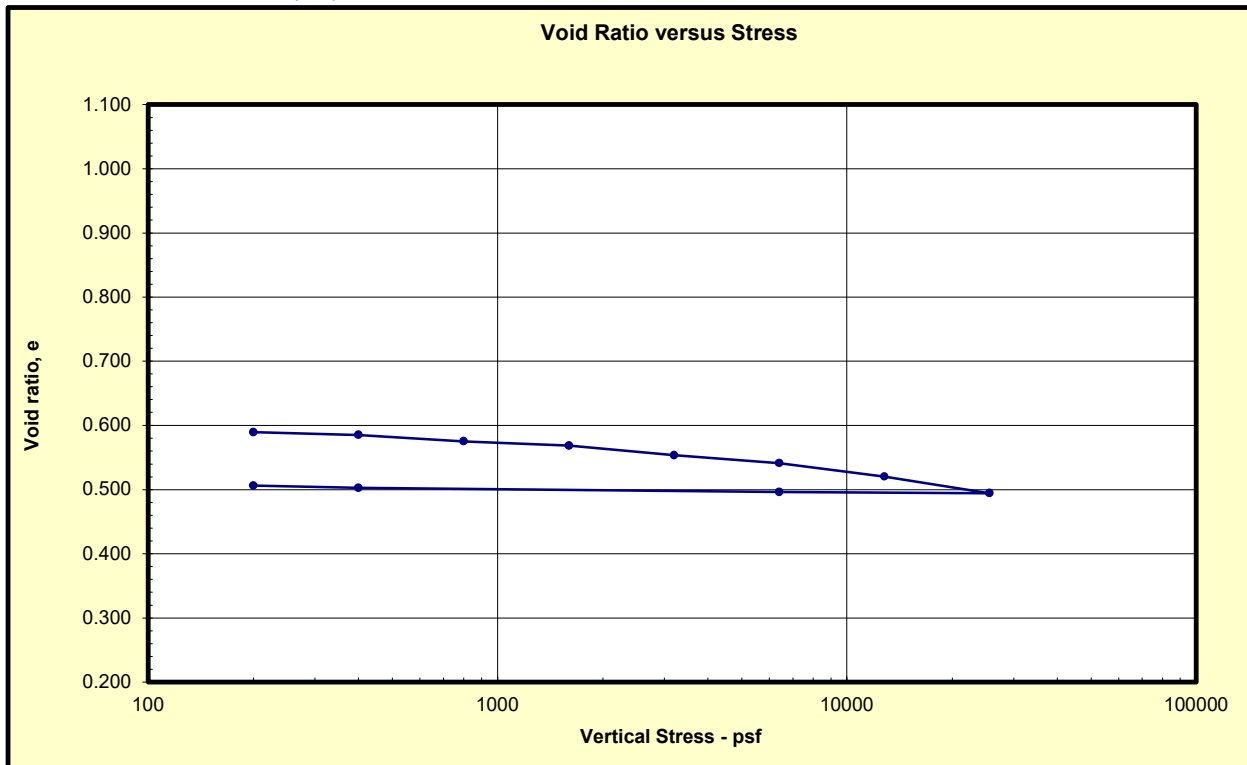
○Sampled By Client
SO-DOFB12-102723 @ 15-17.5
☐SO-DOFB2-102523 @10-12.5
△SO-DOFB12-102723 @ 22.5-25

Date: 4/26/24

Tested By: ○ PK □ WH △ WH **Checked By:** KC

Consolidation Test Results ASTM D-2435

		Load (psf)	H (in)	Consol (%)	Vs	e
Project	L231011	200	0.992	0.3	0.63	0.59
Boring	B-2	400	0.989	0.6	0.63	0.59
Depth (ft)	10.4-10.5	800	0.983	1.2	0.63	0.58
Sampled by	Client	1600	0.979	1.6	0.64	0.57
Sample diameter (in)	2.495	3200	0.970	2.6	0.64	0.55
Wet density (pcf)	122.7	6400	0.962	3.3	0.65	0.54
Initial moisture (%)	18.3	12800	0.949	4.6	0.66	0.52
Initial dry Density (pcf)	103.7	25600	0.933	6.3	0.67	0.49
Final moisture (%)	19.2	6400	0.934	6.2	0.67	0.50
Final dry density	110.3	400	0.938	5.7	0.67	0.50
Specific gravity (assumed)	2.65	200	0.940	5.5	0.66	0.51
Initial height, H (in)	0.995					
Volume of solids (Vs)	0.63					
Volume of voids (Vv)	0.37					
Initial void ratio (e0)	0.59					
Total consolidation (%)	6.3					
Final Volume of solids (Vs)	0.67					
Minimum void ratio (ef)	0.49					
Effective stress in-situ(psf)	-					
Pre-consolidation stress (psf)	-					
Over-consolidation ratio, OCR	-					
Saturate sample at (psf)	200					



Time Deformation Readings

200 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.03	0.18	0.0000
0.07	0.26	0.0000
0.10	0.32	0.0000
0.13	0.37	0.0001
0.20	0.45	0.0001
0.27	0.52	0.0001
0.35	0.59	0.0002
0.45	0.67	0.0003
0.58	0.76	0.0005
0.75	0.87	0.0005
0.95	0.97	0.0006
1.22	1.10	0.0007
1.53	1.24	0.0008
1.95	1.40	0.0009
2.47	1.57	0.0011
3.12	1.77	0.0011
3.95	1.99	0.0012
4.98	2.23	0.0012
6.28	2.51	0.0013
7.92	2.81	0.0021
9.97	3.16	0.0021
12.57	3.54	0.0025
15.83	3.98	0.0025
19.93	4.46	0.0027
25.10	5.01	0.0027
31.60	5.62	0.0028
39.80	6.31	0.0032
50.10	7.08	0.0031
60.13	7.75	0.0031

400 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0014
0.20	0.45	0.0016
0.22	0.47	0.0015
0.25	0.50	0.0016
0.30	0.55	0.0016
0.35	0.59	0.0016
0.42	0.65	0.0016
0.50	0.71	0.0016
0.60	0.77	0.0017
0.73	0.86	0.0017
0.90	0.95	0.0017
1.12	1.06	0.0018
1.37	1.17	0.0018
1.70	1.30	0.0018
2.12	1.45	0.0020
2.63	1.62	0.0020
3.28	1.81	0.0020
4.10	2.02	0.0020
5.13	2.27	0.0022
6.43	2.54	0.0022
8.07	2.84	0.0023
10.13	3.18	0.0025
12.72	3.57	0.0025
15.98	4.00	0.0026
20.08	4.48	0.0028
25.25	5.02	0.0028
31.77	5.64	0.0028
39.95	6.32	0.0029
50.27	7.09	0.0033
60.12	7.75	0.0034

800 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.08	0.29	0.0031
0.20	0.45	0.0034
0.22	0.47	0.0034
0.25	0.50	0.0034
0.30	0.55	0.0034
0.35	0.59	0.0035
0.42	0.65	0.0035
0.50	0.71	0.0036
0.60	0.77	0.0037
0.73	0.86	0.0038
0.90	0.95	0.0040
1.12	1.06	0.0041
1.37	1.17	0.0042
1.70	1.30	0.0042
2.12	1.45	0.0043
2.63	1.62	0.0044
3.28	1.81	0.0045
4.10	2.02	0.0045
5.13	2.27	0.0045
6.43	2.54	0.0046
8.07	2.84	0.0047
10.13	3.18	0.0055
12.72	3.57	0.0054
15.98	4.00	0.0055
20.08	4.48	0.0054
25.25	5.02	0.0055
31.77	5.64	0.0055
39.95	6.32	0.0056
50.27	7.09	0.0055
63.23	7.95	0.0061
79.58	8.92	0.0063
100.15	10.01	0.0063
126.05	11.23	0.0063
158.65	12.60	0.0063
199.68	14.13	0.0063
251.35	15.85	0.0063
316.38	17.79	0.0066
398.27	19.96	0.0074
501.37	22.39	0.0074
631.13	25.12	0.0074
794.52	28.19	0.0075
1000.18	31.63	0.0075
1259.12	35.48	0.0075
1440.45	37.95326	0.007406

Time Deformation Readings

1600 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0052
0.20	0.45	0.0052
0.22	0.47	0.0052
0.25	0.50	0.0052
0.30	0.55	0.0052
0.35	0.59	0.0052
0.42	0.65	0.0052
0.50	0.71	0.0052
0.60	0.77	0.0052
0.73	0.86	0.0052
0.90	0.95	0.0052
1.10	1.05	0.0052
1.37	1.17	0.0052
1.70	1.30	0.0052
2.12	1.45	0.0052
2.63	1.62	0.0052
3.28	1.81	0.0053
4.10	2.02	0.0060
5.13	2.27	0.0060
6.43	2.54	0.0060
8.07	2.84	0.0060
10.12	3.18	0.0060
12.72	3.57	0.0060
15.97	4.00	0.0060
20.08	4.48	0.0060
25.25	5.02	0.0060
31.75	5.63	0.0060
39.95	6.32	0.0060
50.25	7.09	0.0060
60.10	7.75	0.0061

3200 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.08	0.29	0.0077
0.20	0.45	0.0077
0.22	0.47	0.0078
0.25	0.50	0.0078
0.30	0.55	0.0078
0.35	0.59	0.0078
0.42	0.65	0.0079
0.50	0.71	0.0080
0.60	0.77	0.0080
0.73	0.86	0.0081
0.90	0.95	0.0081
1.10	1.05	0.0082
1.37	1.17	0.0082
1.70	1.30	0.0083
2.10	1.45	0.0083
2.62	1.62	0.0084
3.27	1.81	0.0085
4.10	2.02	0.0086
5.13	2.27	0.0087
6.43	2.54	0.0088
8.07	2.84	0.0088
10.12	3.18	0.0089
12.72	3.57	0.0090
15.98	4.00	0.0091
20.08	4.48	0.0095
25.25	5.02	0.0096
31.75	5.63	0.0096
39.95	6.32	0.0096
50.25	7.09	0.0098
63.23	7.95	0.0098
79.57	8.92	0.0101
100.13	10.01	0.0102
126.03	11.23	0.0103
158.63	12.59	0.0104
199.68	14.13	0.0105
251.35	15.85	0.0106
316.38	17.79	0.0107
398.27	19.96	0.0109
501.35	22.39	0.0110
631.13	25.12	0.0112
794.52	28.19	0.0113
1000.18	31.63	0.0114
1259.12	35.48	0.0115
1440.4	37.9526	0.011552

6400 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0082
0.20	0.45	0.0082
0.23	0.48	0.0082
0.27	0.52	0.0083
0.30	0.55	0.0083
0.35	0.59	0.0083
0.42	0.65	0.0084
0.52	0.72	0.0084
0.62	0.79	0.0085
0.75	0.87	0.0085
0.90	0.95	0.0086
1.12	1.06	0.0087
1.37	1.17	0.0088
1.70	1.30	0.0088
2.12	1.45	0.0089
2.63	1.62	0.0090
3.28	1.81	0.0090
4.10	2.02	0.0091
5.13	2.27	0.0091
6.43	2.54	0.0092
8.08	2.84	0.0093
10.13	3.18	0.0093
12.73	3.57	0.0094
15.98	4.00	0.0097
20.10	4.48	0.0099
25.27	5.03	0.0099
31.77	5.64	0.0099
39.95	6.32	0.0100
50.27	7.09	0.0100
60.13	7.75	0.0103

Time Deformation Readings

12800 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0115
0.20	0.45	0.0118
0.22	0.47	0.0119
0.25	0.50	0.0120
0.30	0.55	0.0121
0.35	0.59	0.0123
0.42	0.65	0.0124
0.52	0.72	0.0126
0.62	0.79	0.0127
0.75	0.87	0.0128
0.92	0.96	0.0132
1.12	1.06	0.0133
1.38	1.18	0.0135
1.70	1.30	0.0136
2.12	1.45	0.0137
2.63	1.62	0.0138
3.28	1.81	0.0139
4.10	2.02	0.0140
5.13	2.27	0.0142
6.43	2.54	0.0143
8.07	2.84	0.0145
10.13	3.18	0.0146
12.72	3.57	0.0149
15.98	4.00	0.0151
20.08	4.48	0.0152
25.25	5.02	0.0152
31.77	5.64	0.0155
39.95	6.32	0.0157
50.27	7.09	0.0158
60.12	7.75	0.0160

25600 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0139
0.20	0.45	0.0147
0.23	0.48	0.0150
0.27	0.52	0.0153
0.30	0.55	0.0157
0.35	0.59	0.0157
0.42	0.65	0.0161
0.50	0.71	0.0164
0.62	0.79	0.0165
0.73	0.86	0.0167
0.90	0.95	0.0170
1.12	1.06	0.0173
1.37	1.17	0.0177
1.70	1.30	0.0179
2.12	1.45	0.0181
2.63	1.62	0.0182
3.28	1.81	0.0184
4.10	2.02	0.0185
5.13	2.27	0.0186
6.43	2.54	0.0187
8.07	2.84	0.0189
10.13	3.18	0.0191
12.72	3.57	0.0192
15.98	4.00	0.0193
20.08	4.48	0.0194
25.25	5.02	0.0197
31.77	5.64	0.0203
39.95	6.32	0.0205
50.25	7.09	0.0208
60.12	7.75	0.0208

6400 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	-0.0072
0.20	0.45	-0.0071
0.22	0.47	-0.0071
0.25	0.50	-0.0071
0.30	0.55	-0.0071
0.35	0.59	-0.0071
0.42	0.65	-0.0071
0.50	0.71	-0.0071
0.60	0.77	-0.0071
0.73	0.86	-0.0071
0.90	0.95	-0.0072
1.12	1.06	-0.0071
1.37	1.17	-0.0072
1.70	1.30	-0.0071
2.12	1.45	-0.0072
2.63	1.62	-0.0072
3.28	1.81	-0.0071
4.10	2.02	-0.0072
5.13	2.27	-0.0072
6.43	2.54	-0.0071
8.07	2.84	-0.0072
10.13	3.18	-0.0071
12.72	3.57	-0.0072
15.98	4.00	-0.0072
20.08	4.48	-0.0072
25.25	5.02	-0.0072
31.77	5.64	-0.0072
39.95	6.32	-0.0073
50.27	7.09	-0.0073
60.12	7.75	-0.0073

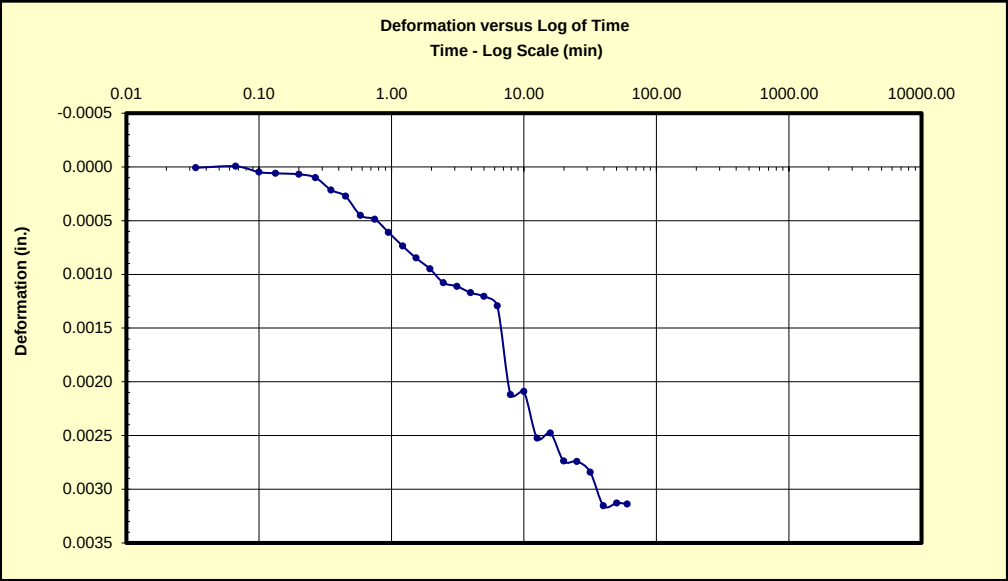
Time Deformation Readings

400 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	-0.0082
0.20	0.45	-0.0089
0.23	0.48	-0.0092
0.27	0.52	-0.0091
0.30	0.55	-0.0092
0.35	0.59	-0.0095
0.42	0.65	-0.0095
0.50	0.71	-0.0094
0.62	0.79	-0.0097
0.75	0.87	-0.0097
0.90	0.95	-0.0100
1.12	1.06	-0.0100
1.37	1.17	-0.0102
1.70	1.30	-0.0101
2.12	1.45	-0.0101
2.63	1.62	-0.0102
3.28	1.81	-0.0103
4.12	2.03	-0.0103
5.15	2.27	-0.0104
6.45	2.54	-0.0105
8.08	2.84	-0.0105
10.13	3.18	-0.0105
12.73	3.57	-0.0105
16.00	4.00	-0.0105
20.10	4.48	-0.0105
25.27	5.03	-0.0107
31.78	5.64	-0.0107
39.97	6.32	-0.0107
50.28	7.09	-0.0108
60.12	7.75	-0.0108

200 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	-0.0017
0.20	0.45	-0.0022
0.23	0.48	-0.0023
0.27	0.52	-0.0022
0.30	0.55	-0.0026
0.37	0.61	-0.0026
0.43	0.66	-0.0026
0.52	0.72	-0.0026
0.62	0.79	-0.0026
0.75	0.87	-0.0026
0.92	0.96	-0.0026
1.12	1.06	-0.0026
1.38	1.18	-0.0027
1.70	1.30	-0.0027
2.12	1.45	-0.0027
2.63	1.62	-0.0027
3.28	1.81	-0.0027
4.10	2.02	-0.0027
5.13	2.27	-0.0027
6.43	2.54	-0.0027
8.07	2.84	-0.0028
10.13	3.18	-0.0027
12.72	3.57	-0.0027
15.98	4.00	-0.0029
20.08	4.48	-0.0029
25.25	5.02	-0.0029
31.77	5.64	-0.0030
39.95	6.32	-0.0031
50.25	7.09	-0.0030
60.13	7.75	-0.0031



Scan Data

Step List

ISTEP 21

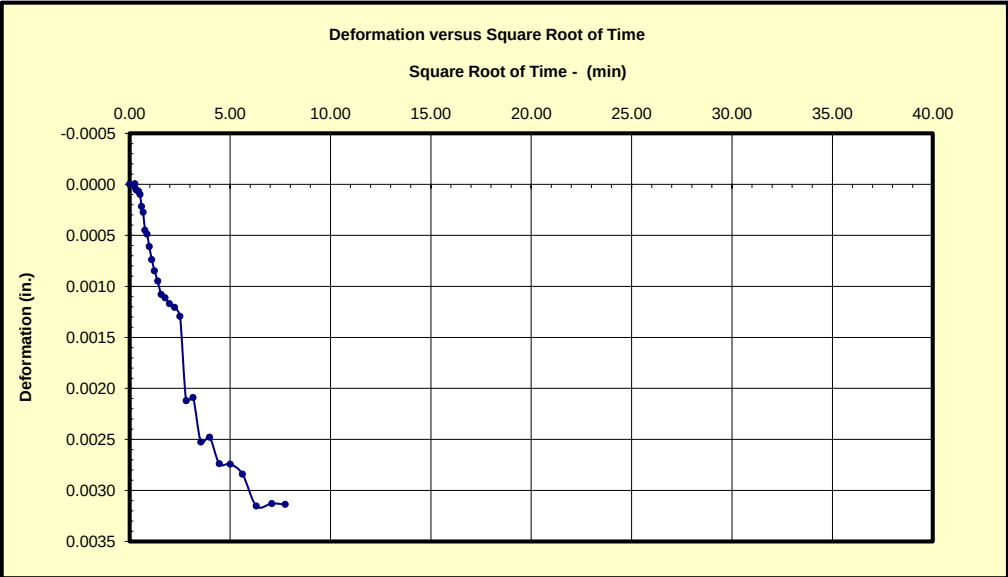
Update

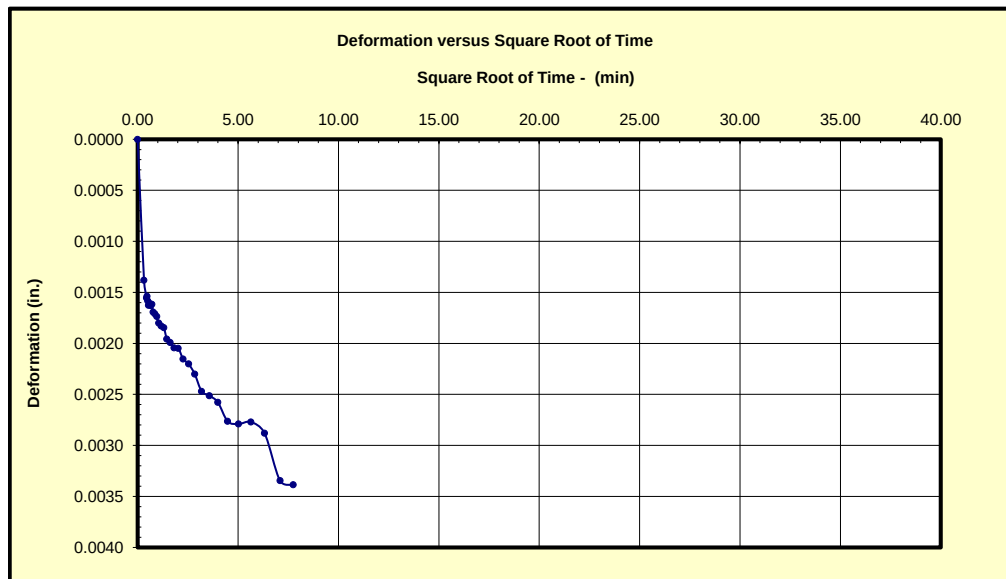
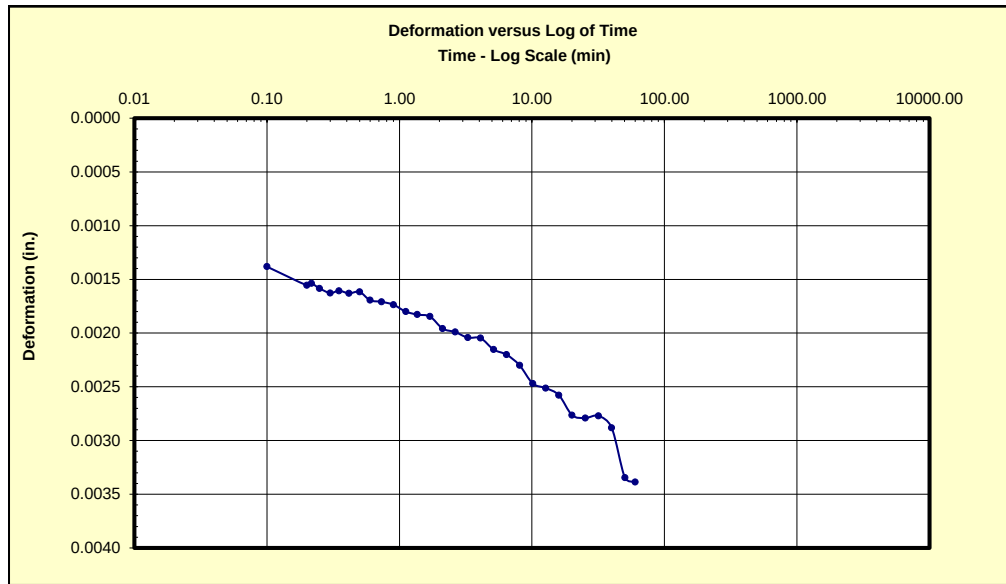
Vertical Stress
200 psf
S100
No match!!!

☒ End of Primary
☐ End of Increment

Project:
L231011

B2
Depth (ft):
10.3





Scan Data

Step List

ISTEP 31

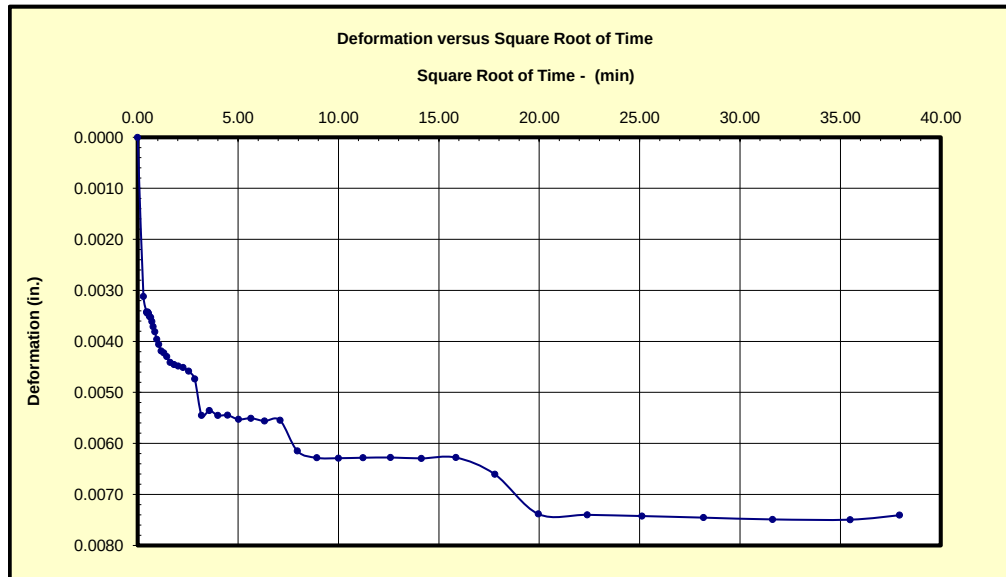
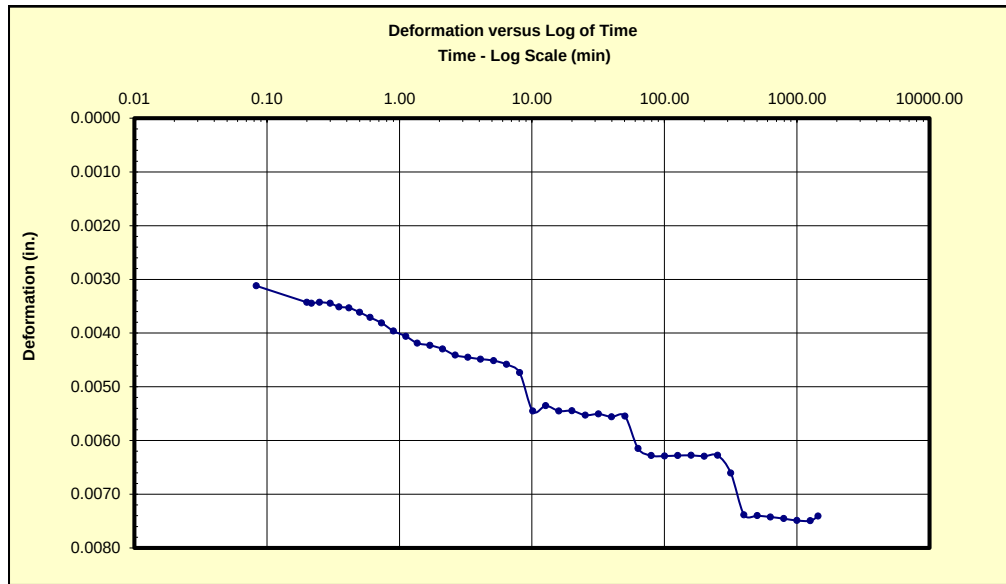
Update

Vertical Stress
400 psf
S100
No match!!!

☒ End of Primary
☐ End of Increment

Project:
L231011

B2
Depth (ft):
10.3



Scan Data

Step List

ISTEP 41

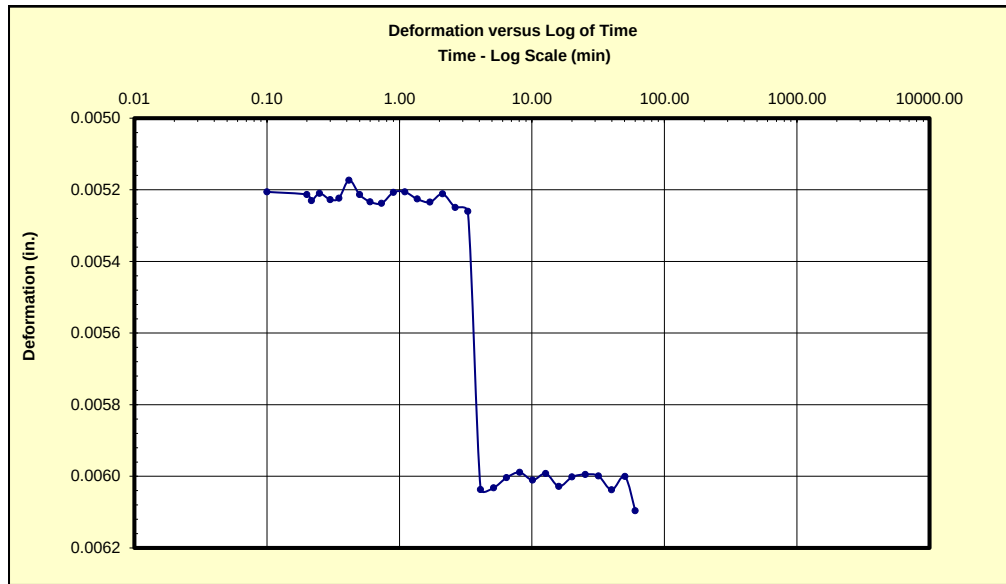
Update

Vertical Stress
800 psf
S100
No match!!!

- ☒ End of Primary
☐ End of Increment

Project:
L231011

B2
Depth (ft):
10.3



Scan Data

Step List

ISTEP 51

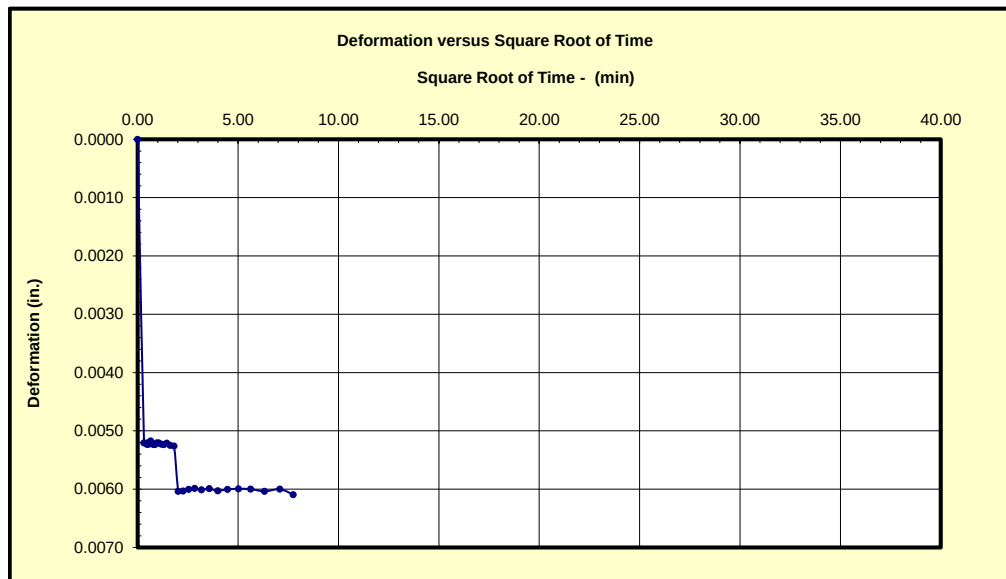
Update

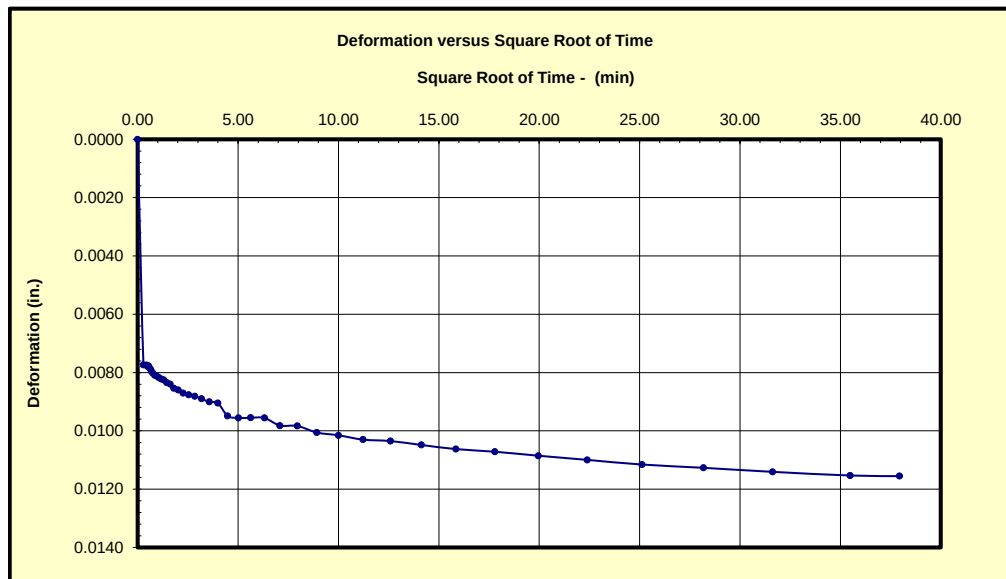
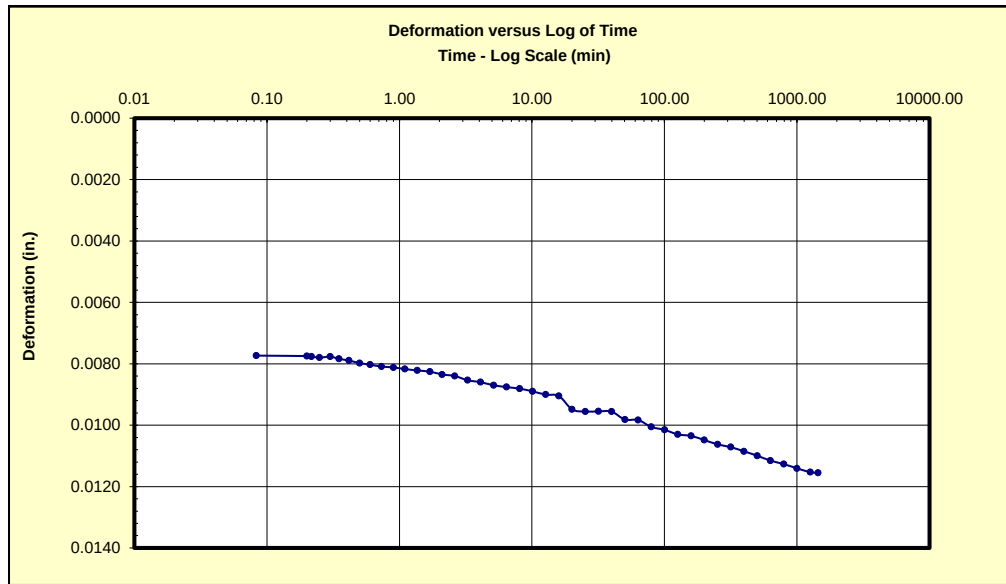
Vertical Stress
1600 psf
S100
No match!!!

☒ End of Primary
☐ End of Increment

Project:
L231011

B2
Depth (ft):
10.3





Scan Data

Step List

ISTEP 61

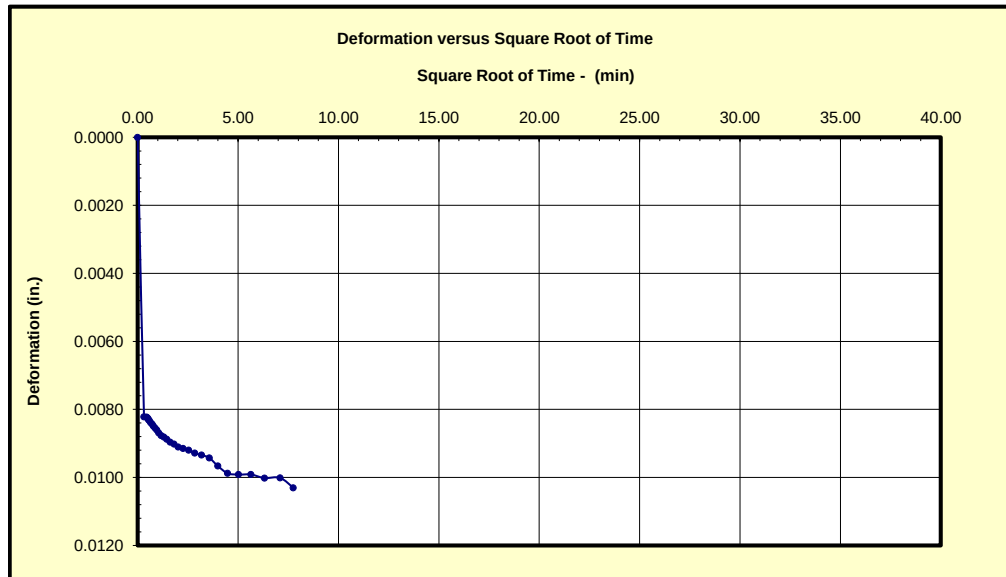
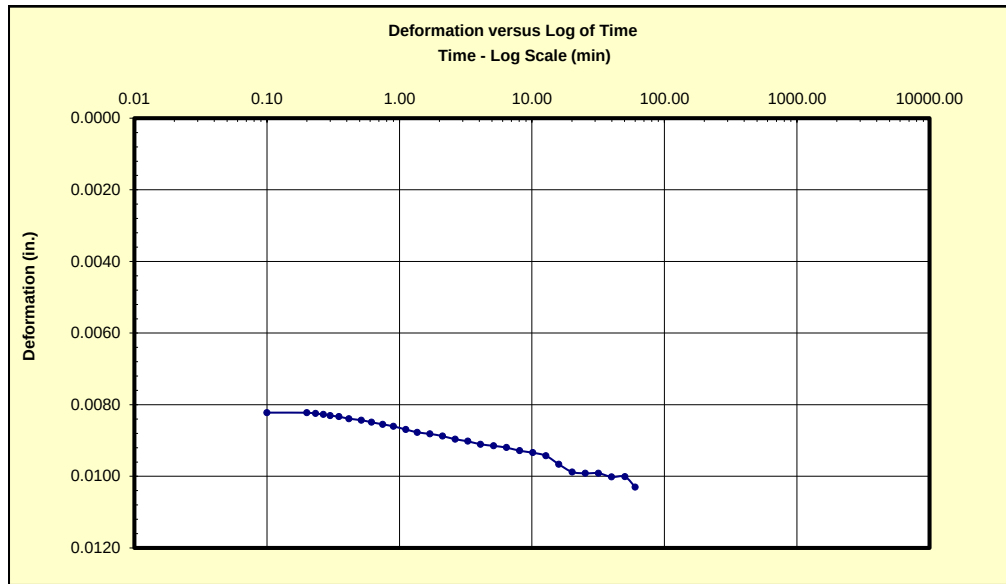
Update

Vertical Stress
3200 psf
S100
No match!!!

☒ End of Primary
☐ End of Increment

Project:
L231011

B2
Depth (ft):
10.3



Scan Data

Step List

ISTEP 71

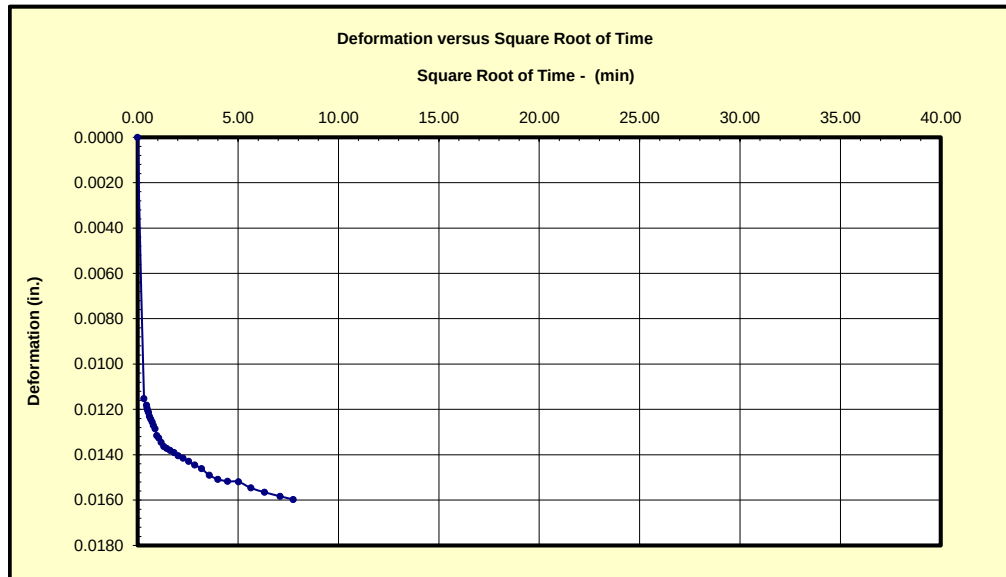
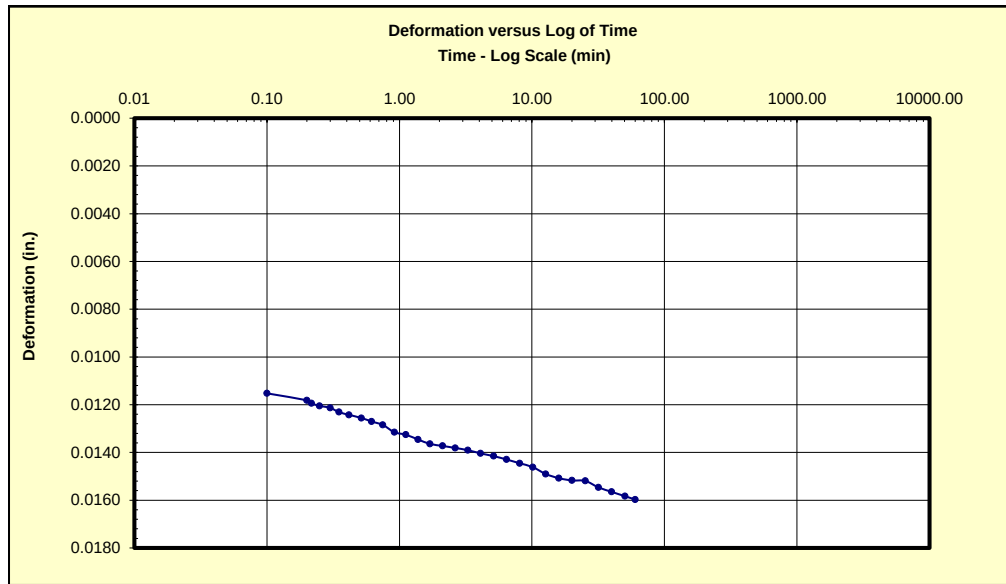
Update

Vertical Stress
6400 psf
S100
No match!!!

☒ End of Primary
☐ End of Increment

Project:
L231011

B2
Depth (ft):
10.3



Scan Data

Step List

ISTEP 81

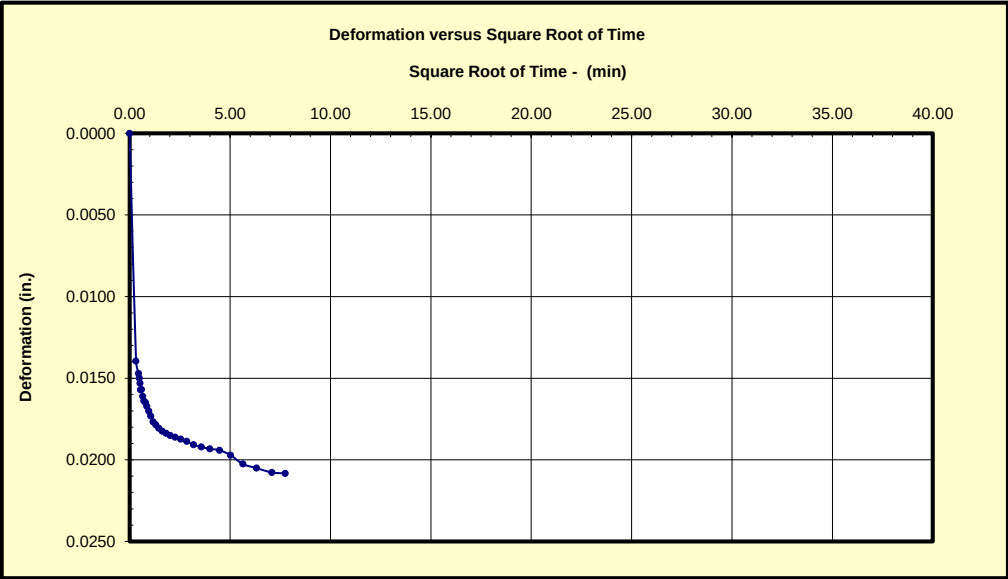
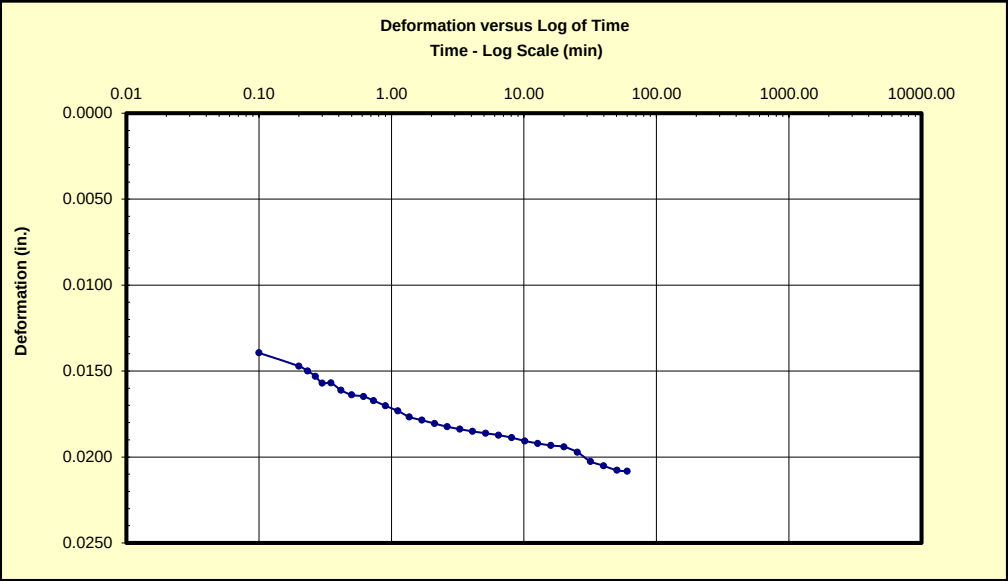
Update

Vertical Stress
12800 psf
S100
No match!!!

☒ End of Primary
☐ End of Increment

Project:
L231011

B2
Depth (ft):
10.3



Scan Data

Step List

ISTEP 91

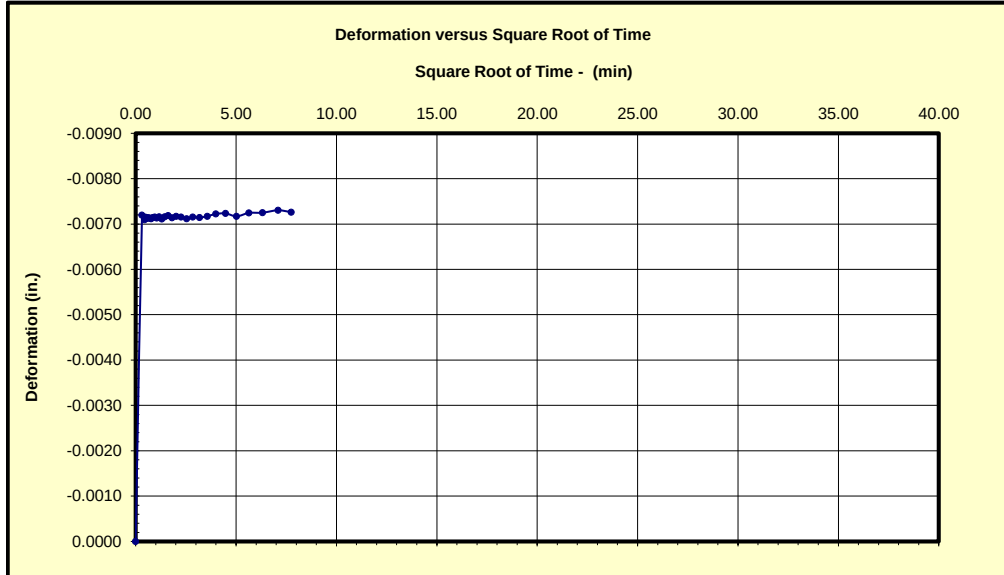
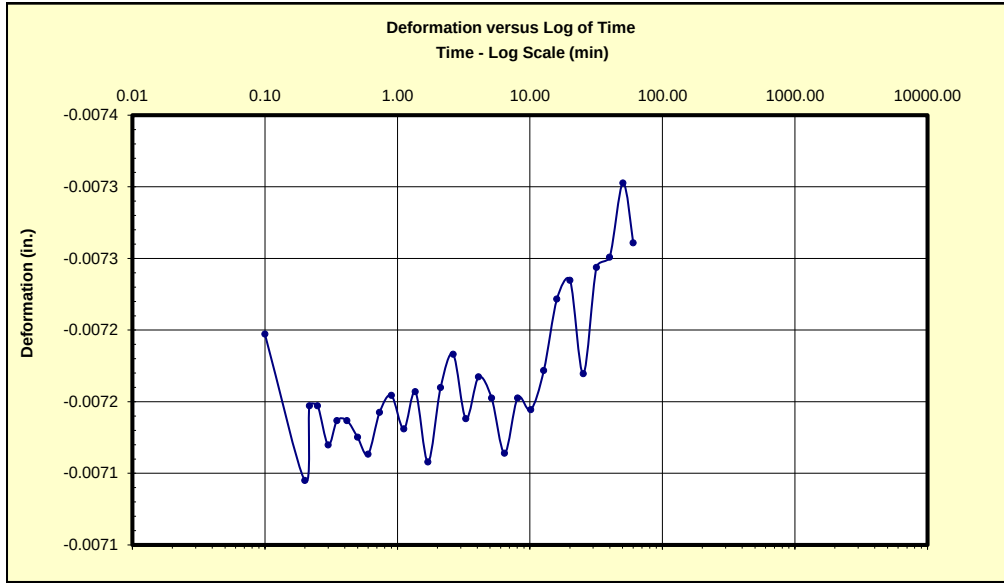
Update

Vertical Stress
25600 psf
S100
No match!!!

☒ End of Primary
☐ End of Increment

Project:
L231011

B2
Depth (ft):
10.3



Scan Data

Step List

ISTEP 101

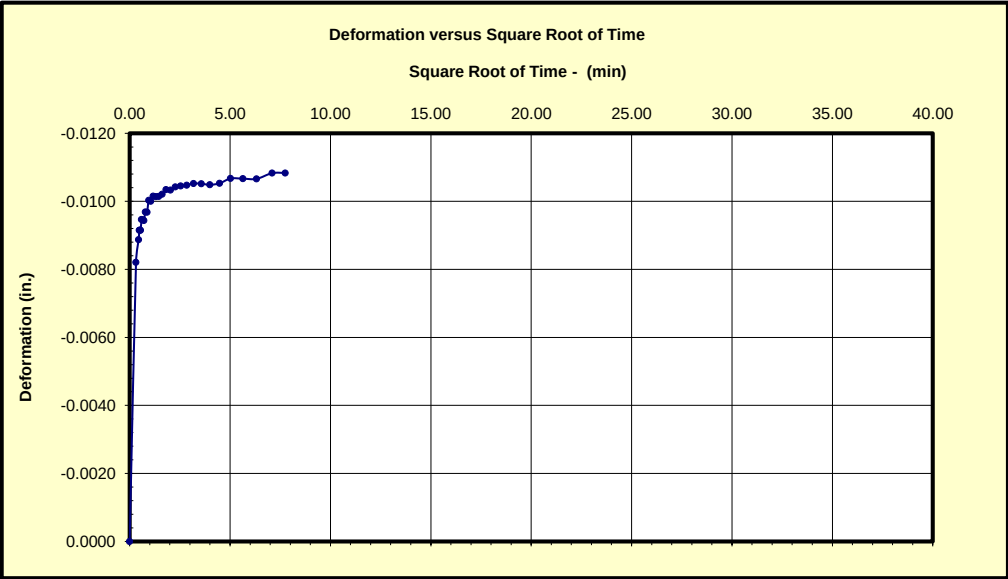
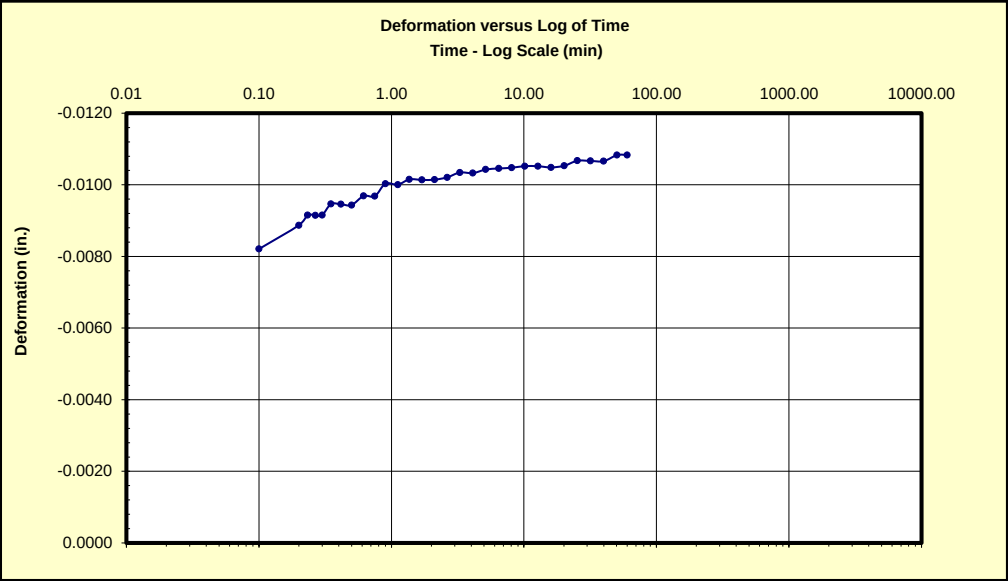
Update

Vertical Stress
6400 psf
S100
No match!!!

☒ End of Primary
☐ End of Increment

Project:
L231011

B2
Depth (ft):
10.3



Scan Data

Step List

ISTEP 111

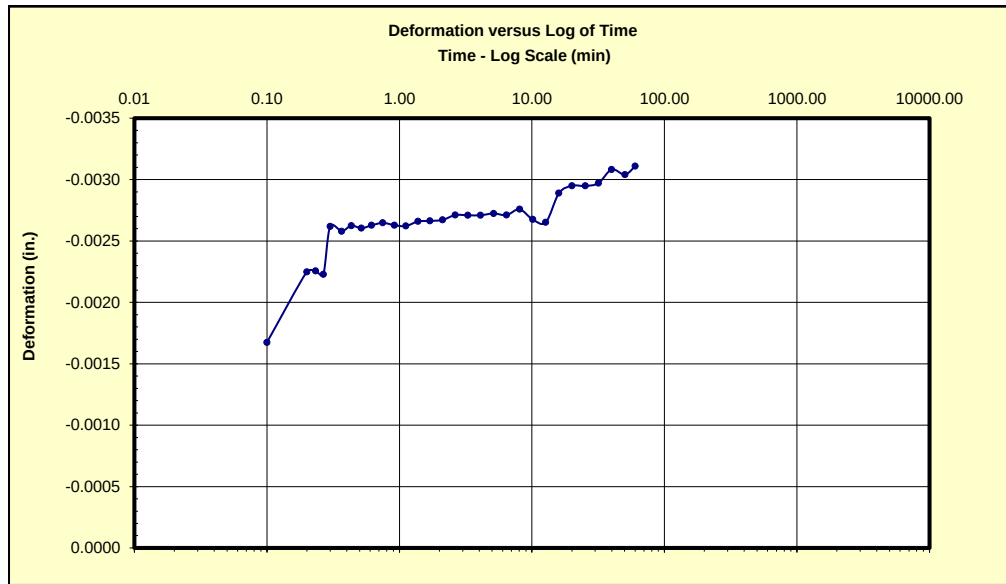
Update

Vertical Stress
400 psf
S100
No match!!!

☒ End of Primary
☐ End of Increment

Project:
L231011

B2
Depth (ft):
10.3



Scan Data

Step List

ISTEP 111

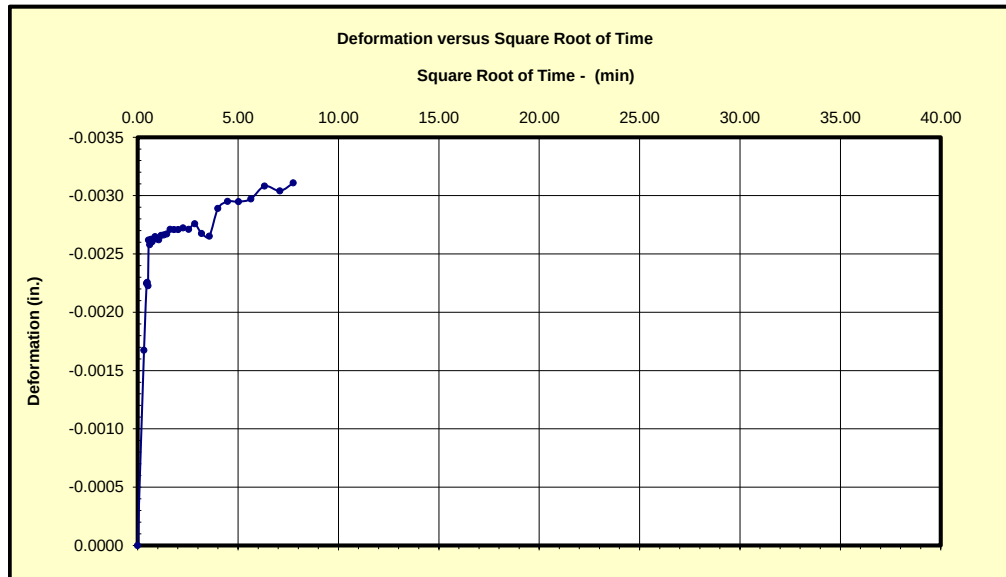
Update

Vertical Stress
200 psf
S100
No match!!!

☒ End of Primary
☐ End of Increment

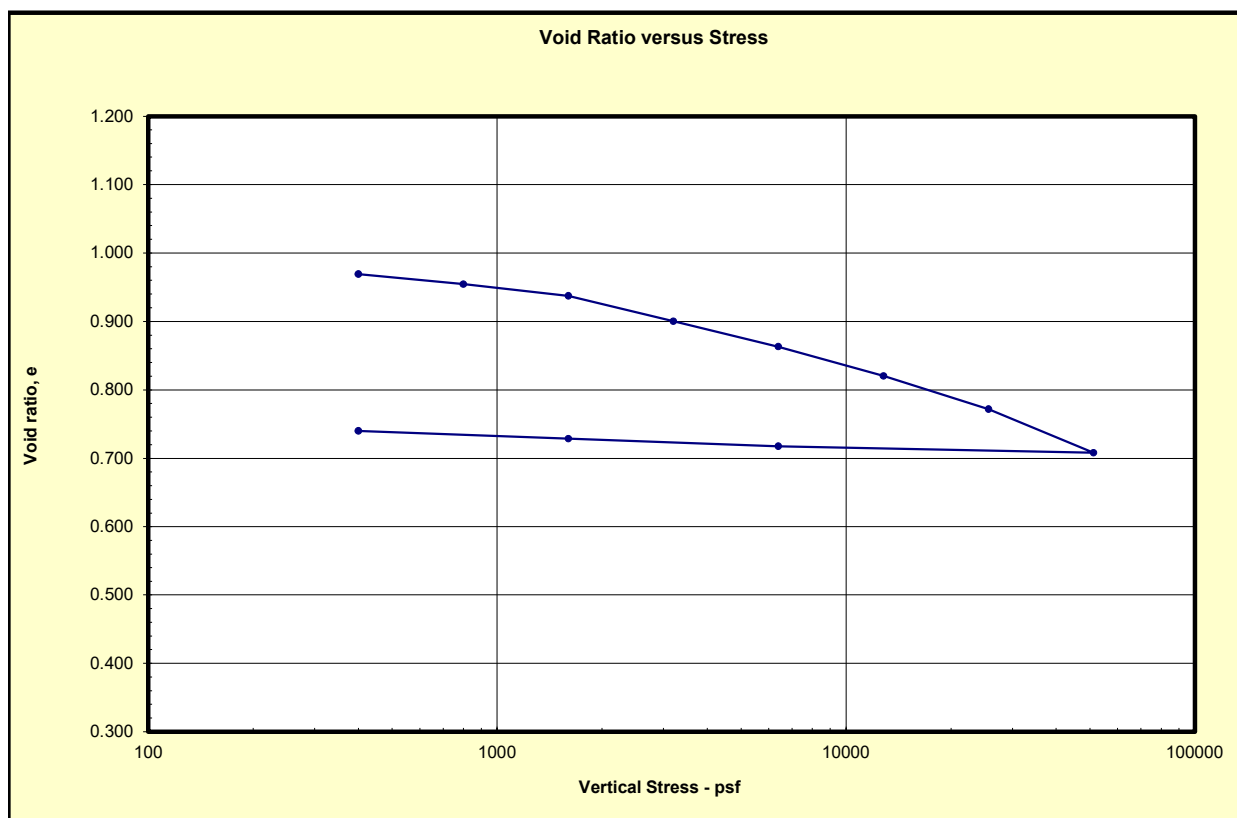
Project:
L231011

B2
Depth (ft):
10.3



Consolidation Test Results ASTM D-2435

		Load (psf)	H (in)	Consol (%)	V _s	e
Project	L231011	400	0.988	0.8%	0.51	0.97
Boring	B2	800	0.980	1.5%	0.51	0.95
Depth (ft)	32.0	1600	0.972	2.4%	0.52	0.94
Sampled by	Client	3200	0.953	4.2%	0.53	0.90
Sample diameter (in)	2.495	6400	0.934	6.1%	0.54	0.86
Wet density (pcf)	113.5	12800	0.913	8.3%	0.55	0.82
Initial moisture (%)	36.2	25600	0.888	10.7%	0.56	0.77
Initial dry Density (pcf)	83.3	51200	0.857	13.9%	0.59	0.71
Final moisture (%)	29.2	6400	0.861	13.4%	0.58	0.72
Final dry density	96.8	1600	0.867	12.9%	0.58	0.73
Specific gravity (assumed)	2.65	400	0.873	12.3%	0.57	0.74
Initial height, H (in)	0.995					
Volume of solids (Vs)	0.50					
Volume of voids (Vv)	0.50					
Initial void ratio (e ₀)	0.98					
Total consolidation (%)	13.9%					
Final Volume of solids (Vs)	0.59					
Minimum void ratio (e _f)	0.71					
Effective stress in-situ(psf)	-					
Pre-consolidation stress (psf)	-					
Over-consolidation ratio, OCR	-					
Saturate sample at (psf)	400					



Time Deformation Readings

400 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.03	0.18	0.0000
0.07	0.26	0.0002
0.10	0.32	0.0003
0.15	0.39	0.0006
0.20	0.45	0.0015
0.28	0.53	0.0023
0.37	0.61	0.0028
0.47	0.68	0.0034
0.60	0.77	0.0040
0.77	0.88	0.0042
0.98	0.99	0.0045
1.25	1.12	0.0046
1.57	1.25	0.0046
1.98	1.41	0.0049
2.50	1.58	0.0050
3.17	1.78	0.0052
3.98	2.00	0.0054
5.02	2.24	0.0057
6.32	2.51	0.0059
7.97	2.82	0.0063
10.02	3.16	0.0064
12.62	3.55	0.0064
15.88	3.99	0.0066
20.00	4.47	0.0067
25.17	5.02	0.0068
31.67	5.63	0.0071
39.87	6.31	0.0073
50.18	7.08	0.0074
60.38	7.77	0.0075

800 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.08	0.29	0.0038
0.18	0.43	0.0044
0.22	0.47	0.0045
0.25	0.50	0.0045
0.30	0.55	0.0047
0.37	0.61	0.0048
0.43	0.66	0.0052
0.52	0.72	0.0051
0.63	0.80	0.0054
0.77	0.88	0.0055
0.92	0.96	0.0056
1.13	1.06	0.0057
1.40	1.18	0.0058
1.73	1.32	0.0060
2.15	1.47	0.0061
2.67	1.63	0.0061
3.32	1.82	0.0063
4.15	2.04	0.0064
5.18	2.28	0.0069
6.48	2.55	0.0070
8.12	2.85	0.0071
10.18	3.19	0.0071
12.78	3.58	0.0072
16.03	4.00	0.0073
20.15	4.49	0.0074
25.32	5.03	0.0073
31.83	5.64	0.0074
40.02	6.33	0.0075
50.33	7.09	0.0075
63.32	7.96	0.0077
79.65	8.92	0.0077
100.23	10.01	0.0079
126.12	11.23	0.0082
158.72	12.60	0.0082
199.77	14.13	0.0082
251.43	15.86	0.0083
316.48	17.79	0.0082
398.37	19.96	0.0083
501.45	22.39	0.0083
631.23	25.12	0.0084
794.60	28.19	0.0084
1000.28	31.63	0.0085
1066.55	32.66	0.0085

1600 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0038
0.20	0.45	0.0053
0.23	0.48	0.0054
0.27	0.52	0.0055
0.32	0.56	0.0056
0.37	0.61	0.0058
0.43	0.66	0.0060
0.53	0.73	0.0061
0.63	0.80	0.0063
0.77	0.88	0.0065
0.93	0.97	0.0066
1.15	1.07	0.0068
1.42	1.19	0.0070
1.75	1.32	0.0072
2.17	1.47	0.0073
2.68	1.64	0.0074
3.33	1.83	0.0075
4.17	2.04	0.0076
5.20	2.28	0.0077
6.50	2.55	0.0078
8.13	2.85	0.0079
10.18	3.19	0.0079
12.78	3.58	0.0081
16.05	4.01	0.0082
20.15	4.49	0.0081
25.33	5.03	0.0084
31.83	5.64	0.0086
40.03	6.33	0.0086
50.35	7.10	0.0088
63.33	7.96	0.0089
79.67	8.93	0.0091
100.25	10.01	0.0091
126.15	11.23	0.0095
158.75	12.60	0.0097
199.78	14.13	0.0098
251.45	15.86	0.0099
316.50	17.79	0.0099
398.38	19.96	0.0099
417.37	20.43	0.0100

Time Deformation Readings

3200 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.12	0.34	0.0082
0.22	0.47	0.0097
0.25	0.50	0.0102
0.28	0.53	0.0106
0.32	0.56	0.0110
0.38	0.62	0.0115
0.45	0.67	0.0118
0.55	0.74	0.0123
0.65	0.81	0.0126
0.80	0.89	0.0129
0.97	0.98	0.0130
1.17	1.08	0.0131
1.43	1.20	0.0132
1.77	1.33	0.0135
2.18	1.48	0.0137
2.70	1.64	0.0139
3.35	1.83	0.0142
4.17	2.04	0.0144
5.20	2.28	0.0145
6.50	2.55	0.0148
8.15	2.85	0.0150
10.20	3.19	0.0152
12.80	3.58	0.0155
16.07	4.01	0.0157
20.17	4.49	0.0160
25.33	5.03	0.0162
31.85	5.64	0.0166
40.03	6.33	0.0168
50.35	7.10	0.0170
63.33	7.96	0.0171
79.68	8.93	0.0175
100.25	10.01	0.0175
126.15	11.23	0.0179
158.75	12.60	0.0180
199.78	14.13	0.0183
251.45	15.86	0.0184
316.50	17.79	0.0188
398.38	19.96	0.0190
501.48	22.39	0.0192
631.25	25.12	0.0194
794.63	28.19	0.0196
1000.32	31.63	0.0203
1020.28	31.94	0.0204

6400 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0114
0.20	0.45	0.0130
0.23	0.48	0.0132
0.27	0.52	0.0138
0.30	0.55	0.0142
0.37	0.61	0.0146
0.43	0.66	0.0151
0.52	0.72	0.0152
0.63	0.80	0.0152
0.77	0.88	0.0154
0.93	0.97	0.0155
1.13	1.06	0.0158
1.40	1.18	0.0162
1.73	1.32	0.0164
2.15	1.47	0.0166
2.67	1.63	0.0170
3.33	1.83	0.0172
4.15	2.04	0.0175
5.18	2.28	0.0177
6.48	2.55	0.0179
8.13	2.85	0.0182
10.18	3.19	0.0184
12.78	3.58	0.0186
16.05	4.01	0.0191
20.15	4.49	0.0196
25.32	5.03	0.0197
31.83	5.64	0.0198
40.03	6.33	0.0202
50.33	7.09	0.0203
63.32	7.96	0.0207
78.07	8.84	0.0209

12800 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.20	0.45	0.0115
0.30	0.55	0.0152
0.88	0.94	0.0154
0.92	0.96	0.0154
0.97	0.98	0.0165
1.22	1.10	0.0175
1.23	1.11	0.0175
1.32	1.15	0.0177
1.42	1.19	0.0178
1.55	1.24	0.0180
2.00	1.41	0.0188
3.50	1.87	0.0206
3.77	1.94	0.0205
4.10	2.02	0.0205
4.52	2.13	0.0207
5.03	2.24	0.0208
5.68	2.38	0.0209
6.50	2.55	0.0211
7.53	2.74	0.0212
8.83	2.97	0.0214
10.48	3.24	0.0215
12.53	3.54	0.0217
15.13	3.89	0.0217
18.40	4.29	0.0220
22.50	4.74	0.0221
27.67	5.26	0.0222
34.18	5.85	0.0227
42.37	6.51	0.0228
52.68	7.26	0.0231
65.67	8.10	0.0235
82.02	9.06	0.0237
102.60	10.13	0.0237
128.50	11.34	0.0242
143.72	11.99	0.0243

Time Deformation Readings

25600 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0147
0.20	0.45	0.0183
0.23	0.48	0.0190
0.27	0.52	0.0192
0.32	0.56	0.0197
0.38	0.62	0.0202
0.45	0.67	0.0207
0.53	0.73	0.0209
0.63	0.80	0.0212
0.77	0.88	0.0215
0.93	0.97	0.0217
1.15	1.07	0.0219
1.42	1.19	0.0223
1.75	1.32	0.0225
2.17	1.47	0.0226
2.68	1.64	0.0231
3.33	1.83	0.0235
4.17	2.04	0.0240
5.20	2.28	0.0243
6.50	2.55	0.0247
8.13	2.85	0.0249
10.20	3.19	0.0252
12.78	3.58	0.0255
16.05	4.01	0.0257
20.17	4.49	0.0258
25.33	5.03	0.0261
31.83	5.64	0.0264
40.03	6.33	0.0268
50.35	7.10	0.0272
63.33	7.96	0.0275
79.67	8.93	0.0276
100.23	10.01	0.0277
126.13	11.23	0.0284
158.73	12.60	0.0284
199.78	14.13	0.0285
202.95	14.25	0.0285

51200 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0233
0.20	0.45	0.0246
0.23	0.48	0.0251
0.27	0.52	0.0255
0.32	0.56	0.0257
0.37	0.61	0.0260
0.45	0.67	0.0263
0.53	0.73	0.0264
0.63	0.80	0.0266
0.77	0.88	0.0268
0.93	0.97	0.0272
1.15	1.07	0.0275
1.42	1.19	0.0279
1.75	1.32	0.0281
2.17	1.47	0.0284
2.68	1.64	0.0286
3.33	1.83	0.0288
4.17	2.04	0.0290
5.20	2.28	0.0297
6.50	2.55	0.0300
8.13	2.85	0.0303
10.20	3.19	0.0306
12.78	3.58	0.0308
16.05	4.01	0.0315
20.15	4.49	0.0319
25.32	5.03	0.0323
31.83	5.64	0.0326
40.02	6.33	0.0328
50.33	7.09	0.0331
63.32	7.96	0.0337
79.65	8.92	0.0338
100.23	10.01	0.0341
126.13	11.23	0.0343
158.73	12.60	0.0346
199.77	14.13	0.0349
251.45	15.86	0.0350
316.48	17.79	0.0355
398.37	19.96	0.0357
501.47	22.39	0.0362
631.25	25.12	0.0366
794.62	28.19	0.0371
1000.30	31.63	0.0378
1023.07	31.99	0.0378

6400 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	-0.0148
0.20	0.45	-0.0151
0.23	0.48	-0.0151
0.27	0.52	-0.0152
0.32	0.56	-0.0152
0.37	0.61	-0.0154
0.45	0.67	-0.0154
0.53	0.73	-0.0155
0.63	0.80	-0.0155
0.77	0.88	-0.0156
0.93	0.97	-0.0156
1.15	1.07	-0.0156
1.42	1.19	-0.0157
1.73	1.32	-0.0157
2.15	1.47	-0.0157
2.68	1.64	-0.0158
3.33	1.83	-0.0159
4.17	2.04	-0.0159
5.20	2.28	-0.0158
6.50	2.55	-0.0158
8.13	2.85	-0.0160
10.18	3.19	-0.0160
12.78	3.58	-0.0162
16.05	4.01	-0.0163
20.15	4.49	-0.0164
25.32	5.03	-0.0164
31.83	5.64	-0.0163
40.02	6.33	-0.0164
50.33	7.09	-0.0165
63.32	7.96	-0.0166
79.67	8.93	-0.0166
87.23	9.34	-0.0167

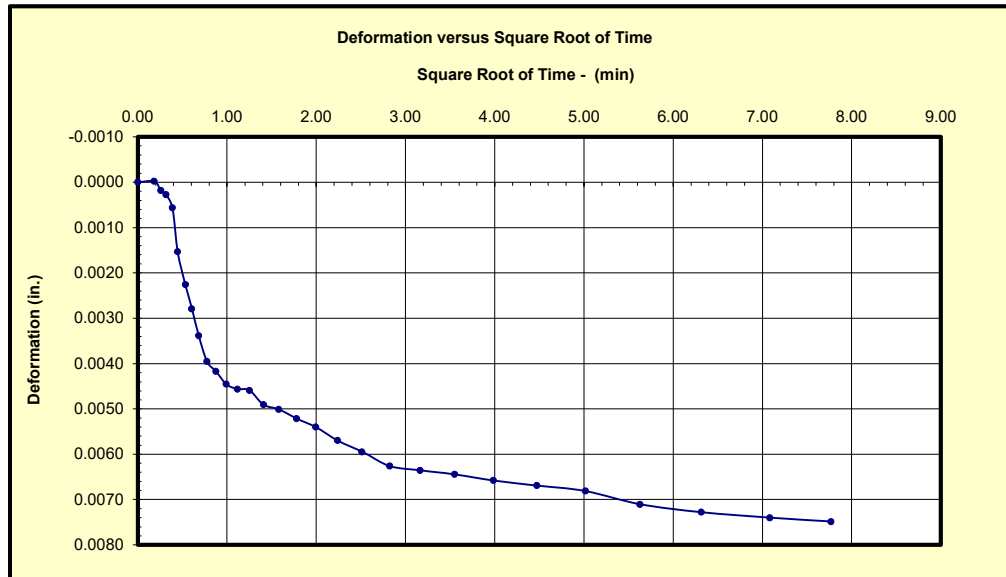
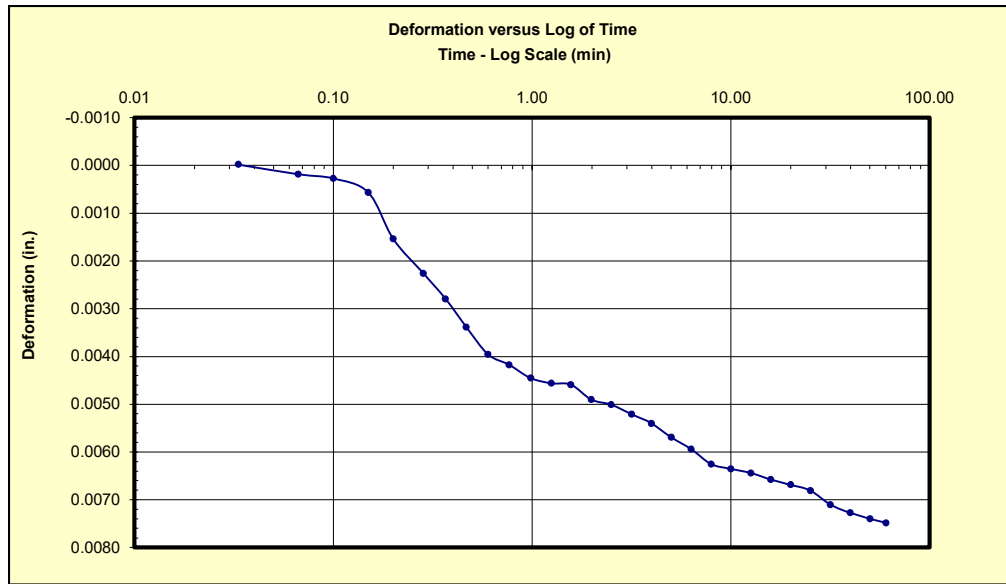
Time Deformation Readings

1600 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	-0.0067
0.20	0.45	-0.0067
0.23	0.48	-0.0067
0.28	0.53	-0.0068
0.32	0.56	-0.0068
0.38	0.62	-0.0069
0.45	0.67	-0.0069
0.53	0.73	-0.0070
0.65	0.81	-0.0071
0.78	0.89	-0.0071
0.95	0.97	-0.0072
1.15	1.07	-0.0072
1.42	1.19	-0.0073
1.75	1.32	-0.0073
2.17	1.47	-0.0074
2.68	1.64	-0.0075
3.35	1.83	-0.0077
4.17	2.04	-0.0077
5.20	2.28	-0.0077
6.50	2.55	-0.0077
8.13	2.85	-0.0077
10.20	3.19	-0.0077
12.78	3.58	-0.0077
16.05	4.01	-0.0081
20.17	4.49	-0.0082
25.33	5.03	-0.0083
31.85	5.64	-0.0083
40.03	6.33	-0.0083
50.33	7.09	-0.0084
63.32	7.96	-0.0083
79.67	8.93	-0.0084
100.23	10.01	-0.0085
126.13	11.23	-0.0086
158.73	12.60	-0.0086
189.02	13.75	-0.0087

400 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	-0.0044
0.20	0.45	-0.0044
0.23	0.48	-0.0044
0.27	0.52	-0.0044
0.30	0.55	-0.0045
0.37	0.61	-0.0045
0.43	0.66	-0.0046
0.52	0.72	-0.0046
0.63	0.80	-0.0047
0.77	0.88	-0.0048
0.93	0.97	-0.0048
1.13	1.06	-0.0049
1.40	1.18	-0.0050
1.73	1.32	-0.0051
2.15	1.47	-0.0053
2.67	1.63	-0.0054
3.33	1.83	-0.0056
4.15	2.04	-0.0059
5.18	2.28	-0.0062
6.48	2.55	-0.0063
8.13	2.85	-0.0066
10.18	3.19	-0.0067
12.78	3.58	-0.0068
16.03	4.00	-0.0071
20.15	4.49	-0.0072
25.32	5.03	-0.0072
31.83	5.64	-0.0073
40.02	6.33	-0.0074
50.33	7.09	-0.0077
63.32	7.96	-0.0077
79.67	8.93	-0.0078
100.23	10.01	-0.0082
126.13	11.23	-0.0083



Scan Data

Step List

ISTEP 21

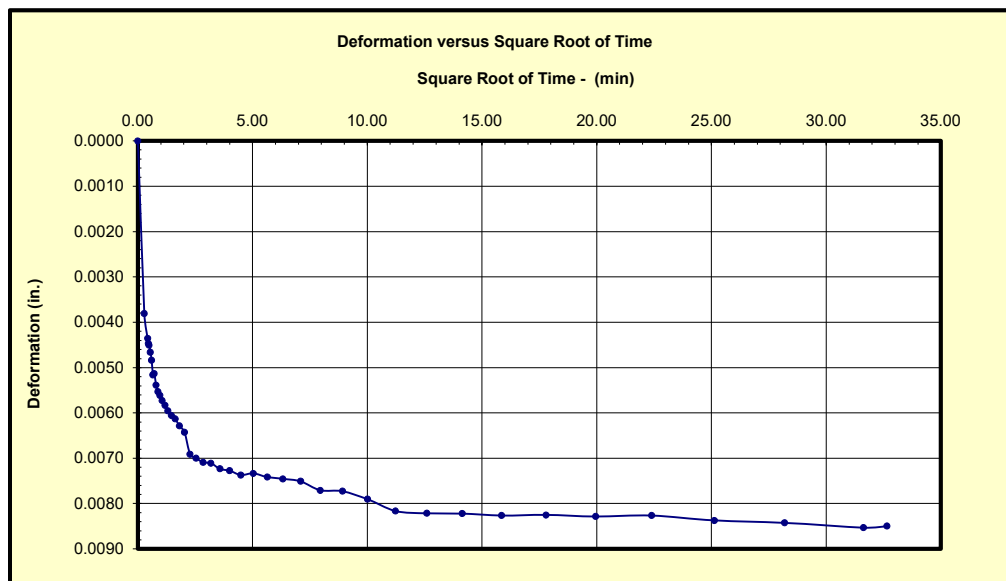
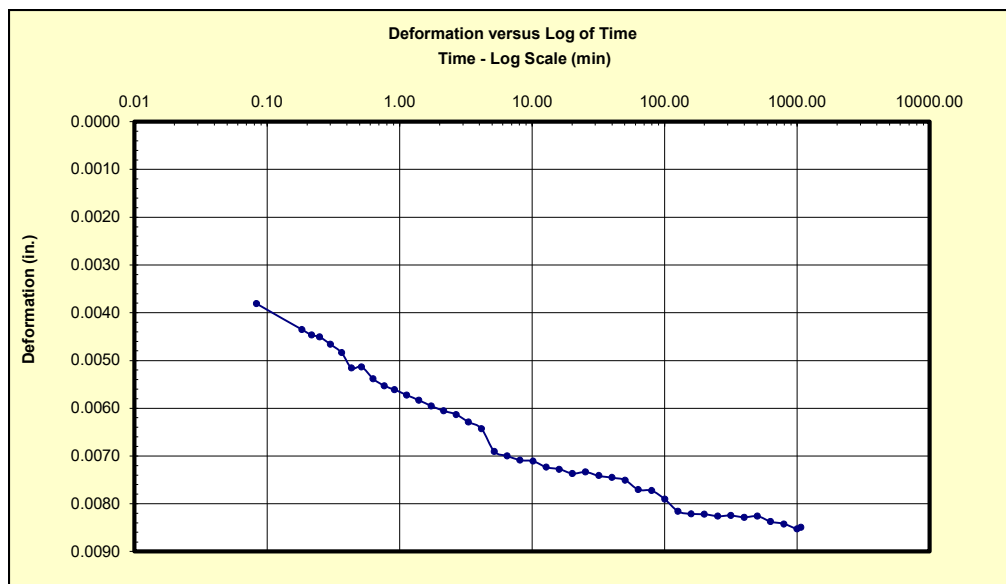
Update

Vertical Stress
400 psf
S100
No match!!!

☒ End of Primary
☐ End of Increment

Project:
L231011

B2
Depth (ft):
32



Scan Data

Step List

ISTEP 31

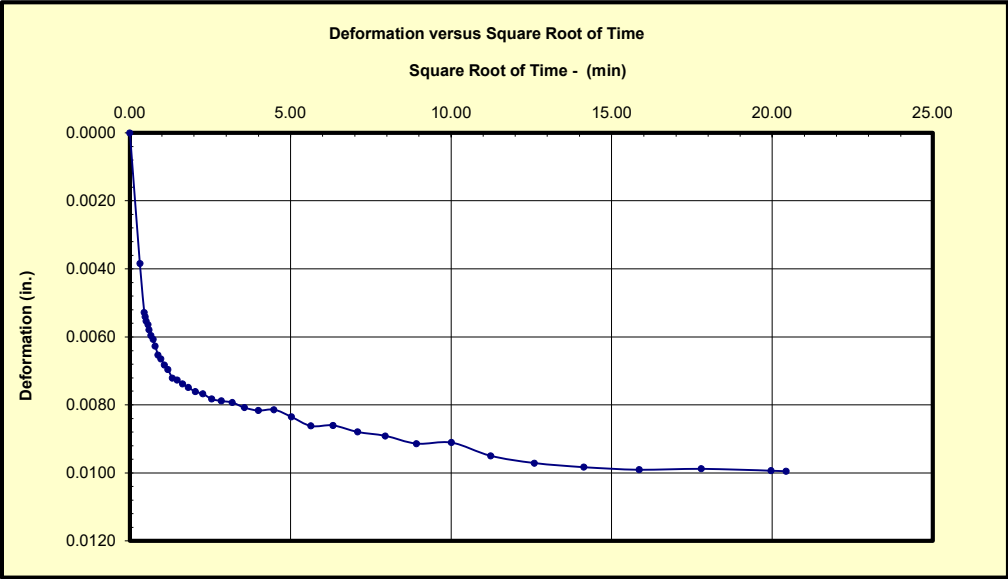
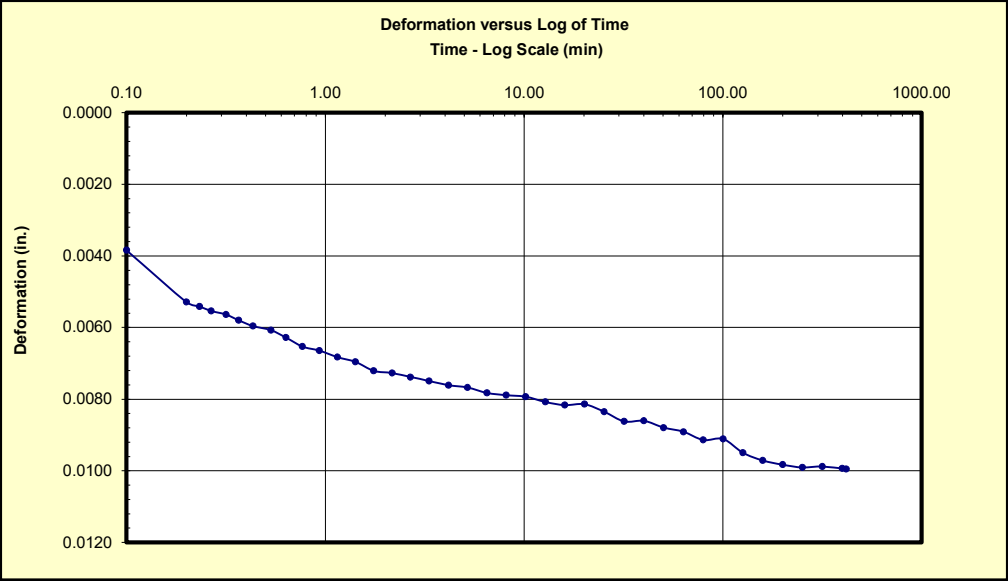
Update

Vertical Stress
800 psf
S100
No match!!!

☒ End of Primary
☐ End of Increment

Project:
L231011

B2
Depth (ft):
32



Scan Data

Step List

ISTEP 41

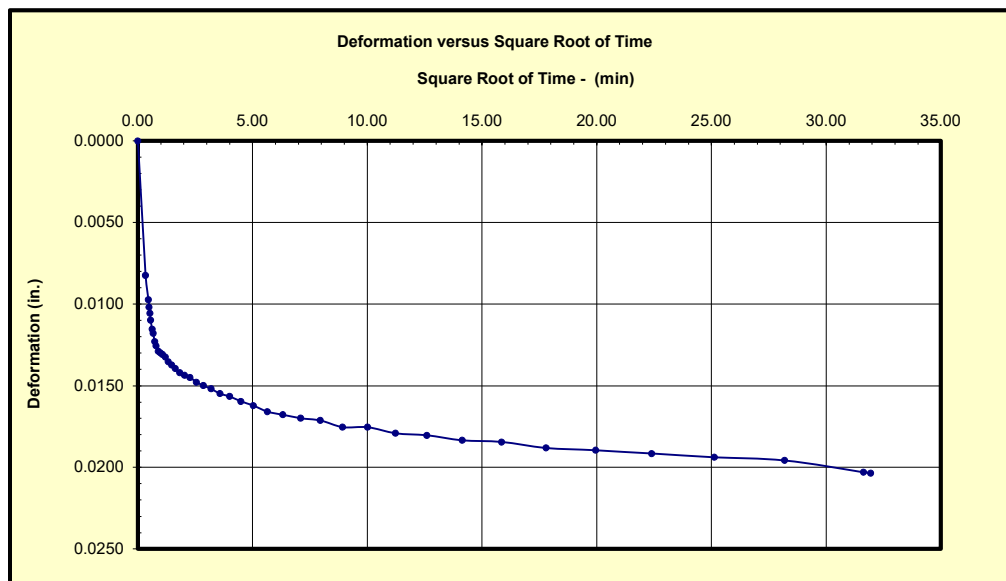
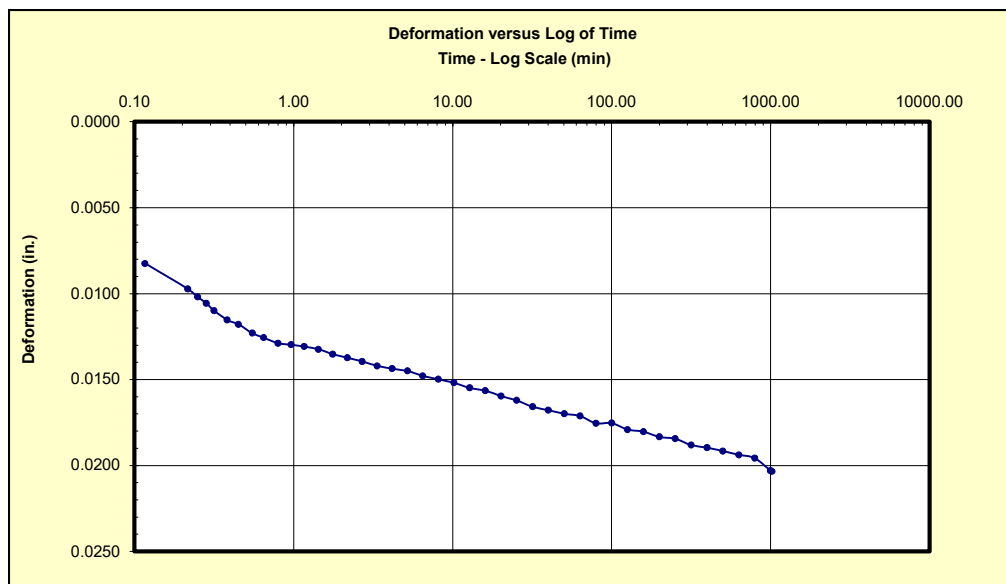
Update

Vertical Stress
1600 psf
S100
No match!!!

☒ End of Primary
☐ End of Increment

Project:
L231011

B2
Depth (ft):
32



Scan Data

Step List

ISTEP 51

Update

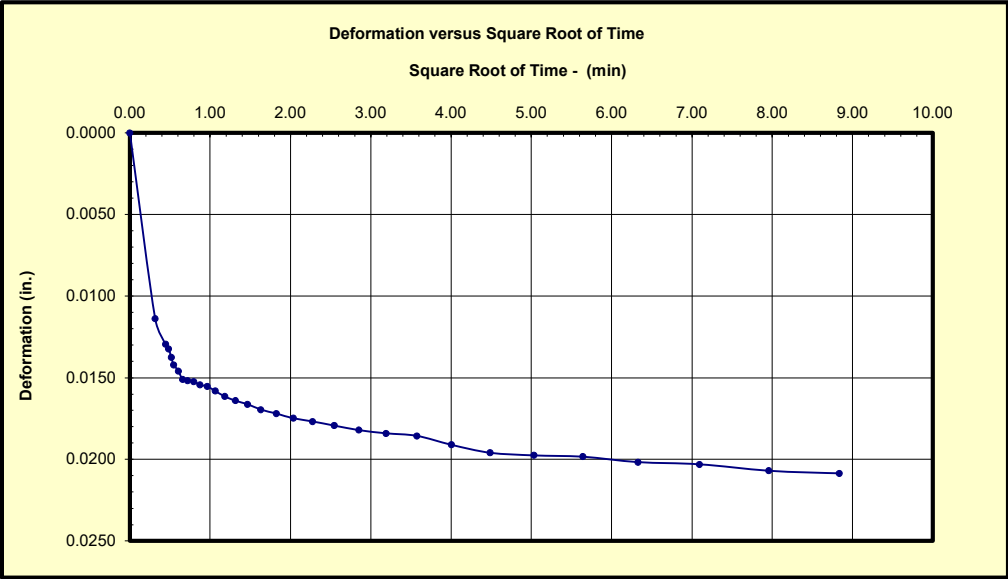
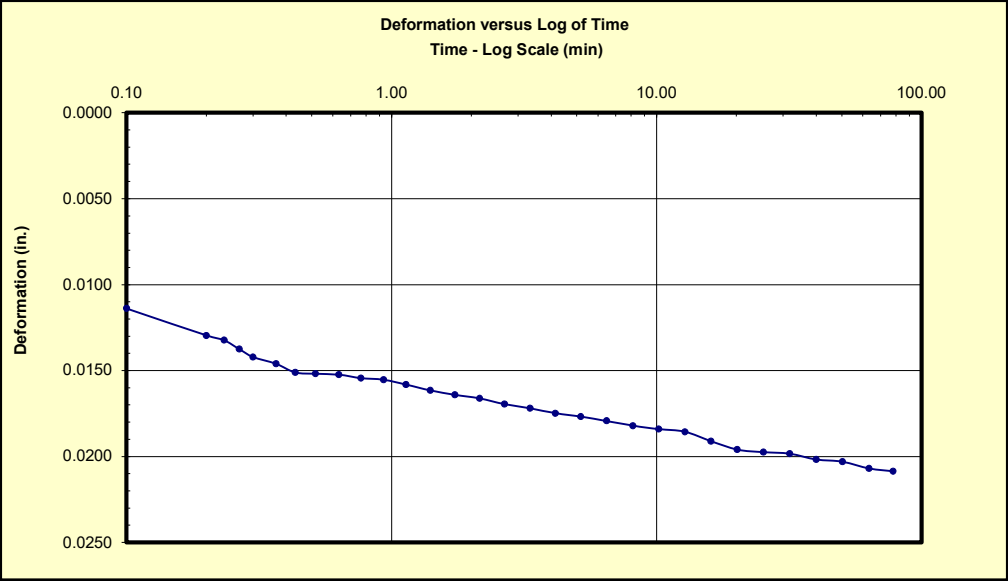
Vertical Stress
3200 psf
S100
No match!!!

☒ End of Primary

☐ End of Increment

Project:
L231011

B2
Depth (ft):
32



Scan Data

Step List

ISTEP 61

Update

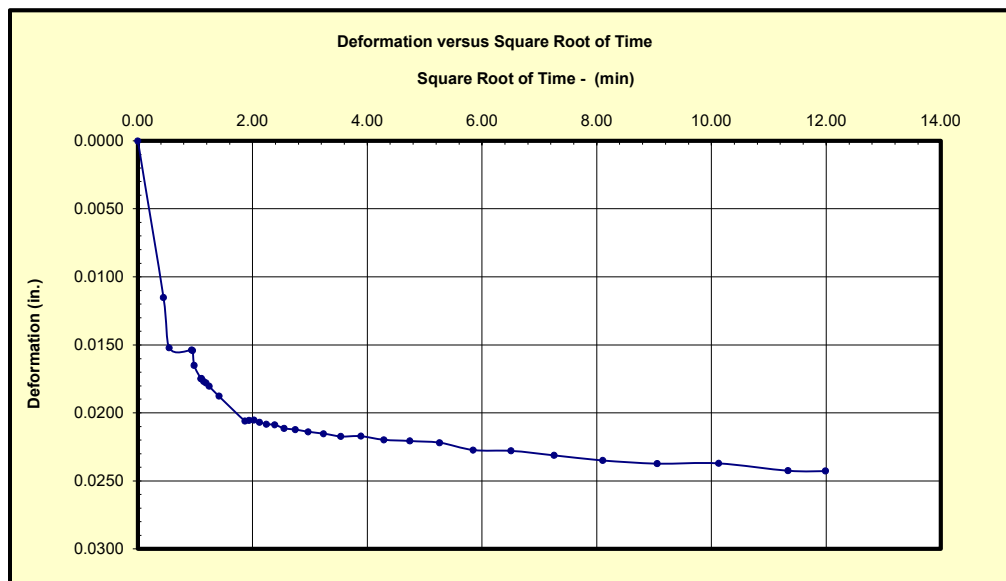
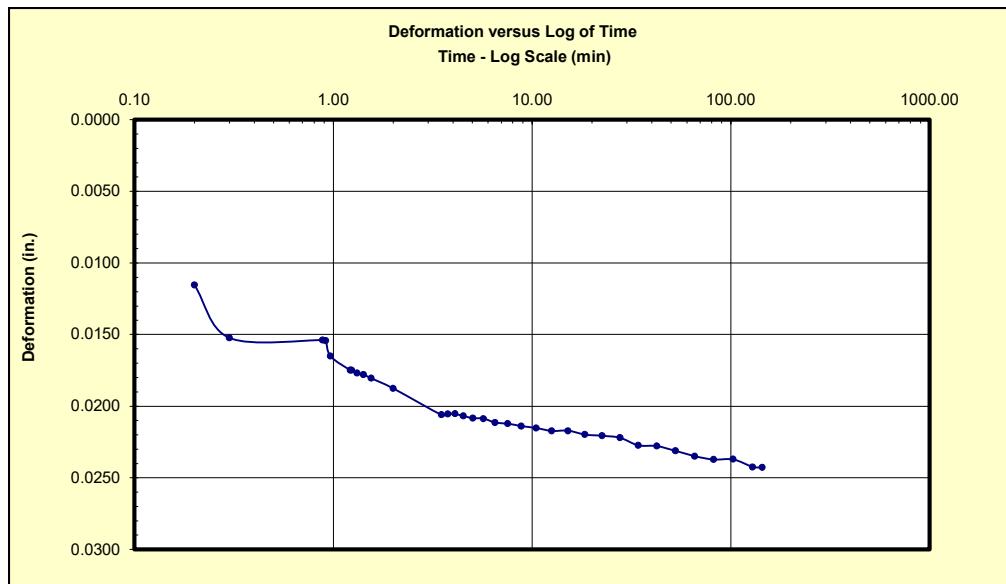
Vertical Stress
6400 psf

S100
No match!!!

- ☒ End of Primary
- ☐ End of Increment

Project:
L231011

B2
Depth (ft):
32



Scan Data

Step List

ISTEP 71

Update

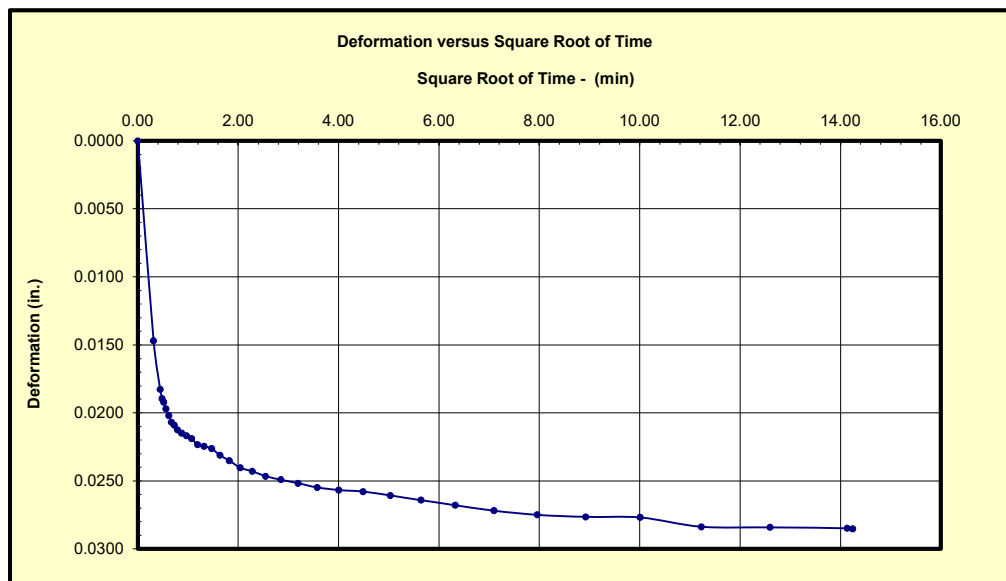
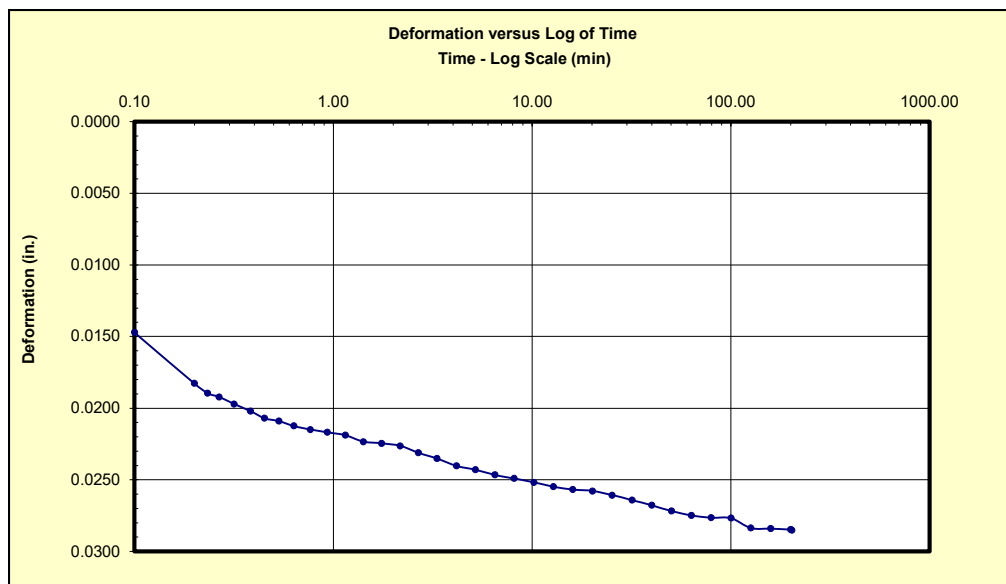
Vertical Stress
12800 psf

S100
No match!!!

- ☒ End of Primary
- ☐ End of Increment

Project:
L231011

B2
Depth (ft):
32



Scan Data

Step List

ISTEP 81

Update

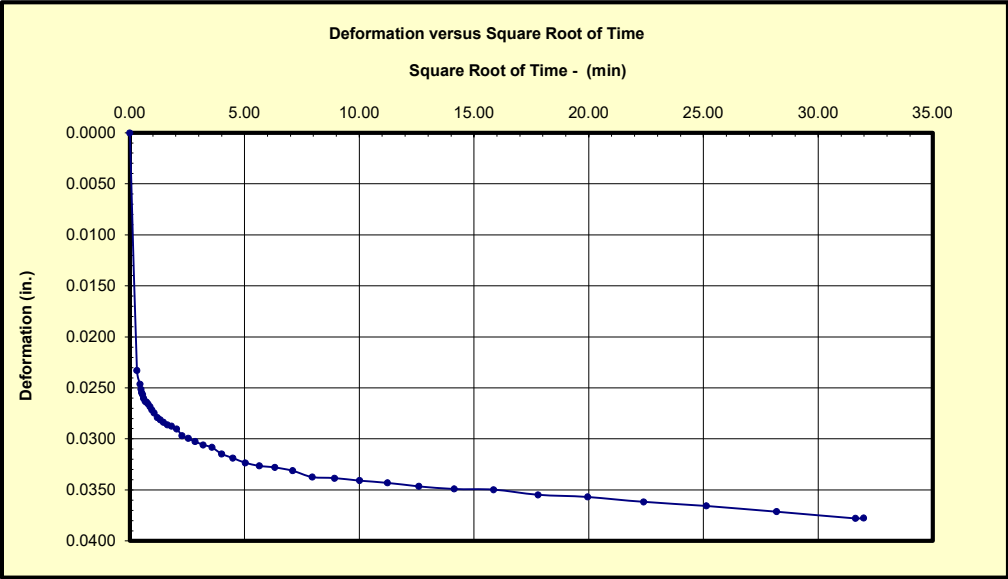
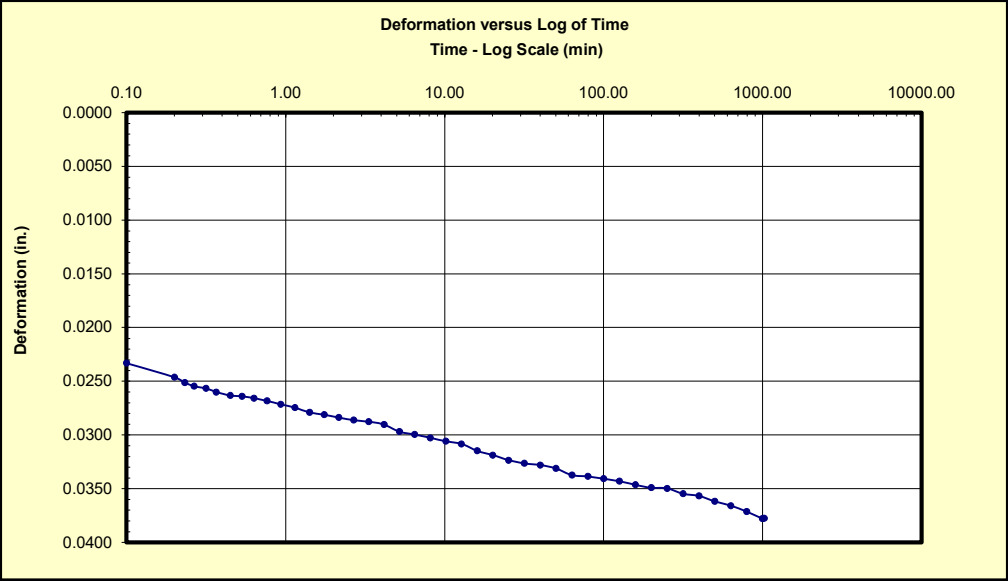
Vertical Stress
25600 psf
S100
No match!!!

☒ End of Primary

☐ End of Increment

Project:
L231011

B2
Depth (ft):
32



Scan Data

Step List

ISTEP 91

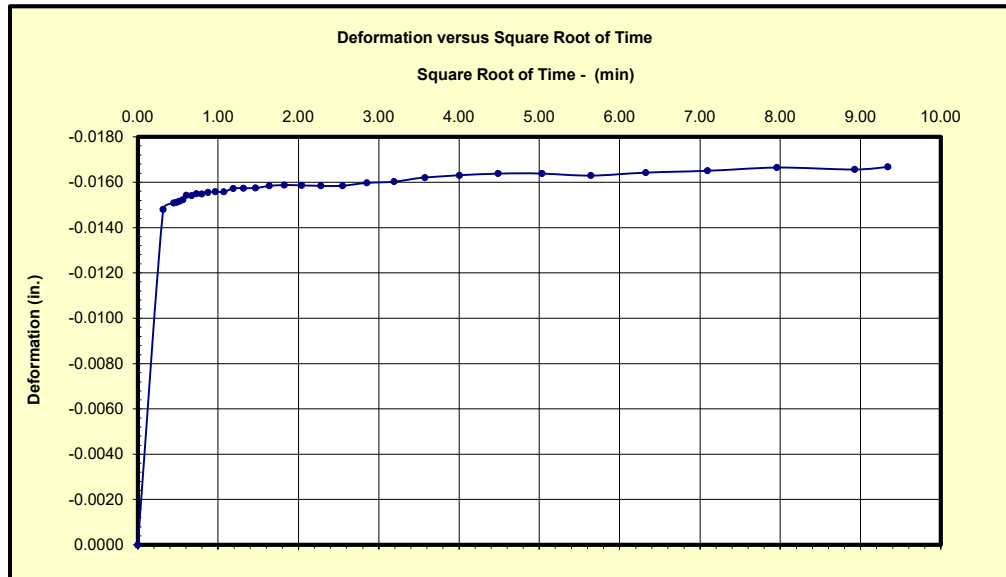
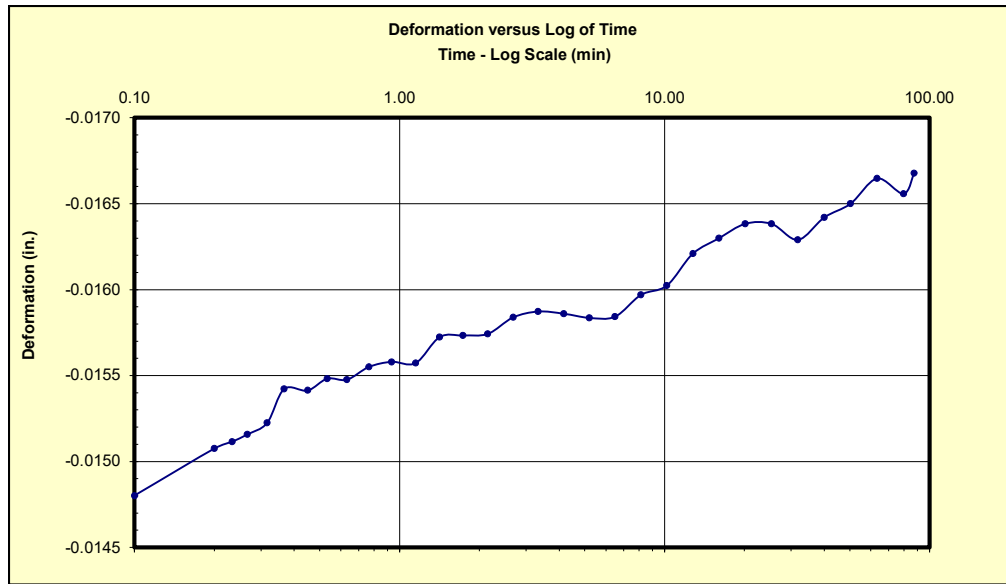
Update

Vertical Stress
51200 psf
S100
No match!!!

☒ End of Primary
☐ End of Increment

Project:
L231011

B2
Depth (ft):
32



Scan Data

Step List

ISTEP 101

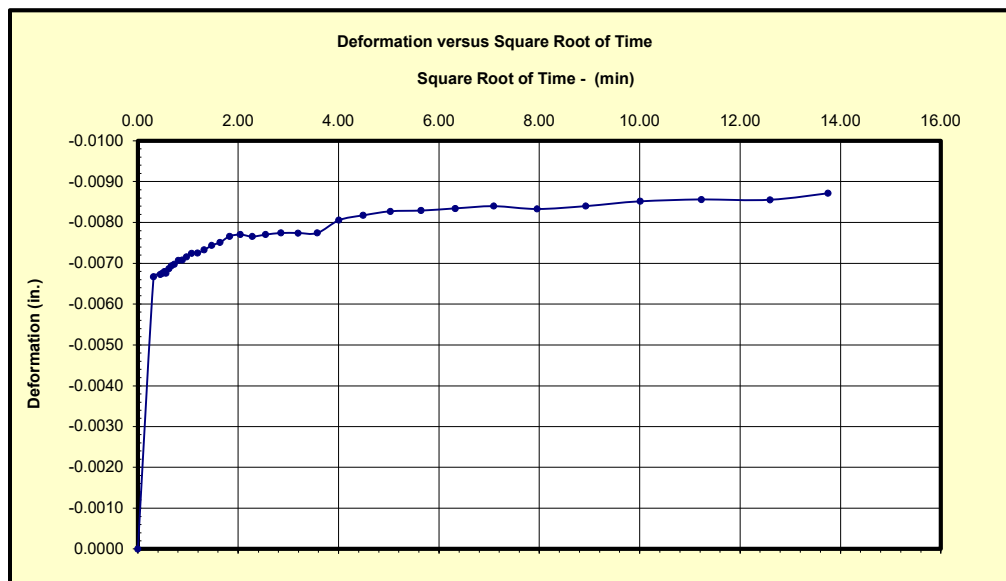
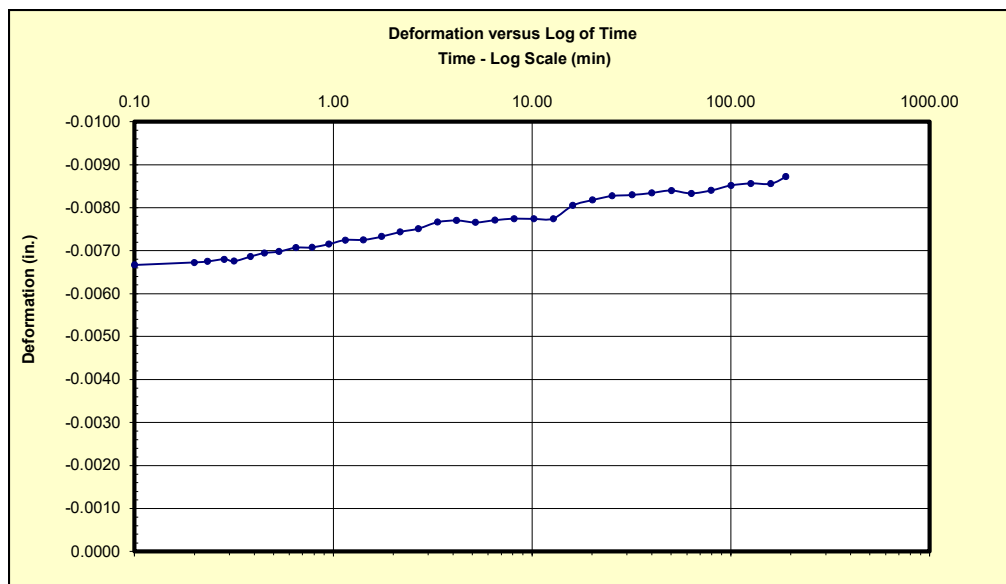
Update

Vertical Stress
6400 psf
S100
No match!!!

☒ End of Primary
☐ End of Increment

Project:
L231011

B2
Depth (ft):
32



Scan Data

Step List

ISTEP 111

Update

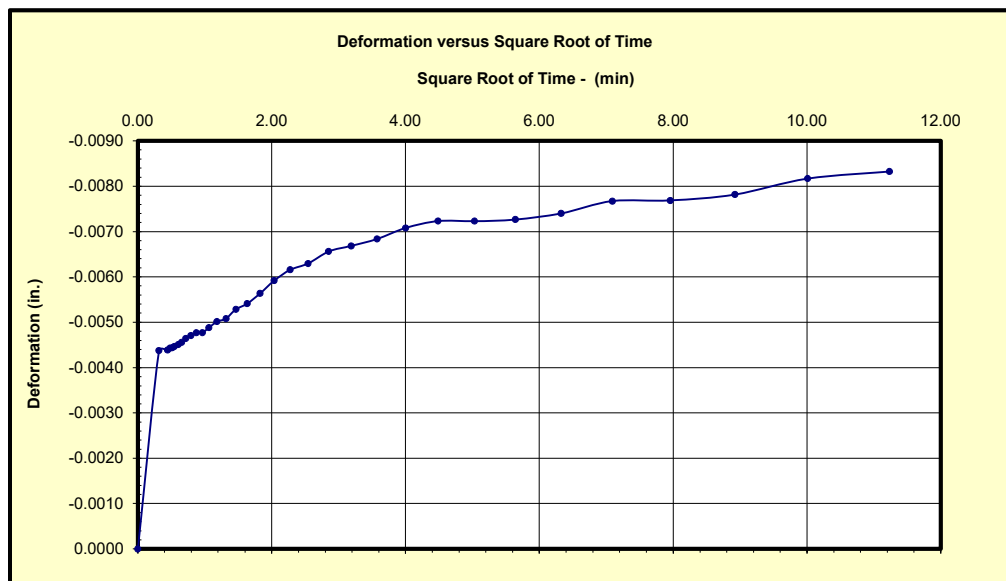
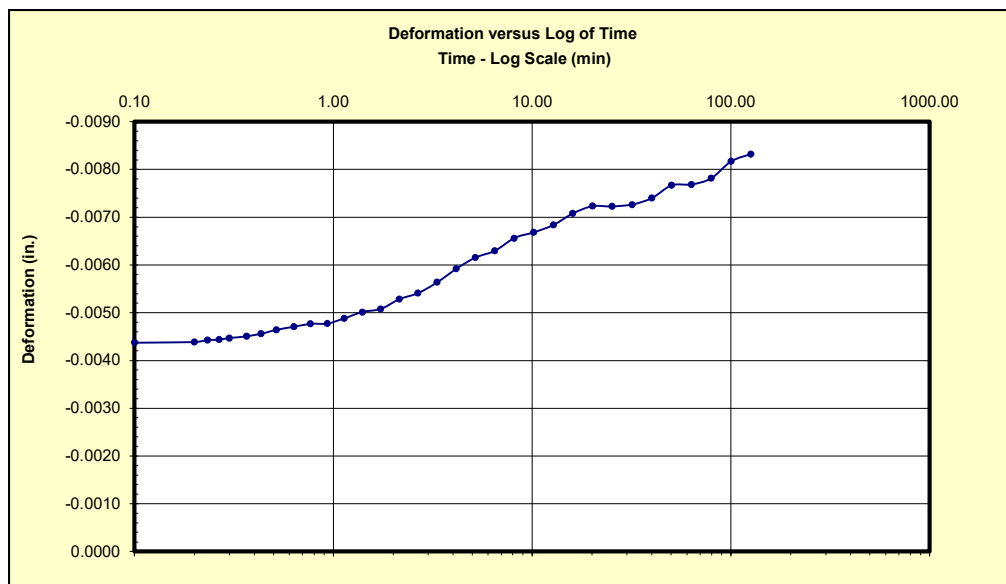
Vertical Stress
1600 psf
S100
No match!!!

☒ End of Primary

☐ End of Increment

Project:
L231011

B2
Depth (ft):
32



Scan Data

Step List

ISTEP 111

Update

Vertical Stress
400 psf
S100
Calculating...

☒ End of Primary

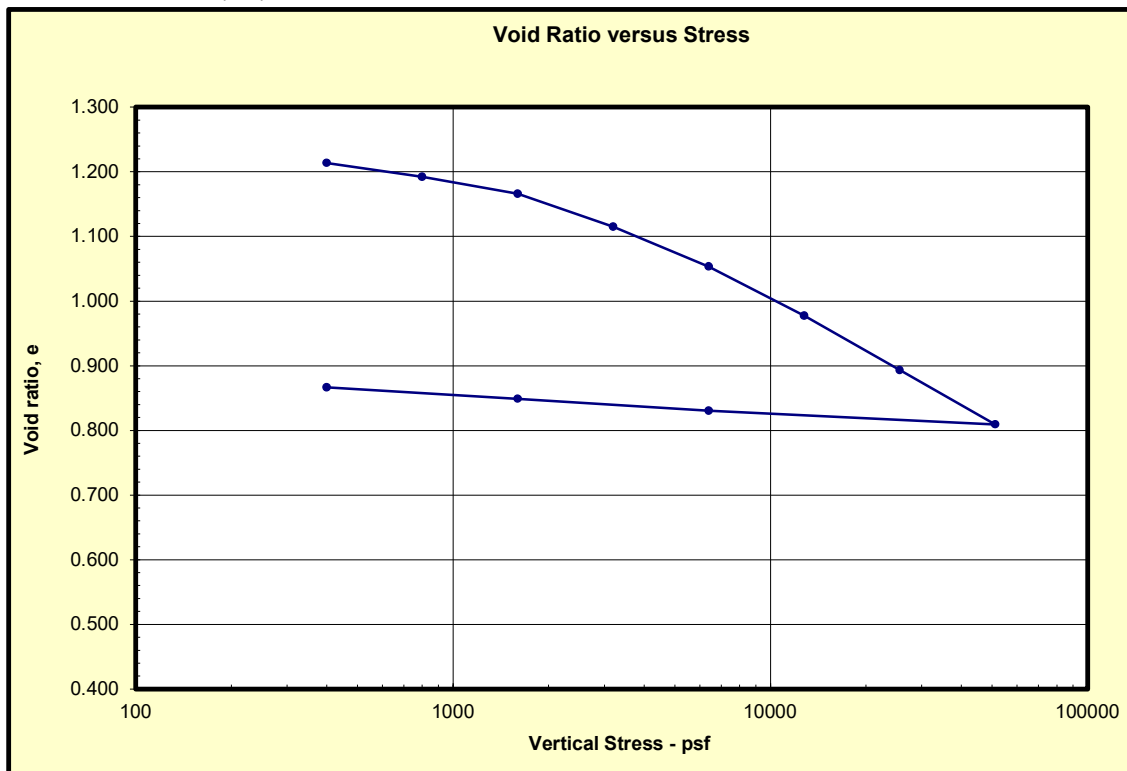
☐ End of Increment

Project:
L231011

B2
Depth (ft):
32

Consolidation Test Results ASTM D-2435

		Load (psf)	H (in)	Consol (%)	Vs	e
Project	L231011	400	0.990	0.6%	0.45	1.21
Boring	B4	800	0.980	1.5%	0.46	1.19
Depth (ft)	32.7	1600	0.968	2.7%	0.46	1.17
Sampled by	Client	3200	0.945	5.0%	0.47	1.12
Sample diameter (in)	2.495	6400	0.918	7.7%	0.49	1.05
Wet density (pcf)	106.6	12800	0.884	11.2%	0.51	0.98
Initial moisture (%)	43.5	25600	0.846	15.0%	0.53	0.89
Initial dry Density (pcf)	74.3	51200	0.809	18.7%	0.55	0.81
Final moisture (%)	33.9	6400	0.818	17.8%	0.55	0.83
Final dry density	90.8	1600	0.826	16.9%	0.54	0.85
Specific gravity (assumed)	2.65	400	0.834	16.2%	0.54	0.87
Initial height, H (in)	0.995					
Volume of solids (Vs)	0.45					
Volume of voids (Vv)	0.55					
Initial void ratio (e ₀)	1.226					
Total consolidation (%)	0.19					
Final Volume of solids (Vs)	0.55					
Minimum void ratio (e _f)	0.81					
Effective stress in-situ (psf)	-					
Pre-consolidation stress (psf)	-					
Over-consolidation ratio, OCR	-					
Saturate sample at (psf)	400					



Time Deformation Readings

400 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.03	0.18	0.0001
0.07	0.26	0.0004
0.10	0.32	0.0008
0.13	0.37	0.0011
0.20	0.45	0.0015
0.27	0.52	0.0018
0.35	0.59	0.0020
0.47	0.68	0.0022
0.60	0.77	0.0025
0.77	0.88	0.0027
0.97	0.98	0.0028
1.23	1.11	0.0029
1.57	1.25	0.0032
1.98	1.41	0.0034
2.50	1.58	0.0034
3.17	1.78	0.0036
3.98	2.00	0.0037
5.02	2.24	0.0038
6.32	2.51	0.0040
7.95	2.82	0.0041
10.02	3.16	0.0042
12.62	3.55	0.0044
15.88	3.99	0.0046
19.98	4.47	0.0047
25.17	5.02	0.0048
31.67	5.63	0.0050
39.87	6.31	0.0051
50.17	7.08	0.0052
63.15	7.95	0.0053
79.50	8.92	0.0056
100.07	10.00	0.0057
125.97	11.22	0.0056
158.57	12.59	0.0058
180.47	13.43	0.0057

800 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.12	0.34	0.0027
0.22	0.47	0.0037
0.25	0.50	0.0039
0.28	0.53	0.0040
0.32	0.56	0.0044
0.38	0.62	0.0045
0.45	0.67	0.0046
0.53	0.73	0.0048
0.65	0.81	0.0049
0.78	0.89	0.0050
0.95	0.97	0.0051
1.15	1.07	0.0053
1.42	1.19	0.0055
1.75	1.32	0.0057
2.17	1.47	0.0061
2.68	1.64	0.0063
3.35	1.83	0.0064
4.17	2.04	0.0065
5.20	2.28	0.0067
6.50	2.55	0.0069
8.15	2.85	0.0071
10.20	3.19	0.0073
12.80	3.58	0.0075
16.07	4.01	0.0075
20.17	4.49	0.0075
25.33	5.03	0.0078
31.85	5.64	0.0082
40.03	6.33	0.0085
50.35	7.10	0.0086
63.33	7.96	0.0086
79.68	8.93	0.0088
100.25	10.01	0.0089
126.15	11.23	0.0088
158.77	12.60	0.0089
199.80	14.14	0.0090
251.47	15.86	0.0089
316.50	17.79	0.0088
398.40	19.96	0.0089
501.48	22.39	0.0089
631.27	25.13	0.0090
794.63	28.19	0.0093
1000.32	31.63	0.0106
1259.27	35.49	0.0108
1297.117	36.01551	0.01087

1600 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0038
0.20	0.45	0.0043
0.23	0.48	0.0045
0.28	0.53	0.0047
0.32	0.56	0.0048
0.38	0.62	0.0049
0.45	0.67	0.0052
0.53	0.73	0.0055
0.65	0.81	0.0057
0.78	0.89	0.0058
0.95	0.97	0.0060
1.15	1.07	0.0063
1.42	1.19	0.0067
1.75	1.32	0.0069
2.17	1.47	0.0072
2.68	1.64	0.0074
3.35	1.83	0.0076
4.17	2.04	0.0077
5.22	2.28	0.0079
6.52	2.55	0.0079
8.15	2.85	0.0081
10.22	3.20	0.0083
12.80	3.58	0.0085
16.07	4.01	0.0086
20.18	4.49	0.0087
25.35	5.03	0.0089
31.85	5.64	0.0091
40.03	6.33	0.0093
50.35	7.10	0.0094
63.33	7.96	0.0096
79.68	8.93	0.0098
100.25	10.01	0.0100
126.15	11.23	0.0102
158.75	12.60	0.0106
199.80	14.14	0.0110
251.45	15.86	0.0112
316.50	17.79	0.0116
398.38	19.96	0.0115
501.48	22.39	0.0115
631.25	25.12	0.0119
794.63	28.19	0.0122
1000.32	31.63	0.0126
1205.63	34.72	0.0127

Time Deformation Readings

3200 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0092
0.28	0.53	0.0102
0.30	0.55	0.0102
0.33	0.58	0.0101
0.37	0.61	0.0105
0.43	0.66	0.0109
0.50	0.71	0.0111
0.60	0.77	0.0114
0.70	0.84	0.0116
0.83	0.91	0.0119
1.00	1.00	0.0124
1.22	1.10	0.0129
1.50	1.22	0.0133
1.80	1.34	0.0138
2.22	1.49	0.0143
2.73	1.65	0.0147
3.38	1.84	0.0149
4.20	2.05	0.0151
5.23	2.29	0.0154
6.53	2.56	0.0159
8.17	2.86	0.0163
10.23	3.20	0.0166
12.82	3.58	0.0168
16.08	4.01	0.0170
20.20	4.49	0.0171
25.37	5.04	0.0174
31.87	5.65	0.0177
40.07	6.33	0.0179
50.38	7.10	0.0186
63.37	7.96	0.0189
79.70	8.93	0.0197
100.28	10.01	0.0199
126.18	11.23	0.0202
158.78	12.60	0.0206
199.83	14.14	0.0208
251.50	15.86	0.0210
316.53	17.79	0.0213
398.43	19.96	0.0220
501.50	22.39	0.0226
631.28	25.13	0.0226
794.67	28.19	0.0229
1000.35	31.63	0.0232
1259.28	35.49	0.0234
1440.367	37.95216	0.02389

6400 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0060
0.20	0.45	0.0080
0.23	0.48	0.0086
0.27	0.52	0.0092
0.30	0.55	0.0100
0.37	0.61	0.0110
0.43	0.66	0.0113
0.52	0.72	0.0115
0.63	0.80	0.0117
0.77	0.88	0.0122
0.93	0.97	0.0131
1.13	1.06	0.0139
1.40	1.18	0.0144
1.73	1.32	0.0151
2.15	1.47	0.0157
2.67	1.63	0.0164
3.33	1.83	0.0168
4.15	2.04	0.0174
5.20	2.28	0.0180
6.50	2.55	0.0184
8.13	2.85	0.0188
10.20	3.19	0.0192
12.78	3.58	0.0196
16.05	4.01	0.0199
20.17	4.49	0.0203
25.33	5.03	0.0208
31.85	5.64	0.0215
40.03	6.33	0.0223
50.35	7.10	0.0229
63.33	7.96	0.0234
79.68	8.93	0.0240
100.25	10.01	0.0244
126.13	11.23	0.0248
158.73	12.60	0.0255
199.77	14.13	0.0262
251.45	15.86	0.0266
316.50	17.79	0.0274
398.38	19.96	0.0284
501.47	22.39	0.0287
631.25	25.12	0.0289
794.63	28.19	0.0290
1000.30	31.63	0.0293
1259.23	35.49	0.0298
1440	37.94733	0.030245

12800 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0099
0.20	0.45	0.0118
0.23	0.48	0.0121
0.27	0.52	0.0124
0.30	0.55	0.0131
0.35	0.59	0.0135
0.43	0.66	0.0143
0.52	0.72	0.0150
0.62	0.79	0.0159
0.75	0.87	0.0170
0.92	0.96	0.0177
1.13	1.06	0.0182
1.40	1.18	0.0190
1.73	1.32	0.0203
2.15	1.47	0.0211
2.67	1.63	0.0216
3.32	1.82	0.0221
4.15	2.04	0.0227
5.18	2.28	0.0235
6.48	2.55	0.0241
8.12	2.85	0.0246
10.18	3.19	0.0252
12.77	3.57	0.0259
16.03	4.00	0.0263
20.15	4.49	0.0271
25.32	5.03	0.0276
31.83	5.64	0.0280
40.02	6.33	0.0286
50.33	7.09	0.0293
63.32	7.96	0.0297
79.67	8.93	0.0303
100.23	10.01	0.0305
126.13	11.23	0.0312
158.73	12.60	0.0320
199.77	14.13	0.0327
251.43	15.86	0.0331
316.48	17.79	0.0336
398.37	19.96	0.0344
501.45	22.39	0.0353
631.23	25.12	0.0357
794.62	28.19	0.0363
1000.30	31.63	0.0366
1259.23	35.49	0.0370
1440.333	37.95172	0.037172

Time Deformation Readings

25600 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0096
0.20	0.45	0.0121
0.23	0.48	0.0128
0.27	0.52	0.0135
0.30	0.55	0.0142
0.37	0.61	0.0153
0.43	0.66	0.0160
0.52	0.72	0.0174
0.63	0.80	0.0185
0.77	0.88	0.0193
0.93	0.97	0.0200
1.13	1.06	0.0209
1.40	1.18	0.0220
1.73	1.32	0.0232
2.15	1.47	0.0242
2.67	1.63	0.0247
3.33	1.83	0.0252
4.15	2.04	0.0262
5.20	2.28	0.0275
6.50	2.55	0.0280
8.13	2.85	0.0285
10.18	3.19	0.0288
12.78	3.58	0.0292
16.05	4.01	0.0298
20.17	4.49	0.0301
25.33	5.03	0.0304
31.83	5.64	0.0315
40.03	6.33	0.0324
50.35	7.10	0.0333
63.33	7.96	0.0337
79.67	8.93	0.0343
100.25	10.01	0.0348
126.15	11.23	0.0352
158.75	12.60	0.0357
199.80	14.14	0.0362
251.47	15.86	0.0367
316.52	17.79	0.0374
398.40	19.96	0.0383
501.48	22.39	0.0388
631.25	25.12	0.0393
794.63	28.19	0.0396
1000.32	31.63	0.0398
1259.25	35.49	0.0403
1439.483	37.94052	0.040857

51200 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.12	0.34	0.0141
0.22	0.47	0.0168
0.25	0.50	0.0179
0.28	0.53	0.0185
0.32	0.56	0.0198
0.38	0.62	0.0207
0.45	0.67	0.0217
0.53	0.73	0.0224
0.65	0.81	0.0233
0.78	0.89	0.0243
0.95	0.97	0.0250
1.15	1.07	0.0261
1.42	1.19	0.0267
1.75	1.32	0.0274
2.17	1.47	0.0283
2.68	1.64	0.0291
3.35	1.83	0.0299
4.17	2.04	0.0305
5.20	2.28	0.0311
6.50	2.55	0.0315
8.13	2.85	0.0321
10.20	3.19	0.0326
12.78	3.58	0.0335
16.05	4.01	0.0341
20.17	4.49	0.0346
25.33	5.03	0.0350
31.83	5.64	0.0356
40.03	6.33	0.0360
50.33	7.09	0.0366
63.32	7.96	0.0370
79.67	8.93	0.0378
100.23	10.01	0.0383
126.13	11.23	0.0387
158.73	12.60	0.0396
199.77	14.13	0.0399
251.43	15.86	0.0403
316.48	17.79	0.0412
398.37	19.96	0.0416
501.47	22.39	0.0423
631.23	25.12	0.0424
794.62	28.19	0.0429
1000.30	31.63	0.0431
1259.25	35.49	0.0442
1440.317	37.9515	0.044568

6400 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	-0.0155
0.20	0.45	-0.0160
0.23	0.48	-0.0161
0.27	0.52	-0.0163
0.32	0.56	-0.0166
0.37	0.61	-0.0167
0.43	0.66	-0.0169
0.52	0.72	-0.0171
0.63	0.80	-0.0173
0.77	0.88	-0.0175
0.93	0.97	-0.0177
1.13	1.06	-0.0179
1.42	1.19	-0.0180
1.75	1.32	-0.0182
2.17	1.47	-0.0182
2.68	1.64	-0.0183
3.33	1.83	-0.0184
4.17	2.04	-0.0184
5.20	2.28	-0.0185
6.50	2.55	-0.0187
8.13	2.85	-0.0187
10.20	3.19	-0.0187
12.78	3.58	-0.0187
16.05	4.01	-0.0188
20.17	4.49	-0.0188
25.33	5.03	-0.0188
31.83	5.64	-0.0189
40.03	6.33	-0.0189
50.33	7.09	-0.0192
63.32	7.96	-0.0191
79.65	8.92	-0.0194
100.22	10.01	-0.0195
126.12	11.23	-0.0195
158.73	12.60	-0.0195
199.77	14.13	-0.0196
251.43	15.86	-0.0197
316.48	17.79	-0.0197
398.37	19.96	-0.0199
501.45	22.39	-0.0200
631.23	25.12	-0.0202
794.62	28.19	-0.0202
1000.28	31.63	-0.0204
1259.23	35.49	-0.0205
1440.283	37.95106	-0.02055

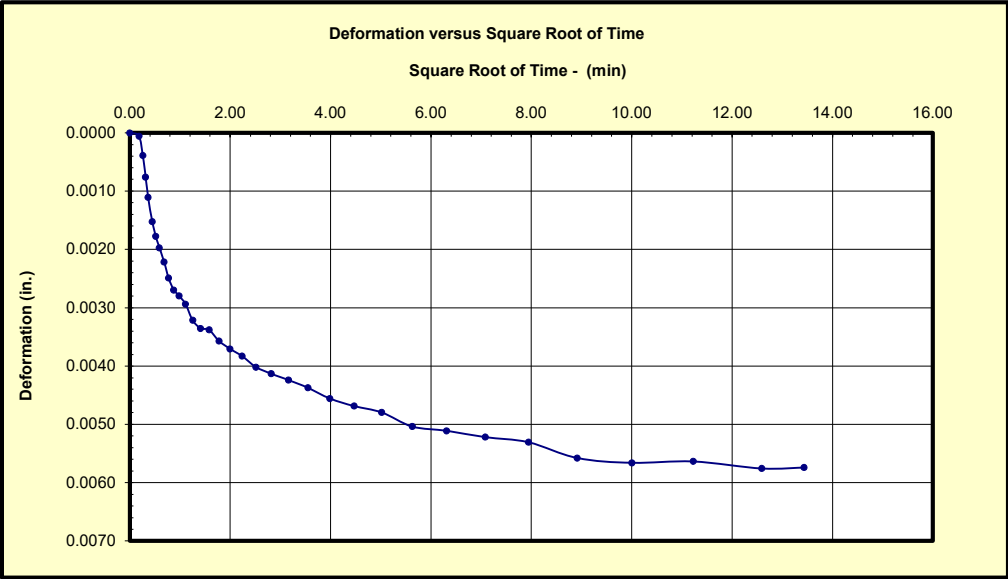
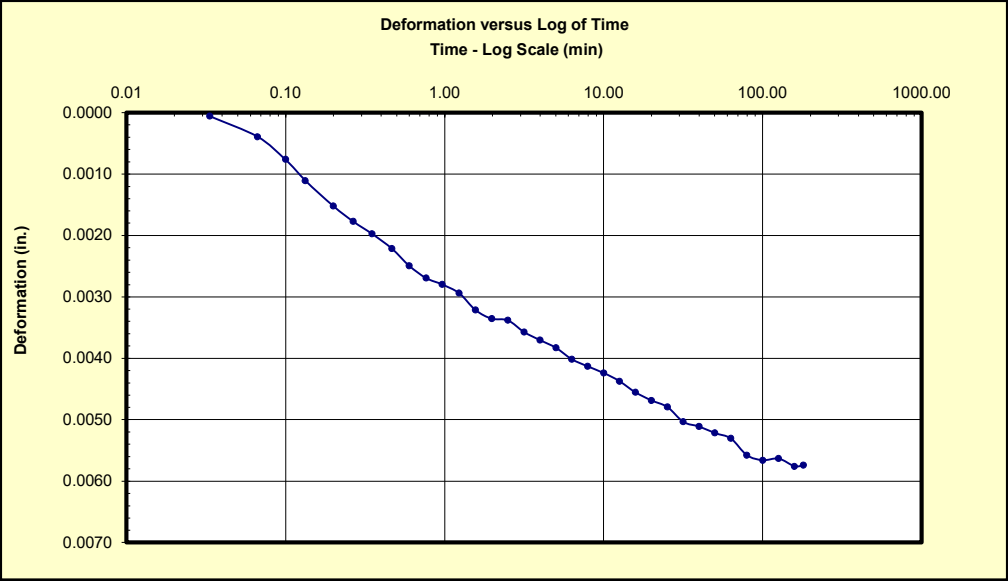
Time Deformation Readings

1600 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	-0.0039
0.20	0.45	-0.0048
0.23	0.48	-0.0049
0.27	0.52	-0.0054
0.30	0.55	-0.0055
0.37	0.61	-0.0057
0.43	0.66	-0.0059
0.52	0.72	-0.0060
0.63	0.80	-0.0062
0.77	0.88	-0.0064
0.93	0.97	-0.0066
1.13	1.06	-0.0071
1.40	1.18	-0.0074
1.73	1.32	-0.0075
2.15	1.47	-0.0078
2.67	1.63	-0.0079
3.33	1.83	-0.0080
4.15	2.04	-0.0081
5.18	2.28	-0.0082
6.48	2.55	-0.0083
8.13	2.85	-0.0083
10.18	3.19	-0.0084
12.78	3.58	-0.0084
16.05	4.01	-0.0085
20.15	4.49	-0.0087
25.32	5.03	-0.0088
31.83	5.64	-0.0088
40.02	6.33	-0.0090
50.33	7.09	-0.0093
63.32	7.96	-0.0094
79.67	8.93	-0.0095
100.23	10.01	-0.0097
126.13	11.23	-0.0103
158.73	12.60	-0.0105
199.78	14.13	-0.0107
251.45	15.86	-0.0109
316.50	17.79	-0.0114
398.38	19.96	-0.0117
501.47	22.39	-0.0118
631.25	25.12	-0.0119
794.63	28.19	-0.0121
1000.32	31.63	-0.0124
1259.25	35.49	-0.0124
1440.233	37.95041	-0.01258

400 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	-0.0029
0.20	0.45	-0.0023
0.23	0.48	-0.0023
0.27	0.52	-0.0023
0.30	0.55	-0.0023
0.37	0.61	-0.0024
0.43	0.66	-0.0026
0.52	0.72	-0.0027
0.62	0.79	-0.0029
0.75	0.87	-0.0031
0.92	0.96	-0.0032
1.13	1.06	-0.0033
1.40	1.18	-0.0034
1.73	1.32	-0.0035
2.15	1.47	-0.0037
2.67	1.63	-0.0039
3.32	1.82	-0.0042
4.13	2.03	-0.0043
5.17	2.27	-0.0045
6.47	2.54	-0.0048
8.12	2.85	-0.0050
10.17	3.19	-0.0052
12.77	3.57	-0.0055
16.03	4.00	-0.0058
20.13	4.49	-0.0060
25.32	5.03	-0.0063
31.82	5.64	-0.0066
40.02	6.33	-0.0076
50.32	7.09	-0.0079
63.30	7.96	-0.0083
79.65	8.92	-0.0083
100.22	10.01	-0.0085
126.12	11.23	-0.0086
158.72	12.60	-0.0090
199.77	14.13	-0.0092
251.43	15.86	-0.0094
316.47	17.79	-0.0095



Scan Data

Step List

ISTEP 21

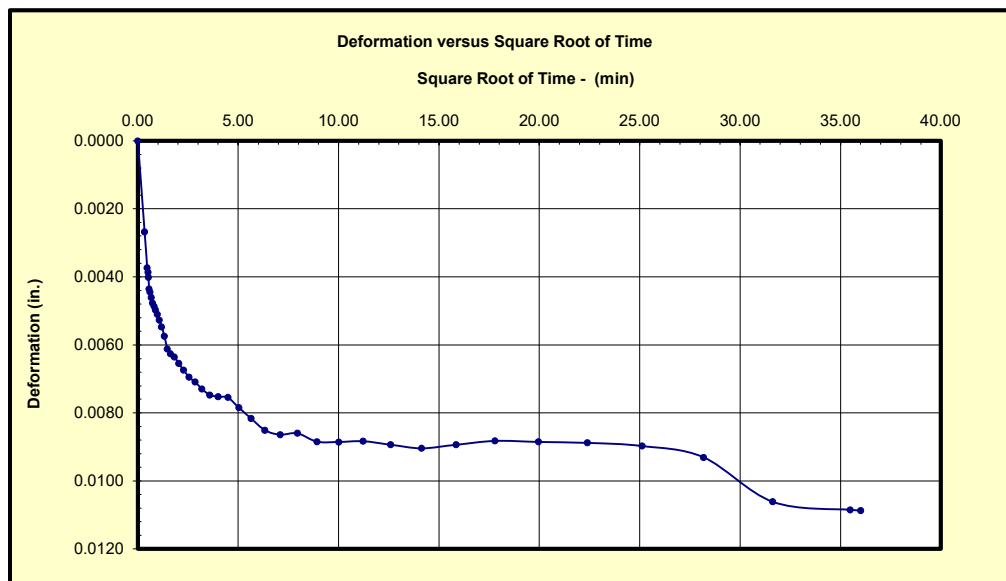
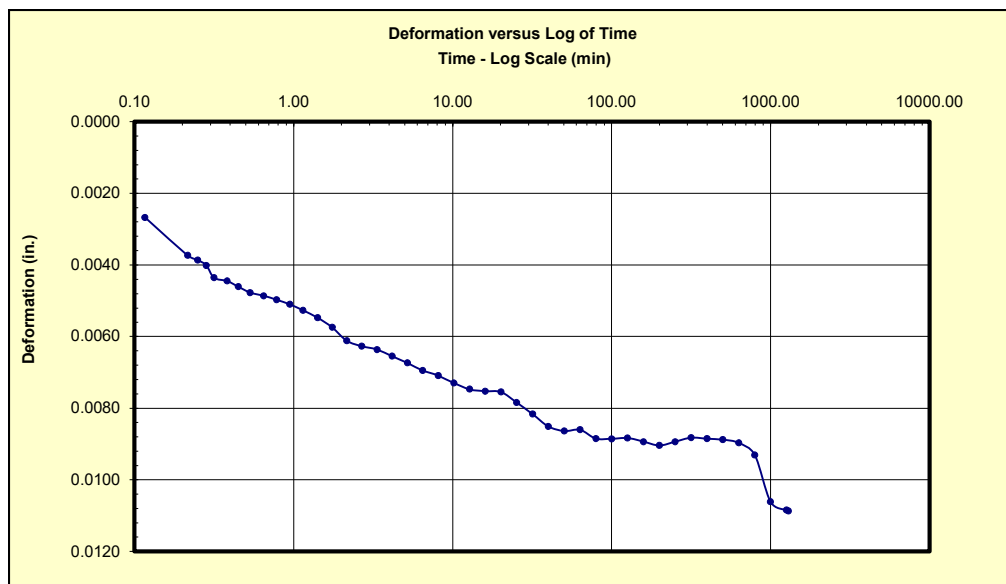
Update

Vertical Stress
400 psf
S100
No match!!!

☒ End of Primary
☐ End of Increment

Project:
L231011

B4
Depth (ft):
32.7



Scan Data

Step List

ISTEP 31

Update

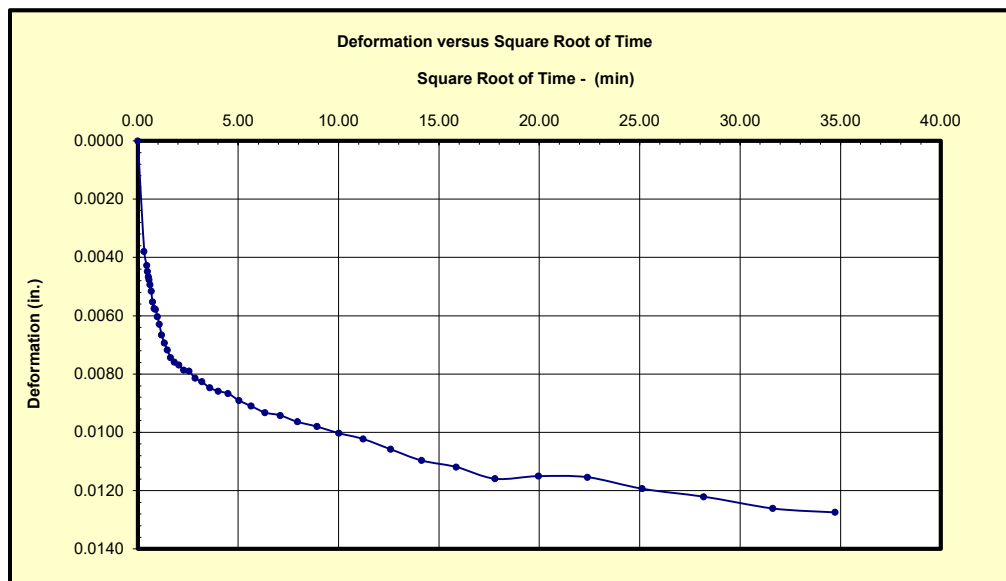
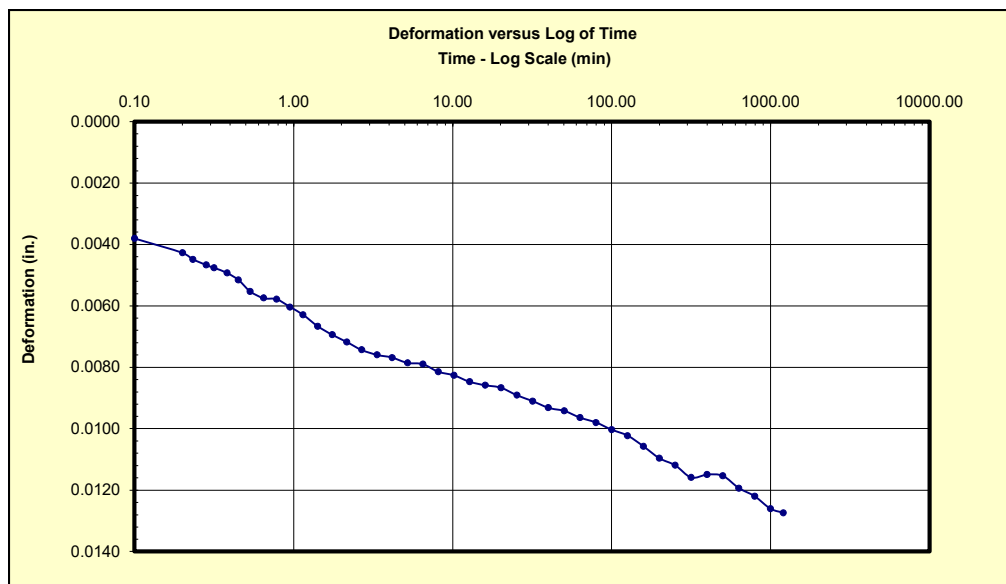
Vertical Stress
800 psf
S100
No match!!!

☒ End of Primary

☐ End of Increment

Project:
L231011

B4
Depth (ft):
32.7



Scan Data

Step List

ISTEP 41

Update

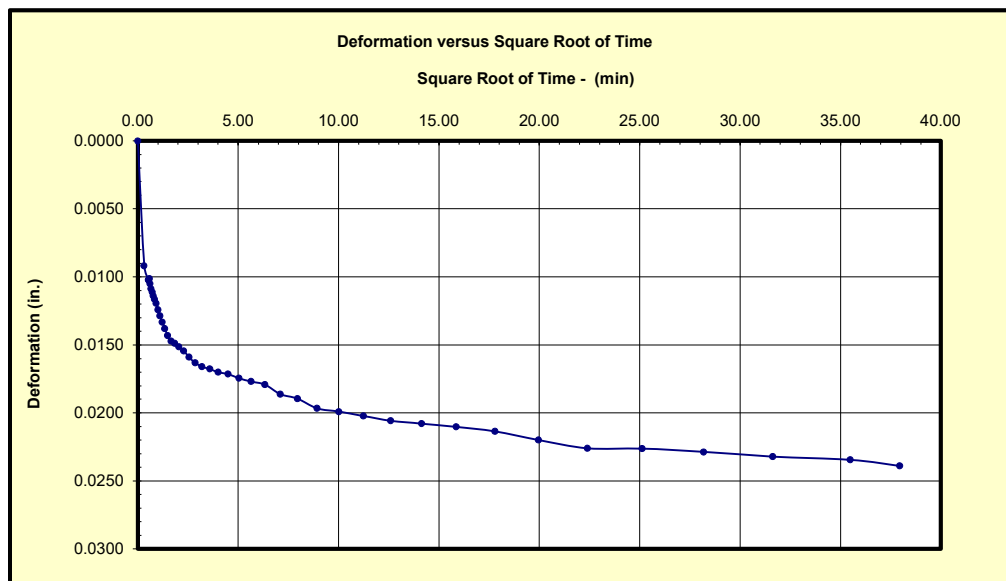
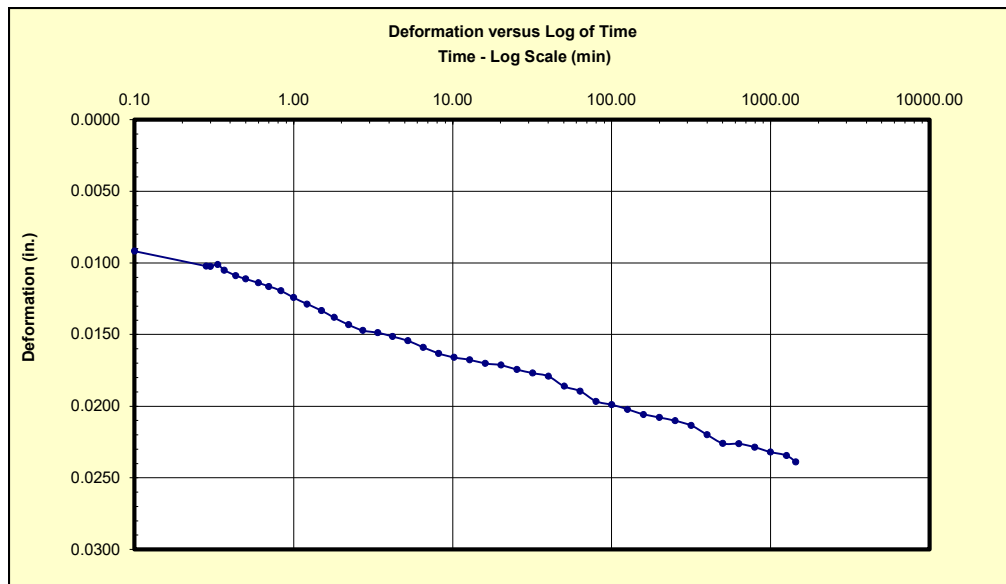
Vertical Stress
1600 psf
S100
No match!!!

☒ End of Primary

☐ End of Increment

Project:
L231011

B4
Depth (ft):
32.7



Scan Data

Step List

ISTEP 51

Update

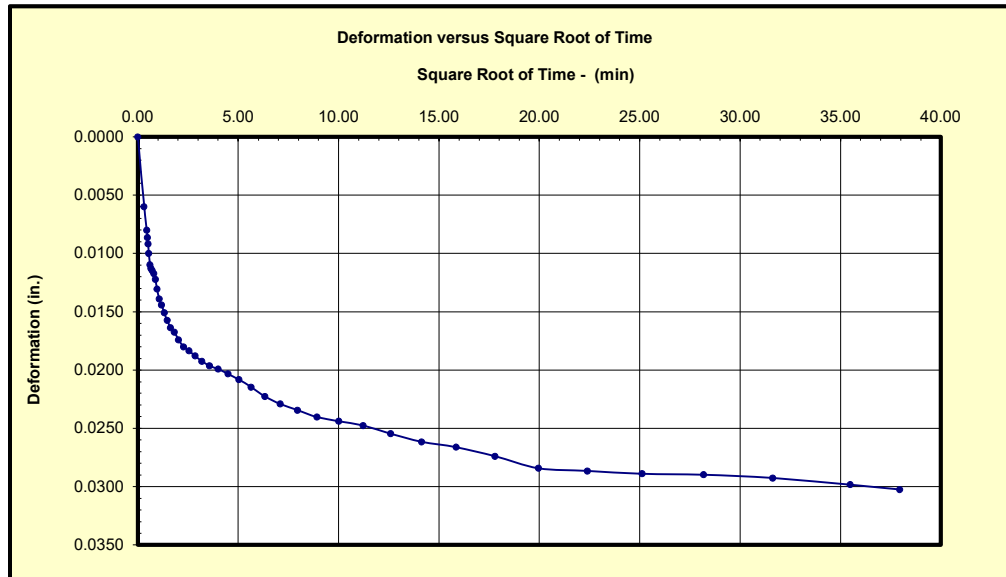
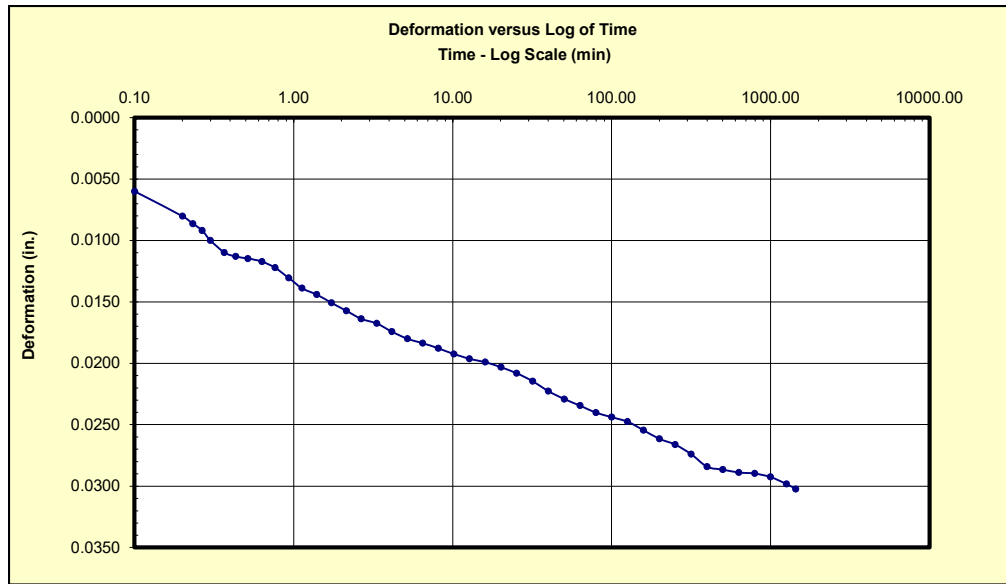
Vertical Stress
3200 psf

S100
No match!!!

☒ End of Primary
☐ End of Increment

Project:
L231011

B4
Depth (ft):
32.7



Scan Data

Step List

ISTEP 61

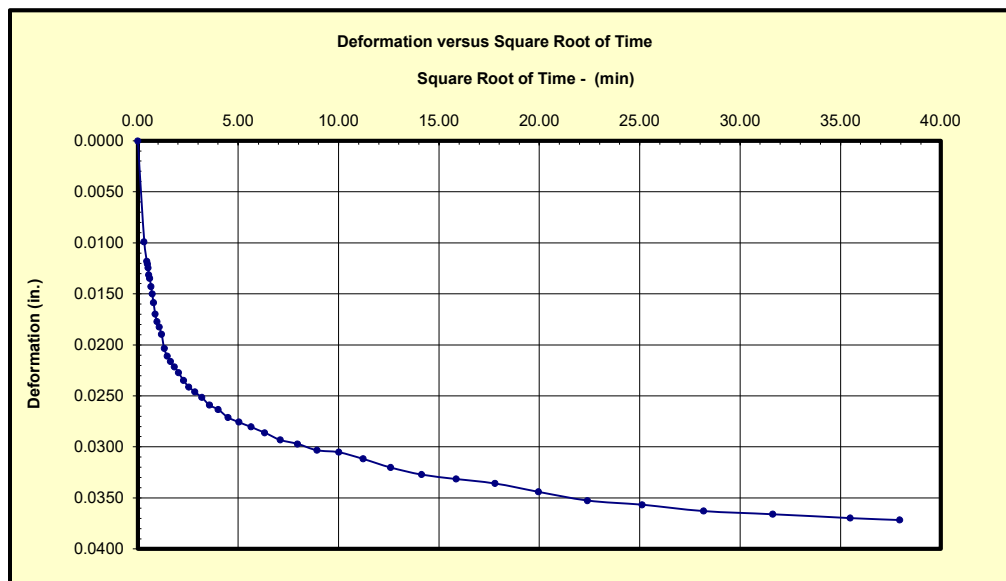
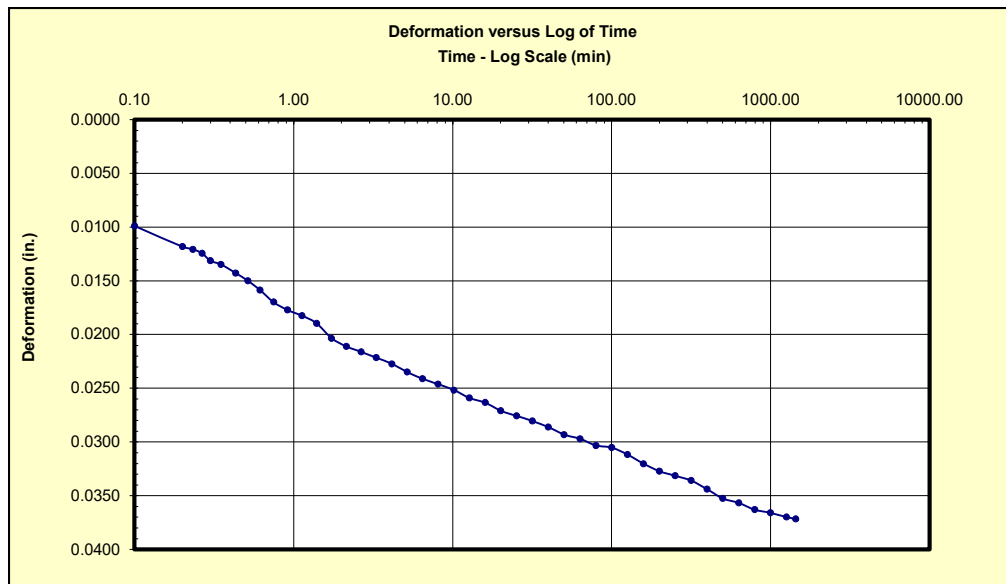
Update

Vertical Stress
6400 psf
S100
No match!!!

☒ End of Primary
☐ End of Increment

Project:
L231011

B4
Depth (ft):
32.7



Scan Data

Step List

ISTEP 71

Update

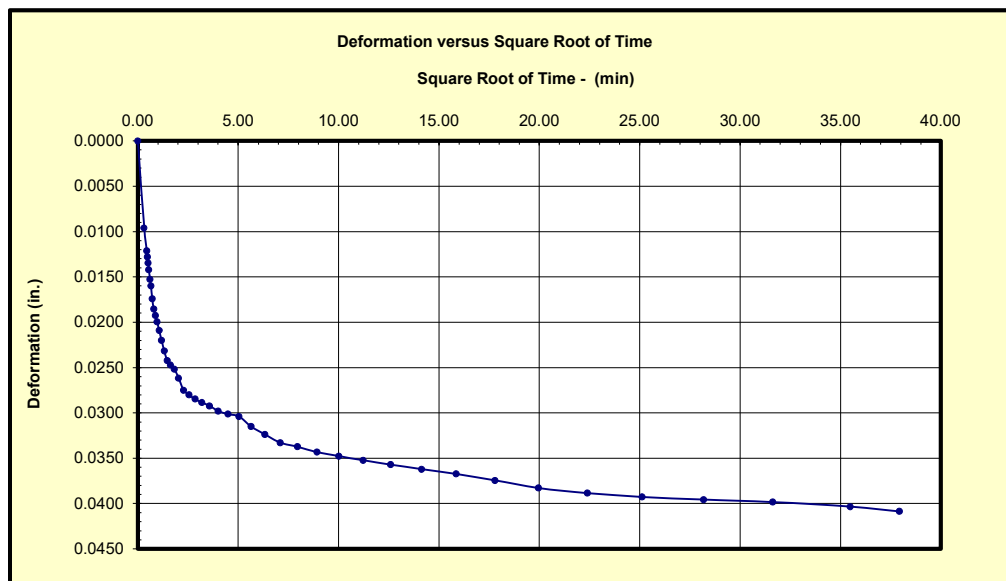
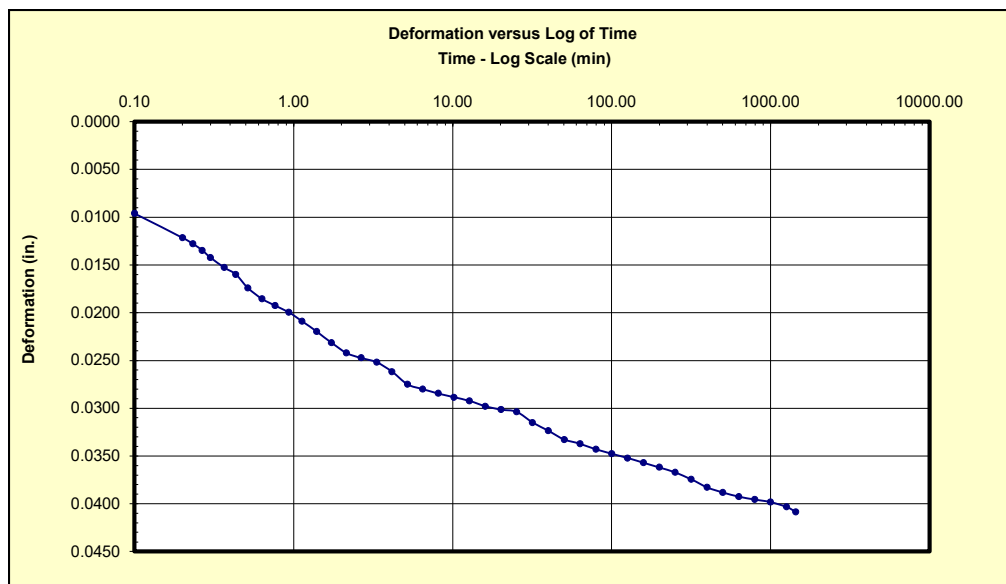
Vertical Stress
12800 psf
S100
No match!!!

☒ End of Primary

☐ End of Increment

Project:
L231011

B4
Depth (ft):
32.7



Scan Data

Step List

ISTEP 81

Update

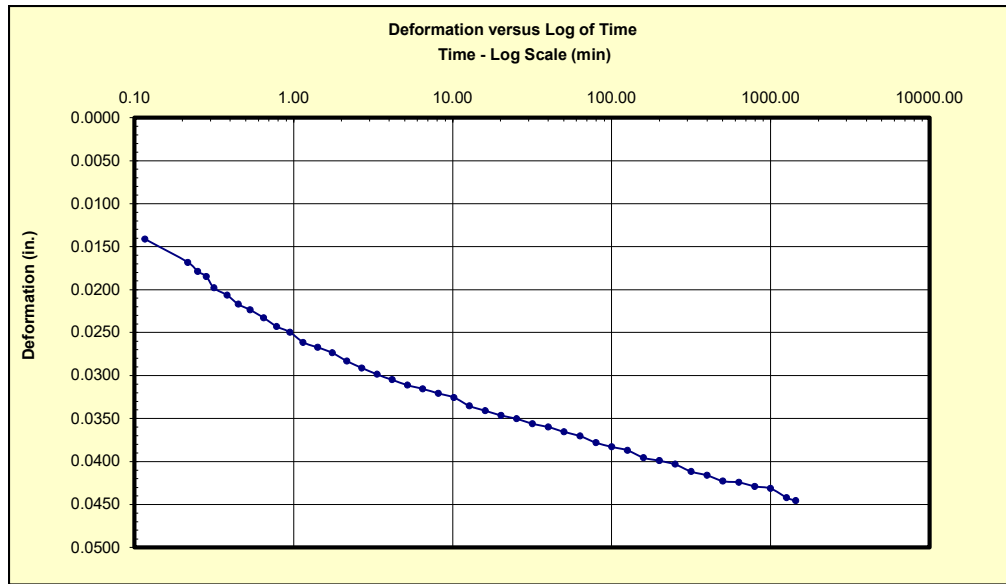
Vertical Stress
25600 psf
S100
No match!!!

☒ End of Primary

☐ End of Increment

Project:
L231011

B4
Depth (ft):
32.7



Scan Data

Step List

ISTEP 91

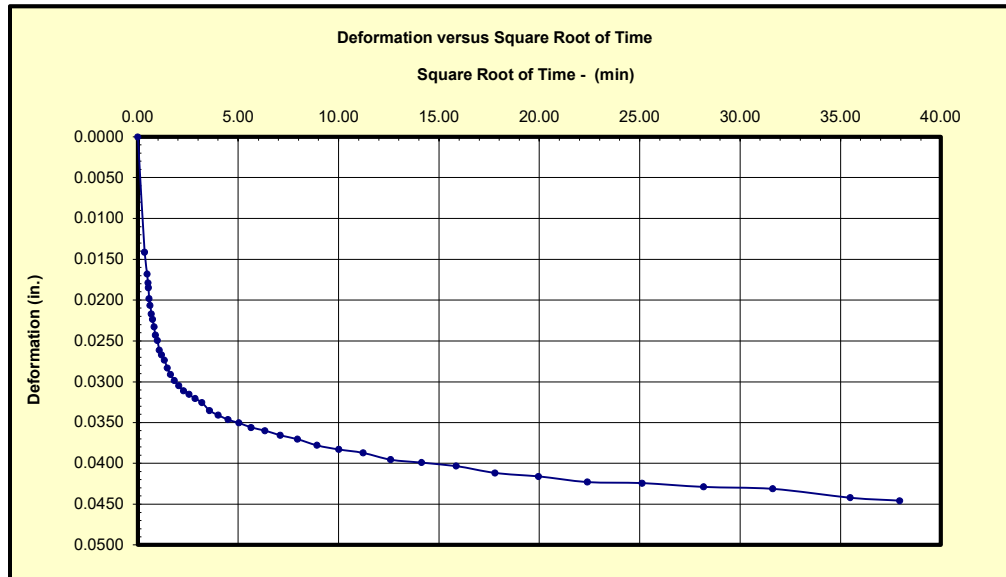
Update

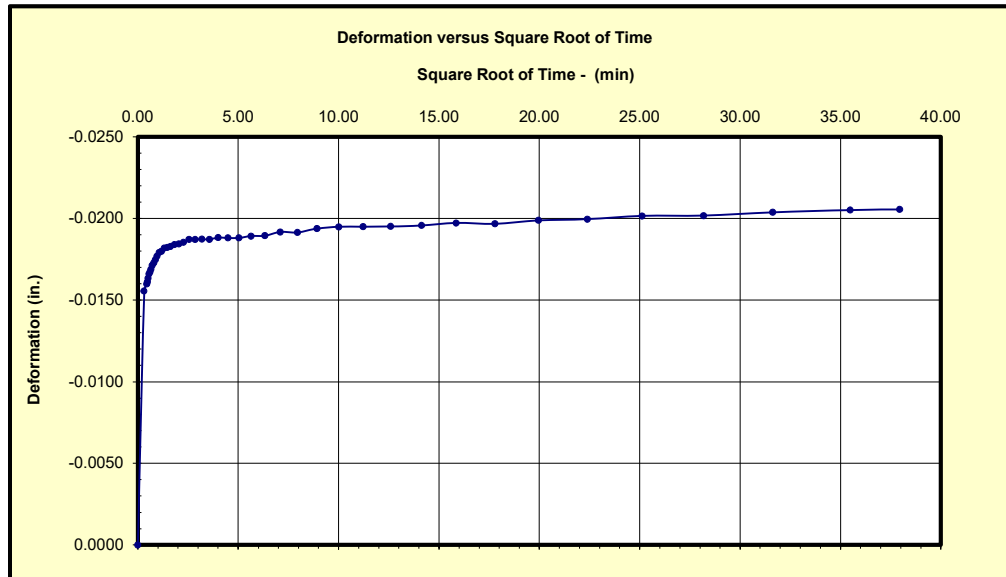
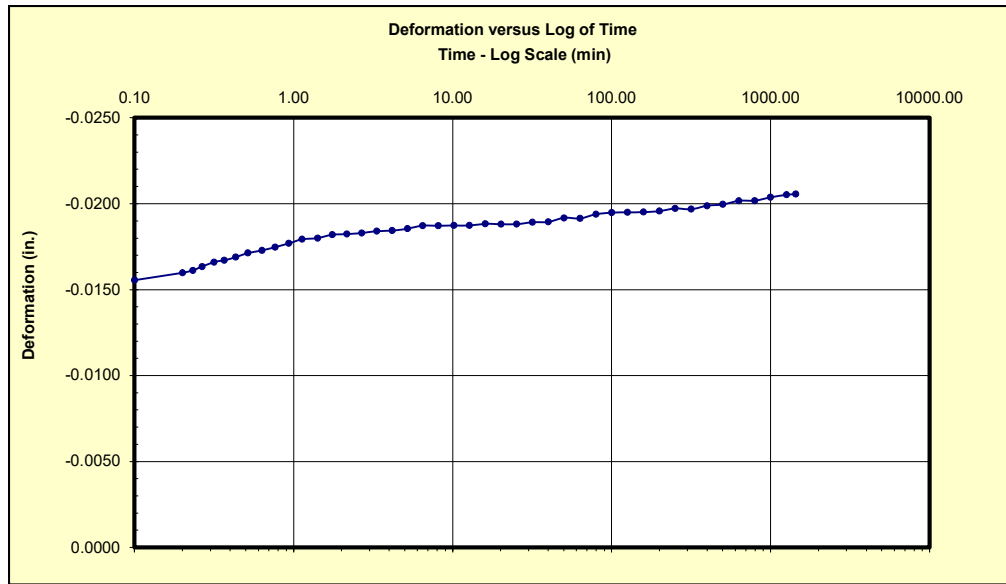
Vertical Stress
51200 psf
S100
No match!!!

☒ End of Primary
☐ End of Increment

Project:
L231011

B4
Depth (ft):
32.7





Scan Data

Step List

ISTEP 101

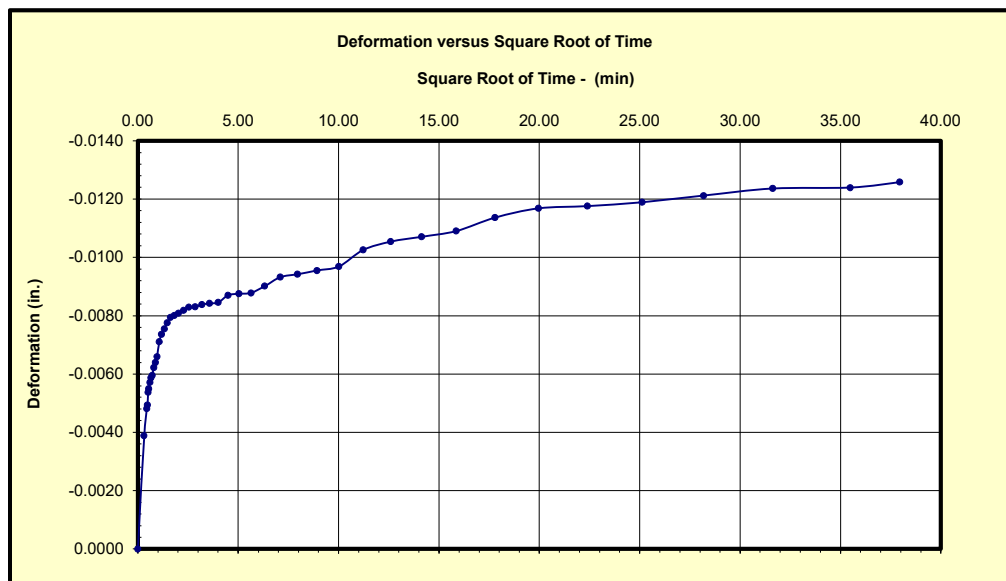
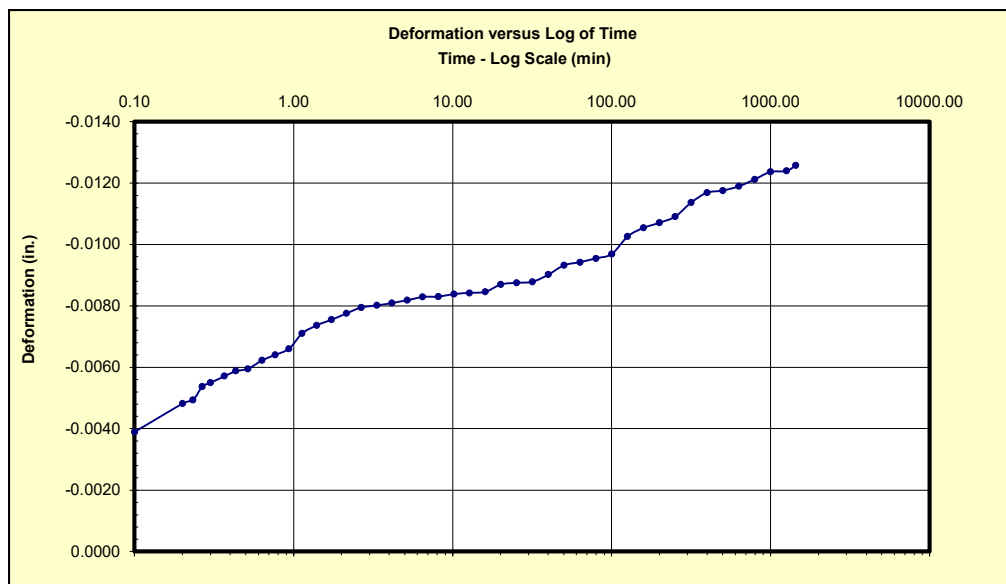
Update

Vertical Stress
6400 psf
S100
No match!!!

☒ End of Primary
☐ End of Increment

Project:
L231011

B4
Depth (ft):
32.7



Scan Data

Step List

ISTEP 111

Update

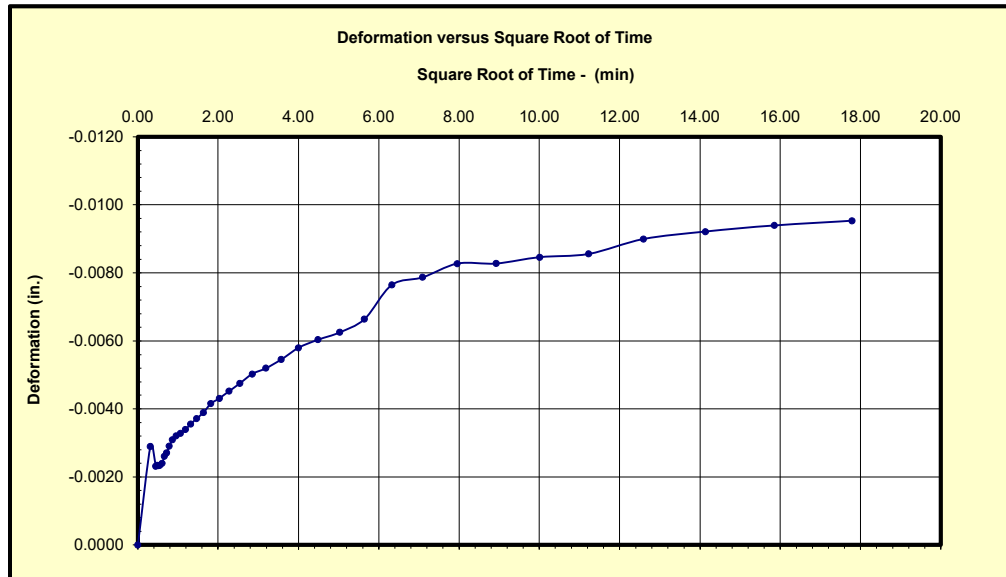
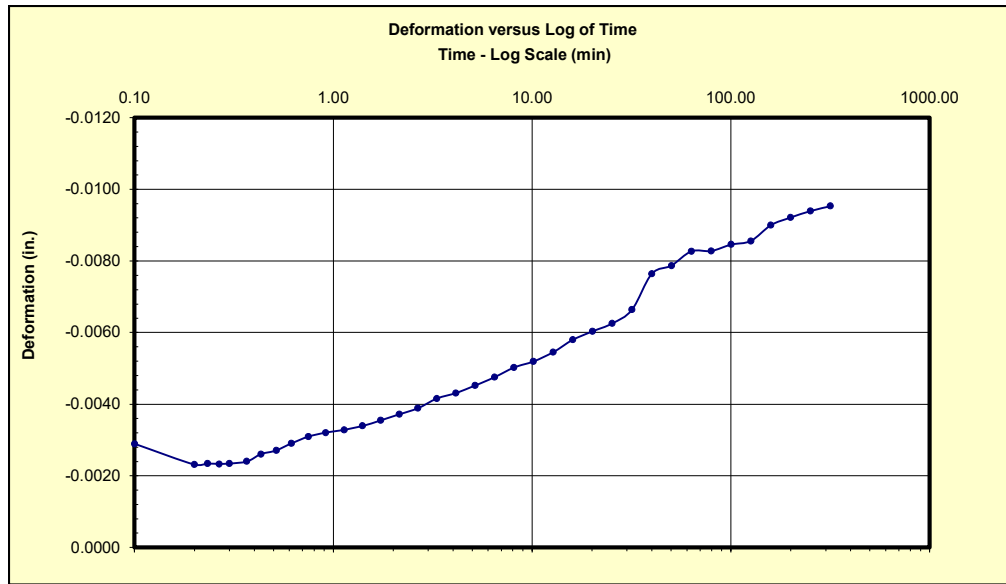
Vertical Stress
1600 psf
S100
No match!!!

☒ End of Primary

☐ End of Increment

Project:
L231011

B4
Depth (ft):
32.7



Scan Data

Step List

ISTEP 111

Update

Vertical Stress
400 psf
S100
No match!!!

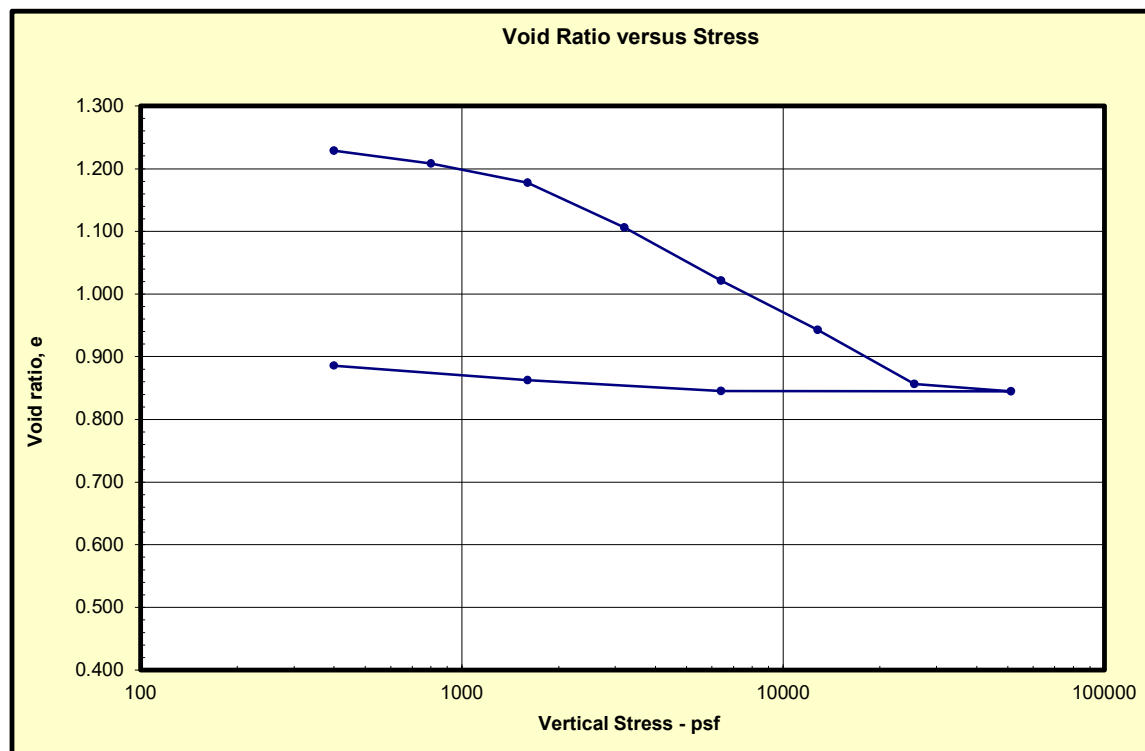
☒ End of Primary
☐ End of Increment

Project:
L231011

B4
Depth (ft):
32.7

Consolidation Test Results ASTM D-2435

		Load (psf)	H (in)	Consol (%)	Vs	e
Project	L231011	400	0.991	0.4	0.45	1.23
Boring	B-6	800	0.982	1.4	0.45	1.21
Depth (ft)	35.4-35.5	1600	0.968	2.7	0.46	1.18
Sampled by	Client	3200	0.936	5.9	0.47	1.11
Sample diameter (in)	2.495	6400	0.899	9.7	0.49	1.02
Wet density (pcf)	106.3	12800	0.864	13.2	0.51	0.94
Initial moisture (%)	43.9	25600	0.825	17.1	0.54	0.86
Initial dry Density (pcf)	73.9	**51200**	0.820	17.6	0.54	0.84
Final moisture (%)	34.1	6400	0.820	17.6	0.54	0.85
Final dry density	90.1	1600	0.828	16.8	0.54	0.86
Specific gravity (assumed)	2.65	400	0.838	15.7	0.53	0.89
Initial height, H (in)	0.995	**Note: 51200 step did not reach target load.				
Volume of solids (Vs)	0.45	See Time Deformation readings for actual loads.				
Volume of voids (Vv)	0.55					
Initial void ratio (e0)	1.24					
Total consolidation (%)	17.6					
Final Volume of solids (Vs)	0.54					
Minimum void ratio (ef)	0.84					
Effective stress in-situ(psf)	-					
Pre-consolidation stress (psf)	-					
Over-consolidation ratio, OCR	-					
Saturate sample at (psf)	400					



Time Deformation Readings

400 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.03	0.18	0.0001
0.05	0.22	0.0000
0.08	0.29	0.0003
0.13	0.37	0.0009
0.18	0.43	0.0015
0.25	0.50	0.0020
0.33	0.58	0.0023
0.43	0.66	0.0025
0.57	0.75	0.0025
0.73	0.86	0.0028
0.95	0.97	0.0028
1.20	1.10	0.0029
1.53	1.24	0.0029
1.93	1.39	0.0030
2.45	1.57	0.0034
3.10	1.76	0.0035
3.93	1.98	0.0036
4.97	2.23	0.0036
6.27	2.50	0.0037
7.90	2.81	0.0037
9.95	3.15	0.0038
12.55	3.54	0.0037
15.80	3.97	0.0037
19.92	4.46	0.0039
25.08	5.01	0.0040
31.58	5.62	0.0040
39.78	6.31	0.0041
50.08	7.08	0.0041
63.07	7.94	0.0044
79.40	8.91	0.0046
99.97	10.00	0.0047
125.87	11.22	0.0046
158.47	12.59	0.0046
180.35	13.43	0.0047

800 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0037
0.20	0.45	0.0043
0.23	0.48	0.0042
0.27	0.52	0.0044
0.30	0.55	0.0044
0.37	0.61	0.0046
0.43	0.66	0.0046
0.52	0.72	0.0048
0.62	0.79	0.0050
0.75	0.87	0.0052
0.92	0.96	0.0054
1.12	1.06	0.0056
1.38	1.18	0.0057
1.72	1.31	0.0060
2.13	1.46	0.0061
2.65	1.63	0.0062
3.30	1.82	0.0063
4.12	2.03	0.0064
5.15	2.27	0.0065
6.45	2.54	0.0066
8.08	2.84	0.0067
10.15	3.19	0.0067
12.73	3.57	0.0069
16.00	4.00	0.0071
20.10	4.48	0.0073
25.27	5.03	0.0073
31.77	5.64	0.0074
39.97	6.32	0.0075
50.27	7.09	0.0075
63.25	7.95	0.0075
79.58	8.92	0.0075
100.17	10.01	0.0076
126.05	11.23	0.0076
158.65	12.60	0.0078
199.68	14.13	0.0078
251.35	15.85	0.0080
316.40	17.79	0.0079
398.28	19.96	0.0080
501.37	22.39	0.0081
631.13	25.12	0.0082
794.52	28.19	0.0083
918.47	30.31	0.0102

1600 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0026
0.20	0.45	0.0032
0.22	0.47	0.0033
0.25	0.50	0.0034
0.30	0.55	0.0035
0.35	0.59	0.0035
0.42	0.65	0.0036
0.50	0.71	0.0037
0.62	0.79	0.0039
0.75	0.87	0.0040
0.92	0.96	0.0041
1.12	1.06	0.0045
1.37	1.17	0.0049
1.70	1.30	0.0054
2.12	1.45	0.0058
2.63	1.62	0.0063
3.28	1.81	0.0069
4.10	2.02	0.0074
5.13	2.27	0.0079
6.43	2.54	0.0086
8.07	2.84	0.0090
10.13	3.18	0.0092
12.72	3.57	0.0095
15.98	4.00	0.0097
20.08	4.48	0.0101
25.25	5.02	0.0104
31.77	5.64	0.0109
39.95	6.32	0.0110
50.27	7.09	0.0113
63.25	7.95	0.0113
79.58	8.92	0.0116
100.15	10.01	0.0116
126.05	11.23	0.0118
158.65	12.60	0.0121
199.68	14.13	0.0123
251.35	15.85	0.0124
316.40	17.79	0.0126
398.27	19.96	0.0128
501.35	22.39	0.0128
631.13	25.12	0.0130
794.52	28.19	0.0133
1000.20	31.63	0.0140
1259.13	35.48	0.0146
1342.45	36.63946	0.014858

Time Deformation Readings

3200 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0092
0.20	0.45	0.0098
0.23	0.48	0.0099
0.27	0.52	0.0101
0.30	0.55	0.0104
0.35	0.59	0.0105
0.42	0.65	0.0108
0.50	0.71	0.0110
0.62	0.79	0.0112
0.75	0.87	0.0114
0.90	0.95	0.0118
1.12	1.06	0.0123
1.37	1.17	0.0132
1.70	1.30	0.0139
2.12	1.45	0.0147
2.63	1.62	0.0152
3.28	1.81	0.0165
4.10	2.02	0.0176
5.13	2.27	0.0186
6.43	2.54	0.0199
8.07	2.84	0.0214
10.13	3.18	0.0224
12.72	3.57	0.0231
15.98	4.00	0.0238
20.08	4.48	0.0248
25.25	5.02	0.0263
31.75	5.63	0.0275
39.95	6.32	0.0286
50.25	7.09	0.0293
63.23	7.95	0.0297
79.58	8.92	0.0300
100.15	10.01	0.0305
126.03	11.23	0.0311
158.63	12.59	0.0318
199.68	14.13	0.0322
251.35	15.85	0.0326
316.38	17.79	0.0331
398.27	19.96	0.0335
501.35	22.39	0.0340
631.13	25.12	0.0345
794.50	28.19	0.0347
1000.18	31.63	0.0351
1259.12	35.48	0.0359
1440.183	37.94975	0.035967

6400 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0053
0.20	0.45	0.0060
0.23	0.48	0.0060
0.27	0.52	0.0062
0.30	0.55	0.0064
0.35	0.59	0.0066
0.42	0.65	0.0069
0.52	0.72	0.0074
0.62	0.79	0.0080
0.75	0.87	0.0087
0.92	0.96	0.0099
1.12	1.06	0.0105
1.38	1.18	0.0110
1.70	1.30	0.0115
2.12	1.45	0.0130
2.63	1.62	0.0138
3.28	1.81	0.0153
4.12	2.03	0.0165
5.15	2.27	0.0180
6.43	2.54	0.0193
8.08	2.84	0.0206
10.13	3.18	0.0219
12.72	3.57	0.0231
15.98	4.00	0.0242
20.10	4.48	0.0252
25.27	5.03	0.0261
31.77	5.64	0.0268
39.95	6.32	0.0276
50.27	7.09	0.0286
63.25	7.95	0.0295
79.58	8.92	0.0301
100.15	10.01	0.0305
126.05	11.23	0.0308
158.65	12.60	0.0315
199.68	14.13	0.0325
251.35	15.85	0.0333
316.40	17.79	0.0337
398.28	19.96	0.0342
501.37	22.39	0.0347
631.13	25.12	0.0353
794.52	28.19	0.0359
1000.20	31.63	0.0365
1259.13	35.48	0.0369
1440.217	37.95019	0.037213

12800 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0080
0.20	0.45	0.0083
0.22	0.47	0.0086
0.25	0.50	0.0088
0.30	0.55	0.0093
0.35	0.59	0.0096
0.42	0.65	0.0103
0.50	0.71	0.0110
0.60	0.77	0.0115
0.73	0.86	0.0119
0.90	0.95	0.0124
1.10	1.05	0.0133
1.37	1.17	0.0142
1.70	1.30	0.0152
2.12	1.45	0.0161
2.63	1.62	0.0173
3.28	1.81	0.0189
4.10	2.02	0.0202
5.13	2.27	0.0216
6.43	2.54	0.0226
8.07	2.84	0.0241
10.13	3.18	0.0254
12.72	3.57	0.0265
15.98	4.00	0.0279
20.08	4.48	0.0292
25.25	5.02	0.0301
31.77	5.64	0.0314
39.95	6.32	0.0318
50.27	7.09	0.0325
63.25	7.95	0.0331
79.58	8.92	0.0341
100.15	10.01	0.0349
126.05	11.23	0.0356
158.65	12.60	0.0366
199.70	14.13	0.0369
251.35	15.85	0.0373
316.40	17.79	0.0380
360.20	18.98	0.0383

Time Deformation Readings

25600 psf		
Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0071
0.22	0.47	0.0086
0.23	0.48	0.0091
0.27	0.52	0.0090
0.32	0.56	0.0096
0.37	0.61	0.0101
0.43	0.66	0.0107
0.52	0.72	0.0114
0.62	0.79	0.0123
0.75	0.87	0.0131
0.92	0.96	0.0138
1.13	1.06	0.0151
1.38	1.18	0.0164
1.72	1.31	0.0174
2.13	1.46	0.0183
2.65	1.63	0.0210
3.30	1.82	0.0225
4.12	2.03	0.0240
5.15	2.27	0.0257
6.45	2.54	0.0276
8.08	2.84	0.0296
10.15	3.19	0.0306
12.75	3.57	0.0315
16.00	4.00	0.0329
20.12	4.49	0.0345
25.28	5.03	0.0354
31.78	5.64	0.0360
39.97	6.32	0.0368
50.28	7.09	0.0374
63.27	7.95	0.0381
79.60	8.92	0.0386
100.17	10.01	0.0397
126.07	11.23	0.0400
158.67	12.60	0.0409
199.70	14.13	0.0414
247.28	15.73	0.0417

51200 psf			psf	6400 psf		
Time (min.)	Sq. Root Time (min.)	Disp. (in.)		Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000	26021.7	0.00	0.00	0.0000
0.10	0.32	0.0099	50428.1	0.10	0.32	-0.0069
0.20	0.45	0.0102	46258.3	0.20	0.45	-0.0072
0.23	0.48	0.0103	45440.4	0.23	0.48	-0.0073
0.27	0.52	0.0104	44630.1	0.27	0.52	-0.0073
0.30	0.55	0.0106	43772.4	0.30	0.55	-0.0075
0.37	0.61	0.0107	42858.4	0.35	0.59	-0.0075
0.43	0.66	0.0107	41874.4	0.42	0.65	-0.0077
0.52	0.72	0.0109	40905.9	0.52	0.72	-0.0078
0.62	0.79	0.0109	39957.3	0.62	0.79	-0.0079
0.75	0.87	0.0110	39020.4	0.75	0.87	-0.0080
0.92	0.96	0.0111	38102.1	0.92	0.96	-0.0083
1.12	1.06	0.0112	37266.0	1.12	1.06	-0.0083
1.38	1.18	0.0113	36509.1	1.38	1.18	-0.0084
1.72	1.31	0.0114	35837.4	1.70	1.30	-0.0086
2.12	1.45	0.0114	35251.6	2.12	1.45	-0.0088
2.63	1.62	0.0114	34747.0	2.63	1.62	-0.0090
3.30	1.82	0.0115	34304.5	3.28	1.81	-0.0091
4.12	2.03	0.0115	33907.0	4.12	2.03	-0.0092
5.15	2.27	0.0116	33543.2	5.15	2.27	-0.0092
6.45	2.54	0.0116	33204.4	6.45	2.54	-0.0093
8.08	2.84	0.0116	32883.0	8.08	2.84	-0.0095
10.13	3.18	0.0116	32602.6	10.13	3.18	-0.0097
12.73	3.57	0.0115	32315.0	12.73	3.57	-0.0098
16.00	4.00	0.0115	32024.2	15.98	4.00	-0.0098
20.10	4.48	0.0116	31726.2	20.10	4.48	-0.0098
25.27	5.03	0.0116	31435.6	25.27	5.03	-0.0097
31.77	5.64	0.0116	31146.1	31.77	5.64	-0.0099
39.95	6.32	0.0116	30862.5	39.97	6.32	-0.0099
50.27	7.09	0.0116	30624.7	50.27	7.09	-0.0100
63.25	7.95	0.0116	30329.8	63.25	7.95	-0.0100
79.58	8.92	0.0116	30043.8	79.58	8.92	-0.0102
100.15	10.01	0.0116	29804.2	100.15	10.01	-0.0103
126.05	11.23	0.0117	29502.3	126.05	11.23	-0.0103
158.65	12.60	0.0116	29251.4	158.65	12.60	-0.0103
199.70	14.13	0.0116	28983.3	199.70	14.13	-0.0104
251.37	15.85	0.0116	28670.9	251.37	15.85	-0.0106
316.40	17.79	0.0117	28413.3	316.40	17.79	-0.0106
398.28	19.96	0.0117	28149.8	398.28	19.96	-0.0108
501.37	22.39	0.0117	27883.8	501.38	22.39	-0.0109
631.15	25.12	0.0117	27623.7	631.15	25.12	-0.0111
794.52	28.19	0.0117	27350.2	794.53	28.19	-0.0112
940.00	30.66	0.0120	27118.5	1000.22	31.63	-0.0112
				1259.15	35.48	-0.0113
				1379.95	37.14768	-0.01125

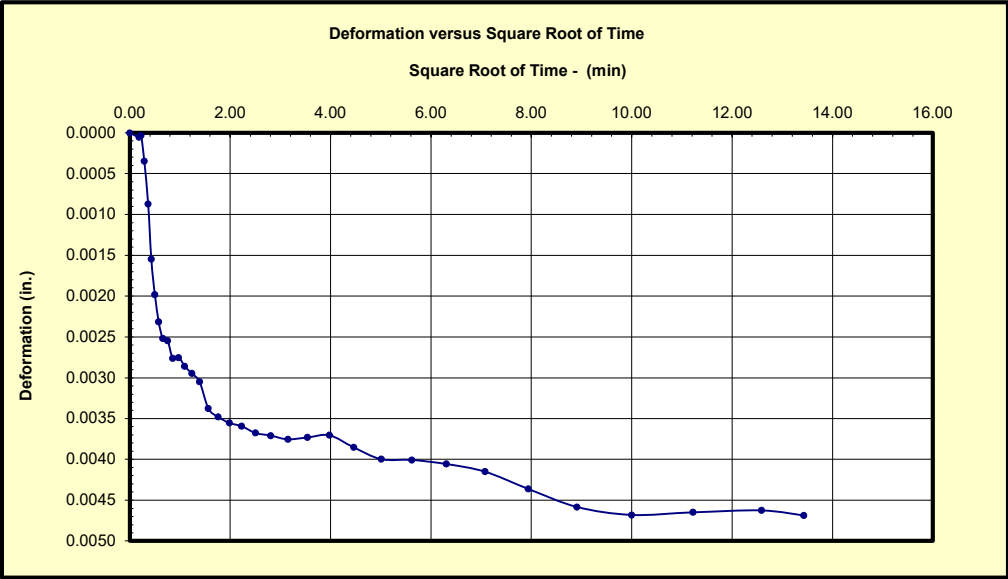
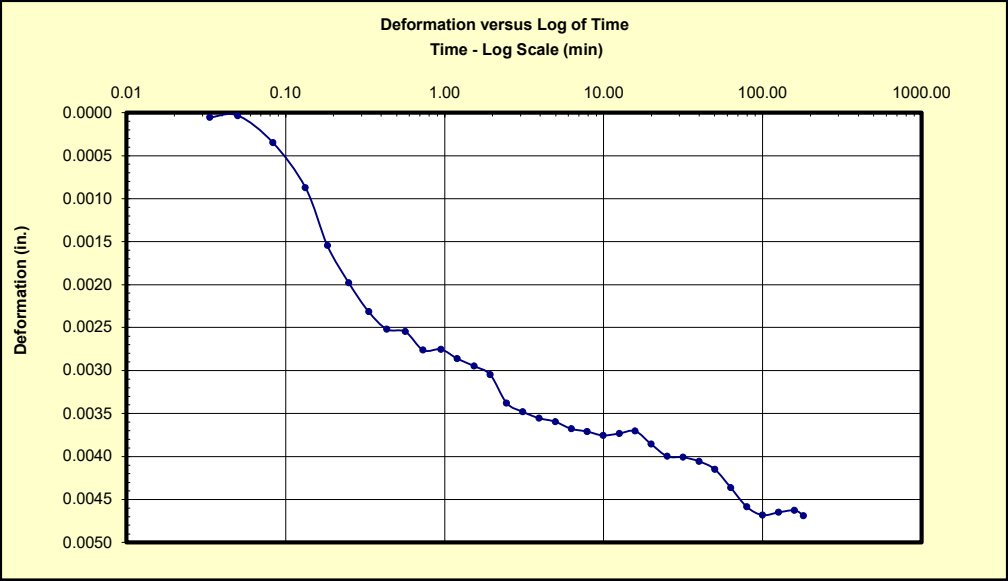
Time Deformation Readings

1600 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	-0.0032
0.20	0.45	-0.0035
0.23	0.48	-0.0036
0.27	0.52	-0.0037
0.30	0.55	-0.0038
0.37	0.61	-0.0039
0.43	0.66	-0.0040
0.52	0.72	-0.0041
0.62	0.79	-0.0043
0.75	0.87	-0.0044
0.92	0.96	-0.0045
1.12	1.06	-0.0047
1.38	1.18	-0.0051
1.70	1.30	-0.0053
2.12	1.45	-0.0056
2.63	1.62	-0.0057
3.28	1.81	-0.0060
4.10	2.02	-0.0063
5.13	2.27	-0.0065
6.43	2.54	-0.0069
8.08	2.84	-0.0070
10.13	3.18	-0.0071
12.72	3.57	-0.0074
15.98	4.00	-0.0076
20.08	4.48	-0.0081
25.27	5.03	-0.0085
31.77	5.64	-0.0089
39.95	6.32	-0.0092
50.27	7.09	-0.0094
63.23	7.95	-0.0097
79.58	8.92	-0.0097
100.15	10.01	-0.0100
126.05	11.23	-0.0100
158.65	12.60	-0.0103
199.68	14.13	-0.0104
251.35	15.85	-0.0105
316.38	17.79	-0.0109
398.28	19.96	-0.0112
501.37	22.39	-0.0114
631.13	25.12	-0.0115
794.52	28.19	-0.0116
1000.20	31.63	-0.0118
1259.13	35.48	-0.0119
1438.783	37.9313	-0.01194

400 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	-0.0013
0.20	0.45	-0.0016
0.23	0.48	-0.0015
0.27	0.52	-0.0015
0.32	0.56	-0.0018
0.37	0.61	-0.0019
0.43	0.66	-0.0027
0.52	0.72	-0.0027
0.62	0.79	-0.0024
0.75	0.87	-0.0025
0.92	0.96	-0.0018
1.12	1.06	-0.0030
1.38	1.18	-0.0030
1.72	1.31	-0.0030
2.13	1.46	-0.0037
2.65	1.63	-0.0040
3.30	1.82	-0.0039
4.12	2.03	-0.0042
5.15	2.27	-0.0045
6.45	2.54	-0.0048
8.08	2.84	-0.0054
10.15	3.19	-0.0059
12.73	3.57	-0.0063
16.00	4.00	-0.0063
20.10	4.48	-0.0066
25.27	5.03	-0.0069
31.77	5.64	-0.0080
39.97	6.32	-0.0083
50.27	7.09	-0.0085
63.25	7.95	-0.0090
79.58	8.92	-0.0092
100.17	10.01	-0.0094
126.05	11.23	-0.0097
158.65	12.60	-0.0100
199.70	14.13	-0.0107
251.37	15.85	-0.0115
316.40	17.79	-0.0123



Scan Data

Step List

ISTEP 21

Update

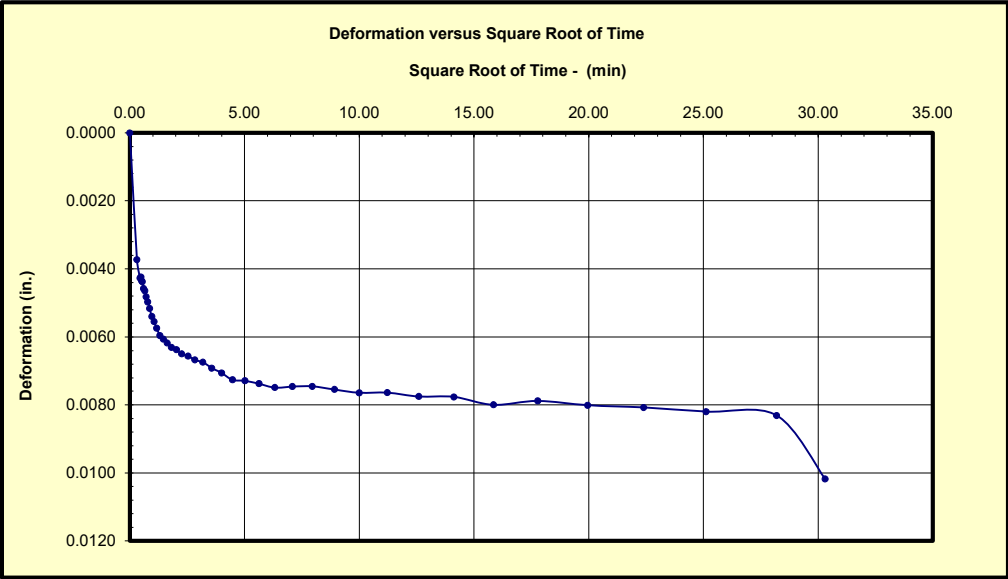
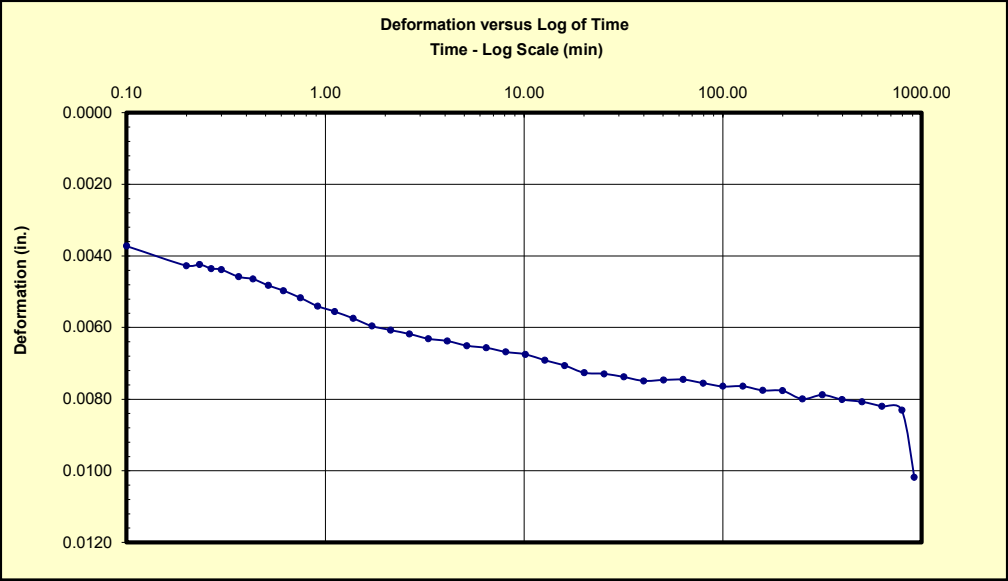
Vertical Stress
400 psf

S100
No match!!!

- ☒ End of Primary
- ☐ End of Increment

Project:
L231011

B6
Depth (ft):
35.4-35.5



Scan Data

Step List

ISTEP 31

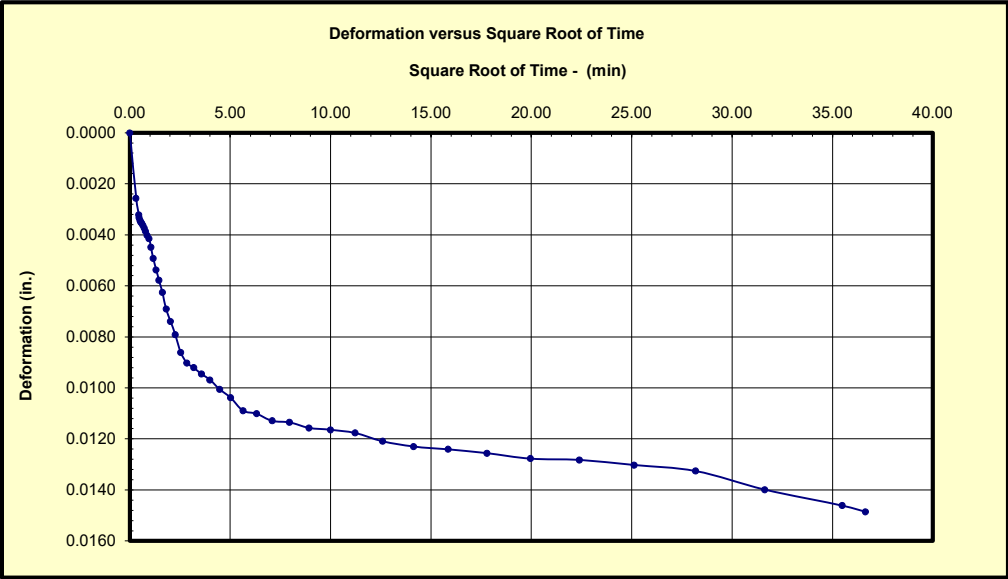
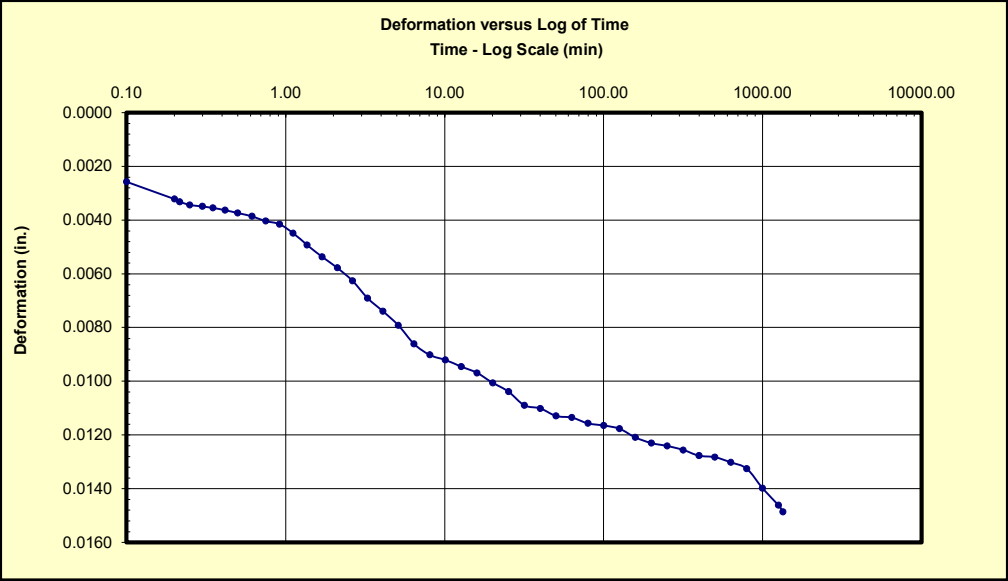
Update

Vertical Stress
800 psf
S100
No match!!!

- ☒ End of Primary
☐ End of Increment

Project:
L231011

B6
Depth (ft):
35.4-35.5



Scan Data

Step List

ISTEP 41

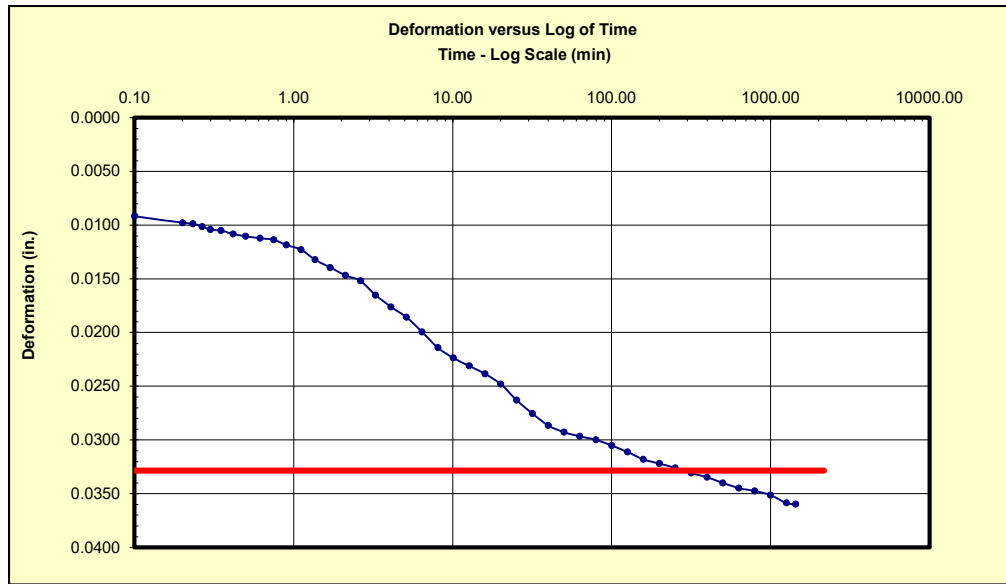
Update

Vertical Stress
1600 psf
S100
Calculating...

☒ End of Primary
☐ End of Increment

Project:
L231011

B6
Depth (ft):
35.4-35.5



Scan Data

Step List

ISTEP 51

Update

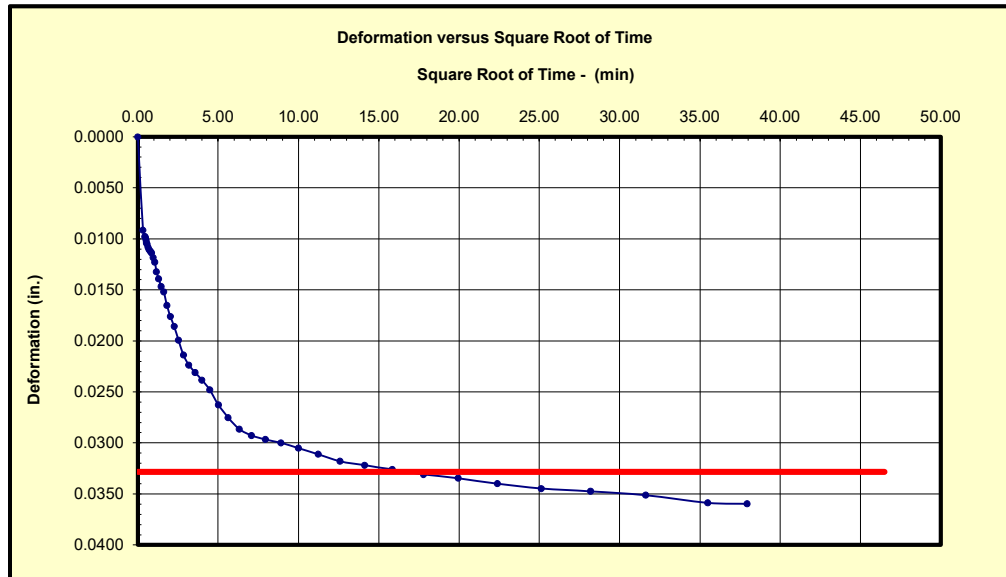
Vertical Stress
3200 psf

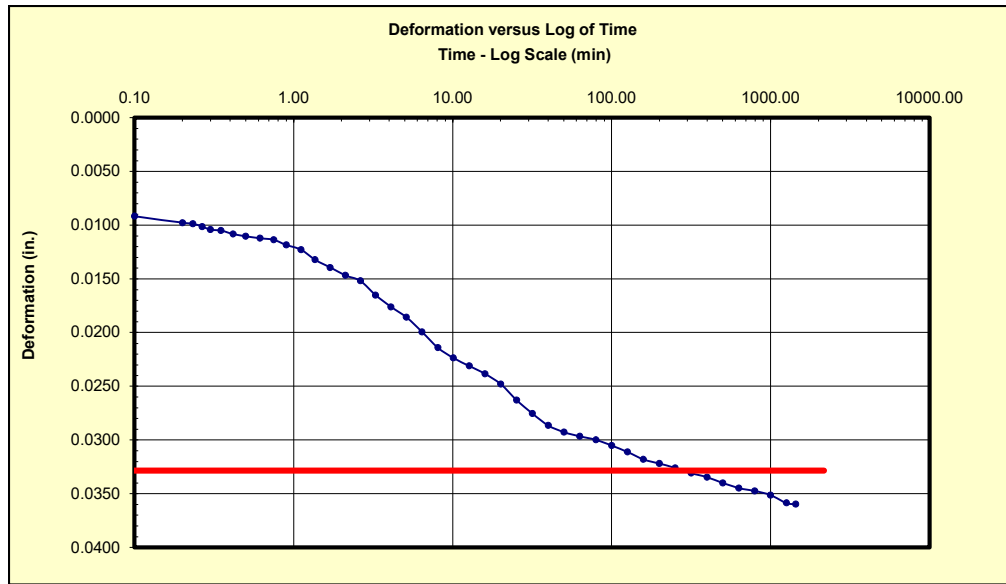
S100
0.0328 inch

☒ End of Primary
☐ End of Increment

Project:
L231011

B6
Depth (ft):
35.4-35.5





Scan Data

Step List

ISTEP 51

Update

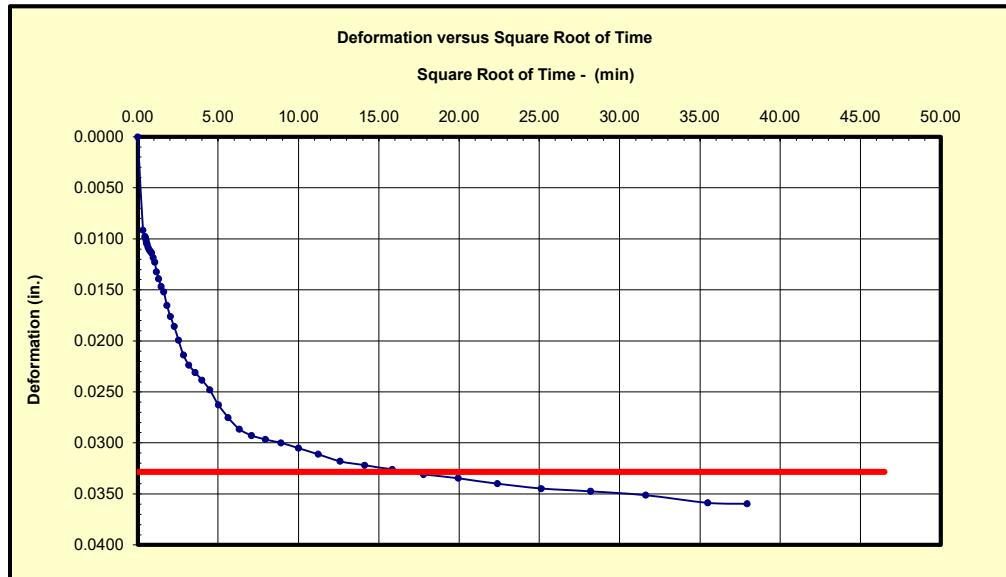
Vertical Stress
3200 psf

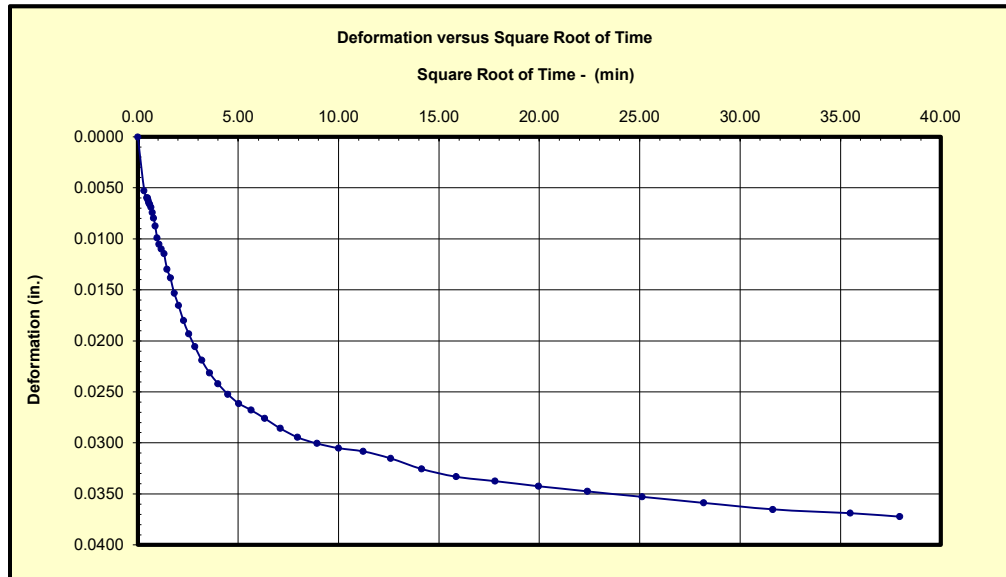
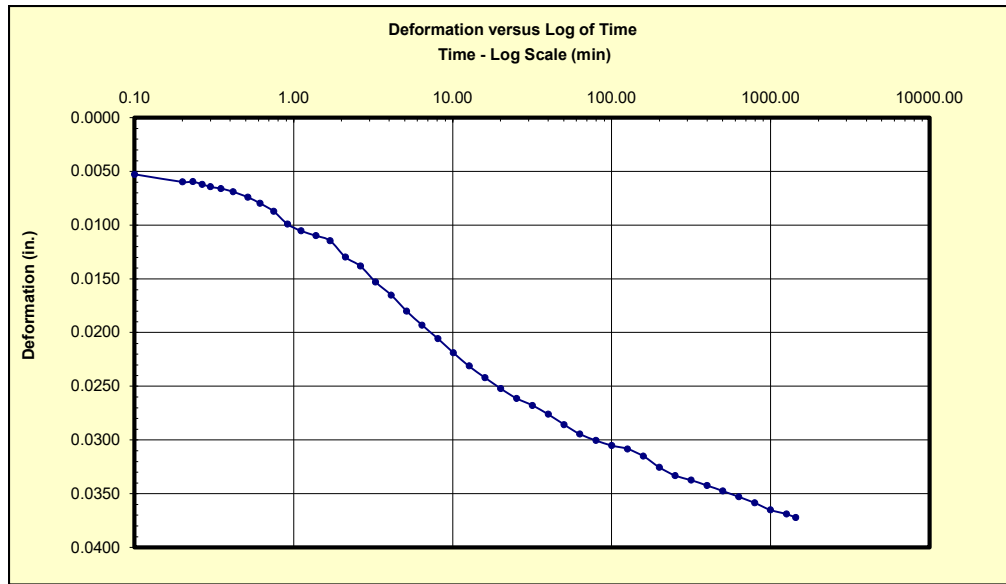
S100
0.0328 inch

☒ End of Primary
☐ End of Increment

Project:
L231011

B6
Depth (ft):
35.4-35.5





Scan Data

Step List

ISTEP 61

Update

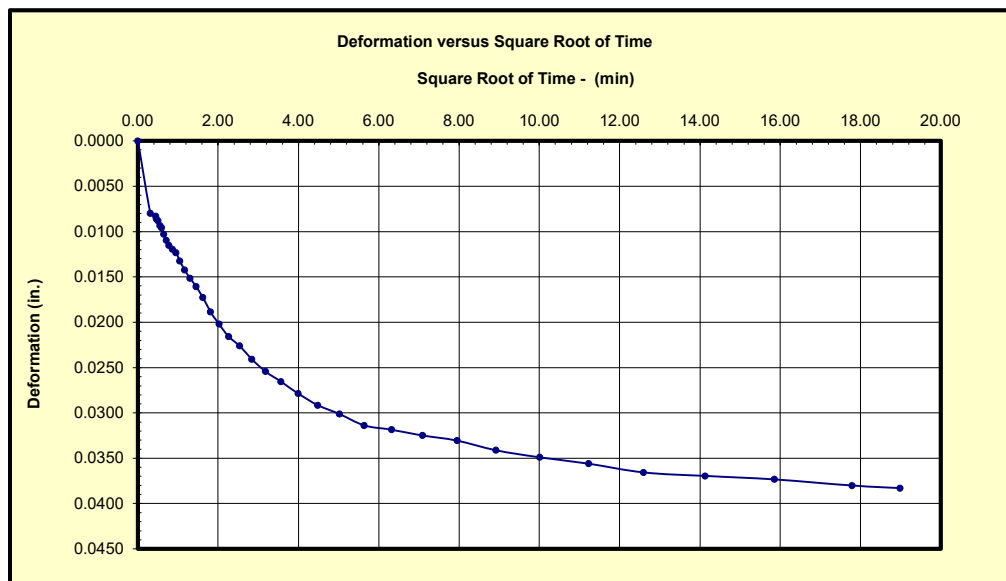
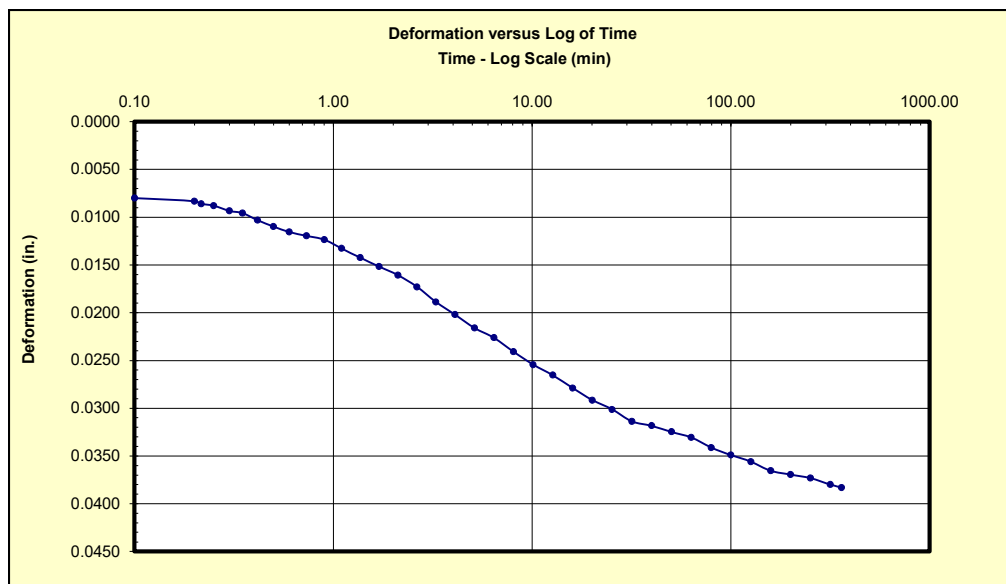
Vertical Stress
6400 psf

S100
Calculating...

☒ End of Primary
☐ End of Increment

Project:
L231011

B6
Depth (ft):
35.4-35.5



Scan Data

Step List

ISTEP 71

Update

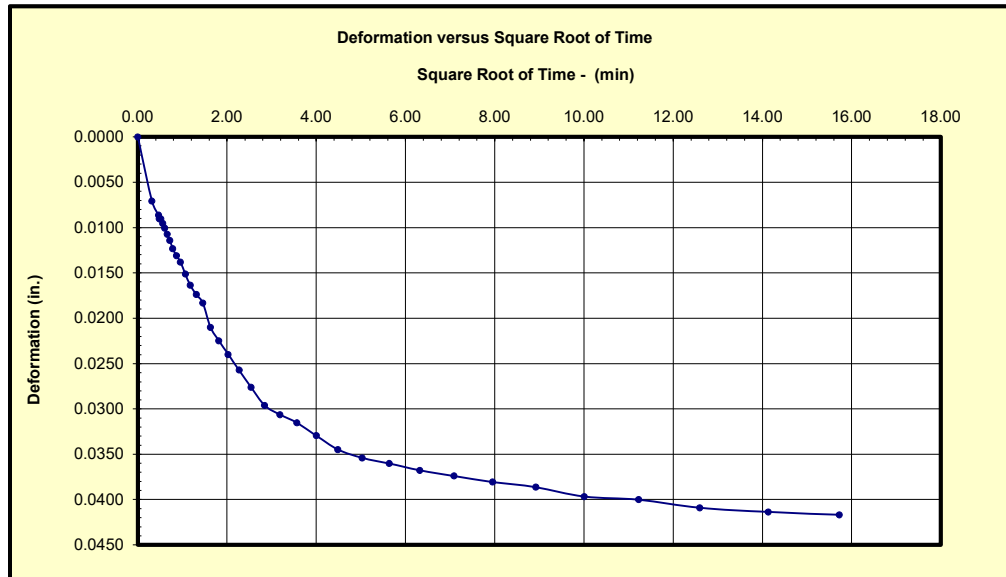
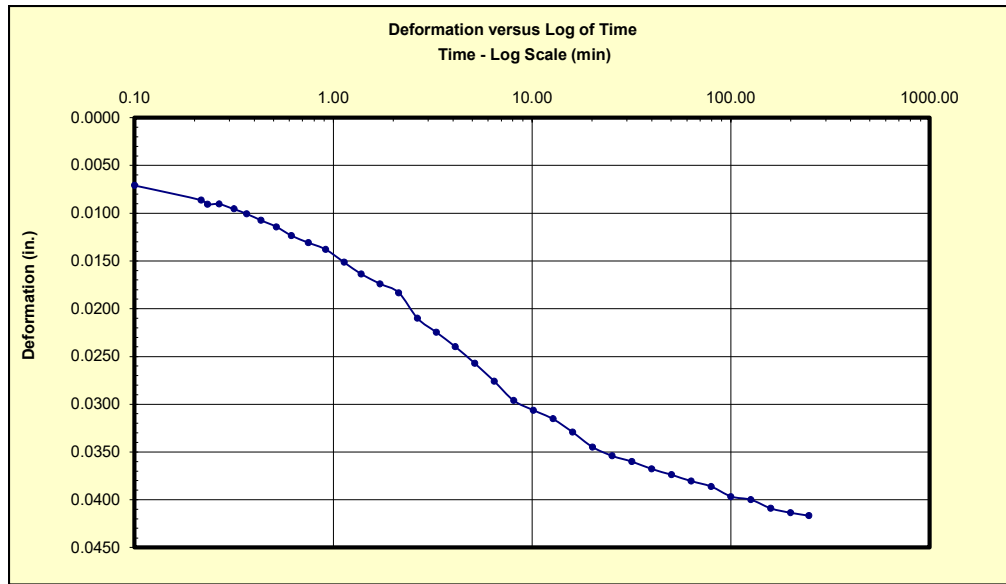
Vertical Stress
12800 psf
S100
Calculating...

☒ End of Primary

☐ End of Increment

Project:
L231011

B6
Depth (ft):
35.4-35.5



Scan Data

Step List

ISTEP 81

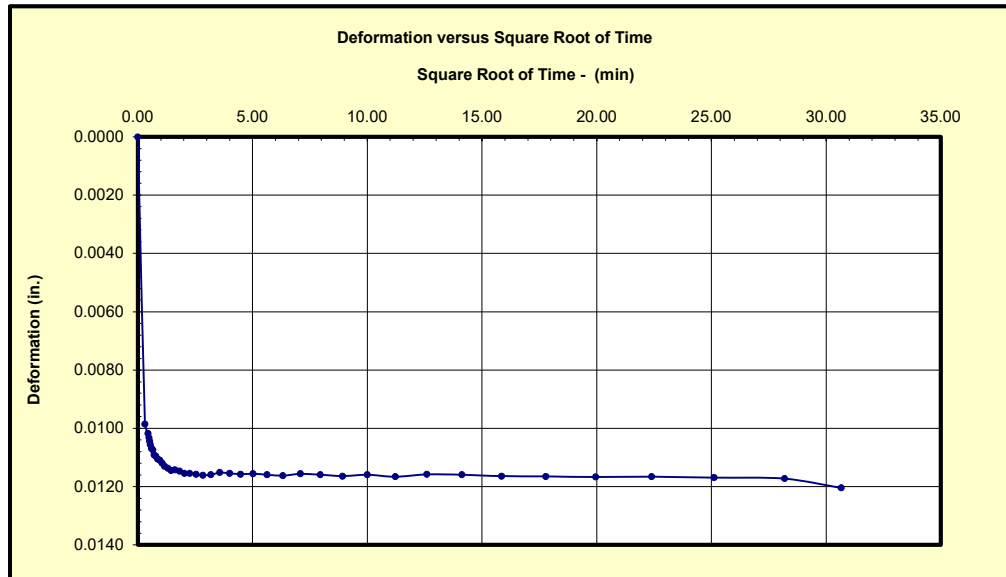
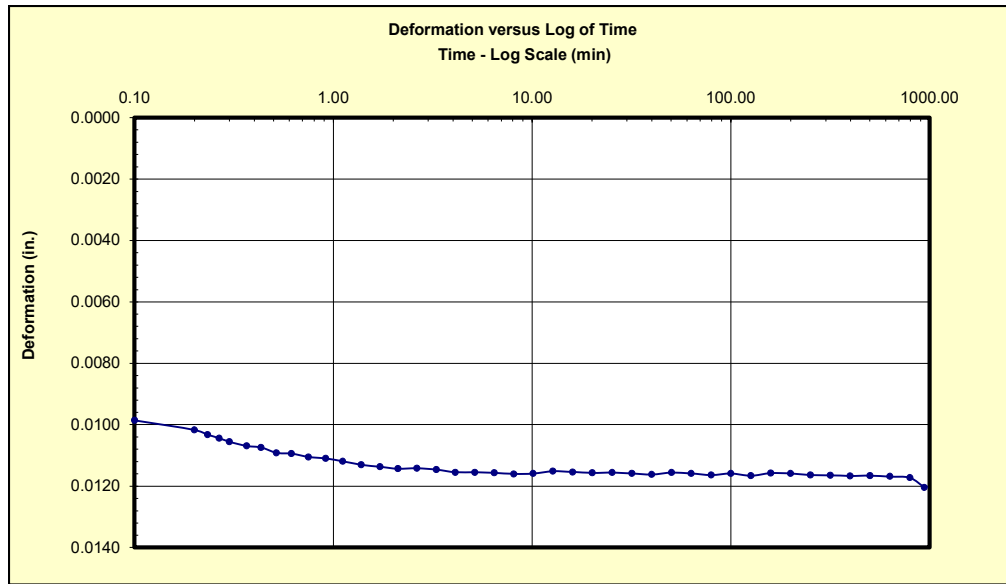
Update

Vertical Stress
25600 psf
S100
No match!!!

☒ End of Primary
☐ End of Increment

Project:
L231011

B6
Depth (ft):
35.4-35.5



Scan Data

Step List

ISTEP 91

Update

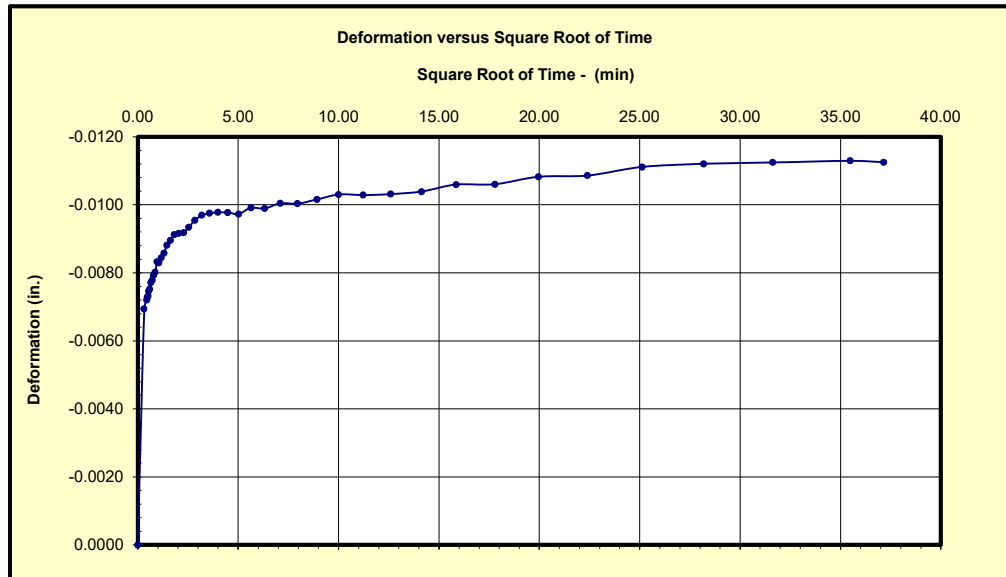
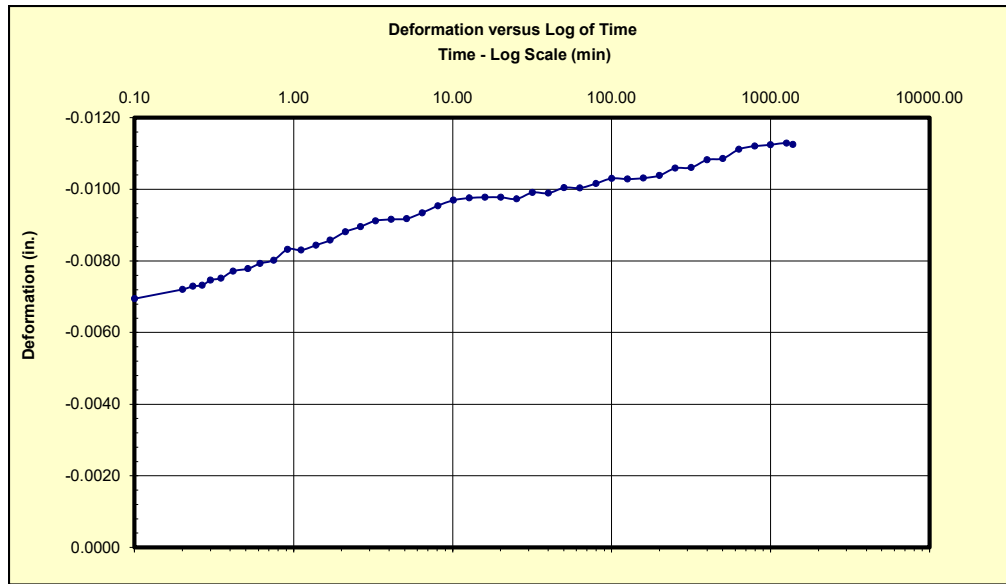
Vertical Stress
51200 psf

S100
No match!!!

- ☒ End of Primary
- ☐ End of Increment

Project:
L231011

B6
Depth (ft):
35.4-35.5



Scan Data

Step List

ISTEP 101

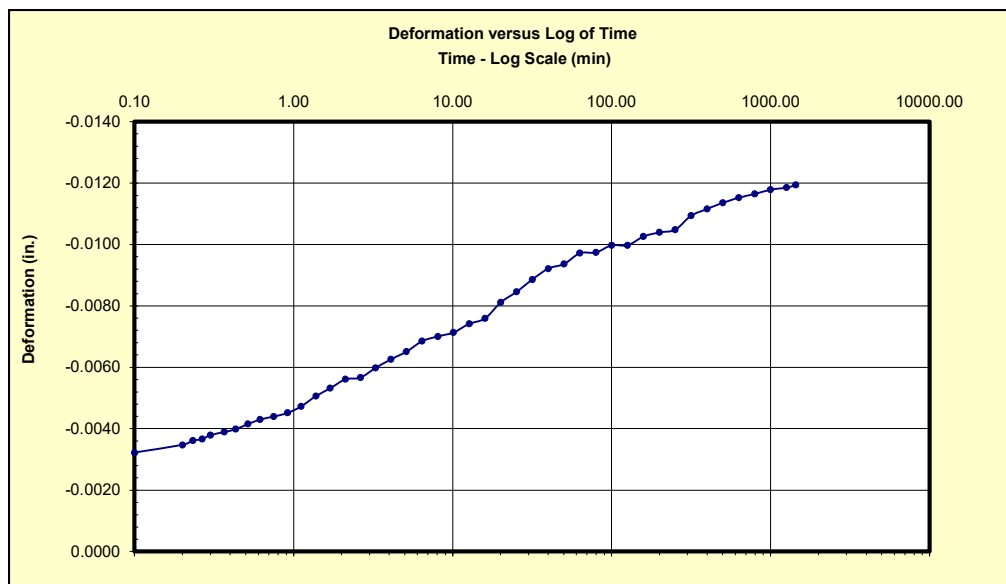
Update

Vertical Stress
6400 psf
S100
No match!!!

☒ End of Primary
☐ End of Increment

Project:
L231011

B6
Depth (ft):
35.4-35.5



Scan Data

Step List

ISTEP 111

Update

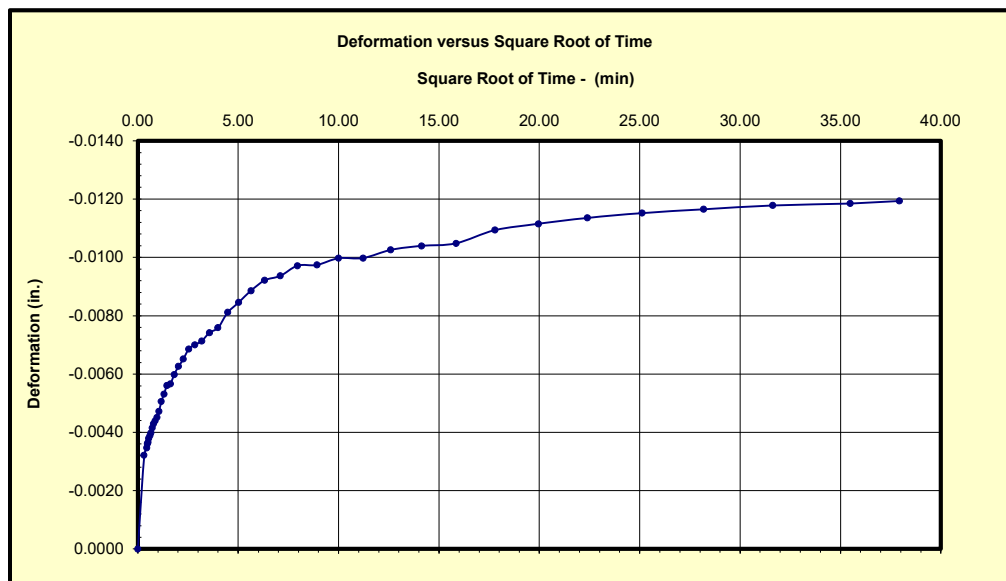
Vertical Stress
1600 psf
S100
No match!!!

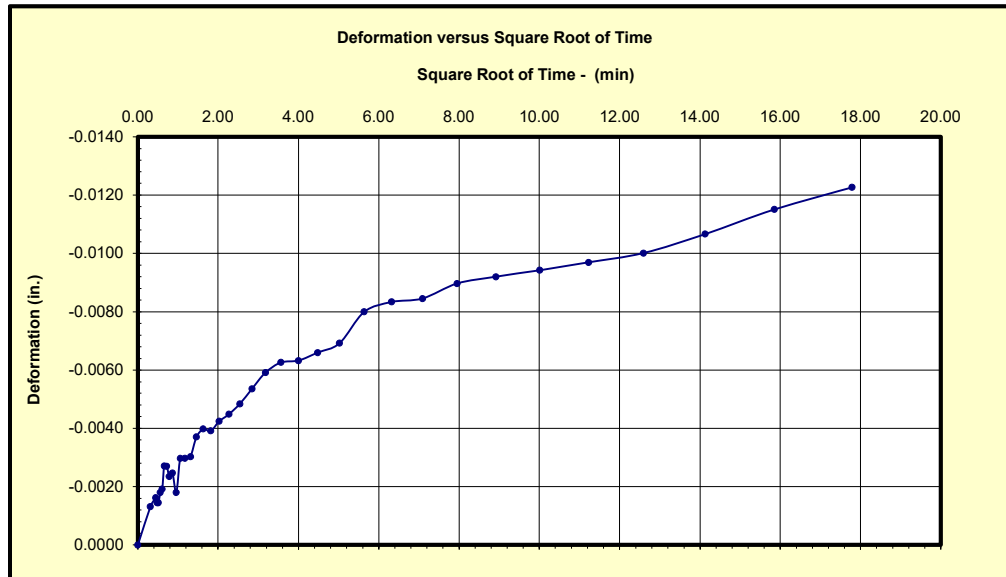
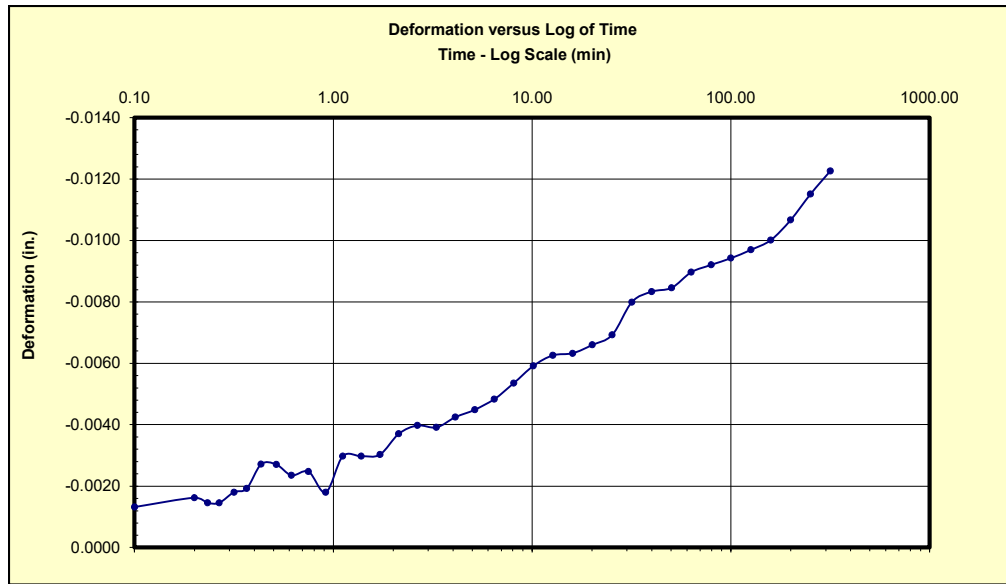
☒ End of Primary

☐ End of Increment

Project:
L231011

B6
Depth (ft):
35.4-35.5





Scan Data

Step List

ISTEP 111

Update

Vertical Stress
400 psf
S100
No match!!!

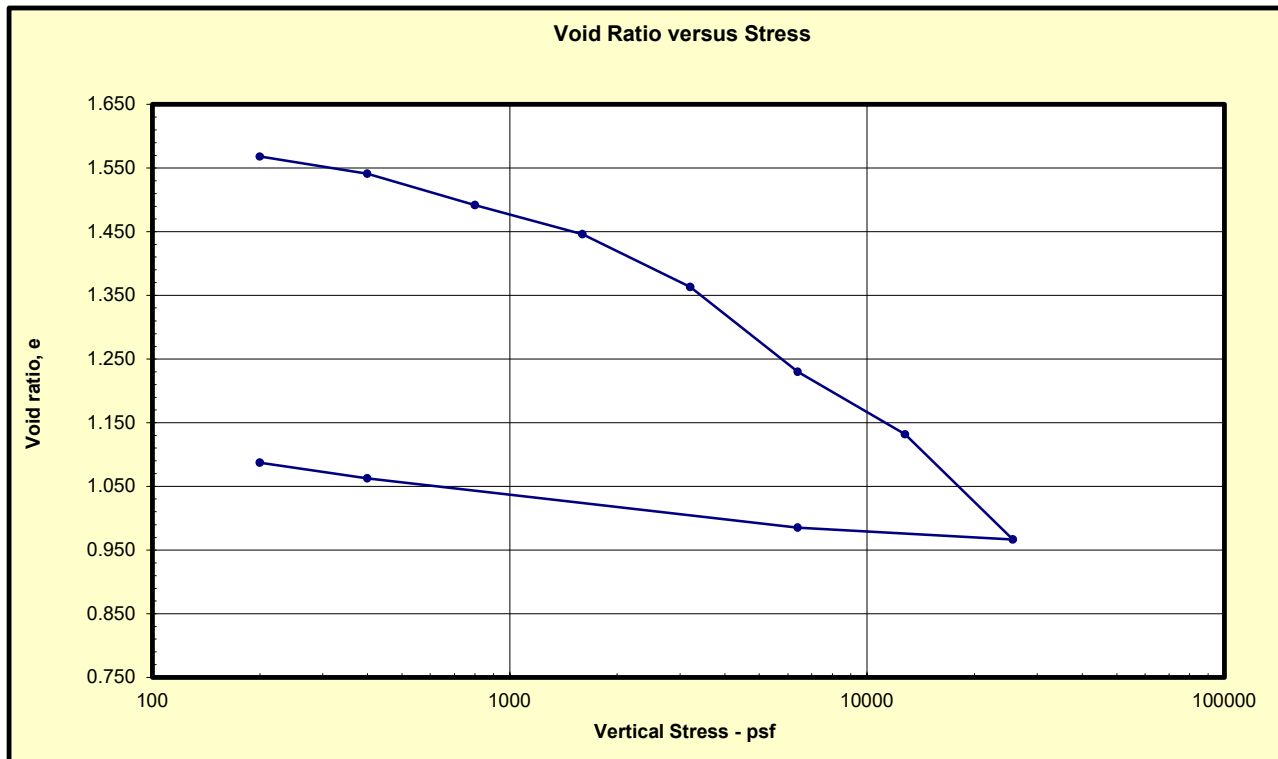
☒ End of Primary
☐ End of Increment

Project:
L231011

B6
Depth (ft):
35.4-35.5

Consolidation Test Results ASTM D-2435

		Load (psf)	H (in)	Consol (%)	Vs	e
Project	L231011	200	0.989	0.6	0.39	1.57
Boring	B-8	400	0.979	1.6	0.39	1.54
Depth (ft)	16.8	800	0.960	3.6	0.40	1.49
Sampled by	Client	1600	0.942	5.3	0.41	1.45
Sample diameter (in)	2.495	3200	0.910	8.5	0.42	1.36
Wet density (pcf)	100.1	6400	0.859	13.7	0.45	1.23
Initial moisture (%)	56.4	12800	0.821	17.5	0.47	1.13
Initial dry Density (pcf)	64.0	25600	0.757	23.9	0.51	0.97
Final moisture (%)	43.5	6400	0.765	23.2	0.50	0.99
Final dry density	79.6	400	0.794	20.2	0.48	1.06
Specific gravity (assumed)	2.65	200	0.804	19.2	0.48	1.09
Initial height, H (in)	0.995					
Volume of solids (Vs)	0.39					
Volume of voids (Vv)	0.61					
Initial void ratio (e0)	1.58					
Total consolidation (%)	23.9%					
Final Volume of solids (Vs)	0.51					
Minimum void ratio (ef)	0.97					
Effective stress in-situ(psf)	-					
Pre-consolidation stress (psf)	-					
Over-consolidation ratio, OCR	-					
Saturate sample at (psf)	200					



Time Deformation Readings

200 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.03	0.18	0.0000
0.07	0.26	0.0001
0.10	0.32	0.0001
0.15	0.39	0.0002
0.22	0.47	0.0002
0.28	0.53	0.0003
0.37	0.61	0.0004
0.48	0.70	0.0006
0.60	0.77	0.0010
0.77	0.88	0.0016
0.98	0.99	0.0019
1.25	1.12	0.0023
1.58	1.26	0.0025
2.00	1.41	0.0028
2.52	1.59	0.0031
3.17	1.78	0.0034
4.00	2.00	0.0038
5.05	2.25	0.0040
6.35	2.52	0.0044
7.98	2.83	0.0046
10.03	3.17	0.0049
12.63	3.55	0.0051
15.90	3.99	0.0052
20.02	4.47	0.0053
25.18	5.02	0.0056
31.68	5.63	0.0057
39.88	6.32	0.0058
50.20	7.09	0.0059
60.35	7.77	0.0061

400 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0032
0.22	0.47	0.0042
0.23	0.48	0.0045
0.27	0.52	0.0046
0.32	0.56	0.0048
0.38	0.62	0.0050
0.45	0.67	0.0055
0.53	0.73	0.0056
0.65	0.81	0.0057
0.78	0.89	0.0060
0.93	0.97	0.0063
1.15	1.07	0.0069
1.42	1.19	0.0072
1.75	1.32	0.0074
2.17	1.47	0.0078
2.68	1.64	0.0079
3.33	1.83	0.0082
4.17	2.04	0.0086
5.20	2.28	0.0087
6.50	2.55	0.0090
8.15	2.85	0.0091
10.20	3.19	0.0093
12.80	3.58	0.0098
16.07	4.01	0.0102
20.17	4.49	0.0103
25.35	5.03	0.0106
31.85	5.64	0.0108
40.05	6.33	0.0109
50.35	7.10	0.0112
60.40	7.77	0.0112

800 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0054
0.20	0.45	0.0062
0.23	0.48	0.0063
0.27	0.52	0.0064
0.32	0.56	0.0064
0.37	0.61	0.0065
0.45	0.67	0.0067
0.53	0.73	0.0071
0.63	0.80	0.0074
0.78	0.89	0.0079
0.95	0.97	0.0086
1.15	1.07	0.0093
1.42	1.19	0.0098
1.75	1.32	0.0103
2.17	1.47	0.0107
2.68	1.64	0.0111
3.33	1.83	0.0116
4.17	2.04	0.0123
5.20	2.28	0.0126
6.50	2.55	0.0130
8.13	2.85	0.0134
10.20	3.19	0.0136
12.78	3.58	0.0139
16.05	4.01	0.0143
20.17	4.49	0.0144
25.33	5.03	0.0146
31.83	5.64	0.0148
40.03	6.33	0.0154
50.33	7.09	0.0159
63.32	7.96	0.0164
79.67	8.93	0.0168
100.23	10.01	0.0169
126.13	11.23	0.0170
158.73	12.60	0.0172
199.78	14.13	0.0173
251.45	15.86	0.0174
316.50	17.79	0.0176
398.38	19.96	0.0177
501.47	22.39	0.0180
631.23	25.12	0.0183
794.62	28.19	0.0187
1000.30	31.63	0.0192
1259.23	35.49	0.0198
1440.317	37.9515	0.019968

Time Deformation Readings

1600 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0065
0.20	0.45	0.0071
0.23	0.48	0.0073
0.27	0.52	0.0075
0.30	0.55	0.0076
0.37	0.61	0.0080
0.43	0.66	0.0084
0.52	0.72	0.0087
0.62	0.79	0.0089
0.75	0.87	0.0095
0.92	0.96	0.0099
1.13	1.06	0.0104
1.40	1.18	0.0109
1.73	1.32	0.0119
2.15	1.47	0.0130
2.67	1.63	0.0136
3.32	1.82	0.0140
4.15	2.04	0.0144
5.18	2.28	0.0151
6.48	2.55	0.0159
8.12	2.85	0.0166
10.18	3.19	0.0173
12.78	3.58	0.0177
16.05	4.01	0.0179
20.15	4.49	0.0181
25.32	5.03	0.0183
31.83	5.64	0.0185
40.02	6.33	0.0191
50.33	7.09	0.0193
60.42	7.77	0.0196

3200 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0084
0.20	0.45	0.0102
0.23	0.48	0.0104
0.27	0.52	0.0109
0.32	0.56	0.0117
0.37	0.61	0.0122
0.45	0.67	0.0129
0.53	0.73	0.0135
0.63	0.80	0.0142
0.77	0.88	0.0151
0.93	0.97	0.0161
1.15	1.07	0.0175
1.42	1.19	0.0189
1.75	1.32	0.0200
2.17	1.47	0.0216
2.68	1.64	0.0230
3.33	1.83	0.0242
4.15	2.04	0.0263
5.18	2.28	0.0278
6.50	2.55	0.0287
8.13	2.85	0.0299
10.18	3.19	0.0308
12.78	3.58	0.0324
16.05	4.01	0.0338
20.15	4.49	0.0345
25.32	5.03	0.0352
31.83	5.64	0.0361
40.02	6.33	0.0371
50.33	7.09	0.0382
63.32	7.96	0.0390
79.67	8.93	0.0396
100.23	10.01	0.0400
126.13	11.23	0.0410
158.73	12.60	0.0417
199.77	14.13	0.0427
251.43	15.86	0.0435
316.48	17.79	0.0442
398.37	19.96	0.0446
501.47	22.39	0.0454
631.23	25.12	0.0463
794.62	28.19	0.0471
1000.30	31.63	0.0474
1259.23	35.49	0.0482
1440.05	37.94799	0.048756

6400 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0074
0.20	0.45	0.0086
0.23	0.48	0.0090
0.27	0.52	0.0093
0.30	0.55	0.0098
0.37	0.61	0.0106
0.43	0.66	0.0113
0.53	0.73	0.0124
0.63	0.80	0.0132
0.77	0.88	0.0138
0.93	0.97	0.0144
1.15	1.07	0.0155
1.42	1.19	0.0167
1.73	1.32	0.0175
2.15	1.47	0.0188
2.67	1.63	0.0204
3.33	1.83	0.0221
4.15	2.04	0.0230
5.18	2.28	0.0244
6.48	2.55	0.0260
8.13	2.85	0.0276
10.20	3.19	0.0293
12.78	3.58	0.0306
16.05	4.01	0.0317
20.15	4.49	0.0333
25.32	5.03	0.0344
31.83	5.64	0.0359
40.02	6.33	0.0371
50.33	7.09	0.0379
60.38	7.77	0.0392

Time Deformation Readings

12800 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.12	0.34	0.0091
0.22	0.47	0.0116
0.25	0.50	0.0119
0.28	0.53	0.0123
0.32	0.56	0.0128
0.38	0.62	0.0139
0.45	0.67	0.0151
0.53	0.73	0.0160
0.65	0.81	0.0168
0.78	0.89	0.0179
0.95	0.97	0.0190
1.15	1.07	0.0208
1.42	1.19	0.0224
1.75	1.32	0.0243
2.17	1.47	0.0261
2.68	1.64	0.0281
3.33	1.83	0.0309
4.17	2.04	0.0333
5.20	2.28	0.0362
6.50	2.55	0.0389
8.13	2.85	0.0407
10.18	3.19	0.0430
12.78	3.58	0.0448
16.05	4.01	0.0460
20.15	4.49	0.0479
25.32	5.03	0.0493
31.83	5.64	0.0506
40.02	6.33	0.0516
50.33	7.09	0.0525
60.27	7.76	0.0534

25600 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0093
0.20	0.45	0.0120
0.23	0.48	0.0126
0.27	0.52	0.0136
0.30	0.55	0.0143
0.37	0.61	0.0152
0.43	0.66	0.0160
0.53	0.73	0.0173
0.63	0.80	0.0184
0.77	0.88	0.0200
0.93	0.97	0.0214
1.15	1.07	0.0229
1.42	1.19	0.0248
1.73	1.32	0.0269
2.15	1.47	0.0297
2.67	1.63	0.0315
3.33	1.83	0.0343
4.17	2.04	0.0369
5.20	2.28	0.0391
6.50	2.55	0.0414
8.15	2.85	0.0431
10.20	3.19	0.0452
12.78	3.58	0.0469
16.07	4.01	0.0480
20.17	4.49	0.0500
25.35	5.03	0.0510
31.85	5.64	0.0526
40.05	6.33	0.0535
50.37	7.10	0.0549
60.40	7.77	0.0555

6400 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	-0.0090
0.20	0.45	-0.0098
0.23	0.48	-0.0101
0.27	0.52	-0.0101
0.32	0.56	-0.0105
0.37	0.61	-0.0105
0.45	0.67	-0.0106
0.53	0.73	-0.0107
0.63	0.80	-0.0109
0.77	0.88	-0.0110
0.93	0.97	-0.0110
1.15	1.07	-0.0111
1.42	1.19	-0.0114
1.73	1.32	-0.0115
2.15	1.47	-0.0116
2.67	1.63	-0.0118
3.33	1.83	-0.0119
4.15	2.04	-0.0122
5.18	2.28	-0.0123
6.48	2.55	-0.0126
8.12	2.85	-0.0127
10.18	3.19	-0.0128
12.77	3.57	-0.0129
16.03	4.00	-0.0130
20.15	4.49	-0.0131
25.32	5.03	-0.0132
31.82	5.64	-0.0132
40.02	6.33	-0.0132
50.33	7.09	-0.0133
60.25	7.76	-0.0132

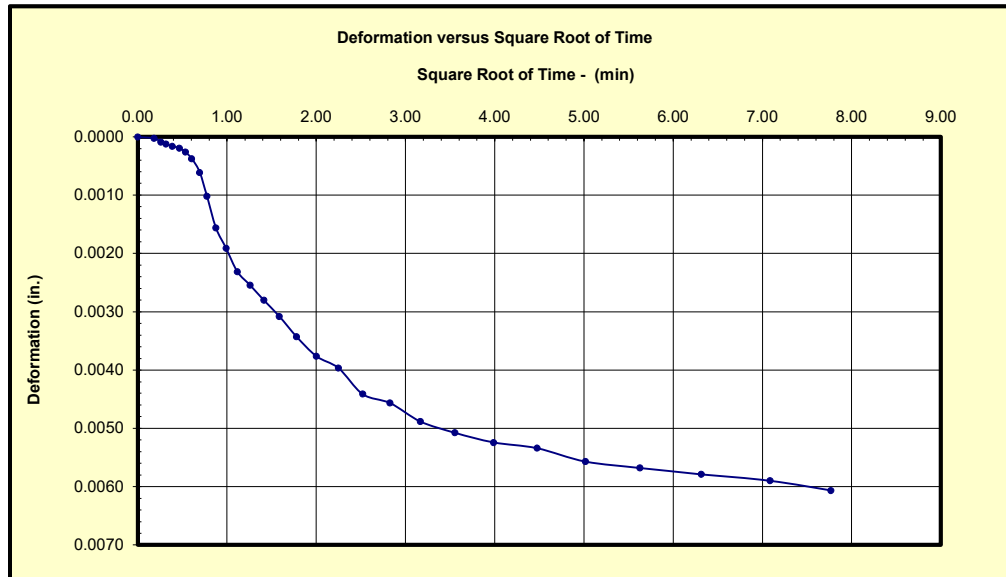
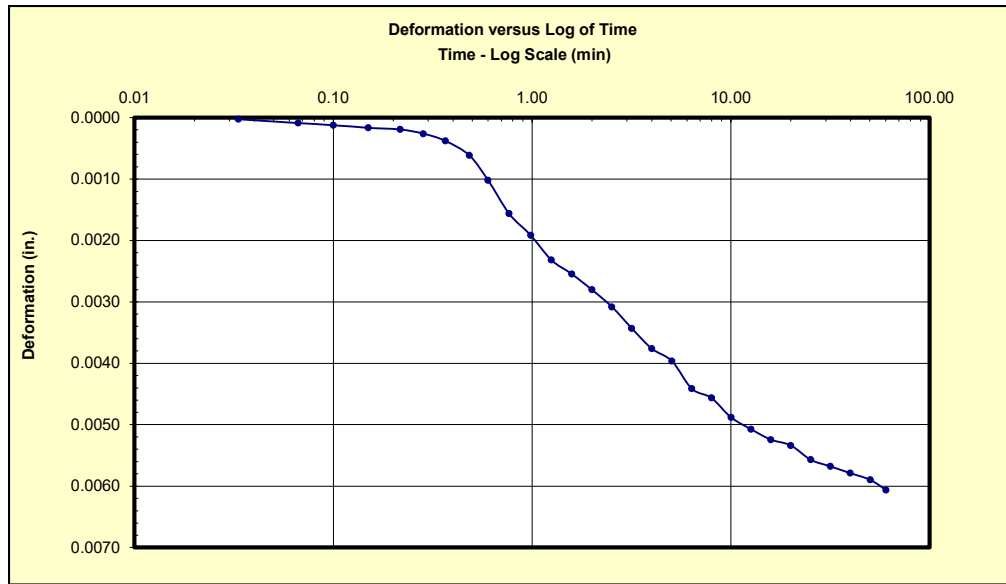
Time Deformation Readings

400 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	-0.0083
0.20	0.45	-0.0101
0.23	0.48	-0.0101
0.27	0.52	-0.0105
0.30	0.55	-0.0108
0.37	0.61	-0.0111
0.43	0.66	-0.0113
0.52	0.72	-0.0115
0.63	0.80	-0.0118
0.77	0.88	-0.0123
0.93	0.97	-0.0127
1.15	1.07	-0.0134
1.40	1.18	-0.0142
1.73	1.32	-0.0151
2.15	1.47	-0.0158
2.67	1.63	-0.0164
3.32	1.82	-0.0173
4.15	2.04	-0.0183
5.18	2.28	-0.0194
6.48	2.55	-0.0204
8.13	2.85	-0.0216
10.18	3.19	-0.0233
12.78	3.58	-0.0246
16.05	4.01	-0.0265
20.15	4.49	-0.0280
25.32	5.03	-0.0302
31.83	5.64	-0.0320
40.02	6.33	-0.0338
50.33	7.09	-0.0355
60.28	7.76	-0.0365

200 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	-0.0011
0.22	0.47	-0.0011
0.23	0.48	-0.0010
0.27	0.52	-0.0011
0.32	0.56	-0.0011
0.38	0.62	-0.0011
0.45	0.67	-0.0011
0.53	0.73	-0.0011
0.63	0.80	-0.0011
0.77	0.88	-0.0011
0.93	0.97	-0.0012
1.15	1.07	-0.0013
1.42	1.19	-0.0015
1.75	1.32	-0.0016
2.17	1.47	-0.0018
2.68	1.64	-0.0021
3.35	1.83	-0.0024
4.17	2.04	-0.0026
5.22	2.28	-0.0030
6.52	2.55	-0.0034
8.15	2.85	-0.0037
10.22	3.20	-0.0041
12.80	3.58	-0.0045
16.07	4.01	-0.0055
20.17	4.49	-0.0066
25.33	5.03	-0.0075
31.85	5.64	-0.0084
40.03	6.33	-0.0092
50.35	7.10	-0.0107
60.33	7.77	-0.0115



Scan Data

Step List

ISTEP 21

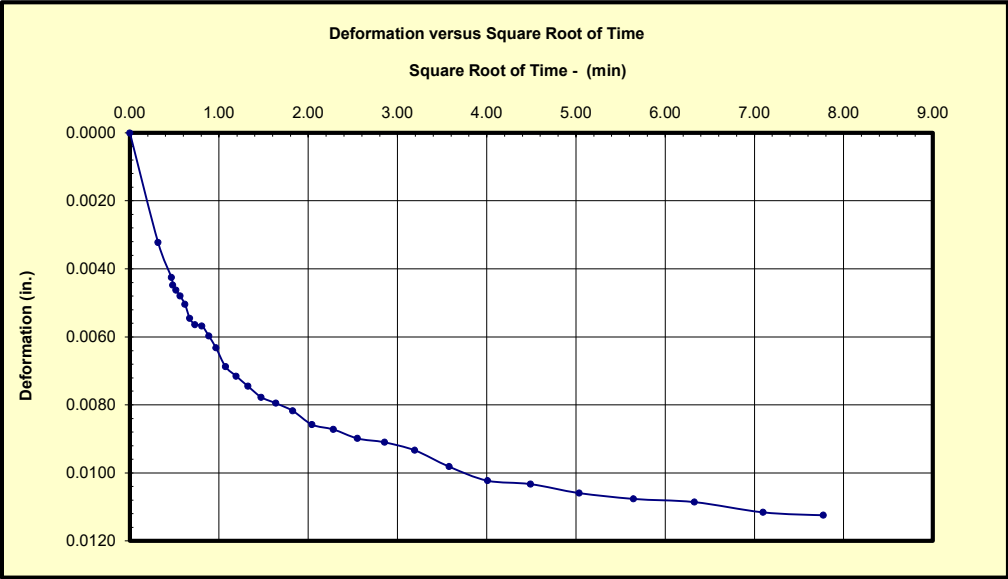
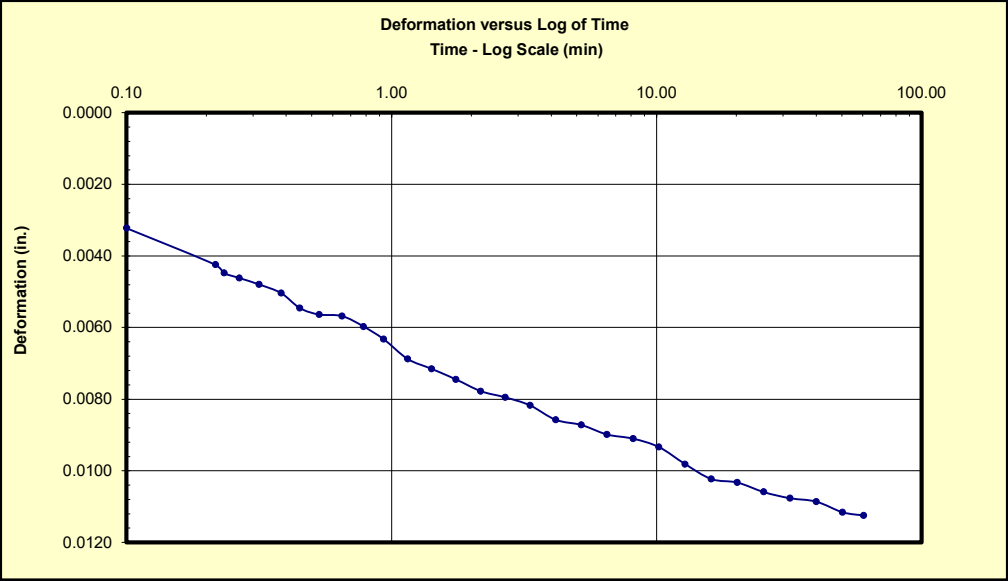
Update

Vertical Stress
200 psf
S100
No match!!!

☒ End of Primary
☐ End of Increment

Project:
L231011

B8
Depth (ft):
16.8



Scan Data

Step List

ISTEP 31

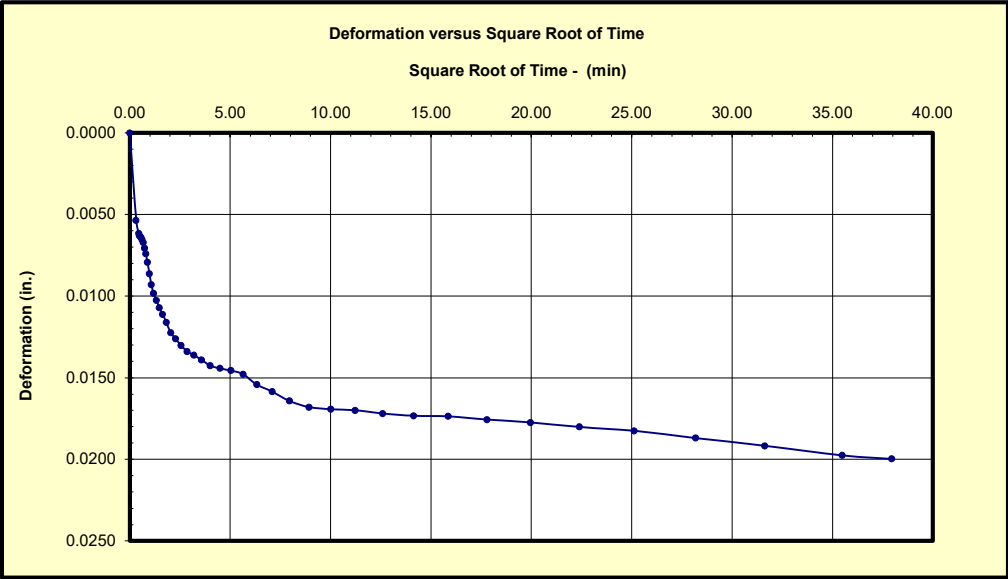
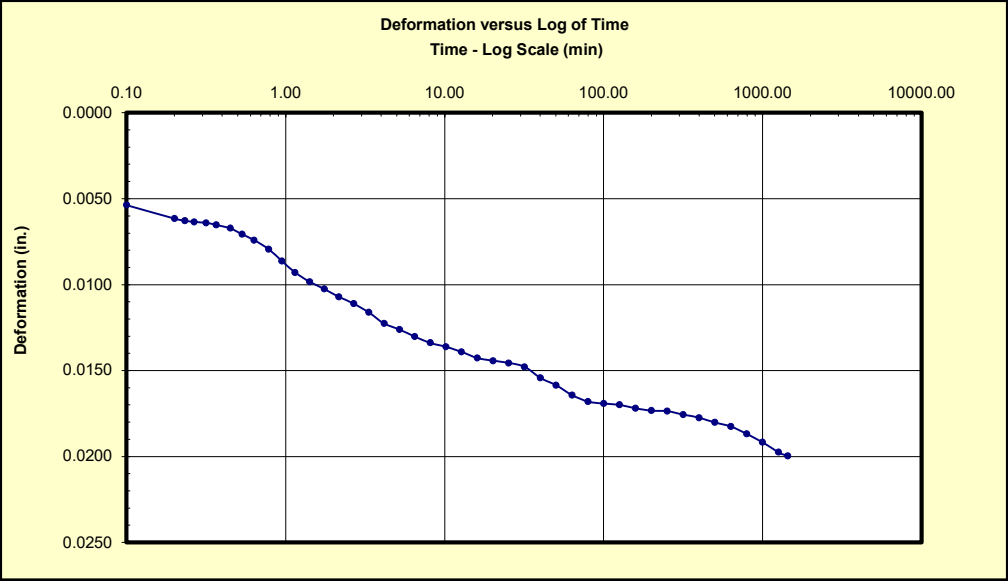
Update

Vertical Stress
400 psf
S100
No match!!!

☒ End of Primary
☐ End of Increment

Project:
L231011

B8
Depth (ft):
16.8



Scan Data

Step List

ISTEP 41

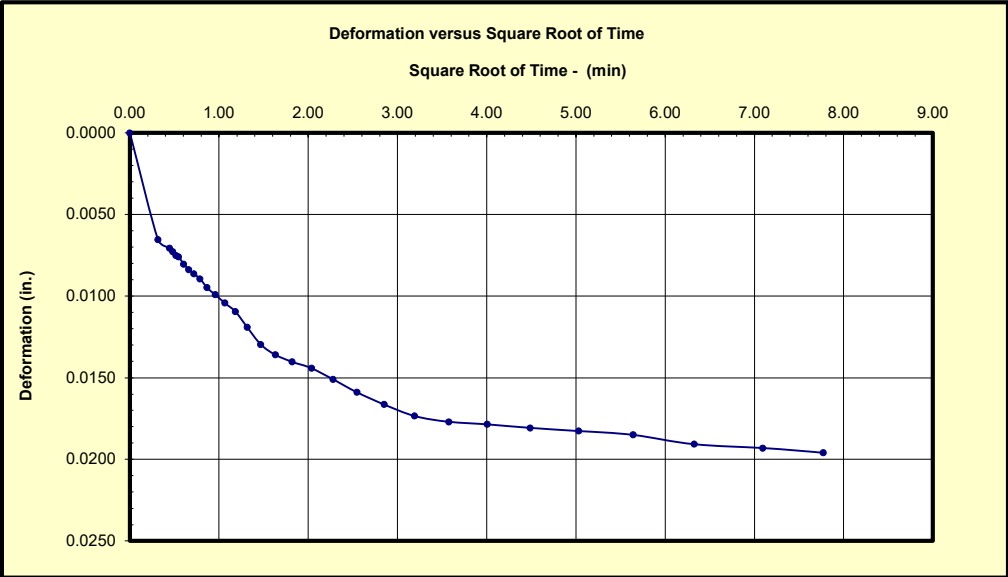
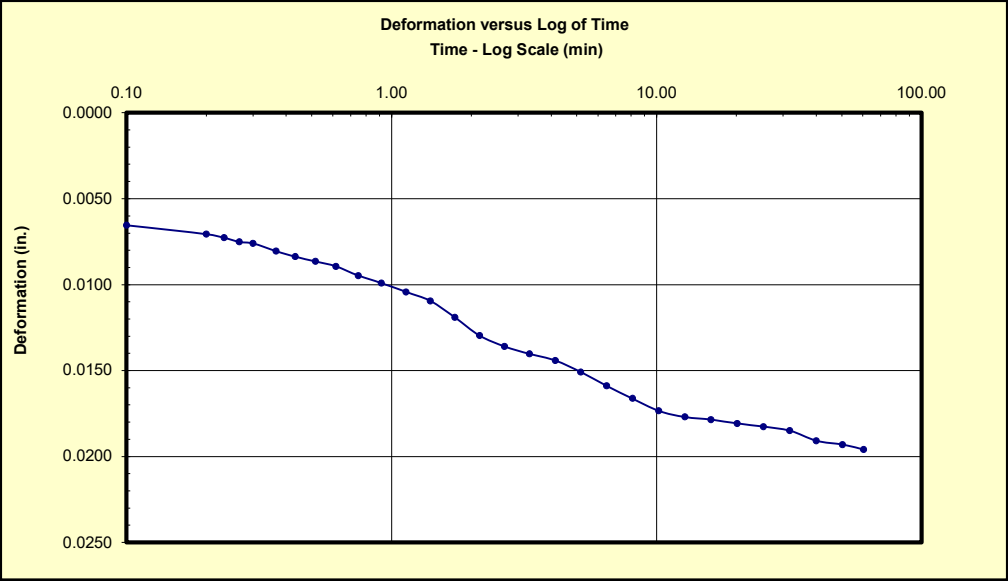
Update

Vertical Stress
800 psf
S100
No match!!!

☒ End of Primary
☐ End of Increment

Project:
L231011

B8
Depth (ft):
16.8



Scan Data

Step List

ISTEP 51

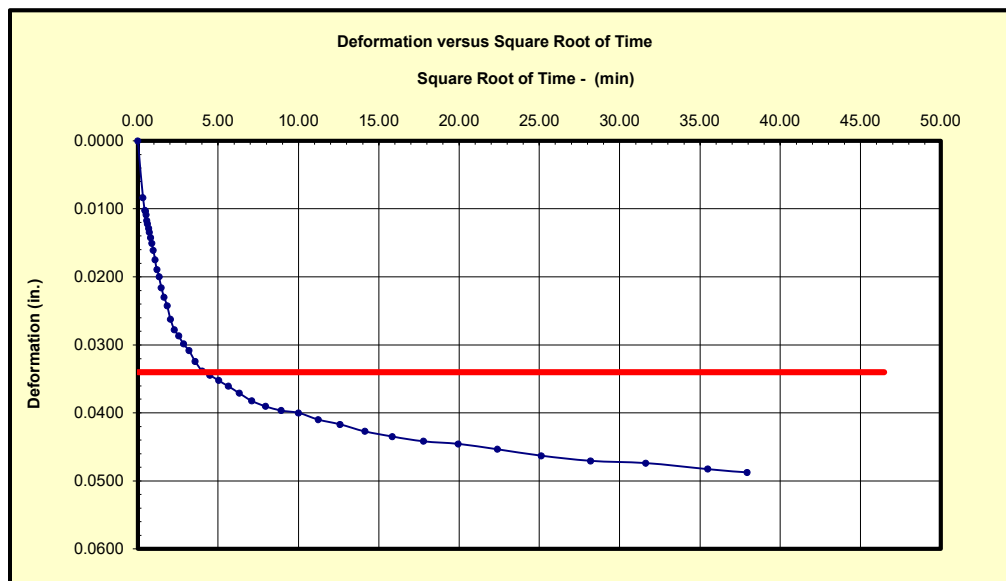
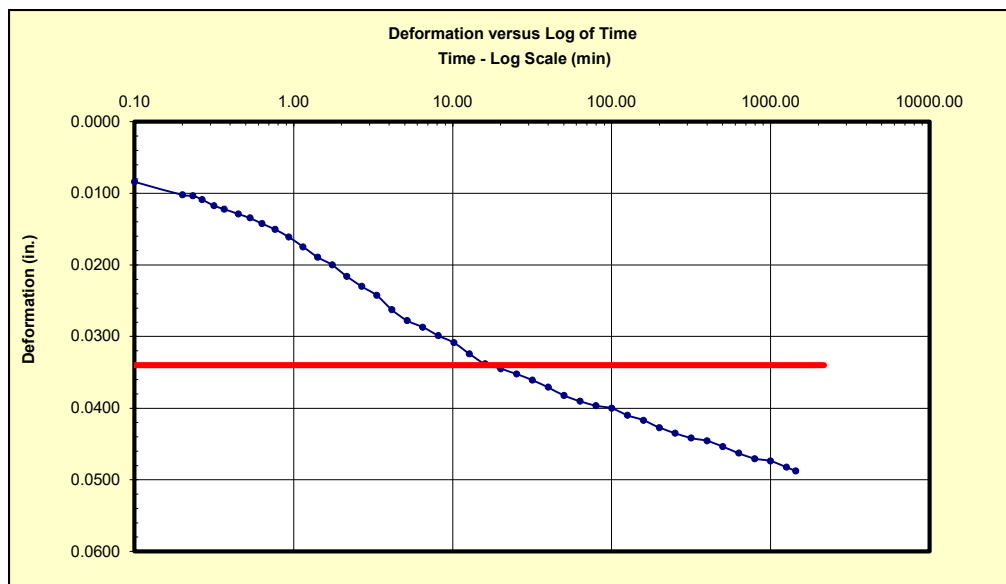
Update

Vertical Stress
1600 psf
S100
No match!!!

☒ End of Primary
☐ End of Increment

Project:
L231011

B8
Depth (ft):
16.8



Scan Data

Step List

ISTEP 61

Update

Vertical Stress
3200 psf

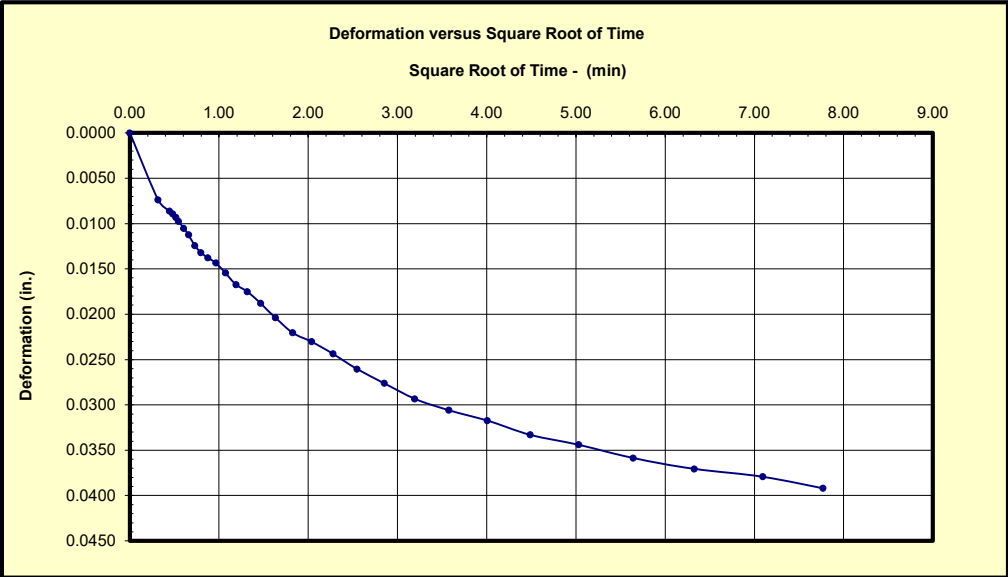
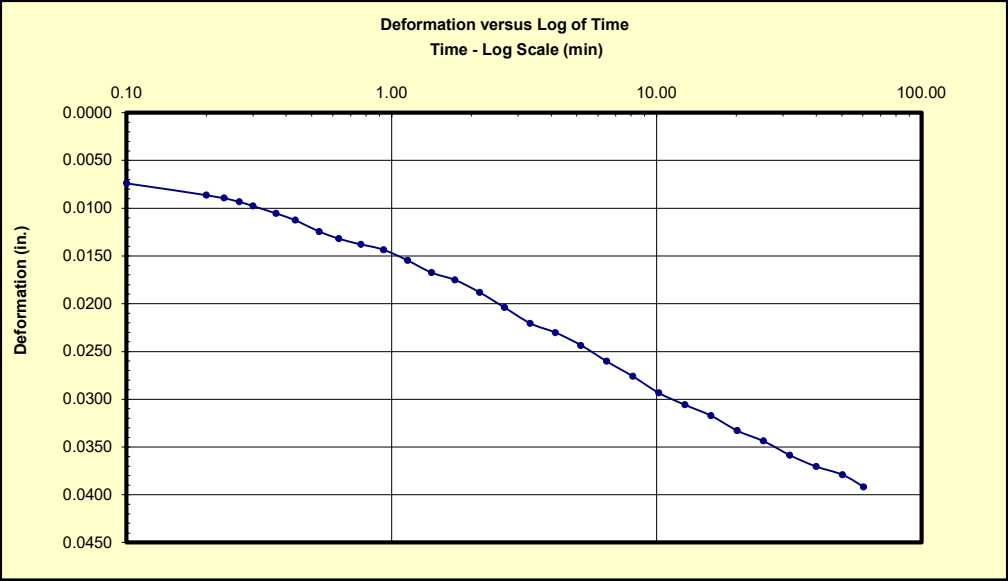
S100
0.0340 inch

☒ End of Primary

☐ End of Increment

Project:
L231011

B8
Depth (ft):
16.8



Scan Data

Step List

ISTEP 71

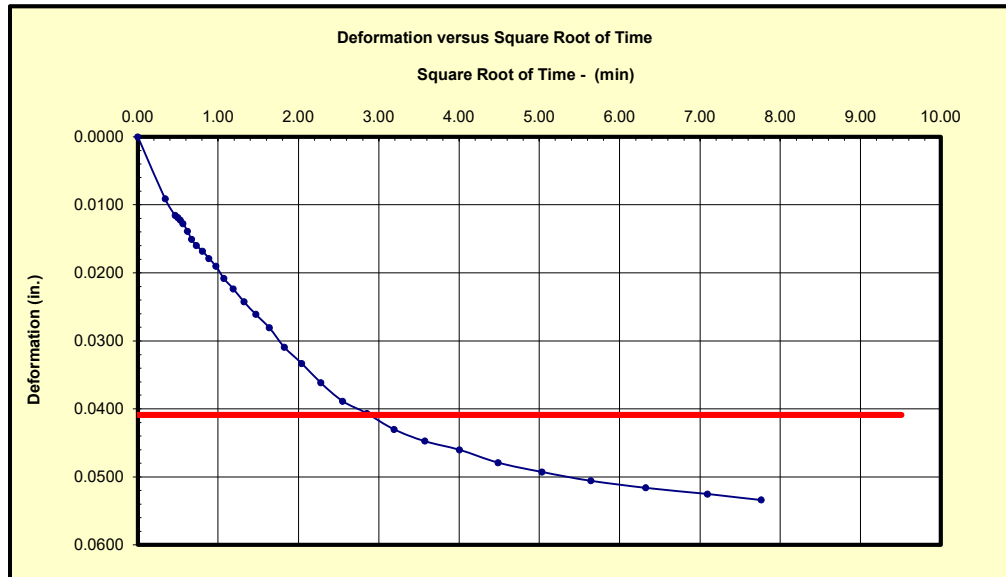
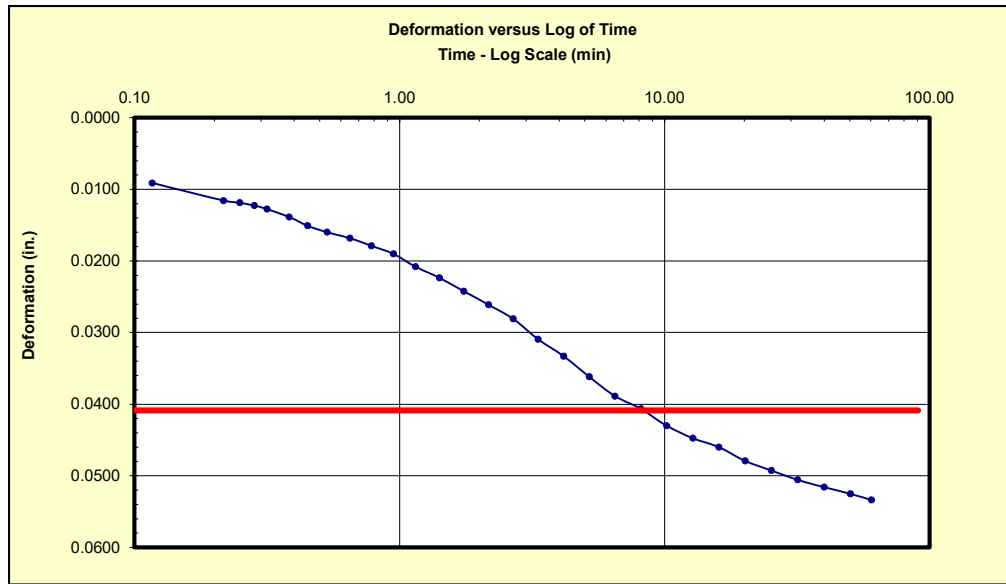
Update

Vertical Stress
6400 psf
S100
Calculating...

☒ End of Primary
☐ End of Increment

Project:
L231011

B8
Depth (ft):
16.8



Scan Data

Step List

ISTEP 81

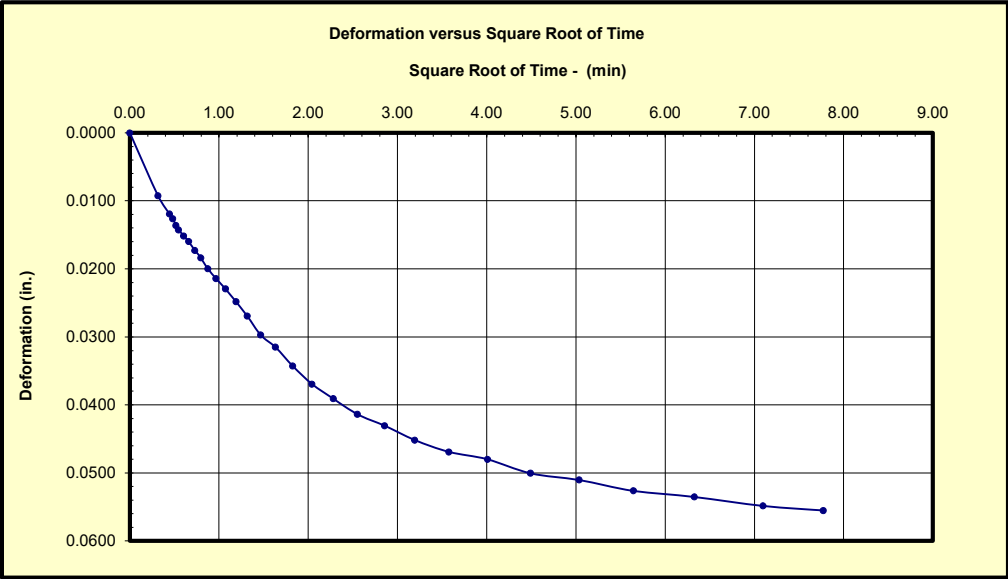
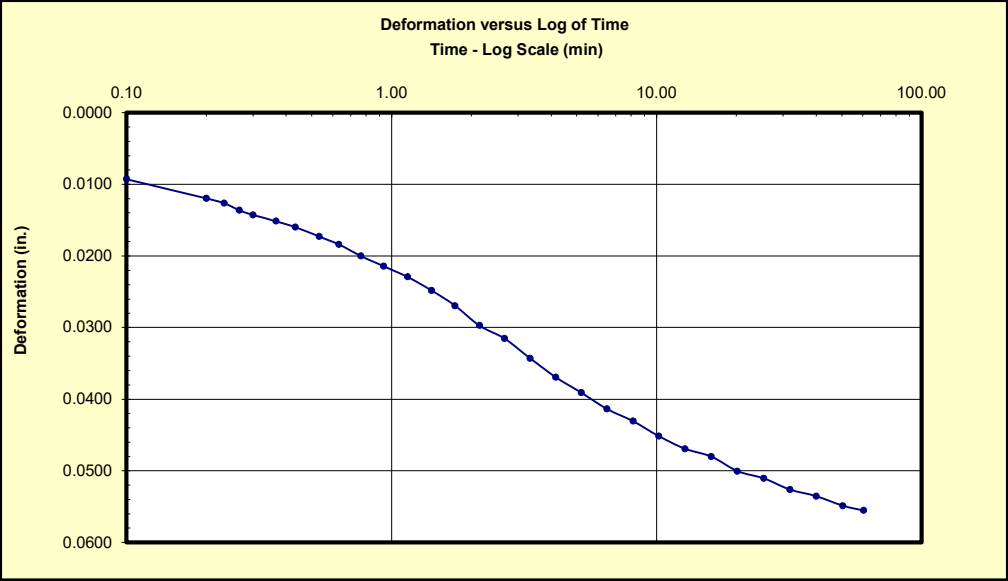
Update

Vertical Stress
12800 psf
S100
0.0409 inch

☒ End of Primary
☐ End of Increment

Project:
L231011

B8
Depth (ft):
16.8



Scan Data

Step List

ISTEP 91

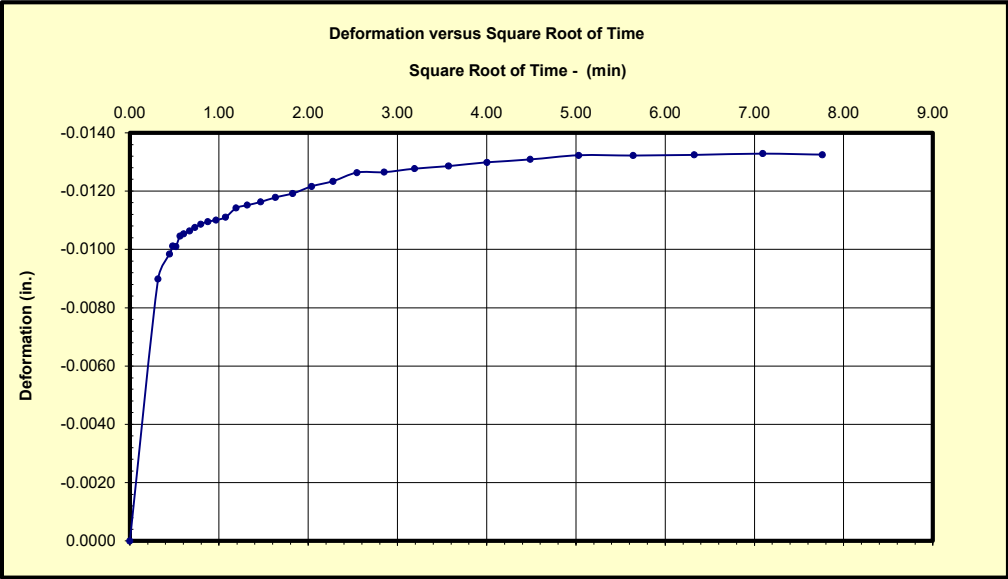
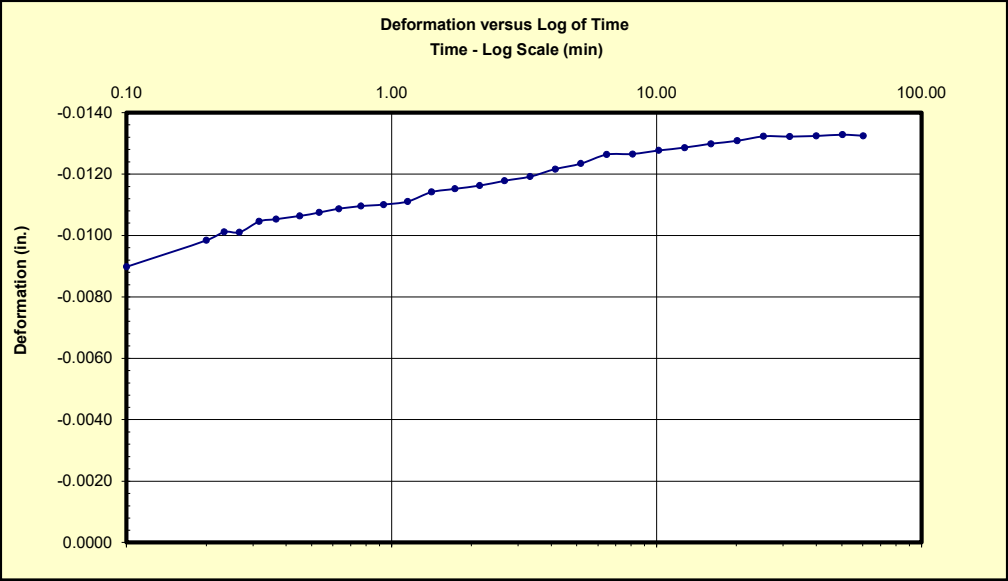
Update

Vertical Stress
25600 psf
S100
Calculating...

☒ End of Primary
☐ End of Increment

Project:
L231011

B8
Depth (ft):
16.8



Scan Data

Step List

ISTEP 101

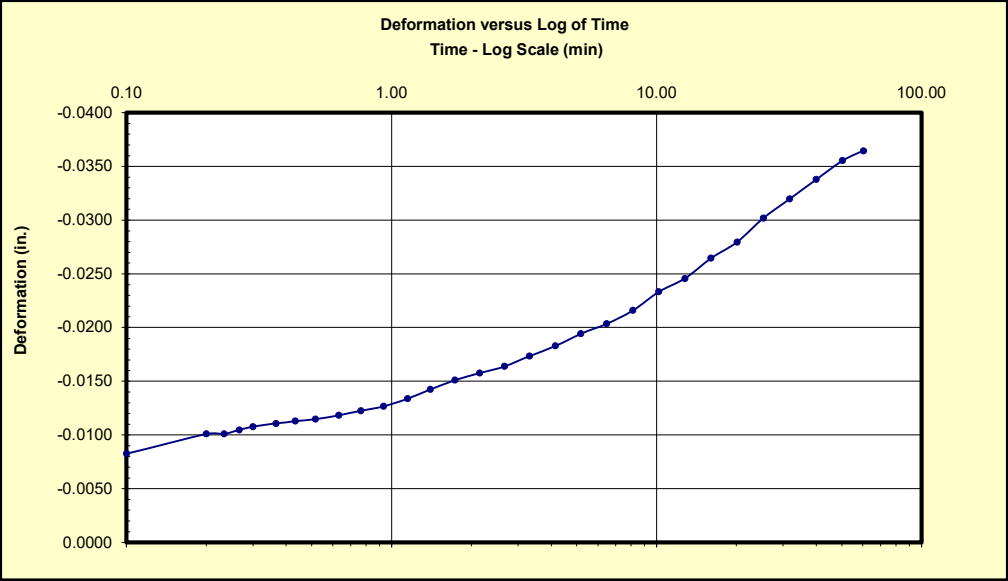
Update

Vertical Stress
6400 psf
S100
No match!!!

☒ End of Primary
☐ End of Increment

Project:
L231011

B8
Depth (ft):
16.8



Scan Data

Step List

ISTEP 111

Update

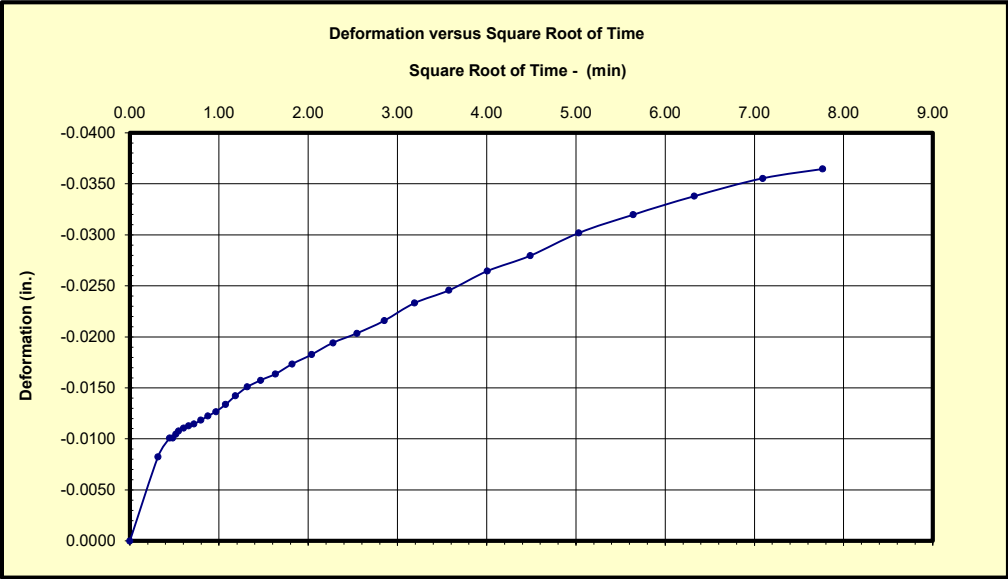
Vertical Stress
400 psf

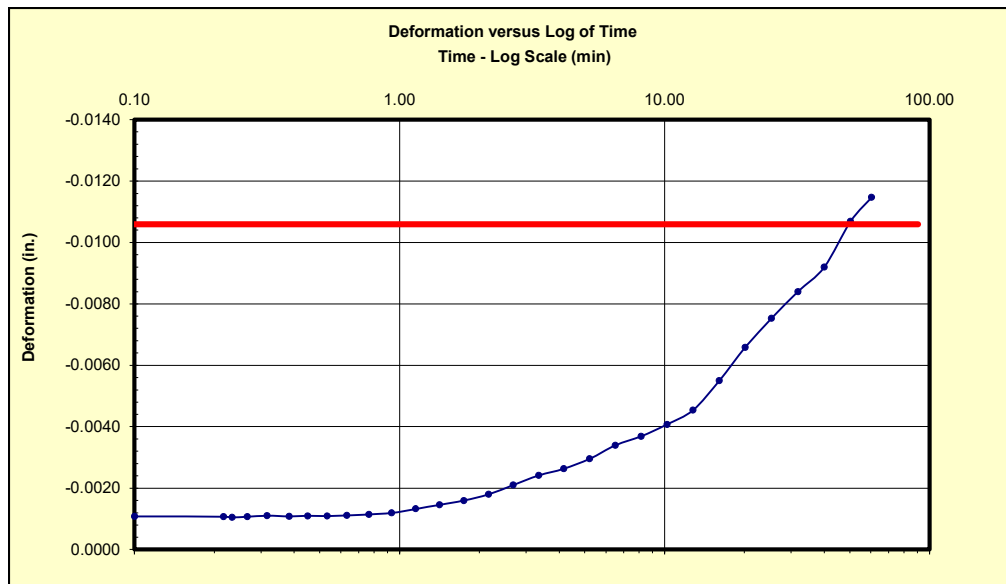
S100
No match!!!

- ☒ End of Primary
- ☐ End of Increment

Project:
L231011

B8
Depth (ft):
16.8





Scan Data

Step List

ISTEP 111

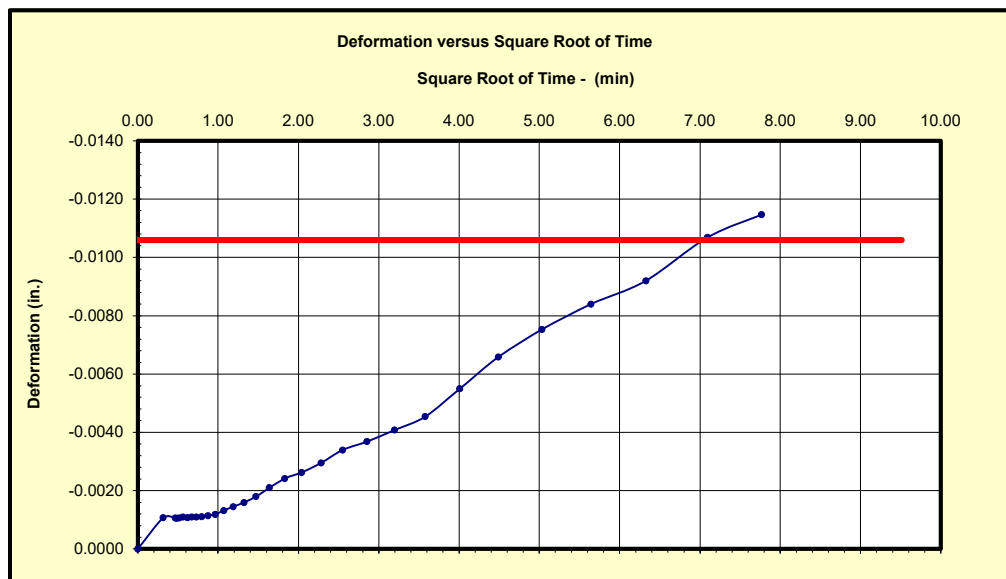
Update

Vertical Stress
200 psf
S100
-0.0106 inch

☒ End of Primary
☐ End of Increment

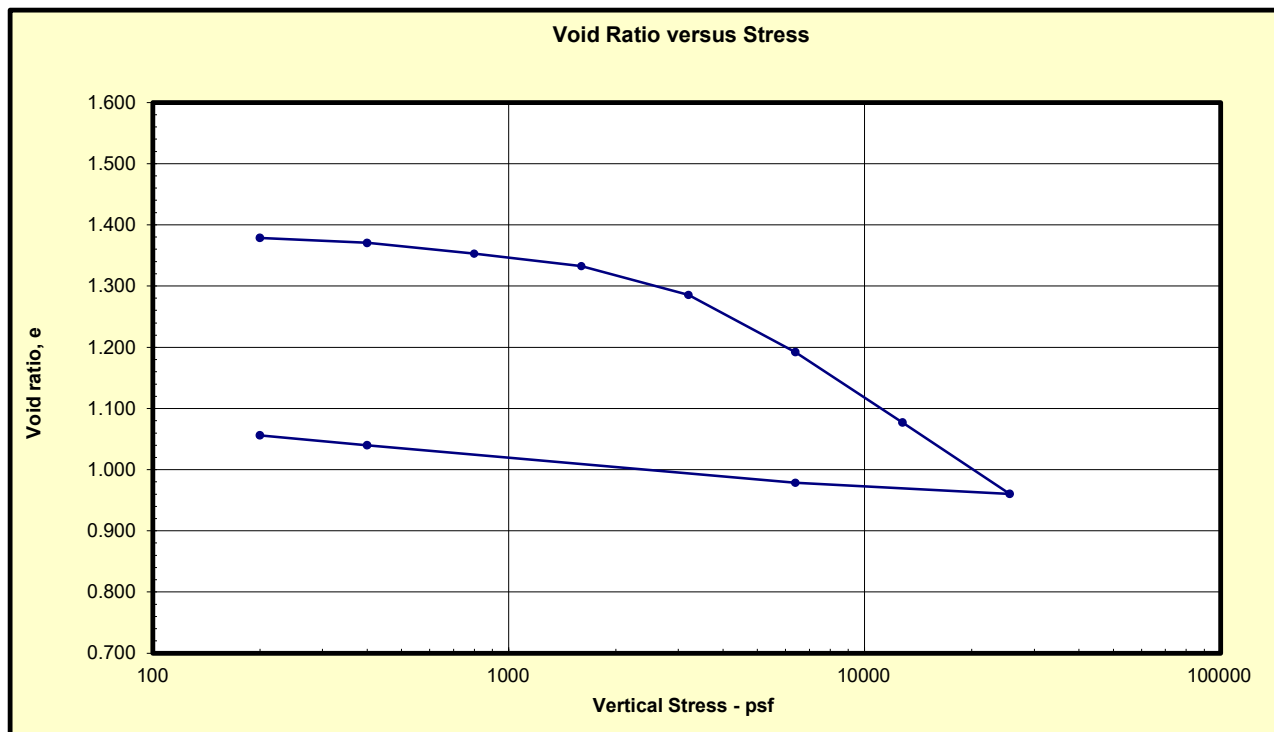
Project:
L231011

B8
Depth (ft):
16.8



Consolidation Test Results ASTM D-2435

		Load (psf)	H (in)	Consol (%)	Vs	e
Project	L231011	200	0.994	0.1	0.42	1.38
Boring	B-8	400	0.990	0.5	0.42	1.37
Depth (ft)	31.4	800	0.983	1.2	0.43	1.35
Sampled by	Client	1600	0.974	2.1	0.43	1.33
Sample diameter (in)	2.5	3200	0.955	4.1	0.44	1.29
Wet density (pcf)	102.4	6400	0.916	8.0	0.46	1.19
Initial moisture (%)	47.5	12800	0.868	12.8	0.48	1.08
Initial dry Density (pcf)	69.4	25600	0.819	17.7	0.51	0.96
Final moisture (%)	42.6	6400	0.826	16.9	0.51	0.98
Final dry density	80.8	400	0.852	14.4	0.49	1.04
Specific gravity (assumed)	2.65	200	0.859	13.7	0.49	1.06
Initial height, H (in)	0.995					
Volume of solids (Vs)	0.42					
Volume of voids (Vv)	0.58					
Initial void ratio (e0)	1.38					
Total consolidation (%)	17.7					
Final Volume of solids (Vs)	0.51					
Minimum void ratio (ef)	0.96					
Effective stress in-situ(psf)	-					
Pre-consolidation stress (psf)	-					
Over-consolidation ratio, OCR	-					
Saturate sample at (psf)	200.0					



Time Deformation Readings

200 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.03	0.18	0.0000
0.07	0.26	0.0000
0.10	0.32	0.0000
0.13	0.37	0.0000
0.20	0.45	0.0001
0.27	0.52	0.0002
0.37	0.61	0.0003
0.47	0.68	0.0003
0.60	0.77	0.0004
0.77	0.88	0.0004
0.98	0.99	0.0005
1.25	1.12	0.0005
1.57	1.25	0.0006
1.98	1.41	0.0006
2.52	1.59	0.0007
3.17	1.78	0.0007
3.98	2.00	0.0007
5.02	2.24	0.0007
6.32	2.51	0.0008
7.97	2.82	0.0009
10.02	3.16	0.0009
12.62	3.55	0.0009
15.88	3.99	0.0009
19.98	4.47	0.0010
25.17	5.02	0.0010
31.67	5.63	0.0010
39.87	6.31	0.0011
50.17	7.08	0.0012
63.15	7.95	0.0012
79.50	8.92	0.0013
100.07	10.00	0.0015
125.97	11.22	0.0015
158.57	12.59	0.0018
199.62	14.13	0.0018
251.28	15.85	0.0018
316.33	17.79	0.0017
398.22	19.96	0.0018
501.30	22.39	0.0018
631.08	25.12	0.0018
720.07	26.83	0.0018

400 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0036
0.20	0.45	0.0036
0.23	0.48	0.0036
0.27	0.52	0.0036
0.32	0.56	0.0036
0.37	0.61	0.0036
0.43	0.66	0.0037
0.53	0.73	0.0037
0.63	0.80	0.0037
0.77	0.88	0.0037
0.93	0.97	0.0037
1.15	1.07	0.0037
1.40	1.18	0.0037
1.73	1.32	0.0038
2.15	1.47	0.0038
2.67	1.63	0.0038
3.33	1.83	0.0039
4.15	2.04	0.0039
5.18	2.28	0.0039
6.48	2.55	0.0039
8.13	2.85	0.0039
10.20	3.19	0.0039
12.78	3.58	0.0040
16.05	4.01	0.0040
20.17	4.49	0.0041
25.33	5.03	0.0041
31.85	5.64	0.0041
40.05	6.33	0.0043
50.35	7.10	0.0044
63.33	7.96	0.0045
79.68	8.93	0.0045
100.25	10.01	0.0045
126.15	11.23	0.0046
158.75	12.60	0.0046
199.80	14.14	0.0046
251.47	15.86	0.0047
313.58	17.71	0.0047

800 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0029
0.20	0.45	0.0035
0.23	0.48	0.0037
0.27	0.52	0.0038
0.32	0.56	0.0039
0.37	0.61	0.0042
0.43	0.66	0.0042
0.53	0.73	0.0044
0.63	0.80	0.0045
0.77	0.88	0.0046
0.93	0.97	0.0046
1.15	1.07	0.0048
1.42	1.19	0.0049
1.75	1.32	0.0050
2.17	1.47	0.0056
2.68	1.64	0.0056
3.33	1.83	0.0056
4.15	2.04	0.0057
5.20	2.28	0.0058
6.50	2.55	0.0060
8.13	2.85	0.0060
10.20	3.19	0.0062
12.78	3.58	0.0062
16.05	4.01	0.0063
20.17	4.49	0.0063
25.33	5.03	0.0063
31.85	5.64	0.0066
40.03	6.33	0.0067
50.35	7.10	0.0067
63.33	7.96	0.0067
79.68	8.93	0.0069
100.25	10.01	0.0070
126.13	11.23	0.0071
158.73	12.60	0.0072
199.78	14.13	0.0072
251.45	15.86	0.0073
316.48	17.79	0.0074
398.38	19.96	0.0080
501.47	22.39	0.0086
631.25	25.12	0.0086
794.62	28.19	0.0087
1000.30	31.63	0.0088
1259.23	35.49	0.0089
1440.083	37.94843	0.008842

Time Deformation Readings

1600 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0041
0.20	0.45	0.0047
0.23	0.48	0.0048
0.27	0.52	0.0050
0.32	0.56	0.0051
0.38	0.62	0.0052
0.45	0.67	0.0054
0.53	0.73	0.0056
0.65	0.81	0.0058
0.78	0.89	0.0060
0.93	0.97	0.0061
1.15	1.07	0.0063
1.42	1.19	0.0064
1.75	1.32	0.0065
2.17	1.47	0.0067
2.68	1.64	0.0070
3.33	1.83	0.0071
4.17	2.04	0.0073
5.20	2.28	0.0076
6.50	2.55	0.0077
8.13	2.85	0.0078
10.18	3.19	0.0079
12.78	3.58	0.0080
16.05	4.01	0.0082
20.17	4.49	0.0085
25.33	5.03	0.0088
31.85	5.64	0.0088
40.03	6.33	0.0089
50.35	7.10	0.0091
63.33	7.96	0.0093
79.67	8.93	0.0094
100.23	10.01	0.0095
126.13	11.23	0.0095
158.73	12.60	0.0096
199.78	14.13	0.0098
251.45	15.86	0.0099
316.48	17.79	0.0100
398.38	19.96	0.0102
501.47	22.39	0.0103
631.25	25.12	0.0104
720.37	26.84	0.0104

3200 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.08	0.29	0.0092
0.18	0.43	0.0097
0.22	0.47	0.0098
0.25	0.50	0.0100
0.30	0.55	0.0102
0.37	0.61	0.0106
0.43	0.66	0.0108
0.52	0.72	0.0115
0.63	0.80	0.0117
0.77	0.88	0.0121
0.92	0.96	0.0123
1.13	1.06	0.0125
1.40	1.18	0.0127
1.73	1.32	0.0129
2.13	1.46	0.0132
2.67	1.63	0.0134
3.32	1.82	0.0135
4.13	2.03	0.0137
5.17	2.27	0.0139
6.47	2.54	0.0141
8.12	2.85	0.0145
10.17	3.19	0.0148
12.75	3.57	0.0150
16.02	4.00	0.0151
20.13	4.49	0.0154
25.30	5.03	0.0157
31.80	5.64	0.0159
40.00	6.32	0.0162
50.32	7.09	0.0163
63.30	7.96	0.0169
79.63	8.92	0.0171
100.22	10.01	0.0174
126.10	11.23	0.0175
158.70	12.60	0.0181
199.73	14.13	0.0187
251.42	15.86	0.0192
316.45	17.79	0.0193
398.33	19.96	0.0196
501.43	22.39	0.0197
631.22	25.12	0.0199
794.58	28.19	0.0202
1000.27	31.63	0.0207
1259.20	35.49	0.0214
1440.35	37.95194	0.022019

6400 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0120
0.22	0.47	0.0146
0.23	0.48	0.0152
0.27	0.52	0.0158
0.32	0.56	0.0165
0.37	0.61	0.0173
0.45	0.67	0.0180
0.53	0.73	0.0182
0.65	0.81	0.0186
0.77	0.88	0.0193
0.93	0.97	0.0200
1.15	1.07	0.0214
1.42	1.19	0.0222
1.75	1.32	0.0228
2.17	1.47	0.0235
2.68	1.64	0.0246
3.33	1.83	0.0252
4.15	2.04	0.0255
5.18	2.28	0.0259
6.50	2.55	0.0268
8.13	2.85	0.0277
10.18	3.19	0.0289
12.78	3.58	0.0296
16.05	4.01	0.0301
20.15	4.49	0.0306
25.32	5.03	0.0318
31.83	5.64	0.0321
40.02	6.33	0.0328
50.33	7.09	0.0333
63.32	7.96	0.0342
79.65	8.92	0.0350
100.22	10.01	0.0355
126.12	11.23	0.0367
158.72	12.60	0.0376
199.77	14.13	0.0384
251.43	15.86	0.0393
316.48	17.79	0.0399
398.37	19.96	0.0405
501.45	22.39	0.0414
631.23	25.12	0.0419
720.17	26.84	0.0422

Time Deformation Readings

12800 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0134
0.20	0.45	0.0167
0.23	0.48	0.0172
0.27	0.52	0.0176
0.30	0.55	0.0182
0.37	0.61	0.0190
0.43	0.66	0.0206
0.52	0.72	0.0216
0.63	0.80	0.0224
0.77	0.88	0.0235
0.93	0.97	0.0246
1.13	1.06	0.0253
1.40	1.18	0.0268
1.73	1.32	0.0285
2.15	1.47	0.0296
2.67	1.63	0.0304
3.32	1.82	0.0319
4.15	2.04	0.0331
5.17	2.27	0.0342
6.47	2.54	0.0352
8.12	2.85	0.0362
10.17	3.19	0.0371
12.77	3.57	0.0387
16.03	4.00	0.0397
20.15	4.49	0.0404
25.32	5.03	0.0408
31.82	5.64	0.0417
40.02	6.33	0.0424
50.32	7.09	0.0434
63.32	7.96	0.0438
79.65	8.92	0.0441
100.22	10.01	0.0450
126.12	11.23	0.0459
158.72	12.60	0.0469
199.77	14.13	0.0475
251.43	15.86	0.0487
316.47	17.79	0.0493
398.35	19.96	0.0498
501.45	22.39	0.0507
631.23	25.12	0.0511
720.35	26.84	0.0516

25600 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0118
0.20	0.45	0.0154
0.23	0.48	0.0161
0.27	0.52	0.0170
0.30	0.55	0.0185
0.37	0.61	0.0198
0.43	0.66	0.0213
0.53	0.73	0.0224
0.63	0.80	0.0236
0.77	0.88	0.0252
0.93	0.97	0.0263
1.15	1.07	0.0276
1.40	1.18	0.0295
1.73	1.32	0.0305
2.15	1.47	0.0316
2.67	1.63	0.0328
3.32	1.82	0.0339
4.15	2.04	0.0353
5.18	2.28	0.0361
6.48	2.55	0.0371
8.12	2.85	0.0379
10.18	3.19	0.0390
12.77	3.57	0.0398
16.03	4.00	0.0403
20.15	4.49	0.0415
25.32	5.03	0.0419
31.83	5.64	0.0424
40.02	6.33	0.0434
50.33	7.09	0.0446
63.32	7.96	0.0452
79.65	8.92	0.0458
100.23	10.01	0.0466
126.13	11.23	0.0474
158.73	12.60	0.0483
199.77	14.13	0.0492
251.45	15.86	0.0501
316.50	17.79	0.0507
398.38	19.96	0.0516
501.47	22.39	0.0525
631.25	25.12	0.0534
720.27	26.84	0.0536

6400 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	-0.0095
0.20	0.45	-0.0097
0.23	0.48	-0.0098
0.27	0.52	-0.0099
0.32	0.56	-0.0101
0.37	0.61	-0.0102
0.43	0.66	-0.0104
0.52	0.72	-0.0106
0.63	0.80	-0.0108
0.77	0.88	-0.0110
0.93	0.97	-0.0112
1.13	1.06	-0.0113
1.40	1.18	-0.0114
1.73	1.32	-0.0115
2.15	1.47	-0.0115
2.67	1.63	-0.0116
3.32	1.82	-0.0118
4.15	2.04	-0.0118
5.18	2.28	-0.0118
6.48	2.55	-0.0118
8.12	2.85	-0.0118
10.17	3.19	-0.0118
12.77	3.57	-0.0119
16.03	4.00	-0.0120
20.13	4.49	-0.0120
25.30	5.03	-0.0120
31.82	5.64	-0.0122
40.00	6.32	-0.0123
50.32	7.09	-0.0123
63.30	7.96	-0.0125
79.65	8.92	-0.0126
100.22	10.01	-0.0127
126.12	11.23	-0.0128
158.72	12.60	-0.0128
199.77	14.13	-0.0128
251.43	15.86	-0.0130
316.48	17.79	-0.0131
398.35	19.96	-0.0131
501.45	22.39	-0.0132
631.22	25.12	-0.0132
720.37	26.84	-0.0132

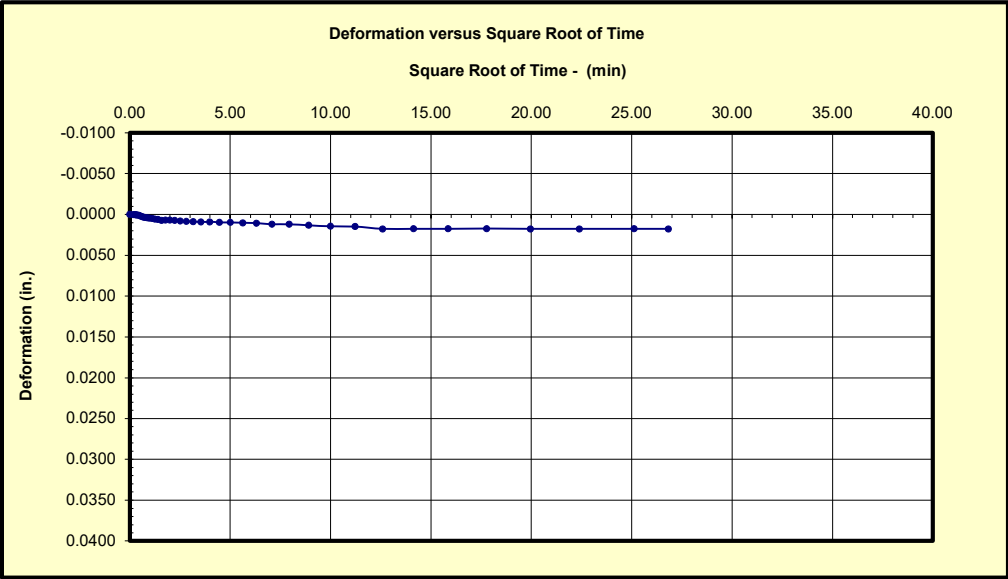
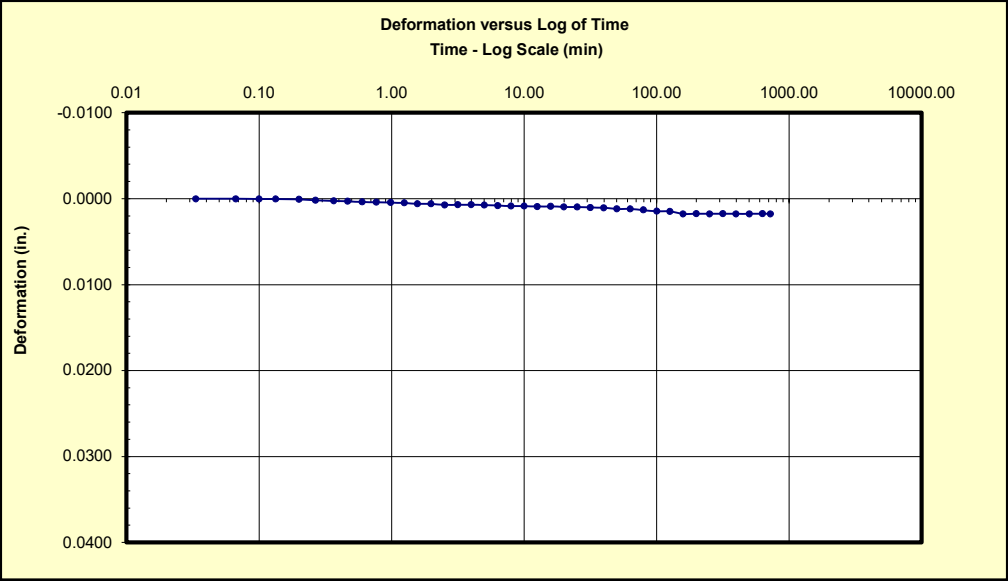
Time Deformation Readings

400 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	-0.0088
0.20	0.45	-0.0098
0.23	0.48	-0.0101
0.27	0.52	-0.0102
0.32	0.56	-0.0103
0.37	0.61	-0.0106
0.45	0.67	-0.0111
0.53	0.73	-0.0120
0.63	0.80	-0.0125
0.77	0.88	-0.0131
0.93	0.97	-0.0136
1.15	1.07	-0.0141
1.42	1.19	-0.0146
1.75	1.32	-0.0152
2.17	1.47	-0.0157
2.68	1.64	-0.0168
3.33	1.83	-0.0176
4.15	2.04	-0.0184
5.18	2.28	-0.0190
6.48	2.55	-0.0197
8.12	2.85	-0.0205
10.18	3.19	-0.0215
12.77	3.57	-0.0223
16.03	4.00	-0.0231
20.15	4.49	-0.0242
25.32	5.03	-0.0247
31.83	5.64	-0.0253
40.02	6.33	-0.0260
50.33	7.09	-0.0267
63.33	7.96	-0.0276
79.67	8.93	-0.0283
100.25	10.01	-0.0285
126.15	11.23	-0.0288
158.75	12.60	-0.0298
199.78	14.13	-0.0305
251.45	15.86	-0.0309
316.50	17.79	-0.0312
398.38	19.96	-0.0317
501.47	22.39	-0.0322
631.25	25.12	-0.0329
704.67	26.55	-0.0331

200 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	-0.0009
0.20	0.45	-0.0009
0.23	0.48	-0.0011
0.27	0.52	-0.0011
0.32	0.56	-0.0011
0.37	0.61	-0.0011
0.45	0.67	-0.0012
0.53	0.73	-0.0012
0.63	0.80	-0.0014
0.77	0.88	-0.0014
0.93	0.97	-0.0015
1.15	1.07	-0.0015
1.42	1.19	-0.0015
1.73	1.32	-0.0017
2.15	1.47	-0.0018
2.67	1.63	-0.0017
3.33	1.83	-0.0018
4.15	2.04	-0.0019
5.18	2.28	-0.0020
6.48	2.55	-0.0020
8.13	2.85	-0.0021
10.45	3.23	-0.0023
12.78	3.58	-0.0025
16.05	4.01	-0.0027
20.15	4.49	-0.0030
25.32	5.03	-0.0034
31.83	5.64	-0.0035
40.02	6.33	-0.0037
50.33	7.09	-0.0038
63.32	7.96	-0.0043
79.67	8.93	-0.0045
100.23	10.01	-0.0048
126.13	11.23	-0.0052
158.73	12.60	-0.0054
199.78	14.13	-0.0058
251.45	15.86	-0.0062
316.50	17.79	-0.0066
398.38	19.96	-0.0071
501.47	22.39	-0.0075
631.25	25.12	-0.0080
720.32	26.84	-0.0081



Scan Data

Step List

ISTEP 21

Update

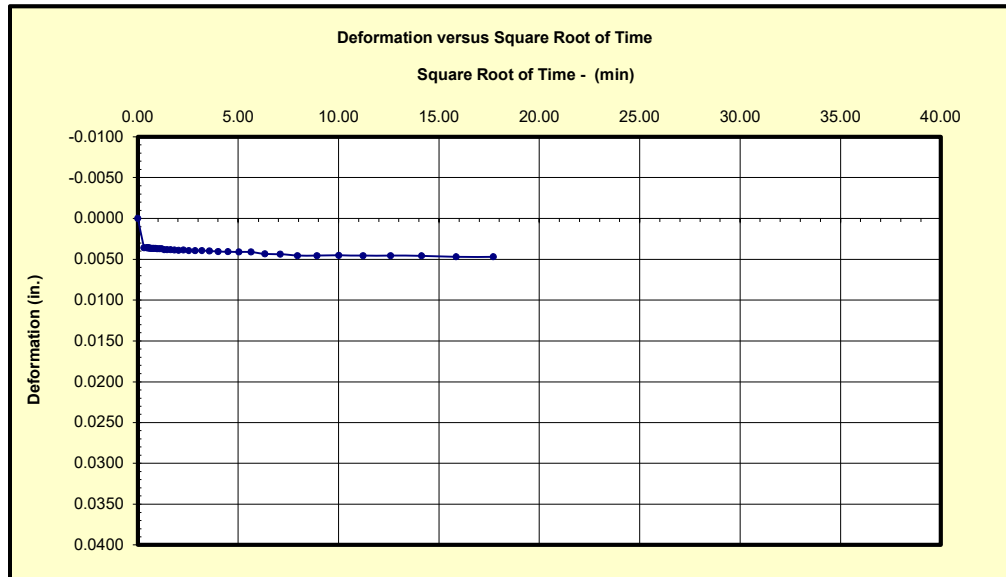
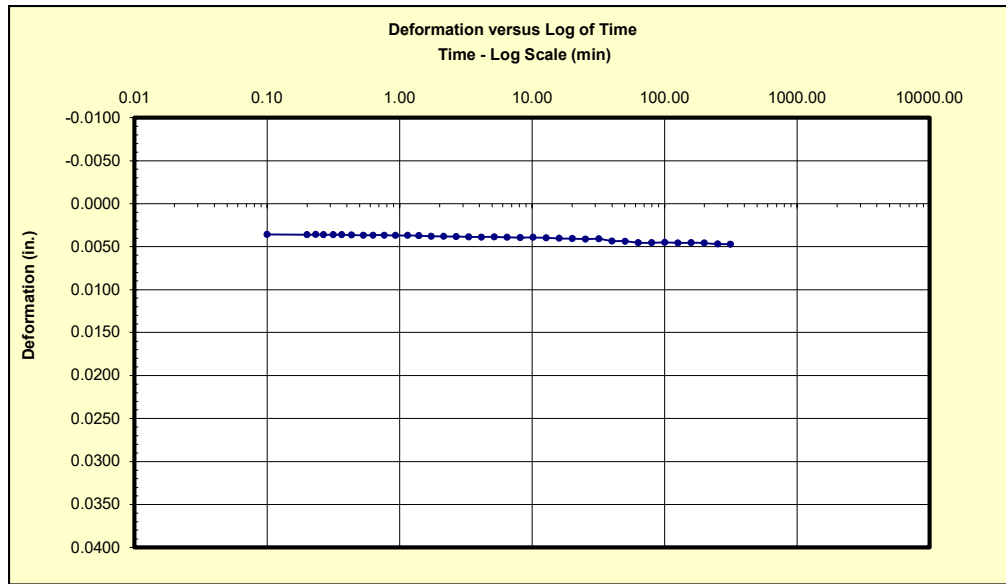
Vertical Stress
200 psf

S100
No match!!!

- ☒ End of Primary
- ☐ End of Increment

Project:
L231011

Boring1
Depth (ft):
10



Scan Data

Step List

ISTEP 31

Update

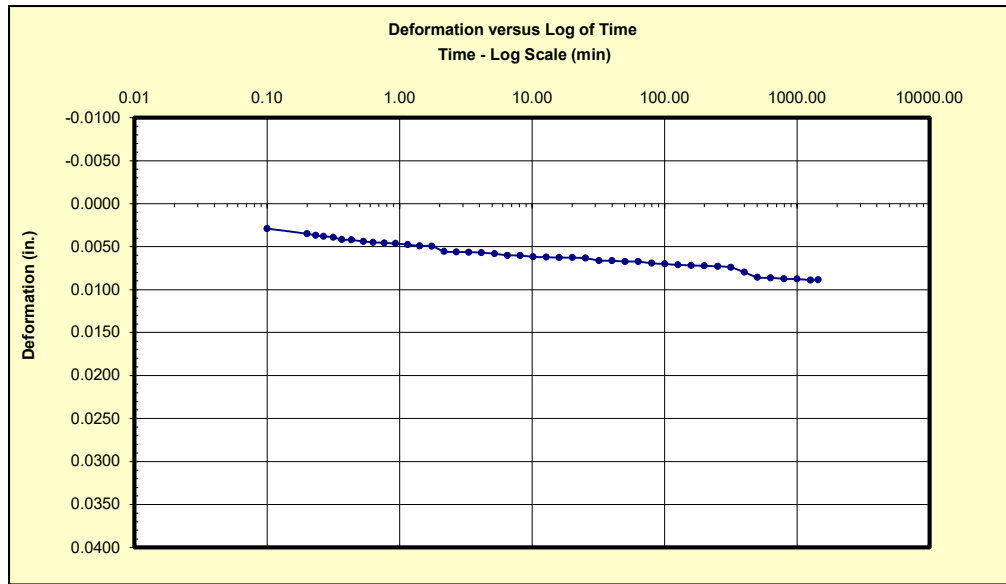
Vertical Stress
400 psf

S100
No match!!!

- ☒ End of Primary
☐ End of Increment

Project:
L231011

B8
Depth (ft):
31.4



Scan Data

Step List

ISTEP 41

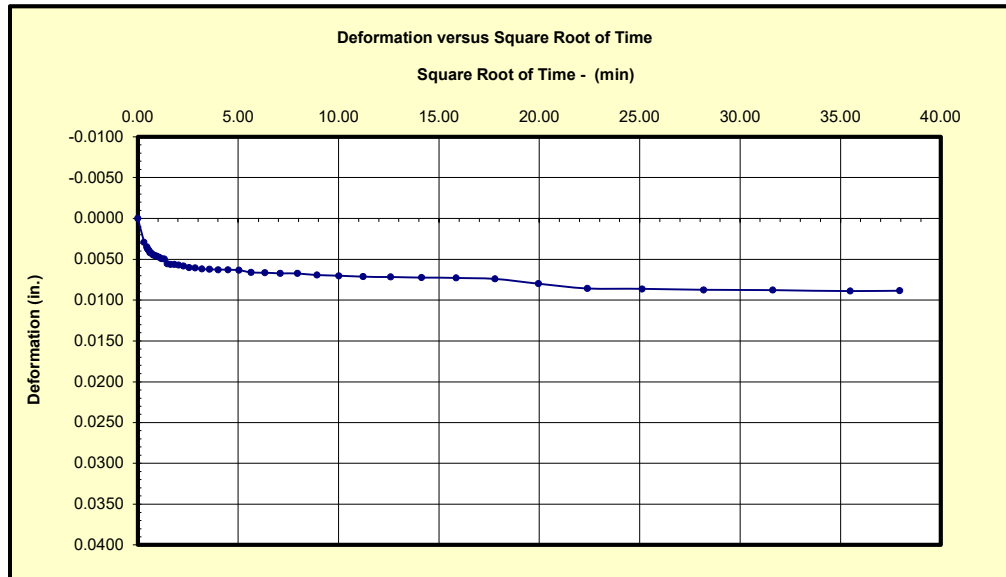
Update

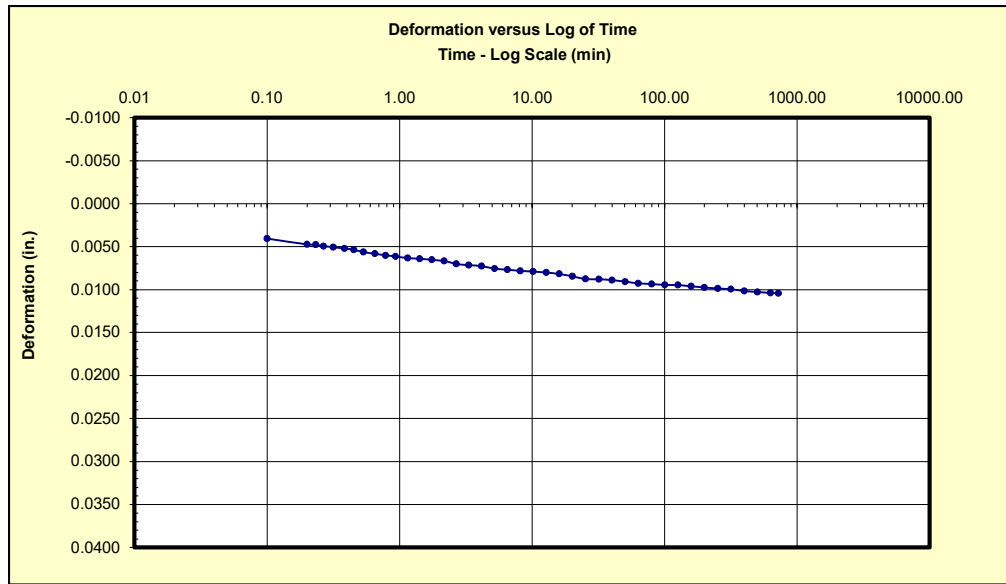
Vertical Stress
800 psf
S100
No match!!!

☒ End of Primary
☐ End of Increment

Project:
L231011

B8
Depth (ft):
31.4





Scan Data

Step List

ISTEP 51

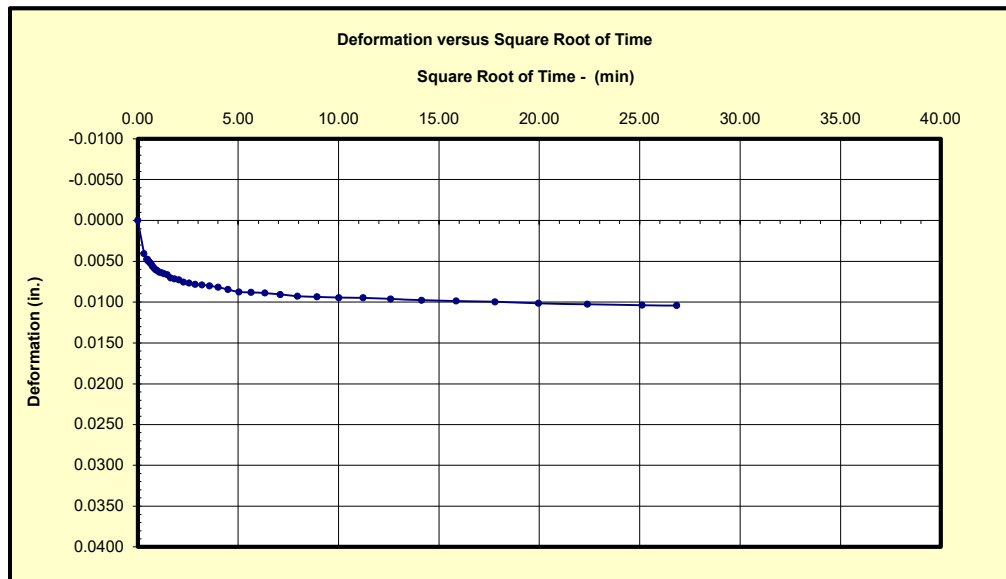
Update

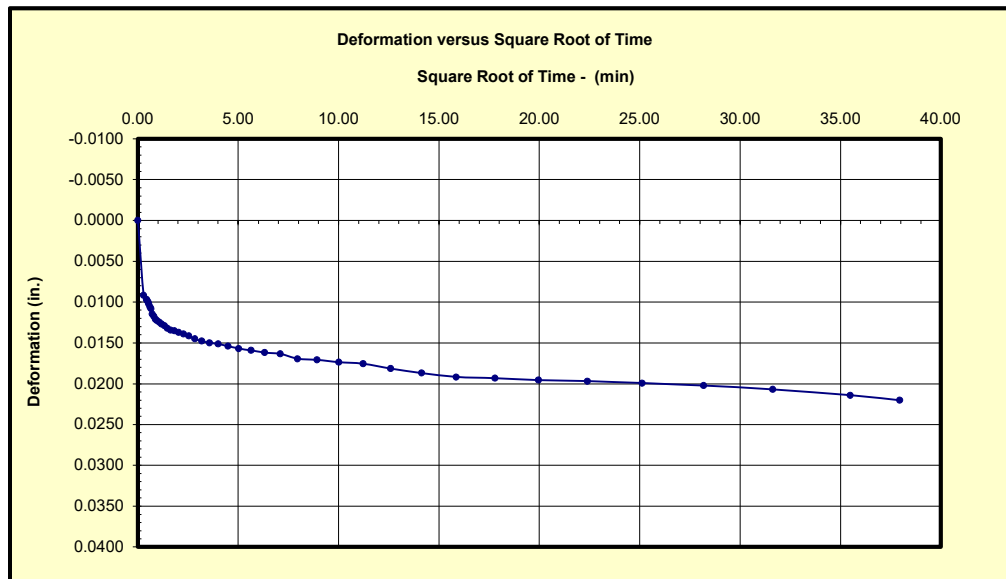
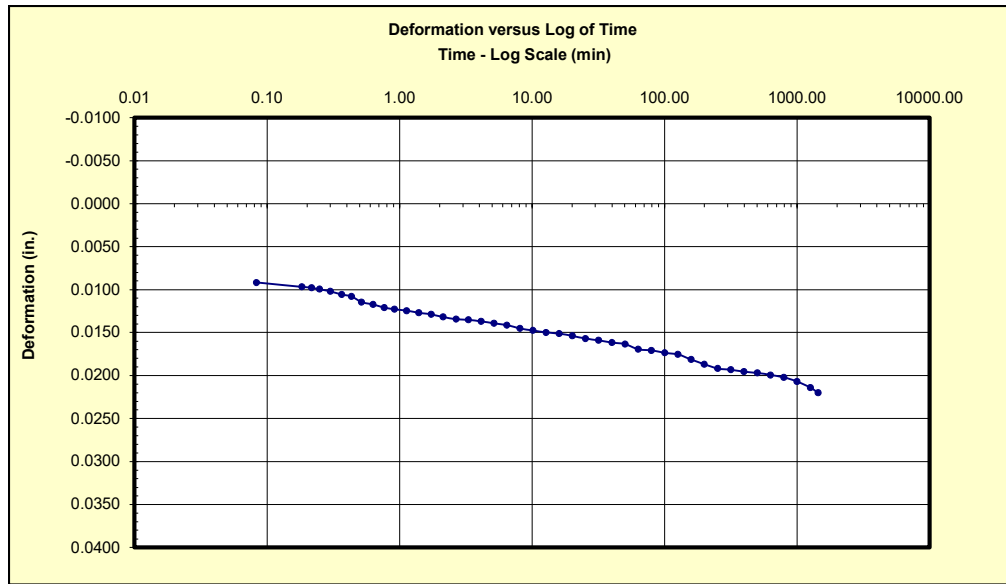
Vertical Stress
1600 psf
S100
No match!!!

☒ End of Primary
☐ End of Increment

Project:
L231011

B8
Depth (ft):
31.4





Scan Data

Step List

ISTEP 61

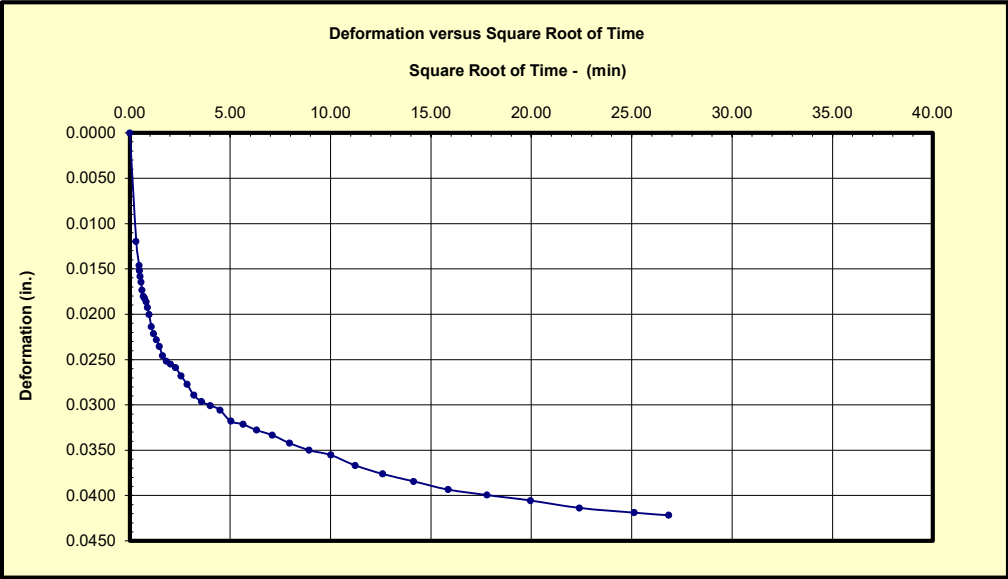
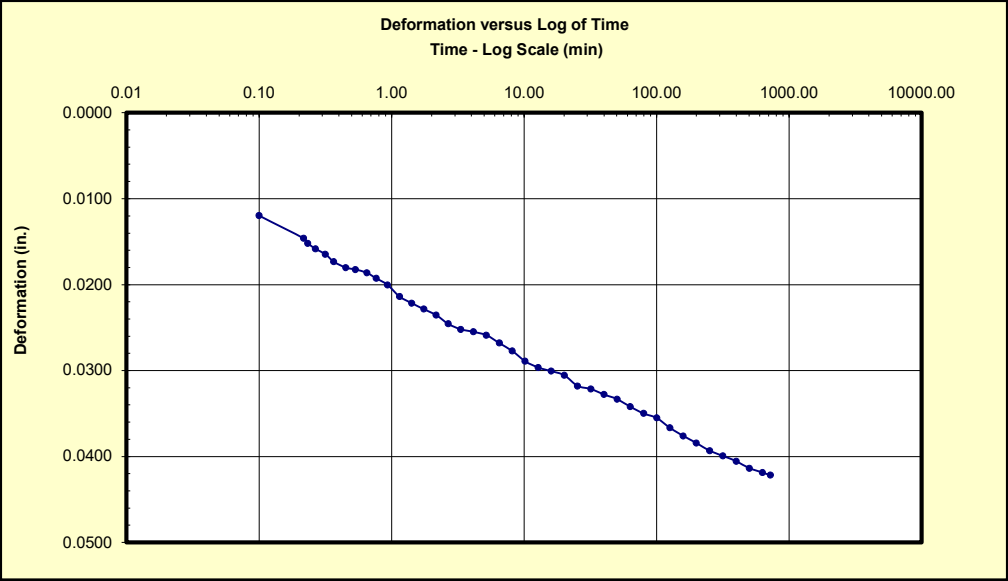
Update

Vertical Stress
3200 psf
S100
No match!!!

☒ End of Primary
☐ End of Increment

Project:
L231011

B8
Depth (ft):
31.4



Scan Data

Step List

ISTEP 71

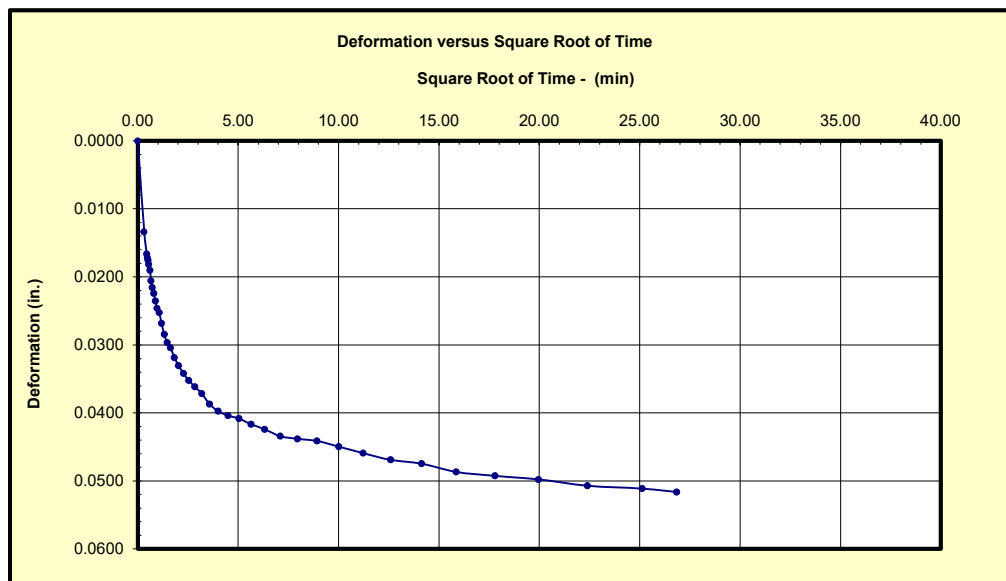
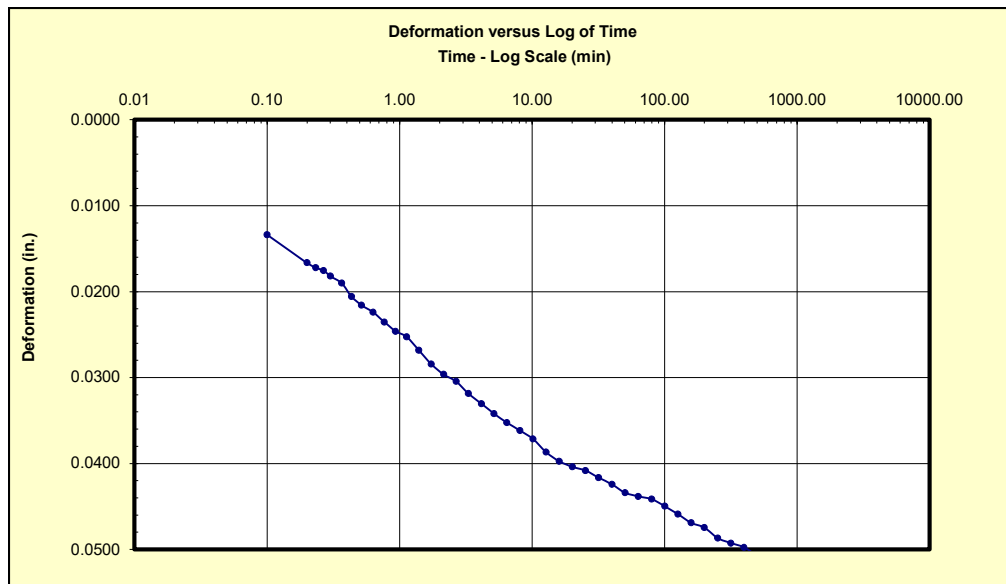
Update

Vertical Stress
6400 psf
S100
No match!!!

☒ End of Primary
☐ End of Increment

Project:
L231011

B8
Depth (ft):
31.4



Scan Data

Step List

ISTEP 81

Update

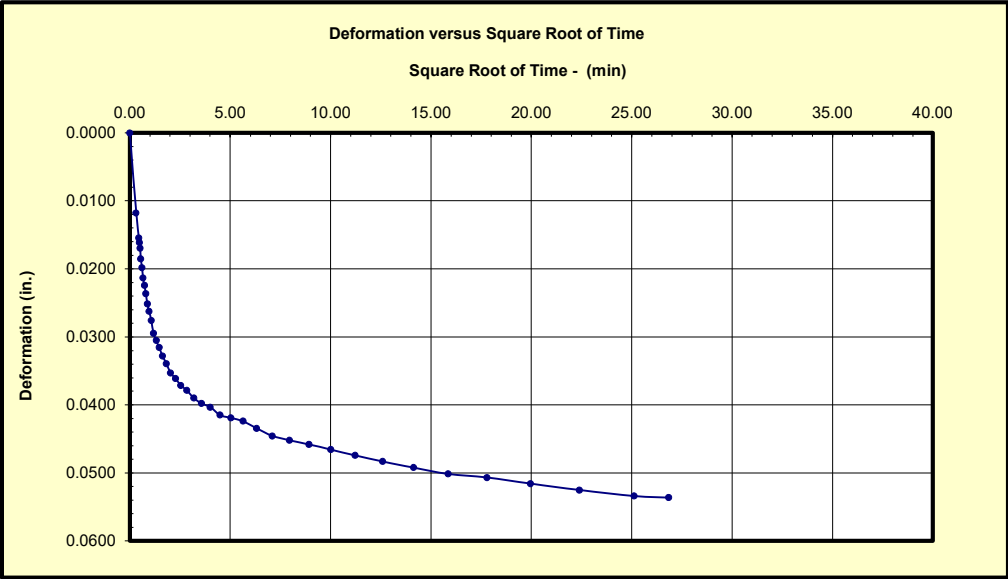
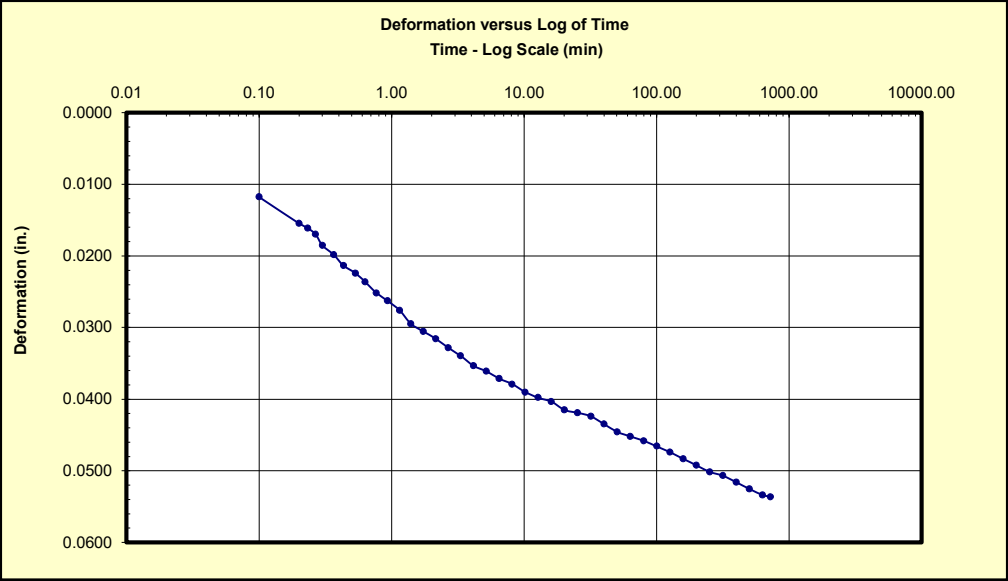
Vertical Stress
12800 psf
S100
No match!!!

☒ End of Primary

☐ End of Increment

Project:
L231011

B8
Depth (ft):
31.4



Scan Data

Step List

ISTEP 91

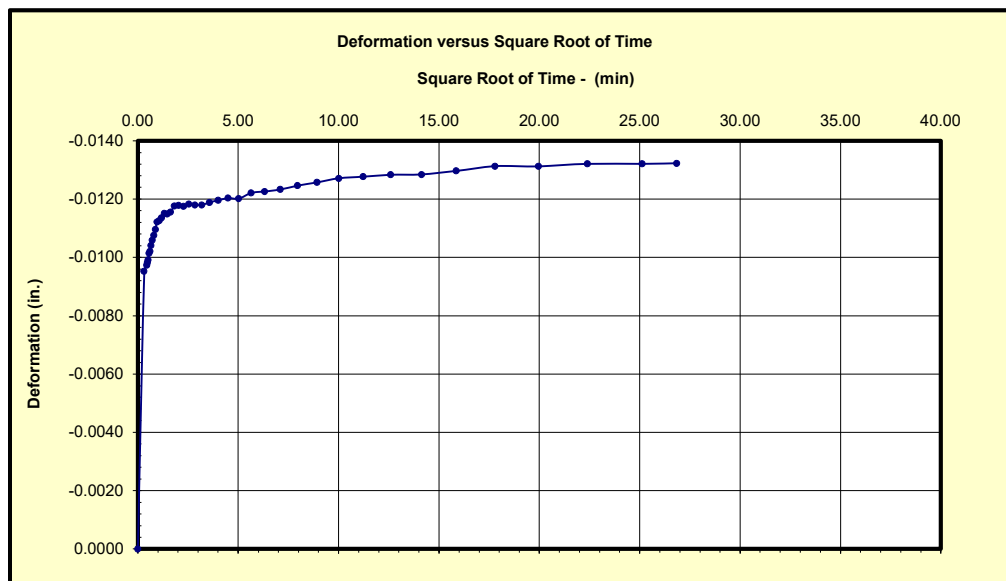
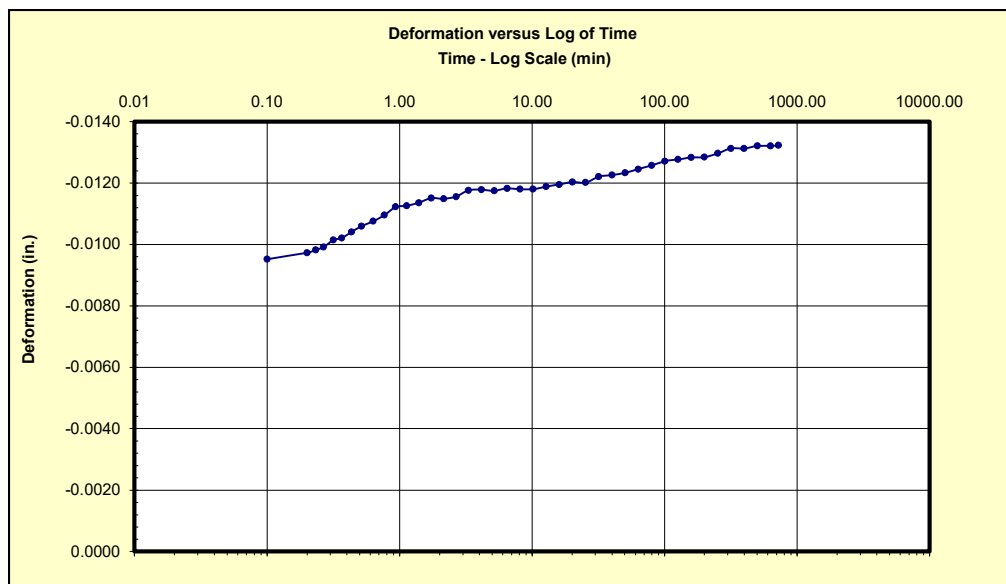
Update

Vertical Stress
25600 psf
S100
No match!!!

☒ End of Primary
☐ End of Increment

Project:
L231011

B8
Depth (ft):
31.4



Scan Data

Step List

ISTEP 101

Update

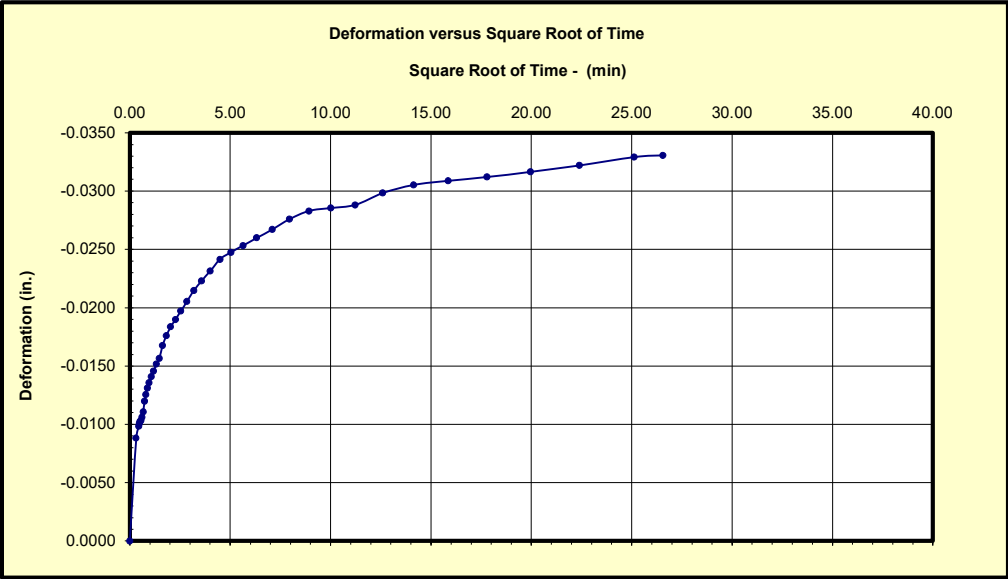
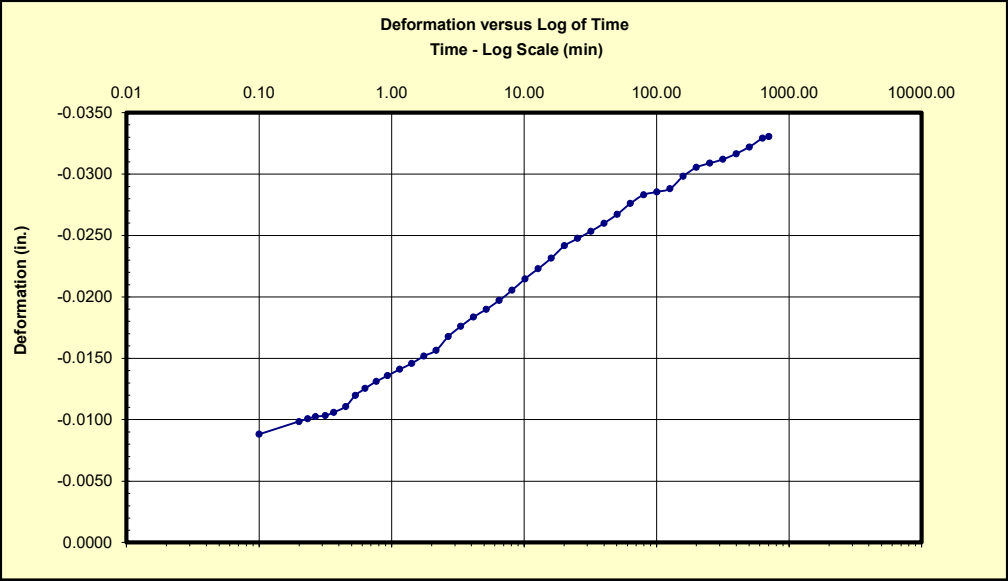
Vertical Stress
6400 psf
S100
No match!!!

☒ End of Primary

☐ End of Increment

Project:
L231011

B8
Depth (ft):
31.4



Scan Data

Step List

ISTEP 111

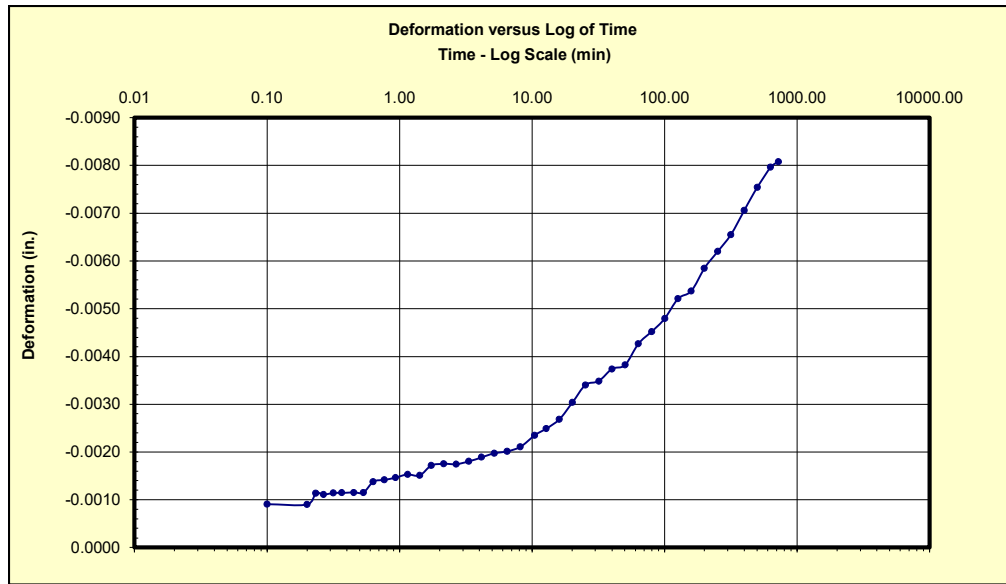
Update

Vertical Stress
400 psf
S100
No match!!!

☒ End of Primary
☐ End of Increment

Project:
L231011

B8
Depth (ft):
31.4



Scan Data

Step List

ISTEP 111

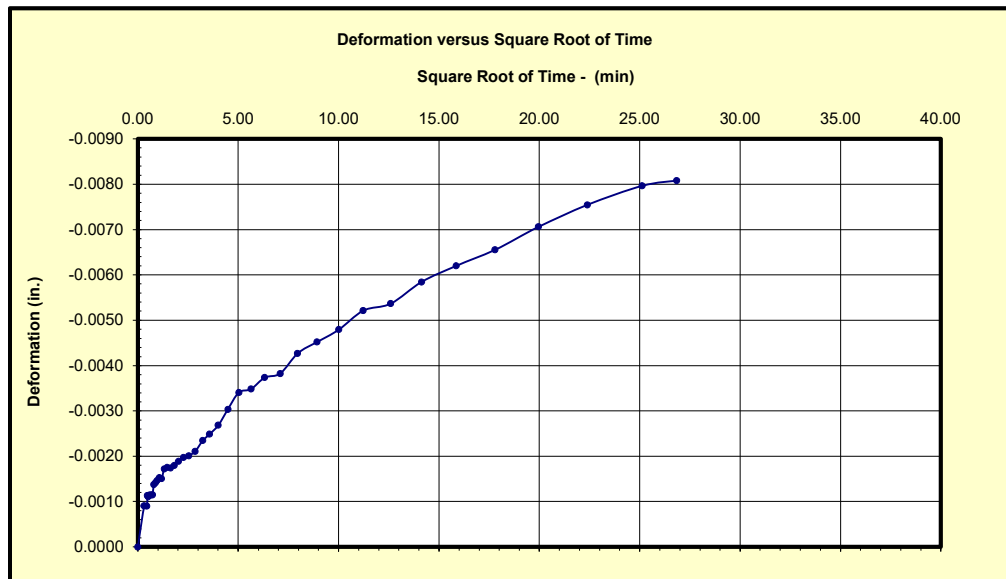
Update

Vertical Stress
200 psf
S100
No match!!!

☒ End of Primary
☐ End of Increment

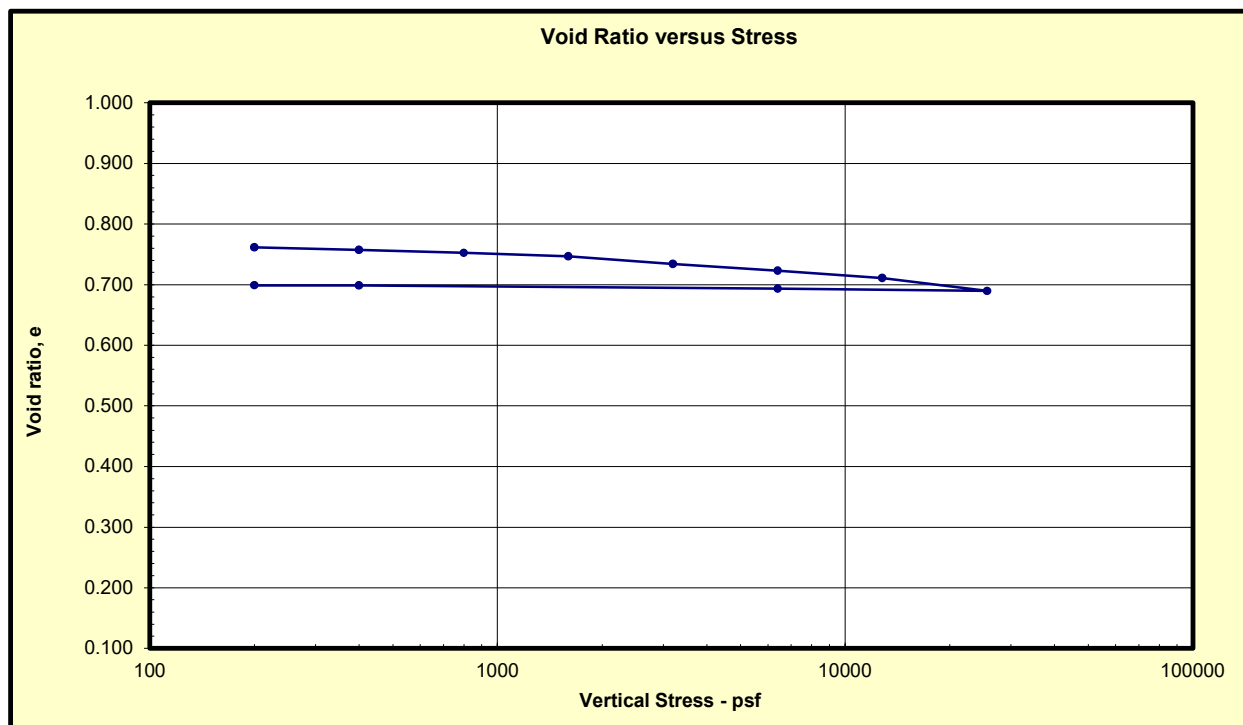
Project:
L231011

B8
Depth (ft):
31.4



Consolidation Test Results ASTM D-2435

		Load (psf)	H (in)	Consol (%)	Vs	e
Project	L231011	200	0.993	0.17%	0.57	0.76
Boring	B12	400	0.991	0.42%	0.57	0.76
Depth (ft)	13.4	800	0.988	0.68%	0.57	0.75
Sampled by	Client	1600	0.985	1.03%	0.57	0.75
Sample diameter (in)	2.495	3200	0.978	1.72%	0.58	0.73
Wet density (pcf)	105.8	6400	0.972	2.35%	0.58	0.72
Initial moisture (%)	12.9	12800	0.965	3.05%	0.58	0.71
Initial dry Density (pcf)	93.7	25600	0.953	4.25%	0.59	0.69
Final moisture (%)	22.5	6400	0.955	4.03%	0.59	0.69
Final dry density	98.1	400	0.958	3.75%	0.59	0.70
Specific gravity (assumed)	2.65	200	0.958	3.71%	0.59	0.70
Initial height, H (in)	0.995					
Volume of solids (Vs)	0.57					
Volume of voids (Vv)	0.43					
Initial void ratio (e0)	0.76					
Total consolidation (%)	4.3%					
Final Volume of solids (Vs)	0.59					
Minimum void ratio (ef)	0.69					
Effective stress in-situ(psf)	-					
Pre-consolidation stress (psf)	-					
Over-consolidation ratio, OCR	-					
Saturate sample at (psf)	200					



Time Deformation Readings

200 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.02	0.13	0.0000
0.05	0.22	0.0000
0.08	0.29	0.0000
0.13	0.37	0.0001
0.18	0.43	0.0006
0.27	0.52	0.0010
0.35	0.59	0.0013
0.45	0.67	0.0016
0.58	0.76	0.0016
0.75	0.87	0.0016
0.97	0.98	0.0017
1.23	1.11	0.0017
1.57	1.25	0.0017
1.98	1.41	0.0017
2.50	1.58	0.0017
3.15	1.77	0.0017
3.98	2.00	0.0017
5.02	2.24	0.0017
6.32	2.51	0.0018
7.95	2.82	0.0018
8.27	2.88	0.0018

400 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0023
0.22	0.47	0.0025
0.23	0.48	0.0026
0.27	0.52	0.0026
0.32	0.56	0.0027
0.38	0.62	0.0027
0.45	0.67	0.0027
0.53	0.73	0.0029
0.65	0.81	0.0028
0.78	0.89	0.0030
0.93	0.97	0.0030
1.15	1.07	0.0030
1.42	1.19	0.0031
1.75	1.32	0.0031
2.17	1.47	0.0032
2.68	1.64	0.0033
3.33	1.83	0.0034
4.17	2.04	0.0035
5.20	2.28	0.0035
6.50	2.55	0.0036
6.75	2.60	0.0036

800 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.12	0.34	0.0031
0.22	0.47	0.0032
0.25	0.50	0.0032
0.28	0.53	0.0033
0.32	0.56	0.0033
0.38	0.62	0.0034
0.45	0.67	0.0034
0.53	0.73	0.0035
0.65	0.81	0.0035
0.78	0.89	0.0035
0.95	0.97	0.0036
1.15	1.07	0.0037
1.42	1.19	0.0037
1.75	1.32	0.0038
2.17	1.47	0.0038
2.68	1.64	0.0038
3.35	1.83	0.0038
4.17	2.04	0.0038
5.20	2.28	0.0039
5.20	2.28	0.0038

Time Deformation Readings

1600 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0049
0.20	0.45	0.0051
0.23	0.48	0.0051
0.27	0.52	0.0051
0.30	0.55	0.0052
0.37	0.61	0.0053
0.43	0.66	0.0053
0.52	0.72	0.0053
0.63	0.80	0.0054
0.77	0.88	0.0054
0.92	0.96	0.0054
1.13	1.06	0.0054
1.40	1.18	0.0055
1.73	1.32	0.0055
2.15	1.47	0.0055
2.67	1.63	0.0056
3.32	1.82	0.0057
4.13	2.03	0.0057
4.38	2.09	0.0058

3200 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0075
0.20	0.45	0.0077
0.23	0.48	0.0078
0.27	0.52	0.0078
0.32	0.56	0.0080
0.38	0.62	0.0080
0.45	0.67	0.0080
0.53	0.73	0.0081
0.63	0.80	0.0081
0.78	0.89	0.0082
0.93	0.97	0.0083
1.15	1.07	0.0083
1.42	1.19	0.0083
1.75	1.32	0.0084
2.17	1.47	0.0084
2.42	1.55	0.0084

6400 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.12	0.34	0.0071
0.22	0.47	0.0078
0.25	0.50	0.0078
0.28	0.53	0.0078
0.32	0.56	0.0079
0.38	0.62	0.0080
0.45	0.67	0.0081
0.53	0.73	0.0081
0.65	0.81	0.0083
0.78	0.89	0.0084
0.95	0.97	0.0084
1.15	1.07	0.0084
1.42	1.19	0.0086
1.75	1.32	0.0087
2.17	1.47	0.0088
2.68	1.64	0.0089
3.33	1.83	0.0090
4.17	2.04	0.0091
5.20	2.28	0.0092
6.10	2.47	0.0092

Time Deformation Readings

12800 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0084
0.20	0.45	0.0092
0.23	0.48	0.0092
0.27	0.52	0.0094
0.32	0.56	0.0094
0.38	0.62	0.0094
0.45	0.67	0.0095
0.53	0.73	0.0096
0.65	0.81	0.0096
0.78	0.89	0.0097
0.95	0.97	0.0098
1.15	1.07	0.0098
1.42	1.19	0.0099
1.75	1.32	0.0100
2.17	1.47	0.0100
2.68	1.64	0.0100
3.35	1.83	0.0102
4.17	2.04	0.0102
4.42	2.10	0.0102

25600 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.12	0.34	0.0126
0.22	0.47	0.0131
0.25	0.50	0.0132
0.28	0.53	0.0133
0.32	0.56	0.0134
0.38	0.62	0.0135
0.45	0.67	0.0138
0.53	0.73	0.0139
0.65	0.81	0.0141
0.78	0.89	0.0142
0.95	0.97	0.0144
1.15	1.07	0.0147
1.42	1.19	0.0148
1.75	1.32	0.0150
2.17	1.47	0.0151
2.68	1.64	0.0152
3.33	1.83	0.0153
4.17	2.04	0.0153
5.20	2.28	0.0156
5.57	2.36	0.0157

6400 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	-0.0065
0.20	0.45	-0.0067
0.23	0.48	-0.0066
0.27	0.52	-0.0067
0.32	0.56	-0.0068
0.38	0.62	-0.0068
0.45	0.67	-0.0068
0.53	0.73	-0.0069
0.63	0.80	-0.0069
0.77	0.88	-0.0070
0.93	0.97	-0.0071
1.15	1.07	-0.0071
1.42	1.19	-0.0071
1.73	1.32	-0.0071
2.15	1.47	-0.0071
2.67	1.63	-0.0070
3.33	1.83	-0.0071
3.83	1.96	-0.0071

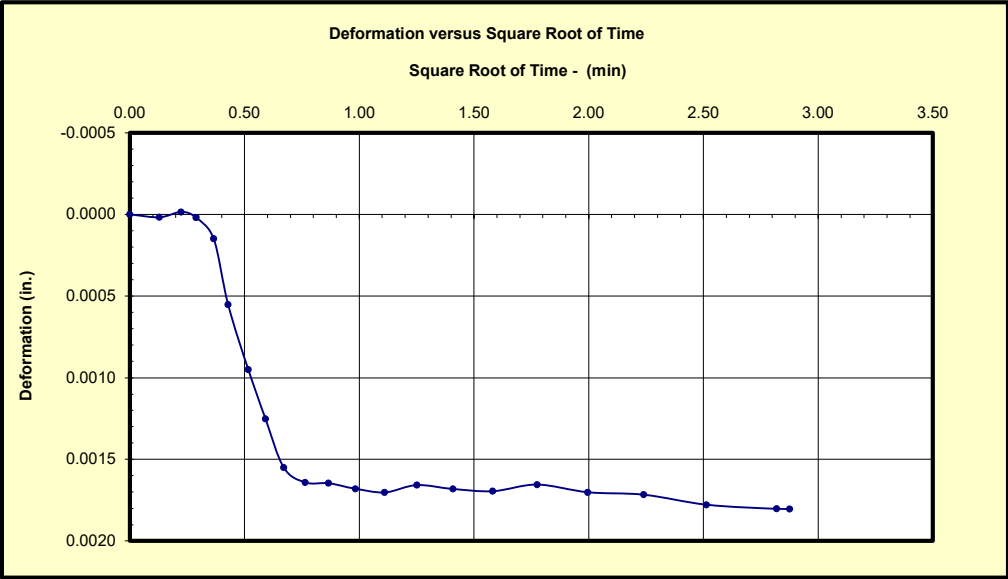
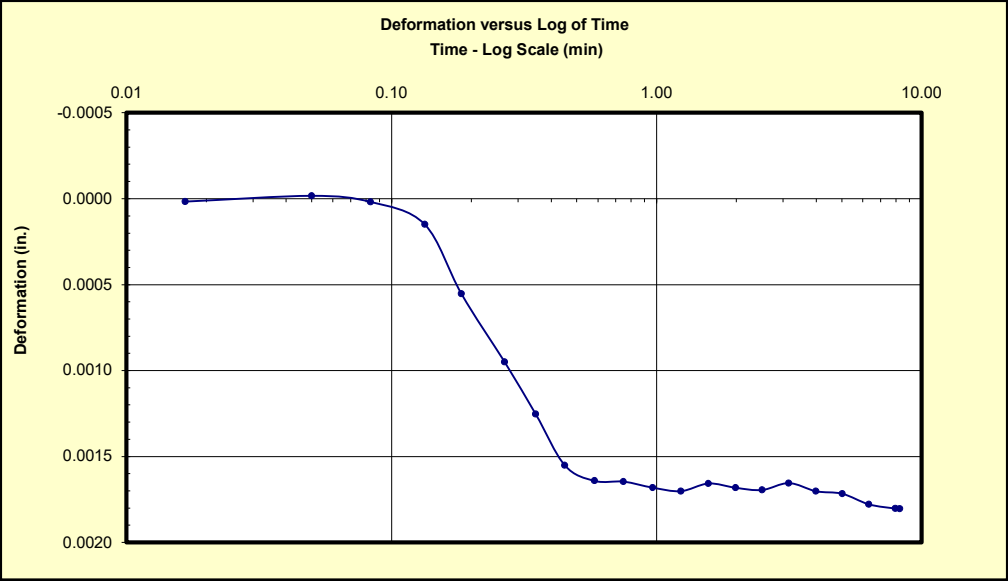
Time Deformation Readings

400 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	-0.0079
0.22	0.47	-0.0088
0.23	0.48	-0.0088
0.27	0.52	-0.0089
0.32	0.56	-0.0089
0.37	0.61	-0.0089
0.43	0.66	-0.0091
0.52	0.72	-0.0091
0.63	0.80	-0.0091
0.77	0.88	-0.0092
0.93	0.97	-0.0092
1.15	1.07	-0.0092
1.42	1.19	-0.0094
1.73	1.32	-0.0093
2.15	1.47	-0.0094
2.67	1.63	-0.0094
2.80	1.67	-0.0094

200 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	-0.0007
0.20	0.45	-0.0008
0.23	0.48	-0.0009
0.27	0.52	-0.0010
0.30	0.55	-0.0009
0.37	0.61	-0.0010
0.43	0.66	-0.0010
0.53	0.73	-0.0010
0.63	0.80	-0.0010
0.77	0.88	-0.0011
0.93	0.97	-0.0011
1.15	1.07	-0.0012
1.40	1.18	-0.0012
1.73	1.32	-0.0012
2.15	1.47	-0.0013
2.67	1.63	-0.0013
3.33	1.83	-0.0014
4.15	2.04	-0.0014
5.20	2.28	-0.0014
6.48	2.55	-0.0015



Scan Data

Step List

ISTEP 21

Update

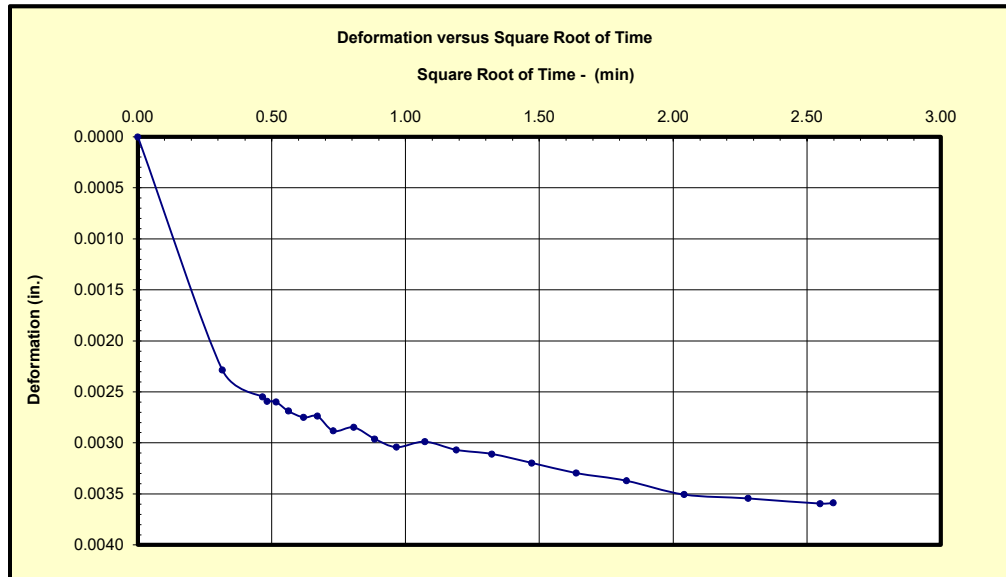
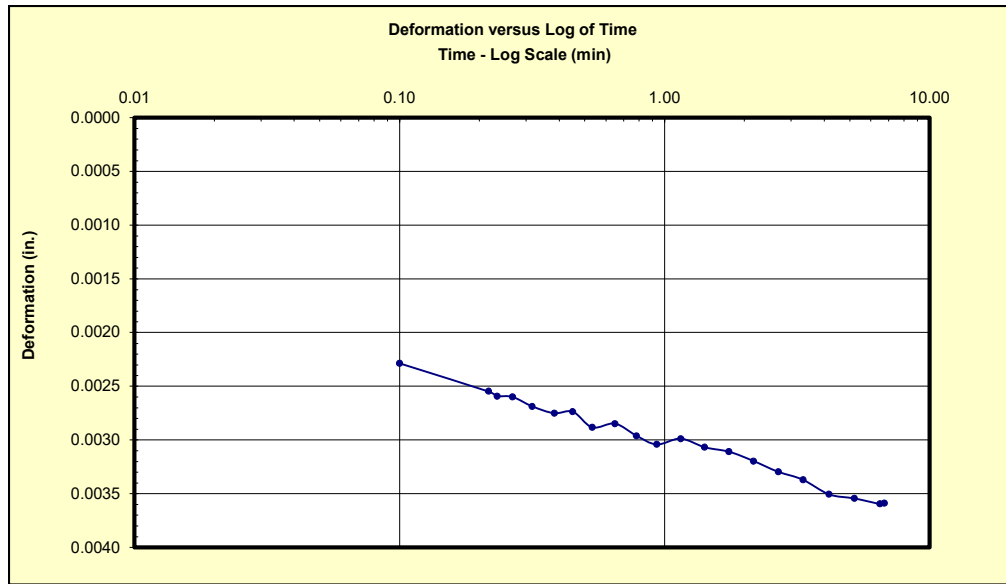
Vertical Stress
200 psf

S100
No match!!!

- ☒ End of Primary
- ☐ End of Increment

Project:
L231011

B12
Depth (ft):
13.4



Scan Data

Step List

ISTEP 31

Update

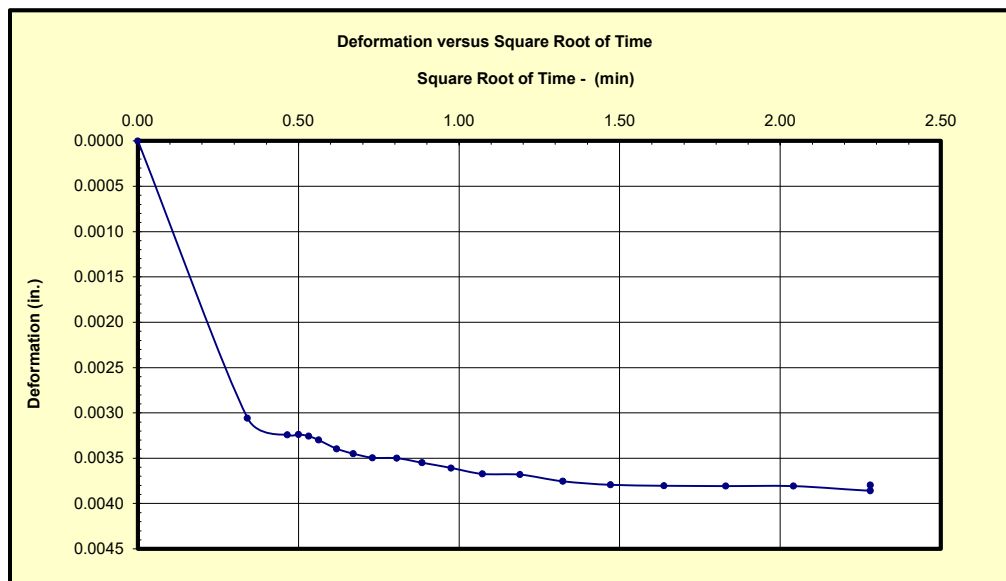
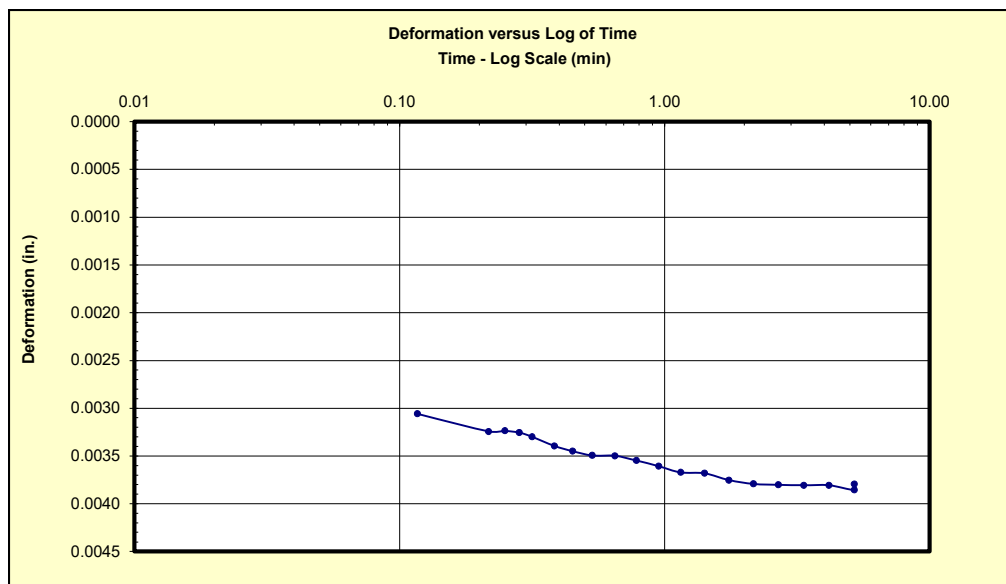
Vertical Stress
400 psf

S100
No match!!!

- ☒ End of Primary
- ☐ End of Increment

Project:
L231011

B12
Depth (ft):
13.4



Scan Data

Step List

ISTEP 41

Update

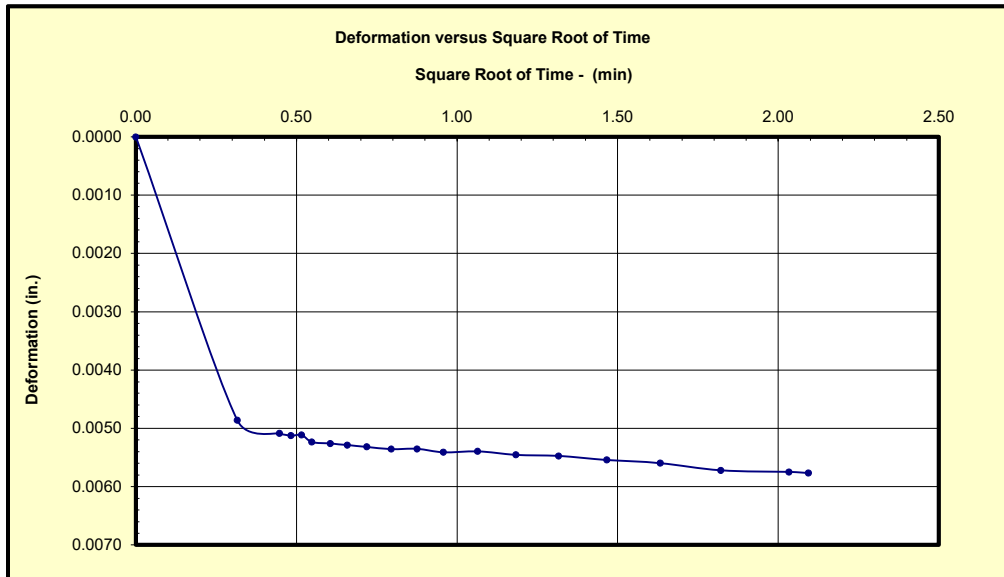
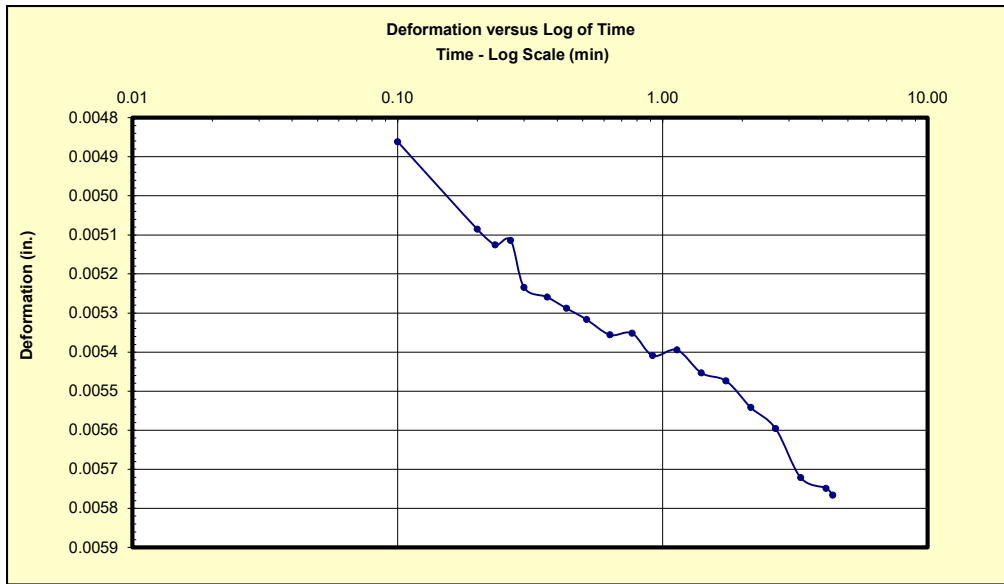
Vertical Stress
800 psf
S100
No match!!!

☒ End of Primary

☐ End of Increment

Project:
L231011

B12
Depth (ft):
13.4



Scan Data

Step List

ISTEP 51

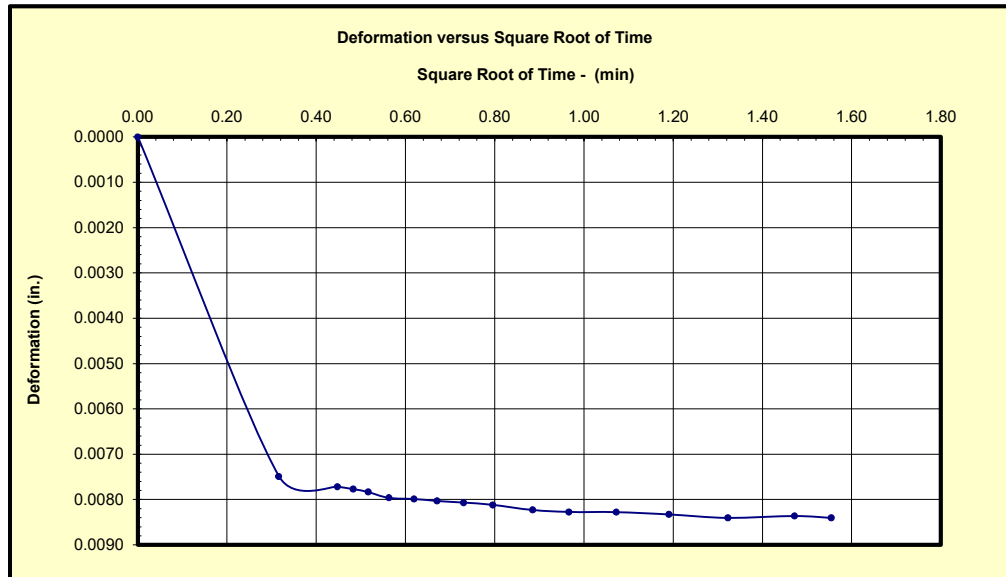
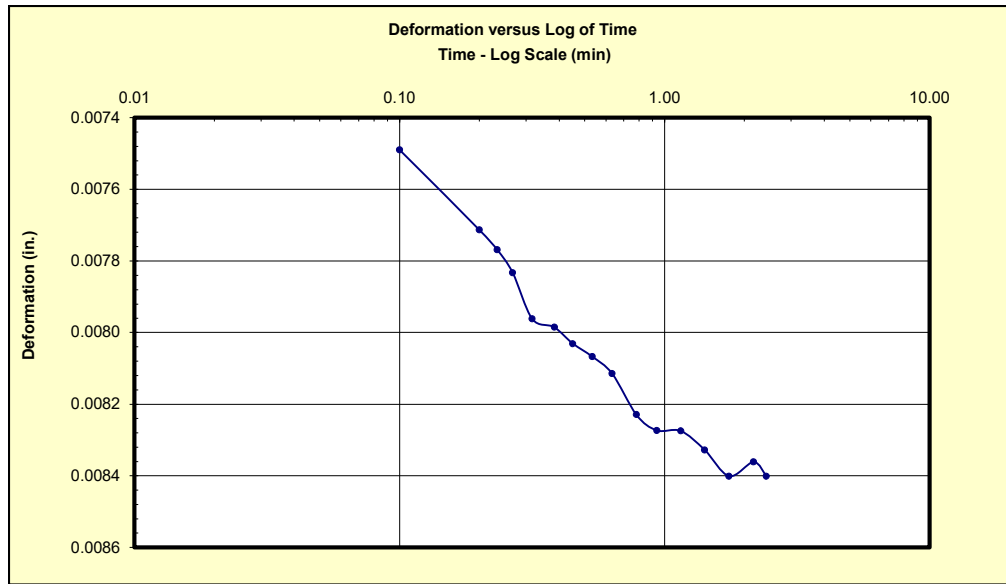
Update

Vertical Stress
1600 psf
S100
No match!!!

☒ End of Primary
☐ End of Increment

Project:
L231011

B12
Depth (ft):
13.4



Scan Data

Step List

ISTEP 61

Update

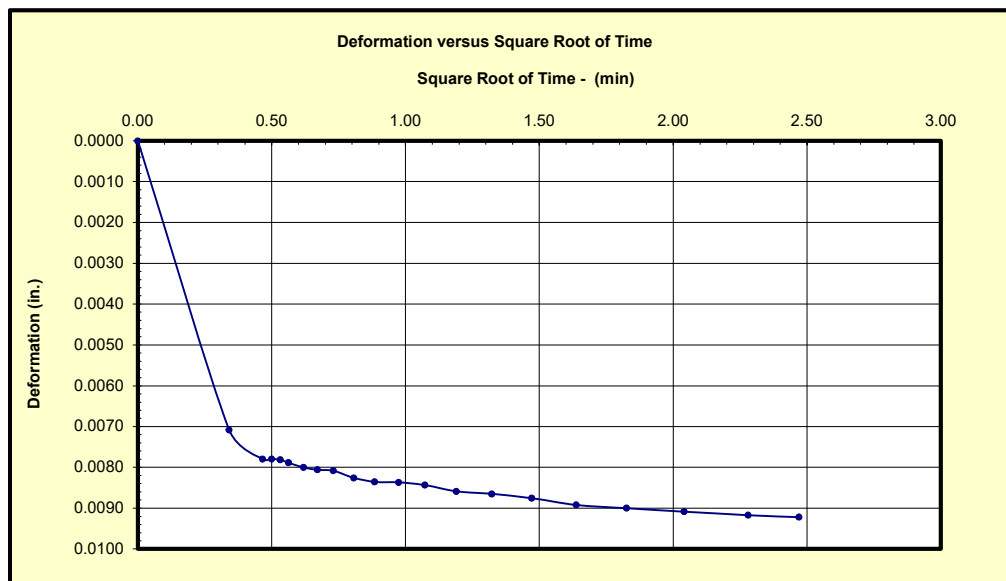
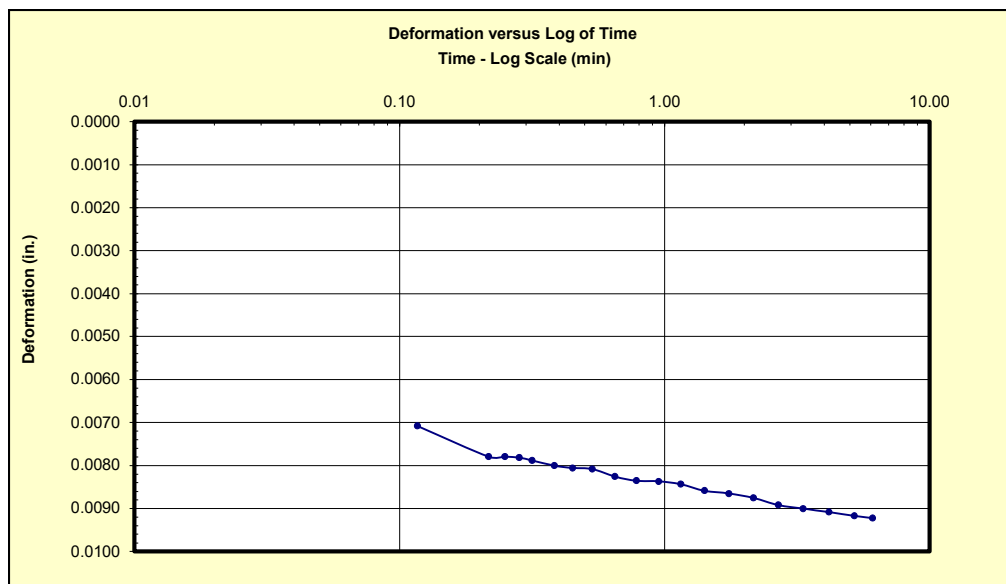
Vertical Stress
3200 psf

S100
Calculating...

- ☒ End of Primary
- ☐ End of Increment

Project:
L231011

B12
Depth (ft):
13.4



Scan Data

Step List

ISTEP 71

Update

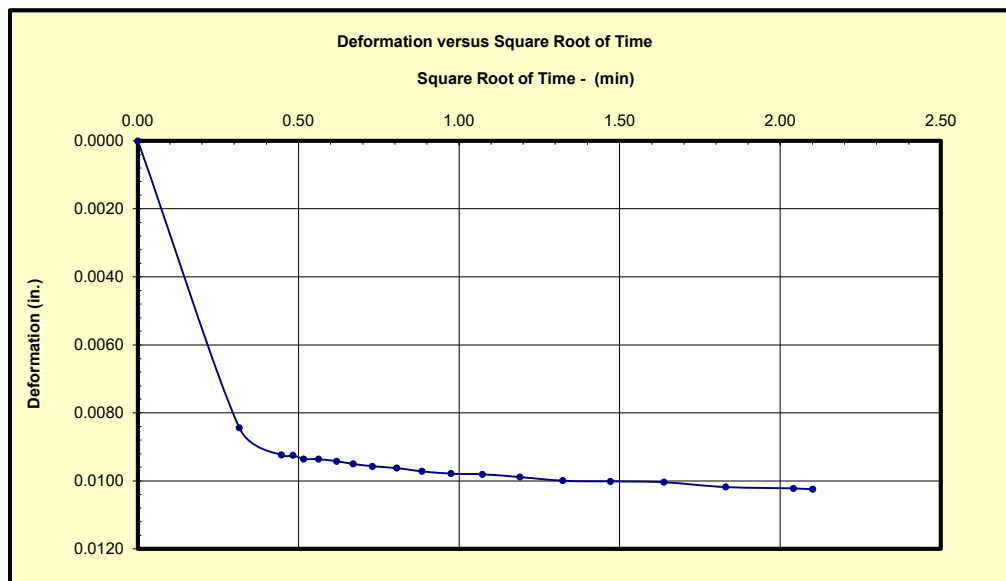
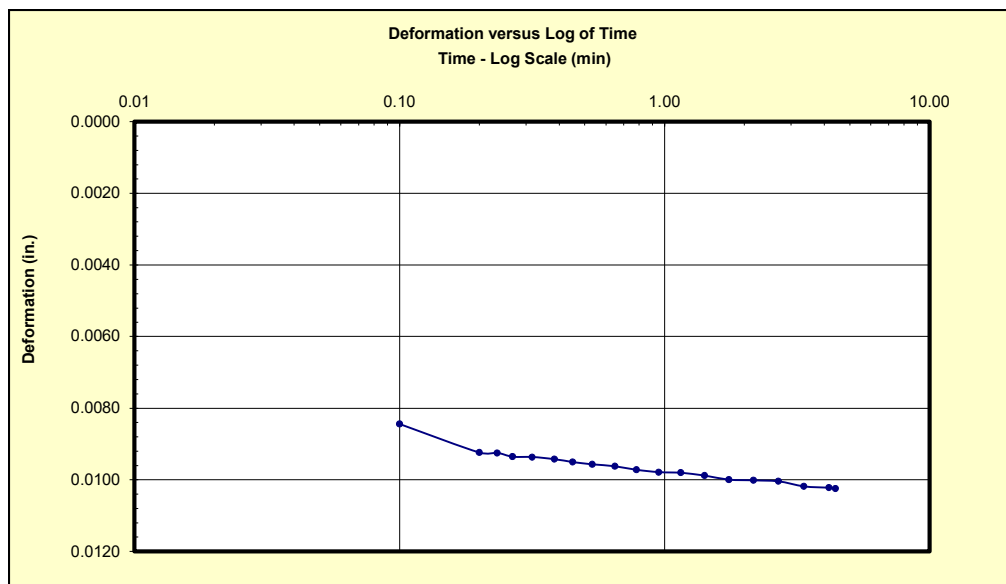
Vertical Stress
6400 psf

S100
No match!!!

- ☒ End of Primary
- ☐ End of Increment

Project:
L231011

B12
Depth (ft):
13.4



Scan Data

Step List

ISTEP 81

Update

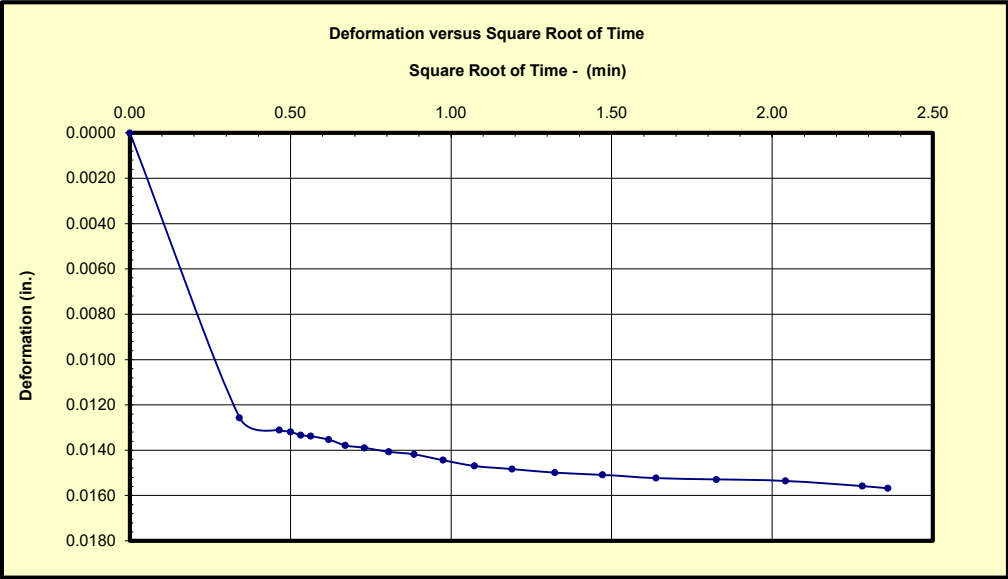
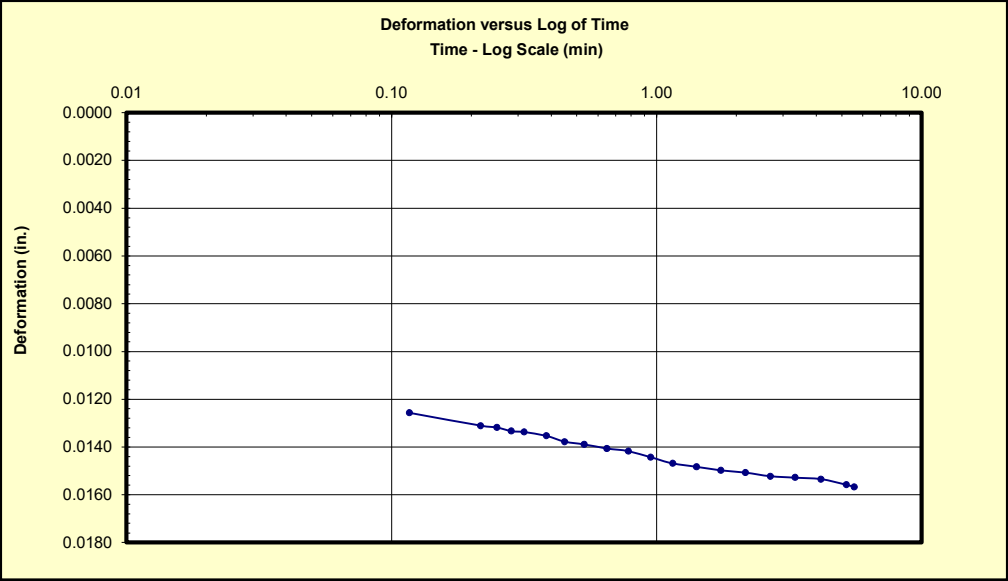
Vertical Stress
12800 psf
S100
No match!!!

☒ End of Primary

☐ End of Increment

Project:
L231011

B12
Depth (ft):
13.4



Scan Data

Step List

ISTEP 91

Update

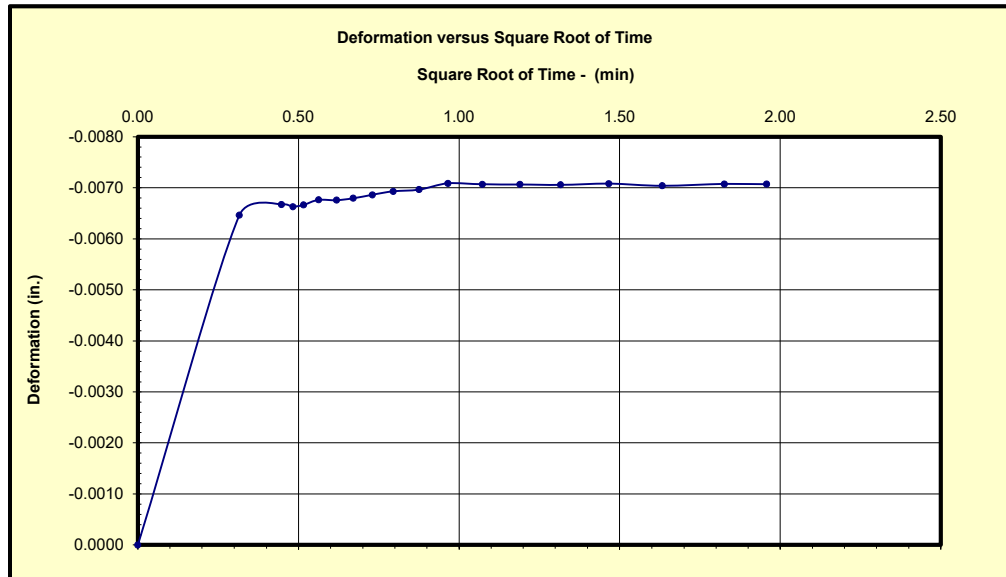
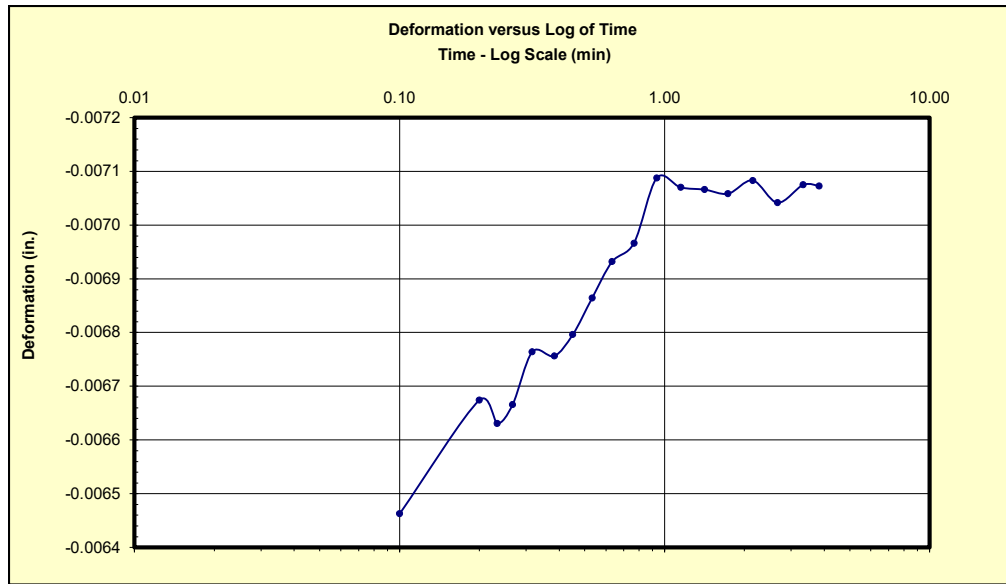
Vertical Stress
25600 psf

S100
No match!!!

- ☒ End of Primary
- ☐ End of Increment

Project:
L231011

B12
Depth (ft):
13.4



Scan Data

Step List

ISTEP 101

Update

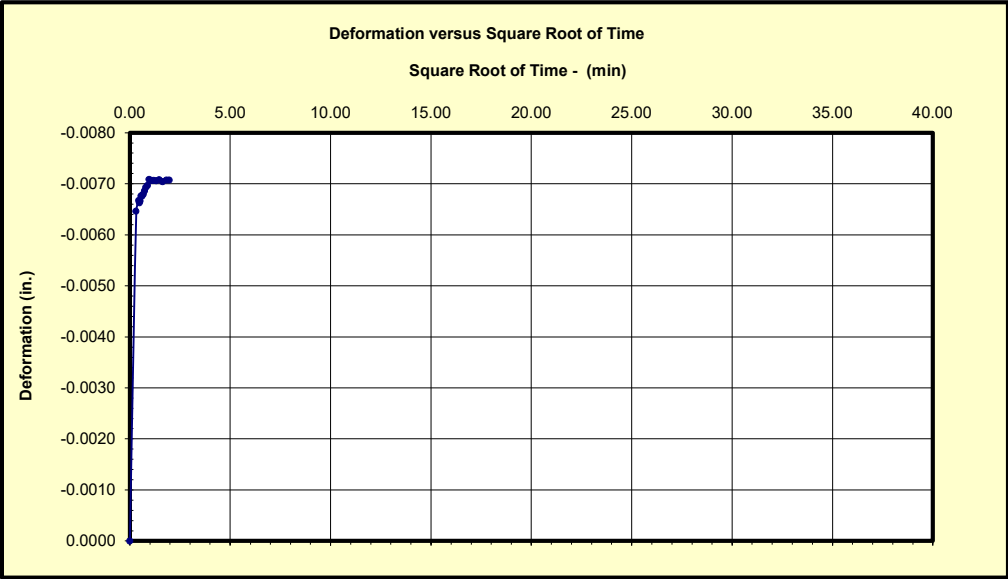
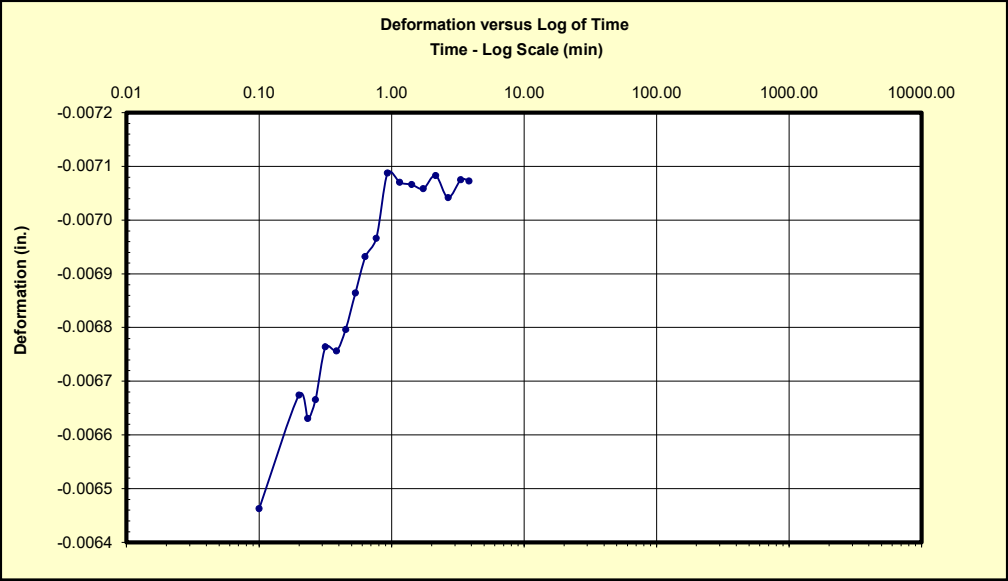
Vertical Stress
6400 psf

S100
No match!!!

- ☒ End of Primary
- ☐ End of Increment

Project:
L231011

B12
Depth (ft):
13.4



Scan Data

Step List

ISTEP 101

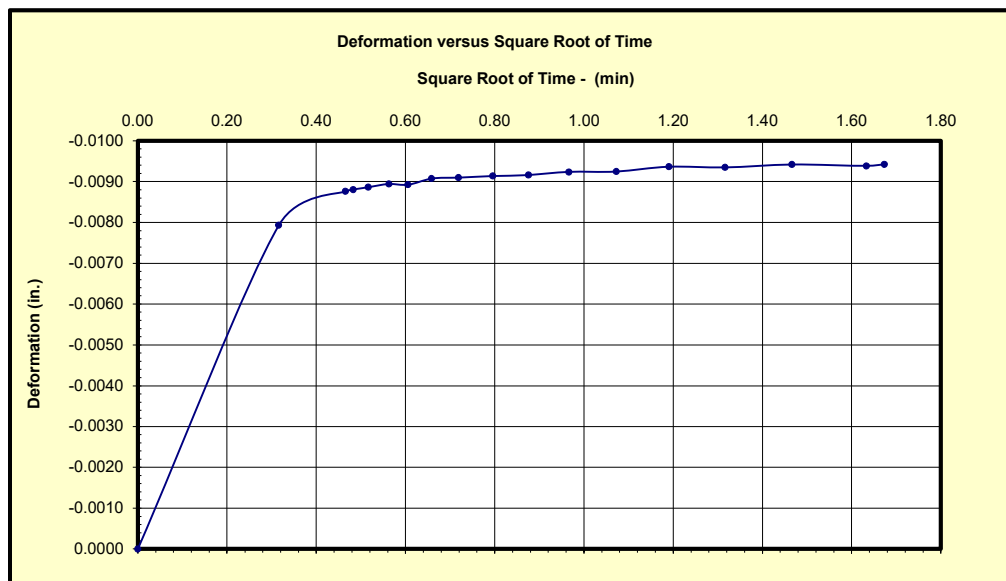
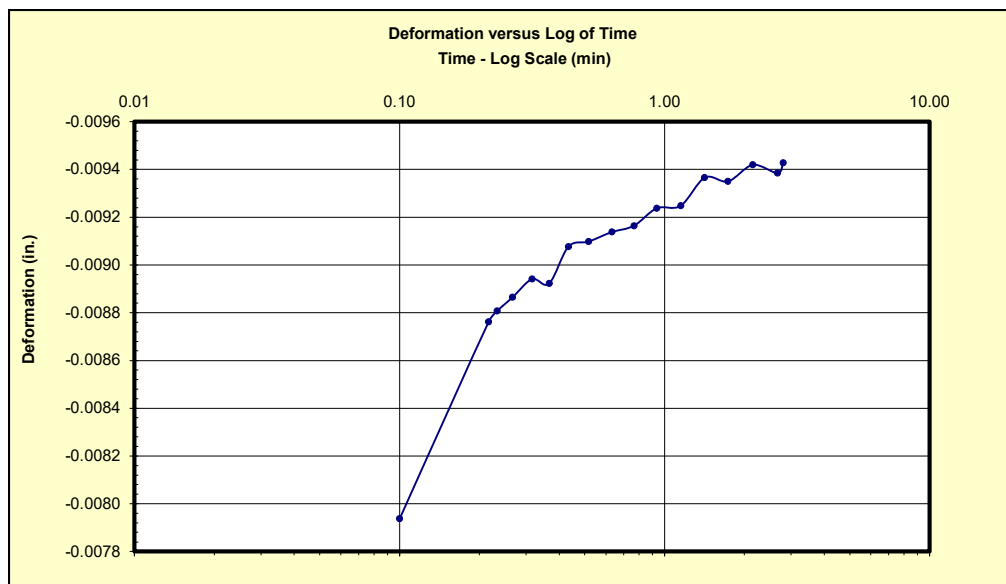
Update

Vertical Stress
6400 psf
S100
No match!!!

☒ End of Primary
☐ End of Increment

Project:
L231011

B12
Depth (ft):
13.4



Scan Data

Step List

ISTEP 111

Update

Vertical Stress
400 psf
S100
Calculating...

☒ End of Primary

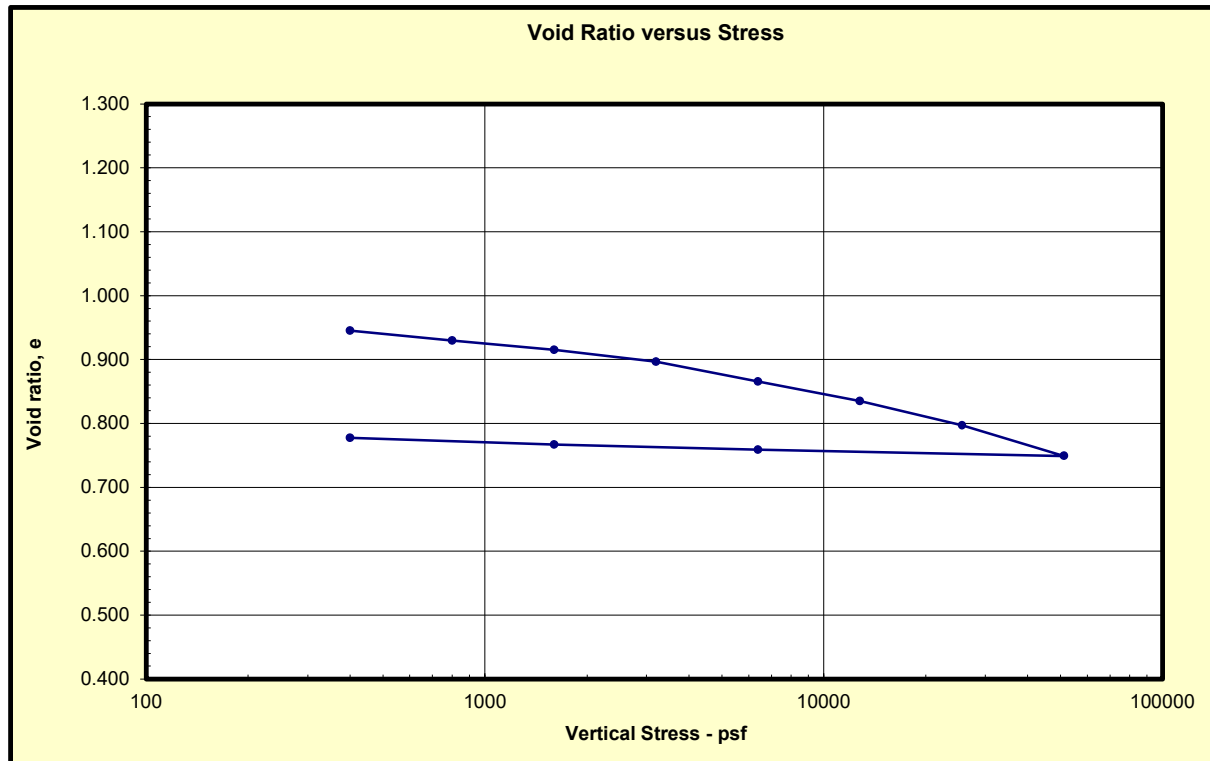
☐ End of Increment

Project:
L231011

B12
Depth (ft):
13.4

Consolidation Test Results ASTM D-2435

		Load (psf)	H (in)	Consol (%)	Vs	e
Project	L231011	400	0.991	0.4%	0.51	0.95
Boring	B-14	800	0.983	1.2%	0.52	0.93
Depth (ft)	16.8	1600	0.976	1.9%	0.52	0.92
Sampled by	Client	3200	0.966	2.9%	0.53	0.90
Sample diameter (in)	2.495	6400	0.951	4.5%	0.54	0.87
Wet density (pcf)	112.8	12800	0.935	6.0%	0.55	0.83
Initial moisture (%)	33.2	25600	0.916	8.0%	0.56	0.80
Initial dry Density (pcf)	84.7	51200	0.891	10.4%	0.57	0.75
Final moisture (%)	31.9	6400	0.896	9.9%	0.57	0.76
Final dry density	93.5	1600	0.900	9.5%	0.57	0.77
Specific gravity (assumed)	2.65	400	0.906	9.0%	0.56	0.78
Initial height, H (in)	0.995					
Volume of solids (Vs)	0.51					
Volume of voids (Vv)	0.49					
Initial void ratio (e0)	0.95					
Total consolidation (%)	10.4%					
Final Volume of solids (Vs)	0.57					
Minimum void ratio (ef)	0.75					
Effective stress in-situ(psf)	-					
Pre-consolidation stress (psf)	-					
Over-consolidation ratio, OCR	-					
Saturate sample at (psf)	400					



Time Deformation Readings

400 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.03	0.18	0.0003
0.07	0.26	0.0009
0.10	0.32	0.0010
0.15	0.39	0.0014
0.22	0.47	0.0015
0.27	0.52	0.0015
0.35	0.59	0.0015
0.47	0.68	0.0016
0.60	0.77	0.0016
0.77	0.88	0.0016
0.97	0.98	0.0016
1.23	1.11	0.0016
1.57	1.25	0.0017
2.00	1.41	0.0018
2.52	1.59	0.0019
3.18	1.78	0.0019
4.00	2.00	0.0020
5.03	2.24	0.0020
6.33	2.52	0.0021
7.98	2.83	0.0021
10.03	3.17	0.0023
12.63	3.55	0.0025
15.90	3.99	0.0026
20.00	4.47	0.0026
25.17	5.02	0.0028
31.68	5.63	0.0031
39.87	6.31	0.0031
50.18	7.08	0.0032
63.17	7.95	0.0032
79.50	8.92	0.0032
100.08	10.00	0.0033
125.97	11.22	0.0037
158.57	12.59	0.0037
180.48	13.43	0.0037

800 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0048
0.20	0.45	0.0050
0.23	0.48	0.0050
0.27	0.52	0.0052
0.30	0.55	0.0052
0.37	0.61	0.0054
0.43	0.66	0.0054
0.52	0.72	0.0054
0.62	0.79	0.0055
0.75	0.87	0.0055
0.92	0.96	0.0056
1.13	1.06	0.0057
1.40	1.18	0.0057
1.73	1.32	0.0058
2.15	1.47	0.0059
2.67	1.63	0.0059
3.33	1.83	0.0060
4.15	2.04	0.0061
5.18	2.28	0.0061
6.48	2.55	0.0061
8.13	2.85	0.0062
10.18	3.19	0.0062
12.78	3.58	0.0063
16.05	4.01	0.0063
20.15	4.49	0.0064
25.32	5.03	0.0065
31.83	5.64	0.0068
40.02	6.33	0.0069
50.33	7.09	0.0070
63.32	7.96	0.0072
79.65	8.92	0.0073
100.23	10.01	0.0077
126.13	11.23	0.0079
158.73	12.60	0.0082
199.77	14.13	0.0083
251.43	15.86	0.0084
316.48	17.79	0.0086
398.37	19.96	0.0088
501.45	22.39	0.0088
631.23	25.12	0.0091
794.60	28.19	0.0093
1000.28	31.63	0.0094
1238.67	35.19	0.0095

1600 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0045
0.20	0.45	0.0054
0.23	0.48	0.0054
0.27	0.52	0.0054
0.32	0.56	0.0056
0.37	0.61	0.0057
0.43	0.66	0.0057
0.52	0.72	0.0058
0.63	0.80	0.0059
0.77	0.88	0.0062
0.93	0.97	0.0062
1.13	1.06	0.0063
1.40	1.18	0.0063
1.73	1.32	0.0063
2.15	1.47	0.0066
2.68	1.64	0.0066
3.33	1.83	0.0068
4.17	2.04	0.0070
5.20	2.28	0.0071
6.50	2.55	0.0072
8.13	2.85	0.0073
10.20	3.19	0.0074
12.80	3.58	0.0076
16.07	4.01	0.0077
20.17	4.49	0.0082
25.33	5.03	0.0082
31.83	5.64	0.0082
40.03	6.33	0.0084
50.33	7.09	0.0084
63.32	7.96	0.0086
79.67	8.93	0.0087
100.25	10.01	0.0088
125.37	11.20	0.0088

Time Deformation Readings

3200 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0075
0.20	0.45	0.0079
0.23	0.48	0.0080
0.27	0.52	0.0081
0.32	0.56	0.0081
0.38	0.62	0.0082
0.45	0.67	0.0083
0.53	0.73	0.0084
0.65	0.81	0.0086
0.78	0.89	0.0087
0.95	0.97	0.0089
1.15	1.07	0.0090
1.42	1.19	0.0093
1.75	1.32	0.0096
2.17	1.47	0.0099
2.70	1.64	0.0101
3.35	1.83	0.0101
4.18	2.05	0.0103
5.22	2.28	0.0104
6.52	2.55	0.0106
8.15	2.85	0.0108
10.22	3.20	0.0110
12.80	3.58	0.0111
16.07	4.01	0.0112
20.18	4.49	0.0114
25.35	5.03	0.0115
31.87	5.65	0.0115
40.05	6.33	0.0116
50.37	7.10	0.0116
63.35	7.96	0.0117
79.68	8.93	0.0117
100.27	10.01	0.0119
126.17	11.23	0.0121
158.77	12.60	0.0122
199.80	14.14	0.0124
251.47	15.86	0.0125
300.17	17.33	0.0126

6400 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0100
0.20	0.45	0.0106
0.23	0.48	0.0108
0.27	0.52	0.0110
0.32	0.56	0.0110
0.37	0.61	0.0112
0.43	0.66	0.0114
0.52	0.72	0.0115
0.63	0.80	0.0117
0.77	0.88	0.0119
0.93	0.97	0.0119
1.13	1.06	0.0120
1.40	1.18	0.0121
1.73	1.32	0.0122
2.15	1.47	0.0123
2.67	1.63	0.0125
3.33	1.83	0.0126
4.15	2.04	0.0129
5.18	2.28	0.0132
6.48	2.55	0.0135
8.13	2.85	0.0138
10.18	3.19	0.0141
12.78	3.58	0.0143
16.05	4.01	0.0146
20.15	4.49	0.0146
25.32	5.03	0.0147
31.83	5.64	0.0149
40.02	6.33	0.0150
50.33	7.09	0.0152
63.32	7.96	0.0156
79.65	8.92	0.0158
100.23	10.01	0.0159
126.13	11.23	0.0162
158.73	12.60	0.0163
199.77	14.13	0.0165
251.43	15.86	0.0168
316.48	17.79	0.0168
398.37	19.96	0.0168
501.45	22.39	0.0171
631.23	25.12	0.0174
794.62	28.19	0.0175
1000.28	31.63	0.0180
1259.23	35.49	0.0186
1440.3	37.95128	0.018839

12800 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0103
0.20	0.45	0.0109
0.23	0.48	0.0111
0.27	0.52	0.0112
0.30	0.55	0.0114
0.37	0.61	0.0114
0.43	0.66	0.0116
0.52	0.72	0.0117
0.62	0.79	0.0119
0.75	0.87	0.0122
0.92	0.96	0.0123
1.13	1.06	0.0125
1.40	1.18	0.0126
1.73	1.32	0.0129
2.15	1.47	0.0133
2.67	1.63	0.0137
3.32	1.82	0.0140
4.13	2.03	0.0140
5.18	2.28	0.0141
6.47	2.54	0.0142
8.12	2.85	0.0144
10.17	3.19	0.0145
12.77	3.57	0.0147
16.03	4.00	0.0148
20.15	4.49	0.0151
25.32	5.03	0.0154
31.83	5.64	0.0160
40.02	6.33	0.0160
50.33	7.09	0.0166
63.32	7.96	0.0168
79.65	8.92	0.0170
100.23	10.01	0.0171
126.12	11.23	0.0171
158.72	12.60	0.0174
199.77	14.13	0.0177
251.43	15.86	0.0181
316.47	17.79	0.0183
398.35	19.96	0.0186
501.45	22.39	0.0188
631.22	25.12	0.0191
794.60	28.19	0.0192
1000.28	31.63	0.0195
1259.22	35.49	0.0198
1440.4	37.9526	0.019904

Time Deformation Readings

25600 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0131
0.20	0.45	0.0146
0.23	0.48	0.0147
0.27	0.52	0.0151
0.32	0.56	0.0152
0.38	0.62	0.0156
0.45	0.67	0.0159
0.53	0.73	0.0160
0.65	0.81	0.0161
0.78	0.89	0.0165
0.95	0.97	0.0170
1.15	1.07	0.0174
1.42	1.19	0.0176
1.75	1.32	0.0177
2.17	1.47	0.0181
2.70	1.64	0.0181
3.35	1.83	0.0182
4.18	2.05	0.0183
5.22	2.28	0.0185
6.52	2.55	0.0186
8.15	2.85	0.0191
10.22	3.20	0.0194
12.80	3.58	0.0196
16.07	4.01	0.0202
20.18	4.49	0.0205
25.35	5.03	0.0206
31.85	5.64	0.0208
40.05	6.33	0.0211
50.35	7.10	0.0213
63.33	7.96	0.0214
79.68	8.93	0.0215
100.25	10.01	0.0219
126.15	11.23	0.0221
158.75	12.60	0.0222
199.80	14.14	0.0224
251.47	15.86	0.0229
316.52	17.79	0.0233
398.40	19.96	0.0235
501.48	22.39	0.0239
631.27	25.13	0.0241
794.63	28.19	0.0244
1000.32	31.63	0.0247
1115.13	33.39	0.0247

51200 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0185
0.20	0.45	0.0199
0.23	0.48	0.0206
0.27	0.52	0.0208
0.32	0.56	0.0210
0.37	0.61	0.0213
0.43	0.66	0.0215
0.52	0.72	0.0216
0.63	0.80	0.0218
0.77	0.88	0.0219
0.93	0.97	0.0221
1.13	1.06	0.0224
1.40	1.18	0.0228
1.73	1.32	0.0230
2.15	1.47	0.0231
2.68	1.64	0.0232
3.33	1.83	0.0234
4.17	2.04	0.0238
5.20	2.28	0.0240
6.50	2.55	0.0244
8.13	2.85	0.0250
10.20	3.19	0.0253
12.78	3.58	0.0254
16.05	4.01	0.0256
20.15	4.49	0.0260
25.32	5.03	0.0264
31.83	5.64	0.0268
40.02	6.33	0.0271
50.33	7.09	0.0272
63.32	7.96	0.0273
79.65	8.92	0.0276
100.22	10.01	0.0282
126.12	11.23	0.0290
158.73	12.60	0.0295
199.77	14.13	0.0298
251.43	15.86	0.0300
316.48	17.79	0.0303
398.37	19.96	0.0304
501.45	22.39	0.0305
631.23	25.12	0.0307
794.60	28.19	0.0310
1000.28	31.63	0.0312
1259.22	35.49	0.0313
1440.067	37.94821	0.031489

6400 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	-0.0172
0.20	0.45	-0.0177
0.23	0.48	-0.0177
0.27	0.52	-0.0176
0.30	0.55	-0.0177
0.37	0.61	-0.0177
0.43	0.66	-0.0177
0.52	0.72	-0.0177
0.62	0.79	-0.0178
0.75	0.87	-0.0178
0.92	0.96	-0.0179
1.13	1.06	-0.0179
1.40	1.18	-0.0179
1.73	1.32	-0.0180
2.15	1.47	-0.0180
2.67	1.63	-0.0181
3.33	1.83	-0.0181
4.15	2.04	-0.0181
5.18	2.28	-0.0181
6.48	2.55	-0.0182
8.13	2.85	-0.0182
10.20	3.19	-0.0182
12.78	3.58	-0.0182
16.05	4.01	-0.0183
20.15	4.49	-0.0185
25.32	5.03	-0.0186
31.83	5.64	-0.0186
40.02	6.33	-0.0187
50.33	7.09	-0.0187
63.32	7.96	-0.0187
79.65	8.92	-0.0187
100.23	10.01	-0.0187
126.12	11.23	-0.0187
158.72	12.60	-0.0188
199.77	14.13	-0.0187
251.43	15.86	-0.0187
316.47	17.79	-0.0187
398.37	19.96	-0.0187
501.45	22.39	-0.0187
631.23	25.12	-0.0187
794.60	28.19	-0.0187
988.12	31.43	-0.0188

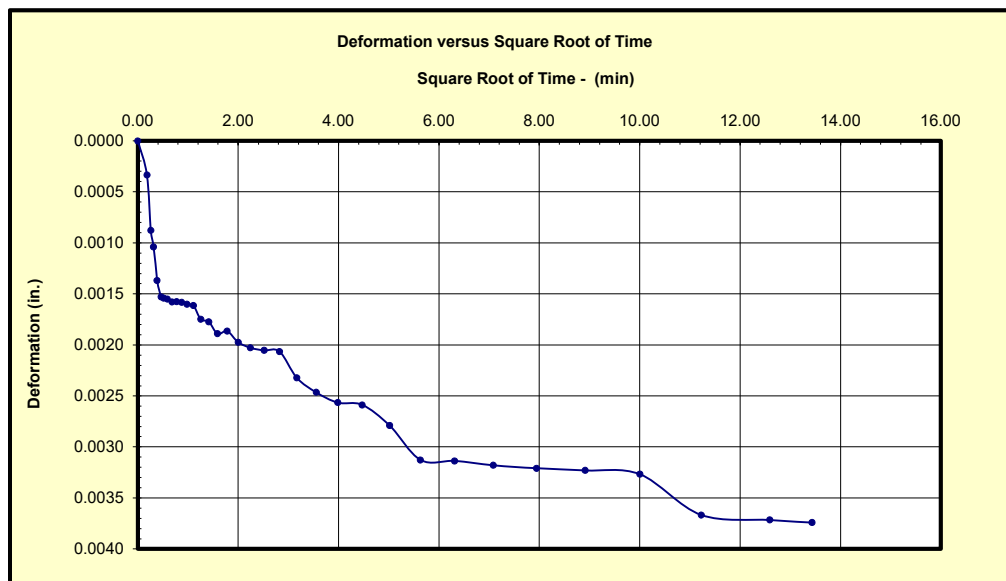
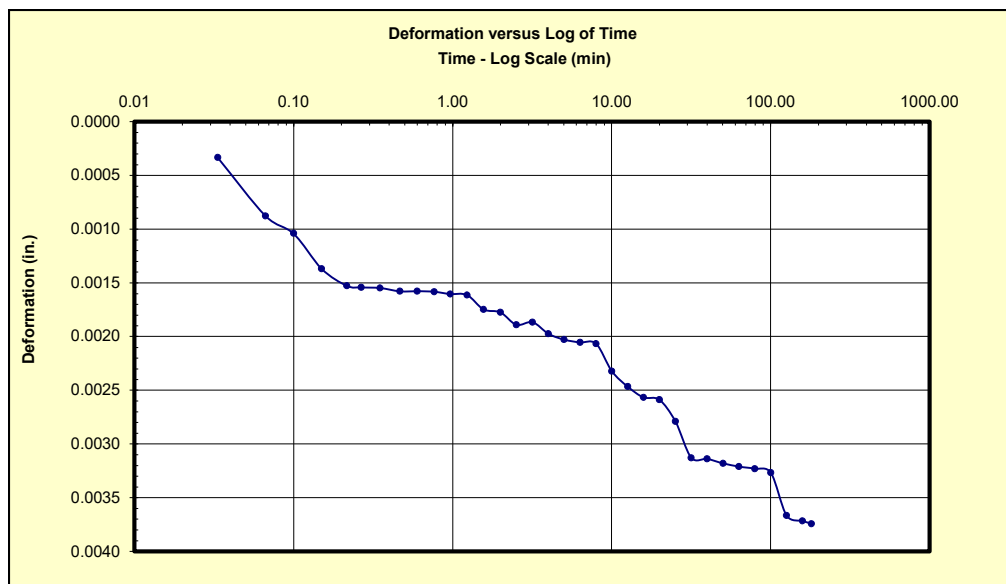
Time Deformation Readings

1600 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	-0.0072
0.20	0.45	-0.0077
0.23	0.48	-0.0077
0.27	0.52	-0.0078
0.32	0.56	-0.0078
0.37	0.61	-0.0078
0.43	0.66	-0.0078
0.52	0.72	-0.0078
0.62	0.79	-0.0078
0.77	0.88	-0.0078
0.92	0.96	-0.0078
1.13	1.06	-0.0078
1.40	1.18	-0.0078
1.73	1.32	-0.0078
2.15	1.47	-0.0078
2.67	1.63	-0.0079
3.32	1.82	-0.0079
4.15	2.04	-0.0079
5.18	2.28	-0.0079
6.48	2.55	-0.0080
8.12	2.85	-0.0082
10.18	3.19	-0.0082
12.77	3.57	-0.0083
16.03	4.00	-0.0083
20.15	4.49	-0.0084
25.32	5.03	-0.0085
31.82	5.64	-0.0086
40.02	6.33	-0.0086
50.33	7.09	-0.0088
63.32	7.96	-0.0091
79.65	8.92	-0.0091
100.23	10.01	-0.0093
126.12	11.23	-0.0094
158.72	12.60	-0.0094
199.77	14.13	-0.0095
251.43	15.86	-0.0095
316.47	17.79	-0.0095
398.35	19.96	-0.0096
501.45	22.39	-0.0096
631.22	25.12	-0.0096
794.60	28.19	-0.0096
1000.28	31.63	-0.0097
1259.22	35.49	-0.0097
1440.133	37.94909	-0.00973

400 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	-0.0048
0.20	0.45	-0.0054
0.23	0.48	-0.0054
0.27	0.52	-0.0054
0.32	0.56	-0.0055
0.37	0.61	-0.0055
0.43	0.66	-0.0055
0.53	0.73	-0.0056
0.63	0.80	-0.0056
0.77	0.88	-0.0056
0.93	0.97	-0.0056
1.15	1.07	-0.0057
1.42	1.19	-0.0057
1.75	1.32	-0.0057
2.15	1.47	-0.0057
2.68	1.64	-0.0058
3.33	1.83	-0.0060
4.15	2.04	-0.0061
5.18	2.28	-0.0061
6.48	2.55	-0.0062
8.13	2.85	-0.0062
10.20	3.19	-0.0063
12.78	3.58	-0.0063
16.05	4.01	-0.0064
20.17	4.49	-0.0065
25.33	5.03	-0.0065
31.83	5.64	-0.0066
40.03	6.33	-0.0067
50.33	7.09	-0.0067
63.32	7.96	-0.0068
79.67	8.93	-0.0069
100.23	10.01	-0.0070
126.13	11.23	-0.0071
158.73	12.60	-0.0072
199.78	14.13	-0.0074
251.45	15.86	-0.0076
316.48	17.79	-0.0079
398.37	19.96	-0.0083
501.45	22.39	-0.0083
631.23	25.12	-0.0086
794.62	28.19	-0.0091
1000.30	31.63	-0.0092
1259.23	35.49	-0.0093
1440.167	37.94953	-0.00941



Scan Data

Step List

ISTEP 21

Update

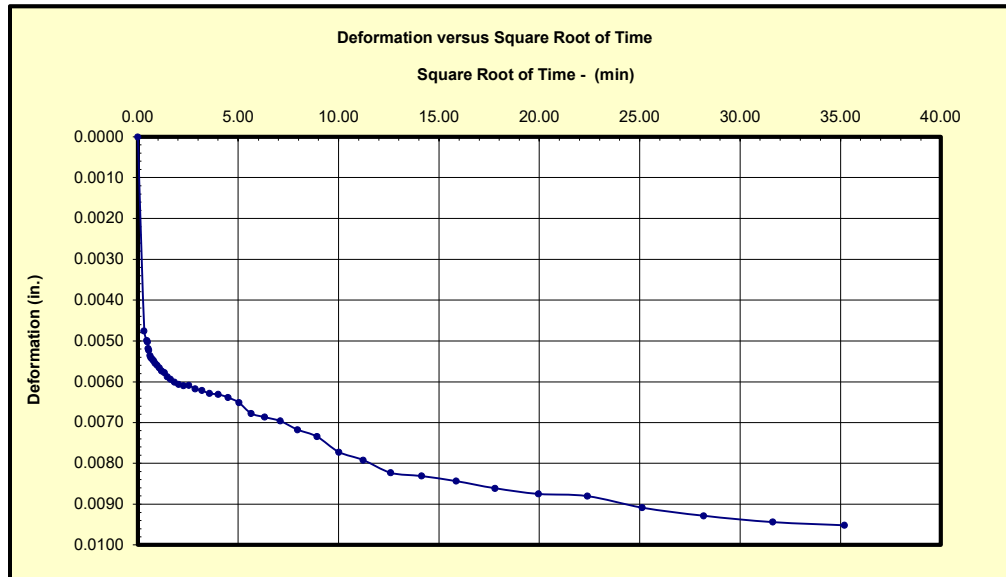
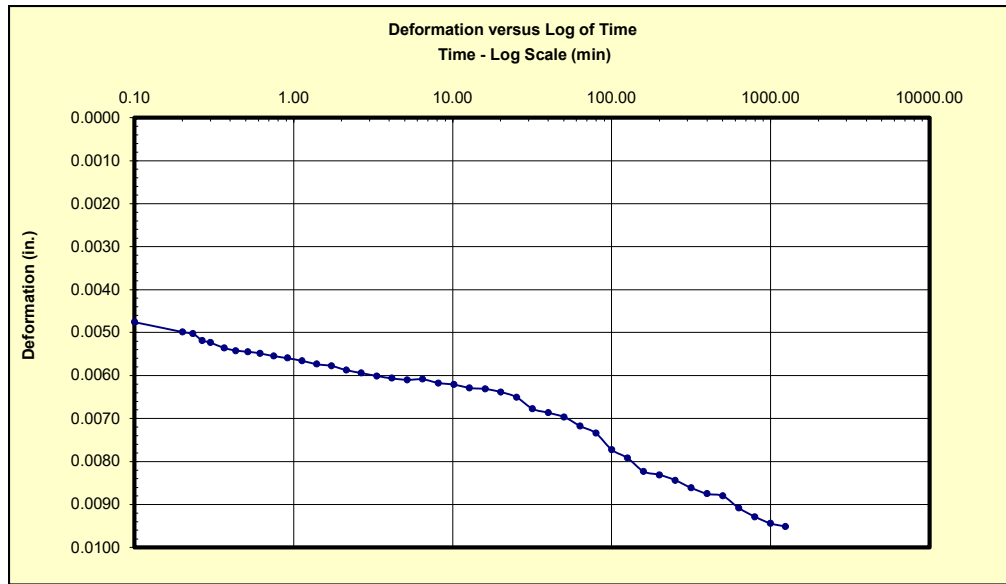
Vertical Stress
400 psf
S100
No match!!!

☒ End of Primary

☐ End of Increment

Project:
L231011

B14
Depth (ft):
16.8



Scan Data

Step List

ISTEP 31

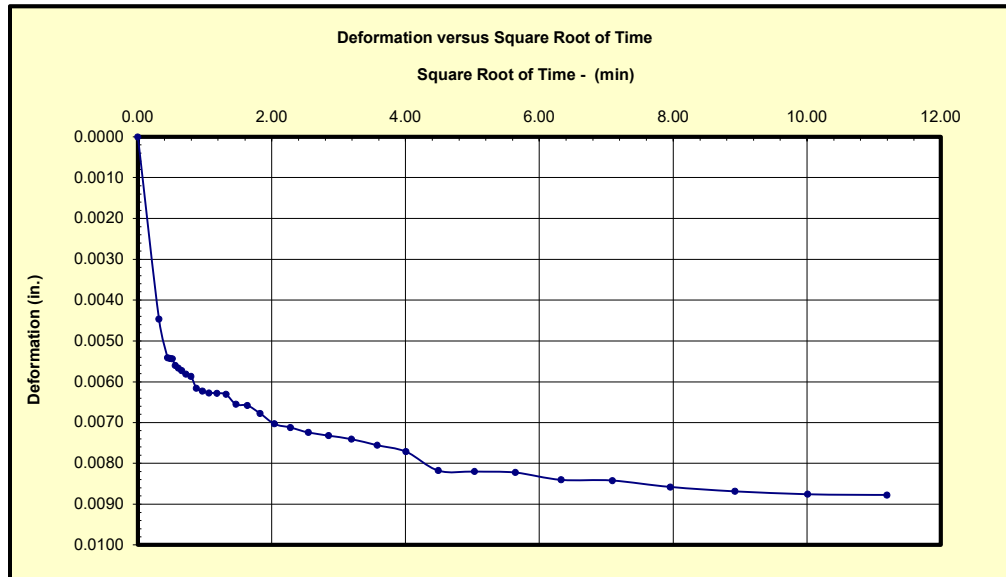
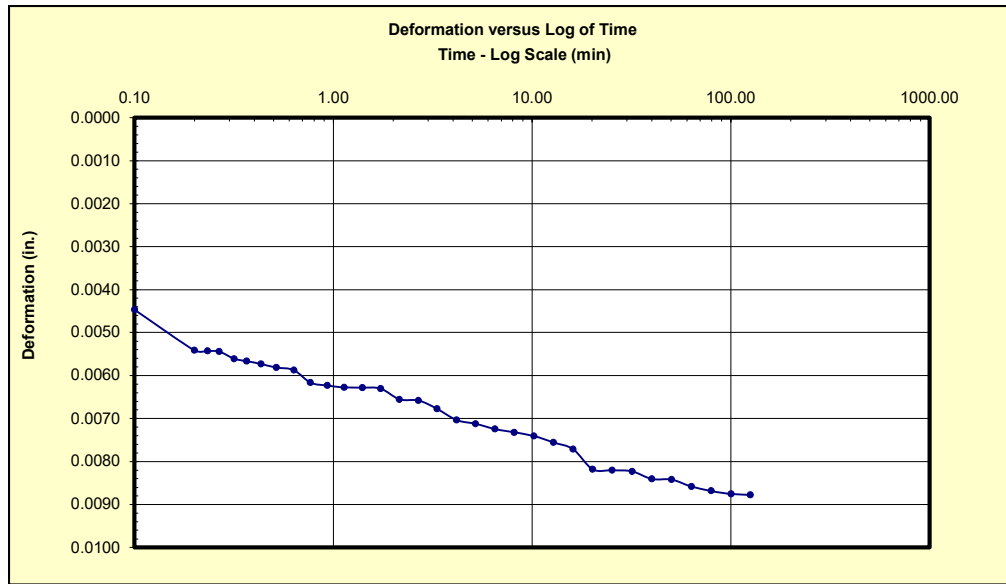
Update

Vertical Stress
800 psf
S100
No match!!!

☒ End of Primary
☐ End of Increment

Project:
L231011

B14
Depth (ft):
16.8



Scan Data

Step List

ISTEP 41

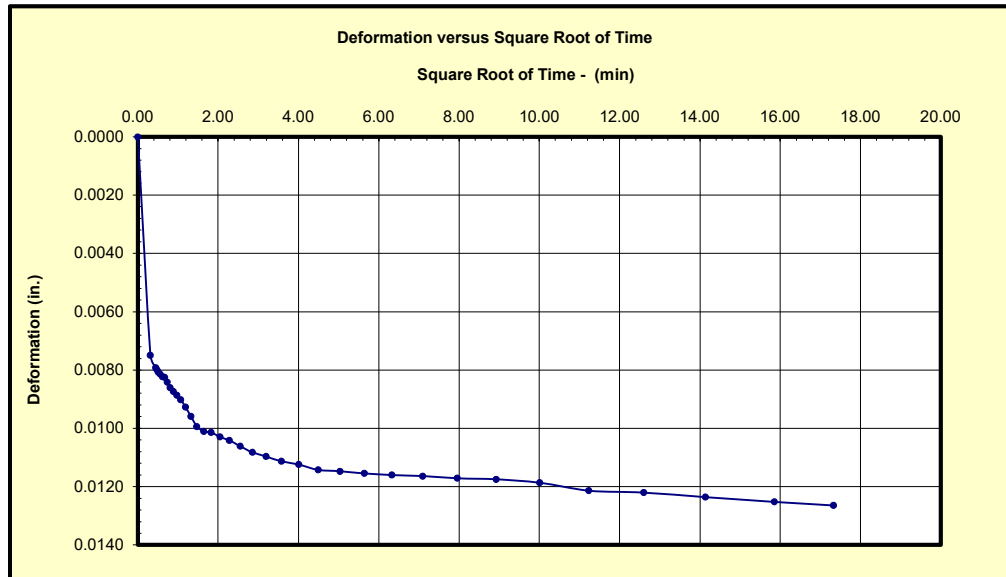
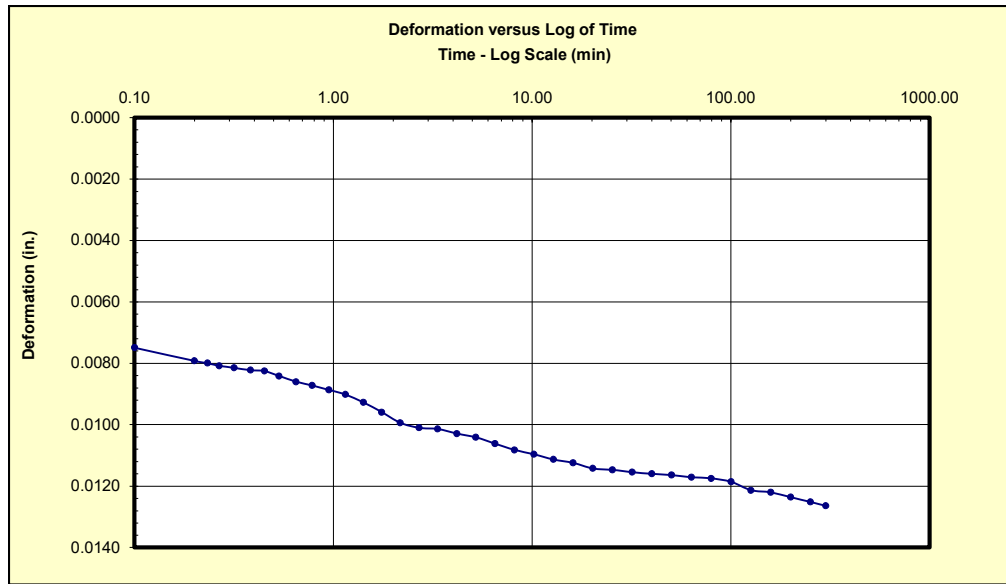
Update

Vertical Stress
1600 psf
S100
No match!!!

☒ End of Primary
☐ End of Increment

Project:
L231011

B14
Depth (ft):
16.8



Scan Data

Step List

ISTEP 51

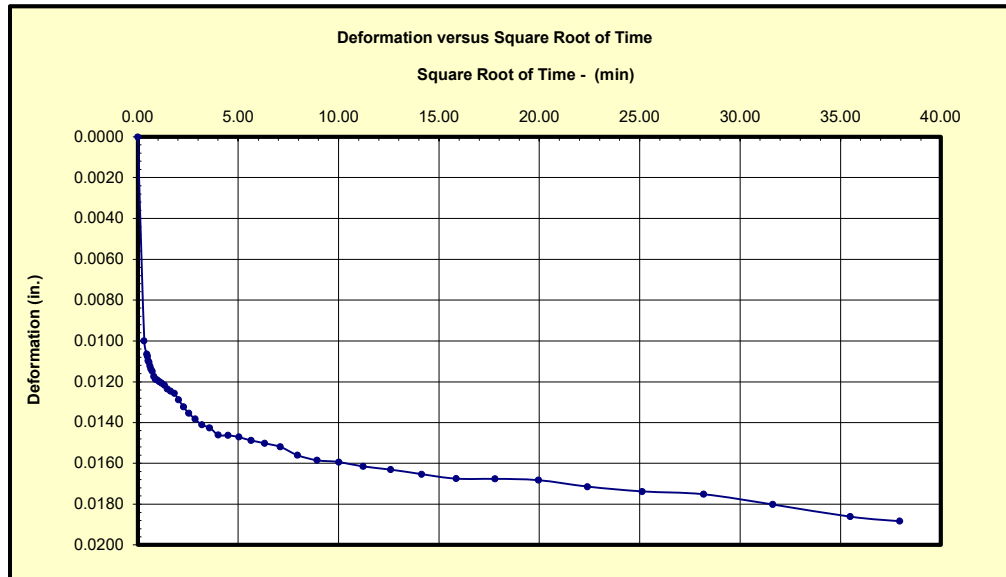
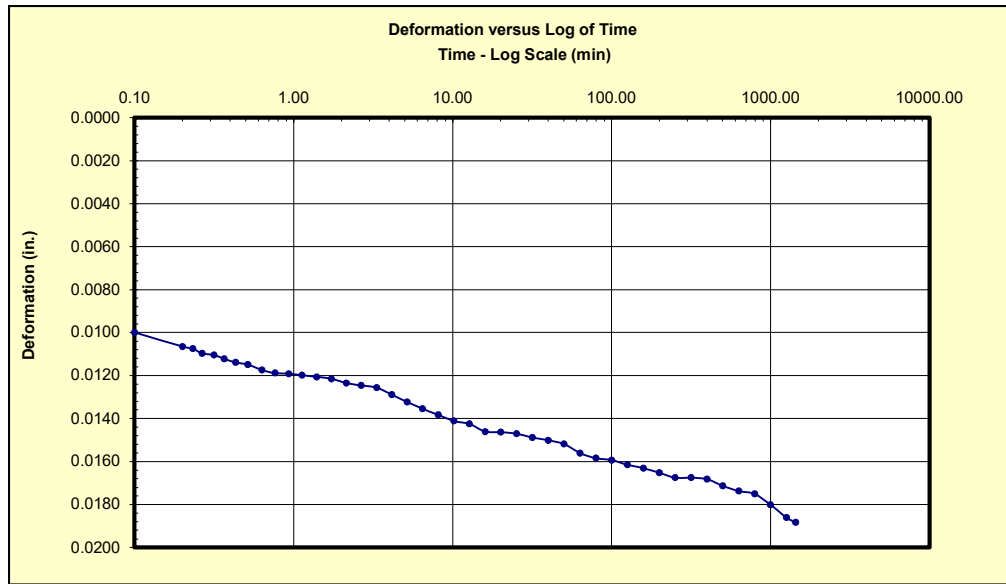
Update

Vertical Stress
3200 psf
S100
No match!!!

☒ End of Primary
☐ End of Increment

Project:
L231011

B14
Depth (ft):
16.8



Scan Data

Step List

ISTEP 61

Update

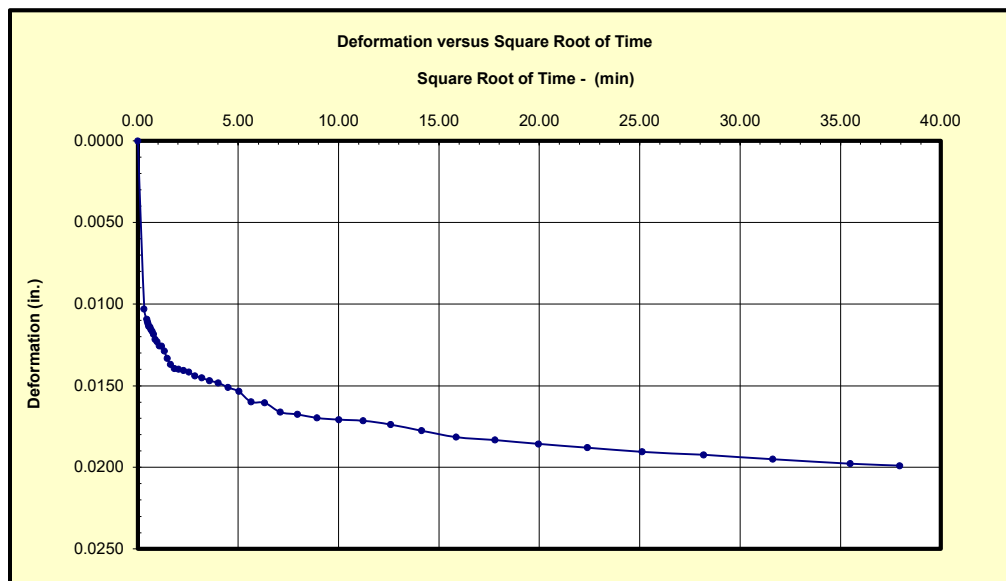
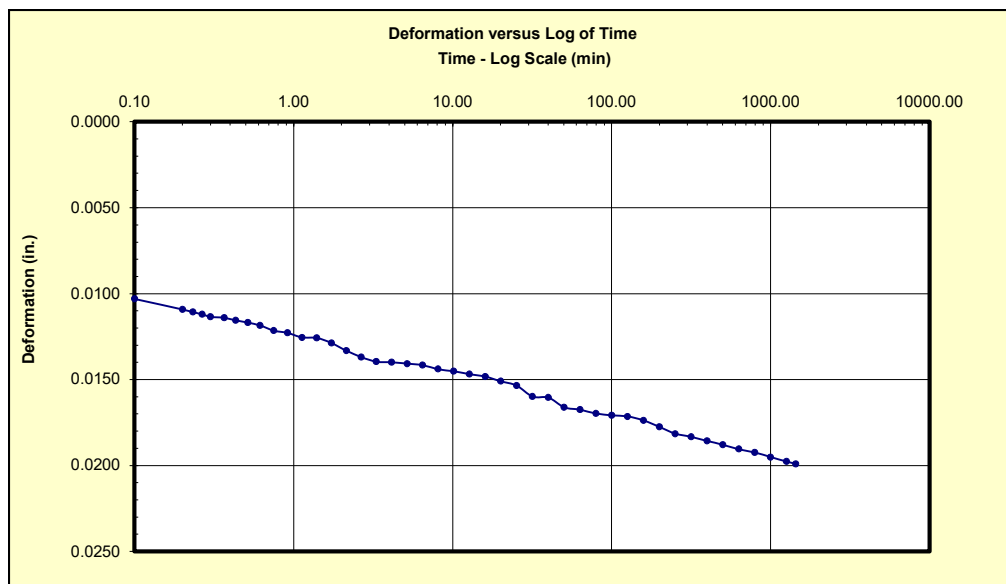
Vertical Stress
6400 psf

S100
No match!!!

- ☒ End of Primary
- ☐ End of Increment

Project:
L231011

B14
Depth (ft):
16.8



Scan Data

Step List

ISTEP 71

Update

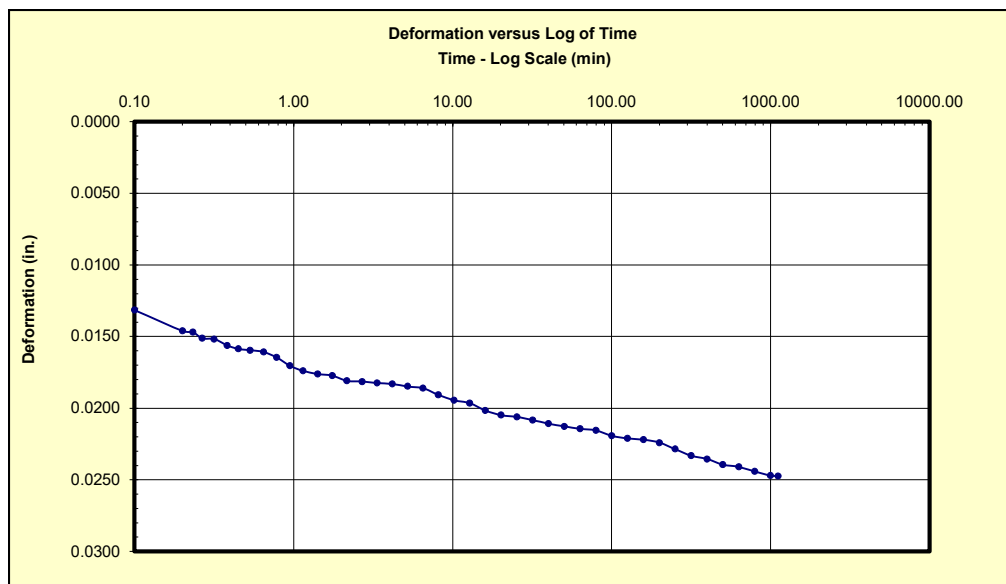
Vertical Stress
12800 psf
S100
No match!!!

☒ End of Primary

☐ End of Increment

Project:
L231011

B14
Depth (ft):
16.8



Scan Data

Step List

ISTEP 81

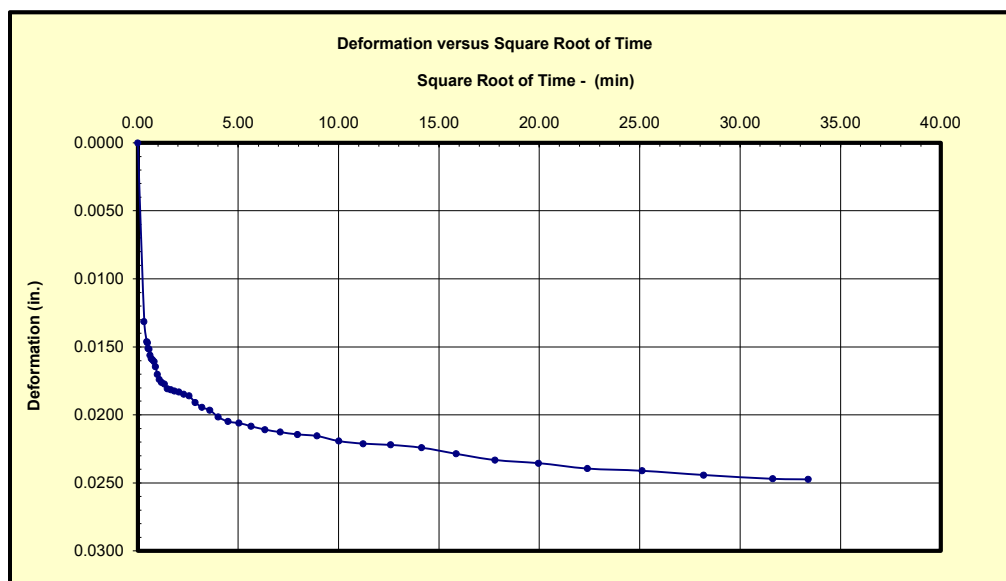
Update

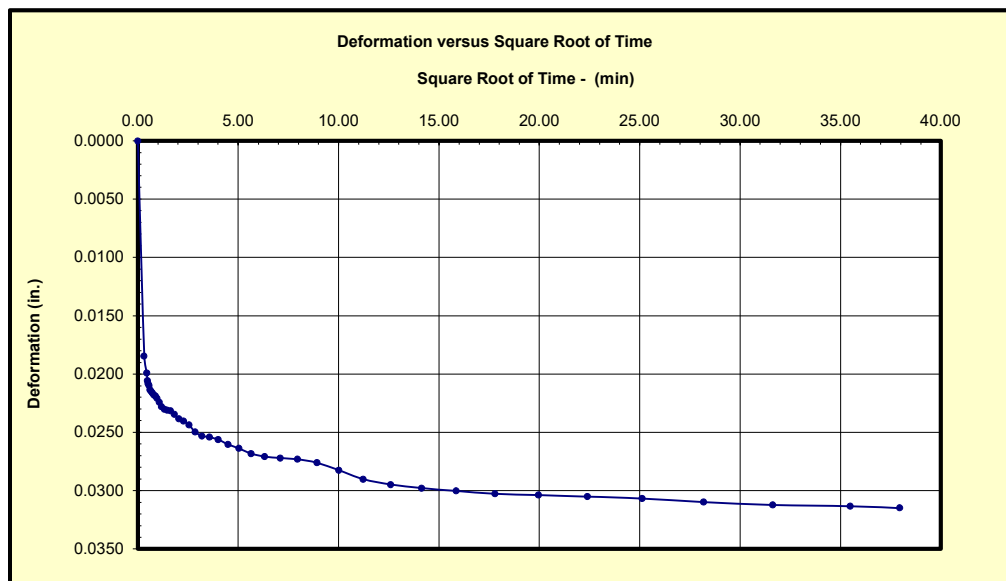
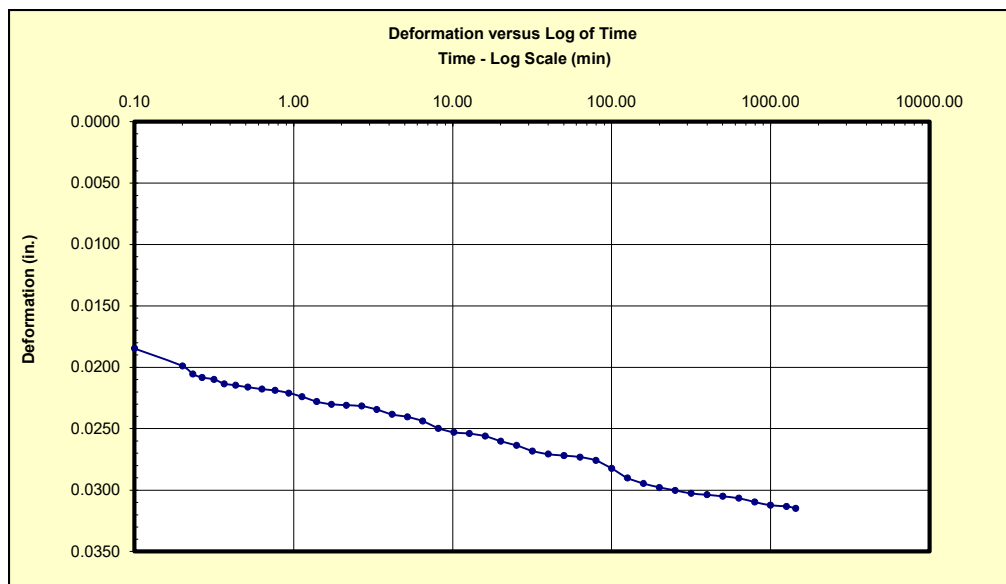
Vertical Stress
25600 psf
S100
No match!!!

- ☒ End of Primary
☐ End of Increment

Project:
L231011

B14
Depth (ft):
16.8





Scan Data

Step List

ISTEP 91

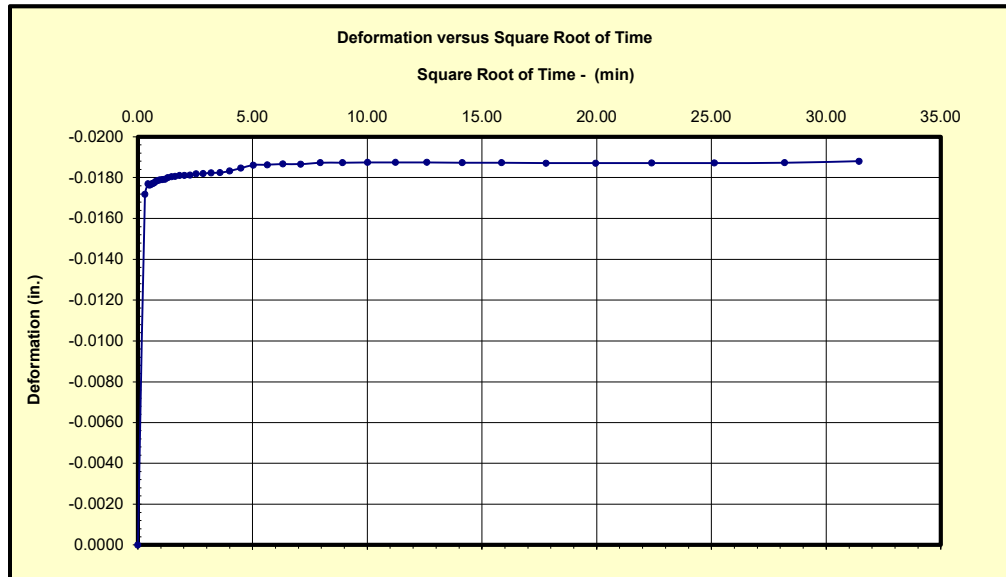
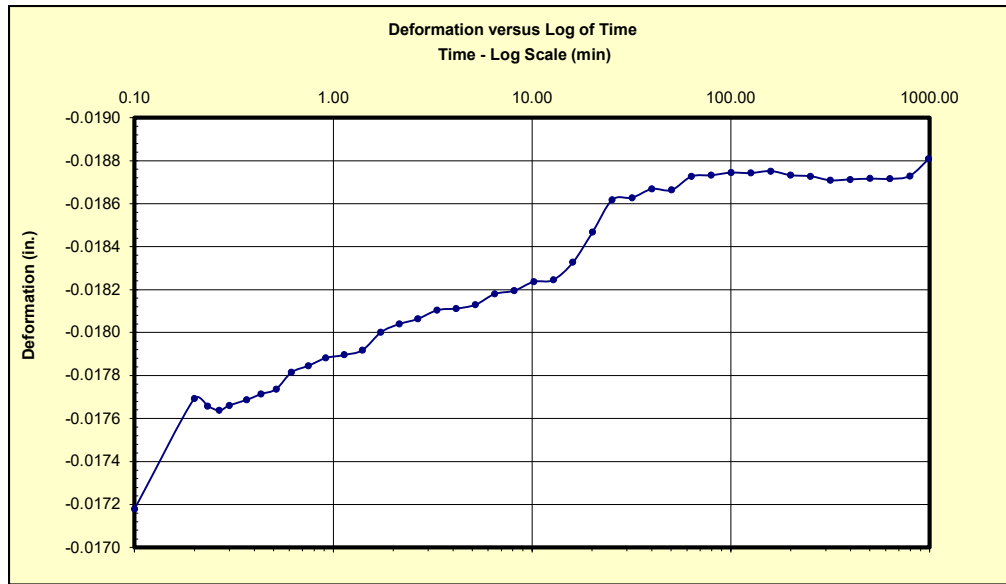
Update

Vertical Stress
51200 psf
S100
No match!!!

☒ End of Primary
☐ End of Increment

Project:
L231011

B14
Depth (ft):
16.8



Scan Data

Step List

ISTEP 101

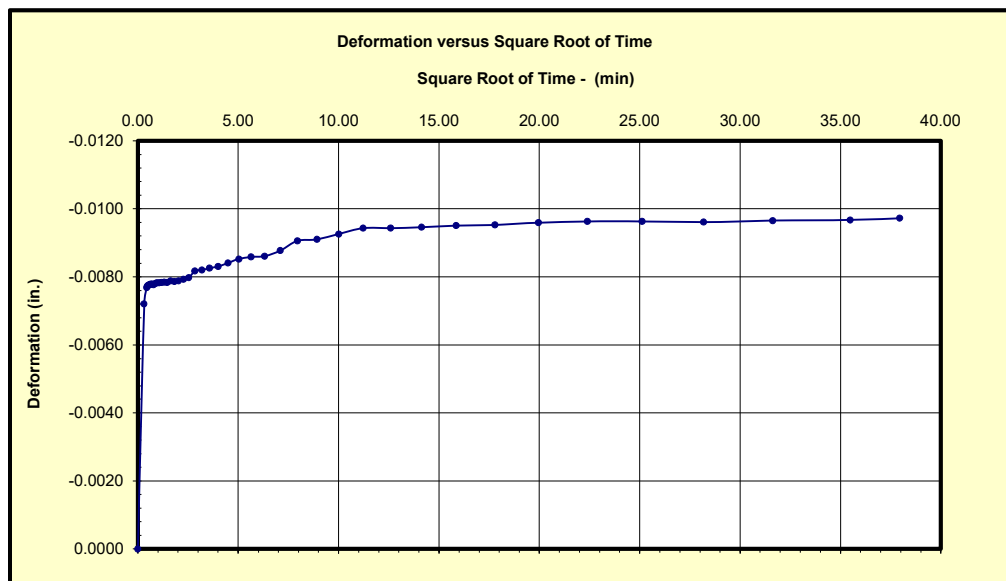
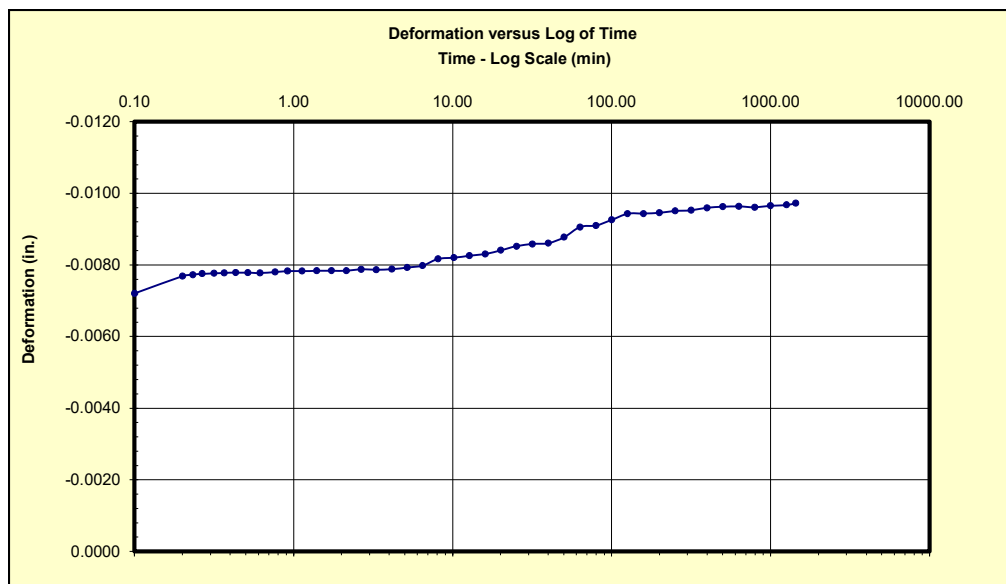
Update

Vertical Stress
6400 psf
S100
No match!!!

☒ End of Primary
☐ End of Increment

Project:
L231011

B14
Depth (ft):
16.8



Scan Data

Step List

ISTEP 111

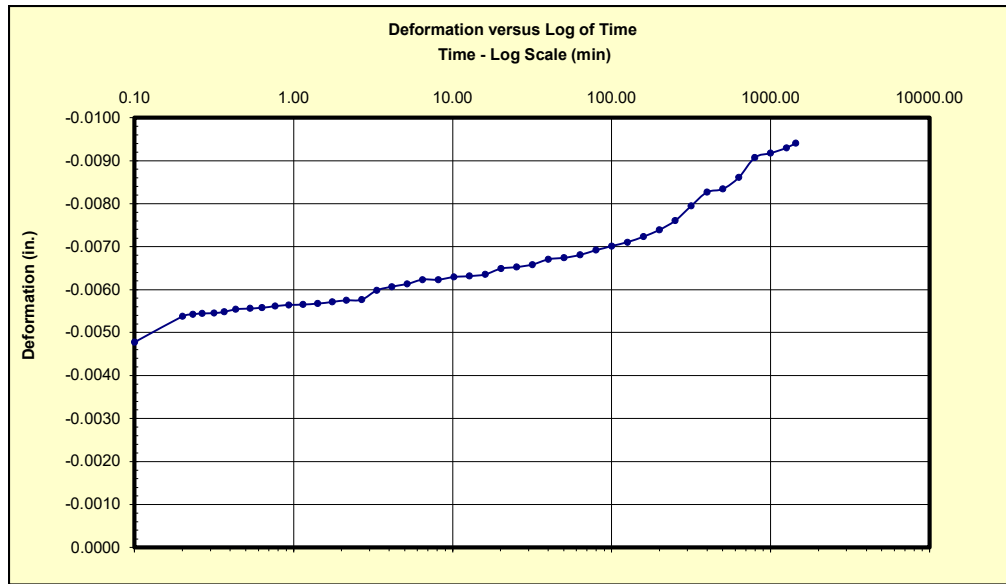
Update

Vertical Stress
1600 psf
S100
No match!!!

- ☒ End of Primary
☐ End of Increment

Project:
L231011

B14
Depth (ft):
16.8



Scan Data

Step List

ISTEP 111

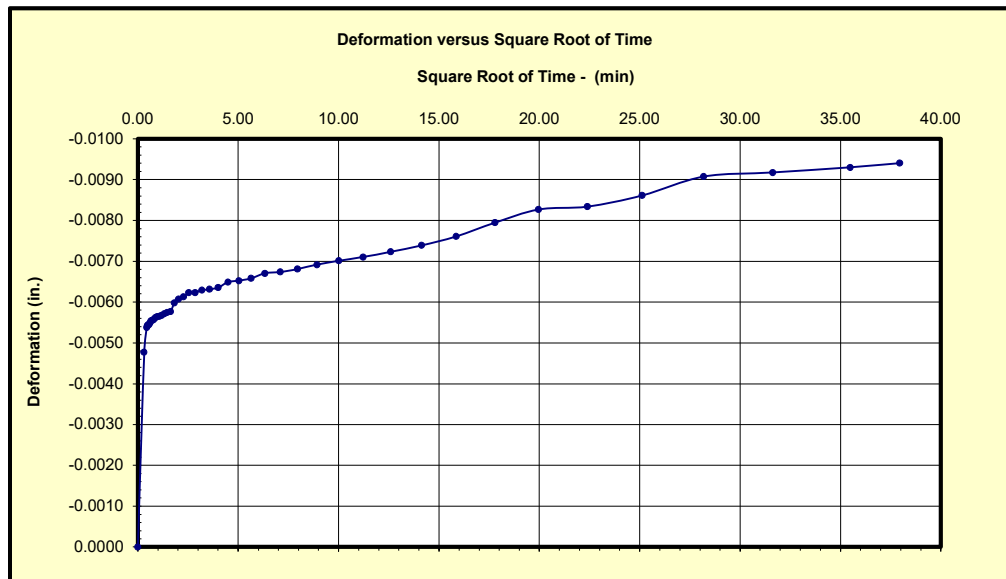
Update

Vertical Stress
400 psf
S100
No match!!!

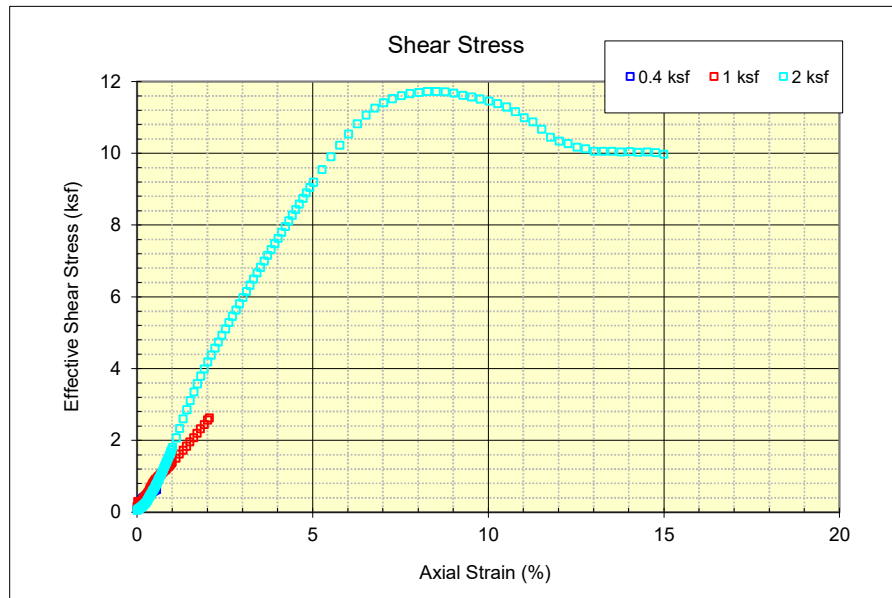
☒ End of Primary
☐ End of Increment

Project:
L231011

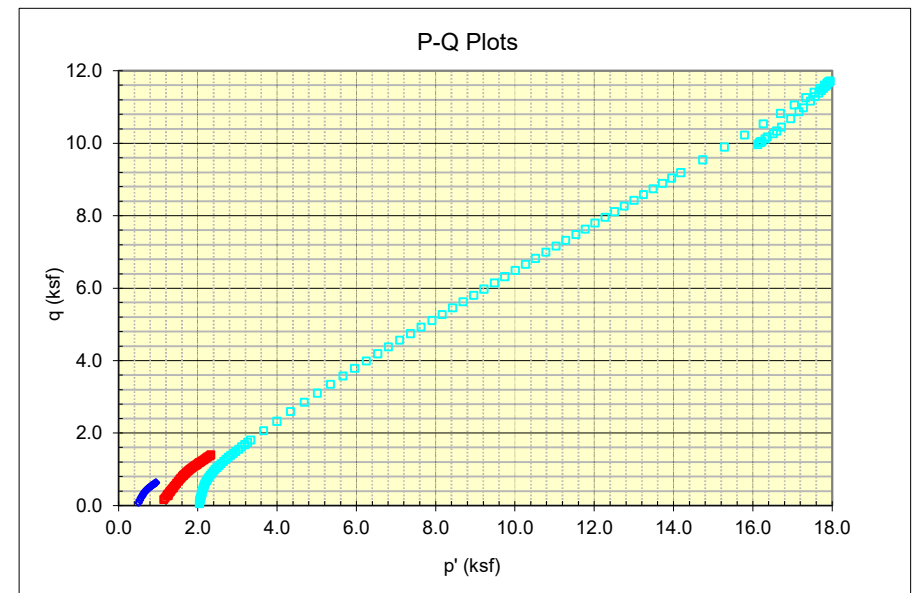
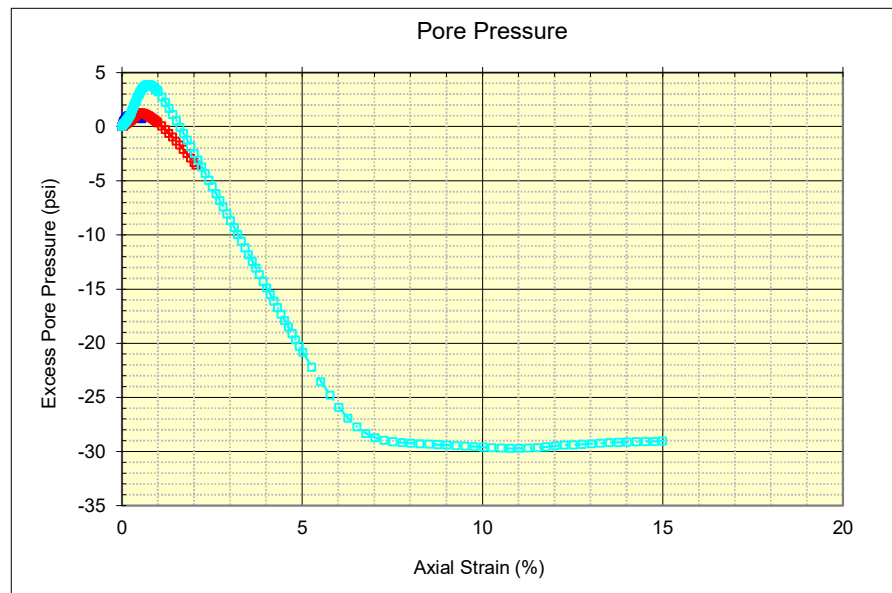
B14
Depth (ft):
16.8



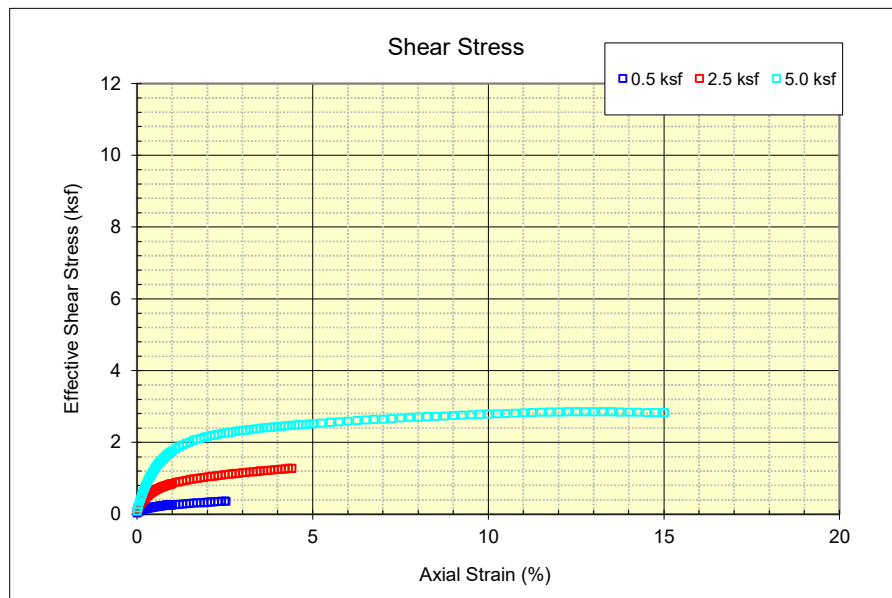
Multistage CU Triaxial Shear Report ASTM D-4767



Project Name: Arkema Manufacturing Site Project Location: Tacoma, WA Laboratory Number: 23-1265 Sample Description: SP-SM Type: Intact from thin walled tube Sample Source: SO-DOFB2-102523-11.8-12.3 				
Initial dry unit weight (pcf)	94.8	--	--	
Initial Wc (%)	30.6%	--	--	
Final dry unit weight (pcf)	--	--	97.7	
Final Wc (%)	--	--	25.8%	
Consolidation Stress (ksf)	0.4	1.0	2.0	
Peak p' (ksf)	0.946	4.119	17.96	
Peak q (ksf)	0.633	2.621	11.72	



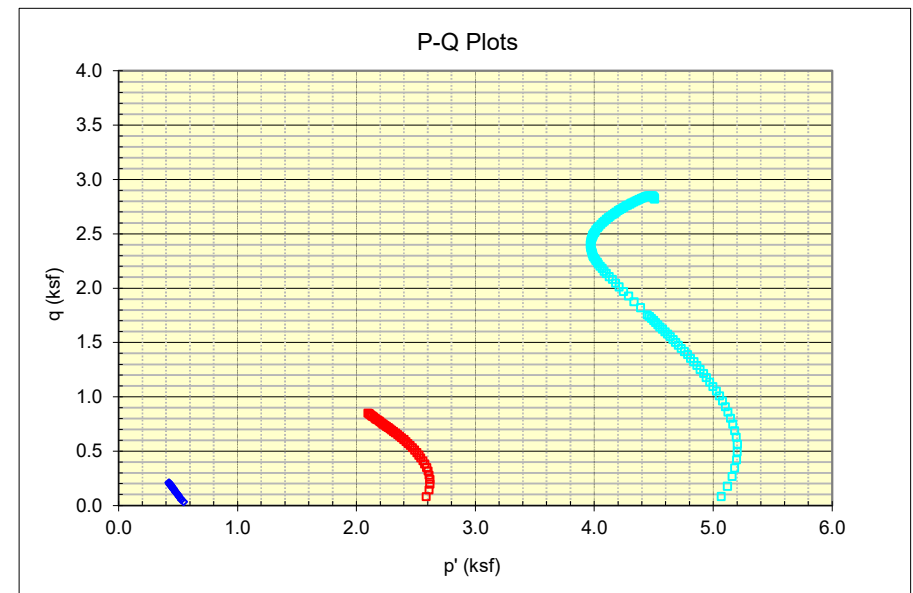
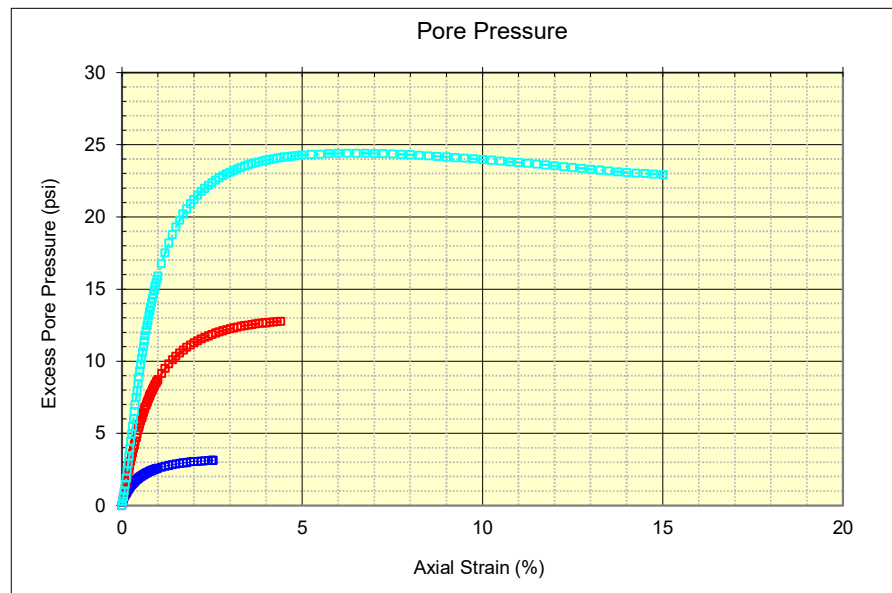
Multistage CU Triaxial Shear Report ASTM D-4767

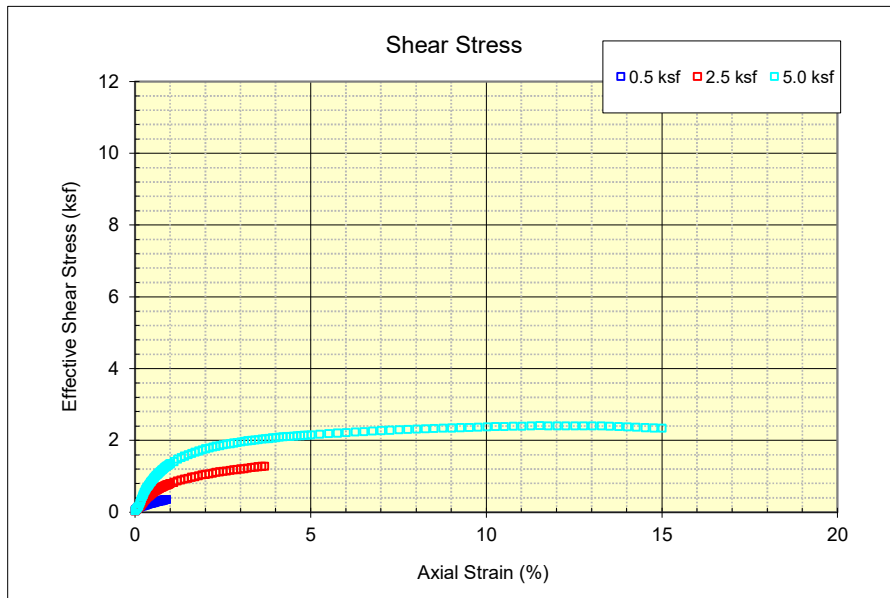


Project Name: Arkema Manufacturing Site
Project Location: Tacoma, WA
Laboratory Number: 23-1266
Sample Description: ML
Type: Intact from thin walled tube
Sample Source: SO-DOFB2-102523-31.5-32



Initial dry unit weight (pcf)	73.1	--	--
Initial Wc (%)	45.2%	--	--
Final dry unit weight (pcf)	--	--	78.9
Final Wc (%)	--	--	39.0%
Consolidation Stress (ksf)	0.5	2.5	5.0
Peak p' (ksf)	0.549	2.620	5.20
Peak q (ksf)	0.361	1.274	2.85

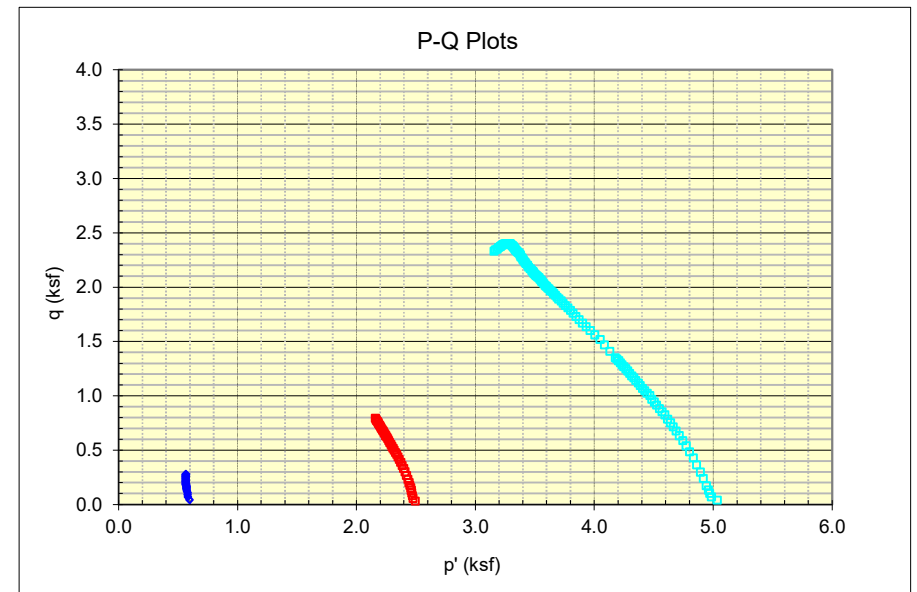
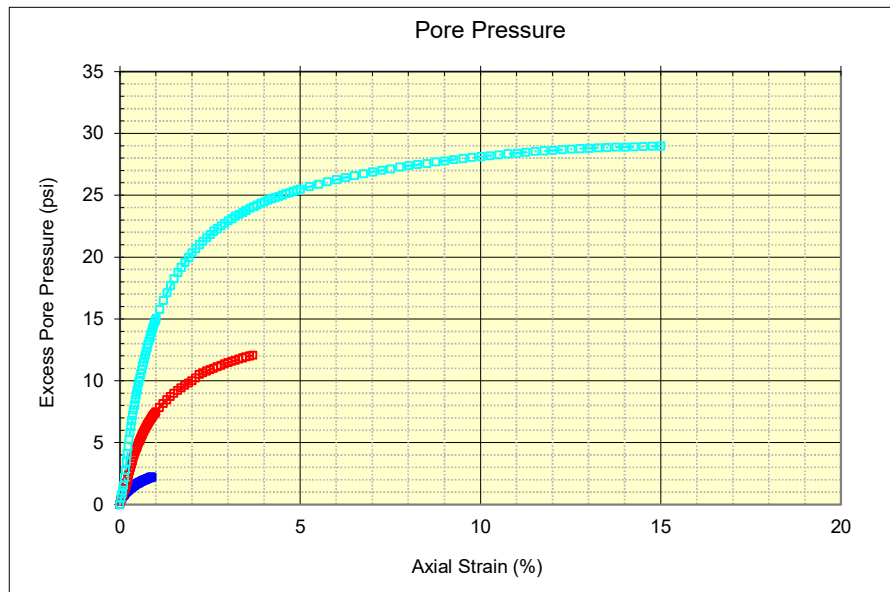


Multistage CU Triaxial Shear Report
ASTM D-4767

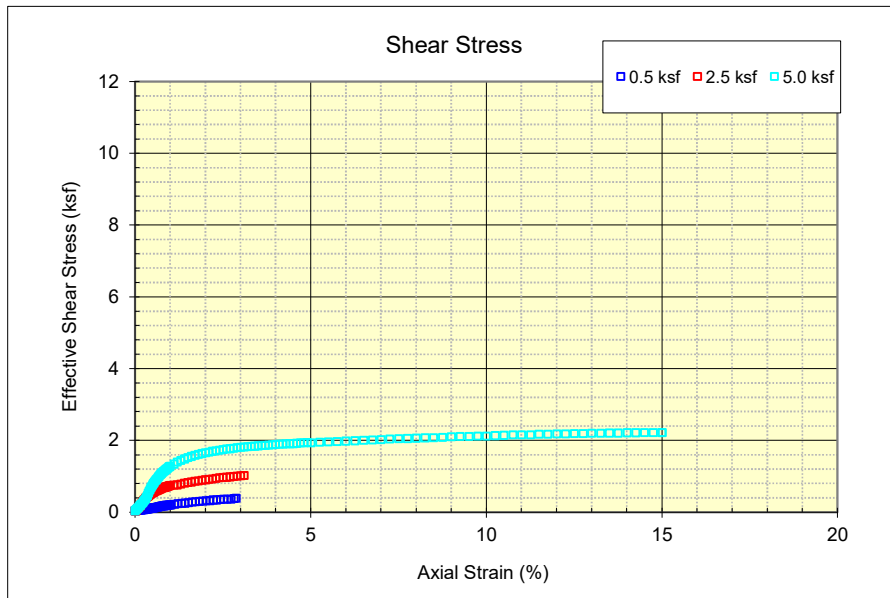
Project Name:	Arkema Manufacturing Site		
Project Location:	Tacoma, WA		
Laboratory Number:	23-1268		
Sample Description:	SM/ML		
Type:	Intact from thin walled tube		
Sample Source:	SO-DOFB4-102523-32.75-33.25		



Initial dry unit weight (pcf)	60.2	--	--
Initial Wc (%)	61.7%	--	--
Final dry unit weight (pcf)	--	--	68.0
Final Wc (%)	--	--	42.6%
Consolidation Stress (ksf)	0.5	2.5	5.0
Peak p' (ksf)	0.598	2.50	5.04
Peak q (ksf)	0.354	1.28	2.40



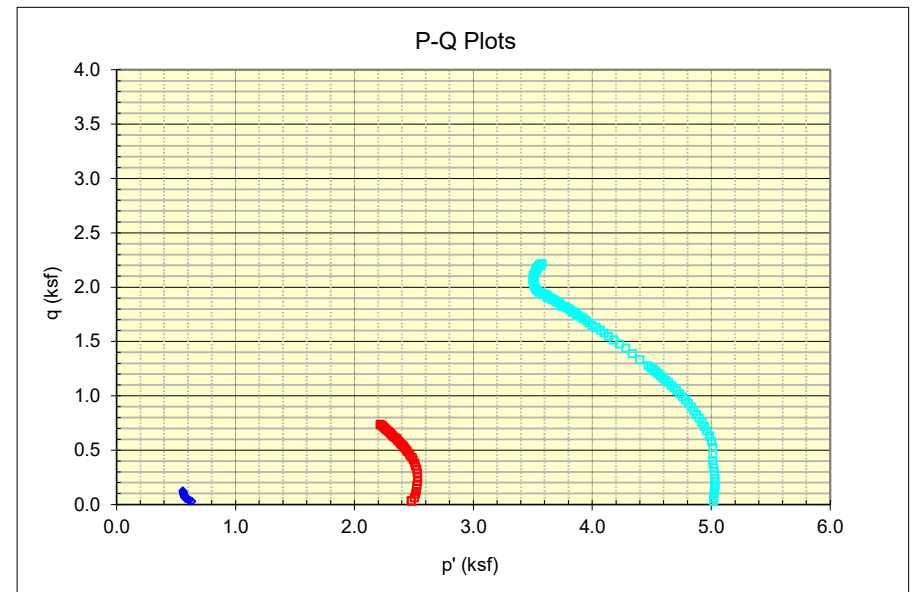
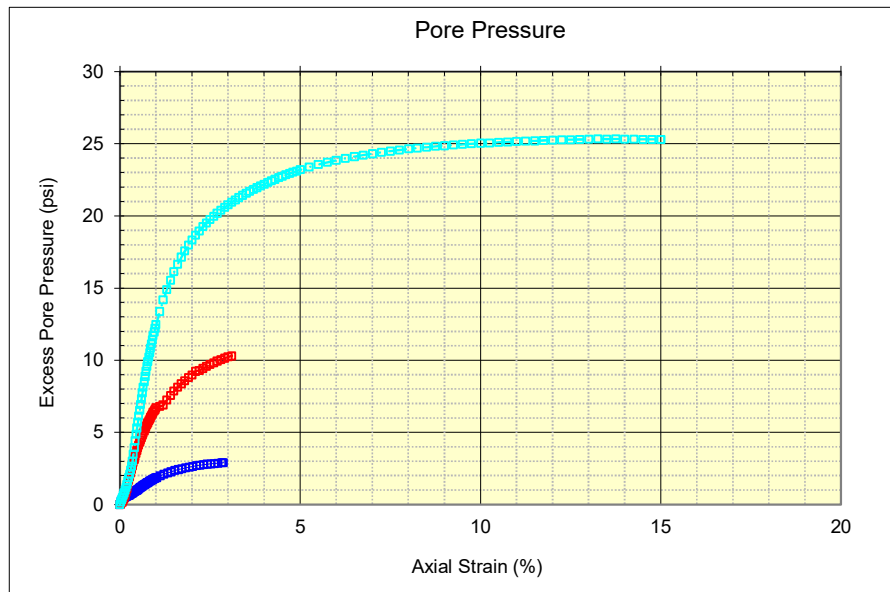
Multistage CU Triaxial Shear Report ASTM D-4767



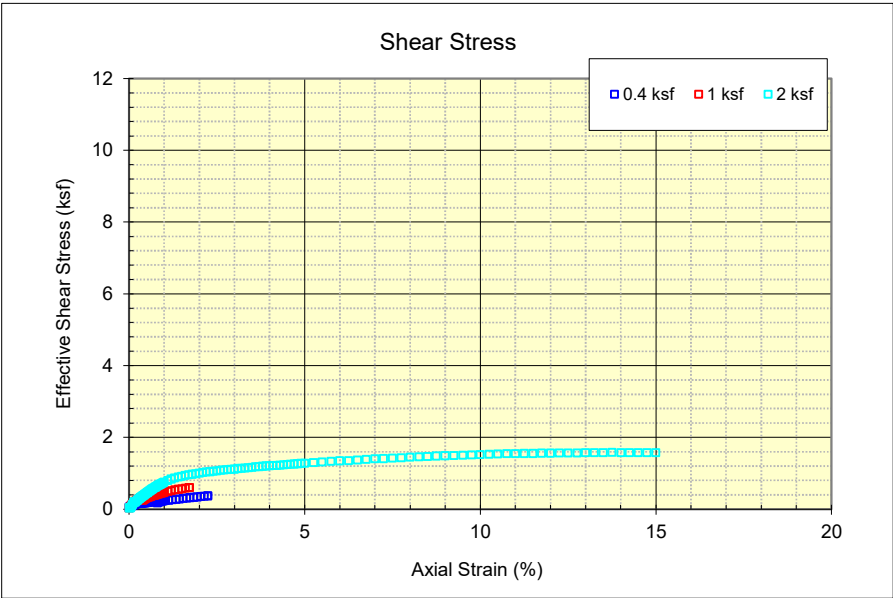
Project Name: Arkema Manufacturing Site
Project Location: Tacoma, WA
Laboratory Number: 23-1270
Sample Description: MH
Type: Intact from thin walled tube
Sample Source: SO-DOFB6-102523-35.5-36



Initial dry unit weight (pcf)	62.2	--	--
Initial Wc (%)	51.7%	--	--
Final dry unit weight (pcf)	--	--	75.7
Final Wc (%)	--	--	44.2%
Consolidation Stress (ksf)	0.5	2.5	5.0
Peak p' (ksf)	0.634	2.535	5.03
Peak q (ksf)	0.378	1.015	2.22



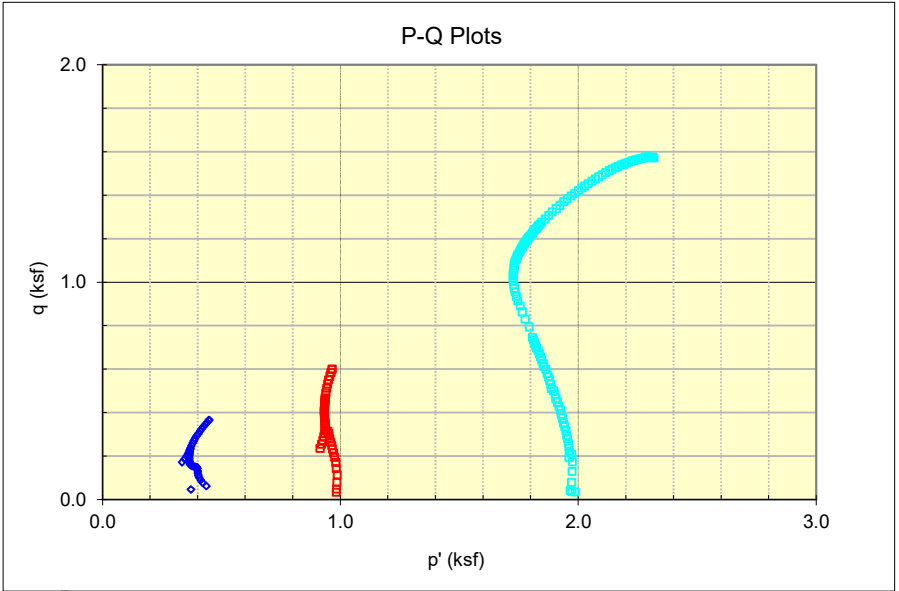
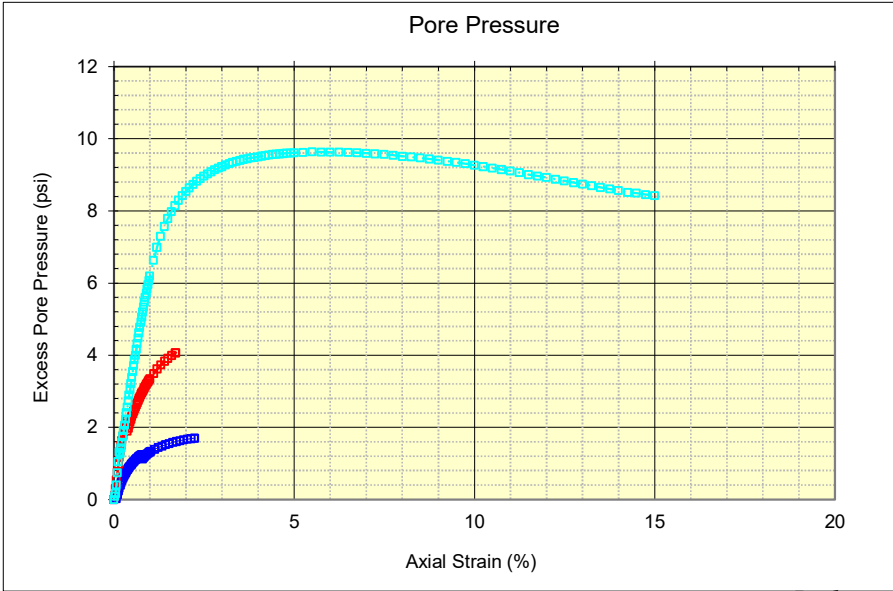
Multistage CU Triaxial Shear Report
ASTM D-4767



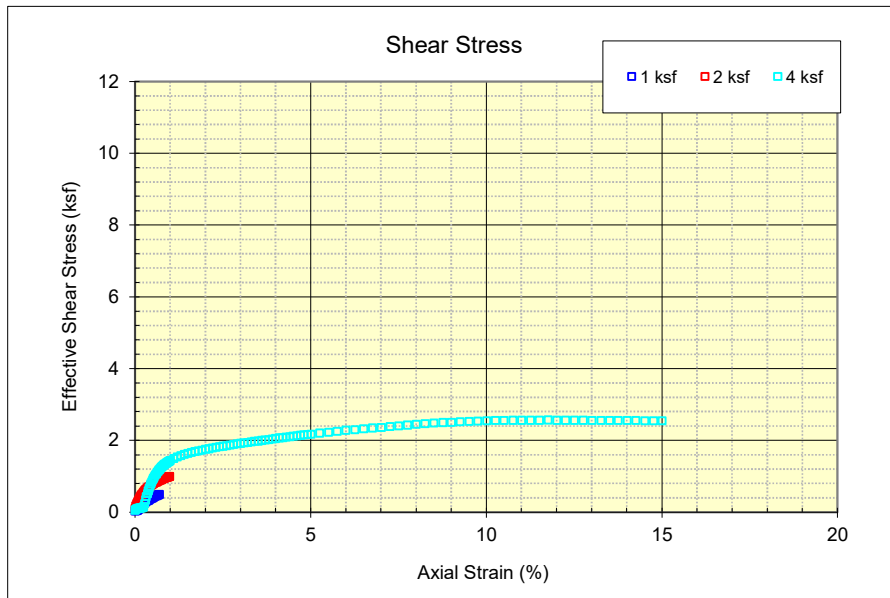
Project Name:	Arkema Manufacturing Site		
Project Location:	Tacoma, WA		
Laboratory Number:	23-1271		
Sample Description:	MH		
Type:	Intact from thin walled tube		
Sample Source:	SO-DOFB8-102623-16.9-17.4		



Initial dry unit weight (pcf)	74.8	--	--
Initial Wc (%)	46%	--	--
Final dry unit weight (pcf)	--	--	76.3
Final Wc (%)	--	--	41%
Consolidation Stress (ksf)	0.4	1.0	2.0
Peak p' (ksf)	0.449	0.967	2.32
Peak q (ksf)	0.366	0.598	1.57



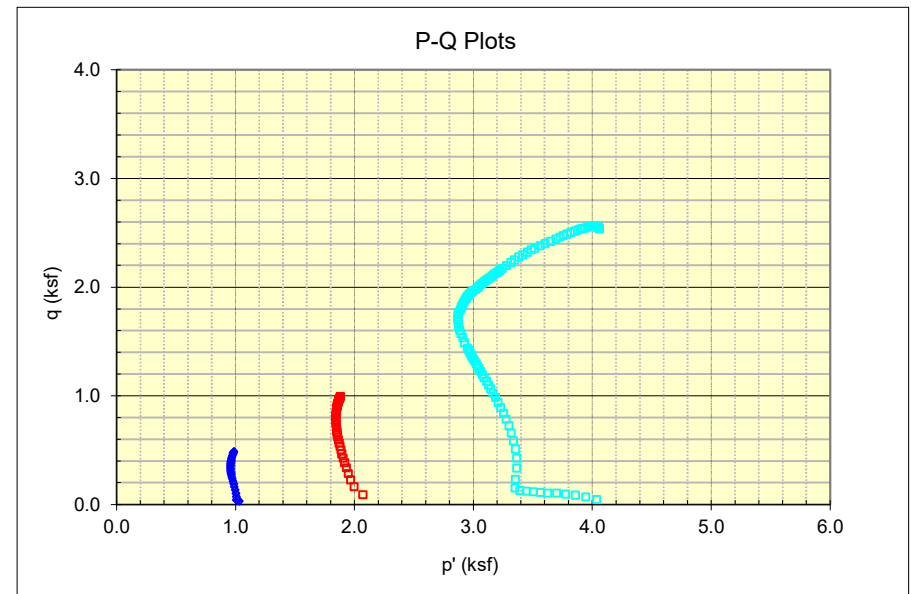
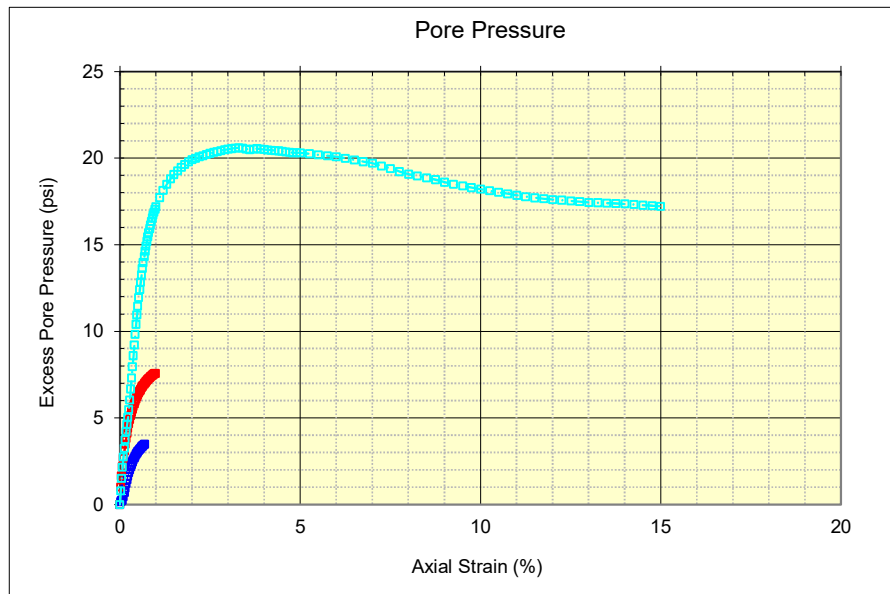
Multistage CU Triaxial Shear Report ASTM D-4767



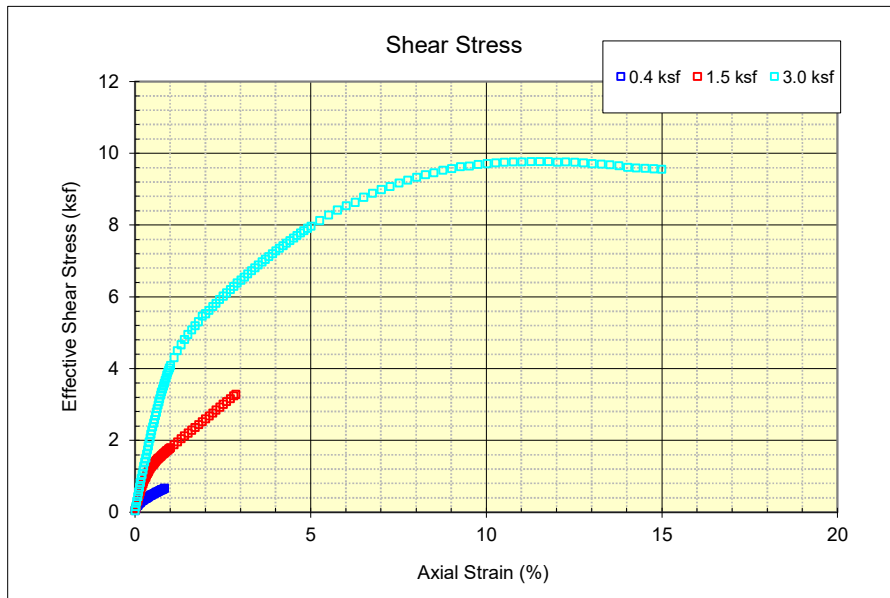
Project Name: Arkema Manufacturing Site
Project Location: Tacoma, WA
Laboratory Number: 23-1272
Sample Description: SM/ML
Type: Intact from thin walled tube
Sample Source: SO-DOFB8-102623-31.5-32



Initial dry unit weight (pcf)	78.9	--	--
Initial Wc (%)	39.9%	--	--
Final dry unit weight (pcf)	--	--	83.0
Final Wc (%)	--	--	40.2%
Consolidation Stress (ksf)	1.0	2.0	4.0
Peak p' (ksf)	0.988	1.885	4.06
Peak q (ksf)	0.489	0.995	2.54



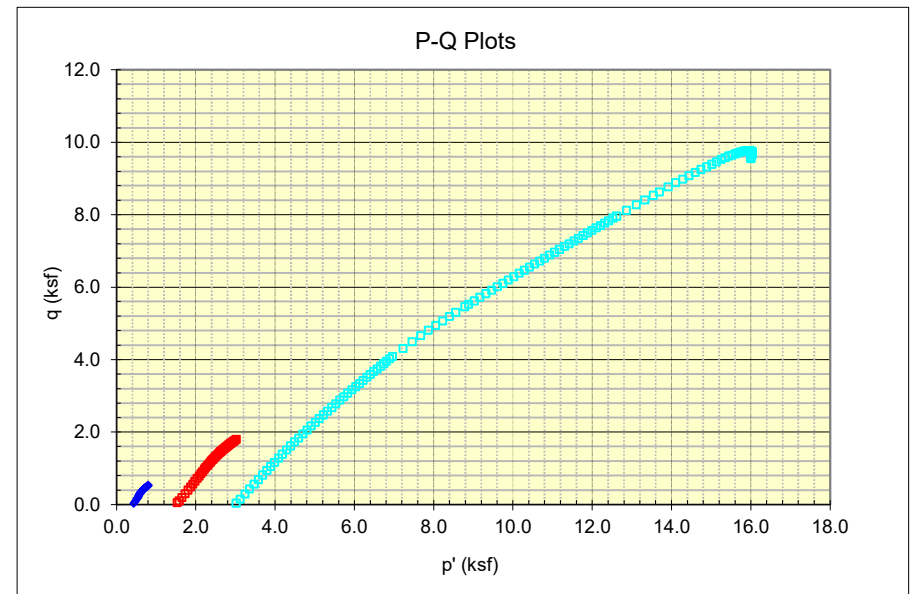
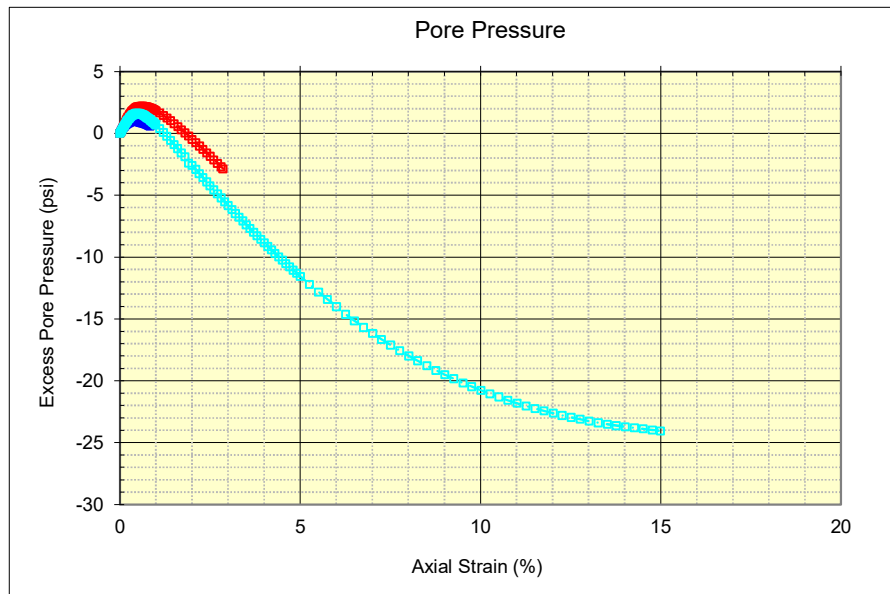
Multistage CU Triaxial Shear Report ASTM D-4767



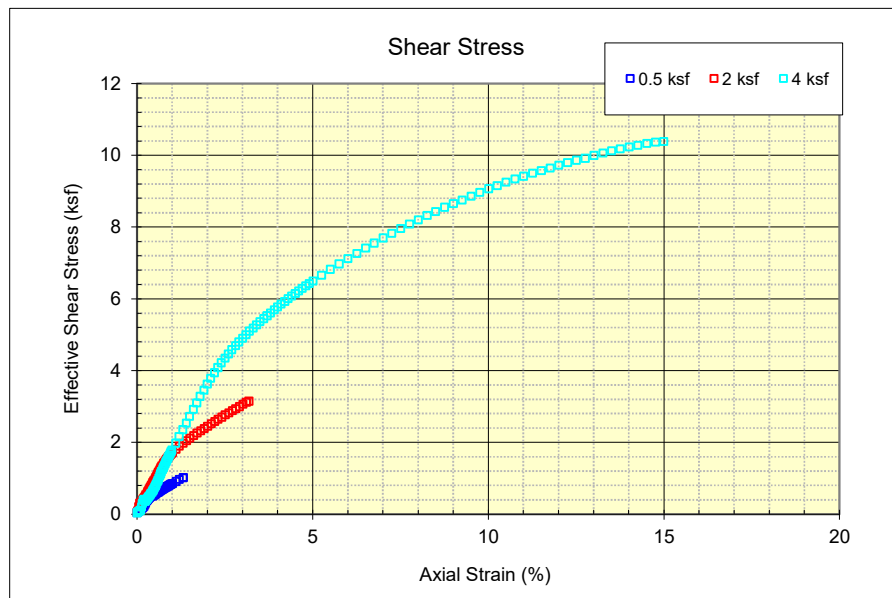
Project Name: Arkema Manufacturing Site
Project Location: Tacoma, WA
Laboratory Number: 23-1276
Sample Description: SP
Type: Intact from thin walled tube
Sample Source: SO-DOFB12-102723-13.5-14



Initial dry unit weight (pcf)	94.4	--	--
Initial Wc (%)	24.3%	--	--
Final dry unit weight (pcf)	--	--	95.7
Final Wc (%)	--	--	25.6%
Consolidation Stress (ksf)	0.4	1.5	3.0
Peak p' (ksf)	0.973	5.18	16.0
Peak q (ksf)	0.660	3.28	9.77



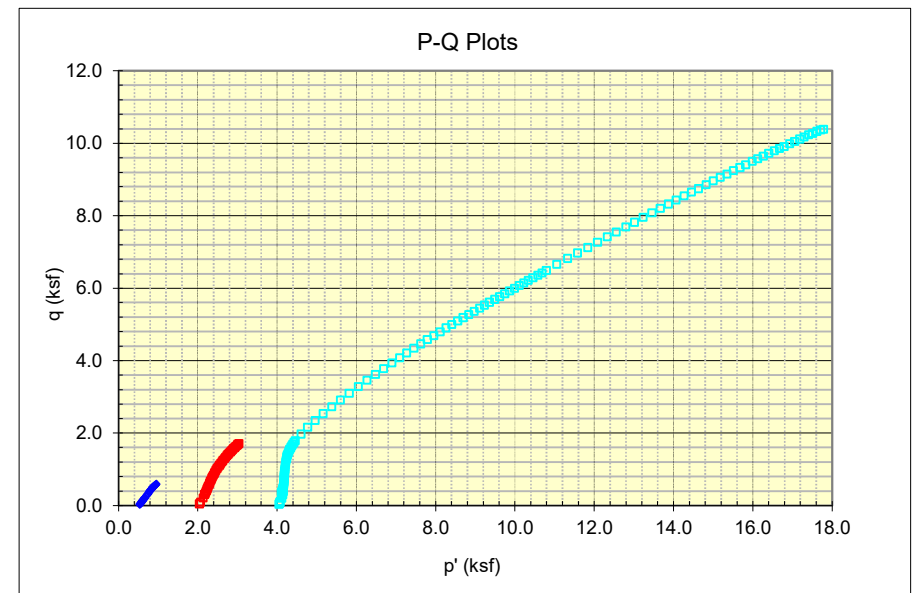
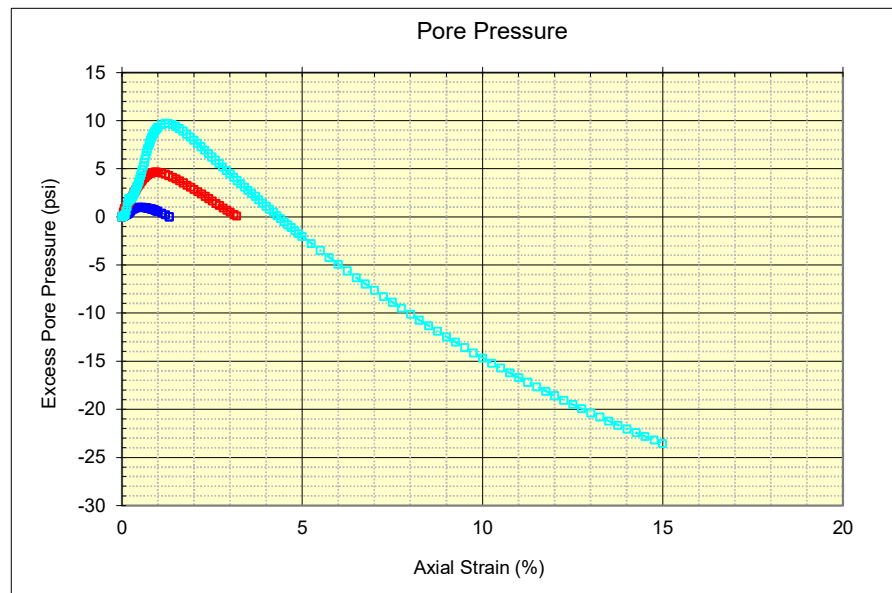
Multistage CU Triaxial Shear Report ASTM D-4767



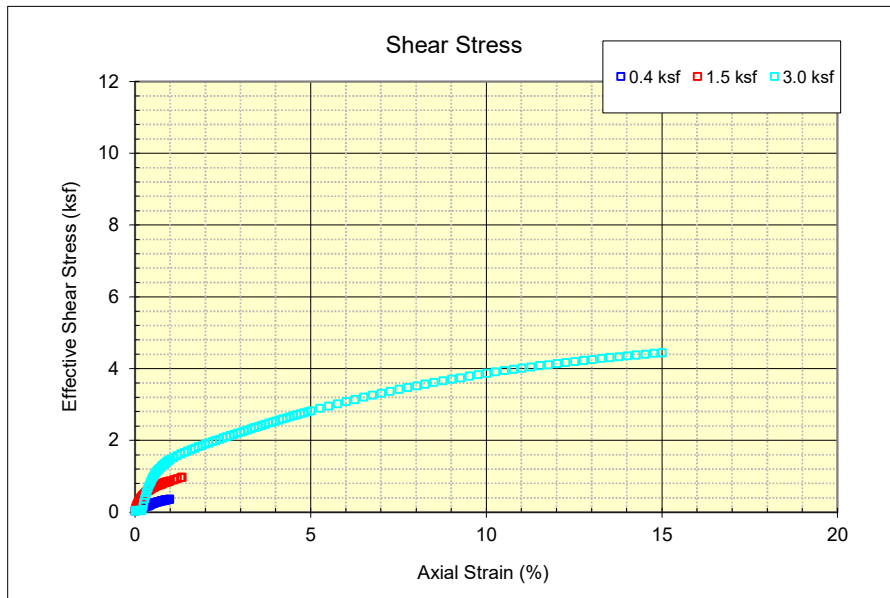
Project Name: Arkema Manufacturing Site
Project Location: Tacoma, WA
Laboratory Number: 23-1277
Sample Description: SP-SM
Type: Intact from thin walled tube
Sample Source: SO-DOFB12-102723-22.5-23



Initial dry unit weight (pcf)	97.7	--	--
Initial Wc (%)	9.7%	--	--
Final dry unit weight (pcf)	--	--	98.9
Final Wc (%)	--	--	26.9%
Consolidation Stress (ksf)	0.5	2.0	4.0
Peak p' (ksf)	1.52	5.13	17.8
Peak q (ksf)	1.01	3.14	10.4



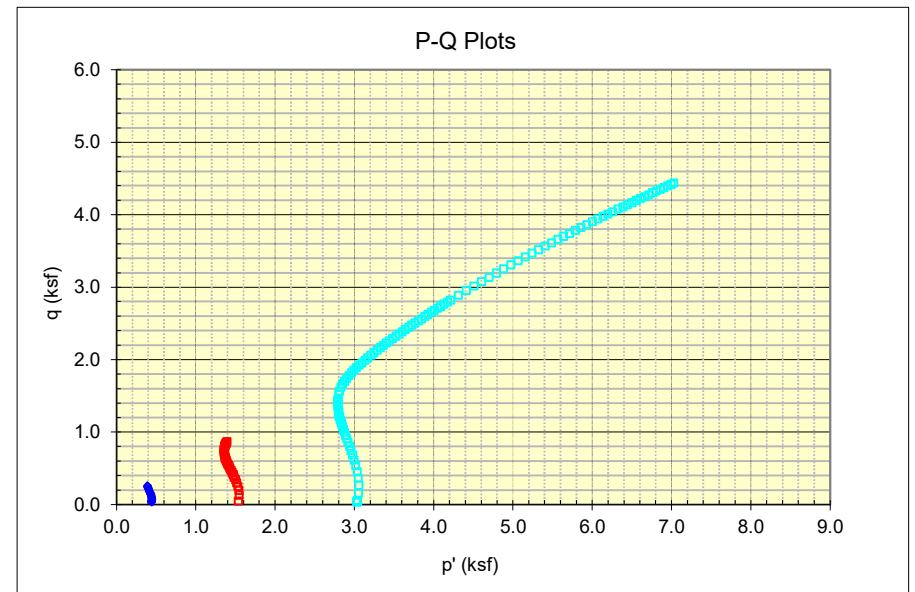
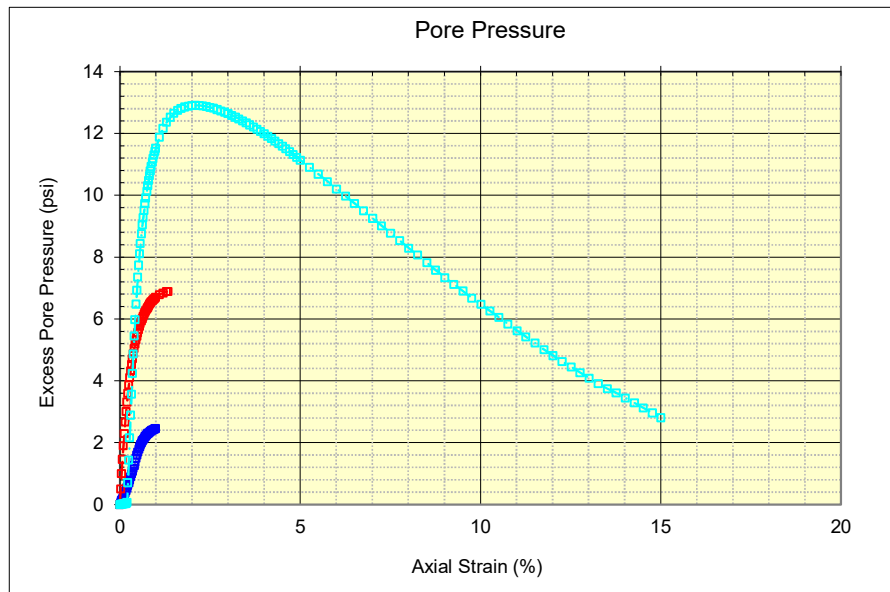
Multistage CU Triaxial Shear Report ASTM D-4767



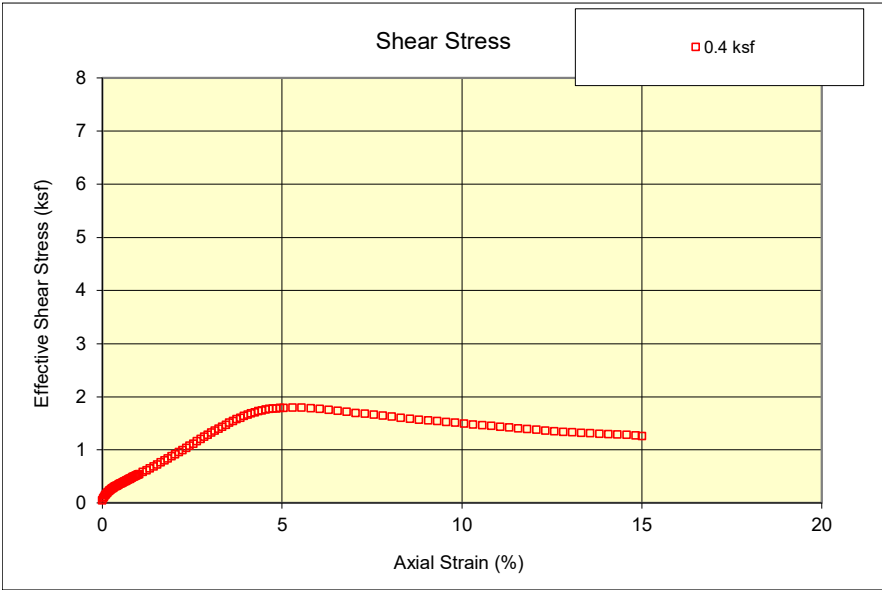
Project Name: Arkema Manufacturing Site
Project Location: Tacoma, WA
Laboratory Number: 23-1279
Sample Description: ML
Type: Intact from thin walled tube
Sample Source: SO-DOFB14-102623-16.9-17.4



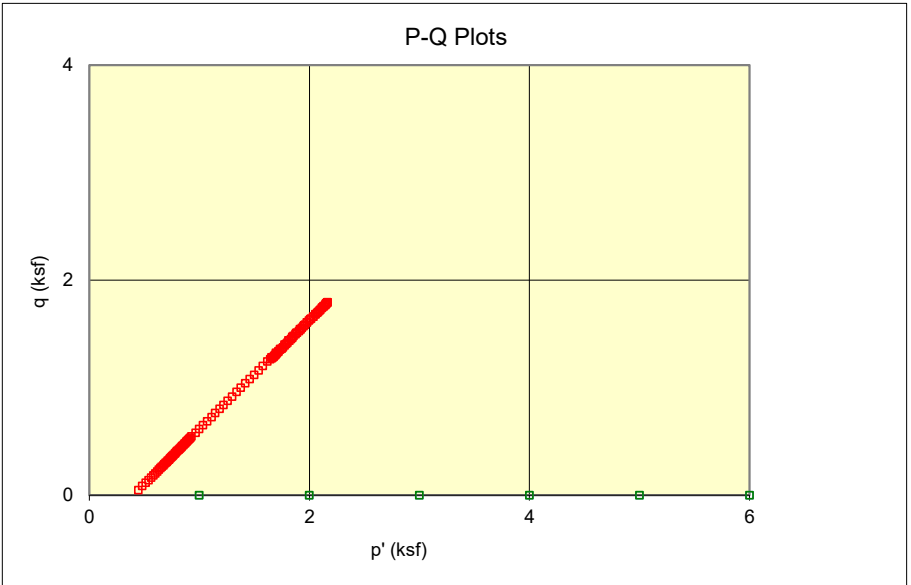
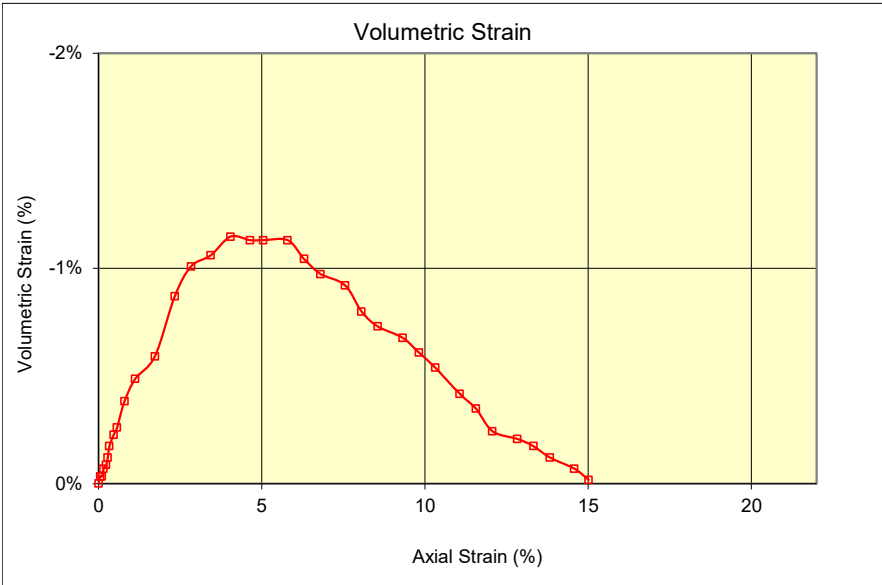
Initial dry unit weight (pcf)	85.9	--	--
Initial Wc (%)	34.4%	--	--
Final dry unit weight (pcf)	--	--	88.1
Final Wc (%)	--	--	33.6%
Consolidation Stress (ksf)	0.5	1.5	3.0
Peak p' (ksf)	0.447	1.552	7.03
Peak q (ksf)	0.358	0.967	4.44



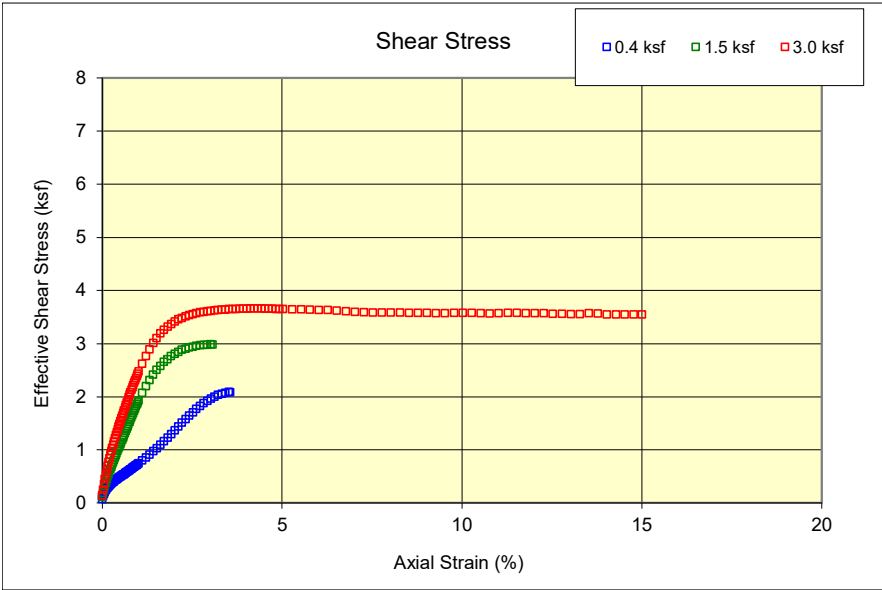
Single Point CD Triaxial Shear Report
ASTM D-7181



Project Name: Arkema Manufacturing Site		
Project Location: Tacoma, WA		
Laboratory Number: 23-1269		
Sample Description: ML		
Type: Intact from thin walled tube		
Sample Source: SO-DOFB6-102523-14.0-14.5		
Initial dry unit weight (pcf)		69.0
Initial Wc (%)		48.4
Final dry unit weight (pcf)		69.1
Final Wc (%)		55.7
Consolidation Stress (ksf)		0.4
Peak p' (ksf)		2.17
Peak q (ksf)		1.79



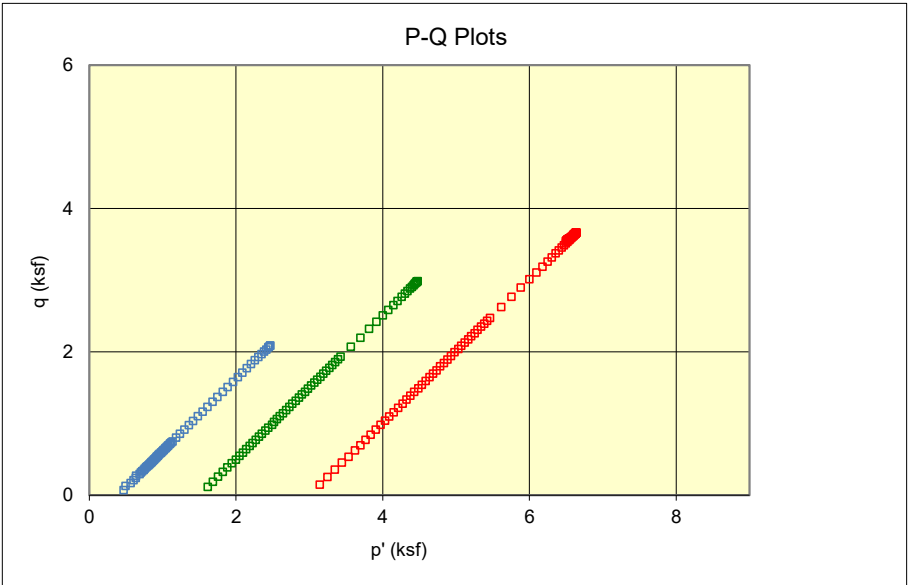
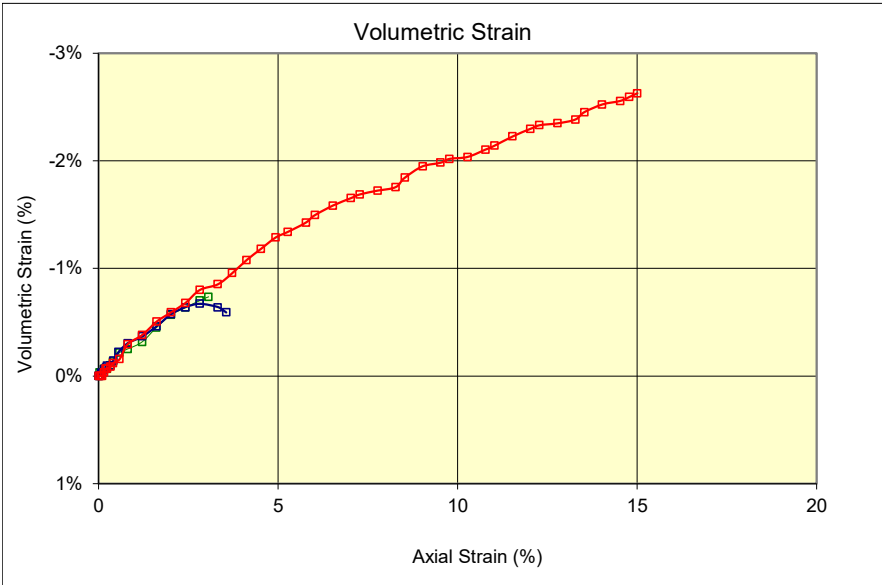
Multistage CD Triaxial Shear Report
ASTM D-7181



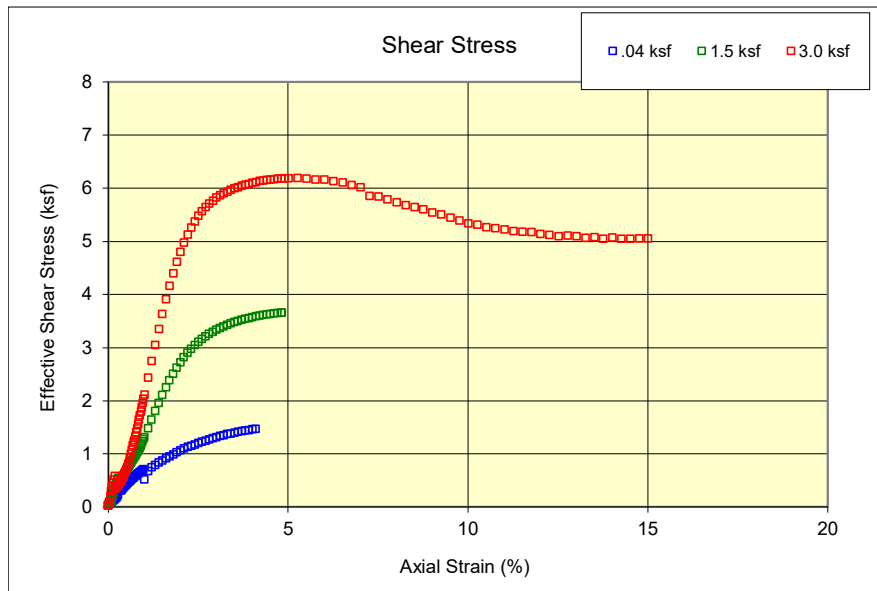
Project Name:	Arkema Manufacturing Site		
Project Location:	Tacoma, WA		
Laboratory Number:	23-1269		
Sample Description:	ML		
Type:	Intact from thin walled tube		
Sample Source:	SO-DOFB6-102523-14.5-15.0		



Initial dry unit weight (pcf)	72.6	--	--
Initial Wc (%)	44.7%	--	--
Final dry unit weight (pcf)	--	--	74.3
Final Wc (%)	--	--	47.6%
Consolidation Stress (ksf)	0.4	1.5	3.0
Peak p' (ksf)	2.47	4.48	6.64
Peak q (ksf)	2.09	2.99	3.66



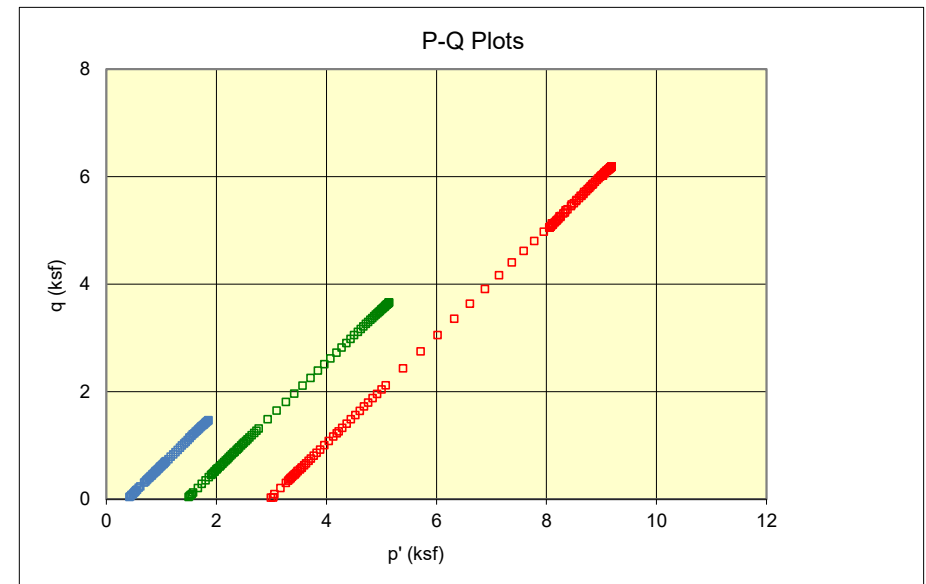
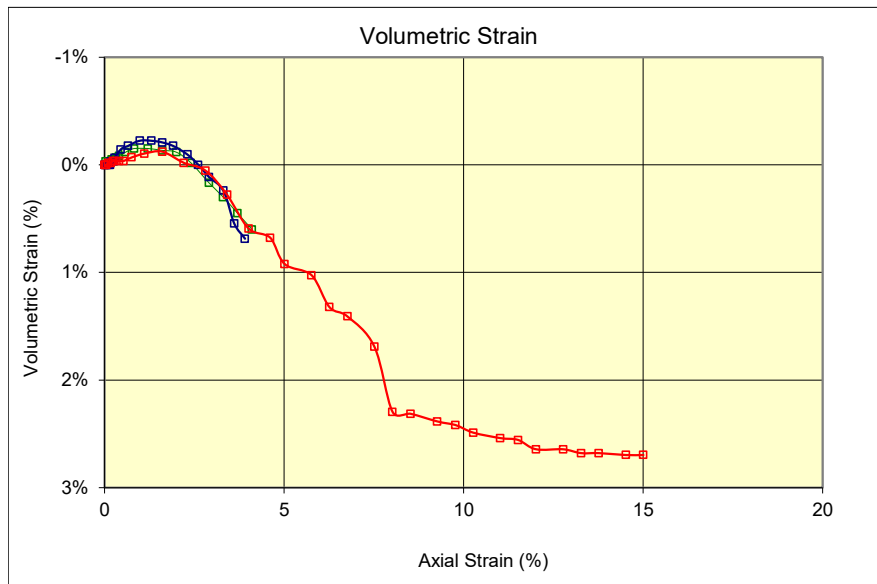
Multistage CD Triaxial Shear Report ASTM D-7181



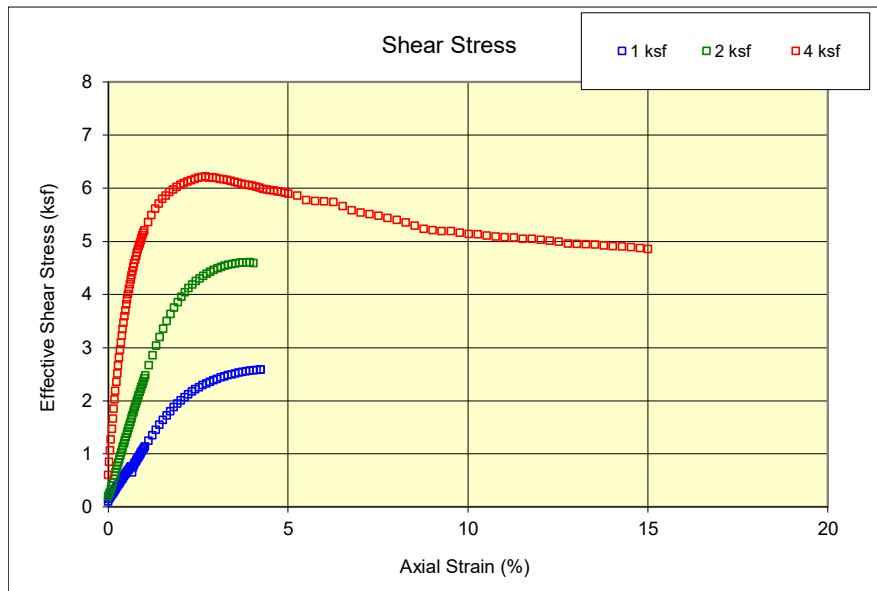
Project Name: Arkema Manufacturing Site
Project Location: Tacoma, WA
Laboratory Number: 23-1275
Sample Description: SP
Type: Intact from thin walled tube
Sample Source: SO-DOFB12-102723-9.5-10



Initial dry unit weight (pcf)	92.9	--	--
Initial Wc (%)	21.8%	--	--
Final dry unit weight (pcf)	--	--	94.5
Final Wc (%)	--	--	31.8%
Consolidation Stress (ksf)	0.4	1.5	3.0
Peak p' (ksf)	1.86	5.14	9.19
Peak q (ksf)	1.47	3.66	6.19



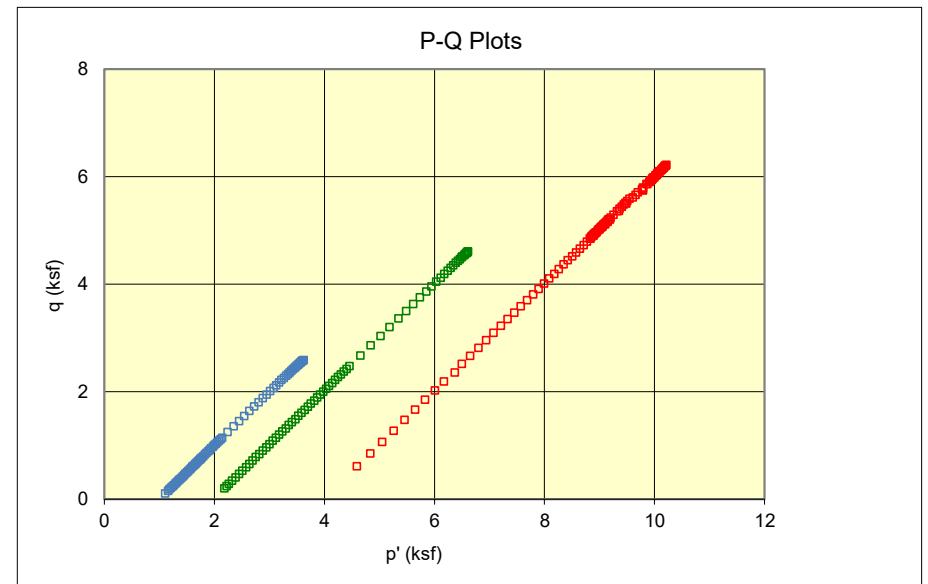
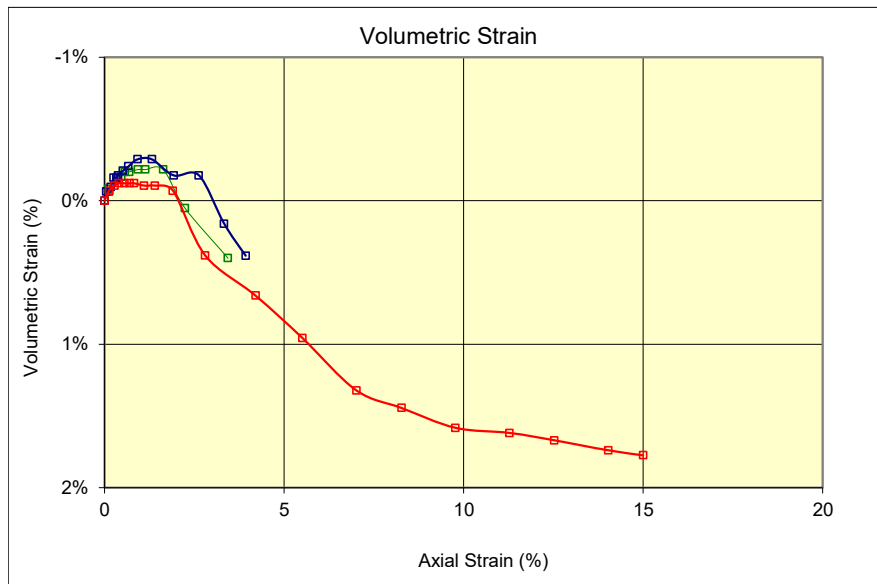
Multistage CD Triaxial Shear Report ASTM D-7181



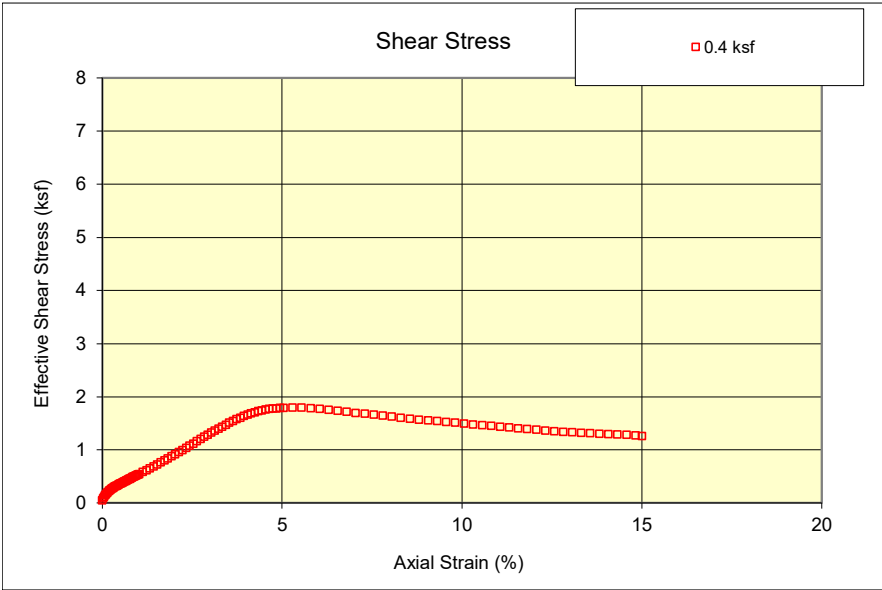
Project Name: Arkema Manufacturing Site
Project Location: Tacoma, WA
Laboratory Number: 23-1278
Sample Description: ML
Type: Intact from thin walled tube
Sample Source: SO-DOFB12-102723-31.5-32



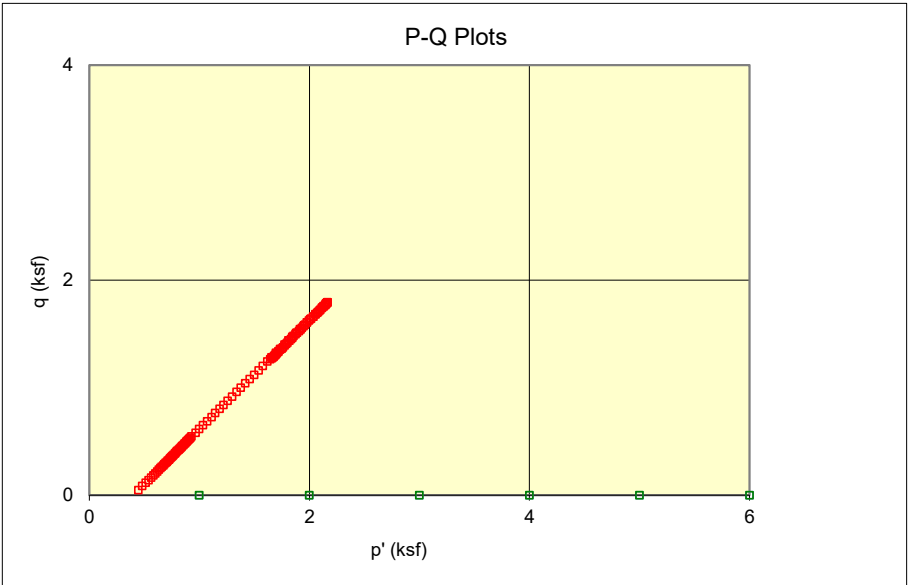
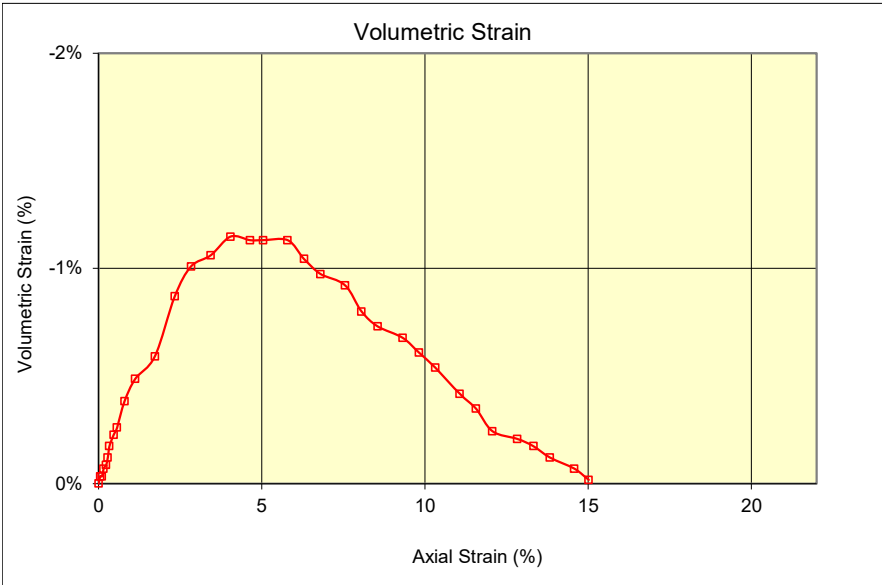
Initial dry unit weight (pcf)	93.1	--	--
Initial Wc (%)	46.0	--	--
Final dry unit weight (pcf)	--	--	94.0
Final Wc (%)	--	--	31.2
Consolidation Stress (ksf)	1.0	2.0	4.0
Peak p' (ksf)	3.63	6.61	10.2
Peak q (ksf)	2.59	4.61	6.22



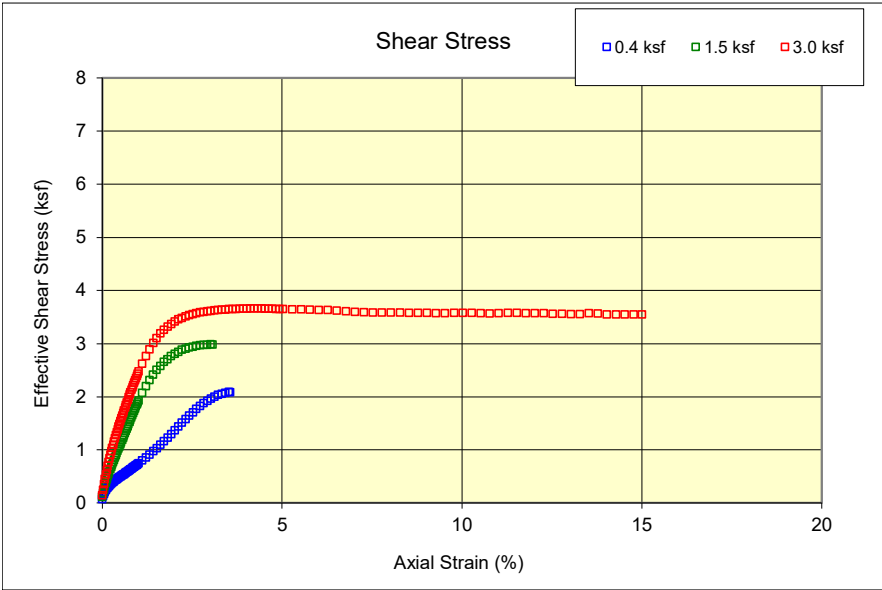
Single Point CD Triaxial Shear Report
ASTM D-7181



Project Name: Arkema Manufacturing Site		
Project Location: Tacoma, WA		
Laboratory Number: 23-1269		
Sample Description: ML		
Type: Intact from thin walled tube		
Sample Source: SO-DOFB6-102523-14.0-14.5		
Initial dry unit weight (pcf)	69.0	
Initial Wc (%)	48.4	
Final dry unit weight (pcf)	69.1	
Final Wc (%)	55.7	
Consolidation Stress (ksf)	0.4	
Peak p' (ksf)	2.17	
Peak q (ksf)	1.79	



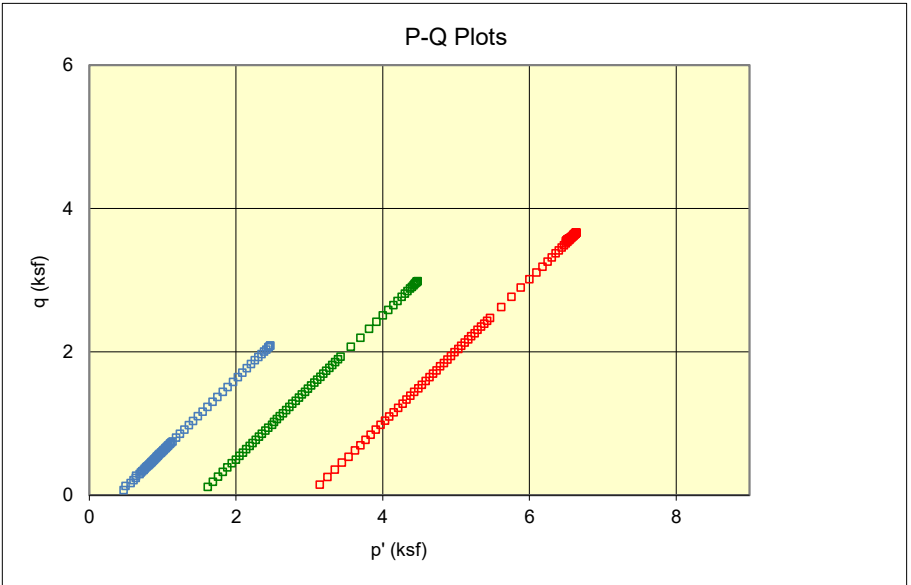
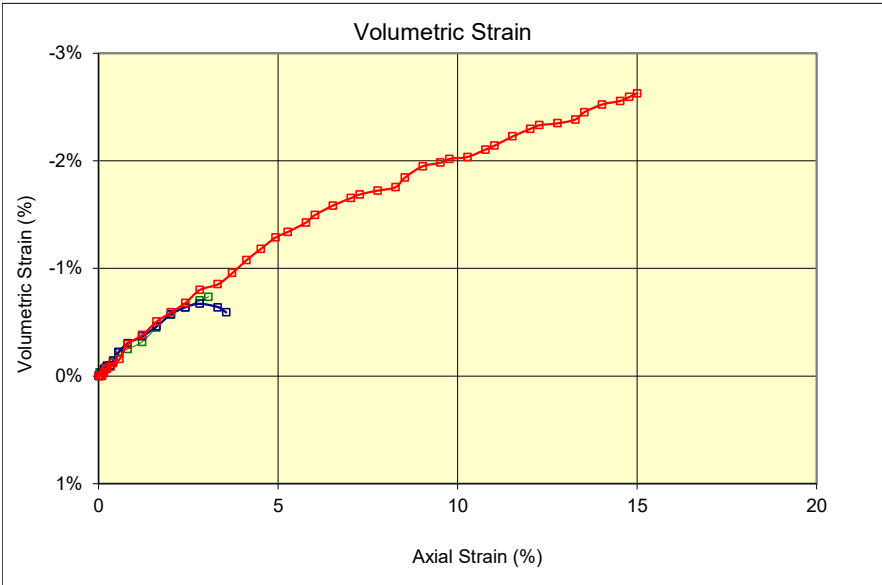
Multistage CD Triaxial Shear Report
ASTM D-7181



Project Name:	Arkema Manufacturing Site		
Project Location:	Tacoma, WA		
Laboratory Number:	23-1269		
Sample Description:	ML		
Type:	Intact from thin walled tube		
Sample Source:	SO-DOFB6-102523-14.5-15.0		

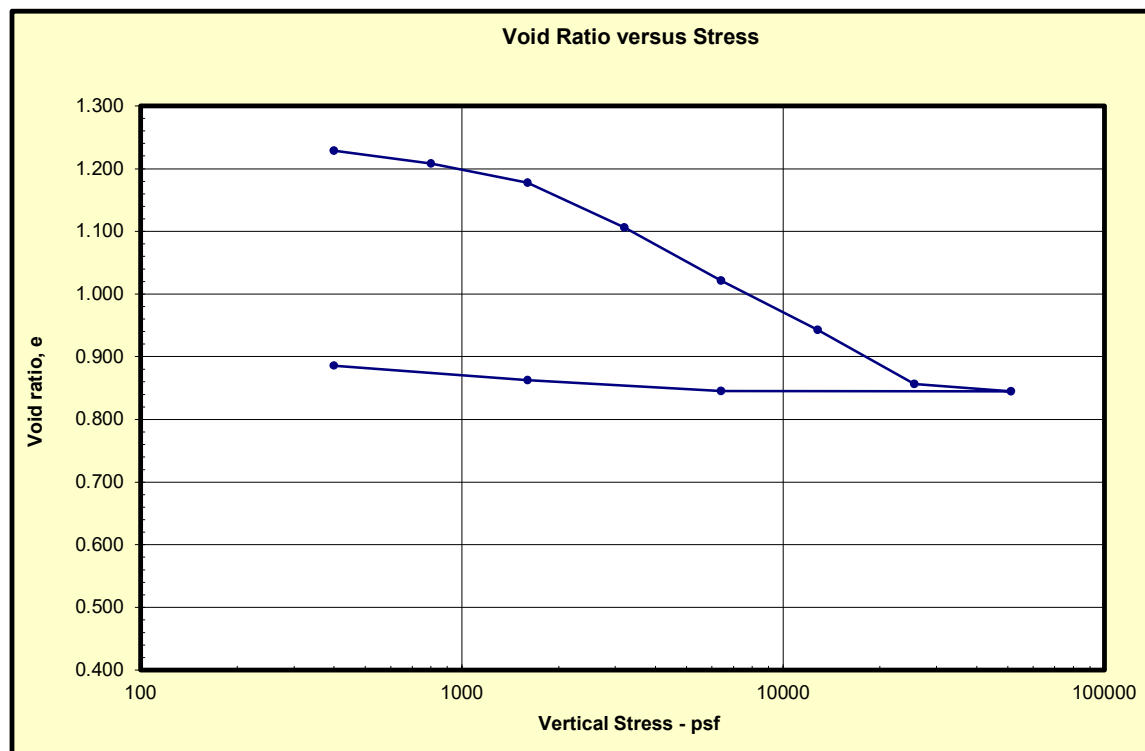


Initial dry unit weight (pcf)	72.6	--	--
Initial Wc (%)	44.7%	--	--
Final dry unit weight (pcf)	--	--	74.3
Final Wc (%)	--	--	47.6%
Consolidation Stress (ksf)	0.4	1.5	3.0
Peak p' (ksf)	2.47	4.48	6.64
Peak q (ksf)	2.09	2.99	3.66



Consolidation Test Results ASTM D-2435

		Load (psf)	H (in)	Consol (%)	Vs	e
Project	L231011	400	0.991	0.4	0.45	1.23
Boring	B-6	800	0.982	1.4	0.45	1.21
Depth (ft)	35.4-35.5	1600	0.968	2.7	0.46	1.18
Sampled by	Client	3200	0.936	5.9	0.47	1.11
Sample diameter (in)	2.495	6400	0.899	9.7	0.49	1.02
Wet density (pcf)	106.3	12800	0.864	13.2	0.51	0.94
Initial moisture (%)	43.9	25600	0.825	17.1	0.54	0.86
Initial dry Density (pcf)	73.9	**51200**	0.820	17.6	0.54	0.84
Final moisture (%)	34.1	6400	0.820	17.6	0.54	0.85
Final dry density	90.1	1600	0.828	16.8	0.54	0.86
Specific gravity (assumed)	2.65	400	0.838	15.7	0.53	0.89
Initial height, H (in)	0.995	**Note: 51200 step did not reach target load.				
Volume of solids (Vs)	0.45	See Time Deformation readings for actual loads.				
Volume of voids (Vv)	0.55					
Initial void ratio (e0)	1.24					
Total consolidation (%)	17.6					
Final Volume of solids (Vs)	0.54					
Minimum void ratio (ef)	0.84					
Effective stress in-situ(psf)	-					
Pre-consolidation stress (psf)	-					
Over-consolidation ratio, OCR	-					
Saturate sample at (psf)	400					



Time Deformation Readings

400 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.03	0.18	0.0001
0.05	0.22	0.0000
0.08	0.29	0.0003
0.13	0.37	0.0009
0.18	0.43	0.0015
0.25	0.50	0.0020
0.33	0.58	0.0023
0.43	0.66	0.0025
0.57	0.75	0.0025
0.73	0.86	0.0028
0.95	0.97	0.0028
1.20	1.10	0.0029
1.53	1.24	0.0029
1.93	1.39	0.0030
2.45	1.57	0.0034
3.10	1.76	0.0035
3.93	1.98	0.0036
4.97	2.23	0.0036
6.27	2.50	0.0037
7.90	2.81	0.0037
9.95	3.15	0.0038
12.55	3.54	0.0037
15.80	3.97	0.0037
19.92	4.46	0.0039
25.08	5.01	0.0040
31.58	5.62	0.0040
39.78	6.31	0.0041
50.08	7.08	0.0041
63.07	7.94	0.0044
79.40	8.91	0.0046
99.97	10.00	0.0047
125.87	11.22	0.0046
158.47	12.59	0.0046
180.35	13.43	0.0047

800 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0037
0.20	0.45	0.0043
0.23	0.48	0.0042
0.27	0.52	0.0044
0.30	0.55	0.0044
0.37	0.61	0.0046
0.43	0.66	0.0046
0.52	0.72	0.0048
0.62	0.79	0.0050
0.75	0.87	0.0052
0.92	0.96	0.0054
1.12	1.06	0.0056
1.38	1.18	0.0057
1.72	1.31	0.0060
2.13	1.46	0.0061
2.65	1.63	0.0062
3.30	1.82	0.0063
4.12	2.03	0.0064
5.15	2.27	0.0065
6.45	2.54	0.0066
8.08	2.84	0.0067
10.15	3.19	0.0067
12.73	3.57	0.0069
16.00	4.00	0.0071
20.10	4.48	0.0073
25.27	5.03	0.0073
31.77	5.64	0.0074
39.97	6.32	0.0075
50.27	7.09	0.0075
63.25	7.95	0.0075
79.58	8.92	0.0075
100.17	10.01	0.0076
126.05	11.23	0.0076
158.65	12.60	0.0078
199.68	14.13	0.0078
251.35	15.85	0.0080
316.40	17.79	0.0079
398.28	19.96	0.0080
501.37	22.39	0.0081
631.13	25.12	0.0082
794.52	28.19	0.0083
918.47	30.31	0.0102

1600 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0026
0.20	0.45	0.0032
0.22	0.47	0.0033
0.25	0.50	0.0034
0.30	0.55	0.0035
0.35	0.59	0.0035
0.42	0.65	0.0036
0.50	0.71	0.0037
0.62	0.79	0.0039
0.75	0.87	0.0040
0.92	0.96	0.0041
1.12	1.06	0.0045
1.37	1.17	0.0049
1.70	1.30	0.0054
2.12	1.45	0.0058
2.63	1.62	0.0063
3.28	1.81	0.0069
4.10	2.02	0.0074
5.13	2.27	0.0079
6.43	2.54	0.0086
8.07	2.84	0.0090
10.13	3.18	0.0092
12.72	3.57	0.0095
15.98	4.00	0.0097
20.08	4.48	0.0101
25.25	5.02	0.0104
31.77	5.64	0.0109
39.95	6.32	0.0110
50.27	7.09	0.0113
63.25	7.95	0.0113
79.58	8.92	0.0116
100.15	10.01	0.0116
126.05	11.23	0.0118
158.65	12.60	0.0121
199.68	14.13	0.0123
251.35	15.85	0.0124
316.40	17.79	0.0126
398.27	19.96	0.0128
501.35	22.39	0.0128
631.13	25.12	0.0130
794.52	28.19	0.0133
1000.20	31.63	0.0140
1259.13	35.48	0.0146
1342.45	36.63946	0.014858

Time Deformation Readings

3200 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0092
0.20	0.45	0.0098
0.23	0.48	0.0099
0.27	0.52	0.0101
0.30	0.55	0.0104
0.35	0.59	0.0105
0.42	0.65	0.0108
0.50	0.71	0.0110
0.62	0.79	0.0112
0.75	0.87	0.0114
0.90	0.95	0.0118
1.12	1.06	0.0123
1.37	1.17	0.0132
1.70	1.30	0.0139
2.12	1.45	0.0147
2.63	1.62	0.0152
3.28	1.81	0.0165
4.10	2.02	0.0176
5.13	2.27	0.0186
6.43	2.54	0.0199
8.07	2.84	0.0214
10.13	3.18	0.0224
12.72	3.57	0.0231
15.98	4.00	0.0238
20.08	4.48	0.0248
25.25	5.02	0.0263
31.75	5.63	0.0275
39.95	6.32	0.0286
50.25	7.09	0.0293
63.23	7.95	0.0297
79.58	8.92	0.0300
100.15	10.01	0.0305
126.03	11.23	0.0311
158.63	12.59	0.0318
199.68	14.13	0.0322
251.35	15.85	0.0326
316.38	17.79	0.0331
398.27	19.96	0.0335
501.35	22.39	0.0340
631.13	25.12	0.0345
794.50	28.19	0.0347
1000.18	31.63	0.0351
1259.12	35.48	0.0359
1440.183	37.94975	0.035967

6400 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0053
0.20	0.45	0.0060
0.23	0.48	0.0060
0.27	0.52	0.0062
0.30	0.55	0.0064
0.35	0.59	0.0066
0.42	0.65	0.0069
0.52	0.72	0.0074
0.62	0.79	0.0080
0.75	0.87	0.0087
0.92	0.96	0.0099
1.12	1.06	0.0105
1.38	1.18	0.0110
1.70	1.30	0.0115
2.12	1.45	0.0130
2.63	1.62	0.0138
3.28	1.81	0.0153
4.12	2.03	0.0165
5.15	2.27	0.0180
6.43	2.54	0.0193
8.08	2.84	0.0206
10.13	3.18	0.0219
12.72	3.57	0.0231
15.98	4.00	0.0242
20.10	4.48	0.0252
25.27	5.03	0.0261
31.77	5.64	0.0268
39.95	6.32	0.0276
50.27	7.09	0.0286
63.25	7.95	0.0295
79.58	8.92	0.0301
100.15	10.01	0.0305
126.05	11.23	0.0308
158.65	12.60	0.0315
199.68	14.13	0.0325
251.35	15.85	0.0333
316.40	17.79	0.0337
398.28	19.96	0.0342
501.37	22.39	0.0347
631.13	25.12	0.0353
794.52	28.19	0.0359
1000.20	31.63	0.0365
1259.13	35.48	0.0369
1440.217	37.95019	0.037213

12800 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0080
0.20	0.45	0.0083
0.22	0.47	0.0086
0.25	0.50	0.0088
0.30	0.55	0.0093
0.35	0.59	0.0096
0.42	0.65	0.0103
0.50	0.71	0.0110
0.60	0.77	0.0115
0.73	0.86	0.0119
0.90	0.95	0.0124
1.10	1.05	0.0133
1.37	1.17	0.0142
1.70	1.30	0.0152
2.12	1.45	0.0161
2.63	1.62	0.0173
3.28	1.81	0.0189
4.10	2.02	0.0202
5.13	2.27	0.0216
6.43	2.54	0.0226
8.07	2.84	0.0241
10.13	3.18	0.0254
12.72	3.57	0.0265
15.98	4.00	0.0279
20.08	4.48	0.0292
25.25	5.02	0.0301
31.77	5.64	0.0314
39.95	6.32	0.0318
50.27	7.09	0.0325
63.25	7.95	0.0331
79.58	8.92	0.0341
100.15	10.01	0.0349
126.05	11.23	0.0356
158.65	12.60	0.0366
199.70	14.13	0.0369
251.35	15.85	0.0373
316.40	17.79	0.0380
360.20	18.98	0.0383

Time Deformation Readings

25600 psf		
Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	0.0071
0.22	0.47	0.0086
0.23	0.48	0.0091
0.27	0.52	0.0090
0.32	0.56	0.0096
0.37	0.61	0.0101
0.43	0.66	0.0107
0.52	0.72	0.0114
0.62	0.79	0.0123
0.75	0.87	0.0131
0.92	0.96	0.0138
1.13	1.06	0.0151
1.38	1.18	0.0164
1.72	1.31	0.0174
2.13	1.46	0.0183
2.65	1.63	0.0210
3.30	1.82	0.0225
4.12	2.03	0.0240
5.15	2.27	0.0257
6.45	2.54	0.0276
8.08	2.84	0.0296
10.15	3.19	0.0306
12.75	3.57	0.0315
16.00	4.00	0.0329
20.12	4.49	0.0345
25.28	5.03	0.0354
31.78	5.64	0.0360
39.97	6.32	0.0368
50.28	7.09	0.0374
63.27	7.95	0.0381
79.60	8.92	0.0386
100.17	10.01	0.0397
126.07	11.23	0.0400
158.67	12.60	0.0409
199.70	14.13	0.0414
247.28	15.73	0.0417

51200 psf			psf	6400 psf		
Time (min.)	Sq. Root Time (min.)	Disp. (in.)		Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000	26021.7	0.00	0.00	0.0000
0.10	0.32	0.0099	50428.1	0.10	0.32	-0.0069
0.20	0.45	0.0102	46258.3	0.20	0.45	-0.0072
0.23	0.48	0.0103	45440.4	0.23	0.48	-0.0073
0.27	0.52	0.0104	44630.1	0.27	0.52	-0.0073
0.30	0.55	0.0106	43772.4	0.30	0.55	-0.0075
0.37	0.61	0.0107	42858.4	0.35	0.59	-0.0075
0.43	0.66	0.0107	41874.4	0.42	0.65	-0.0077
0.52	0.72	0.0109	40905.9	0.52	0.72	-0.0078
0.62	0.79	0.0109	39957.3	0.62	0.79	-0.0079
0.75	0.87	0.0110	39020.4	0.75	0.87	-0.0080
0.92	0.96	0.0111	38102.1	0.92	0.96	-0.0083
1.12	1.06	0.0112	37266.0	1.12	1.06	-0.0083
1.38	1.18	0.0113	36509.1	1.38	1.18	-0.0084
1.72	1.31	0.0114	35837.4	1.70	1.30	-0.0086
2.12	1.45	0.0114	35251.6	2.12	1.45	-0.0088
2.63	1.62	0.0114	34747.0	2.63	1.62	-0.0090
3.30	1.82	0.0115	34304.5	3.28	1.81	-0.0091
4.12	2.03	0.0115	33907.0	4.12	2.03	-0.0092
5.15	2.27	0.0116	33543.2	5.15	2.27	-0.0092
6.45	2.54	0.0116	33204.4	6.45	2.54	-0.0093
8.08	2.84	0.0116	32883.0	8.08	2.84	-0.0095
10.13	3.18	0.0116	32602.6	10.13	3.18	-0.0097
12.73	3.57	0.0115	32315.0	12.73	3.57	-0.0098
16.00	4.00	0.0115	32024.2	15.98	4.00	-0.0098
20.10	4.48	0.0116	31726.2	20.10	4.48	-0.0098
25.27	5.03	0.0116	31435.6	25.27	5.03	-0.0097
31.77	5.64	0.0116	31146.1	31.77	5.64	-0.0099
39.95	6.32	0.0116	30862.5	39.97	6.32	-0.0099
50.27	7.09	0.0116	30624.7	50.27	7.09	-0.0100
63.25	7.95	0.0116	30329.8	63.25	7.95	-0.0100
79.58	8.92	0.0116	30043.8	79.58	8.92	-0.0102
100.15	10.01	0.0116	29804.2	100.15	10.01	-0.0103
126.05	11.23	0.0117	29502.3	126.05	11.23	-0.0103
158.65	12.60	0.0116	29251.4	158.65	12.60	-0.0103
199.70	14.13	0.0116	28983.3	199.70	14.13	-0.0104
251.37	15.85	0.0116	28670.9	251.37	15.85	-0.0106
316.40	17.79	0.0117	28413.3	316.40	17.79	-0.0106
398.28	19.96	0.0117	28149.8	398.28	19.96	-0.0108
501.37	22.39	0.0117	27883.8	501.38	22.39	-0.0109
631.15	25.12	0.0117	27623.7	631.15	25.12	-0.0111
794.52	28.19	0.0117	27350.2	794.53	28.19	-0.0112
940.00	30.66	0.0120	27118.5	1000.22	31.63	-0.0112
				1259.15	35.48	-0.0113
				1379.95	37.14768	-0.01125

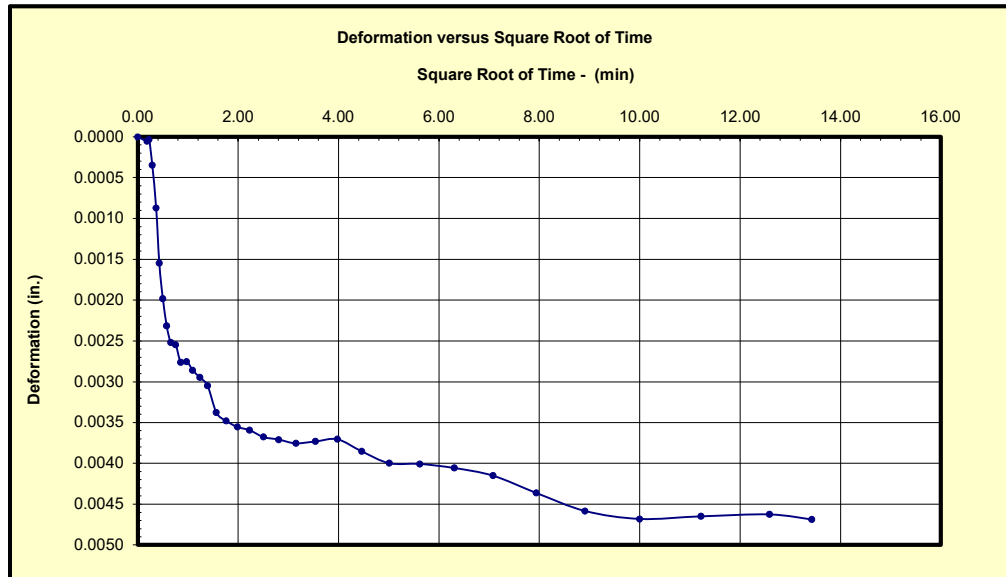
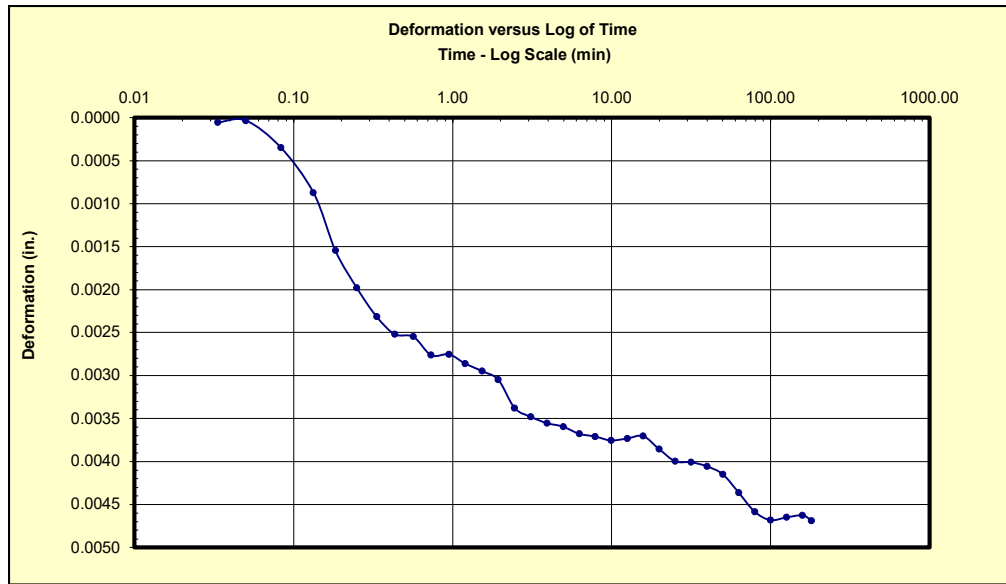
Time Deformation Readings

1600 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	-0.0032
0.20	0.45	-0.0035
0.23	0.48	-0.0036
0.27	0.52	-0.0037
0.30	0.55	-0.0038
0.37	0.61	-0.0039
0.43	0.66	-0.0040
0.52	0.72	-0.0041
0.62	0.79	-0.0043
0.75	0.87	-0.0044
0.92	0.96	-0.0045
1.12	1.06	-0.0047
1.38	1.18	-0.0051
1.70	1.30	-0.0053
2.12	1.45	-0.0056
2.63	1.62	-0.0057
3.28	1.81	-0.0060
4.10	2.02	-0.0063
5.13	2.27	-0.0065
6.43	2.54	-0.0069
8.08	2.84	-0.0070
10.13	3.18	-0.0071
12.72	3.57	-0.0074
15.98	4.00	-0.0076
20.08	4.48	-0.0081
25.27	5.03	-0.0085
31.77	5.64	-0.0089
39.95	6.32	-0.0092
50.27	7.09	-0.0094
63.23	7.95	-0.0097
79.58	8.92	-0.0097
100.15	10.01	-0.0100
126.05	11.23	-0.0100
158.65	12.60	-0.0103
199.68	14.13	-0.0104
251.35	15.85	-0.0105
316.38	17.79	-0.0109
398.28	19.96	-0.0112
501.37	22.39	-0.0114
631.13	25.12	-0.0115
794.52	28.19	-0.0116
1000.20	31.63	-0.0118
1259.13	35.48	-0.0119
1438.783	37.9313	-0.01194

400 psf

Time (min.)	Sq. Root Time (min.)	Disp. (in.)
0.00	0.00	0.0000
0.10	0.32	-0.0013
0.20	0.45	-0.0016
0.23	0.48	-0.0015
0.27	0.52	-0.0015
0.32	0.56	-0.0018
0.37	0.61	-0.0019
0.43	0.66	-0.0027
0.52	0.72	-0.0027
0.62	0.79	-0.0024
0.75	0.87	-0.0025
0.92	0.96	-0.0018
1.12	1.06	-0.0030
1.38	1.18	-0.0030
1.72	1.31	-0.0030
2.13	1.46	-0.0037
2.65	1.63	-0.0040
3.30	1.82	-0.0039
4.12	2.03	-0.0042
5.15	2.27	-0.0045
6.45	2.54	-0.0048
8.08	2.84	-0.0054
10.15	3.19	-0.0059
12.73	3.57	-0.0063
16.00	4.00	-0.0063
20.10	4.48	-0.0066
25.27	5.03	-0.0069
31.77	5.64	-0.0080
39.97	6.32	-0.0083
50.27	7.09	-0.0085
63.25	7.95	-0.0090
79.58	8.92	-0.0092
100.17	10.01	-0.0094
126.05	11.23	-0.0097
158.65	12.60	-0.0100
199.70	14.13	-0.0107
251.37	15.85	-0.0115
316.40	17.79	-0.0123



Scan Data

Step List

ISTEP 21

Update

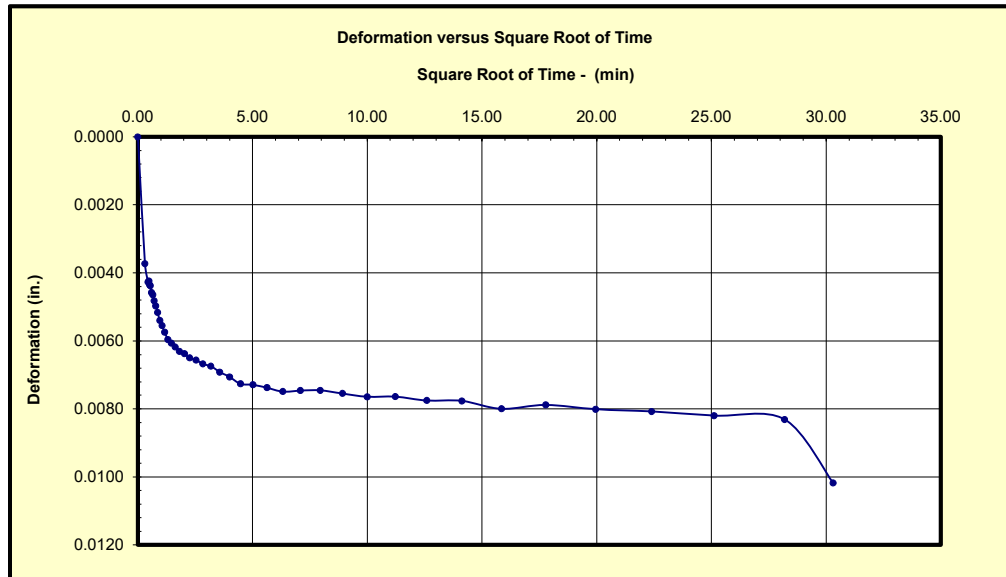
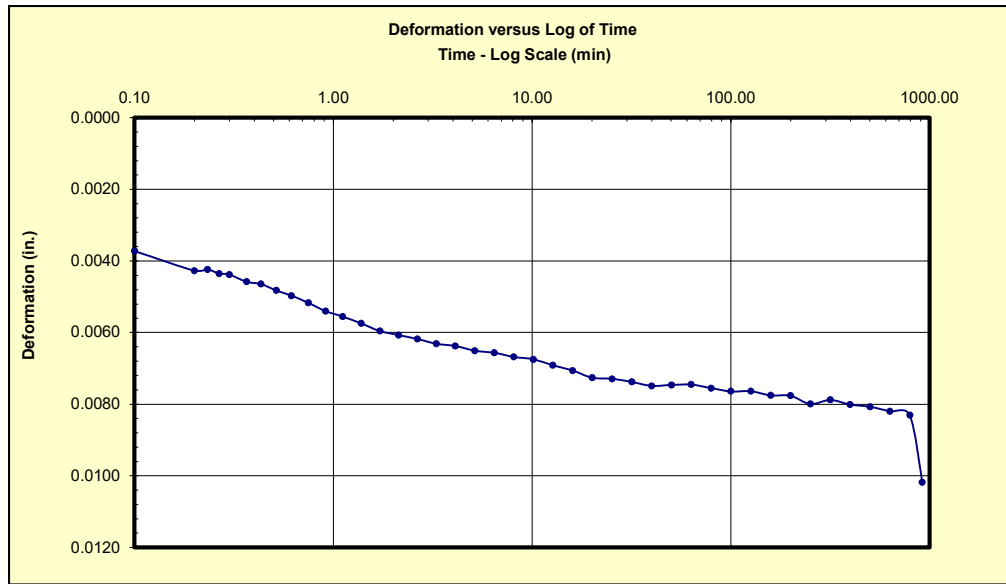
Vertical Stress
400 psf

S100
No match!!!

- ☒ End of Primary
- ☐ End of Increment

Project:
L231011

B6
Depth (ft):
35.4-35.5



Scan Data

Step List

ISTEP 31

Update

Vertical Stress

800 psf

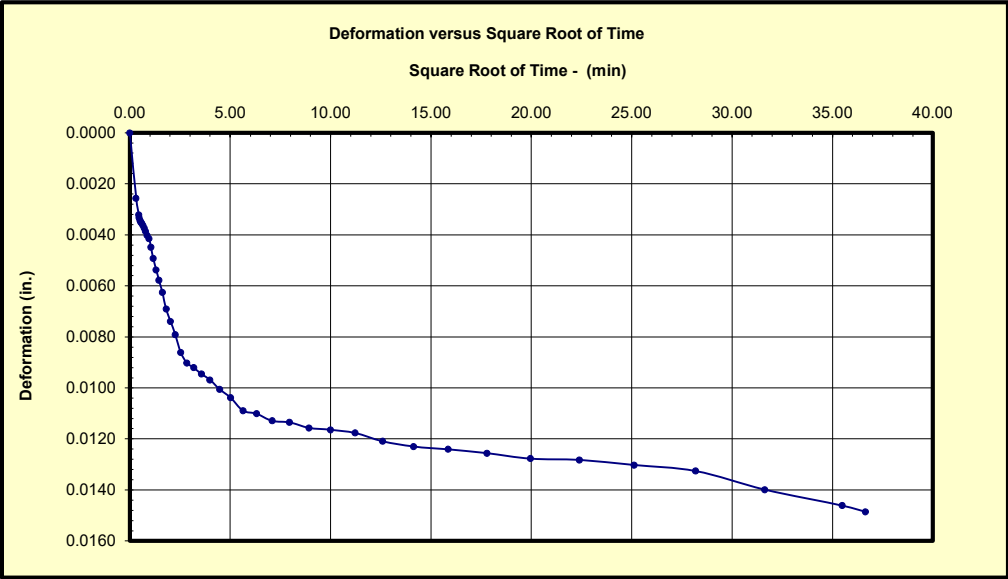
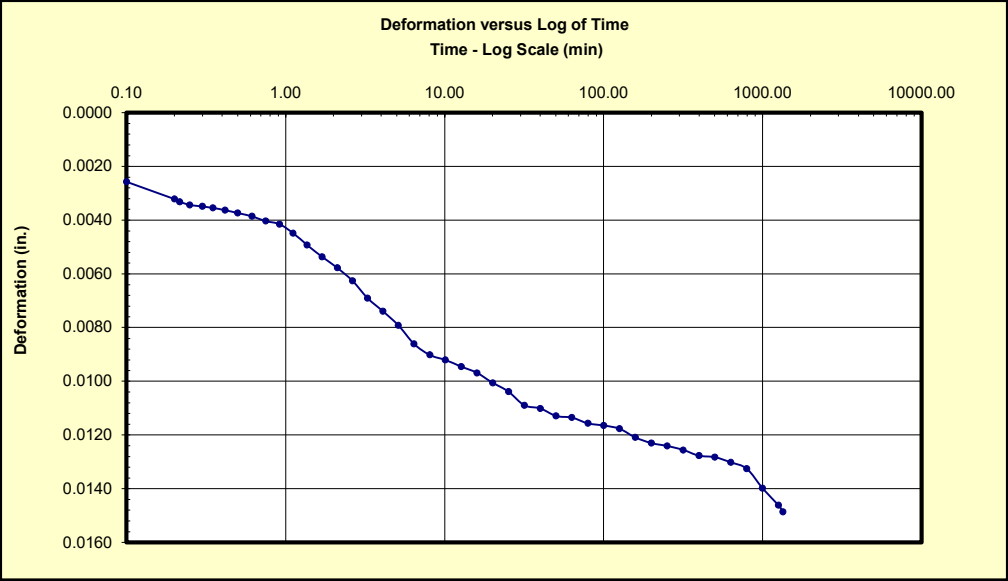
S100

No match!!!

- ☒ End of Primary
- ☐ End of Increment

Project:
L231011

B6
Depth (ft):
35.4-35.5



Scan Data

Step List

ISTEP 41

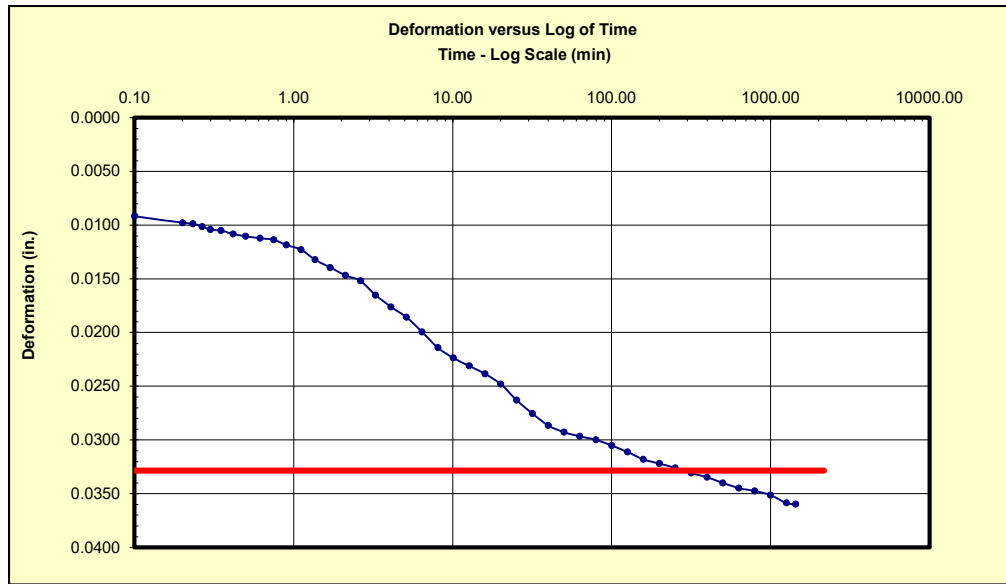
Update

Vertical Stress
1600 psf
S100
Calculating...

☒ End of Primary
☐ End of Increment

Project:
L231011

B6
Depth (ft):
35.4-35.5



Scan Data

Step List

ISTEP 51

Update

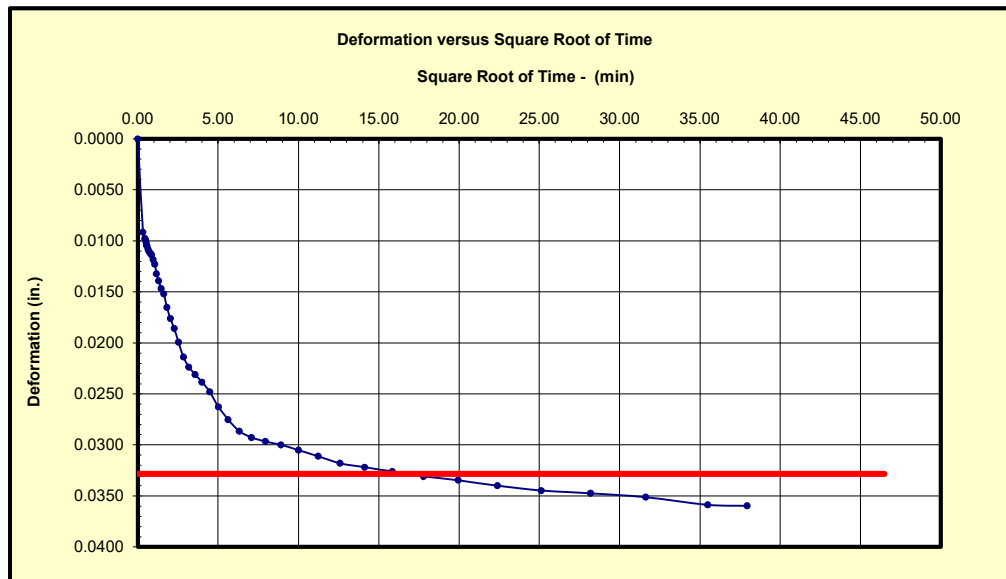
Vertical Stress
3200 psf

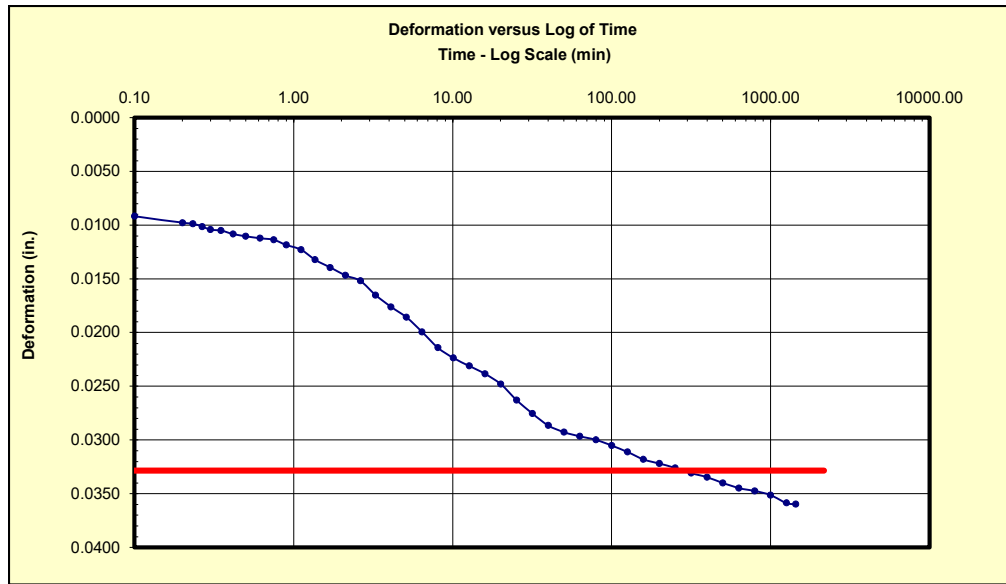
S100
0.0328 inch

☒ End of Primary
☐ End of Increment

Project:
L231011

B6
Depth (ft):
35.4-35.5





Scan Data

Step List

ISTEP 51

Update

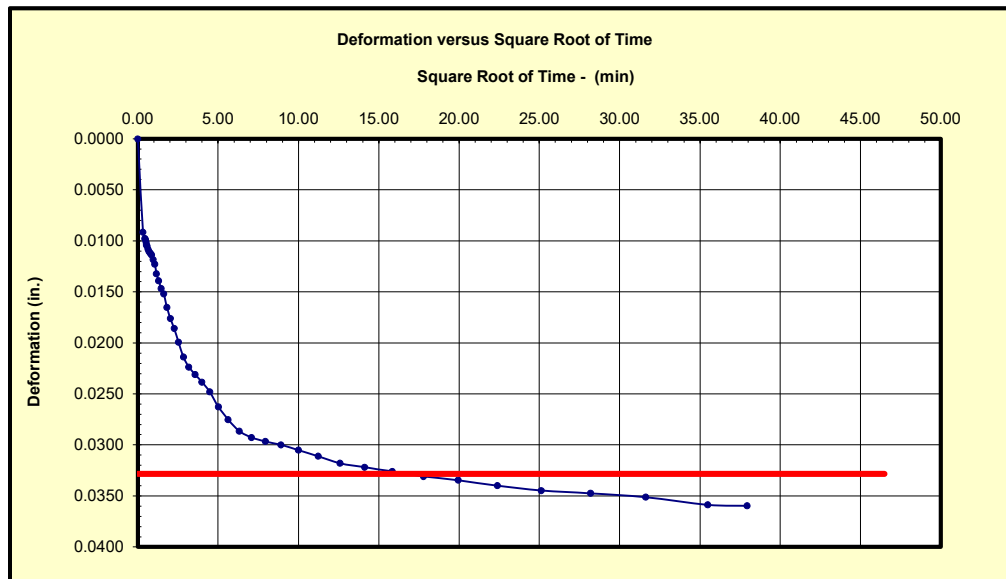
Vertical Stress
3200 psf

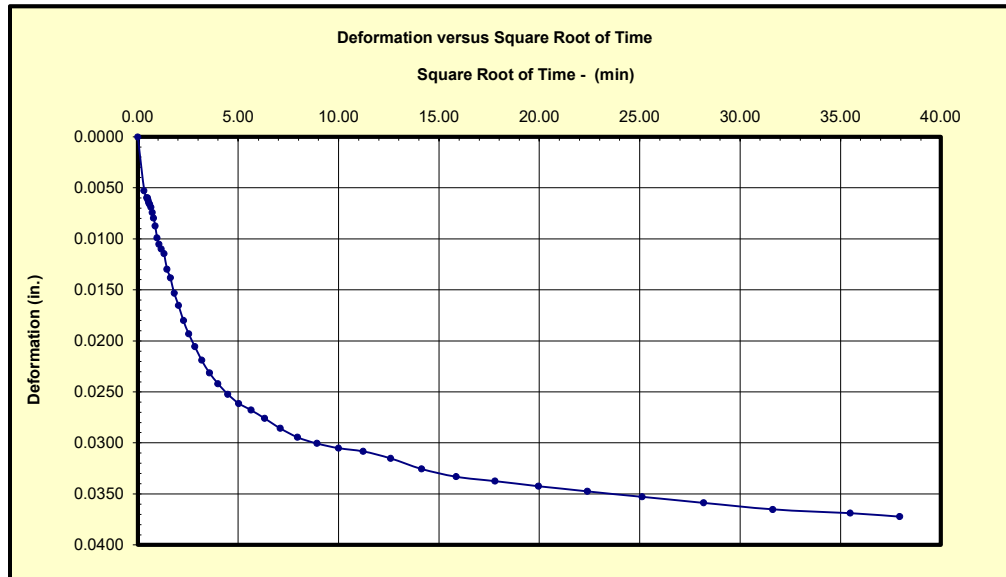
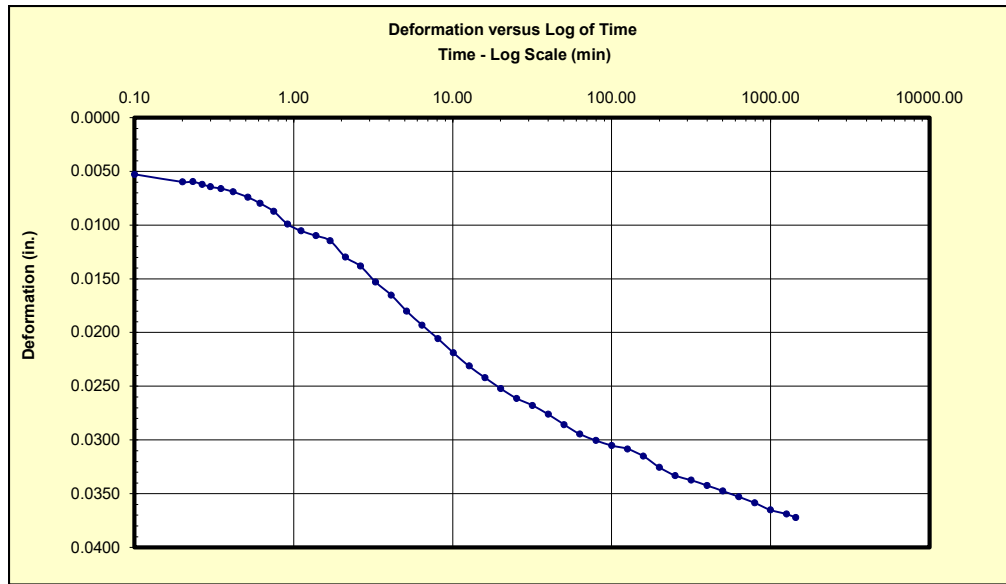
S100
0.0328 inch

☒ End of Primary
☐ End of Increment

Project:
L231011

B6
Depth (ft):
35.4-35.5





Scan Data

Step List

ISTEP 61

Update

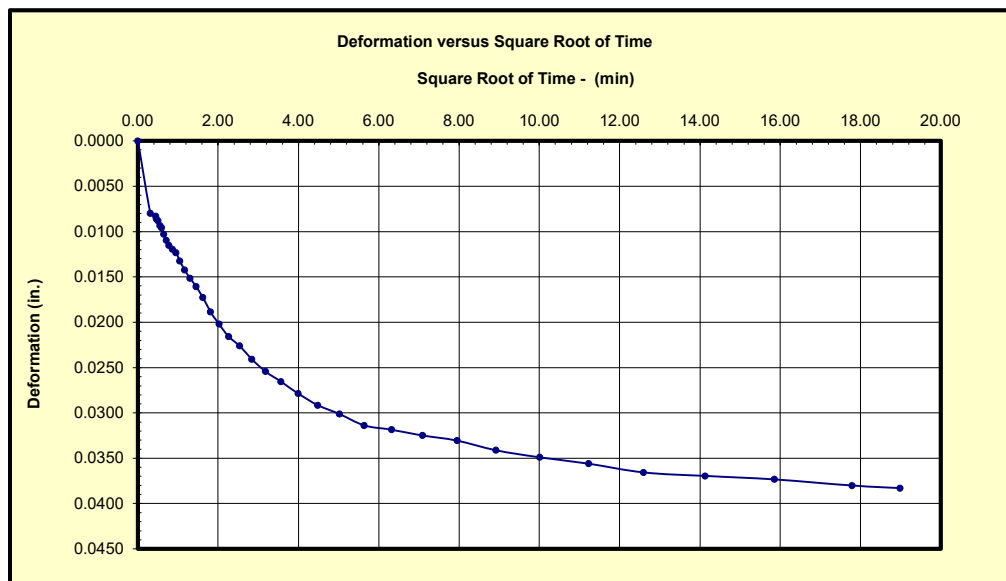
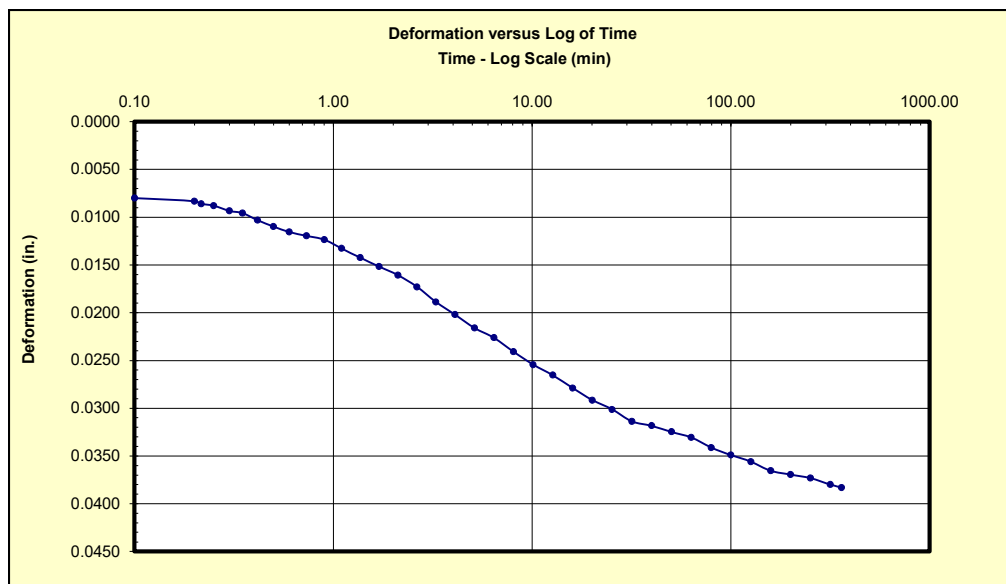
Vertical Stress
6400 psf

S100
Calculating...

☒ End of Primary
☐ End of Increment

Project:
L231011

B6
Depth (ft):
35.4-35.5



Scan Data

Step List

ISTEP 71

Update

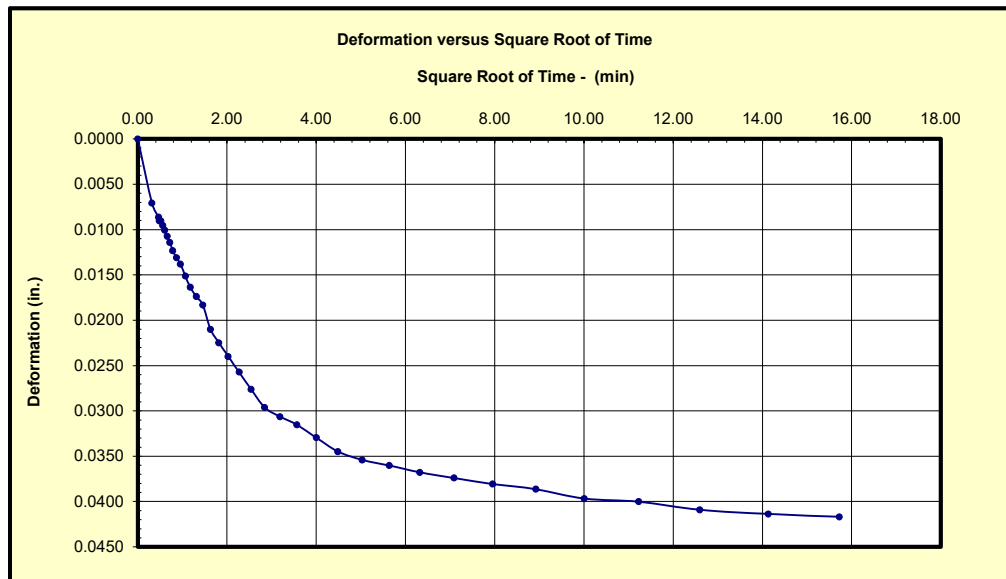
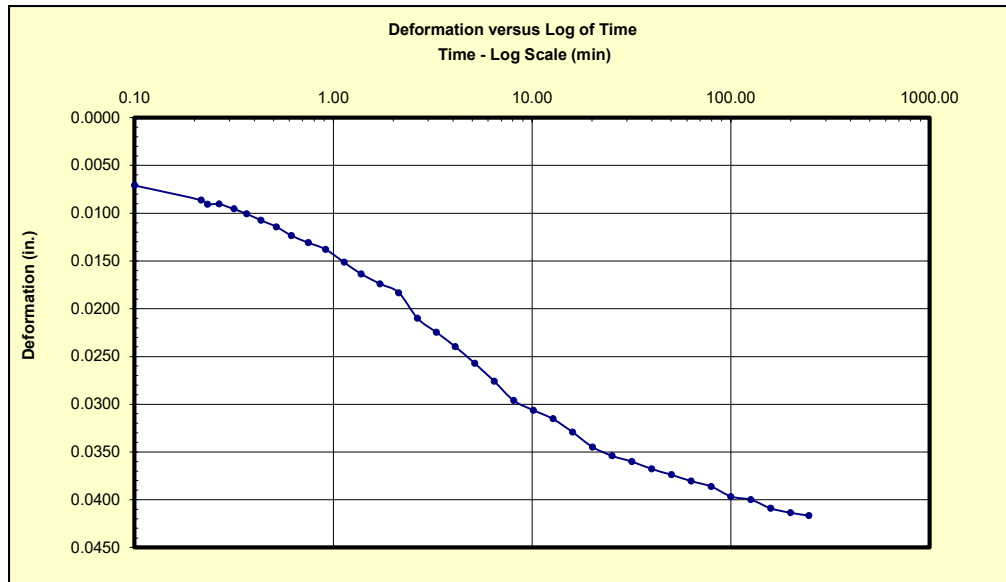
Vertical Stress
12800 psf
S100
Calculating...

☒ End of Primary

☐ End of Increment

Project:
L231011

B6
Depth (ft):
35.4-35.5



Scan Data

Step List

ISTEP 81

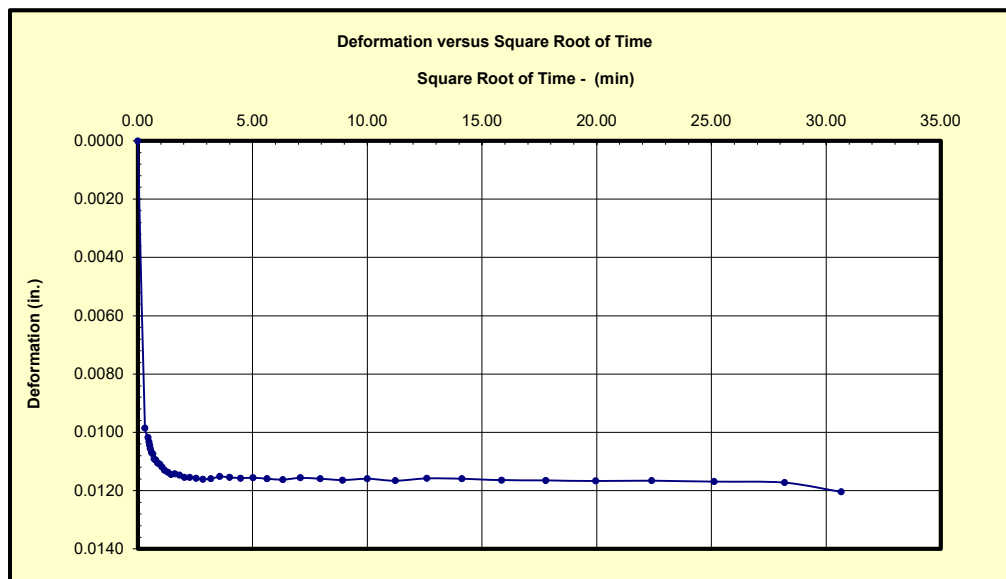
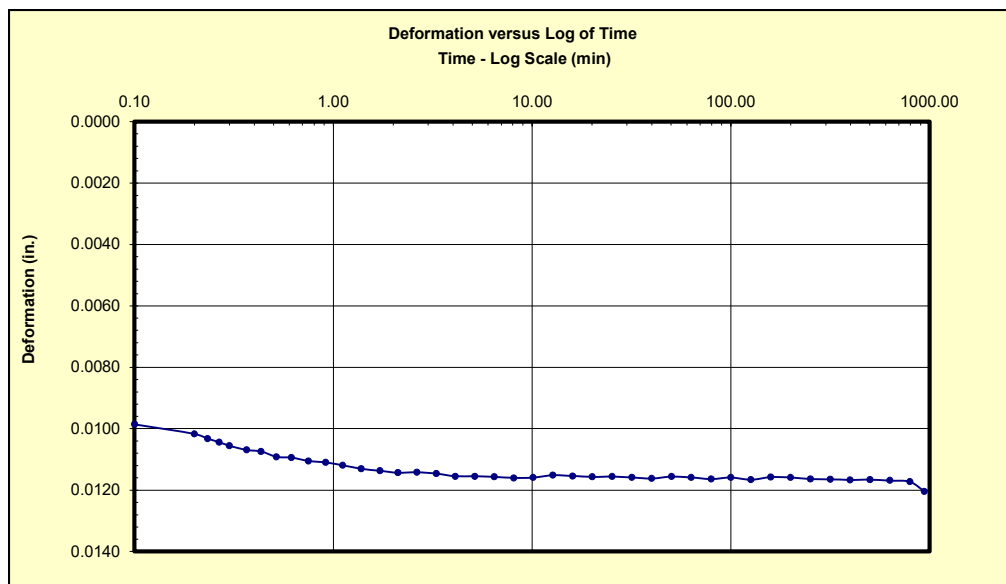
Update

Vertical Stress
25600 psf
S100
No match!!!

☒ End of Primary
☐ End of Increment

Project:
L231011

B6
Depth (ft):
35.4-35.5



Scan Data

Step List

ISTEP 91

Update

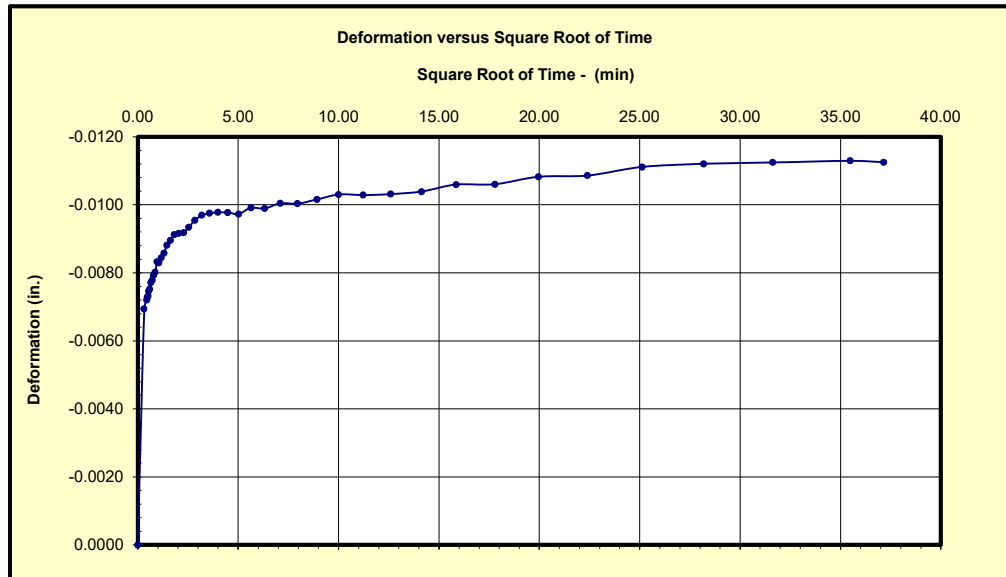
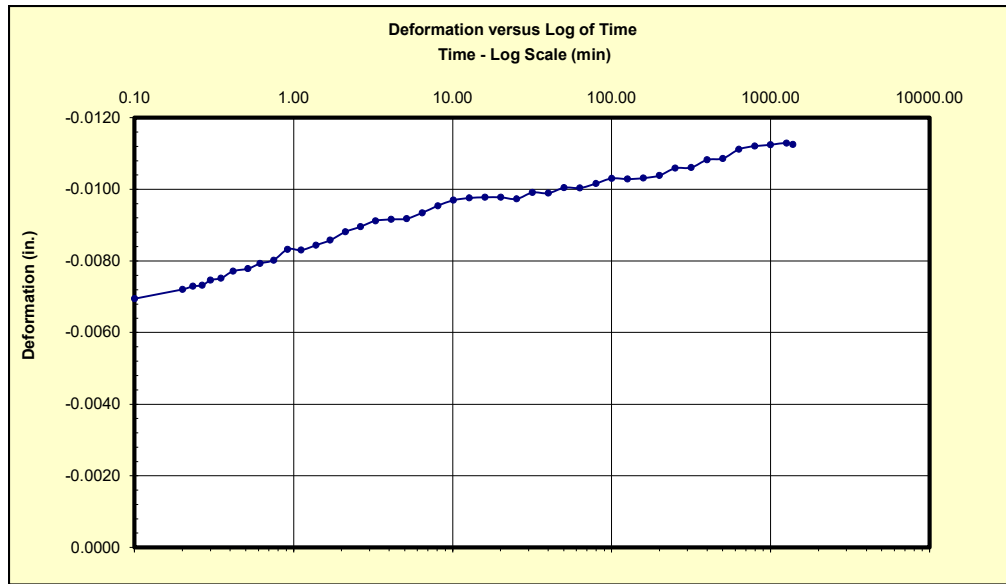
Vertical Stress
51200 psf
S100
No match!!!

☒ End of Primary

☐ End of Increment

Project:
L231011

B6
Depth (ft):
35.4-35.5



Scan Data

Step List

ISTEP 101

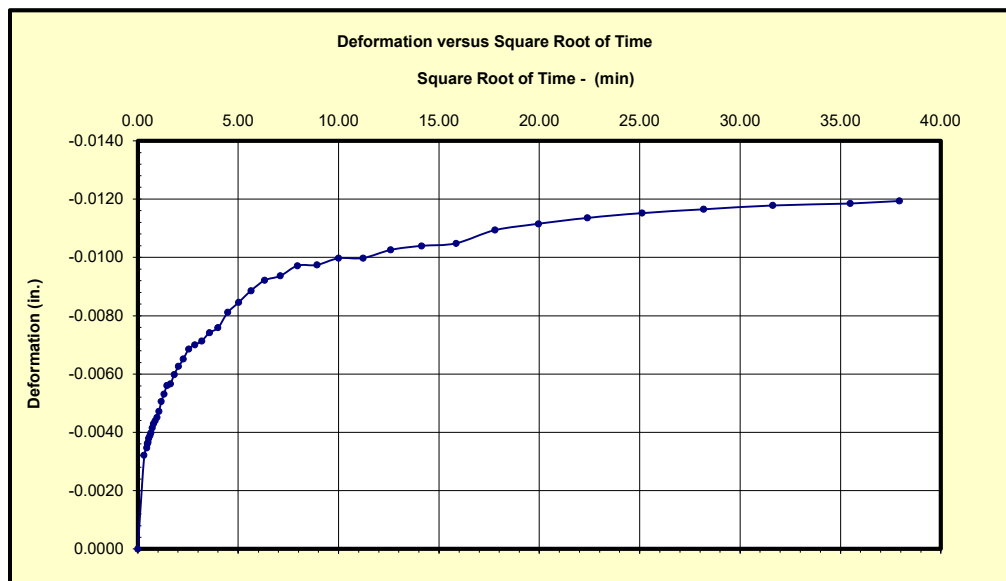
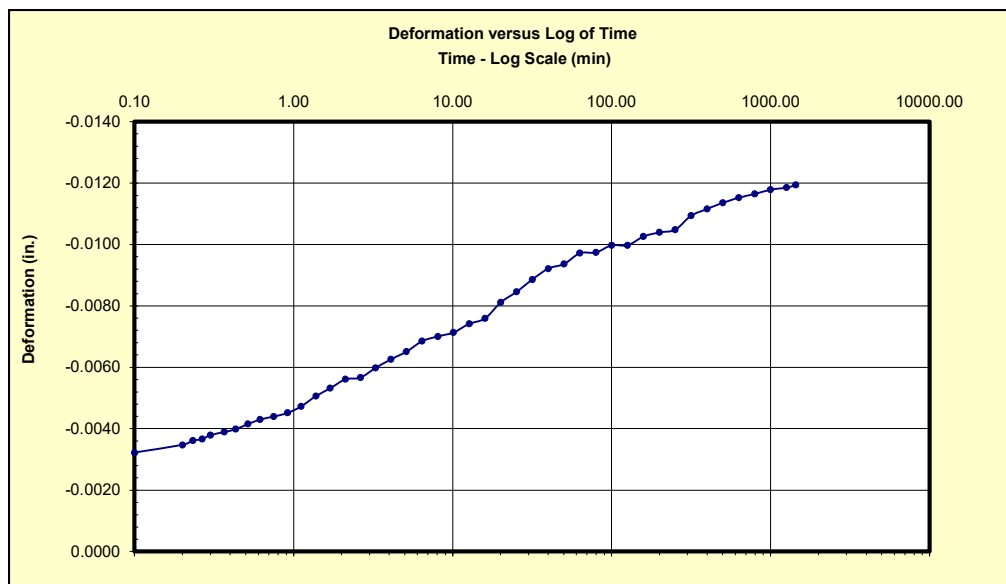
Update

Vertical Stress
6400 psf
S100
No match!!!

☒ End of Primary
☐ End of Increment

Project:
L231011

B6
Depth (ft):
35.4-35.5



Scan Data

Step List

ISTEP 111

Update

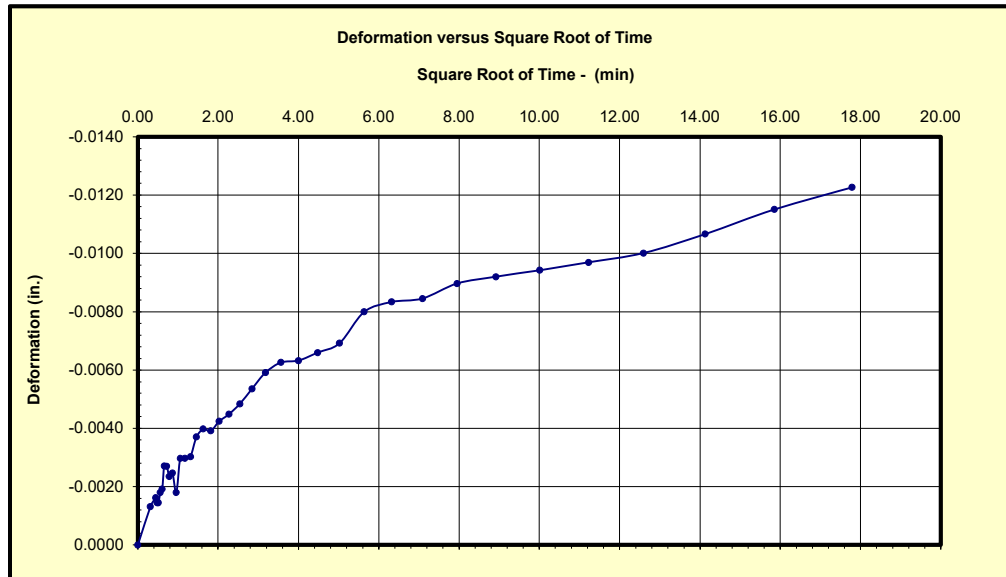
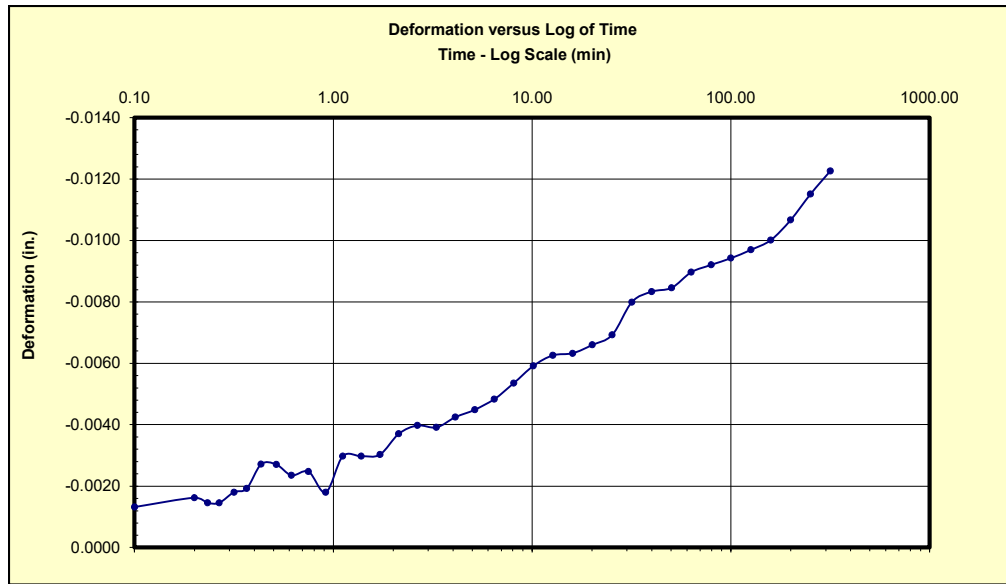
Vertical Stress
1600 psf
S100
No match!!!

☒ End of Primary

☐ End of Increment

Project:
L231011

B6
Depth (ft):
35.4-35.5



Scan Data

Step List

ISTEP 111

Update

Vertical Stress
400 psf

S100
No match!!!

- ☒ End of Primary
☐ End of Increment

Project:
L231011

B6
Depth (ft):
35.4-35.5

Trevor Louviere, PE
Dalton Olmsted & Fuglevand
1011 SW Klickitat Way, Ste 2008
Seattle, WA 98134

May 8, 2024

Project Number L231011

PROJECT: Arkema Manufacturing Site 2023 Materials

SUBJECT: Results of Laboratory Testing
Report #3

At your request, we provided laboratory testing services for the subject project. Services were limited to the performance of testing of laboratory tests, selected at your discretion.

For this period, our involvement was limited to laboratory testing of one sample delivered to our laboratory on November 3, 2023. Laboratory tests were conducted in general accordance with methods listed in the attached *Laboratory Summary* sheets.

If you have questions regarding this report, please call.

Respectfully Submitted,
Budinger & Associates, Inc.



Kiel Couch
Laboratory Manager

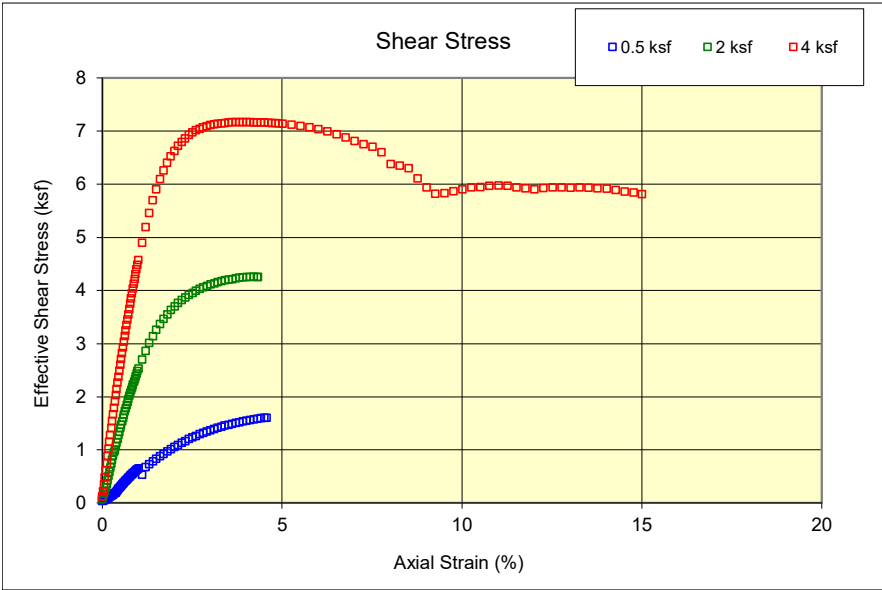
KC/lat/Addressee –
Trevor Louviere – tlouviere@dofnw.com

Attachments:
Soils Laboratory Summary – 1 page
CD Triaxial Shear Report – 1 page

SOILS
LABORATORY SUMMARY

LABORATORY NUMBER			23-1277
SAMPLED BY			Client
SAMPLE TYPE			Bulk
DATE RECEIVED			11/3/23
SAMPLE SOURCE			SO-DOFB12 - 102723-23.5-24
	<u>UNITS</u>	<u>TEST METHOD</u>	
MOISTURE	%	ASTM D2216	28.9
CD TRIAXIAL SHEAR		ASTM D7181	See attached
SIEVE ANALYSIS		ASTM D6913	
S #4	%		100
I #10			100-
E #16	P		100-
V #30	A		99
E #40	S		96
#100	S		84
S #200	I		51
I	N		
Z	G		
E			

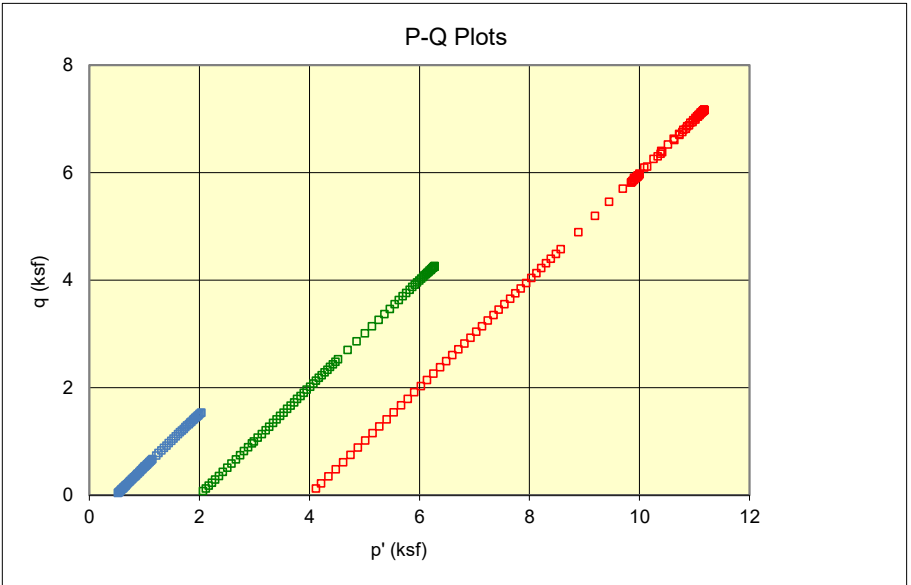
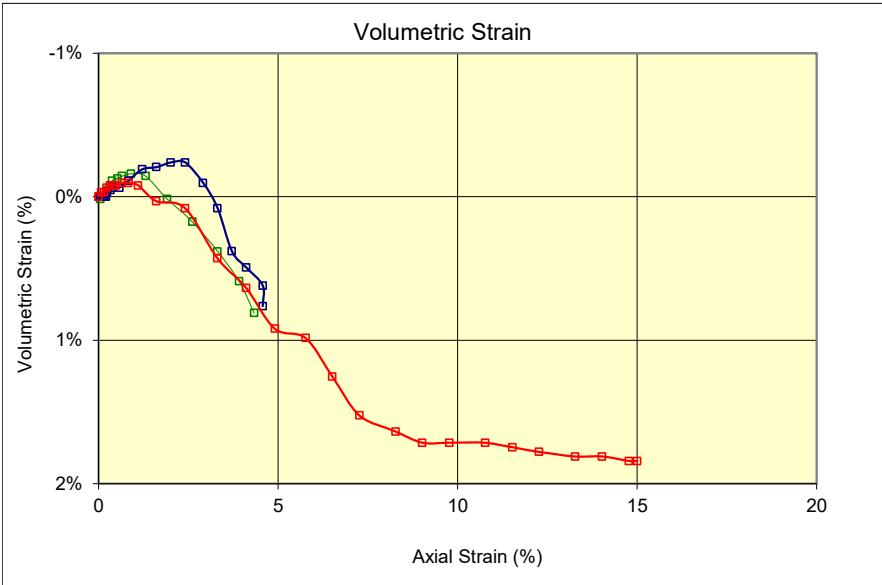
Multistage CD Triaxial Shear Report
ASTM D-7181



Project Name:	Arkema Manufacturing Site		
Project Location:	Tacoma, WA		
Laboratory Number:	23-1277		
Sample Description:	SP-SM		
Type:	Intact from thin walled tube		
Sample Source:	SO-DOFB12-102723-23.5-24		



Initial dry unit weight (pcf)	103.1	--	--
Initial Wc (%)	21.3%	--	--
Final dry unit weight (pcf)	--	--	85.8
Final Wc (%)	--	--	28.9%
Consolidation Stress (ksf)	0.5	2.0	4.0
Peak p' (ksf)	2.12	6.28	11.2
Peak q (ksf)	1.60	4.26	7.17



Appendix C



August 26, 2024

TerraSense Project Number: 23014938A

RE: Design Testing for the Slurry Wall at the Former Arkema Manufacturing Site

SCOPE OF SERVICES

This report summarizes the results of testing performed by TerraSense Lab CED (TerraSense) for Dalton, Olmsted & Fuglevand, Inc. (DOF) under Task Order No.: TER-POT-01, dated 11/3/2023.

The purpose of the test program was to support development of a self-hardening slurry appropriate for use in the construction of a vertical groundwater containment barrier at the site which has groundwater with a high pH and metal content. Self-hardening slurry mixes based on a 5% Clay 18% Cement mix were studied using New Cem, a locally available slag cement for the cement component. Since the standard bentonite clay behaves poorly when exposed to high pH waters, two types of specialty clay additives were evaluated, attapulgite clay and sepiolite. Attapulgite has worked well as the clay component in past projects of this type but due to the closer availability of sepiolite, another relatively inert clay type, this was considered also. This program provides a basis for on-site slurry mixing to achieve the required hydraulic conductivity after construction, which for the purposes of this program was assumed to be a maximum of 1×10^{-7} cm/sec. Although no strength requirements were set, an Unconfined Compressive Strength of 40-psi or greater was considered acceptable for the purposes of this program. As part of this program, the compatibility characteristics of the proposed mixes with site groundwater were also studied to evaluate long-term behavior.

The basic test program was executed based on an initial proposal for services, dated 11/27/2023, prepared by TerraSense with consultation with Mr. Daniel J. Hawk, President of Earth'n Wind, LLC, who acted as the client technical representative during the test program. This program was periodically revised based on test results provided during the execution of the program.

The laboratory effort generally comprised the following:

- Performance of basic initial compatibility tests to evaluate the proposed clay types for use with the site ground water.
- Performance of unconfined compression testing on specimens prepared from selected mixes to evaluate set times and strengths.

- Performance of flexible wall hydraulic conductivity tests using the selected clay mineral and cement additives to confirm that the selected mixes meet the desired coefficient of hydraulic conductivity for the proposed barrier wall.
- Evaluation of the likelihood of long-term compatibility problems between the mix and the site groundwater.

MATERIALS USED

The following materials were used in the program:

- 1) Attapulgite (Fullers Earth): Florigel-HY from Active Minerals International, LLC;
- 2) Sepiolite: Sea Mud from IMV Nevada;
- 3) Slag Cement: New Cem, provided to lab by DOF;
- 4) Four Jugs Ground Water, provided to lab by DOF;
- 5) 1 bag soil, provided to lab by DOF;
- 6) Totowa Tap Water.

References to these materials in the test documentation were either by brand name or material type. In this report, the materials were generally referred to by material type.

TESTING PROGRAM

CLAY MINERAL EVALUATION

The initial feasibility of using each of these clay mineral additives was evaluated using a screening test. This test compared the relative behaviors of the minerals when combined with the mix water (Totowa tap water which was used to represent the potable hydrant water expected to be used during construction) and with the high pH water present as the groundwater on site. Compatibility problems may often quickly be identified from variations in these tests so that only suitable minerals need be studied in subsequent test phases.

The following screening test was used:

1. Sedimentation/Separation of the prepared slurry mix:

For each of the clay minerals being investigated, a standard slurry with a marsh funnel viscosity of approximately 40 was prepared using the mineral and Totowa tap water. This slurry was allowed to hydrate for at least 24 hours before use in the screening test. Basic slurry properties (Marsh Funnel Velocity, pH, and density) were evaluated prior to use after the hydration period.

The sedimentation test provides an indication of the stability of the mineral slurry with the ground water. The test consists of diluting a sample of the prepared slurry 1:1 by volume with water, with one dilution using tap water and the other using site groundwater. These samples were then allowed to settle overnight and observed for differences in settling behavior.

Based on these initial qualitative tests, the suitability of the clay minerals for further testing was evaluated.

SLURRY MIXES

Self-hardening slurry mixes based on a 5% Clay, 18% Cement mix, by weight of water were studied for both clay types. The following three types of water were used in the preparation of these mixes:

- 1) Totowa Tap water, representative of the potable hydrant water expected to be used during construction and representing the initial wall condition;
- 2) 50:50 ratio of Totowa Tap water and the site ground water, which may be representative of the water in the wall as the site ground water partially penetrates the wall, for representing mid-term condition of the wall;
- 3) Site ground water, which may be representative of the water in the wall after the site ground water fully penetrates the wall, representing the long-term condition of the wall.

Initially, two small test mixes were prepared by adding the dry combined cement-clay mixes to the 50:50 test water, while mixing in a blender. One mix, identified as Test Mix 1, was prepared this way using Sepiolite as the clay type and resulted in a very thick slurry. A second mix, using Attapulgate, was impossible to thoroughly mix as it caused a flash set in the mixer. This second mix was abandoned.

Two more small mixes, denoted as Test Mix 2 and Test Mix 3 were then prepared using Attapulgate as the clay, with one mix using tap water as the mix water and the second mix again using the 50:50 test water. However, for these two mixes the cement was first mixed in with the water and then the clay subsequently added. This resulted in workable slurries.

After a short cure period which allowed the samples to start to change to a green color indicating that the chemical reactions between the ingredients had initiated, Unconfined Compression tests were performed. These tests indicated that the selected mix ratios met or exceeded program strength requirements.

Subsequently, for each water type and clay type, larger mixes were prepared using the same mix ratios and adding the clay in after the cement. After mixing, basic slurry properties (Mud Balance Density and Marsh Funnel Velocity) were determined for each mix.

From each mix, multiple test specimens were prepared by pouring some of the mix into specimen molds, tapping and rodding the slurry in the molds to remove entrapped air bubbles.

These molded specimens were left open to the atmosphere overnight as initial curing initiated, and the molds were then closed for the rest of their cure time. The molds were stored in coolers with a moist atmosphere until removal for testing. During the initial curing period, the mixes were monitored for the initiation of greening.

UNCONFINED COMPRESSION TESTS

Mixes were evaluated for Unconfined Compressive Strength in general accordance with ASTM D2166 periodically during the program to evaluate the progression of curing and that program minimum strengths were obtained.

HYDRAULIC CONDUCTIVITY TESTS

After allowing the samples to cure for approximately 90-days (a typical cure time for slag-cement mixes), the specimens were back-pressure saturated and consolidated at an effective stress of 20-psi prior to initiation of permeation. Testing was performed following the general guidelines in ASTM test method D5084 using the site ground water as the permeant. Due to the low hydraulic conductivities expected for the mixes, higher than normal gradients were initially applied to increase flow volumes during the program. Initial hydraulic conductivities were obtained when the flow stabilized after the initiation of permeation.

COMPATABILITY TESTS

After the initial determination of the specimen hydraulic conductivity, permeation was continued using the ground water as the permeant for approximately three months to evaluate the long-term responses of each selected mix.

TEST RESULT DISCUSSION

Results of the individual tests are presented in the Appendix and further summarized on the tables and figures attached to this report.

Clay-Slurry and Cement-Clay-Water Slurry Tests

The results of these tests are summarized in Table 1 and Table 2. For the preparation of the test mixes in this program the materials were added dry to the mix-water. This technique was considered acceptable since the two clays studied are not hydratable, viscosity changes are primarily only due to the mechanical mix action. For the initial check mixes, the dry ingredients were all added together as a composite. This resulted in unacceptably viscous mixes. The mixes for the main program were all added to the water with the cement component first and then the clay component, which resulted in acceptable mixes. After adjusting the mix procedure, the ratios used provided acceptable slurry workable mixes for use in the field. The mix order should be considered in the field use.

Clay Screening Tests

The screening tests showed that the clays tested had little reaction when exposed to the site groundwater. This indicated that changes of material behavior over time were still possible but are expected to be low, so the clays were appropriate for more advanced testing to further evaluate this time behavior. The results of these tests are shown in Figure 1 and Figure 2.

Unconfined Compression and Hydraulic Conductivity Tests

Results of the Unconfined Compression and Hydraulic Conductivity tests are summarized in Table 3.

Unconfined Compression Tests

Since the specimens were prepared by curing the slurry mixes in standard cement molds, the resulting specimens did not meet the minimum length/diameter requirements in ASTM D2166. This difference was minimal, is normal for testing cement-based cylinders, and is considered to have negligible influence on the results. As shown on Figure 3, each mix showed strength exceeding the program minimum by approximately 40-days of curing and the strengths continued to increase with ongoing curing - even up to ~250 days. No significant differences in strength or cure rate were noted as a result of the type of mix water used.

Hydraulic Conductivity Tests

After initial flow stabilization of each test, all samples except the mixes prepared with Ground Water had hydraulic conductivities well below the program maximum. The initial Ground Water specimens' hydraulic conductivities were slightly above this value but after about 1 week of flow these mixes also dropped below the program maximum. Testing for both of these specimens was initiated at a lower cure time than the other mixes which may have contributed to this. It is noted that the total unit weight measured for the Attapulgitte specimen was somewhat less than the other specimens tested and also was below the initial slurry density; its unit weight upon consolidation and initial permeation was similar to the others at that stage. It is considered that some defect, may have been initially present in the test specimen that may have at least partially healed. In addition, due to the unexpectedly high initial hydraulic conductivity of this specimen, the hydraulic gradient was reduced to a more standard value after approximately two weeks. However, this action appeared to cause some erratic readings and lowered hydraulic conductivities as the specimen re-stabilized after additional consolidation. Air coming out of the groundwater permeant may have also affected the hydraulic conductivity at this time.

Also noted, for the specimen prepared from the Sepiolite-Tap Water mix, the test unit used had limited backpressure available. As such the maximum gradient that could be applied during the test was limited to a value significantly lower than that used in the other tests - but still within the range normally recommended by ASTM D5084. While not significantly affecting the measured conductivities, this did result in reduced volume of total flow over the course of the test compared to the others.

COMPATIBILITY TEST DISCUSSION

Generally, compatibility tests on standard cement-bentonite mixes are continued until approximately two to three pore volumes of permeant pass through the specimen. Breakthrough of most contaminants usually occurs within the first pore volume, however up to two pore volumes may be required for breakthrough of contaminants that have been adsorbed on the soil. Passing of more than two pore volumes allows for the complete specimen length to have been exposed to all contaminants. Due to the unique chemistry of self-hardening slurry mixes, where most of the water becomes part of the structure, determination of the material porosity required for the determination of pore volume is not strictly possible. Therefore, permeation was performed over a period of time to evaluate time effects.

During the permeation phase of the compatibility tests, the volumes of influent and effluent waters were measured over time intervals longer than normal for hydraulic conductivity tests (intervals of days to weeks). Hydraulic gradients somewhat higher than normal were also used to facilitate greater permeant volumes to pass through the specimens during the period allotted for this program than would normally occur using more standard practice. Essentially discrete hydraulic conductivity values were recorded during the compatibility tests, rather than averages as would normally be reported during more standard hydraulic conductivity tests. Accordingly, more variation between individual readings often is apparent in the data presentations. Nonetheless the permeability trends are considered similar and negligibly affected by this procedure compared to more standard hydraulic conductivity tests.

In addition, for technical and health and safety reasons, the site ground waters were isolated from the external environment using interface pots to hold the influent and effluent water. These pots introduce a small uncorrected resistance to the flow of the system as they form a closed system. Of importance, therefore, is the relative variation of the hydraulic conductivity with a permeant as a function of flow, rather than the absolute values.

Lastly, it is noted that apparently organic growths developed within the source groundwater provided to the lab over time, which may have influenced long-term permeability readings – although such growths were not readily observable in the specimens or lines.

To simulate the replacement of mix water with ground water over time, three mixes were prepared for each cement-clay mix, with varying proportions of tap water-to-groundwater. The specimens prepared with 100% tap water and then permeated with ground water were representative of the initial materials to be placed in a trench at the site and subject to permeation with ground water while the readings at the end of permeation were considered representative of approximately 10% ground water replacement. The specimens prepared with half ground water and half tap water were considered representative of the same entrenched materials after some groundwater flow occurs. The specimens prepared with 100% ground water were considered representative of the entrenched materials' long-term condition after all of the original mix water has been replaced with ground water.

As shown on Figure 4, it is demonstrated that the Hydraulic Conductivity vs. Mix Water Ground Water Replacement plot that even with full replacement of the ground water the

measured hydraulic conductivity remained at least an order of magnitude below the test program objective. This plot does show an upward trend of conductivity when more than ~50% of the mix water has been replaced by the ground water.

Figures 5 to 10, which show the variation of permeability as a function of time, show that in all cases the permeabilities showed an overall decreasing trend.

Taken together, the results of the program suggest that the long-term permeability tends to decrease and occasional permeability increases observed in the specimens may be more the result of curing effects, specimen anomalies, potential organic growth in the supplied groundwater, and viscosity and adsorption of the permeants themselves rather than degradation of the various mixes. Regardless, each mix essentially stabilized with hydraulic conductivities below the test program objective and remained so for the duration of the program.

LIMITATIONS

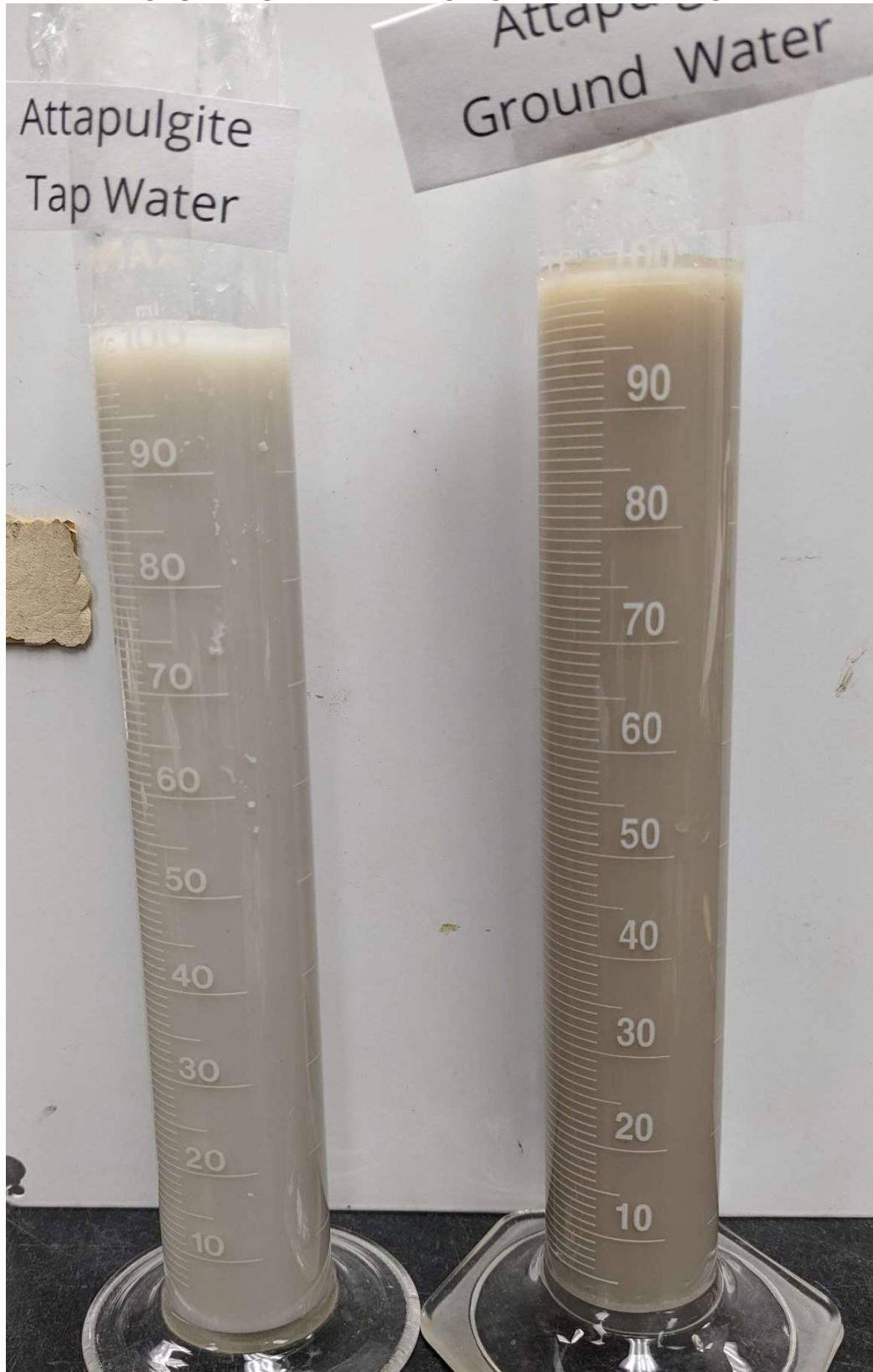
Our professional services for this project have been performed in accordance with generally accepted engineering practices; no other warranty, expressed or implied, is made.

SAMPLE DISPOSITION

If we do not receive other instructions from you within thirty days, this material will be disposed of.

FIGURES

SLURRY SEDIMENTATION/SETTLEMENT TEST



Recorded Separation

6%

2%

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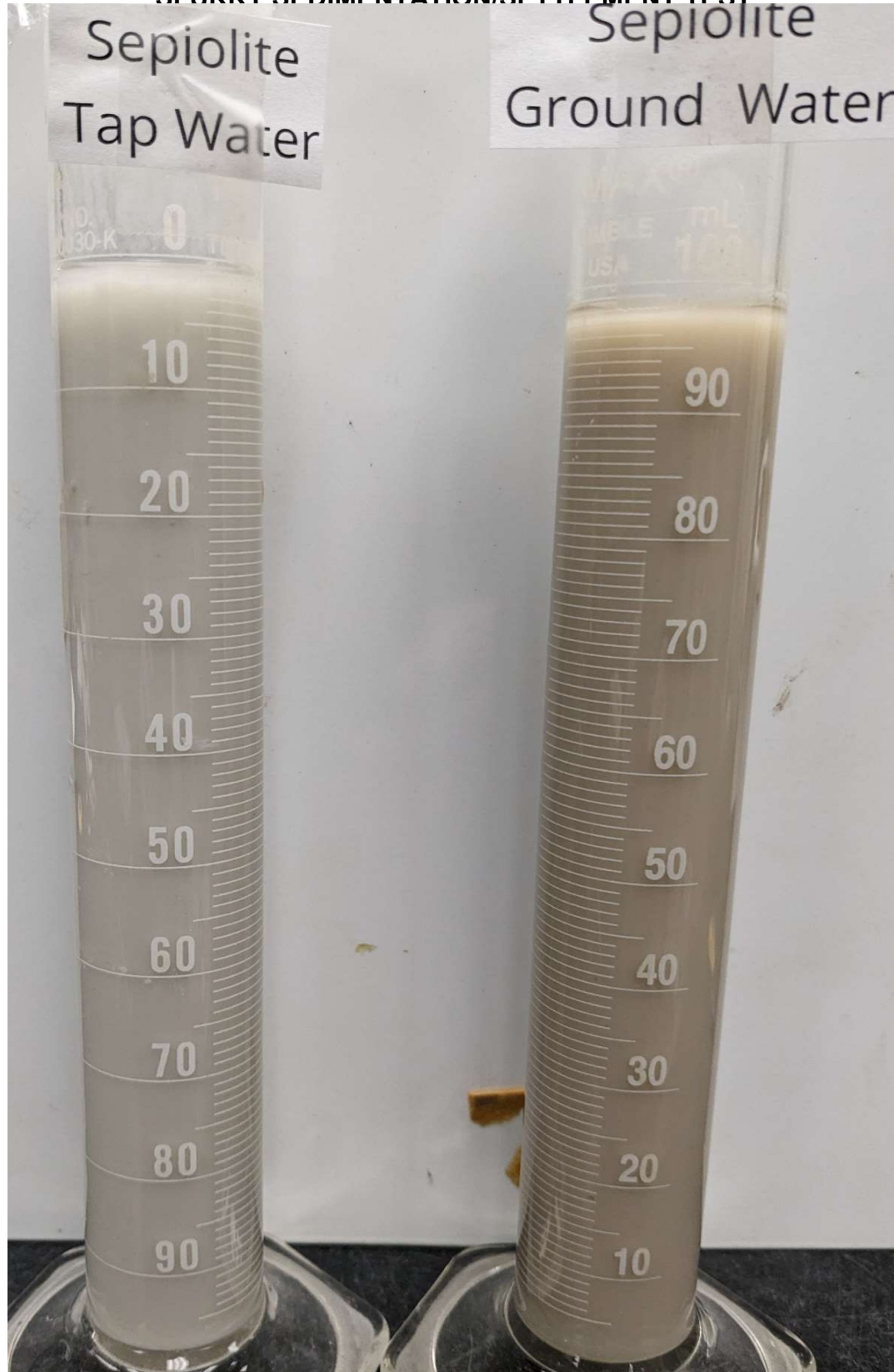
**Project #
TER-POT-01**

**Project #
23014938A**

**PoT - Former Arkema
Manufacturing Site**

**(Fig. 1)
Slurry Separation Test
Attapulgite Clay**

SLURRY SEDIMENTATION/SETTLEMENT TEST



Recorded Separation

6%

5%

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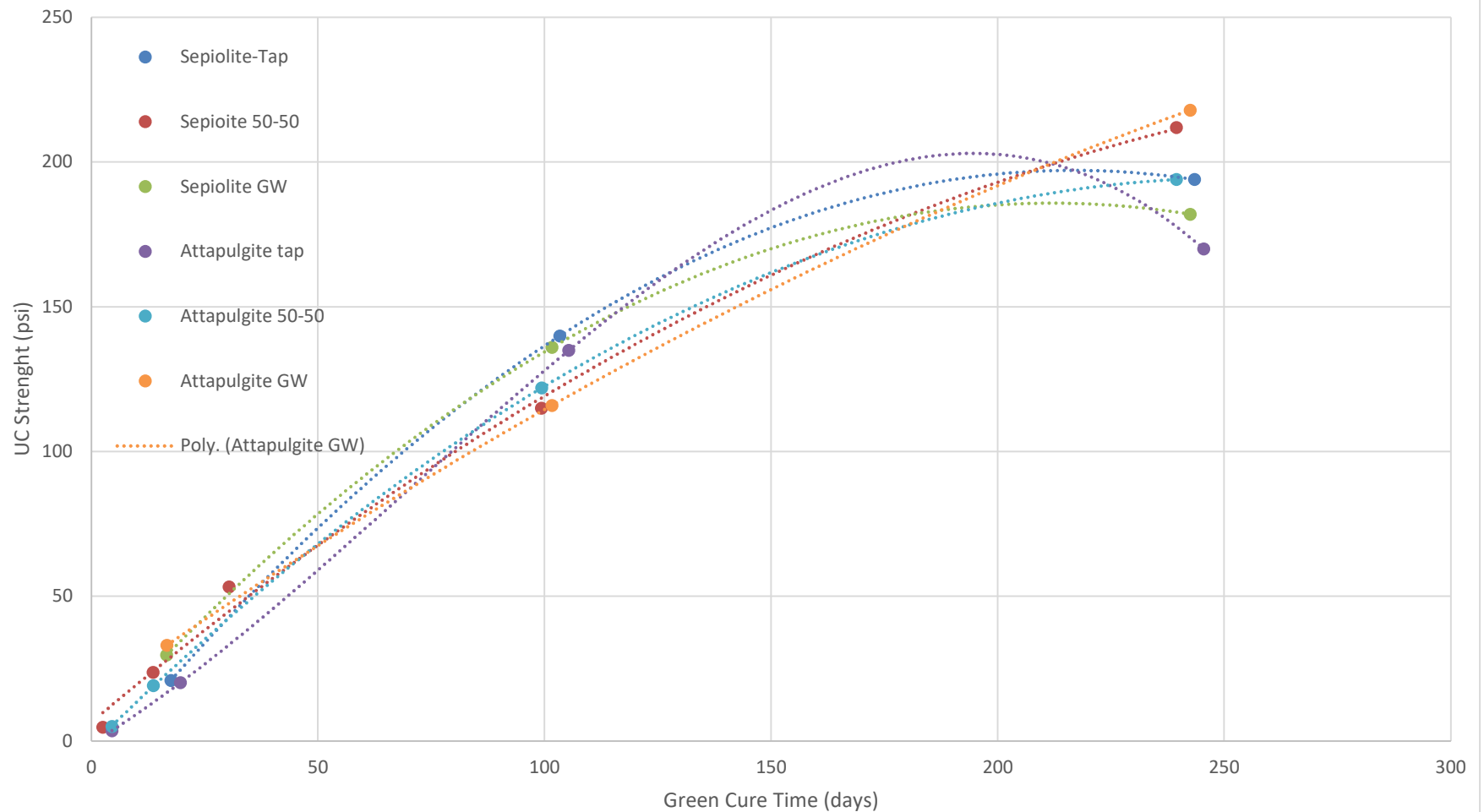


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(Fig. 2)
Slurry Separation Test
Sepiolite Clay



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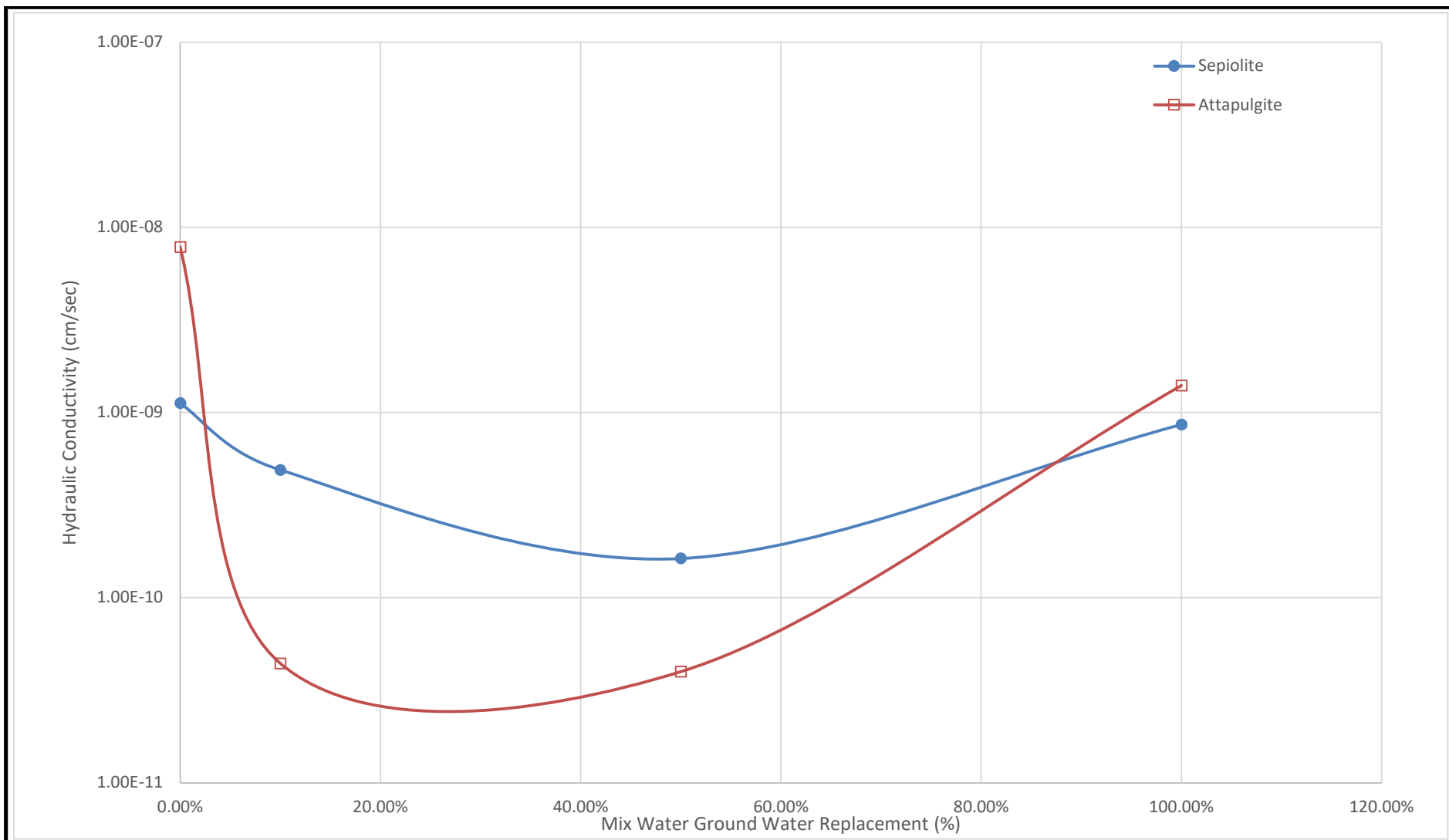


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(Fig. 3)
Plot of Green Cure Time vs. UC Strength for
All Mix Samples



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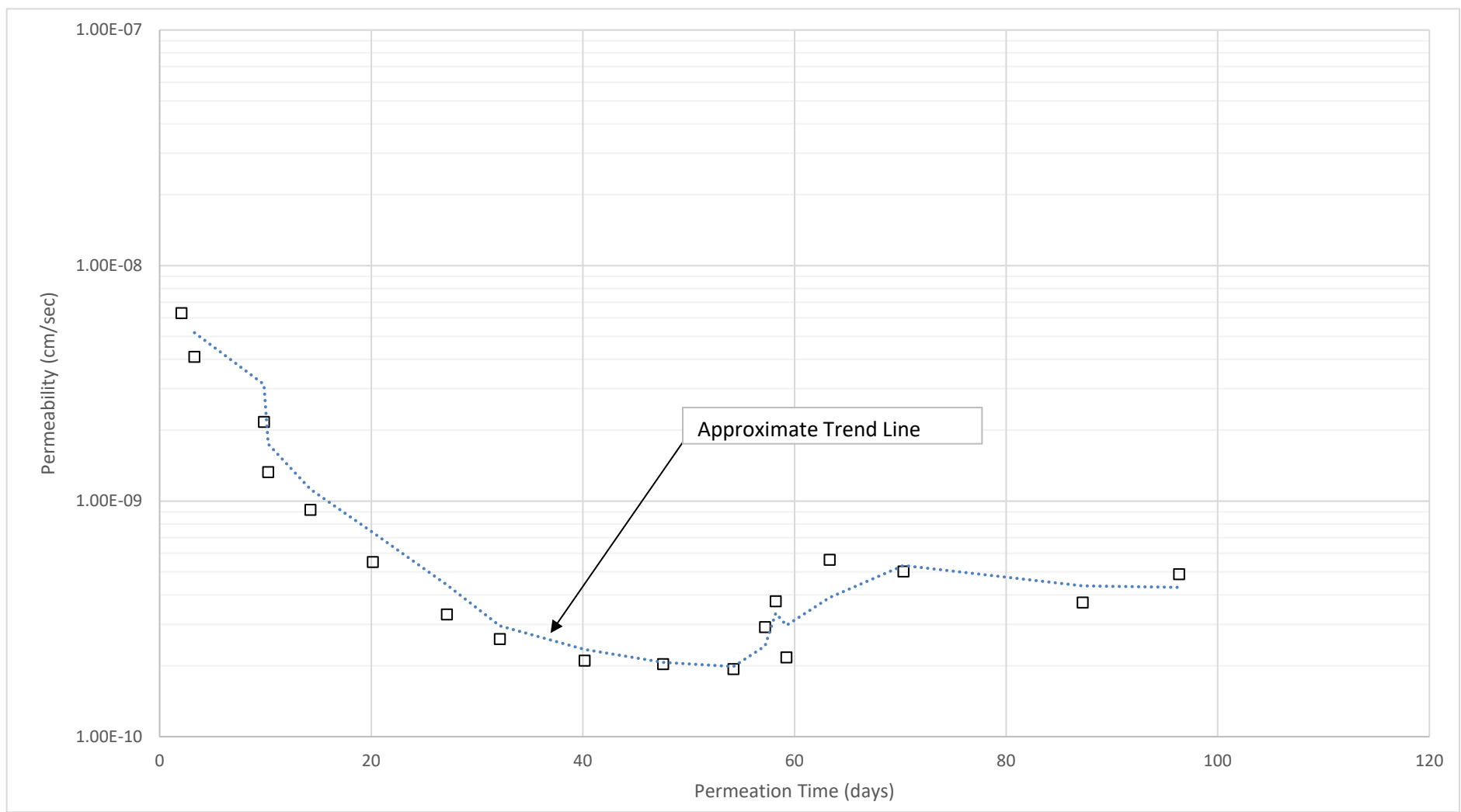
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(Fig. 4)
Plot of Hydraulic Conductivity Variation vs.
Estimated Ground Water Replacement



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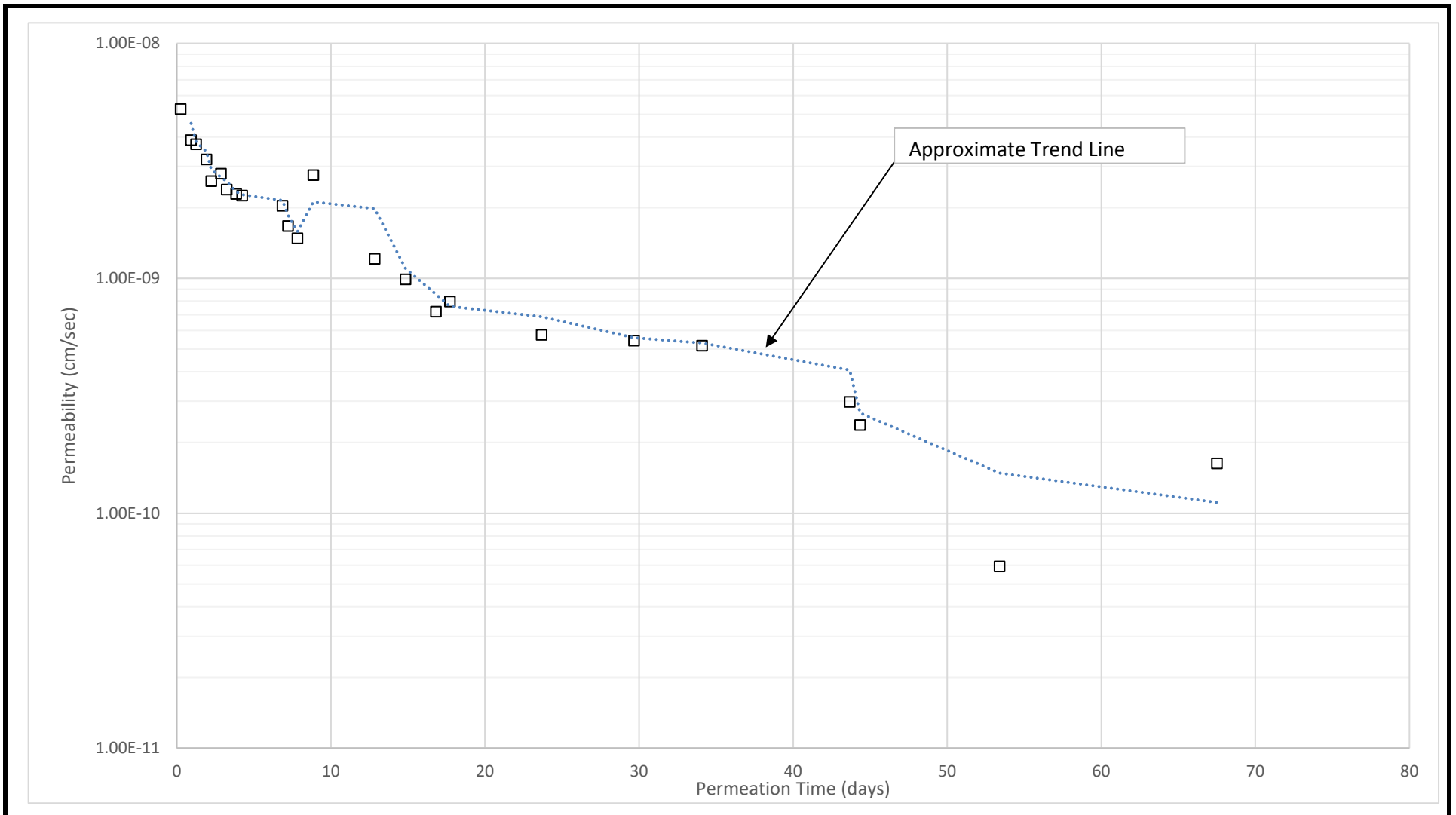


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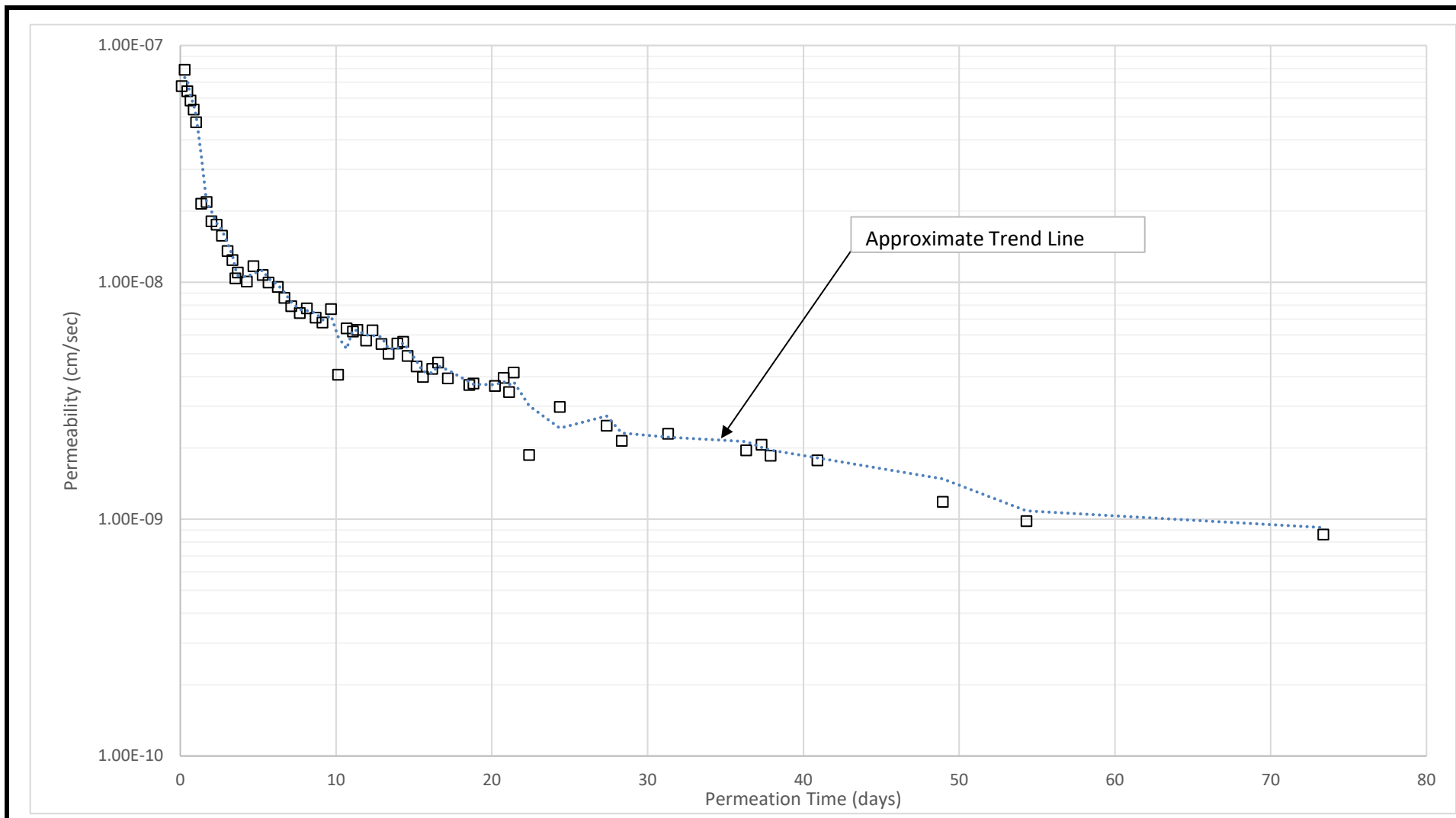
Project#
23014938A

(Fig. 5)
Compatibility Test
Groundwater as Permeant

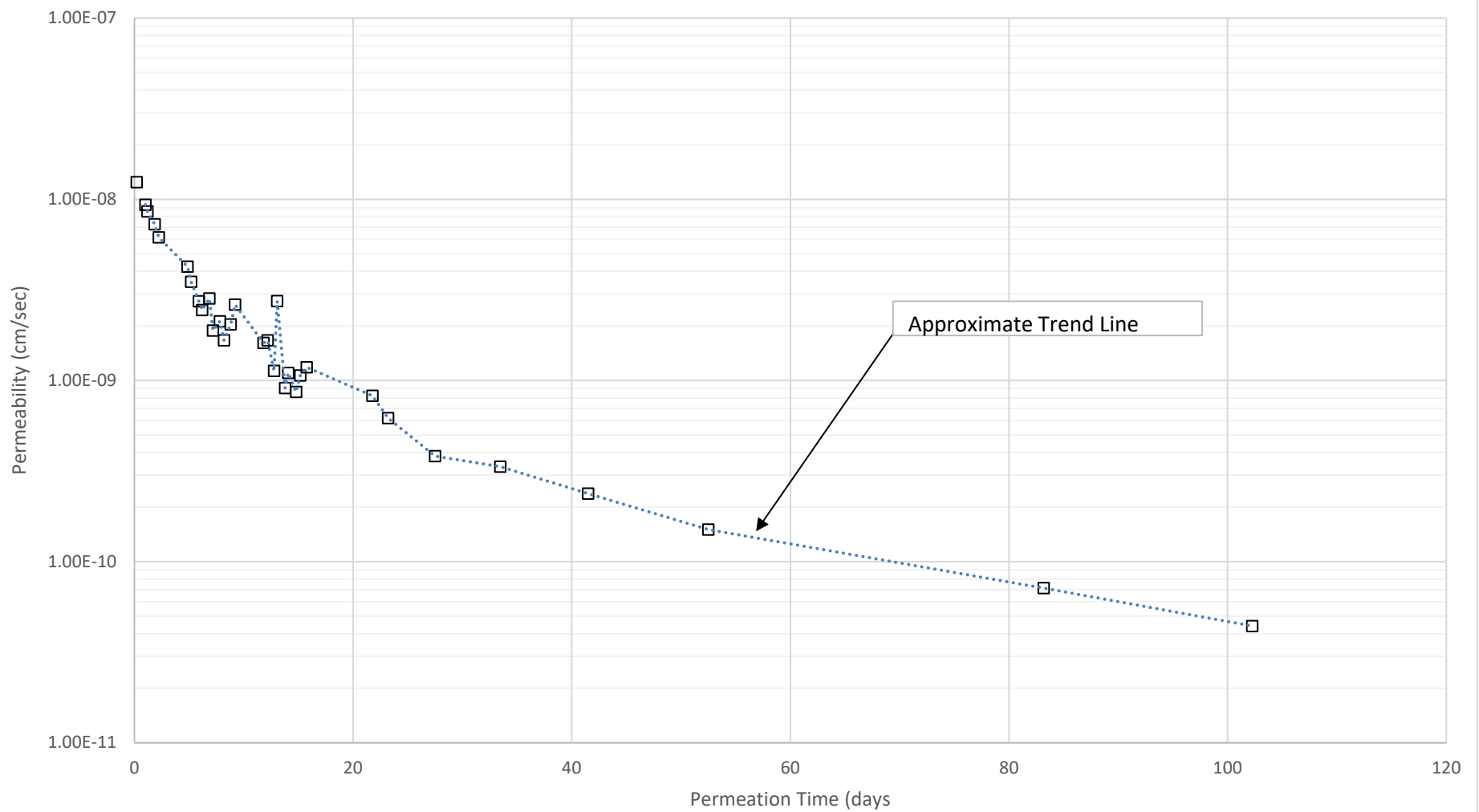
Clay Type: Sepiolite
Mix water: Tap



Dalton, Olmsted & Fuglevand, Inc.	Project# TER-POT-01	PoT - Former Arkema Manufacturing Site	(Fig. 6) Compatibility Test Groundwater as Permeant Clay Type: Sepiolite Mix water: 50/50
 TERRASENSE Geotechnical Laboratory	Project# 23014938A		



Dalton, Olmsted & Fuglevand, Inc.	Project# TER-POT-01	PoT - Former Arkema Manufacturing Site	(Fig. 7) Compatibility Test Groundwater as Permeant Clay Type: Sepiolite Mix water: GW
 TERRASENSE Geotechnical Laboratory	Project# 23014938A		



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TER-POT-01

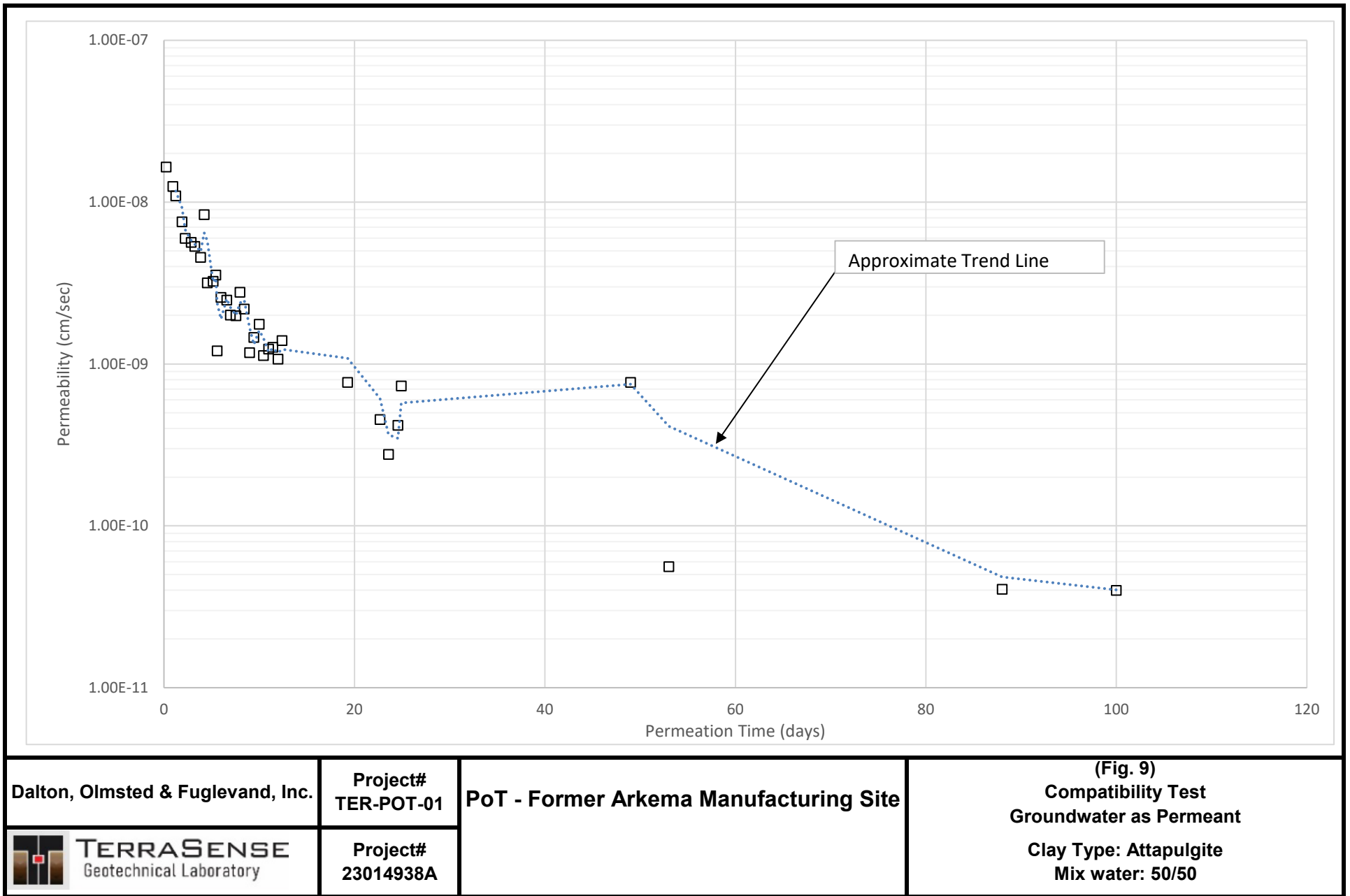


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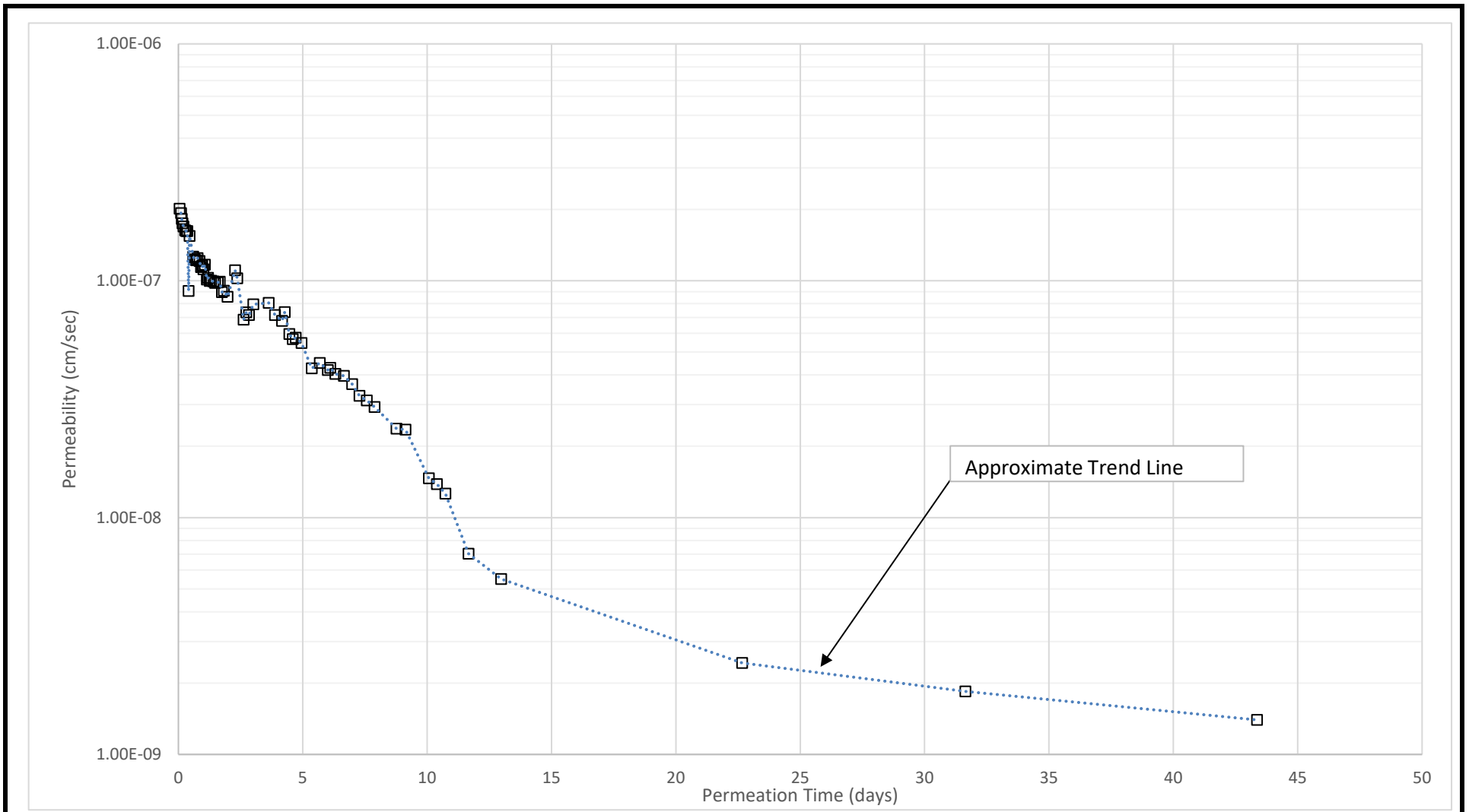
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(Fig. 8)
Compatibility Test
Groundwater as Permeant
Clay Type: Attapulgite
Mix water: Tap Water



Dalton, Olmsted & Fuglevand, Inc.		Project# TER-POT-01	PoT - Former Arkema Manufacturing Site	(Fig. 9) Compatibility Test Groundwater as Permeant Clay Type: Attapulgite Mix water: 50/50
		Project# 23014938A		



Dalton, Olmsted & Fuglevand, Inc.	Project# TER-POT-01	PoT - Former Arkema Manufacturing Site	(Fig. 10) Compatibility Test Groundwater as Permeant Clay Type: Attapulgite Mix water: GW
 TERRA SENSE Geotechnical Laboratory	Project# 23014938A		

TABLES

Dalton, Olmsted & Fuglevand, Inc. #TER-POT-01
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TABLE 1
CLAY-WATER SLURRY MIXES

Slurry Mix No.	Ratio of additive to water by wgt	Mix Date	Slurry Constituents		pH	Marsh Funnel Viscosity	Mud Balance Density	Separation		Remarks
			Mix Water (type)	Bentonite (type)				1/1 Slurry/Tap Water Dilution	1/1 Slurry/Ground Water Dilution	
	(%)				(pH units)	initial after hyd. (sec)	initial after hyd. (pcf)	(%)	(%)	
1	5.00	11/28/23	Totowa Tap	Attapulgate	9.5	38	-	-	-	
						42	64.0	6	2	
2	5.00	11/28/23	Totowa Tap	Sepiolite	9.1	44	-	-	-	
						47	64.0	6	5	

All slurries hydrated at least 24 hours

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TABLE 2
Cement-Clay-Water Mix Data

ID	water	clay	mix date	green date	w	Marsh	Balance
Test Mix 1	50%Tap 50% GW	Sepiolite	11/29/2023	12/3/2023		81	71
Test Mix 2	Tap	Attapulgite	12/12/2023	12/14/2023		49	71
Test Mix 3	50%Tap 50% GW	Attapulgite	12/12/2023	12/14/2023		43	71
Sepiolite Tap	Tap	Sea Mud Sepiolite	12/14/2023	12/17/2023	399.0	43	71
Sepiolite GW	Ground Water	Sea Mud Sepiolite	12/15/2023	12/18/2023	391.2	43	71
Sepiolite 50-50	50%Tap 50% GW	Sepiolite	12/15/2023	12/21/2023	396.4	47	71
Attapulgite Tap	Tap	Attapulgite Clay	12/13/2023	12/15/2023	396.7	45	71
Attapulgite GW	Site Ground Water	Attapulgite Clay	12/14/2023	12/18/2023	398.2	37	70
Attapulgite 50-50	50%Tap 50% GW	Attapulgite Clay	12/15/2023	12/21/2023	378.4	35	70.5

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TABLE 3

SUMMARY OF UNCONFINED COMPRESSION AND PERMEABILITY TESTING

MIX WATER	CLAY	CEMENT	TEST ID	MIX ID	CAST DATE	GREEN DATE	TEST DATE	TOTAL CURE (days)	GREEN CURE (days)	INITIAL CONDITIONS			PEAK COMPRESSIVE STRESS (psi)	STRAIN @ FAILURE (%)	INITIAL HYDRAULIC CONDUCTIVITY (cm/sec)
										WATER CONTENT (%)	TOTAL UNIT WGT. (pcf)	DRY UNIT WGT. (pcf)			
Tap	5% Sepiolite	18% slag	UC24005	Sepiolite Tap	12/14/23	12/17/23	01/03/24	20	18	359.5	71.3	15.5	21	0.8	
			UC24146				03/29/24	106	103	336.5	72.3	16.6	140	1.1	
			P13223				4/9/2024	117	114	314.8	71.9	17.3			1.1E-09
			UC24215				08/16/24	246	243	333.2	72.3	16.7	194	0.7	
50%Tap 50% GW	5% Sepiolite	18% slag	UC230242	Test Mix 1	11/29/23	12/03/23	12/05/23	6	3	384.8	71.0	14.7	5	1.4	
			UC24007	Sepiolite 50-50	12/15/23	12/21/23	01/03/24	20	14	354.6	71.4	15.7	24	0.7	
			UC24001	Test Mix 1	11/29/23	12/03/23	01/02/24	34	30	350*	71.0	15.8	53	0.9	
			UC24145	Sepiolite 50-50	12/15/23	12/21/23	03/29/24	105	99	340.9	72.2	16.4	115	1.6	
			P13224				4/15/2024	122	116	326.2	71.6	16.8			3.4E-09
			UC24217				08/16/24	245	239	331.7	72.6	16.8	212	0.6	
Ground Water	5% Sea Mud Sepiolite	18% slag	UC24006	Sepiolite GW	12/15/23	12/18/23	01/03/24	20	17	348.9	71.4	15.9	30	1.0	
			UC24143				03/28/24	105	102	213.9**	71.0	22.6	136	1.0	
			P13222				4/5/2024	112	109	323.7	72.5	17.1			2.0E-08
			UC24219				08/16/24	246	243	330.6	72.3	16.8	182	0.6	



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Dalton, Olmsted & Fuglevand, Inc. #TER-POT-01
PoT - Former Arkema Manufacturing Site
TABLE 3

SUMMARY OF UNCONFINED COMPRESSION AND PERMEABILITY TESTING

MIX WATER	CLAY	CEMENT	TEST ID	MIX ID	CAST DATE	GREEN DATE	TEST DATE	TOTAL CURE (days)	GREEN CURE (days)	INITIAL CONDITIONS			PEAK COMPRESSIVE STRESS (psi)	STRAIN @ FAILURE (%)	INITIAL HYDRAULIC CONDUCTIVITY (cm/sec)
										WATER CONTENT (%)	TOTAL UNIT WGT. (pcf)	DRY UNIT WGT. (pcf)			
100%Tap	5% Attapulgate	18% slag	UC230254	Test Mix 2	12/12/23	12/14/23	12/18/23	6	5	388.9	71.7	14.7	4	1.3	
Tap	5% Attapulgate Clay	18% slag	UC24008	Attapulgate Tap	12/13/23	12/15/23	01/03/24	22	20	363.1	71.7	15.5	20	0.9	
			UC24147				03/29/24	107	105	353.4	71.2	15.7	135	1.4	
			P13220				4/10/2024	119	117	348.9	70.8	15.8			7.8E-09
			UC24216				08/16/24	247	245	335.6	71.3	16.4	170	0.6	
50%Tap 50% GW	5% Attapulgate	18% slag	UC230255	Test Mix 3	12/12/23	12/14/23	12/18/23	6	5	366.9	71.5	15.3	5	1.2	
50%Tap 50% GW	5% Attapulgate Clay	18% slag	UC24010	Attapulgate 50-50	12/15/23	12/21/23	01/03/24	20	14	350.8	71.4	15.9	19	0.9	
			UC24148				03/29/24	105	99	333.4	72.6	16.8	122	1.3	
			P13221				4/15/2024	122	116	310.5	72.1	17.6			6.1E-09
			UC24218				08/16/24	246	240	324.2	72.7	17.1	194	0.7	
Site Ground Water	5% Attapulgate Clay	18% slag	UC24009	Attapulgate GW	12/14/23	12/18/23	01/03/24	21	17	354.2	71.2	15.7	33	1.5	
			UC24144				03/28/24	106	102	304.7	72.1	17.8	116	0.9	
			P13219				4/8/2024	116	112	321.7	68.3	16.2			1.3E-07
			UC24220				08/16/24	247	243	334.4	71.7	16.5	218	0.7	

* Data problem, estimated value

** Possibly incomplete drying



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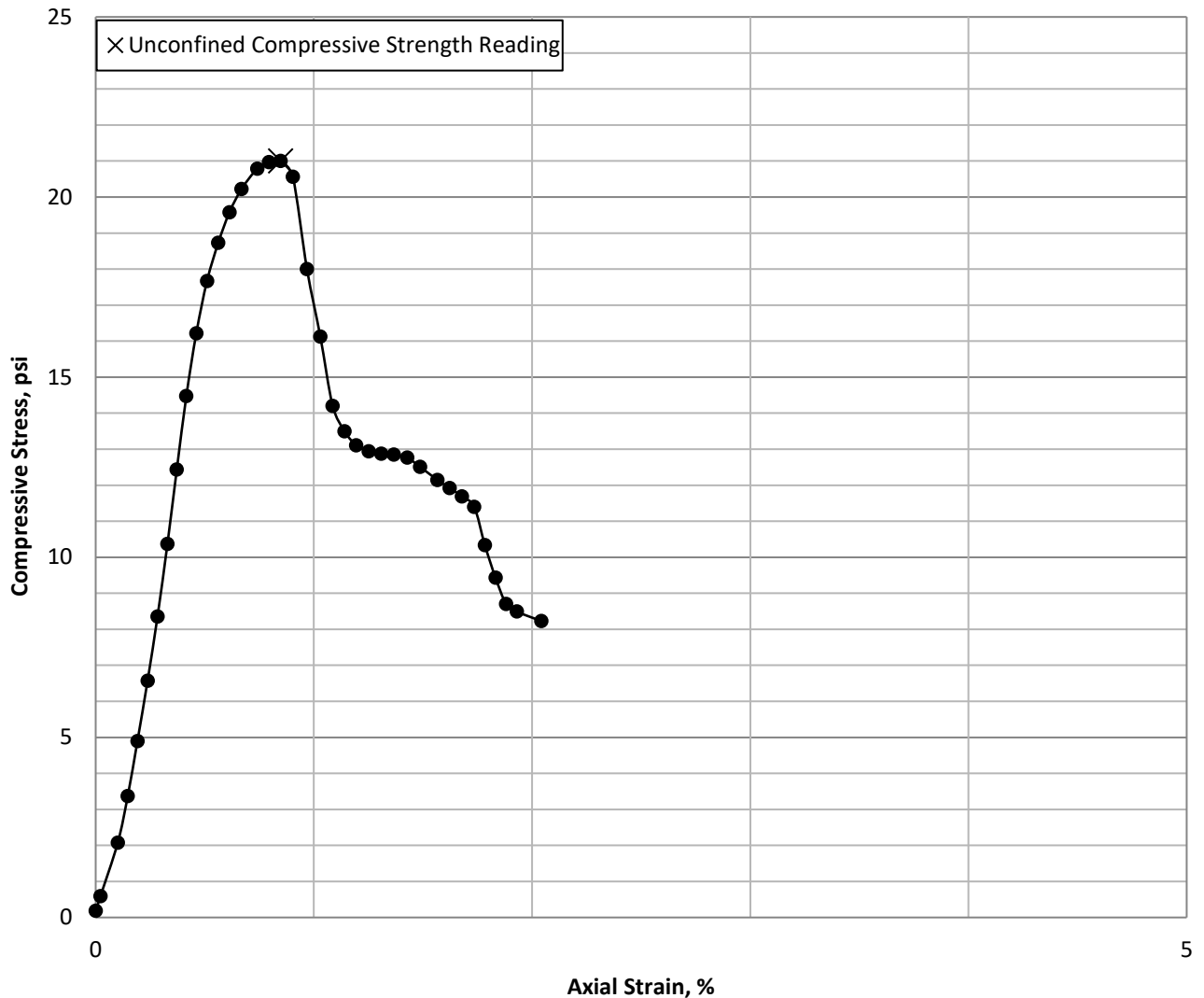
45 H Commerce Way
Totowa, NJ 07512

Project No.: 23014938A
Table 3 UC-PermSumr1 8/21/2024
Page 2 of 2

APPENDIX

Test Results

UNCONFINED COMPRESSIVE STRENGTH TEST, ASTM METHOD D2166



Specimen and Material Property Information

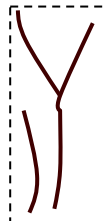
Sample Type: Cast

Description and/or Classification: Cast Self-Hardening Slurry Greening started: 12/17/2023

	Water ⁽¹⁾ Content (%)	Wet Unit Weight (pcf)	Dry Unit ⁽¹⁾ Weight (pcf)	Void ⁽²⁾ Ratio (-)	Saturation ⁽²⁾ (%)	Length (inch)	Diameter (inch)	L/D (3) (-)	LL (-)	PI (-)	Specific ⁽²⁾ Gravity (-)
Initial	359.5	71.3	15.5	10.47	97.9	5.554	3.029	1.8			2.85

Failure Summary

UC Compressive Strength, q_u (psi)	UC Shear Strength, s_u (psi)	Strain to Peak (%)	Strain Rate (%/min)
21	10.5	0.8	0.52



FAILURE
SKETCH

Remarks and Notes:

- (1) Water Content determined after shear from partial specimen.
 - (2) Assumed specific gravity
 - (3) Does not meet min. L/D specification.
- Mix Ingredients
Clay Used: 5% Sepiolite
Mix Water: Tap

Tested by: BB

Reviewed by: DM

Test Date: 1/3/2024

Review Date: 4/5/2024

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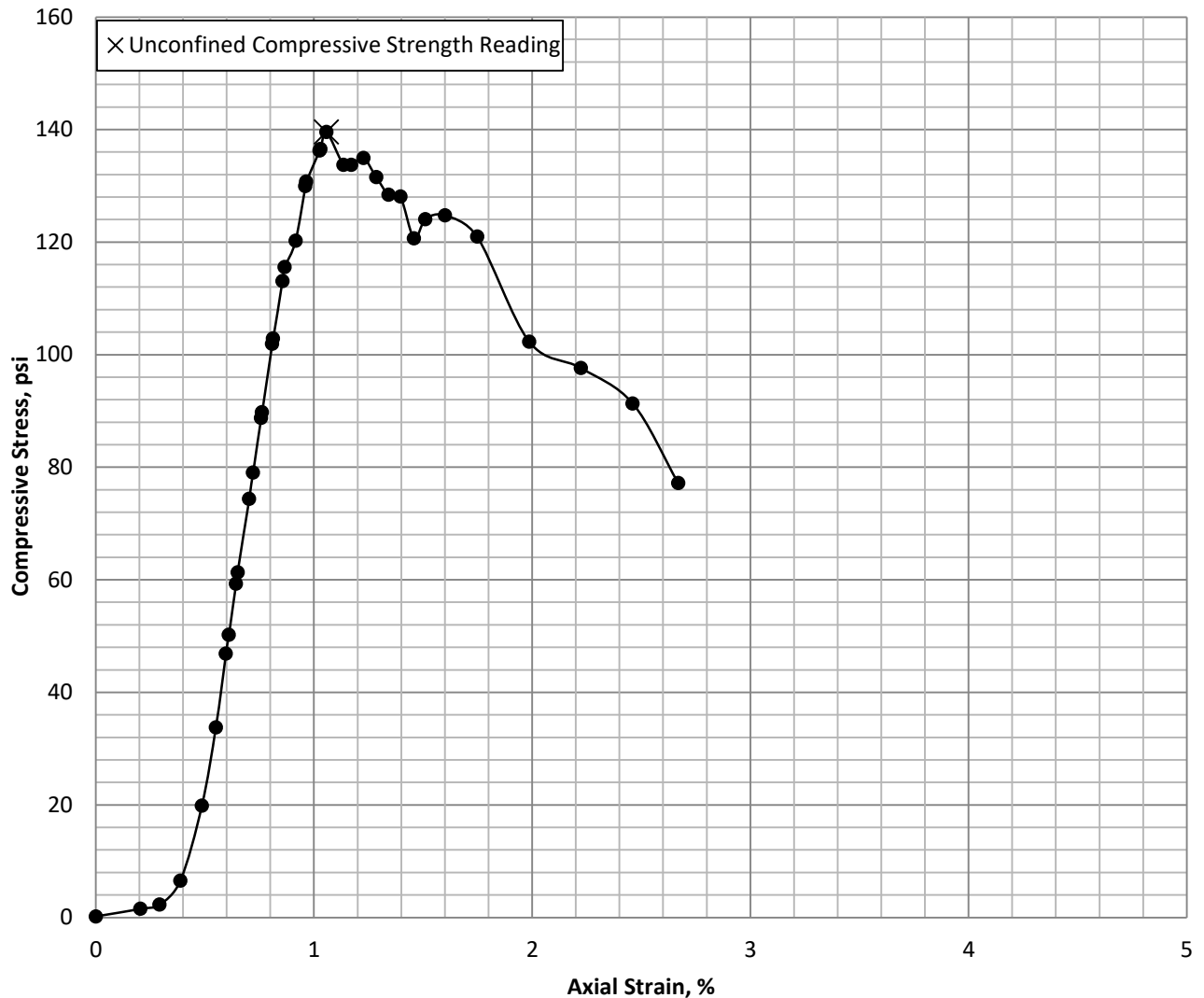
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UNCONFINED COMPRESSION
TEST

Mix: Sepiolite Tap 18% slag
Mix Date: 12/14/23 Total Cure: 20 days

UNCONFINED COMPRESSIVE STRENGTH TEST, ASTM METHOD D2166



Specimen and Material Property Information

Sample Type: Cast

Description and/or Classification: Cast Self-Hardening Slurry Greening started: 12/17/2023

	Water ⁽¹⁾ Content (%)	Wet Unit Weight (pcf)	Dry Unit ⁽¹⁾ Weight (pcf)	Void ⁽²⁾ Ratio (-)	Saturation ⁽²⁾ (%)	Length (inch)	Diameter (inch)	L/D (3) (-)	LL (-)	PI (-)	Specific ⁽²⁾ Gravity (-)
Initial	336.5	72.3	16.6	9.74	98.5	5.611	3.012	1.9			2.85

Failure Summary

UC Compressive Strength, q_u (psi)	UC Shear Strength, s_u (psi)	Strain to Peak (%)	Strain Rate (%/min)
140	70	1.1	0.53



FAILURE
SKETCH

Remarks and Notes:

- (1) Water Content determined after shear from partial specimen.
- (2) Assumed specific gravity
- (3) Does not meet min. L/D specification.

Mix Ingredients

Clay Used: 5% Sepiolite
Mix Water: Tap

Tested by: DD

Test Date: 3/29/2024

Review Date: 8/20/2024

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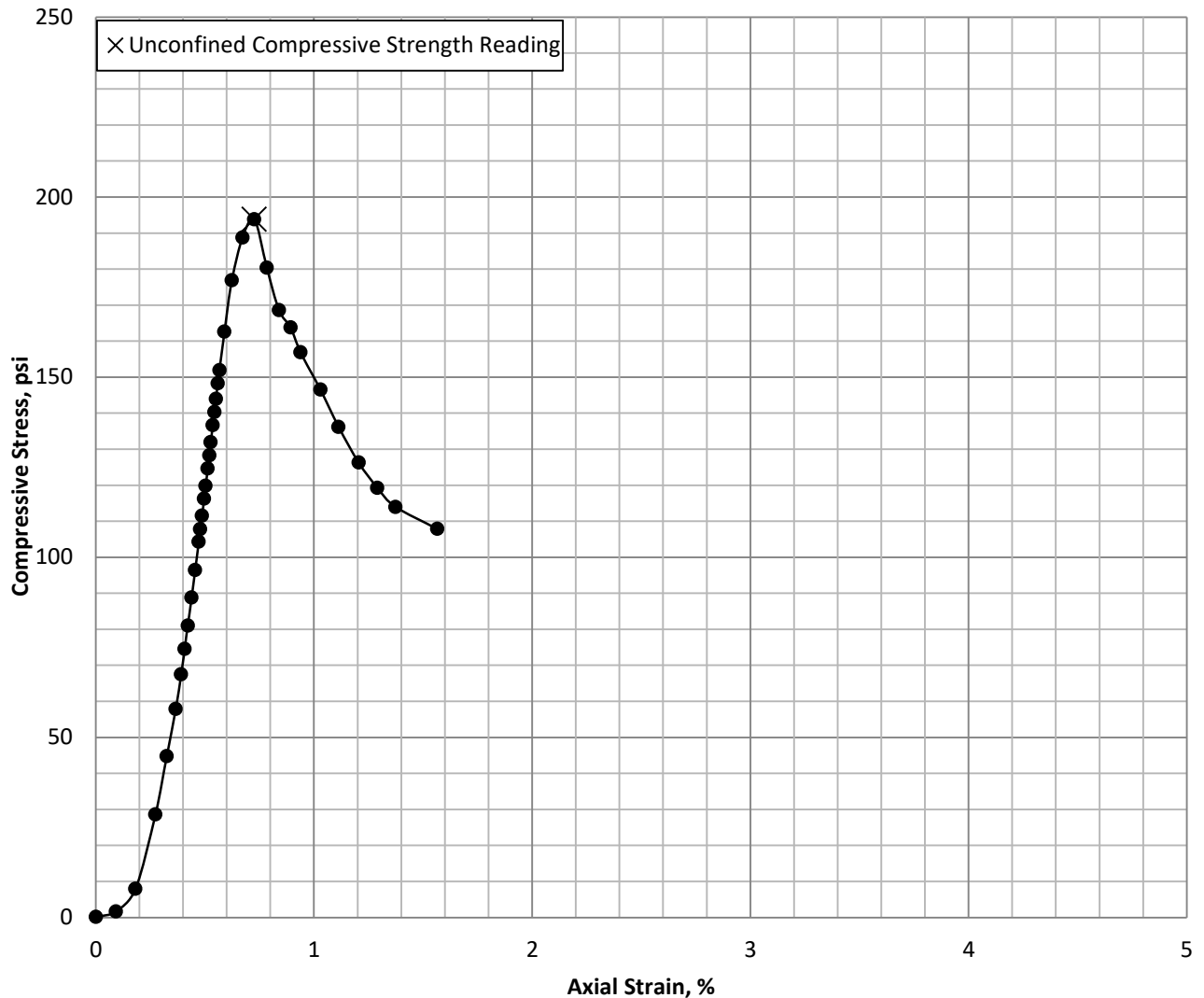
Project #
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PoT - Former Arkema
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UNCONFINED COMPRESSION
TEST

Mix: Sepiolite Tap 18% slag
Mix Date: 12/14/23 Total Cure: 106 days

UNCONFINED COMPRESSIVE STRENGTH TEST, ASTM METHOD D2166



Specimen and Material Property Information

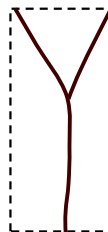
Sample Type: Cast

Description and/or Classification: Cast Self-Hardening Slurry Greening started: 12/17/2023

	Water ⁽¹⁾ Content (%)	Wet Unit Weight (pcf)	Dry Unit ⁽¹⁾ Weight (pcf)	Void ⁽²⁾ Ratio (-)	Saturation ⁽²⁾ (%)	Length (inch)	Diameter (inch)	L/D (3) (-)	LL (-)	PI (-)	Specific ⁽²⁾ Gravity (-)
Initial	333.2	72.3	16.7	9.65	98.4	5.542	3.014	1.8			2.85

Failure Summary

UC Compressive Strength, q_u (psi)	UC Shear Strength, s_u (psi)	Strain to Peak (%)	Strain Rate (%/min)
194	97	0.7	0.53



**FAILURE
SKETCH**

Remarks and Notes:

- (1) Water Content determined after shear from partial specimen.
- (2) Assumed specific gravity
- (3) Does not meet min. L/D specification.

Mix Ingredients

Clay Used: 5% Sepiolite
Mix Water: Tap

Tested by: DD

Test Date: 8/16/2024

Review Date: 8/19/2024

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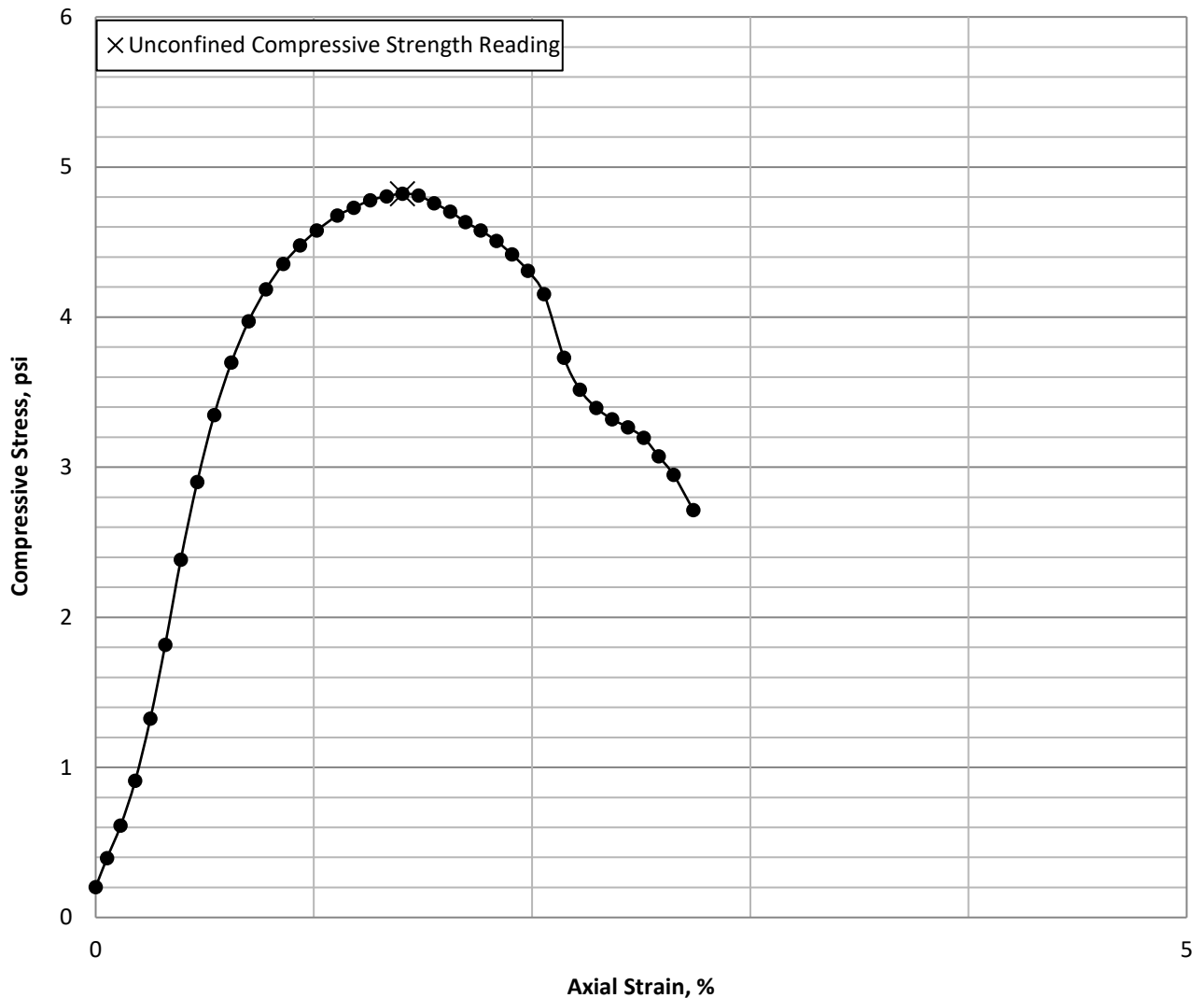
**PoT - Former Arkema
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**UNCONFINED COMPRESSION
TEST**

Mix: Sepiolite Tap 18% slag

Mix Date: 12/14/23 Total Cure: 246days

UNCONFINED COMPRESSIVE STRENGTH TEST, ASTM METHOD D2166



Specimen and Material Property Information

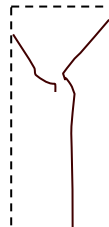
Sample Type: Cast

Description and/or Classification: Cast Self-Hardening Slurry Greening started: 12/03/2023

	Water ⁽¹⁾ Content (%)	Wet Unit Weight (pcf)	Dry Unit ⁽¹⁾ Weight (pcf)	Void ⁽²⁾ Ratio (-)	Saturation ⁽²⁾ (%)	Length (inch)	Diameter (inch)	L/D	LL	PI	Specific ⁽²⁾ Gravity (-)
Initial	384.8	71.0	14.7	11.14	98.4	5.665	2.872	2.0			2.85

Failure Summary

UC Compressive Strength, q_u (psi)	UC Shear Strength, s_u (psi)	Strain to Peak (%)	Strain Rate (%/min)
4.82	2.41	1.4	0.53



FAILURE
SKETCH

Remarks and Notes:

- (1) Water Content determined after shear from partial specimen.
- (2) Assumed specific gravity

Mix Ingredients

Clay Used: 5% Sepiolite
Mix Water: 50% Tap 50% GW

Tested by: MB

Reviewed by: DM

Test Date: 12/5/2023

Review Date: 8/14/24

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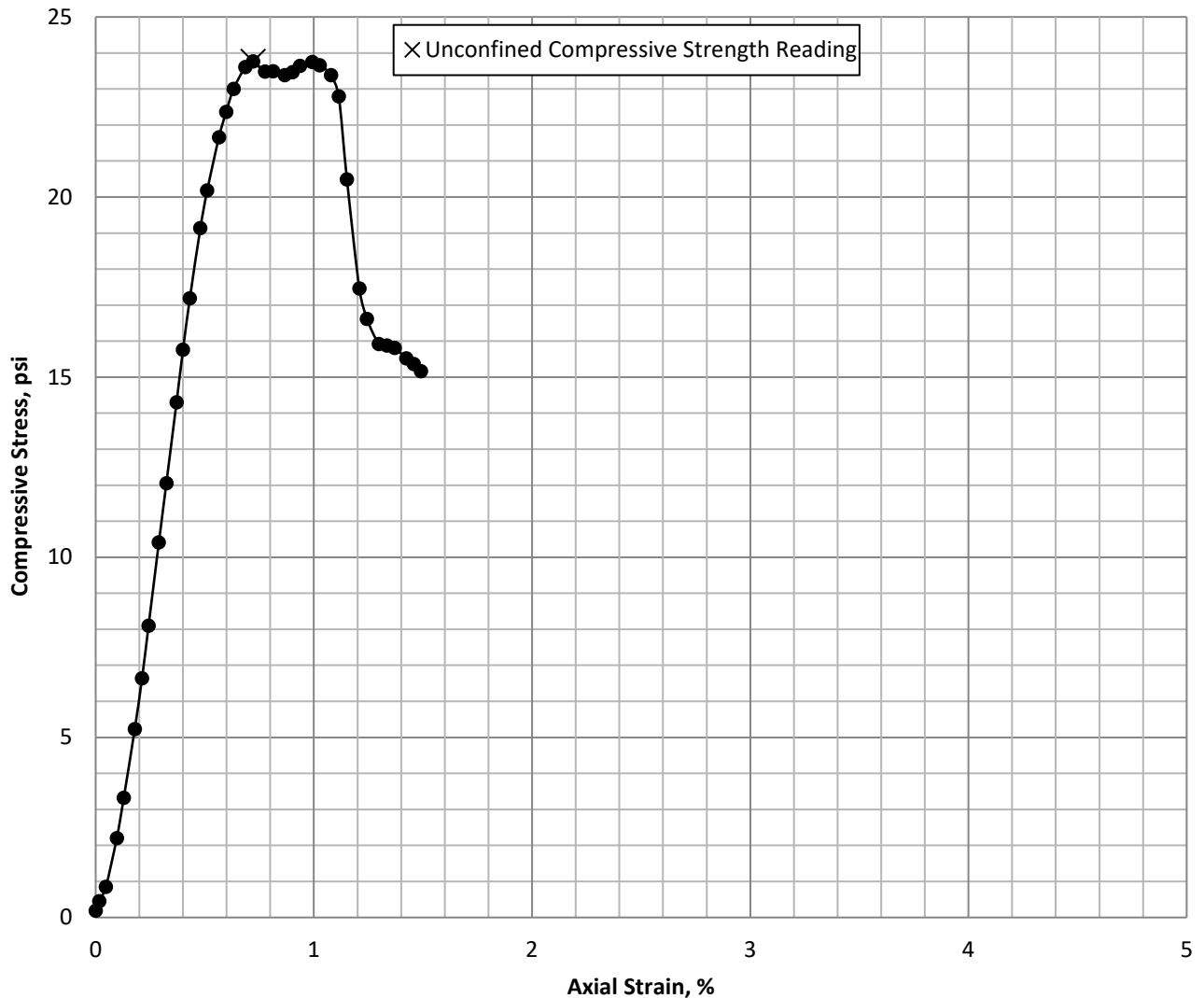
Project #
23014938A

PoT - Former Arkema
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UNCONFINED COMPRESSION
TEST

Mix: Test Mix 1 18% slag
Mix Date: 11/29/23 Total Cure: 6 days

UNCONFINED COMPRESSIVE STRENGTH TEST, ASTM METHOD D2166



Specimen and Material Property Information

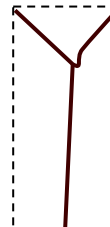
Sample Type: Cast

Description and/or Classification: Cast Self-Hardening Slurry Greening started: 12/21/2023

	Water ⁽¹⁾ Content (%)	Wet Unit Weight (pcf)	Dry Unit ⁽¹⁾ Weight (pcf)	Void ⁽²⁾ Ratio (-)	Saturation ⁽²⁾ (%)	Length (inch)	Diameter (inch)	L/D (3) (-)	LL (-)	PI (-)	Specific ⁽²⁾ Gravity (-)
Initial	354.6	71.4	15.7	10.32	98.0	5.650	3.027	1.9			2.85

Failure Summary

UC Compressive Strength, q_u (psi)	UC Shear Strength, s_u (psi)	Strain to Peak (%)	Strain Rate (%/min)
23.8	11.9	0.7	0.51



**FAILURE
SKETCH**

Remarks and Notes:

- (1) Water Content determined after shear from partial specimen.
- (2) Assumed specific gravity
- (3) Does not meet min. L/D specification.

Mix Ingredients

Clay Used: 5% Sepiolite
Mix Water: 50% Tap 50% GW

Tested by: BB

Reviewed by: DM

Test Date: 1/3/2024

Review Date: 4/5/2024

**Dalton, Olmsted &
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**Project #
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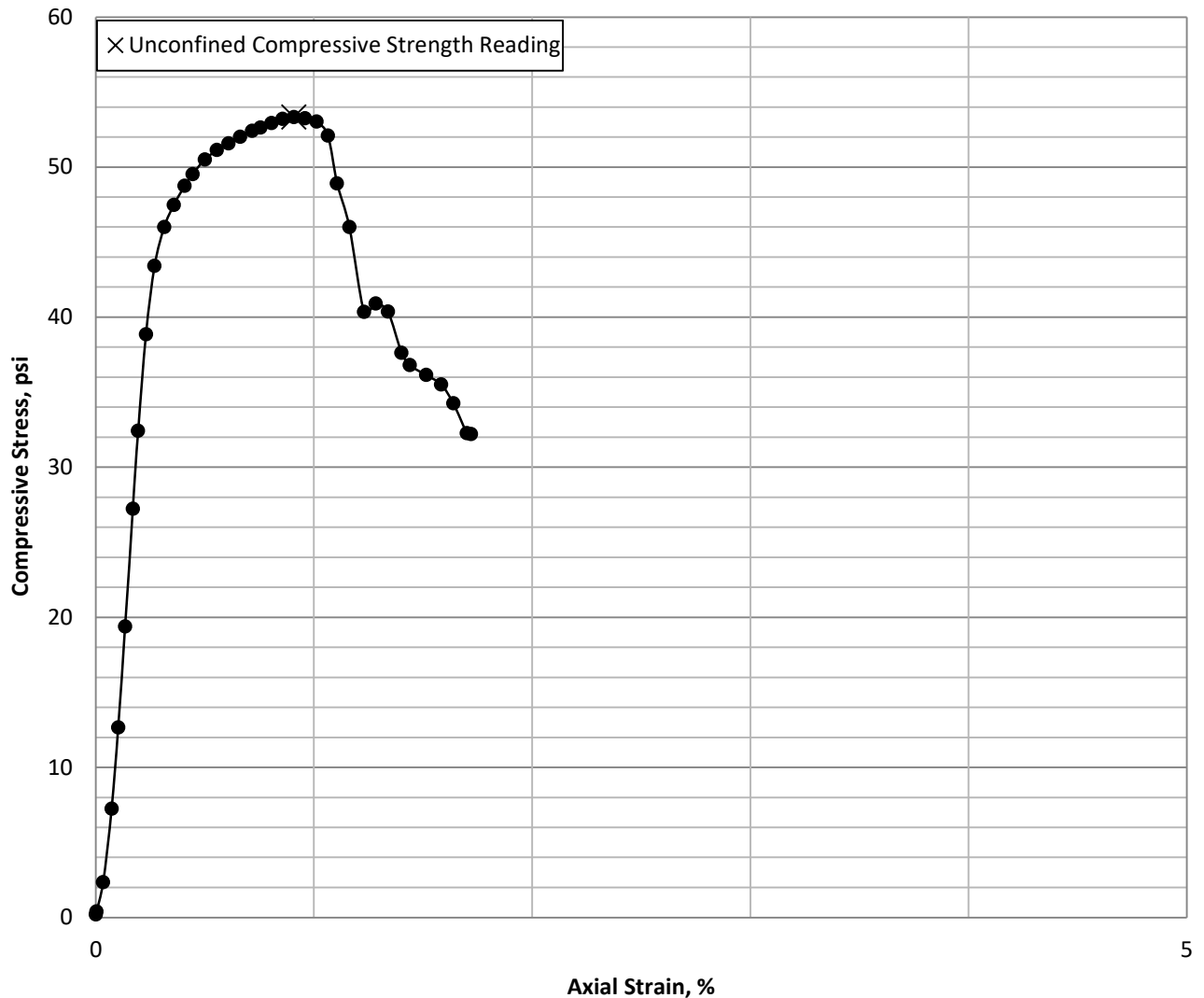
**Project #
23014938A**

**PoT - Former Arkema
Manufacturing Site**

**UNCONFINED COMPRESSION
TEST**

**Mix: Sepiolite 50-50 18% slag
Mix Date: 12/15/23 Total Cure: 20 days**

UNCONFINED COMPRESSIVE STRENGTH TEST, ASTM METHOD D2166



Specimen and Material Property Information

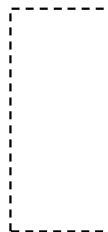
Sample Type: Cast

Description and/or Classification: Cast Self-Hardening Slurry Greening started: 12/03/2023

	Water ⁽¹⁾ Content (%)	Wet Unit Weight (pcf)	Dry Unit ⁽¹⁾ Weight (pcf)	Void ⁽²⁾ Ratio (-)	Saturation ⁽²⁾ (%)	Length (inch)	Diameter (inch)	L/D	LL	PI	Specific ⁽²⁾ Gravity (-)
Initial	350.0 *	71.0	15.8 *	10.28	97.1	5.633	2.881	2.0			2.85

Failure Summary

UC Compressive Strength, q_u (psi)	UC Shear Strength, s_u (psi)	Strain to Peak (%)	Strain Rate (%/min)
53.3	26.65	0.9	0.50



FAILURE
SKETCH

Remarks and Notes:

(1) Estimated Water Content

(2) Assumed specific gravity

* estimated value

Mix Ingredients

Clay Used: 5% Sepiolite

Mix Water: 50% Tap 50% GW

Tested by: MB

Test Date: 1/2/2024

Review Date: 8/24/24

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TER-POT-01

Project #
23014938A

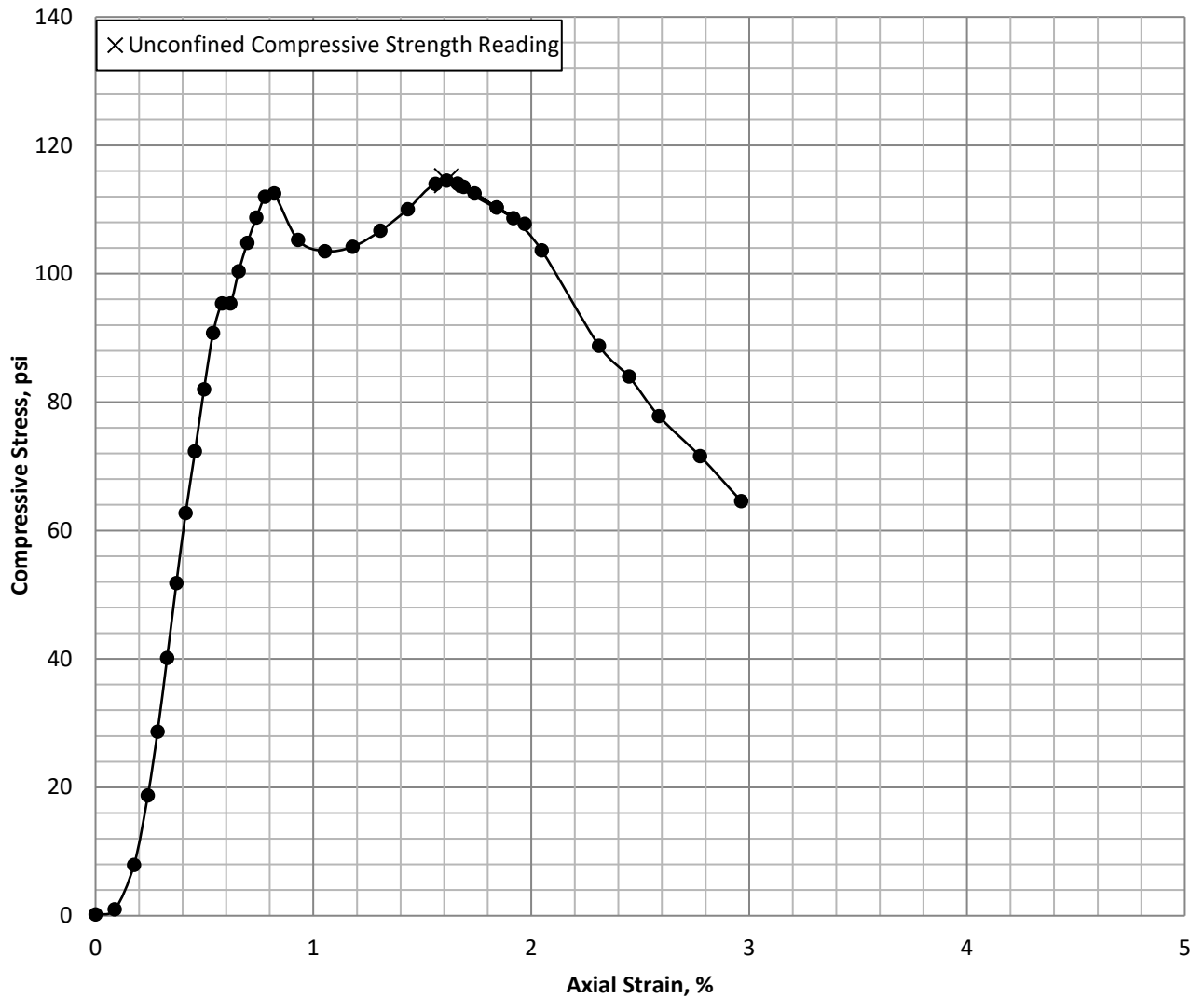
PoT - Former Arkema
Manufacturing Site

UNCONFINED COMPRESSION
TEST

Mix: Test Mix 1 18% slag

Mix Date: 11/29/23 Total Cure: 34 days

UNCONFINED COMPRESSIVE STRENGTH TEST, ASTM METHOD D2166



Specimen and Material Property Information

Sample Type: Cast

Description and/or Classification: Cast Self-Hardening Slurry Greening started: 12/21/2023

	Water ⁽¹⁾ Content (%)	Wet Unit Weight (pcf)	Dry Unit ⁽¹⁾ Weight (pcf)	Void ⁽²⁾ Ratio (-)	Saturation ⁽²⁾ (%)	Length (inch)	Diameter (inch)	L/D (3) (-)	LL (-)	PI (-)	Specific ⁽²⁾ Gravity (-)
Initial	340.9	72.2	16.4	9.87	98.5	5.694	3.017	1.9			2.85

Failure Summary

UC Compressive Strength, q_u (psi)	UC Shear Strength, s_u (psi)	Strain to Peak (%)	Strain Rate (%/min)
115	57.5	1.6	0.52



FAILURE
SKETCH

Remarks and Notes:

- (1) Water Content determined after shear from partial specimen.
- (2) Assumed specific gravity
- (3) Does not meet min. L/D specification.

Mix Ingredients

Clay Used: 5% Sepiolite
Mix Water: 50% Tap 50% GW

Tested by: DD

Reviewed by: DM

Test Date: 3/29/2024

Review Date: 4/4/2024

Dalton, Olmsted &
Fuglevand, Inc.

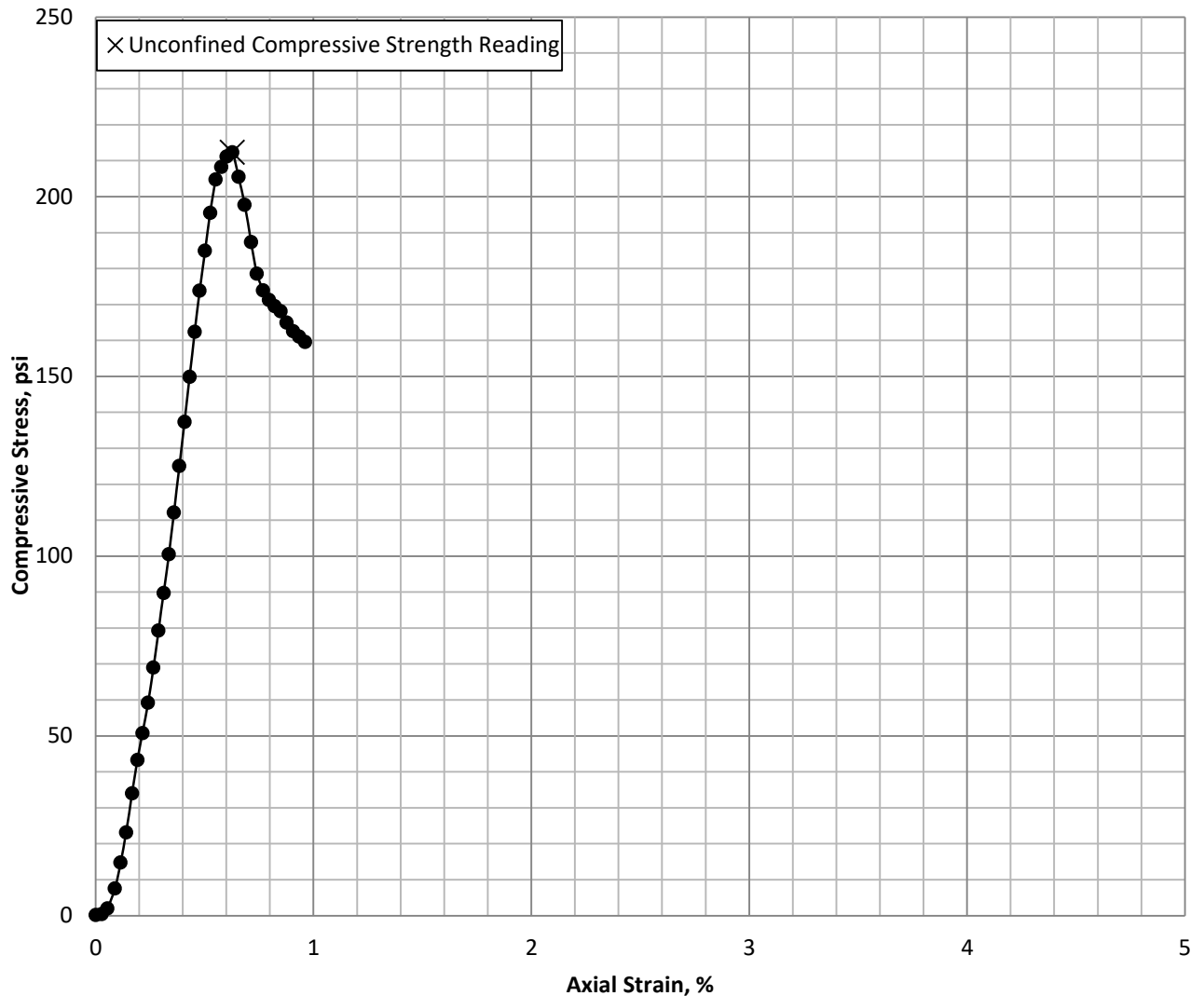
Project #
TER-POT-01

PoT - Former Arkema
Manufacturing Site

UNCONFINED COMPRESSION
TEST

Mix: Sepiolite 50-50 18% slag
Mix Date: 12/15/23 Total Cure: 105 days

UNCONFINED COMPRESSIVE STRENGTH TEST, ASTM METHOD D2166



Specimen and Material Property Information

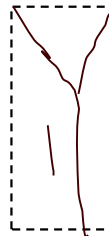
Sample Type: Cast

Description and/or Classification: Cast Self-Hardening Slurry Greening started: 12/21/2023

	Water ⁽¹⁾ Content (%)	Wet Unit Weight (pcf)	Dry Unit ⁽¹⁾ Weight (pcf)	Void ⁽²⁾ Ratio (-)	Saturation ⁽²⁾ (%)	Length (inch)	Diameter (inch)	L/D (3) (-)	LL (-)	PI (-)	Specific ⁽²⁾ Gravity (-)
Initial	331.7	72.6	16.8	9.58	98.7	5.618	3.015	1.9			2.85

Failure Summary

UC Compressive Strength, q_u (psi)	UC Shear Strength, s_u (psi)	Strain to Peak (%)	Strain Rate (%/min)
212	106	0.6	0.51



**FAILURE
SKETCH**

Remarks and Notes:

- (1) Water Content determined after shear from partial specimen.
- (2) Assumed specific gravity
- (3) Does not meet min. L/D specification.

Mix Ingredients

Clay Used: 5% Sepiolite
Mix Water: 50% Tap 50% GW

Tested by: DD

Test Date: 8/16/2024

Review Date: 8/19/2024

**Dalton, Olmsted &
Fuglevand, Inc.**



**Project #
TER-POT-01**

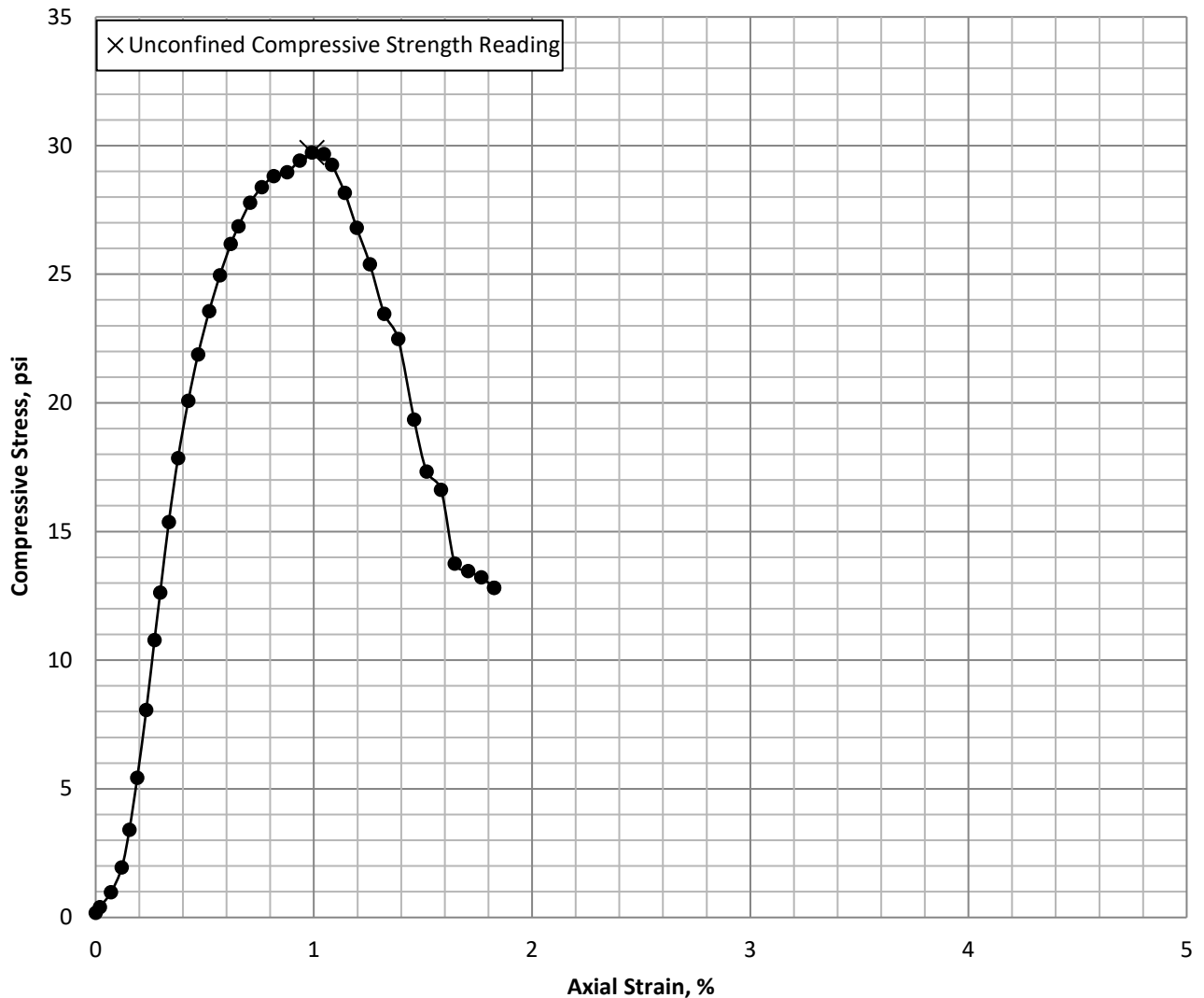
**Project #
23014938A**

**PoT - Former Arkema
Manufacturing Site**

**UNCONFINED COMPRESSION
TEST**

**Mix: Sepiolite 50-50 18% slag
Mix Date: 12/15/23 Total Cure: 245 days**

UNCONFINED COMPRESSIVE STRENGTH TEST, ASTM METHOD D2166



Specimen and Material Property Information

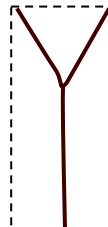
Sample Type: Cast

Description and/or Classification: Cast Self-Hardening Slurry Greening started: 12/18/2023

	Water ⁽¹⁾ Content (%)	Wet Unit Weight (pcf)	Dry Unit ⁽¹⁾ Weight (pcf)	Void ⁽²⁾ Ratio (-)	Saturation ⁽²⁾ (%)	Length (inch)	Diameter (inch)	L/D (3) (-)	LL (-)	PI (-)	Specific ⁽²⁾ Gravity (-)
Initial	348.9	71.4	15.9	10.18	97.6	5.669	3.027	1.9			2.85

Failure Summary

UC Compressive Strength, q_u (psi)	UC Shear Strength, s_u (psi)	Strain to Peak (%)	Strain Rate (%/min)
29.7	14.85	1.0	0.53



FAILURE
SKETCH

Remarks and Notes:

- (1) Water Content determined after shear from partial specimen.
- (2) Assumed specific gravity
- (3) Does not meet min. L/D specification.

Mix Ingredients

Clay Used: 5% Sea Mud Sepiolite
Mix Water: Ground Water

Tested by: BB

Test Date: 1/3/2024

Reviewed by: DM

Review Date: 4/5/2024

Dalton, Olmsted &
Fuglevand, Inc.



Project #
TER-POT-01

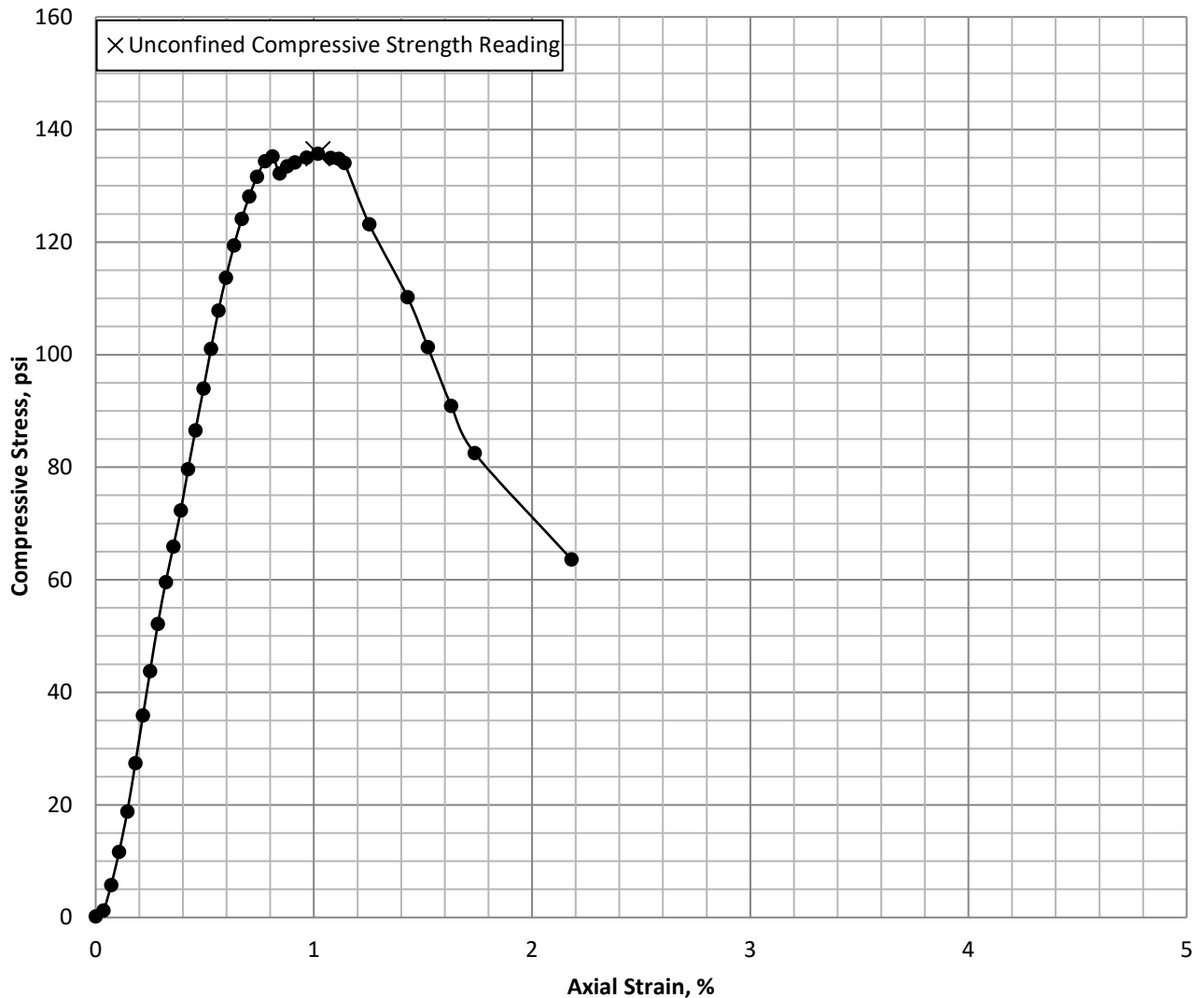
Project #
23014938A

PoT - Former Arkema
Manufacturing Site

UNCONFINED COMPRESSION
TEST

Mix: Sepiolite GW 18% slag
Mix Date: 12/15/23 Total Cure: 20 days

UNCONFINED COMPRESSIVE STRENGTH TEST, ASTM METHOD D2166



Specimen and Material Property Information

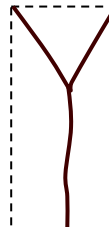
Sample Type: Cast

Description and/or Classification: Cast Self-Hardening Slurry Greening started: 12/18/2023

	Water ⁽¹⁾ Content (%)	Wet Unit Weight (pcf)	Dry Unit ⁽¹⁾ Weight (pcf)	Void ⁽²⁾ Ratio (-)	Saturation ⁽²⁾ (%)	Length (inch)	Diameter (inch)	L/D (3) (-)	LL (-)	PI (-)	Specific ⁽²⁾ Gravity (-)
Initial	213.9	71.0	22.6	6.86	88.8	5.614	3.025	1.9			2.85

Failure Summary

UC Compressive Strength, q_u (psi)	UC Shear Strength, s_u (psi)	Strain to Peak (%)	Strain Rate (%/min)
136	68	1.0	0.53



**FAILURE
SKETCH**

Remarks and Notes:

(1) Water Content determined after shear from partial specimen. Note: only one-day in oven - therefore WC considered low.

(2) Assumed specific gravity

(3) Does not meet min. L/D specification.

Mix Ingredients

Clay Used: 5% Sea Mud Sepiolite

Mix Water: Ground Water

Tested by: DD

Reviewed by: DM

Test Date: 3/28/2024

Review Date: 4/4/2024

**Dalton, Olmsted &
Fuglevand, Inc.**



TERRA SENSE
Geotechnical Laboratory

**Project #
TER-POT-01**

**Project #
23014938A**

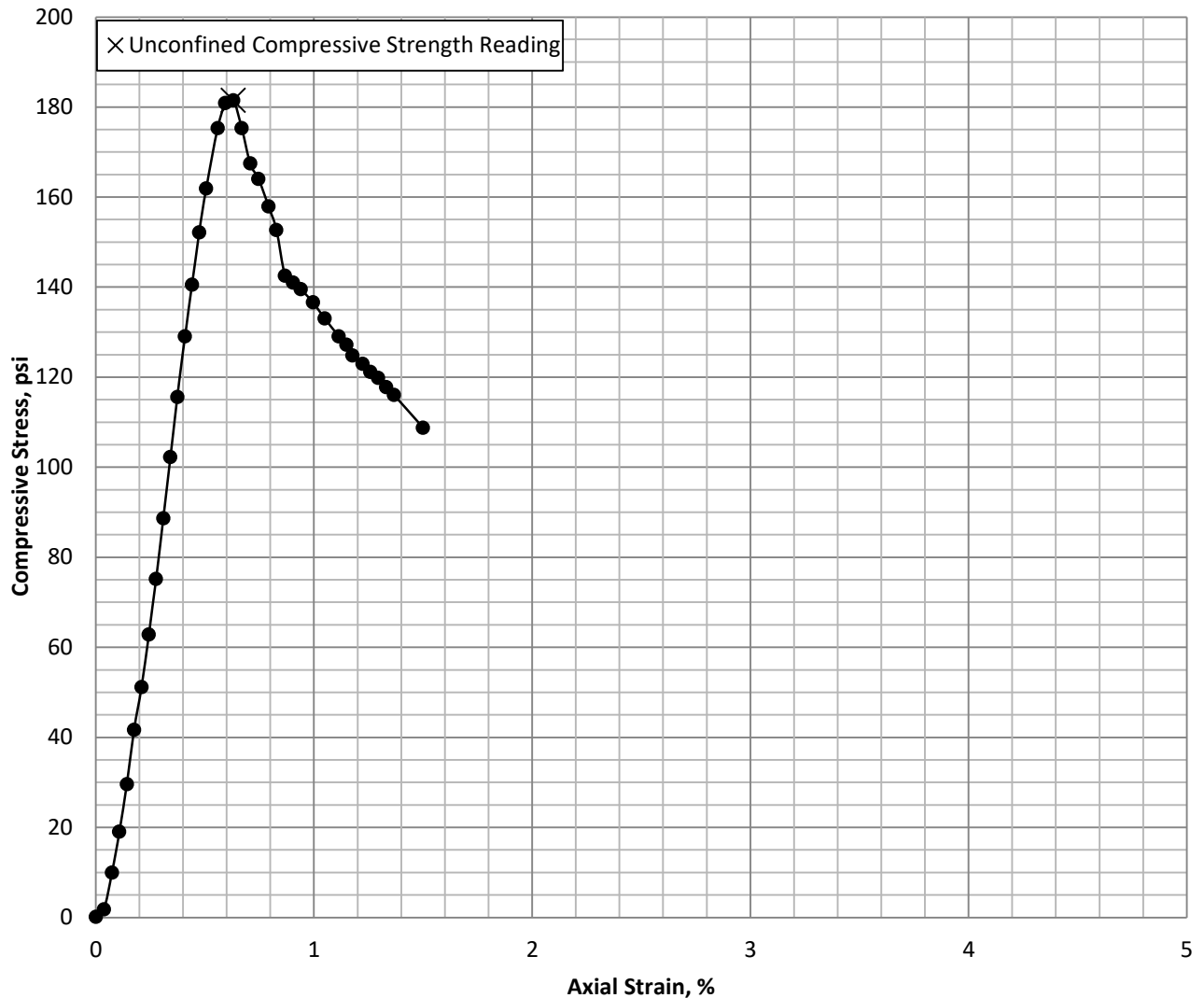
**PoT - Former Arkema
Manufacturing Site**

**UNCONFINED COMPRESSION
TEST**

Mix: Sepiolite GW 18% slag

Mix Date: 12/15/23 Total Cure: 105 days

UNCONFINED COMPRESSIVE STRENGTH TEST, ASTM METHOD D2166



Specimen and Material Property Information

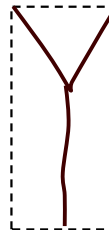
Sample Type: Cast

Description and/or Classification: Cast Self-Hardening Slurry Greening started: 12/18/2023

	Water ⁽¹⁾ Content (%)	Wet Unit Weight (pcf)	Dry Unit ⁽¹⁾ Weight (pcf)	Void ⁽²⁾ Ratio (-)	Saturation ⁽²⁾ (%)	Length (inch)	Diameter (inch)	L/D (3) (-)	LL (-)	PI (-)	Specific ⁽²⁾ Gravity (-)
Initial	330.6	72.3	16.8	9.59	98.2	5.511	3.015	1.8			2.85

Failure Summary

UC Compressive Strength, q_u (psi)	UC Shear Strength, s_u (psi)	Strain to Peak (%)	Strain Rate (%/min)
182	91	0.6	0.53



FAILURE
SKETCH

Remarks and Notes:

(1) Water Content determined after shear from partial specimen. Note: only one-day in oven - therefore WC considered low.

(2) Assumed specific gravity

(3) Does not meet min. L/D specification.

Mix Ingredients

Clay Used: 5% Sea Mud Sepiolite

Mix Water: Ground Water

Tested by: DD

Test Date: 8/16/2024

Review Date: 8/19/2024

Dalton, Olmsted &
Fuglevand, Inc.



TERRASENSE
Geotechnical Laboratory

Project #
TER-POT-01

Project #
23014938A

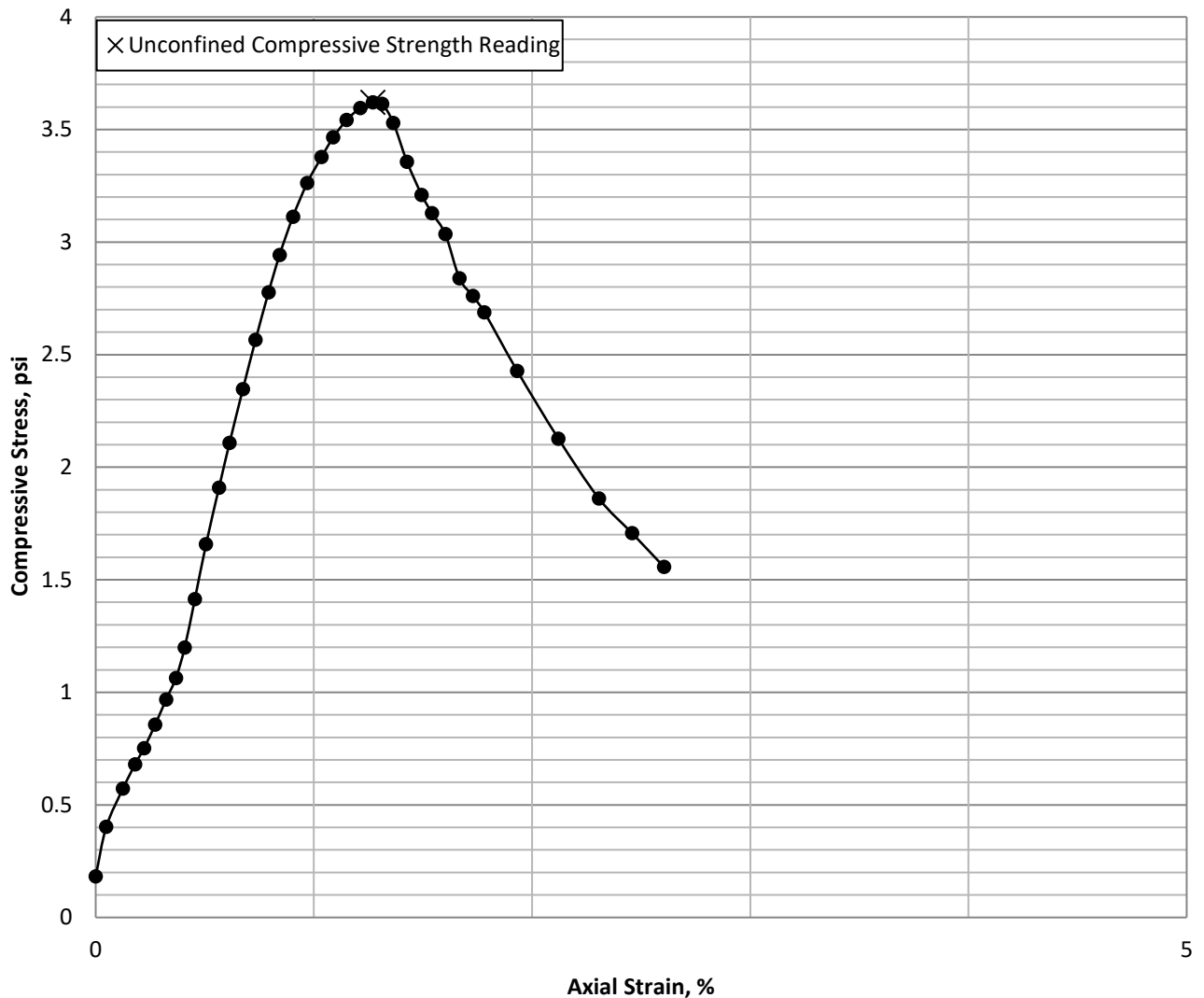
PoT - Former Arkema
Manufacturing Site

UNCONFINED COMPRESSION
TEST

Mix: Sepiolite GW 18% slag

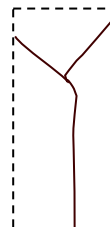
Mix Date: 12/15/23 Total Cure: 246 days

UNCONFINED COMPRESSIVE STRENGTH TEST, ASTM METHOD D2166



Specimen and Material Property Information											
Sample Type: Cast											
Description and/or Classification: Cast Self-Hardening Slurry Greening started: 12/14/2023											
	Water ⁽¹⁾ Content (%)	Wet Unit Weight (pcf)	Dry Unit ⁽¹⁾ Weight (pcf)	Void ⁽²⁾ Ratio (-)	Saturation ⁽²⁾ (%)	Length (inch)	Diameter (inch)	L/D (3) (-)	LL (-)	PI (-)	Specific ⁽²⁾ Gravity (-)
Initial	388.9	71.7	14.7	11.13	99.6	5.210	3.027	1.7			2.85

Failure Summary			
UC Compressive Strength, q_u (psi)	UC Shear Strength, s_u (psi)	Strain to Peak (%)	Strain Rate (%/min)
3.62	1.81	1.3	0.59



**FAILURE
SKETCH**

Remarks and Notes:

(1) Water Content determined after shear from partial specimen.
 (2) Assumed specific gravity
 (3) Does not meet min. L/D specification.

Mix Ingredients
 Clay Used: 5% Attapulgite
 Mix Water: 100% Tap

Tested by: MB

Reviewed by: DM

Test Date: 12/18/2023

Review Date: 8/14/2024

**Dalton, Olmsted &
Fuglevand, Inc.**



**Project #
TER-POT-01**

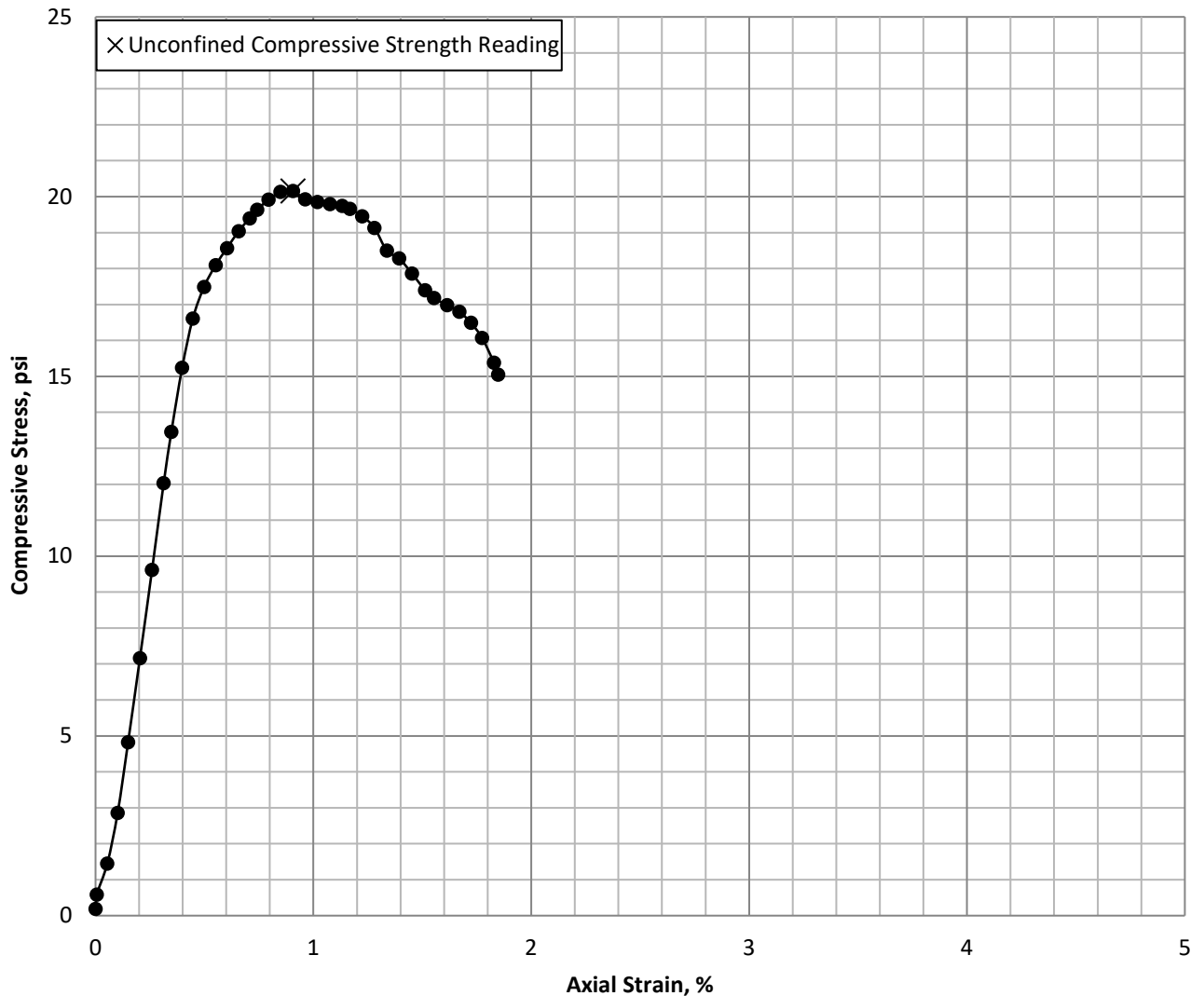
**Project #
23014938A**

**PoT - Former Arkema
Manufacturing Site**

**UNCONFINED COMPRESSION
TEST**

**Mix: Test Mix 2 18% slag
Mix Date: 12/12/23 Total Cure: 6 days**

UNCONFINED COMPRESSIVE STRENGTH TEST, ASTM METHOD D2166



Specimen and Material Property Information

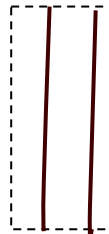
Sample Type: Cast

Description and/or Classification: Cast Self-Hardening Slurry Greening started: 12/15/2023

	Water ⁽¹⁾ Content (%)	Wet Unit Weight (pcf)	Dry Unit ⁽¹⁾ Weight (pcf)	Void ⁽²⁾ Ratio (-)	Saturation ⁽²⁾ (%)	Length (inch)	Diameter (inch)	L/D (3) (-)	LL (-)	PI (-)	Specific ⁽²⁾ Gravity (-)
Initial	363.1	71.7	15.5	10.49	98.6	5.516	3.013	1.8			2.85

Failure Summary

UC Compressive Strength, q_u (psi)	UC Shear Strength, s_u (psi)	Strain to Peak (%)	Strain Rate (%/min)
20.2	10.1	0.9	0.53



FAILURE
SKETCH

Remarks and Notes:

- (1) Water Content determined after shear from partial specimen.
- (2) Assumed specific gravity
- (3) Does not meet min. L/D specification.

Mix Ingredients

Clay Used: 5% Attapulgite Clay
Mix Water: Tap

Tested by: BB

Reviewed by: DM

Test Date: 1/3/2024

Review Date: 4/5/2024

Dalton, Olmsted &
Fuglevand, Inc.



Project #
TER-POT-01

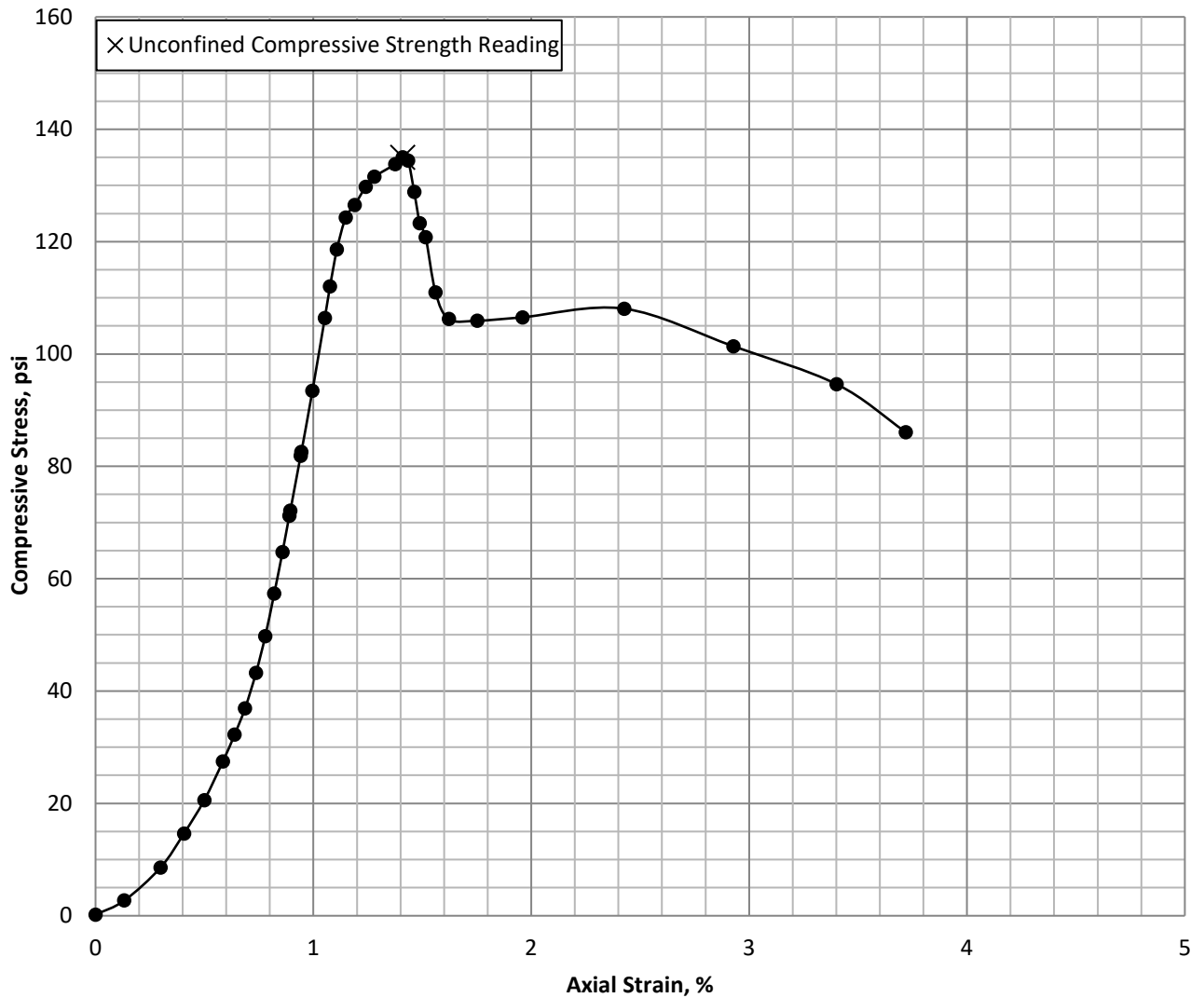
Project #
23014938A

PoT - Former Arkema
Manufacturing Site

UNCONFINED COMPRESSION
TEST

Mix: Attapulgite Tap 18% slag
Mix Date: 12/13/23 Total Cure: 22 days

UNCONFINED COMPRESSIVE STRENGTH TEST, ASTM METHOD D2166



Specimen and Material Property Information

Sample Type: Cast

Description and/or Classification: Cast Self-Hardening Slurry Greening started: 12/15/2023

	Water ⁽¹⁾ Content (%)	Wet Unit Weight (pcf)	Dry Unit ⁽¹⁾ Weight (pcf)	Void ⁽²⁾ Ratio (-)	Saturation ⁽²⁾ (%)	Length (inch)	Diameter (inch)	L/D (3) (-)	LL (-)	PI (-)	Specific ⁽²⁾ Gravity (-)
Initial	353.4	71.2	15.7	10.33	97.5	5.717	3.017	1.9			2.85

Failure Summary

UC Compressive Strength, q_u (psi)	UC Shear Strength, s_u (psi)	Strain to Peak (%)	Strain Rate (%/min)
135	67.5	1.4	0.52



**FAILURE
SKETCH**

Remarks and Notes:

- (1) Water Content determined after shear from partial specimen.
- (2) Assumed specific gravity
- (3) Does not meet min. L/D specification.

Mix Ingredients

Clay Used: 5% Attapulgite Clay
Mix Water: Tap

Tested by: DD

Reviewed by: DM

Test Date: 3/29/2024

Review Date: 4/4/2024

**Dalton, Olmsted &
Fuglevand, Inc.**



**Project #
TER-POT-01**

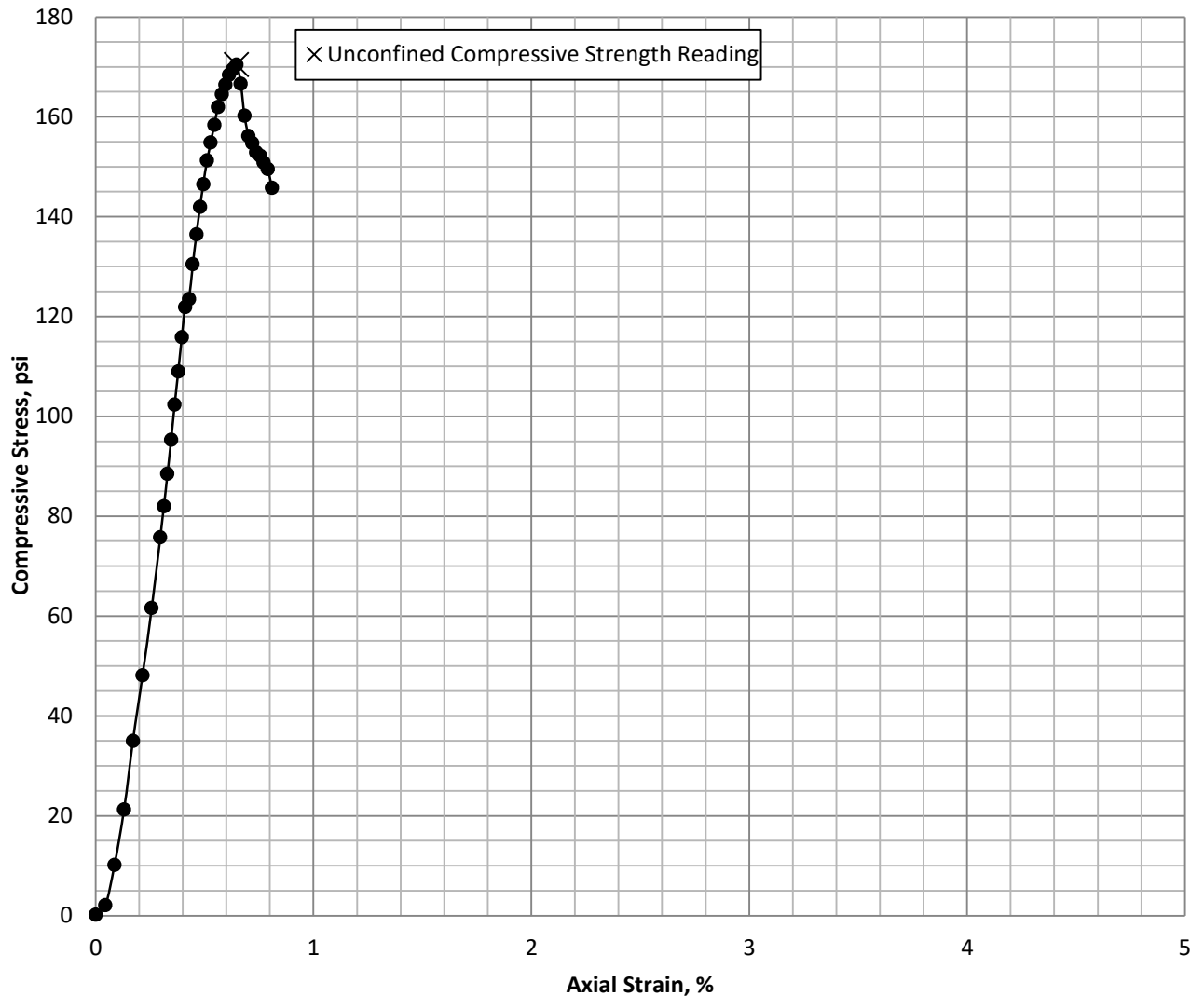
**Project #
23014938A**

**PoT - Former Arkema
Manufacturing Site**

**UNCONFINED COMPRESSION
TEST**

**Mix: Attapulgite Tap 18% slag
Mix Date: 12/13/23 Total Cure: 107 days**

UNCONFINED COMPRESSIVE STRENGTH TEST, ASTM METHOD D2166



Specimen and Material Property Information

Sample Type: Cast

Description and/or Classification: Cast Self-Hardening Slurry Greening started: 12/15/2023

	Water ⁽¹⁾ Content (%)	Wet Unit Weight (pcf)	Dry Unit ⁽¹⁾ Weight (pcf)	Void ⁽²⁾ Ratio (-)	Saturation ⁽²⁾ (%)	Length (inch)	Diameter (inch)	L/D (3) (-)	LL (-)	PI (-)	Specific ⁽²⁾ Gravity (-)
Initial	335.6	71.3	16.4	9.86	97.0	5.632	3.016	1.9			2.85

Failure Summary

UC Compressive Strength, q_u (psi)	UC Shear Strength, s_u (psi)	Strain to Peak (%)	Strain Rate (%/min)
170	85	0.6	0.51



**FAILURE
SKETCH**

Remarks and Notes:

- (1) Water Content determined after shear from partial specimen.
- (2) Assumed specific gravity
- (3) Does not meet min. L/D specification.

Mix Ingredients

Clay Used: 5% Attapulgite Clay
Mix Water: Tap

Tested by: DD

Test Date: 8/16/2024

Review Date: 8/19/2024

**Dalton, Olmsted &
Fuglevand, Inc.**



**Project #
TER-POT-01**

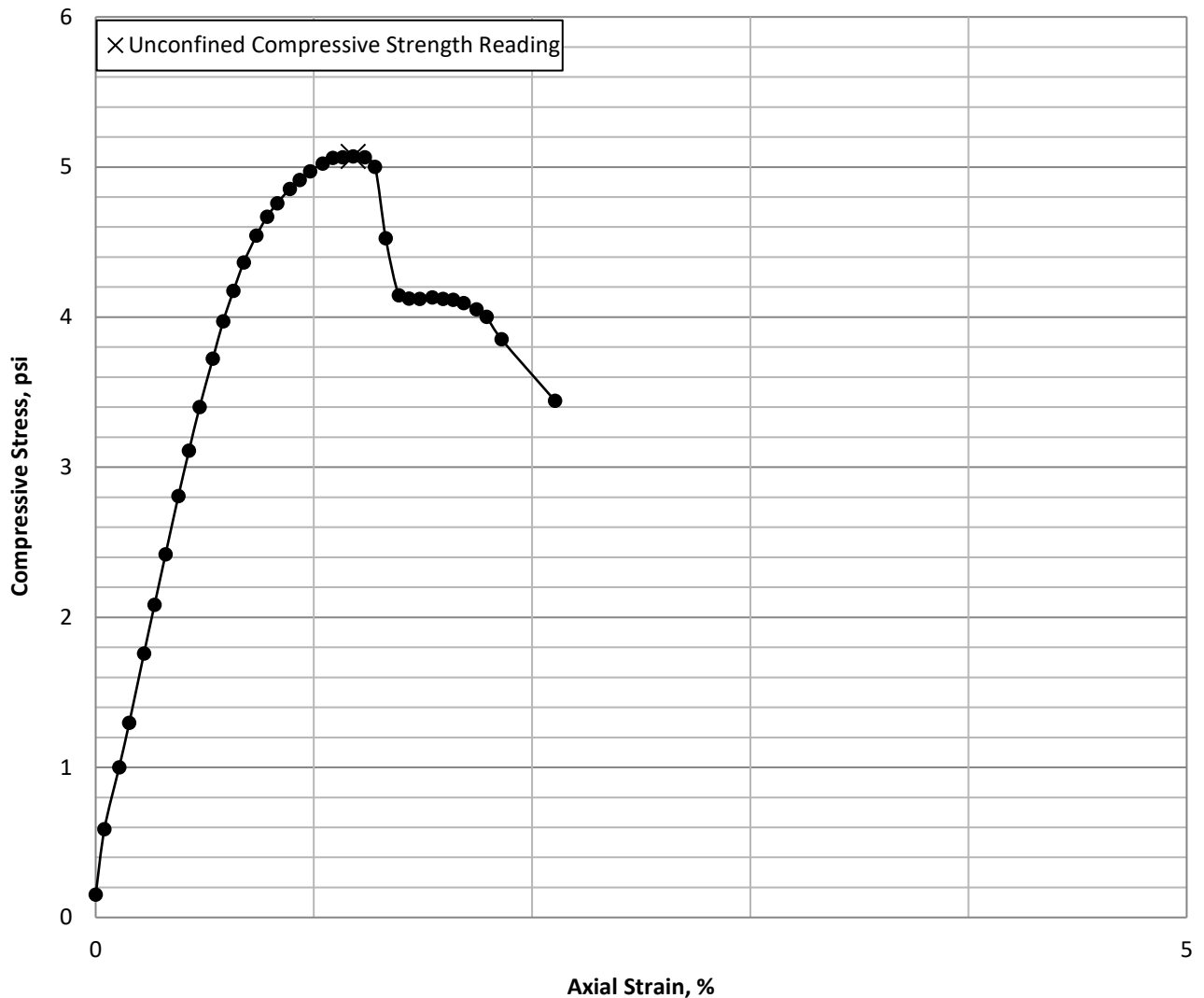
**Project #
23014938A**

**PoT - Former Arkema
Manufacturing Site**

**UNCONFINED COMPRESSION
TEST**

**Mix: Attapulgite Tap 18% slag
Mix Date: 12/13/23 Total Cure: 247 days**

UNCONFINED COMPRESSIVE STRENGTH TEST, ASTM METHOD D2166



Specimen and Material Property Information

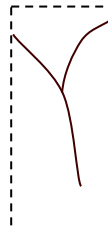
Sample Type: Cast

Description and/or Classification: Cast Self-Hardening Slurry Greening started: 12/14/2023

	Water ⁽¹⁾ Content (%)	Wet Unit Weight (pcf)	Dry Unit ⁽¹⁾ Weight (pcf)	Void ⁽²⁾ Ratio (-)	Saturation ⁽²⁾ (%)	Length (inch)	Diameter (inch)	L/D (3) (-)	LL (-)	PI (-)	Specific ⁽²⁾ Gravity (-)
Initial	366.9	71.5	15.3	10.61	98.5	5.402	3.011	1.8			2.85

Failure Summary

UC Compressive Strength, q_u (psi)	UC Shear Strength, s_u (psi)	Strain to Peak (%)	Strain Rate (%/min)
5.07	2.535	1.2	0.57



FAILURE
SKETCH

Remarks and Notes:

- (1) Water Content determined after shear from partial specimen.
- (2) Assumed specific gravity
- (3) Does not meet min. L/D specification.

Mix Ingredients

Clay Used: 5% Attapulgite
Mix Water: 50% Tap 50% GW

Tested by: MB

Reviewed by: DM

Test Date: 12/18/2023

Review Date: 8/14/2024

Dalton, Olmsted &
Fuglevand, Inc.



Project #
TER-POT-01

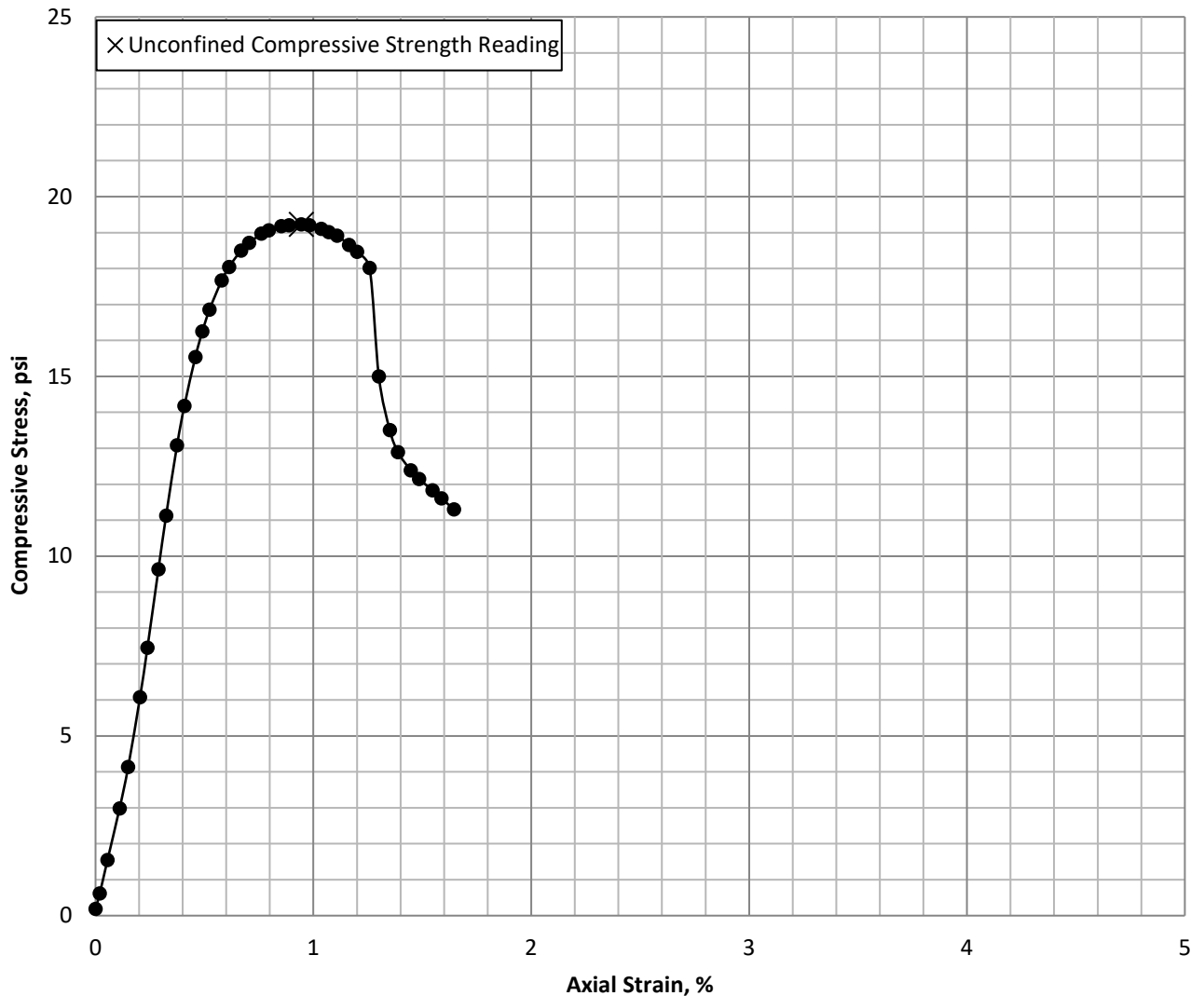
Project #
23014938A

PoT - Former Arkema
Manufacturing Site

UNCONFINED COMPRESSION
TEST

Mix: Test Mix 3 18% slag
Mix Date: 12/12/23 Total Cure: 6 days

UNCONFINED COMPRESSIVE STRENGTH TEST, ASTM METHOD D2166



Specimen and Material Property Information

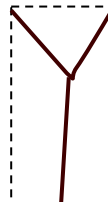
Sample Type: Cast

Description and/or Classification: Cast Self-Hardening Slurry Greening started: 12/21/2023

	Water ⁽¹⁾ Content (%)	Wet Unit Weight (pcf)	Dry Unit ⁽¹⁾ Weight (pcf)	Void ⁽²⁾ Ratio (-)	Saturation ⁽²⁾ (%)	Length (inch)	Diameter (inch)	L/D (3) (-)	LL (-)	PI (-)	Specific ⁽²⁾ Gravity (-)
Initial	350.8	71.4	15.9	10.22	97.8	5.498	3.029	1.8			2.85

Failure Summary

UC Compressive Strength, q_u (psi)	UC Shear Strength, s_u (psi)	Strain to Peak (%)	Strain Rate (%/min)
19.2	9.6	0.9	0.54



**FAILURE
SKETCH**

Remarks and Notes:

- (1) Water Content determined after shear from partial specimen.
- (2) Assumed specific gravity
- (3) Does not meet min. L/D specification.

Mix Ingredients

Clay Used: 5% Attapulgite Clay
Mix Water: 50% Tap 50% GW

Tested by: BB

Reviewed by: DM

Test Date: 1/3/2024

Review Date: 4/5/2024

**Dalton, Olmsted &
Fuglevand, Inc.**



**Project #
TER-POT-01**

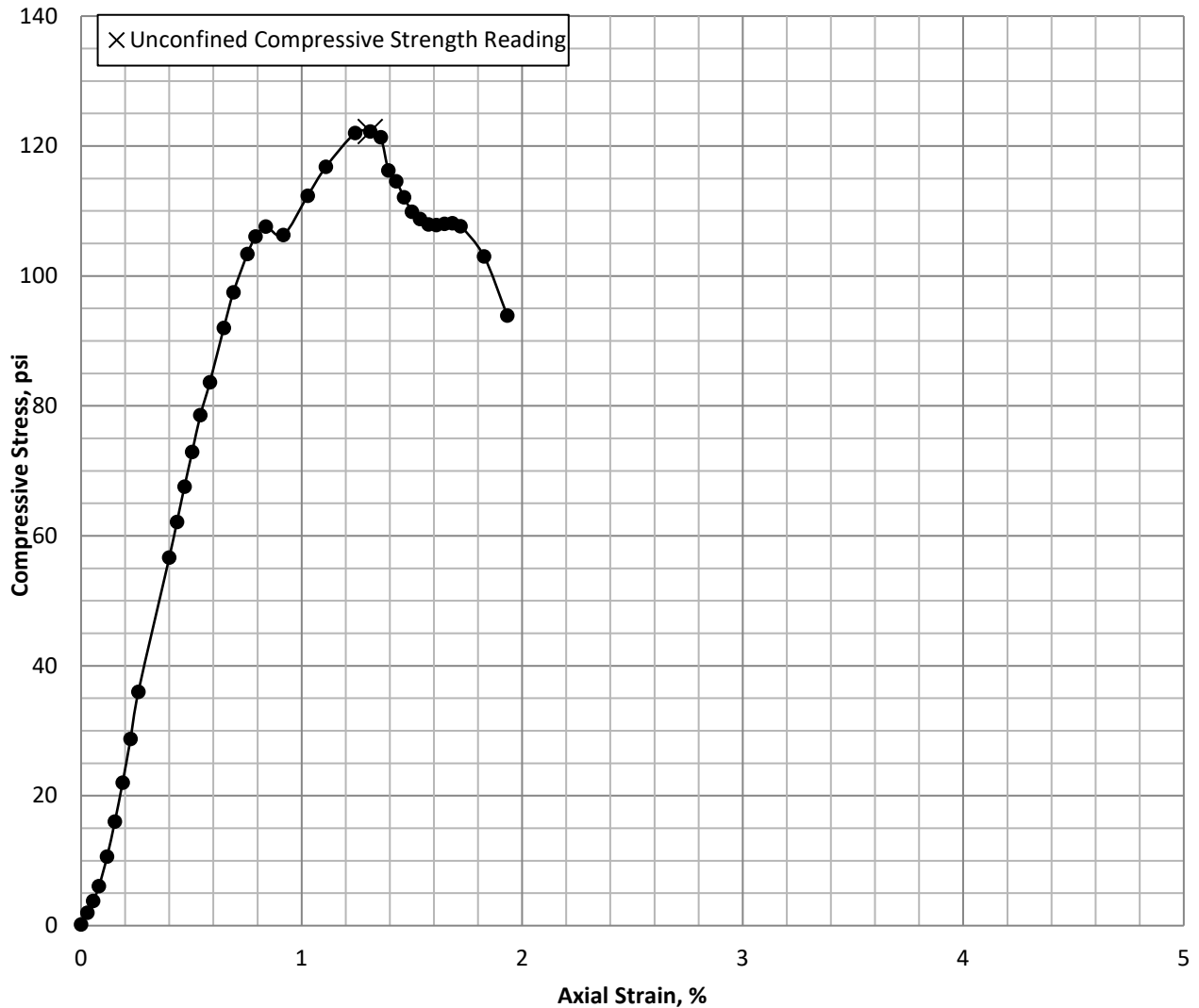
**Project #
23014938A**

**PoT - Former Arkema
Manufacturing Site**

**UNCONFINED COMPRESSION
TEST**

**Mix: Attapulgite 50-50 18% slag
Mix Date: 12/15/23 Total Cure: 20 days**

UNCONFINED COMPRESSIVE STRENGTH TEST, ASTM METHOD D2166



Specimen and Material Property Information

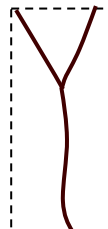
Sample Type: Cast

Description and/or Classification: Cast Self-Hardening Slurry Greening started: 12/21/2023

	Water ⁽¹⁾ Content (%)	Wet Unit Weight (pcf)	Dry Unit ⁽¹⁾ Weight (pcf)	Void ⁽²⁾ Ratio (-)	Saturation ⁽²⁾ (%)	Length (inch)	Diameter (inch)	L/D (3) (-)	LL (-)	PI (-)	Specific ⁽²⁾ Gravity (-)
Initial	333.4	72.6	16.8	9.62	98.8	5.435	3.015	1.8			2.85

Failure Summary

UC Compressive Strength, q_u (psi)	UC Shear Strength, s_u (psi)	Strain to Peak (%)	Strain Rate (%/min)
122	61	1.3	0.54



**FAILURE
SKETCH**

Remarks and Notes:

- (1) Water Content determined after shear from partial specimen.
- (2) Assumed specific gravity
- (3) Does not meet min. L/D specification.

Mix Ingredients

Clay Used: 5% Attapulgite Clay
Mix Water: 50% Tap 50% GW

Tested by: DD

Reviewed by: DM

Test Date: 3/29/2024

Review Date: 4/4/2024

**Dalton, Olmsted &
Fuglevand, Inc.**



**Project #
TER-POT-01**

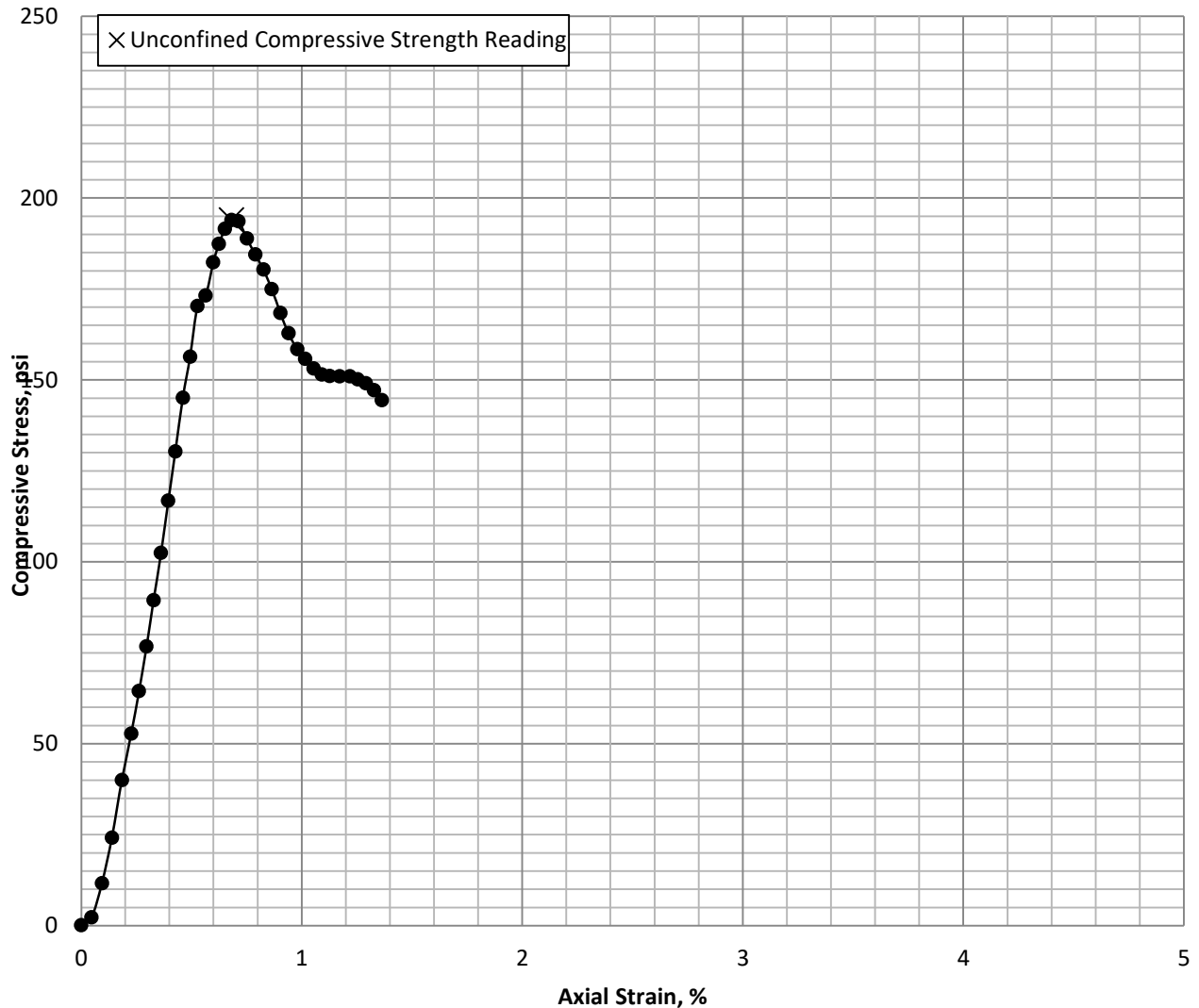
**Project #
23014938A**

**PoT - Former Arkema
Manufacturing Site**

**UNCONFINED COMPRESSION
TEST**

**Mix: Attapulgite 50-50 18% slag
Mix Date: 12/15/23 Total Cure: 105 days**

UNCONFINED COMPRESSIVE STRENGTH TEST, ASTM METHOD D2166



Specimen and Material Property Information

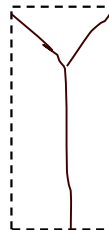
Sample Type: Cast

Description and/or Classification: Cast Self-Hardening Slurry Greening started: 12/21/2023

	Water ⁽¹⁾ Content (%)	Wet Unit Weight (pcf)	Dry Unit ⁽¹⁾ Weight (pcf)	Void ⁽²⁾ Ratio (-)	Saturation ⁽²⁾ (%)	Length (inch)	Diameter (inch)	L/D (3) (-)	LL (-)	PI (-)	Specific ⁽²⁾ Gravity (-)
Initial	324.2	72.7	17.1	9.38	98.5	5.411	3.016	1.8			2.85

Failure Summary

UC Compressive Strength, q_u (psi)	UC Shear Strength, s_u (psi)	Strain to Peak (%)	Strain Rate (%/min)
194	97	0.7	0.54



FAILURE
SKETCH

Remarks and Notes:

- (1) Water Content determined after shear from partial specimen.
- (2) Assumed specific gravity
- (3) Does not meet min. L/D specification.

Mix Ingredients

Clay Used: 5% Attapulgite Clay
Mix Water: 50% Tap 50% GW

Tested by: DD

Test Date: 8/16/2024

Review Date: 8/19/2024

Dalton, Olmsted &
Fuglevand, Inc.



Project #
TER-POT-01

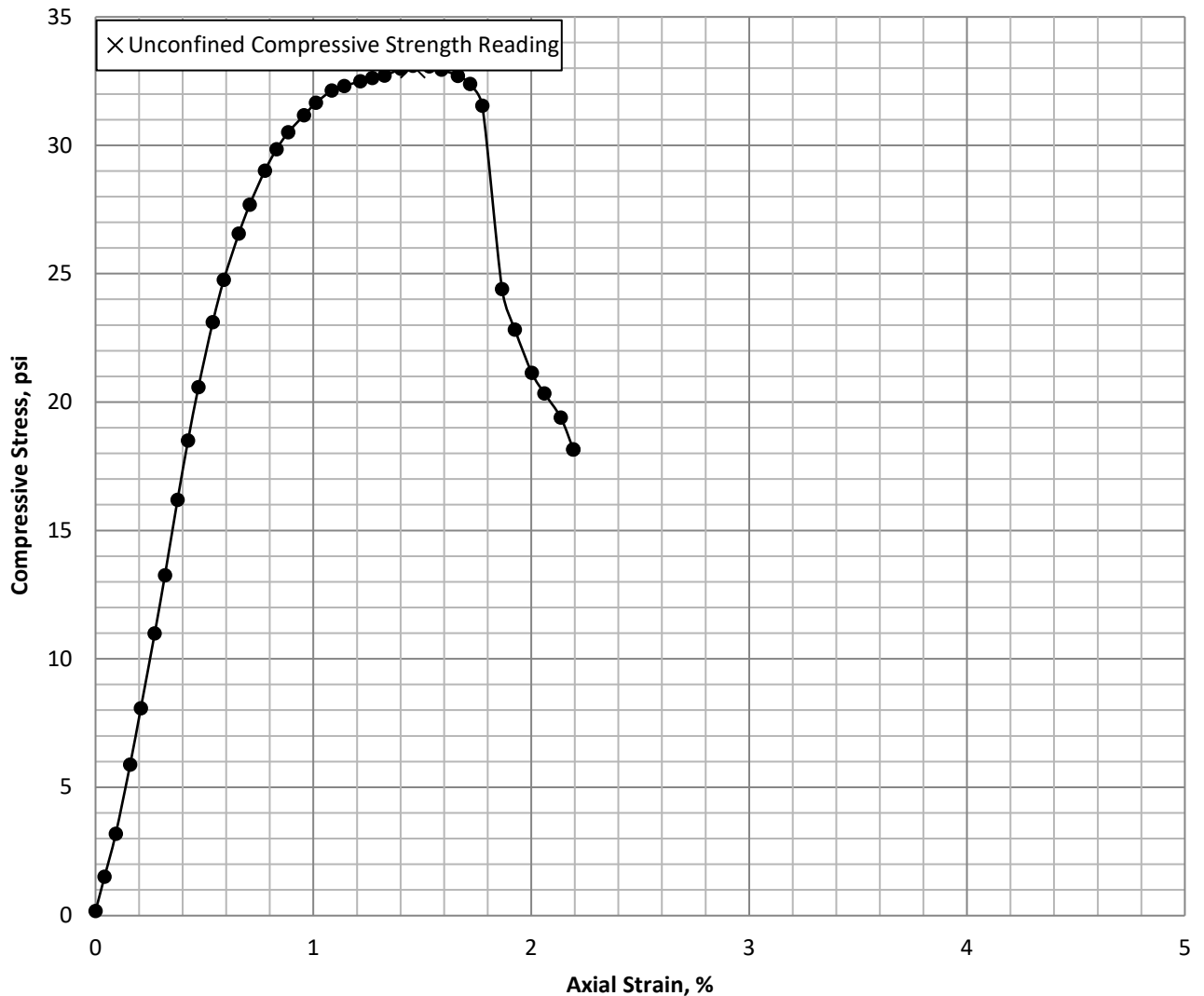
Project #
23014938A

PoT - Former Arkema
Manufacturing Site

UNCONFINED COMPRESSION
TEST

Mix: Attapulgite 50-50 18% slag
Mix Date: 12/15/23 Total Cure: 246 days

UNCONFINED COMPRESSIVE STRENGTH TEST, ASTM METHOD D2166



Specimen and Material Property Information

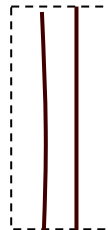
Sample Type: Cast

Description and/or Classification: Cast Self-Hardening Slurry Greening started: 12/18/2023

	Water ⁽¹⁾ Content (%)	Wet Unit Weight (pcf)	Dry Unit ⁽¹⁾ Weight (pcf)	Void ⁽²⁾ Ratio (-)	Saturation ⁽²⁾ (%)	Length (inch)	Diameter (inch)	L/D (3) (-)	LL (-)	PI (-)	Specific ⁽²⁾ Gravity (-)
Initial	354.2	71.2	15.7	10.34	97.6	5.679	3.025	1.9			2.85

Failure Summary

UC Compressive Strength, q_u (psi)	UC Shear Strength, s_u (psi)	Strain to Peak (%)	Strain Rate (%/min)
33.1	16.55	1.5	0.53



**FAILURE
SKETCH**

Remarks and Notes:

- (1) Water Content determined after shear from partial specimen.
- (2) Assumed specific gravity
- (3) Does not meet min. L/D specification.

Mix Ingredients

Clay Used: 5% Attapulgite Clay
Mix Water: Site Ground Water

Tested by: BB

Test Date: 1/3/2024

Reviewed by: DM

Review Date: 4/5/2024

**Dalton, Olmsted &
Fuglevand, Inc.**



**Project #
TER-POT-01**

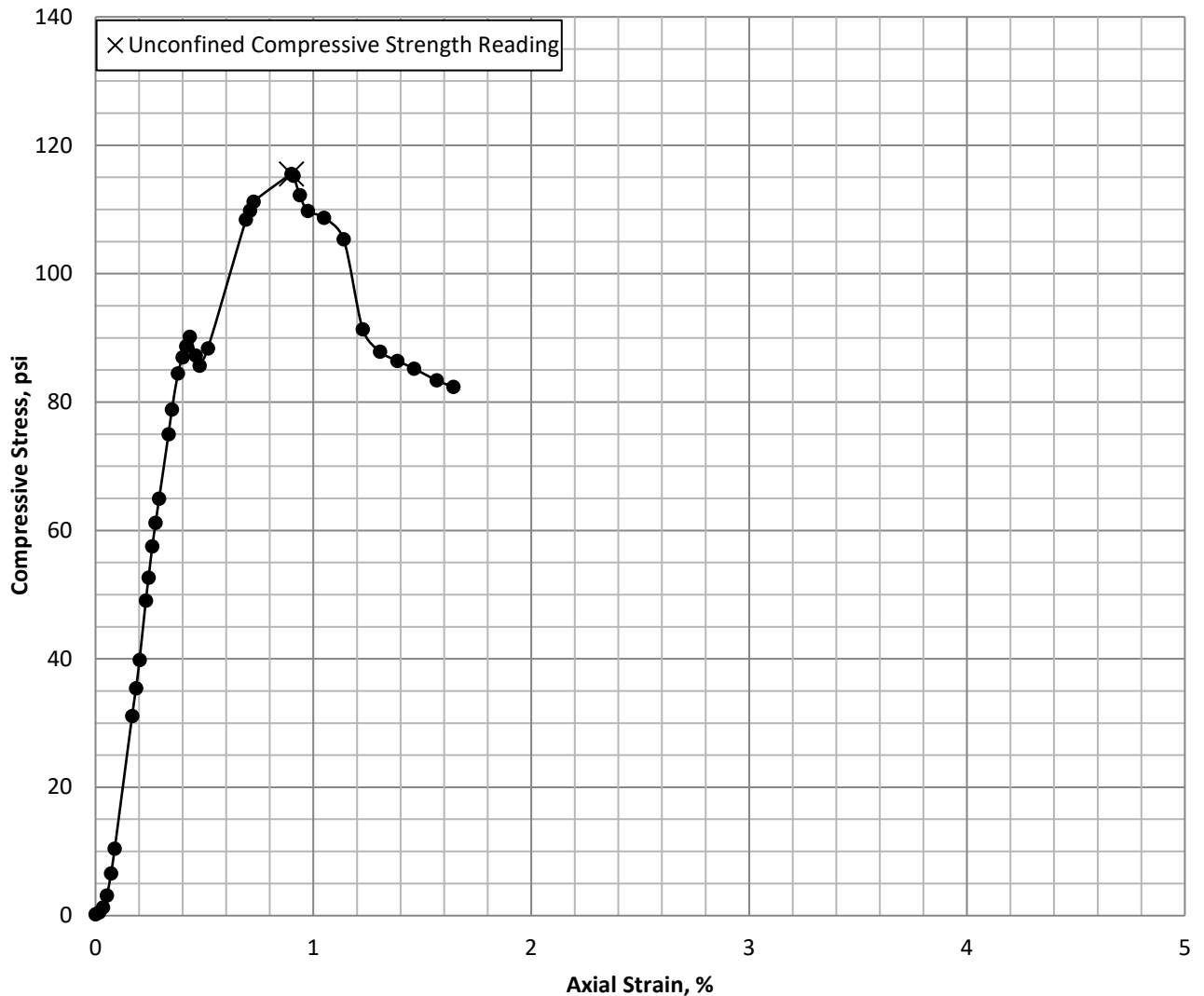
**Project #
23014938A**

**PoT - Former Arkema
Manufacturing Site**

**UNCONFINED COMPRESSION
TEST**

**Mix: Attapulgite GW 18% slag
Mix Date: 12/14/23 Total Cure: 21 days**

UNCONFINED COMPRESSIVE STRENGTH TEST, ASTM METHOD D2166



Specimen and Material Property Information

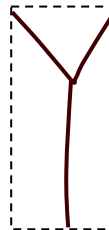
Sample Type: Cast

Description and/or Classification: Cast Self-Hardening Slurry Greening started: 12/18/2023

	Water ⁽¹⁾ Content (%)	Wet Unit Weight (pcf)	Dry Unit ⁽¹⁾ Weight (pcf)	Void ⁽²⁾ Ratio (-)	Saturation ⁽²⁾ (%)	Length (inch)	Diameter (inch)	L/D (3) (-)	LL (-)	PI (-)	Specific ⁽²⁾ Gravity (-)
Initial	304.7	72.1	17.8	8.98	96.7	5.719	3.016	1.9			2.85

Failure Summary

UC Compressive Strength, q_u (psi)	UC Shear Strength, s_u (psi)	Strain to Peak (%)	Strain Rate (%/min)
116	58	0.9	0.52



**FAILURE
SKETCH**

Remarks and Notes:

- (1) Water Content determined after shear from partial specimen.
- (2) Assumed specific gravity
- (3) Does not meet min. L/D specification.

Mix Ingredients

Clay Used: 5% Attapulgite Clay
Mix Water: Site Ground Water

Tested by: DD

Reviewed by: DM

Test Date: 3/28/2024

Review Date: 4/4/2024

**Dalton, Olmsted &
Fuglevand, Inc.**



**Project #
TER-POT-01**

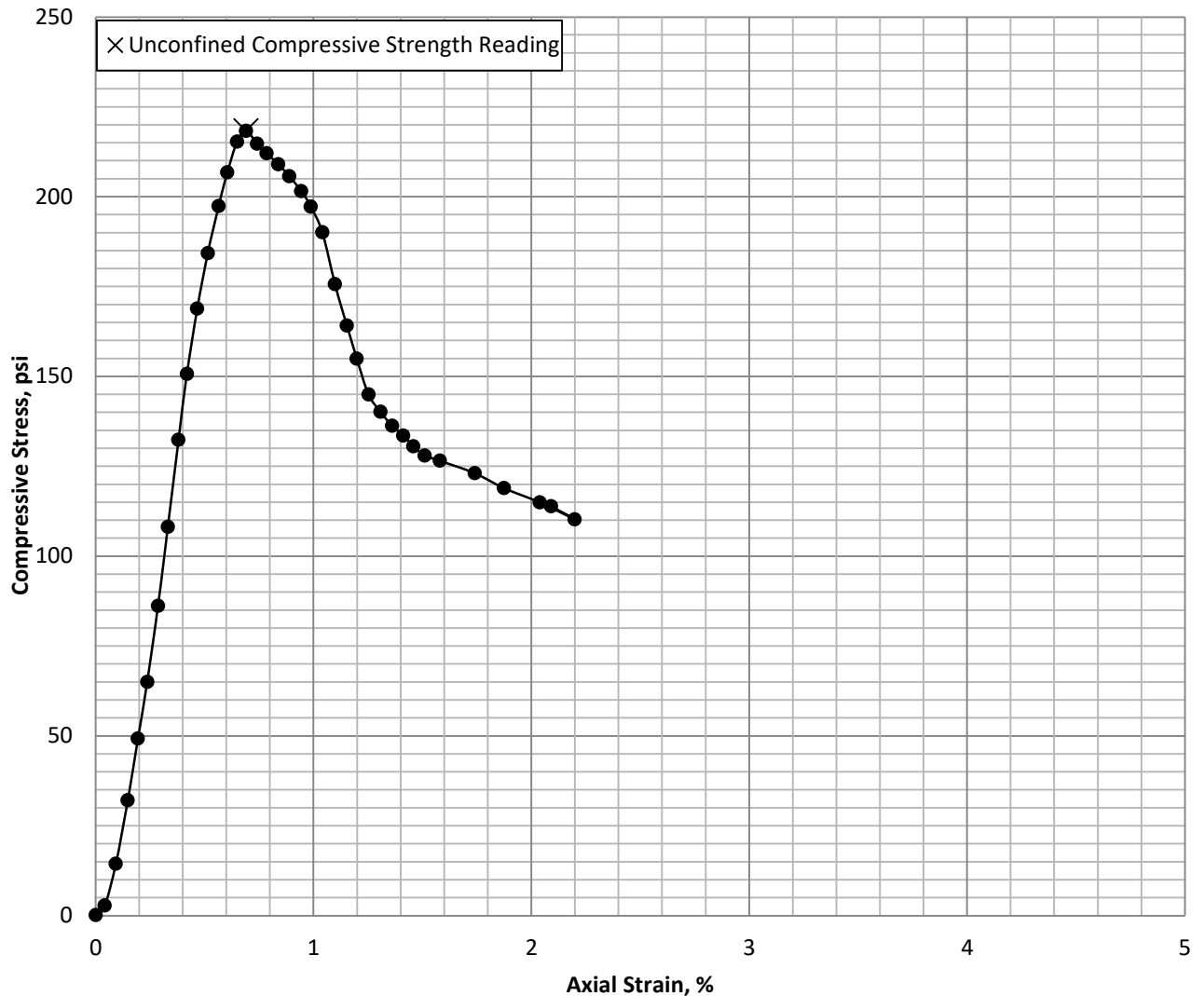
**Project #
23014938A**

**PoT - Former Arkema
Manufacturing Site**

**UNCONFINED COMPRESSION
TEST**

**Mix: Attapulgite GW 18% slag
Mix Date: 12/14/23 Total Cure: 106 days**

UNCONFINED COMPRESSIVE STRENGTH TEST, ASTM METHOD D2166



Specimen and Material Property Information

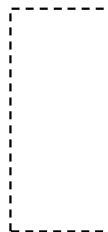
Sample Type: Cast

Description and/or Classification: Cast Self-Hardening Slurry Greening started: 12/18/2023

	Water ⁽¹⁾ Content (%)	Wet Unit Weight (pcf)	Dry Unit ⁽¹⁾ Weight (pcf)	Void ⁽²⁾ Ratio (-)	Saturation ⁽²⁾ (%)	Length (inch)	Diameter (inch)	L/D (3) (-)	LL (-)	PI (-)	Specific ⁽²⁾ Gravity (-)
Initial	334.4	71.7	16.5	9.77	97.6	5.680	3.022	1.9			2.85

Failure Summary

UC Compressive Strength, q_u (psi)	UC Shear Strength, s_u (psi)	Strain to Peak (%)	Strain Rate (%/min)
218	109	0.7	0.52



Remarks and Notes:

- (1) Water Content determined after shear from partial specimen.
- (2) Assumed specific gravity
- (3) Does not meet min. L/D specification.

Mix Ingredients

Clay Used: 5% Attapulgite Clay
Mix Water: Site Ground Water

Tested by: DD

Test Date: 8/16/2024

Review Date: 8/19/2024

**FAILURE
SKETCH**

**Dalton, Olmsted &
Fuglevand, Inc.**



**Project #
TER-POT-01**

**Project #
23014938A**

**PoT - Former Arkema
Manufacturing Site**

**UNCONFINED COMPRESSION
TEST**

**Mix: Attapulgite GW 18% slag
Mix Date: 12/14/23 Total Cure: 247 days**

PERMEABILITY TEST: FALLING HEAD - INCREASING TAILWATER

ASTM D 5084 - Method C

Project No. 23014938A

Clay Type: Sepiolite

Project Name: PoT - Former Arkema Manufacturing Mix water: Tap

Final Specimen and Test Conditions

Lc = 3.328 cm $\epsilon_{axial} = 1.1\%$
Ac = 45.841 cm²
Vc = 152.56 cm³ $\epsilon_{vol} = 0.7\%$
Vvoid 137.584 cm³

	w (%)	γ_t (pcf)	γ_d (pcf)	S (%)
Initial	314.83	71.9	17.3	96.9
PreTest	326.53	74.5	17.5	101.3

Test Operator: MB
Reviewed By: DM

Specimen - Apparatus set-up - Test Information

- 1) Specimen Tested in : ☒ Triaxial Cell or ☐ Compaction Mold or ☐ top + bottom
☒ with stones or ☐ Stones with filter paper or ☐
2) Specimen orientation for: ☒ Vertical or ☐ Horizontal permeability determination
3) During saturation: Water flushed up sides of specimen to remove air: ☒ No ☐ Yes
4) During consolidation: ☒ Top and bottom drainage or ☐ Top ☐ Bottom only
5) Direction of permeant : ☒ Up during or ☐ Down during permeation
6) Permeant used : ☐ Demineralized ☐ Distilled ☐ Tap or ☐
or Groundwater

Stage No.:		16	σ_c	120.0	psi		System: p=pipette, a = annulus, b =both						
Apparatus No.		9	Ub	100.0	psi		Head Tube Area =				p	0.9979	cm ²
Cell No.		D	$(\sigma'_c)_{\max}= 20$ psi		$(\sigma'_c)_{\min}= 19$ psi		$(\sigma'_c)_{av}= 19$ psi		Tail Tube Area =		p	0.9976	cm ²
Trial No.	Stage	Temp. ° C	Time				Influent Pressure Head		Fluid Head/ Vol. Reading		Flow Ratio in/out	Total Head (cm H2O)	Permeability (cm/sec) Preliminary Final at 20°C Dev. from Start
			Day	hour	minute	second	Mercury (inch)	Gage (psi)	Head (cm)/cc	Tail (cm)/cc			
1-4	I	22.6	4/9/24	9	35	0	0.00	100.00	96.40	13.60	1.42	82.80	6.87E-09
	F	22.7	4/11/24	11	11	0	0.00	100.00	90.11	18.08		72.03	6.28E-09
		Rt= 0.940	dT = 2976.00 min				0.00	100.00	1.49 cc	1.05 cc		io =24.9	-
5-7	I	22.7	4/11/24	11	11	0	0.00	100.00	90.11	18.08	1.43	72.03	4.51E-09
	F	23.1	4/12/24	16	34	0	0.00	100.00	87.88	19.65		68.23	4.10E-09
		Rt= 0.933	dT = 1763.00 min				0.00	100.00	0.53 cc	0.37 cc		io =21.6	-34%
8-16	I	23.1	4/12/24	16	37	0	0.00	100.00	96.40	12.42	1.80	83.98	2.37E-09
	F	22.0	4/19/24	6	30	0	0.00	100.00	88.78	16.70		72.08	2.17E-09
		Rt= 0.942	dT = 9473.00 min				0.00	100.00	1.81 cc	1.01 cc		io =25.2	-66%
17	I	22.0	4/19/24	6	32	0	0.00	100.00	88.78	16.70	2.36	72.08	1.44E-09
	F	22.4	4/19/24	16	1	0	0.00	100.00	88.50	16.82		71.68	1.33E-09
		Rt= 0.951	dT = 569.00 min				0.00	100.00	0.07 cc	0.03 cc		io =21.7	-79%
18-22	I	22.4	4/19/24	16	5	0	0.00	100.00	97.22	12.34	1.84	84.88	1.01E-09
	F	22.9	4/23/24	15	57	0	0.00	100.00	95.10	13.50		81.60	9.19E-10
		Rt= 0.940	dT = 5752.00 min				0.00	100.00	0.50 cc	0.27 cc		io =25.5	-85%
25-32	I	22.0	4/26/24	8	40	0	0.00	100.00	98.81	12.92	4.02	85.89	5.91E-10
	F	21.8	5/2/24	6	11	0	0.00	100.00	96.50	13.50		83.00	5.51E-10
		Rt= 0.958	dT = 8491.00 min				0.00	100.00	0.55 cc	0.14 cc		io =25.8	-91%
33-42	I	21.8	5/2/24	6	11	0	0.00	100.00	96.50	13.50	2.36	83.00	3.55E-10
	F	22.1	5/9/24	6	9	0	0.00	100.00	95.10	14.10		81.00	3.31E-10
		Rt= 0.957	dT = 10078.00 min				0.00	100.00	0.33 cc	0.14 cc		io =24.9	-95%
43-48	I	22.1	5/9/24	6	9	0	0.00	100.00	95.10	14.10	0.84	81.00	2.78E-10
	F	21.7	5/14/24	6	17	0	0.00	100.00	94.60	14.70		79.90	2.59E-10
		Rt= 0.958	dT = 7208.00 min				0.00	100.00	0.12 cc	0.14 cc		io =24.3	-96%
49-60	I	21.7	5/14/24	6	17	0	0.00	100.00	94.75	14.65	0.48	80.10	2.25E-10
	F	21.9	5/22/24	6	9	0	0.00	100.00	94.30	15.60		78.70	2.10E-10
		Rt= 0.960	dT = 11512.00 min				0.00	100.00	0.11 cc	0.22 cc		io =24.1	-97%
61-69	I	21.9	5/22/24	6	9	0	0.00	100.00	94.30	15.60	-0.04	78.70	2.20E-10
	F	22.5	5/29/24	16	17	0	0.00	100.00	94.35	16.90		77.45	2.03E-10
		Rt= 0.951	dT = 10688.00 min				0.00	100.00	-0.01 cc	0.31 cc		io =23.6	-97%

70-78	I	22.5	5/29/24	16	17	0	0.00	100.00	94.35	16.90		77.45	2.09E-10
	F	21.9	6/5/24	7	47	0	0.00	100.00	94.40	18.00		76.40	1.94E-10
		Rt= 0.951	dT = 9570.00 min				0.00	100.00	-0.01 cc	0.26 cc	-0.05	io =23.3	-97%
79	I	22.0	6/7/24	6	18	0	0.00	100.00	94.35	18.35		76.00	3.14E-10
	F	22.0	6/10/24	6	20	0	0.00	100.00	94.20	18.90		75.30	2.92E-10
		Rt= 0.956	dT = 4322.00 min				0.00	100.00	0.04 cc	0.13 cc	0.28	io =22.8	-95%
80	I	22.0	5/30/24	6	13	0	0.00	100.00	94.10	19.10		75.00	4.04E-10
	F	21.9	5/31/24	6	30	0	0.00	100.00	94.00	19.30		74.70	3.76E-10
		Rt= 0.957	dT = 1457.00 min				0.00	100.00	0.02 cc	0.05 cc	0.50	io =22.5	-94%
81	I	21.7	6/13/24	6	14	0	0.00	100.00	93.95	19.48		74.47	2.33E-10
	F	22.0	6/14/24	6	15	0	0.00	100.00	93.90	19.60		74.30	2.17E-10
		Rt= 0.959	dT = 1441.00 min				0.00	100.00	0.01 cc	0.03 cc	0.42	io =22.4	-97%
82-83	I	25.1	6/17/24	6	31	0	0.00	100.00	94.40	21.10		73.30	6.56E-10
	F	24.9	6/21/24	8	26	0	0.00	100.00	93.60	22.20		71.40	5.63E-10
		Rt= 0.882	dT = 5875.00 min				0.00	100.00	0.19 cc	0.26 cc	0.73	io =22.0	-90%
84-86	I	24.9	6/21/24	8	26	0	0.00	100.00	93.60	22.20		71.40	5.63E-10
	F	22.1	6/28/24	7	57	0	0.00	100.00	91.80	23.10		68.70	5.03E-10
		Rt= 0.919	dT = 10051.00 min				0.00	100.00	0.43 cc	0.21 cc	2.02	io =21.5	-92%
87-93	I	22.1	6/28/24	7	57	0	0.00	100.00	91.80	23.10		68.70	3.98E-10
	F	21.8	7/15/24	6	11	0	0.00	100.00	90.10	25.80		64.30	3.71E-10
		Rt= 0.957	dT = 24374.00 min				0.00	100.00	0.40 cc	0.63 cc	0.64	io =20.6	-94%
94-98	I	21.8	7/15/24	6	11	0	0.00	100.00	90.10	25.80		64.30	5.52E-10
	F	25.8	7/24/24	9	12	0	0.00	100.00	89.10	27.90		61.20	4.89E-10
		Rt= 0.911	dT = 13141.00 min				0.00	100.00	0.24 cc	0.49 cc	0.48	io =19.3	-92%

PERMEABILITY TEST: FALLING HEAD - INCREASING TAILWATER

ASTM D 5084 - Method C

Project No. 23014938A

Clay Type: Sepiolite

Project Name: PoT - Former Arkema Manufacturing Mix water: 50/50

Final Specimen and Test Conditions

Lc = 3.576 cm $\epsilon_{axial} = 0.6\%$
 Ac = 45.360 cm²
 Vc = 162.20 cm³ $\epsilon_{vol} = 1.6\%$
 Vvoid 146.630 cm³

	w (%)	γ_t (pcf)	γ_d (pcf)	S (%)
Initial	326.19	71.6	16.8	97.0
PreTest	327.54	73.0	17.1	99.1

Test Operator: MB
 Reviewed By: DM

Specimen - Apparatus set-up - Test Information

- 1) Specimen Tested in : ☒ Triaxial Cell or ☐ Compaction Mold or ☐ top + bottom
☒ with stones or ☐ Stones with filter paper or ☐
 2) Specimen orientation for: ☒ Vertical or ☐ Horizontal permeability determination
 3) During saturation: Water flushed up sides of specimen to remove air: ☒ No ☐ Yes
 4) During consolidation: ☒ Top and bottom drainage or ☐ Top ☐ Bottom only
 5) Direction of permeant : ☒ Up during or ☐ Down during permeation
 6) Permeant used : ☐ Demineralized ☐ Distilled ☐ Tap or ☐
 or Groundwater

Stage No.:		16	σ_c	120.0	psi		System: p=pipette, a = annulus, b =both								
Apparatus No.		9	Ub	100.0	psi		Head Tube Area =				p	0.9979	cm ²		
Cell No.		D	$(\sigma'_c)_{max}= 20$ psi		$(\sigma'_c)_{min}= 16$ psi		$(\sigma'_c)_{av}= 18$ psi		Tail Tube Area =				p	0.9976	cm ²
Trial No.	Stage	Temp. ° C	Time				Influent Pressure Head		Fluid Head/ Vol. Reading		Flow Ratio in/out	Total Head (cm H2O) gradient	Permeability (cm/sec) Preliminary Final at 20°C Dev. from Start		
			Day	hour	minute	second	Mercury (inch)	Gage (psi)	Head (cm)/cc	Tail (cm)/cc					
1	I	22.8	4/15/24	10	17	0	0.00	103.50	1.01	23.98	0.91	269.58	5.64E-09		
	F	22.8	4/15/24	16	6	0	0.00	103.50	1.40	23.55		268.76	5.27E-09		
		Rt= 0.936	dT = 349.00 min				0.00	103.50	0.38 cc	0.42 cc		io =75.4	-		
2	I	22.8	4/15/24	16	6	0	0.00	103.50	1.40	23.55	1.01	268.76	4.14E-09		
	F	22.4	4/16/24	8	32	0	0.00	103.50	2.25	22.71		267.07	3.88E-09		
		Rt= 0.941	dT = 986.00 min				0.00	103.50	0.83 cc	0.82 cc		io =75.2	-27%		
3	I	22.4	4/16/24	8	32	0	0.00	103.50	2.25	22.71	0.79	267.07	3.95E-09		
	F	22.4	4/16/24	16	12	0	0.00	103.50	2.58	22.29		266.32	3.73E-09		
		Rt= 0.946	dT = 460.00 min				0.00	103.50	0.32 cc	0.41 cc		io =74.7	-30%		
4	I	22.4	4/16/24	16	12	0	0.00	103.50	2.58	22.29	1.23	266.32	3.39E-09		
	F	22.0	4/17/24	8	15	0	0.00	103.50	3.32	21.69		264.98	3.21E-09		
		Rt= 0.951	dT = 963.00 min				0.00	103.50	0.73 cc	0.59 cc		io =74.5	-40%		
5	I	22.0	4/17/24	8	15	0	0.00	103.50	3.32	21.69	0.53	264.98	2.74E-09		
	F	22.5	4/17/24	15	58	0	0.00	103.50	3.50	21.35		264.46	2.60E-09		
		Rt= 0.949	dT = 463.00 min				0.00	103.50	0.18 cc	0.33 cc		io =74.1	-51%		
6	I	22.5	4/17/24	15	59	0	0.00	103.50	3.50	21.35	1.20	264.46	2.96E-09		
	F	22.2	4/18/24	7	10	0	0.00	103.50	4.10	20.85		263.36	2.79E-09		
		Rt= 0.947	dT = 911.00 min				0.00	103.50	0.59 cc	0.49 cc		io =74.0	-48%		
7	I	22.2	4/18/24	7	11	0	0.00	103.50	4.10	20.85	1.20	263.36	2.53E-09		
	F	22.4	4/18/24	16	6	0	0.00	103.50	4.40	20.60		262.81	2.39E-09		
		Rt= 0.948	dT = 535.00 min				0.00	103.50	0.29 cc	0.25 cc		io =73.6	-55%		
8	I	22.4	4/18/24	16	7	0	0.00	103.50	4.40	20.60	1.13	262.81	2.42E-09		
	F	22.0	4/19/24	6	34	0	0.00	103.50	4.85	20.20		261.96	2.29E-09		
		Rt= 0.951	dT = 867.00 min				0.00	103.50	0.44 cc	0.39 cc		io =73.5	-57%		
9	I	22.0	4/19/24	6	35	0	0.00	103.50	4.85	20.20	1.20	261.96	2.38E-09		
	F	22.4	4/19/24	16	7	0	0.00	103.50	5.15	19.95		261.41	2.25E-09		
		Rt= 0.951	dT = 572.00 min				0.00	103.50	0.29 cc	0.25 cc		io =73.3	-58%		
10	I	22.4	4/19/24	16	9	0	0.00	103.50	0.25	24.09		270.45	2.14E-09		
	F	21.5	4/22/24	6	45	0	0.00	103.50	1.80	22.30		267.11	2.04E-09		

		Rt= 0.957	dT = 3756.00 min				0.00	103.50	1.52 cc	1.75 cc	0.87	io =75.6	-62%
11	I	21.5	4/22/24	6	46	0	0.00	103.50	1.80	22.30		267.11	1.76E-09
	F	22.5	4/22/24	15	44	0	0.00	103.50	1.99	22.10		266.72	1.67E-09
		Rt= 0.956	dT = 538.00 min				0.00	103.50	0.19 cc	0.20 cc	0.95	io =74.7	-69%
12	I	22.5	4/23/24	15	44	0	0.00	103.50	1.99	22.10		266.72	1.56E-09
	F	21.6	4/24/24	6	16	0	0.00	103.50	2.20	21.75		266.16	1.48E-09
		Rt= 0.954	dT = 872.00 min				0.00	103.50	0.21 cc	0.34 cc	0.60	io =74.6	-72%
13-16	I	21.6	4/24/24	6	17	0	0.00	103.50	2.20	21.75		266.16	2.87E-09
	F	21.8	4/25/24	7	3	0	0.00	103.50	2.90	20.70		264.41	2.75E-09
		Rt= 0.963	dT = 1486.00 min				0.00	103.50	0.69 cc	1.03 cc	0.67	io =74.4	-49%
17-20	I	21.8	4/25/24	7	5	0	0.00	103.50	2.90	20.70		264.41	1.31E-09
	F	24.6	4/29/24	6	23	0	0.00	103.50	3.90	18.65		261.36	1.21E-09
		Rt= 0.926	dT = 5718.00 min				0.00	103.50	0.98 cc	2.01 cc	0.49	io =73.9	-77%
21-24	I	24.6	4/29/24	6	36	0	0.00	103.50	0.40	24.50		270.71	1.08E-09
	F	22.0	5/1/24	6	49	0	0.00	103.50	1.00	23.80		269.41	9.91E-10
		Rt= 0.924	dT = 2893.00 min				0.00	103.50	0.59 cc	0.69 cc	0.86	io =75.7	-81%
25-28	I	22.0	5/1/24	6	49	0	0.00	103.50	1.00	23.80		269.41	7.58E-10
	F	22.0	5/3/24	6	24	0	0.00	103.50	1.30	23.20		268.51	7.22E-10
		Rt= 0.956	dT = 2855.00 min				0.00	103.50	0.29 cc	0.59 cc	0.50	io =75.3	-87%
29-31	I	22.3	5/6/24	8	57	0	0.00	103.50	1.30	23.00		268.31	8.38E-10
	F	21.7	5/7/24	6	33	0	0.00	103.50	1.45	22.70		267.86	7.98E-10
		Rt= 0.956	dT = 1296.00 min				0.00	103.50	0.15 cc	0.29 cc	0.50	io =75.0	-85%
32-39	I	22.6	5/7/24	16	36	0	0.00	103.50	1.95	22.50		267.16	6.10E-10
	F	22.2	5/13/24	15	26	0	0.00	103.50	2.10	20.50		265.01	5.75E-10
		Rt= 0.946	dT = 8570.00 min				0.00	103.50	0.15 cc	1.96 cc	0.08	io =74.7	-89%
40-47	I	21.7	5/14/24	6	19	0	0.00	103.50	2.10	20.30		264.81	5.67E-10
	F	21.8	5/20/24	6	23	0	0.00	103.50	2.50	18.70		262.81	5.44E-10
		Rt= 0.962	dT = 8644.00 min				0.00	103.50	0.39 cc	1.57 cc	0.25	io =74.1	-90%
48-56	I	21.8	5/20/24	6	23	0	0.00	103.50	2.50	18.70		262.81	5.44E-10
	F	22.5	5/24/24	16	8	0	0.00	103.50	2.70	17.50		261.41	5.16E-10
		Rt= 0.952	dT = 6345.00 min				0.00	103.50	0.20 cc	1.18 cc	0.17	io =73.5	-90%
57-65	I	22.5	5/24/24	16	15	0	0.00	103.50	1.35	24.00		269.26	3.14E-10
	F	21.9	6/3/24	6	24	0	0.00	103.50	1.65	22.50		267.46	2.98E-10
		Rt= 0.951	dT = 13809.00 min				0.00	103.50	0.29 cc	1.47 cc	0.20	io =75.3	-94%
68	I	22.4	6/4/24	15	43	0	0.00	103.50	1.75	22.40		267.26	2.50E-10
	F	21.9	6/5/24	7	50	0	0.00	103.50	1.75	22.30		267.16	2.37E-10
		Rt= 0.952	dT = 967.00 min				0.00	103.50	0.00 cc	0.10 cc	0.00	io =74.7	-96%
76-79	I	25.5	6/26/24	6	41	0	0.00	103.50	1.35	20.80		266.06	6.52E-11
	F	22.0	7/5/24	7	52	0	0.00	103.50	1.90	21.70		266.41	5.93E-11
		Rt= 0.913	dT = 13031.00 min				0.00	103.50	0.54 cc	-0.88 cc	-0.61	io =74.4	-99%
82-88	I	22.0	7/10/24	6	30	0	0.00	103.50	1.40	20.90		266.11	1.80E-10
	F	25.8	7/24/24	9	16	0	0.00	103.50	1.60	19.60		264.61	1.63E-10
		Rt= 0.909	dT = 20326.00 min				0.00	103.50	0.20 cc	1.27 cc	0.15	io =74.4	-97%

PERMEABILITY TEST: FALLING HEAD - INCREASING TAILWATER

ASTM D 5084 - Method C

Project No. 23014938A

Clay Type: Sepiolite

Project Name: PoT - Former Arkema Manufacturing Mix water: GW

Final Specimen and Test Conditions

Lc = 5.150 cm $\epsilon_{axial} = 0.7\%$

Ac = 45.803 cm²

Vc = 235.89 cm³ $\epsilon_{vol} = 0.7\%$

Vvoid 214.176 cm³

w

(%)

γ_t

(pcf)

γ_d

(pcf)

S

(%)

Initial 323.71 72.5 17.1 97.7

PreTest 332.62 74.6 17.2 101.2

Test Operator: MB

Reviewed By: DM

Specimen - Apparatus set-up - Test Information

- 1) Specimen Tested in : ☒ Triaxial Cell or ☐ Compaction Mold or ☐ top + bottom
☒ with stones or ☐ Stones with filter paper or ☐
2) Specimen orientation for: ☒ Vertical or ☐ Horizontal permeability determination
3) During saturation: Water flushed up sides of specimen to remove air: ☒ No ☐ Yes
4) During consolidation: ☒ Top and bottom drainage or ☐ Top ☐ Bottom only
5) Direction of permeant : ☒ Up during or ☐ Down during permeation
6) Permeant used : ☐ Demineralized ☐ Distilled ☐ Tap or ☐
or Groundwater

Stage No.:		16	σ_c	120.0	psi										System: p=pipette, a = annulus, b =both				
Apparatus No.		9	Ub	100.0	psi										Head Tube Area =		p	0.9979	cm ²
Cell No.		D	$(\sigma'_c)_{\max}$	20 psi	$(\sigma'_c)_{\min}$	16 psi	$(\sigma'_c)_{\text{av}}$	18 psi	Tail Tube Area =		p	0.9976	cm ²						
Trial No.	Stage	Temp. ° C	Time				Influent Pressure Head		Fluid Head/ Vol. Reading		Flow Ratio	Total Head (cm H2O)	Permeability (cm/sec)						
			Day	hour	minute	second	Mercury (inch)	Gage (psi)	Head (cm)/cc	Tail (cm)/cc			in/out	gradient	Preliminary Final at 20°C				
1	I	22.6	4/5/24	13	45	0	0.00	103.50	0.35	24.10	0.99	270.36	7.27E-08						
	F	22.6	4/5/24	16	5	0	0.00	103.50	1.78	22.65		267.48	6.74E-08						
		Rt= 0.941	dT = 140.00 min				0.00	103.50	1.43 cc	1.45 cc		io =52.5	-						
2	I	22.3	4/8/24	7	54	0	0.00	103.50	1.70	22.80	1.00	267.71	8.51E-08						
	F	22.7	4/8/24	12	20	0	0.00	103.50	4.85	19.65		261.41	7.91E-08						
		Rt= 0.943	dT = 266.00 min				0.00	103.50	3.15 cc	3.15 cc		io =52.0	17%						
3	I	22.7	4/8/24	12	23	0	0.00	103.50	0.32	23.55	1.00	269.84	6.93E-08						
	F	22.7	4/8/24	16	36	0	0.00	103.50	2.79	21.09		264.91	6.40E-08						
		Rt= 0.938	dT = 253.00 min				0.00	103.50	2.47 cc	2.46 cc		io =52.4	-5%						
4	I	22.7	4/9/24	7	59	0	0.00	103.50	2.88	21.05	0.95	264.78	6.33E-08						
	F	22.7	4/9/24	12	33	0	0.00	103.50	5.22	18.60		259.99	5.85E-08						
		Rt= 0.938	dT = 274.00 min				0.00	103.50	2.34 cc	2.45 cc		io =51.4	-13%						
5	I	22.6	4/10/24	8	7	0	0.00	103.50	0.49	23.90	0.97	270.02	5.79E-08						
	F	22.6	4/10/24	13	20	0	0.00	103.50	3.00	21.31		264.92	5.37E-08						
		Rt= 0.941	dT = 313.00 min				0.00	103.50	2.51 cc	2.59 cc		io =52.4	-20%						
6	I	22.7	4/11/24	12	51	0	0.00	103.50	0.19	23.80	0.99	270.22	5.13E-08						
	F	22.7	4/11/24	16	34	0	0.00	103.50	1.80	22.18		266.99	4.74E-08						
		Rt= 0.938	dT = 223.00 min				0.00	103.50	1.61 cc	1.62 cc		io =52.5	-30%						
7	I	23.0	4/12/24	7	57	0	0.00	103.50	0.60	23.68	0.98	269.69	2.35E-08						
	F	23.1	4/12/24	15	50	0	0.00	103.50	2.15	22.10		266.56	2.15E-08						
		Rt= 0.930	dT = 473.00 min				0.00	103.50	1.55 cc	1.58 cc		io =52.4	-68%						
8	I	22.8	4/15/24	7	49	0	0.00	103.50	0.38	24.25	0.71	270.48	2.37E-08						
	F	22.8	4/15/24	15	52	0	0.00	103.50	1.72	22.35		267.24	2.19E-08						
		Rt= 0.936	dT = 483.00 min				0.00	103.50	1.34 cc	1.90 cc		io =52.5	-67%						
9	I	22.4	4/16/24	8	28	0	0.00	103.50	0.41	23.71	0.92	269.91	1.94E-08						
	F	22.4	4/16/24	16	7	0	0.00	103.50	1.62	22.40		267.39	1.81E-08						
		Rt= 0.946	dT = 459.00 min				0.00	103.50	1.21 cc	1.31 cc		io =52.4	-73%						
10	I	22.0	4/17/24	8	12	0	0.00	103.50	0.50	23.42	0.96	269.53	1.86E-08						
	F	22.0	4/17/24	15	55	0	0.00	103.50	1.69	22.18		267.10	1.75E-08						
		Rt= 0.956	dT = 463.00 min				0.00	103.50	1.19 cc	1.24 cc		io =52.3	-74%						

11	I	22.3	4/18/24	8	0	0	0.00	103.50	0.51	23.52	0.95	269.62	1.69E-08
	F	22.4	4/18/24	16	24	0	0.00	103.50	1.68	22.29		267.22	1.57E-08
		Rt= 0.947	dT = 504.00 min				0.00	103.50	1.17 cc	1.23 cc		io =52.4	-77%
12	I	22.0	4/19/24	7	41	0	0.00	103.50	0.10	23.40	0.93	269.91	1.45E-08
	F	22.4	4/19/24	16	19	0	0.00	103.50	1.12	22.30		267.79	1.35E-08
		Rt= 0.951	dT = 518.00 min				0.00	103.50	1.02 cc	1.10 cc		io =52.4	-80%
13	I	21.6	4/22/24	7	49	0	0.00	103.50	0.45	24.10	0.86	270.26	1.31E-08
	F	21.6	4/22/24	15	12	0	0.00	103.50	1.21	23.22		268.62	1.24E-08
		Rt= 0.965	dT = 443.00 min				0.00	103.50	0.76 cc	0.88 cc		io =52.5	-82%
14	I	21.0	4/23/24	8	6	0	0.00	103.50	0.50	24.10	0.80	270.21	1.10E-08
	F	22.5	4/23/24	12	55	0	0.00	103.50	0.90	23.60		269.31	1.04E-08
		Rt= 0.962	dT = 289.00 min				0.00	103.50	0.40 cc	0.50 cc		io =52.5	-85%
15	I	22.5	4/23/24	12	55	0	0.00	103.50	0.90	23.60	0.75	269.31	1.19E-08
	F	22.9	4/23/24	16	23	0	0.00	103.50	1.20	23.20		268.61	1.10E-08
		Rt= 0.938	dT = 208.00 min				0.00	103.50	0.30 cc	0.40 cc		io =52.3	-84%
16	I	22.9	4/23/24	16	23	0	0.00	103.50	1.20	23.20	1.00	268.61	1.09E-08
	F	22.3	4/24/24	6	33	0	0.00	103.50	2.50	21.90		266.01	1.01E-08
		Rt= 0.941	dT = 850.00 min				0.00	103.50	1.30 cc	1.30 cc		io =52.2	-85%
17	I	22.3	4/24/24	6	35	0	0.00	103.50	0.40	24.10	0.91	270.31	1.25E-08
	F	22.3	4/24/24	16	26	0	0.00	103.50	1.40	23.00		268.21	1.17E-08
		Rt= 0.948	dT = 591.00 min				0.00	103.50	1.00 cc	1.10 cc		io =52.5	-83%
18	I	22.3	4/24/24	16	26	0	0.00	103.50	1.40	23.00	1.00	268.21	1.14E-08
	F	21.8	4/25/24	6	58	0	0.00	103.50	2.80	21.60		265.41	1.08E-08
		Rt= 0.954	dT = 872.00 min				0.00	103.50	1.40 cc	1.40 cc		io =52.1	-84%
19	I	21.8	4/25/24	7	1	0	0.00	103.50	2.80	21.60	1.00	265.41	1.06E-08
	F	22.5	4/25/24	16	1	0	0.00	103.50	3.60	20.80		263.81	9.98E-09
		Rt= 0.952	dT = 540.00 min				0.00	103.50	0.80 cc	0.80 cc		io =51.5	-85%
20	I	22.5	4/25/24	16	1	0	0.00	103.50	3.60	20.80	1.00	263.81	1.02E-08
	F	21.5	4/26/24	6	15	0	0.00	103.50	4.80	19.60		261.41	9.57E-09
		Rt= 0.956	dT = 854.00 min				0.00	103.50	1.20 cc	1.20 cc		io =51.2	-86%
21	I	21.5	4/26/24	6	15	0	0.00	103.50	4.80	19.60	0.89	261.41	9.10E-09
	F	22.2	4/26/24	16	20	0	0.00	103.50	5.51	18.80		259.90	8.60E-09
		Rt= 0.959	dT = 605.00 min				0.00	103.50	0.71 cc	0.80 cc		io =50.8	-87%
22	I	24.6	4/29/24	6	27	0	0.00	103.50	0.60	23.45	1.38	269.46	8.79E-09
	F	22.6	4/29/24	16	51	0	0.00	103.50	1.50	22.80		267.91	7.93E-09
		Rt= 0.916	dT = 624.00 min				0.00	103.50	0.90 cc	0.65 cc		io =52.3	-88%
23	I	22.6	4/29/24	16	51	0	0.00	103.50	1.50	22.80	1.00	267.91	7.94E-09
	F	22.0	4/30/24	6	18	0	0.00	103.50	2.40	21.90		266.11	7.42E-09
		Rt= 0.948	dT = 807.00 min				0.00	103.50	0.90 cc	0.90 cc		io =52.0	-89%
24	I	22.0	4/30/24	6	18	0	0.00	103.50	2.40	21.90	1.00	266.11	8.25E-09
	F	22.0	4/30/24	17	9	0	0.00	103.50	3.15	21.15		264.61	7.77E-09
		Rt= 0.956	dT = 651.00 min				0.00	103.50	0.75 cc	0.75 cc		io =51.7	-89%
25	I	22.0	4/30/24	17	9	0	0.00	103.50	3.15	21.15	1.00	264.61	7.54E-09
	F	22.0	5/1/24	6	42	0	0.00	103.50	4.00	20.30		262.91	7.09E-09
		Rt= 0.956	dT = 813.00 min				0.00	103.50	0.85 cc	0.85 cc		io =51.4	-90%
26	I	22.0	5/1/24	6	45	0	0.00	103.50	0.40	24.20	0.86	270.41	7.21E-09
	F	22.3	5/1/24	17	20	0	0.00	103.50	1.00	23.50		269.11	6.76E-09
		Rt= 0.952	dT = 635.00 min				0.00	103.50	0.60 cc	0.70 cc		io =52.5	-90%
27	I	22.3	5/1/24	17	20	0	0.00	103.50	1.00	23.50	1.00	269.11	8.20E-09
	F	21.8	5/2/24	6	18	0	0.00	103.50	1.90	22.60		267.31	7.71E-09
		Rt= 0.954	dT = 778.00 min				0.00	103.50	0.90 cc	0.90 cc		io =52.3	-89%
28	I	21.8	5/2/24	6	18	0	0.00	103.50	1.90	22.60	1.00	267.31	4.34E-09
	F	22.3	5/2/24	17	15	0	0.00	103.50	2.30	22.20		266.51	4.08E-09
		Rt= 0.954	dT = 657.00 min				0.00	103.50	0.40 cc	0.40 cc		io =51.9	-94%
29	I	22.3	5/2/24	17	15	0	0.00	103.50	2.30	22.20	0.87	266.51	6.82E-09
	F	22.0	5/3/24	6	22	0	0.00	103.50	3.00	21.40		265.01	6.39E-09
		Rt= 0.952	dT = 787.00 min				0.00	103.50	0.70 cc	0.80 cc		io =51.7	-91%
30	I	22.0	5/3/24	6	22	0	0.00	103.50	3.00	21.40	0.83	265.01	6.61E-09
	F	22.3	5/3/24	16	20	0	0.00	103.50	3.50	20.80		263.91	6.20E-09
		Rt= 0.952	dT = 598.00 min				0.00	103.50	0.50 cc	0.60 cc		io =51.5	-91%
31	I	21.8	5/7/24	8	7	0	0.00	103.50	0.15	23.95	0.87	270.41	6.72E-09
	F	22.4	5/7/24	14	40	0	0.00	103.50	0.50	23.55		269.66	6.31E-09
		Rt= 0.953	dT = 393.00 min				0.00	103.50	0.35 cc	0.40 cc		io =52.5	-91%
32	I	22.6	5/7/24	16	47	0	0.00	103.50	0.00	24.00	1.00	270.61	6.06E-09
	F	21.8	5/8/24	6	21	0	0.00	103.50	0.70	23.30		269.21	5.67E-09
		Rt= 0.951	dT = 814.00 min				0.00	103.50	0.70 cc	0.70 cc		io =52.5	-92%
33	I	21.8	5/8/24	6	21	0	0.00	103.50	0.70	23.30	0.83	269.21	6.69E-09
	F	22.5	5/8/24	16	3	0	0.00	103.50	1.20	22.70		268.11	6.27E-09
		Rt= 0.952	dT = 582.00 min				0.00	103.50	0.50 cc	0.60 cc		io =52.3	-91%

34	I	22.5	5/8/24	16	3	0	0.00	103.50	1.20	22.70	1.00	268.11	5.87E-09
	F	22.1	5/9/24	6	10	0	0.00	103.50	1.90	22.00		266.71	5.49E-09
		Rt= 0.948	dT = 847.00 min				0.00	103.50	0.70 cc	0.70 cc		io =52.1	-92%
35	I	22.1	5/9/24	6	10	0	0.00	103.50	1.90	22.00	0.90	266.71	5.33E-09
	F	22.3	5/9/24	16	46	0	0.00	103.50	2.35	21.50		265.76	4.99E-09
		Rt= 0.951	dT = 636.00 min				0.00	103.50	0.45 cc	0.50 cc		io =51.8	-93%
36	I	22.3	5/9/24	16	46	0	0.00	103.50	2.35	21.50	0.93	265.76	5.86E-09
	F	21.7	5/10/24	6	32	0	0.00	103.50	3.00	20.80		264.41	5.52E-09
		Rt= 0.956	dT = 826.00 min				0.00	103.50	0.65 cc	0.70 cc		io =51.6	-92%
37	I	21.7	5/10/24	6	32	0	0.00	103.50	3.00	20.80	1.25	264.41	5.94E-09
	F	22.0	5/10/24	15	38	0	0.00	103.50	3.50	20.40		263.51	5.61E-09
		Rt= 0.959	dT = 546.00 min				0.00	103.50	0.50 cc	0.40 cc		io =51.3	-92%
38	I	22.0	5/13/24	8	33	0	0.00	103.50	0.30	23.90	1.86	270.21	5.20E-09
	F	22.2	5/13/24	15	19	0	0.00	103.50	0.69	23.69		269.61	4.89E-09
		Rt= 0.953	dT = 406.00 min				0.00	103.50	0.39 cc	0.21 cc		io =52.5	-93%
39	I	22.2	5/13/24	16	44	0	0.00	103.50	0.70	23.68	0.86	269.59	4.69E-09
	F	21.7	5/14/24	6	18	0	0.00	103.50	1.20	23.10		268.51	4.42E-09
		Rt= 0.957	dT = 814.00 min				0.00	103.50	0.50 cc	0.58 cc		io =52.3	-94%
40	I	21.7	5/14/24	6	18	0	0.00	103.50	1.20	23.10	0.75	268.51	4.23E-09
	F	22.2	5/14/24	16	5	0	0.00	103.50	1.50	22.70		267.81	3.98E-09
		Rt= 0.957	dT = 587.00 min				0.00	103.50	0.30 cc	0.40 cc		io =52.1	-94%
41	I	22.2	5/14/24	16	5	0	0.00	103.50	1.50	22.70	1.20	267.81	4.57E-09
	F	21.7	5/15/24	6	21	0	0.00	103.50	2.10	22.20		266.71	4.31E-09
		Rt= 0.957	dT = 856.00 min				0.00	103.50	0.60 cc	0.50 cc		io =52.0	-94%
42	I	21.7	5/15/24	6	21	0	0.00	103.50	2.10	22.20	0.87	266.71	4.87E-09
	F	22.2	5/15/24	15	31	0	0.00	103.50	2.45	21.80		265.96	4.59E-09
		Rt= 0.957	dT = 550.00 min				0.00	103.50	0.35 cc	0.40 cc		io =51.8	-93%
43	I	22.2	5/15/24	15	31	0	0.00	103.50	2.45	21.80	1.10	265.96	4.16E-09
	F	21.6	5/16/24	6	34	0	0.00	103.50	3.00	21.30		264.91	3.93E-09
		Rt= 0.958	dT = 903.00 min				0.00	103.50	0.55 cc	0.50 cc		io =51.6	-94%
44-46	I	21.6	5/16/24	6	34	0	0.00	103.50	3.00	21.30	0.95	264.91	3.91E-09
	F	22.3	5/17/24	15	36	0	0.00	103.50	4.05	20.20		262.76	3.68E-09
		Rt= 0.957	dT = 1982.00 min				0.00	103.50	1.05 cc	1.10 cc		io =51.4	-95%
47	I	22.0	5/20/24	9	45	0	0.00	103.50	0.85	23.95	0.50	269.71	3.99E-09
	F	22.3	5/20/24	16	23	0	0.00	103.50	1.00	23.65		269.26	3.74E-09
		Rt= 0.952	dT = 398.00 min				0.00	103.50	0.15 cc	0.30 cc		io =52.4	-95%
48-50	I	21.7	5/21/24	6	42	0	0.00	103.50	1.50	23.20	0.95	268.31	3.89E-09
	F	22.5	5/22/24	15	29	0	0.00	103.50	2.55	22.10		266.16	3.65E-09
		Rt= 0.953	dT = 1967.00 min				0.00	103.50	1.05 cc	1.10 cc		io =52.1	-95%
51	I	22.5	5/22/24	16	24	0	0.00	103.50	0.79	23.48	0.71	269.30	4.22E-09
	F	22.0	5/23/24	6	13	0	0.00	103.50	1.20	22.90		268.31	3.95E-09
		Rt= 0.949	dT = 829.00 min				0.00	103.50	0.41 cc	0.58 cc		io =52.3	-94%
52	I	22.1	5/24/24	8	4	0	0.00	103.50	1.52	22.62	0.56	267.71	3.69E-09
	F	22.5	5/24/24	16	6	0	0.00	103.50	1.70	22.30		267.21	3.44E-09
		Rt= 0.948	dT = 482.00 min				0.00	103.50	0.18 cc	0.32 cc		io =52.0	-95%
53	I	22.2	5/28/24	8	47	0	0.00	103.50	1.75	22.40	0.83	267.26	4.46E-09
	F	22.4	5/28/24	16	6	0	0.00	103.50	2.00	22.10		266.71	4.17E-09
		Rt= 0.948	dT = 439.00 min				0.00	103.50	0.25 cc	0.30 cc		io =51.9	-94%
54-55	I	22.4	5/28/24	16	32	0	0.00	103.50	2.00	22.10	3.00	266.71	2.01E-09
	F	22.5	5/29/24	16	16	0	0.00	103.50	2.60	21.90		265.91	1.87E-09
		Rt= 0.945	dT = 1424.00 min				0.00	103.50	0.60 cc	0.20 cc		io =51.8	-97%
56-59	I	22.5	5/29/24	16	30	0	0.00	103.50	1.00	23.05	0.89	268.66	3.20E-09
	F	22.5	5/31/24	15	40	0	0.00	103.50	2.20	21.70		266.11	2.98E-09
		Rt= 0.943	dT = 2830.00 min				0.00	103.50	1.20 cc	1.35 cc		io =52.2	-96%
60-61	I	22.4	5/31/24	16	5	0	0.00	103.50	2.20	21.65	0.94	266.06	2.74E-09
	F	24.5	6/3/24	16	15	0	0.00	103.50	3.80	19.95		262.76	2.48E-09
		Rt= 0.920	dT = 4330.00 min				0.00	103.50	1.60 cc	1.70 cc		io =51.7	-96%
62-63	I	24.5	6/3/24	16	25	0	0.00	103.50	3.80	19.91	1.22	262.72	2.37E-09
	F	22.4	6/4/24	15	39	0	0.00	103.50	4.30	19.50		261.81	2.14E-09
		Rt= 0.920	dT = 1394.00 min				0.00	103.50	0.50 cc	0.41 cc		io =51.0	-97%
64-67	I	22.4	6/4/24	16	21	0	0.00	103.50	4.40	19.50	0.93	261.71	2.46E-09
	F	22.4	6/7/24	15	58	0	0.00	103.50	5.80	18.00		258.81	2.30E-09
		Rt= 0.946	dT = 4297.00 min				0.00	103.50	1.40 cc	1.50 cc		io =50.8	-97%
68-71	I	22.5	6/7/24	16	20	0	0.00	103.50	5.90	18.00	0.95	258.71	2.11E-09
	F	22.6	6/12/24	16	30	0	0.00	103.50	7.90	15.90		254.61	1.95E-09
		Rt= 0.942	dT = 7210.00 min				0.00	103.50	2.00 cc	2.10 cc		io =50.2	-97%

72-73	I	22.6	6/12/24	16	39	0	0.00	103.50	7.90	15.80	1.12	254.51	2.23E-09
	F	22.6	6/13/24	16	28	0	0.00	103.50	8.35	15.40		253.66	2.06E-09
		Rt= 0.941	dT = 1429.00 min				0.00	103.50	0.45 cc	0.40 cc		io =49.4	-97%
74	I	22.6	6/13/24	16	29	0	0.00	103.50	1.59	22.05	0.31	267.07	1.98E-09
	F	21.9	6/14/24	6	16	0	0.00	103.50	1.70	21.70		266.61	1.85E-09
		Rt= 0.949	dT = 827.00 min				0.00	103.50	0.11 cc	0.35 cc		io =51.9	-97%
75-76	I	22.4	6/14/24	16	15	0	0.00	103.50	1.20	22.80	0.63	268.21	2.02E-09
	F	26.8	6/17/24	16	15	0	0.00	103.50	2.15	21.30		265.76	1.77E-09
		Rt= 0.892	dT = 4320.00 min				0.00	103.50	0.95 cc	1.50 cc		io =52.1	-97%
77-80	I	26.8	6/17/24	16	20	0	0.00	103.50	0.58	23.95	0.99	269.98	1.43E-09
	F	26.6	6/25/24	17	34	0	0.00	103.50	2.90	21.60		265.31	1.18E-09
		Rt= 0.840	dT = 11594.00 min				0.00	103.50	2.32 cc	2.35 cc		io =52.4	-98%
81-83	I	22.1	6/28/24	8	0	0	0.00	103.50	3.70	21.15	1.14	264.06	1.05E-09
	F	22.5	7/3/24	16	51	0	0.00	103.50	4.90	20.10		261.81	9.83E-10
		Rt= 0.948	dT = 7731.00 min				0.00	103.50	1.20 cc	1.05 cc		io =51.3	-99%
84-92	I	22.0	7/5/24	7	48	0	0.00	103.50	0.20	22.05	0.46	268.46	9.61E-10
	F	25.8	7/24/24	9	12	0	0.00	103.50	2.50	17.00		261.11	8.61E-10
		Rt= 0.909	dT = 27444.00 min				0.00	103.50	2.30 cc	5.05 cc		io =52.1	-99%

PERMEABILITY TEST: FALLING HEAD - INCREASING TAILWATER

ASTM D 5084 - Method C

Project No. 23014938A

Clay Type: Attapulgite

Project Name: PoT

Mix water: Tap Water

Final Specimen and Test Conditions

Lc = 3.864 cm $\epsilon_{axial} = 0.0\%$
 Ac = 45.598 cm²
 Vc = 176.21 cm³ $\epsilon_{vol} = 1.0\%$
 Vvoid 160.430 cm³

	w (%)	γ_t (pcf)	γ_d (pcf)	S (%)
Initial	348.89	70.8	15.8	96.7
PreTest	356.83	72.8	15.9	100.0

Test Operator: MB
 Reviewed By: DM

Specimen - Apparatus set-up - Test Information

- 1) Specimen Tested in : ☒ Triaxial Cell or ☐ Compaction Mold or ☐ top + bottom
☒ with stones or ☐ Stones with filter paper or ☐
 2) Specimen orientation for: ☒ Vertical or ☐ Horizontal permeability determination
 3) During saturation: Water flushed up sides of specimen to remove air: ☒ No ☐ Yes
 4) During consolidation: ☒ Top and bottom drainage or ☐ Top ☐ Bottom only
 5) Direction of permeant : ☒ Up during or ☐ Down during permeation
 6) Permeant used : ☐ Demineralized ☐ Distilled ☐ Tap or ☐
 or Groundwater

Stage No.:		16	σ_c	120.0	psi		System: p=pipette, a = annulus, b =both								
Apparatus No.		9	Ub	100.0	psi		Head Tube Area =				p	0.9979	cm ²		
Cell No.		D	$(\sigma'_c)_{\max}= 20$ psi		$(\sigma'_c)_{\min}= 16$ psi		$(\sigma'_c)_{av}= 18$ psi		Tail Tube Area =				p	0.9976	cm ²
Trial No.	Stage	Temp. ° C	Time				Influent Pressure Head		Fluid Head/ Vol. Reading		Flow Ratio in/out	Total Head (cm H2O) gradient	Permeability (cm/sec) Preliminary Final at 20°C Dev. from Start		
			Day	hour	minute	second	Mercury (inch)	Gage (psi)	Head (cm)/cc	Tail (cm)/cc					
1	I	22.6	4/10/24	11	21	0	0.00	103.50	0.71	23.60	1.20	269.50	1.31E-08		
	F	22.6	4/10/24	16	27	0	0.00	103.50	1.55	22.90		267.96	1.24E-08		
		Rt= 0.941	dT = 306.00 min				0.00	103.50	0.84 cc	0.70 cc		io =69.7	-		
2	I	22.6	4/10/24	16	27	0	0.00	103.50	1.55	22.90	1.24	267.96	9.83E-09		
	F	22.7	4/11/24	11	19	0	0.00	103.50	3.90	21.01		263.72	9.33E-09		
		Rt= 0.940	dT = 1132.00 min				0.00	103.50	2.35 cc	1.89 cc		io =69.3	-25%		
3	I	22.7	4/11/24	11	21	0	0.00	103.50	0.60	23.60	1.02	269.61	9.03E-09		
	F	22.7	4/11/24	16	11	0	0.00	103.50	1.11	23.10		268.60	8.56E-09		
		Rt= 0.938	dT = 290.00 min				0.00	103.50	0.51 cc	0.50 cc		io =69.8	-31%		
4	I	22.7	4/11/24	16	11	0	0.00	103.50	1.11	23.10	1.14	268.60	7.70E-09		
	F	23.0	4/12/24	7	53	0	0.00	103.50	2.59	21.80		265.82	7.27E-09		
		Rt= 0.935	dT = 942.00 min				0.00	103.50	1.48 cc	1.30 cc		io =69.5	-41%		
5	I	23.0	4/12/24	7	53	0	0.00	103.50	2.59	21.80	1.15	265.82	6.55E-09		
	F	23.1	4/12/24	16	39	0	0.00	103.50	3.29	21.19		264.51	6.15E-09		
		Rt= 0.930	dT = 526.00 min				0.00	103.50	0.70 cc	0.61 cc		io =68.8	-50%		
6	I	23.1	4/12/24	16	42	0	0.00	103.50	0.49	24.19	1.15	270.31	4.51E-09		
	F	22.8	4/15/24	7	50	0	0.00	103.50	3.99	21.15		263.77	4.25E-09		
		Rt= 0.932	dT = 3788.00 min				0.00	103.50	3.49 cc	3.03 cc		io =69.9	-65%		
7	I	22.8	4/15/24	7	52	0	0.00	103.50	0.80	23.50	1.19	269.31	3.71E-09		
	F	22.8	4/15/24	16	2	0	0.00	103.50	1.18	23.18		268.61	3.50E-09		
		Rt= 0.936	dT = 490.00 min				0.00	103.50	0.38 cc	0.32 cc		io =69.7	-72%		
8	I	22.8	4/15/24	16	2	0	0.00	103.50	1.18	23.18	1.29	268.61	2.88E-09		
	F	22.4	4/16/24	8	36	0	0.00	103.50	1.80	22.70		267.51	2.74E-09		
		Rt= 0.941	dT = 994.00 min				0.00	103.50	0.62 cc	0.48 cc		io =69.5	-78%		
9	I	22.4	4/16/24	8	36	0	0.00	103.50	1.80	22.70	0.84	267.51	2.56E-09		
	F	22.4	4/16/24	16	25	0	0.00	103.50	2.01	22.45		267.05	2.45E-09		
		Rt= 0.946	dT = 469.00 min				0.00	103.50	0.21 cc	0.25 cc		io =69.2	-80%		
10	I	22.4	4/16/24	16	25	0	0.00	103.50	2.01	22.45		267.05	2.95E-09		
	F	22.0	4/17/24	8	13	0	0.00	103.50	2.61	21.98		265.98	2.84E-09		

		Rt= 0.951	dT = 948.00 min			0.00	103.50	0.60 cc	0.47 cc	1.28	io =69.1	-77%
11	I	22.0	4/17/24	8	13	0	0.00	103.50	2.61	21.98	265.98	1.97E-09
	F	22.5	4/17/24	16	0	0	0.00	103.50	2.78	21.80	265.63	1.89E-09
		Rt= 0.949	dT = 467.00 min				0.00	103.50	0.17 cc	0.18 cc	io =68.8	-85%
12	I	22.5	4/17/24	16	3	0	0.00	103.50	2.78	21.80	265.63	2.22E-09
	F	22.2	4/18/24	7	17	0	0.00	103.50	3.20	21.45	264.86	2.12E-09
		Rt= 0.947	dT = 914.00 min				0.00	103.50	0.42 cc	0.35 cc	io =68.7	-83%
13	I	22.2	4/18/24	7	18	0	0.00	103.50	3.20	21.45	264.86	1.74E-09
	F	22.4	4/18/24	16	9	0	0.00	103.50	3.40	21.30	264.51	1.66E-09
		Rt= 0.948	dT = 531.00 min				0.00	103.50	0.20 cc	0.15 cc	io =68.5	-87%
14	I	22.4	4/18/24	16	9	0	0.00	103.50	3.40	21.30	264.51	2.12E-09
	F	22.0	4/19/24	6	40	0	0.00	103.50	3.80	21.00	263.81	2.04E-09
		Rt= 0.951	dT = 871.00 min				0.00	103.50	0.40 cc	0.30 cc	io =68.4	-84%
15	I	22.0	4/19/24	6	40	0	0.00	103.50	3.80	21.00	263.81	2.73E-09
	F	22.4	4/19/24	16	13	0	0.00	103.50	4.09	20.70	263.22	2.62E-09
		Rt= 0.951	dT = 573.00 min				0.00	103.50	0.29 cc	0.30 cc	io =68.3	-79%
16	I	22.4	4/19/24	16	17	0	0.00	103.50	0.30	23.91	270.22	1.66E-09
	F	21.5	4/22/24	6	51	0	0.00	103.50	1.60	22.80	267.81	1.61E-09
		Rt= 0.957	dT = 3754.00 min				0.00	103.50	1.30 cc	1.11 cc	io =69.9	-87%
17	I	21.5	4/22/24	6	53	0	0.00	103.50	1.60	22.80	267.81	1.73E-09
	F	22.5	4/22/24	16	12	0	0.00	103.50	1.85	22.68	267.44	1.67E-09
		Rt= 0.956	dT = 559.00 min				0.00	103.50	0.25 cc	0.12 cc	io =69.3	-87%
18	I	22.5	4/22/24	16	12	0	0.00	103.50	1.85	22.68	267.44	1.17E-09
	F	21.6	4/23/24	6	20	0	0.00	103.50	2.00	22.45	267.06	1.13E-09
		Rt= 0.954	dT = 848.00 min				0.00	103.50	0.15 cc	0.23 cc	io =69.2	-91%
19	I	21.6	4/23/24	6	21	0	0.00	103.50	2.00	22.45	267.06	2.85E-09
	F	22.5	4/23/24	13	14	0	0.00	103.50	2.30	22.30	266.61	2.75E-09
		Rt= 0.954	dT = 413.00 min				0.00	103.50	0.30 cc	0.15 cc	io =69.1	-78%
20	I	22.5	4/23/24	13	14	0	0.00	103.50	2.30	22.30	266.61	9.49E-10
	F	22.3	4/24/24	6	42	0	0.00	103.50	2.48	22.10	266.23	9.07E-10
		Rt= 0.946	dT = 1048.00 min				0.00	103.50	0.18 cc	0.20 cc	io =69.0	-93%
21	I	22.3	4/24/24	6	42	0	0.00	103.50	2.48	22.10	266.23	1.16E-09
	F	23.0	4/24/24	13	6	0	0.00	103.50	2.55	22.00	266.06	1.10E-09
		Rt= 0.940	dT = 384.00 min				0.00	103.50	0.07 cc	0.10 cc	io =68.9	-91%
22	I	23.0	4/24/24	13	18	0	0.00	103.50	0.70	23.60	269.51	8.94E-10
	F	21.0	4/25/24	7	10	0	0.00	103.50	0.95	23.48	269.14	8.63E-10
		Rt= 0.956	dT = 1072.00 min				0.00	103.50	0.25 cc	0.12 cc	io =69.7	-93%
23	I	21.8	4/25/24	7	12	0	0.00	103.50	0.95	23.48	269.14	1.11E-09
	F	22.5	4/25/24	16	10	0	0.00	103.50	1.00	23.30	268.91	1.07E-09
		Rt= 0.952	dT = 538.00 min				0.00	103.50	0.05 cc	0.18 cc	io =69.6	-92%
24	I	22.5	4/25/24	16	10	0	0.00	103.50	1.00	23.30	268.91	1.22E-09
	F	21.5	4/26/24	6	19	0	0.00	103.50	1.30	23.20	268.51	1.18E-09
		Rt= 0.956	dT = 849.00 min				0.00	103.50	0.30 cc	0.10 cc	io =69.6	-91%
25-32	I	21.5	4/26/24	6	19	0	0.00	103.50	1.30	23.20	268.51	8.46E-10
	F	21.8	5/2/24	6	24	0	0.00	103.50	3.00	22.10	265.71	8.24E-10
		Rt= 0.964	dT = 8645.00 min				0.00	103.50	1.70 cc	1.10 cc	io =69.5	-94%
33-35	I	21.8	5/2/24	6	24	0	0.00	103.50	3.00	22.10	265.71	6.42E-10
	F	22.3	5/3/24	16	29	0	0.00	103.50	3.25	21.85	265.21	6.19E-10
		Rt= 0.954	dT = 2045.00 min				0.00	103.50	0.25 cc	0.25 cc	io =68.8	-95%
36-44	I	22.3	5/6/24	8	30	0	0.00	103.50	0.70	23.90	269.81	3.97E-10
	F	22.0	5/10/24	15	44	0	0.00	103.50	1.25	23.50	268.86	3.82E-10
		Rt= 0.952	dT = 6194.00 min				0.00	103.50	0.55 cc	0.40 cc	io =69.8	-97%
45-52	I	22.0	5/10/24	15	44	0	0.00	103.50	1.25	23.50	268.86	3.47E-10
	F	22.3	5/16/24	15	16	0	0.00	103.50	2.00	23.10	267.71	3.34E-10
		Rt= 0.952	dT = 8612.00 min				0.00	103.50	0.75 cc	0.40 cc	io =69.6	-97%
53-64	I	22.3	5/16/24	15	16	0	0.00	103.50	2.00	23.10	267.71	2.48E-10
	F	22.5	5/24/24	16	9	0	0.00	103.50	2.80	22.80	266.61	2.37E-10
		Rt= 0.946	dT = 11573.00 min				0.00	103.50	0.80 cc	0.30 cc	io =69.3	-98%
65-76	I	22.5	5/24/24	16	9	0	0.00	103.50	2.80	22.80	266.61	1.57E-10
	F	22.4	6/4/24	15	48	0	0.00	103.50	3.60	22.65	265.66	1.50E-10
		Rt= 0.945	dT = 15819.00 min				0.00	103.50	0.80 cc	0.15 cc	io =69.0	-99%
77-88	I	22.5	6/4/24	15	48	0	0.00	103.50	3.60	22.65	265.66	7.45E-11
	F	22.0	7/5/24	7	55	0	0.00	103.50	5.00	22.80	264.41	7.14E-11
		Rt= 0.949	dT = 44167.00 min				0.00	103.50	1.40 cc	-0.15 cc	io =68.7	-99%
89-97	I	22.0	7/5/24	7	55	0	0.00	103.50	5.00	22.80	264.41	4.80E-11
	F	25.8	7/24/24	9	57	0	0.00	103.50	5.50	22.80	263.91	4.41E-11
		Rt= 0.909	dT = 27482.00 min				0.00	103.50	0.50 cc	0.00 cc	io =68.4	-100%

PERMEABILITY TEST: FALLING HEAD - INCREASING TAILWATER

ASTM D 5084 - Method C

Project No. 23014938A

Clay Type: Attapulgite

Project Name: PoT - Former Arkema Manufacturing Mix water: 50/50

Final Specimen and Test Conditions

Lc = 3.816 cm $\epsilon_{axial} = 0.8\%$
 Ac = 47.321 cm²
 Vc = 180.56 cm³ $\epsilon_{vol} = -2.4\%$
 Vvoid 162.180 cm³

	w (%)	γ_t (pcf)	γ_d (pcf)	S (%)
Initial	310.52	72.1	17.6	97.5
PreTest	326.54	73.2	17.2	99.9

Test Operator: MB
 Reviewed By: DM

Specimen - Apparatus set-up - Test Information

- 1) Specimen Tested in : ☒ Triaxial Cell or ☐ Compaction Mold or ☐ top + bottom
☒ with stones or ☐ Stones with filter paper or ☐
 2) Specimen orientation for: ☒ Vertical or ☐ Horizontal permeability determination
 3) During saturation: Water flushed up sides of specimen to remove air: ☒ No ☐ Yes
 4) During consolidation: ☒ Top and bottom drainage or ☐ Top ☐ Bottom only
 5) Direction of permeant : ☒ Up during or ☐ Down during permeation
 6) Permeant used : ☐ Demineralized ☐ Distilled ☐ Tap or ☐
 or Groundwater

Stage No.:		16	σ_c	120.0	psi		System: p=pipette, a = annulus, b =both								
Apparatus No.		9	Ub	100.0	psi		Head Tube Area =				p	0.9979	cm ²		
Cell No.		D	$(\sigma'_c)_{max}= 20$ psi		$(\sigma'_c)_{min}= 16$ psi		$(\sigma'_c)_{av}= 18$ psi		Tail Tube Area =				p	0.9976	cm ²
Trial No.	Stage	Temp. ° C	Time				Influent Pressure Head		Fluid Head/ Vol. Reading		Flow Ratio in/out	Total Head (cm H2O) gradient	Permeability (cm/sec) Preliminary Final at 20°C Dev. from Start		
			Day	hour	minute	second	Mercury (inch)	Gage (psi)	Head (cm)/cc	Tail (cm)/cc					
1	I	22.8	4/15/24	10	24	0	0.00	103.50	0.60	23.81	1.06	269.82	1.85E-08		
	F	22.8	4/15/24	16	0	0	0.00	103.50	1.82	22.65		267.44	1.65E-08		
		Rt= 0.936	dT = 336.00 min				0.00	103.50	1.22 cc	1.15 cc		io =70.7	-		
2	I	22.8	4/15/24	16	0	0	0.00	103.50	1.82	22.65	1.14	267.44	1.39E-08		
	F	22.4	4/16/24	8	34	0	0.00	103.50	4.60	20.20		262.21	1.25E-08		
		Rt= 0.941	dT = 994.00 min				0.00	103.50	2.77 cc	2.43 cc		io =70.1	-25%		
3	I	22.4	4/16/24	8	34	0	0.00	103.50	4.60	20.20	1.48	262.21	1.21E-08		
	F	22.4	4/16/24	16	18	0	0.00	103.50	5.85	19.35		260.11	1.09E-08		
		Rt= 0.946	dT = 464.00 min				0.00	103.50	1.25 cc	0.84 cc		io =68.7	-34%		
4	I	22.4	4/16/24	16	23	0	0.00	103.50	1.68	24.12	1.15	269.05	8.33E-09		
	F	22.0	4/17/24	8	18	0	0.00	103.50	3.30	22.70		266.01	7.56E-09		
		Rt= 0.951	dT = 955.00 min				0.00	103.50	1.62 cc	1.41 cc		io =70.5	-55%		
5	I	22.0	4/17/24	8	18	0	0.00	103.50	3.30	22.70	1.01	266.01	6.60E-09		
	F	22.4	4/17/24	16	2	0	0.00	103.50	3.88	22.12		264.85	5.98E-09		
		Rt= 0.951	dT = 464.00 min				0.00	103.50	0.58 cc	0.57 cc		io =69.7	-64%		
6	I	22.4	4/17/24	16	3	0	0.00	103.50	1.20	24.18	1.03	269.59	6.25E-09		
	F	22.2	4/18/24	7	13	0	0.00	103.50	2.30	23.10		267.41	5.65E-09		
		Rt= 0.948	dT = 910.00 min				0.00	103.50	1.10 cc	1.07 cc		io =70.7	-66%		
7	I	22.2	4/18/24	7	14	0	0.00	103.50	2.30	23.10	1.01	267.41	5.90E-09		
	F	22.4	4/18/24	16	8	0	0.00	103.50	2.90	22.50		266.21	5.33E-09		
		Rt= 0.948	dT = 534.00 min				0.00	103.50	0.60 cc	0.59 cc		io =70.1	-68%		
8	I	22.4	4/18/24	16	9	0	0.00	103.50	2.90	22.50	1.21	266.21	5.02E-09		
	F	22.0	4/19/24	6	36	0	0.00	103.50	3.80	21.75		264.56	4.55E-09		
		Rt= 0.951	dT = 867.00 min				0.00	103.50	0.90 cc	0.74 cc		io =69.8	-73%		
9	I	22.0	4/19/24	6	38	0	0.00	103.50	3.80	21.75	0.33	264.56	9.25E-09		
	F	22.4	4/19/24	16	10	0	0.00	103.50	4.29	20.25		262.57	8.38E-09		
		Rt= 0.951	dT = 572.00 min				0.00	103.50	0.49 cc	1.49 cc		io =69.3	-50%		
10	I	21.6	4/22/24	7	57	0	0.00	103.50	0.80	24.20		270.01	3.44E-09		
	F	21.5	4/22/24	15	45	0	0.00	103.50	1.12	23.90		269.39	3.17E-09		

		Rt= 0.967	dT = 468.00 min				0.00	103.50	0.32 cc	0.30 cc	1.07	io =70.8	-81%
11	I	21.5	4/22/24	15	45	0	0.00	103.50	1.12	23.90		269.39	3.52E-09
	F	21.6	4/23/24	6	18	0	0.00	103.50	1.70	23.30		268.21	3.25E-09
		Rt= 0.967	dT = 873.00 min				0.00	103.50	0.58 cc	0.59 cc	0.97	io =70.6	-81%
12	I	21.6	4/23/24	6	19	0	0.00	103.50	1.70	23.30		268.21	3.90E-09
	F	22.5	4/23/24	13	1	0	0.00	103.50	2.00	23.00		267.61	3.55E-09
		Rt= 0.954	dT = 402.00 min				0.00	103.50	0.30 cc	0.30 cc	1.01	io =70.3	-79%
13	I	22.9	4/23/24	13	1	0	0.00	103.50	2.00	23.00		267.61	1.36E-09
	F	22.9	4/23/24	16	14	0	0.00	103.50	2.05	22.95		267.51	1.21E-09
		Rt= 0.933	dT = 193.00 min				0.00	103.50	0.05 cc	0.05 cc	1.01	io =70.1	-93%
14	I	22.3	4/24/24	6	40	0	0.00	103.50	2.60	22.50		266.51	2.86E-09
	F	22.5	4/24/24	16	29	0	0.00	103.50	2.89	22.15		265.87	2.58E-09
		Rt= 0.946	dT = 589.00 min				0.00	103.50	0.29 cc	0.35 cc	0.83	io =69.8	-85%
15	I	22.5	4/24/24	16	29	0	0.00	103.50	2.89	22.15		265.87	2.74E-09
	F	21.8	4/25/24	7	7	0	0.00	103.50	3.40	21.75		264.96	2.48E-09
		Rt= 0.952	dT = 878.00 min				0.00	103.50	0.51 cc	0.40 cc	1.28	io =69.7	-85%
16	I	21.8	4/25/24	7	9	0	0.00	103.50	3.40	21.75		264.96	2.21E-09
	F	22.5	4/25/24	16	7	0	0.00	103.50	3.60	21.50		264.51	2.01E-09
		Rt= 0.952	dT = 538.00 min				0.00	103.50	0.20 cc	0.25 cc	0.81	io =69.4	-88%
17	I	22.5	4/25/24	16	7	0	0.00	103.50	3.60	21.50		264.51	2.18E-09
	F	21.5	4/26/24	6	18	0	0.00	103.50	4.00	21.20		263.81	1.99E-09
		Rt= 0.956	dT = 851.00 min				0.00	103.50	0.40 cc	0.30 cc	1.34	io =69.3	-88%
18	I	21.5	4/26/24	6	18	0	0.00	103.50	4.00	21.20		263.81	3.04E-09
	F	22.2	4/26/24	16	31	0	0.00	103.50	4.30	20.80		263.11	2.78E-09
		Rt= 0.959	dT = 613.00 min				0.00	103.50	0.30 cc	0.40 cc	0.76	io =69.1	-84%
19	I	24.6	4/29/24	6	31	0	0.00	103.50	1.20	23.10		268.51	2.50E-09
	F	22.6	4/29/24	16	57	0	0.00	103.50	1.60	22.90		267.91	2.19E-09
		Rt= 0.916	dT = 626.00 min				0.00	103.50	0.40 cc	0.20 cc	2.02	io =70.4	-86%
20	I	22.6	4/29/24	16	57	0	0.00	103.50	1.60	22.90		267.91	1.30E-09
	F	22.0	4/30/24	6	22	0	0.00	103.50	1.90	22.80		267.51	1.18E-09
		Rt= 0.948	dT = 805.00 min				0.00	103.50	0.30 cc	0.10 cc	3.02	io =70.2	-93%
21	I	22.0	4/30/24	6	22	0	0.00	103.50	1.90	22.80		267.51	1.60E-09
	F	22.0	4/30/24	17	16	0	0.00	103.50	2.10	22.60		267.11	1.46E-09
		Rt= 0.956	dT = 654.00 min				0.00	103.50	0.20 cc	0.20 cc	1.01	io =70.1	-91%
22	I	22.0	4/30/24	17	16	0	0.00	103.50	2.10	22.60		267.11	1.93E-09
	F	22.0	5/1/24	6	51	0	0.00	103.50	2.40	22.30		266.51	1.76E-09
		Rt= 0.956	dT = 815.00 min				0.00	103.50	0.30 cc	0.30 cc	1.01	io =70.0	-90%
23	I	22.0	5/1/24	6	51	0	0.00	103.50	2.40	22.30		266.51	1.24E-09
	F	22.3	5/1/24	17	25	0	0.00	103.50	2.60	22.20		266.21	1.13E-09
		Rt= 0.952	dT = 634.00 min				0.00	103.50	0.20 cc	0.10 cc	2.02	io =69.8	-93%
24	I	22.3	5/1/24	17	25	0	0.00	103.50	2.60	22.20		266.21	1.36E-09
	F	21.8	5/2/24	6	21	0	0.00	103.50	2.80	22.00		265.81	1.24E-09
		Rt= 0.954	dT = 776.00 min				0.00	103.50	0.20 cc	0.20 cc	1.01	io =69.8	-93%
25	I	21.8	5/2/24	6	21	0	0.00	103.50	2.80	22.00		265.81	1.39E-09
	F	22.3	5/2/24	17	23	0	0.00	103.50	3.00	21.85		265.46	1.27E-09
		Rt= 0.954	dT = 662.00 min				0.00	103.50	0.20 cc	0.15 cc	1.34	io =69.7	-92%
26	I	22.3	5/2/24	17	23	0	0.00	103.50	3.00	21.85		265.46	1.18E-09
	F	22.0	5/3/24	6	26	0	0.00	103.50	3.20	21.70		265.11	1.07E-09
		Rt= 0.952	dT = 783.00 min				0.00	103.50	0.20 cc	0.15 cc	1.34	io =69.6	-94%
27	I	22.0	5/3/24	6	26	0	0.00	103.50	3.20	21.70		265.11	1.54E-09
	F	22.3	5/3/24	16	27	0	0.00	103.50	3.35	21.50		264.76	1.40E-09
		Rt= 0.952	dT = 601.00 min				0.00	103.50	0.15 cc	0.20 cc	0.76	io =69.5	-92%
28-39	I	22.3	5/6/24	8	58	0	0.00	103.50	1.10	23.30		268.81	8.45E-10
	F	21.7	5/13/24	6	20	0	0.00	103.50	2.95	21.95		265.61	7.70E-10
		Rt= 0.956	dT = 9922.00 min				0.00	103.50	1.85 cc	1.34 cc	1.38	io =70.4	-95%
40-46	I	21.7	5/14/24	6	20	0	0.00	103.50	2.95	21.95		265.61	4.98E-10
	F	22.3	5/17/24	15	40	0	0.00	103.50	3.52	21.60		264.69	4.54E-10
		Rt= 0.956	dT = 4880.00 min				0.00	103.50	0.57 cc	0.35 cc	1.64	io =69.6	-97%
47-48	I	22.0	5/20/24	8	57	0	0.00	103.50	3.85	23.05		265.81	3.03E-10
	F	21.7	5/21/24	6	44	0	0.00	103.50	3.95	23.00		265.66	2.77E-10
		Rt= 0.959	dT = 1307.00 min				0.00	103.50	0.10 cc	0.05 cc	2.02	io =69.7	-98%
49-50	I	22.5	5/21/24	15	57	0	0.00	103.50	4.00	23.70		266.31	4.64E-10
	F	22.5	5/22/24	15	34	0	0.00	103.50	4.20	23.65		266.06	4.18E-10
		Rt= 0.943	dT = 1417.00 min				0.00	103.50	0.20 cc	0.05 cc	4.03	io =69.8	-97%
51	I	22.3	5/23/24	8	10	0	0.00	103.50	1.00	20.90		266.51	8.10E-10
	F	22.3	5/23/24	16	17	0	0.00	103.50	1.15	20.90		266.36	7.32E-10
		Rt= 0.948	dT = 487.00 min				0.00	103.50	0.15 cc	0.00 cc	-	io =69.8	-96%
52-58	I	22.1	5/29/24	11	56	0	0.00	103.50	0.22	22.21		268.60	8.74E-10
	F	24.5	6/3/24	16	20	0	0.00	103.50	0.80	20.30		266.11	7.70E-10
		Rt= 0.924	dT = 7464.00 min				0.00	103.50	0.58 cc	1.89 cc	0.31	io =70.4	-95%

59-61	I	22.0	6/4/24	6	50	0	0.00	103.50	0.80	20.40		266.21	6.14E-11
	F	22.0	6/7/24	6	13	0	0.00	103.50	1.00	20.50		266.11	5.60E-11
		Rt= 0.956	dT = 4283.00 min				0.00	103.50	0.20 cc	-0.10 cc	-	io =69.8	-100%
65-74	I	23.7	6/18/24	9	13	0	0.00	103.50	1.50	20.70		265.81	4.55E-11
	F	22.0	7/12/24	11	25	0	0.00	103.50	2.10	21.90		266.41	4.06E-11
		Rt= 0.935	dT = 34692.00 min				0.00	103.50	0.60 cc	-1.19 cc	-	io =69.7	-100%
75-80	I	22.0	7/12/24	11	25	0	0.00	103.50	2.10	21.90		266.41	4.60E-11
	F	25.8	7/24/24	9	5	0	0.00	103.50	2.20	22.30		266.71	3.99E-11
		Rt= 0.909	dT = 17140.00 min				0.00	103.50	0.10 cc	-0.40 cc	-	io =69.8	-100%

PERMEABILITY TEST: FALLING HEAD - INCREASING TAILWATER

ASTM D 5084 - Method C

Project No. 23014938A

Clay Type: Attapulgite

Project Name: PoT - Former Arkema Manufacturing Mix water: GW

Final Specimen and Test Conditions

Lc = 3.421 cm $\epsilon_{axial} = 1.0\%$
 Ac = 46.910 cm²
 Vc = 160.50 cm³ $\epsilon_{vol} = -0.9\%$
 Vvoid 146.010 cm³

	w (%)	γ_t (pcf)	γ_d (pcf)	S (%)
Initial	321.65	68.3	16.2	91.8
PreTest	349.26	72.2	16.1	98.8

Test Operator: MB
 Reviewed By: DM

Specimen - Apparatus set-up - Test Information

- 1) Specimen Tested in : ☒ Triaxial Cell or ☐ Compaction Mold or ☐ top + bottom
☒ with stones or ☐ Stones with filter paper or ☐
 2) Specimen orientation for: ☒ Vertical or ☐ Horizontal permeability determination
 3) During saturation: Water flushed up sides of specimen to remove air: ☒ No ☐ Yes
 4) During consolidation: ☒ Top and bottom drainage or ☐ Top ☐ Bottom only
 5) Direction of permeant : ☒ Up during or ☐ Down during permeation
 6) Permeant used : ☐ Demineralized ☐ Distilled ☐ Tap or ☐
 or Groundwater

Stage No.:		16	σ_c	120.0	psi		System: p=pipette, a = annulus, b =both						
Apparatus No.		9	Ub	100.0	psi		Head Tube Area =				p	0.9979	cm ²
Cell No.		D	$(\sigma'_c)_{max}= 20$ psi		$(\sigma'_c)_{min}= 16$ psi		$(\sigma'_c)_{av}= 18$ psi		Tail Tube Area =		p	0.9976	cm ²
Trial No.	Stage	Temp. ° C	Time				Influent Pressure Head		Fluid Head/ Vol. Reading		Flow Ratio in/out	Total Head (cm H2O) gradient	Permeability (cm/sec) Preliminary Final at 20°C Dev. from Start
			Day	hour	minute	second	Mercury (inch)	Gage (psi)	Head (cm)/cc	Tail (cm)/cc			
1	I	22.7	4/8/24	12	28	0	0.00	103.50	1.10	22.70	1.04	268.21	2.23E-07
	F	22.7	4/8/24	13	31	0	0.00	103.50	4.11	19.80		262.30	2.01E-07
		Rt= 0.938	dT = 63.00 min				0.00	103.50	3.00 cc	2.89 cc		io =78.4	-
2	I	22.7	4/8/24	13	31	0	0.00	103.50	4.11	19.79	1.00	262.29	2.14E-07
	F	22.7	4/8/24	14	55	0	0.00	103.50	7.80	16.11		254.92	1.93E-07
		Rt= 0.938	dT = 84.00 min				0.00	103.50	3.68 cc	3.67 cc		io =76.7	-4%
3	I	22.7	4/8/24	14	56	0	0.00	103.50	7.80	16.11	1.00	254.92	2.02E-07
	F	22.7	4/8/24	15	43	0	0.00	103.50	9.70	14.20		251.11	1.82E-07
		Rt= 0.938	dT = 47.00 min				0.00	103.50	1.90 cc	1.90 cc		io =74.5	-9%
4	I	22.6	4/9/24	8	3	0	0.00	103.50	2.10	22.82	1.09	267.33	1.93E-07
	F	22.6	4/9/24	8	50	0	0.00	103.50	4.09	20.99		263.51	1.75E-07
		Rt= 0.941	dT = 47.00 min				0.00	103.50	1.99 cc	1.83 cc		io =78.1	-13%
5	I	22.6	4/9/24	8	53	0	0.00	103.50	4.10	20.90	1.05	263.41	1.88E-07
	F	22.6	4/9/24	9	51	0	0.00	103.50	6.40	18.70		258.91	1.69E-07
		Rt= 0.941	dT = 58.00 min				0.00	103.50	2.30 cc	2.19 cc		io =77.0	-16%
6	I	22.6	4/9/24	9	52	0	0.00	103.50	6.40	22.30	1.03	262.51	1.81E-07
	F	22.6	4/9/24	11	25	0	0.00	103.50	9.90	18.91		255.62	1.63E-07
		Rt= 0.941	dT = 93.00 min				0.00	103.50	3.49 cc	3.38 cc		io =76.7	-19%
7	I	22.6	4/9/24	11	26	0	0.00	103.50	9.90	23.95	1.01	260.66	1.79E-07
	F	22.6	4/9/24	12	27	0	0.00	103.50	12.15	21.72		256.18	1.62E-07
		Rt= 0.941	dT = 61.00 min				0.00	103.50	2.25 cc	2.22 cc		io =76.2	-20%
8	I	22.6	4/9/24	12	28	0	0.00	103.50	1.40	21.70	1.01	266.91	1.79E-07
	F	22.6	4/9/24	13	29	0	0.00	103.50	3.70	19.42		262.33	1.62E-07
		Rt= 0.941	dT = 61.00 min				0.00	103.50	2.30 cc	2.27 cc		io =78.0	-20%
9	I	22.6	4/10/24	8	13	0	0.00	103.50	3.82	22.60	0.95	265.39	1.00E-07
	F	22.6	4/10/24	9	23	0	0.00	103.50	5.25	21.10		262.46	9.05E-08
		Rt= 0.941	dT = 70.00 min				0.00	103.50	1.43 cc	1.50 cc		io =77.6	-55%
10	I	22.6	4/9/24	9	24	0	0.00	103.50	1.22	24.30		269.69	1.71E-07
	F	22.6	4/9/24	10	27	0	0.00	103.50	3.58	22.10		265.13	1.54E-07

		Rt= 0.941	dT = 63.00 min			0.00	103.50	2.36 cc	2.19 cc	1.07	io =78.8	-23%
11	I	22.6	4/9/24	10	29	0	0.00	103.50	3.58	23.70	266.73	1.18E-07
	F	22.6	4/9/24	11	42	0	0.00	103.50	6.50	23.00	263.11	1.07E-07
		Rt= 0.941	dT = 73.00 min				0.00	103.50	2.91 cc	0.70 cc	4.17	io =78.0
12	I	22.6	4/9/24	13	0	0	0.00	103.50	1.40	20.08	265.29	1.45E-07
	F	22.6	4/9/24	13	51	0	0.00	103.50	3.60	19.20	262.21	1.31E-07
		Rt= 0.941	dT = 51.00 min				0.00	103.50	2.20 cc	0.88 cc	2.50	io =77.5
13	I	22.7	4/11/24	11	18	0	0.00	103.50	2.08	22.60	267.13	1.40E-07
	F	22.7	4/11/24	12	48	30	0.00	103.50	4.80	20.00	261.81	1.26E-07
		Rt= 0.938	dT = 90.50 min				0.00	103.50	2.71 cc	2.59 cc	1.05	io =78.1
14	I	22.7	4/11/24	12	50	0	0.00	103.50	1.32	22.15	267.44	1.37E-07
	F	22.7	4/11/24	14	4	0	0.00	103.50	3.52	20.10	263.19	1.23E-07
		Rt= 0.938	dT = 74.00 min				0.00	103.50	2.20 cc	2.04 cc	1.07	io =78.2
15	I	22.7	4/11/24	14	5	0	0.00	103.50	3.52	22.95	266.04	1.35E-07
	F	22.7	4/11/24	15	37	0	0.00	103.50	6.12	20.35	260.84	1.22E-07
		Rt= 0.938	dT = 92.00 min				0.00	103.50	2.60 cc	2.59 cc	1.00	io =77.8
16	I	23.0	4/12/24	7	59	0	0.00	103.50	2.10	23.20	267.71	1.39E-07
	F	23.0	4/12/24	9	23	0	0.00	103.50	4.60	20.78	262.79	1.25E-07
		Rt= 0.931	dT = 84.00 min				0.00	103.50	2.50 cc	2.41 cc	1.03	io =78.2
17	I	23.0	4/12/24	9	51	0	0.00	103.50	4.68	23.20	265.13	1.35E-07
	F	23.0	4/12/24	11	38	0	0.00	103.50	7.70	20.20	259.11	1.21E-07
		Rt= 0.931	dT = 107.00 min				0.00	103.50	3.01 cc	2.99 cc	1.01	io =77.5
18	I	23.0	4/12/24	11	40	0	0.00	103.50	2.00	22.80	267.41	1.28E-07
	F	23.0	4/12/24	13	4	0	0.00	103.50	4.30	20.60	262.91	1.14E-07
		Rt= 0.931	dT = 84.00 min				0.00	103.50	2.30 cc	2.19 cc	1.05	io =78.2
19	I	23.1	4/12/24	13	15	0	0.00	103.50	1.60	23.20	268.21	1.30E-07
	F	23.1	4/12/24	14	25	0	0.00	103.50	3.55	21.32	264.38	1.16E-07
		Rt= 0.929	dT = 70.00 min				0.00	103.50	1.95 cc	1.87 cc	1.04	io =78.4
20	I	23.1	4/12/24	14	27	0	0.00	103.50	2.05	22.80	267.36	1.25E-07
	F	23.1	4/12/24	15	48	0	0.00	103.50	4.21	20.70	263.10	1.12E-07
		Rt= 0.929	dT = 81.00 min				0.00	103.50	2.16 cc	2.09 cc	1.03	io =78.1
21	I	22.8	4/15/24	8	5	0	0.00	103.50	1.65	23.21	268.17	1.30E-07
	F	22.8	4/15/24	9	19	0	0.00	103.50	3.90	21.40	264.11	1.17E-07
		Rt= 0.936	dT = 74.00 min				0.00	103.50	2.25 cc	1.81 cc	1.24	io =78.4
22	I	22.8	4/15/24	9	27	0	0.00	103.50	1.95	23.40	268.06	1.13E-07
	F	22.8	4/15/24	11	20	0	0.00	103.50	4.75	20.85	262.71	1.01E-07
		Rt= 0.936	dT = 113.00 min				0.00	103.50	2.79 cc	2.54 cc	1.10	io =78.3
23	I	22.8	4/15/24	11	20	0	0.00	103.50	1.62	23.13	268.12	1.14E-07
	F	22.8	4/15/24	12	35	0	0.00	103.50	3.51	21.40	264.50	1.03E-07
		Rt= 0.936	dT = 75.00 min				0.00	103.50	1.89 cc	1.73 cc	1.09	io =78.4
24	I	22.8	4/15/24	12	44	0	0.00	103.50	3.62	23.75	266.74	1.11E-07
	F	22.8	4/15/24	14	17	0	0.00	103.50	5.80	21.60	262.41	9.99E-08
		Rt= 0.936	dT = 93.00 min				0.00	103.50	2.18 cc	2.14 cc	1.01	io =78.0
25	I	22.8	4/15/24	14	20	0	0.00	103.50	1.42	23.70	268.89	1.11E-07
	F	22.8	4/15/24	15	49	0	0.00	103.50	3.55	21.65	264.71	9.99E-08
		Rt= 0.936	dT = 89.00 min				0.00	103.50	2.13 cc	2.04 cc	1.04	io =78.6
26	I	22.4	4/16/24	8	30	0	0.00	103.50	1.61	23.40	268.40	1.09E-07
	F	22.4	4/16/24	10	36	0	0.00	103.50	4.60	20.60	262.61	9.93E-08
		Rt= 0.946	dT = 126.00 min				0.00	103.50	2.98 cc	2.79 cc	1.07	io =78.4
27	I	22.4	4/16/24	10	38	0	0.00	103.50	2.41	22.62	266.82	1.08E-07
	F	22.4	4/16/24	12	26	0	0.00	103.50	4.91	20.25	261.95	9.78E-08
		Rt= 0.946	dT = 108.00 min				0.00	103.50	2.50 cc	2.36 cc	1.06	io =78.0
28	I	22.4	4/16/24	12	28	0	0.00	103.50	2.22	22.18	266.57	1.08E-07
	F	22.4	4/16/24	14	51	0	0.00	103.50	5.60	19.10	260.11	9.84E-08
		Rt= 0.946	dT = 143.00 min				0.00	103.50	3.37 cc	3.07 cc	1.10	io =77.9
29	I	22.0	4/17/24	8	24	0	0.00	103.50	2.35	23.01	267.27	1.09E-07
	F	22.4	4/17/24	10	24	0	0.00	103.50	5.40	20.60	261.81	9.92E-08
		Rt= 0.951	dT = 120.00 min				0.00	103.50	3.04 cc	2.40 cc	1.27	io =78.1
30	I	22.4	4/17/24	10	28	0	0.00	103.50	1.75	23.20	268.06	9.85E-08
	F	22.4	4/17/24	12	37	0	0.00	103.50	4.51	20.62	262.72	8.95E-08
		Rt= 0.946	dT = 129.00 min				0.00	103.50	2.75 cc	2.57 cc	1.07	io =78.3
31	I	22.3	4/18/24	8	2	0	0.00	103.50	1.71	22.60	267.50	9.99E-08
	F	22.4	4/18/24	9	55	0	0.00	103.50	4.15	20.30	262.76	9.09E-08
		Rt= 0.947	dT = 113.00 min				0.00	103.50	2.44 cc	2.29 cc	1.06	io =78.2
32	I	22.4	4/18/24	9	56	0	0.00	103.50	2.29	22.29	266.61	2.61E-07
	F	22.4	4/18/24	10	50	30	0.00	103.50	7.22	21.28	260.67	2.37E-07
		Rt= 0.946	dT = 54.50 min				0.00	103.50	4.92 cc	1.01 cc	4.89	io =77.9
33	I	22.4	4/18/24	10	54	60	0.00	103.50	1.81	22.51	267.31	9.42E-08
	F	22.4	4/18/24	13	24	0	0.00	103.50	4.80	19.62	261.43	8.56E-08
		Rt= 0.946	dT = 149.00 min				0.00	103.50	2.98 cc	2.88 cc	1.04	io =78.1

34	I	22.0	4/19/24	0	0	0	0.00	102.50	2.01	22.88		197.02	1.63E-07
	F	22.0	4/19/24	1	9	0	0.00	102.50	4.30	21.68		193.53	1.50E-07
		Rt= 0.956	dT = 69.00 min				0.00	102.50	2.29 cc	1.20 cc	1.91	io =57.6	-27%
35	I	22.0	4/19/24	0	0	0	0.00	102.50	1.70	23.50		197.95	1.20E-08
	F	22.5	4/19/24	2	10	0	0.00	102.50	0.01	21.32		197.46	1.10E-08
		Rt= 0.949	dT = 130.00 min				0.00	102.50	-1.69 cc	2.17 cc	-0.78	io =57.9	-95%
36	I	22.5	4/19/24	0	0	0	0.00	102.50	1.80	22.70		197.05	1.37E-07
	F	22.5	4/19/24	1	31	0	0.00	102.50	4.15	21.19		193.19	1.24E-07
		Rt= 0.943	dT = 91.00 min				0.00	102.50	2.35 cc	1.51 cc	1.56	io =57.6	-39%
37	I	22.5	4/19/24	0	0	0	0.00	102.50	4.18	23.48		195.45	1.22E-07
	F	22.5	4/19/24	2	37	0	0.00	102.50	7.40	20.85		189.60	1.11E-07
		Rt= 0.943	dT = 157.00 min				0.00	102.50	3.21 cc	2.62 cc	1.23	io =57.1	-45%
38	I	21.6	4/22/24	0	0	0	0.00	102.50	1.80	24.20		198.55	1.10E-07
	F	21.6	4/22/24	1	54	0	0.00	102.50	3.81	22.29		194.63	1.02E-07
		Rt= 0.965	dT = 114.00 min				0.00	102.50	2.01 cc	1.90 cc	1.05	io =58.0	-51%
39	I	21.6	4/22/24	0	0	0	0.00	102.50	2.02	23.78		197.91	2.52E-07
	F	21.6	4/22/24	1	14	0	0.00	102.50	6.65	22.65		192.15	2.34E-07
		Rt= 0.965	dT = 74.00 min				0.00	102.50	4.62 cc	1.13 cc	4.10	io =57.8	13%
40	I	21.6	4/22/24	0	0	0	0.00	102.50	2.00	23.35		197.50	1.92E-07
	F	21.6	4/22/24	1	21	0	0.00	102.50	5.60	22.15		192.70	1.78E-07
		Rt= 0.965	dT = 81.00 min				0.00	102.50	3.59 cc	1.20 cc	3.00	io =57.7	-14%
43	I	22.2	4/26/24	0	0	0	0.00	102.50	1.45	23.55		198.25	1.39E-07
	F	22.2	4/26/24	1	1	0	0.00	102.50	2.99	22.45		195.61	1.27E-07
		Rt= 0.951	dT = 61.00 min				0.00	102.50	1.54 cc	1.10 cc	1.40	io =57.9	-38%
44	I	24.6	4/29/24	0	0	0	0.00	102.50	1.70	24.30		198.75	7.80E-08
	F	22.8	4/29/24	2	36	10	0.00	102.50	3.70	22.50		194.95	6.85E-08
		Rt= 0.914	dT = 156.17 min				0.00	102.50	2.00 cc	1.80 cc	1.11	io =58.1	-65%
45	I	22.8	4/29/24	0	0	0	0.00	102.50	1.10	24.30		199.35	8.18E-08
	F	22.8	4/29/24	2	36	21	0.00	102.50	3.20	22.40		195.35	7.36E-08
		Rt= 0.936	dT = 156.35 min				0.00	102.50	2.10 cc	1.89 cc	1.11	io =58.3	-63%
46	I	22.0	4/30/24	0	0	0	0.00	102.50	1.10	24.30		199.35	7.82E-08
	F	22.2	4/30/24	2	39	27	0.00	102.50	3.10	22.40		195.45	7.16E-08
		Rt= 0.953	dT = 159.45 min				0.00	102.50	2.00 cc	1.89 cc	1.05	io =58.3	-65%
47	I	22.2	4/30/24	0	0	0	0.00	102.50	0.90	24.20		199.45	9.54E-08
	F	22.3	4/30/24	1	53	49	0.00	102.50	3.00	22.90		196.05	8.70E-08
		Rt= 0.949	dT = 113.82 min				0.00	102.50	2.10 cc	1.30 cc	1.62	io =58.3	-57%
48	I	22.3	4/30/24	0	0	0	0.00	102.50	1.00	24.20		199.35	8.80E-08
	F	22.9	4/30/24	2	18	7	0.00	102.50	3.10	22.50		195.55	7.95E-08
		Rt= 0.941	dT = 138.12 min				0.00	102.50	2.10 cc	1.70 cc	1.24	io =58.3	-61%
49	I	22.1	4/30/24	0	0	0	0.00	102.50	1.20	24.00		198.95	1.50E-07
	F	22.1	4/30/24	0	55	32	0.00	102.50	3.20	23.40		196.35	1.37E-07
		Rt= 0.953	dT = 55.53 min				0.00	102.50	2.00 cc	0.60 cc	3.34	io =58.1	-33%
50	I	22.1	4/30/24	0	0	0	0.00	102.50	1.10	24.30		199.35	1.70E-07
	F	22.1	4/30/24	0	48	48	0.00	102.50	3.10	23.70		196.75	1.55E-07
		Rt= 0.953	dT = 48.80 min				0.00	102.50	2.00 cc	0.60 cc	3.34	io =58.3	-24%
51	I	22.0	4/30/24	0	0	60	0.00	102.50	1.10	24.00		199.05	1.37E-07
	F	22.2	4/30/24	1	3	52	0.00	102.50	3.10	23.30		196.35	1.26E-07
		Rt= 0.953	dT = 62.87 min				0.00	102.50	2.00 cc	0.70 cc	2.86	io =58.2	-39%
52	I	22.2	5/2/24	0	0	0	0.00	102.50	1.25	24.20		199.10	1.64E-07
	F	22.3	5/2/24	0	59	29	0.00	102.50	3.40	23.30		196.05	1.49E-07
		Rt= 0.949	dT = 59.48 min				0.00	102.50	2.15 cc	0.90 cc	2.39	io =58.2	-27%
53	I	22.3	5/2/24	0	0	0	0.00	102.50	1.10	24.30		199.35	2.18E-07
	F	22.0	5/2/24	0	55	51	0.00	102.50	4.10	23.50		195.55	1.99E-07
		Rt= 0.952	dT = 55.85 min				0.00	102.50	2.99 cc	0.80 cc	3.75	io =58.3	-3%
54	I	22.0	5/2/24	11	59	0	0.00	102.50	1.00	24.30		199.45	1.44E-07
	F	22.1	5/2/24	13	12	0	0.00	102.50	3.20	23.20		196.15	1.32E-07
		Rt= 0.954	dT = 73.00 min				0.00	102.50	2.20 cc	1.10 cc	2.00	io =58.3	-35%
55	I	22.1	5/2/24	13	14	0	0.00	102.50	0.90	24.20		199.45	1.11E-07
	F	22.3	5/2/24	14	58	0	0.00	102.50	3.00	22.70		195.85	1.01E-07
		Rt= 0.951	dT = 104.00 min				0.00	102.50	2.10 cc	1.50 cc	1.40	io =58.3	-50%
56	I	22.3	5/2/24	15	1	0	0.00	102.50	1.05	23.90		199.00	9.92E-08
	F	22.3	5/2/24	17	7	0	0.00	102.50	3.25	22.20		195.10	9.03E-08
		Rt= 0.948	dT = 126.00 min				0.00	102.50	2.20 cc	1.70 cc	1.30	io =58.2	-56%
57	I	22.3	5/3/24	8	11	0	0.00	102.50	1.10	23.90		198.95	1.02E-07
	F	22.3	5/3/24	10	7	0	0.00	102.50	3.20	22.30		195.25	9.31E-08
		Rt= 0.948	dT = 116.00 min				0.00	102.50	2.10 cc	1.60 cc	1.31	io =58.1	-54%
58	I	22.3	5/3/24	10	10	0	0.00	102.50	1.10	23.90		198.95	8.84E-08
	F	22.3	5/3/24	13	8	0	0.00	102.50	3.60	21.50		194.05	8.06E-08
		Rt= 0.948	dT = 178.00 min				0.00	102.50	2.50 cc	2.39 cc	1.04	io =58.1	-60%
59	I	22.3	5/3/24	13	11	0	0.00	102.50	1.10	23.90		198.95	1.21E-07

	F	22.4	5/3/24	14	30	30	0.00	102.50	3.10	22.90		195.95	1.10E-07
		Rt= 0.947	dT =	79.50 min			0.00	102.50	2.00 cc	1.00 cc	2.00	io =58.1	-46%
60	I	22.4	5/3/24	14	33	60	0.00	102.50	1.10	23.95		199.00	6.80E-08
	F	22.4	5/3/24	16	48	0	0.00	102.50	3.10	23.10		196.15	6.17E-08
		Rt= 0.946	dT =	134.00 min			0.00	102.50	2.00 cc	0.85 cc	2.35	io =58.2	-70%
61	I	22.3	5/6/24	8	43	0	0.00	102.50	1.80	24.00		198.35	7.84E-08
	F	22.0	5/6/24	11	27	0	0.00	102.50	3.80	22.00		194.35	7.17E-08
		Rt= 0.952	dT =	164.00 min			0.00	102.50	2.00 cc	1.99 cc	1.00	io =58.0	-65%
62	I	22.0	5/6/24	11	46	0	0.00	102.50	1.59	23.72		198.28	1.19E-07
	F	22.0	5/6/24	13	49	0	0.00	102.50	4.60	22.20		193.75	1.09E-07
		Rt= 0.956	dT =	123.00 min			0.00	102.50	3.00 cc	1.52 cc	1.98	io =58.0	-47%
63	I	22.0	5/6/24	14	0	0	0.00	102.50	1.10	23.90		198.95	9.90E-08
	F	22.1	5/6/24	15	45	0	0.00	102.50	3.10	22.65		195.70	9.08E-08
		Rt= 0.954	dT =	105.00 min			0.00	102.50	2.00 cc	1.25 cc	1.60	io =58.1	-56%
64	I	22.3	5/9/24	8	28	0	0.00	102.50	6.70	22.70		192.15	7.42E-08
	F	22.2	5/9/24	11	27	0	0.00	102.50	8.70	20.70		188.15	6.77E-08
		Rt= 0.949	dT =	179.00 min			0.00	102.50	2.00 cc	1.99 cc	1.00	io =56.2	-67%
65	I	22.2	5/9/24	11	31	0	0.00	102.50	2.00	23.00		197.15	8.08E-08
	F	22.3	5/9/24	13	57	0	0.00	102.50	4.00	21.35		193.50	7.37E-08
		Rt= 0.949	dT =	146.00 min			0.00	102.50	2.00 cc	1.65 cc	1.21	io =57.6	-64%
66	I	21.7	5/10/24	8	47	0	0.00	102.50	6.70	22.65		192.10	1.43E-07
	F	21.7	5/10/24	9	59	0	0.00	102.50	9.00	21.85		189.00	1.32E-07
		Rt= 0.963	dT =	72.00 min			0.00	102.50	2.30 cc	0.80 cc	2.88	io =56.1	-36%
67	I	22.2	5/13/24	8	37	0	0.00	102.50	1.15	24.00		199.00	6.52E-08
	F	22.2	5/13/24	12	1	0	0.00	102.50	3.30	22.00		194.85	5.96E-08
		Rt= 0.951	dT =	204.00 min			0.00	102.50	2.15 cc	1.99 cc	1.08	io =58.2	-71%
68	I	22.2	5/13/24	12	1	0	0.00	102.50	3.30	22.00		194.85	6.20E-08
	F	22.2	5/13/24	15	21	30	0.00	102.50	5.20	20.10		191.05	5.66E-08
		Rt= 0.951	dT =	200.50 min			0.00	102.50	1.90 cc	1.89 cc	1.00	io =57.0	-72%
70	I	22.2	5/14/24	8	6	0	0.00	102.50	5.28	20.10		190.97	6.29E-08
	F	22.2	5/14/24	10	55	0	0.00	102.50	6.88	18.51		187.78	5.75E-08
		Rt= 0.951	dT =	169.00 min			0.00	102.50	1.60 cc	1.59 cc	1.01	io =55.8	-72%
71	I	22.2	5/14/24	10	55	0	0.00	102.50	6.88	18.51		187.78	5.98E-08
	F	22.2	5/14/24	16	22	0	0.00	102.50	9.80	15.70		182.05	5.46E-08
		Rt= 0.951	dT =	327.00 min			0.00	102.50	2.91 cc	2.80 cc	1.04	io =54.9	-73%
72	I	22.1	5/15/24	9	4	0	0.00	102.50	1.90	23.90		198.15	1.04E-07
	F	22.1	5/15/24	10	41	0	0.00	102.50	4.10	22.95		195.00	9.55E-08
		Rt= 0.953	dT =	97.00 min			0.00	102.50	2.20 cc	0.95 cc	2.32	io =57.9	-53%
73	I	22.3	5/15/24	10	44	0	0.00	102.50	4.15	22.90		194.90	8.10E-08
	F	22.1	5/15/24	12	49	0	0.00	102.50	6.20	21.85		191.80	7.39E-08
		Rt= 0.951	dT =	125.00 min			0.00	102.50	2.05 cc	1.05 cc	1.95	io =57.0	-64%
74	I	21.8	5/16/24	8	56	0	0.00	102.50	1.20	23.90		198.85	3.95E-07
	F	21.8	5/16/24	9	24	0	0.00	102.50	4.45	23.70		195.40	3.64E-07
		Rt= 0.960	dT =	28.00 min			0.00	102.50	3.24 cc	0.20 cc	16.26	io =58.1	77%
75	I	21.8	5/16/24	9	27	0	0.00	102.50	4.60	23.70		195.25	3.07E-07
	F	21.8	5/16/24	10	15	0	0.00	102.50	8.70	23.30		190.75	2.83E-07
		Rt= 0.960	dT =	48.00 min			0.00	102.50	4.09 cc	0.40 cc	10.26	io =57.1	37%
77	I	21.9	5/17/24	10	46	0	0.00	102.50	1.95	21.70		195.90	4.66E-08
	F	22.3	5/17/24	15	51	30	0.00	102.50	3.90	19.28		191.53	4.27E-08
		Rt= 0.953	dT =	305.50 min			0.00	102.50	1.95 cc	2.41 cc	0.81	io =57.3	-79%
78	I	22.0	5/20/24	9	0	60	0.00	102.50	1.40	23.90		198.65	5.78E-08
	F	22.0	5/20/24	12	32	0	0.00	102.50	3.60	22.30		194.85	5.30E-08
		Rt= 0.956	dT =	211.00 min			0.00	102.50	2.20 cc	1.60 cc	1.38	io =58.1	-74%
79	I	22.2	5/20/24	12	35	0	0.00	102.50	3.60	22.30		194.85	4.93E-08
	F	22.3	5/20/24	16	47	0	0.00	102.50	5.60	20.50		191.05	4.50E-08
		Rt= 0.949	dT =	252.00 min			0.00	102.50	2.00 cc	1.80 cc	1.11	io =57.0	-78%
80	I	22.0	5/21/24	9	0	0	0.00	102.50	1.60	24.00		198.55	5.46E-08
	F	22.0	5/21/24	13	2	0	0.00	102.50	4.00	22.29		194.44	5.01E-08
		Rt= 0.956	dT =	242.00 min			0.00	102.50	2.40 cc	1.71 cc	1.40	io =58.0	-76%
81	I	22.0	5/21/24	13	2	0	0.00	102.50	4.00	22.29		194.44	4.60E-08
	F	22.5	5/21/24	16	38	0	0.00	102.50	5.60	20.85		191.40	4.20E-08
		Rt= 0.949	dT =	216.00 min			0.00	102.50	1.60 cc	1.44 cc	1.11	io =56.8	-79%
82	I	22.3	5/22/24	8	14	0	0.00	102.50	5.70	20.80		191.25	4.71E-08
	F	22.3	5/22/24	10	42	0	0.00	102.50	6.80	19.80		189.15	4.29E-08
		Rt= 0.948	dT =	148.00 min			0.00	102.50	1.10 cc	1.00 cc	1.10	io =55.9	-79%
83	I	22.3	5/22/24	10	42	0	0.00	102.50	6.80	19.80		189.15	4.45E-08
	F	22.5	5/22/24	15	30	0	0.00	102.50	8.70	17.90		185.35	4.04E-08
		Rt= 0.946	dT =	288.00 min			0.00	102.50	1.90 cc	1.89 cc	1.00	io =55.3	-80%
84	I	22.3	5/23/24	8	1	0	0.00	102.50	8.80	17.90		185.25	4.36E-08
	F	22.3	5/23/24	16	14	0	0.00	102.50	11.90	14.80		179.05	3.97E-08

		Rt= 0.948	dT = 493.00 min				0.00	102.50	3.09 cc	3.09 cc	1.00	io =54.1	-80%
85	I	22.1	5/24/24	8	9	0	0.00	102.50	2.82	23.10		196.43	9.19E-08
	F	22.1	5/24/24	10	51	0	0.00	102.50	6.30	22.00		191.85	8.42E-08
		Rt= 0.953	dT = 162.00 min				0.00	102.50	3.47 cc	1.10 cc	3.17	io =57.4	-59%
86	I	22.1	5/24/24	10	53	0	0.00	102.50	6.30	22.00		191.85	4.02E-08
	F	22.5	5/24/24	16	7	30	0.00	102.50	8.30	20.20		188.05	3.66E-08
		Rt= 0.948	dT = 314.50 min				0.00	102.50	2.00 cc	1.80 cc	1.11	io =56.1	-82%
87	I	22.2	5/28/24	8	51	60	0.00	102.50	1.10	24.00		199.05	4.42E-08
	F	22.5	5/28/24	12	58	0	0.00	102.50	3.10	22.60		195.65	4.02E-08
		Rt= 0.947	dT = 246.00 min				0.00	102.50	2.00 cc	1.40 cc	1.43	io =58.2	-80%
88	I	22.5	5/28/24	12	58	0	0.00	102.50	3.10	22.60		195.65	3.60E-08
	F	22.4	5/28/24	16	7	0	0.00	102.50	4.20	21.60		193.55	3.27E-08
		Rt= 0.945	dT = 189.00 min				0.00	102.50	1.10 cc	1.00 cc	1.10	io =57.2	-84%
89	I	22.5	5/29/24	9	20	0	0.00	102.50	4.85	21.60		192.90	3.44E-08
	F	22.5	5/29/24	16	18	0	0.00	102.50	7.10	19.50		188.55	3.12E-08
		Rt= 0.943	dT = 418.00 min				0.00	102.50	2.25 cc	2.09 cc	1.07	io =56.4	-85%
90	I	22.0	5/30/24	7	58	0	0.00	102.50	7.40	19.50		188.25	3.21E-08
	F	22.3	5/30/24	15	22	0	0.00	102.50	9.60	17.50		184.05	2.93E-08
		Rt= 0.952	dT = 444.00 min				0.00	102.50	2.20 cc	1.99 cc	1.10	io =55.0	-86%
91	I	22.3	5/31/24	8	8	0	0.00	102.50	1.20	23.90		198.85	4.32E-08
	F	22.4	5/31/24	15	43	0	0.00	102.50	5.30	21.90		192.75	3.93E-08
		Rt= 0.947	dT = 455.00 min				0.00	102.50	4.09 cc	1.99 cc	2.05	io =58.1	-81%
93	I	22.3	6/3/24	10	23	0	0.00	102.50	1.10	24.00		199.05	4.90E-08
	F	24.5	6/3/24	16	17	0	0.00	102.50	4.90	22.40		193.65	4.34E-08
		Rt= 0.921	dT = 354.00 min				0.00	102.50	3.79 cc	1.60 cc	2.38	io =58.2	-78%
94	I	22.3	6/4/24	8	1	0	0.00	102.50	5.40	22.50		193.25	2.61E-08
	F	22.4	6/4/24	15	42	0	0.00	102.50	7.35	20.80		189.60	2.38E-08
		Rt= 0.947	dT = 461.00 min				0.00	102.50	1.95 cc	1.70 cc	1.15	io =56.5	-88%
95	I	21.9	6/5/24	7	49	0	0.00	102.50	7.80	20.80		189.15	2.57E-08
	F	22.5	6/5/24	16	33	30	0.00	102.50	9.95	18.95		185.15	2.35E-08
		Rt= 0.951	dT = 524.50 min				0.00	102.50	2.15 cc	1.85 cc	1.16	io =55.3	-88%
97-98	I	22.1	6/7/24	8	12	0	0.00	102.50	11.00	22.20		187.35	3.25E-08
	F	22.5	6/7/24	16	15	0	0.00	102.50	14.10	20.70		182.75	2.96E-08
		Rt= 0.948	dT = 483.00 min				0.00	102.50	3.09 cc	1.50 cc	2.07	io =54.8	-85%
99-102	I	21.9	6/11/24	9	27	0	0.00	102.50	1.40	23.80		198.55	9.68E-08
	F	22.5	6/11/24	15	18	0	0.00	102.50	10.60	22.60		188.15	8.84E-08
		Rt= 0.951	dT = 351.00 min				0.00	102.50	9.18 cc	1.20 cc	7.67	io =58.0	-57%
103	I	22.2	6/12/24	7	58	0	0.00	102.50	1.20	24.20		199.15	1.61E-08
	F	22.6	6/12/24	16	32	0	0.00	102.50	2.50	22.90		196.55	1.47E-08
		Rt= 0.946	dT = 514.00 min				0.00	102.50	1.30 cc	1.30 cc	1.00	io =58.2	-93%
104	I	22.0	6/12/24	8	30	0	0.00	102.50	2.60	22.90		196.45	1.52E-08
	F	22.6	6/12/24	16	28	0	0.00	102.50	3.70	21.75		194.20	1.39E-08
		Rt= 0.948	dT = 478.00 min				0.00	102.50	1.10 cc	1.15 cc	0.96	io =57.4	-93%
105	I	22.3	6/14/24	8	0	0	0.00	102.50	3.80	21.75		194.10	1.40E-08
	F	22.9	6/14/24	16	12	0	0.00	102.50	4.80	20.65		192.00	1.26E-08
		Rt= 0.941	dT = 492.00 min				0.00	102.50	1.00 cc	1.10 cc	0.91	io =56.7	-94%
106	I	25.5	6/17/24	8	12	0	0.00	102.50	4.70	20.40		191.85	8.23E-09
	F	23.8	6/18/24	6	22	0	0.00	102.50	6.40	18.80		188.55	7.05E-09
		Rt= 0.891	dT = 1330.00 min				0.00	102.50	1.70 cc	1.60 cc	1.06	io =56.1	-96%
107-108	I	23.6	6/19/24	9	8	0	0.00	102.50	4.49	21.40		193.06	6.63E-09
	F	27.8	6/20/24	16	47	0	0.00	102.50	6.20	19.30		189.25	5.50E-09
		Rt= 0.865	dT = 1899.00 min				0.00	102.50	1.71 cc	2.09 cc	0.81	io =56.4	-97%
109	I	24.9	6/21/24	8	36	0	0.00	102.50	7.15	18.50		187.50	5.07E-09
	F	27.8	6/21/24	16	35	0	0.00	102.50	7.45	18.08		186.78	4.13E-09
		Rt= 0.849	dT = 479.00 min				0.00	102.50	0.30 cc	0.42 cc	0.71	io =54.8	-98%
110	I	26.6	6/24/24	7	49	0	0.00	102.50	1.50	23.80		198.45	4.60E-09
	F	23.8	6/24/24	15	54	0	0.00	102.50	2.00	23.60		197.75	3.88E-09
		Rt= 0.877	dT = 485.00 min				0.00	102.50	0.50 cc	0.20 cc	2.50	io =58.0	-98%
111-117	I	23.8	6/24/24	15	54	0	0.00	102.50	2.00	23.60		197.75	2.73E-09
	F	22.4	7/3/24	16	18	0	0.00	102.50	7.50	18.30		186.95	2.44E-09
		Rt= 0.929	dT = 12984.00 min				0.00	102.50	5.49 cc	5.29 cc	1.04	io =57.8	-99%
118-124	I	22.4	7/3/24	16	21	0	0.00	102.50	3.00	23.00		196.15	2.04E-09
	F	22.5	7/12/24	15	36	0	0.00	102.50	7.30	19.30		188.15	1.85E-09
		Rt= 0.945	dT = 12915.00 min				0.00	102.50	4.29 cc	3.69 cc	1.16	io =57.3	-99%
125-130	I	22.5	7/12/24	15	40	0	0.00	102.50	1.20	23.90		198.85	1.61E-09
	F	25.8	7/24/24	9	14	0	0.00	102.50	5.00	19.30		190.45	1.40E-09
		Rt= 0.903	dT = 16894.00 min				0.00	102.50	3.79 cc	4.59 cc	0.83	io =58.1	-99%

Appendix D

Table D-1: Potentially Applicable or Relevant and Appropriate Requirements for IA Design and Implementation

Type	Law/Regulation/Requirement	Brief Synopsis of Law/Regulation/Requirement	Chemical	Location	Action	ARAR?	Comment for IA Implementation
Cleanup and Waste Management	State Model Toxics Control Act (Chapter 70.105D RCW, Chapter 173-340 WAC)	Processes and standards are used to identify, investigate, and cleanup sites where hazardous substances are located.	✓		✓	Yes	MTCA regulations are the primary requirement for IA implementation. The IAWP was developed and the IA will be designed and implemented to address applicable MTCA regulations. For simplicity, ARARs used to develop MTCA cleanup levels (e.g., surface water protection ARARs) are not included in this table.
	Federal Resource Conservation and Recovery Act (42 USC 6901 et seq., 40 CFR 257-268)	The characterization, generation, transportation, treatment, storage, and disposal of hazardous solid wastes are regulated (Subtitle C), and minimum national guidelines exist for management of non-hazardous solid wastes (Subtitle D).	✓		✓	Yes	The characterization, generation, transportation, treatment, storage, and disposal of any solid waste generated during IA implementation will be conducted in accordance with applicable federal, state, and local waste management regulations. Solid waste generated during the IA will be disposed of at an off-site facility permitted to receive the waste. However, it is expected that relatively little solid waste will be generated during the IA given the nature of the IA. For instance, on-site surface soil will be re-graded prior to capping and concrete and asphalt will be crushed on-site and used as fill material under the cap.
	State Hazardous Waste Management (Chapter 70.105 RCW, Chapter 173-303 WAC)	The state's regulation for the characterization, generation, transportation, treatment, storage, and disposal of hazardous solid wastes defined in Resource Conservation and Recovery Act Subtitle C and additional dangerous solid wastes defined in Chapter 173-303 WAC.	✓		✓	Yes	
	State Solid Waste Management (Chapter 70.95 RCW, Chapter 173-350 WAC, Chapter 173-304 WAC)	The state's regulation for the management of non-hazardous and non-dangerous solid waste.			✓	Yes	
	Federal Hazardous Materials Transportation (49 USC 5101 et seq., 49 CFR Parts 171-180)	Requirements exist (e.g., packaging, labeling, placarding, communications, emergency response) for the transportation of hazardous materials, including hazardous waste.	✓		✓	Yes	The transportation of any hazardous materials generated during IA implementation will comply with these regulations.
	State Sediment Management Standards (Chapter 70.105D RCW, Chapter 90.48 RCW, various other RCW chapters, Chapter 173-204 WAC)	Processes and standards are used to serve as the basis for making decisions about pollutant discharges that affect surface sediments and the cleanup of contaminated surface sediments.	✓		✓	No	These are not ARARs because this IA does not involve contaminated surface sediment or open water disposal of dredged material.
	State Dredge Materials Management (various RCW chapters, Chapter 332-30-166 WAC)	Requirements exist for open water disposal of dredged material obtained from marine or fresh waters.			✓	No	
USTs	Federal UST Program (42 USC 82 Subchapter IX, 40 CFR 280, 40 CFR 281)	Requirements exist for UST owners and operators regarding the installation, operation and maintenance, release detection, release reporting, cleanup, and closure of regulated UST systems as well as the delegation of state UST programs.			✓	No	These are not ARARs because the IA does not involve any USTs.
	State UST Program (Chapter 70A.355 RCW, Chapter 173-360A WAC)	Requirements exist for UST owners and operators regarding the installation, operation and maintenance, release detection, release reporting, cleanup, and closure of regulated UST systems.			✓	No	
Worker Health and Safety	Federal Occupational Safety and Health Standards (various laws, 29 CFR 1910)	Development and enforcement of national safety standards are used to establish safe and healthful working conditions for workers, including hazardous waste operations and emergency response workers in 29 CFR 1910.120.	✓		✓	Yes	IA implementation will be conducted in accordance with applicable federal and state safety and health regulations. For instance, the selected remediation contractor will be required to prepare and submit a project-specific health and safety plan for Port review.
	Federal Construction Safety and Health (Contract Work Hours and Safety Standards Act, 29 CFR 1926)	Development and enforcement of national safety standards are used to establish safe and healthful working conditions for construction workers.			✓	Yes	
	State Industrial Safety and Health Act (Chapter 49.17 RCW, various Chapter 296 WACs)	Development and enforcement of state safety standards are used to establish safe and healthful working conditions for workers, including hazardous waste operations workers (Chapter 296-843 WAC) and construction workers (Chapter 296-155 WAC).	✓		✓	Yes	
	Arsenic Workplace Exposure Rules (Chapter 49.17 RCW, Chapter 296-848 WAC)	Requirements exist to measure and minimize employee exposure to inorganic arsenic.	✓			Yes	

Table D-1: Potentially Applicable or Relevant and Appropriate Requirements for IA Design and Implementation

Type	Law/Regulation/Requirement	Brief Synopsis of Law/Regulation/Requirement	Chemical	Location	Action	ARAR?	Comment for IA Implementation
Biological Resources	Federal Endangered Species Act (16 USC 1531 et seq., 50 CFR 17, 50 CFR 402)	The taking of any listed endangered species is prohibited. In addition, federal agencies are required to ensure that any federally funded or permitted project is not likely to jeopardize the continued existence or adversely effect critical habitat for a listed endangered species.		✓		No	These are not ARARs because there is no reason to believe IA implementation activities could result in the taking of an endangered species, migratory bird species, bald eagle, or golden eagle given the nature and location of the IA implementation activities.
	Federal Migratory Bird Treaty Act (16 USC 703 et seq., 50 CFR 10.13)	The taking of a migratory bird species is prohibited without a permit.		✓		No	
	Federal Bald and Golden Eagle Protection Act (16 USC 668 et seq., 50 CFR 22)	The taking (e.g., pursuing, killing, capturing, collecting, disturbing) of a bald or golden eagle, including their parts, nests, or eggs, is prohibited without a permit.		✓		No	
	State Bald Eagle Protection Rules (Chapter 77.12.655 RCW, Chapter 220-610-100 WAC)	Requirements exist to protect bald eagle habitat by promoting cooperative land management efforts that incorporate eagle habitat needs.		✓		No	
	Federal Fish and Wildlife Coordination Act (16 USC. 661 et seq., 33 CFR 320-330)	Coordination with federal and state fish and wildlife agencies is required to ensure adequate protection of fish and wildlife resources for any federally funded or permitted project that proposes to modify a water body.		✓	✓	Yes	These are ARARs because one new outfall structure will be constructed and one existing outfall structure will be modified along the Hylebos Waterway for the new stormwater utility system. The Port will prepare and submit a JARPA to the applicable agencies to address these ARARs.
	State Hydraulic Project Approval (Chapter 77.55 RCW, Chapter 220-660 WAC)	Requirements (e.g., obtaining a permit from the Washington Department of Fish and Wildlife) exist for using, diverting, obstructing, or changing the natural flow or bed of a water of the state to ensure that fish and their aquatic habitats are protected.		✓	✓	Yes	
	City Critical Areas Preservation for Stream Corridors and Fish and Wildlife Habitat Conservation Areas (Chapters 13.11.400-13.11.560 TMC)	Establishes requirements to classify, protect, and preserve the City's stream corridors and fish and wildlife habitat conservation areas. Other critical areas (i.e., wetlands, flood hazard areas, geologically hazardous areas, and critical aquifer recharge areas) were evaluated as separate requirements.		✓	✓	Yes	
Cultural Resources	Federal Historic Preservation Act (54 USC 300101 et seq., 36 CFR Part 800)	Federal agencies are required to take into account the effect of an action upon any district, site, building, structure, or object that is included in or eligible for the National Register of Historic Places (generally 50 years old or older).		✓		Yes	Given the nature of IA implementation activities (e.g., installing a barrier wall with the vibrating beam method and grading surficial fill soil), the potential for encountering cultural resources (e.g., human remains, tribal artifacts, historical resources, archaeological resources) during the IA is low. Nonetheless, an IDP is included in the IAWP, and will be implemented in the unlikely event that a cultural resource is inadvertently discovered during IA implementation activities.
	State Executive Order 21-02	Consultation with DAHP and any affected tribes and implementation of measures to avoid, minimize, or mitigate adverse effects to archeological and historic archaeological sites, historic buildings/structures, traditional cultural places, sacred sites or other cultural resources are required for state-funded construction or acquisition projects.		✓		Yes	
	Federal Archaeological and Historic Preservation Act (54 USC 312501 et seq., 43 CFR 7)	Requirements exist to evaluate and preserve historical and archaeological data.		✓		Yes	
	Archaeological Sites and Resources (Chapter 27.53 RCW, Chapter 25-46 WAC, Chapter 25-48 WAC)	Requirements exist to conserve, preserve, and protect archaeological sites and resources, including procedures for (1) registering previously unreported historic archaeological resources discovered on state-owned aquatic lands, (2) issuing archaeological excavation and removal permits, and (3) issuing civil penalties.		✓		Yes	
	Indian Graves and Records (Chapter 27.44 RCW, Chapter 25-48 WAC)	Requirements exist to protect Indian burial sites, cairns, glyptic markings, and historic graves, including procedures for (1) notifying affected Indian tribes which may consider the site to be of historic or cultural significance, (2) issuing archaeological excavation and removal permits, and (3) issuing civil penalties.		✓		Yes	
	Protection of Historic Graves (RCW 68.60.050)	Requirements exist to protect historic graves, including (1) issuing a felony for anyone who knowingly damages a historic grave, and (2) working under DAHP supervision for inadvertent discovery of a historic grave during construction.		✓		Yes	
	City Landmarks and Historic Districts (Chapter 13.07 TMC)	Requirements exist to protect, enhance, and use landmarks, districts, and elements of historic, cultural, architectural, archeological, engineering, and geographic significance located within the City.		✓		Yes	

Table D-1: Potentially Applicable or Relevant and Appropriate Requirements for IA Design and Implementation

Type	Law/Regulation/Requirement	Brief Synopsis of Law/Regulation/Requirement	Chemical	Location	Action	ARAR?	Comment for IA Implementation
Water and Shorelines	Federal Clean Water Act (33 USC 1251 et seq., 40 CFR 122-136)	Requirements (e.g., obtaining a NPDES permit) exist for wastewater and stormwater discharges to avoid adversely affecting water quality.	✓		✓	Yes	An individual construction stormwater NPDES permit or coverage under a general construction stormwater NPDES permit will be obtained prior to IA grading activities, and best management practices will be implemented during IA implementation to minimize erosion and address potential adverse affects from construction stormwater. Coverage under an applicable NPDES permit will be updated/obtained for stormwater discharges from the new on-site stormwater utility system.
	State NPDES Permit Program (Chapter 90.48 RCW, Chapter 173-220 WAC)	A state program exists to regulate the discharge of pollutants, wastes, and materials to surface waters of the state via Clean Water Act NPDES permits.	✓		✓	Yes	
	State Waste Discharge Permit Program (Chapter 90.48 RCW, WAC 173-216)	A state program exists to regulate the discharge of waste materials from industrial, commercial, and municipal operations into municipal sewerage systems and waters of the state via non-NPDES individual permits.	✓		✓	No	These are not ARARs because wastes will not be discharged to (1) municipal sewerage systems (e.g., publicly owned treatment works), (2) the City storm drainage system, or (3) the waters of the state via a non-NPDES general or individual permit.
	State Waste Discharge General Permit Program (Chapter 90.48 RCW, Chapter 173-226 WAC)	A state program exists to regulate the discharge of pollutants, wastes, and other materials to municipal sewerage systems and waters of the state via non-NPDES general permits.	✓		✓	No	
	City Wastewater and Surface Water Management (Chapter 12.08 TMC)	Requirements exist for users of the publicly owned treatment works and the City storm drainage system.	✓		✓	No	
	Federal Clean Water Act Permits for Dredge or Fill Materials (33 USC 1344, 33 CFR 323)	Unless exempted, the discharge of dredge or fill material into waters of the United States, including wetlands, requires a permit.		✓	✓	Yes	This is an ARAR because one new outfall structure will be constructed and one existing outfall structure will be modified along the Hylebos Waterway for the new stormwater utility system. The Port will prepare and submit a JARPA to the United States Army Corps of Engineers to address this ARAR.
	Federal Floodplain Management (Executive Order 11988)	Federal agencies shall take actions in order to avoid, to the extent possible, the adverse effects associated with modifications of floodplains and direct or indirect support of floodplain development whenever there is a practicable alternative.		✓	✓	No	These are not ARARs since IA implementation does not involve modification of a floodplain or wetland. Further, fill is being added to the Site during the IA to raise the overall ground surface of the Site, which will decrease the potential for any future floods.
	State Floodplain Management (Chapter 86.16 RCW, Chapter 173-158 WAC)	Establishes standards to be administered by local governments, and provides assistance to local governments. In addition, local governments are encouraged to avoid the adverse impacts associated with the destruction or modification of wetlands.		✓	✓	No	
	Federal Protection of Wetlands (Executive Order 11990)	Federal agencies shall take actions in order to avoid, to the extent possible, the adverse effects associated with modifications of wetlands and direct or indirect support of new construction in wetlands whenever there is a practicable alternative.		✓	✓	No	
	City Critical Areas Preservation for Flood Hazard Areas and Wetlands (Chapters 13.11.300-13.11.360, 13.11.600-13.11.640 TMC)	Regulations exist to classify, protect, and preserve the City's flood hazard areas and wetlands. Other critical areas (i.e., stream corridors, fish and wildlife habitat conservation areas, geologically hazardous areas, and critical aquifer recharge areas) were evaluated as a separate requirement.		✓	✓	No	
	State Shoreline Management Act (Chapter 90.58 RCW; Chapter 173-26 WAC)	Requirements exist for substantial development occurring within 200 feet of a state shoreline to prevent harm from uncoordinated and piecemeal development of shorelines.		✓	✓	Yes	These are ARARs since IA implementation activities will occur within 200 feet of the Hylebos Water shoreline. A City Shoreline Substantial Development Permit (or a permit exemption) will be obtained prior to IA implementation.
	City Shoreline Master Program (Chapter 19 TMC)	Implements the state Shoreline Management Act by providing goals, policies, and regulations for shoreline use and protection, and establishing a permit system for substantial development occurring within 200 feet of a City shoreline. Specific requirements for the Port Industrial Area are included in TMC 19.12.		✓	✓	Yes	
	Federal UIC Program (42 USC 300f et seq., 42 USC 6901 et seq., 40 CFR 144 through 147)	Establishes requirements, technical criteria, and standards for the UIC program, specifies procedures for approving state UIC programs, and establishes applicable UIC program elements for each state.			✓	No	These are not ARARs since IA implementation does not involve discharge of fluids to UIC wells.
	State UIC Program (Chapter 90.48 RCW, Chapter 173-218 WAC)	Protects groundwater quality and prevents groundwater contamination by regulating the discharge of fluids into UIC wells.			✓	No	
	State Well Construction Standards (Chapter 18.104 RCW, Chapter 173-160 WAC)	Establishes standards for construction, maintenance, and decommissioning of water supply wells and resource protection wells (e.g., monitoring wells).			✓	Yes	Any MWs that need to be constructed, maintained, or decommissioned during IA activities will be constructed, maintained, and decommissioned in accordance with Chapter 173-160 WAC.
	Federal Drinking Water Standards (Safe Drinking Water Act, 40 CFR 141)	Establishes maximum contaminant levels and other chemical standards for public drinking water systems.	✓			No	These are not ARARs because no current drinking water supplies are located in or downgradient of the Site, groundwater in and downgradient of the Site is not potable, and surface water downgradient of the Site is not potable.
	State Drinking Water Standards (RCW 70A.125, WAC 246-290-310)	Establishes maximum contaminant levels and other chemical standards for public drinking water systems.	✓			No	
	State Water Quality Standards for Groundwater (Chapters 90.48 RCW, Chapter 90.54 RCW, Chapter 173-200 WAC)	Establishes groundwater quality standards to provide for protection of existing and future use of groundwater.	✓		✓	No	This is not an ARAR since cleanup actions approved by Ecology under MTCA are exempt pursuant to WAC 173-200-010(3)(c).

Table D-1: Potentially Applicable or Relevant and Appropriate Requirements for IA Design and Implementation

Type	Law/Regulation/Requirement	Brief Synopsis of Law/Regulation/Requirement	Chemical	Location	Action	ARAR?	Comment for IA Implementation
Air	Federal Clean Air Act (42 USC 7401 et seq., 40 CFR 50)	Air emissions from stationary and mobile sources are regulated by directing states to develop state implementation plans to achieve National Ambient Air Quality Standards.	✓		✓	No	These are not ARARs since IA implementation does not involve regulated air emissions.
	State General Regulations for Air Pollution Sources (Chapter 70A.15 RCW, Chapter 173-400 WAC)	Establishes standards and rules generally applicable to the control and/or prevention of the emission of air contaminants from stationary sources. Dust control requirements were evaluated as a separate requirement.	✓		✓	No	
	State Controls for New Sources of Toxic Air Pollutants (Chapter 70A.15 RCW, Chapter 173-460 WAC)	Establishes controls for new or modified sources emitting toxic air pollutants by requiring best available control technologies, toxic air pollutant emission quantifications, and human health and safety protection demonstrations.	✓		✓	No	
	State Ambient Air Quality Standards (Chapter 70A.15 RCW, Chapter 173-476 WAC)	Adopts National Ambient Air Quality Standards for particulate matter, lead, sulfur dioxide, nitrogen dioxide, ozone, and carbon monoxide.	✓		✓	No	
	PSCAA Regulation I	Establishes regulations to control the emission of air contaminants from sources (e.g., new sources, outdoor burning, solid fuel burning) in Pierce, King, Snohomish, and Kitsap Counties. Dust control requirements were evaluated as a separate requirement.	✓		✓	No	
	PSCAA Regulation III	Adopts state and federal requirements for regulation of toxic air contaminants in in Pierce, King, Snohomish, and Kitsap Counties.	✓		✓	No	
	Dust control requirements (WAC 173-400-040(9). PSCAA Regulation I Article 9.15)	Requirements exist to implement reasonable precautions to prevent or minimize visible emissions of fugitive dust during activities such as construction.			✓	Yes	Dust control measures (e.g., watering/misting exposed surfaces, covering stockpiles not in use with heavy duty plastic sheeting and securing with ropes and sandbags, covering haul trucks, inspecting haul trucks before they enter public roads and removing any excess dirt on the truck) will be incorporated as necessary into the IA design to prevent and minimize visible emissions of fugitive dust during IA implementation.
Other	State Environmental Policy Act (Chapter 43.21C RCW, Chapter 197-11 WAC)	Requires all government agencies to consider and assess the environmental impacts of a proposed action within the state before making a decision. The SEPA procedural requirements are fulfilled via the MTCA remedy selection process pursuant to WAC 197-11-250 through 197-11-268.			✓	Yes	It is expected that Port and/or Ecology (the lead agency) will prepare a SEPA checklist as part of the IAWP public participation package.
	City Site Development Code (Chapter 2.19 TMC)	Requirements (e.g., obtaining a Site Development Permit) exist for the development and maintenance of building and building sites to minimize negative impacts to the environment.			✓	Yes	Prior to IA implementation, a Site Development Permit and any other associated City permits required for IA activities will be obtained or exempted.
	City Critical Area Preservation for Geologically Hazardous Areas and Critical Aquifer Recharge Areas (Chapters 13.11.700 - 13.11.820 TMC)	Establishes requirements to classify, protect, and preserve the City's geologically hazardous areas and critical aquifer recharge areas. Other critical areas (i.e., wetlands, stream corridors, fish and wildlife habitat conservation areas, and flood hazard areas) were evaluated as separate requirements.		✓	✓	No	This is not an ARAR since the Site is not located within a geologically hazardous or critical aquifer recharge area, and any nearby geologically hazardous or critical aquifer recharge areas would not be affected by IA implementation activities.
	State Noise Control Act (Chapter 70A.20 RCW, Chapter 173-60 WAC)	Establishes maximum noise levels at specified times for specified durations, with some exemptions such as temporary construction activity in 173-60-050(3)(a).			✓	Yes	IA implementation activities will be designed to comply with applicable noise requirements (e.g., limiting construction activities to the working hours specified in TMC 8.122.070).
	City Noise Enforcement (Chapter 8.122 TMC)	Requirements exist to mitigate the adverse impact of noise while recognizing the economic value of construction and industry. Construction-specific requirements are included in TMC 8.122.070.			✓	Yes	
	City Right-of-Way Development (Chapter 2.22 TMC)	Requirements (e.g., obtaining a Right-of-Way Construction Permit or Right-of-Way Use Permit) exist for activities such as installing sidewalks, installing utilities, installing driveways, repairing streets, and activities that temporarily impede the normal flow of vehicular traffic or pedestrian traffic.		✓	✓	No	This is not an ARAR since IA implementation activities do not include construction within, or cause temporary impediment for, a City right-of-way.
	City Electrical Code (Chapter 12.06A TMC)	Requirements (e.g., obtaining an electrical permit) exist to safeguard people and property from electrical hazards arising from the use of electricity, including temporary power connections and wiring used for remediation systems.			✓	No	This is not an ARAR since IA implementation activities do not include temporary power connections or wiring for remediation systems.

Notes:

ARAR: Applicable or relevant and appropriate; City: City of Tacoma; CFR: Code of Federal Regulations; DAHP: Department of Archaeology and Historic Preservation; FEMA: Federal Emergency Management Agency; HASP: Health and Safety Plan; IDP: Inadvertent Discovery Plan; JARPA: Joint Aquatic Resources Permit Application; MTCA: Model Toxics Control Act; NPDES: National Pollutant Discharge Elimination System; PSCAA: Puget Sound Clean Air Agency; RCW: Revised Code of Washington; SEPA: State Environmental Policy Act; TMC: Tacoma Municipal Code; UIC: Underground Injection Control; USC: United States Code; UST: Underground Storage Tank; WAC: Washington Administrative Code

Appendix E

Memo



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To: Sam Meng (Washington State Department of Ecology [Ecology])

From: Troy Bussey, PE, LG, LHG (PIONEER Technologies Corporation [PIONEER]) and Logan Rower, EIT (PIONEER)

Cc: Brett Ozolin, PE (Port of Tacoma [Port]), Scott Hooton (Port), Rob Healy (Port), and Trevor Louviere, PE (Dalton, Olmsted, & Fuglevand, Inc. [DOF])

Date: March 28, 2026

Subject: IA Disproportionate Cost Analysis Memo
Former Arkema Manufacturing Site
Facility/Site ID No. 1220, Cleanup Site ID No. 3405

The purpose of this memo is to document a disproportionate cost analysis (DCA) conducted per WAC 173-340-360(5) to evaluate four interim action (IA) alternatives for a 24-acre area (located outside of the barrier wall and barrier wall cap) on the Former Arkema Manufacturing Site (Site) to determine which alternative uses permanent solutions to the maximum extent practicable (WAC 173-340-360(3)(a)(x)). The four IA alternatives for the 24-acre area were developed and the IA DCA for these alternatives was conducted per Ecology's recommendation pursuant to Ecology's November 2024 comments on the October 2024 IA Work Plan (IAWP). The 24-acre area is shown on all memo figures.

Background Information

Site background information is presented in the draft IAWP (PIONEER 2024). Key background information for this memo includes:

- The primary Site constituent of concern (COC) is arsenic. The other Site COCs are copper, lead (soil only), mercury, nickel, tetrachloroethylene (PCE), trichloroethylene (TCE), vinyl chloride (VC), and chloroform (CF; PIONEER 2021). The preliminary Site soil and groundwater (GW) cleanup levels (CLs) for these COCs are (PIONEER 2024):¹
 - Soil CLs: arsenic 20 mg/kg, copper 36 mg/kg, lead 1,000 mg/kg, mercury 0.070 mg/kg, nickel 38 mg/kg, PCE 0.067 mg/kg, TCE 0.0077 mg/kg, VC 0.0013 mg/kg, and CF 0.094 mg/kg.
 - GW CLs: arsenic 8.0 ug/L, copper 3.1 ug/L, mercury 0.025 ug/L, nickel 8.2 ug/L, PCE 2.9 ug/L, TCE 0.70 ug/L, VC 0.18 ug/L, and CF 12 ug/L.
- The highest soil arsenic concentrations (and the overwhelming majority of arsenic mass) are present within or immediately downgradient of the proposed barrier wall (see Figure 1). The magnitude and extent of arsenic soil CL exceedances in the 24-acre area are substantially less than in the barrier wall area, although there are scattered arsenic soil CL exceedances throughout the 24-acre area. Relatively low-level soil CL exceedances for the other COCs are also scattered throughout the 24-acre area (see Figure 2).

¹ These preliminary soil CLs are the Fill Acceptance Soil CLs in Table 1 of Appendix H to the draft IAWP, with the exception that the arsenic soil CL of 88 mg/kg was reduced to 20 mg/kg. These preliminary GW CLs are the Target GW Concentrations in Table 2 of Appendix H to the draft IAWP.

- The highest arsenic GW concentrations are present in the Upper and Intermediate Aquifers within or immediately downgradient of the proposed barrier wall (see Figures 3 and 4). Although the magnitude of arsenic GW CL exceedances in the 24-acre area is substantially less than in the barrier wall area, arsenic GW CL exceedances are present throughout almost all of the Upper Aquifer and portions of the Intermediate Aquifer within the 24-acre area. GW CL exceedances for other COCs are also present in most of the Upper Aquifer and portions of the Intermediate Aquifer within the 24-acre area (see Figures 5 and 6).
- The barrier wall and barrier wall cap, which are not included within the 24-acre area, are already part of the IA in order to contain the highest arsenic soil and GW concentrations at the Site. GW modeling results estimate that the barrier wall and barrier wall cap will reduce the arsenic discharge to the Hylebos Waterway from 9.9 kilograms per year to 2.4 kilograms per year (see Attachment 1). The proposed barrier wall alignment is shown on all memo figures.

IA Alternatives

The following four IA alternatives for the 24-acre area were evaluated for this DCA:

- Alternative 1 - Asphalt Cap: This alternative involves the installation of an 8-inch-thick asphalt cap across the 24-acre area.
- Alternative 2 - Focused Excavation and Asphalt Cap: This alternative includes three conceptual excavations (Excavation 2-1, 2-2, and 2-3) to remove the highest arsenic concentrations within the 24-acre area (i.e., sampling locations that had soil arsenic concentrations greater than 88 mg/kg) as shown on Figure 7. This alternative also includes the same asphalt cap as in Alternative 1.
- Alternative 3 – In-situ Solidification/Stabilization (ISS): This alternative includes six conceptual ISS areas (ISS 3-1 to ISS 3-6) where reagents (e.g., cement, stabilization amendments) would be mixed with soil and GW containing arsenic and other COCs to form a low permeability monolith that encapsulates, and restricts contaminant migration within the 24-acre area (see Figures 8a through 8c).
- Alternative 4 - Full-scale Excavation: This alternative includes six conceptual excavations (Excavations 4-1 to 4-6) to remove all arsenic and other COCs soil CL exceedances within the 24-acre area (see Figures 8a through 8c).

All four alternatives assume the barrier wall and the barrier wall cap will be installed before the alternative has been implemented. GW modeling was conducted to quantify the anticipated reductions in GW recharge and arsenic mass discharge to the Hylebos Waterway for the Alternative 1 and Alternative 2 asphalt cap (see Attachment 1). The Alternatives 2, 3, and 4 conceptual remediation footprints and depths (see Table 1) were developed based on existing soil concentrations, historical operations, and best professional judgment.

DCA Process

The four-step DCA process in WAC 173-340-360(5) was used to evaluate the four IA alternatives as summarized in this section. The semi-quantitative DCA approach was utilized as outlined in Ecology's public comment draft DCA guidance document (Ecology 2025). Ecology's public comment draft DCA Excel tool was used to document the semi-quantitative DCA.

Step 1 - Determine the Benefits and Costs of Each Alternative

Step 1 of the DCA process is to determine the benefits and costs of each cleanup action alternative (or each IA alternative in this case). In accordance with WAC 173-340-360(5)(d), the following criteria were used to evaluate the five benefits and the IA cost of the four IA alternatives:

1. **Protectiveness:** The degree to which the alternative protects human health and the environment, including likely vulnerable populations and overburdened communities.
2. **Permanence:** The degree to which the alternative permanently reduces the toxicity, mobility, or mass of hazardous substances.
3. **Effectiveness over the long term:** The degree to which the alternative is likely to be effective over the long term, including for likely vulnerable populations and overburdened communities.
4. **Management of implementation risks:** The risks to human health and the environment, including likely vulnerable populations and overburdened communities, associated with the alternative during construction and implementation, and the effectiveness of the alternative to manage such risks.
5. **Technical and administrative implementability:** The ability to implement the alternative.
6. **Costs:** The costs of remedial actions necessary to implement the alternative.

A best professional judgment score for each of the five benefits was assigned based on the above criteria and the supporting criteria factors in WAC 173-340-360(5)(d). The benefits for each alternative were ranked on a linear numerical scale from 1 to 10 with the higher score indicating a higher degree of benefit. The default weighting of 20% for each benefit was used (Ecology 2025). The benefit scores for each alternative are presented in Table 2.

The cost estimates for Alternatives 1 through 4 were developed using unit costs from vendors, unit costs from similar projects, anticipated level of effort, and best professional judgment (see Tables 3 through 6). The estimated Alternative 1, Alternative 2, Alternative 3, and Alternative 4 costs are on the order of \$9.6 million, \$14 million, \$43 million, and \$89 million, respectively.² Redevelopment costs (e.g., demolition and removal of slabs and foundations, importing fill, mass grading, installing utilities such as stormwater, sanitary sewer, domestic water, fire water, and lighting, stormwater management, ground improvements, and asphalt cap maintenance) were not included in the Alternative 1 and 2 cost estimates since these items are not cleanup components.

Using the public comment draft Ecology DCA Excel tool, the cost, weighted benefits score, and cost effectiveness (cost/benefit [B]) score for each alternative are presented in Table 2. The cost effectiveness scores (\$/B with \$ in millions) for Alternative 1, Alternative 2, Alternative 3, and Alternative 4 are 1.45, 2.06, 5.97, and 12.03, respectively.

Step 2 - Rank Alternatives by Degree of Permanence

Step 2 of the DCA process is to rank each alternative by degree of permanence. For this IA DCA, Alternative 4 has the highest relative permanence, followed by Alternative 3, Alternative 2, and Alternative 1 (see Table 2).

² Post-construction GW monitoring within the 24-acre area was not included in the cost estimates because (1) long-term GW monitoring within the 24-acre area will be determined after the Cleanup Action Plan is finalized, and (2) GW monitoring within the 24-acre area for the four alternatives would probably have similar order of magnitude costs.

Step 3 - Identify Initial Baseline Alternative for DCA

Step 3 of the DCA process is to identify the initial baseline alternative to use in DCA Step 4. For this IA DCA, Alternative 4 is the initial baseline alternative.

Step 4 - Conduct a DCA of the Ranked List Alternatives

Step 4 of the DCA process is to conduct a DCA of the top two ranked alternatives identified in DCA Step 2. Thus, the baseline alternative (Alternative 4) was evaluated relative to the next most permanent alternative identified in Step 2 (Alternative 3). The cost effectiveness score of Alternative 4 is 12.03, whereas the cost effectiveness score of Alternative 3 is 5.97. Therefore, in accordance with WAC 173-340-360(5)(c)(iv)(B)(III), Alternative 4 is eliminated from further analysis because its incremental costs are disproportionate to its incremental benefits, and Step 4 is repeated by comparing Alternative 3 (the new baseline alternative) versus Alternative 2. The cost effectiveness score of Alternative 3 is 5.97, whereas the cost effectiveness score of Alternative 2 is 2.06. Therefore, in accordance with WAC 173-340-360(5)(c)(iv)(B)(III), Alternative 3 is eliminated from further analysis because its incremental costs are disproportionate to its incremental benefits, and Step 4 is repeated by comparing Alternative 2 (the new baseline alternative) versus Alternative 1. The cost effectiveness score of Alternative 1 (1.45) is less than the cost effectiveness score of Alternative 2 (2.06). Since the Alternative 1 cost effectiveness score is less than Alternative 2, Alternative 1 uses permanent solutions to the maximum extent practicable and the DCA is complete per WAC 173-340-360(5)(c)(iv)(B)(III).³

Conclusion

Based on the results of this DCA, the recommended IA alternative for the 24-acre area is Alternative 1 (Asphalt Cap). The asphalt cap would cost-effectively (1) address the widespread and low-level exceedances of arsenic industrial soil direct contact cleanup levels (20 mg/kg) that are present across the 24-acre area, and (2) further decrease arsenic transport within the barrier wall (where the arsenic plume core and almost all of the arsenic mass is located). GW modeling results estimate that the 24-acre asphalt cap will decrease the arsenic mass discharge to the Hylebos Waterway by 34% compared to a non-capped situation (see Attachment 1).

References

- Ecology. 2025. Public Comment Draft Guidance for Determining if a Cleanup Action uses Permanent Solutions to the Maximum Extent Practicable using Disproportionate Cost Analysis. February.
- PIONEER. 2021. Draft Feasibility Study Report, Former Arkema Manufacturing Site. April.
- PIONEER. 2024. Draft Interim Action Work Plan, Former Arkema Manufacturing Site. October.

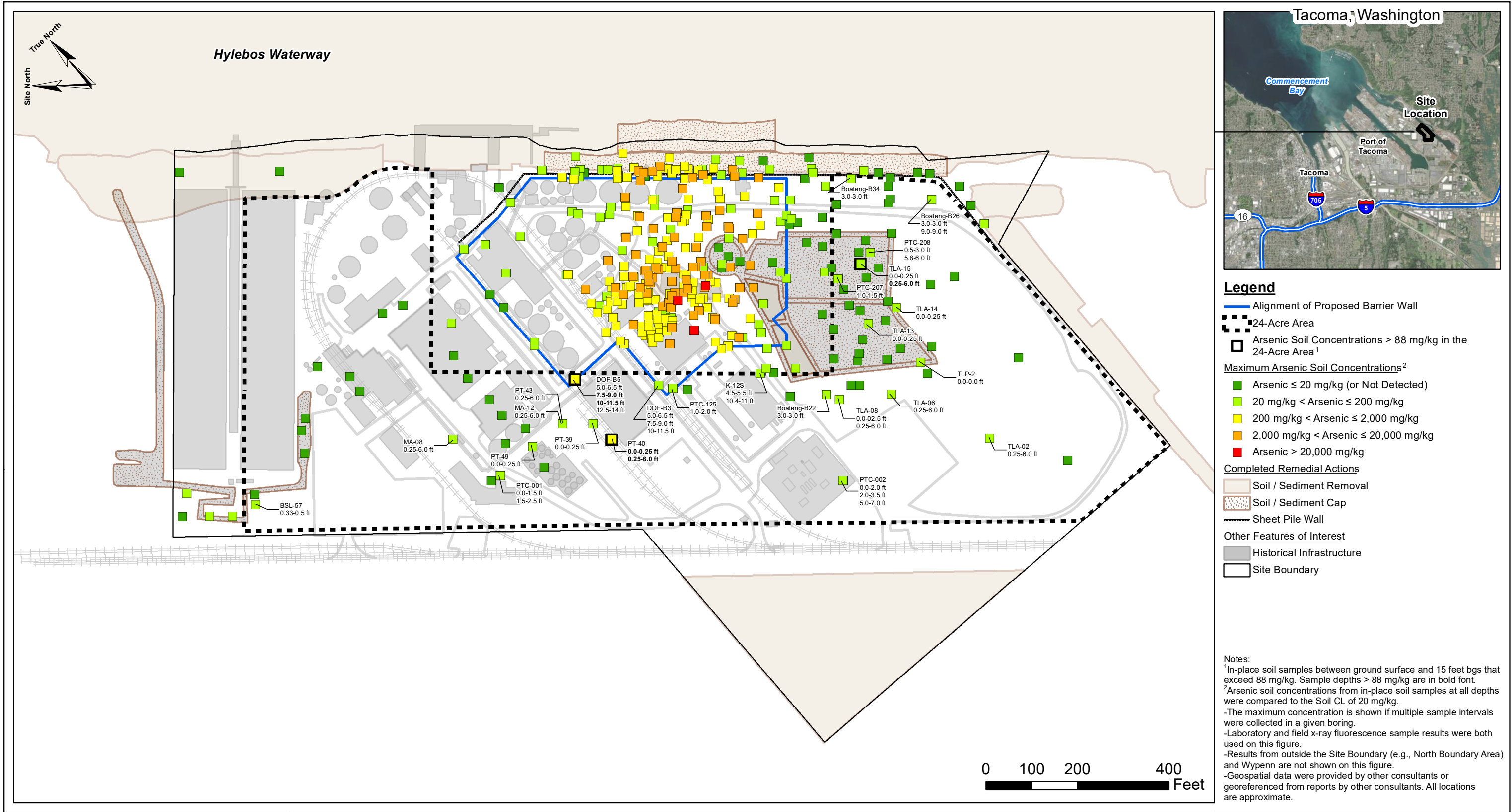
Enclosures

Figure 1	Arsenic Soil Concentrations
Figure 2	Other COC Soil Concentrations
Figure 3	Recent Dissolved Arsenic Concentrations in the Upper Aquifer
Figure 4	Recent Dissolved Arsenic Concentrations in the Intermediate Aquifer

³ In addition, Alternative 1 is the alternative that uses permanent solutions to the maximum extent practicable per WAC 173-340-360(5)(c)(iv)(B)(II) because the lower cost alternative (Alternative 1) has similar benefits to Alternative 2.

Figure 5	Other COC Groundwater Concentrations in the Upper Aquifer
Figure 6	Other COC Groundwater Concentrations in the Intermediate Aquifer
Figure 7	Alternative 2 - Conceptual Excavation Footprints
Figure 8a	Alternative 3 and Alternative 4 - Conceptual Footprints Based on Arsenic Soil Concentrations
Figure 8b	Alternative 3 and Alternative 4 - Conceptual Footprints Based on Other COC Soil Concentrations
Figure 8c	Alternative 3 and Alternative 4 - Combined Conceptual Footprints
Table 1	Conceptual Areas for Alternatives 2, 3, and 4
Table 2	Semi-quantitative Disproportionate Cost Analysis
Table 3	Conceptual Cost Estimate for Alternative 1
Table 4	Conceptual Cost Estimate for Alternative 2
Table 5	Conceptual Cost Estimate for Alternative 3
Table 6	Conceptual Cost Estimate for Alternative 4
Attachment 1	Keta Waters GW Modeling Memos

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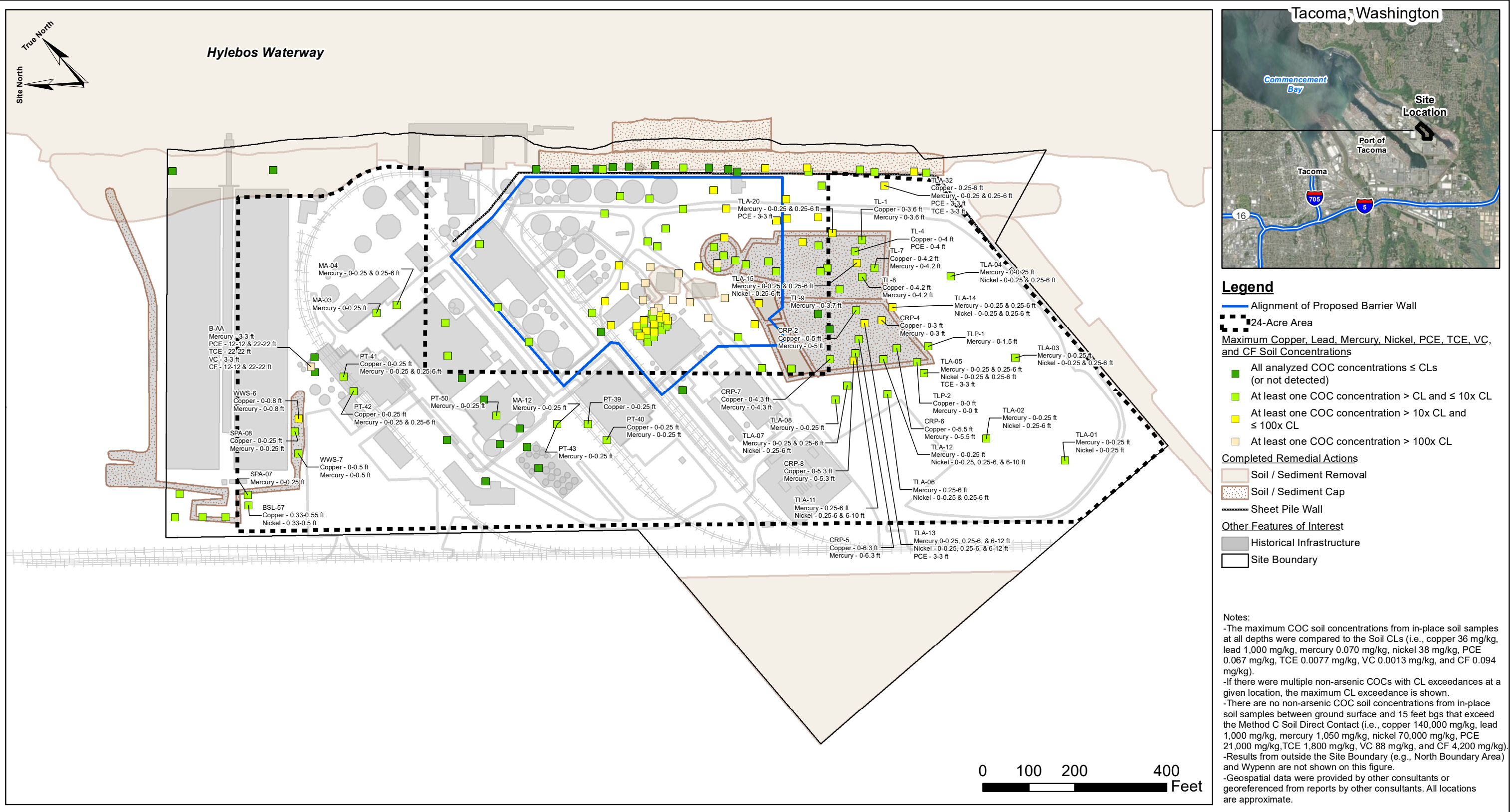


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Arsenic Soil Concentrations IA Disproportionate Cost Analysis Memo Former Arkema Manufacturing Site

Figure 1

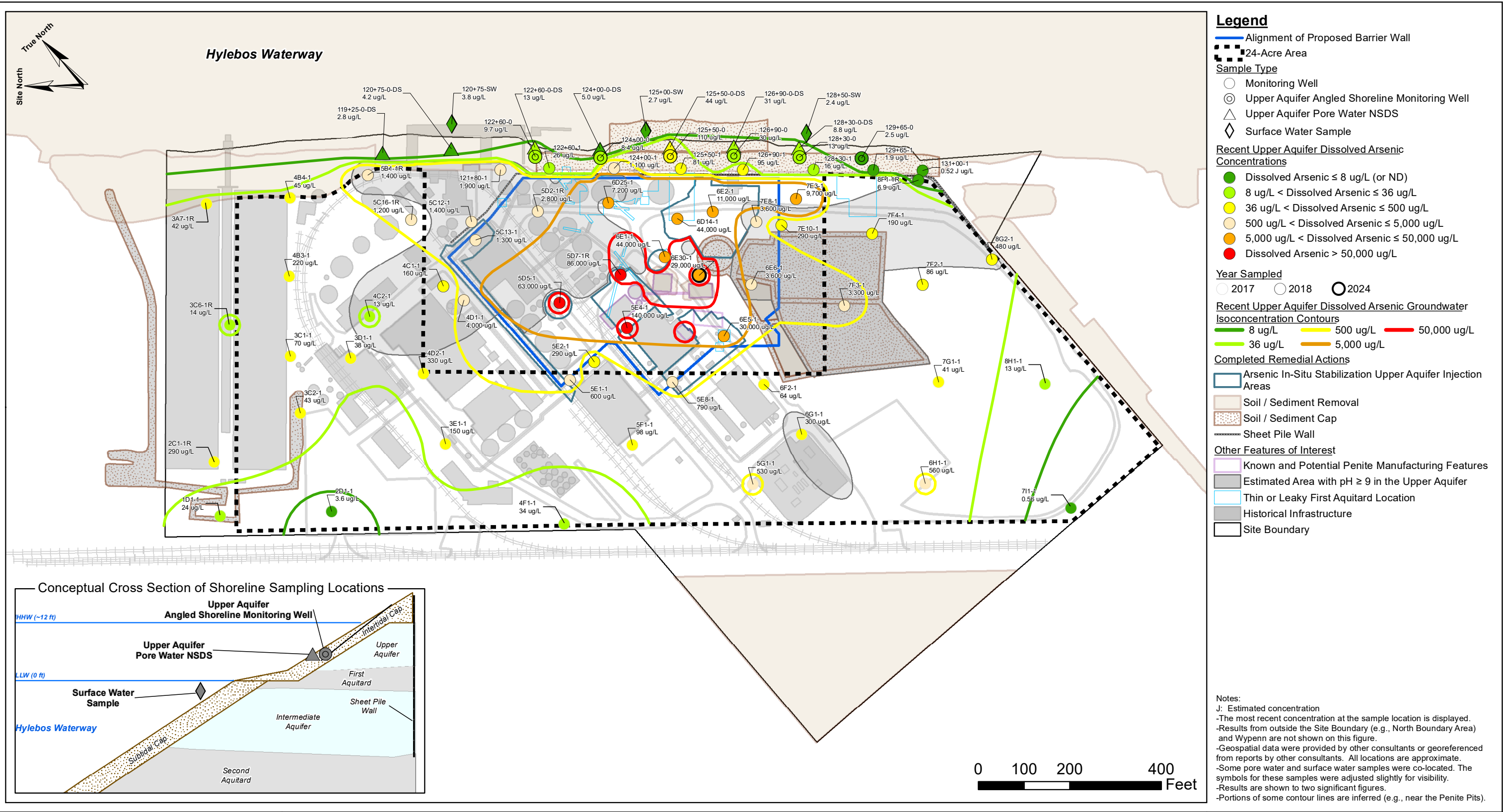
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Other COC Soil Concentrations
IA Disproportionate Cost Analysis Memo
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Figure 2

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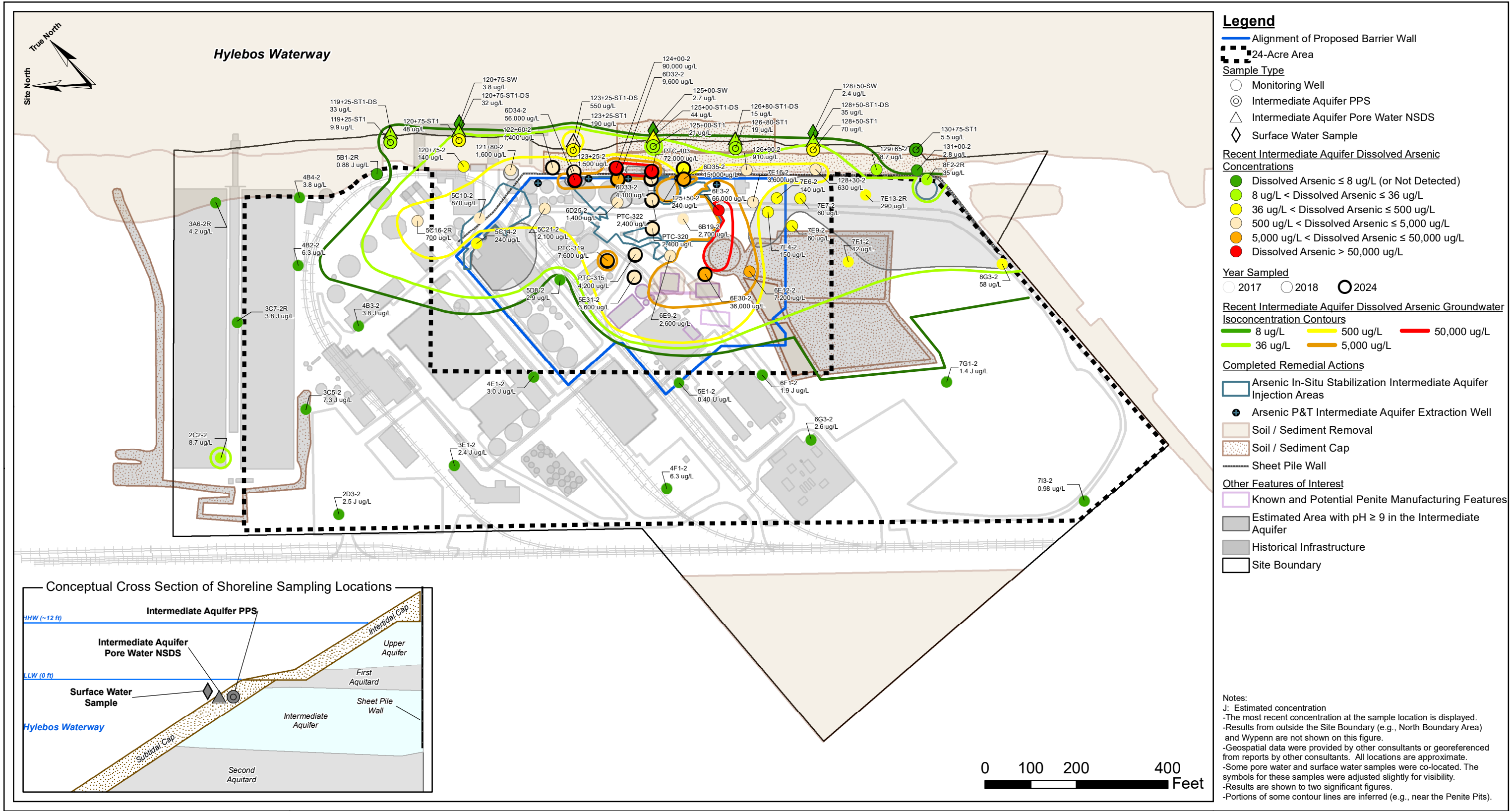


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Recent Dissolved Arsenic Concentrations in the Upper Aquifer IA Disproportionate Cost Analysis Memo Former Arkema Manufacturing Site

Figure 3

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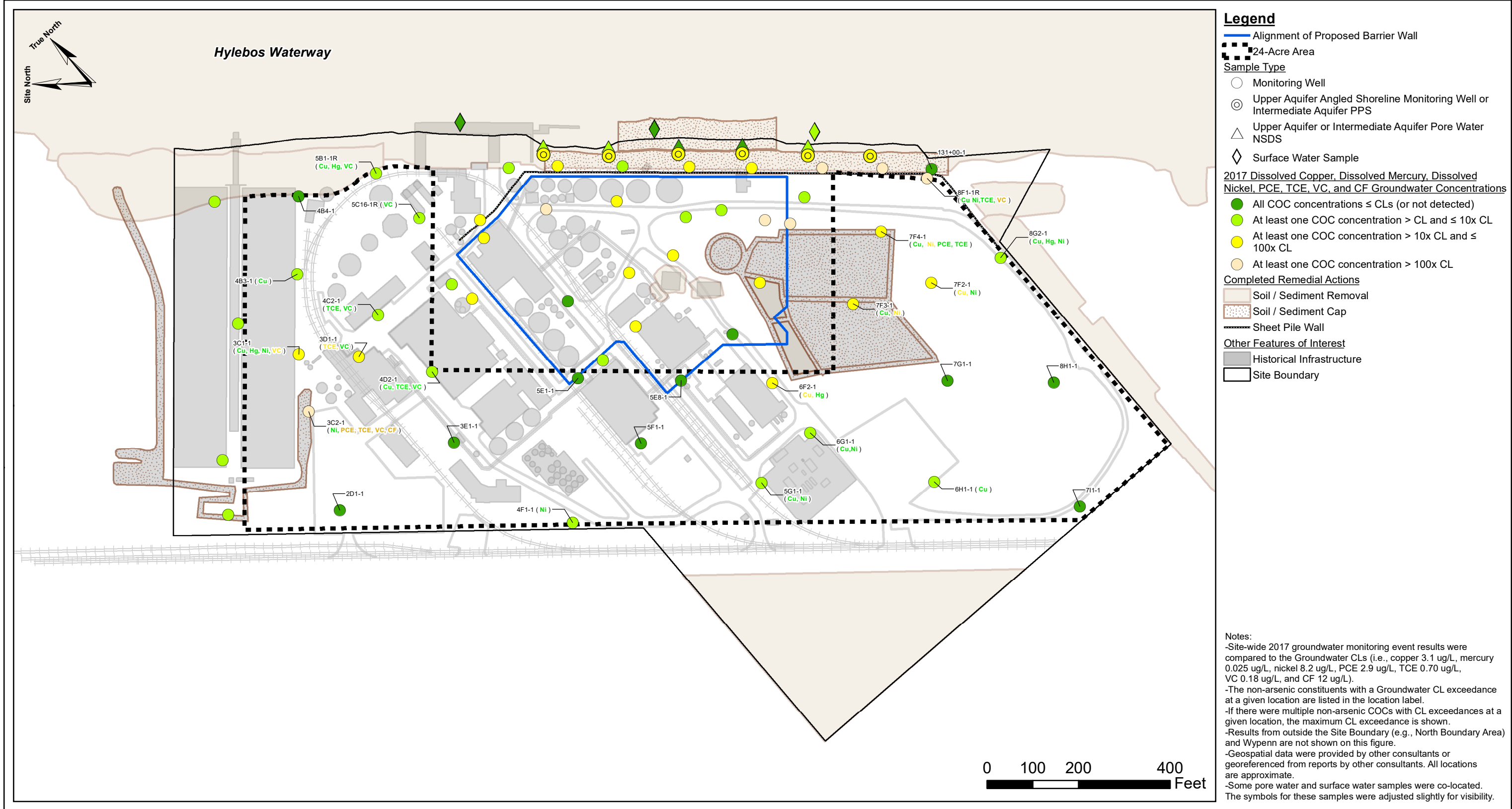


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Recent Dissolved Arsenic Concentrations in the Intermediate Aquifer IA Disproportionate Cost Analysis Memo Former Arkema Manufacturing Site

Figure 4

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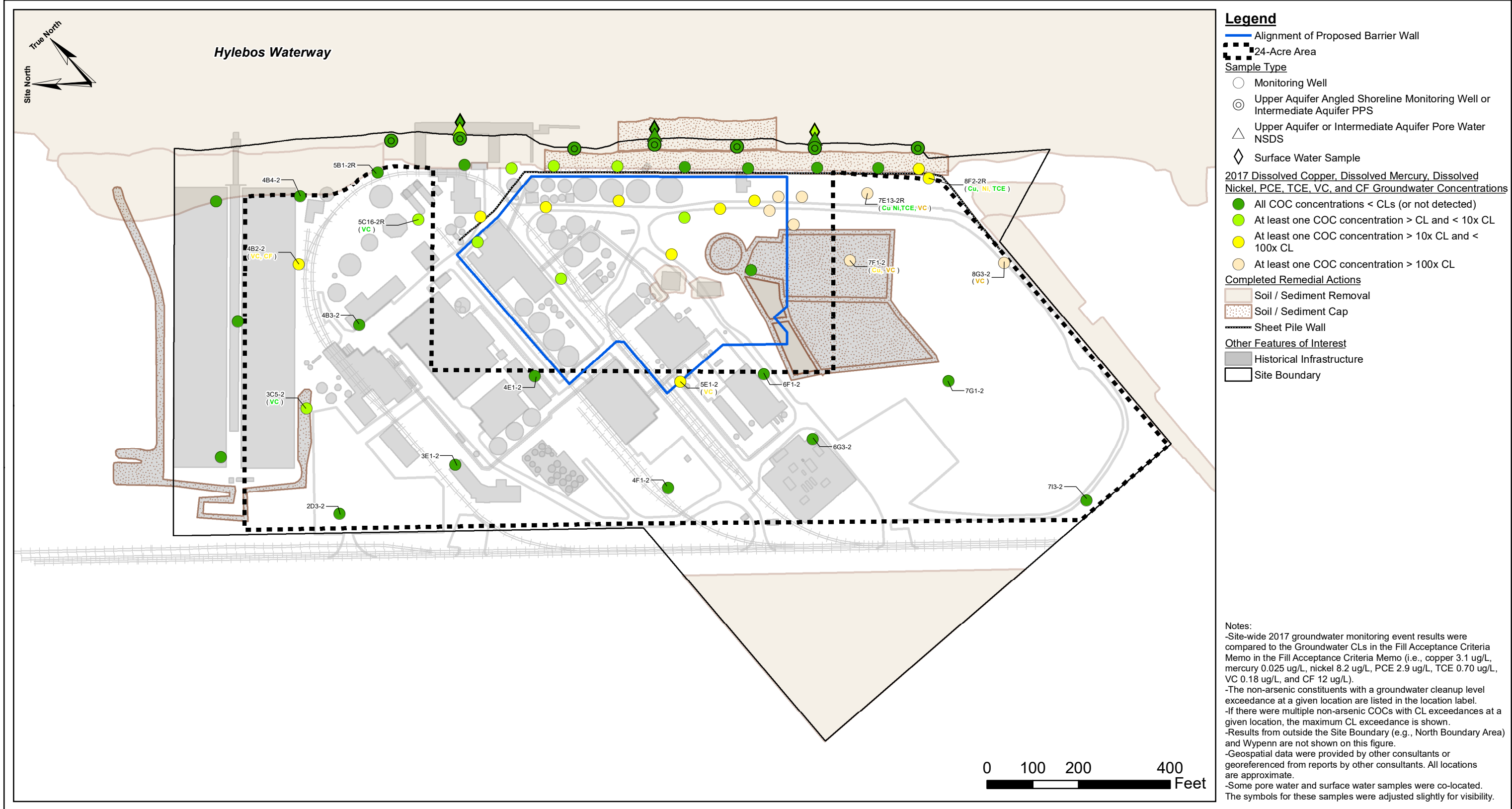


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Other COC Groundwater Concentrations in the Upper Aquifer IA Disproportionate Cost Analysis Memo Former Arkema Manufacturing Site

Figure 5

Document Path: G:\Projects\Arkema\Maps\IA DCA Memo\Fig 6_IA COC GW Conc.mxd; Author: VN; Date Saved: 3/26/2025

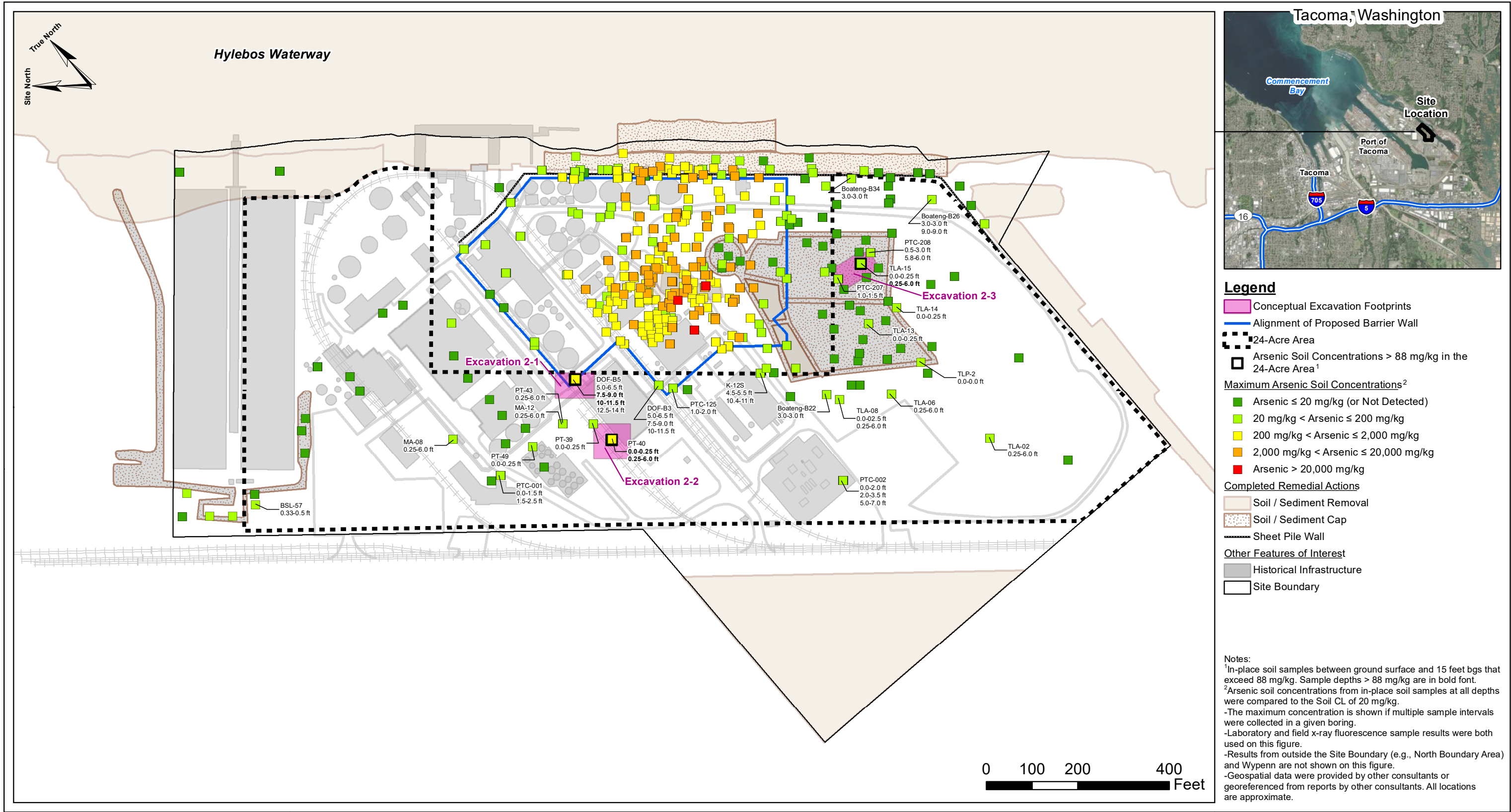


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Other COC Groundwater Concentrations in the Intermediate Aquifer
IA Disproportionate Cost Analysis Memo
Former Arkema Manufacturing Site

Figure 6

Document Path: G:\Projects\Arkema\Maps\IA DCA Memo\Fig 7_Conceptual Excavation Footprints.mxd; Author: VN; Date Saved: 4/8/2025

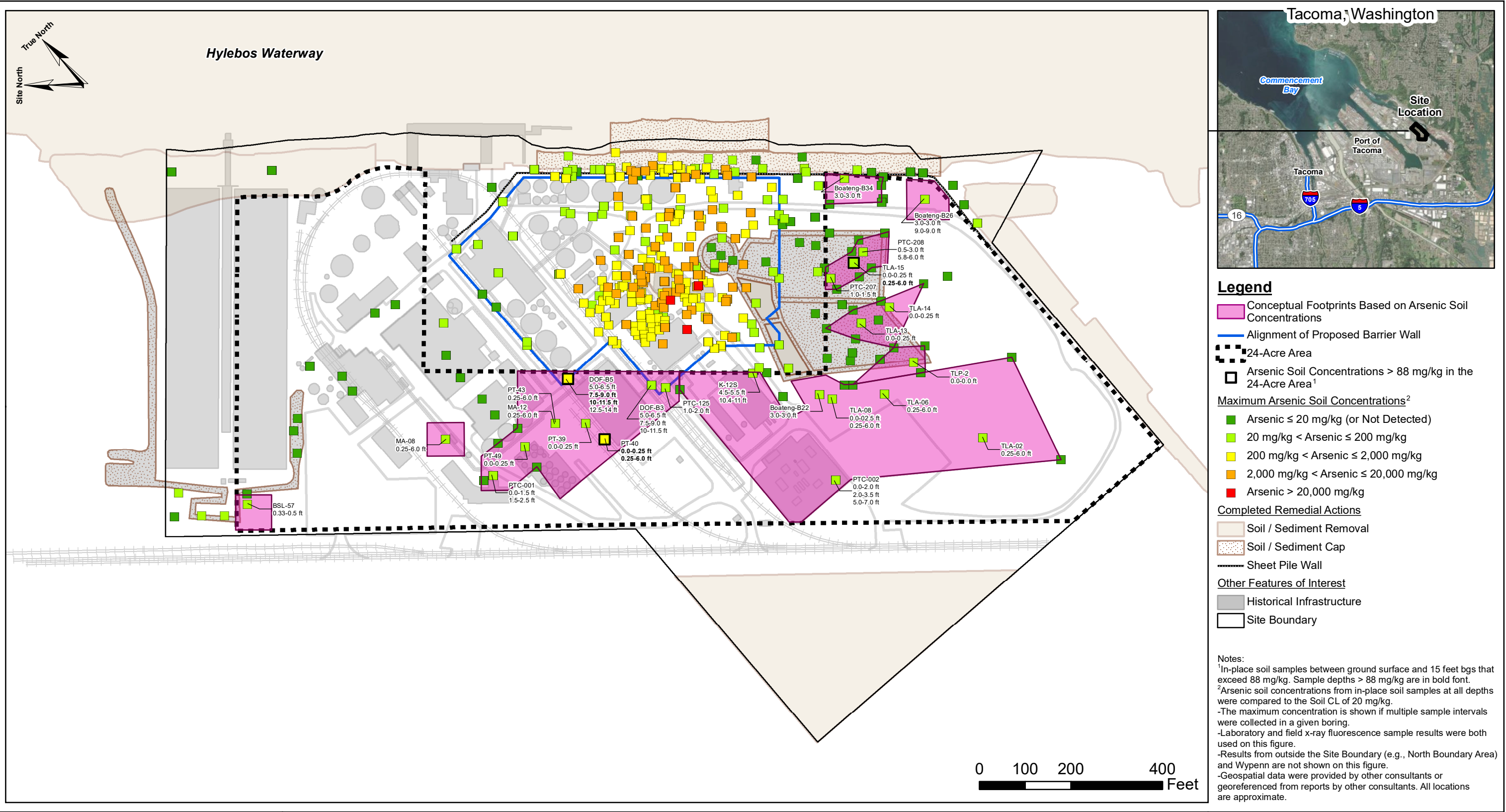


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Alternative 2 - Conceptual Excavation Footprints IA Disproportionate Cost Analysis Memo Former Arkema Manufacturing Site

Figure 7

Document Path: G:\Projects\Arkema\Maps\IA DCA Memo\Fig 8a_Concep_ExcFoot_Arsenic Soil Concentrations.mxd; Author: VN; Date Saved: 6/9/2025



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Alternative 3 and Alternative 4 - Conceptual Footprints
Based on Arsenic Soil Concentrations
IA Disproportionate Cost Analysis Memo
Former Arkema Manufacturing Site

Figure 8a

Document Path: G:\Projects\Arkema\Maps\IA DCA Memo\Fig 8b_Concep_ExcFoot_Other COC Soil Concentrations.mxd; Author: VN; Date Saved: 6/9/2025

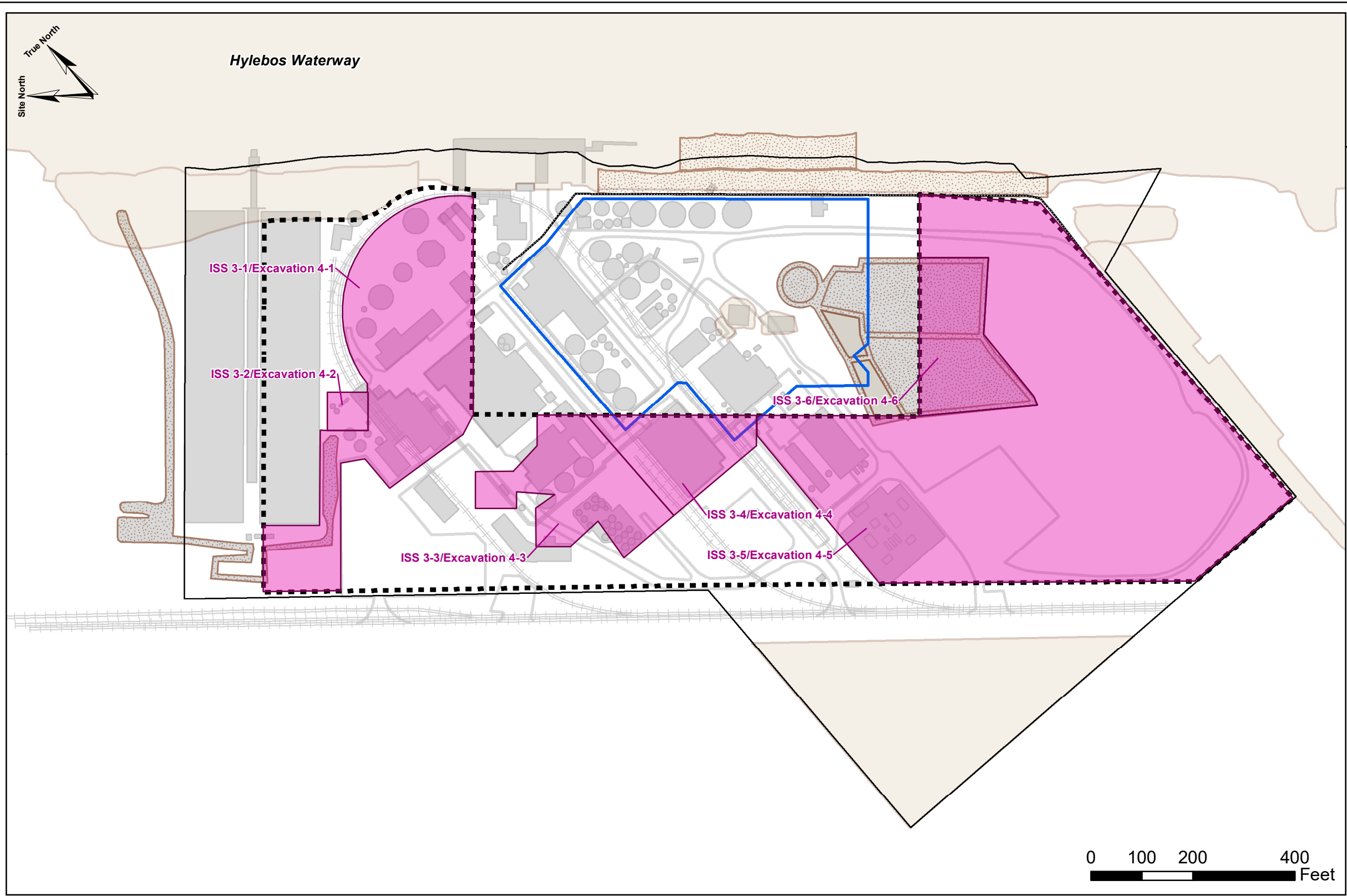


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**Alternative 3 and Alternative 4 - Conceptual Footprints
Based on Other COC Soil Concentrations
IA Disproportionate Cost Analysis Memo
Former Arkema Manufacturing Site**

Figure 8b

Document Path: G:\Projects\Arkema\Maps\IA DCA Memo\Fig 8c_Combined_Excavation Footprints.mxd; Author: VN; Date Saved: 6/9/2025



- Legend**
- Combined Conceptual Footprints
 - Alignment of Proposed Barrier Wall
 - 24-Acre Area
 - Completed Remedial Actions**
 - Soil / Sediment Removal
 - Soil / Sediment Cap
 - Sheet Pile Wall
 - Other Features of Interest**
 - Historical Infrastructure
 - Site Boundary

Notes:
-Geospatial data were provided by other consultants or georeferenced from reports by other consultants. All locations are approximate.



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Alternative 3 and Alternative 4 - Combined Conceptual Footprints
IA Disproportionate Cost Analysis Memo
Former Arkema Manufacturing Site

Figure 8c

Table 1. Conceptual Areas for Alternatives 2, 3, and 4

Alternative	Technology	Area #	Depth (ft)	Perimeter (ft) ⁽¹⁾	Area (SF) ⁽¹⁾	Volume (CY) ⁽¹⁾
Alternative 2	Excavation	2-1	12	280	4,700	2,100
		2-2	6	310	6,200	1,400
		2-3	6	280	4,700	1,000
Total				870	16,000	4,500
Alternative 3	ISS	3-1	6	2300	140,000	31,000
		3-2	22	310	6,000	4,900
		3-3	6	1300	57,000	13,000
		3-4	12	870	38,000	17,000
		3-5	6	3400	410,000	91,000
		3-6	10	1000	47,000	17,000
Total				9,200	700,000	170,000
Alternative 4	Excavation	4-1	6	2300	140,000	31,000
		4-2	22	310	6,000	4,900
		4-3	6	1300	57,000	13,000
		4-4	12	870	38,000	17,000
		4-5	6	3400	410,000	91,000
		4-6	10	1000	47,000	17,000
Total				9,200	700,000	170,000

Notes:

CY: cubic yards; ft: feet; SF: square feet

⁽¹⁾Rounded to 2 significant figures.

Table 2. Semi-quantitative Disproportionate Cost Analysis

Arkema Interim Action	Name	ALT 1	ALT 2	ALT 3	ALT 4		
	Cost (\$M)	9.6	14.0	43.0	89.0		
Semi-Quantitative Benefits Analysis							
DCA Criteria	Weight	Relative Degrees of Benefit				Factors	Rationale
Protectiveness	20%	5	6	8	9	The degree to which the alternative reduces existing risks.	ALT 4 > ALT 3 > ALT 2 > ALT 1
						The time required for alternative to reduce risks at the site and attain cleanup standards.	ALT 4 > ALT 3 > ALT 2 > ALT 1
						The on-site and offsite risks remaining after implementing the alternative.	ALT 4 > ALT 3 > ALT 2 > ALT 1
						Improvement of the overall environmental quality.	ALT 4 > ALT 3 > ALT 2 > ALT 1
	Notes: • Although Alternative 4 would likely reduce soil-to-groundwater-to-surface water impacts downgradient of the 24-acre area, it would also increase the potential off-site risk for the overburdened community that received the generated waste. • Alternative 3 reduces the soil-to-groundwater-to-surface water impacts downgradient of the 24-acre area, but contamination still remains on-site in a less mobile form. • The asphalt cap in Alternatives 1 and 2 provide protectiveness for the widespread and low-level exceedances of arsenic industrial soil direct contact cleanup levels (20 mg/kg) that are present across the 24-acre area. • The asphalt cap in Alternatives 1 and 2 has the unique ability to further decrease arsenic transport within the barrier wall (where the arsenic plume core and almost all of the arsenic mass is located). For instance, it is estimated that the asphalt cap would decrease the arsenic mass discharge to the Hylebos Waterway by 34% compared to a non-capped situation (Keta Waters 2025).						
Permanence	20%	5	6	8	9	The adequacy of the alternative in destroying the hazardous substances.	ALT 4 > ALT 3 > ALT 2 > ALT 1
						The reduction or elimination of hazardous substance releases and sources of releases.	ALT 4 > ALT 3 > ALT 2 > ALT 1
						The degree of irreversibility of waste treatment process.	ALT 4 > ALT 3 > ALT 2 > ALT 1
						The characteristics and quantity of treatment residuals generated.	ALT 1 > ALT 2 > ALT 3 > ALT 4
Notes: • Although Alternative 4 is the most permanent alternative from an on-site perspective, Alternative 4 would simply transfer impacted soil from the 24-acre area to an off-site facility (landfill) for perpetuity.							
Effectiveness Over the Long Term	20%	5	6	8	9	The degree of certainty that the alternative will be successful.	ALT 1 = ALT 2 = ALT 3 = ALT 4
						The reliability of the alternative during the period of time hazardous substances are expected to remain on-site at concentrations that exceed cleanup levels.	ALT 4 > ALT 3 > ALT 2 > ALT 1
						The resilience of the alternative to climate change impacts.	ALT 1 = ALT 2 = ALT 3 = ALT 4
						The magnitude of residual risk with the alternative in place.	ALT 4 > ALT 3 > ALT 2 > ALT 1
						The effectiveness of controls required to manage treatment residues or remaining wastes.	ALT 1 > ALT 2 > ALT 3 > ALT 4
Notes: • Alternative 4 would require substantial controls given the large quantity of generated waste. • Even though Alternative 4 includes substantial soil excavation in the vadose zone and Upper Aquifer, Alternative 4 may not fully achieve groundwater cleanup levels in the Intermediate Aquifer due to existing Intermediate Aquifer exceedances at depth within the 24-acre area.							
Management of Implementation Risks	20%	9	8	6	5	The risks to human health and the environment, including likely vulnerable populations and overburdened communities, associated with the alternative during construction and implementation.	ALT 1 > ALT 2 > ALT 3 > ALT 4
						The effectiveness of the alternative to manage such risks.	ALT 1 > ALT 2 > ALT 3 > ALT 4
Notes: • Alternative 1 poses the least construction and implementation risks given the simplicity of the alternative.							
Technical and Administrative Implementability	20%	9	8	6	5	The technical difficulty of designing, constructing, and otherwise implementing the alternative in a reliable and effective manner, regardless of cost.	ALT 1 > ALT 2 > ALT 3 > ALT 4
						The availability of necessary off-site facilities, services, and materials.	ALT 1 > ALT 2 > ALT 3 > ALT 4
						Administrative and regulatory requirements.	ALT 1 > ALT 2 > ALT 3 > ALT 4
						Scheduling, size, and complexity.	ALT 1 > ALT 2 > ALT 3 > ALT 4
						Monitoring requirements.	ALT 1 > ALT 2 > ALT 3 > ALT 4
						Access for construction operations and monitoring. This may require cooperation of property owners other than the person conducting the cleanup.	ALT 1 = ALT 2 = ALT 3 = ALT 4
						Integration with existing facility operations and other current or potential remedial actions.	ALT 1 = ALT 2 = ALT 3 = ALT 4
Notes: • Alternatives 3 and 4 have a substantially larger scope, size, and complexity than Alternatives 1 and 2, and would be extremely challenging in terms of design, construction, off-site facilities (e.g., landfill for Alternative 4), and administrative and regulatory requirements.							
Total weighted benefits score	100%	6.6	6.8	7.2	7.4		
Cost Effectiveness (\$/B)		1.45	2.06	5.97	12.03		

Notes:

In the rationale column, ">" means better benefit and "=" means similar benefit.

Table 3: Conceptual Cost Estimate for Alternative 1

Category	Item	Qty	Unit	Basis for Quantity Assumption	Unit Cost	Basis for Unit Cost Assumption	Cost
Direct Capital Construction Costs	Contractor-prepared plans and submittals	1	LS	Qty used to simplify estimate.	\$20,000	Assumed based on anticipated level of effort.	\$20,000
	Contractor mobilization and de-mobilization	1	LS		\$20,000		\$20,000
	Site prep and miscellaneous requirements ⁽¹⁾	1	LS		\$40,000		\$40,000
	Obtain and install CSBC	51,627	CY	Assumed 16 inches of CSBC used across entire 24-acre area.	\$40	Estimated based on correspondence between Trevor Louviere of DOF and Troy Bussey of PIONEER 2025.	\$2,065,067
	Obtain and install HMA	51,627	Ton	Assumed 8 inches of HMA used across entire 24-acre area. Assumed a HMA density of 2 ton/CY.	\$100	Estimated based on correspondence between Trevor Louviere of DOF and Troy Bussey of PIONEER 2025.	\$5,162,667
	Sales tax	10.3%	%	2025 sales tax in Tacoma.	N/A	N/A	\$752,697
	Subtotal ⁽²⁾						
Indirect Capital Construction Costs	Project management	5%	%	These general categories were used in accordance with the approach in USACE and USEPA 2000. Each item was estimated as a percentage of the direct capital construction cost subtotal.	N/A	N/A	\$405,000
	Remedial design	8%	%				\$648,000
	Construction management	6%	%				\$486,000
	Subtotal ⁽²⁾						
Total ⁽²⁾							\$9,600,000

Notes:
CSBC: crushed surfacing base course; CY: cubic yards; ft: feet; HMA: hot mix asphalt; LS: lump sum; N/A: not applicable; Qty: quantity; USACE: United States Army Corps of Engineers; USEPA: United States Environmental Protection Agency
This cost estimate does not include any costs for redevelopment.

These cost estimates were prepared solely to facilitate relative comparisons between alternatives for the purpose of this memo, and are intended to be -30% to +50%. Since these ballpark estimates were based on a variety of simplifying assumptions and PIONEER has no control over the results from future investigation and remediation activities, the remedial design, Port requirements, the cost of labor, materials, and equipment, or the nature of a particular competitive bidding process at the time the work would be performed, the estimated costs should not be construed to equal actual implementation costs. It is expected that implementation cost estimates would be refined during remedial design, and then following procurement.

Post-construction groundwater monitoring will occur within and/or downgradient of the 24-acre area pursuant to the Cleanup Action Plan. For the purpose of this analysis, groundwater monitoring within the 24-acre area was not included in the cost estimate because (1) long-term groundwater monitoring within the 24-acre area will be determined after the Cleanup Action Plan is finalized, and (2) groundwater monitoring within the 24-acre area for the four alternatives would probably have similar order of magnitude costs.

⁽¹⁾This item includes costs associated with health and safety implementation, traffic control, site control, dust control, stormwater control, clearing and grubbing, performing utility locates, providing temporary utilities and facilities, creating containment areas for stockpiles, stockpile management, and general project requirements.

⁽²⁾Rounded to 2 significant figures.

Table 4: Conceptual Cost Estimate for Alternative 2

Category	Item	Qty	Unit	Basis for Quantity Assumption	Unit Cost	Basis for Unit Cost Assumption	Cost
Direct Capital Construction Costs	Contractor-prepared plans and submittals	1	LS	Qty used to simplify estimate.	\$30,000	Assumed based on antipipated level of effort.	\$30,000
	Contractor mobilization and de-mobilization	1	LS		\$30,000		\$30,000
	Site prep and miscellaneous requirements ⁽¹⁾	1	LS		\$60,000		\$60,000
	Install temporary sheet pile wall for excavations deeper than 6 ft bgs	280	LF	Estimated perimeter of 280 ft for Excavation 2-1 in Table 1 (see Figure 7).	\$800	Estimated based on 2024 personal correspondence between Calvin McCaughan of Sage Geotechnical and Troy Bussey of PIONEER.	\$224,000
	Excavate soil within excavation areas	10,800	Ton	Estimated 4,500 CY volume of excavation areas in Table 1 plus assumed 50% extra soil volume based on results from remedial design investigation and from confirmation soil sampling (which would occur prior to construction for excavations that will have a temporary sheet pile wall). Assumed soil density of 1.6 ton/CY.	\$35	Estimated based on similar items at this site and other sites.	\$378,000
	Dewater excavations, and treat and dispose of generated water	1	LS	Qty assumed to simplify estimate.	\$250,000	Assumed based on anticipated level of effort.	\$250,000
	Dry, load, haul, and dispose of excavated material that is non-hazardous waste at the LRI Landfill in Graham, Washington	8,100	Ton	Assumed 75% of excavated soil will be non-hazardous waste.	\$125	Estimated \$25/ton for drying/loading, \$27/ton for haul, and \$73/ton for disposal per 2025 correspondence between Jeff Bishop of LRI and Logan Rower of PIONEER.	\$1,012,500
	Dry, load, haul, and dispose of excavated soil that is hazardous waste at the Waste Management facility in Arlington, Oregon	2,700	Ton	Assumed 25% of excavated soil will be hazardous waste.	\$378	Estimated \$25/ton for drying/loading, and \$58/ton for haul, and \$295/ton for disposal per 2025 correspondence between Robert Yates of Waste Management and Logan Rower of PIONEER.	\$1,020,600
	Obtain, place and compact gravel backfill	10,800	Ton	Assumed Qty equals the excavation Qty.	\$40	Estimated based on similar items at this site and other sites.	\$432,000
	Obtain and install CSBC	51,627	CY	Assumed 16 inches of CSBC used across entire 24-acre area.	\$40	Estimated based on correspondence between Trevor Louviere of DOF and Troy Bussey of PIONEER 2025.	\$2,065,067
	Obtain and install HMA	51,627	Ton	Assumed 8 inches of HMA used across entire 24-acre area. Assumed a HMA density of 2 ton/CY.	\$100	Estimated based on correspondence between Trevor Louviere of DOF and Troy Bussey of PIONEER 2025.	\$5,162,667
	Sales tax	10.3%	%	2025 sales tax in Tacoma.	N/A	N/A	\$1,098,478
Subtotal ⁽²⁾							\$12,000,000
Indirect Capital Construction Costs	Remedial design investigation work plan, field, lab, and reporting	1	LS	Qty assumed to simplify estimate.	\$100,000	Assumed based on antipipated level of effort.	\$100,000
	Project management	5%	%	These general categories were used in accordance with the approach in USACE and USEPA 2000. Each item was estimated as a percentage of the direct capital construction cost subtotal.	N/A	N/A	\$600,000
	Remedial design	6%	%				\$720,000
	Construction management	6%	%				\$720,000
	Subtotal ⁽²⁾						
Total ⁽²⁾							\$14,000,000

Notes:

bgs: below ground surface; CSBC: crushed surfacing base course; CY: cubic yards; ft: feet; HMA: hot mix asphalt; LF: linear feet; LS: lump sum; N/A: not applicable; Qty: quantity; SF: square feet; USACE: United States Army Corps of Engineers; USEPA: United States Environmental Protection Agency

This cost estimate does not include any costs for redevelopment.

These cost estimates were prepared solely to facilitate relative comparisons between alternatives for the purpose of this memo, and are intended to be -30% to +50%. Since these ballpark estimates were based on a variety of simplifying assumptions and PIONEER has no control over the results from future investigation and remediation activities, the remedial design, Port requirements, the cost of labor, materials, and equipment, or the nature of a particular competitive bidding process at the time the work would be performed, the estimated costs should not be construed to equal actual implementation costs. It is expected that implementation cost estimates would be refined during remedial design, and then following procurement.

Post-construction groundwater monitoring will occur within and/or downgradient of the 24-acre area pursuant to the Cleanup Action Plan. For the purpose of this analysis, groundwater monitoring within the 24-acre area was not included in the cost estimate because (1) long-term groundwater monitoring within the 24-acre area will be determined after the Cleanup Action Plan is finalized, and (2) groundwater monitoring within the 24-acre area for the four alternatives would probably have similar order of magnitude costs.

⁽¹⁾This item includes costs associated with health and safety implementation, traffic control, site control, dust control, stormwater control, clearing and grubbing, performing utility locates, providing temporary utilities and facilities, creating containment areas for stockpiles, stockpile management, and general project requirements.

⁽²⁾Rounded to 2 significant figures.

Table 5: Conceptual Cost Estimate for Alternative 3

Category	Item	Qty	Unit	Basis for Quantity Assumption	Unit Cost	Basis for Unit Cost Assumption	Cost
Direct Capital Construction Costs	Contractor-prepared plans and submittals	1	LS	Qty used to simplify estimate.	\$40,000	Assumed based on anticipated level of effort.	\$40,000
	Contractor mobilization and de-mobilization	1	LS		\$40,000		\$40,000
	Site prep and miscellaneous requirements ⁽¹⁾	1	LS		\$80,000		\$80,000
	In-situ solidification/stabilization to bottom of Intermediate Aquifer	187,000	Ton	Estimated 170,000 CY volume of excavation areas in Table 1 plus assumed 10% extra soil volume based on results from remedial design investigation.	\$173	Estimated based on 2020 personal correspondence with ENTACT, and assumed 15% inflation since 2020.	\$32,257,500
	Sales tax	10.3%	%	2025 sales tax in Tacoma.	N/A	N/A	\$3,339,003
	Subtotal ⁽²⁾						
Indirect Capital Construction Costs	Remedial design investigation work plan, field, lab, and reporting	1	LS	Qty assumed to simplify estimate.	\$500,000	Assumed based on anticipated level of effort.	\$500,000
	Project management	5%	%	These general categories were used in accordance with the approach in USACE and USEPA 2000. Each item was estimated as a percentage of the direct capital construction cost subtotal.	N/A	N/A	\$1,800,000
	Remedial design	6%	%				\$2,160,000
	Construction management	6%	%				\$2,160,000
	Subtotal ⁽²⁾						
Total ⁽²⁾							\$43,000,000

Notes:
bgs: below ground surface; CY: cubic yards; LS: lump sum; N/A: not applicable; Qty: quantity; USACE: United States Army Corps of Engineers; USEPA: United States Environmental Protection Agency
This cost estimate does not include any costs for redevelopment.

These cost estimates were prepared solely to facilitate relative comparisons between alternatives for the purpose of this memo, and are intended to be -30% to +50%. Since these ballpark estimates were based on a variety of simplifying assumptions and PIONEER has no control over the results from future investigation and remediation activities, the remedial design, Port requirements, the cost of labor, materials, and equipment, or the nature of a particular competitive bidding process at the time the work would be performed, the estimated costs should not be construed to equal actual implementation costs. It is expected that implementation cost estimates would be refined during remedial design, and then following procurement.

Post-construction groundwater monitoring will occur within and/or downgradient of the 24-acre area pursuant to the Cleanup Action Plan. For the purpose of this analysis, groundwater monitoring within the 24-acre area was not included in the cost estimate because (1) long-term groundwater monitoring within the 24-acre area will be determined after the Cleanup Action Plan is finalized, and (2) groundwater monitoring within the 24-acre area for the four alternatives would probably have similar order of magnitude costs.

⁽¹⁾This item includes costs associated with health and safety implementation, traffic control, site control, dust control, stormwater control, clearing and grubbing, performing utility locates, providing temporary utilities and facilities, creating containment areas for stockpiles, stockpile management, and general project requirements.

⁽²⁾Rounded to 2 significant figures.

Table 6: Conceptual Cost Estimate for Alternative 4

Category	Item	Qty	Unit	Basis for Quantity Assumption	Unit Cost	Basis for Unit Cost Assumption	Cost
Direct Capital Construction Costs	Contractor-prepared plans and submittals	1	LS	Qty used to simplify estimate.	\$40,000	Assumed based on anticipated level of effort.	\$40,000
	Contractor mobilization and de-mobilization	1	LS		\$40,000		\$40,000
	Site prep and miscellaneous requirements ⁽¹⁾	1	LS		\$80,000		\$80,000
	Install temporary sheet pile wall for excavations deeper than 6 ft bgs	2,180	LF	Estimated perimeter of 2,180 ft for Excavations 3-2, 3-4, and 3-6 in Table 1 (see Figure 8c).	\$800	Estimated based on 2024 personal correspondence between Calvin McCaughan of Sage Geotechnical and Troy Bussey of PIONEER.	\$1,744,000
	Excavate soil within excavation areas	299,200	Ton	Estimated 170,000 CY volume of excavation areas in Table 1 plus assumed 10% extra soil volume based on results from remedial design investigation and from confirmation soil sampling (which would occur prior to construction for excavations that will have a temporary sheet pile wall). Assumed soil density of 1.6 ton/CY.	\$35	Estimated based on similar items at this site and other sites.	\$10,472,000
	Dewater excavations, and treat and dispose of generated water	1	LS	Qty assumed to simplify estimate.	\$2,500,000	Assumed based on anticipated level of effort.	\$2,500,000
	Dry, load, haul, and dispose of excavated material that is non-hazardous waste at the LRI Landfill in Graham, Washington	284,240	Ton	Assumed 95% of excavated soil will be non-hazardous waste.	\$125	Estimated \$25/ton for drying/loading, \$27/ton for haul, and \$73/ton for disposal per 2025 correspondence between Jeff Bishop of LRI and Logan Rower of PIONEER.	\$35,530,000
	Dry, load, haul, and dispose of excavated soil that is hazardous waste at the Waste Management facility in Arlington, Oregon	14,960	Ton	Assumed 5% of excavated soil will be hazardous waste.	\$378	Estimated \$25/ton for drying/loading, and \$58/ton for haul, and \$295/ton for disposal per 2025 correspondence between Robert Yates of Waste Management and Logan Rower of PIONEER.	\$5,654,880
	Obtain, place and compact gravel backfill	299,200	Ton	Assumed Qty equals the excavation Qty.	\$40	Estimated based on similar items at this site and other sites.	\$11,968,000
	Sales tax	10.3%	%	2025 sales tax in Tacoma.	N/A	N/A	\$7,006,975
Subtotal ⁽²⁾							\$75,000,000
Indirect Capital Construction Costs	Remedial design investigation work plan, field, lab, and reporting	1	LS	Qty assumed to simplify estimate.	\$1,000,000	Assumed based on anticipated level of effort.	\$1,000,000
	Project management	5%	%	These general categories were used in accordance with the approach in USACE and USEPA 2000. Each item was estimated as a percentage of the direct capital construction cost subtotal.	N/A	N/A	\$3,750,000
	Remedial design	6%	%				\$4,500,000
	Construction management	6%	%				\$4,500,000
	Subtotal ⁽²⁾						
Total ⁽²⁾							\$89,000,000

Notes:

bgs: below ground surface; CSBC: crushed surfacing base course; CY: cubic yards; ft: feet; HMA: hot mix asphalt; LF: linear feet; LS: lump sum; N/A: not applicable; Qty: quantity; SF: square feet; USACE: United States Army Corps of Engineers; USEPA: United States Environmental Protection Agency

This cost estimate does not include any costs for redevelopment.

These cost estimates were prepared solely to facilitate relative comparisons between alternatives for the purpose of this memo, and are intended to be -30% to +50%. Since these ballpark estimates were based on a variety of simplifying assumptions and PIONEER has no control over the results from future investigation and remediation activities, the remedial design, Port requirements, the cost of labor, materials, and equipment, or the nature of a particular competitive bidding process at the time the work would be performed, the estimated costs should not be construed to equal actual implementation costs. It is expected that implementation cost estimates would be refined during remedial design, and then following procurement.

Post-construction groundwater monitoring will occur within and/or downgradient of the 24-acre area pursuant to the Cleanup Action Plan. For the purpose of this analysis, groundwater monitoring within the 24-acre area was not included in the cost estimate because (1) long-term groundwater monitoring within the 24-acre area will be determined after the Cleanup Action Plan is finalized, and (2) groundwater monitoring within the 24-acre area for the four alternatives would probably have similar order of magnitude costs.

⁽¹⁾This item includes costs associated with health and safety implementation, traffic control, site control, dust control, stormwater control, clearing and grubbing, performing utility locates, providing temporary utilities and facilities, creating containment areas for stockpiles, stockpile management, and general project requirements.

⁽²⁾Rounded to 2 significant figures.

Attachment 1

MEMORANDUM

To: Dalton, Olmsted & Fuglevand, Inc.
10827 NE 68th Street, Suite B
Kirkland, WA 98033

Attn: Trevor Louviere <tlouviere@dofnw.com>

From: Joel Massmann, Ph.D., P.E.

Date: September 28, 2022

Subject: Former Arkema Manufacturing Site
Model results for conceptual containment scenarios

This memorandum summarizes results from model simulations that were developed to aid in evaluating a conceptual containment scenario for the former Arkema Manufacturing Site (Arkema). The scenario that was considered is described in emails from Trevor Louviere dated August 17, 2022 and August 23, 2022. The MODFLOW model developed for the Arkema site was used for the simulations. This model is described in Keta Waters (2021).¹

Scenario description

The conceptual containment scenarios consider a barrier wall that penetrates through the intermediate aquifer at the Arkema site.² The alignment of the wall is shown in Figure 1. The barrier wall is assumed to have a permeability (i.e., hydraulic conductivity) of 1×10^{-9} cm/s and a thickness of 5 inches. The “Wall” boundary condition that is an option within the MODFLOW software was used to incorporate the barrier wall into the model.

Two variations of the conceptual containment scenario were simulated. The first variation includes only the barrier wall shown in Figure 1. The second variation includes

¹ Keta Waters, 2021. Description of Groundwater Flow and Transport Modeling, Former Arkema Manufacturing Site, Tacoma, WA. Prepared for Dalton, Olmsted & Fuglevand, Inc. Bellevue, WA. March 29, 2021.

² The bottom of the intermediate aquifer in the vicinity of the barrier wall is approximately elevation -10 feet MLLW. MLLW elevations in the model area are equal to NAVD88 elevations plus 2.46 feet.

both the barrier wall and a low-permeability surface cap within the same footprint of vertical containment walls. Recharge through the cap is assumed to be 0.23 inches/year (1% of normal recharge).

The barrier wall was added to the “CAA-2” model alternative described in Keta Waters (2021). This model alternative assumes focused soil removal for the upper aquifer where soils with total arsenic concentrations greater than 10,000 mg/kg are excavated and the arsenic source term is eliminated. The sorbed arsenic mass and arsenic groundwater concentrations are set to zero within excavation areas. It is assumed that clean soil is used as backfill, and the hydraulic conductivity of the backfill is the same as the excavated material. The existing sheet pile cutoff wall is included in the CAA-2 model.³

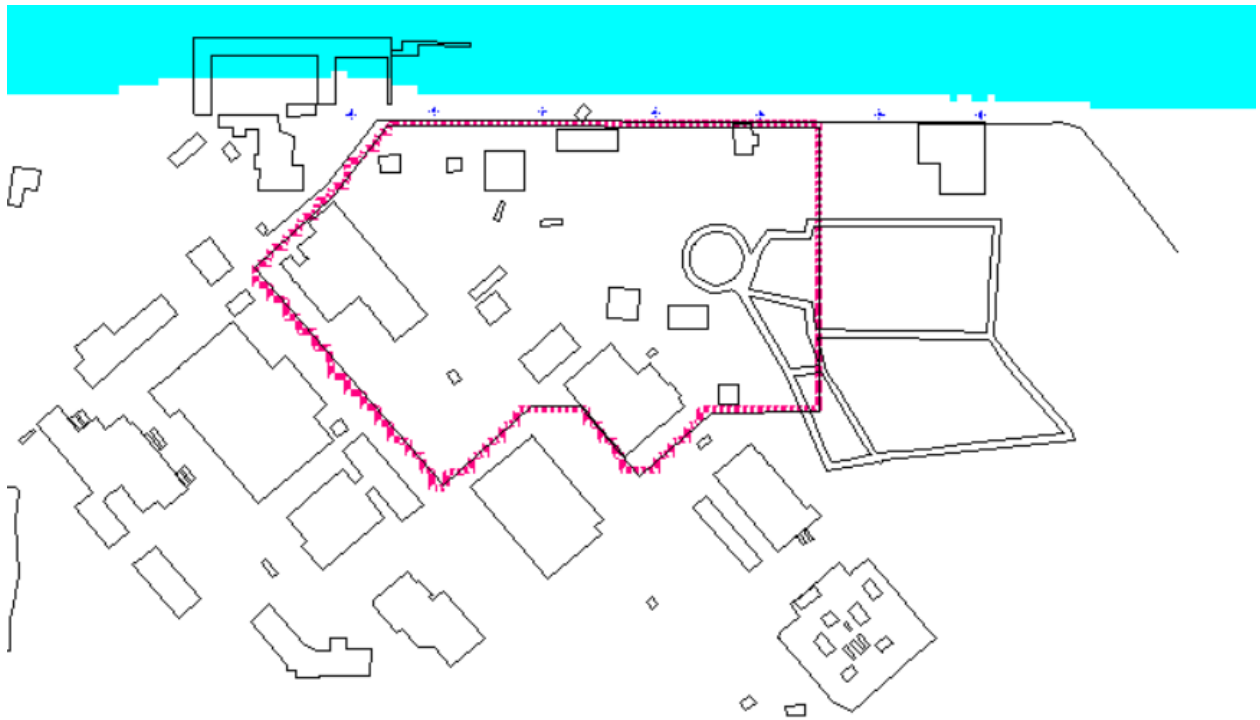


Figure 1. Alignment of barrier walls in the conceptual containment simulations.

³ The CAA2 model also assumes that a subtidal cap extension results in additional attenuation of arsenic concentrations at the angled shoreline monitoring wells and nylon-screen diffusion samplers (NSDS). These additional attenuation factors, which are applied to the model results, were used to estimate time frames to achieve 5 ug/L and 36 ug/L concentration levels. The additional attenuation factors were not used in the current simulations for the conceptual containment scenarios.

Scenario results

Table 1 compares the results from the conceptual containment scenarios with results from the CAA-2 simulation reported in Keta Waters (2021).⁴ The results are compared in terms of average arsenic discharge to the Hylebos Waterway during the next 100 years and in terms of time frames to achieve concentration targets.

The conceptual containment scenarios reduce the estimated arsenic discharge from approximately 9.9 kg/year to 3.1 kg/year for the scenario without a low-permeability surface cap and to 2.4 kg/year for the scenario with a low-permeability surface cap. The predicted times to achieve concentration targets are greater than the CAA-2 baseline simulation for both conceptual containment scenarios. The timeframes for the containment scenario with a low-permeability cap are all greater than 10,000 years, which was the limit for the model simulation period.

Table 1. Comparison of Conceptual Containment Simulations with Previous Scenarios

	Average arsenic discharge to Hylebos Waterway for next 100 years (kg/yr)	Predicted Relative Timeframes to Achieve Concentration Targets (years)				
		500 ug/L at Vertical OMMP MWs	5 ug/L at Angled Shoreline MWs	36 ug/L at Angled Shoreline MWs	5 ug/L at NSDS Pore Water	36 ug/L at NSDS Pore Water
CAA-2 from Keta Waters (2021)	9.9	5,153	4,588	752	3,711	423
CAA-2 without additional attenuation	9.9	5,153	6,172	1,782	5,299	1,169
Conceptual Containment (without cap)	3.1	6,944	8,671	2,274	6,941	1,545
Conceptual Containment (with cap)	2.4	>10,000	>10,000	>10,000	>10,000	>10,000

⁴ The results from two versions of the CAA-2 simulations are included in Table 1. The first version includes the effects of the additional attenuation factors from a subtidal cap extension. The second version does not include these additional attenuation factors.

Impact of the cutoff wall on arsenic transport and deep aquifer concentrations.

The barrier wall increases downward migration of arsenic into the deep aquifer, as compared to the CAA-2 baseline scenario. This is illustrated with the results shown in Figure 2, which compares simulated arsenic concentrations at monitoring well 125+50-3 in the deep aquifer. The CAA-2 baseline scenario results in a maximum simulated arsenic concentration at 125+50-3 equal to 548 ppb. Adding the barrier wall increases this concentration to 685 ppb. These maximum concentrations occur approximately 2,000 years into the future, based on the model simulations. Adding the low-permeability cap with the barrier wall slows down the migration to the deep aquifer, but causes elevated concentrations for a longer period of time.

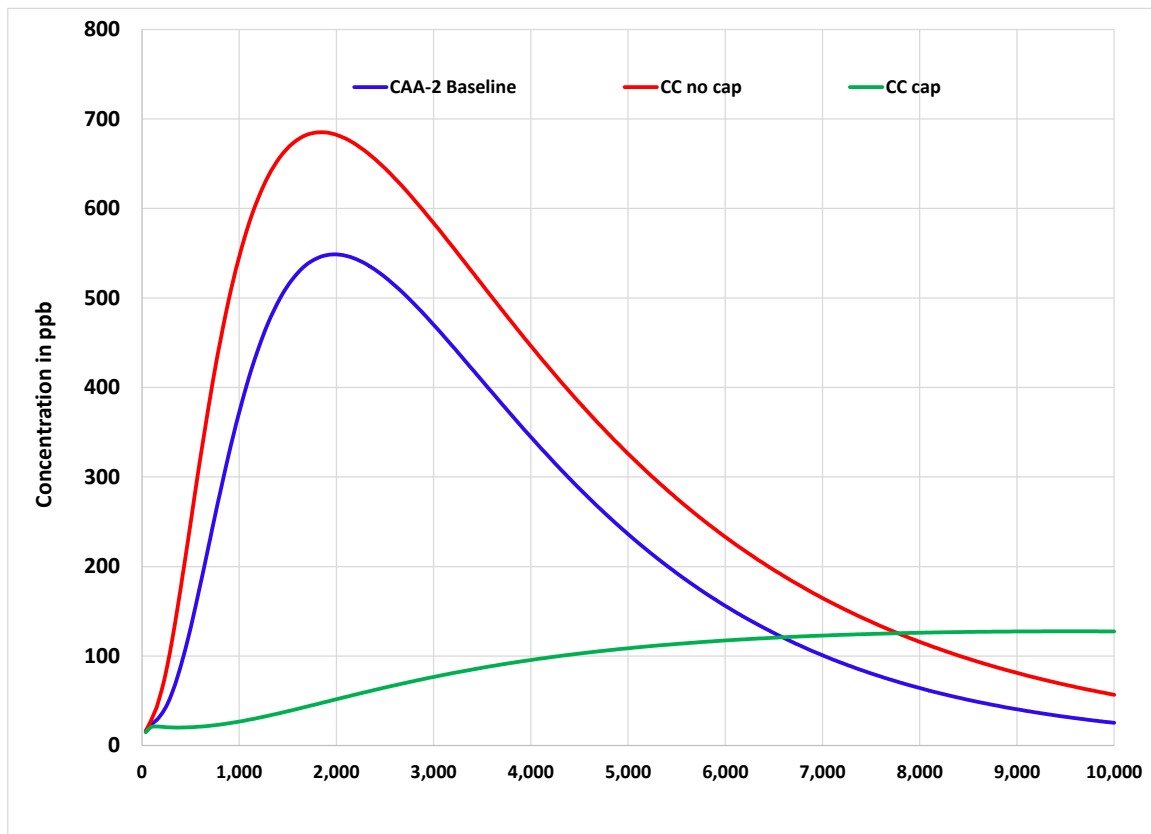


Figure 2. Simulated concentrations in the deep aquifer at monitoring well 125+50-3.

The impact of the barrier wall on deep aquifer arsenic transport can also be seen by considering the arsenic discharge to the Hylebos Waterway, as shown in Table 2. This table lists the arsenic discharge to the Hylebos Waterway in year 100.⁵ For the CAA-2 baseline scenario, the discharge to the waterway from the deep aquifer is 0.18 kg/year, or 1.4% of the total discharge in year 100. For the conceptual containment scenario without

⁵ The arsenic discharge to the Hylebos Waterway varies with time. The discharge in year 100 was chosen as a representative value for each alternative to illustrate the impact of the cutoff wall. The model output does not provide average fluxes over a period of time from individual aquifers.

a low-permeability cap, the estimated discharge to the waterway from the deep aquifer is 0.21 kg/year, or 5.1% of the total discharge in year 100. The estimated discharge from the deep aquifer for the conceptual containment scenario with a cap is 0.14 kg/year or 4.1% of the total discharge.

All arsenic in the model area will eventually discharge to the Hylebos Waterway in the modeled scenarios. The barrier wall decreases the percentage that discharges to the waterway from the upper aquifer and increases the percentage that discharges from the intermediate and deep aquifers.

Table 2. Source of arsenic discharge to Hylebos Waterway in year 100.

	Arsenic discharge in year 100 (kg/yr and % of total)		
Source of arsenic discharge to Hylebos	CAA-2 baseline	Conceptual containment without cap	Conceptual containment with cap
Upper aquifer	2.19 (17.1%)	0.37 (8.9%)	0.32 (9.5%)
Intermediate aquifer	10.40 (81.4%)	3.59 (86.0%)	2.89 (86.4%)
Deep aquifer	0.18 (1.4%)	0.21 (5.1%)	0.14 (4.1%)
Total	12.8 (100%)	4.17 (100%)	3.34 (100%)

MEMORANDUM

To: Dalton, Olmsted & Fuglevand, Inc.
10827 NE 68th Street, Suite B
Kirkland, WA 98033

Attn: Trevor Louviere <tlouviere@dofnw.com>

From: Joel Massmann, Ph.D., P.E.
Adam Massmann, Ph.D., EIT

Date: April 28, 2025

Subject: Former Arkema Manufacturing Site
Model results for caps and covers in containment scenarios

This memorandum summarizes results from model simulations that were developed to aid in evaluating containment scenarios for the former Arkema Manufacturing Site (Arkema). The scenarios that were considered are described in emails from Trevor Louviere dated December 9, 2024, and January 8, February 3, and February 19, 2025. The MODFLOW model developed for the Arkema site was used for the simulations. This model is described in Keta Waters (2021).¹

A. SCENARIO DESCRIPTIONS

All scenarios described in this memorandum consider a barrier wall that penetrates through the intermediate aquifer at the Arkema site, as described in Keta Waters (2022).² The alignment of the wall is shown in Figure 1.³ The barrier wall is assumed to have a permeability (i.e., hydraulic conductivity) of 1×10^{-9} cm/s and a thickness of 5 inches.

¹ Keta Waters, 2021. Description of Groundwater Flow and Transport Modeling, Former Arkema Manufacturing Site, Tacoma, WA. Prepared for Dalton, Olmsted & Fuglevand, Inc. Bellevue, WA. March 29, 2021.

² Keta Waters, 2022. Former Arkema Manufacturing Site, Model results for conceptual containment scenarios. Memorandum from Joel Massmann (Keta Waters) to Trevor Louviere, (Dalton, Olmsted & Fuglevand, Inc.) dated September 28, 2022.

³ The bottom of the intermediate aquifer in the vicinity of the barrier wall is approximately elevation -10 feet MLLW. MLLW elevations in the model area are equal to NAVD88 elevations plus 2.46 feet.

Four sets of scenarios were developed to evaluate different options for land cover at the Arkema site. These scenarios, which are identified as Scenarios A through D, are described below and are summarized in Table 1. The scenarios are described using four zones that represent areas within the Arkema property. In all four scenarios, Zone 1 represents undeveloped areas that are assumed to be similar to existing conditions with silty and sandy soil at the ground surface. Zone 2 represents areas that are treated as undeveloped areas in Scenario A and as areas covered with asphalt in other all scenarios. Zone 3 represents an undeveloped area in Scenario A, an asphalt-covered area in Scenario B, a gravel-covered area with catch basins in Scenario C, and an asphalt-covered area with catch basins in Scenario D. In all four scenarios, Zone 4 represents the containment area, which is defined as the area inside the barrier wall.

Scenario A. The first set of scenarios, which are considered the Base Case scenarios, considers the barrier wall with a compacted gravel cover, as shown in Figure 1. The compacted gravel cover is underlain with a 30-mil PVC membrane. This containment area is shown as Zone 4 in Figure 1.⁴ The surface area of Zone 4 is approximately 256,000 ft² or 5.9 acres.

All areas outside of the containment area (i.e., Zones 1, 2, and 3) are assumed to be undeveloped in Scenario A. The land surface in this undeveloped area is assumed to be similar to existing conditions with silty and sandy soils at the ground surface. These undeveloped areas are shown as Zones 1, 2, and 3 in Figure 1. There are no catch basins or other surface-water collection features adjacent to the containment area.

Scenario A is divided into two subsets based on whether or not surface runoff from the containment area infiltrates along the outer edges of the containment area. Scenario A1 assumes that all surface water runoff from the containment area is infiltrated along the outer edge of the containment area.⁵ Scenario A2 assumes the surface runoff continues to flow away from the containment area and that none of this surface water runoff is infiltrated along the edges of the containment area.

Scenario B. The second set of scenarios is the same as Scenario A except that Zones 2 and 3 shown in Figure 1 are covered with asphalt. The containment area is covered with compacted gravel and there are no catch basins or other surface-water collection features in Zone 3 adjacent to the containment areas. Zone 1 represents undeveloped areas that

⁴ The containment area shown in Figure 1 represents the extent of the barrier wall and PVC membrane. There are two small triangular areas where the barrier wall and PVC membrane extend into Zone 2. In setting up the model simulations, the material that overlays the PVC membrane in these triangular areas was assigned the same values associated with Zone 4. This is compacted gravel scenarios A, B, and C and asphalt in scenario D.

⁵ The surface water runoff in Scenario A1 is infiltrated in the cells of the groundwater model that are located immediately adjacent to the barrier wall on the outside edge of the wall. These cells are approximately 10 to 20 feet wide. The total surface area over which this surface water infiltrates is 28,940 ft² or approximately 0.66 acres.

are assumed to be similar to existing conditions with silty and sandy soil at the ground surface.

Scenario B is also divided into two subsets based on whether or not surface runoff from the containment area infiltrates along the edges of the containment area. Scenario B1 assumes that all surface water runoff from the containment area is infiltrated along the edge of the containment area and Scenario B2 assumes that the surface runoff continues to flow away from the containment area and that none of this surface water runoff is infiltrated along the edge of the containment area.

Scenario C. The third set of scenarios includes catch basins that are intended to collect surface water runoff from the containment area. These catch basins, which are located in the area shown as Zone 3 in Figure 1, are constructed with compacted gravel. Multiple individual catch basins will be included in the catchment area identified as Zone 3. All parts of the catchment area slope to one of the catch basins. The total surface area of this catchment area is approximately 138,210 ft² or 3.2 acres. Scenario C assumes that all surface water runoff from the containment area is collected in the stormwater catch basins and that none of this runoff infiltrates.

Scenario D. The fourth set of scenarios is similar to Scenario C except that Zones 2, 3, and 4 shown in Figure 1 are all covered with asphalt. This includes the containment area (Zone 4), the catchment basins (Zone 3) and the area adjacent to the catchment basins (Zone 2). Zone 1 is assumed to be undeveloped with silty and sandy soil at the ground surface, as was the case in all other scenarios. Scenario D also assumes that none of the surface water runoff infiltrates.

In all scenarios, a portion of the surface recharge that occurs within the containment area is assumed to leak through the PVC membrane and the remaining portion is assumed to flow laterally along the top of the membrane. This lateral flow becomes recharge along the edges of the containment area in all scenarios.

B. ESTIMATING RECHARGE RATES

Recharge rates for different land surface materials were estimated by considering precipitation, evaporation, and runoff on a daily time step for the 30-year period from 1995 through 2024. Average annual recharge rates were then determined from this 30-year time series. Three recharge scenarios were considered. These scenarios represent middle, high, and low estimates of recharge.

The resulting estimates for recharge rates are summarized in Table 2. Additional details describing how these estimated recharge rates were developed are included in Attachment A.⁶

⁶ The value assigned to recharge rates in the undeveloped areas is the same value that was used in the original MODFLOW model (Keta Waters, 2021). This value was determined as part of model calibration.

As noted above, a portion of the recharge that occurs at the land surface within the containment area is assumed to leak through the PVC membrane. This leakage through the PVC membrane is assumed to equal 2% of the recharge for the medium case, 0% of the recharge for the low case, and 20% of the recharge for the high case. The portion of the recharge in the containment area that does not leak through the PVC membrane is assumed to flow laterally along the top of the membrane. This lateral flow becomes recharge along the edges of the containment zone in all scenarios.

C. RESULTS

The results from the simulations for the various scenarios are summarized in Table 3. The right-most columns in Table 3 give the total recharge within Zones 2, 3, and 4 and the average arsenic flux to the Hylebos Waterway over a 100-year simulation period. The remaining left-most columns in Table 3 describe the differences among the scenarios.

The arsenic flux is calculated in each scenario by starting with the same set of initial arsenic concentrations. These initial arsenic concentrations are based on the available data describing arsenic concentrations in the groundwater during the 2008 to 2017 timeframe (see Keta Waters, 2021). The model then progresses through time and calculates how the arsenic moves with the groundwater. As the arsenic discharges into the Hylebos Waterway over time, the total amount of arsenic in the groundwater system decreases. However, this is a relatively slow process as much of the arsenic is sorbed in relatively low-permeability materials.

The containment system does not fully isolate the arsenic that is located within the barrier walls. The arsenic within the containment area (i.e., Zone 4) continues to migrate and eventually discharges into the Hylebos Waterway. Much of this arsenic transport is due to downward migration through aquitard materials. However, this migration is significantly reduced by the barrier walls and surface cover system. The barrier walls and cover system reduce the flow of water through the areas that contain arsenic, but arsenic flux to the waterway continues.

The general relationship between recharge rates and arsenic flux values is illustrated in Figure 2. While the sources and locations of recharge differ for the various scenarios, lower recharge typically results in lower arsenic flux values. For example, Figure 2 identifies the points on the graph that correspond to the middle recharge scenarios. (These middle recharge scenarios are described in Rows 1, 4, 7, 10, 13, and 16 in Table 3.) The base case scenarios (Rows 1 and 4) result in significantly higher arsenic flux values over the 100-year simulation period, relative to those scenarios with asphalt cover adjacent to the containment area (Rows 7 and 10) or with catchment basins (Rows 13 and 16). The lowest recharge and arsenic flux values correspond to the scenario with asphalt over Zones 2, 3, and 4 (Row 16).

Water levels for scenarios B2, C, and D with middle recharge rates are shown in Figures 3, 4 and 5. The water levels are presented as the change in level relative to the base case scenario (Scenario A2). In all cases, it is assumed that surface runoff from the containment area does not become groundwater recharge along the edges of the containment area. This is considered more defensible than scenarios where the surface runoff is assumed to infiltrate, as discussed in Section D below.

Water levels decrease throughout the model area for Scenarios B2, C, and D, relative to the base case scenario. The decreases are most pronounced for Scenario D with an asphalt cover over all of Zones 2, 3, and 4 (Figure 5).

Estimates of arsenic flux were also developed for a “hybrid” scenario that considers Scenario C for the first 5 years followed by Scenario D for 95 years. The results are summarized in Figure 5. This figure shows the cumulative arsenic flux to the Hylebos Waterway that is estimated over a 100-year simulation period. The estimated total flux over the 100-year period is 224.2 kilograms for Scenario C, 141.3 kilograms for Scenario D, and 143.2 kilograms for the hybrid scenario.

D. DISCUSSIONS AND LIMITATIONS

The results presented above are based on assumptions regarding the recharge characteristics of different land surface covers. These include the following:

- The recharge rates for compacted gravel and asphalt assume the surfaces are maintained throughout the simulation period so that recharge rates remain constant.
- The estimated recharge rates do not include effects of transpiration of plants on compacted gravel surfaces. Plant transpiration would reduce recharge rates.
- The recharge rates for asphalt used in this memorandum are based on a combination of literature values and model simulations. The literature values are based in part on data from asphalt road sections that may be thinner than pavement sections used at container terminals (the specific thicknesses were not reported in the literature review). Thicker sections associated with container terminals would tend to have lower infiltration rates.
- Surface runoff is expected to flow away from the containment area unless there are features that would allow the flow to accumulate (i.e., ponding). This surface runoff will be dependent on the slope of the land surface, which is assumed to be away from the containment area (i.e., Zone 4). In the absence of infiltration trenches or swales, the large majority of surface runoff from the containment area is expected to continue to flow downslope away from containment zone.

- Surface runoff is assumed to flow away from the containment area for all scenarios except A1 and B1. A comparison of scenario A1 with A2 and B1 with B2 shows that if the surface runoff from the containment zone infiltrates along the edges of the containment area, arsenic flux to the Hylebos Waterway increases by approximately 18%.
- The asphalt and gravel surfaces are relatively uniform without depressions that would collect surface runoff. In particular, recharge rates on asphalt surfaces with cracks and fissures may be significantly higher than the values used in the simulations.
- Catch basins are assumed to be constructed and maintained so that all surface runoff that is collected is transferred away from the containment zone.
- The middle recharge rate used for compacted gravel was 18 in/yr. This estimate, which represents approximately 45% of annual precipitation, was developed using the USGS Soil Water Balance model with a curve number of 91, as described in Attachment A.⁷ A curve number of 91 is at the upper end of recommended curve numbers. Given that the surface is compacted gravel overlying compacted fill, we would expect the soil group to be in the “most likely-to-generate-runoff group,” or “Group D.” This corresponds to a curve number of 91.
- The middle recharge rate of 18 in/yr for compacted gravel may seem relatively large when compared to the recharge rate of 22.9 in/yr assigned to the undeveloped areas of the model. The recharge rate for the undeveloped areas is based on model calibration. It represents the average recharge over areas that are vegetated and areas that have lower recharge due to concrete slabs from abandoned buildings. The recharge estimate for the compacted gravel does not include effects of vegetation.

E. CONCLUSION

The groundwater modeling simulations and results presented in this memorandum demonstrate that all asphalt cap scenarios (i.e., Scenarios B1/B2, C, and D) substantially decrease groundwater recharge and the average arsenic mass discharge to the Hylebos Waterway over the next 100 years compared to Scenarios A1/A2, which do not include any capping outside the barrier wall (Zone 4). For example, Scenario C shows that capping only Zone 2 (also known as the 24-acre area) decreases the arsenic mass discharge to the Hylebos Waterway by 34% compared to Scenario A2 when middle recharge rates are used (See Table 3).⁸

⁷ Higher curve numbers result in more surface runoff and less recharge. These curve numbers are supplied as a function of “soil class”, which represent the drainage and runoff producing variability within a soil type.

⁸ Percent decrease is calculated as (Flux for A2- Flux for C)/Flux for A2.

Even though almost all the arsenic mass is located within Zone 4, capping area outside of Zone 4 substantially decreases arsenic mass discharge by reducing recharge to groundwater and lowering Upper Aquifer static water levels. For instance, Scenario C (i.e., installing an asphalt cap in the 24-acre area [Zone 2]) is predicted to decrease groundwater recharge by 63% (see Table 3) and decrease Upper Aquifer static water levels by 0.6 to 4.6 feet in the area immediately surrounding the barrier wall (Zone 4) in the middle recharge scenario (see Figure 3).⁹ Thus, installing asphalt caps outside of the main source area (i.e., Zone 4) can have substantial benefits for reducing arsenic groundwater transport towards the Hylebos Waterway.

⁹ Percent decrease is calculated as $\text{Recharge for A2} - \text{Recharge for C} / \text{Recharge for A2}$.

Table 1. Summary Descriptions of Scenarios

Scenario		Zone in Figure 1				Runoff from containment area	
		1	2	3	4		
A	Containment area is covered with compacted gravel and all adjacent areas are undeveloped. Interflow on the PVC membrane infiltrates along edges of containment area. There are no catch basins.	Sand and silt	Sand and silt	Sand and silt	Gravel	A1	Runoff from containment area is infiltrated along edges of containment area.
						A2	Runoff from containment area does not infiltrate along edges of containment area.
B	Containment area is covered with compacted gravel and adjacent area is asphalt. Interflow on the PVC membrane infiltrates along edges of containment area. There are no catch basins.	Sand and silt	Asphalt	Asphalt	Gravel	B1	Runoff from containment area is infiltrated along edges of containment area.
						B2	Runoff from containment area does not infiltrate along edges of containment area.
C	Containment area and adjacent area are covered with compacted gravel. Interflow on the PVC membrane infiltrates along edges of containment area. There are catch basins.	Sand and silt	Asphalt	Gravel	Gravel		Runoff from containment area does not infiltrate along edges of containment area.
D	Containment area is covered with asphalt and adjacent areas are asphalt. Interflow on the PVC membrane infiltrates along edges of containment area. There are catch basins.	Sand and silt	Asphalt	Asphalt	Asphalt		Runoff from containment area does not infiltrate along edges of containment area.

Table 2. Recharge rates in inches/year.

Material description	Middle	Low	High
Sand and silt	22.93	22.93	22.93
Gravel	18	2	24
Asphalt	4	0	23
PVC membrane ^a	2%	0%	20%
PVC membrane under a gravel cover	0.36	0	4.8
PVC membrane under an asphalt cover	0.08	0	4.6

^a Recharge through the PVC membrane is calculated as a percentage of infiltration through the cover layer.

Table 3. Summary of Results.

Scenario	Row	Recharge category	Catch basin?	Containment surface	Leakage through PVC	Recharge on gravel surfaces	Surface runoff on gravel surfaces	Recharge on asphalt surfaces	Recharge on undeveloped area	Containment area runoff infiltrated?	Recharge within Zones 2,3, and 4	100-year arsenic flux
					%	in/yr	in/yr	in/yr	in/yr		ft ³ /day	kg/yr
A1	1	Middle	None	Gravel	2%	18	12	n.a.	22.9	yes	7,572	4.021
A1	2	Low	None	Gravel	0%	2	28	n.a.	22.9	yes	7,465	3.948
A1	3	High	None	Gravel	20%	23	7	n.a.	22.9	yes	7,605	3.952
A2	4	Middle	None	Gravel	2%	18	12	n.a.	22.9	no	6,869	3.420
A2	5	Low	None	Gravel	0%	2	28	n.a.	22.9	no	5,829	2.453
A2	6	High	None	Gravel	20%	23	7	n.a.	22.9	no	7,211	3.600
B1	7	Middle	None	Gravel	2%	18	12	4.00	22.9	yes	2,866	2.693
B1	8	Low	None	Gravel	0%	2	28	0.00	22.9	yes	1,766	2.555
B1	9	High	None	Gravel	20%	23	7	23.00	22.9	yes	7,620	3.953
B2	10	Middle	None	Gravel	2%	18	12	4.00	22.9	no	2,165	2.271
B2	11	Low	None	Gravel	0%	2	28	0.00	22.9	no	130	1.170
B2	12	High	None	Gravel	20%	23	7	23.00	22.9	no	7,211	3.600
C	13	Middle	Gravel	Gravel	2%	18	12	4.00	22.9	no	2,544	2.242
C	14	Low	Gravel	Gravel	0%	2	28	0.00	22.9	no	206	1.160
C	15	High	Gravel	Gravel	20%	23	7	23.00	22.9	no	7,233	3.347
D	16	Middle	Asphalt	Asphalt	2%	4	n.a.	4.00	22.9	no	1,280	1.413
D	17	Low	Asphalt	Asphalt	0%	0	n.a.	0.00	22.9	no	26	1.051
D	18	High	Asphalt	Asphalt	20%	23	n.a.	23.00	22.9	no	7,232	3.347

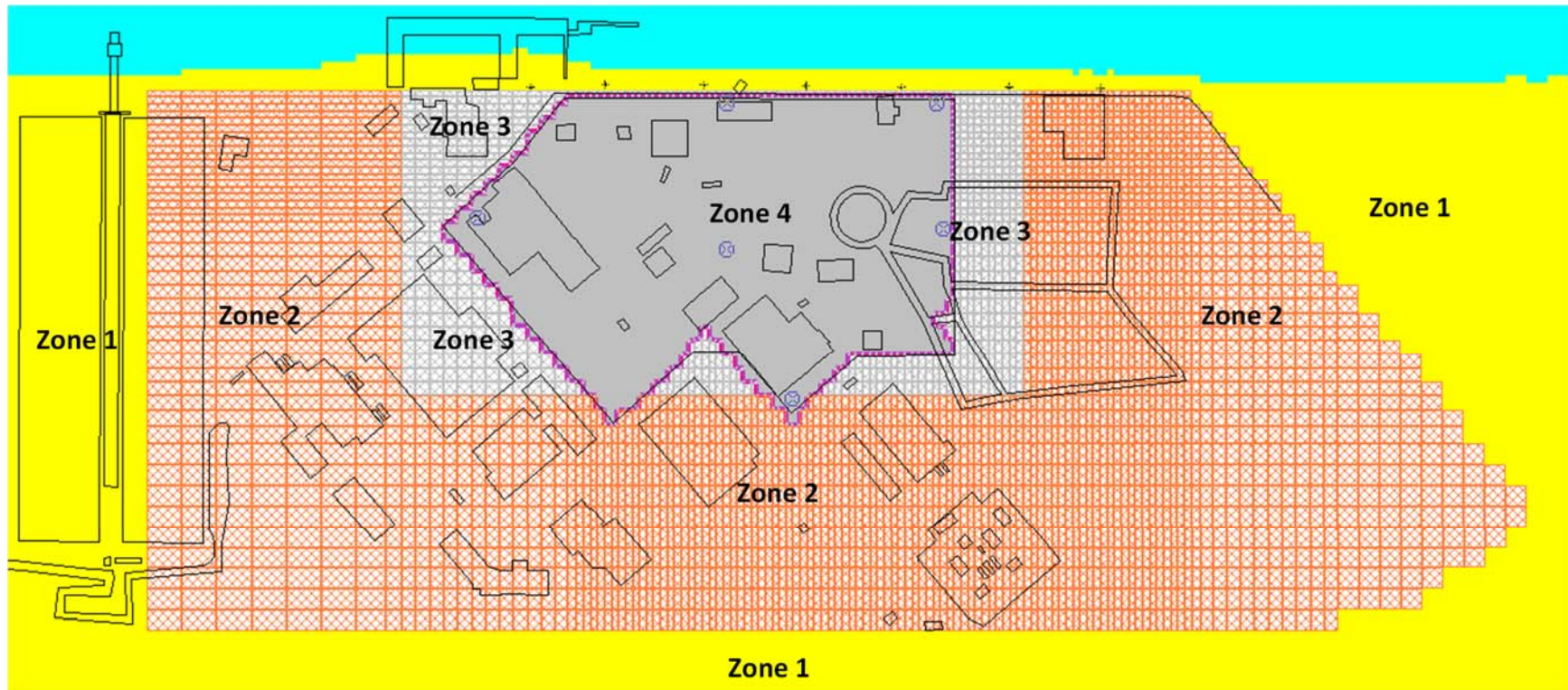


Figure 1. Alignment of the barrier wall and zones used in defining the scenarios described in Table 1.

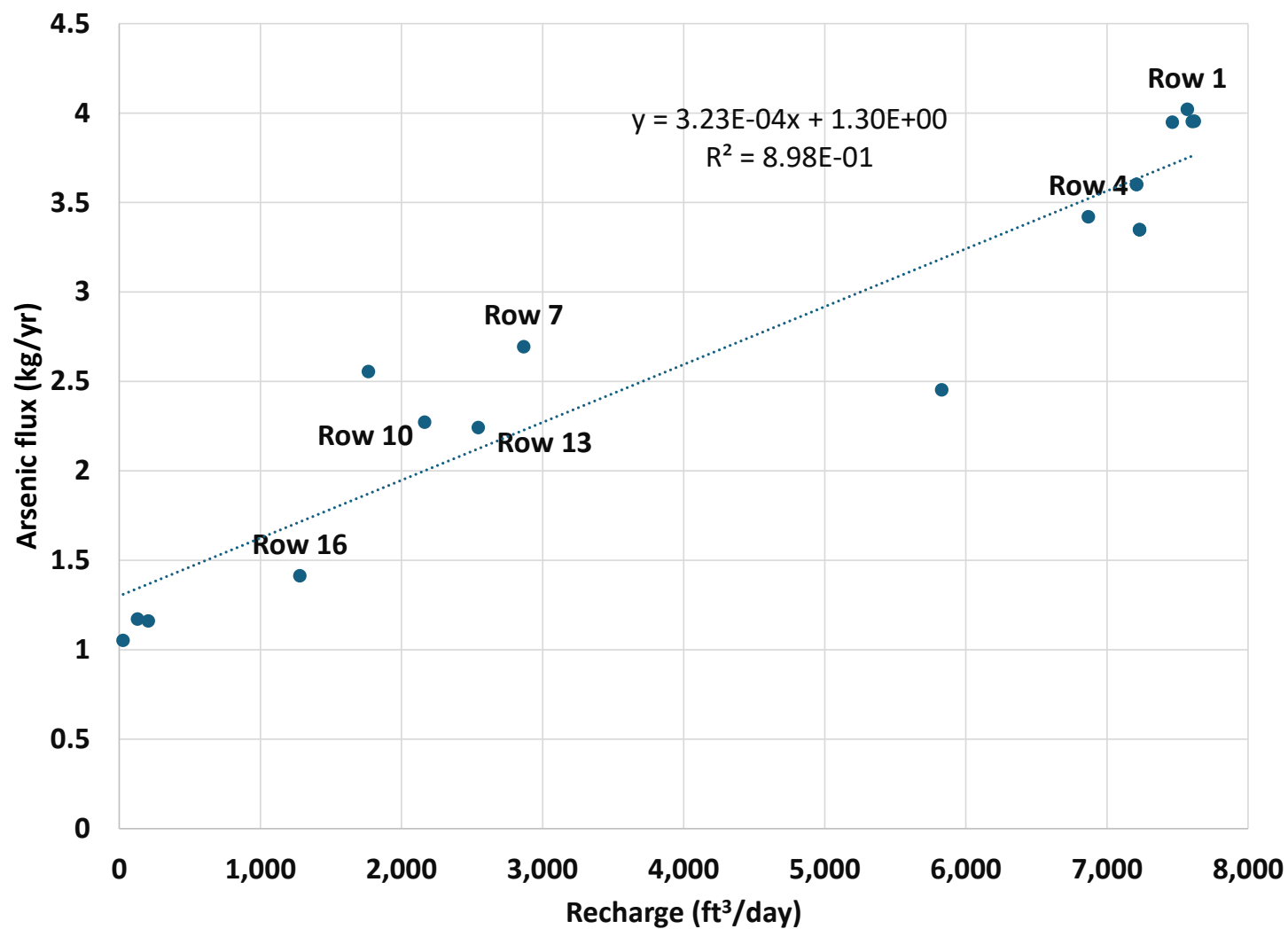


Figure 2. Average annual arsenic flux to the Hylebos Waterway versus total recharge in Zones 2, 3, and 4

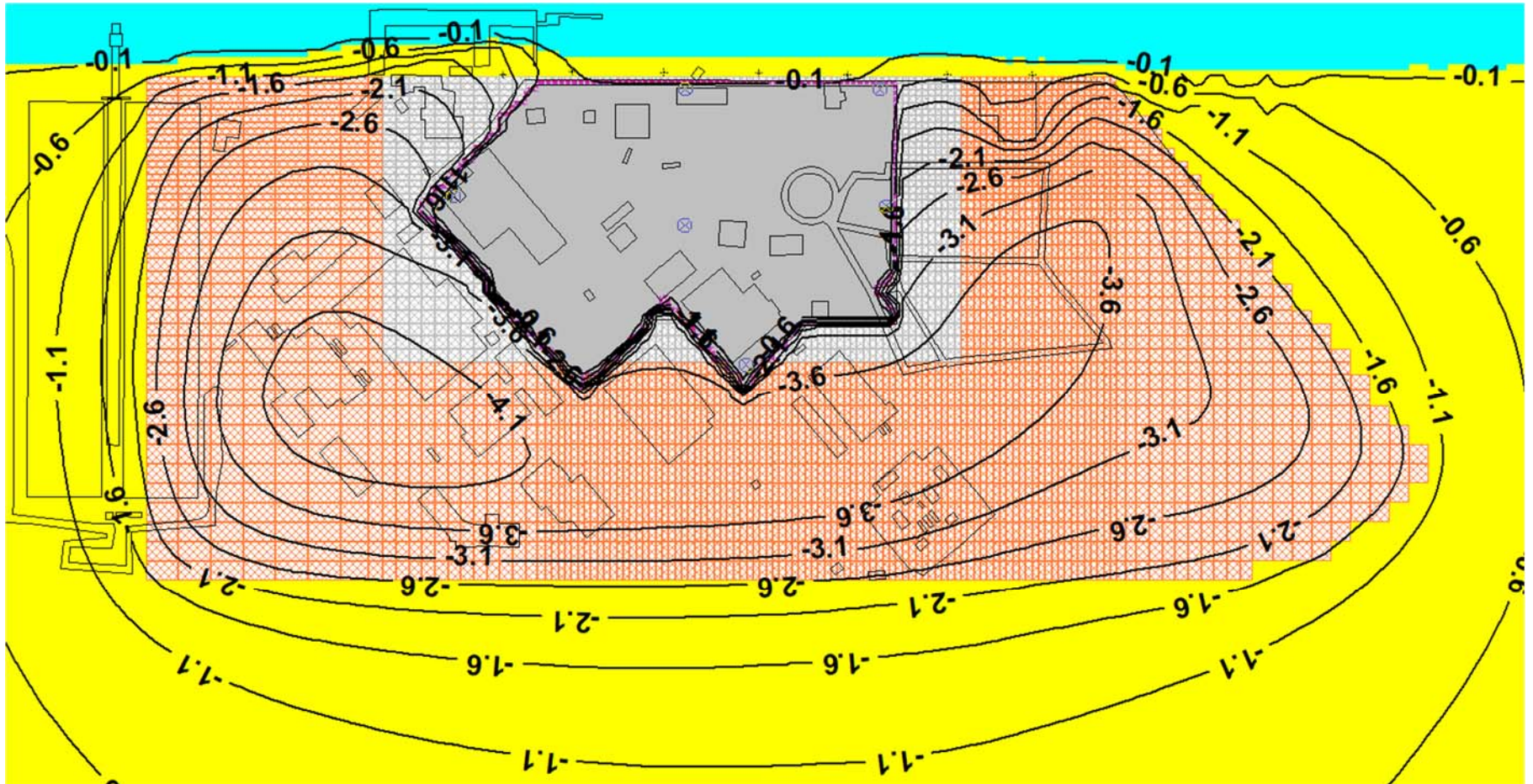


Figure 3. Contours showing the change in Layer 1 water levels between Scenario A2 (the base case) and Scenario B2 (asphalt cover to the edge of the containment zone) assuming middle recharge rates. Values are in feet.

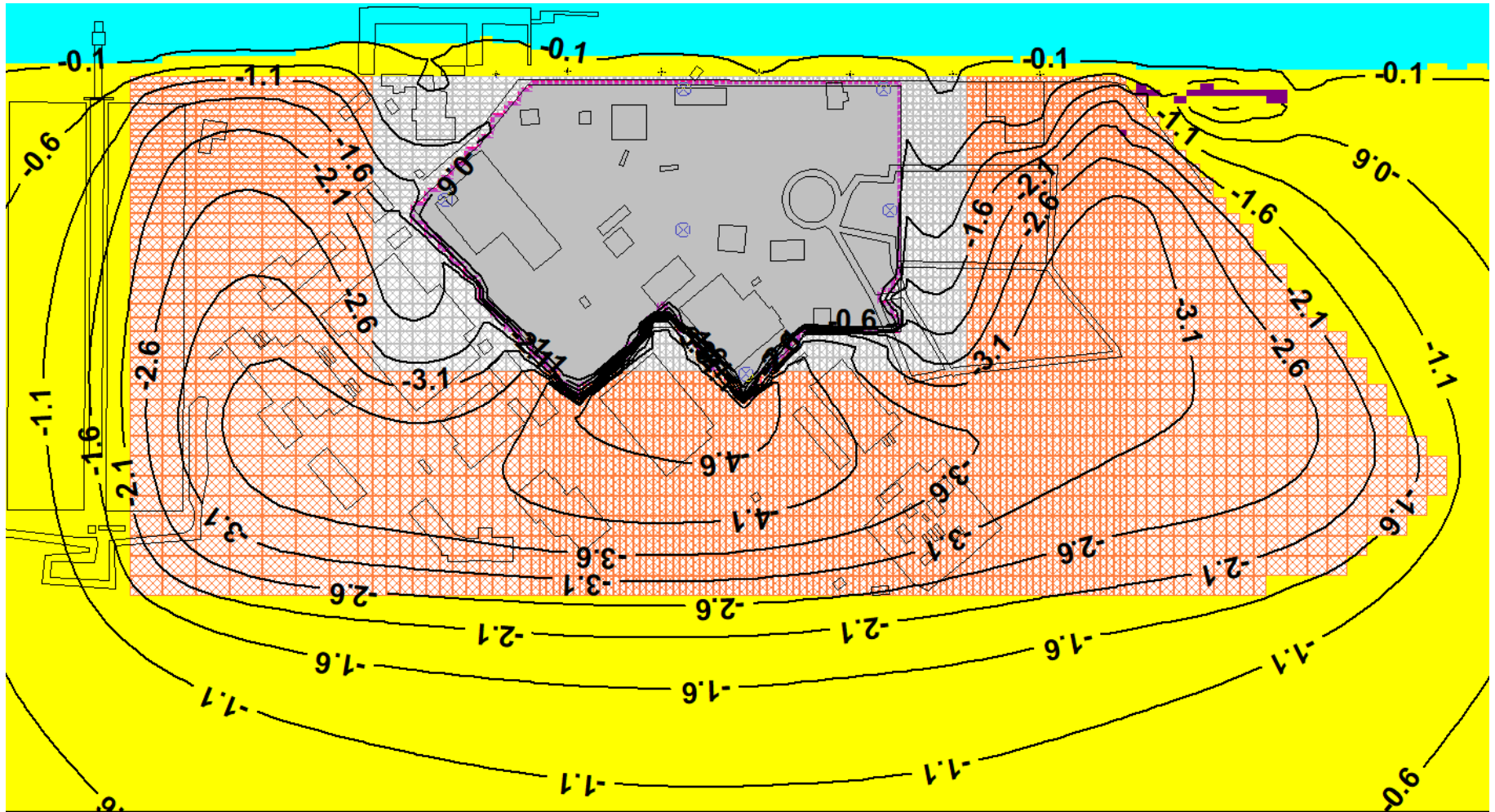


Figure 4. Contours showing the change in Layer 1 water levels between Scenario A2 (the base case) and Scenario C (compacted gravel catch basins) assuming middle recharge rates. Values are in feet.

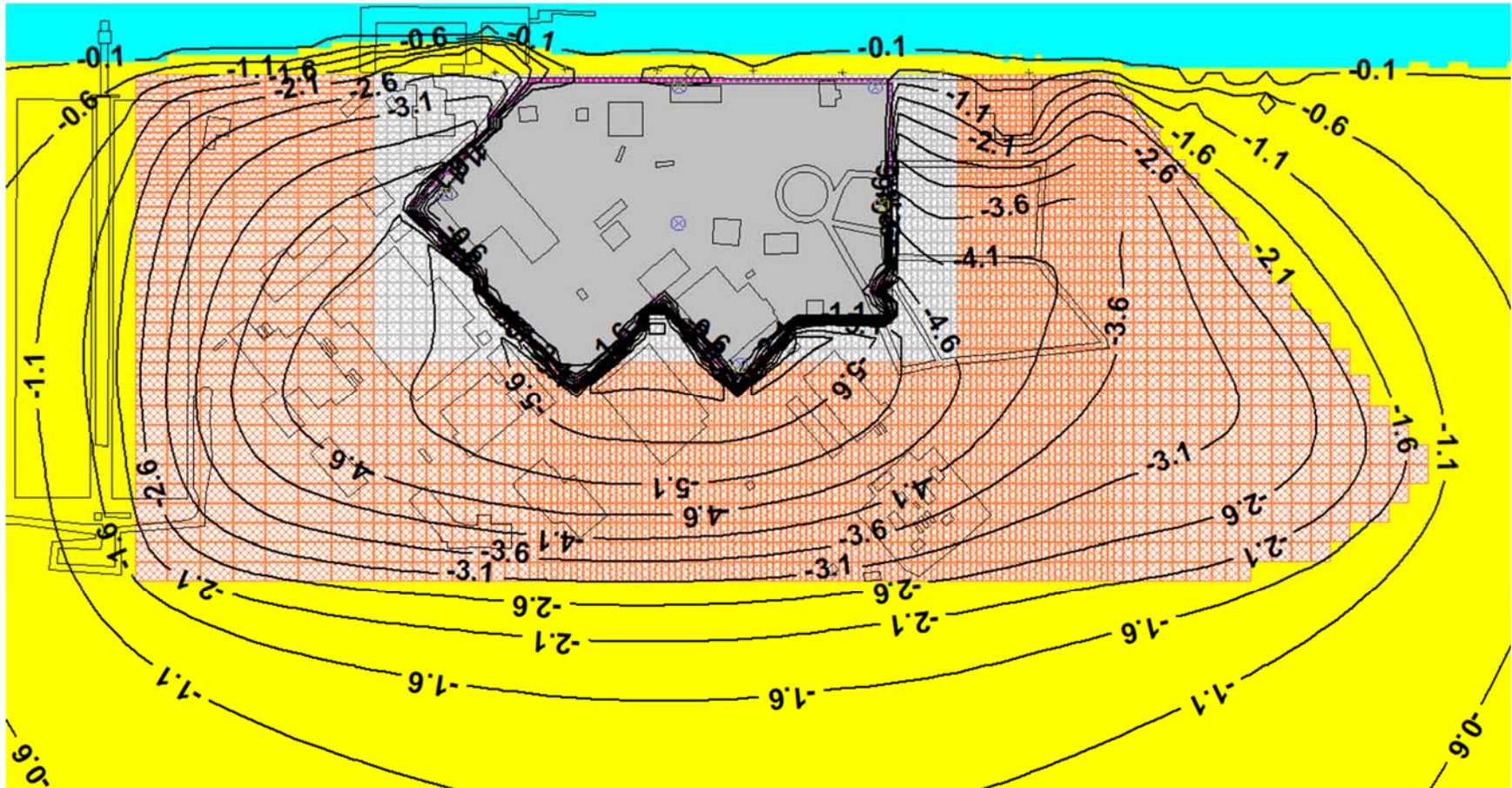


Figure 5. Contours showing the change in Layer 1 water levels between Scenario A2 (the base case) and Scenario D (asphalt cover over Zones 2, 3, and 4) assuming middle recharge rates. Values are in feet.

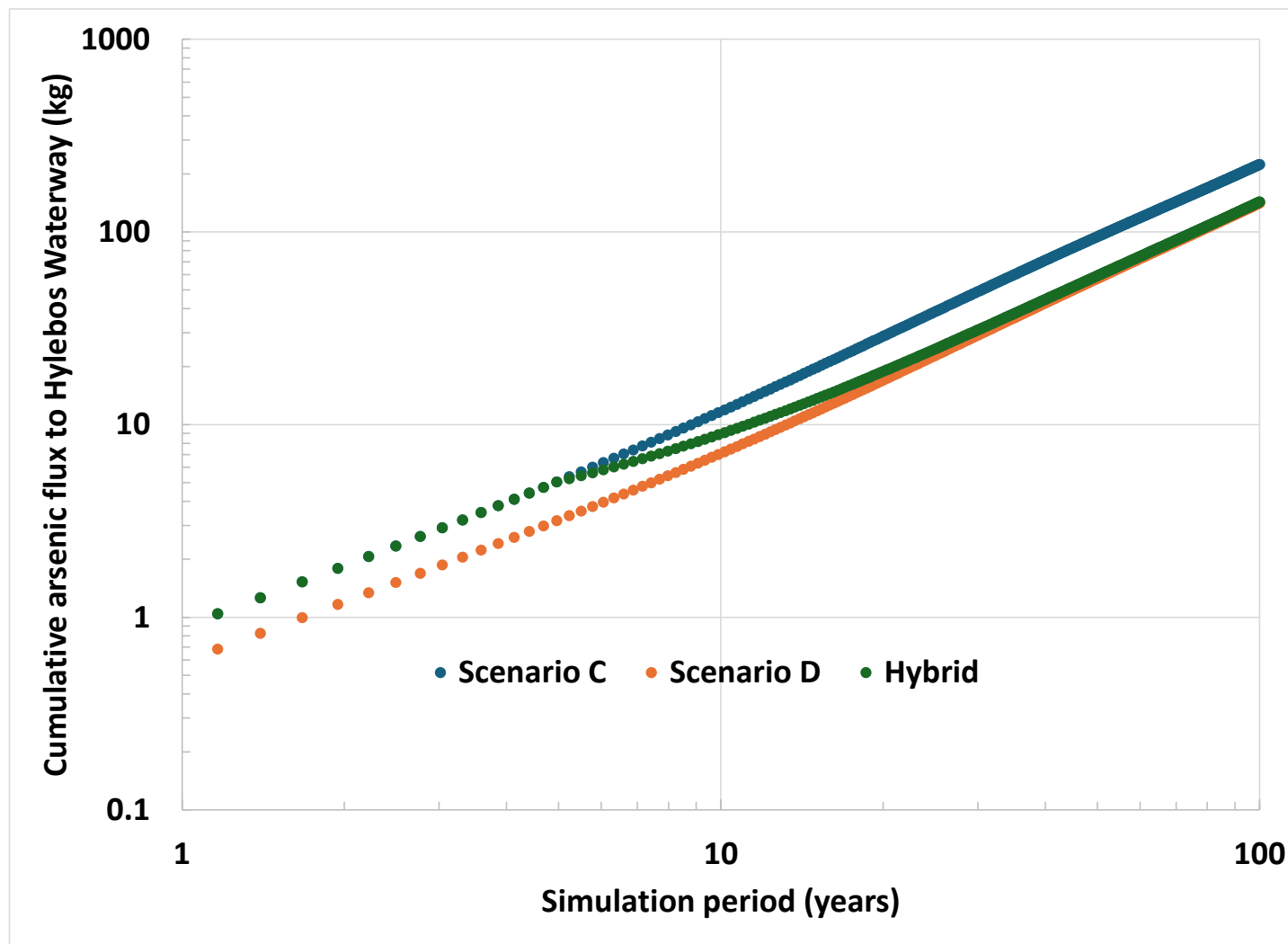


Figure 6. Cumulative arsenic flux for a hybrid scenario consisting of Scenario C for 5 years followed by Scenario D for 95 years.

Attachment A

Additional details describing how
recharge rates were estimated

Contents

1. Asphalt

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4. Low, Med and High Recharge Recommendations and Justification

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4.2 Gravel

4.3 Liner

5. Soil Balance Modeling Summary

6. References

In the initial sections we summarize observed and modeled guidance for each surface, before providing our explicit recommendations for the low, middle and high recharge cases.

1. Asphalt

1.1 Observed Guidance

- Observational studies in Timm et al. (2018) document a range of recharge fractions usually from 6-9% of annual precipitation for asphalt.
- Also noteworthy is that asphalt caps can become substantially damaged through time, facilitating enhanced recharge (Levitt et al., 2005).

1.2 Modeled Guidance

- See "Modeling Summary" for a summary of the system.
- Available water storage for the middle and high recharge experiments is 0.06 inches (1.5 mm), the middle of the range in Timm et al. (2018). In the low recharge experiment, available water storage is 0.12 in (3.0 mm).

- SCS curve numbers for the low, middle, and high recharge experiments are 99, 98, and 88, respectively. The middle curve number of 98 is what is commonly used for paved impervious surfaces (Mishra and Singh, 2013). The high curve number of 99 is as estimated by Pandit and Heck (2019). The low curve number of 88 is also estimated by Pandit and Heck (2019), but for defective asphalt. This rejects a case where improper installation, damage, and/or weathering cause the asphalt to become more porous.
- These estimates result in recharge values of:
Precipitation: 40.0in; Runoff: 9.8in (24%); ET: 7.6in (19.0%); Recharge 22.6in (56.6%)
Precipitation: 40.0in; Runoff: 26.9in (67%); ET: 8.0in (19.9%); Recharge 5.1in (12.9%)
Precipitation: 40.0in; Runoff: 31.9in (80%); ET: 7.0in (17.5%); Recharge 1.1in (2.7%)

2. Gravel

2.1 Observed Guidance

In Timm et al. (2018) report recharge was 67% of precipitation for a gravel parking lot (86% in winter). The original study behind this number, which is documented in a German dissertation, was not available to evaluate how the results might be generalized to the Arkema site.

2.2 Modeled Guidance

- Available water storage is 0.15 inches; this assumes an available water storage fraction of 1.9% (from the HELP model, Tolaymat and Krause, 2020), and an 8 in layer of gravel.
- Runoff curve numbers are 91 (low recharge), 84 (middle recharge), and 76 (high recharge). The high and low bounds represent the high and low bounds used for gravel roads in runoff modeling with the curve number method (Mishra and Singh, 2013), and the middle bound is near the midpoint of those high and low bounds.
- These parameters result in recharge values of:
Precipitation: 40.0in; Runoff: 4.3in (11%); ET: 9.2in (23.0%); Recharge 26.5in (66.2%)
Precipitation: 40.0in; Runoff: 7.3in (18%); ET: 9.2in (23.0%); Recharge 23.5in (58.8%)
Precipitation: 40.0in; Runoff: 12.5in (31%); ET: 9.2in (22.9%); Recharge 18.4in (45.9%)

3. PVC Cap

3.1 Observed Guidance

In Udoh (1993), observed leakage through a 20 MIL PVC liner was 2% (first year) and 12% (second year).

3.2 Modeled Guidance

- We did not directly simulate leakage through a 20 MIL PVC liner.

- The HELP model can represent liners. In Udoh (1993), simulations from the HELP model deviated from the test sites.
- When tuning the HELP model, an effective saturated hydraulic conductivity of the liner of $5\text{--}7.5\text{e-}7$ cm/s was found to give best results (Udoh, 1993). This is substantially higher than the saturated hydraulic conductivity for PVC membranes of $2\text{e-}11$ cm/s (Tolaymat and Krause, 2020). HELP reduces these very low conductivities of the raw material to an effective hydraulic conductivity according to the "membrane pin-hole density", "membrane installation defects", and "membrane placement quality" parameters (Tolaymat and Krause, 2020). From the manual, it is not clear how the model uses those parameters to increase the hydraulic conductivity, and how those parameters should be selected for a given site.

4 Low, Middle and High Recharge Recommendations and Justification

The middle case represents a best-estimate given all the background research and modeling that was conducted. The low and high bounds aim to be more conservative and represent best and worst cases.

4.1 Asphalt

- Low: 0.0 in recharge. Justification one observational study in England observed 0 in recharge through asphalt (Mansel and Rollet, 2006), and 0 in recharge through asphalt is a common modeling assumption in hydrology ("impervious surface").
- Middle: 4.4 in recharge (11% of precipitation). This represents a blend between the middle modeled case (5.1 in, 12.9%), and observed recharge fractions documented in the literature of 6-9% (Timm et al., 2018).
- High: 22.6 in recharge (57.7% of precipitation). This represents an absolute high end estimate based on modeled recharge using a curve number of 88 observed for "defective pavement". This would be a failure case where the asphalt is poorly constructed or degrades and becomes porous.

4.2 Gravel

- Low: 1.8 in recharge (4.5% of precipitation). This is low-confidence value: there was not much evidence we could find. We selected something an order of magnitude smaller than the "best estimate" in an effort to span the range of possible recharge values. There is relatively little evidence to support that exact reduction (or any exact reduction), but our assumption is that the model is unlikely to be more than order of magnitude off, so an order of magnitude reduction should capture the range of possible values. If we want to be absolutely certain we could go with 0.0 in recharge.
- Middle: 18.4 in (45.9% of precipitation). This is the modeled estimate using a curve number on the high end of recommended curve numbers. These curve numbers are

supplied as a function of "soil class", which represent the drainage and runoff producing variability within a soil type. Given that the surface is compacted gravel overlying compacted fill, we would expect the soil group to be in most likely-to-generate-runoff group, or "Group D", which has a curve number of 91 and corresponds to the low recharge modeled experiment.

- High: 26.5 in (66.2% of precipitation). This is the high end of modeled recharge, and also nearly matches the fraction of observed recharge under a gravel parking lot in Germany (67% of precipitation).

4.3 Liner

- Low: 0.0% passage. Absolute best case; impermeable.
- Med: 7% passage. Average of two years of observation of a 20 MIL PVC liner. Less confident in this value; the site's liner is thicker (30 MIL), the sample size is low behind this estimate, and site/climate characteristics may not generalize well.
- High: 24% passage. Factor of 2 margin of safety from the most permissive year of the 20 MIL liner experiment in Udoh (1993).

5 Soil Balance Modeling Summary

- Recharge estimates are calculated in the same manner as Westenbroek et al. 2010, using the Hargreaves and Samani method for calculating potential evapotranspiration, but with the following exceptions:
 - There is no canopy and no snow model.
 - For the low and middle recharge asphalt estimates it is assumed that top layer's water storage is on the surface (e.g., this simulates ponding), because the majority of surface storage for asphalt is in surface depressions (Timm et al., 2018) . With this configuration, evaporation is higher and recharge is lower.
- This method requires estimates of:
 - Available water capacity for the surface layer
 - An SCS Curve Number for the rainfall-runoff relationship parameterization.
 - Daily estimates of precipitation, minimum temperature and maximum temperature. These are provided by Sea-Tac airport data accessed through the Global Historical Climatological Network Daily (Menne et al., 2012). On rare occurrences when Sea-Tac data are not available, data are filed with nearby stations in the network. Sensitivity to alternative stations and methods for estimating the weather at the site were explored, and there was little change to recharge estimates.

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Appendix I

Memo



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To: Sam Meng (Ecology), Tia Misuraca (Ecology)
From: Troy Bussey Jr., PE, LG, LHG (PIONEER)
Cc: Scott Hooton (Port), Brett Ozolin, PE (Port), Rob Healy (Port), Trevor Louviere, PE (DOF)
Date: July 29, 2025
Subject: Acceptance Criteria for Virgin Quarry Material
Former Arkema Manufacturing Site
Agreed Order No. DE 5668, Facility/Site ID No. 1220, Cleanup Site ID No. 3405

The purpose of this memo is to define the criteria for accepting material from a virgin quarry borrow source (e.g., crushed surfacing base course [CSBC], crushed surfacing top course [CSTC]) that will be placed at the Former Arkema Manufacturing Site (Site) as part of a proposed interim action (IA). CSBC, CSTC, and other quarry materials obtained from virgin quarry borrow sources are universally used throughout the state and nation on a wide variety of paving and construction projects with little to no chemical testing. Nonetheless, per Ecology's request, soil samples of virgin quarry material to be used at the Site will be collected at a sampling frequency of 1 sample per 1,000 cubic yards (CY) for the first 10,000 CY, after which the sampling frequency will be decreased to 1 sample per 10,000 CY if there are no soil cleanup level exceedances in the first 10 samples.¹ Each soil sample will be analyzed for Resource Conservation and Recovery Act (RCRA) 8 metals, copper, nickel, zinc, and total petroleum hydrocarbons (TPH) in the gasoline (TPH-G), diesel (TPH-D), and heavy oil (TPH-HO) ranges.² The soil cleanup levels for accepting virgin quarry material are presented in Table 1, which is supported by calculations in Tables 2 through 4.

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¹ Given the nature of quarry operations, it is not practicable or timely to collect and analyze soil samples on a 1,000 CY basis for loads being actively delivered to the Site. As a result, the first 10 soil samples will be collected a month or two prior to Site delivery to pre-characterize the type of material that will be delivered to the Site from the virgin quarry borrow source. In addition, if the sampling frequency for a single virgin quarry material (e.g., CSBC) has graduated to the 1 sample per 10,000 CY frequency, then the 1 sample per 10,000 CY frequency will also apply to all other virgin quarry materials generated by the same quarry.

² The RCRA 8 metals are arsenic, barium, cadmium, chromium (total), lead, mercury, selenium, and silver. If the total chromium concentration in a given sample exceeds the natural background chromium concentration of 48 mg/kg, the sample will also be analyzed for chromium (VI).

Ecology. 2025. Toxics Cleanup Program's Cleanup Levels and Risk Calculations database,
<https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx>, February update.

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Enclosures

Table 1	Soil Cleanup Levels for Accepting Virgin Quarry Material
Table 2	Calculation of Soil-to-Groundwater Cleanup Levels
Table 3	Calculation of Method B Surface Water Cleanup Levels
Table 4	Calculation of Method C Soil Direct Contact Cleanup Levels

Table 1: Soil Cleanup Levels for Accepting Virgin Quarry Material

Type	CAS No.	Constituent	Soil-to-Groundwater Cleanup Level ⁽¹⁾ (mg/kg)	Method C Soil Direct Contact Cleanup Level ⁽²⁾ (mg/kg)	Soil Cleanup Level for CSBC Import ⁽³⁾ (mg/kg)	Adjustment Note
Metals	7440-38-2	Arsenic	20	20	20	
	7440-39-3	Barium	--	700,000	700,000	
	7440-43-9NP	Cadmium	1.1	3,500	1.1	
	16065-83-1	Chromium (III)	4,800,960	5,300,000	4,800,960	
	18540-29-9	Chromium (VI)	1.6	820	1.6	
	7440-47-3	Total Chromium	48	48	48	
	7440-50-8	Copper	36	140,000	36	
	7439-92-1	Lead	1,620	1,000	1,000	
	7439-97-6	Mercury	0.070	1,050	0.070	
	7440-02-0	Nickel	38	70,000	38	
	7782-49-2	Selenium	7.4	18,000	7.4	
	7440-22-4	Silver	0.61	18,000	0.61	
	7440-66-6	Zinc	101	1,100,000	101	
TPH	unavailable08	TPH-G	1,000	150,000	1,000	
	unavailable09	TPH-D ⁽⁴⁾	2,000	39,000	2,000	
	unavailable10	TPH-HO ⁽⁴⁾	2,000	39,000	2,000	

Notes:

--: No value exists for this constituent in the Cleanup Levels and Risk Calculation (CLARC) database (Ecology 2025) or a cleanup level cannot be calculated because no values exist in CLARC.

All values are presented as two significant figures in standard notation, except numbers greater than 100 are rounded to a whole number.

⁽¹⁾ See Table 2 for calculation of these cleanup levels.

⁽²⁾ See Table 4 for calculation of these cleanup levels.

⁽³⁾ Each soil cleanup level is the most stringent of the cleanups levels in the two previous columns, unless a subsequent adjustment is necessary.

⁽⁴⁾ In accordance with Ecology guidance (Ecology 2004), if TPH-D and TPH-HO are both detected in a given sample, results will be evaluated as the sum of TPH-D and TPH-HO unless NWTPH-HCID results and/or the chromatogram demonstrate that both petroleum products are present. If either TPH-D or TPH-HO are non-detect in a given sample, TPH-D and TPH-HO will not be added together.

Table 2: Calculation of Soil-to-Groundwater Cleanup Levels

Type	CAS No.	Constituent	Target Groundwater Concentration ⁽¹⁾ (ug/L)	Physiochemical Properties ⁽²⁾				Soil-to-Groundwater Calculations		Soil-to-Groundwater Cleanup Level ⁽⁶⁾ (mg/kg)	Adjustment Note
				Henry's Law Constant (Hcc) (unitless)	Organic Carbon Partitioning Coefficient (Koc) (L/kg)	Aqueous Solubility (mg/L)	Distribution Coefficient (Kd) (L/kg)	Soil Concentration Protective of Target Groundwater Concentration ^(3,4) (mg/kg)	Soil Saturation Concentration ⁽⁵⁾ (mg/kg)		
Metals	7440-38-2	Arsenic	8.0	0.0	--	--	29	4.7	Not Applicable	20	(7)
	7440-39-3	Barium	--	0.0	--	--	41	--	Not Applicable	--	
	7440-43-9NP	Cadmium	7.9	0.0	--	--	6.7	1.1	Not Applicable	1.1	
	16065-83-1	Chromium (III)	240,000	0.0	--	--	1,000	4,800,960	Not Applicable	4,800,960	
	18540-29-9	Chromium (VI)	4.1	0.0	--	1,690,000	19	1.6	Not Applicable	1.6	
	7440-47-3	Total Chromium	--	0.0	--	--	1000	--	Not Applicable	48	(7)
	7440-50-8	Copper	3.1	0.0	--	--	22	1.4	Not Applicable	36	(7)
	7439-92-1	Lead	8.1	0.0	--	--	10,000	1,620	Not Applicable	1,620	
	7439-97-6	Mercury	0.025	0.17	--	0.060	52	0.026	Not Applicable	0.070	(7)
	7440-02-0	Nickel	8.2	0.0	--	--	65	11	Not Applicable	38	(7)
	7782-49-2	Selenium	71	0.0	--	--	5.0	7.4	Not Applicable	7.4	
	7440-22-4	Silver	0.91	0.0	--	--	8.3	0.15	Not Applicable	0.61	(7)
	7440-66-6	Zinc	81	0.0	--	--	62	101	Not Applicable	101	
TPH	unavailable08	TPH-G ⁽⁹⁾	1,700	--	--	--	--	--	1,000	1,000	
	unavailable09	TPH-D ⁽⁹⁾	2,100	--	--	--	--	--	2,000	2,000	
	unavailable10	TPH-HO ⁽⁹⁾	--	--	--	--	--	--	2,000	2,000	

Notes:

--: No value exists for this constituent in the Cleanup Levels and Risk Calculation (CLARC) database (Ecology 2025) or a cleanup level cannot be calculated because no values exist in CLARC.

All values are presented as two significant figures in standard notation, except numbers greater than 100 are rounded to a whole number.

⁽¹⁾ The target groundwater concentration is the most stringent of the Method B Surface Water Cleanup Level in Table 3.

⁽²⁾ Physiochemical property values from CLARC (Ecology 2025), unless otherwise noted. Henry's Law Constant values are for 13 degrees Celsius.

⁽³⁾ For conservatism, the calculations assumed there will be no attenuation from upland groundwater to surface water even though substantial attenuation does occur at the Site (even with the upland in its current uncapped state). For instance, there is at least a 30 fold attenuation of arsenic in groundwater between the Vertical Shoreline Monitoring Wells (located downgradient of the existing sheet pile wall) and groundwater near the shoreline (see Appendix G of PIONEER 2021).

⁽⁴⁾ Calculated using the MTCA three-phase model in accordance with WAC 173-340-747(4), using standard MTCA three-phase model defaults.

⁽⁵⁾ Calculated by substituting aqueous solubility value for target groundwater concentration * dilution factor in MTCA Equation 747-1 (Ecology 2001a), unless otherwise noted. The Soil Saturation Concentrations for TPH are the default residual soil saturation concentrations in MTCA Table 745-5.

⁽⁶⁾ Most stringent of soil concentration protective of the target groundwater concentration and soil saturation concentration, unless a subsequent adjustment is necessary.

⁽⁷⁾ Adjusted values up to the natural background concentration in accordance with WAC 173-340-740(5)(c). The arsenic value is Ecology's accepted soil background concentration per MTCA Table 740-1 footnote b. The chromium, copper, mercury, and nickel values are Ecology's Puget Sound natural background concentrations (Ecology 1994). The silver value is Ecology's statewide natural background concentration (Ecology 1994).

Table 3: Calculation of Method B Surface Water Cleanup Levels

Type	CAS No.	Constituent	Standard Method B Surface Water Value for Carcinogens ⁽¹⁾ (ug/L)	Standard Method B Surface Water Value for Non-Carcinogens ⁽¹⁾ (ug/L)	Surface Water Value for Acute Marine Aquatic Life 173-201A WAC ⁽¹⁾ (ug/L)	Surface Water Value for Acute Marine Aquatic Life CWA §304 ⁽¹⁾ (ug/L)	Surface Water Value for Chronic Marine Aquatic Life 173-201A WAC ⁽¹⁾ (ug/L)	Surface Water Value for Chronic Marine Aquatic Life CWA §304 ⁽¹⁾ (ug/L)	Surface Water Value for Human Health in Marine Waters 173-201A WAC ⁽¹⁾ (ug/L)	Surface Water Value for Human Health in Marine Waters 40 CFR 131.45 ⁽¹⁾ (ug/L)	Surface Water Value for Human Health in Marine Waters CWA §304 ⁽¹⁾ (ug/L)	Method B Surface Water Cleanup Level ⁽²⁾ (ug/L)	Adjustment Note
Metals	7440-38-2	Arsenic	0.0046	3.5	69	69	36	36	0.14	0.14	0.14	8.0	(3)
	7440-39-3	Barium	--	--	--	--	--	--	--	--	--	--	
	7440-43-9NP	Cadmium	--	41	33	33	7.9	7.9	--	--	--	7.9	
	16065-83-1	Chromium (III)	--	240,000	--	--	--	--	--	--	--	240,000	
	18540-29-9	Chromium (VI)	0.41	150	1,100	1,100	50	50	--	--	--	4.1	(4)
	7440-47-3	Total Chromium	--	--	--	--	--	--	--	--	--	--	
	7440-50-8	Copper	--	2,900	4.8	4.8	3.1	3.1	--	--	--	3.1	
	7439-92-1	Lead	--	--	210	210	8.1	8.1	--	--	--	8.1	
	7439-97-6	Mercury	--	--	1.8	1.8	0.025	0.94	--	--	--	0.025	
	7440-02-0	Nickel	--	1,100	74	74	8.2	8.2	100	100	4,600	8.2	
	7782-49-2	Selenium	--	2,700	290	290	71	71	200	200	4,200	71	
	7440-22-4	Silver	--	26,000	2.3	1.9	0.91	--	--	--	--	0.91	
	7440-66-6	Zinc	--	17,000	90	90	81	81	1,000	1,000	26,000	81	
TPH	unavailable25	TPH-G (benzene present)	--	--	--	--	1,700	--	--	--	--	1,700	
	unavailable08	TPH-G (no detectable benzene)	--	--	--	--	1,700	--	--	--	--	1,700	
	unavailable09	TPH-D (weathered)	--	--	--	--	2,100	--	--	--	--	2,100	
	unavailable09	TPH-D (unweathered)	--	--	--	--	50	--	--	--	--	50	
	unavailable10	TPH-HO	--	--	--	--	--	--	--	--	--	--	

Notes:

--: No value exists for this constituent in the Cleanup Levels and Risk Calculation (CLARC) database (Ecology 2025) or a cleanup level cannot be calculated because no values exist in CLARC.

All values are presented as two significant figures in standard notation, except numbers greater than 100 are rounded to a whole number.

⁽¹⁾ Values from CLARC (Ecology 2025), unless otherwise noted.

⁽²⁾ The cleanup level is the most stringent of the standard Method B surface water value for carcinogens, the standard Method B surface water value for non-carcinogens, the 173-210A WAC and CWA §304 acute marine aquatic life values, the 173-210A WAC and CWA §304 chronic marine aquatic life values, and the 173-210A WAC, CWA §304, and 40 CFR 131.45 human health marine water values, unless a subsequent adjustment is necessary.

⁽³⁾ Adjusted up to the Puget Sound Basin groundwater background concentration of 8 ug/L (Ecology 2022) in accordance with WAC 173-340-720(7)(c).

⁽⁴⁾ In accordance with WAC 173-340-730(5)(b), the standard Method B value for carcinogens was adjusted upward towards concentrations established under applicable state and federal laws by a maximum factor of ten (not to exceed concentrations established under applicable state and federal laws).

Table 4: Calculation of Method C Soil Direct Contact Cleanup Levels

Type	CAS No.	Constituent	Standard Method C Soil Value for Carcinogens ⁽¹⁾ (mg/kg)	Standard Method C Soil Value for Non-carcinogens ⁽¹⁾ (mg/kg)	Method C Soil Direct Contact Cleanup Level ⁽²⁾ (mg/kg)	Adjustment Note
Metals	7440-38-2	Arsenic	4.1	210	20	(3)
	7440-39-3	Barium	--	700,000	700,000	
	7440-43-9NP	Cadmium	--	3,500	3,500	
	16065-83-1	Chromium (III)	--	5,300,000	5,300,000	
	18540-29-9	Chromium (VI)	820	3,200	820	
	7440-47-3	Total Chromium	--	--	48	(3)
	7440-50-8	Copper	--	140,000	140,000	
	7439-92-1	Lead	--	--	1,000	(4)
	7439-97-6	Mercury	--	--	1,050	(5)
	7440-02-0	Nickel	--	70,000	70,000	
	7782-49-2	Selenium	--	18,000	18,000	
	7440-22-4	Silver	--	18,000	18,000	
	7440-66-6	Zinc	--	1,100,000	1,100,000	
Others	unavailable08	TPH-G	--	--	150,000	(5)
	unavailable09	TPH-D	--	--	39,000	(5)
	unavailable10	TPH-HO	--	--	39,000	(5)

Notes:

--: No value exists for this constituent in the Cleanup Levels and Risk Calculation (CLARC) database (Ecology 2025) or a cleanup level cannot be calculated because no values exist in CLARC.

All values are presented as two significant figures in standard notation, except numbers greater than 100 are rounded to a whole number.

⁽¹⁾ Values from CLARC (Ecology 2025), unless otherwise noted.

⁽²⁾ The cleanup level is the most stringent of the carcinogenic and non-carcinogenic values, unless a subsequent adjustment is necessary.

⁽³⁾ Adjusted values up to the natural background concentration in accordance with WAC 173-340-740(5)(c). The arsenic value is Ecology's accepted soil background concentration per MTCA Table 740-1 footnote b. The total chromium value is Ecology's Puget Sound natural background concentrations (Ecology 1994).

⁽⁴⁾ The lead soil direct contract value is the MTCA Method A soil cleanup level for industrial land use.

⁽⁵⁾ The mercury, TPH-G, TPH-D, and TPH-HO direct contact values are the default direct contract values for an industrial land use scenario (Ecology 2001b).

Appendix J

**Health and Safety Plan
Expanded RTC Data Gaps Investigation Work
Former Arkema Manufacturing Plant
Port of Tacoma, Washington**

**Prepared for:
Port of Tacoma**



May 2023

**Health and Safety Plan
Expanded RTC Data Gaps Investigation
Former Arkema Manufacturing Plant
Port of Tacoma, Washington**

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**Health and Safety Plan
Expanded RTC Data Gaps Investigation
Former Arkema Manufacturing Plant
Port of Tacoma, Washington**

1. INTRODUCTION

This Health and Safety Plan (HASP) addresses the health and safety practices and controls that will be implemented by Dalton, Olmsted & Fuglevand Inc. (DOF) during their site characterization work at the Port of Tacoma's Arkema property. Activities addressed in this plan include investigation for the design for the Barrier Wall PDI and the investigation for the Expanded RTC Data Gaps.

The safety and health directives discussed herein apply only to DOF employees and their subcontractors engaged in the work activities mentioned above. Furthermore, this plan has been developed specifically for this project and should not be used in whole or in part for any other project unless such application is reviewed and approved by DOF management. This plan, however, will be updated as appropriate to account for changes in the scope of work and for new hazards discovered at the jobsite once work is underway.

Site work activities will comply with WAC 173-340-810 (of the Model Toxics Control Act) and applicable sections of WAC 296-843 and other relevant WISHA construction industry health and safety regulations. Where appropriate, specific WISHA standards will be referenced within the plan to highlight additional health and safety requirements not otherwise discussed. These standards are available on Washington L&I's Division of Occupational Safety and Health (DOSH) web-based homepage. The content of this plan and any relevant WISHA standards will be discussed with DOF project personnel before work begins. However, DOF management, its subcontractors, and its client do not guarantee the health or safety of any person entering this site. Because of the nature of this site and the many different activities occurring thereon, it is not possible to discover, evaluate, and provide protection for all possible hazards that may be encountered. Strict

adherence to the safety and health guidelines set forth herein will reduce, but not eliminate, the potential for injury at this site.

2. DESCRIPTION OF PROJECT

The Arkema property is currently contaminated with several chemical constituents that were released into the soil and groundwater from a chemical manufacturing plant that once occupied the site. To facilitate cleanup and development of the property it will be necessary to address identified site characterization data gaps by collecting new data on the site. These data collection efforts will involve a geophysical survey and collecting sediment, soil, surface water and groundwater samples. This field work will be implemented by DOF personnel and their subcontractors.

3. DOF PROJECT ORGANIZATION

DOF employees and their subcontractors working on site are expected to maintain vigilance at all times to ensure that the work is conducted in a safe and efficient manner. To provide an organizational structure that supports this objective, the following individuals are assigned specific responsibilities and lines of communication for the duration of this project.

3.1 On-site Field Project Manager (FPM)

The On-site Field Project Manager (FPM), David Cooper of DOF is responsible for overall administration of site field operations. His duties include directing DOF technical staff, coordinating the activities of on-site subcontractors, tracking budget, ensuring adequate resources are available to complete the work, resolving site safety and health issues as they arise, project planning, and maintaining communications between contractors, regulatory agencies, client, and off-site resources. The Field Project Manager reports directly to the Project Manager, Troy Bussey of Pioneer Technologies Corp. and indirectly to the Port of Tacoma project management.

3.2 Technical Lead

A technical lead may be assigned to each field team to supervise the well inventory and environmental sample collection work. The Technical Lead will also monitor compliance with applicable environmental regulations, WISHA standards, and other client-specific requirements. The Technical Lead will coordinate any DOF-related spill response activities that may be needed during the sampling work, inform site management of health and safety issues as they arise, document site activities, and verify that site personnel are adequately trained and qualified for the work. The Technical Lead reports directly to the FPM.

3.3 Site Health and Safety Officer

The FPM will act as DOF's Site Health and Safety Officer (SHSO) on the project. He is responsible for verification and overall compliance with this site health and safety plan (HASP). His duties include: 1) on site monitoring to determine appropriate levels and use of Personal Protective Equipment (PPE); 2) site surveillance, hazard identification, and health risk analysis; 3) implementation of procedures and programs to eliminate risk to site personnel including initiating changes to the HASP; 4) implementation of site control measures; 5) conducting and documenting daily health and safety briefings; 6) tracking health and safety issues in DOF field note book; 7) conducting incident investigations; 8) informing DOF site personnel of the contents of the HASP; 9) maintaining medical clearance letters and training documentation for site personnel; 10) conducting regular site safety inspections and; 11) exercising stop work authority when warranted by conditions. The Site Health and Safety Officer reports directly to DOF's Project Manager.

3.4 DOF Technical Staff

Each member of DOF's technical staff has the responsibility to report any unsafe or potentially hazardous situations to the FPM. They will maintain knowledge of the information, instructions, and emergency response actions contained in the HASP and comply with rules, regulations, and procedures established for the site. Site employees

are expected to stop work and contact their supervisor whenever they believe their work, or that of their coworkers, poses an uncontrolled hazard or unreasonable risk of injury or illness. Furthermore, each project participant is expected and encouraged to participate in the implementation of the environmental safety and health process through participation in meetings, incident reporting and investigations, inspections, hazard identification and hazard analyses.

3.5 Visitors

On occasion, appropriately authorized visitors may come to the site to observe the site characterization operations. Visitors may be from city, state, and federal regulatory and resource agencies that have a specific interest in the project. Before accessing the site, visitors will be briefed on the hazards of the site, contents of the HASP, site safety rules, hazard control measures, and required personal protective equipment. This orientation session will be documented on the Daily Site Briefing form. Visitors will also be expected to follow the direction of the FPM while on-site.

4. DOF WORK PLAN

As indicated in Section 1 above, DOF personnel will conduct activities which include investigation for the design for the Barrier Wall PDI and investigation for the Expanded RTC Data Gaps.

The investigation design for the Barrier Wall PDI activities include:

- Locating, identifying, and documenting utilities and other potential subsurface obstructions via surface geophysics and shallow trenching along the barrier wall alignment.
- Collecting one composite soil sample during shallow trenching along the barrier wall alignment and analyzing that sample for total metals and toxicity characteristic leaching procedure (TCLP) metals to evaluate on-site reuse and off-site disposal options for soil excavated from the trench.
- Advancing 15 soil borings along the barrier wall alignment and collecting geotechnical data (e.g., standard penetration tests, gradation analyses, Atterberg Limits, triaxial tests, consolidation tests).

- Evaluating different slurry mix design options.
- Completing compatibility testing for one or more slurry mix design options.

RTC Data Gaps Investigation activities include:

- Geophysical survey.
- Hydraulic profiling tool (HPT) borings.
- Plume core borings.
- Plume core Upper Aquifer groundwater samples.
- Plume core Intermediate Aquifer groundwater samples.
- Sequential extraction and pore water samples from plume core borings.
- Tidal fluctuation study.
- Shoreline Wedge borings.
- Shoreline Wedge Intermediate Aquifer groundwater samples.
- Sequential extraction and pore water samples from wedge boring.
- Surface Water and Intermediate Aquifer pore water and pushpoint samples.
- Additional plume core borings.
- Field x-ray fluorescence (XRF).

Push-probe or hollow-stem auger core sampling will be used to collect upland samples. Sediment samples potentially contaminated with arsenic will also be collected from the inter-tidal and subtidal region of the Hylebos Waterway that borders the eastern boundary of the Arkema property. This sampling will largely be conducted during low tides. Some sediment and pore water sampling will be conducted by commercial divers and some sediment samples may be collected from a boat. Note because of the very specialized nature of commercial diving, the divers will be responsible for preparing there own health and safety plan. This DOF plan will be supplemented to cover the over water sampling after a contractor has been selected. It is expected that sediments collected by the divers

and/or from a boat will not be highly contaminated and the primary health and safety issues will be associated with sampling over and in water.

5. SITE CHARACTERIZATION

This section presents an assessment of the chemical and physical hazards that may be encountered during the tasks specified in Section 4.0 of this HASP. Additional hazard control information can be found in the Activity Hazard Analyses table in Appendix A and in the listing of General Site Work Rules found in Appendix B. Site personnel will be informed of these hazards and the means that will be taken to control them prior to beginning work

5.1 Chemical Contaminants

Extensive environmental sampling of soil and groundwater has been conducted at the Arkema Site in the past by various environmental contractors. These samples were analyzed for a wide array of potential environmental pollutants, including metals, high and low molecular weight polycyclic aromatic hydrocarbons (PAHs), chlorinated and non-chlorinated volatile organic compounds, polychlorinated biphenyls (PCBs), pesticides, and petroleum hydrocarbons. It is highly unlikely, though, that most of these contaminants could present an exposure hazard to site personnel when compared that is, to WISHA's permissible exposure limits (PELs) where inhalation of the offending chemical agent is the exposure route of concern. This evaluation is based on the fact that the majority of site contaminants are relatively non-volatile (PCBs, lube oil) or for the most part consist of solids (metals, PAHs, pesticides, asbestos) and, at least with respect to the volatile organic and chlorinated compounds, are likely to be adsorbed onto the surface of the soil particles or are dissolved in the groundwater. The site is also well ventilated.

In addition, the majority of contaminants are present in soil and groundwater at relatively low concentrations. The volatile organic hydrocarbons detected in the site soils, for example, all have concentrations less than 1 ppm except for xylenes and isopropyl toluene, whose concentrations are 5 ppm and 8 ppm respectively. The maximum soil

concentrations of the PAH's were all less than 2 ppm while PCB levels were all less than 0.2 ppm.

Pesticide soil concentrations range from a high of 30,000 ppm for DDT to a low of 1900 ppm for DDE. And likewise, petroleum hydrocarbon soil levels are 4700 ppm (max.) for lube oil and 1800 ppm (min.) for gasoline. Even at these soil concentrations, though, airborne exposure levels could not reasonably be expected to exceed the PELs of these contaminants even under extreme ambient dust conditions ($> 10 \text{ mg/m}^3$ total dust). The same can be said for all of the metals detected in the site soils except one – arsenic. Certain “hot spots” (Attachment A) in the waste disposal area contain arsenic in the site soils at a maximum concentration of 25,000 ppm while it's most common concentration throughout the site is less than 1,000 ppm. These hot spot areas are shown on Attachment A.

Several of the site contaminants present in the soil and groundwater, however, are substances which if exposed to the skin can to some degree be cutaneously absorbed into the body (see American Conference of Governmental Industrial Hygienists Threshold Limit Values with “Skin” notations) or produce other adverse dermal effects (i.e., dermatitis, skin cancer). These materials include PAHs, arsenic, nickel, mercury, antimony, and PCBs. Fortunately, the actual concentrations of these materials in these contaminated substrates are relatively low (ppm range) and, as such, are not likely to be hazardous from a skin absorption standpoint. Nonetheless, appropriate chemical protective clothing will be worn whenever the potential for significant dermal contact with these materials exists. Decontamination measures will also be instituted to further reduce contaminant contact and to minimize the spread of contamination in the work area.

A listing of current occupational exposure limits, primary toxicological effects, and relevant physical properties for each of the skin absorbable contaminants is presented in Table 5-1. It is important to note when reviewing this table that the physical and toxicological data contained therein are derived from studies on concentrated (pure) forms

of the contaminants and do not accurately represent the low level (ppm) exposure conditions which will be encountered by site personnel working on the project.

Table 5-1. Chemical Data

CHEMICAL	ACGIH TLV	WISHA PEL	ROUTES OF EXPOSURE	SYMPTOMS OF EXPOSURE	TARGET ORGANS	PHYSICAL DATA
Arsenic	10 ug/m ³	10 ug/m ³	Inhalation Ingestion Skin contact	Skin and eye irritation, resp. tract irritation, lung and skin cancer.	Kidneys, liver, skin, lungs, bone marrow, and lymph.	Sp.G.=3.74 BP= 869F MP=599F Reactivity: acids, bases, oxidizers, iron solutions, and zinc.
Antimony	0.5 mg/m ³	0.5 mg/m ³	Inhalation Ingestion Skin contact	Irritation of eyes, skin, nose, throat, mouth; cough, dizziness, headache, nausea, diarrhea, stomach cramps, insomnia, anorexia.	Eyes, skin, respiratory system, cardiovascular system.	Sp.G.=6.69 BP= 2975F MP=1166F Reactivity: acids, oxidizers,
Nickel	1.5 mg/m ³	1.0 mg/m ³	Inhalation Ingestion Skin contact	Resp. tract irritation, allergic contact dermatitis, conjunctivitis, asthma, lung and nasal cancer.	Skin, lungs, and sinuses,	Sp.G.=4.84 Reactivity: H ₂ O ₂
Mercury	0.025 mg/m ³	0.1 mg/m ³	Inhalation Ingestion Skin contact	Resp. tract irritation, allergic contact dermatitis, asthma, skin and eye irritation, bronchitis, dyspnea, GI tract irritation, tremor, and weakness.	Central nervous system, kidneys, skin, lungs, and eyes.	Sp.G.=13.6 BP= 674 F Reactivity: Acetylene, ammonia, azides, calcium, sodium carbide, and copper
PAHs	0.2 mg/m ³ as coal tar pitch.	0.2 mg/m ³ as coal tar pitch volatil.	Inhalation Ingestion Skin contact	Skin, eye, and respir. tract irritation, nervous system effects, skin cancer, teratogenesis.	Skin, eyes, respiratory tract, and nervous system.	Pyrene example: Sp.G.=1.27 BP=759F MP=313F Reactivity: acids and oxidizers.
PCBs	0.5 mg/m ³	0.5 mg/m ³	Inhalation Ingestion Skin contact	Eye irritation, liver damage, chloracne, Reproductive effects, potential human carcinogen.	Skin, eyes, liver, and reproductive system.	Sp.G.=1.38 BP=689 – 734 F VP=0.00006 Reactivity: Oxidizers.

LEL= Lower Explosive Limit F.Pt.=Flash Point VP=Vapor Pressure BP=Boiling Point
UEL= Upper Explosive Limit React.=Reactivity Sp.G.=Specific Gravity MP=Melting Pt.

5.2 Physical Hazards

Several physical hazards are anticipated to be associated with the planned work. These hazards included working around heavy equipment (i.e. drill rigs, backhoes), noise, thermal stress, slips, trips and falls, adverse contact with mechanical equipment and power tools, drilling, and physical injury from heavy lifting. A general discussion of the aforementioned hazards and the work practices that will be used to control them is presented below. A more detailed listing of hazard control strategies for specific tasks is included in the Activity Hazard Analysis (AHA) in Appendix A. This discussion is intended to point out the more obvious hazards reasonably anticipated on this project and assumes that any DOF subcontractor will be responsible for, and meet, all applicable OSHA/WISHA regulations and requirements to their work.

5.2.1 Noise

Noise levels in excess of 85 dBs are likely to exist near motorized equipment, such as, drill rigs and portable generators, operating in the work area. To evaluate and control this hazard, sound level measurements may be collected around each work area periodically throughout the duration of the project. If noise levels exceed 85 dBs and DOF personnel are exposed to these noise levels for the majority of their shift, then they will be required to wear hearing protection and comply with the hearing conservation requirements of WAC 296-817.

5.2.2 Slips, Trips and Falls

Tripping on equipment, uneven walking surfaces, and on debris left on the ground is likely to be a concern on this project. There are likely to be slip, trip, and fall hazards on-board the work boats from wet walkways, unsecured equipment left on deck, open hatches, and pitching and rolling actions of the vessels in rough water. These hazards may also exist on the dock where boats will be moored. In addition, there is a risk that workers could fall from equipment. Slip, trip, and fall hazards will be controlled by keeping the work area free of debris and other litter. Site workers will wear steel-toed safety boots and pay careful

attention to surface conditions to prevent trip and fall injuries. The work area will be inspected before the start of work each day to identify any hazards that could cause injury. The results of these inspections will be communicated to site personnel during the daily tailgate safety briefings. Workers will wear personal fall protection whenever they must work at heights 6 ft. or greater above the ground. These situations will be evaluated beforehand by the SSHO and an activity-specific fall protection plan will be drafted.

5.2.3 Thermal Stress

Because all site work will be conducted outside where temperature conditions vary, there is a risk that site workers could develop heat or cold stress. The likelihood of this occurring is dependent on environmental conditions, the level of work activity, and the personal control measures that are used to manage heat loads (work/rest cycles, use of clothing and/or cooling devices, hydration, etc.).

The planned soil and groundwater sampling work, however, is not likely to subject workers to significant heat stress risks unless low-permeability protective clothing is worn (i.e. Tyvek, raingear, etc.) during periods of warm weather. As such, modified Level D and Level C protective clothing will be worn only as necessary and for as short a time period as possible. In addition, workers will be encouraged to self-limit their exposures to heat stress conditions and have co-workers watch for signs and symptoms of heat strain in others. Shaded rest areas and chilled beverages will also be provided.

If visual monitoring indicates that a worker is suffering from heat stress, or if conditions/PPE requirements warrant, workers will be evaluated for heat strain by monitoring their heart rate, body core temperature, and heat strain symptomology. Excessive heat strain may be marked by one or more of the following measures, and an individual's exposure to heat stress will be discontinued when any of the following occur:

- Sustained heart rate is in excess of 180 beats per minute (bpm) minus the individual's age in years, for individuals with assessed normal cardiac performance, or

- Recovery heart rate at one minute after a peak work effort is greater than 110 bpm, or
- Body core temperature - as measured with an infrared ear drum scanner - is greater than 100.4°F, or
- There are symptoms of sudden and severe fatigue, nausea, dizziness, or lightheadedness.

Workers who appear to be disoriented or confused, or suffer inexplicable irritability, malaise, or flu-like symptoms will also stop work and rest in a cool location with rapidly circulating air and kept under skilled observation.

5.2.4 Drilling and Heavy Equipment Hazards

Light duty pickup trucks, backhoe and drill rigs will be used on site during the project. There is a potential for workers to be struck by these vehicles or to be injured by contact with exposed moving parts on mechanical equipment. To control these hazards, safe distances will be maintained between workers and mechanical equipment. Mobile equipment will be equipped with backup alarms and spotters will be utilized as necessary to direct equipment operators when moving and placing equipment. Personnel needing to approach heavy equipment while in operation will observe the following protocols:

- Make eye contact with the operator (and spotter).
- Signal the operator to cease heavy equipment activity.
- Approach the equipment and inform the operator of intentions.

All site workers will wear American National Standards Institute (ANSI) / International Safety Equipment Association (ISEA) 107-2004 Class II compliant reflective road vests when heavy equipment or vehicular traffic is in the vicinity. Workers will avoid standing in the blind areas behind vehicles, particularly when they are backing up.

The drilling subcontractor will ensure that the equipment they bring to the site is in proper working order and that all exposed, mechanical moving parts are appropriately

guarded. The driller will also follow such safe work practices as: conducting an underground utility search before drilling, parking their drill rig on level, stable ground with outriggers fully extended, keeping the drill rig's mast at least 15 ft. away from overhead power lines, not moving the rig while its mast is extended, keeping hands clear of the drilling auger, making sure emergency kill switches are operational, inspecting the drill rig before use, using only experienced drill rig operators, and shutting down and securing the drill rig when not in use.

Ambient dust conditions in the work area will be evaluated with a direct-reading, MiniRam dust monitor when using a backhoe to excavate soil from around the sheet pile wall. Action levels for these dust measurements are listed in Table 12-1. Full-shift personal exposure samples for arsenic will also be collected on representative members of the drilling crew when drilling under worst-case soil conditions in the Penite Pit. Results will be compared to arsenic's action (AL) level of 5 ug/m³ and applicable sections of WISHA's arsenic standard (WAC 296-62-07347). Necessary exposure control measures will be implemented should the AL be exceeded. This exposure monitoring approach may be applied to other dust producing work activities on-site depending on site conditions and the level of work activity creating the dust hazard

To control dermal exposures to the contaminated drill cuttings, drill rig operators will wear the chemical protective clothing listed in Section 10.0.

5.2.6 Heavy Lifting

Site personnel will be cautioned not to lift or exert themselves beyond their physical ability and to apply proper ergonomic principles when doing their work. Each contractor on site will be responsible for monitoring the work practices of their employees to ensure that they are not over-exerting themselves or engaging in high risk, heavy lifting or repetitive motion activities. Mechanical lifting devices, such as, winches, pulleys, forklifts, hand carts, and dollies, should be used to lift and move equipment whenever feasible. Also, workers should enlist the help of others when lifting and moving

exceptionally heavy loads whenever the use of mechanical lifting devices is not feasible. As a matter of policy, DOF employees will not lift more than 50 lbs. individually. Other contractors on-site are encouraged to follow this rule, as well.

5.2.7 Hand and Power Tools

Heavy equipment operators may have occasion to use hand and power tools to operate or repair the equipment they bring to the site. They will ensure that their tools are inspected before use and are used in the proper manner by qualified individuals. Damaged tools must be tagged-out and removed from service. Only non-sparking or intrinsically safe tools must be used in locations where sources of ignition may cause fire or explosion. Electrically powered tools using AC current must be GFCI protected. If portable generators are used to power tools and equipment, they must be placed outdoors, downwind and away from workers. Refueling will be done with the generator shut off. Internal combustion engines will be equipped with spark arresters.

5.2.8 Sediment Sampling From Boat

Operating boats or vessels on the water carries the risk of having a crew member fall overboard and possibly drown, striking or being struck by other vessels operating in the area, losing power or steering and drifting into hazardous areas (i.e. shore, marine facilities etc.) and encountering severe weather and dangerous seas, to name a few. The risk of a boating accident can be reduced by ensuring that boat operators are experienced; operating the vessel in compliance with Coast Guard rules and regulations; maintaining the vessel in good mechanical order; avoiding bad weather and dangerous seas; and ensuring emergency equipment is available on-board (i.e. life vests, life rings, life boats, fire extinguishers, communication equipment etc.)

To address these concerns, all work conducted from the sediment sampling boat will comply with all applicable Coast Guard regulations. Boats will be operated by experienced crewmembers and all equipment will be inspected prior to use to ensure that it is in proper working order. The boat operator will be responsible for the safety of all personnel on the boat and for the integrity of the vessel and its safety equipment.

Prior to the start of field activities, the boat operator will give a detailed health and safety briefing on the location and use of all vessel safety equipment and the procedures for addressing on-board emergencies (i.e. fire, mechanical failure, man overboard situation, etc.) All sample boats will meet U.S. Coast Guard license and registration requirements and be equipped to safely support maximum rated crew and passenger sizes. The maximum number of passengers and weight shall be conspicuously posted on each vessel. The number of passengers shall not exceed the number of PFDs (personal flotation devices). Personnel working from the sample boat will be required to wear a Type II or equivalent PFD at all times. The sample boat will have at least one sound signaling device (air horn), a fire extinguisher, and at least one vessel mounted or hand held radio to communicate with shore-based support facilities and other vessels operating in the waterway. To avoid collision with other vessels operating in the area, boat operators will look for and avoid other vessels operating in the area at all times. Boating operations will be suspended during severe weather or rough seas.

5.2.9 Diving Operations

The placement and retrieval of pore water samplers and collection of sub-tidal sediment samples in the Hylebos Waterway will be conducted by commercial divers using surface-supplied air diving equipment. The diving contractor will be responsible for complying with all applicable requirements of WISHA's Commercial Diving Standard (WAC 296-37) and for providing a Safe Practices Manual before beginning work. This manual must include:

- Copy of WAC 296-37-520
- Safety procedures and checklists for diving operations;
- Assignments and responsibilities of the dive team members;
- Equipment procedures and checklists; and
- Emergency procedures for fire, equipment failure, adverse environmental conditions, and medical illness and injury.

In addition, the contractor will produce a Site-Specific Dive Plan for each diving operation that specifies the procedures that will be implemented, given current site

conditions, to comply with WISHA diving requirements and control health and safety hazards related to the diving work. Some of the more noteworthy regulatory requirements specified in the WISHA standard, as well as, other pertinent restrictions that must be addressed in the Dive Plan include the following:

- All surface-supplied air divers will be continuously tended and in 2-way voice communication with a surface dive team member. A standby diver will also be in attendance during the dives.
- No night diving will be allowed;
- No decompression diving, mixed gas diving, or diving conducted at depths greater than 100 feet are allowed.
- Decompression tables and a depth-time profiles, including when appropriate any breathing gas changes, will be maintained for each diver.
- No diving will be conducted in enclosed or physically confining spaces;
- No diving will be conducted against excessive currents (usually those exceeding 1 knot).
- No diving will take place if surface visibility is less than 300 feet.
- Dives must be terminated whenever communication is lost with the diver, diver fails to respond to a communication or diver requests that the dive be terminated.
- Divers must carry a reserve breathing gas supply.
- A list shall be kept at the dive location of the telephone or call numbers of an operational decompression chamber; accessible hospital; available physician; available means of transportation; and the nearest U.S. Coast Guard Rescue Coordination Center.
- A first aid kit appropriate for the diving operation must be available at the dive location along with an American Red Cross standard first aid handbook or equivalent and a manual bag-type resuscitator.

- To minimize hazards to the dive team, diving operations must be coordinated with other activities in the vicinity that could potentially interfere with the diving operation.
- A warning flag must be displayed at the dive site.
- Divers must be provided a means for entry into and exit from the water if the water cannot otherwise be accessed from the shore.
- Prior to diving, divers must be briefed on emergency procedures, communications, surface and underwater conditions and hazards, diving equipment and systems, breathing gas supplies and dive team assignments and fitness of dive team members.
- Dive team members must possess a nationally recognized diving certificate, have current certifications in first aid and CPR and be medically fit to perform their diving duties.
- A qualified person will be located at the dive site who will be in charge of all aspects of the diving operation affecting the safety and health of dive team members.
- Off-site communications for summoning emergency services will be available at the site.

5.2.10 Use of XRF Analyzer

A hand-held XRF analyzer will be used on-site to evaluate the metal content of the soil samples collected during the soil boring work. These instruments operate by generating a beam of X-rays that, when aimed at sample target, ionize the metal constituents of the sample causing the metal to fluoresce at very specific wavelengths which are then detected and identified by the instrument. Ionizing radiation can damage body tissues depending on the type and intensity of the radiation and duration of exposure. As such, several safety precautions will be taken to ensure project personnel are not injured when this instrument is being used. They include the following:

- Only properly trained and authorized personnel will be allowed to operate the instrument. They must have completed formal training in radiation safety and in safe instrument operating procedures. They will also be responsible for ensuring

that only authorized individuals have access to the equipment and that the instrument is secured, and locked when not in use.

- All reasonable measures, including labeling, operator training and certification, and the concepts of time, distance, & shielding, should be implemented to limit radiation exposure to as low as reasonably achievable (ALARA).
- Operators should minimize the time around the energized instrument, maximize the distance from the instrument window, and shoot into high density materials whenever possible.
- Restrict access to the location of instrument storage and use to limit potential exposure to ionizing radiation. Keep the instrument in a controlled location, where only trained and authorized users have access.
- Never point the instrument at a person, yourself, or hold a sample in your hand or point the instrument into the air when performing a test.
- Keep the test area clear of people for at least four to five feet in front of the analyzer. This no admittance zone should be a sufficient distance from the instrument's measurement window to allow ambient air to attenuate the x-ray beam. If necessary, use portable panels to shield others from radiation (for example, 1/8" stainless steel can attenuate the beam to background levels).
- When analyzing a sample, ensure that the probe (nose) of the instrument is firmly placed on the target and that no part of your body (including hands and/or fingers) is near the measurement window.
- Do not use the instrument if there is any chance that it is damaged or might leak radiation. In such a case, arrange for qualified personnel to perform a radiation safety test and repair any analyzer damage.
- If required by the operator's radiation safety program, the operator will wear a radiation dosimeter when using the XFR analyzer.

5.2.10 Dermal Contact with Contaminated Soil and Groundwater

Certain areas of the site contain significantly higher levels of contamination than the site in general. Such areas present a higher risk of dermal contact with the site contaminants depending on the nature and extent of the work activity (i.e. degree of contact with contaminated soil and groundwater). These areas will be identified before work begins and are illustrated on the attached site diagram, Attachment A. The SHSO will evaluate all work activities occurring within these work areas and determine if dermal contact with the soil and groundwater is excessive. If so, personnel working in these areas will be required to wear the chemical protective clothing specified in Section 10. They will also undergo decontamination before leaving the regulated area and they will wash their hands before eating, smoking or exiting the site.

6. SITE CONTROL MEASURES

6.1 Property Access and Site Security

Except for the shoreline that borders the Hylebos Waterway, the entire Arkema property is secured with cyclone fencing or other access controls. The fencing incorporates several gates with access roads that open to Taylor Way. DOF site management will control access to the work site by requiring all project personnel and visitors to check with site management and sign the Daily Site Briefing form for the day. These individuals will receive a site orientation briefing on site hazards, controls, emergency procedures, and general site rules, before they will be allowed to enter the jobsite. Visitors will be escorted by an authorized site representative at all times while on-site. They will also stay within designated walkways and behind fenced-off areas including work zones that have been secured with barricades, boundary tape or rope.

Regular site workers will receive site orientation training when first entering the site and attend daily site safety meetings thereafter. They will also follow the “buddy rule” (work with or in close proximity to another worker) when doing their work.

6.2 Regulated Work Areas

Because access to the Arkema site is controlled, and because there are no regular activities on the site, there is little chance of exposing the public to the anticipated work activity of soil/sediment/groundwater sampling. Consequently there generally will not be a requirement to establish additional regulated work areas while performing these activities. At soil/sediment/groundwater sampling locations where respirators are required, or where significant risk is associated with exposure to chemicals, then specific exclusion zones, contamination reduction zones, and support zones will be established as described below. These zones will be clearly marked and only properly trained and medically qualified personnel will be allowed to enter them. Smoking, eating, or drinking will only be allowed in the support zone.

6.2.1 Exclusion Zones

As required by site conditions, exclusion zones (EZs) will be placed around work areas as described below. As a minimum, EZs will be established around each drilling site and active groundwater monitoring and soil / sediment sampling location. EZs will be demarcated with warning tape or other equivalent means (for example cones, barricade, stanchions) and marked with warning signs. Only Hazardous Waste Operations and Emergency Response (HAZWOPER) trained and medically qualified workers wearing the necessary PPE as described in Section 10.0 will be allowed to enter the EZ. All site personnel will be accompanied by another crewmember when working in the EZ. Upon exiting the EZ, site workers will doff personal protective equipment (PPE) and wash their hands and face prior to eating, drinking, smoking or performing any other hand-to-mouth activity.

EZ locations will be altered to account for changing site conditions.

6.2.2 Contamination Reduction Zones

As required by site conditions, Contamination Reduction Zone (CRZ) will be established adjacent to each EZ to provide a secure area for decontaminating and removing the

protective clothing worn by those site workers working in the EZs. The CRZs will be equipped with the following equipment, as necessary.

- Chairs or benches for the workers to sit on when removing their clothing
- Wash buckets and brushes for cleaning protective clothing and tools
- First Aid Kit
- Bloodborne pathogen kit
- Air horn (or other emergency alert signal)
- Fire Extinguisher (ABC Type, at least five pound size)
- Spill Kit
- Eyewash station
- Hand wash station (or equivalent materials)
- Containers appropriate for containing used PPE
- Additional PPE components (for example, additional disposable gloves or hearing protection)

6.2.3 Support Zone

As required by site conditions, all areas outside of the exclusion and contamination reduction areas will be considered the support zone (SZ). The SZ will include equipment and material storage areas, employee break areas, temporary office facilities, etc. and will be considered open access for site personnel. No special access requirements other than the general security requirements will be required for access to the SZ.

7. COMMUNICATIONS

Communications at the jobsite will be by verbal command, hand signals, cell phone, or a combination of all three. DOF personnel will carry with them cellular telephones and a listing of emergency telephone numbers. These phone numbers are listed in Section 13 of this plan. Copies of these phone numbers will be available at each operational work area.

In the event of an emergency requiring evacuation, the Emergency Coordinator will verbally alert each contractor working on-site to immediately proceed to the designated staging location for a head count and for further instructions on exiting the site.

8. TRAINING AND RECORDKEEPING REQUIREMENTS

Site personnel directly involved in soil, sediment, surface water and groundwater sampling or other site workers who could potentially incur significant dermal or inhalation exposures to the site contaminants will have completed at least 40 hours of hazardous waste operations training, as required by 29 CFR 1910.120/1926.65. These individuals must also have received a minimum of three days of actual field experience under the direct supervision of a trained, experienced supervisor. Those personnel who completed the 40-hour training more than 12 months prior to the start of the project will have attended an 8-hour refresher course within the past 12 months. The Field Project Manager, Site Supervisor (including subcontractor supervisors), and the SHSO must have completed an additional 8 hours of hazardous waste site supervisor training.

A copy of the training completion certificates for each employee (including subcontractors) working in either the EZ or CRZ will be maintained at the project office. All personnel working on site will receive site orientation training that will include a discussion of each element of this HASP and all of its attachments. At least one site worker, who has current first aid/cardiopulmonary resuscitation (CPR) training, will be on site at all times when work is underway. The aforementioned training requirements and other mandatory training and certifications required for this project are summarized in Table 8-1.

Table 8-1 Summary of Training Requirements

Personnel	Requirements
SHSO, Field Project Manager, and Site Supervisors	• 40-Hour HAZWOPER, 3 days of supervised field experience training, current 8-hour refresher training • Bloodborne pathogens awareness • Fire extinguisher training [29 CFR 1910.157(g)]

Personnel	Requirements
	8 Hr. Site Supervisor Course (29 CFR 1910.120 p. (e)(8)) - First Aid/CPR training - Hearing protection training [29 CFR 1910.95(i),(k)] and hearing conservation program - Site- specific training (including hazcom training)
Technicians working in the EZ or CRZ (includes laborers, scientists, engineers, technicians, etc.)	40-Hour HAZWOPER, 3 days of supervised field experience training, current 8-hour refresher training - Hearing protection training [29 CFR 1910.95(i),(k)] and hearing conservation program - Bloodborne pathogens awareness - Fire extinguisher training [29 CFR 1910.157(g)] - Site specific training (including hazcom training)
General site workers not working in the EZ or CRZ (includes laborers, scientists, engineers, technicians, etc.)	- Hearing protection training [29 CFR 1910.95(i),(k)] and hearing conservation program - Bloodborne pathogens awareness - Fire extinguisher training [29 CFR 1910.157(g)] - Site specific training (including hazcom training)
Subcontractors and Visitors (not operating in an area where a potential for exposure to contamination exists)	Site safety brief / safety awareness training

CPR = cardiopulmonary resuscitation

8.1 Site Specific Training

Prior to starting work, each employee will receive site specific health and safety training. The SHSO, or designee, will provide and document site-specific orientation training during the project site kickoff meeting and whenever new workers arrive on site. No site workers will be allowed to begin work on site until the site-specific training is completed and documented by the SHSO. This training will address this HASP and health and safety requirements and procedures pertinent to site operations.

As part of the site-specific orientation training, the following topics will be covered:

- Project introduction and orientation
- Potential site hazards (chemical, physical, and biological)

- Hazard Communication as per 29 CFR 1910.1200 (particularly arsenic hazard awareness training)
- Selection, use, and limitation of PPE
- Emergency procedures
- Contents of the HASP

8.2 Hazard Communication Training

Material Data Safety Sheets (MSDS) will be kept in Appendix C of this HASP for each hazardous chemical used during the project. These MSDSs will be made available to each employee on request. Employees will also be informed about any site operations involving the use of hazardous chemicals, the hazardous nature of the chemicals used, and the location of the MSDSs. Workers who are exposed to hazardous chemicals will be trained to recognized chemical contact hazards in the workplace, the physical properties and health hazards of hazardous chemicals, and the personal protective measures that will be taken to control exposures. All chemical containers used to store hazardous chemicals will also be marked or labeled with the name of the chemical and its hazard warning.

8.3 Emergency Response Training

Personnel on this project will not respond to off-site releases of hazardous materials, structural or major fires, or other catastrophic incidents. Project personnel will only respond to on-site incidents within their training and competency. On-site response training during initial orientation, as well as periodic drills and reviews at each work area will include:

- Employee alarm system
- Evacuation procedures, routes, meeting places, and accountability
- Control of fuel sources
- Fire extinguisher education (No employee is permitted to attempt to fight a fire beyond incipient stage.)

- Minor spill control/cleanup on site in accordance with the plan. This may include source control (e.g., shutoffs, repositioning containers); containment (e.g., drum overpacks, sorbent booms, earthen dikes); and non-emergency cleanup (e.g., sweeping, digging, pumping, and containerization of spills and residues).
- Rescue operations, as necessary

8.4 First Aid and CPR Training

At a minimum, one site worker per work shift will have received first aid and CPR training taught by a certified instructor and approved by an organization such as the American Red Cross. Persons trained in first aid and CPR shall have received instruction on bloodborne pathogens according to 29 CFR 1910.1030. Site-specific briefings will include information about bloodborne pathogen hazards, and the SHSO will keep a record of all site personnel having such training.

On-site medical emergencies will be handled as discussed in the Emergency Response Plan (Section 13). Type III, 16-unit first aid kits that comply with the criteria contained in ANSI Z308.1-1998 will be located on site and in each of the site vehicles, where possible. Bloodborne pathogen barrier kits containing latex gloves, CPR barrier, masks, and eye protectors will also be staged with the first aid kits. They will be inspected weekly and replenished as necessary.

8.5 Tools and Equipment

Any worker using a specific tool must have had training on the proper use of the tool. For tools having common use in construction activities, a visual observation by a supervisor is sufficient to document that worker is knowledgeable of general trade tools (screwdrivers, hammers, pliers, wrenches, etc.). Workers operating heavy equipment must have training or equivalent experience in operating that equipment. Training in the operation of forklifts requires training specified in 29 CFR 1910.178, which includes

recertification on a periodic basis. A certificate of training in compliance with this regulation is required in the employee's training record.

8.6 Safety Meetings

Site safety briefings will be conducted prior to the start of work each day. During these sessions, each worker (subcontractors included) will be encouraged to share their observations, thoughts, and experiences on safety and health-related issues pertinent to the jobsite. This venue also allows site management to share important hazard communication topics with the workers, such as plan-of-the-day activities and associated hazards and controls, required use of PPE, decontamination procedures, emergency procedures, safe work practices, and HASP changes.

The SHSO will conduct these briefings at the start of each shift. Site briefings may be repeated during the day if new hazards arise, which must be communicated to site personnel, or if other workers arrive at the jobsite later in the day. It is at this meeting that site workers will review the AHA for the tasks to be performed that day. A Daily Site Briefing form will be used to document these meetings and will include a listing of topics discussed, hazards identified, recommended remedial controls, other pertinent issues, and the names of all attendees. The information gathered in these sessions will be used to correct any unsafe conditions or work practices at the jobsite and amend the SSHP as appropriate. Copies of Daily Site Briefing forms will be maintained in the project files. A copy of this form is included in Attachment C.

8.7 Recordkeeping Requirements

In accordance with the recordkeeping requirements of 29 CFR 1910 and 1926, and DOF's Health and Safety Program, the following health and safety documents will be generated and maintained at the jobsite or project office:

- Daily Tailgate Safety Briefings
- Medical clearance letters

- Training course certificates (i.e. 40Hr. Hazwoper, 8Hr. Refresher, First Aid/CPR, etc.)
- Respirator fit test forms
- Accident report and investigation forms.
- MSDS sheets
- DOF project field notebook
- HASP review declaration
- Weekly and monthly site inspection forms

Copies of these forms are included in Appendix C.

8.8 Inspections

The SHSO will conduct informal daily inspections of the jobsite. The results of these inspections will be recorded in the DOF project field notebook. Safety and health inspections will also be conducted each week by the Field Project Manager and every month by the Project Manager or their designee. Inspection results will be recorded on the “Project Inspection Checklist” found in Appendix C. Copies of the inspection reports will be kept on file for review by the PHSM.

Deficiencies noted during these inspections will be recorded in DOF’s project field notebook . Each deficiency will be corrected by a designated authority according to a pre-assigned completion date. Copies of the inspection findings will be sent to the Project Manager for evaluation and correction of any deficiencies.

9. MEDICAL SURVEILLANCE

DOF site personnel and subcontractors who are exposed to hazardous substances on this project will participate in either DOF’s Medical Surveillance program or in a comparable surveillance program chosen by their employer that meets the requirements of 29 CFR 1910.120(f). This program requires a complete pre-employment physical with associated laboratory tests and a drug screen. DOF site personnel must have passed this

examination and have a copy of their medical clearance on file at the site before they will be allowed to enter the EZ or CRZ. This clearance letter, applicable to both DOF and subcontractor personnel, must include the physician's opinion as to whether the employee has any detected medical conditions which would place the employee at increased risk of material impairment of the employee's health from work in hazardous waste operations or emergency response or from respirator use. It must also list any limitations upon the employee's assigned work.

An annual or biennial physical examination (as determined by the occupational health physician) is also required for all personnel participating in this program. Additional physical exams will be made available to program participants who terminate their employment with DOF or who are reassigned to a job position, which does not require participation in the program.

The medical examinations will be provided by a licensed physician, preferably one knowledgeable in occupational medicine, in accordance with 29 CFR 1910.120 (f)(5).

10. PERSONAL PROTECTIVE EQUIPMENT

Prior to the start of work, the SHSO will review the applicable work plans, site historical records, remedial investigation results, etc. and evaluate each major work activity to determine the appropriate level of PPE needed for the work. This evaluation will include a consideration of potential chemical, physical, and biological hazards present; work operations to be performed; potential routes of exposure; concentrations of contaminants present; and characteristics, capabilities, and limitations of PPE, including any hazards that the PPE may create or exacerbate (i.e., heat stress). Evaluation findings and recommendations for the project, to date, are listed in the AHA tables found in Appendix A.

The SHSO will also evaluate PPE usage at the jobsite on a daily basis and determine the necessary PPE for specific activities or portions of activities not included in the AHAs. If

necessary, the HASP will be amended to reflect new or modified PPE requirements. All PPE changes will be communicated to site personnel during the daily site briefings and hazard communication training sessions. At a minimum, though, all field activities will require the use of ANSI-approved hard hats, safety glasses, safety-toe footwear; short-sleeve shirts; and long pants and ANSI / International Safety Equipment Association (ISEA) 107-2004 Class II compliant reflective road vests.

Three different levels of PPE—Level D, modified Level D, and Level C —will be available for use during the planned project activities. The PPE components that make up these levels are listed below.

10.1 Level D

For activities not presenting a risk of significant contact with contaminated sediment, soil or groundwater, site personnel will wear Level D consisting of:

- Standard work clothing (long pants and short or long sleeve shirt), gloves (as appropriate), ANSI-approved hard hat and safety glasses
- Chemical-resistant boots or leather work boots with safety toe (as appropriate)
- Hearing protection as required
- ANSI/ISEA 107-2004 Class II reflective road vests where equipment traffic is present
- Leather work gloves

Site operations that are likely to result in minimal contact with contaminated soil and groundwater include operating mobile equipment, working in the SZ, and working in areas where airborne contaminant levels are below PELs. Personnel performing these tasks will wear Level D PPE unless the SHSO determines an upgrade is necessary.

10.2 Modified Level D

Modified Level D will be worn by those site personnel directly engaged in activities that could result in significant skin contact to contaminated sediment, soil, and groundwater. This includes the “hot spot” areas identified on Attachment A in the vicinity of the Former Penite Pit Areas discussed in section 5.1. Also, personnel assigned to assist in decontaminating these individuals will wear the same level of PPE. Modified Level D will consist of the following items:

- Disposable Tyvek coveralls or lightweight neoprene raingear or PolyTyvek coveralls if contact with liquid is possible.
- Nitrile gloves
- Rubber boots with steel toes or leather steel toe boots with chemical resistant boot covers.
- Hard hat
- Safety glasses
- Hearing protection as required
- ANSI/ISEA 107-2004 Class II reflective road vests worn on the outside of the coveralls in areas of equipment traffic.

Workers directly engaged in manually handling contaminated sediment, soil or groundwater (such as, drillers and sampling technicians) in the designated exclusion zones and those who repair equipment that is soiled have the greatest potential for contacting site contaminants.

10.3 Level C

Level C will be worn if the air monitoring results described in Section 12.0 indicate that an inhalation exposure hazard (in addition to a skin contact hazard) to volatile organic vapors or arsenic contaminated dust in excess of the specific action levels listed in Table 12-1 exist at the site. Level C will consist of the Modified Level D clothing specified above plus a full-face air purifying respirator (APR) equipped with organic vapor / HEPA

cartridges. Cartridges will not be used beyond their calculated end-of-service-life and at a minimum will be discarded at the end of each day.

Efforts will be made to eliminate airborne exposure hazards before resorting to the use of respiratory protection by, for example, allowing vapor emissions to dissipate before resuming work, using water to wet the ground to control dust release, and using exhaust fans to dilute potentially toxic or explosive atmospheres.

10.4 Respirator Use Requirements

All DOF personnel who must wear half-face air purifying respirators (APR) will receive a qualitative fit test in the exact same model, type, and size respirator to be used on the project prior to starting work. Fit test records will be kept on-file at the jobsite. Fit testing will be repeated every twelve months. Only medically qualified personnel will be allowed to use respiratory protective equipment. Medical clearance letters indicating the worker's ability to wear a respirator will be maintained at the jobsite.

Respirator users will also be trained in the selection, use, limitations, and maintenance of the respirators they have been assigned. This training is typically included in the worker's 40 Hr. Hazwoper training course and 8 Hr. Refresher training. Re-training on this subject, however, will be offered to anyone unfamiliar with the aforementioned topics.

Each respirator user on the project will be issued and fit tested in their own respirator which will be issued to them before work begins. They will be responsible for properly cleaning, inspecting, maintaining, repairing, and storing this equipment. Respirators will be cleaned in the manufacturer's recommended cleaning and disinfecting solution after each use. They will then be dried, placed in plastic bags and stored on-site for future use. Each storage bag will be identified with the respirator user's name. The Site Safety and Health Officer will conduct periodic inspections of all operations requiring the use of respirators to ensure the aforementioned respirator use requirements are being implemented.

10.5 PPE Use and Maintenance

Employees assigned to use PPE are required to inspect the equipment before and after each use, discard any equipment that is defective, clean and maintain the equipment according to manufacturer's recommendations, and store their PPE in a clean, secure area. Specific PPE inspection, cleaning, and maintenance procedures vary according to the type of equipment being used. Employees will be informed of these equipment-specific use and maintenance procedures prior to being assigned to their jobs. Training in PPE equipment inspection, cleaning, and maintenance protocols will be provided during the requisite 40-Hour Hazardous Waste Operations course and in the site-specific orientation training conducted by the SHSO. Employees will practice use and inspection of PPE before entering an EZ.

At the end of each shift, the SHSO will examine the inside of a representative sample of protective garments before they are discarded or cleaned to identify evidence of breakthrough. Such evidence would include any discoloration or staining of the clothing; thinning, blistering, or cracking of the clothing material; and the presence of torn seams and perforations. The SHSO will also note if the workers themselves have become contaminated while wearing the PPE. If, based on this examination, it is apparent that the PPE designated for the work is not adequately controlling worker exposures, the level of personal protection will be upgraded.

11. DECONTAMINATION

11.1 Personnel Decontamination

Decontamination for site personnel wearing Level D PPE will consist of having workers remove their hard hats, safety glasses, leather gloves, hearing protectors, and outer protective garments prior to leaving the site and storing them in a clean area for reuse the next day.

Site personnel engaged in activities requiring Modified Level D and Level C PPE will be required to wash their boots and remove their gloves when leaving the EZ. Disposable coveralls will be placed in a designated container for disposal. Workers will wash their hands and face before leaving the CRZ. Respirators, if worn, will be removed last and placed in plastic bags for later inspection, cleaning, and storage. Separate areas for storing street clothing and changing into and out of chemical protective clothing will be determined at the jobsite should level C or modified level C be required.

Personnel decontamination will be conducted in a CRZ situated adjacent to and contiguous with the EZ. A washtub will be placed in the CRZ for workers to use during the decontamination process. Scrub brushes and soap solution may be used to remove soil from clothing. Wash and rinse water will be managed and disposed of as discussed in the Site Work Plan.

The SHSO will ensure that the above-mentioned decontamination procedures are effectively controlling the spread of contamination in the work area by periodically inspecting the recently cleaned clothing and equipment for evidence of residual contamination. The work area also will be examined to detect any sign of contamination outside of the work zones. Should it become apparent that contamination is being dispersed into clean areas of the site, work activities will cease until more effective decontamination methods can be devised.

11.2 Equipment Decontamination

Decontamination of hand tools and heavy machinery will be performed prior to leaving the site or at the conclusion of site activities. Equipment will be cleaned of gross materials using hand tools and brushes and will then be sprayed with water, as necessary. To the greatest extent possible, rinsates will be maintained within the consolidation area or containments. General cleaning of equipment and tools where contact with contaminated materials has not occurred will not be considered decontamination and will

not require containment of rinsates. Generation of dust will be minimized to the greatest extent possible.

12. AIR MONITORING

Ambient air measurements for volatile organic vapors will be collected in the breathing zone of site workers when sampling monitoring wells and collecting soil core samples in areas that are known to be contaminated with volatile organic hydrocarbons. The purpose of this monitoring is to ensure that: 1) vapor levels do not pose an inhalation hazard to site personnel, 2) the appropriate level of PPE is being used, and 3) potentially explosive environments do not exist.

Organic vapor levels will be measured with an organic vapor analyzer, such as a PID or FID. As indicated in Table 12-1, total organic vapor levels equal to or less than background will be considered acceptable. Vapor levels in excess of this limit will require that work temporarily stop until vapors dissipate, effective engineering controls are implemented, or workers wear Level C PPE.

Collecting soil borings within the data-gap evaluation area is the only other work activity that presents a noteworthy contaminated dust exposure hazard. However, because relatively small amounts of soil are unearthed and handled during the drilling process, dust exposure levels are expected to be low. Past personal exposure monitoring on drilling personnel collecting soil borings at the site in 2012 and field soil analysis operations with an XRF analyzer in 2017 showed exposure results well below the Action Level and Permissible Exposure Limit for arsenic. Similar exposure monitoring conducted on drilling and sampling personnel within the former Penite Pit Area in 2017 also showed identical results.

Air sampling for arsenic will be conducted as per the National Institute for Occupational Safety and Health (NIOSH) Sampling and Analytical Method 7300. Exposure monitoring samples will be sent to an American Industrial Hygiene Association (AIHA)

accredited laboratory, NVL Laboratories, Inc. in Seattle, Washington for analysis. Air monitoring results will be recorded in the site field logbook and will be made available for review by all site personnel. Personnel will be notified of any levels of concern verbally upon receipt of the results or through discussions during the next daily safety meeting. Employees who had their personal exposures to arsenic measured will receive a written letter with their test results. This letter will be delivered no later than five days after receipt of air monitoring results.

Calibration and maintenance of monitoring equipment will be done by the SHSO in compliance with the manufacturer's specifications and will be performed prior to daily monitoring. Calibration records will be kept in the project health and safety files. All direct reading air sampling results from the previous day will be discussed with the site crews at the morning tailgate safety meeting.

The above-mentioned instrument readings will be compared to the actions levels listed in Table 12-1.

Table 12-1 Air Monitoring Action Levels

Monitoring Instruments	Activity	Action Level	Site Action
Organic Vapor Analyzer (PID or FID)	• Drilling soil borings. • Constructing groundwater monitoring wells. • Purging and sampling wells. • Working in VOC contaminated soils	$\leq$ background $>$ background but ≤ 10 ppm. >10 ppm	• Continue working • Wear Level C PPE or stop work until vapors are $\leq$ background. • Discontinue work • Shut down equipment • Evacuate area • Call Project Manager

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Personal exposure monitoring for arsenic	• Drilling soil borings. • Constructing groundwater monitoring wells. • Other significant dust generating activities.	$\leq 0.005 \text{ mg/m}^3 \text{ As}$ $> 0.005 \text{ mg/m}^3 \text{ As but } \leq 0.01 \text{ mg/m}^3 \text{ As}$ $> 0.01 \text{ mg/m}^3 \text{ As but } \leq 0.03 \text{ mg/m}^3 \text{ As}$ $> 0.03 \text{ mg/m}^3 \text{ As}$	Wear Modified Level D Medical Monitoring Biological Monitor. Hazcom Training Decontamination and Change areas Wear Level C Comply with WAC 296-62-07347. Suspend work and call PHSM.
Combustible Gas / H ₂ S Indicator	Drilling soil borings and installing wells in slag pile.	$< 10\% \text{ LEL}$ $> 10\% \text{ LEL}$ $< 20 \text{ ppm H}_2\text{S}$ $\geq 20 \text{ ppm H}_2\text{S}$	Continue or resume working Stop work, shut down equipment, isolate ignition sources, evacuate immediate work area. Inert auger as appropriate to control explosive atmosphere. Continue or resume working Evacuate immediate work area.
MiniRam Dust Monitor	Sheet pile wall soil excavation and inspection.	$< 2.5 \text{ mg/m}^3$ $\geq 2.5 \text{ mg/m}^3 \text{ but } < 5.0 \text{ mg/m}^3$ $> 5.0 \text{ mg/m}^3$	Continue working Implement dust control measure and/or have site personnel wear Level C PPE. Stop work and evacuate site.

13. EMERGENCY RESPONSE

There is a possibility that DOF personnel or their contractors could experience a medical emergency in the normal course of their work or, perhaps, spill fuels and lubricants used to service their equipment. For these emergencies, the following emergency response plan has been drafted. It will be discussed with all project personnel during their initial site orientation training. A copy of the Emergency Response Plan (this section) and a map to the emergency medical facility (Appendix E) will be readily available in each work area.

A listing of emergency response contacts for this project is presented in following table:

13-1. Emergency Response Contacts	
Site Address: 2901 Taylor Way Tacoma, WA	
Hospital:	
St. Joseph's Medical Center 1717 South J Street Tacoma, WA 98405	(253) 426-4100
EMT/Ambulance	911
Pierce County Sheriff's Dept.:	
Emergency	911
Business	(253) 798-4721
Tacoma Fire Dept.:	
Emergency	911
Business	
US Coast Guard	(206) 217-6000 or VHF chnl 16
DOF Field Project Manager, Dave Cooper	Cell: (206) 660-3466
DOF Emergency Coordinator, Dave Cooper	Cell: (206) 660-3466
Pioneer Project Manager, Troy Bussey	Cell: (360) 528-3057
Port of Tacoma Security (after hours)	(253) 383-9472
Port of Tacoma Security (Agnes TooToo)	Cell: (253) 571-8872
National Response Center	800-424-8802
Dept. of Ecology	800-258-5990

13.1 Emergency Coordinator

DOF's Technical Lead will be the designated emergency coordinator responsible for implementing this emergency response plan. This person will notify emergency

responders during a medical emergency (ambulance, hospital, etc.) or spill incident and ensure that the client and all affected project contractors are made aware of any emergencies occurring on-site. DOF's Technical Lead will initiate emergency evacuation procedures, as appropriate, and ensure that injured DOF employees are given emergency medical treatment and are transported to the hospital for follow-up treatment.

The emergency coordinator will conduct an inspection of emergency response equipment every month. This equipment includes fire extinguishers, first aid kits, and spill control equipment. As part of the daily site walk-through, he/she will pay close attention to potential fire hazards, spill potentials, and individual work practices. Emergency response equipment will be stored at an easily accessible location in the work area. Monthly fire extinguisher checks will be documented, either on the fire extinguisher or in the SHSO logbook.

13.2 Site Evacuation

Should a serious or catastrophic situation arise on site, such as but not limited to, an uncontrollable fire, airborne release of flammable or toxic chemical, hazardous liquid spill, significant injury to site personnel, and major earthquake or explosion, the jobsite will be evacuated. Site personnel will be notified of an evacuation through direct communication.

If an evacuation is necessary, all site personnel will proceed immediately to the entry gate to the site on Taylor Way. The emergency coordinator will be informed of the emergency and a head count of all assembled site personnel will be taken. Once everyone is accounted for, they will evacuate further to a safe area designated during site orientation training and the emergency coordinator will assess the situation and outline the actions to be taken.

During the emergency, the emergency coordinator will:

- Ensure injured personnel are given first aid treatment, as appropriate.
- Shut down equipment that could cause a hazard or act as an ignition source;
- Notify applicable emergency response services.
- Prohibit unauthorized personnel from entering the evacuated area by calling Port of Tacoma Security.
- Provide emergency equipment as appropriate; and
- Notify the project manager and client of the incident.

13.3 Environmental Incident (Spill)

Each contractor working on-site will be responsible for containing, controlling, and cleaning up any spills they create. Except for collecting environmental samples, DOF will not be engaged in any work activities that could result in the significant release of hazardous materials into the environment. Spills associated with drilling activities would likely result from the release of diesel fuel, lubricants, or hydraulic fluid into the water from the refueling or maintenance of their equipment. Should such an event occur, the Technical Lead will isolate the spill area; identify the nature and hazardous properties of the spilled material (i.e. reference MSDS sheets); notify site management of the situation; don appropriate personal protective equipment and; contain and control the spill using plugs, patches, containment boom and absorbents, etc.

A small spill, less than 5 gallons, will be handled by the responsible contractor. For spills greater than 5 gallons, the responsible contractor or DOF will call the local emergency response hazmat team (Fire Dept.) for assistance. The heavy equipment contractor will have on hand appropriate spill control equipment consisting of sorbent pads, sorbent boom, vermiculite, duct tape, large plastic bags, shovel, and one 55-gallon drum (or two 35-gallon drums). This spill kit will also include personal protective equipment, such as, disposable PolyTyvek coveralls or lightweight PVC raingear, nitrile gloves, PVC boot

covers, and chemical protective goggles. This equipment will be staged at each major work area.

Any spills that occur in the water will be reported to the appropriate regulatory authorities (i.e. Coast Guard, EPA, Dept. of Ecology, etc.) They will direct on-site cleanup resources and efforts.

13.4 Explosion

In the event of an explosion, all non-essential personnel will be evacuated from the site and the work area will be secured. No one will be allowed to re-enter the site, except to possibly save a life, until cleared by the emergency coordinator. If adjacent properties are threatened by the explosion, local emergency response authorities will be called to evaluate the situation and possibly initiate an evacuation of the surrounding community.

13.5 Personal Injury

In the event of serious personnel injury (fatality, patient unconscious, possibility of broken bones, severe bleeding, burns, blood loss, shock, or trauma), the first person on-scene will immediately:

- Administer first aid if qualified; if not qualified, seek out a person qualified to administer first aid; and
- Notify the emergency coordinator of the name of the individual involved, their location, and the nature of injury.

The emergency coordinator, upon receipt of notification of the injury, will immediately:

- Notify emergency medical services and give the appropriate patient information and their location.
- Assist the injured party as deemed appropriate.

- Designate someone to accompany the injured party to the hospital and to provide chemical data sheets to the emergency medical team.
- Notify DOF's project manager.
- Complete an injury report (see Appendix C.)

If the emergency coordinator determines that emergency medical services are not necessary (minor injury such as sprain or abrasion, patient is conscious and can be moved), he/she may direct someone to transport the patient by vehicle to the hospital. A hospital route map will be located in DOF's field vehicle which will be present at each major work area.

13.6 Adverse Weather

Weather conditions in Washington State are typically punctuated by severe winds and rain. In the event of adverse weather, the SHSO working with the site superintendent will determine if work can continue without sacrificing the health and safety of field personnel. Some of the items to be considered prior to determining if work should continue are:

- Extreme cold and wind,
- Heavy precipitation,
- Limited visibility, and
- Potential for accidents.

13.7 Emergency Equipment

The following emergency response equipment will be stored at DOF's field vehicle:

- First aid kits for 5 people,
- 2-pound ABC fire extinguishers,
- Portable, emergency eyewash.

- Cellular phones and/or radios.

This equipment will be inspected monthly by the FPM. It will be cleaned, inspected, and replenished immediately after each use.

Postings related to the Emergency Response Plan will be placed in the DOF field vehicle, sediment sampling boat, or each major work area. The following information from the Emergency Response Plan will be highlighted on these postings:

- Emergency telephone numbers for fire, ambulance, hospitals, police
- Location of fire extinguishers and emergency equipment
- Map to the hospital.

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14. HEALTH AND SAFETY PLAN CERTIFICATION

By their signature, the following undersigned certify that this plan has been read, or otherwise communicated to them. They further certify that they completely understand this plan and will follow its procedures for the protection of the health and safety of all persons entering this site.

NAME

DATE

APPENDIX A

AHA TABLES

ACTIVITY HAZARD ANALYSIS

Project / Location: Former Arkema Facility, Tacoma, WA.	Estimated Start Date: March 2008	Phase of Work: Mobilization
Analysis Performed By: Steve Frost	Date: 2-2-08	Analysis Approved By:
PRINCIPAL STEPS	POTENTIAL SAFETY / HEALTH HAZARDS	RECOMMENDED CONTROLS
Site Preparation (i.e. establishing control zone around work area, removing surface obstructions, identifying and securing overhead and underground utilities.), including using portable power tools.	Contact with traffic operating near work area.	- Establish traffic lanes around work area using signs, flags, barricade tape, etc. - Install Jersey barriers or equivalent as appropriate. - Ensure vehicles parked in the work area are chocked and have their parking brakes set.
	Back strain from lifting and moving materials stored in work area.	- Use mechanical lifting devices when feasible. - Do not lift more than 50 lbs. per individual. - Have others help lift excessively heavy loads. - When lifting, maintain ergonomically correct lifting posture.
	Cuts and scrapes from handling and moving materials.	- Ensure loads to be handled are free of sharp edges and points. - Wear leather gloves and long sleeved shirts.
	Electrocution from relocating surface and overhead electrical utilities	- De-energize and lockout/tagout surface electrical utilities in the immediate work area that will not be used and could be accidentally disturbed by the construction work. - Ensure temporary electrical wiring is protected from contact by vehicles and equipment. - Have licensed electrical conduct all electrical disconnects.
	Being struck by mobile equipment operating within the work area.	- Ensure mobile equipment has backup alarms - Make eye contact with operator before approaching vehicle. - Have ground crews wear high intensity road vests. - Use spotters to direct traffic as appropriate. - Inspect vehicles and equipment for mechanical integrity daily.

	Slips and trips from uneven or obstructed walking surfaces in the work area.	• Clear work area and walkways of debris. • Cover holes, pits, or other openings in walking surface. • Wear high traction, steel toed boots. • Provide adequate illumination of the work area.
	Heat stress from working outside	• Monitor temperatures and establish work/rest schedules as per SHSP. • Provide shaded rest areas and cold beverages for workers. • Train workers in thermal stress recognition, treatment, and controls.
	Excessive noise exposure	• Monitor noise levels with sound level meter • Demarcate areas where noise levels exceed 85dBs • Post noise hazard warning signs in high noise areas • Post copy of OSHA's noise standard • Have workers wear hearing protection when working in high noise areas.
	Struck by, caught in or between	• Wear leather work gloves and long sleeved work shirts. • Inspect power tools for damage or defects before and after each use. • Ensure all guards are in place. • Use tools only as designed. • Receive proper training in tool use.
	Struck by flying debris	• Wear impact-resistant, ANSI-approved safety glasses with sideshields • Wear face protection in addition to safety glasses for electric or pneumatic grinding, chipping, abrasive saw metal cutting, chain saw and brush cutter work
	Sprains/strains and vibration-induced musculoskeletal disorders	• Do not use heavy tools over shoulder height. • Where tool use is necessary on a continuous or repetitive basis take frequent breaks to rest muscles and joints, particularly if working in awkward positions • Use lightest tool acceptable for application • Use anti-vibration gloves for repetitive use of high velocity or high impact tools, such as impact wrenches, reciprocating saws, etc.

	Electrical contact	• Ensure electrical power tools are connected to ground fault circuit interruptors • Do not use electrical power tools in wet environments. • Use only heavy duty extension cords and inspect daily to ensure insulation and plug connections are intact.
Driving pickup trucks and delivery vehicles	Workers injured while driving vehicles	• Follow all driving rules and regulations. Always wear seat belts whenever vehicle is in motion. Licensed drivers only may drive vehicles. • Wear high-visibility reflective vests at all times in work areas.
	Struck by or against vehicles	• Make eye contact with operators of vehicles. • Understand and review posted hand signals. Traffic barricades, signs, flags, and backup spotters will be used during field activities, as necessary.
Connecting Temporary Power to Site Trailer	Electrocution	• Shut-off and lockout/tagout primary electrical power sources when making electrical connections to office trailer. • Have licensed electrician make all electrical connections. • Check grounding, continuity, and polarity of all electrical service outlets. • Make sure trailer is properly grounded. • Ensure circuit breaker switches are labeled.
	Fall from heights	• Use personal fall protection when working 6 ft or higher above ground. • Secure all ladders when in use. • Use manlifts when feasible to access elevated work locations
EQUIPMENT TO BE USED	INSPECTION REQUIREMENTS	TRAINING AND CP REQUIREMENTS
Pickup trucks Forklifts Ladders Power drills and saws Hand tools Level D PPE Personal fall protection as needed	Daily vehicle and equipment inspection. Inspect ladders before use Inspect personal fall protection equipment before use	OSHA compliant forklift training Ladder safety training Use of PPE Use of personal fall protection and content of OSHA fall protection standard as needed.

ACTIVITY HAZARD ANALYSIS

Project / Location: Former Arkema Facility, Tacoma, WA	Estimated Start Date: March 2008	Phase of Work: Monitoring Well Inventory and Sampling
Analysis Performed By: Steve Frost	Date: 2-2-08	Analysis Approved By:
PRINCIPAL STEPS	POTENTIAL SAFETY / HEALTH HAZARDS	RECOMMENDED CONTROLS
Park vehicle at well.	Vehicle contact	Use spotters when positioning vehicle if needed. Ensure vehicle's backup lights are operational.
	Location could create a traffic hazard.	Locate vehicle in an area that will not obstruct traffic.
Unload equipment and materials from vehicle.	Back strain from heavy lifting	Use proper lifting techniques such as keeping the back straight, lifting with legs, limiting twisting, and getting help when moving bulky/heavy materials and equipment. Use hand truck if needed. For loads greater than 50 pounds, use two people to lift.
Move equipment and materials to designated well location.	Handling of equipment could cause strain to worker.	Use care when walking so that there are no sudden jerks or mis-steps that can cause the worker to strain to maintain control of the equipment. Get assistance from other workers if needed. For loads greater than 50 pounds, use two people to carry.
	Slip, trip, and fall hazards could be present.	Maintain good housekeeping in work area. Mark or remove all identified trip, slip, and fall hazards from sampling area. Maintain proper illumination in work area.
	Worker could be struck by vehicles.	Wear high-visibility reflective vests at all times in work areas. Make eye contact with operators of vehicles. Post an observer, as needed, when well is close to busy streets. Use traffic controls or barricades, if necessary, to keep traffic away from workers.
	Thermal Stress	Provide cold beverages and shaded rest areas for work crews. Establish work/rest schedules based on WBGT readings and physiological monitoring. Train workers in thermal stress signs, symptoms, treatments, and controls. Ensure all workers have been enrolled in a medical surveillance program and they are physically fit to work in temperature conditions existing at jobsite. Ensure no one works alone. Have workers keep track of each other and report any symptoms of thermal stress to supervisor immediately.

Inspect condition of well and remove well cap.	Back strain from heavy lifting	Use proper lifting techniques such as keeping the back straight, lifting with legs, limiting twisting, and getting help if cover is too heavy or it is too difficult to handle because cover is wedged or impaired. If cover is on hinges, ensure that cover is secured in upright position by latching or tie-off to prevent cover from closing on worker.
	Adverse contact with hand tools.	Inspect all tools for damage before use. Do not use damaged tools (mark and tag “out of service”). Select hand tools to minimize following stressors: chronic muscle contraction or steady force; extreme or awkward finger/hand/arm positions; repetitive forceful motions; or excessive gripping, pinching, or pressing with hands and fingers.
	Release of volatile vapors	Test air in breathing zone with organic vapor analyzer. Continue work only if vapor concentrations are at or below background.
	Cuts to hands and fingers	Wear leather gloves.
Measure depth to groundwater.	Dermal contact with contaminated groundwater	Wear nitrile gloves and neoprene, steel-toed boots. Wear disposable Poly-Tyvek coveralls if there is a potential for work clothing to become significantly contaminated with groundwater.
Set up sampling equipment.	Polyethylene sheeting can be slippery.	Wear boots with traction. Use caution when maneuvering on or around polyethylene sheeting, especially if sheeting is wet.
	Worker could be exposed to pinch points.	Use care when setting up equipment. Wear leather gloves if necessary.
Purge well.	Dermal contact with contaminated groundwater	Wear nitrile gloves and neoprene, steel-toed boots Wear disposable Poly-Tyvek coveralls if there is a potential for work clothing to become significantly contaminated with groundwater. Wash hands before leaving exclusion zone
	Back strain from heavy lifting	Use proper lifting techniques such as keeping the back straight, lifting with legs, limiting twisting, and getting help to lift heavy loads.

	Thermal Stress	Provide cold beverages and shaded rest areas for work crews. Establish work/rest schedules based on WBGT readings and physiological monitoring. Train workers in thermal stress signs, symptoms, treatments, and controls. Ensure all workers have been enrolled in a medical surveillance program and they are physically fit to work in temperature conditions existing at jobsite. Ensure no one works alone. Have workers keep track of each other and report any symptoms of thermal stress to supervisor immediately.
	Electrical contact	Ensure electrical equipment (i.e. pumps) is connected to ground fault circuit interruptors Use only heavy duty, water resistant, extension cords and inspect daily to ensure insulation and plug connections are intact.
Collect groundwater samples.	Muscle strain.	Maintain steady pace and follow rest periods given on job. Select a position during sampling to minimize following stressors: chronic muscle contraction or steady force; extreme or awkward positions; repetitive forceful motions; or excessive gripping, pinching, or pressing.
	Dermal contact with contaminated groundwater	Wear nitrile gloves and neoprene, steel-toed boots Wear disposable Poly-Tyvek coveralls if there is a potential for work clothing to become significantly contaminated with groundwater. Decontaminate exteriors of sample containers. Avoid spills. Ensure spill cleanup supplies are available. Wash hands before leaving exclusion zone
	Thermal Stress	Provide cold beverages and shaded rest areas for work crews. Establish work/rest schedules based on WBGT readings and physiological monitoring. Train workers in thermal stress signs, symptoms, treatments, and controls. Ensure all workers have been enrolled in a medical surveillance program and they are physically fit to work in temperature conditions existing at jobsite. Ensure no one works alone. Have workers keep track of each other and report any symptoms of thermal stress to supervisor immediately.

	Electrical contact	Ensure electrical equipment (i.e. pumps) is connected to ground fault circuit interruptors Use only heavy duty, water resistant, extension cords and inspect daily to ensure insulation and plug connections are intact.
Replace well cap	Worker could experience strain from use of tools.	Inspect all tools for damage before use. Do not use damaged tools. Mark and tag “out of service”. Select hand tools to minimize the following stressors: chronic muscle contraction or steady force; extreme or awkward finger/hand/arm positions; repetitive forceful motions; or excessive gripping, pinching, or pressing with hands and fingers.
	Worker could get hand caught between cover and top when replacing cover.	Use care when replacing well cover. Wear leather gloves when handling covers.
Decontaminate all reusable materials and equipment.	Lifting of equipment and materials could cause strain to worker.	Use proper lifting techniques such as keeping the back straight, lifting with legs, limiting twisting, and getting help when moving bulky/heavy materials and equipment. Use hand truck if needed. For loads greater than 50 pounds, use two people to lift.
	Dermal contact with contaminants.	Avoid spills. Ensure that spill cleanup supplies are available. Wear required PPE as specified in the SHSP. Remove PPE properly and wash hands.
	Decontamination area may become slippery.	Visually inspect work areas and mark, barricade, or eliminate slip, trip, and fall hazards as feasible. Maintain proper illumination in all work areas. If decontaminating on plastic sheeting, use caution since plastic sheeting is extremely slippery. Wear boots with good traction.
Pack samples for shipment.	Manually moving materials and equipment could cause strains.	Use proper lifting techniques such as keeping the back straight, lifting with legs, limiting twisting, and getting help when moving bulky/heavy materials and equipment. Use hand truck when handling more than one box at a time. Try to pack shipping boxes so that each box does not exceed 50 pounds. For loads greater than 50 pounds, use two people to carry.
	Contents of sample containers could leak, causing exposure to worker and possibly to people handling shipping box.	Ensure that each container top is securely tightened. Pack each container in a manner to prevent damage to container during handling of shipping box and during transportation. Ensure boxes meet required packaging standards based on mode of transportation used for shipping.
EQUIPMENT TO BE USED	INSPECTION REQUIREMENTS	TRAINING AND CP REQUIREMENTS
Pickup trucks Hand tools	Daily vehicle and equipment inspection. Outlets – prior to use during site inspection	OSHA compliant forklift training Use of PPE

Modified Level D PPE Personal fall protection as needed Temporary power supplies including GFCIs, extension cords, cord and plug-operated tools	GFCI – prior to use during site inspection Extension cords and cords and plugs on equipment – daily by users	Use of personal fall protection and content of OSHA fall protection standard as needed. General electrical safe work practices training provided during site orientation. Only licensed electricians will install, repair, and maintain electrical equipment and current carrying parts of electrically supplied tools and equipment.
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ACTIVITY HAZARD ANALYSIS

Project / Location: : Former Arkema Facility, Tacoma, WA	Estimated Start Date: March 2008	Phase of Work: Installing groundwater monitoring wells.
Analysis Performed By: Steve Frost	Date: 2-2-08	Analysis Approved By:
PRINCIPAL STEPS	POTENTIAL SAFETY / HEALTH HAZARDS	RECOMMENDED CONTROLS
Site Preparation (i.e. establishing control zone around work area, removing surface obstructions, identifying and securing overhead and underground utilities.)	Contact with traffic operating near work area.	• Establish traffic lanes around work area using signs, flags, barricade tape, etc. • Have workers wear traffic vests • Ensure vehicles parked in the work area are chocked and have their parking brakes set.
	Back strain from lifting and moving materials stored in work area.	• Use mechanical lifting devices when feasible. • Do not lift more than 50 lbs. per individual. • Have others help lift excessively heavy loads. • When lifting, maintain ergonomically correct lifting posture.
	Cuts and scrapes from handling and moving materials.	• Ensure loads to be handled are free of sharp edges and points. • Wear leather gloves and long sleeved shirts.
	Electrocution from relocating surface and overhead electrical utilities	• De-energize and lockout/tagout surface electrical utilities in the immediate work area that will not be used and could be accidentally disturbed by the excavation or need to be relocated. • Ensure temporary electrical wiring is protected from contact by vehicles and equipment.
	Being struck by mobile equipment operating within the work area.	• Ensure mobile equipment has backup alarms • Make eye contact with operator before approaching vehicle. • Have ground crews wear high intensity road vests. • Secure area around mobile equipment. • Use spotters to direct traffic as appropriate. • Inspect vehicles and equipment for mechanical integrity daily. • Ensure forklift operators are trained

	Slips and trips from uneven or obstructed walking surfaces in the work area.	• Clear work area and walkways of debris. • Cover holes, pits, or other openings in walking surface. • Wear high traction, steel toed boots. • Provide adequate illumination of the work area.
Operating Drill Rig	Contact with underground utilities and overhead powerlines.	• Conduct an underground utility search before drilling. • Maintain a minimum 15 ft. clearance from overhead power lines. • Review site design drawings • Use non-intrusive utility detection equipment (i.e. magnetometers, ground penetrating radar, etc.) as necessary to locate utilities. • Identify shut off valves and switches to all utilities traversing site before drilling. • De-energize and lockout / tagout utilities passing in, through, or near drilling site if feasible. • Evacuate site if utilities are damaged. Shut off ignition sources. • Use hand shovels and/or air lances to excavate soils when drilling near active utilities.
	Equipment rollover	• Ensure outriggers on drill rig are extended and placed on solid ground. • Ensure drill rig operates on level ground. • Ensure equipment is equipped with roll over protection and seat belts. • Do not move drill rig when drill mast is deployed in vertical position.

	Dermal and inhalation contact with contaminated soil and groundwater	• Wear modified Level D PPE as appropriate. • Wear leather work gloves (over nitrile gloves) that are left in the work area and which are disposed of regularly. • Wash hands and face before each break and before leaving the jobsite. • Undergo decontamination before leaving work area. • Ensure workers are informed and trained in recognition and control of petroleum contact hazard. • Conduct air monitoring near breathing zone of drillers with organic vapor analyzer. • Keep cab of drill rig and support vehicles clean. • Have a portable eyewash available at the jobsite. • Wear Level as indicated by air monitoring
	Struck by drill rig	• Ensure drill rig has backup alarms • Make eye contact with operator before approaching equipment. • Have ground crews wear high intensity road vests. • Secure area around drill rig • Use spotters to direct movement of equipment as appropriate. • Inspect drill rig for mechanical integrity daily. • Ensure operators are trained and experienced
	Thermal stress from working outside	• Evaluate temperature in work area, have work crews wear appropriate clothing. • Comply with thermal stress controls discussed in Section 6. • Have crews take frequent breaks in temperature controlled break room to either warm up or cool down. • Provide water or hot or cold beverages as needed. • Ensure workers are aware of thermal stress symptoms, treatments, and preventative measures.
	Contact with moving mechanical parts.	• Ensure all moving mechanical parts on the drill rig that are accessible to workers are guarded. • Ensure emergency kill switches on drill rig are operational. • Stay a safe distance away from auger. Do not touch auger while drilling. • Do not wear loose clothing around equipment.

	Excessive noise exposure	• Have personnel working near heavy equipment wear hearing protection. • Monitor noise levels in work area with a sound level meter as appropriate. • Post noise hazard warning signs, enroll workers in hearing conservation program, and post copy of OSHA noise standard if noise levels exceed 85 dBs.
	Back strain from heavy lifting	• Do not lift equipment (particularly auger flites) that weighs more than 50 lbs. individually. Have others help. • Use mechanical lifting devices whenever feasible. • Maintain proper posture when lifting (i.e. back straight, lift with legs, keep load close to body, don't twist, etc.) • Size up load before lifting • Clear path when carrying loads. • Wear leather gloves to avoid cuts and scrapes.
Installing Well Casing	Back strain from heavy lifting	• Do not lift equipment that weighs more than 50 lbs. individually. Have others help. • Use mechanical lifting devices whenever feasible. • Maintain proper posture when lifting (i.e. back straight, lift with legs, keep load close to body, don't twist, etc.) • Size up load before lifting • Clear path when carrying loads. • Wear leather gloves to avoid cuts and scrapes.
	Thermal stress from working outside	• Evaluate temperature in work area, have work crews wear appropriate clothing. • Comply with thermal stress controls discussed in SHSP. • Have crews take frequent breaks in temperature controlled break room to either warm up or cool down. • Provide water or hot or cold beverages as needed. • Ensure workers are aware of thermal stress symptoms, treatments, and preventative measures.

	Adverse contact with portable power tools (i.e. cuts, scrapes, puncture, electrocution, noise).	• Wear leather work gloves and long sleeved work shirts. • Inspect power tools for damage or defects before and after each use. • Ensure all guards are in place. • Use tools only as designed. • Receive proper training in tool use. Wear impact-resistant, ANSI-approved safety glasses with sideshields • Wear face protection in addition to safety glasses for grinding, chipping, sanding or sawing. • Monitor noise in work area with sound level meter. • Have workers wear hearing protection when noise levels exceed 85 dBA. • Use quieter equipment, if possible. Do not use heavy tools over shoulder height. • Where tool use is necessary on a continuous or repetitive basis take frequent breaks to rest muscles and joints, particularly if working in awkward positions • Use lightest tool acceptable for application • Use anti-vibration gloves for repetitive use of high velocity tools, such as reciprocating saws, etc. • Ensure electrical power tools are connected to ground fault circuit interrupters • Do not use electrical power tools in wet environments. • Use only heavy duty extension cords and inspect daily to ensure insulation and plug connections are intact.
	Dermal and inhalation exposure to pvc glues and solvents.	• Wear nitrile gloves when cleaning and gluing pvc piping. • Glue and clean pvc pipe only in well ventilated areas. • Eliminate all ignition sources in work area when using pvc glues and solvents. • Have MSDS sheet for pvc glues and solvents available for workers to review before beginning work.

	Contact with bentonite grout and cement	• Wear modified level D PPE. • Use water spray to control dust emissions. • Do not wear non-chemical protective clothing (i.e. standard work clothing) that is contaminated with cement or bentonite. • Wash skin if it becomes contaminated with cement or bentonite. • Wear chemical protective goggles when mixing cement and bentonite. • Stage emergency eyewash in work area.
	Excessive noise exposure	• Have personnel working near heavy equipment wear hearing protection. • Monitor noise levels in work area with a sound level meter as appropriate. • Post noise hazard warning signs, enroll workers in hearing conservation program, and post copy of OSHA noise standard if noise levels exceed 85 dBs.
	Dermal contact with contaminated soil and groundwater	• Control dust emissions with water spray • Wear modified Level D PPE as appropriate. • Wear leather work gloves (over nitrile gloves) that are left in the work area and which are disposed of regularly. • Wash hands and face before each break and before leaving the jobsite. • Undergo decontamination before leaving work area. • Ensure workers are informed and trained in recognition and control of petroleum contact hazard. • Have a portable eyewash available at the jobsite.
EQUIPMENT TO BE USED	INSPECTION REQUIREMENTS	TRAINING AND CP REQUIREMENTS
Drill rig	Daily drill rig inspection.	Equipment operators must trained in the type of equipment they are operating.
Portable power tools	Daily tool inspection	Tool operators must be trained in the inspection and use of their tools.

ACTIVITY HAZARD ANALYSIS

Project / Location: Former Arkema Facility, Tacoma, WA	Estimated Start Date: March 2008	Phase of Work: Collecting Soil and Sediment Samples
Analysis Performed By: Steve Frost	Date: 2-2-08	Analysis Approved By:
PRINCIPAL STEPS	POTENTIAL SAFETY / HEALTH HAZARDS	RECOMMENDED CONTROLS
Securing work area	Struck by vehicles and mobile equipment operating in area.	Demarcate work area (i.e. rope, barricade tape, signage, etc.) Use spotters to direct traffic away from work area. Wear high visibility traffic vests. Maintain proper illumination
	Slip, trip, and fall	Inspect work area for slip, trip, and fall hazards Cover all surface openings Remove surface obstructions Wear high traction steel-toed work boots. Do not work at heights greater than 6 ft. without fall protection.
Unload equipment and materials from vehicle.	Back strain from heavy lifting	Use proper lifting techniques such as keeping the back straight, lifting with legs, limiting twisting, and getting help when moving bulky/heavy materials and equipment. Use hand truck if needed. For loads greater than 50 pounds, use two people to lift.
Move equipment and materials to designated sampling location.	Handling of equipment could cause strain to worker.	Use care when walking so that there are no sudden jerks or mis-steps that can cause the worker to strain to maintain control of the equipment. Get assistance from other workers if needed. For loads greater than 50 pounds, use two people to carry.
	Slip, trip, and falls.	Maintain good housekeeping in work area. Mark or remove all identified trip, slip, and fall hazards from sampling area. Maintain proper illumination in work area.
	Worker could be struck by vehicles.	Wear high-visibility reflective vests at all times in work areas. Make eye contact with operators of vehicles. Post an observer, as needed, when well is close to busy streets. Use traffic controls or barricades, if necessary, to keep traffic away from workers.

	Thermal Stress	Provide cold beverages and shaded rest areas for work crews. Establish work/rest schedules based on ambient temps, work load and physiological monitoring. Train workers in thermal stress signs, symptoms, treatments, and controls. Ensure all workers have been enrolled in a medical surveillance program and they are physically fit to work in temperature conditions existing at jobsite. Ensure no one works alone. Have workers keep track of each other and report any symptoms of thermal stress to supervisor immediately.
Collect soil or sediment samples	Back strain from heavy lifting	Use proper lifting techniques such as keeping the back straight, lifting with legs, limiting twisting, and getting help if cover is too heavy or it is too difficult to handle because cover is wedged or impaired. If cover is on hinges, ensure that cover is secured in upright position by latching or tie-off to prevent cover from closing on worker.
	Adverse contact with hand tools.	Inspect all tools for damage before use. Do not use damaged tools (mark and tag “out of service”). Select hand tools to minimize following stressors: chronic muscle contraction or steady force; extreme or awkward finger/hand/arm positions; repetitive forceful motions; or excessive gripping, pinching, or pressing with hands and fingers.
	Release of volatile vapors from VOC contaminated areas	Test air in breathing zone with organic vapor analyzer. Continue work only if vapor concentrations are at or below background.
	Cuts to hands and fingers	Wear leather gloves.
	Dermal contact with contaminated soil or sediment	Wear nitrile gloves and neoprene, steel-toed boots. Wear disposable Tyvek coveralls. Undergo decontamination before leaving work area. Wash hands and face before leaving site.
	Tidal engulfment when sampling sediments in waterway	Collect samples only at low tide. Confirm tide schedule. Stay at least 6 ft. from water’s edge. Ensure clear access and egress from sampling area Ensure sediment surface is firm enough to support weight

	Thermal Stress	Provide cold beverages and shaded rest areas for work crews. Establish work/rest schedules based on WBGT readings and physiological monitoring. Train workers in thermal stress signs, symptoms, treatments, and controls. Ensure all workers have been enrolled in a medical surveillance program and they are physically fit to work in temperature conditions existing at jobsite. Ensure no one works alone. Have workers keep track of each other and report any symptoms of thermal stress to supervisor immediately.
Decontaminate all reusable materials and equipment.	Lifting of equipment and materials could cause strain to worker.	Use proper lifting techniques such as keeping the back straight, lifting with legs, limiting twisting, and getting help when moving bulky/heavy materials and equipment. Use hand truck if needed. For loads greater than 50 pounds, use two people to lift.
	Dermal contact with contaminants.	Avoid spills. Ensure that spill cleanup supplies are available. Wear required PPE as specified in the SHSP. Remove PPE properly and wash hands.
	Decontamination area may become slippery.	Visually inspect work areas and mark, barricade, or eliminate slip, trip, and fall hazards as feasible. Maintain proper illumination in all work areas. If decontaminating on plastic sheeting, use caution since plastic sheeting is extremely slippery. Wear boots with good traction.
Pack samples for shipment.	Manually moving materials and equipment could cause strains.	Use proper lifting techniques such as keeping the back straight, lifting with legs, limiting twisting, and getting help when moving bulky/heavy materials and equipment. Use hand truck when handling more than one box at a time. Try to pack shipping boxes so that each box does not exceed 50 pounds. For loads greater than 50 pounds, use two people to carry.
	Contents of sample containers could leak, causing exposure to worker and possibly to people handling shipping box.	Ensure that each container top is securely tightened. Pack each container in a manner to prevent damage to container during handling of shipping box and during transportation. Ensure boxes meet required packaging standards based on mode of transportation used for shipping.
EQUIPMENT TO BE USED	INSPECTION REQUIREMENTS	TRAINING AND CP REQUIREMENTS
Pickup trucks Hand tools Modified Level D PPE Personal fall protection as needed	Daily vehicle and equipment inspection Before each use. Before each use. Before each use.	OSHA compliant forklift training Tool-specific training Use of PPE Use of personal fall protection

ACTIVITY HAZARD ANALYSIS

Project/Location: Former Arkema Facility, Tacoma, WA.	Estimated Start Date: September 2017	Phase of Work: Deployment of pore water samplers and collection of sediment samples.
Analysis Performed By: S. Frost	Date: 8-29-17	Analysis Approved By:
PRINCIPAL STEPS	POTENTIAL SAFETY/HEALTH HAZARDS	RECOMMENDED CONTROLS
Boarding boat	Slip, trips, and possibly falling into water	- Secure boat firmly to dock - Clear walkways of equipment and other trip hazards - Use gangway as appropriate. Ensure gangway has guardrails as appropriate. - Passengers and crew must wear PFDs while accessing dock area and boat. - Grab handholds on boat when boarding. - Be vigilant for physical hazards. - Maintain work areas in safe and orderly manner. - Unloading areas will be level and even if feasible. - Watch for wet walking surfaces. Use caution. - Use handholds and wear dive booties or other high traction footwear as appropriate.
Operating small boat	Falling overboard and drowning.	- Ensure boat has guardrails as appropriate. - Ensure no standing or leaning over edge of boat. - Rehearse man overboard drill. - Ensure water rescue is available. - Vessel must have at least one throwable PFD (Type IV PFD) with 90 feet of line attached. - All personnel on board must wear PFDs. - Crewmembers must wear PFDs.
	Colliding with other boats operating in area.	- Maintain vigilance and ensure boat has proper running lights. - Notify other site contractors of work location. - Comply with Coast Guard right-of-way rules. - Use horn to signal or warn other boats as appropriate. - Suspend work during bad weather or poor visibility. - Have experienced boat crews operate vessel.
	Vessel mechanical failure or on-board emergency (fire, loss of power, breach of hull, etc.).	- Inspect vessel for mechanical integrity before each use. - Communicate fire and emergency evacuation procedures to all boat occupants. - Ensure radio communications with Coast Guard are available. - Have emergency telephone/radio numbers available. - Ensure emergency life boats, life rings, and vests are available. - Verify presence and working order of fire extinguishers.

	Heavy lifting.	- Limit lifting to 50 lbs./person or less. - Use proper lifting techniques. - Use mechanical equipment when feasible.
	Thermal stress.	- Wear thermally insulated clothing as appropriate. - Wear raingear when needed. - Take frequent warm-up breaks in heated boat cabin or car, as appropriate. - Review thermal stress treatments and controls with personnel. - Monitor level of work activity and ambient temperature conditions. - Have water available to drink. - Work in shaded areas as appropriate.
	Slip, trips, and possibly falling into water	- Clear walkways of equipment and other trip hazards - Passengers and crew must wear PFDs while operating boat. - Be vigilant for physical hazards. - Maintain work areas in safe and orderly manner. - Unloading areas will be level and even if feasible. - Watch for wet walking surfaces. Use caution. - Use handholds and wear dive booties or other high traction footwear as appropriate.
	Noise	- Wear hearing protection if noise levels exceed 85 dbs. - H&S Officer will determine need for hearing protection.
	Adverse weather	- Use sunscreen as necessary - Terminate boating operations during thunderstorms or other severe weather. - Comply with thermal stress treatments and controls found in Sec. 5.2.3 of HASP. Increase fluid intake during hot weather.
	Grounding and contacting objects in the water	- Use caution in shallow areas - Use depth meter and visual observation to avoid collision with objects and striking bottom. - Reference nautical charts and tide charts to ascertain depths. - Be certain of position at all times.
Underwater diving to deploy pore water samplers and collect sediment samples.	Uncertain of work practices and procedures	- Follow approved site-specific dive plan. - Comply with WAC 296-37. - Use only experienced, commercial divers and boat operators for work. - Have safe dive practices manual available at jobsite. - Do not dive during high seas, strong currents, or poor visibility.

	Becoming disoriented	- Always dive with a buddy. - Deploy buoys with tether lines at each dive location. Use tether lines to guide divers to surface. - Do not disturb sediments when diving - Tether divers when using surface supplied air. - Designate surface standby/rescue divers. - Have diver follow tether line back to surface in the event of disorientation or loss of communications. - Use underwater two-way communication system. - Do not dive during high seas or strong currents. - Divers will maintain visual or tactile contact with each other at all times.
	Cut off from air supply	- Have all divers carry emergency air supply. - Surface immediately when air supply fails. - Buddy breath as necessary - Deploy standby diver to assist as necessary.
	Losing communications with surface	- Terminate dive if communications with dive tender is lost or any problems arise. - Have diver follow tether line back to surface in the event of disorientation or loss of communications. - Use underwater two-way communication system.
	Being struck by boats operating in the area	- Display "Diver Down" flag and have dive tenders warn divers of boat traffic in the area.
	Decompression sickness, drowning, and arterial gas embolism.	- Do not allow decompression dives. Monitor depth and down times. - Post emergency telephone numbers and radio frequencies in dive boat. Verify that emergency medical, transport, and decompression (hyperbaric chamber) services are available. - Utilize experienced divers - Provide diving physicals - Conduct training on equipment - Procure top quality equipment - Follow approved written procedures - Check cylinder pressure and equipment before each dive. - Display dive flag on boat. Have dive supervisor and standby diver onboard at all times. - Avoid diving in areas with low visibility - Avoid areas with heavy boat traffic. - Maximum diving depth is 100 ft.

	Underwater entrapment or entanglement	- Do not enter areas that could entrap or entangle divers. Carry knife. - Designate surface standby/rescue divers.
	Dive-related medical emergencies	- Designate surface standby/rescue divers. - Post emergency telephone numbers and radio frequencies in dive boat. Verify that emergency medical, transport, and decompression (hyperbaric chamber) services are available. - Ensure all divers are first aid/CPR trained. - Have first aid kit available at dive site.
	Equipment failure	- Inspect dive equipment before use.
	Poor weather	- Use sunscreen as necessary - Terminate diving and boating operations during thunderstorms or other severe weather. - Comply with thermal stress treatments and controls found in Sec. 5.2.3 of HASP. Increase fluid intake during hot weather.
	Contact with hazardous marine fauna	- Be aware of surroundings. Look for hazardous fauna and avoid it. - Approach debris, rock piles, and other crevices with caution. - Dive in pairs at all times. - Avoid diving in murky water and always have a Dive Supervisor and Standby Diver on the boat.
	Handling compressed air cylinders	- All cylinders will have current hydrostatic tests and visual inspections. - Cylinders will be properly stowed and secured when not in use. - Regulators, manifolds, and valves will be handled with care.
	Inhaling compressed air contaminants such as carbon monoxide, elevated levels of carbon dioxide, oil mist, and other contaminants.	- Procure dive air from a facility that meets all federal and state requirements. - Test air before use. - Compressed air must meet standards published in Navy Diving Manual.
	Cuts and scrapes on hands from handling equipment..	- Divers should wear leather gloves when handling equipment. - Round off all sharp edges and corners on equipment..

	Reduced visibility from disturbed sediments.	- Divers should not disturb sediments when inspecting equipment - Be sure marker buoys have been attached to equipment. - Dive only when visibility conditions are good.
Handing sampling equipment to divers from the boat while the divers are in the water.	Back strain from heavy lifting	- If feasible, use vessel crane or davit to lift and lower equipment from boat into water. - If not feasible, have multiple crew members assist in lowering equipment into water. - Attach lifting sling and lines to equipment to facilitate handling as appropriate.
	Striking divers with equipment when it is lowered into water.	- Use tag lines on equipment as appropriate when moving equipment with cranes / davits. - Do not suspend load/equipment over divers when they are in the water. - Lower load into water and have divers disengage lifting line/sling from load. Divers should adjust their buoyancy to compensate for additional weight of load before detaching lifting lines. - Ensure load is reasonable buoyant in water so as not to sink rapidly and possibly pull divers underwater. - If load is not buoyant, lower equipment to bottom of waterway using lifting line from boat.
	Cuts and scrapes on hands from handling equipment	- Crewmembers and divers should wear leather gloves when handling equipment.
Installing support stakes in sediment to hold equipment	Cuts and scrapes on hands from pushing stakes into sediments.	- Divers should wear leather gloves when driving stakes. - Round off all sharp edges and corners on stakes.
	Reduced visibility from disturbed sediments.	- Divers should not disturb sediments when installing equipment
EQUIPMENT TO BE USED	INSPECTION REQUIREMENTS	TRAINING AND CP REQUIREMENTS
Motor boat	Inspect boat before each day's use.	Experienced boat operator (USCG license; training certification documenting that they are proficient in the handling of the boat they will operate (written and operational); boating safety course meeting the criteria of the USCG Auxiliary, NASBLA, or equivalent). Use properly registered/licensed vessel.
First aid kit, bloodborne pathogen kit, and DANS O ₂ and AMBU bag	Dive supervisor will inspect prior to bringing on-site.	All dive personnel will have current first aid/cpr training. At least two individual qualified to administer first aid/cpr will be qualified to use DANS O ₂ and AMBU bag.

GPS unit	Dive Supervisor checks each day prior to operations.	An experienced operator will use.
Type II or higher PFDs to be worn	Inspected daily by Dive Supervisor and boat operator	All users of PFDs will be instructed in their use by the Dive Supervisor and/or boat operator.
Type IV PFDs (safety ring)	Inspected daily by Dive Supervisor and boat operator	All users of PFDs will be instructed in their use by the Dive Supervisor and/or boat operator.
Flare gun	Inspected initially before start of work by Dive Supervisor and boat operator and monthly thereafter.	Personnel will be instructed on proper emergency notification procedures and use of emergency equipment by Dive Supervisor and/or boat operator.
Air horn	Inspected and tested initially before start of work by Dive Supervisor and boat operator and monthly thereafter.	Personnel will be instructed on proper emergency notification procedures and use of emergency equipment by Dive Supervisor and/or boat operator.
Cellular telephone	Dive supervisor and boat operator will check operation of cell phones each morning.	Personnel will be instructed on proper emergency notification procedures and use of emergency equipment by Dive Supervisor and/or boat operator.
Fire extinguishers	Inspected initially before start of work and monthly thereafter.	Fire extinguisher trained and qualified person as per OSHA requirements. Dive supervisor will have this training.
Diving equipment	Before and after each use.	Commercial diving certificates. First Aid/CPR certification and 40-hour HAZWOPER.
Personal protective equipment (Mod. Level D)	Before and after use.	Specific training in selection, use, limitations, inspection and maintenance of PPE by qualified instructor.
Emergency eyewash	Before use	N/A
Sediment monitoring equipment	Before deployment.	N/A

APPENDIX B

GENERAL SITE WORK RULES

GENERAL SITE WORK RULES

1. All DOF personnel must attend weekly site briefings and other scheduled meetings.
2. Any individual taking prescribed drugs shall inform the site health and safety officer of the type of medication and any possible adverse side effects that could effect the health and well being of the worker while they are performing their jobs. The SHSO will decide if the employee can safely work on-site while taking the medication.
3. The personal protective equipment specified by the SHSO and in the Site Safety and Health Plan(s) shall be worn by all DOF site personnel. This includes hard hats, safety glasses, and steel-toed boots, as a minimum.
4. Facial hair (beards, long sideburns or mustaches) which may interfere with a satisfactory fit of a respirator mask is not allowed on any person who may be required to wear a respirator.
5. All personnel must sign the site log when visiting the jobsite.
6. Personnel must follow proper decontamination procedures.
7. Eating, drinking, chewing tobacco or gum, smoking and any other practice that may increase the possibility of hand-to-mouth contact is prohibited in regulated areas of the jobsite.
8. All lighters, matches, cigarettes and other forms of tobacco are prohibited in regulated areas of the jobsite.
9. All signs and demarcations shall be followed. Such signs and demarcation shall not be removed except as authorized by the site superintendent.
10. No one shall enter a permit-required confined space without approval from the site superintendent and site health and safety officer.
11. All personnel must use the Buddy System when working in regulated areas.
12. All personnel must follow the work-rest regimens and other practices required by the heat stress program.
13. All personnel must follow lockout/tagout procedures when working on equipment involving moving parts or hazardous energy sources.
14. No person shall operate equipment unless trained and authorized. No one may enter an excavation greater than four feet deep unless authorized by the Competent Person.

Excavations must be sloped or shored properly. Safe means of access and egress from excavations must be maintained.

15. Ladders and scaffolds shall be solidly constructed, in good working condition and inspected prior to use. No one may use defective ladders or scaffolds.
16. Fall protection or fall arrest systems must be in place when working at elevations greater than six feet for temporary working surfaces and four feet for fixed platforms.
17. Safety belts, harnesses and lanyards must be selected by the SHSO. The user must inspect the equipment prior to use. No defective personal fall protection equipment shall be used. Personal fall protection equipment that has been shock loaded must be discarded.
18. Hand and portable power tools must be inspected prior to use. Defective tools and equipment shall not be used.
19. Ground fault interrupters shall be used for cord and plug equipment used outdoors or in damp locations. Electrical cords shall be kept out of walkways and puddles unless protected and rated for the service.
20. Improper use, mishandling, or tampering with safety and health equipment and samples is prohibited.
21. Horseplay of any kind is prohibited.
22. Possession or use of alcoholic beverages or controlled substances on-site is forbidden.
23. All incidents, no matter how minor must be reported immediately to the site superintendent. .
24. All personnel shall be familiar with the Site Emergency Response Plan.
25. All personnel will report any unsafe conditions or practices to site management immediately upon discovery.

The above Work Rules are not all inclusive and it is the responsibility of each employee to comply with all applicable regulations set forth by WISHA, DOF management, the site safety and health plan, the client, DOF, the SHSO and the controlling contractor's work rules and health and safety requirements.

APPENDIX C

HEALTH AND SAFETY FORMS

SITE SAFETY BRIEFING

- Dalton, Olmsted & Fuglevand, Inc. -

Date: _____ Time: _____ Location: _____

Shift: _____ Person Conducting Briefing: _____

1. **HEALTH AND SAFETY CONCERNS** (i.e. use of PPE, chemical, physical, or biological hazards, unsafe conditions, unsafe work practices, communication problems, safety equipment, training issues, etc.):

2. **RECENT INCIDENTS** (i.e. near misses, first aid cases, serious injuries, environmental spills, etc.):

3. **HAZARD CONTROL MEASURES** (i.e. PPE changes, new site control requirements, recommended work practices, etc.):

2. **OTHER ISSUES:**

3. **ATTENDEES (Print Name):**

1.	12.
2.	13.
3.	14.
4.	15.
5.	16.
6.	17.
7.	18.
8.	19.
9.	20.
10.	21.
11.	22.

SUPERVISOR'S REPORT OF AN ACCIDENT

Name of Injured Employee: _____ Date of Report _____

Age	Length of Employment At plant On job	Department	Section
-----	--	------------	---------

☐ Head	☐ Hands	☐ Wounds	☐ Amputation	☐ Death	☐ Lost Time
☐ Eyes	☐ Legs	☐ Strain & Sprain	☐ Burns	☐ First Aid Only	
☐ Trunk	☐ Toes	☐ Hernia	☐ Foreign Body		
☐ Arms	☐ Internal	☐ Fracture	☐ Skin (occupational)	☐ Due to Delayed Medical Treatment	
Remarks: _____		Remarks: _____		Remarks: _____	

Date of Injury	Hour	Department	Exact Location
----------------	------	------------	----------------

Eyewitnesses _____

Describe accident: Include the machine, equipment, object or substance involved All Details Use back space if necessary

CAUSE: Mark basic cause ☒ Mark contributing cause, if any ☐**UNSAFE CONDITIONS**

- 1 ☐ Inadequately Guarded
- 2 ☐ Unguarded
- 3 ☐ Defective Tools, Equipment, or Substance
- 4 ☐ Unsafe Design or Construction
- 5 ☐ Hazardous Arrangement
- 6 ☐ Unsafe Illumination
- 7 ☐ Unsafe Ventilation
- 8 ☐ Unsafe Clothing
- 9 ☐ Insufficient Instruction

UNSAFE ACTS

- 1 ☐ Operating Without Authority
- 2 ☐ Operating at Unsafe Speed
- 3 ☐ Making Safety Devices Inoperative
- 4 ☐ Using Unsafe Equipment or Equipment Unsafely
- 5 ☐ Unsafe Loading, Placing, Mixing
- 6 ☐ Taking Unsafe Position
- 7 ☐ Working on Moving or Dangerous Equipment
- 8 ☐ Distraction, Teasing, Horse Play
- 9 ☐ Failure to use Personal Protective Devices

Why was the unsafe act committed? _____ Why did the unsafe condition exist? _____

Any physical disabilities? _____

Number of previous disabling injuries _____

GUIDES TO CORRECTIVE ACTION

Based on the cause checked above, I am taking the following corrective action:

UNSAFE ACT

- ☐ 1 Stop the Behavior
- ☐ 2 Study the Job
- ☐ 3 Instruct (tell--show--try--check)
- ☐ 4 Follow Up
- ☐ 5 Enforce

UNSAFE CONDITION

- ☐ 1 Remove
- ☐ 2 Guard
- ☐ 3 Warn
- ☐ 4 Supervisory Training

If Supervisor Can't Handle, Then

- 5 Recommend To: (a) ☐ Own Boss, OR
 (b) ☐ Safety Committee, OR
 (c) ☐ Maintenance Dept., OR
 (d) ☐ _____
- 6 Follow Up

What I am actually doing to prevent similar injuries _____

What further recommendations? _____

SIGNATURES

Immediate Supervisor or Foreman_____
Received by Plant Manager or Superintendent

1. Describe the accident in your own words just as you saw it happen. Describe the surroundings or setting before the accident and the position of the injured party in relation to the surroundings, then describe the steps in proper sequence leading to the accident that happened. If possible attach a picture or make a drawing.
2. Describe any near accidents you have observed in the past week.
3. Report any unsafe procedures you have observed in the past week. (Physical hazards are classed as unsafe procedures as well as human acts.)

Safety and Health Inspection Check List

A = Adequate at time of inspection
B = Needs immediate attention

A B

1. JOB SITE INFORMATION

- ☐ ☐ WISHA and other job site warning posters posted
- ☐ ☐ Scheduled safety meetings held and documented
- ☐ ☐ Adequate employee training – general and specific
- ☐ ☐ Medical services, first aid equipment, stretchers and a qualified first aider available
- ☐ ☐ Emergency telephone numbers posted (medical services, fire department, police)

2. HOUSEKEEPING AND SANITATION

- ☐ ☐ Working areas generally neat
- ☐ ☐ Waste and trash regularly disposed
- ☐ ☐ Enclosed chute provided when material dropped outside of building from over 20 feet
- ☐ ☐ Lighting adequate for all work tasks
- ☐ ☐ Projecting nails removed or bent over
- ☐ ☐ Oil and grease removed from walkways and stairs
- ☐ ☐ Waste containers provided and used
- ☐ ☐ Sanitary facilities adequate and clear
- ☐ ☐ Potable water available for drinking
- ☐ ☐ Disposable drinking cups and container for used cups provided

3. FIRE PREVENTION

- ☐ ☐ Fire protection program developed
- ☐ ☐ Fire instructions provided to personnel
- ☐ ☐ Proper type and number of fire extinguishers, identified, checked and accessible
- ☐ ☐ Phone number of fire department posted
- ☐ ☐ Hydrants clear, access open
- ☐ ☐ NO SMOKING signs posted and enforced where needed
- ☐ ☐ Temporary heating devices safe. Adequate ventilation provided

4. ELECTRICAL INSTALLATIONS

- ☐ ☐ Adequate wiring, well insulated, grounded, protected from damage
- ☐ ☐ Assured grounding program followed (OR)
- ☐ ☐ Ground fault circuit interrupters used
- ☐ ☐ Terminal boxes equipped with required covers

5. HAND TOOLS

- ☐ ☐ Proper tools being used for each job
- ☐ ☐ Safe carrying practices used
- ☐ ☐ Company and employees' tools regularly inspected and maintained

Safety and Health Inspection Check List – continued

A = Adequate at time of inspection

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A B

6. POWER TOOLS

- ☐ ☐ Good housekeeping where tools are used
- ☐ ☐ Tools and cords in good condition
- ☐ ☐ Proper grounding of all tools (OR)
- ☐ ☐ Double insulated tools used
- ☐ ☐ Proper instruction in use provided
- ☐ ☐ All mechanical guards in use
- ☐ ☐ Tools neatly stored when not in use.
- ☐ ☐ Right tool being used for the job at hand
- ☐ ☐ Wiring properly installed

7. POWDER-ACTUATED TOOLS

- ☐ ☐ All operators licensed
- ☐ ☐ Tools and charges protected from unauthorized use
- ☐ ☐ Competent instruction and supervision provided
- ☐ ☐ Tools used only on recommended materials
- ☐ ☐ Flying hazards checked by backing up, removal of personnel, or use of captive stud tool

8. LADDERS

- ☐ ☐ Ladders inspected and in good condition
- ☐ ☐ Ladders properly secured to prevent slipping, sliding or falling
- ☐ ☐ Side rails extended 36" above the top of landing
- ☐ ☐ Job-built ladders properly constructed
- ☐ ☐ Stepladders fully open when in use
- ☐ ☐ Metal ladders not used around electrical hazards
- ☐ ☐ Ladders not painted
- ☐ ☐ Ladders properly stored
- ☐ ☐ Ladder safety feet in use

9. HEAVY EQUIPMENT

- ☐ ☐ Inspection and maintenance records up to date
- ☐ ☐ Lights, brakes, warning signals operative
- ☐ ☐ Wheels chocked when necessary
- ☐ ☐ Haul roads well maintained and properly laid out
- ☐ ☐ Equipment is properly secured when not in use
- ☐ ☐ Shut-off devices on hose air lines, in case of hose failure
- ☐ ☐ Noise arrestors in use
- ☐ ☐ ROPS in place

Safety and Health Inspection Check List – continued

A = Adequate at time of inspection

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A

B

10. SCAFFOLDING

- | | | |
|--------------------------|--------------------------|---|
| ☐ | ☐ | Erection properly supervised |
| ☐ | ☐ | All structural members meet safety factors |
| ☐ | ☐ | All connections secure |
| ☐ | ☐ | Scaffold tied in to the structure when required |
| ☐ | ☐ | Working areas free of debris, snow, ice and grease |
| ☐ | ☐ | Foot sills and mud sills provided |
| ☐ | ☐ | Workers protected from falling objects |
| ☐ | ☐ | Scaffolds plumb and square, with cross-bracing |
| ☐ | ☐ | Guard rails, intermediate rails, and toeboards in place |
| ☐ | ☐ | Adequate, sound planking provided |
| ☐ | ☐ | Scaffold equipment in good working order |
| ☐ | ☐ | Ropes and cables in good condition |

11. MOTOR VEHICLES

- | | | |
|--------------------------|--------------------------|---|
| ☐ | ☐ | Roadways or walkway hazards effectively barricaded |
| ☐ | ☐ | Barricades illuminated or reflectorized at night |
| ☐ | ☐ | Traffic control devices used when appropriate |
| ☐ | ☐ | Inspection and maintenance records up to date |
| ☐ | ☐ | Operators qualified for vehicles in use |
| ☐ | ☐ | Local and state vehicle laws and regulations observed |
| ☐ | ☐ | Brakes, lights, warning devices operative |
| ☐ | ☐ | Weight limits and load sizes controlled |
| ☐ | ☐ | Personnel transported in a safe manner |
| ☐ | ☐ | All glass in good condition |
| ☐ | ☐ | Back-up signals provided |
| ☐ | ☐ | Fire extinguishers installed where required |
| ☐ | ☐ | SLOW MOVING VEHICLE signs used when required |

12. HOISTS, CRANES AND DERRICKS

- | | | |
|--------------------------|--------------------------|--|
| ☐ | ☐ | Cables and sheaves regularly inspected |
| ☐ | ☐ | Slings and chains, hooks and eyes inspected before each use |
| ☐ | ☐ | Equipment firmly supported |
| ☐ | ☐ | Outriggers used if needed |
| ☐ | ☐ | Power lines inactivated, removed, or at a safe distance |
| ☐ | ☐ | Proper loading for capacity at lifting radius. Rated load capacities posted? |
| ☐ | ☐ | All equipment properly lubricated and maintained |
| ☐ | ☐ | Signalmen where needed |
| ☐ | ☐ | Signals posed, understood, and observed |
| ☐ | ☐ | Inspection and maintenance logs maintained |
| ☐ | ☐ | Hazard signs posted and visible to operator |

Safety and Health Inspection Check List - continued

A = Adequate at time of inspection

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A

B

13. BARRICADES

- ☐ ☐ Floor and well openings planked over or barricaded
- ☐ ☐ Roadways or walkway hazards effectively barricaded
- ☐ ☐ Barricades illuminated or reflectorized at night
- ☐ ☐ Traffic control devices used when appropriate

14. HANDLING AND STORAGE OF MATERIALS

- ☐ ☐ Materials properly stored or stacked
- ☐ ☐ Passageways clear
- ☐ ☐ Stacks on firm footings, not too high
- ☐ ☐ Materials protected against weather conditions
- ☐ ☐ Trash chutes safeguarded and properly used
- ☐ ☐ Dust protection observed
- ☐ ☐ Traffic controlled in the storage area

15. EXPLOSIVES

- ☐ ☐ Qualified operators and supervision during all explosives operations
- ☐ ☐ Proper transport vehicles as required by Department of Transportation and WISHA
- ☐ ☐ State and local laws and regulations observed
- ☐ ☐ Storage magazines constructed per regulations
- ☐ ☐ Cases opened ONLY with wooden tools
- ☐ ☐ NO SMOKING signs posted and observed where appropriate
- ☐ ☐ Detonators tested before each shot
- ☐ ☐ All personnel familiar with signals; signals properly used at all times
- ☐ ☐ Inspection after each shot
- ☐ ☐ Proper protection and accounting for all explosives at all times
- ☐ ☐ Proper disposition of wrappings, waste, and scrap
- ☐ ☐ Nearby residents advised of blasting and danger
- ☐ ☐ Radio frequency hazards checked

16. WELDING AND CUTTING

- ☐ ☐ Operators qualified
- ☐ ☐ Screens and shields used when needed
- ☐ ☐ Goggles, welding helmets, gloves, clothing used as required
- ☐ ☐ Equipment in safe operating condition
- ☐ ☐ Electrical equipment grounded
- ☐ ☐ Power cables and hoses protected and in good repair
- ☐ ☐ Fire extinguishers of proper type nearby
- ☐ ☐ Surrounding area inspected for fire hazards
- ☐ ☐ Flammable materials protected or removed
- ☐ ☐ Gas cylinders secured upright
- ☐ ☐ Cylinder caps in use

Safety and Health Inspection Check List – continued

A = Adequate at time of inspection

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A B

17. FLAMMABLE GASES AND LIQUIDS

- ☐ ☐ All containers approved and clearly identified
- ☐ ☐ Proper storage practices observed
- ☐ ☐ Fire hazards checked
- ☐ ☐ Proper types and number of extinguishers nearby
- ☐ ☐ Proper method for moving cylinders used

18. EXCAVATION AND SHORING

- ☐ ☐ Adjacent structures properly shored
- ☐ ☐ Excavation shored, shielded, or sloped as required
- ☐ ☐ Roads and sidewalks supported and protected
- ☐ ☐ Material stored away from excavations
- ☐ ☐ Excavation barricades and lighting adequate
- ☐ ☐ Equipment a safe distance from edge of excavation
- ☐ ☐ Ladders provided
- ☐ ☐ Equipment ramps adequate
- ☐ ☐ Observer(spotter) provided during trenching operations

19. STEEL ERECTION

- ☐ ☐ Fall protection provided with safety nets, plank floors, or personnel restraint devices
- ☐ ☐ Hard hats worn as required
- ☐ ☐ Tools and materials secured from falling
- ☐ ☐ Fire hazards at rivet, forge, and welding operations eliminated
- ☐ ☐ Floor openings covered or barricaded
- ☐ ☐ Ladders, stairs, or other safe access provided
- ☐ ☐ Daily inspection of hoisting apparatus
- ☐ ☐ Employees prohibited from riding the tail or loads

20. PERSONAL PROTECTIVE EQUIPMENT MONITORED BY SUPERVISORS

- ☐ ☐ Hard hats available on-site; worn when overhead hazards exist
- ☐ ☐ Eye protection
- ☐ ☐ Face shields
- ☐ ☐ Written respirator program; respirators fit-tested; replacement cartridges; cleaning and maintenance
- ☐ ☐ Helmets and hoods
- ☐ ☐ Hearing protection – noise monitoring; written program
- ☐ ☐ Foot protection
- ☐ ☐ Rubber or plastic gloves, aprons, and sleeves for chemical protection
- ☐ ☐ Electrician's rubber gloves and protectors

Safety and Health Inspection Check List -- continued

A = Adequate at time of inspection

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A

B

21. HIGHWAY CONSTRUCTION

- ☐ ☐ Laws and ordinances observed
- ☐ ☐ Competent flaggers properly instructed and dressed; area posted
- ☐ ☐ Adequate traffic control devices used throughout construction area
- ☐ ☐ Equipment cleared from right-of-way
- ☐ ☐ Adequate marking and maintenance of detours approaching construction area
- ☐ ☐ Dust controlled
- ☐ ☐ Adequate lighting for night crews

☐

☐

22. CONCRETE CONSTRUCTION

- ☐ ☐ Forms properly installed and braced
- ☐ ☐ Adequate shoring, plumbed and cross-braced
- ☐ ☐ Shoring remain in place until strength is attained
- ☐ ☐ Proper curing period and procedures followed
- ☐ ☐ Heating devices checked for fire safety
- ☐ ☐ Mixing and transport equipment supported; traffic planned and routed
- ☐ ☐ Adequate runways and ramps provided for concrete placement equipment
- ☐ ☐ Employees protected from cement dust
- ☐ ☐ Hard hats, boots, gloves, eye protection, and skin protection worn at all times
- ☐ ☐ Nails bent over or removed and stripped material removed from area

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23. LIFTING AND BACK SAFETY

- ☐ ☐ Team lifting used for heavy or awkward loads
- ☐ ☐ Mechanical lifting devices used when appropriate
- ☐ ☐ Back care training provided to all employees
- ☐ ☐ Bent-knee lifting used by workers
- ☐ ☐ Work hardening program used for returning time-loss employees
- ☐ ☐ Employees do "warm up" exercises before strenuous work

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☐

24. HAZARD COMMUNICATION PROGRAM

- ☐ ☐ Chemical inventory list developed and maintained
- ☐ ☐ Containers properly labeled
- ☐ ☐ Material Safety Data Sheets collected and available
- ☐ ☐ Adequate employee information and training provided
- ☐ ☐ Written program available

Safety and Health Inspection Check List -- continued

A = Adequate at time of inspection

B = Needs immediate attention

A

B

25. MASONRY

- ☐ ☐ Scaffolding procedures meet at least minimum requirements
- ☐ ☐ Masonry saws properly equipped and grounded, dust protection provided
- ☐ ☐ Hoisting equipment in safe operating condition and used by qualified personnel
- ☐ ☐ Limited access zone established
- ☐ ☐ Walls over 8 feet in height adequately braced

26. CONFINED SPACE

- ☐ ☐ Written confined space program
- ☐ ☐ Competent instruction and supervisors provided
- ☐ ☐ Hot work permits obtained, if needed, prior to entry and work
- ☐ ☐ Evaluation and monitoring -- sampling devices adequate, calibrated, and used
- ☐ ☐ Ventilation adequate, testing and monitoring during operation
- ☐ ☐ Respirators, standby person, harness/lifeline at the site

27. DEMOLITION

- ☐ ☐ Written demolition plan
- ☐ ☐ Protection of adjacent structures
- ☐ ☐ Material chutes used. Floor openings for material disposal barricaded
- ☐ ☐ Sidewalk and other public protection provided
- ☐ ☐ Clear opening space for trucks and other vehicles
- ☐ ☐ Adequate access ladders or stairs maintained

28. PILE DRIVING

- ☐ ☐ Stored piles properly secured
- ☐ ☐ Unloading only by properly instructed workers
- ☐ ☐ Steam lines, slings, etc., in safe operating condition
- ☐ ☐ Piledriving rigs properly supported
- ☐ ☐ Cofferdams maintained and inspected
- ☐ ☐ Adequate pumping available

Customize the checklist above by adding any additional areas or amendments and deleting the information that does not apply to your business.

APPENDIX D

MSDS SHEETS

MATERIAL SAFETY DATA SHEET

ALCONOX®

Prepared to U.S. OSHA, CMA, ANSI, Canadian WHMIS, Australian WorkSafe, Japanese Industrial Standard JIS Z 7250:2000, and European Union REACH Regulations



SECTION 1 - PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: **ALCONOX®**
CHEMICAL FAMILY NAME: Detergent.
PRODUCT USE: Critical-cleaning detergent for laboratory, healthcare and industrial applications
U.N. NUMBER: Not Applicable
U.N. DANGEROUS GOODS CLASS: Non-Regulated Material
SUPPLIER/MANUFACTURER'S NAME: Alconox, Inc.
ADDRESS: 30 Glenn St., Suite 309, White Plains, NY 10603. USA
EMERGENCY PHONE: **TOLL-FREE in USA/Canada** 800-255-3924
International calls 813-248-0585
BUSINESS PHONE: 914-948-4040
DATE OF PREPARATION: May 2011
DATE OF LAST REVISION: February 2008

SECTION 2 - HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW: This product is a white granular powder with little or no odor. Exposure can be irritating to eyes, respiratory system and skin. It is a non-flammable solid. The Environmental effects of this product have not been investigated.

US DOT SYMBOLS

Non-Regulated

CANADA (WHMIS) SYMBOLS



EUROPEAN and (GHS) Hazard Symbols



Signal Word: **Warning!**

EU LABELING AND CLASSIFICATION:

Classification of the substance or mixture according to Regulation (EC) No1272/2008 Annex 1

EC# 205-633-8 This substance is not classified in the Annex I of Directive 67/548/EEC

EC# 268-356-1 This substance is not classified in the Annex I of Directive 67/548/EEC

EC# 231-838-7 This substance is not classified in the Annex I of Directive 67/548/EEC

EC# 231-767-1 This substance is not classified in the Annex I of Directive 67/548/EEC

EC# 207-638-8 Index# 011-005-00-2

EC# 205-788-1 This substance is not classified in the Annex I of Directive 67/548/EEC

GHS Hazard Classification(s):

Eye Irritant Category 2A

Hazard Statement(s):

H319: Causes serious eye irritation

Precautionary Statement(s):

P260: Do not breath dust/fume/gas/mist/vapors/spray

P264: Wash hands thoroughly after handling

P271: Use only in well ventilated area.

P280: Wear protective gloves/protective clothing/eye protection/face protection/

Hazard Symbol(s):

[Xi] Irritant

MATERIAL SAFETY DATA SHEET

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Risk Phrases:

R20: Harmful by inhalation
R36/37/38: Irritating to eyes, respiratory system and skin

Safety Phrases:

S8: Keep container dry
S22: Do not breath dust
S24/25: Avoid contact with skin and eyes

HEALTH HAZARDS OR RISKS FROM EXPOSURE:

ACUTE: Exposure to this product may cause irritation of the eyes, respiratory system and skin. Ingestion may cause gastrointestinal irritation including pain, vomiting or diarrhea.

CHRONIC: This product contains an ingredient which may be corrosive.

TARGET ORGANS:

ACUTE: Eye, respiratory System, Skin

CHRONIC: None Known

SECTION 3 - COMPOSITION and INFORMATION ON INGREDIENTS

HAZARDOUS INGREDIENTS:	CAS #	EINECS #	ICSC #	WT %	HAZARD CLASSIFICATION; RISK PHRASES
Sodium Bicarbonate	144-55-8	205-633-8	1044	33 - 43%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Sodium (C10 – C16) Alkylbenzene Sulfonate	68081-81-2	268-356-1	Not Listed	10 – 20%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Sodium Tripolyphosphate	7758-29-4	231-838-7	1469	5 - 15%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Tetrasodium Pyrophosphate	7722-88-5	231-767-1	1140	5 - 15%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Sodium Carbonate	497-19-8	207-638-8	1135	1 - 10%	HAZARD CLASSIFICATION: [Xi] Irritant RISK PHRASES: R36
Sodium Alcohol Sulfate	151-21-3	205-788-1	0502	1 – 5%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Balance of other ingredients are non-hazardous or less than 1% in concentration (or 0.1% for carcinogens, reproductive toxins, or respiratory sensitizers).					

NOTE: ALL WHMIS required information is included in appropriate sections based on the ANSI Z400.1-2004 format. This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR, EU Directives and the Japanese Industrial Standard JIS Z 7250: 2000.

SECTION 4 - FIRST-AID MEASURES

Contaminated individuals of chemical exposure must be taken for medical attention if any adverse effect occurs. Rescuers should be taken for medical attention, if necessary. Take copy of label and MSDS to health professional with contaminated individual.

EYE CONTACT: If product enters the eyes, open eyes while under gentle running water for at least 15 minutes. Seek medical attention if irritation persists.

SKIN CONTACT: Wash skin thoroughly after handling. Seek medical attention if irritation develops and persists. Remove contaminated clothing. Launder before re-use.

INHALATION: If breathing becomes difficult, remove victim to fresh air. If necessary, use artificial respiration to support vital functions. Seek medical attention if breathing difficulty continues.

INGESTION: If product is swallowed, call physician or poison control center for most current information. If professional advice is not available, do not induce vomiting. Never induce vomiting or give diluents (milk or water) to someone who is unconscious, having convulsions, or who cannot swallow. Seek medical advice. Take a copy of the label and/or MSDS with the victim to the health professional.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Pre-existing skin, or eye problems may be aggravated by prolonged contact.

RECOMMENDATIONS TO PHYSICIANS: Treat symptoms and reduce over-exposure.

MATERIAL SAFETY DATA SHEET

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SECTION 5 - FIRE-FIGHTING MEASURES

FLASH POINT:

Not Flammable

AUTOIGNITION TEMPERATURE:

Not Applicable

FLAMMABLE LIMITS (in air by volume, %):

Lower (LEL): NA Upper (UEL): NA

FIRE EXTINGUISHING MATERIALS:

As appropriate for surrounding fire. Carbon dioxide, foam, dry chemical, halon, or water spray.

UNUSUAL FIRE AND EXPLOSION HAZARDS:

This product is non-flammable and has no known explosion hazards.

Explosion Sensitivity to Mechanical Impact:

Not Sensitive.

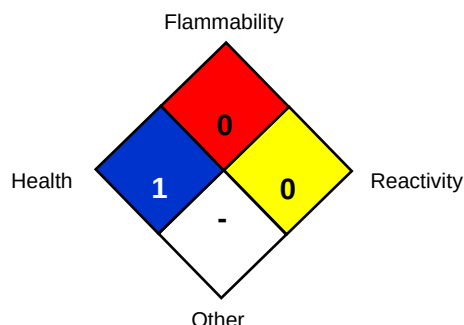
Explosion Sensitivity to Static Discharge:

Not Sensitive

SPECIAL FIRE-FIGHTING PROCEDURES:

Incipient fire responders should wear eye protection. Structural firefighters must wear Self-Contained Breathing Apparatus and full protective equipment. Isolate materials not yet involved in the fire and protect personnel. Move containers from fire area if this can be done without risk; otherwise, cool with carefully applied water spray. If possible, prevent runoff water from entering storm drains, bodies of water, or other environmentally sensitive areas.

NFPA RATING SYSTEM



HMIS RATING SYSTEM

HAZARDOUS MATERIAL IDENTIFICATION SYSTEM			
HEALTH HAZARD (BLUE)			1
FLAMMABILITY HAZARD (RED)			0
PHYSICAL HAZARD (YELLOW)			0
PROTECTIVE EQUIPMENT			
EYES	RESPIRATORY	HANDS	BODY
	See Sect 8		See Sect 8
For Routine Industrial Use and Handling Applications			

Hazard Scale: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe * = Chronic hazard

SECTION 6 - ACCIDENTAL RELEASE MEASURES

SPILL AND LEAK RESPONSE: Personnel should be trained for spill response operations.

SPILLS: Contain spill if safe to do so. Prevent entry into drains, sewers, and other waterways. Sweep, shovel or vacuum spilled material and place in an appropriate container for re-use or disposal. Avoid dust generation if possible. Dispose of in accordance with applicable Federal, State, and local procedures (see Section 13, Disposal Considerations).

SECTION 7 - HANDLING and STORAGE

WORK PRACTICES AND HYGIENE PRACTICES: As with all chemicals, avoid getting this product ON YOU or IN YOU. Wash thoroughly after handling this product. Do not eat, drink, smoke, or apply cosmetics while handling this product. Avoid breathing dusts generated by this product. Use in a well-ventilated location. Remove contaminated clothing immediately.

STORAGE AND HANDLING PRACTICES: Containers of this product must be properly labeled. Store containers in a cool, dry location. Keep container tightly closed when not in use. Store away from strong acids or oxidizers.

MATERIAL SAFETY DATA SHEET

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SECTION 8 - EXPOSURE CONTROLS - PERSONAL PROTECTION

EXPOSURE LIMITS/GUIDELINES:

Chemical Name	CAS#	ACGIH TWA	OSHA TWA	SWA
Sodium Bicarbonate	144-55-8	10 mg/m ³ Total Dust	15 mg/m ³ Total Dust	10 mg/m ³ Total Dust
Sodium (C10 – C16) Alkylbenzene Sulfonate	68081-81-2	10 mg/m ³ Total Dust	15 mg/m ³ Total Dust	10 mg/m ³ Total Dust
Sodium Tripolyphosphate	7758-29-4	10 mg/m ³ Total Dust	15 mg/m ³ Total Dust	10 mg/m ³ Total Dust
Tetrasodium Pyrophosphate	7722-88-5	5 mg/m ³	5 mg/m ³	5 mg/m ³
Sodium Carbonate	497-19-8	10 mg/m ³ Total Dust	15 mg/m ³ Total Dust	10 mg/m ³ Total Dust
Sodium Alcohol Sulfate	151-21-3	10 mg/m ³ Total Dust	15 mg/m ³ Total Dust	10 mg/m ³ Total Dust

Currently, International exposure limits are not established for the components of this product. Please check with competent authority in each country for the most recent limits in place.

VENTILATION AND ENGINEERING CONTROLS: Use with adequate ventilation to ensure exposure levels are maintained below the limits provided below. Use local exhaust ventilation to control airborne dust. Ensure eyewash/safety shower stations are available near areas where this product is used.

The following information on appropriate Personal Protective Equipment is provided to assist employers in complying with OSHA regulations found in 29 CFR Subpart I (beginning at 1910.132) or equivalent standard of Canada, or standards of EU member states (including EN 149 for respiratory PPE, and EN 166 for face/eye protection), and those of Japan. Please reference applicable regulations and standards for relevant details.

RESPIRATORY PROTECTION: Based on test data, exposure limits should not be exceeded under normal use conditions when using Alconox Detergent. Maintain airborne contaminant concentrations below guidelines listed above, if applicable. If necessary, use only respiratory protection authorized in the U.S. Federal OSHA Respiratory Protection Standard (29 CFR 1910.134), equivalent U.S. State standards, Canadian CSA Standard Z94.4-93, the European Standard EN149, or EU member states.

EYE PROTECTION: Safety glasses. If necessary, refer to U.S. OSHA 29 CFR 1910.133 or appropriate Canadian Standards.

HAND PROTECTION: Use chemical resistant gloves to prevent skin contact.. If necessary, refer to U.S. OSHA 29 CFR 1910.138 or appropriate Standards of Canada.

BODY PROTECTION: Use body protection appropriate to prevent contact (e.g. lab coat, overalls). If necessary, refer to appropriate Standards of Canada, or appropriate Standards of the EU, Australian Standards, or relevant Japanese Standards.

SECTION 9 - PHYSICAL and CHEMICAL PROPERTIES

PHYSICAL STATE:	Solid
APPEARANCE & ODOR:	White granular powder with little or no odor.
ODOR THRESHOLD (PPM):	Not Available
VAPOR PRESSURE (mmHg):	Not Applicable
VAPOR DENSITY (AIR=1):	Not Applicable.
BY WEIGHT:	Not Available
EVAPORATION RATE (nBuAc = 1):	Not Applicable.
BOILING POINT (C°):	Not Applicable.
FREEZING POINT (C°):	Not Applicable.
pH:	9.5 (1% aqueous solution)
SPECIFIC GRAVITY 20°C: (WATER =1)	0.85 – 1.1
SOLUBILITY IN WATER (%)	>10% w/w
COEFFICIENT OF WATER/OIL DIST.:	Not Available
VOC:	None
CHEMICAL FAMILY:	Detergent

MATERIAL SAFETY DATA SHEET

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SECTION 10 - STABILITY and REACTIVITY

STABILITY: Product is stable

DECOMPOSITION PRODUCTS: When heated to decomposition this product produces Oxides of carbon (COx)

MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE: Strong acids and strong oxidizing agents.

HAZARDOUS POLYMERIZATION: Will not occur.

CONDITIONS TO AVOID: Contact with incompatible materials and dust generation.

SECTION 11 - TOXICOLOGICAL INFORMATION

TOXICITY DATA: Toxicity data is available for mixture:

CAS# 497-19-8 LD50 Oral (Rat)	4090 mg/kg
CAS# 497-19-8 LD50 Oral (Mouse)	6600 mg/kg
CAS# 497-19-8 LC50 Inhalation (Rat)	2300 mg/m ³ 2H
CAS# 497-19-8 LC50 Inhalation (Mouse)	1200 mg/m ³ 2H
CAS# 7758-29-4 LD50 Oral (Rat)	3120 mg/kg
CAS# 7758-29-4 LD50 Oral (Mouse)	3100 mg/kg
CAS# 7722-88-5 LD50 Oral (Rat)	4000 mg/kg

SUSPECTED CANCER AGENT: None of the ingredients are found on the following lists: FEDERAL OSHA Z LIST, NTP, CAL/OSHA, IARC and therefore is not considered to be, nor suspected to be a cancer-causing agent by these agencies.

IRRITANCY OF PRODUCT: Contact with this product can be irritating to exposed skin, eyes and respiratory system.

SENSITIZATION OF PRODUCT: This product is not considered a sensitizer.

REPRODUCTIVE TOXICITY INFORMATION: No information concerning the effects of this product and its components on the human reproductive system.

SECTION 12 - ECOLOGICAL INFORMATION

ALL WORK PRACTICES MUST BE AIMED AT ELIMINATING ENVIRONMENTAL CONTAMINATION.

ENVIRONMENTAL STABILITY: No Data available at this time.

EFFECT OF MATERIAL ON PLANTS or ANIMALS: No evidence is currently available on this product's effects on plants or animals.

EFFECT OF CHEMICAL ON AQUATIC LIFE: No evidence is currently available on this product's effects on aquatic life.

SECTION 13 - DISPOSAL CONSIDERATIONS

PREPARING WASTES FOR DISPOSAL: Waste disposal must be in accordance with appropriate Federal, State, and local regulations, those of Canada, Australia, EU Member States and Japan.

SECTION 14 - TRANSPORTATION INFORMATION

US DOT; IATA; IMO; ADR:

THIS PRODUCT IS NOT HAZARDOUS AS DEFINED BY 49 CFR 172.101 BY THE U.S. DEPARTMENT OF TRANSPORTATION.

PROPER SHIPPING NAME: Non-Regulated Material

HAZARD CLASS NUMBER and DESCRIPTION: Not Applicable

UN IDENTIFICATION NUMBER: Not Applicable

PACKING GROUP: Not Applicable.

DOT LABEL(S) REQUIRED: Not Applicable

NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (2004): Not Applicable

MARINE POLLUTANT: None of the ingredients are classified by the DOT as a Marine Pollutant (as defined by 49 CFR 172.101, Appendix B)

U.S. DEPARTMENT OF TRANSPORTATION (DOT) SHIPPING REGULATIONS:

This product is not classified as dangerous goods, per U.S. DOT regulations, under 49 CFR 172.101.

TRANSPORT CANADA, TRANSPORTATION OF DANGEROUS GOODS REGULATIONS:

This product is not classified as Dangerous Goods, per regulations of Transport Canada.

INTERNATIONAL AIR TRANSPORT ASSOCIATION (IATA):

This product is not classified as Dangerous Goods, by rules of IATA:

INTERNATIONAL MARITIME ORGANIZATION (IMO) DESIGNATION:

This product is not classified as Dangerous Goods by the International Maritime Organization.

EUROPEAN AGREEMENT CONCERNING THE INTERNATIONAL CARRIAGE OF DANGEROUS GOODS BY ROAD (ADR):

MATERIAL SAFETY DATA SHEET

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This product is not classified by the United Nations Economic Commission for Europe to be dangerous goods.

SECTION 15 - REGULATORY INFORMATION

UNITED STATES REGULATIONS

SARA REPORTING REQUIREMENTS: This product is not subject to the reporting requirements of Sections 302, 304 and 313 of Title III of the Superfund Amendments and Reauthorization Act., as follows: None

TSCA: All components in this product are listed on the US Toxic Substances Control Act (TSCA) inventory of chemicals.

SARA 311/312:

Acute Health: Yes Chronic Health: No Fire: No Reactivity: No

U.S. SARA THRESHOLD PLANNING QUANTITY: There are no specific Threshold Planning Quantities for this product. The default Federal MSDS submission and inventory requirement filing threshold of 10,000 lb (4,540 kg) may apply, per 40 CFR 370.20.

U.S. CERCLA REPORTABLE QUANTITY (RQ): None

CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT (PROPOSITION 65): None of the ingredients are on the California Proposition 65 lists.

CANADIAN REGULATIONS:

CANADIAN DSL/NDL INVENTORY STATUS: All of the components of this product are on the DSL Inventory

CANADIAN ENVIRONMENTAL PROTECTION ACT (CEPA) PRIORITIES SUBSTANCES LISTS: No component of this product is on the CEPA First Priorities Substance Lists.

CANADIAN WHMIS CLASSIFICATION and SYMBOLS: This product is categorized as a Controlled Product, Hazard Class D2B as per the Controlled Product Regulations

EUROPEAN ECONOMIC COMMUNITY INFORMATION:

EU LABELING AND CLASSIFICATION:

Classification of the mixture according to Regulation (EC) No1272/2008. See section 2 for details.

AUSTRALIAN INFORMATION FOR PRODUCT:

AUSTRALIAN INVENTORY OF CHEMICAL SUBSTANCES (AICS) STATUS: All components of this product are listed on the AICS.

STANDARD FOR THE UNIFORM SCHEDULING OF DRUGS AND POISONS: Not applicable.

JAPANESE INFORMATION FOR PRODUCT:

JAPANESE MINISTER OF INTERNATIONAL TRADE AND INDUSTRY (MITI) STATUS: The components of this product are not listed as Class I Specified Chemical Substances, Class II Specified Chemical Substances, or Designated Chemical Substances by the Japanese MITI.

INTERNATIONAL CHEMICAL INVENTORIES:

Listing of the components on individual country Chemical Inventories is as follows:

Asia-Pac:	Listed
Australian Inventory of Chemical Substances (AICS):	Listed
Korean Existing Chemicals List (ECL):	Listed
Japanese Existing National Inventory of Chemical Substances (ENCS):	Listed
Philippines Inventory of Chemicals and Chemical Substances (PICCS):	Listed
Swiss Giftlist List of Toxic Substances:	Listed
U.S. TSCA:	Listed

SECTION 16 - OTHER INFORMATION

PREPARED BY: Paul Eigbrett Global Safety Management, 10006 Cross Creek Blvd. Suite 440, Tampa, FL 33647

MATERIAL SAFETY DATA SHEET

ALCONOX®

Disclaimer: To the best of Alconox, Inc. knowledge, the information contained herein is reliable and accurate as of this date; however, accuracy, suitability or completeness is not guaranteed and no warranties of any type either express or implied are provided. The information contained herein relates only to this specific product.

ANNEX:

IDENTIFIED USES OF ALCONOX® AND DIRECTIONS FOR USE

Used to clean: Healthcare instruments, laboratory ware, vacuum equipment, tissue culture ware, personal protective equipment, sampling apparatus, catheters, tubing, pipes, radioactive contaminated articles, optical parts, electronic components, pharmaceutical apparatus, cosmetics manufacturing equipment, metal castings, forgings and stampings, industrial parts, tanks and reactors. Authorized by USDA for use in federally inspected meat and poultry plants. Passes inhibitory residue test for water analysis. FDA certified.

Used to remove: Soil, grit, grime, buffing compound, slime, grease, oils, blood, tissue, salts, deposits, particulates, solvents, chemicals, radioisotopes, radioactive contaminations, silicon oils, mold release agents.

Surfaces cleaned: Corrosion inhibited formulation recommended for glass, metal, stainless steel, porcelain, ceramic, plastic, rubber and fiberglass. Can be used on soft metals such as copper, aluminum, zinc and magnesium if rinsed promptly. Corrosion testing may be advisable.

Cleaning method: Soak, brush, sponge, cloth, ultrasonic, flow through clean-inplace. Will foam—not for spray or machine use.

Directions: Make a fresh 1% solution (2 1/2 Tbsp. per gal., 1 1/4 oz. per gal. or 10 grams per liter) in cold, warm, or hot water. If available use warm water. Use cold water for blood stains. For difficult soils, raise water temperature and use more detergent. Clean by soak, circulate, wipe, or ultrasonic method. Not for spray machines, will foam. For nonabrasive scouring, make paste. Use 2% solution to soak frozen stopcocks. To remove silver tarnish, soak in 1% solution in aluminum container. RINSE THOROUGHLY—preferably with running water. For critical cleaning, do final or all rinsing in distilled, deionized, or purified water. For food contact surfaces, rinse with potable water. Used on a wide range of glass, ceramic, plastic, and metal surfaces. Corrosion testing may be advisable.

SAFETY DATA SHEET

Nitrogen

Airgas
an Air Liquide company

Section 1. Identification

GHS product identifier	: Nitrogen
Chemical name	: nitrogen
Other means of identification	: nitrogen (dot); nitrogen gas; Nitrogen NF, Nitrogen FG
Product use	: Synthetic/Analytical chemistry.
Synonym	: nitrogen (dot); nitrogen gas; Nitrogen NF, Nitrogen FG
SDS #	: 001040
Supplier's details	: Airgas USA, LLC and its affiliates 259 North Radnor-Chester Road Suite 100 Radnor, PA 19087-5283 1-610-687-5253
24-hour telephone	: 1-866-734-3438

Section 2. Hazards identification

OSHA/HCS status	: This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).
Classification of the substance or mixture	: GASES UNDER PRESSURE - Compressed gas

GHS label elements

Hazard pictograms

:



Signal word

: Warning

Hazard statements

: Contains gas under pressure; may explode if heated.
May displace oxygen and cause rapid suffocation.

Precautionary statements

General

: Read and follow all Safety Data Sheets (SDS'S) before use. Read label before use. Keep out of reach of children. If medical advice is needed, have product container or label at hand. Close valve after each use and when empty. Use equipment rated for cylinder pressure. Do not open valve until connected to equipment prepared for use. Use a back flow preventative device in the piping. Use only equipment of compatible materials of construction.

Prevention

: Not applicable.

Response

: Not applicable.

Storage

: Protect from sunlight when ambient temperature exceeds 52°C/125°F. Store in a well-ventilated place.

Disposal

: Not applicable.

Hazards not otherwise classified

: In addition to any other important health or physical hazards, this product may displace oxygen and cause rapid suffocation.

Section 3. Composition/information on ingredients

Substance/mixture : Substance
Chemical name : nitrogen
Other means of identification : nitrogen (dot); nitrogen gas; Nitrogen NF, Nitrogen FG

CAS number/other identifiers

CAS number : 7727-37-9
Product code : 001040

Ingredient name	%	CAS number
Nitrogen	100	7727-37-9

Any concentration shown as a range is to protect confidentiality or is due to batch variation.

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Get medical attention if irritation occurs.

Inhalation : Remove victim to fresh air and keep at rest in a position comfortable for breathing. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Get medical attention if adverse health effects persist or are severe. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband. In case of inhalation of decomposition products in a fire, symptoms may be delayed. The exposed person may need to be kept under medical surveillance for 48 hours.

Skin contact : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. Get medical attention if symptoms occur. Wash clothing before reuse. Clean shoes thoroughly before reuse.

Ingestion : As this product is a gas, refer to the inhalation section.

Most important symptoms/effects, acute and delayed

Potential acute health effects

Eye contact : Contact with rapidly expanding gas may cause burns or frostbite.
Inhalation : No known significant effects or critical hazards.
Skin contact : Contact with rapidly expanding gas may cause burns or frostbite.
Frostbite : Try to warm up the frozen tissues and seek medical attention.
Ingestion : As this product is a gas, refer to the inhalation section.

Over-exposure signs/symptoms

Eye contact : No specific data.
Inhalation : No specific data.
Skin contact : No specific data.
Ingestion : No specific data.

Indication of immediate medical attention and special treatment needed, if necessary

Notes to physician : In case of inhalation of decomposition products in a fire, symptoms may be delayed. The exposed person may need to be kept under medical surveillance for 48 hours.

Section 4. First aid measures

- Specific treatments** : No specific treatment.
- Protection of first-aiders** : No action shall be taken involving any personal risk or without suitable training. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Extinguishing media

- Suitable extinguishing media** : Use an extinguishing agent suitable for the surrounding fire.
- Unsuitable extinguishing media** : None known.

- Specific hazards arising from the chemical** : Contains gas under pressure. In a fire or if heated, a pressure increase will occur and the container may burst or explode.

- Hazardous thermal decomposition products** : Decomposition products may include the following materials:
nitrogen oxides

- Special protective actions for fire-fighters** : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Contact supplier immediately for specialist advice. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool.

- Special protective equipment for fire-fighters** : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

- For non-emergency personnel** : No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Avoid breathing gas. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.
- For emergency responders** : If specialised clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

- Environmental precautions** : Ensure emergency procedures to deal with accidental gas releases are in place to avoid contamination of the environment. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

Methods and materials for containment and cleaning up

- Small spill** : Immediately contact emergency personnel. Stop leak if without risk.
- Large spill** : Immediately contact emergency personnel. Stop leak if without risk. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

Section 7. Handling and storage

Precautions for safe handling

- Protective measures** : Put on appropriate personal protective equipment (see Section 8). Contains gas under pressure. Avoid contact with eyes, skin and clothing. Avoid breathing gas. Empty containers retain product residue and can be hazardous. Do not puncture or incinerate container. Use equipment rated for cylinder pressure. Close valve after each use and when empty. Protect cylinders from physical damage; do not drag, roll, slide, or drop. Use a suitable hand truck for cylinder movement.

Section 7. Handling and storage

Advice on general occupational hygiene : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

Conditions for safe storage, including any incompatibilities : Store in accordance with local regulations. Store in a segregated and approved area. Store away from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10). Keep container tightly closed and sealed until ready for use. Cylinders should be stored upright, with valve protection cap in place, and firmly secured to prevent falling or being knocked over. Cylinder temperatures should not exceed 52 °C (125 °F).

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

Ingredient name	Exposure limits
Nitrogen	Oxygen Depletion [Asphyxiant]

Appropriate engineering controls : Good general ventilation should be sufficient to control worker exposure to airborne contaminants.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: safety glasses with side-shields.

Skin protection

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.

Body protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Other skin protection : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory protection : Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Section 9. Physical and chemical properties

Appearance

Physical state	: Gas. [Compressed gas.]
Color	: Colorless.
Molecular weight	: 28.02 g/mole
Molecular formula	: N ₂
Boiling/condensation point	: -196°C (-320.8°F)
Melting/freezing point	: -210.01°C (-346°F)
Critical temperature	: -146.95°C (-232.5°F)
Odor	: Odorless.
Odor threshold	: Not available.
pH	: Not available.
Flash point	: [Product does not sustain combustion.]
Burning time	: Not applicable.
Burning rate	: Not applicable.
Evaporation rate	: Not available.
Flammability (solid, gas)	: Not available.
Lower and upper explosive (flammable) limits	: Not available.
Vapor pressure	: Not available.
Vapor density	: 0.967 (Air = 1) Liquid Density@BP: 50.46 lb/ft ³ (808.3 kg/m ³)
Specific Volume (ft ³ /lb)	: 13.8889
Gas Density (lb/ft ³)	: 0.072
Relative density	: Not applicable.
Solubility	: Not available.
Solubility in water	: Not available.
Partition coefficient: n-octanol/water	: 0.67
Auto-ignition temperature	: Not available.
Decomposition temperature	: Not available.
SADT	: Not available.
Viscosity	: Not applicable.

Section 10. Stability and reactivity

Reactivity	: No specific test data related to reactivity available for this product or its ingredients.
Chemical stability	: The product is stable.
Possibility of hazardous reactions	: Under normal conditions of storage and use, hazardous reactions will not occur.
Conditions to avoid	: No specific data.
Incompatible materials	: No specific data.
Hazardous decomposition products	: Under normal conditions of storage and use, hazardous decomposition products should not be produced.
Hazardous polymerization	: Under normal conditions of storage and use, hazardous polymerization will not occur.

Section 10. Stability and reactivity

Irritation/Corrosion

Not available.

Sensitization

Not available.

Mutagenicity

Not available.

Carcinogenicity

Not available.

Reproductive toxicity

Not available.

Teratogenicity

Not available.

Specific target organ toxicity (single exposure)

Not available.

Specific target organ toxicity (repeated exposure)

Not available.

Aspiration hazard

Not available.

Information on the likely routes of exposure : Not available.

Potential acute health effects

Eye contact : Contact with rapidly expanding gas may cause burns or frostbite.
Inhalation : No known significant effects or critical hazards.
Skin contact : Contact with rapidly expanding gas may cause burns or frostbite.
Ingestion : As this product is a gas, refer to the inhalation section.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact : No specific data.
Inhalation : No specific data.
Skin contact : No specific data.
Ingestion : No specific data.

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

Potential immediate effects : Not available.
Potential delayed effects : Not available.

Long term exposure

Potential immediate effects : Not available.
Potential delayed effects : Not available.

Potential chronic health effects

Not available.

General : No known significant effects or critical hazards.
Carcinogenicity : No known significant effects or critical hazards.

Section 11. Toxicological information

Mutagenicity	: No known significant effects or critical hazards.
Teratogenicity	: No known significant effects or critical hazards.
Developmental effects	: No known significant effects or critical hazards.
Fertility effects	: No known significant effects or critical hazards.

Numerical measures of toxicity

Acute toxicity estimates

Not available.

Section 12. Ecological information

Toxicity

Not available.

Persistence and degradability

Not available.

Bioaccumulative potential

Product/ingredient name	LogP _{ow}	BCF	Potential
Nitrogen	0.67	-	low

Mobility in soil

Soil/water partition coefficient (K_{oc}) : Not available.

Other adverse effects : No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Empty Airgas-owned pressure vessels should be returned to Airgas. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Do not puncture or incinerate container.

Section 14. Transport information

	DOT	TDG	Mexico	IMDG	IATA
UN number	UN1066	UN1066	UN1066	UN1066	UN1066
UN proper shipping name	NITROGEN, COMPRESSED	NITROGEN, COMPRESSED	NITROGEN, COMPRESSED	NITROGEN, COMPRESSED	NITROGEN, COMPRESSED
Transport hazard class(es)	2.2 	2.2 	2.2 	2.2 	2.2 

Section 14. Transport information

Packing group	-	-	-	-	-
Environment	No.	No.	No.	No.	No.
Additional information	<u>Limited quantity</u> Yes. <u>Packaging instruction</u> Passenger aircraft Quantity limitation: 75 kg Cargo aircraft Quantity limitation: 150 kg	Product classified as per the following sections of the Transportation of Dangerous Goods Regulations: 2.13-2.17 (Class 2). <u>Explosive Limit and Limited Quantity Index</u> 0.125 <u>Passenger Carrying Road or Rail Index</u> 75	-	-	<u>Passenger and Cargo Aircraft</u> Quantity limitation: 75 kg <u>Cargo Aircraft Only</u> Quantity limitation: 150 kg

“Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product.”

Special precautions for user : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code : Not available.

Section 15. Regulatory information

U.S. Federal regulations : **TSCA 8(a) CDR Exempt/Partial exemption:** This material is listed or exempted.
United States inventory (TSCA 8b): This material is listed or exempted.

Clean Air Act Section 112 (b) Hazardous Air Pollutants (HAPs) : Not listed

Clean Air Act Section 602 Class I Substances : Not listed

Clean Air Act Section 602 Class II Substances : Not listed

DEA List I Chemicals (Precursor Chemicals) : Not listed

DEA List II Chemicals (Essential Chemicals) : Not listed

SARA 302/304

Composition/information on ingredients

No products were found.

SARA 304 RQ : Not applicable.

SARA 311/312

Classification : Sudden release of pressure

Composition/information on ingredients

Name	%	Fire hazard	Sudden release of pressure	Reactive	Immediate (acute) health hazard	Delayed (chronic) health hazard
Nitrogen	100	No.	Yes.	No.	No.	No.

Section 15. Regulatory information

State regulations

Massachusetts	: This material is listed.
New York	: This material is not listed.
New Jersey	: This material is listed.
Pennsylvania	: This material is listed.

International regulations

International lists

National inventory

Australia	: This material is listed or exempted.
Canada	: This material is listed or exempted.
China	: This material is listed or exempted.
Europe	: This material is listed or exempted.
Japan	: Not determined.
Malaysia	: Not determined.
New Zealand	: This material is listed or exempted.
Philippines	: This material is listed or exempted.
Republic of Korea	: This material is listed or exempted.
Taiwan	: This material is listed or exempted.

Canada

WHMIS (Canada)	: Class A: Compressed gas.
CEPA Toxic substances:	This material is not listed.
Canadian ARET:	This material is not listed.
Canadian NPRI:	This material is not listed.
Alberta Designated Substances:	This material is not listed.
Ontario Designated Substances:	This material is not listed.
Quebec Designated Substances:	This material is not listed.

Section 16. Other information

Canada Label requirements : Class A: Compressed gas.

Hazardous Material Information System (U.S.A.)

Health	0
Flammability	0
Physical hazards	3

Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks. Although HMIS® ratings are not required on SDSs under 29 CFR 1910.1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered mark of the National Paint & Coatings Association (NPCA). HMIS® materials may be purchased exclusively from J. J. Keller (800) 327-6868.

The customer is responsible for determining the PPE code for this material.

National Fire Protection Association (U.S.A.)



Reprinted with permission from NFPA 704-2001, Identification of the Hazards of Materials for Emergency Response Copyright ©1997, National Fire Protection Association, Quincy, MA 02269. This reprinted material is not the complete and official position of the National Fire Protection Association, on the referenced subject which is represented only by the standard in its entirety.

Section 16. Other information

Copyright ©2001, National Fire Protection Association, Quincy, MA 02269. This warning system is intended to be interpreted and applied only by properly trained individuals to identify fire, health and reactivity hazards of chemicals. The user is referred to certain limited number of chemicals with recommended classifications in NFPA 49 and NFPA 325, which would be used as a guideline only. Whether the chemicals are classified by NFPA or not, anyone using the 704 systems to classify chemicals does so at their own risk.

Procedure used to derive the classification

Classification	Justification
Press. Gas Comp. Gas, H280	Expert judgment

History

Date of printing : 5/26/2016

Date of issue/Date of revision : 5/26/2016

Date of previous issue : 8/7/2015

Version : 0.02

Key to abbreviations :

- ATE = Acute Toxicity Estimate
- BCF = Bioconcentration Factor
- GHS = Globally Harmonized System of Classification and Labelling of Chemicals
- IATA = International Air Transport Association
- IBC = Intermediate Bulk Container
- IMDG = International Maritime Dangerous Goods
- LogPow = logarithm of the octanol/water partition coefficient
- MARPOL 73/78 = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)
- UN = United Nations

References : Not available.

📌 Indicates information that has changed from previously issued version.

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.

Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.



Material Safety Data Sheet: Oxygen Absorber

1. Identification of the substance/preparation and the company

Substance: Oxygen Absorber

Application: Oxygen Scavenger

Company:

IMPAK Corporation
13700 South Broadway
Los Angeles, CA 90061

2. Composition/Information of ingredients

Iron Powder (Fe)

Weight %: N/A

CAS No.: --

Hazard symbols: --

R-phrased: --

Index No.: --

EINECS No.: --

Active Carbon (C)

Weight %: N/A

CAS No.: --

Hazard symbols: --

R-phrases: --

Index No.: --

EINECS No.: --

Salt

Weight %: N/A

CAS No.: --

Hazard symbols: --

R-phrased: --

Index No.: --

EINECS No.: --

Vermiculite Granule

Weight %: N/A

CAS No.: --

Hazard symbols: --

R-phrases: --

Index No.: --

EINECS No.: --

3. Hazards Identification

Not Available

4. First-aid measures

May cause eye irritation/possible skin irritation upon prolonged direct contact with black powder, when the packet is broken and the contents are spilled.

Eye Contact: Immediately rinse with water for 15 minutes

Ingestion: Induce vomiting, drink water, and call physician immediately

5. Fire-fighting measures

This product is not combustible. If ignited can be extinguished with CO₂ foam or a water sprayer.

6. Accidental release measures

If product is released or spilled sweep off and place in disposal can.

7. Handling and Storage

Handling

Keep out of reach of children

Storage

Store in a dry place with cool, or normal room temperature

8. Exposure controls/personal protection

If large amounts of contents are spilled from packets, safety goggles recommended.

9. Physical and chemical properties

Form:	Black powder
Physical State	Powder
Odor:	odorless
PH Value	not available
Melting point:	Not available
Boiling point	not known
Solubility	Insoluble for iron powder and active carbon, soluble for salt
Vapor density:	not known
Vapor pressure	not known

10. Stability and reactivity

Chemical Stability: Avoid to expose packet in the air for a long time. When the master bag is open, iron will start chemical reaction with oxygen in the air, and form iron oxide in the packet

Incompatibility: Strong Acids

Hazardous Decomposition: Iron oxide

Hazardous Polymerization: Will not occur

11. Toxicological Information

None toxic with Oral LD₅₀
NTP- Not known

12. Ecological information

Not Available.

13. Disposal Considerations

Sweep off and place in disposal can
Dispose of in compliance with all federal, state, and local laws and regulations.

14. Transport information

GGVSE: --	UN: --	PG: --	
RID/ADR: --	UN: --	PG: --	
Warning sign: Hazard No. --	UN No.: ----		
ADNR: --	UN: --	PG: --	
GGVsee/IMDG Code: --	UN: --	PG: --	MPO: --
ICAO-TI/IATA-DGR: --	UN: --	PG: --	
Declaration for land shipment: --			
Declaration for sea shipment: --			
Declaration of shipment by air: --			
Other information: Not dangerous cargo. Keep separated from foodstuffs			

15. Regulatory information

Not Available

16. Other Information

Not Available



Material Safety Data Sheet Zinc Acetate Solutions

Section 1 - Chemical Product and Company Identification

MSDS Name:

Zinc Acetate Solutions

Catalog Numbers:

LC27080, LC27100

Synonyms:

None

Company Identification:

LabChem Inc

200 William Pitt Way

Pittsburgh, PA 15238

Company Phone Number:

(412) 826-5230

Emergency Phone Number:

(800) 424-9300

CHEMTREC Phone Number:

(800) 424-9300 or

(011) 703-527-3887

Section 2 – Composition, Information on Ingredients

CAS#	Chemical Name:	Percent
7732-18-5	Water	balance
5970-45-6	Zinc acetate, dihydrate	10-22

Section 3 - Hazards Identification

Emergency Overview

Appearance: Clear, colorless solution

Caution. May cause eye irritation.

Target Organs: Eyes.

Potential Health Effects

Eye:

May cause eye irritation.

Skin:

May cause skin irritation.

Ingestion:

May cause irritation of the digestive tract.

Inhalation:

May cause respiratory tract irritation.

Chronic:

Chronic exposure may cause kidney damage.



Material Safety Data Sheet Zinc Acetate Solutions

Section 4 - First Aid Measures

Eyes:

Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid.

Skin:

Flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical aid.

Ingestion:

Do not induce vomiting. If victim is conscious and alert, give 2-4 cupfuls of milk or water. Get medical aid immediately.

Inhalation:

Remove from exposure and move to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid.

Notes to Physician:

Treat symptomatically and supportively.

Section 5 - Fire Fighting Measures

General Information:

As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear.

Extinguishing Media:

For small fires, use dry chemical, carbon dioxide, water spray or alcohol-resistant foam.

Autoignition Temperature:

No information found.

Flash Point:

No information found.

NFPA Rating:

CAS# 7732-18-5: Health- 0, Flammability- 0, Instability- 0.

CAS# 5970-45-6: Health- 2, Flammability- 1, Instability- 0.

Explosion Limits:

Lower: n/a Upper: n/a

Section 6 - Accidental Release Measures

General Information:

Use proper personal protective equipment as indicated in Section 8.

Spills/Leaks:

Absorb spills with inert absorbent (vermiculite, sand, fuller's earth) and place in suitable containers labeled for later disposal.



Material Safety Data Sheet Zinc Acetate Solutions

Section 7 - Handling and Storage

Handling:

Wash thoroughly after handling. Do not get in eyes, on skin, or on clothing. Do not ingest or inhale.

Storage:

Store capped at room temperature. Protect from heat and incompatibles.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls:

Facilities using or storing this material should be equipped with an eyewash and safety shower.

Provide local exhaust or general dilution ventilation.

Exposure Limits:

Chemical Name:	ACGIH	NIOSH	OSHA
Water	None of the components are on this list	None of the components are on this list	None of the components are on this list
Zinc acetate, dihydrate	None of the components are on this list	None of the components are on this list	None of the components are on this list

OSHA Vacated PELs:

None.

Personal Protective Equipment**Eyes:**

Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133. Do not wear contact lenses when working with chemicals.

Skin:

Wear appropriate protective gloves to prevent skin exposure.

Clothing:

Wear appropriate protective clothing to prevent skin exposure.

Respirators:

Follow the OSHA respirator regulations found in 29 CFR 1910.134. Always use a NIOSH-approved respirator when necessary.

Section 9 - Physical and Chemical Properties

Physical State:	Clear liquid
Color:	Colorless
Odor:	Slight acetic
pH:	5-7
Vapor Pressure:	No information found.
Vapor Density:	No information found.
Evaporation Rate:	No information found.
Viscosity:	No information found.
Boiling Point:	No information found.
Freezing/Melting Point:	No information found.
Decomposition Temperature:	No information found.
Solubility in water:	Soluble



Material Safety Data Sheet Zinc Acetate Solutions

Specific Gravity/Density: 1.0 – 1.2
Molecular Formula: No information found.
Molecular Weight: No information found.

Section 10 - Stability and Reactivity

Chemical Stability:

Stable under normal temperatures and pressures.

Conditions to Avoid:

Incompatible materials, excess heat.

Incompatibilities with Other Materials:

Strong oxidizing agents.

Hazardous Decomposition Products:

Carbon monoxide, carbon dioxide, zinc oxides.

Hazardous Polymerization:

Has not been reported.

Section 11 - Toxicological Information

RTECS:

CAS# 7732-18-5: ZC0110000.

CAS# 5970-45-6: ZG8750000.

LD50/LC50:

CAS# 7732-18-5:

Oral, rat: LD50 = >90 mL/kg.

CAS# 5970-45-6:

Oral, mouse: LD50 = 287 mg/kg

Oral, rat: LD50 = 794 mg/kg.

Carcinogenicity:

CAS# 7732-18-5: Not listed as a carcinogen by ACGIH, IARC, NIOSH, NTP, OSHA, or CA Prop 65.

CAS# 5970-45-6: Not listed as a carcinogen by ACGIH, IARC, NIOSH, NTP, OSHA, or CA Prop 65.

Epidemiology:

No information found

Teratogenicity:

No information found

Reproductive:

No information found

Mutagenicity:

No information found

Neurotoxicity:

No information found

Section 12 - Ecological Information

No information found



Material Safety Data Sheet Zinc Acetate Solutions

Section 13 - Disposal Considerations

Dispose of in accordance with Federal, State, and local regulations.

Section 14 - Transport Information

US DOT

Shipping Name: Not regulated.

Hazard Class:

UN Number:

Packing Group:

Section 15 - Regulatory Information

US Federal

TSCA:

CAS# 7732-18-5 is listed on the TSCA Inventory.

CAS# 5970-45-6 is not on the TSCA Inventory; however, its anhydrous form is on the inventory and so this hydrate is exempt from TSCA Inventory requirements (40CFR270.3(u)(2)).

SARA Reportable Quantities (RQ):

Zinc Acetate, Anhydrous (CAS No. 557-34-6): 1000 lbs. (453.6 kg)

CERCLA/SARA Section 313:

This material contains Zinc acetate dihydrate (CAS# 5970-45-6, 10-22%), listed as Zinc compounds, which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373.

OSHA - Highly Hazardous:

None of the components are on this list.

US State

State Right to Know:

Zinc acetate, anhydrous, can be found on the following state Right-to-Know lists: California, New Jersey, Florida, Pennsylvania, Massachusetts.

California Regulations:

None.

European/International Regulations

Canadian DSL/NDL:

CAS# 7732-18-5 is listed on Canada's DSL List.

CAS# 5970-45-6 is listed on Canada's DSL List.

Canada Ingredient Disclosure List:

CAS# 7732-18-5 is not listed on Canada's Ingredient Disclosure List.

CAS# 5970-45-6 is not listed on Canada's Ingredient Disclosure List.



Material Safety Data Sheet

Zinc Acetate Solutions

Section 16 - Other Information

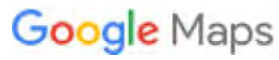
MSDS Creation Date: February 14, 1998

Revision Date: February 17, 2011

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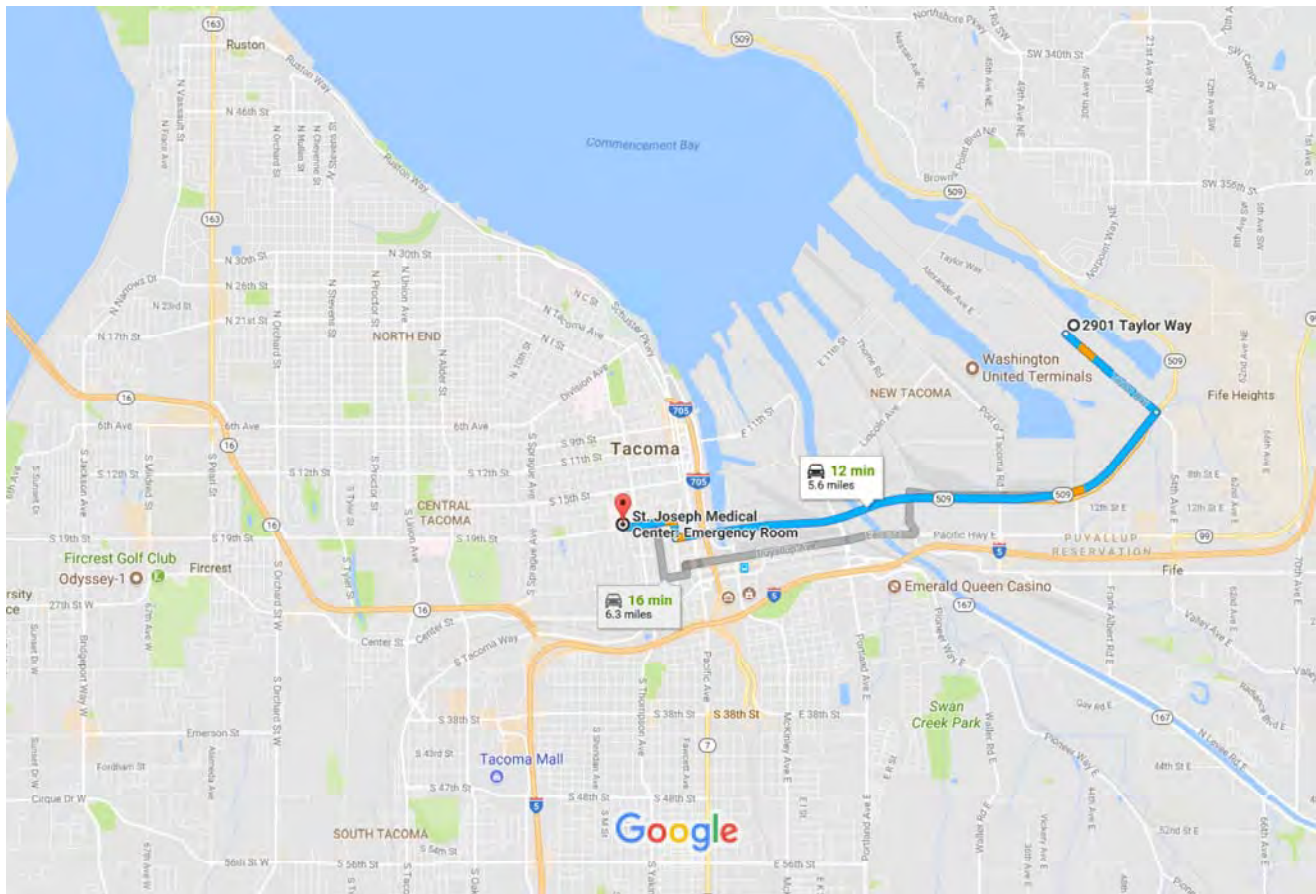
APPENDIX E

HOSPITAL ROUTE MAP



2901 Taylor Way, Tacoma, WA to St.
Joseph Medical Center: Emergency Room

Drive 5.6 miles, 12 min



Map data ©2017 Google United States 2000 ft

via WA-509 S

Fastest route, the usual traffic

12 min

5.6 miles

via Puyallup Ave

16 min

6.3 miles

Appendix K



INADVERTENT DISCOVERY PLAN PLAN AND PROCEDURES FOR THE DISCOVERY OF CULTURAL RESOURCES AND HUMAN SKELETAL REMAINS

To request ADA accommodation, including materials in a format for the visually impaired, call Ecology at 360-407-6000 or visit <https://ecology.wa.gov/accessibility>. People with impaired hearing may call Washington Relay Service at 711. People with a speech disability may call TTY at 877-833-6341.

Site Name(s): Location:

Project Lead/Organization: County:

If this Inadvertent Discovery Plan (IDP) is for multiple (batched) projects, ensure the location information covers all project areas.

1. INTRODUCTION

The IDP outlines procedures to perform in the event of a discovery of archaeological materials or human remains, in accordance with applicable state and federal laws. An IDP is required, as part of Agency Terms and Conditions for all grants and loans, for any project that creates disturbance above or below the ground. An IDP is not a substitute for a formal cultural resource review (Executive 21-02 or Section 106).

Once completed, **the IDP should always be kept at the project site** during all project activities. All staff, contractors, and volunteers should be familiar with its contents and know where to find it.

2. CULTURAL RESOURCE DISCOVERIES

A cultural resource discovery could be prehistoric or historic. Examples include (see images for further examples):

- An accumulation of shell, burned rocks, or other food related materials.
- Bones, intact or in small pieces.
- An area of charcoal or very dark stained soil with artifacts.
- Stone tools or waste flakes (for example, an arrowhead or stone chips).
- Modified or stripped trees, often cedar or aspen, or other modified natural features, such as rock drawings.
- Agricultural or logging materials that appear older than 50 years. These could include equipment, fencing, canals, spillways, chutes, derelict sawmills, tools, and many other items.
- Clusters of tin cans or bottles, or other debris that appear older than 50 years.
- Old munitions casings. **Always assume these are live and never touch or move.**
- Buried railroad tracks, decking, foundations, or other industrial materials.
- Remnants of homesteading. These could include bricks, nails, household items, toys, food containers, and other items associated with homes or farming sites.

The above list does not cover every possible cultural resource. When in doubt, assume the material is a cultural resource.

3. ON-SITE RESPONSIBILITIES

If any employee, contractor, or subcontractor believes that they have uncovered cultural resources or human remains at any point in the project, take the following steps to ***Stop-Protect-Notify***. If you suspect that the discovery includes human remains, also follow Sections 5 and 6.

STEP A: Stop Work.

All work must stop immediately in the vicinity of the discovery.

STEP B: Protect the Discovery.

Leave the discovery and the surrounding area untouched and create a clear, identifiable, and wide boundary (30 feet or larger) with temporary fencing, flagging, stakes, or other clear markings. Provide protection and ensure integrity of the discovery until cleared by the Department of Archaeological and Historical Preservation (DAHP) or a licensed, professional archaeologist.

Do not permit vehicles, equipment, or unauthorized personnel to traverse the discovery site. Do not allow work to resume within the boundary until the requirements of this IDP are met.

STEP C: Notify Project Archaeologist (if applicable).

If the project has an archaeologist, notify that person. If there is a monitoring plan in place, the archaeologist will follow the outlined procedure.

STEP D: Notify Project and Washington Department of Ecology (Ecology) contacts.

Project Lead Contacts

Primary Contact

Name: Scott Hooton
Organization: Port of Tacoma
Phone: 253-383-9428
Email: shooton@portoftacoma.com

Alternate Contact

Name: Trevor Louviere
Organization: Dalton, Olmsted & Fuglevar
Phone: 425-785-6322
Email: tlouviere@dofnw.com

Ecology Contacts (completed by Ecology Project Manager)

Ecology Project Manager

Name: Sam Meng
Program: Toxics Cleanup Program
Phone: 360-999-9587
Email: same461@ecy.wa.gov

Alternate or Cultural Resource Contact

Name: Jon Klem
Program: Toxics Cleanup Program
Phone: 206.556.5584
Email: jon.klem@ecy.wa.gov

STEP E: Ecology will notify DAHP.

Once notified, the Ecology Cultural Resource Contact or the Ecology Project Manager will contact DAHP to report and confirm the discovery. To avoid delay, the Project Lead/Organization will contact DAHP if they are not able to reach Ecology.

DAHP will provide the steps to assist with identification. DAHP, Ecology, and Tribal representatives may coordinate a site visit following any necessary safety protocols. DAHP may also inform the Project Lead/Organization and Ecology of additional steps to further protect the site.

Do not continue work until DAHP has issued an approval for work to proceed in the area of, or near, the discovery.

DAHP Contacts:

Name: Rob Whitlam, PhD
Title: State Archaeologist
Cell: 360-890-2615
Email: Rob.Whitlam@dahp.wa.gov
Main Office: 360-586-3065

Human Remains/Bones:

Name: Guy Tasa, PhD
Title: State Anthropologist
Cell: 360-790-1633 (24/7)
Email: Guy.Tasa@dahp.wa.gov

4. TRIBAL CONTACTS

In the event cultural resources are discovered, the following tribes will be contacted. See Section 10 for Additional Resources.

Tribe:	Puyallup Tribe of Indians	Tribe:	Confederated Tribes and Bands of the Yakama Nation
Name:	Brandon Reynon	Name:	Jerry Meninick
Title:	Cultural Resources	Title:	Deputy Director of Cultural Resources
Phone:	253-573-7965 or 253-442-9361 (cell)	Phone:	509-865-5121
Email:	brandon.reynon@puyalluptribe-nsn.gov	Email:	jerry_meninick@yakama.com
Tribe:	Suquamish Tribe	Tribe:	Squaxin Island Tribe
Name:	Stephanie Trudel	Name:	Rhonda Foster
Title:	THPO	Title:	THPO
Phone:	360-394-8533	Phone:	360-432-3850
Email:	strudel@Suquamish.nsn.us	Email:	rfoster@squaxin.us

Please provide contact information for additional tribes within your project area, if needed, in Section 11.

5. FURTHER CONTACTS (if applicable)

If the discovery is confirmed by DAHP as a cultural or archaeological resource, or as human remains, and there is a partnering federal or state agency, Ecology or the Project Lead/Organization will ensure the partnering agency is immediately notified.

Federal Agency:

Agency: U.S. Army Corps of Engineers
Name: LeeAnn Simmons
Title: Project Manager, Biologist
Phone: (206) 949-1461
Email: LeeAnn.W.Simmons@usace.army.mil

State Agency:

Agency:
Name:
Title:
Phone:
Email:

6. SPECIAL PROCEDURES FOR THE DISCOVERY OF HUMAN SKELETAL MATERIAL

Any human skeletal remains, regardless of antiquity or ethnic origin, will at all times be treated with dignity and respect. Follow the steps under ***Stop-Protect-Notify***. For specific instructions on how to handle a human remains discovery, see: [RCW 68.50.645: Skeletal human remains—Duty to notify—Ground disturbing activities—Coroner determination—Definitions.](#)

Suggestion: If you are unsure whether the discovery is human bone or not, contact Guy Tasa with DAHP, for identification and next steps. Do not pick up the discovery.

Guy Tasa, PhD State Physical Anthropologist

Guy.Tasa@dahp.wa.gov

(360) 790-1633 (Cell/Office)

For discoveries that are confirmed or suspected human remains, follow these steps:

1. Notify law enforcement and the Medical Examiner/Coroner using the contacts below. **Do not call 911** unless it is the only number available to you.

Enter contact information below (required):

- Local Medical Examiner or Coroner name and phone:

CME: Karen Cline-Parhamovich 253-798-6494

- Local Law Enforcement main name and phone:

Tacoma Police: 911

- Local Non-Emergency phone number (911 if without a non-emergency number):

253-287-4455

2. The Medical Examiner/Coroner (with assistance of law enforcement personnel) will determine if the remains are human or if the discovery site constitutes a crime scene and will notify DAHP.
3. **DO NOT speak with the media, allow photography or disturbance of the remains, or release any information about the discovery on social media.**
4. If the remains are determined to be non-forensic, Cover the remains with a tarp or other materials (not soil or rocks) for temporary protection and to shield them from being photographed by others or disturbed.

Further activities:

- Per [RCW 27.44.055](#), [RCW 68.50](#), and [RCW 68.60](#), DAHP will have jurisdiction over non-forensic human remains. Ecology staff will participate in consultation. Organizations may also participate in consultation.
- Documentation of human skeletal remains and funerary objects will be agreed upon through the consultation process described in [RCW 27.44.055](#), [RCW 68.50](#), and [RCW 68.60](#).
- When consultation and documentation activities are complete, work in the discovery area may resume as described in Section 8.

If the project occurs on federal lands (such as a national forest or park or a military reservation) the provisions of the Native American Graves Protection and Repatriation Act of 1990 (NAGPRA) apply and the responsible federal agency will follow its provisions. Note that state highways that cross federal lands are on an easement and are not owned by the state.

If the project occurs on non-federal lands, the Project Lead/Organization will comply with applicable state and federal laws, and the above protocol.

7. DOCUMENTATION OF ARCHAEOLOGICAL MATERIALS

Archaeological resources discovered during construction are protected by state law [RCW 27.53](#) and assumed eligible for inclusion in the National Register of Historic Places under Criterion D until a formal Determination of Eligibility is made.

The Project Lead/Organization must ensure that proper documentation and field assessment are made of all discovered cultural resources in cooperation with all parties: the federal agencies (if any), DAHP, Ecology, affected tribes, and the archaeologist.

The archaeologist will record all prehistoric and historic cultural material discovered during project construction on a standard DAHP archaeological site or isolate inventory form. They will photograph site overviews, features, and artifacts and prepare stratigraphic profiles and soil/sediment descriptions for minimal subsurface exposures. They will document discovery locations on scaled site plans and site location maps.

Cultural features, horizons, and artifacts detected in buried sediments may require the archaeologist to conduct further evaluation using hand-dug test units. They will excavate units in a controlled fashion to expose features, collect samples from undisturbed contexts, or to interpret complex stratigraphy. They may also use a test unit or trench excavation to determine if an intact occupation surface is present. They will only use test units when necessary to gather information on the nature, extent, and integrity of subsurface cultural deposits to evaluate the site's significance. They will conduct excavations using standard archaeological techniques to precisely document the location of cultural deposits, artifacts, and features.

The archaeologist will record spatial information, depth of excavation levels, natural and cultural stratigraphy, presence or absence of cultural material, and depth to sterile soil, regolith, or bedrock for each unit on a standard form. They will complete test excavation unit level forms, which will include plan maps for each excavation level and artifact counts and material types, number, and vertical provenience (depth below

surface and stratum association where applicable) for all recovered artifacts. They will draw a stratigraphic profile for at least one wall of each test excavation unit.

The archaeologist will screen sediments excavated for purposes of cultural resources investigation through 1/8-inch mesh, unless soil conditions warrant 1/4-inch mesh.

The archaeologist will analyze, catalogue, and temporarily curate all prehistoric and historic artifacts collected from the surface and from probes and excavation units. The ultimate disposition of cultural materials will be determined in consultation with the federal agencies (if any), DAHP, Ecology, and the affected tribe(s).

Within 90 days of concluding fieldwork, the archaeologist will provide a technical report describing any and all monitoring and resultant archaeological excavations to the Project Lead/Organization, who will forward the report to Ecology, the federal agencies (if any), DAHP, and the affected tribe(s) for review and comment.

If assessment activities expose human remains (burials, isolated teeth, or bones), the archaeologist and Project Lead/Organization will follow the process described in **Section 6**.

8. PROCEEDING WITH WORK

The Project Lead/Organization shall work with the archaeologist, DAHP, and affected tribe(s) to determine the appropriate discovery boundary and where work can continue.

Work may continue at the discovery location only after the process outlined in this plan is followed and the Project Lead/Organization, DAHP, any affected tribe(s), Ecology, and the federal agencies (if any) determine that compliance with state and federal laws is complete.

9. ORGANIZATION RESPONSIBILITY

The Project Lead/Organization is responsible for ensuring:

- This IDP has complete and accurate information.
- This IDP is immediately available to all field staff at the sites and available by request to any party.
- This IDP is implemented to address any discovery at the site.
- That all field staff, contractors, and volunteers are instructed on how to implement this IDP.

10. ADDITIONAL RESOURCES

Informative Video

Ecology recommends that all project staff, contractors, and volunteers view this informative video explaining the value of IDP protocol and what to do in the event of a discovery. The target audience is anyone working on the project who could unexpectedly find cultural resources or human remains while excavating or digging. The video is also posted on DAHP's inadvertent discovery language website.

[Ecology's IDP Video](https://www.youtube.com/watch?v=ioX-4cXfbDY) (<https://www.youtube.com/watch?v=ioX-4cXfbDY>)

Informational Resources

[DAHPP](https://dahp.wa.gov) (<https://dahp.wa.gov>)

[Washington State Archeology \(DAHPP 2003\)](https://dahp.wa.gov/sites/default/files/Field%20Guide%20to%20WA%20Arch_0.pdf)

(https://dahp.wa.gov/sites/default/files/Field%20Guide%20to%20WA%20Arch_0.pdf)

[Association of Washington Archaeologists](https://www.archaeologyinwashington.com) (<https://www.archaeologyinwashington.com>)

Potentially Interested Tribes

[Interactive Map of Tribes by Area](https://dahp.wa.gov/archaeology/tribal-consultation-information)

(<https://dahp.wa.gov/archaeology/tribal-consultation-information>)

[WSDOT Tribal Contact Website](https://wsdot.wa.gov/tribal/TribalContacts.htm)

(<https://wsdot.wa.gov/tribal/TribalContacts.htm>)

11. ADDITIONAL INFORMATION

Please add any additional contact information or other information needed within this IDP.

Additional Puyallup Tribe of Indians contacts:

- Alternate Contact: Michael Shong, Archaeologist, 253-339-1967 (mobile);
Mike.Shong@PuyallupTribe-nsn.gov

Additional Tribes to consult:

Snoqualmie Indian Tribe: Steven Moses, Archaeology and Historic Preservation
Cell: 425-495-6097, email: steve@snoqualmietribe.us

Nisqually Indian Tribe: Brad Beach, THPO, Phone: 360-456-5221 ext 127
email: beach.brad@nisqually-nsn.gov

Muckleshoot Indian Tribe: Laura Murphy, Archaeologist Cultural Resources,
Phone: 253-876-3272, Email: laura.murphy@muckleshoot.nsn.us

Implement the IDP if you see...

Chipped stone artifacts.

Examples are:

- Glass-like material.
- Angular material.
- “Unusual” material or shape for the area.
- Regularity of flaking.
- Variability of size.



Stone artifacts from Oregon.



Stone artifacts from Washington.



Biface-knife, scraper, or pre-form found in NE Washington. Thought to be a well knapped object of great antiquity. Courtesy of Methow Salmon Rec. Foundation.

Implement the IDP if you see...

Ground stone artifacts.

Examples are:

- Unusual or unnatural shapes or unusual stone.
- Striations or scratching.
- Etching, perforations, or pecking.
- Regularity in modifications.
- Variability of size, function, or complexity.



Above: Fishing Weight - credit [CRITFC Treaty Fishing Rights website](#).



Artifacts from unknown locations (left and right images).



Implement the IDP if you see...

Bone or shell artifacts, tools, or beads.

Examples are:

- Smooth or carved materials.
- Unusual shape.
- Pointed as if used as a tool.
- Wedge shaped like a “shoehorn”.
- Variability of size.
- Beads from shell (*dentalium*) or tusk.



Upper Left: Bone Awls from Oregon.

Upper Center: Bone Wedge from California.

Upper Right: Plateau dentalium choker and bracelet, from Nez Perce National Historical Park, 19th century, made using *Antalis pretiosa* shells Credit: Nez Perce - Nez Perce National Historical Park, NEPE 8762, Public Domain.

Above: Tooth Pendants. Right: Bone Pendants. Both from Oregon and Washington.



Implement the IDP if you see...

Culturally modified trees, fiber, or wood artifacts.

Examples are:

- Trees with bark stripped or peeled, carvings, axe cuts, de-limbing, wood removal, and other human modifications.
- Fiber or wood artifacts in a wet environment.
- Variability of size, function, and complexity.



Left and Below: *Culturally modified tree and an old carving on an aspen (Courtesy of DAHP).*

Right, Top to Bottom: *Artifacts from Mud Bay, Olympia: Toy war club, two strand cedar rope, wet basketry.*



Implement the IDP if you see...

Strange, different, or interesting looking dirt, rocks, or shells.

Human activities leave traces in the ground that may or may not have artifacts associated with them. Examples are:

- “Unusual” accumulations of rock (especially fire-cracked rock).
- “Unusual” shaped accumulations of rock (such as a shape similar to a fire ring).
- Charcoal or charcoal-stained soils, burnt-looking soils, or soil that has a “layer cake” appearance.
- Accumulations of shell, bones, or artifacts. Shells may be crushed.
- Look for the “unusual” or out of place (for example, rock piles in areas with otherwise few rocks).



Shell Midden pocket in modern fill discovered in sewer trench.



Underground oven. Courtesy of DAHP.

Shell midden with fire cracked rock.



Hearth excavated near Hamilton, WA.

Implement the IDP if you see...

Historic period artifacts (historic archaeology considered older than 50 years).

Examples are:

- Agricultural or logging equipment. May include equipment, fencing, canals, spillways, chutes, derelict sawmills, tools, etc.
- Domestic items including square or wire nails, amethyst colored glass, or painted stoneware.



Left: Top to Bottom: *Willow pattern serving bowl and slip joint pocket knife discovered during Seattle Smith Cove shantytown (45-KI-1200) excavation.*



Right: *Collections of historic artifacts discovered during excavations in eastern Washington cities.*



Implement the IDP if you see...

Historic period artifacts (historic archaeology considered older than 50 years).

Examples are:

- Railway tokens, coins, and buttons.
- Spectacles, toys, clothing, and personal items.
- Items helping to understand a culture or identity.
- Food containers and dishware.



Main Image: *Dishes, bottles, workboot found at the North Shore Japanese bath house (ofuro) site, Courtesy Bob Muckle, Archaeologist, Capilano University, B.C. This is an example of an above ground resource.*



Right, from Top to Bottom:
Coins, token, spectacles and Montgomery Ward pitchfork toy discovered during Seattle Smith Cove shantytown (45-KI-1200) excavation.



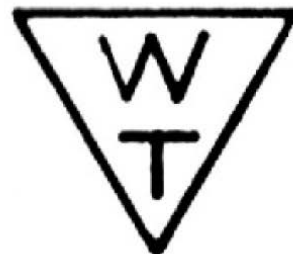
Implement the IDP if you see...

- Old munition casings – if you see ammunition of any type – ***always assume they are live and never touch or move!***
- Tin cans or glass bottles with an older manufacturer's technique – maker's mark, distinct colors such as turquoise, or an older method of opening the container.



Far Left: .303 British cartridge found by a WCC planting crew on Skagit River. Don't ever touch something like this!
Left: Maker's mark on bottom of old bottle.

Right: Old beer can found in Oregon. ACME was owned by Olympia Brewery. Courtesy of Heather Simmons.



Logo employed by Whithall Tatum & Co. between 1924 to 1938 (Lockhart et al. 2016).



Can opening dates, courtesy of W.M. Schroeder.

Implement the IDP if you see...

You see historic foundations or buried structures.

Examples are:

- Foundations.
- Railroad and trolley tracks.
- Remnants of structures.



Counter Clockwise, Left to Right: *Historic structure 45KI924, in WSDOT right of way for SR99 tunnel. Remnants of Smith Cove shantytown (45-KI-1200) discovered during Ecology CSO excavation, City of Spokane historic trolley tracks uncovered during stormwater project, intact foundation of historic home that survived the Great Ellensburg Fire of July 4, 1889, uncovered beneath parking lot in Ellensburg.*

Implement the IDP if you see...

Potential human remains.

Examples are:

- Grave headstones that appear to be older than 50 years.
- Bones or bone tools--intact or in small pieces. It can be difficult to differentiate animal from human so they must be identified by an expert.
- These are all examples of animal bones and are not human.

Center: *Bone wedge tool, courtesy of Smith Cove Shantytown excavation (45K11200).*

Other images (Top Right, Bottom Left, and Bottom) Center: Courtesy of DAHP.



Directly Above: This is a real discovery at an Ecology sewer project site.

What would you do if you found these items at a site? Who would be the first person you would call?

Hint: Read the plan!